



# **Analysing the potential for wide scale roll out of integrated Smart Cities and Communities solutions**

*SCC solution best practices*

March 2016

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## Solutions overview

<i>Solution</i>	<i>City</i>	<i>Country</i>	<i>City Population Range</i>	<i>Prevalent Area of Reference of the Solution</i>	<i>Type of solution</i>
<b>Bus Integrated Management System</b>	Donostia-San Sebastian	Spain	100,000 < x < 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Connected Smart Port Logistics</b>	Hamburg	Germany	> 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Copenhagen Intelligent Traffic Solution</b>	Copenhagen	Denmark	> 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Data One Smart Portal</b>	Hong Kong	Hong Kong	> 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Intelligent Urban Mobility Management and Traffic Control System</b>	Thessaloniki	Greece	100,000 < x < 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>MNPass</b>	Minneapolis	USA	100,000 < x < 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Singapore Congestion Charging</b>	Singapore	Singapore	> 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Smart Traffic Management System</b>	Buncheon City	South Korea	> 500,000	Sustainable Urban Mobility	ITS for traffic monitoring, management, enforcement
<b>Data-driven Pop-up Buses</b>	Boston	USA	> 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>SMILE and Integrated eMobility Service</b>	Vienna	Austria	> 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>Octopus System</b>	Hong Kong	Hong Kong	> 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>OpenMove</b>	Trento	Italy	100,000 < x < 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>Tallinn Smart Card</b>	Tallinn	Estonia	100,000 < x < 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>Tram Smart Enhancement</b>	Melbourne	Australia	> 500,000	Sustainable Urban Mobility	ITS-based enhancement of public transport
<b>Streetline Parker</b>	Los Angeles	USA	> 500,000	Sustainable Urban Mobility	Real time road users information
<b>Citizens Connect</b>	Boston	USA	> 500,000	Sustainable Districts & Built Environment	Place Making
<b>Barangaroo District Renewal</b>	Sydney	Australia	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Blue Gate District</b>	Antwerp	Belgium	100,000 < x < 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Corridor Manchester</b>	Manchester	United Kingdom	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>ECO2 - Tampere</b>	Tampere	Finland	100,000 < x < 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>HafenCity</b>	Hamburg	Germany	> 500,000	Sustainable	Sustainable districts

<i>Solution</i>	<i>City</i>	<i>Country</i>	<i>City Population Range</i>	<i>Prevalent Area of Reference of the Solution</i>	<i>Type of solution</i>
				Districts & Built Environment	
<b>Hammarby Sjöstad</b>	Stockholm	Sweden	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Hudson Yard</b>	New York	USA	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Hyllie Sustainable District</b>	Malmö	Sweden	100,000 < x < 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Kalasatama Sustainable District</b>	Helsinki	Finland	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Lyon Smart Community</b>	Lyon	France	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Mass-Retrofitting - Hackbridge</b>	London	United Kingdom	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Nordhavnen Smart District</b>	Copenhagen	Denmark	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Smart Buildings - Pudong New Area</b>	Shanghai Pudong New Area	China	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Smart Melit</b>	Toyota City	Japan	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Stockholm Royal Seaport</b>	Stockholm	Sweden	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Växjö - Fossil Fuel Free City</b>	Växjö	Sweden	< 100,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Waterfront Toronto</b>	Toronto	Canada	> 500,000	Sustainable Districts & Built Environment	Sustainable districts
<b>Bigbelly Smart City Waste Management</b>	Philadelphia	USA	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Bremen Building Management System</b>	Bremen	Germany	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Climate Street</b>	Amsterdam	Netherlands	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Connected Boulevard</b>	Nice	France	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Districlima Network</b>	Barcelona	Spain	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Energy Efficient Housing - 3e-HOUSES</b>	Bristol	United Kingdom	100,000 < x < 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment

<i>Solution</i>	<i>City</i>	<i>Country</i>	<i>City Population Range</i>	<i>Prevalent Area of Reference of the Solution</i>	<i>Type of solution</i>
<b>Klimastrasse</b>	Cologne	Germany	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>School Energy Management System</b>	Lisbon	Portugal	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Smart District Heating - CELSIUS</b>	Gothenburg	Sweden	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Smart Street Sant Cugat</b>	Barcelona	Spain	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Vienna Citizens' Solar Power Plant</b>	Vienna	Austria	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Waste Water Management System</b>	Copenhagen	Denmark	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Water Management System</b>	Mumbai	India	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Water Network Monitoring &amp; Management</b>	Jerusalem	Israel	> 500,000	Sustainable Districts & Built Environment	Smart technologies for the built environment
<b>Center of Operations</b>	Rio de Janeiro	Brazil	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>City Protocol</b>	Barcelona	Spain	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>City Services Smart Platform</b>	Carson City	USA	< 100,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Energy Matching Infrastructure – eHub</b>	Leuven	Belgium	< 100,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Future City Glasgow</b>	Glasgow	United Kingdom	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Integrated Security and Emergencies Center</b>	Madrid	Spain	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Interoperable Open Platform – iScope</b>	Zadar County	Croatia	100,000 < x < 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Neighbourhood Urban Observatory</b>	Bilbao	Spain	100,000 < x < 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Demo Norway Smart Grid</b>	Rogaland Region	Norway	100,000 < x < 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Urban EcoMap</b>	San Francisco	USA	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services

<i>Solution</i>	<i>City</i>	<i>Country</i>	<i>City Population Range</i>	<i>Prevalent Area of Reference of the Solution</i>	<i>Type of solution</i>
<b>WindyGrid</b>	Chicago	USA	> 500,000	Integrated Infrastructures & Processes	Intelligent City Services
<b>Integrated Smart Grid Initiative</b>	Glendale	USA	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart grid
<b>E-Energy Mannheim</b>	Mannheim	Germany	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>Envision Charlotte</b>	Charlotte	USA	< 100,000	Integrated Infrastructures & Processes	Smart grid
<b>Fiber Optics Smart Grid</b>	Chattanooga	USA	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart grid
<b>Hengqin Smart Grid</b>	Hengqin New Area	China	< 100,000	Integrated Infrastructures & Processes	Smart grid
<b>Integrated Smart City Grid</b>	Yokohama	Japan	> 500,000	Integrated Infrastructures & Processes	Smart grid
<b>Island EcoGrid</b>	Bornholm	Denmark	< 100,000	Integrated Infrastructures & Processes	Smart grid
<b>Island Integrated Smart Grid</b>	Jeju Island	South Korea	> 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>IssyGrid</b>	Issy-les-Moulineaux	France	< 100,000	Integrated Infrastructures & Processes	Smart grid
<b>London Underground Energy Recovery</b>	London	United Kingdom	> 500,000	Integrated Infrastructures & Processes	Smart grid
<b>Malaga Integrated Smart Grid</b>	Malaga	Spain	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>MeRegio Smart Grid</b>	Baden Württemberg Region	Germany	> 500,000	Integrated Infrastructures & Processes	Smart grid
<b>Nice - grid</b>	Carros	France	< 100,000	Integrated Infrastructures & Processes	Smart Grid
<b>PowerMatching City</b>	Hoogkerk	Netherlands	< 100,000	Integrated Infrastructures & Processes	Smart grid
<b>Smart Grid Newcastle</b>	New Castle	Australia	> 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>Smart Power - Intelligent Network of Urban Infrastructures</b>	Hamburg	Germany	> 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>UCSD Microgrid</b>	San Diego	USA	> 500,000	Integrated Infrastructures & Processes	Smart grid

<i>Solution</i>	<i>City</i>	<i>Country</i>	<i>City Population Range</i>	<i>Prevalent Area of Reference of the Solution</i>	<i>Type of solution</i>
<b>Vehicle2Grid</b>	Amsterdam	Netherlands	> 500,000	Integrated Infrastructures & Processes	Smart Grid
<b>MK:Smart</b>	Milton Keynes	United Kingdom	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart City Platform
<b>Smart Santander Urban Platform</b>	Santander	Spain	100,000 < x < 500,000	Integrated Infrastructures & Processes	Smart City Platform
<b>Urban Platform</b>	Barcelona	Spain	> 500,000	Integrated Infrastructures & Processes	Smart City Platform
<b>Valencia Smart City Platform</b>	Valencia	Spain	> 500,000	Integrated Infrastructures & Processes	Smart City Platform

# SUSTAINABLE URBAN MOBILITY



# ***ITS for traffic monitoring, management, enforcement***





## Bus Integrated Management System Donostia, San Sebastian, Spain

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The **Bus Management System** in San Sebastian is **part of a large-scale effort project** called Civitas (CItY-VITAlity-Sustainability) or, more specifically, **Civitas Archimedes**. The final **purpose** of this European initiative, co-financed by the European Commission, **is to implement integrated and sustainable urban mobility strategies**, in order to optimize transport in European cities and increase citizen welfare. The solution was introduced in May 2010 in the San Sebastian Bus Fleet.

The general improvement in the efficiency and effectiveness of urban mobility has contributed to making citizens more likely to use means of public transport, instead of private cars. Overall, **the solution had an impact on educating citizens on environmental sustainability principles**, which also had positive consequences on CO<sub>2</sub> emission reduction targets.

Finally, **San Sebastian has been chosen as one of the leading cities to implement this smart solution**, in order to test the replicability of the integrated standards employed, so as to then focus on the key success ones and reproduce the initiative in other European cities.

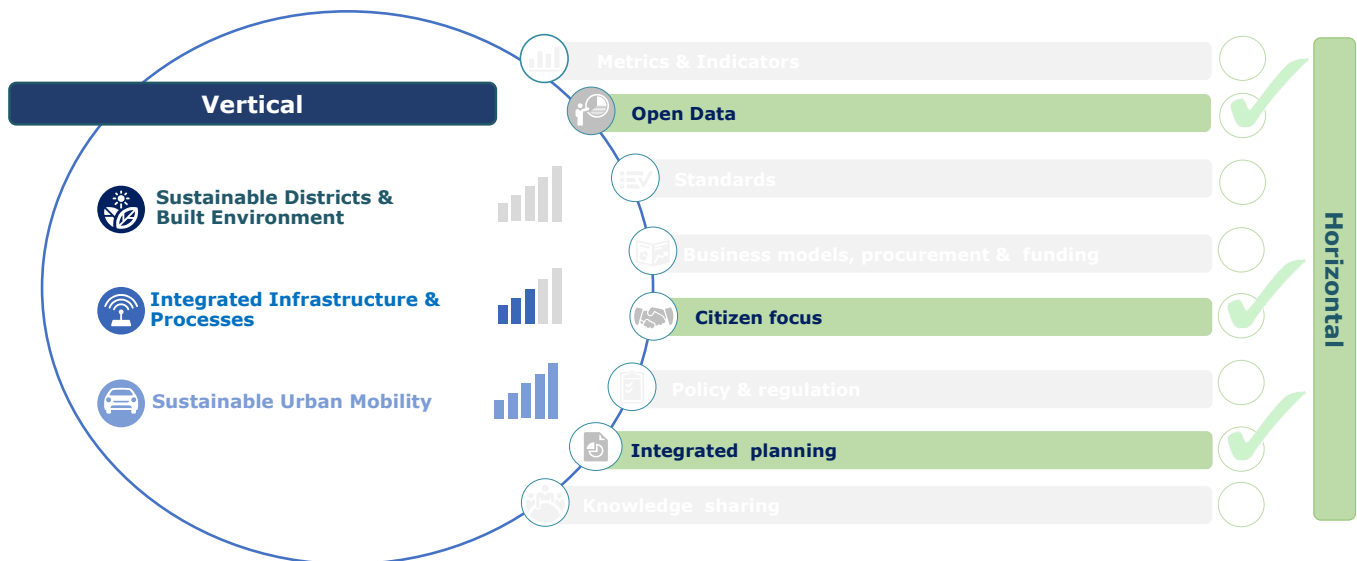
<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling or Replication</b>	Yes, Madrid
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 227,400
<b>Number of impacted users</b>	The entire population of the city
<b>Link</b>	<a href="http://www.dbus.eus/en/the-company/dbus-technology/">http://www.dbus.eus/en/the-company/dbus-technology/</a>



## Level of integration

The solution can be considered as integrated, in that it combines **sustainable urban mobility** with **ICT infrastructure**. The new planning and fleet management system enables the calculation and deployment of the required number of buses and drivers. **The system operates thanks to a real time data exchange** between the buses and a central platform in which mobility data is collected.

Thanks to this ICT infrastructure, which provides a **constant update of the traffic flow and user needs**, drivers' timetables have been rescheduled and the ratio between their productive hours and the total amount of the working ones have improved. Furthermore, the information exchange mechanism is bilateral, since **travelers are also kept constantly updated** on the scheduled departure and arrival times of their chosen means of public transport.



## Business case

**The first stage** of preparation and procurement **ran from October 2008 to September 2009**; during this timespan, the IT software and the fleet management system were purchased.

During **the second step**, which corresponds to the testing phase, **the mobility data of San Sebastian's fleet and personnel were integrated with the IT system**; this trial period spanned almost one year (September 2009 to May 2010), and its purpose was to monitor and then elaborate the evaluation results.

After the system was tuned at the end of this last phase, **the solution became fully operational in May 2010**.

As previously mentioned, **the project is part of the European initiative "Civitas Archimedes"** and involves the public transport company of San Sebastian – CTSS DBUS (120 buses and 346 drivers). Regarding the technology, the public entity decided to use HSDPA-3G communication technologies to share data between the vehicles and the central platform.

**The solution is entirely public funded, with 70% of the required financing coming from EU funds and the remaining 30% from regional public funds.** The total amount of funds necessary to set up the solution amounted to € 227,400 of which € 154,500 for equipment and purchases and the remaining € 72,900 for human resources.

The solution doesn't have any place-specific limitations that prevent its replicability. It is potentially replicable in every municipality with an established public transportation system. **A similar system has already been introduced in Madrid.**

## Community & Citizen Focus

The solution benefits all citizens. They are the main targets of the initiative and their behavior totally influences the success of the implementation. Indeed, **the user-friendly environment developed aims to encourage citizens to make a greater use of public transport** (instead of private cars).

Given that user behavior is the key factor determining the potential success of the initiative, San Sebastian's public administration worked on conveying the benefits of making greater use of the public transportation network, including: lower carbon emissions, (consequently) better air quality, reduced noise levels, and, overall, better health and quality of life.

Cooperation between the public administration and users is therefore a necessary component and it has driven these two actors to co-create the final service, through a constant feedback mechanism.

## Impact

One of the major impacts of the new bus management system has been **the decrease of the operating costs by 2.5%**. Overall, the **total savings** amounted to **€ 700,000 per year**, equal to **€ 3.5 Mln** overall in the **period 2011-2015**.

Furthermore, it is worth highlighting the impact on the human resources involved (i.e. the operational staff). The overall level of acceptance of the new schedules on the part of the employees is positive.

Between 2006 and 2011, **the number of public transport users increased by 9.6%**, even exceeding the 5% target required to be in line with Civitas standards. The increase in public transport users came hand in hand with **a significant improvement in the customer satisfaction** index in relation to the new bus management system. Finally, even if no data is currently available regarding the environmental impact of the solution, enhancing the use of the public transport system has contributed to improving environmental indicators in the city.



## The solution in context: Smart City – San Sebastian

### About the smart city vision in the city

**San Sebastian is part of the European Innovation Partnership on Smart Cities and Communities**, the European cluster in which cities share integrated practices and expertise concerning smart city policies.

In addition to the project analysed in this case, San Sebastian is part of other smart initiatives, including **SmartCem**, a pilot focused on **smart mobility** through both **electric car sharing** and **hybrid buses**.

The city also takes part in the **Smart City Advisory Group (SCAG)**, made up of experts in cooperation with end users, and which **aims to implement cleaner energy services**.

Finally, San Sebastian, in partnership with Bristol and Florence, has undertaken another important European initiative focused on energy efficiency: **Systems Thinking for Efficient Energy Planning (STEEP)**.

**Name of City** *San Sebastian*

**Country** *Spain*

**No of Inhabitants** *100,000 < x < 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

### Sources

- › **Civitas EU**; “Bus management system donostia- san Sebastian”  
(<http://civitas.eu/content/bus-management-system-donostia-san-sebastian-1429>)
- › **Civitas EU**; “New Fleet Management System”  
(<http://www.civitas.eu/content/new-fleet-management-system>)
- › **Citivas EU**  
([http://www.civitas.eu/sites/default/files/arc\\_mert\\_74\\_f\\_dss\\_busmanagementsystem\\_v\\_f.pdf](http://www.civitas.eu/sites/default/files/arc_mert_74_f_dss_busmanagementsystem_v_f.pdf))
- › **Citivas EU**  
([http://civitas.eu/sites/default/files/t74\\_1-donostia-san20sebastian.pdf](http://civitas.eu/sites/default/files/t74_1-donostia-san20sebastian.pdf))  
(<https://eu-smartcities.eu/place/san-sebasti%C3%A1n-donostia>)
- › **First image source:** Dbus  
(<http://www.dbus.eus/en/the-company/background/>)
- › **The solution in context image source:** Spain guide  
(<http://spainguides.com>)





## Connected Smart Port Logistics Hamburg, Germany

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

City of Hamburg and its main harbour play a major role within the area of global shipping. The **harbour of Hamburg** is the second largest commercial harbour in Europe and it **handles almost 140 Mln metric tons of goods each year**, and multiple routes pass through this north German port. Moreover, an increase in global marine traffic is expected to more than double container throughput by 2030, pushing it up to 18 Mln twenty-foot equivalent units.

The ambition behind Smart Port Logistics in Hamburg is to connect people, processes, data and things to lower energy consumption. With Smart Traffic, Smart Parking, and Smart Port Logistics, Hamburg is reducing the amount of energy it takes to get people and goods where they need to go. Indeed, the Port of Hamburg and the port-based industry account for a large proportion of the industrial energy consumed in the City of Hamburg and for a considerable amount of emissions.



Image source: <http://www.cisco.com/web/tomorrow-starts-here/cars/hamburg/index.html>

The Hamburg Port of the Future 2025 vision features a strong commitment to **sustainability**, including **the support of a green supply chain**. This chain supports reliable and low-emission transport, and implies a development of the modal split away from road transport and towards rail and inland waterways. The idea is that this development can be achieved through the establishment of new connections to the railway and waterway networks, and the expansion of existing connections.

To enable smart business solutions which result in more efficient logistics operations and in energy and emissions savings, Hamburg Port is running multiple solutions:

- The concept of **smartPORT logistics** stands for smart traffic and trade flow solutions in the Port of Hamburg. The **project focuses on infrastructure, traffic flows and trade flows**, and brings in both economic and ecological considerations in the development of new intelligent initiatives.
- The concept of **smartPORT energy** reflects the efforts made towards making the Port of Hamburg less dependent on traditional electricity sources by **switching to renewables**. More specifically, the port aims to promote eco-friendly mobility by redistributing energy, thus reducing energy consumption and saving costs.

Through its **Internet of Everything approach**, Hamburg is connecting streetlights to sensors. These systems recognize when there is traffic and when there isn't. Data from the sensors is processed and transmitted automatically, telling lights to turn on when a vehicle is coming, and turn off after it passes. The Port of Hamburg has been gradually streamlining its logistics processes since 2011. It provides a public cloud solution that delivers **real-time information** to all the different types of actors operating within the harbour: fleet managers, parking slot coordinators, road traffic, port operators. Access to this information makes it possible for all actors to respond more efficiently to changing requirements. Under the smartPORT logistics umbrella, the Hamburg Port Authority (HPA), Deutsche Telekom and SAP launched smartPORT logistics (SPL) in 2014, following a two-year pilot phase. SPL is a traffic management IT solution that interconnects businesses, partners and customers of the port. The three main areas that SPL covers are **infrastructure, traffic flows and trade flows**.

SPL is based on **SAP Connected Logistics**, which **integrates all relevant information** from multiple data sources, including location and partner-dependent information. The desktop and mobile apps allow even non-commercially linked entities such as mobile personnel, visitors, and small businesses and agencies to participate on a subscription-based model. The personalized recommendations support the users even without having local knowledge about the area.

The SPL services merge individual information and make it available via smart device apps. They can be used without the need for complex IT equipment. In order to provide comprehensive and **reliable up-to-date traffic information**, data that is already available from stationary points is merged into one system to effectively determine the traffic situation. This system is called **EVE**, and it offers data evaluation. EVE also serves to **determine reliable indicators for road traffic** in the port such as **travelling times, hours spent stuck in jams, and CO<sub>2</sub> emissions**. In a longer-term perspective, the ambition is to increase the number of measuring points and establish a system that depicts an integrated traffic situation.

Some of the information has been tested in a pilot. Railway points are located at critical points of the Port Railway's network, and the points were equipped with multi-sensor technology. Supported by IT, the sensors will centrally display the measured values captured whenever a point is switched or crossed. The data can be used to predict wear and tear on the railway point. Heaviness of movement can be anticipated early on and addressed immediately.

The aim is also to develop a **mobile GPS sensor**, using its ID to allocate it to an object through a web-based administration system. The sensor will then transmit its position and ID to a central system that collects this information and makes it available for further processing.

**A Port Traffic Centre will connect the information on the various modes of transport** and make traffic flows on water, rail and road more efficient. The centre will process all traffic information collected in the Port of Hamburg. Transport users and decision makers will be able to read the relevant traffic information in real time. This means that they will have the opportunity to choose the fastest and most favourable mode of transport to get their goods to their final destination.

**The aim of the SPL solution is to manage and use the existing infrastructure in the Port of Hamburg in an efficient manner.** Also, the solution contributes to the reduction of traffic-related emissions of air pollutants and greenhouse gases. Another aim is to **establish intelligent infrastructure** in the Port of Hamburg and to **optimize the flow of information** to manage trade flows efficiently

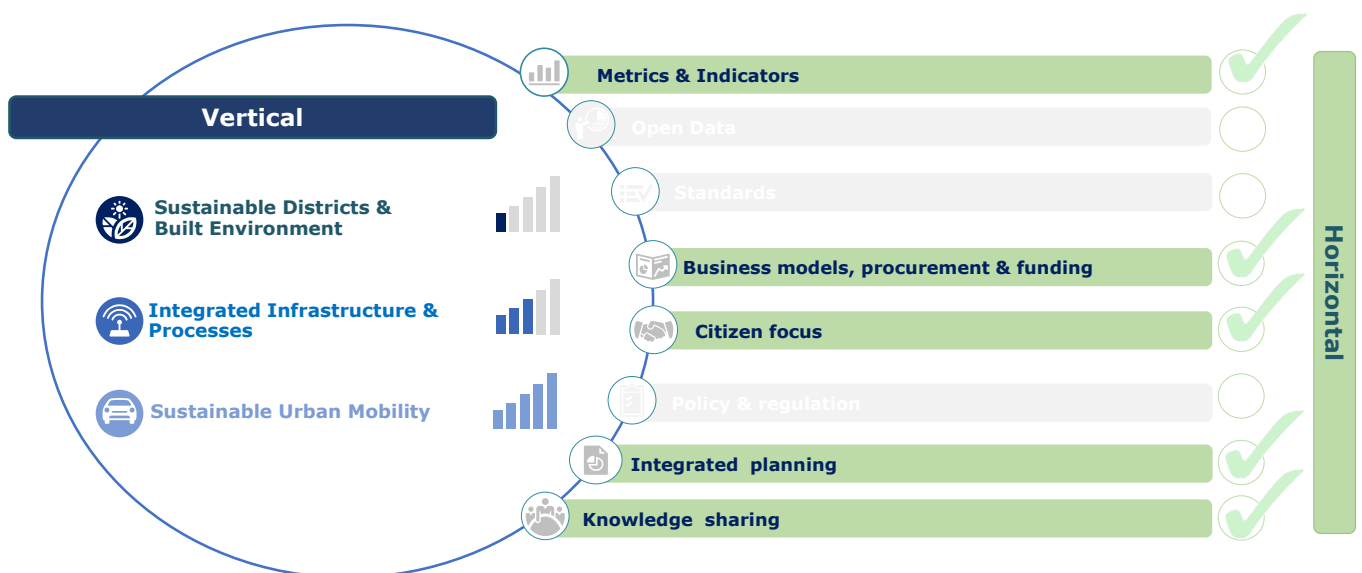
<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling or Replication</b>	Yes, replicated in more than 40 cities
<b>Key actors / stakeholders</b>	Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://www.hamburg-port-authority.de/de/presse/broschueren-und-publikationen/Documents/140401_HPA_Broschuere_spl_web.pdf">http://www.hamburg-port-authority.de/de/presse/broschueren-und-publikationen/Documents/140401_HPA_Broschuere_spl_web.pdf</a>

## Level of integration

**The solution uses ICT and big data to improve mobility, infrastructure and trade flows.** The HPA strives to increase the efficiency of the port as an important link in the supply chain. The solution also takes account of both economic and ecological aspects. The system has the potential to reduce emissions by improving traffic flow in the port areas through ICT platforms.

The **Smart Port Logistics platform is highly innovative** and the first of its kind as it combines traffic innovation with service innovation. It has also created an infrastructure to look into energy optimization. With the SPL project, the HPA is venturing into new territory with regards to application development. The project will interlink and manage the services and functions offered by different providers.

Besides SmartPORT Logistics, the Hamburg Harbour Authority is also focusing on the parallel SmartPORT Energy solutions. **The aim is to develop further solutions specifically tackling energy consumption and emissions.** For instance, some port-based businesses produce more industrial waste heat than they can use for their own purposes. Supplying the surplus to neighbouring companies may prove to be an ideal ecological and economic solution. In the future, **"energy co-operatives"** such as this will be taken account of in the location and land use policy. Studies are already being conducted as part of **Enterprises for Resource Protection** programme to identify unused waste-heat sources in the port and how they can best be exploited. The objective (set for May 2015) was the implementation of pilot projects in cross-company waste-heat exploitation. The integration of logistics solutions and energy-focussed solutions is quite weak so far, but this gap could be bridged by utilizing and connecting the smart infrastructure that is being developed.



## Business case

This solution is an **industry-lead project**. The main actor behind smartPORT logistics is HPA. The project has been setup as a **co-innovation project**, whereby each actor funded the efforts from within. Private companies have supported the solution through data development and management. SAP Connected Logistics software and the Connected Car solution from T-Systems, a subsidiary of Deutsche Telekom, provide the basis of the system.

With smartPORT logistics, the two lead companies involved have created a comprehensive IT platform that has been combined with mobile apps. The offering is not only directed at ports but also at other logistics hubs, such as airports, parcel distribution centers and production sites. The partners are committed to work to extend the ongoing cooperation for cloud services in the domain of **telematics services and real-time information** for logistics solutions. The smartPORT logistics project is the frontrunner for the available cloud offering, called SAP Networked Logistics Hub (SAP NLH).

**The SAP NLH is a software-as-a-service** and its implementation costs are split into:

- **smartPORT logistics setup:** < 5 person days based on the data to be accessed;



- **Integration effort for carrier's order management system** (any system applicable): Up to 20 days. The underlying assumption is that a trucker's on-board units are already integrated with the T-Systems Connected Car solution;
- **Monthly subscription fee:** Desktop users (~€ 15), mobile users (free) and movable assets e.g. trucks (~€ 30)
- **Connectivity costs and devices** are covered by existing or to-be-made third party agreements

The business model is based on a **HANA Cloud Platform offering a digital service engagement layer including:**

- Information already offered within today's contextual third party services, e.g. **traffic information** provided by the German Car Association (ADAC) are being used, as well as published construction sites via BAST (launched by the German Ministry of Transportation and Infrastructure);
- Other contextual services can be added by third party service providers, e.g. **fleet analytics, retail services for the mobile personnel, predictive maintenance** and service scheduling for moving assets – integration efforts, e.g. identifying data formats, will be conducted

SAP and T-Systems are already offering the data solution to other ports in the world. Furthermore, the offering is not only directed at ports but also at other logistics hubs such as airports, parcel distribution centers and major production sites. **The solution can be replicated in other logistic locations that face the challenge of optimizing the flow of goods in a limited area.**

## Community & Citizen Focus

Transport users and decision makers are the core community targeted by the solution, with different strategic goals defined for each subgroup. The system is designed to be able to produce the **relevant traffic information in real time**, enabling users to choose the fastest and most favourable mode of transport to get their goods to their final destination. Additionally, some of the engaged individual stakeholders are citizens of Hamburg or of the original destination. The large number of external material produced by local media engaging truck drivers and dispatchers demonstrated the high impact of the solution towards the citizens.

Throughout the project and field-testing phases, users were involved in various ways:

- In the **conceptual phase** by interviewing dispatchers, truck drivers, management personnel, hub operators, hardware and software architects and business personnel;
- By conducting **usability testing of the applications**, especially the desktop app with dispatchers, hub operator, CEOs of truck companies and the mobile app with truck drivers;
- The developers of the application and business personnel also tested both the desktop and the mobile apps themselves;
- Users were involved by the business personnel and decision makers on matters concerning the business modelling options and execution
- A stakeholder event was held with other stakeholders part of the same hub who had not yet been involved in the initiative in order to gather feedback, introduce the application and give them the opportunity to test it;
- In the feedback and refinement phase, an **extensive round of feedback sessions** was conducted throughout the field tests, after development completion and after deployment;
- Webinars** take place on a continuous bases with SAP's ecosystem, business partners, customers and prospects and experts from distinct industries that are related to one hub. The aim of these webinars is to gather feedback, insights and suggestions for additional feature that should be added to the application in future releases.

Communication with and among users takes place in different ways during deployment:

- The solution does not only supply traffic information: Distinct routing information is produced, along with communication feeds among the harbor community;



- B. Peer to peer communication: Users broadcast back to the geographical area they are moving within to other users, e.g. their own dispatcher(s), their colleagues, and their peers (mostly unknown users); the same is true for the dispatcher(s) and the hub operator, who is able to broadcast to any user in a geographical area;
- C. User to unknown recipient: The solution includes an anonymous broadcasting mechanism; where once can warn/advise others that use the app;
- D. User/device interface: Other forms of interaction happen when users receive responses linked to the interactive messages that appear on the digital screens placed in the harbor area. For example, these might indicate that a bridge is opening for vessels as a result of the solution managing the volume of approaching trucks or receiving warning messages from the hub operator that also uses the system. Messages could also contain a warning in case of storm surges in the port area that could lead to immediate evacuation measures.

## Impact

Evaluations of the energy-efficiency measures implemented under the funding and support programme **Enterprises for Resource Protection** programme revealed that port-based companies account for more than **40% of Hamburg's energy savings**. This shows that the potential for saving energy in the Port of Hamburg is considerable, which is exactly what Hamburg's funding and support programme is aimed at: port-based companies receive consulting and financial support to implement energy-saving measures as well as to install energy measurement and control technology and introduce energy management systems. The supported measures include, inter alia, heating and cooling technology, electric-powered motors, compressed air, production technology and information technology. **The goals are the implementation of energy-efficiency measures and the introduction of energy management systems to reduce annual carbon emissions by 12,000 tonnes.**

Even though the Smart Port Logistics solution is still in its early phases it has already delivered results: trucks have experienced shorter waiting times and more precise routes. In pilot operations, the hauliers taking part in the project were able to increase their productivity by more than 12% due to substantially reduced waiting times.

Also, order deliveries have increased and the openness of the platform allows for the further development of services and the involvement of additional service providers.

All results, especially the economic ones, will indirectly contribute to the environmental agenda by **smoothing traffic flows** and **decreasing CO<sub>2</sub> emissions**. The results so far also reflect a significant reduction in unnecessary driving and waiting time for trucks. On average, a test has shown that a truck that saves 1 km of driving contributes a 60-150 g CO<sub>2</sub> emission reduction. On an overall scale, this will have a significant impact, especially when considering that the entire port area covers 130 km of roads.

**The solution enables people in Hamburg to make smart decisions** due to the sensors and systems HPA has in place. Therefore, the more parties actively use the system, the shorter truck waiting times will be and congestion in the port and on its approach roads will be minimised.



## The solution in context: Smart City – Hamburg

### **About the smart city vision in the city**

The future prosperity of cities also lies in embracing the benefits of connectivity. The City of Hamburg is already a frontrunner in this regard. Hamburg aims to improve quality of life by ensuring greater mobility, efficiency, safety and sustainability. This will primarily be achieved through systematic and **efficient use of the Internet of Everything**. To this end, leaders of the City of Hamburg and Cisco have signed a Memorandum of Understanding (MoU).

The MoU reflects the shared visions and beliefs on smart cities that were developed during the Smart City Summit, hosted in Hamburg in December 2013. Representatives of public sector, research and education institutions, and local and international companies came together to define a Smart City framework. More specifically, The MoU contains descriptions of specific smart city pilot projects in relation to **smart traffic, smart street lighting, infrastructure sensing and remote citizen services**. Several actors are supporting the first projects, including AGT International, avodaq, InnoTec Data, Philips, Streetline, T-Systems and Worldsensing. Other partners are also invited to join the open smart city ecosystem.

**Name of City** Hamburg

**Country** Germany

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): **46**

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## Copenhagen Intelligent Traffic Solution Copenhagen, Denmark

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Copenhagen Intelligent Traffic Solution (ITS) System **allows city officials to track traffic conditions by mapping the position of city road users** and categorizing their patterns, through a smart network of Wi-Fi sensors and access points installed around the city, which collect anonymous information from city users. The data collected is based on the positions and behaviour of both car users and cyclists.

**The software is a cloud dashboard** in which actual data is aggregated and used to both assess impacts and estimate future trends, in conjunction with sophisticated mathematical models.

**The purpose of the system is to improve traffic mobility and the safety of car users, cyclists and pedestrians.** Also, the solution makes it possible to identify road users' patterns and get insights on their behaviour, in order to **adapt city mobility components to road users' long-term tendencies**. This leads to a general optimization. For example, traffic lights are green for longer in case of congestion and connected traffic signals communicate this real-time information to city buses.

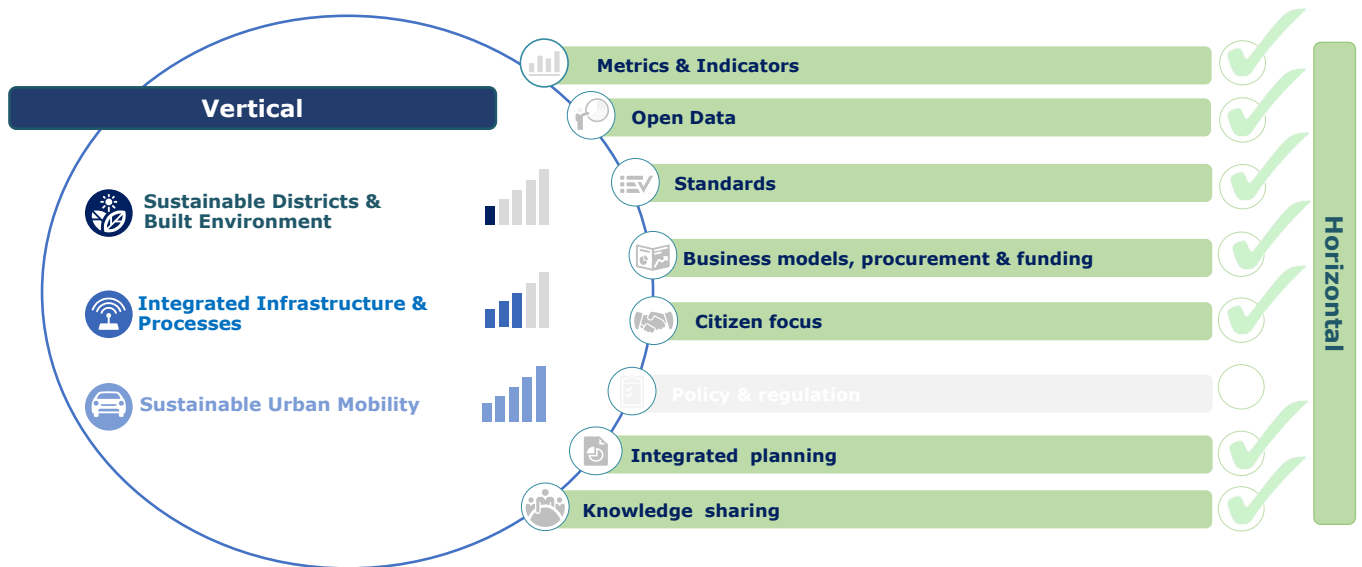
In addition to the components listed above, this smart mobility system also makes it possible to **gather data useful for other applications**, like the adaptation of the lighting system depending on bicycle and pedestrian transit trends. Combined with advanced mathematical models, the system is actually able to produce future scenario hypotheses, by matching traffic conditions with variables like weather or road works.

The first phase of implementation (2013-2014) has included a pilot test, launched by the Technical University of Denmark, focused on testing the feasibility of the solution. Following this pilot test, the phase of actual implementation began in 2015, in which a network of Wi-Fi access points around the city was installed, beginning the acquisition of geolocalized data concerning road users.

<b>Starting year</b>	2013
<b>Type of integrated solution</b>	ITS for traffic monitoring, management and enforcement
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry, University
<b>Budget</b>	€ 9.1 Mln
<b>Number of impacted users</b>	Approx 560,000
<b>Link</b>	<a href="https://stateofgreen.com/en/profiles/city-of-copenhagen/solutions/copenhagen-intelligent-traffic-solutions">https://stateofgreen.com/en/profiles/city-of-copenhagen/solutions/copenhagen-intelligent-traffic-solutions</a>

## Level of integration

The solution is an example of **an innovative platform that integrates ICT, sustainable urban mobility components, traffic safety and issues concerning CO<sub>2</sub> emission reduction**. The solution makes it possible to categorize traffic, map mobility patterns of citizens and, through ICT, to match traffic conditions with other relevant variables, aiming at improving overall mobility and traffic efficiency, increasing safety for car users, cyclists, bus passengers and pedestrians. Another very important aspect of the solution is the potential to **ensure cleaner air, less noise and CO<sub>2</sub> emission reductions in the city**. This corresponds to the city's aim of becoming the world's first carbon-neutral city by 2025.



## Business case

The solution is driven by a process including both public and private actors creating a **public-private innovation (PPI) process**. The main actors are the City of Copenhagen and a consortium consisting of a group of companies and a knowledge institution: CITILUM, the Danish Technical University and Leapcraft, in partnership with CISCO and Silver Spring Networks. The consortium, in collaboration with the City of Copenhagen, results in a team that covers a wide range of expertise and experience from both the public and private sector.

Copenhagen City Council **invested** almost **€ 9.1 Mln** to carry out the Copenhagen ITS smart solution, split between the following dimensions (source: City of Copenhagen):

- Better flow and green driving: € 2.8 Mln
- Traffic safety: € 0.4 Mln
- Dynamic urban space: € 0.3 Mln
- Traffic management and data: € 3.1 Mln
- Information and services: € 0.5 Mln

In 2015-16, approximately **DKK 55 Mln** (€ 7.3 Mln) is needed to **further maintain and redevelop the chosen ITS initiatives initiated in 2013-2014**.

The solution has a **great potential for replication** and there are no place-related limitations to be identified. In the future, all big cities will face major traffic and mobility problems because of increasing urbanisation. Many companies already offer intelligent traffic management systems to ease environmental and climate impacts from the growth in mobility in the cities.

## Community & Citizen Focus

The initiative is totally **committed to citizens** or, more specifically, to road users. The behavior of the citizens is the main source of data in the solution. The solution has been projected with a prevalent focus on cyclists, since Copenhagen residents are very much engaged in making their city green, greatly contributing to combating environmental issues.

In addition, even if the **cloud dashboard automatically gathers data** from road users' smartphones, their privacy is not compromised, as all the information remains anonymous.

This last component makes the whole system even smarter, since it presents an integrated ICT framework: **a mobility solution that benefits citizens without privacy violations.**

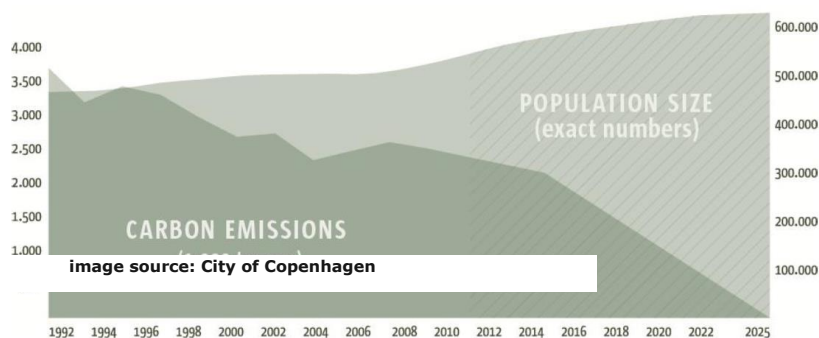
## Impact

The solution contributed to **optimizing and shortening response time**, thanks to an improved capability in reacting to specific traffic conditions.

A traffic simulation has shown that optimisation of traffic signals on one of the main streets in Copenhagen, H.C. Andersens Boulevard, can provide up to **a 14% reduction in travel time** for motorists during rush hour in one direction. The number of stops cyclists made on the same stretch of road was also reduced by up to 16%. Bus travel time was also improved in a similar way, especially in the daytime at the Stormgade / H.C. Andersens Boulevard intersection. Pedestrian traffic safety is also expected to improve following a series of technical adjustments to the signals.

Another test demonstrated that it is now possible to **go via some city routes cutting the travel time by 30%**. In 2014, The Technical and Environmental Department of the City of Copenhagen tested the traffic situation after a football match in Parken, the national football field. **The test showed** that the time when there was **traffic congestion was halved**, from about 40 minutes to about 20 minutes. The test also showed that it is possible to create intelligent traffic management based on an early analysis of the traffic situation at a given point in time.

Overall, the solution will result in a **decrease in noise and air pollution**, thus contributing to Copenhagen reaching its CO<sub>2</sub> emissions reduction target.





## The solution in context: Smart City – Copenhagen

### **About the smart city vision in the city**

According to the declarations made in the Eco-metropole of the world (City of Copenhagen, 2007), Copenhagen aims to **demonstrate global leadership in the field of green urban environment management.**

Aside from the case presented, Copenhagen qualifies as a smart city for other policies and practices. Indeed, the city council declared Copenhagen on track **to becoming the first carbon neutral city in the world by 2025**, with a decrease of CO<sub>2</sub> consumption **under 1.2 Mln tonnes from the initial level of 2.5 Mln.** The four focal points of the Climate Plan 2025 are energy consumption, energy, mobility and city administration.

Finally, as part of an initiative by the European Commission, Copenhagen has been nominated **European Green Capital 2014**, especially thanks to its focus on environmental improvement and green growth for the last 20 years. These impressive results are not accomplished by the city alone: the citizens are really engaged in these objectives and particularly motivated to pursue common goals in order to see and increase in their quality of life.

<b>Name of City</b>	Copenhagen
<b>Country</b>	Denmark
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): <b>15</b> Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): <b>15</b>

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## Data.One Smart Portal Hong Kong, China

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Following the new prevailing trend in the field of Public Sector Information, the Government of Hong Kong launched a series of initiatives related to **information sharing**. Within this framework, **Data.One is one of the most relevant e-government initiatives** included in the Hong Kong IT strategy.

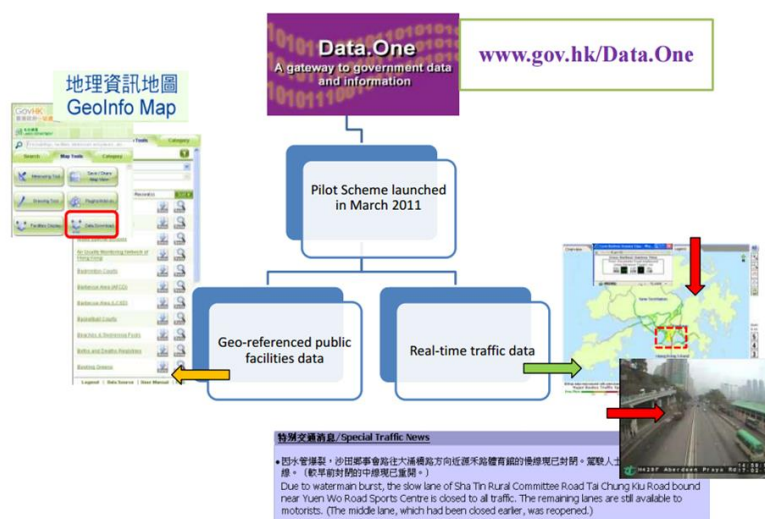
**Data.One is an 18-month pilot scheme** launched the Government of Hong Kong special Administrative Region in March 2011. The vision of the project is to develop the Hong Kong economy as a **knowledge-based economy**, leveraging on sharing information for value-added re-use.

In essence, Data.One is a portal that makes a variety of information available, such as **geo-referenced public facility data, real-time traffic data, water quality, weather, population census, public transport** and more.

In this way, the portal is not only a valuable source of reference, it also acts like and instruments in order to:

- Facilitate the wider dissemination of Public Sector Information (PSI);
- Enable the public to obtain information more easily;
- Stimulate the power of re-use by the public;
- Generate valuable applications.

The portal is maintained by the Office of the Government Chief Information Officer through datasets and information provided by different government departments and public / private organisations.



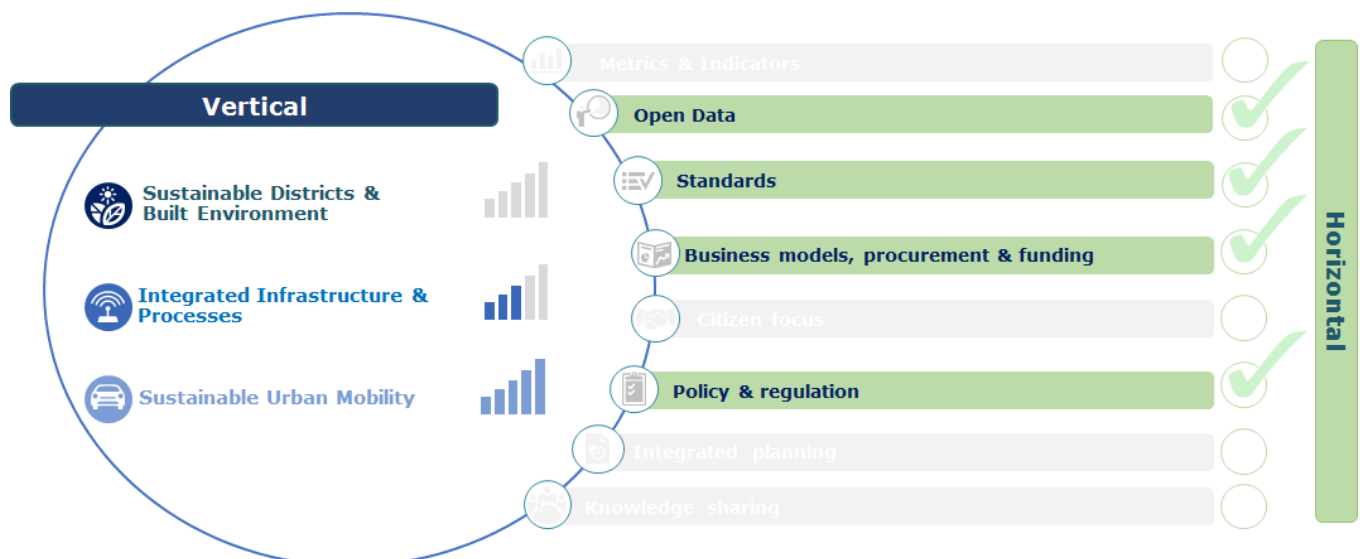
<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Hong Kong City
<b>Budget</b>	€0.6 <sup>1</sup> Mln
<b>Number of impacted users</b>	The entire population of the city
<b>Link</b>	<a href="https://data.gov.hk/en-data/category/transport">https://data.gov.hk/en-data/category/transport</a>

## Level of integration

The data portal shows a **great level of integration: 16 categories** comprising about **3000 public sector information datasets** are available on the Data.One portal, including **real-time road traffic information, air pollution indices, weather data, geo-referenced public facility data, population census statistics, and public transport routes and fares**.

The user of the on line platform is allowed to browse, download, distribute, reproduce, hyperlink to, and print (in their original format) the data released, which shows a great level of integration as far as format and data characteristics are concerned. Data is in open source format, and are accessible free-of-charge for both commercial and non-commercial purposes. The key categories include public data such as city management, education and environment.

Transportation data is also included. **Citymapper and HK Drivers** are among the applications relevant from a transportation point of view. The former is an iPhone/Android/Web application with a comprehensive source of information for navigating Hong Kong, including information on the Citybus, First Bus, Green Minibus, ferries, light rail, trams, cycling, and Uber, with real-time information when available. HK Drivers is an all-in-one app for drivers to easily access real-time traffic and other essential information (e.g. carpark, garage, etc). It provides an intuitive and streamlined interface for providing ease to use information while driving.



## Business case

All datasets of the Data.One solution are **free-of-charge for commercial or non-commercial re-use**.

All data on the portal is freely downloadable and re-usable, and some datasets are in XML format for convenient data transfer and processing by computers.

<sup>1</sup> The conversion rate used for this case study is 1€=8,5 HK \$.

The city government has encouraged the local departments to release data. As pointed out by Joey Lam Kam-ping, Deputy Government Chief Information Officer, *"the data is there ready for public release. It is just that some departments don't know they have such data themselves. We will encourage the departments to release more data. In the past, government departments needed to give data to us for uploading. But now, with the launch of the new platform, they can go to the platform themselves to release data. We organised seminars and released guidelines and circulars to them on how to use the new portal"* (Scmp, 2015).

The solution can be applied elsewhere based on the extent to which public service data is available (e.g. London, New York, Dublin, Glasgow). Open Data initiatives are thriving in cities because ideas for **service innovation are often rooted in densely populated, diverse and shared urban spaces** where people need just-in-time information to navigate the city, such as real-time public transport information, weather information, information about the environment, energy, health, culture, as well as information about policy decisions that affect life in the city and future developments, such as information about housing policy, municipal budgeting, and demographics.

In terms of costs, Data.One requires **€ 100,000 annually for maintenance** of the public service information portal, plus **€ 150,000 as costs for obtaining public cloud service**. The cumulated investment from 2011 until now is about €0.6 Mln.

## Community & Citizen Focus

**The Open Data Hong Kong Community is an open, participative, volunteer-run group composed of Hong Kong citizens** who support Open Data. Anyone can join, take part and lead. Open Data initiatives often start by building a multi-stakeholder community through public events where officials, digital community, business and citizens meet and experiment with data in a way that was not possible in the times when public information was not readily accessible in open formats, not accessible at all, or only on request.

For the Hong Kong government, building such a community is important because open data is still a new field for most stakeholders, and it also provides a space to negotiate and define the expectations and terms of using and **re-using public data** before a policy on public data is developed. Questions around licensing, technical standards, and cost need to be agreed upon based on practical experiences in the new open data environment as well as on an analysis of the outcomes.

## Impact

Data.One has released selected data sets in open format to the public to encourage **the creation of new services and citizen-centric applications**. Economic and social impacts of Open Data have been hundreds of new applications in several fields of public and social services.

Many of the apps use the real time information on the congested cross-harbour tunnel traffic or the **Intelligent Emergency Reporter** app, which can display crime rates, traffic black spots, traffic accidents, special traffic arrangements as well as the location and telephone numbers of nearby police stations.

The Data.One portal disseminates information from the Road Traffic Information Service (RTIS) and the **eTransport**, a free one-stop, multi-modal public transport route search system with map information available to the public. It is estimated that the solutions over the period 2011-2012 have lead to a relocation and reduction of bus trips, contributing to congestion reduction (Environmental Report, 2012).



## The solution in context: Smart City – Hong Kong

### About the smart city vision in the city

Hong Kong has become a major **information, communication and technology hub** in the region, with international rankings consistently putting it at the forefront. Its public transport network is one of the most efficient in the world, with public transport and walking making up 92% of the modal split. **Hong Kong's transport system is a multi-modal network** based on rail transport supported by buses, minibuses, trams, ferries, and taxis. The network is well integrated and the Octopus smart card allows customers to use all modes of transport and to pay for parking, shops and leisure facilities. The city performs very well for financial attractiveness of public transportation, share of public transportation in modal split, smart card penetration, number of vehicles per capita, traffic safety, climate impact of transport and public sector initiatives. In addition to this, it has an above average performance with regard to **share of zero-emission modes** in modal split, road density, agglomeration density and public transportation frequency. Improvement potentials lie in the areas of cycle path network density, car and bike sharing as well as air quality, especially with regard to NO2.

**Name of City** Hong Kong

**Country** China

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Intelligent Urban Mobility Management and Traffic Control System Thessaloniki, Greece

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The solution deployed in the central area of Thessaloniki deals with the **set-up of a Traffic Control Centre**. Real time traffic data is collected through road traffic counters and detectors. Technologies applied include cameras, radars and loop detectors.

The following **services** are provided to the users (citizens, businesses, transport operators):

- **Car routes:** Total travel time of urban routes using real data traffic conditions;
- **Routes using public transport:** The most efficient routes in terms of cost and time, using public transport;
- **Pedestrians routes:** Shortest paths to reach destinations on foot;
- **Intermodal transport:** Shortest paths using intermodal solutions (car + public transport + walking);
- **Environmental impact:** Environmental impact (emissions) of transport solutions on the basis of daily air quality data;
- **Public transport information:** Timetables, service type, number of stops, travel time, etc;
- **Traffic condition:** Information concerning real time traffic conditions on the city road network.

Overall, the combination of these services should improve awareness of the impacts of transport solutions, paving the way for a growing use of environmentally friendly transport modes and solutions.

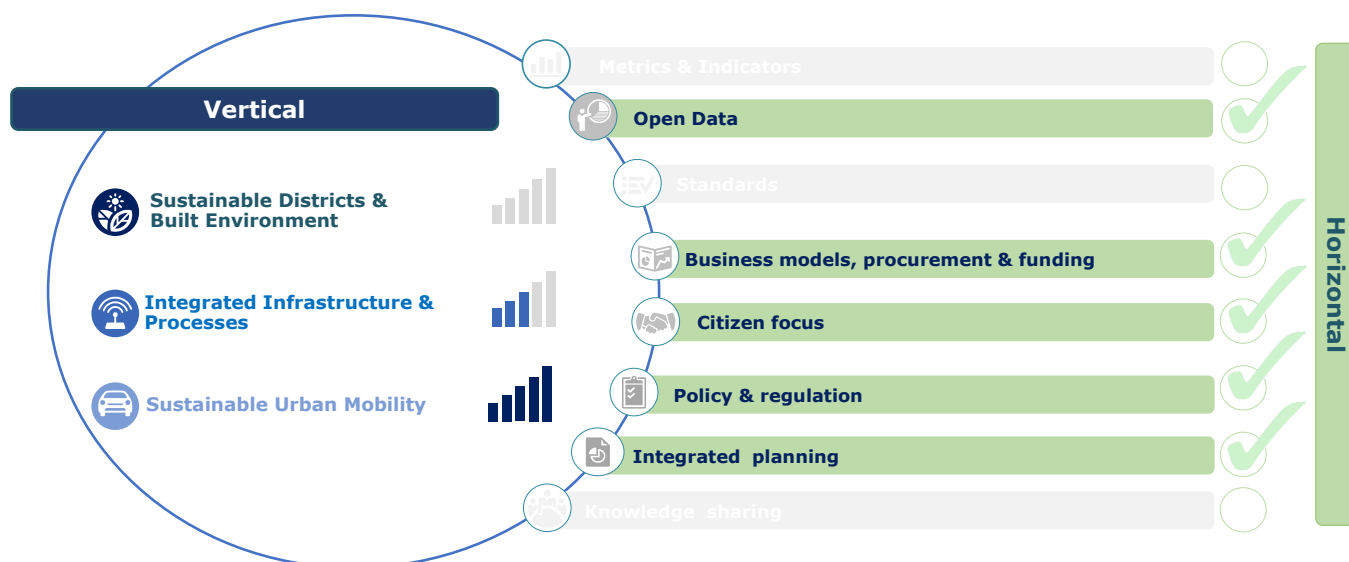
The Traffic Control Centre operates under the responsibility of the Region of Central Macedonia. It was launched in 2010 in order to face the negative impacts of traffic conditions in the central area of Thessaloniki.

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, Academia, Transport operators
<b>Budget</b>	€ 2.9 Mln
<b>Number of impacted users</b>	Approx. 1 Mln
<b>Link</b>	<a href="http://www.thita.gov.gr/en/project/intelligent-urban-mobility-management-and-traffic-control-system">http://www.thita.gov.gr/en/project/intelligent-urban-mobility-management-and-traffic-control-system</a>

## Level of integration

The Intelligent Urban Mobility Management and Traffic Control System in the City of Thessaloniki is an example of **infrastructure integration through ICTs**, e.g. sensors, cameras and road infrastructure.

The solution integrates real time traffic information from sensors and camera applications, centrally managed by the Traffic Control Center, with information to **promote, enhance and facilitate the access to transport services for the end users**, managed by the Centre for Urban Mobility. In particular, the Center informs citizens about alternative routes when planning their journey, providing them with the optimal solution using real time data and suggesting the most environmentally friendly route.



## Business case

The Intelligent Urban Mobility Management and Traffic Control System in the City of Thessaloniki is the result of joint efforts by the key players of the city dealing with **urban mobility, intelligent technology systems applications, transport and environment**.

The project had a total budget of approximately **€ 2.9 Mln**, funded via **grants**:

- **50%** provided by Iceland, Liechtenstein and Norway through the **EEA Financial Mechanism**;
- **50%** provided by the **Greek national Public Investments Programmes**.

The solution aims to improve a public service and – at the same time – to test new ITC solutions. It has not been designed to be profitable.

## Community & Citizen Focus

The direct involvement of the citizens in setting up this solution has been important. An extensive survey carried out in 2010 identified the mobility patterns, origin-destination patterns and transport modes used by citizens living in the area.

The **survey** was carried out through phone interviews **over a sample of 5,043 citizens** in the wider area of Thessaloniki. The survey gave citizens the opportunity to actively contribute to the **improvement of the environmental quality in Thessaloniki**, providing qualitative evaluations on transport conditions and contributing with their feedback to set priorities and the agenda for the transport policy.

Furthermore, in the long-term, through the organization of urban mobility training programs, the use of the web portal of the solution, etc, a new culture for urban mobility is expected to spread among transport users and citizens.

## Impact

The main registered impacts in the area of Thessaloniki have been the following:

- **Reduction of traffic flows and delays** on major axes;
- **Reduction in the concentration of air pollutants** between 5-25%;
- **Increase of public transport use** by about 20% (average over two years);
- **Increase in the use of environmentally friendly modes of transport** (bicycle and walking);
- **Reduction of the time needed to restore normal traffic conditions** following major incidents (by around 50%).





## The solution in context: Smart City – Thessaloniki

### About the smart city vision in the city

The Urban and Regional Innovation Research of the Aristotle University of Thessaloniki provides an overview of the current strategies underpinning the transition of Thessaloniki towards becoming a smart city. The review shows that **"the strategy for 'Intelligent Thessaloniki' relies on the identification of specific areas of the City of Thessaloniki, Greece in which the implementation and development of ICT application is promising."**

The most important **districts of innovation and entrepreneurship** within Thessaloniki have been included, namely: (1) the port area of Thessaloniki, (2) the Central Business District and commercial centre of the city, (3) the campus of the Aristotle University of Thessaloniki, (4) the technology district of eastern Thessaloniki, and (5) the airport area. In each district a wide range of digital applications and e-services are deemed to have improved innovation and entrepreneurship.

These include the development of wired and wireless broadband networks using sensors for **real-time information, processing and alerts**, the development of **e-services** for the business community of each district and **training services** for the involvement of end-users, businesses, and organizations in e-content development and social media use.

<b>Name of City</b>	Thessaloniki
<b>Country</b>	Greece
<b>No of Inhabitants</b>	100,000 > x > 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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<http://www.thita.gov.gr/en/project/intelligent-urban-mobility-management-and-traffic-control-system>



## MnPass Minneapolis, Minnesota, US



→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The MnPass solution was first **launched in 2005** by converting underused car pool lanes. The freeway I-394 was chosen as the site for the implementation due to the high levels of commuters using it every day.

The system **allows drivers only to get access to the lanes by paying a fee**. Users can also choose whether to access MnPass on a daily basis. In order to do so, drivers need to have a MnPass account and the MnPass transponder installed on their cars. Drivers can lease the transponder at a cost of € 1.40 a month with a pre-charged credit card of € 37 in order to get the system started. The hourly costs for using the pass range from € 0.90 to € 3.78 depending on supply and demand levels.

**MnPass works by using road sensors to collect data to be sent to Mn/Dot computers to adjust prices based on traffic levels.** Once the pooling lanes begin to get more vehicles, the system automatically starts charging higher fees in order to get the lanes decongested and re-establish regular speed levels. The average price paid by users is around € 1.40. Signs at each entry point communicate to the drivers the cost of their journey depending on where they want to exit. Offenses for violating the MnPass lines are charged with fees up to € 134.

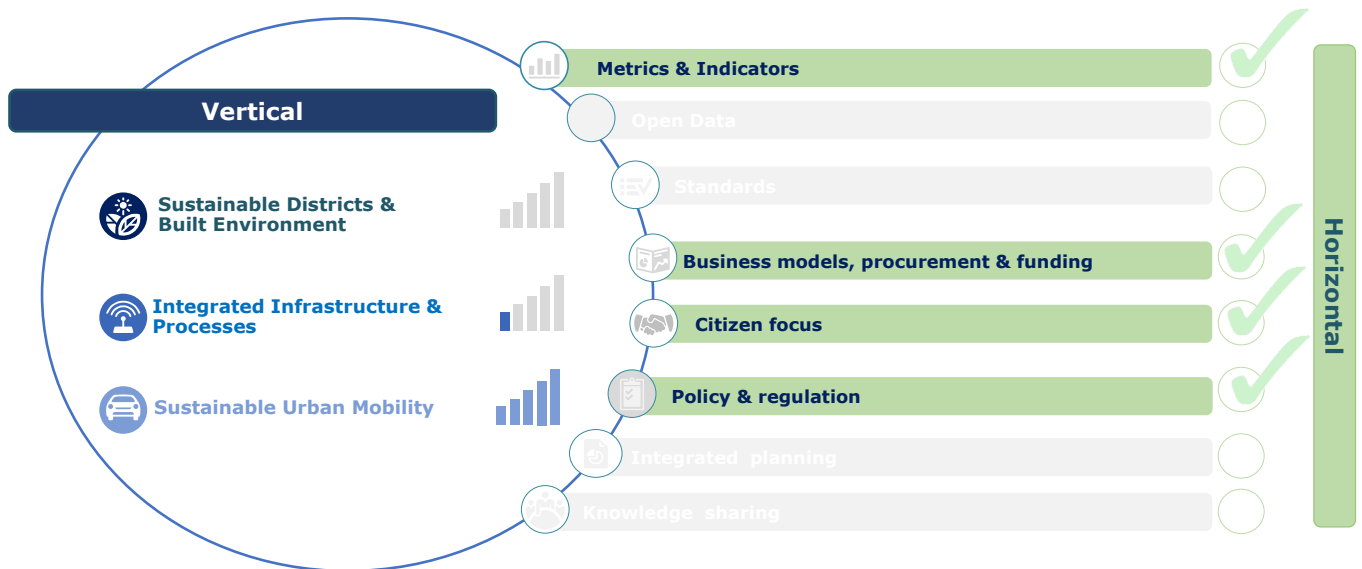
Further expansions of the projects are currently underway on the I-35E highway. Authorities are also planning to use the system between Minneapolis, Blaine and St.Paul by 2030.

<b>Starting year</b>	2005
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 93 <sup>2</sup> Mln
<b>Number of impacted users</b>	Approx. 9,000 users signed in for the MnPass when it was first launched in 2005.
<b>Link</b>	<a href="http://www.mnpass.org">http://www.mnpass.org</a>

<sup>2</sup> The conversion rate used for this case study is €1 = \$1,06

## Level of integration

The MnPass can be considered an integrated solution **adopting elements of ICT** to monitor and charge access to the pool lanes. The system enables a **reduction in congestion levels on highways** therefore contributing to more sustainable urban mobility in the Minneapolis area. Moreover, the system also enables improved transit for public transport vehicles. A new express bus service started in 2009 on the I-35W with an **increase in transit service of 11% and in ridership of up to 55%**.



## Business case

The project for MnPass was approved in 2003 by the state legislature. A task force (made up of officials from 22 cities, regions and states, was established to oversee the development of the system). The main areas of competence of the task force included **technical issues and guidance concerning education and public outreach**. Similar systems have been implemented in other regions across the US (e.g. California).

The costs as well as the funding sources for implementing the solution differ based on the motorways on which the system has been introduced. More specifically, the following major interventions and related costs can be identified:

- On the I-394, toll equipment and MnPass customer service have been installed; no specific lanes have been added, due to the existence of high occupancy vehicle (HOV) lanes, which were converted into high occupancy toll (HOT) lanes. **The total costs for the intervention amounted to € 9.4 Mln**, funded via a loan from the **ABC parking garage revenue** (parking facilities owned by MnDOT).
- On the I-35W South, the cost for implementing MnPass included the installation of toll equipment plus the construction of new lanes. About half of the I-35W South corridor already had HOV lanes that were converted into HOT lanes. The overall area was also subject to other infrastructure improvements. **The overall cost amounted to € 37 Mln** funded via a combination of state trunk highway funds and federal funds.

## Community & Citizen Focus

A **survey** was conducted between 2005 and 2006 with the aim of including citizens in the MnPass project by testing their level of satisfaction with the system. The total number of people involved amounted to **950 residents** living along the routes where the system was installed. The overall outcome of the survey showed how the majority of people were in favour of the MnPass (59%) describing it as a good idea. Only 29% of respondents described it in a negative way. High levels of satisfaction were also expressed by those using the system regularly, with 90% of the respondents providing positive feedback. Clear signage, customer service staff and the dynamic pricing system were also reported in a positive way by those surveyed.

## Impact

The introduction of the MnPass system resulted in approximately additional 1600 vehicles moving into the express lane from the general purpose every morning and evening. Therefore, MnPass helped increasing the average speed on the highway and to cut gas and pollution by reducing traffic congestion. The success of the programme was also shown by the 9000 people signing in to lease a transponder when the project started in 2005. More in details **substantial environmental impacts have been achieved by the implementation of the solution**. The reduction of **CO<sub>2</sub> emissions amount to 2.3 tonnes** per day and 845.2 tonnes per year. Economic benefits have been also achieved by **reducing pollution and amounting to approximately € 216,000**. Moreover, a total of **€ 477 Mln benefits** have been generated since the initial adoption of the system. Finally, as underpinned in the previous chapter the system enabled also to enhance the quality of life for those living close to the areas where it has been implemented.

The success of the MnPass system is leading to several other replication projects across the US from New York to Portland. Besides Minneapolis, other cities that pioneered the implementation of similar systems were San Diego, Orange County, Lee County and Houston.



## The solution in context: Smart City – Minneapolis

### About the smart city vision in the city

The Minneapolis Municipality has been putting great amounts of effort to rebrand the city as one of the most innovative and cutting-edge centres in the north part of the USA. In order to achieve this goal, the city is involved in several projects spanning from the plan to increase population to 500,000 residents by 2025, to the development of light rail lines and new housing, as well as fostering community involvement for citizens.

A central point in the plan for boosting the city's reputation is the growth project for the Downtown district. The aim is to make **the area attractive again by investing in new sustainable mobility solutions** like trams, streetcars and rapid transit lines for busses.

**Name of City** Minneapolis

**Country** United States of America

**No of Inhabitants**  $100,000 < x < 500,000$

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Singapore Congestion Charging Singapore

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Singapore road congestion charging plays an important role in the story of design and application of pricing measures to urban transport policy management. In fact, Singapore was an early leader in adopting congestion charging. Firstly, as a follow-up of an one-year public consultation in 1975, Singapore implemented a paper system of daily licenses for vehicles entering the central zone during peak traffic periods. But the importance of Singapore's experience marked a landmark event in September 1998, when Singapore became the **first city in the world to implement an Electronic Road Pricing (ERP) system**. In the most congested parts of the city, a Restricted Zone (RZ) was identified in which a cordon was demarcated through the installation of 33 overhead gantries. The gantries were then progressively increased.

The solution is based on four pillars:

- **Cordon-based** marking by gantries;
- **Electronic In-Vehicle Unit** with smart-card (for payment on entry);
- **Enforcement** via camera images;
- **Back-end Central Control System**.

Dedicated in-vehicle units (IUs) were initially installed in **680,000 vehicles** at no charge to the user. They were purchased for approximately SGD 156 each (€ 104) (ICCT, 2010). The units communicate with overhead gantries at charging points and deduct the appropriate charge from a smart card (which can also be used for other transactions such as parking and public transportation) inserted into the IU. ERP charges are flexible: they are calibrated to avoid congestion.

<b>Starting year</b>	1998
<b>Type of integrated solution</b>	Intelligent transport systems for traffic monitoring, management, enforcement
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry
<b>Budget</b>	Capital cost: € 130 <sup>3</sup> Mln (1998) Annual Operating cost: € 10.6 Mln Manpower: 30 operations staff, 35 dedicated maintenance staff
<b>Number of impacted users</b>	Entire city for about 500,000 vehicles (1:10 car ownership)
<b>Link</b>	<a href="http://www.lta.gov.sg/">http://www.lta.gov.sg/</a>

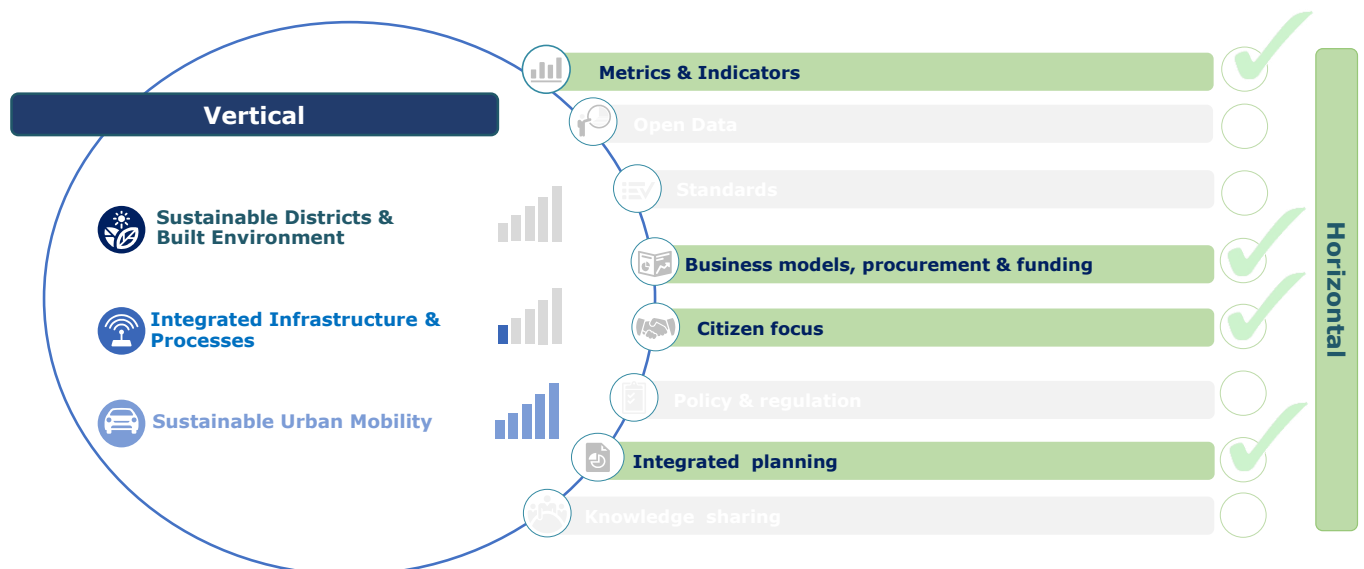
<sup>3</sup> The conversion rate used for this case study is 1€=1,5 SGD

## Level of integration

The Singapore Road charging solution enables the **integration of information flows** between road infrastructure and vehicles. More specifically, it makes it possible to **manage and control traffic in the city via a network of sensors and cameras installed along road infrastructure**. Along expressways, as the vehicle approaches the gantry, the antenna installed communicates with the onboard unit of the vehicle, determining the charge according to time, gantry location and vehicle characteristics. Each time the vehicle passes through the gantry, the charges are deducted from the smart card installed in the onboard unit via short-range radio communication.

The corresponding charge appears to the driver on board unit. In restricted zones, in case of two gantries, as the vehicle moves between the first and the second gantry, the smart card installed in the onboard unit makes the payment and the optical sensor detects the passage of the vehicle, validating the payment. If payment is not valid, the enforcement camera installed in the second gantry takes the digital image of the vehicle's license plate.

**The integration of ICT technologies and integrated infrastructure is high:** short-range communication technologies using microwave wireless communication allow the interchange of information between in-vehicle units and road infrastructure gantries to ensure enforcement and charging.



## Business case

The ERP in Singapore involves the **Land Transport Authority** and the key technological players of the city. To set up the **technological infrastructure of the solution**, three contractors were short-listed and their solutions tried on newly-completed and unopened stretches of roads. **The Government provided funding of € 671,000 to each of the 3 contractors** to mitigate their risks and cover part of their expenses (Kian-Keong Chin, 2010).

Electronic road pricing, which uses electronic or optical tolling, is a mature technology. It has been successfully implemented in cities such as London and Stockholm, and on many highways worldwide. Cities in several countries, including in Indonesia and in the Netherlands, are currently considering the implementation of electronic road pricing systems as well.

Initial capital costs of the ALS component in 1975 were estimated to be SGD 500,000 (~ € 330,000). The annual operating costs during the period 1975-1988 were estimated to be SGD 600,000 (~ € 397,000). Estimated annual revenues during the period were about SGD 6,800,000 (~ € 4 Mln). Therefore, **the revenues amounted to about 11 times the costs**.

Capital costs of the **new ERP integrated System have been estimated to be SGD 200 Mln** (€ 130 Mln at the time of implementation in 1998), half of which resulted from the purchase and installation of about € 1.1 Mln onboard units. Annual operating costs are estimated to be approximately € 10.6 Mln,

while annual revenues generated by the integrated system exceed € 50 Mln, demonstrating the high sustainability of the solution.

## Community & Citizen Focus

The implementation of pricing measures must take into account citizen involvement. In Singapore, **information and awareness campaigns were launched as background measures to involve citizens.**

The government introduced broad improvements that both preceded and accompanied the introduction of pricing. Among other things, congestion-pricing reforms have been accompanied with major expansion in public transportation modes and services and reductions in certain vehicle purchase and ownership taxes.

Generally, people in Singapore reacted positively to the pricing and accompanying package of improvements. Early scepticism has been addressed effectively via information and on-ground experience.

## Impact

The main impacts in Singapore as a result of this solution have been the following:

- **Traffic volume** into the restricted areas has been reduced by about 10-15% during the ERP operating hours, when compared to the previous scheme;
- **A 20% increase in the use of public transport;**
- **Emissions declined in the restricted zones** because there was such a large reduction in automobile travel.



## The solution in context: Smart City – Singapore

### About the smart city vision in the city

The Singapore government is embarking in a long term project called **Smart Nation Platform (SNP)**, which looks to harness technology to the fullest with the aim of improving the lives of citizens, creating more opportunities, and building stronger communities.

The SNP will be built based on a systematic premise to enable greater pervasive connectivity, better situational awareness through **data collection**, and **efficient sharing of collected sensor data**.

In the government plans, the Smart Nation should improve access to data and become more participatory through the contribution of **innovative ideas** and **solutions**, and a more anticipatory government that utilises technology to better serve citizens' needs.

Among the SNP initiatives, the following ones can be highlighted:

- **Smart Mobility:** To create a more seamless transport experience, through new travel options, providing greater access to real-time transport information so that citizens can better plan their journeys;
- **Smart Living:** To develop smart technologies and introduce them to housing estates. A Smart Town Framework has been developed to guide the development of Smart Towns across 4 key dimensions: Smart Planning, Smart Environment, Smart Estate and Smart Living. Various Smart technologies will be trialled at various sites across the island.

**Name of City** Singapore

**Country** Singapore

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Smart Traffic Management System Buncheon City, South Korea

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Buncheon City is using **intelligent video analytics** to provide **real-time traffic information** to drivers, conduct traffic surveillance and improve traffic congestion and safety on city roads. Eliminating manual processes, the solution is able to **collect and analyse traffic volume data and measure average traffic speed** to provide accurate, meaningful information to drivers.

Using intelligent video analytics, **the solution detects traffic accidents** and other **critical events** on the roadways and alerts the city's command centre so that emergency responders can be quickly dispatched to the site. In addition, the solution aids traffic surveillance by providing information and detection tools that improve search capabilities and that allow investigators to quickly search videos and find evidence of illegal or criminal activity.

Furthermore, the intelligent transportation system is helping **to keep the population informed in real time about the latest traffic news**. The system is built on an advanced transmission network, providing resilient packet-based technologies to support advanced applications. The application also eliminates the city authority's dependence on leased lines.

**Starting year**

2007

**Type of integrated solution**

Intelligent transport systems for traffic monitoring, management, enforcement

**Scaling or Replication**

Yes

**Key actors / stakeholders**

Public authorities, industry

**Budget**

€ 10 Mln

**Number of impacted users**

Entire city

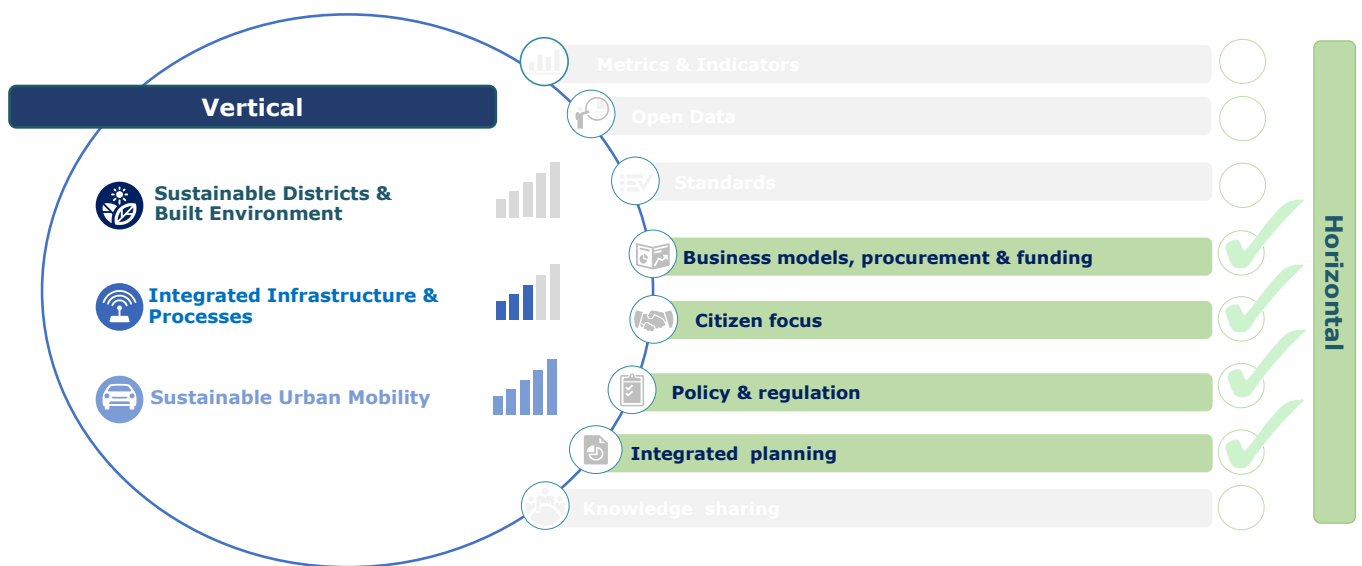
**Link**

<http://www.bcits.go.kr>

## Level of integration

The Bucheon city real time traffic information system **integrates several urban and metropolitan components**, e.g. from enforcement, to real-time information to users, as specified in the following bullet points:

- **Parking management:** Unmanned control of illegal stopping and parking;
- **Checking the speed of vehicles** travelling on the metropolitan segments of national highways;
- **Monitoring of traffic situation** in real-time;
- **Monitoring the speed** at which vehicles are travelling in the city;
- **Bus information system (BIS):** Real time updates on bus arrival times;
- **The traffic signal controller**, which allows the periodic optimization of signals and collection of transit speed data;
- **GPS functions:** Locating the vehicle on the metropolitan segments of the national highway.



## Business case

Before the installation of the optical transmission system in 2007, the city used leased lines from local fixed network operators. However, with the cost of the leased lines rising at a rate of 10% annually, the financial burden was becoming too high to sustain. Similar large-scale applications of real time traffic information center have been replicated in Thessaloniki (Greece).

The solution has been the result of a common effort between government and industry. According to the Nokia Siemens Network-DIZNET, the technical solution led to **a three-year payback for the Korean city traffic control scheme**. The report stressed that *"the advanced services and applications for the ITS demanded a packet-based infrastructure rather than the traditional SDH-based communications technology used. Investing in its own fiber network instead of relying on leased lines was expected to achieve a payback within three years for the Bucheon government. The system supported a large number of nodes and had more than 100 switches that aggregate all the data from the local monitoring systems. The compact size of the switches enabled them to be installed in small roadside and pole-mounted cabinets, simplifying deployment and reducing the network's cost"* (Diznet, 2010).

Finally, the Carrier Ethernet system was supplied and installed by Diznet, Nokia Siemens Networks' local sales partner in Korea and one of the country's leading systems integrators.

The report stressed that *"the A-Series system was around 70% lower cost than other solutions and it also offered better technical performance, such as hard Quality of Service (QoS) and end-to-end protection to support critical applications, as explained by Mr Yong Sun Choi, CEO of Diznet"* (Diznet, 2010).

## Community & Citizen Focus

Population growth is straining the transportation infrastructure and roadways of urban areas across the globe. To overcome this problem, Bucheon City implemented a solution that **provides real-time traffic information and alerts to help drivers avoid congestion**, and enables citizens to better understand traffic flow and improve roadways to meet driver needs.

According to a press release (2012), Buncheon City is also a good example of citizen involvement. *"Once a month, Bucheon City residents, civic workers and Mr. Lee, Senior consultant of the Convergence Business Center at Korea Productivity Center, gather together to discuss what is needed for their Smart city so that they maintain regional characteristic and culture, while economically self-sustainable. They are cooperating to achieve city engineering, economy and governance simultaneously."*

## Impact

Impacts of the solution, from the business results reported in KISDI, 2014, are the following:

- **Increased accuracy of traffic volume data**, from 50% (or less) to 90%, ensuring that drivers receive more accurate reports on traffic tie-ups, suggested route changes, etc;
- **Increased speed of collecting traffic data** by over 1,200%, enabling the city to deliver traffic information to drivers, law enforcement and emergency responders in real time;
- **Savings on costs** by using existing closed circuit television videos without needing to instal an additional vehicle detection system;
- **Reduced labour costs** to manually monitoring traffic volumes and count vehicles;
- **Increased average traffic speed by 5%.**

## The solution in context: Smart City – Buncheon city



### About the smart city vision in the city

The Buncheon smart city vision is part of the **South Korean strategy**, developed in **early 2009**, which looks to create the Smart city or Ubiquitous city (u-City). In this context, Buncheon has developed technological solutions in various areas. In particular, as far as fast transportation is concerned, as stressed by the McKinsey report, "*Buncheon City in South Korea actually provides drivers with real-time traffic information from various sources, such as cameras and speed radars, helping drivers to avoid congested roads and city authorities to track traffic volumes and plan for new roads*".

<b>Name of City</b>	Buncheon City
<b>Country</b>	South Korea
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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[www.bcits.go.kr](http://www.bcits.go.kr)
- › **The solution in context image source:**  
<http://google map>

# ***ITS-based enhancement of public transport***



## Data-driven Pop-up Buses Boston, US

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In early 2015, the on-demand bus service Bridj, based in Cambridge (US) started a new transportation service in the city of Boston (US), moving towards the concept of **dynamic service**. This means that the transportation services moved from traditional transportation services provided along fixed routes to transportation services offering to modify routes and destinations according to user demand. In practice, once the users state their preference between the origin and destination points, an application will intelligently put together a route to the desired destination, based on nearby passengers going in the same general direction.

From the collaboration of transportation engineers and software developers, a specific application has been built, which **helps to determine the pickup points and routes**. The buses have also been equipped with some navigation tools. Since the bus drivers can be flexible with their routes (after picking up passengers), the buses can use traffic data to avoid crashes or construction works, reducing travel time for the users.

**Data collection** is fundamental to the service. For this reason, when users sign up for the application, they contribute anonymous data about where they live and work, and can request new stops, as well as buy tickets and find buses. In exchange for discounts on fares, it is expected that the application will ask people's permission to use the GPS on their phones to anonymously track their movements across the city.

The solution has been designed and implemented taking into account the transport situation and the socio-economic context of the Boston area, determining the conditions for a strong potential demand for "individual" bus transportation services. Only about 30% of jobs are accessible in the Boston metro area to the average citizen in 90 minutes via transit (Tomer, A. et al, 2011). Furthermore, the Boston metropolitan area has the third-highest share of households without cars in the country (UMTRI, 2014).

<b>Starting year</b>	2015
<b>Type of integrated solution</b>	ITS-based enhancement of public transport
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Transportation manager, venture capital, private funds
<b>Budget</b>	€ 3.7 <sup>4</sup> Mln
<b>Number of impacted users</b>	Approx. 1.3 Mln people each day
<b>Link</b>	<a href="http://www.bridj.com/#connect">http://www.bridj.com/#connect</a>

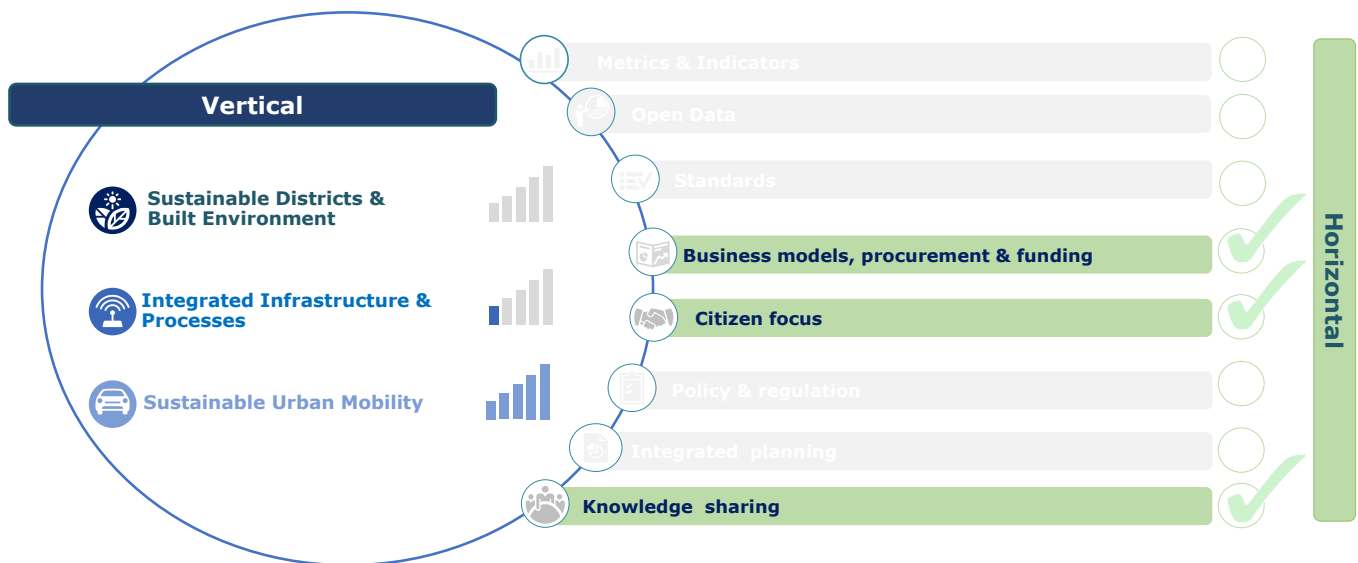
<sup>4</sup> The conversion rate used for this case study is € 1 = \$ 1,060

## Level of integration

The solution allows the **integration of information flows between the smart phone application and the vehicles trips**. From a user point of view, once the application is downloaded, customers sign up, identify their origin and destination points, and then Bridj tells them where to go to meet one of its minibuses. Rather than use the same static routes as the usual city bus routes, Bridj dynamically designs routes that aggregate commuter pickups where demand is highest.

Payments happen through the app, integrating information flows coming from the users' decisions about where and when to go, which also makes it possible **to estimate travel time**. The company, through information coming from the applications, takes into account multiple data points related to when and where people travel to and from, creating a map for the city managing all pick-up and delivery points.

With all this information, **the application can reduce the time, cost, and barriers to a quick and effective trip**.



## Business case

This solution raised funds in the private market. The solution **raised \$ 4 Mln (€ 3.7 Mln) from a number of Boston-based investors** who supported the solution in that launch market. This includes Atlas Ventures, ZipCar investor Jill Preotle, NextView Ventures, Suffolk Equity, Freshtracks Capital.

The Bridj **business model is considered with interest by investors and governments** in other cities and countries. The company can either come directly into the city as a third party provider (behaving as a competitor to the incumbent transportation services), or actively establishing itself to have discussions to integrate the company transportation services into the services provided by the public transportation systems themselves. **The solution has recently been replicated in Washington, DC.**

At \$ 5 to \$ 8 a trip, the fee will be higher than local public transportation buses and trains, but the higher quality of the service, e.g. travel time, Wi-Fi, leather seats, and complementary snacks, can make the difference for the user.

The management of the solution was part of a team that built one of the nation's largest network of pop-up bus services for college students going home for the holidays. Called BreakShuttle, it has generated about \$ 1 Mln a year in revenue by serving 15 colleges; it is scheduled to serve about 40 by autumn.

## Community & Citizen Focus

Community and citizen focus is important for the service. Transport on demand provides a solution to the problem of serving areas that are sparsely populated, newly settled, isolated or underserved by local transport networks. Accessible through simple telephone booking, this service fits the schedules and expectations of travellers, picking them up and dropping them off close to home.

## Impact

The impacts of the solution have been the following:

- **Reducing travel time:** Travel times on specific routes has been cut in half, with 20vminute rides compared to city transit routes that would typically take 45 minutes;
- **High loading factor:** 70% of seats on the 15-passenger vehicles and many routes are typically sold out.





## The solution in context: Smart City – Boston

### About the smart city vision in the city

The City of Boston has recently established the **Trust for Public Land's Climate-Smart Cities Program**. The goal of this partnership is to help the City of Boston in implementing green infrastructure as a strategy to better connect people, keep Bostonians cool, absorb storm water, and protect the city. Through this partnership, The Trust for Public Land will help the City and its partners integrate these four objectives into green infrastructure development by creating a Geographic Information System (GIS) decision support tool, conducting research, and developing projects.

As a result of the partnership, by late 2016 the City will have new research on climate impacts and an interactive online mapping tool. The Trust for Public Land will also assist Boston in creating **green infrastructure design interventions** such as flood mitigation and reducing the urban heat island effect.

Bringing natural features into urban environments can cool summer nights, absorb rainstorms, protect against coastal flooding, and help connect residents to mass transit and pedestrian corridors. These natural features, or **green infrastructure**, like street trees, biking corridors, urban farms, and waterfront parks can keep neighborhoods of all kinds safe and livable when weather turns bad.

<b>Name of City</b>	<i>Boston</i>
<b>Country</b>	<i>USA</i>
<b>No of Inhabitants</b>	<i>&gt; 500,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## SMILE and Integrated eMobility Service for Public Transport (eMORAIL) Vienna, Austria

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

SMILE is a **mobility platform** in the form of a phone-application. It allows the user to **inform him/herself about all available means of transport and book, pay and use them**. The innovative element is that the app provides an overview of tickets available for each mean of transport, without changes in the tariff structure, and it allows users to validate them.

Users may also book the entire trip – even with several mobility providers – without changing between different apps.

This integrated transport service for commuters has been tested in two rural regions (Bucklige Welt, Leibnitz) and has created synergies with another project, the **eMORAIL, a pilot project that developed an integrated mobility service in Austria**, coupling railway and e-vehicles in a single source, ultimately facilitating cooperation and system integration of different providers with SMILE.

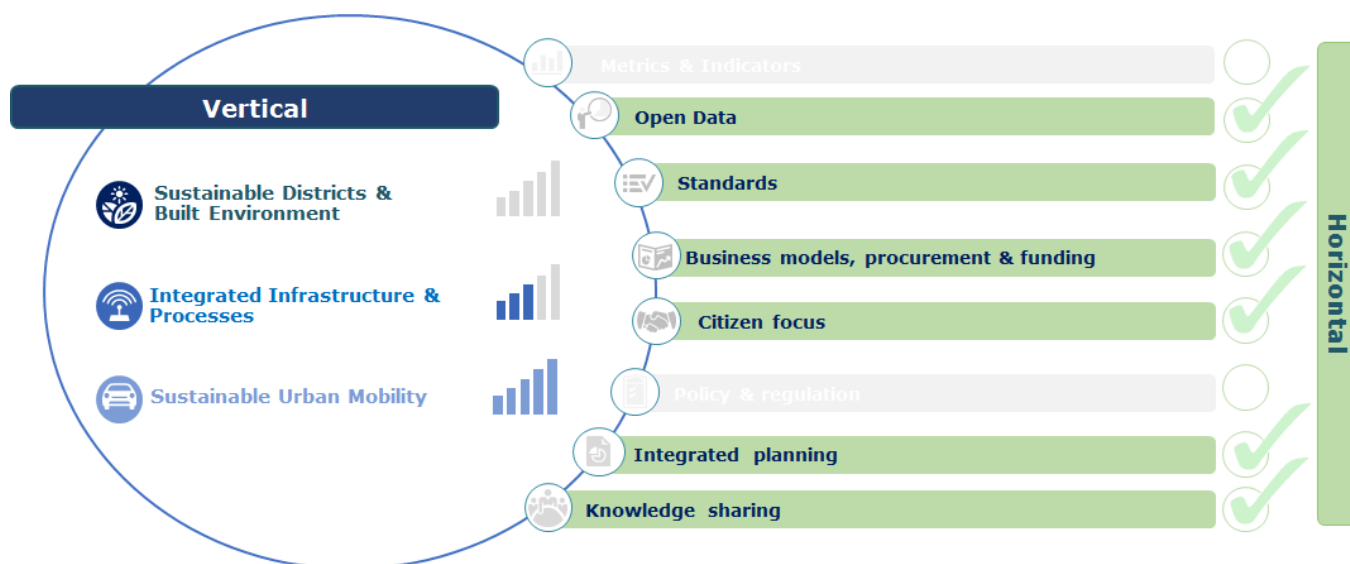
**eMORAIL offers commuters a railway ticket** combined with an **e-car** at their place of residence and a ticket for public transport/an intermodal **e-car-sharing/e-bike-offer** at their destination. By providing the first/last mile mobility access in the form of a shared e-vehicle or e-bike, eMORAIL aims to **improve local citizens' ability to travel from their homes to their workplace**. In this case, SMILE allows software interfaces of different mobility providers to be integrated, in order to manage information, reservation and billing for eMORAIL.

<b>Starting year</b>	2012
<b>Type of integrated solution</b>	ITS-based enhancement of public transport
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, private actors
<b>Budget</b>	€ 7.7 Mln
<b>Number of impacted users</b>	Approx. 500,000 users
<b>Link</b>	<a href="http://imob-ext.nttdata-emea.com:8081/eMorailAdvanced/">http://imob-ext.nttdata-emea.com:8081/eMorailAdvanced/</a> <a href="http://smile-einfachmobil.at/index_en.html">http://smile-einfachmobil.at/index_en.html</a>

## Level of integration

The two projects can be regarded as an example of **integrated solution across Sustainable Urban Mobility and Integrated infrastructure and processes**.

Its services target citizens, and the solution is clearly structured around a business model and it is based on integrated planning. The knowledge sharing aspect is also relevant.



## Business case

**SMILE is a research project whose overall cost is € 7.7 Mln, partly funded (by € 2.9 Mln) by the Climate and Energy Fund of the Austrian Federal Government** and is carried out as a part of the third call of the "Austrian Electric Mobility Flagship Projects" programme.

Roughly 140 people working on the project for around three years turned SMILE from a simple idea into a working prototype. Although Wiener Stadtwerke initiated the SMILE project, at the core of the project team is a cooperation between Austria's two largest mobility service providers: Wiener Linien (Vienna's public transport provider, part of the Wiener Stadtwerke group) and Österreichische Bundesbahnen ÖBB (Austrian Federal Railways). **The project consortium includes all aspects of mobility, software development and engineering, usability, service and system design, environmental protection and sustainable development, research and project management.**

The connection of VAO (Verkehrsauskunft, i.e. traffic information), as well as AIT (e-mobility) and toursprung (bike) to the mobility platform ensured the supply of necessary routing information for all routes whilst the wide range of routing options was enabled by the project partners Wiener Linien and ÖBB as well as many other renowned mobility partners (e.g. Public Transport operators, bike-sharing operators etc.).

**eMORAIL** is a cooperation partner of **SMILE**. Its **business model** has been drawn up so that it provides users with an Austrian Federal Railways card with a linked **electric vehicle in their place of residence**, and an intermodal e-car sharing scheme in their town or city of destination. Additional services such as information, repairs and maintenance, offer public transport customers a high level of convenience and great ease of use. This is provided in collaboration with local authorities and communities.

By 2020, up to 100 sites in Austria will be equipped with the eMORAIL solution.

## Community & Citizen Focus

The SMILE app is the user interface of the **mobility platform**. After opening SMILE, the user is informed about available means of transport in the area around the current user location or at any other chosen point in the map. Via tapping the according icons, further information can be accessed, e.g. departure times of public transport at a stop, available rental bikes, condition of a car-sharing vehicle or the available charging points in park houses. For trips from A to B, the mobility platform offers different

individual options and combinations. These can be sorted by mean of transport, time, price and CO<sub>2</sub>. **SMILE provides information about season tickets, discounts and memberships** e.g. from sharing providers as well as private vehicles which can be saved in the mobility profile. For prices based on the distance driven (e.g. taxis and car-sharing), an estimated price is calculated; the actual payment happens after usage, when the final price is known. At the end of a taxi ride, a push notification appears on the users' mobile phone confirming the final price. By tapping it the price is accepted and the ride is paid for.

## Impact

For over a year, all functions of the mobility platform have been tested. Afterwards, changes in mobility behaviour have been surveyed.

The most outstanding result of SMILE is that it increases car sharing and e-mobility offers and reduces private car use.

For the pilot operation, more than 1,000 external persons extensively tested the platform and its functions, and by filling out an online questionnaire, they assessed their experience as follows:

- **48% used public transportation more often;**
- **21% reduced their use of private cars;**
- **10% increased their use of shared bikes;**
- **4% increased the use of shared e-cars;**
- **4% increased the use of the e-bike/pedelec.**

Moreover, SMILE enhanced intermodality: 26% claimed to have combined car and public transportation or bike and public transportation more often.

The main driver behind the increase in combining public transportation and car/bike is the quicker alternative SMILE suggested (69%/74%).

Concerning **eMORAIL**, the biggest impact was on the reduction of GHG emissions. This resulted from shifting from individual mobility using personal private vehicles to trips using combined modes, with public transport and electric-based vehicles for first and last miles.



## The solution in context: Smart City – Vienna

### About the smart city vision in the city

Smart City Vienna is a **long-term initiative** that aims to improve the **design, development** and **perception of the city**. It looks at various sections of the city, **covering a full range of areas of life**, including work and leisure activities, and infrastructure, energy and mobility as well as urban development.

Smart City Vienna's focus is on resource preservation and aims to consistently and continuously modernize the city in view of **reducing energy consumption** and **emissions significantly** without having to sacrifice any aspects of consumption or mobility. The goal is to dramatically reduce CO<sub>2</sub> emissions by 2050.

For this purpose, the city has committed itself to make much more efficient use of the required input energy. This is detailed in the first big task of the strategy, which highlights ways and means in which Vienna can contribute to the attainment of the major European climate and energy objectives (for 2020, 2030 and 2050). Although Vienna, due to ambitious plans and decades of consistent action, has already achieved much in the fields of climate and environmental protection, potentials towards these goals still exist to a high degree.

**Name of City** Vienna

**Country** Austria

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **1**  
Global Cities Index – Bloomberg (2014): **17**  
The Economist – City Competitiveness rankings (2013): **29**

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## Octopus System Hong Kong, China

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Octopus system was introduced in 1997 in Hong Kong. Initially, the solution was conceived as an **efficient and effective smart card payment system** allowing fast and easy payments for public transport without the need for exact cash. The main objective was to **make everyday life easier for commuters in the city of Hong Kong**. After this initial stage, the Octopus system was upgraded in order to make it possible to make small-value payments in other settings, e.g. the retail sector.

From its birth to his first implementation, the results achieved have been significant. The Octopus card has become an integral part of the city life.

The main features of the solution are:

- **Hong Kong citizens don't need cash to go about their daily life;**
- The Octopus card carries out each **transaction in around 30 sec;**
- It is **accepted all over Hong Kong;**
- The platform achieved his maturity phase with high stability and reliability.

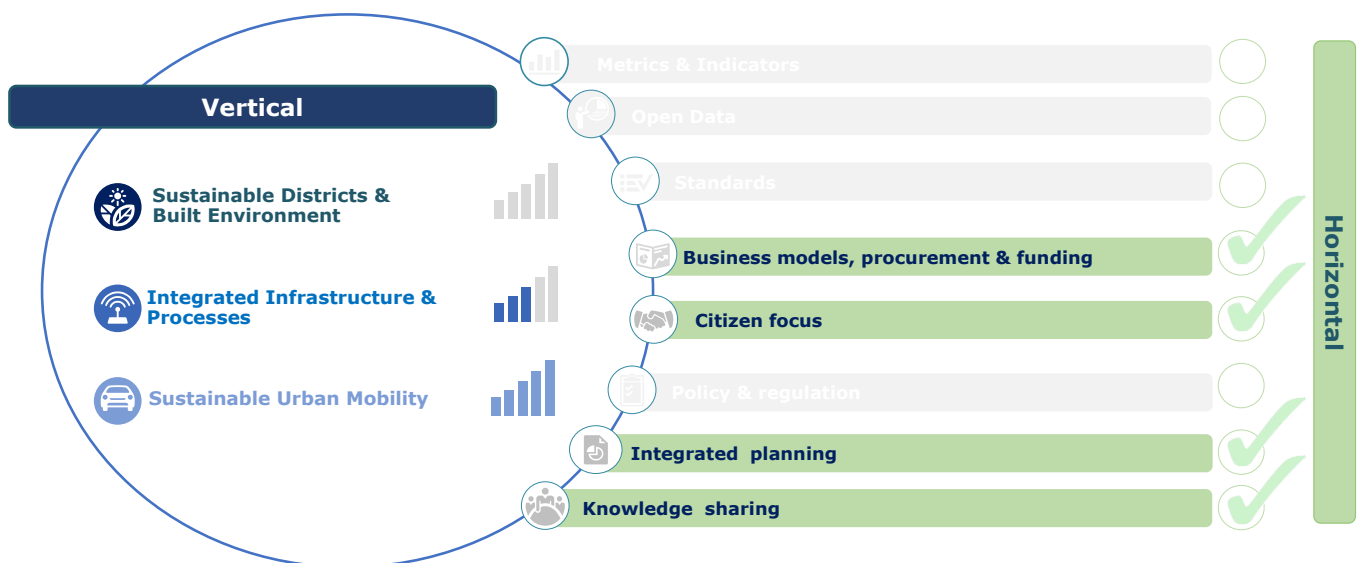
<b>Starting year</b>	1997
<b>Type of integrated solution</b>	ITS-based enhancement of public transport
<b>Scaling or Replication</b>	Yes, scaling within the city and in neighbouring areas, international replication
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 27 Mln cards, 99% of Hong Kong's population (aged 15-64)
<b>Link</b>	<a href="http://www.octopus.com.hk/home/en/">http://www.octopus.com.hk/home/en/</a>

## Level of integration

The solution can be considered as **integrated across ICT and mobility**, as it involves an ICT infrastructure aiming to incentivise and improve public transport.

The idea behind the development of the Octopus card was to **reduce waiting times at ticket machines**, to **facilitate intermodal connection** and to **increase cost-efficiency and security**. Over the years, the offer was developed and expanded. Today it is used to perform access control and small-value cashless transactions besides those related to transportation. In fact, the **card is accepted in 15,000 retail outlets and 6,000 service providers**, ranging from fast food outlets to supermarkets, from parking machines to residential and commercial buildings access.

The joint development with watch and phone manufacturer allows the service to be integrated into mobile devices. An additional service being offered by the company is the geographic localisation of Octopus-enabled taxis through a phone application. Finally, Octopus Ltd is preparing to expand its product offer, launching a money-transfer app which will enable the account holder to make payments to friends and relatives.



## Business case

Octopus was established in **1994** as a joint venture **of the five major transport operators** in Hong Kong, with the goal to **oversee the implementation of contactless card technology in Hong Kong**.

The Octopus card has been developed to **facilitate transport ticketing services**. As a consequence, the business model, which this success story is built upon, has not been developed with the purpose of increasing profits through service innovation. This happened as an unexpected consequence of offering a competitive payment system that outdoes the former credit card players by enabling quicker payments, integrated services (transport and payments) and security access card functions.

The **business scheme** on which the Octopus Card is based upon is simple:

- **Octopus Cards Ltd has been established as a company owned by the joint venture of transport operators** in Hong-Kong, with the aim to facilitate the transport business and reduce operating costs related to ticketing;
- **The fixed cost of the asset are very limited.** The cost of the card is fully covered by the HKD 50 deposit for the Octopus card, which is refunded when the card is returned.
- **Octopus Cards Ltd anticipated the production and distribution of 2.5 Mln cards for the users of the Mass Transit Railway Corporation (MTRC) transportation services.** MTRC is not only the subway service provider, but it also owns the land above and around Hong Kong's subways, most of which is leased to retail businesses.
- The card has been widely used thanks to its ability **to facilitate transactions**.



Although not designed to be a profit centre, Octopus Card Ltd is now a proper transaction mechanism. It allowed **significant cost savings related to the ticketing businesses**. Previous to the introduction of the card, 60 tons of coins were collected on a daily basis, which cost as much as **0.8% of revenue to collect and count**.<sup>5</sup>

Octopus has been replicated both cross-border and in the rest of the world:

- In 2002, **Octopus was extended to cross-border buses**;
- One year later, **the technology was exported to the Netherlands**;
- In 2004, **Octopus was implemented in Chinese-style wet markets** and two years later it was exported to the Chinese region of Shenzhen;
- In 2007, Octopus was awarded a tender to develop and **implement a contactless smart card payment system** for multiple transport services in Dubai;
- In 2009 Octopus was used in developing a new multi-modal public transport **e-ticketing system** for Auckland, New Zealand.

## Community & Citizen Focus

The services offered by the Octopus card benefit the citizens of Hong Kong and neighbouring areas by **reducing their need for cash during various daily activities**, e.g. commuting, shopping, and eating. Initially, the card addressed a specific transportation need but it was then redefined to accommodate additional requirements of its end-users, reflecting the evolution of the community.

An interesting aspect related to sustainability awareness-raising is the introduction of so-called fare saver machines. These allow people to be entitled to a discount on the transportation fares, if they decide to walk to a designated location rather than taking a bus or a taxi. To do so, the card needs to be swiped over two readers along the way.

## Impact

It is estimated that **27 Mln Octopus cards are in circulation today, with 99% of Hong Kong's population (aged 15-64) possessing one**. In total, there are 15,000 retail outlets and over 6,000 service providers that accept the card, leading to **over 13 Mln transactions per day** with a value of about € 17 Mln<sup>6</sup>.

Besides the higher security and lower transaction costs related to the avoidance of cash, the transportation sector has experienced a positive impact due to reduced congestion at fare collection points. Furthermore, the card entitles users to lower fares compared to single-ride tickets. Hence, one can say that the introduction of the card generally contributed to promote public transportation with a sustainable impact. However, there are no comparative studies available that quantify this effect. The excellent adoption rate of the Octopus card is also due to the inclusion by the company of diverse retail businesses besides the transport sector. It is thus worth mentioning that over 3 Mln Octopus cards are registered to the Rewards Programme, to access promotional prices at participating outlets.

<sup>5</sup> Ming L. M. 2011 Value Chain Flexibility with RFID: A Case Study of the Octopus Card. *International Journal of Engineering Business Management*, Vol. 3, No. 1 (2011), pp. 44-49

<sup>6</sup> The conversion rate used for this case study is € 1 = HKD 8.5.



## The solution in context: Smart City – Hong Kong

### About the smart city vision in the city

Hong Kong is a world-leader when it comes to mass transit, healthcare, public security and technology integration, and the well-established Octopus card is excellent proof of this. However, the city faces pressures when looking at **waste and water management, energy supply and air quality**. The city is aware of the required combination of environmental, economic and social needs to achieve long-lasting sustainability. It is with this objective in mind that it initiated an ongoing process to define a shared vision to lead Hong Kong's development for the decades to come. A first result was the study "**Hong Kong 2030: Planning vision and strategy**", which identifies the priorities for the future.

To ultimately strengthen Hong Kong's position as Asia's world city the main pillars are: **a renewed focus towards the environment to ensure good quality living**, strengthening the city's position as a financial, business and innovation centre, and developing an efficient and effective transport system to increase connectivity with the mainland and provide housing and community facilities, promoting arts, culture and tourism.

**Name of City** Hong Kong

**Country** Hong Kong

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): **4**  
The Economist – City Competitiveness rankings (2013): **5**

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(<http://www.octopus.com.hk/home/en/>)
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- › **The solution in context image source:** Telegraph Travel  
(<http://www.telegraph.co.uk>)



## OpenMove Trento, Italy

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

OpenMove is a **smart mobility solution** introduced by the start up Lucian SrL **to optimize access to transport services**. The major step that brought to the development of OpenMove was the decision by the Trentino Alto Adige region to **make mobility data open to citizens**.

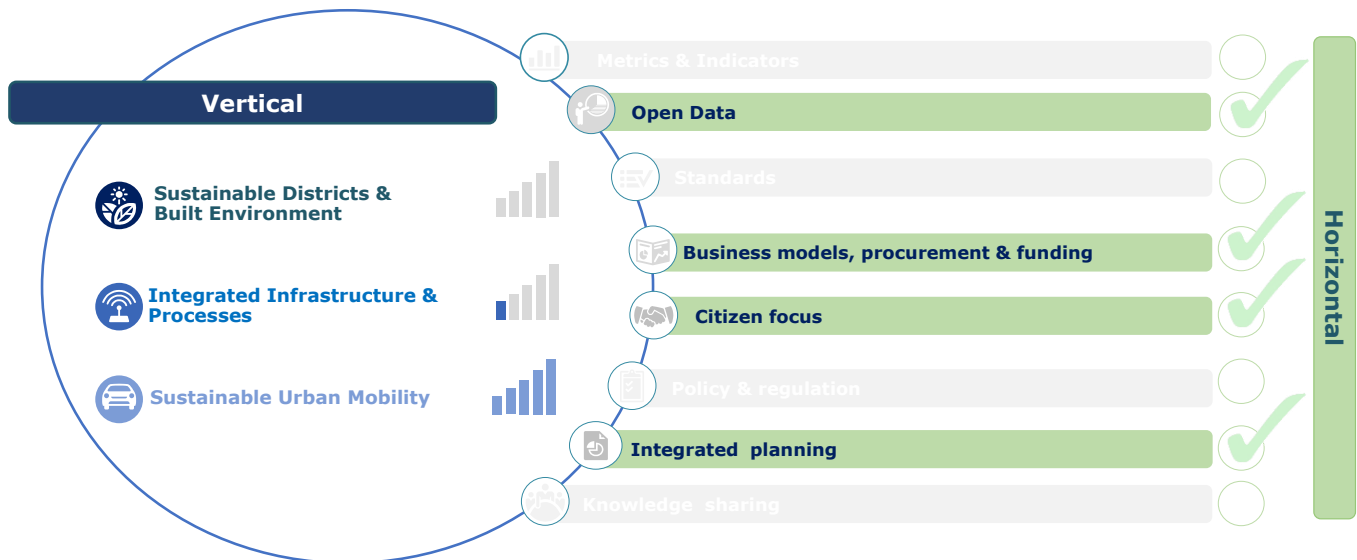
In September 2014, Lucian SrL, in partnership with the province of Trento, Trentino Public Transport company and Trenitalia (the national railway company) tested the App in the city of Trento and in the whole province area. After the success recorded in this initial phase, Lucian SrL decided to officially launch the app in March 2015. **A mix of public funding and private financing was used** in order to support the development and introduction of the solution

Through the **OpenMove App**, citizens are given the possibility to purchase ski lifts, parking, bus, and train tickets both for urban and extra-urban routes; validation takes place onboard by scanning the QR code on the ticket. The app is currently managing mobile ticketing for the entire public transport system in the region: urban and suburban bus, train, cableway and skibus. This plurality makes it a state-of-the-art solution in Italy.

<b>Starting year</b>	2014
<b>Type of integrated solution</b>	ITS- based enhancement of public transport
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, Public Transport companies
<b>Budget</b>	€ 100,000
<b>Number of impacted users</b>	Approx. 100,000
<b>Link</b>	<a href="http://openmove.com/en">http://openmove.com/en</a>

## Level of integration

The solution can be considered as **integrated in that it features ICT elements applied to urban mobility**. Through this application, citizens are given the possibility to purchase parking, bus and train tickets both for urban and extra-urban routes. Moreover, the geo-referencing of the users makes it possible to provide them with additional information about **services** and **city businesses** close to their current position.



## Business case

In September 2014 the pilot phase allowed Lucian SrL, in partnership with the Province of Trento, Trentino Public Transport Company and Trenitalia (the national railway company) to test the App in the city of Trento and in the whole province area as well. Citizens tested and evaluated the service, and the output of this phase was deemed successful. Indeed, in March 2015 **OpenMove app was formally launched**.

Concerning the business mechanism, the user can download the app for free, without any subscription cost. This highlights the fact that OpenMove has been conceived as an optional service that contributes to integrating and **optimizing the public mobility as a whole**. The app developer earns a profit thanks to the geolocalized advertising of the city's businesses. The solution was supported through both private financing and public funding. The public funding component amounted to approximately € 100,000, coming from the European accelerator FINODEX. No funds were invested by local public entities. The only direct contribution of the local administration for the development of the solution came in the form of open access to data.

**The solution has the potential to be replicated elsewhere** and does not present any place-specific limitations. Moreover, as is the case in Trento, OpenMove has inter-modal transportation as one of its strengths, making it potentially appealing for replication. Two cities in the northern part of Italy are currently evaluating the possibility of implementing the solution in the near future.

## Community & Citizen Focus

Citizens are the main targets of the app. Any tourist who is travelling across the Trento area is also seen as a potential user.

The **perspective** is definitely **bilateral**: on the one hand the app **has been totally designed to serve citizens' needs**; on the other, the user has to make the choice of using the app in order to concretely perceive its positive impacts. The main reasons why users are encouraged to purchase tickets through the OpenMove app are:

- **Avoiding queues** when buying tickets;
- **Ubiquity for the purchase process**, without any space or time restriction;

- **Discounted prices for tickets** purchased through the app: 10 cents less for urban tickets, 10% discount for extra urban routes;
- **Multimodality**, since the user can buy different public transport tickets, parking area ones included, with the same app.

Finally, citizens take advantage of additional geo-referenced advertising on services and city businesses close to their position. The citizens of Trento took part in the development of the solution by trying and evaluating the service in its early development phases.

## Impact

OpenMove **speeds up the ticket purchasing process**; this, together with discounted prices, contributes to making citizens use public means of transport more frequently. Moreover, 90% of those that tried mobile ticketing decided to drop paper ticketing. **The solution also encourages the use of public transport** by providing discounted fares to the users of. Therefore, **social impacts** can be evaluated as relevant for this solution, especially regarding the access to services and **improvements in quality of life** related to the use of the public transport.

Additional benefits are linked with the environmental impact. Indeed, the increase in public mobility services use leads to a healthier and less polluted environment. Approximately 20,000 paper tickets were saved and a CO<sub>2</sub> reduction of 30 tonnes was also achieved in 2014. Additionally, the adoption of the OpenMove system enables **significant economic savings especially** in relation to ticket printing, hardware maintenance, administration and personal costs.

Last but not least, this solution **generates social impact by enabling several business synergies**. For example, if the app user is paying for a parking area in front of the restaurant he/she has chosen for dinner, the restaurant can apply a discount on the parking ticket. This synergy allows exploiting two-way communication benefits and brings a wealthier economic environment. In the near future, Lucian Srl is also planning to implement an **open platform** where public transportation companies can sign up and gain access to OpenMove services. The process is planned to be swift and entirely online, enabling also economic savings in terms of labour costs.



## The solution in context: Smart City – Trento

### About the smart city vision in the city

Trento is particularly active in smart city policies. The city is taking part in the **IEEE** (Institute of Electrical and Electronic Engineers) **Smart City Initiative**, which aims at selecting potential smart cities from a group of global municipalities.

Citizens are seen as the main stakeholders of this smart policy implementation process; Trento developed several smart crowd initiatives with the **purpose of co-creating innovative services with citizens**, in line with their real needs, identified through a constant feedback process. In particular, the city municipality launched the **initiative Welive** in order to publish open data and then **optimize public services** with a proactive involvement of the local community. Furthermore, Trento is ranked as the second best Italian city according to the *Sole 24 Ore* quality of life 2014 ranking. Finally, the city also subscribed to the Covenant of Mayors, the European initiative which aims at a **20% carbon emission reduction by 2020**.

**Name of City** Trento

**Country** Italy

**No of Inhabitants**  $100,000 < x < 500,000$

**Smart City Rankings** Europeansmartcities3.0 ranking (2014): **52**  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Tallinn Smart Card Tallinn, Estonia

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Even before the implementation of an innovative integrated, ICT platform-governed public transport ticketing system, Tallinn was well positioned in the ticketing domain. In particular, there were two different systems in place: simple paper-based tickets and ID-tickets, connected to Estonian national personal identification cards. User acceptance of the ID-based ticketing was high, as users did not have to present or register their tickets when using public transportation. The main problem with the previous systems was a total lack of feedback to transport planners on the actual usage of the network, together with high operating and maintenance cost of having two systems in place at the same time, which amounted to approximately € 1.5 Mln every year.

Thanks also to the impulse and initial financial support provided by the EU (through participation in the **MIMOSA project**, in the framework of the **CIVITAS Plus initiative**) Tallinn implemented a new smartcard ticketing solution, requiring passengers to register their trip using a personal contactless card when entering vehicles. Immediate benefits for the city were that planners could obtain information on trip origins, destinations and use of routes, fundamental for optimising the entire network, assuring energy savings and lower traffic. The benefit for the users was a wider and more flexible fare system with multiple options for combining different modes and services.

The integrated solution builds on a number of different components, including: i) **real time information** exchange between on-board computers and back-end system (ticketing and route/position info); ii) **cross usage of different cards** (i.e. cards issued by other organisations: student cards, ISIC cards, transportation cards of other regions, etc.); iii) **ticket distribution possible** also over the internet and mobile phones, and ready to work with NFC mobile phones and contactless bank-cards (Visa PayWave/Mastercard PayPass)

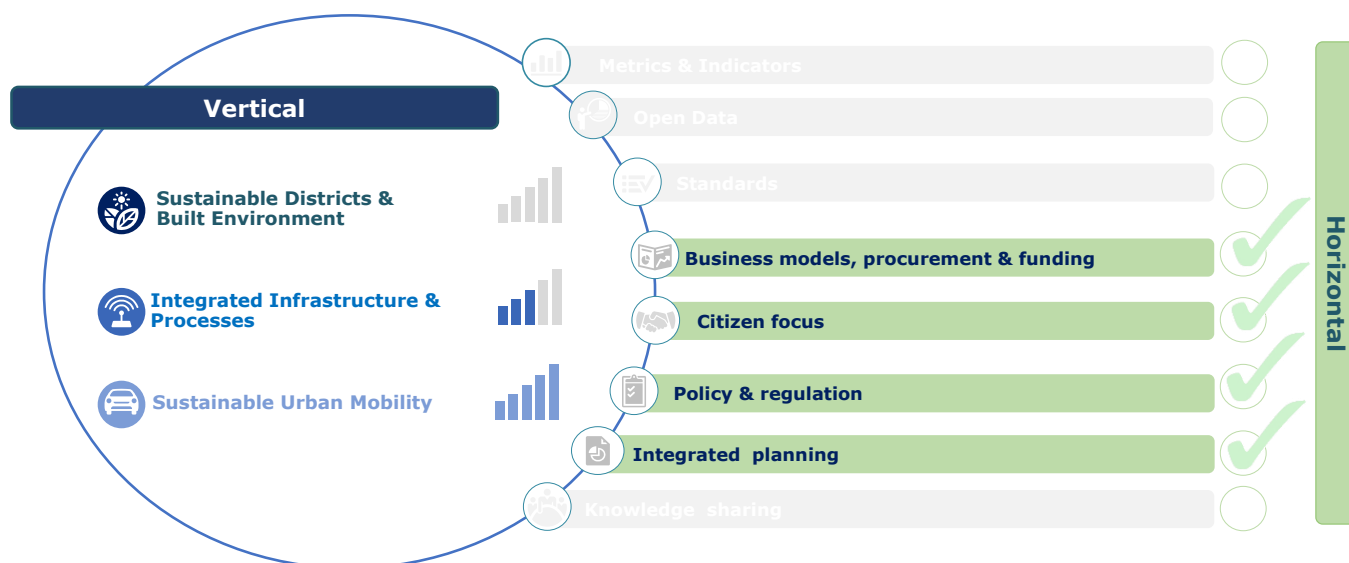
<b>Starting year</b>	2009
<b>Type of integrated solution</b>	ITS – based enhancement of public transport
<b>Scaling or Replication</b>	Yes, the measure was followed up by a full scale regional system implementation, which is currently further expanding through replication in partner cities, located also
<b>Key actors / stakeholders</b>	Public authority, Industry, University, Citizens
<b>Budget</b>	€ 1.67 Mln initial cost, plus 4-year maintenance € 4.6 Mln. EU contribution through MIMOSA-CIVITAS, of about € 577,000.
<b>Number of impacted users</b>	Approx. 600,000
<b>Link</b>	<a href="http://www.tallinn.ee/">http://www.tallinn.ee/</a>



## Level of integration

The study of this solution started in June 2009, but it was only in December 2011 that the software was created and the required equipment (on-board computers, validating machines, printers) installed in selected buses. The new ticketing and validating system became compulsory except for ID-card based tickets users until March 2013. This solution entails two innovative aspects:

- **Use of new technology:** The contactless ticketing system enables full scale trip data collection based on user registration upon entering the vehicle, enabling dynamic fares in public transport;
- **New conceptual approach:** The system gathers public transport usage data to optimize the network.



## Business case

The whole implementation process started in 2009 with preliminary studies and surveys carried out to assess feasibility and identify the optimal solution, as well as with the creation of a mixed local expert working group, dedicated to drawing up the terms of reference for the activity. During the research phase, it became clear that the most effective solution would have been a joint ticketing system, based on smart contactless cards with a unique and standardised protocol for all partners; it was also immediately decided to include, in addition to the city, the wider county area.

**A competitive dialogue procurement procedure for purchasing the new integrated solution was prepared by the local tender commission.** In May 2010, the call for tender was published within Estonia and at the European level on Tenders Europe Daily. Initially, 12 applications were requested from three individual companies and nine consortia (overall, 27 companies were involved). The application that was finally chosen was a platform-based online ticketing system that does not store personal data on the cards, ensuring the privacy of users.

**The ticketing system** is on an **open platform**, meaning no extensive licence fees need to be paid. This also makes it easy for other cities to participate in the scheme and introduce the system in their network, with a dedicated ticketing web-platform making it easy for users to buy tickets for the various regions.

The total cost of the system for the City of Tallinn was **€ 1.67 Mln**, including devices for all public transport vehicles (almost 600), installation, initial management, training, communication, licences, and so on. On top of this, a four year (until the end of 2016) maintenance and management contract was signed covering the whole County territory, totalling an additional € 4.6 Mln, covered with public funds both of the City, as well as of the County. **Initial financial support from the CIVITAS initiative was slightly over € 1 Mln**, of which 53% was made up of EU funding. Direct revenues coming from Tallinn's public transportation ticketing strategy are limited, given that **the city has opted to grant free transportation to all its residents (representing over 90% of monthly users).**



## Community & Citizen Focus

The core aim of the implementation, was – apart from assuring monetary and environmental impact savings – also **improving the community user experience with public transport**. A survey was conducted during the evaluation period showing that end users were **appreciating the new system implemented, taking advantage also of its interoperability and rollout** extended to the whole region. By carrying out the survey, the city demonstrated a willingness to involve the community in the development and evaluation of this Smart City solution.

Because of its characteristics, this solution can easily be replicated in other cities. Indeed, the project has already been replicated in many partner cities, both in Estonia (e.g. Harju County, city of Tartu, city of Kohtla-Järve) and abroad, for example in the Gotland region (Sweden) and Västmanland County (Sweden).

## Impact

The impacts of the solution were evaluated by tracking changes between the year 2011, before the implementation process started, and then again regularly during the 2013-2016 timeframe, i.e. the period of contract management by the external provider of the new system. **The main impact can be seen in the annual management costs of the public transport ticketing system (1.5 times less expensive)**, as well as public awareness and acceptance of the system. The environmental impact has not been assessed yet. Nevertheless, the solution has had a significant social impact, as from January 2013 public transport is free for all residents, incentivising residents to use public transport.

Data on costs is provided by local governments, while the level of awareness and acceptance were measured by conducting surveys before and after the implementation of the measure. The key figures of the evaluation showed positive results: between 2010 and 2013-2016, running costs for Tallinn's public transport integrated ticketing system went down by 64%, and the level of citizens' awareness of the new solution increased more than four times. Finally, surveys also showed that the level of acceptance for the implementation of the new system increased slowly by 18% between 2010 and 2012.



## The solution in context: Smart City – Tallinn

### About the smart city vision in the city

Among Tallinn's most pressing Smart City challenges, there is the objective of **renewing, extending and increasing the smartness of the public transport network**, including buses, trolleys, tramways and suburban trains. In the city's last Innovation and Development **five-year strategic plan** (2014-2018), there is an action dedicated to the **Creation and development of the Smart City concept**; to this end, the plan foresees also the organisation of regular events, which bring together the creative community, higher education, the entrepreneurial sector and city agencies, which are meant to put in place key initiatives for city development. The declared quantitative objective that should be reached by 2018 is to lower by 10% the time for people working in Tallinn to move between their job and their home (with respect to 2013 values).

Tallinn ranks fifth in the fDi European Cities and Regions of the Future 2014/15 Business Friendliness assessment, demonstrating constant attention to ICT-enabled, integrated city development solutions. By participating in CIVITAS, Tallinn has been able to draw on the support of international partners in order to develop a framework to address more sustainable and more integrated ICT-enhanced mobility in the city; the future direction is oriented the same way, following the objective of creating a wider collaboration network among neighbouring cities (i.e. Helsinki, St. Petersburg, etc), meant to capitalize on, scale and better exploit innovative solutions that have already been implemented.

<b>Name of City</b>	Tallinn
<b>Country</b>	Estonia
<b>No of Inhabitants</b>	100,000 < x < 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Tram Smart Enhancement Melbourne, Australia

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In late 2013, Yarra Trams, the operator of Melbourne's tram network, introduced **a new class of trams including several ICT solutions provided by IBM** in order to improve the performance of the whole network system by enabling predictive maintenance, offering a better service to passengers and therefore encouraging the use of a sustainable means of transport.

Leveraging IBM technology, the new generation of trams makes it possible to **access real-time information** in order to know more about **service disruptions, tram punctuality and real-time location**. Thanks to this solution, Yarra Trams was able to improve the quality of the service especially in relation to its punctuality.

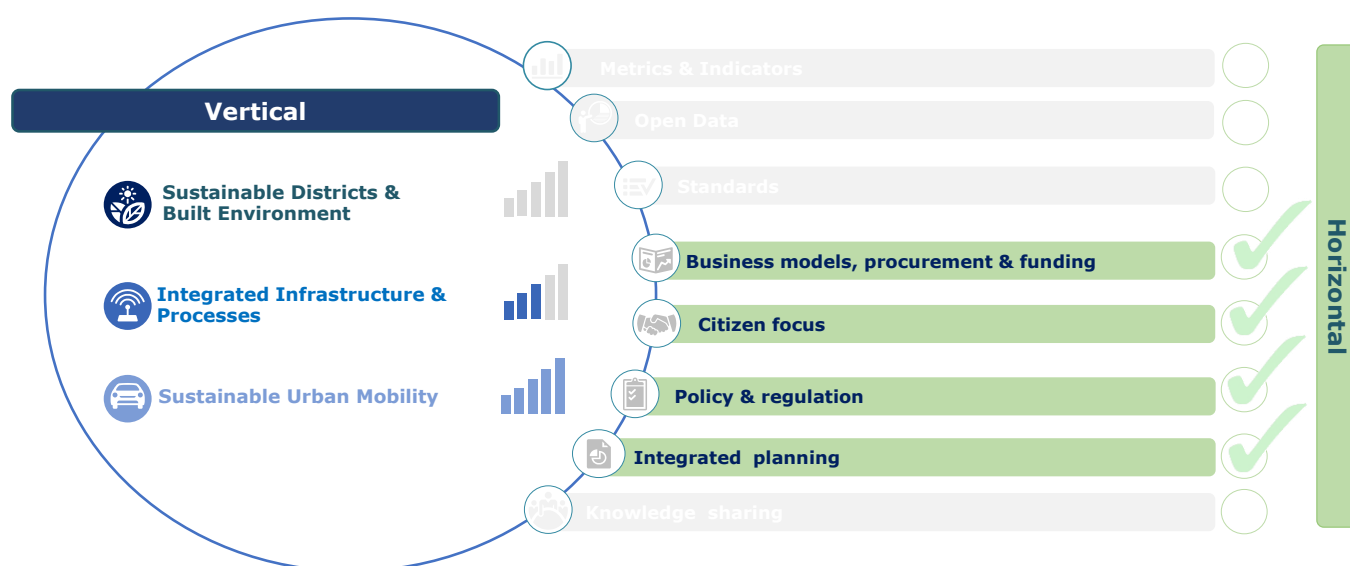
**Melbourne's tram system is currently the largest in the world** with 250 km of tracks and 185 Mln journeys taking place every year. The system has been in operation for more than 100 years and accounts for trams from 8 to 74 years in service.

<b>Starting year</b>	2013
<b>Type of integrated solution</b>	ITS-based enhancement of public transport
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industry, Public Authority
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://www.yarratrams.com.au/">http://www.yarratrams.com.au/</a>

## Level of integration

The solution can be considered as integrated by using an **ICT component for the improvement of sustainable urban mobility in the city**. The solution includes a package of different and integrated software units provided by IBM: IBM Maximo Asset Management (for controlling and managing physical assets via a common platform) IBM Maximo Mobile (providing mobile access to processes and enabling workers to increase their productivity), and IBM System X.

This ICT infrastructure equips the old trams as well as the new E Class trams provided by the Canadian firm Bombardier. Sensors located at Yarra tram's main depot make it possible to collect and create accessibility to information coming from the different vehicles, especially in relation to wheel conditions and potential electrical irregularities. The total number of equipment parts monitored amounts to 91,000 pieces. The system also incorporates the feedback received from tram operators as well as passengers. Moreover, a free mobile application called **"tramTRACKER"** is available, in order to enable customers to get updates about potential delays or changes in trams schedule. Through constant maintenance, the system allows trams to operate also in critical weather conditions (the annual rainfall rate in Melbourne is of 24 inches) by spotting criticalities and preventing tracks from flooding.



## Business case

**Yarra Trams** is the operating name of KDR Victoria, **the transportation company in the Melbourne area**, which operates in partnership with Downer, a French transportation company. Ageing of both the infrastructure and the assets increased the costs for repair and replacement. Furthermore, maintaining a high-quality transport service became more complex and expensive.

In 2013, the Victorian Government decided **to renew the transportation assets by investing AUD 800 Mln in new trams and modern infrastructure**. The *Tram Smart Enhancement* receives funding from this investment programme. Yarra Trams purchased an **integrated solution from IBM**, which monitors the infrastructure and the vehicles in real time and contributes to an optimised asset management system.

**The project is not designed to generate revenues repaying the upfront investment;** instead, it aims to cater to the future demand of Melbourne's tram network, **increasing the quality and performance of the service provided**. Although it does not recover the upfront investment, the solution enables increased efficiency in the operating cost.

The system has been adopted in other urban transportation contexts. The Washington D.C. Metro deployed a similar solution to monitor more than 12,300 bus stops and 170 km of rail network.

## Community & Citizen Focus

Citizens play a central role in the system developed by IBM. The system operators use customer reports and feedback to spot potential problems or criticalities in the network. Moreover, citizens are also the final users of the tram network: therefore, improvements in its daily operations bring relevant benefits for the whole city and citizens as well.

## Impact

Some of the first impacts achieved by the system are related to the change from a paper-based asset management system to a fully online one. Additionally, thanks to the deployment of the new IBM system, citizens can count on an improvement in the quality of the public transport system. **Service delivery is now around 99% with tram punctuality scoring 82,70%** (the targets were 98% and 77% respectively). Therefore, the solution can be regarded as carrying important social impacts for the city of Melbourne. Economic impacts are also a key outcome of the deployment of the solution. Even though data is not available, thanks to a fully automatic system **Yarra Trams can now reduce operating costs by improving the overall system efficiency and applying predictive maintenance.** By improving the tram network's reliability and technical conditions, the system also makes it possible to achieve improved efficiency in terms of environmental impact.



## The solution in context: Smart City – Melbourne

### About the smart city vision in the city

Melbourne City Council is actively involved in fostering a smart city vision. A **Smart City office** has already been established with the aim of **promoting the use of the internet of things applied to a wide range of problems and fields in Melbourne**. Cooperation among different organisations and sectors is also promoted by the Municipality. Within this context, the industry, the university and the different community centres are encouraged to collaborate in order to find solutions especially in the field of infrastructure management.

Some of the Smart City solutions deployed across the city include: pedestrian counting system or solar powered sensors for collecting real time data on temperature, humidity and other environmental indicators (Sensing the City programme). Big Data is also at the centre of attention in the city, especially with regards to its application to transport, water and waste, as well as education and health.

**Name of City** Melbourne

**Country** Australia

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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## ***Real time road user information***



## Streetline Parker Los Angeles, US

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Streetline's solution provides real-time information about available private and public parking slots, reducing driver frustration, traffic and emission levels. By integrating street-level sensors and a meshed network with an analysis platform powered by **IBM Cognos** and a suite of web and mobile applications, Streetline offers a holistic and smart approach to parking management.

Although the solution is based on a variety of hardware and technologies, the added value of Streetline is its capacity to aggregate, analyse and present information through its apps:

- **ParkerMap:** A guidance map to on- and off-street parking that can be embedded into any website (retailer, city, etc);
- **ParkEdge:** An inventory specific to off-street parking;
- **ParkSight Analytics:** Standardised reporting to city governments of the collected data, i.e parking and meter usage, officer actions etc.;
- **ParkSight Guided Enforcement:** An app for enforcement officers to geolocate potential violations.

Streetline gives the drivers the possibility to search for available parking spaces based on distance from their destination or price, optimising the utilisation of parking space. In addition, the app **keeps track of parking timings** and the **time left in the parking meter**, it locates the parked vehicle and monitors dynamic pricing. Finally, the solution may **integrate with existing parking infrastructure from other manufacturers** and, where available, **supports mobile payment and electric vehicle charging**.

**Starting year**

2010

**Type of integrated solution**

Real time road users information

**Scaling or Replication**

Yes, replicated in more than 40 cities

**Key actors / stakeholders**

Public authority, Industry

**Budget**

N.a.

**Number of impacted users**

N.a.

**Link**

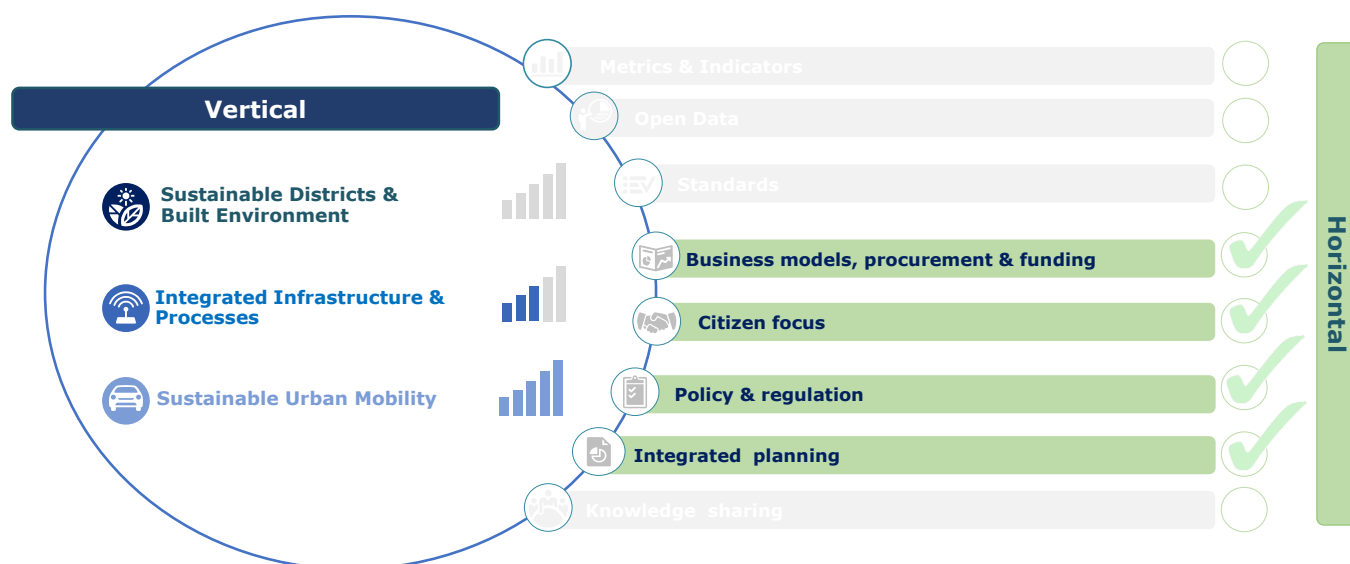
<http://www.streetline.com/find-parking/parker-mobile>



## Level of integration

The whole solution can be regarded as an example of **integrated solution across Sustainable Urban Mobility and Integrated Infrastructure and Processes**.

Through ParkerMap, users can constantly be informed about the availability of parking spaces and parking tariffs, while cities, through the ParkSight Analytics, **keep track of the space occupancy** and can, based on demand, adjust parking tariffs. Therefore, the solution has a clear citizen focus and includes knowledge sharing features both for users and for the city administration. Also, the data acquired through ParkSight Analytics, allows the public administration to carry out integrated planning.



## Business case

Streetline's solution addresses the issue of congestion and parking scarcity faced by motorists and city governments worldwide.

To date over 40 cities and 20,000 off-street facilities, i.e. garages, universities, corporates, have adopted Streetline's technology. In fact, these are the two primary customer categories that benefit from the company's solution, which improves parking, analyses the efficacy of parking policies and management, and raises revenues.

The company generally retains ownership of the network of sensors, which it operates and maintains in exchange of a **monthly fee of € 18.20-27.30 per sensor**. In the case of cities, past experience has shown that installation costs (approx. € 236 based on own calculations) are usually recovered within two years through incremental revenues from expired meter and over-the-limit fines.

Despite the fact that parking scarcity is projected to increase in the future, due to the financial situation of many cities and long procurement times, the company is currently scouting alternatives such as airports, malls, and hospitals to expand its customer base also in Europe, the Middle East and Africa. For this purpose, it has partnered with companies such as IBM, Xerox, Cisco, and Siemens as well as closed a financing round (€ 22.7 Mln) in 2013. In this perspective, it is worth mentioning that the Streetline solution was designed to support the **integration of additional sensors** in order to monitor parameters such as air quality, light, noise, temperature, etc. The solution can therefore adapt with evolving city needs and be a base for the expansion of the Internet of Things.

There are no major limitations concerning the solution. Data is collected anonymously so there are no privacy issues. However, as the concept behind the solution is relatively new, there is still a lack of awareness among public authorities, which negatively affects the scalability of the solution around the world.

## Community & Citizen Focus

Although the focus of the solution is not on community engagement, end-user behaviour was considered, especially when developing the mobile apps. Furthermore, the analysed data provided by Streetline

through its ParkSight Analytics is made available to city planners. The latter can adjust, based on the gained insights, pricing and regulations to influence habits and optimise the use of parking slots. In accordance to the impact measured through the sensors they can then fine-tune the policy changes.

## Impact

Positive impacts of the Streetline's solution include:

- **Increased revenues** by attracting people to commercial areas through enhanced parking possibilities and dynamic pricing schemes (price reduction by 7%; revenue increase by 2%);
- **Decreased parking congestion** by 15% (for spaces greater than 90% occupied);
- **Reduced overall area pricing** by 7% (only the blocks in highest demand saw an increase in pricing), which lead to 2% in additional meter revenue, a 7% rise in paid hours, and an improvement in the total utilization of parking spaces;
- **Higher meter revenues** due to improved driver behaviour;
- **Increased enforcement** of parking policies (violation capture rises on average from 7% up to 20%);
- **Space optimisation** and avoidance of the requirement for new parking infrastructure.

With the high amount of benchmark data available to Streetline, the solution can support city governments in their analysis and identification of realistic objectives, contributing to **reduce GHG emissions** and to **increase local GDP**.



## The solution in context: Smart City – Los Angeles

### **About the smart city vision in the city**

Los Angeles does not have a smart city vision yet.

However, a major step forward was made in December 2013 by Los Angeles Mayor Eric Garcetti, ordering each city department to open data collected by sharing them on a publicly accessible website. Moreover, in February 2014, the Mayor launched **DataLA, the city's online data portal**.

Furthermore, recently the city adopted the **2016-2020 LA County Strategic Plan for Economic Development**, the region's collaborative effort to define priorities that will lead to the creation of well-paying jobs, and help the city's key industries and workforce to navigate the challenging transition to an Information Age economy.

The goals of the 2016-2020 Strategic Plan for Economic Development include:

- Invest in people;
- Enhance export-oriented industry clusters;
- Foster innovation and entrepreneurship;
- Enhance business-friendly orientation;
- Remove obstacles for infrastructure development, financing and delivery;
- Increase global connectedness;
- Enhance quality of life.

**Name of City** *Los Angeles*

**Country** *United States of America*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): **6**  
The Economist – City Competitiveness rankings (2013): **17**

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# SUSTAINABLE DISTRICTS & BUILT ENVIRONMENT



## ***Place making***





## Citizens Connect Boston, US

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Citizens Connect (CC) was launched in 2009 by the City of Boston. Its main purpose was to **engage residents and citizens in the daily maintenance of urban neighborhoods** and increase the efficiency of city services along with reducing physical disorder.

CC is a mobile application that enables residents to be actively engaged in the maintenance of their neighborhoods. In particular, by using their smartphone, **residents can report public issues** related to, for example, street light outages or the more common "*broken windows*."<sup>7</sup>

Thanks to this application, each member of the community is **encouraged to be more active in the preservation of the public space**, therefore bringing substantial benefits to the public good and to the entire community. The Office of New Urban Mechanics of the City of Boston was involved as coordinator in the project, which also saw the participation of a local technology company along also with academic institutions.

The app was presented with awards and replicated or used as a model in other cities in Massachusetts and the US in general. Moreover the city of Boston scaled it up by creating a group of apps such as Commonwealth Connect, City Worker, Spot Tag and Citizens Connect TXT, each of which deals with different issues.

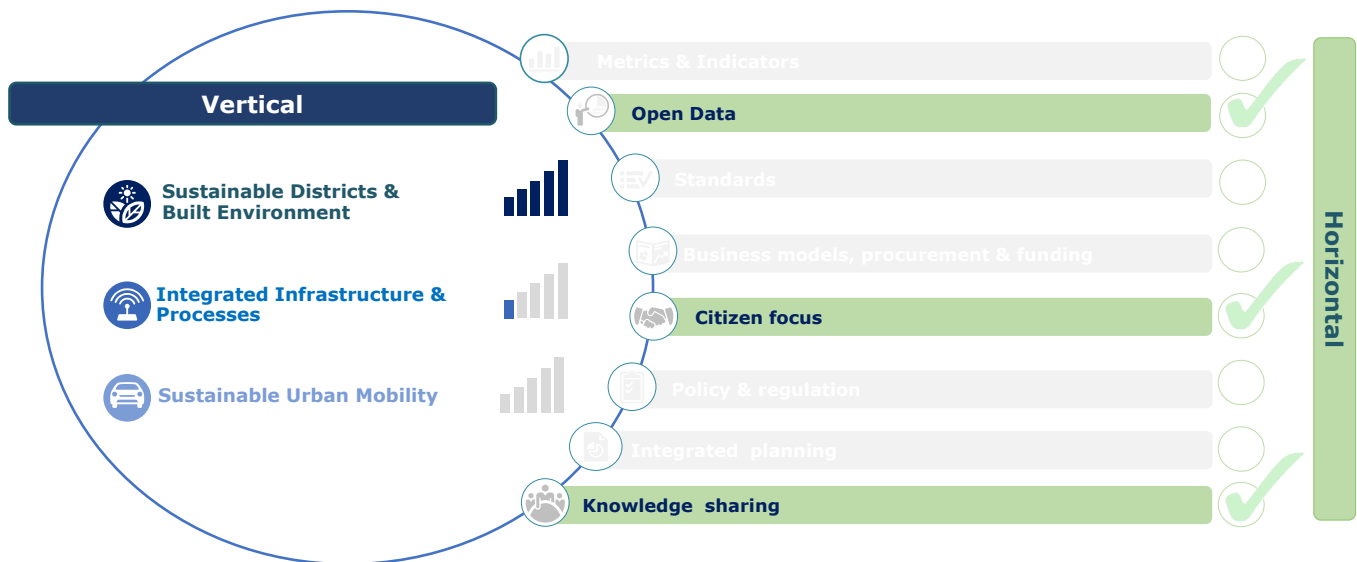
<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Place making
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 636,000
<b>Link</b>	<a href="http://commonwealthconnect.io/">http://commonwealthconnect.io/</a>

<sup>7</sup> The broken windows theory is a criminological theory of the norm-setting and signaling effect of urban disorder and vandalism on additional crime and anti-social behaviour. The theory was introduced in a 1982 article by social scientists James Q. Wilson and George L. Kelling.

## Level of integration

The solution can be considered as integrated, since it combines the adoption of an ICT infrastructure for improving the city's services and neighborhoods conditions. **Citizens are given the possibility to report problems and issues via their smart phones.** The City's work order management system then redirects the message to the person in the city who is supposed to deal with such problem.

When the problem is fixed, information about the City team who attended to the issue and the work carried out are displayed on the app, sometimes with pictures of the team or of the completed work.



## Business case

Before adopting the app, the city of Boston used a 24-hour hotline that had existed for decades. In 2008, this line underwent technical and managerial changes aimed at improving it and adapting it to new needs. The City acknowledged that all residents were not making use of the line, and therefore decided to build the app.

A partnership was established with a local technology company called Connected Bits. A fast-paced, iterative and collaborative design process gave birth to the app, which has also been improved several times over subsequent years.

The Innovation department of the Office of New Urban Mechanics encouraged and facilitated this process by leading and facilitating the discussion and development even without dedicated budgetary authority or staff. The stakeholders ranged from academic institutions, to technologists and other city governments.

**The solution doesn't have any place-specific limitations for its replicability.** Following the success in the city of Boston, the local government decided to extend it to other cities located in the State. **The initiative was called Commonwealth Connect and involved approximately 60 communities.**

## Community & Citizen Focus

Boston's CRM System has the goal of making the city agencies responsible for public maintenance more sensitive to the real needs of neighbourhoods, thereby reducing the presence or persistence of physical disorder. The City Hall did not focus on predictive analytics or the public release of data; instead, its main goal was to improve service delivery and encourage citizen engagement.

Citizens are given the possibility to report service issues to the City and to follow up on the management of their requests. The application let them share reports, also adding photos and text to the basic request. **The visibility and sharing of requests increase the citizens' information level,** their commitment and their participation to improve the city where *"participation and custodianship shape the impact of CC on the community."*

The social habit of reporting may be increased by the greater and more frequent reporting of other users.



However, application developers are also aware of a sort of digital divide in those neighbourhoods with lower economic status. Also, certain (older) age groups use the app much less than younger generations.

## Impact

Apart from higher civic engagement, especially of groups that are usually characterized by low participation rates, the app also impacted city service efficiency, reducing the prevalence of physical disorder in the neighborhoods.

A study of the Boston Area Research Initiative<sup>8</sup> evaluated the success of Citizen Connect based on two metrics:

- **Increase in report frequency and geographic coverage;**
- **Rate of users underrepresented in traditional Customer Relation Management systems.**

Results show that, in 2010, 6% of all service requests tracked within the City's CRM came from the app. **By 2014, apps accounted for roughly 28% of all service requests.** The geographic range increased modestly, but frequency coverage of citizens reporting was higher, and a higher engagement has been registered among young, renter residents, a group that is underrepresented in reports submitted through traditional channels.

This technology let Boston innovate, solve problems, reduce costs and improve services and internal operations. Approximately 9,000 requests have been fielded since the launch of the app in 2009 up until 2011, and more than 10,000 users have registered in the system. Moreover, 55% less crime is reported in targeted locations.<sup>9</sup>

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<sup>8</sup> "Citizens Connect: A Smartphone Application that Reduces 'Broken Windows'", Daniel O'Brien, Boston Area Research Initiative, 2013

<sup>9</sup> <http://www.sap.com/customer-testimonials/public-sector/city-boston.html>



## The solution in context: Smart City – Boston

### About the smart city vision in the city

The City of Boston has a vision and a set of implementation projects which make it **a world leader in technology and innovation**: it also won the **Driving Digital Government Award** for a system that turns real time data into measurable outcomes (Boston About Results). The City managers aim to find ways to use technology to collaborate, to improve services and to increase efficiency.

The CC app is part of a wider innovative tool, which features **several applications** to monitor the city and integrate the citizens' vision and perception into the city management.

Apart from these apps, another example of the City's strategy is the move of 76,000 city employees and students to the cloud with Google Apps. This includes all City departments, the Boston Police Department, Boston Public Schools, teachers, administrators, and over 50,000 students, each with an individual Google apps account. The city claims that this is the first time that the same platform is in use across the City, **"allowing for a consistent, positive user experience."**

<b>Name of City</b>	Boston
<b>Country</b>	United States of America
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): <b>21</b> The Economist – City Competitiveness rankings (2013): <b>19</b>

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## ***Sustainable Districts***



## Barangaroo District Renewal Sydney, Australia

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The **22-hectare harbour renewal site** that is the focus of this case is located in the **centre of Sydney**. The first decision to transform the area, formerly dedicated to stevedoring wharves, was taken in 2005. An international urban design competition was held in 2005 with the winner announced on March 2006. The Concept Plan was approved in 2007. Its construction effectively began in 2012, and the schedule estimates that it will take approximately 20 years for the buildings and infrastructure to reach completion, after which the area will host corporates, new enterprises and residents.

The whole project is divided into three major development areas: Barangaroo Reserve, Central Barangaroo, and Barangaroo South. Barangaroo Reserve will host a **5.7 hectare park** with 75,000 plants, as well as walking and cycling trails. Central Barangaroo will constitute the **central transportation hub** of the area, where a metro station will be built.

Additionally, the design of the area will contribute to make Barangaroo a carbon neutral and zero waste area. Finally, Barangaroo South will be the **commercial district of the area** with the inclusion of **pedestrian connections** and **sustainable buildings**.

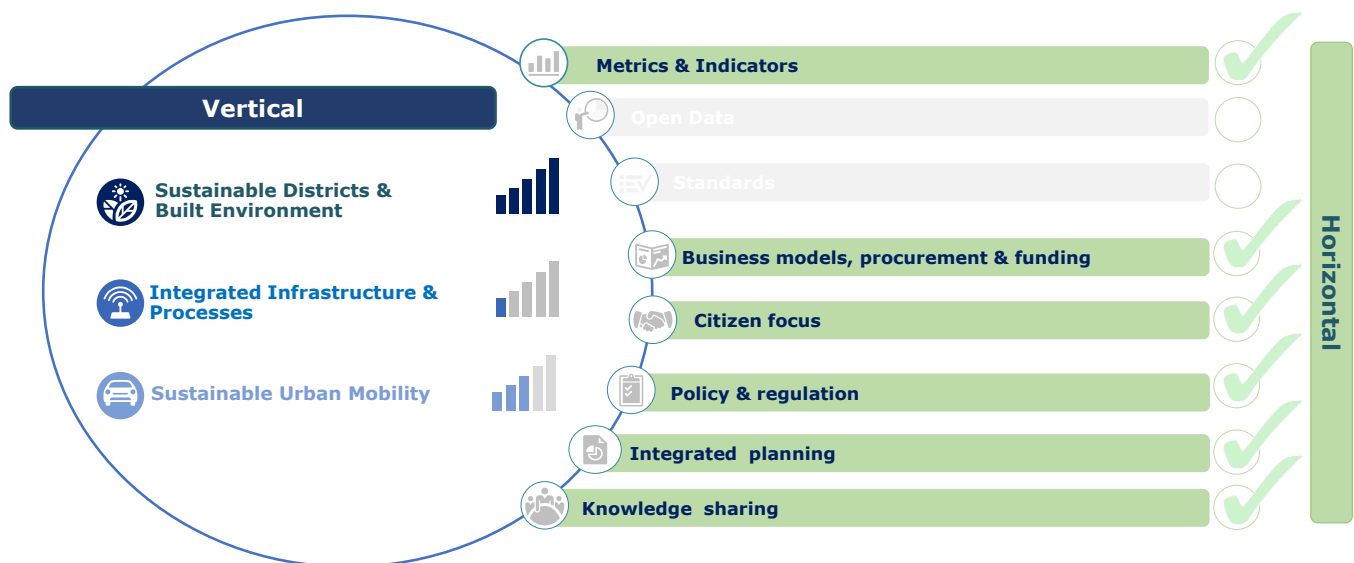
<b>Starting year</b>	2005
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	Around € 4 <sup>10</sup> Bln
<b>Number of impacted users</b>	Approx. 23,000 residents and workers, 33,000 daily visitors.
<b>Link</b>	<a href="http://www.barangaroo.com/">http://www.barangaroo.com/</a>

<sup>10</sup> The conversion rate used for this case study is € 1= AUD 0,66.

## Level of integration

When redesigning the area, particular attention was given to the **aspects of sustainability in the built environment and mobility, favoured through the use of ICT**, making this a fully integrated solution. In fact, Barangaroo aims to be a climate positive precinct, thus being a carbon neutral, water positive and zero waste area. To do so, state-of-the-art materials and technologies, including **smart meters and modern HVAC systems**, are being integrated into the built environment.

Furthermore, **renewable energy** is generated on- and off-site, and irrigation and toilets will soon be operating on recycled water. A **new transportation plan**, including new ferry hubs, pedestrian connections, cycle ways and bus routes, has been drafted to facilitate commuting and maximise the number of visitors, while minimising the use of cars. To achieve these goals, an **extensive use of ICT** is required to guarantee real-time information availability. In addition, **strict guidelines related to packaging avoidance and waste reduction** are being applied during the site's construction phase, so as to reduce environmental impact



## Business case

The site of interest is owned by the New South Wales (NSW) government; however, a dedicated body – the Barangaroo Delivery Authority – was established in 2009 to manage the project and ensure its coordination and financially responsible implementation.

The site was divided into three subunits: 1) Barangaroo Point Reserve, a park; 2) Central Barangaroo, a cultural focus area; 3) Barangaroo South, a residential, commercial and business precinct (50% of the area). Barangaroo represents **one of the world's most ambitious waterfront redevelopments**. Although several other waterfront redevelopments are currently underway across the world, very few combine a full integration of services with attention to design and sustainability.

The cost of the urban renewal is estimated to be around **€ 4 Bln**, and will be mostly **financed through private investors**. For this purpose, Lend Lease Ltd was selected through a tender to develop Barangaroo South. Two of three office towers are under construction and their financing was externally secured, while two residential buildings were sold in 2013 (all units were sold out within 3.5 hours).

Negotiations are currently underway to develop a luxury hotel. All land is given on a 99 years lease from the NSW Government.

## Community & Citizen Focus

Barangaroo's urban renewal area is divided into three sites, two of which are open to the public. Including a space for recreation, envisioned to host events and festivals, as well as a park, is a tangible indicator of the commitment of the city towards its community. The final design is a result of early user

inclusion and community consultations to shape the master planning of the area, carried out mainly through:

- **Public forums held across Sydney** (500 attendees);
- **A series of forums for representatives** from the local community, as well as from the housing and education sectors;
- **An online web-based forum**, which collected responses from almost 8,000 visitors and received more than 20,000 page visits;
- **A qualitative and quantitative interview consultation** of over 2,000 people.

Apart from the consultations, public awareness about and support for the project and its outcomes are still a focus of the initiative. For this purpose, the Barangaroo Delivery Authority introduced measures to quantify, track and improve these aspects, especially by disseminating information through social media. With the community in mind, Barangaroo is designed to promote passive as well as active recreation and living, more generally, a healthy lifestyle.

## Impact

To achieve sustainability, Barangaroo focuses on and integrates the spheres related to the environment, the economy and society.

In fact, through the use of renewable energy and of advanced technologies for transportation and the built environment, the site **aims to be carbon neutral**. The development of new ferry hubs, walking and bicycle lanes, as well as bus and rail networks will contribute to **reduce car commuters to 4%** compared to **the city average of 20%**. A focus on the circular economy, especially with regard to water and waste, and an attention to locally sourced products further enhance the environmental impact.

In addition, the new residential and commercial precinct will host tenants, new enterprises and leading global firms contributing AUD 1.5 Bln yearly to the development of the regional economy.

Finally, 23,000 people are expected to live and work on the site, which is also expected to attract an additional 33,000 temporary visitors per day.



## The solution in context: Smart City – Sydney

### About the smart city vision in the city

Green, global and connected are the key words of Sydney's vision for 2030. These goals were set as a result of inclusive consultations expressing the points of view of the city's residents, workers, visitors and businesses.

The transformation of Barangaroo is just one of major development efforts the city is undertaking to align itself with its long-term objectives. Led by the principles of sustainability and design excellence, the wharf renewal is **aimed at contributing to Sydney's goal to be recognised as a prominent player with high environmental performance and a green economy**. On the other hand, the extensive space dedicated within Barangaroo to public and cultural events, the investment in state-of-the-art infrastructure as well as the decision to offer affordable housing and retail space to stimulate innovation, are part of the strategy to attract tourists and talents.

Finally, the availability of community facilities and services, besides easy commuting, are all efforts to achieve cultural vitality and, ultimately, connection.

<b>Name of City</b>	Sydney
<b>Country</b>	Australia
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): <b>14</b> The Economist – City Competitiveness rankings (2013): <b>6</b>

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## Blue Gate District Antwerp, Belgium

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

**Blue Gate** is an important **district development project** in Antwerp, Belgium, and for which the city has set **high sustainable ambitions**. The brownfield area, which lies to the south of the city centre, is being redeveloped into an eco-effective business park, in collaboration with the Flemish Region. In the future, Blue Gate Antwerp will be home to **sustainable logistics, production and research and development structures**.

A whole series of concrete projects are already running: for instance, collaborative work is focusing on drafting an **integrated district eco-charter**; a business model has also been developed to set up an incubator for sustainable chemistry on the site. Furthermore, a pilot project for urban distribution has been launched and a joint study on a district heating network is under way.

Blue Gate Antwerp also participates in the Flemish Smart Energy Cities network.

<b>Starting year</b>	2001
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry
<b>Budget</b>	€ 6.1 Mln (initial project)
<b>Number of impacted users</b>	Approx. 200,000
<b>Link</b>	<a href="http://www.bluegateantwerp.eu/en">http://www.bluegateantwerp.eu/en</a>



## Level of integration

Blue Gate Antwerp is being developed by the City of Antwerp and the Flemish region. The project is integrated across the following main dimensions:

- **Eco-effective production:** Blue Gate Antwerp is built for eco-effective companies combining economic growth with ecological added value. The industrial estate is designed to host niche production and innovative specialisation.
- **Energy:** The industrial estate has been built to survive entirely on renewable energy sources. It does so by limiting demand, generating as much sustainable energy as possible to meet demand, using fossil-based sources only if necessary and as efficiently as possible.
- **Eco-mobility:** The accessibility of the quays allows companies settled within the district to take advantage of inland navigation as an environmentally friendly mode of transportation.



## Business case

**The development of Blue Gate Antwerp is lead by the public administrations of Antwerp and Flanders in a participative public-private partnership with the private sector.** The share of investment between public and private partners is 49% and 51% respectively, and is being spent mostly on sanitation and development.

BlueChem's business model, one of the leading components of the Blue Gate solution, was finalised in 2015. **The business model is based on a start-up scenario**, with an incubator where companies and knowledge institutions with sustainable chemical labs can establish themselves. BlueChem will also offer various services, including financing instruments, possibilities for upscaling, administrative support and matchmaking with partners.

**The first basic investment** in the building amounted to **€ 6.1 Mln**. An additional basic investment of € 1.8 Mln is needed to evolve towards the growth scenario (expansion to 6,000 m<sup>2</sup>).

Besides the announced Flemish funding, the City of Antwerp has already earmarked € 4 Mln for BlueChem in its investment budget. The incubator will be developed by the end of 2016.

Furthermore, Blue Gate will benefit from the existing quay wall program in which Flanders will contribute 80% of the investment to modernize the existing quay wall, and the private sector 20%.

## Community & Citizen Focus

A crucial factor in the success of an incubator is the collaboration between all stakeholders, which requires **setting up an appropriate framework to ensure effective collaboration**. The eco-effective ambitions of the city of Antwerp and Flanders for Blue Gate are laid down in the *Blue Gate Antwerp Charter*. The issuance policy of the site will be governed by this charter.

The charter is composed of the following three important elements, and **a dedicated commission from Blue Gate Antwerp will assess the development plans and adherence to the charter:**

- **BREEAM Guidelines:** These apply to both the land and the structures that will be built on it;
- **GRI Guidelines:** These international rules provide a comprehensive framework for sustainability reporting;
- **Blue Gate Antwerp Guidelines:** These emphasise a number of areas that have a specific significance for Blue Gate Antwerp and that are either not present or are incompletely formulated in the BREEAM and GRI guidelines. They generally relate to issues such as the level of connection to water for specific activities.

Furthermore, a **public-private partnership (PPP)** scheme has been designed to attract private partners in the decontamination and redevelopment of the site. The private partner will be chosen through the government's new and innovative tendering procedure, which includes a **competition dialogue**, whereby candidates are selected and a dialogue of several rounds is held. At the end of this process, at least two candidates submit a final offer on the basis of a detailed plan.

## Impact

The **Environmental Impact Assessment (EIA)** for the development of the Blue Gate Antwerp business park was approved in February 2014 and required only minor changes to the project before being given the green light. The EIA focused on assessing the consequences of implementing the project on both humans and the environment.

More specifically, the EIA examined a number of aspects related to the **environmental impact** of the Blue Gate Antwerp project:

- In terms of **mobility**, Blue Gate Antwerp has little impact on the **main road network**, but it does affect the surrounding intersections. In time, upgrading work will be necessary;
- **Air quality** will be largely unaffected, which implies that health risks to local residents are very limited;
- No **noise pollution** is foreseen to affect local residents and the Hoboken Polder;
- A number of mitigating measures will need to be put in place to counter the negative effects of **light pollution**.

Rehabilitating the land will have a positive impact on soil and groundwater quality. On the negative side, the encroachment on nature will definitely be substantial and a lot of greenery will disappear. However, the inclusion of a **14.5 hectare green corridor** is planned in order to offset this. The business park will be laid out with ecology and landscaping in mind and, as determined by decree, Blue Gate Antwerp will provide financial compensation for environmental damage. There will also be a considerable impact on the landscape as a result of the planned embankment. This will be counterbalanced by a visual quality plan designed to **guarantee the spatial quality of the development**.

Finally, the **industrial heritage** has to be considered: this will be partly preserved and partly demolished. A heritage covenant was signed to that effect with the Flemish Heritage Agency. Furthermore, it is estimated that Blue Gate will **generate an initial estimate of 1,500 -2,000 new jobs**.



## The solution in context: Smart City – Antwerp

### About the smart city vision in the city

Antwerp is one of eight Flemish cities that have pledged to transform themselves into Smart Cities: together they have formed the **Smart Energy Cities Network**, a sort of “classroom” in which each city is encouraged to share its ideas and come up with a project to make it smarter when it comes to energy.

The eight cities are guided by the Flemish Institute of Technology (VITO) and EnergyVille, a research platform for **sustainable energy and intelligent energy systems** based in Genk. The Smart Energy Cities Network is part of a wider European initiative, called *Step-Up*. It provides cities in the EU with financial support to realise certain innovations in terms of energy policy.

Antwerp is also part of the **Covenant of Mayors**, a city’s commitment to an extensive **reduction of CO<sub>2</sub> emissions via energy efficiency and renewable energy**.

<b>Name of City</b>	Antwerp
<b>Country</b>	Belgium
<b>No of Inhabitants</b>	100,000 < x < 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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- › **The solution in context image source:**  
<http://google earth>



## Corridor Manchester Manchester, United Kingdom

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Corridor Manchester is a **world leading research and knowledge-based district** located around the Oxford Road area of Manchester. The surface covers 243 hectares from the city centre to Whitworth Park. Approximately 43% of the activities in the Corridor belong to knowledge-intensive sectors, and the University of Manchester, Manchester Metropolitan University and the Central Manchester University Hospitals NHS Foundation Trust are all located there.

Approximately 70,000 students and a workforce of 60,000 make up the backbone of the district. **The vision** for the development of the Corridor was **established in 2008**, with the aim of making the area a **leading smart city district centred around transportation, ICT and energy efficiency measures**. Within 10 years' time, by combining the above-mentioned smart city solutions with other investments in education, the Corridor will affirm its status as one of the leading knowledge areas in Europe. In order to do so, a key role will be played by partnerships among local universities, research centres, industry and local public authorities.

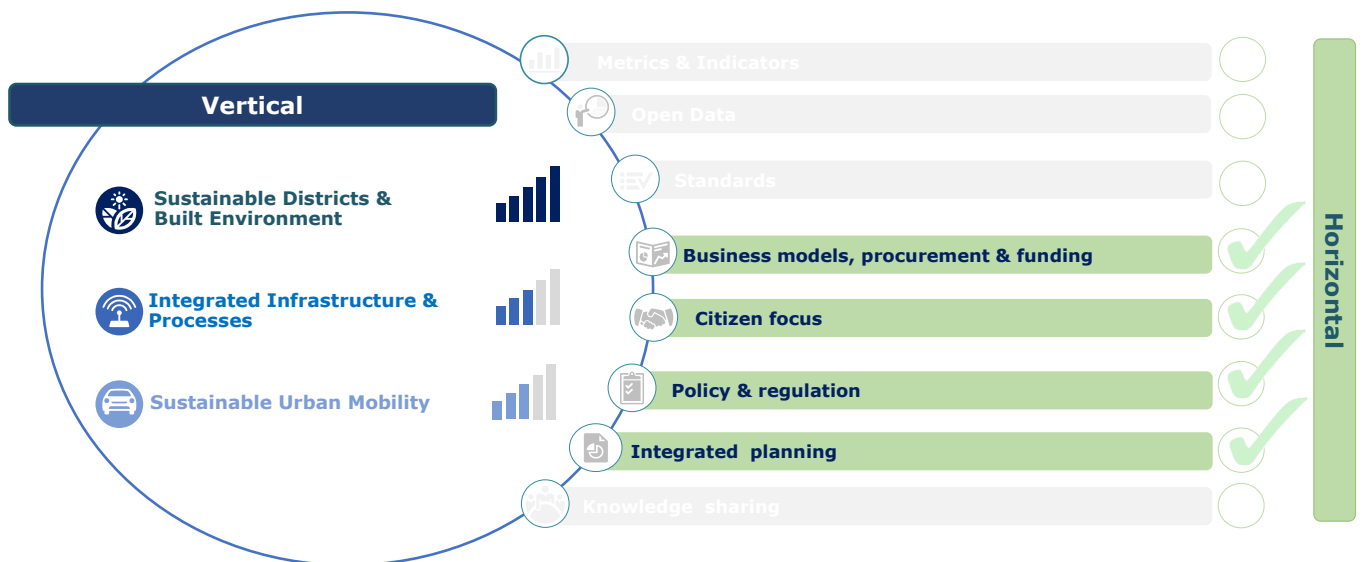
<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Sustainable District
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry, University
<b>Budget</b>	€ 3.4 <sup>11</sup> Bln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.corridormanchester.com/welcome">http://www.corridormanchester.com/welcome</a>

<sup>11</sup> The conversion rate used for this case study is € 1 = £ 1,099

## Level of integration

The smart city solutions that are going to be implemented in the Corridor fully **integrate mobility components with ICT and sustainable districts measures**. There are plans to improve both cycling routes and pedestrian areas, along with an enhancement of bus routes (as part of the bus priority programme). **Sustainable logistics** solutions will also be considered, including new ways for delivering goods via more sustainable means of transport, such as electric cargo bikes.

However, the largest smart city-related project to be implemented in the area belongs to the European Triangulum initiative. The focus area of the project is **to implement renewable energy and storage, enhance energy efficiency as well as intelligent energy management via ICT**. Therefore, it will be possible to connect different energy generation assets as well as electrical devices and buildings in the Corridor to one centralised platform. Additionally the project will also support the use of electric vehicles. The technologies supplied will be provided by Siemens and include: **Decentralized Energy Management System (DEMS); a virtual power plant (VPP); SieStorage Lithium Ion Batteries; distributed generation asset modelling software and building management system integration**. The project completion is set for 2020.



## Business case

Corridor Manchester is a partnership bringing together strategic partners to build on their investments in the ~250 hectare area known as the Corridor in order to generate economic growth and investment in the knowledge economy for the benefit of the city. The partnership includes the Manchester City Council, the University of Manchester, Manchester Metropolitan University and the Central Manchester University Hospitals NHS Foundation Trust.

The case aims to create an innovation-generating environment and realise the economic potential of the area. Therefore, it mostly entails advice and guidance to achieve smart development, rather than a business case per se. Indeed, **the project is not designed to generate financial returns**, apart from specific investments (which represent a separate case).

The overall cost for developing the area has been estimated to amount to approximately € 3.4 Bln. Capital funding for projects varies according to the project and will be drawn from the area's own funding sources, private investment and public funding from the Northwest Regional Development Agency (NWDA).

## Community & Citizen Focus

The Corridor Manchester district is designed and planned to **improve the lives of citizens and students** that are going to live, study and work in the area. Additionally, students from Manchester Metropolitan University and Manchester School of Architecture have been collaborating with professional

design firms in order to create and develop new ideas for the area that could be taken into consideration by client partners in the future.

## Impact

Corridor Manchester already generates substantial economic impacts in the overall city context. The area accounts for approximately 60,000 jobs, an economic output of € 4.1 Bln every year and 20% of the overall city output in the last 5 years. In relation to the environmental impacts generated by the district, no measured data is available. However, a set of environmental indicators has already been created for the Triangulum project, including: energy use, percentage of energy generated from renewable sources, and air quality.

Finally, social impacts can be rated as particularly high in the solution. An improved bus network, planned **energy reduction and optimization systems as well as new education facilities make the area an attractive place to live, work and study.**



## The solution in context: Smart City – Manchester

### About the smart city vision in the city

Manchester can be considered **a leading Smart City in Europe**. The city places a strong focus on digital technologies, and is working in cooperation with several other centres in Europe to develop and share best practices in using technology to improve quality of life in urban areas. The agency representing the Manchester City Council and that is also responsible for the digital agenda in the city is the Manchester Digital Development Agency. The Agency also cooperates with other entities working in the same field in the city.

The whole strategy regarding digital technologies can be seen as part of the **Greater Manchester Strategy, Stronger Together**, a plan focusing on building a new sustainable model that could make the city more connected, talented and greener, with the active participation of all citizens by 2020. **The Greater Manchester Strategy Plan for 2020 draws inspiration from the EU's SMART-IP programme**, focusing on creating Smart Citizens, especially in terms of using new technologies. The aim of the initiative is to **boost the development of digital industry in the area, increase digital inclusion and foster digital innovation**.

**Name of City** Manchester

**Country** United Kingdom

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Tampere region is the **second largest growth centre in Finland** and the increase in population, jobs and services are threatening to increase energy consumption and greenhouse gas emissions. To avoid this, Tampere decided to try and identify **eco-efficient solutions**.

In 2010, ECO2 was launched in the Tampere region to identify, **develop and promote eco-efficient solutions in city planning, construction, energy production and transportation** as a strategic 6-year project. In the project, Tampere's climate and energy objectives are implemented and the city development practices are changed to **support a low-carbon and carbon-neutral urban structure and sustainable business**.

The eco-efficiency of all urban plans is thoroughly assessed prior to building, and **all new constructions on the city's plots have to be at least energy class A**. In terms of land use, the aim is to better integrate the spatial structure of communities: for example, on the shores of lakes Näsijärvi and Pyhäjärvi, new residential areas are being built close to the city centre to facilitate access. The former factory premises in the city centre have also been renovated as housing units, museums, offices and education buildings.

In the field of traffic planning, investments have been made to facilitate public transport and to **improve the conditions of cycling and walking**. In addition to buses, Tampere is planning a new **light rail tramline** to support the public transport system. The main street in the city is being altered to allow access only to public transport, bicycles and pedestrians. To increase cycling, Tampere has built new cycle tracks and launched a cycling campaign in summer 2012. Indeed, Tampere was selected as "The Cycling City of the year 2013."

ECO2 has been operating for six years and it now works as part of the Tampere Smart City Programme. ECO2 has also disseminated its best practice to the city units. Climate initiatives continue as part of the city's normal tasks and ECO2 experts keep working on sustainable transport, construction and energy.

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Sustainable Districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority
<b>Budget</b>	Overall: € 14 Mln; Project: € 350,000 per year; Sub-projects: € 2 Mln per year
<b>Number of impacted users</b>	Approx. 2,000
<b>Link</b>	<a href="http://www.tampere.fi/tampereen-kaupunki/projektit/kaupunkikonsernin-hankkeet/eco2-hanke/eco2-ecoefficienttampere2020.html">http://www.tampere.fi/tampereen-kaupunki/projektit/kaupunkikonsernin-hankkeet/eco2-hanke/eco2-ecoefficienttampere2020.html</a>



## Level of integration

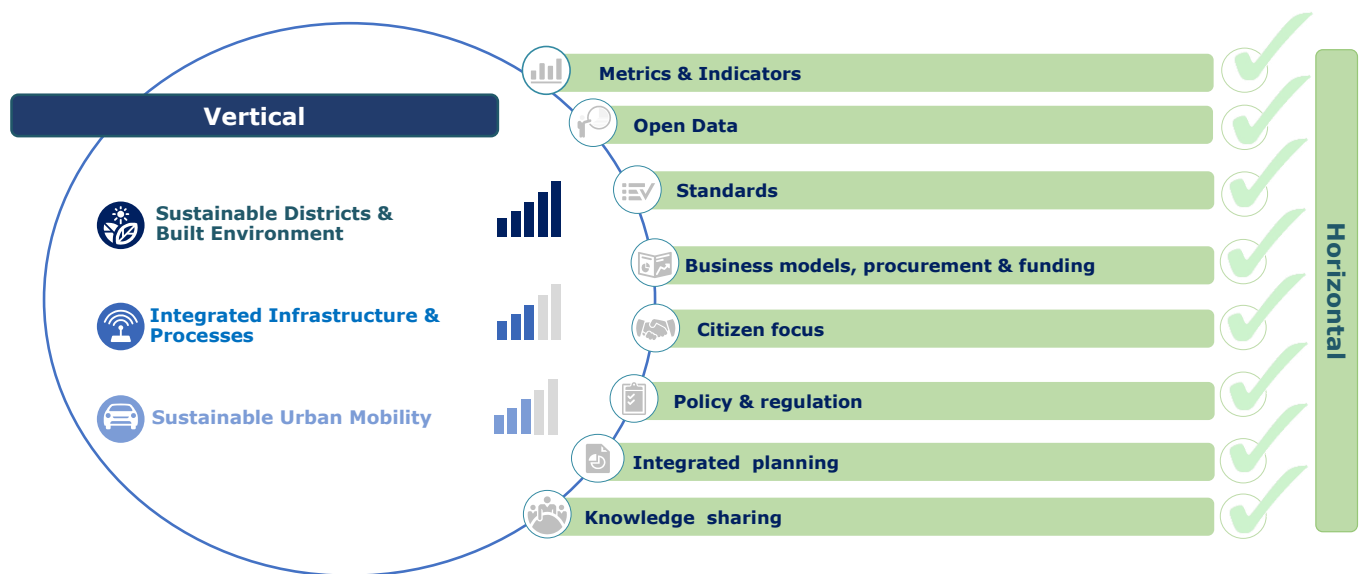
The solution **integrates city planning, construction, energy production, ICT and infrastructure** with the purpose of developing and promoting solutions that have the ability to **support a low-carbon and carbon-neutral urban structure and sustainable business**. The city is defining a strategy for electro-mobility, it is planning how to utilize the electric vehicles in departments of the city, and it is looking into how to invest in infrastructure and charging facilities in order to encourage the private sector and citizens to switch to electro-mobility. The city purchased its first five e-buses in 2015.

The project is an example of a **huge integrated spatial development project** that addresses **energy efficiency, mobility, sustainable built environment and transportation**.

ECO2 is financed entirely by public funds from the government, the region, and the EU. The implementation of the project in 2010-2012 was also supported by the City of Tampere and Sitra, the Finnish Innovation Fund. Tekes, the Finnish Funding Agency for Innovation, has also contributed funding to ECO2.

The project has been funded with € 350,000 per year, in addition to a series of sub-projects, which were financed for a total of € 2 Mln per year. Linked additional investments through the city count for € 160 Mln, investments in **smart mobility systems € 40 Mln**, and, lastly, investments in energy efficient construction have been made for a total of € 20 Mln from 2010 to 2015.

According to the project managers, the replication potential of the solution is very high. At the moment, the best practice solutions from ECO2 are implemented in the different city units with the aim of **adapting the most efficient and replicable initiatives**. The Helsinki Region and the cities of Turku and Oulu have all been implementing initiatives from ECO2.



## Business case

The main actors involved in the ECO2 project are the City of Tampere and Sitra, the Finnish Innovation Fund. The project is publically driven and coordinates the energy and climate actions of the various departments of the city. The City of Tampere also initiates cooperation projects with business partners, universities, research institutes and civil society organizations.

Each partner has its own role to play in **implementing eco-efficiency**:

- The City Planning Department affects the efficiency of community structure, which in turn affects energy density and the profitability of energy systems, waste management organization, frequency of public transport, and local service provision;
- The Real Estate Department influences the terms of plot assignment, planning contracts and compensations that can be used to **promote energy-efficient construction**. This Department also **sets energy-efficient criteria and CO<sub>2</sub> footprint mitigation requirements for construction competitions**.

- The Housing Department distributes state subsidies for energy repairs and administers the housing fund of the city of Tampere, which grants subsidies for projects such as elevator construction and energy efficiency subsidies to various city communities. The Department also grants construction and action permits for activities such as geothermal heat projects, and supervises the quality of the final result.
- The constructor is responsible for the practical planning and implementation of energy and eco-efficient construction. **In the public-private partnership model applied in Tampere, the constructor participates in the planning right from the preparation phase**, which enables interactive consideration of energy and eco-efficiency requirements.

The project is also well integrated into the political system of the City of Tampere. The ECO2 Project Manager works directly under the Vice Mayor for the Economic and Urban Development sector.

An Advisory Board (2010-2012) was lead by the Mayor (elected), who called for a meeting twice a year. Attendees included representatives of different stakeholder groups like universities and other academic institutions, NGOs, industries and selected directors from the city organisation. In the second period of the project (2013-2015) the advisory board and the steering group were brought together and the steering group was lead by the Vice Mayor.

In addition, there are three targeted stakeholder forums: the Construction Forum, the Energy Forum and the Mobility Forum. In practice, these are workshops that take place 4-6 times a year. Each one attracts approximately 50 to 80 invited participants from different stakeholder groups. Forums include presentations from relevant experts, discussions and brainstorming sessions. Forums have proven useful to make contact with and get feedback from local businesses.

## Community & Citizen Focus

In Tampere, public participation is highly prioritised in the city. **Development of public participation** is the responsibility of the city council, the mayors, and therefore the whole organisation. In the core of public participation in Tampere is the possibility for citizens to **take part in the decision making process**. Hence, there is a strong assumption that ECO2 has a strong city & community focus yet the material investigated does not give a concrete overview.

There might even be a concrete focus on **social media-enabled, bottom up community and citizen participation** as the Finnish Somus project supports the ECO2 project and has looked into social media and its potential for public participation. The project looks at four types of **ICT-enabled participation**:

- Public definition of common problems;
- Collection and accumulation of knowledge and other competencies;
- Development of socially grounded innovations;
- Actual decision-making.

The Somus project started based on open online collaboration and the birth of the Open Research Swarm. The project proposal was drafted in an open wiki, which was a new approach to applying research funding. The project therefore took openness and social media way of working as premises for the research work and for the way that the project team itself worked.

## Impact

The goals of the solution were to:

- Reduce the greenhouse gas emissions by 3% in 2012.
- Bring the share of sustainable energy sources delivered by the local city owned energy company down to 30% in 2020;
- Produce 80% of the city's heat and electricity with renewable fuels by 2040.

The environmental impact of the solution can already be seen, according to key documents published by the investor: **between 2010 and 2014, greenhouse gas emissions were reduced by 21% in Tampere**. CO<sub>2</sub> emissions from electricity production at Tampereen Sähkölaitos Oy (Tampere Power Utility Ltd) were cut by 35% during the same period. Furthermore, **the proportion of renewable energy tripled over five years**, from 8% to 25%. The proportion of renewable energy in heat and electricity production has also increased significantly. The recession has slowed down the growth in

consumption and car traffic. Changes in the energy markets have made it unprofitable to produce electricity only from natural gas in CHP plants.

At the end of 2012, Rambøll undertook an emission impact assessment for the activities started within the first three years of the ECO2 project and their effect on greenhouse gas emissions in Tampere. Based on the assessment, **a reduction of over 600,000 CO<sub>2</sub> tons can be achieved through energy and climate projects by 2020**. This is around 20% of the total emissions, which means that Tampere can reach the objective of the EU Covenant of Mayors. The majority of the emission reductions are generated through the increased use of renewable energy in Tampereen Sähkölaitos Oy's heat and electricity production. This is also the sector that the city can influence the most, as the power utility is owned by the city of Tampere and therefore committed to the city's strategic emission reduction targets.

Additionally, **new renewable energy production has created more than 400 new jobs and saved € 100 Mln.**



## The solution in context: Smart City – Tampere

### About the smart city vision in the city

Tampere's **City Strategy 2025** is built on the premise that a compact, green and **low-carbon community** structure supports the development of the entire city region. The city's growth is focused around the current community structure, the regional centres and the quality of the public transport corridors and the southbound railway zone. Public transport and cycling are devised to be convenient transportation alternatives, and developing a city tramline is the leading public transport project.

Tampere is a **forerunner in climate policy**. The city's carbon dioxide emissions will be **reduced by 40% (compared to 1990 levels) by 2025**. In 2020, the City of Tampere will be a **resource-efficient** and **low-carbon** place to live, i.e. a smart ecocity. The carbon footprint of the local residents has reduced, as the proportion of renewable energy in heat and electricity production has increased significantly. Renewable local energy sources (e.g. heat pumps, bio-fuels, solar panels) have become especially common in single-family house areas. The first tramline is already in use, and connects the largest residential and business areas to the city centre. The city has turned into a pedestrian, cycling, and public transport-oriented city. In the planning of new areas, **eco-efficiency** and the **CO<sub>2</sub> footprint** is always assessed. New construction projects always aim at a near-zero energy level and financial incentives are used to encourage constructors to conduct energy repairs. Active innovation platforms have also been set up in Tampere for cleantech companies.

**Name of City** Tampere

**Country** Finland

**No of Inhabitants** 100,000 < x < 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## HafenCity Hamburg, Germany

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

HafenCity is a major urban development project in Hamburg. A lively area will take shape on 157 hectares, enlarging the existing city by 40%, and it will feature workplace and residential units, culture and leisure spots, and tourism and retail facilities.

One of the objectives for HafenCity was that it should be able to develop a type of social life that supported the urban atmosphere and sustainable neighbourhoods. For this to happen, **a holistic approach has been used in order to strengthen both the physical and social spaces within the area.** In this respect, the HafenCity project has used a mix of building uses, types, aesthetics, and ecological diversity by encouraging **mixed groups of actors**, such as investors, builders, designers and residents to collaborate in joint ventures. Sustainability innovations have also been a major factor in the development of the area. Examples of sustainable innovation in relation to energy count new approaches to heat supply, a tailor-made certification system for buildings, sustainable mobility concepts, flood protection and the development of a sustainable urban infrastructure. Also, the aim is to **create 6,000-7,000 homes for around 14,000 residents and up to 45,000 jobs.**

In terms of the **built environment**, heating energy supply is a major focus point of the development plan. The basis of the heating energy supply in HafenCity is a technologically open process to achieve **a mix of district heating and heat generated by de-centralised heating plants within HafenCity**, including cogeneration units, fuel cells and solar panels on residential buildings to provide hot water. The selection of technologies and the local supply of heating energy will deliver a **reduction of approximately 27%** compared to a building-by-building approach that uses natural gas. Additionally, a high temperature fuel cell unit has been built as a pilot plant, supplying approximately 200 homes and offices with heating and power. A smart grid will also be installed to monitor and improve energy savings.

Furthermore, the issue of **ecological construction** has been a major focus point since 2004. Investors certify the sustainability of their buildings using recognised measures and use this as a marketing tool. The measures include **building insulation, air conditioning/heating/ventilation, hot water provision, lighting, and energy management and automation.**

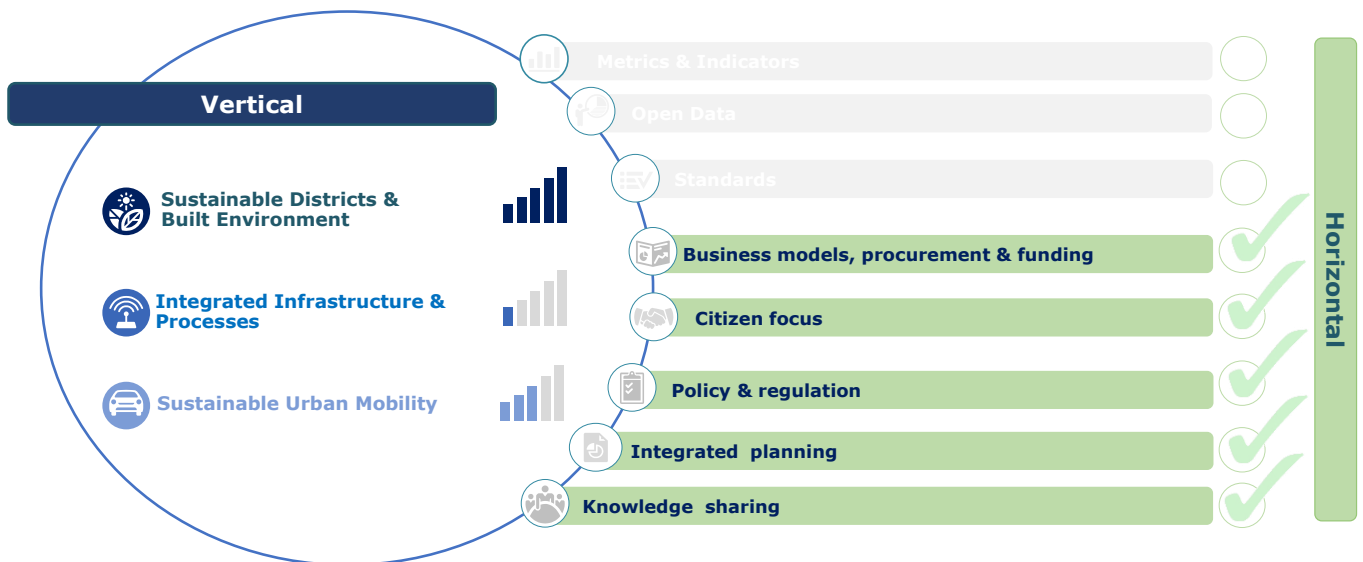
Sustainability, in terms of both ecological and social quality, is one of the most important benchmarks steering transport planning in HafenCity. In its inner-city, a central location and a mix of work, leisure and residential areas make it a district of short distances. In other part of Hamburg, housing units create long, roundabout routes; conversely, in HafenCity pedestrians and cyclists can even make their way using private spaces between individual buildings. New roads and bridges will be established to better connect the different harbour areas, and a new metro station will give HafenCity, and its estimated 40,000 daily commuters, good public transport possibilities.

The HafenCity project was officially announced in 1997, and in 2000, the first activities were initiated. The project will be completed between 2015-2030. Currently, 57 sub-projects have been completed, whereas 50 projects are under construction or planned. After 13 years of construction, HafenCity Hamburg GmbH is well on schedule as far as completion and quality are concerned.

<b>Starting year</b>	1997
<b>Type of integrated solution</b>	Sustainable Districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	Approx. € 10.9 Bln overall (€ 8.5 Bln from private investments and € 2.4 Bln from public investments)
<b>Number of impacted users</b>	Approx. 14,000 residents and large group of firms
<b>Link</b>	<a href="http://www.hafencity.com/en/home.html">http://www.hafencity.com/en/home.html</a>

## Level of integration

The solution is an example of a project that **improves the built environment and urban mobility by focusing on sustainability**. Additionally, the solution brings in new data technology to change energy consumption and mix the different types of energy used in the area.



## Business case

In 1997, the Gesellschaft für Hafen und Standortentwicklung GHS (renamed HafenCity Hamburg GmbH in 2004) was set up to manage the development of HafenCity. HafenCity Hamburg GmbH is **a single organizing body, fully financed by the city of Hamburg but functioning as an independent company** that manages and facilitates the development process.

In 2000, the winning masterplan by Kees Christiaanse / ASTOC was selected based on its clear vision, its compact and fine-grained urban structure, and its ability to support an iterative process which could combine many actors and events within HafenCity's **25 year period of evolution**. It is this last point that makes HafenCity a unique example of sustainable urban development.

When a developer wants to purchase and develop land in HafenCity, they must **compete not only with respect to cost, but also with respect to the quality and creativity of their proposal**. First of all, a developer or constructor articulates a brief, conducts an architectural competition and, together with the selected architect, submits a scheme to HafenCity Hamburg GmbH. HafenCity Hamburg GmbH then judge the scheme in relation to their own set of sustainability standards based on **sustainable energy performance, benefit to public amenities, health and comfort, mix of use, and ease and efficiency of building maintenance over time**. In the construction sector, companies are evaluated according to a certification system called **EcoLabel**.

The development of HafenCity has been financed through a **mix of private and public investments**: around **€ 8.5 Bln from private investments** and **€ 2.4 Bln from public investments**, mostly financed from special asset fund sales of plots in HafenCity (around € 1.5 Bln).

At the moment, there are no pilot projects that are being scaled to the whole of Hamburg. Nevertheless, there might be impacts later on. For example, the HafenCity quarter Baakenhafen is a so-called *Modellquartier Nachhaltige Mobilität* for the development of sustainable mobility, electric mobility and car sharing solutions that may potentially be scaled to the rest of the city.

## Community & Citizen Focus

With the aim of strengthening social capital in the harbour site, a series of **neighbourhood cooperation meetings** has been created in order to include the local residents and firms in the development process.

Additionally, making creativity a development criterion has already given rise to a high level of social entrepreneurship.

## Impact

HafenCity is rather unique as a large-scale inner-city development and waterfront project. Many impacts will be measurable only in the future, after the completion of the development and the interaction with the existing inner city of Hamburg. For example economic impacts, fiscal revenue, the impacts on visits and overnight stays and so on, are examples of where quantitative evidence would be difficult, if not impossible, to gather.

The master plan itself contains some impact targets, but these should be understood more like a set of guidelines, such as:

- The development of HafenCity is expected to create 45,000 jobs;
- In relation to CO<sub>2</sub> emissions, western HafenCity will be connected to district heating networks driven by combined heat and power generation, which may contribute to CO<sub>2</sub> emissions for 175 g/kWh (compared to the average emission level of 240 g/kWh). In eastern HafenCity, CO<sub>2</sub> emissions will reach just 89 g/kWh, made possible through its decentralized, modular local heating supply network;
- The introduction of the **EcoLabel in the building construction sector** will naturally also influence the environmental impact of the solution in a positive way.

The districts of Baakenhafen and Elbbrücken will function as a kind of research lab for low-pollution mobility through the establishment of **garages with charging equipment for electric vehicles and car-sharing systems** including a high proportion of electric vehicles.

Furthermore, learning effects from the specific projects within the solution (the HafenCity EcoLabel and the certification system, the associated market mobilization, the spread of the intended reduction of motorized individual transport, and the experience from creating social sustainability, efficient land use, and quarter management) will occur and be used by the whole city of Hamburg. However, these impacts are not quantifiable yet.





## The solution in context: Smart City – Hamburg

### About the smart city vision in the city

In 1997, the Mayor of Hamburg presented **Vision HafenCity** to the public. The aim was for the inner city to regain its waterfront. At the time, this only applied to a few sections (primarily the River Elbe embankment in Altona, between Fischmarkt and Museumshafen). On February 29, 2000, Hamburg's Senate made history by giving its approval to the Masterplan for the new inner-city district of HafenCity. In 1997, the vision and development plan only affected narrow riverfront sections. Today, **the plan has expanded and covers an area of approximately 157 hectares**, which is being developed into a district with mixed residential, work, cultural and leisure uses.

At the heart of the project is the conviction that, in the medium and long term, the establishment of HafenCity will **significantly contribute to achieve the ambitious climate goal of Hamburg**. The aim is to achieve a 40% cut in CO2 emissions by 2020 (compared with 1990). Through the innovative supply of power and heat within the area of HafenCity, it should be possible to cut pollution by 50%.

**Name of City** Hamburg

**Country** Germany

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): **46**

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## Hammarby Sjöstad Stockholm, Sweden

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Hammarby Sjöstad project is one of the **world's most recognised success stories in the development of a fully integrated sustainable district**. The development of the area dates back to the failed attempt by Stockholm to host the 2004 Summer Olympic Games. **The original plan was to make Hammarby Sjöstad part of the ecological Olympic Village**. Although Stockholm's bid for the Games didn't prove successful, the City Council decided to start the construction of the project in 1999. Thanks to the project, a former abandoned industrial area was reconverted into a modern district with sustainable houses and infrastructure. The project is set for completion in 2017 and, when finished, it will include **11,000 residential apartments** on a total area of 160 hectares, hosting a projected population of 24,000 people with a projected density of 150 persons/hectare.

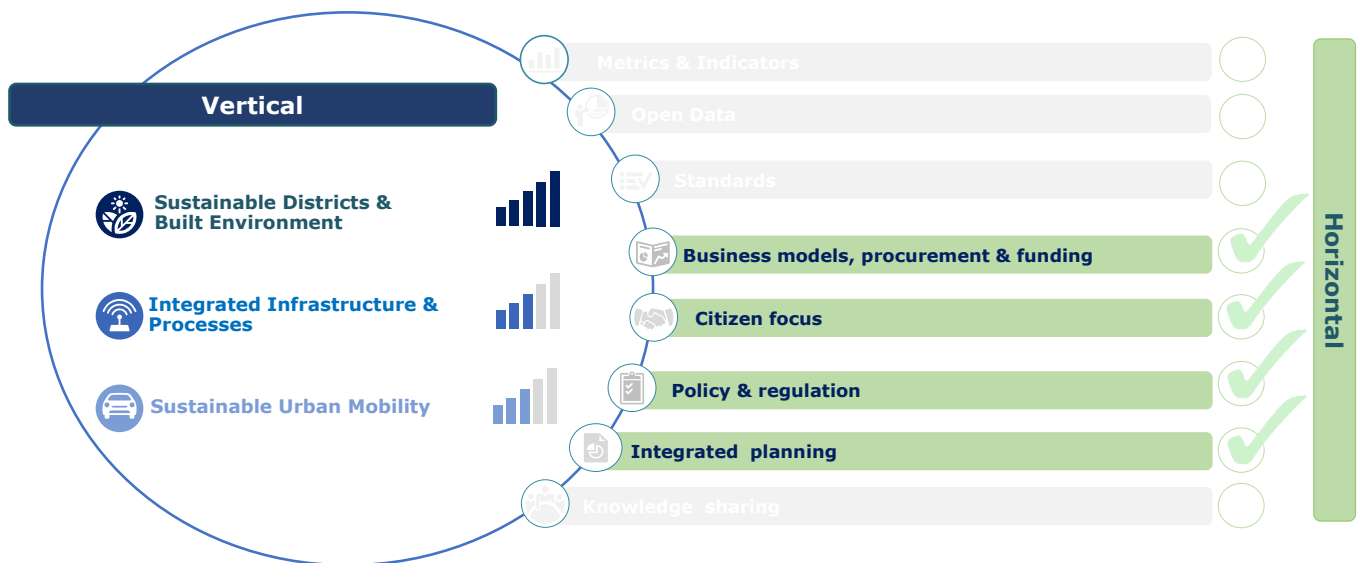
The regulatory framework for the realisation of the district was set in 1999 with the so-called **Stockholm City Plan 99**. The aim of the plan was to set a strategy that could prevent an uncontrolled expansion of the city. Therefore, the main actions fostered by the municipality were targeted at redeveloping already used areas instead of building on unused lands.

<b>Starting year</b>	1999
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 1.7 Bln - € 2 <sup>12</sup> Bln
<b>Number of impacted users</b>	Approx. 24,000 residents
<b>Link</b>	<a href="http://bygg.stockholm.se/hammarbysjostad">http://bygg.stockholm.se/hammarbysjostad</a>

<sup>12</sup> The conversion rate used for this case study is 1€=9,25SEK

## Level of integration

Hammarby Sjöstad can be considered as a **highly integrated project along the domains of sustainable district, urban mobility and ICT infrastructure**. More specifically, the project has been designed in order to enable water, waste and energy systems feeding one other, thus reducing the overall resources needed (the so called **"Hammarby Model"**). The major solutions that have been planned for the area include: two new **bus routes** (with buses fuelled by biogas), **car sharing** (with 25 cars available in the district), **a new tram line, underground pipes for waste collection, solar panels** incorporated in buildings (with ICT integrated infrastructure for managing performances), and sewage used as **biogas** for district heating. Moreover, the project also includes an education centre, Glashus Ett, showcasing environmental technologies to encourage pro-environmental behaviour by the residents.



## Business case

The Hammarby Sjöstad project is carried out by the City Development Administration and the City Planning Administration.

In the early 1990s, the administration of Helsinki realised that the development of new areas was required to accommodate the growing population. At the same time, the Administration aimed to avoid the creation of unsustainable and dangerous surroundings such as the Stockholm post-war residential areas. The development of Hammarby Sjöstad had to comply with these requirements.

Before the project started, the local authority had acquired almost the entire site from the former owners. This made it easier for it to take leadership of each stage of the projects' development. **Hammarby Sjöstad is developed as a real estate project, where private construction companies sustain the business selling residential and commercial spaces.**

The (smart) infrastructure is developed to serve this purpose through the application of two models of ownership. These define the roles of the public and private entities, the responsibilities, and the costs and fees when infrastructure is developed:

- **Model 1:** Power, wastewater, water, and district heating. Infrastructure can be owned by the municipality or private company. The infrastructure supplier owns the technology and the installation and operational costs are financed by connection fees.
- **Model 2:** In case the infrastructure is not owned by the municipality – e.g. underground waste transportation system. Several developers (construction companies) create a joint company that purchase the infrastructure after it is installed by the supplier on the basis of how much land they are developing. As the residential complexes are completed, the developers then transfer the

ownership to the various building owners. Each building owner pays for the operational costs of the infrastructure to the supplier.

The overall cost for developing the district is estimated to be approximately € 2 Bln. **Construction companies contributed 80% of the total cost of realization.** The additional funding sources came from the City of Stockholm, Stockholm Transport, and the National Road Administration. In particular, the City of Stockholm allocated SEK 200 Mln (€ 21 Mln).

Other funding was received from the national government through the **Local Investment Program** (Stockholm LIP, 2003). The LIP represents Sweden's largest single environmental initiative. The LIP stated that municipalities could apply for the subsidy if they employed measures that promoted ecological sustainable development. The majority of the subsidy (67%) was earmarked for development and demonstration projects. The remaining 33% was to be used to encourage better buildings, procure technology, developing the ELP (Environmental Load Profile) and information sharing.

The project is currently considered one of the most advanced sustainable districts in Europe. Some of the solutions already established at Hammarby Sjöstad are currently planned to be replicated in the near Royal Seaport of Stockholm. From a more general perspective, the solution carries also replication potential outside of the Swedish borders. Even though some of the specific solutions are hard to replicate, the overall idea behind the above mentioned Hammarby Model can be applied to other urban contexts, such as the Caoferdian Ecocity development in China.

## Community & Citizen Focus

As discussed in the previous section, the whole community of Hammarby Sjöstad take active part in fostering the ecological features of the district; the Glasshus Ett plays a central role in this direction.

## Impact

Some of the most relevant impacts in relation to the development of the district are especially related to the **environmental aspect**. It has been calculated that **CO<sub>2</sub> emissions per apartment in regards to personal transport by car are 50% lower** in the district than in other areas of the city. An overall **reduction of 2,373 tonnes of CO<sub>2</sub> per year** has been calculated. Moreover, the total emissions of the residents of Hammarby Sjöstad are less than a third of the emissions from other residents in the country. A strong contribution to the achievement of these environmental targets has been played by the efficient transport system in the area, which allows residents to have some of the lowest car ownerships rates in the whole city of Stockholm (210 cars per 1,000 residents versus 370 cars per 1,000 residents in the other city districts).

It has also been calculated that, once the project will be completed, the inhabitants will produce 50% of the fuel necessary to generate the energy required. **The main sources of energy will be solar power, treated wastewater and waste.** In addition, the average water use in the development has been estimated to be around 150 litres compared to 200 litres in the city. Finally, the above-mentioned savings will also bring substantial energy cost reductions (around 39%). Overall the whole district provides state-of-the-art services; therefore social impacts can be also included in the evaluation of project.



## The solution in context: Smart City – Stockholm

### About the smart city vision in the city

Stockholm is one of the **front-runner cities at European level** in regards to the application of smart city technologies. A key role in the success of the city's smart city vision is played by the **strong links and cooperation between the public, private sectors as well as its own inhabitants**. ICT is regarded as the core technology for the building of Stockholm's smart city vision. Green IT is the name of the initiative launched by the municipality for enhancing environmental sustainability through the use of the **latest ICT technologies**. All of the city's smart city programmes are part of the Stockholm 2030 vision, which aims at making the **Swedish capital a world leader in the development and application of information technology, reduction of carbon emissions and enhancement of public transport usage**. The environmental goals set by the municipality can be summarised into 6 key action areas: environmentally efficient transport, non-toxic products and buildings, sustainable energy usage, sustainable use of land and water, environmentally efficient waste management, and healthy indoor environment.

Some example of projects which have scaled into true integrated Smart City solutions are the Royal Seaport but also the **Kista Science City**, Sweden's world-class ICT cluster, where research and technology transfer take place between businesses and the high-tech academia.

<b>Name of City</b>	Stockholm
<b>Country</b>	Sweden
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): <b>5</b> Global Cities Index – Bloomberg (2014): <b>33</b> The Economist – City Competitiveness rankings (2013): <b>8</b>

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## Hudson Yards New York, US



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Hudson Yards project is **the most ambitious and extensive urban development plan** realised in New York since the construction of the Rockefeller Centre. The district is located in the area between the 30<sup>th</sup> and 34<sup>th</sup> street in the Chelsea neighbourhood. It is foreseen that the area will attract more than 24 Mln visitors every year.

The site will include commercial and residential space on a surface of 1.5 Mln m<sup>2</sup>, 100 shops, 5000 residences, cultural spaces and a 750-seat public school. The development is structured in two phases: the first part will be centred around the building of the major facilities on a surface of 1 Mln m<sup>2</sup>; the remaining part will be completed in the second phase with the realisation of the school and other residential buildings.

<b>Starting year</b>	2013
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 18 <sup>13</sup> Bln
<b>Number of impacted users</b>	Approx. 2 Mln
<b>Link</b>	<a href="http://www.hudsonyardsnewyork.com/">http://www.hudsonyardsnewyork.com/</a>

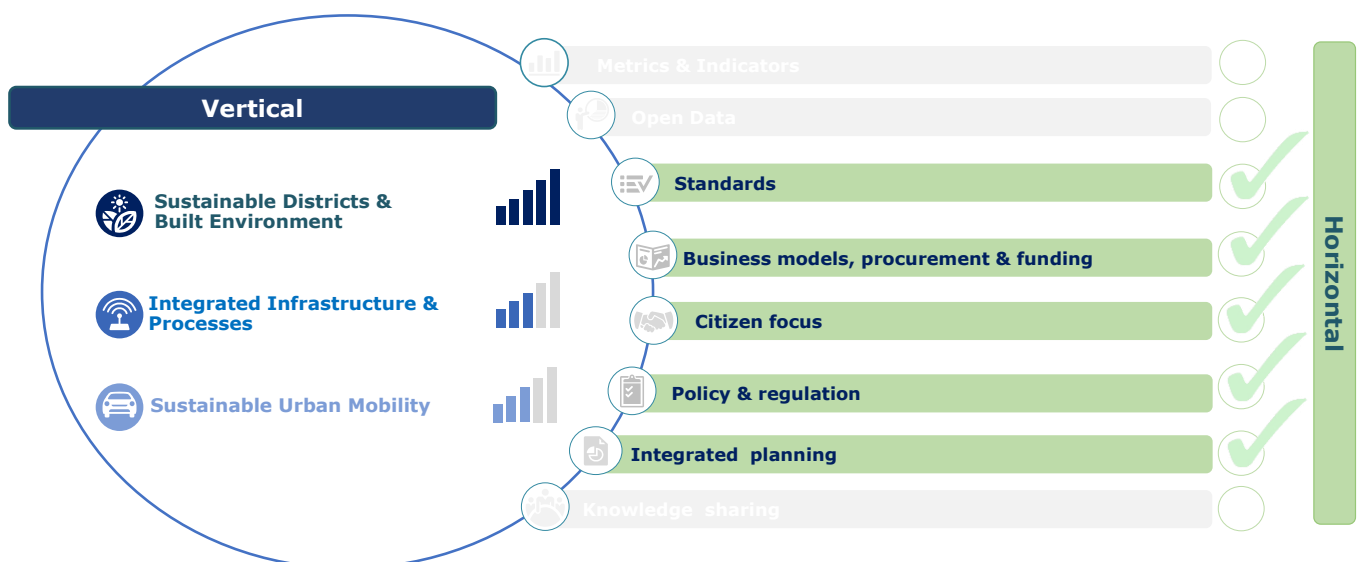
<sup>13</sup> The conversion rate used for this case study is 1€=1,060\$



## Level of integration

The whole project can be regarded as an example of an **integrated solution across Sustainable Districts, ICT infrastructure and Urban Mobility**. An innovative waste management system will have waste sent directly to a central terminal via a vacuum-tube system; therefore, garbage trucks won't be necessary in the area. Moreover, organic waste will be used for creating dry fertilizer. A **micro grid system is planned to be deployed across the district**. Therefore, it will be possible to have apartments or offices heated or cooled via their own equipment. **An energy management system will make it possible to store additional power surplus in the neighbourhood**. Additionally, two of the most iconic new buildings in the district, 10 Hudson Yards and 30 Hudson Yards, will also become the most advanced energy efficient buildings in the whole of Manhattan. By using daylight harvesting and sensors for turning lights off when not required, it would be possible to save resources and improve energy efficiency. Both the buildings are set to achieve a LEED certification.

Finally, by exploiting **big data** and via an advanced **ICT platform** operators in the district will be able to manage **traffic flows, air quality, pedestrian flow and temperature** in the whole Hudson Yards area. In terms of public transportation, an extension of subway line No.7 has been planned in order to link the new district with the other major transportation hubs in the city.



## Business case

The development of the Hudson Yard district is a **real estate** business case in Manhattan. The investment in smart and sustainable services represents a share of the total investment and is covered by the demand for apartments, offices and retail spaces.

Consequently, the real estate development supports the deployment of smart technologies. The revenues are based on the sales of the units (housing and commercial) to private or public customers. Furthermore, positive effects are expected due to the development of smart solutions, determining an increase in value for the real estate market and generating additional profits in the near future.

The development of the area started when, in conjunction with the government of New York City, the Metropolitan Transportation Authority issued a Request for Proposal (RFP) for 12 Mln square feet (1.1 Mln m<sup>2</sup>) of mixed-use space. The space is to be built on platforms over the rail yards, which would still be in use. The MTA then signed a billionaire lease agreement for 99 years for the air rights over the rail yard.

Specific to the case is that a portion of the investment is funded via the EB-5 jobs programme, under which **foreigners can lend a minimum of € 470,000 to fund a project in exchange for US residency**. The projects that can be funded under the EB-5 have to be relevant in terms of future job creation and economic benefits. Hudson Yards has already raised € 560 Mln under the programme,

mostly from Chinese investors, and is expected to raise a similar amount also from other groups of foreigners in the near future.

**The remaining costs for development are being sustained by private firms.** In April 2013, the Related/Oxford joint venture obtained a millionaire construction loan from parties including Barry Sternlicht's Starwood Capital Group and luxury retailer Coach.

Considering that further development of the Hudson Yards will be carried out (until 2023), the overall cost of the project is set to be approximately € 20 Bln. The cost will be sustained by developers and repaid through property sales.

## Community & Citizen Focus

The whole Hudson Yards district has been designed in order to meet the needs of the citizens that are going to live and work in the area. Therefore, a school as well as several green areas, including the final extension of the iconic High-Lane have been included in the project. Moreover, via the EB-5 programme, it has been possible to involve foreign citizens in the direct financing of the project.

## Impact

One of the major impacts regarding the development of Hudson Yards is the economic benefit that it will bring to the whole city of New York. It will generate 23,000 jobs and will have long-term effects on the employment levels in the city. Moreover, large corporations including L'Oreal, Coach and SAP have already agreed to move their headquarters to the area. Hudson Yards is also set to become the third-largest business district in the USA, after Midtown Manhattan and the Chicago Loop.

A core element in the development of Hudson Yards has been the attention to **sustainability and environmental impacts**. As previously mention, 10 Hudson Yards and 30 Hudson Yards are going to be the most energy efficient buildings in the whole city. It has been calculated that an **improvement of 20% in energy efficiency** compared to the NYS Energy code will be achieved. Thanks to the smart grid infrastructure, it will also be possible to cut unnecessary light **consumption by 50%**. Water efficiency will be also be achieved with **a reduction of 30%** in domestic water use. Finally, 75% of construction waste will be recycled. The development of a new school as well as the enhancement of the public transport system are set to have high social impacts for those living in the area.



## The solution in context: Smart City – New York

### **About the smart city vision in the city**

**New York is one of the most committed cities** in the United States in relation to the Smart City paradigm. The strategy was developed 2011 to 2013. A core aspect in the strategy is played by the attention to and **involvement of the latest ICT technologies**. The strategy was designed by **NYC Digital**, a public office from NY Municipality with the specific goal of exploiting technology in order to improve the lives of New Yorkers. An initial assessment of the city's needs as well as collection of data was carried out especially in relation to education, parking, digital tools as well as demographic indicators.

Residents have also been widely engaged, with approximately 4,000 points distributed across the city in order to collect info, feedback and opinions from local residents. The study phase ended with the creation of a Digital Road Map that highlighted four key action areas: access, education, open government, engagement and industry for a total of 40 initiatives.

**Name of City** *New York*

**Country** *United States of America*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **2**  
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## Hyllie Sustainable District Malmö, Sweden

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Hyllie is a recently built district of the city of Malmö aiming at **being completely based on renewable energy by 2020**. The urban plan comprises 8,000 homes, and employment and supporting facilities.

The technological applications involved in the district management are based on advanced **IT solutions called DEMS** – decentralised energy management systems – developed by Siemens. The cooperation with E.ON also allowed the city to develop the smart grid element in the district, providing a demand response control system for electricity, heating and cooling (cogeneration or combined heat and power–CHP). Smart networks enable flexibility in the consumption chain and **optimize the use of renewable energies** thanks to control and monitoring: building contractors can install flow meters for the individual metering of hot tap water and heating. Demand is regulated so that energy is used when supply is high (e.g. on the basis of weather forecasts for solar and wind power): buildings are part of the energy distribution system itself.

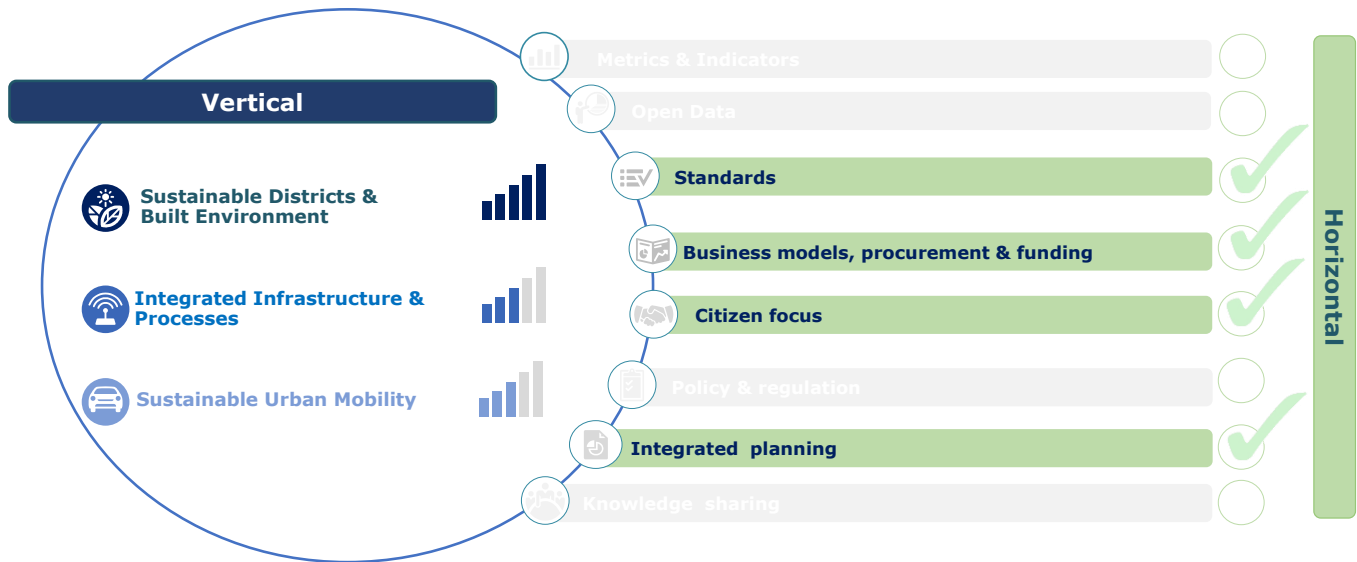
A **sustainable approach to waste management and recycling** is also a key cornerstone and is mainly provided by VA SYD; in particular Malmö introduced mandatory sorting of food waste that is used to make biogas for fueling buses and garbage trucks. The sustainable transport element is considered within the district thanks to easier walking, cycling and public transportation measures; moreover carpooling, will be present and electric car recharging stations, as well as biogas reservoirs, are envisaged.

<b>Starting year</b>	2011.
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 21 <sup>14</sup> Mln
<b>Number of impacted users</b>	Inhabitants of 8,000 houses and expected 9,000 employees (partially the same group of people)
<b>Link</b>	<a href="http://www.hyllie.com/in-english.aspx">http://www.hyllie.com/in-english.aspx</a>

<sup>14</sup> The conversion rate used for this case study is 1€=9,25SEK

## Level of integration

The solution can be considered as **integrating ICT infrastructure as well as Sustainable Districts & Built Environment and Sustainable Urban Mobility solutions**. The ICT component is represented by the above-mentioned DEMS system used for monitoring energy efficiency. Similarly, the waste management and recycling system represent the sustainable district component of the project. The presence of bike and walk paths as well as electric car recharging stations can be mostly related to sustainable urban mobility.



## Business case

The overall funding amount for the solution is € 21 Mln and is provided by **public and private entities**, covering public utility services infrastructure, construction of buildings, etc. The City of Malmö and the companies VA SYD and E.ON made the initial investment. They also signed a climate contract in February 2011, committing themselves to the foundation of the Hillye Sustainable district.

This has been complemented – within specific projects in the same city – through European Commission funds (€ 5.5 Mln) provided via public funding by the Swedish Energy Agency.

Although the different players involved in the provision of services, construction of buildings, infrastructure, etc. have different business cases, at a general level, the solution is based on revenues stemming from real estate (i.e. selling of residential space and commercial areas to private customers).

In the long run (2030), the new sustainable district in the city of Malmö will comprise 9,000 office workspaces and 9,000 residences supported by smart and innovative solutions (e-mobility, smart grid energy systems).

## Community & Citizen Focus

The planning of the district has mainly relied on the agreement between the city administration and private companies. This has given rise to some **criticism as to the effective involvement of citizens in its development**, but user needs have been taken as a central focus when **designing the urban plan** (e.g. facilitation of transport connections).

Moreover, together with the energy impact, social impacts on the quality of life of people living in the district and workers have shaped the plan.

In terms of technology, people are part of the final objective, which is to create new habits giving citizens the information they need to make the most sustainable energy consumption choice. They are not just considered energy consumers but also producers, and they are given the instrument to control and adjust their energy consumption in an automatic or a "human-based" manner.

## Impact

The whole point in the development of this district has been exactly to be climate neutral. Energy efficiency and renewables are a central focus.

Relocation of companies to environmentally certified premises is expected to **generate energy savings of 25%** with the final goal of being fully sustainable by 2020. Moreover, there are good impacts on work efficiency and productivity. The whole district is expected to generate 9,000 jobs.

Overall, the services provided in the district carry also relevant social impacts in the form of better access to city services and enhanced public transportation.



## The solution in context: Smart City – Malmö

### About the smart city vision in the city

The city of Malmö considers **sustainable development** as a driving force for its strategy. Environment is a focus which catalyzes different stakeholders' efforts under the guidance of the public authority. **By 2020, Malmö aims at being climate neutral, and by 2030 the city will be supplied with 100% renewable energy.**

Hyllie in particular is a testing and leading district where technological solutions will be implemented to serve as an example for the rest of the city.

Energy efficiency is a very important target in Sweden, where high per capita electricity consumption rates are generated by heating costs because of the cold climate. The country is currently using large electricity shares based on nuclear power and large hydroelectric plants. Malmö is leading the incorporation of renewables energy (solar, wind and biofuel) to become a leading example of sustainable city.

<b>Name of City</b>	<i>Malmö</i>
<b>Country</b>	<i>Sweden</i>
<b>No of Inhabitants</b>	<i>100,000 &lt; x &lt; 500,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Kalasatama Sustainable District Helsinki, Finland

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Smart Kalasatama is a Smart City district development project in Helsinki. It is a **model district of smart urban development as well as a living lab of new sustainable solutions in Helsinki**. It is an old harbour area of 175 hectares, in the immediate proximity of the city centre, which is being transformed into a residential and working district for more than 20,000 people.

The main goal is to **improve district level energy efficiency** while achieving CO<sub>2</sub> reductions, focusing on **holistic district planning and integration with the existing city structure**, as well as building materials, heating and ventilation systems, automation and smart energy networks, energy storage, and interaction with users. Integrated infrastructure plays a key role in developing Kalasatama: for example, there is the implementation of a smart grid that will be of global significance, as it will combine the latest technological innovations in energy, information and telecommunications and mobility (via an electric vehicle network).

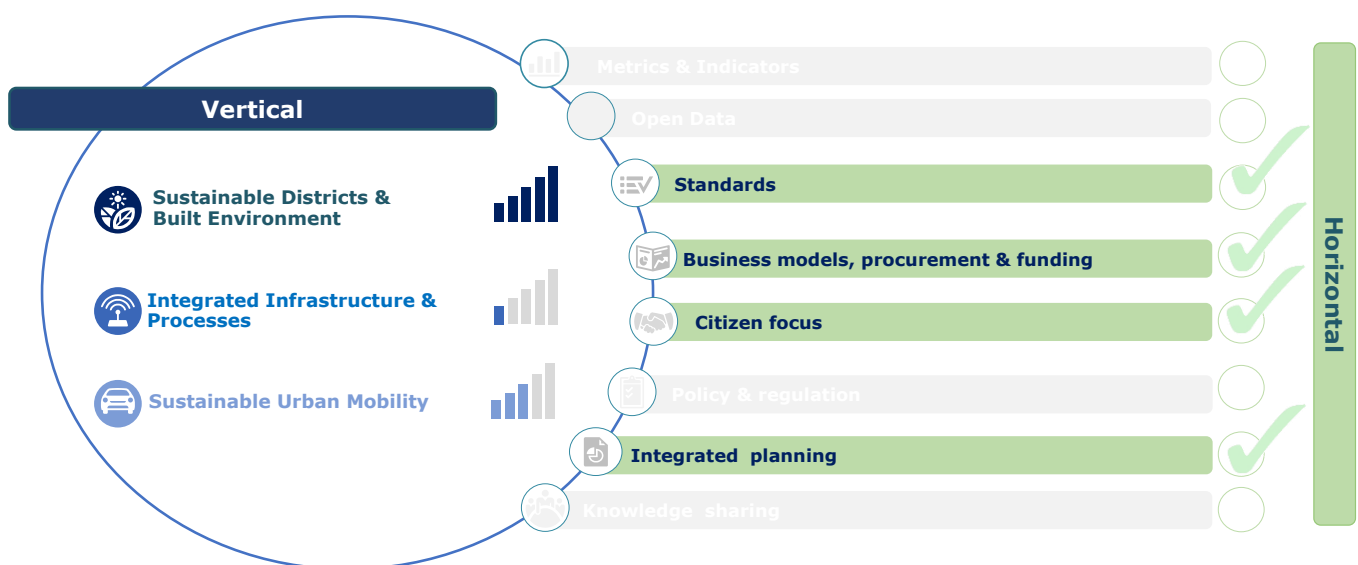
Likewise, sustainable urban mobility levels are pursued via proactive transport management with real-time follow-up of transport, creating new service infrastructure for citizen mobility.

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry
<b>Budget</b>	€ 900,000 (first 3 years)
<b>Number of impacted users</b>	Planned district population 20,000 inhabitants, 5,000-7,000 housing units
<b>Link</b>	<a href="http://en.uuttahelsinki.fi/kalasatama">http://en.uuttahelsinki.fi/kalasatama</a>

## Level of integration

The development of the Kalasatama district is carried out by ABB, Helsingin Energia, Fingrid and the City Planning Department. The project will create **sustainable, high efficiency electric power distribution and services based on modern communication, information and energy technologies**. The companies are deploying a wide range of different technological components, with the following objectives in mind (all in view of lowering electricity consumption and emissions):

- To ensure that any excess power generated from renewable energy sources in the district – including sources such as solar panels or wind turbines – can be fed into the market;
- To enable electric vehicles to draw electricity from the grid or feed it back in;
- To **store energy**;
- To **create easy-to-use services**;
- To provide **more flexibility** and **transparency in the distribution grid**.



## Business case

The project is part of a larger initiative of the City of Helsinki, which looks to reduce its environmental footprint with a focus on sustainable and efficient generation, transmission and distribution of power.

The ambition is to develop the new Kalasatama district into a **global benchmark for smart cities**. In terms of scale, the solution foresees the development of a smarter and more flexible urban grid that can integrate distributed and **renewable energy sources** and help people to realize their vision of **sustainable urban living**.

The consortium organisations involved envision a **smart grid based on industry-wide standards supporting a stable, secure, efficient and environmentally sustainable power system**. It will also accommodate customer demand response management systems that allow local producers and consumers to interact with the network operator and the energy market **to reduce peak loads** and **increase efficiency**.

Smart Kalasatama is coordinated by Forum Virium Helsinki. **The funding comes partly from the Six City Strategy – Open and smart services** (ERDF/Helsinki-Uusimaa Regional Council), which is **a joint strategy carried out by the largest six cities in Finland** (Helsinki, Espoo, Vantaa, Tampere, Oulu and Turku).

Part of the financing of the initiative comes from the City of Helsinki and also from the Ministry for Employment and Economy. From the private investors' perspective, the Kalasatama business is essentially being developed as a **real estate business**. SRV (the construction company) carries out the site deployment either as its own development or by managing the projects.

## Community & Citizen Focus

A very important aspect of the planning of Kalasatama district is to keep in touch with the future users and inhabitants, the citizens of Helsinki. In fact, the project, planned to retrofit energy, heat, water and other consumption metering, involves tenants and encourages them to participate in collecting, using and interpreting data of their (energy) consumption and their surrounding environment.

Smart Kalasatama grows from the collaboration between the city, companies and residents. The aim is to **inspire residents and create new business and innovations in the district**, for the benefit of the entire city and region. Companies and city planners are blending together their projects in an integrated mix; the ideas are being developed, tested and composed together with the inhabitants and those working in the area.

## Impact

Kalasatama district is expected to provide living space for 18,000 people and around 10,000 work places by the early 2030s, and the goal is to develop the new Kalasatama district into a global benchmark for smart cities, providing evidence that **a carbon-neutral energy system based on local renewable wind and solar energy can sustain ever expanding urban living**.

The project responds and faces the issues of climate change, traffic congestion and the lack of social activities. The objective of Helsingin Energia is to have a carbon dioxide neutral future by 2050.

In Kalasatama, the plan is to maintain a balance in the grid, using an energy storage facility of more than one megawatt. The storage facility will stabilize the main grid frequency, while **better balancing production and consumption peaks**, securing the local power grid, and offering reserve power during critical situations. The remotely controlled transformer station will shorten the duration of power failures by 90%, as the faulty location can be located and isolated quickly.

A closed medium-voltage ring network has been planned for the centre of Kalasatama. This guarantees uninterrupted power supply to critical areas even in the event of network failures. For consumers, ICT-based central management and controlled energy intelligence offers comfort and nearly **real-time information** about their **power consumption**. Information about **power** and **water consumption** helps consumers make the correct choices. Nearly simultaneous feedback allows residents to have an impact on their use of energy and water.



## The solution in context: Smart City – Helsinki

### About the smart city vision in the city

In Helsinki, environmental issues such as **efficient use of energy and reduction of carbon dioxide emissions** are considered to be extremely important. Environmental issues are crucial in the planning of new districts, and in further developing the public transport system.

In the forthcoming decades, Helsinki will expand faster than ever before, with the construction of a variety of apartments, offices, kindergartens, schools, parks, streets and recreation areas. The City of Helsinki aims to **build quality neighbourhoods** where people can enjoy both work and leisure. The next few decades will see the construction of a number of new districts along with the expansion of older neighbourhoods. The quality requirements for construction are strict, covering a number of ecological criteria, and these are also taken into account when planning new districts and buildings.

These large-scale construction projects will assist in the densification of Helsinki's urban structure, with the expanded public transportation system connecting the city's districts in an **eco-efficient way**. Helsinki is a clean and green city where nature is present even in the city centre, with parks constituting 36% of the land area. The city is taking measures to prepare for a possible rise in the sea level, and also for potential flooding, which may become more commonplace in the future.

**Name of City** Helsinki

**Country** Finland

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Lyon Smart Community Lyon, France

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Lyon smart city community demonstration project is part of Greater Lyon's broader aim: **becoming an international example of cleantech and a smarter, more sustainable city**. As part of this major multi-dimensional project to transform Lyon into a smart city, an urban redevelopment project is underway in the Confluence district of Lyon. The district is a sandbank nestled between rivers, and to coincide with the redevelopment, smart devices will be incorporated in the new urban infrastructure. The project, which includes homes, buildings and transport in an area of roughly 150 hectares, will involve the active adoption of solutions such as **solar power generation and establish management technologies for its effective use** under the theme of **"a sustainable city through renewable energy utilization and management systems."**

The Lyon Smart Community project includes four demonstration projects:

- A group of **positive-energy buildings**;
- A fleet of **electric vehicles for a car-sharing scheme**;
- An eco renovation project: installing **energy monitoring systems in homes**;
- The setting up a **Community Energy Management System (CMS)** to monitor energy use by the demonstration project as a whole.

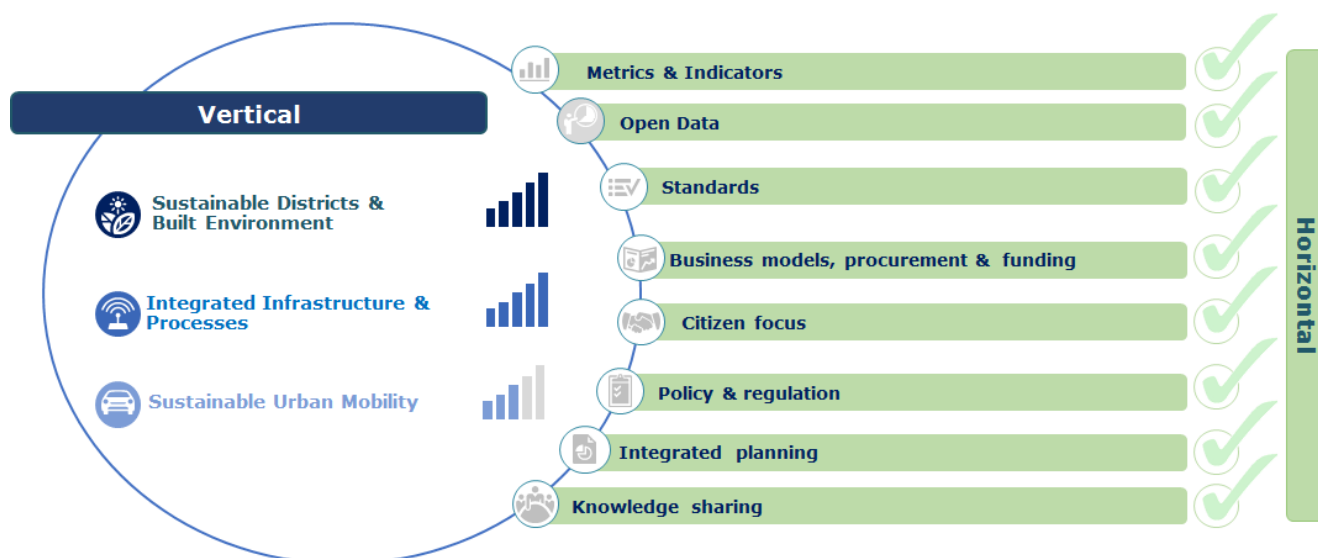
In 2011, the main actors behind the solution, Grand Lyon and NEDO, signed an agreement regarding the roll out of the project.

Between 2012 and 2016, the four demonstration projects were implemented in an experimentation phase, and later evaluated in a post-experimentation phase.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	€ 50 Mln funded by NEDO, and direct and indirect investments by public and private partners
<b>Number of impacted users</b>	Approx. 300,000
<b>Link</b>	<a href="http://www.economie.grandlyon.com/smart-city-lyon-metropole-intelligente-47.html">http://www.economie.grandlyon.com/smart-city-lyon-metropole-intelligente-47.html</a>

## Level of integration

Lyon Smart Community combines energy efficiency, multi-modal solutions and the fostering of individual responsibilities with the support of **ICT enabled data and insight management systems**. Based on the development of efficient ICT systems and data management strategies on both a micro and a macro level, the solution improves urban mobility and the built environment by creating better conditions for energy savings and CO<sub>2</sub> emission reductions.



## Business case

The main actors are Grand Lyon and NEDO, the New Energy and Industrial Technology Development Organisation of Japan. **NEDO** is a public agency that aims to **promote Japanese industry at national and international level**. Additionally, NEDO supports research and development as well as the dissemination of energy, environmental and industrial technologies. The partnership between Grand Lyon and NEDO is therefore based on an agreement made by one French local authority and one national Japanese authority. From NEDO's point of view, the aim is **to use the Lyon Confluence district as a "demonstration" to test new and emerging energy technologies in a European market**.

Grand Lyon serves as facilitator for the project, specifically by arranging local partnerships. Grand Lyon has an operational partner, SPL Confluence, that is in charge of the practical implementation, coordination and development of the four tasks within the Confluence district.

NEDO chose Toshiba as the main operational coordinator of the four tasks in terms of the choice of technology suppliers for each task. NEDO funds Toshiba to implement the projects.

An ecosystem of more than 30 partners has been established in order to implement the four projects. This ecosystem of organisations includes a whole range of entities, of various sizes and with diverse backgrounds and expertise. Over 22 French firms are involved in the project. Some, headed by Bouygues Immobilier, are working on the construction of a group of positive-energy buildings. Others, under Veolia-Transdev, are setting up the electric vehicle car-sharing scheme. Others are working with GRANDLYON HABITAT on eco-renovation of a residential development that will include an energy monitoring system for use by occupants, with ERDF to manage smart electricity grids, or with Toshiba Solutions to set up the CMS system that will host all the energy systems management resources.



So far, the project is reported to have **cost around € 1.2 Bln**<sup>15</sup>. This information is not backed by official sources, as the overall budget is not public information. The article claims that almost **€ 1 Bln of that has come from private sector investment**, which is crucial at a time when public purses are more restricted due to post-crisis-triggered austerity programmes. The biggest investor is NEDO, who has committed € 50 Mln into the project. Based on the official agreement, NEDO finances the project and should cover all the costs of the projects, including the supply of technologies. The funding from NEDO has mainly been used at the start of the project, where a lot of technological equipment was installed in the Confluence District. Grand Lyon has committed to the project in terms of **supporting and facilitating the implementation of the project**, but they are not contributing to the project funding. Instead, Grand Lyon contributes to human resources such as project managers, services at city level and legal support.

Feasibility studies have been carried out in Malaga in Spain and Manchester in the United Kingdom, where parts of the solution are being replicated. The actual solution will be scaled across other districts in Lyon and across a set of partner cities around Europe in a follow-up project funded by the **European Commission for € 24 Mln project**. Vienna and Munich (as well as Santiago de Compostela, Sofia, and Venice as follower cities and Kiev and Yokohama as observer cities) have joined Lyon as part of the "Smarter Together" project. Finally, from the beginning of the project the industry partners themselves (and, as interviewees pointed out, this includes industry partners of all sizes) have replicated their parts of the solution or have further developed products and services based on this pilot.

## Community & Citizen Focus

Lyon Smart Community is an attempt to bring together a broad mix of stakeholders: residents, businesses and retailers, as well as public, cultural and leisure facilities across a neighbourhood who work together to create an energy-positive area. The aim is **to inform citizens and businesses about the benefits of the new solutions** in a pragmatic way, by showing how the projects benefit them in both their everyday and working life.

In terms of public participation, a permanent consultation was established within the local network of inhabitants and associations. This served mainly to adapt planned developments, but also to create engagement with the project within the community. This **"participative democracy"** was based on a Grand Lyon participation charter that promotes transparency, dialogue and common decision-making.

15 <http://www.ibtimes.co.uk/lyon-smart-city-confluence-project-toshiba-nedo-523358>

## Impact

Feasibility studies for the Smart City Community project were completed in the fiscal year 2011, and for the demonstration project in 2015. The CMS System will be an important tool to evaluate each task.

The goals and expected impact of the Lyon Smart Community are:

- Achieve more than **20% energy efficiency improvement** over other low energy buildings;
- Achieve more than **80% of electrical vehicle** usage from PV generation;
- Achieve more than **10% energy savings** by engaging users with energy visualization systems;
- Achieve the **EU "20-20-20" policy** in the Lyon Confluence District 5 years ahead of time.

Impact assessments in relation to the goals mentioned above have not been carried out due to the very short time period. However, some impacts have been assessed in order to ascertain the efficiency of the solution, the scaling potential and the need for further integration into existing city services in the City of Lyon. The assessments are based on data and results collected in the first phase of implementation, the experimentation phase. In a longer-term perspective, and with the establishment of the CMS system, it will be possible to evaluate the environmental impact of the different intelligent solutions as a result of the integration of data from different domains (traffic, heating, energy etc.). Both Grand Lyon and Toshiba plan impact assessments of the four projects.





## The solution in context: Smart City – Lyon

### About the smart city vision in the city

Lyon is the second largest city in France, with a population of 1.5 Mln. The region is the second most attractive city for business in France, and 1,500 new companies are founded there each year. This illustrates the region's high level of business awareness and willingness to meet different needs from a business and innovation perspective. Furthermore, Lyon has one of the leading university campuses in France. The Smart City agenda of Lyon is well developed and recognised around the world. A decision to redevelop the city as a **"model city that can expect sustainable growth"** was made in 2005. Winning the WWF's support for the first time in Europe, ten kinds of action plans, including quantitative goals, were formulated, and are expected to be achieved. The specific goals include "increase both daytime and nighttime populations by 2025 to more than double the current figures" and **"completely eliminate CO<sub>2</sub> emissions,"** based on a number of smart projects. At the moment, around 40 smart city projects are implemented in the city area.

The idea of smart Lyon is built around 4 main drivers:

- Taking into account **environmental challenges and energy constraints**;
- **Main actors functioning as a network** (local authorities, citizens and businesses);
- Movement away **from ownership to usage**, including the participation of users in the design of products and services;
- **Inclusion of new technologies** (information and communication, robotics, intelligent transport systems etc) to facilitate working as a network, encourage changes in energy use and support and encourage behavioural change and usage patterns.

These four drivers are important growth areas for businesses, especially when put into practice cross sectorally. Beyond this, however, there is also a need to build new developmental models for the Greater Lyon area.

Greater Lyon provides local players with the infrastructure and conditions necessary to pursue projects showing great potential: superfast broadband, true-to-life testing, data access, user panels, personalized support for innovation pursuits (dedicated facilities, co-working spaces, business incubators, etc). The community weaves together an entire ecosystem around innovation (universities, laboratories) and sector strategies (such as cleantech and digital), innovation strategies, university strategies, start-up support platforms, and more.

<b>Name of City</b>	Lyon
<b>Country</b>	France
<b>No of Inhabitants</b>	100,000 < x < 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Mass retrofitting - Hackbridge Sutton Borough, Greater London, UK

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Hackbridge is a suburb located in the London Borough of Sutton, in the south-west part of the city. The area accounts for a population of approximately 8,000 people living in houses dating from the Victorian period as well as more recent times. The Sutton council has long been a pioneering entity in terms of sustainability, adopting an **Eco-Management and Audit Scheme** back in 1996, and with the BedZed village built in 2002, it remains the largest low-carbon development area in the UK.

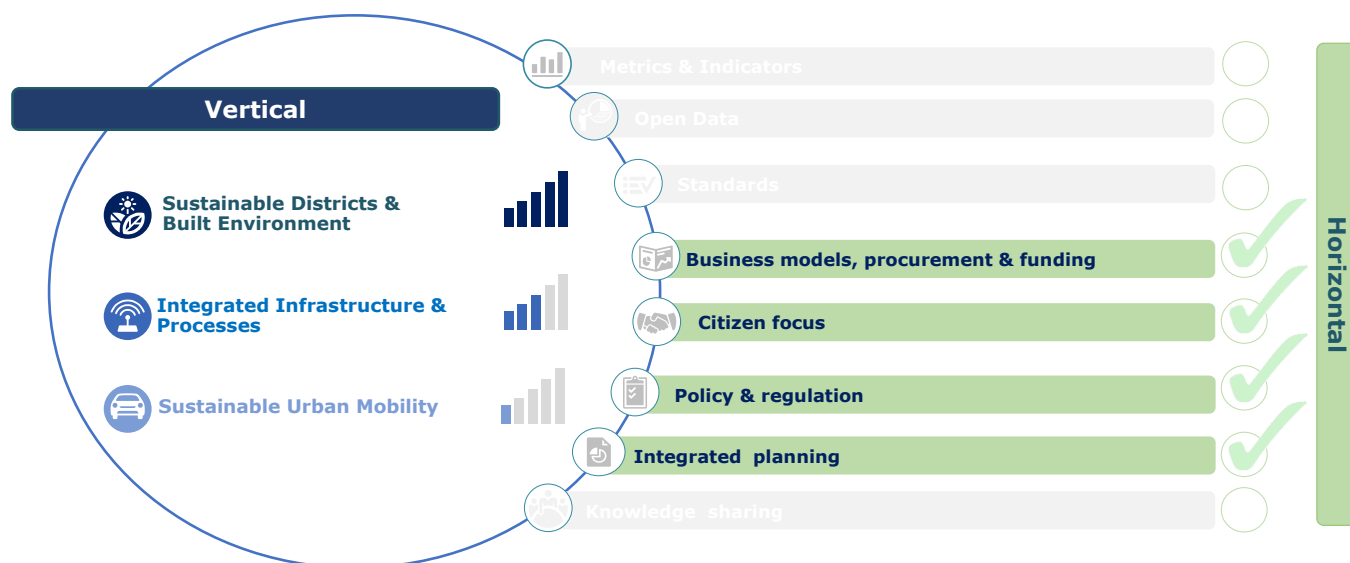
In 2005, the Sutton Council decided to turn Hackbridge in a pilot area for creating the first zero-carbon sustainable suburb in the UK by 2025. The initiative takes a point of departure from the environmental principles **"One Planet Living"** developed by the consultant firm BioRegional. The **"One Planet Living"** principles range from encouraging the promotion of zero-carbon emission buildings to sustainable transport and the use of sustainable materials. The core of the project is a mass retrofitting plan for several houses across the neighbourhood in order to reduce carbon emissions. The total area that is supposed to be affected by the project accounts for 19 hectares.

<b>Starting year</b>	2005
<b>Type of integrated solution</b>	Sustainable Districts
<b>Scaling or Replication</b>	Replication of a similar project has been completed in Stockholm with the Järva project between 2010-2014.
<b>Key actors / stakeholders</b>	Sutton Borough Council
<b>Budget</b>	€ 37.8 <sup>16</sup> Mln, financed by public and private funds.
<b>Number of impacted users</b>	Approx. 8,000 people living in Hackbridge area
<b>Link</b>	<a href="http://www.energyforlondon.org/mass-retrofitting-of-a-low-carbon-zone">http://www.energyforlondon.org/mass-retrofitting-of-a-low-carbon-zone</a>

<sup>16</sup> The conversion rate used for this case study is 1€=1,099 £

## Level of integration

The whole development project in the Hackbridge area is **an integrated solution combining environmentally friendly buildings with sustainable urban mobility and ICT infrastructure**. The environmental aspects of the solution are mostly related to the **mass retrofitting plan** of several houses in the district, which aims at **reducing energy consumption and CO<sub>2</sub> emissions**. In order to provide a higher quality of life in the area, ICT tools have also been deployed in buildings, along with the introduction of **E-government, E-health and E-learning** services in the district. Moreover, the plan includes the development of pedestrian and cycling routes of high standards and the improvement of the public transport system.



## Business case

The main actor involved in the project is the Sutton Borough Council. In order to assess the competences and stages in the project, the Council– with the help from the Government’s Advisory Team for Large Applications (ATLAS) – developed a CHARTER that highlights how the Council will work with developers, the community as well as other parties involved.

The costs for implementing the retrofitting solutions can be divided into costs for basic measures, accounting for an average of close to € 1,000, plus an average of € 15,000 for more complex measures requiring professional installation by qualified personnel per household. The total cost for implementing the measures in the area is estimated to be around € 40 Mln. The type of funding options include a mix of public and private investments. The bodies involved include the Greater London Authority Growth Fund and the European Union with “life + funding.” Partnership agreements should mainly involve energy companies.

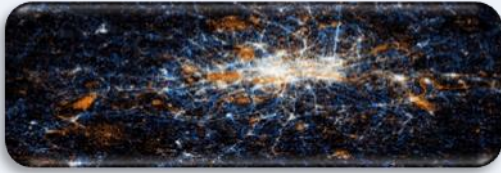
The solution does not include any specific place limitations. **It can be applied to similar urban context characterized by old and energy inefficient buildings**, which are typical of many cities across the European continent. An example is represented by the Järva project realised in Stockholm. Similarly to London’s Hackbridge initiative, the project realised in Sweden targeted the mass retrofitting of some buildings in the Järva area along with the creation of cycling and pedestrian paths.

## Community & Citizen Focus

**Citizens** in the area are **deeply involved** in the planning process. A group of local residents has been included in the production of a first draft of the Neighbourhood Plan for Hackbridge. In addition, a public consultation concerning the Hackbridge Masterplan was carried out since the beginning of the project, with documents and copies of the plan distributed among residents. The whole community of Sutton appears to be largely in favour of the project (90% of the participants) to make Hackbridge the UK’s first greenest suburb.

## Impact

**Hackbridge is expected to be the UK's first fully sustainable suburb by 2025.** The goal will be achieved by focusing primarily on retrofitting households in order to significantly **reduce CO<sub>2</sub> emissions**. It is estimated that the solution will lead to a **56% reduction in energy consumption** and **51.2% less CO<sub>2</sub> emissions** compared to 1990 levels. In addition, the project includes several other integrated solutions in order to tackle the problem from different angles. A new and more efficient transport infrastructure is planned, with priority being given to cycling and pedestrian routes as well as to the public transportation system. More ICT complementary solutions ranging from intelligent building to E-health will be included as well.



## The solution in context: Smart City – London

### **About the smart city vision in the city**

**London** is one of the **major hotspots in Europe and in the world in terms of innovation and ability to adapt to changes and new challenges**. The city is a leading place worldwide for the introduction of new technologies in different fields. London Datastore receives 25,000 visit each month with more than 450 transport apps created from it, making the city an important centre for open data. Sustainable mobility is achieved in different ways, including: **congestion charging** using recognition via number plates, an **intelligent road network management system** and the possibility to use credit or debit cards to pay for public transport.

The citizens of London are also deeply involved in the **policy making process with the Talk London community** created by the Greater London Authority. The aim of the initiative is to use technology and data to stimulate citizen participation in decisions through online discussions, polls or surveys. The involvement of the municipality for making the city grow smart also encompasses fields like energy and utilities, health and safety.

**Name of City** *London*

**Country** *United Kingdom*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
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## Nordhavnen Smart District Copenhagen, Denmark

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Nordhavnen is Scandinavia's largest (200 hectare) sustainable urban area under construction. It is a harbour redevelopment that will consist of housing, shops, cultural institutions, sports facilities and state-of-the-art recreational areas. To make Nordhavnen a model for future smart cities, it will feature **integrated solutions in transportation, renewable energy and data collection** as a basis for a generation of **new smart city services**.

A **sustainable multimodal transportation loop** is planned, consisting of super bike paths, super bus routes and the metro system connecting Nordhavnen to the rest of Copenhagen. Additionally, a lot of the construction work is on the basis of contracts with requirements (BGNP) that reflect sustainability in economic, social and environmental terms.

Nordhavnen also features an EnergyLab, a full-scale lab for tests and demonstrations of how to integrate electricity, heating, energy efficient buildings and electric transport in an **intelligent energy system** to improve the city's ambitious policy goals. The EnergyLab was launched in April 2015. The aim is to **test energy efficient and sustainable solutions in terms of large-scale scalability and replicability**, and to gather important data to demonstrate and compare the smartness of the different aspects of the solution.

The goal is to integrate sustainability into the entire construction of the area. Smart solutions are a vital part of the vision. The area is to be developed over a long period, with a completion date set for 2040.

Following a development plan from 2009 based on a concept competition, the project kicked off at the end of 2011.

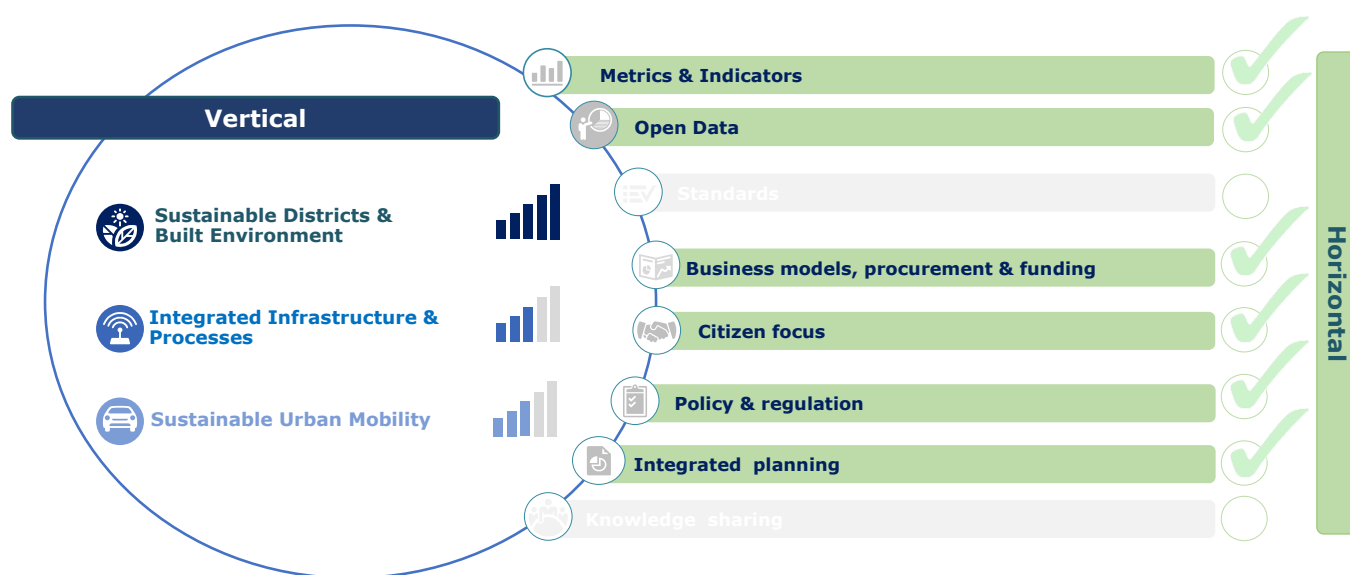
<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Sustainable Districts
<b>Scaling or Replication</b>	No, still in its first phase of implementation
<b>Key actors / stakeholders</b>	Public Authority
<b>Budget</b>	€ 60-65 Mln for the development of the area of Aarhusgade and Sundmolen
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://www.nordhavnen.dk/">http://www.nordhavnen.dk/</a>



## Level of integration

Nordhavnen is an experimentation ground for **integrated smart solutions**. The solution combines the development of city planning, built environment and efficient and eco-friendly transportation systems. There is a specific emphasis on the **optimal integration of clean-tech solutions** in Nordhavnen in the sectors of **water, air, waste and advanced materials** related to the future scarcity of resources. Another emphasis is on **data driven business models**.

Access to public data on transportation, energy consumption, water conditions and other information is a vital cornerstone to the vision of Nordhavnen. The establishment of the EnergyLab makes it possible to collect data via smart meters and sensors with the aim of **improving energy infrastructure and efficiency**. The Technical University of Denmark (DTU) is the actor responsible for data collection and analysis.



## Business case

The general Nordhavn project is a **public driven project** carried out by CPH City and Port Development in collaboration with the City of Copenhagen and a number of consultants. CPH City and Port Development is **owned by City of Copenhagen (95%)** and the **Danish Government (5%)**. The companies COBE, SLETH, Rambøll and Polyform are responsible for the actual architectural and engineering aspects of the construction of Nordhavn. The companies were found through a Concept Competition in 2008, where 180 competition proposals were submitted from around the world. Furthermore, in terms of **electricity, heating and water**, partnerships have been made with HOFOR and the local utility companies in order to **invest in more sustainable systems**.

EnergyLab Nordhavn is based on a shared partnership between the following private companies, public sector actors and research institutions: the Danish Technical University (DTU), City of Copenhagen, CPH City and Port Development, HOFOR, DONG Energy, Balslev, ABB, Clean Charge, METRO THERM, Glen Dimplex and PowerLab.

The cost of developing the areas of Aarhusgade and Sundmolen is **€ 60-65 Mln**. Additionally, private companies are constructing their own buildings, for which the budget is unknown. EnergyLab Nordhavn has a budget on € 17 Mln and is supported by the Danish EUDP Programme. 54.5% of the new metro station in Nordhavnen is funded by the City of Copenhagen, and the remaining 45.5% comes from the Danish state.

Showing that large-scale sustainable urban development is actually fundable, achievable and economical should inspire many cities around the globe to pursue similar developments. Indeed, the project is already receiving a lot of attention from actors all over the world. However, the project has not yet been

replicated. According to the main actors from Nordhavn, this is due to the phase the project is currently in (as it is still in the first phase of implementation).

## Community & Citizen Focus

A very important aspect of the planning of Nordhavnen was to keep in touch with the future users and inhabitants, the citizens of Copenhagen. This strong emphasis on **integrating people's views and opinions** from the project's outset will make Nordhavnen more sustainable. The aim is to create a **living city** that people from the surrounding area will visit and want to be a part of.

Copenhagen Cleantech Cluster established an innovation platform in October 2011 to help determine how a common digital infrastructure can be developed to enable solutions for smart cities. Knowledge institutions, potential clients of building projects and companies – across all industries – are invited to participate with ideas on content to help shape the blueprint for a digital infrastructure.

Several meetings are held with landlords, commercial tenants and residents to update them on the process and to include the users of the area in the city development.

Furthermore, business partners and communities have been an integral part of the project since it began in 2008. An open international concept competition was held in 2008 for the development of Nordhavnen. The aim was to invite people and business to have a say in the development of the city. The winners of the concept competition were a consortium consisting of COBE, SLETH and Rambøll, in collaboration with Polyform.

## Impact

The project is still in its implementation phase, which means that the impact of the solution is difficult to measure. The project is based on a **master plan that reflects the Nordhavn area** but by experience that can easily be changed to adapt for new buildings and new public transport stations. That makes it even more difficult to measure the impact of the solution because the project is always evolving in scale and depth.

Nordhavnen is expected to be **a prime example of how emerging city-areas can integrate sustainability into every cornerstone of its construction**. The goal is to create a **large urban development with zero emissions**. Zero emissions will be achieved by focusing resources on developing intelligent transport systems, renewable energy sources, data collection and educating inhabitants on reducing energy consumption.

With the EnergyLab centered in Nordhavnen, the area also has the potential to become an international hub for research into all aspects of intelligent energy systems. With both research and actual sustainable urban development being brought together in one place, the expectation is to make Nordhavnen a full-scale showroom for sustainability of various kinds.



## The solution in context: Smart City – Copenhagen

### About the smart city vision in the city

Copenhagen is home to numerous projects that showcase the idea of the sustainable city of the future. These projects set new standards for sustainable development in the 21<sup>st</sup> century. State-of-the art technology and know-how will be used to **create sustainable solutions** with the potential for global impact. Efforts are being made to work with international partners in the development and implementation of these projects, which will help to achieve **Copenhagen's vision to become the world's first CO<sub>2</sub> neutral capital.**

Copenhagen City has a vision of developing and designing the city to meet the needs and requirements of its inhabitants. These needs and requirements will be based on an extensive collection of data. The vision is to collect data on a variety of topics like traffic, garbage bins, parking lots, pollution etc. This data will enable realtime solutions i.e. redirecting traffic, sending garbage trucks to pick-up bins that are actually full, text messages informing citizens of available parking spaces and so on. This data will be publicly available for all to use. This also adds another layer of accountability to the political process.

**Name of City** Copenhagen

**Country** Denmark

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **15**  
Global Cities Index – Bloomberg (2014): **43**  
The Economist – City Competitiveness rankings (2013): **15**

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## Smart Buildings - Pudong New Area Shanghai, People's Republic of China

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Pudong New Area is in eastern Shanghai and at the eastern edge of the Yangtze River Delta. The smart and intelligent buildings project was initiated in 2012 and is a key deliverable of Pudong New Area's smart city strategy. The project comprises an **area-level energy consumption monitoring platform**. The platform collects, stores, processes and analyses the energy consumption data of office and public buildings and provides accurate data for statistics and audit. The project includes the whole of Pudong New Area, which is 1,210.41 km<sup>2</sup> with a resident population of 5.154 Mln.

Currently, the platform captures the energy consumption data from 150 buildings, and by the end of the **"Twelfth Five Year Plan,"** the platform will collect energy consumption data from most of Pudong's large public buildings (approx. 500 buildings). By the end of China's "Thirteenth Five Year Plan," the platform will capture and monitor energy consumption data from all buildings in Pudong.

**The platform operates in real-time.** Building energy consumption monitoring data is collected by a sub-metering terminal. It is then transmitted to the sub-platform, and then to the municipal platform. Through this transmission process, the consistency of data is secured. Information such as data comparisons, energy consumption composition analysis, transmission status, energy consumption (and rankings) by different divisions/companies within the building are available. This enables the building management/occupants to understand the characteristics, trends and changes in energy consumption.

The data is analysed by the Pudong Public Building Energy-saving & Environmental Protection Technology Corporation Ltd. In June 2014, this company, in cooperation with the Shanghai Public Security Bureau, introduced the use of **contract energy management services for public institutions**. The company has developed practical solutions to evaluate and improve the effect of energy savings and emission reduction from the buildings. For example, the energy consumption trend reveals the power utilisation for each building by day and night, and highlights areas where there is scope for energy savings e.g. lighting retrofit or installation of intelligent air conditioning control systems. The monitoring system also **enables the users to save more energy through the integration of solar energy, wind power and other renewable energy technologies** (solar photovoltaic power generation system and solar hot water system) and transformation to LED lighting

**Starting year** 2012

**Type of integrated solution** Sustainable districts

**Scaling & Replication** Yes

**Key actors / stakeholders** Public Authority

**Budget** Approx. € 4 Bln (2009-2013)

**Number of impacted users** N.a.

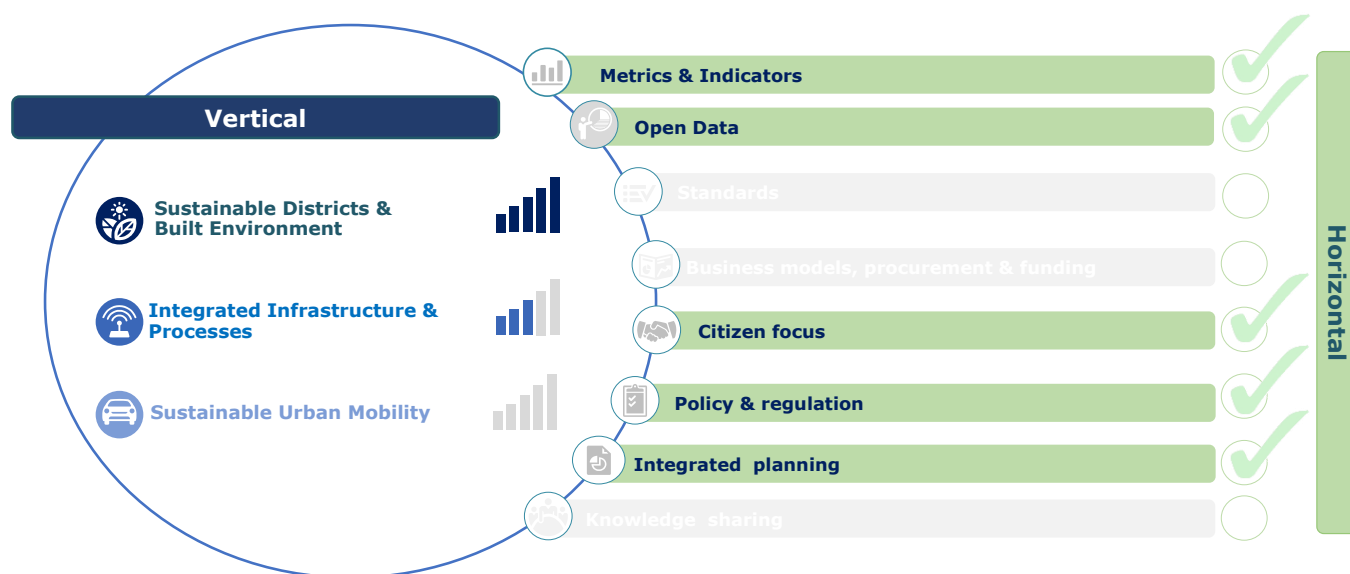
**Link** <http://english.pudong.gov.cn/html/pden/portal/index/index.htm>

## Level of integration

The Pudong New Area integrates aspects from both the **integrated infrastructure process and sustainable districts**.

The monitoring system enables building owners/occupants to **save more energy through the integration of solar energy, wind power and other renewable energy technologies**.

Building owners/occupants are provided with extensive information, such as energy consumption trends, enabling them to take action to make energy savings.



## Business case

The Pudong development is a real estate business case and **the revenues will be the result of the selling activities (housing and commercial) to private and public entities**.

Investments in the Pudong New Area Smart City **Construction projects are both government-led – funded through the national budget – and market-based**. From the public side, the funding is part of a “special fund for energy saving and emission reduction” administered by the Construction and Transportation Commission and the municipal government’s departmental budget. The private investments are based on investors’ own capital and bank loans.

Approximately € 4 Bln were planned for a 3-year investment according to the Three-Year Action Plan for Smart Pudong (2009–2013), with approximately 10% coming from government investment and 90% from private investment (social investment funds).

The government supports private investments through the provision of procurement services, subsidies and other means. When projects have distinct market characteristics and good predictability of earnings, the public party is generally involved to encourage the development of a sustainable development model.

## Community & Citizen Focus

The citizens and community have some involvement in the development of smart city solutions in the Pudong New Area. For example:

- The city has implemented an initiative called **“My advice for the Smart City”** and other activities to encourage people to contribute their ideas to the development of smart city solutions;
- A museum and experience centre has been built to showcase smart city solutions for the citizens of Pudong New Area;

- Public perception surveys are conducted to evaluate the effectiveness of smart city solutions.

However, with respect to **the smart and intelligent buildings project**, this service is mainly driven by the government, with very limited public participation.

## Impact

The smart and intelligent buildings project has **reduced energy consumption and pollution emission rates** and has brought tangible benefits to the public by continuing to promote a **low-carbon** and **sustainable urban transformation**.

According to the *2014 Energy consumption monitoring report of the government offices and public buildings in Shanghai*, published by the government, the average energy consumption of office buildings has reduced from 91.7kWh/(m<sup>2</sup>·a) in 2013 to 82.5kWh/(m<sup>2</sup>·a) in 2014 (i.e. a reduction of 10%).



## The solution in context: Smart City – Pudong New Area, Shanghai

### **About the smart city vision in the city**

Shanghai is located at the estuary of the Yangtze River and is the largest Chinese city by population. It is also one of the four direct-controlled municipalities of the People's Republic of China, with a population of more than 24 Mln as of 2013. It is a **global financial centre** and a **transport hub** with the world's busiest container port.

Pudong New Area's GDP reached € 86 Bln in 2012; the electronic information and software information service sectors represent € 39 Bln and € 25.4 Bln respectively.

In 2009, the Pudong New Area proposed the development of a smart city and the iPudong2015 action plan was developed. The objective of the smart city strategy is to improve the public well-being and city operating efficiency with **"Smart Leads Model Changes"** by promoting digital, networked, intelligent, interactive, integrated and open IT applications in social development, national economy, urban management and public services.

The core mission of iPudong2015 is summarised in the *3935 Campaign*, which entails the building of a moderately **advanced infrastructure system** (three plans), **enhancing the efficient application demonstration system** (nine projects), **establishing a solid smart industrial system** (three tasks), and **developing the environment and security system** (five measures).

The implementation of Pudong New Area's smart city vision has meant **that urban planning has transitioned from one with a single aim to one that focuses on urban safety, traffic management and environmental protection.**

The city has implemented the following Smart Cities and Communities solutions that have had a positive impact on the well-being of its citizens:

- **Investment in ICT infrastructure:** Pudong has invested in its broadband infrastructure (fixed, wireless and converged networks). The city has many Wi-Fi hotspots and high speed mobile broadband is widely available. Cellular affordability (in terms of tariffs) is one of the most competitive in leading cities (Ericsson's Networked City, 2014); fixed broadband tariffs are above average.
- **Improving the safety of the city:** The city is developing a platform for food safety; building intelligent fire control platforms and an early-warning system for disasters; establishing a security video resource-sharing system and enhancing the utilisation efficiency of the city's security video resources.
- **Intelligent transportation:** The city is improving information sharing and exchange; developing an intelligent transportation framework based on road transportation, with public transit as the core; increasing the coverage of its Electronic Toll Control (ETC) system to speed up traffic flow; providing the general public, transportation carriers and government departments with comprehensive information services.
- **Smart medical care:** The Pudong New Area has implemented a national electronic health records system, established self-help medical services including self-registration, self-charging and self-report printing in the East Hospital, Nanhui Central Hospital (these services will be rolled out to tier II and III hospitals and community health centers in Pudong).
- **Improved government services:** An integrated information E-government platform has been developed, which has reduced the approval of 123 services from a statutory 22 working days to an average of 8.4 working days.



**Name of City** Pudong New Area, Shanghai

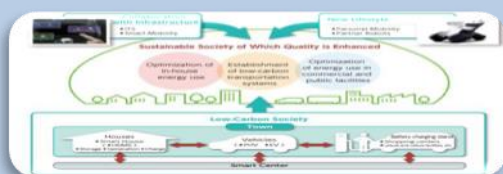
**Country** People's Republic of China

**No of Inhabitants** > 500,000

**Smart City Rankings** UN Habitat – City Prosperity Index (2012): **21**  
Global Cities Index – Bloomberg (2014): **38**  
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<https://upload.wikimedia.org>
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## Smart Melit (Smart Mobility & Energy Life) Toyota, Japan

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Toyota City is a major city in Japan, and home of the largest plant of Toyota Motors Corporation, the Tsutsumi plant. **Smart Melit** (Smart Mobility & Energy Life in Toyota City) is a **smart city experimental project** developed in Toyota City. This experimental project was promoted by METI with the intention to develop a low-carbon society and ensure that people and vehicles coexist better in the same place and in harmony.

The project aims at **achieving a low-carbon society by reducing energy use in residential, commercial and public buildings**, and by **facilitating sustainable urban mobility**. A central role is played by the Toyota Smart Center, which includes solutions for households, mobility and energy storage. In terms of energy use in households, the project focuses on envisioning the future of the home environment, especially in relation to the introduction of renewable energy and energy-saving and storage devices.

In terms of sustainable urban mobility, the project foresees the introduction of a **next-generation of low-carbon vehicles directly impacting citizens' lifestyle**. The initiatives are all part of the major Toyota City vision, based on the encouragement and engagement of citizens in their own carbon-reduction activities.

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, academia, transport operators
<b>Budget</b>	€ 168 <sup>17</sup> Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://jscp.nepc.or.jp/en/toyota/index.shtml">http://jscp.nepc.or.jp/en/toyota/index.shtml</a>

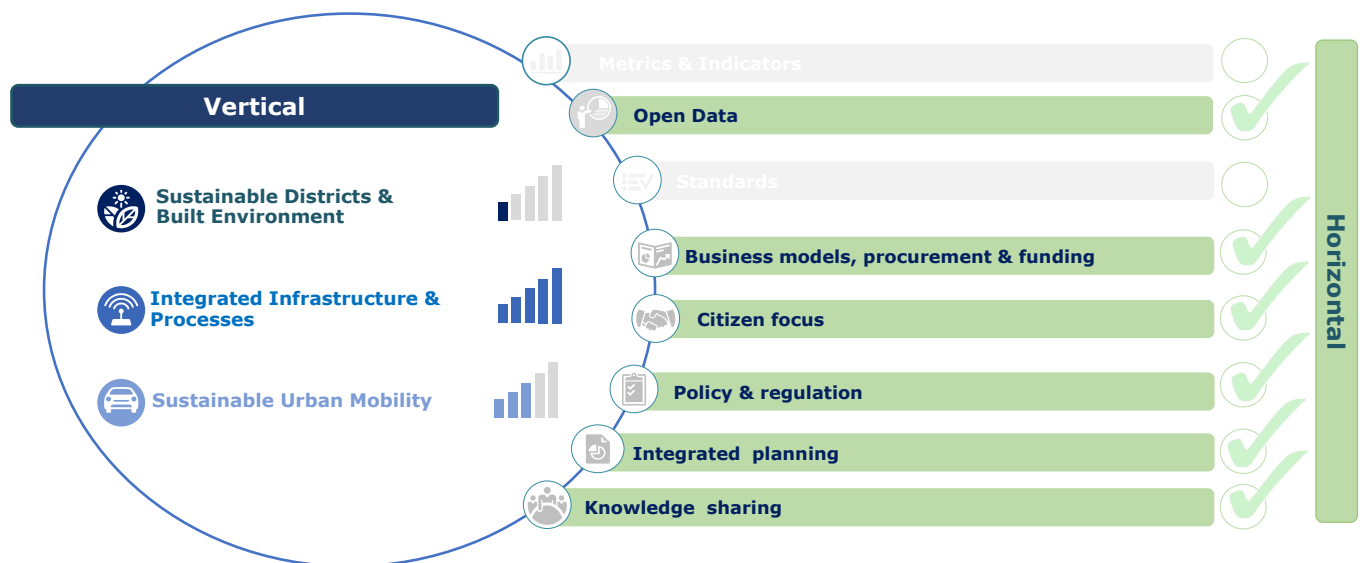
<sup>17</sup> The conversion rate used for this case study is 1€=133 YEN

## Level of integration

The Smart Melit solution integration relies on a smart center, which manages energy consumption and production, as well as traffic at the city level. Big data is collected by vehicle and transport management systems, as well as an energy data management system (VDMS, TDMS, and EDMS). These compose the Toyota Smart Center, which includes solutions for households, mobility and energy storage:

- **Building and home energy management systems** (BEMS & HEMS);
- An **energy data management system** (EDMS) that collects data and gives guidance on how to consume less energy;
- **Monitoring and feedback systems** in the households (tablets, information screen on energy prices, etc);
- A **traffic and vehicle data management system** (TDMS, VDMS) that collects data;
- An **Intelligent Transportation System** that uses the collected data from the TDMS to give guidance on car sharing and on on-demand public transport, parking and driving options to avoid congestion and increase traffic flow;
- **Battery charging stations for electric**, plug-in hybrid and fuel cell vehicles;
- Distributed **green energy production systems** (photovoltaic panels, biomass, and recycled heat);
- **Energy storage systems** that make it possible to use green energy produced by households in electric vehicle batteries

Furthermore, the solution integrates incentives **aiming at raising awareness amongst citizens** on how to consume energy in a smarter way, providing support for action and enabling to control energy usage through terminal services at each individual home. This makes it possible to offer a ready-to-use, individual menu of low-carbon activities adapted for the living environment.



## Business case

The project consortium involves 50 organizations, the main partners being the Japanese Ministry of Economy, Trade and Industry, Toyota City and Toyota Motor Corporation (Toyota Motor Corporation, SHARP, TOSHIBA, etc.).

The budget for the project is ¥ 21.8 Bln (€ 168 Mln). The share is 60% public funds (by the Ministry of Economy, Trade and Industry) and 40% private financing (by each entity of the Council). Most of the money raised is to be devoted to research and development activities.

The main purpose of the exercise is to test technologies, standards, integrated solutions and eventually develop them into assets that can be either sold outside Japan or integrated in other solutions that would be further developed.

Smart Melit is expected to be replicated in a mountainous area, where other primary sector industries are situated.

## Community & Citizen Focus

Smart Melit's strategy is built around the **engagement of citizens** to actively change their behaviour related to **energy consumption and transportation**. With the ITS, which comprises the Harmonious Mobility Network transportation support system (Ha:mo) and the Traffic Data Management System, citizens have the opportunity to enjoy **real-time public transport information**, and to be informed about available parking spots and available electric vehicles for car-sharing. They are **empowered to drive in an eco-friendly way**, avoid traffic congestions and use environmentally friendly transport solutions, such as on-demand bus services and car sharing. The Smart City solution enables them to **track and control the energy consumption in their households**. Hence, by providing information on consumption patterns and energy prices, the project is able to raise awareness on energy efficiency among the general public.

By making the economic benefits visible, users are guided to adjust their day-to-day activities according to the electricity supply and demand conditions of the region. Ultimately, this empowers the consumers to monitor their consumption and, as a consequence, not only reduces their carbon footprint but also increases their satisfaction. The active involvement of citizens is encouraged by a number of **gamification aspects included in the PHV charging system**. Points accumulated by charging (distributed according to amount and location) can be used in a computer game that is for the families to enjoy.

In Smart Melit, devices feature power transfer patterns, which allows citizens to benefit from a low-carbon lifestyle without much additional effort.

## Impact

The project has conducted tests on the solutions for households, mobility and energy storage. Energy management has addressed the following measures:

- **Building and home energy management systems** (BEMS & HEMS);
- An **energy data management system** (EDMS) that collects data and gives guidance on how to consume less energy.

The test has involved 227 detached houses, including 67 newly constructed smart houses located in two areas within the limits of the city. This has been the first demonstration case in Japan from which data has been collected during the everyday life of citizens (from September 2011 to March 2015). Results have been the following:

- At home, data shows an **average reduction by 49.1% of CO<sub>2</sub> emissions**, and in the most eco-conscious households, this reaches 64.9% (optimization of the energy by HEMS and FC controller)
- In addition to this, **an additional 4% in emission cuts** by the has been reported for whole verification area

Moreover, energy efficiency improvement through BEMS/HEMS and Energy Cost reduction through a multi-tariff model were also achieved. Price notifications to customers raise awareness on when it is cheaper to use energy from the grid.

The measure has also involved an Intelligent Transportation System that uses the data collected from the TDMS (traffic and vehicle data management system) to give guidance on car sharing and on on-demand public transport, parking and driving options to avoid congestion and increase traffic flow. Results have included a 180kg of CO<sub>2</sub>/year/person cut by TDMS (CO<sub>2</sub> comes from private vehicle).

## The solution in context: Smart City – Toyota



### About the smart city vision in the city

The headquarters and production plants of Toyota Motor Corporation, generally known to be a **“company castle town,”** shape Toyota City. It is also due to Toyota Motor Corporation that the city focuses on transportation and mobility issues for its smart city solutions. It is a model city for the electric vehicle and plug-in hybrid vehicle (EV and PHV) industry. Toyota city also pilots **next generation vehicles and transport systems**, ultimately working towards accomplishing a **low-carbon society**. The city develops a variety of different demonstration projects focusing on **sustainable transport**, such as a plug-in **hybrid car-sharing system**, and a **solar power-based charging infrastructure for electric vehicles**.

Furthermore, Toyota City is also experimenting **home energy management systems** and **demand-response programs for energy consumption**, the development of wired and wireless broadband networks and intelligent environments using sensors for real-time information processing and alerts, the development of **e-services for the business community** of each district, and training services for the involvement of end-users, businesses, and organizations in e-content development and social media use.”

<b>Name of City</b>	Toyota-city
<b>Country</b>	Japan
<b>No of Inhabitants</b>	100,000 > x > 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Stockholm Royal Seaport Stockholm, Sweden

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The **Stockholm Royal Seaport** – formerly a brownfield industrial and port site – has been designed to become a **renovated waterfront urban district with a strong focus on sustainability**. When completed in 2030, it is expected to provide approximately 12,000 new apartments and 35,000 additional workspaces. The design phase was carried out in 2008-2009, building on experience already achieved by the city through a similar project called "**Hammarby Sjöstad**," while construction work started in 2010 and first homes have already been occupied as of 2012.

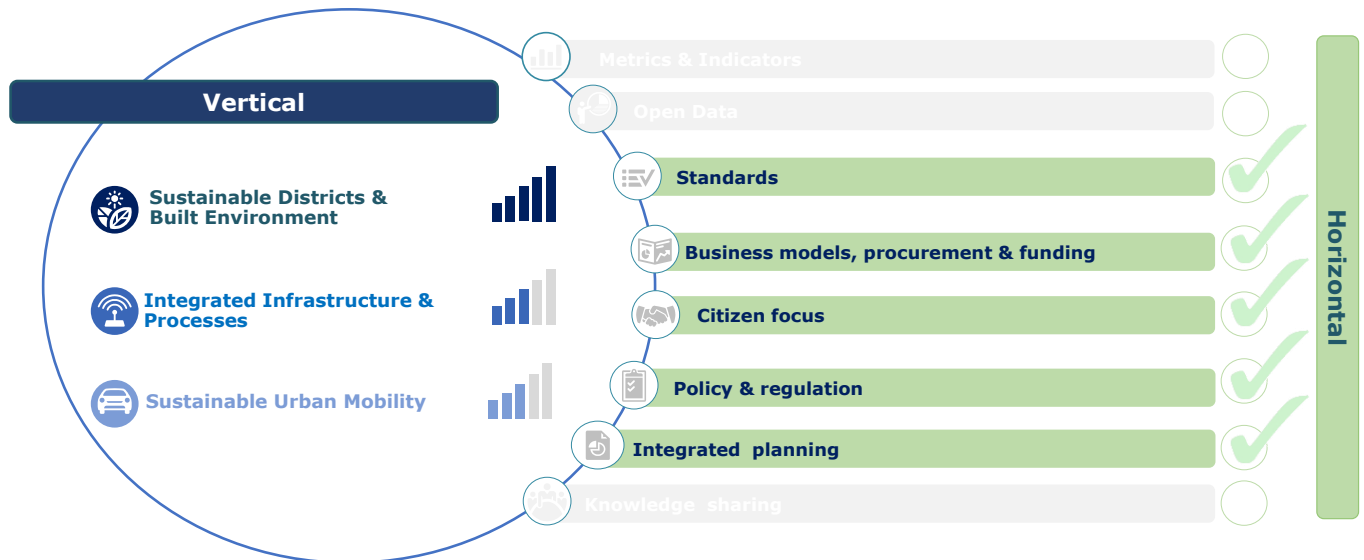
In addition to new homes and workplaces, the port's operations will be modernised and concentrated on the piers, while container and oil handling will be moved out. All neighbourhood development is also being adapted accordingly to the prognosis for future sea-level rise, and integration of different components is proving to be the solution to effectively manage environmental targets.

<b>Starting year</b>	2008-2009
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	Around € 13.6 <sup>18</sup> Mln city infrastructural investment
<b>Number of impacted users</b>	By the end of implementation phase, 12,000 new houses and 35,000 new workplaces
<b>Link</b>	<a href="http://www.stockholmroyalseaport.com/en/">http://www.stockholmroyalseaport.com/en/</a>

<sup>18</sup> The conversion rate used for this case study is 1€=9,25SEK

## Level of integration

The Royal Seaport is a **fully integrated solution across mobility, the built environment and integrated infrastructure**. More specifically, the neighbourhood will provide public transport in the form of subway, biogas-powered buses, tram and boat buses. It includes a closed loop integrated **waste management system** and Leadership in Energy and Environmental Design (LEED)-certified<sup>19</sup> buildings. Furthermore, the area is prepared for a future **smart grid electrical system** and also represents an investment and showcase to market Swedish solutions for sustainable development. Additionally, an ICT infrastructure will also help managing port activities in an efficient and sustainable way.



## Business case

The City of Stockholm has **invested approximately € 13.6 Mln in the project**. Most of this has gone towards cleaning polluted soil, compensating affected stakeholders in the area, and public infrastructure. Any land to be built up was owned by the City of Stockholm; desirable lots were then sold to private developers on the condition that developments would comply with the tight environmental targets.

In order to finance the project, **the City of Stockholm sold the land to private developers at a very high price**. Developers are now selling apartments at a high price. The downside is that this limits lower-income residents from investing in the area, thereby reducing the diversity of its inhabitants. However, there is also the plan to open the district to young couples and the elderly by offering high quality social services.

Given the quality of the land, no further financing incentives were needed to attract private developer interest. The developers are covering their costs by selling the apartments and lending spaces to businesses.

Furthermore, a pilot smart grid system is being installed under a **new model of collaboration between the private sector, academia, and local government**. This joint venture was additionally sponsored by the **Swedish Energy Agency** and the **Swedish Governmental Agency for Innovation Systems**. Today, the district is already home to financial institutions such as Nasdaq OMX, and aims to host even more financial service industries, becoming a reference hub for finance in Sweden. These industries, together with high-tech businesses, will also benefit from close collaboration with Stockholm's main universities and research institutes, many of them involved in the innovation enhancement of the integrated solution.

The solution is one of Europe's largest redevelopment areas and it presents some similarities, in terms of infrastructure, with projects currently under construction in Sweden and other countries. A direct example is represented by Stockholm's Hammarby Sjöstad and Copenhagen's Nordhavnen.

<sup>19</sup> <http://www.usgbc.org/leed>

## Community & Citizen Focus

The Royal Seaport initiative does not originate as a general community-driven project, but as **a solution initiated by the city itself**, building on previous similar experiences, in particular the Hammarby Sjöstad built environment project, which is characterized by smaller dimensions and has mainly a residential focus. In spite of this, **the specific business community has been constantly and strongly involved in the design phase of the project**, and businesses – mainly of the construction, financial and high-tech sectors (i.e. Fortum, Ericsson, ABB, Electrolux, HEBA, NCC, Envac AB and others) – still represent the main partners in the implementation of the integrated solution.

In order to overcome the lack of initial general community involvement, the town's management team is now working intensively on communication and dissemination of the sustainability profile of the whole project, directed towards prospective residents and businesses.

Furthermore, a number of key organisations are playing an important role in guiding the innovation-related aspects of the solution, among which are the Swedish Royal Institute of Technology (KTH), the Interactive Institute of Swedish ICT, Business Sweden (formerly the Swedish Trade Council), as well as also the Clinton Climate Initiative.

## Impact

After only six years since its inception and when the first development work began, the Royal Seaport has contributed to the achievement of the city's target of lowering CO<sub>2</sub> levels in 2015 to 3 tonnes per person (-30%). Furthermore, still moving in this direction, **the planned bio-fuel combined heat and power plant of the Royal Seaport will generate 10% of the city's overall electricity needs and 25% of its district heating requirements**, also contributing to reaching the targeted emission reduction levels.

Its environmental targets include lowering carbon dioxide emissions to below 1.5 tonnes per person by 2020 (compared to Stockholm's registered average of 4.5 tonnes per person in 2008). By 2030, the target is for Stockholm Royal Seaport residents to be completely fossil fuel free. An additional goal is also to limit water consumption to 100 lt per day. Through this solution, **district heating, sewage treatment, biogas production, and waste management are being linked into an integrated system, which is contributing to closing the loop on resources**. The area carries also relevant economic interests from large companies, especially in the financial sector. Therefore, the solution will have an important impact that could potentially benefit the whole of Stockholm's economic system. Finally, through its environmental focus, the creation of the Royal Seaport also makes it possible to further strengthen the already significant ecological orientation of the city's inhabitants.





## The solution in context: Smart City – Stockholm

### **About the smart city vision in the city**

Stockholm has been the first city to be awarded **European Green Capital** by the European Commission in 2010. Within its smart city strategy, information technologies are used extensively throughout the city's infrastructure with **the purpose of creating a prosperous ecosystem that involves citizens, private industry and the public sector, while fostering the local economy.**

The overall city strategy is citizen-centric, focusing on providing **enhanced e-government services** to Stockholm's inhabitants. Government services include online City Hall services and services for mobility and energy improvement based on real-time data collection about traffic and weather. The data is collected through GPS devices placed on public vehicles, as well as traffic and weather sensors, pollution monitoring equipment, etc. In this way, residents have **real-time information about traffic flow, journey times, and best travel options, including a journey planner.**

For the smart cities market, the city finds good two-way communication with private stakeholders especially important. The City is also using pilot projects to **test technology solutions**, but using a different approach to most of the counterpart smart cities: it uses **large scale, real environment test beds**. An example (aside from the Royal Seaport) of a pilot project that has scaled up into a true integrated smart city solution, is the **Kista Science City**, Sweden's world-class ICT cluster, where research and technology transfer take place between businesses and high-tech academia

**Name of City** *Stockholm*

**Country** *Sweden*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **5**  
Global Cities Index – Bloomberg (2014): **33**  
The Economist – City Competitiveness rankings (2013): **8**

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## Växjö - Fossil Fuel Free City Växjö, Sweden

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Växjö is a city in southern Sweden that wants to become free from fossil fuels, and in so doing, to play a role in the global climate change struggle. In 1996, the politicians in Växjö unanimously set out the long-term vision of a fossil fuel free city, deciding that Växjö should become this by 2030 at the latest.

The goal covers the entire geographical area, meaning that **all inhabitants, companies, NGOs and public authorities have to contribute**. The vision is to create a city where energy consumption does not lead to any climate change. **Växjö's strategy for a change to a fossil fuel free community comprises a combination of changed behaviour, energy efficiency, and transition to renewable energy in heating, power and transport**. To achieve these goals, the project includes instruments that address energy efficiency, heating and transport.

The City of Växjö works with different kinds of **renewable fuels for the transport sector** and, since 2013, all the buses are fuelled by locally produced biogas. There are plenty of ethanol fuel stations, one biogas station, and the infrastructure for charging electric vehicles is one of the best in south Sweden.

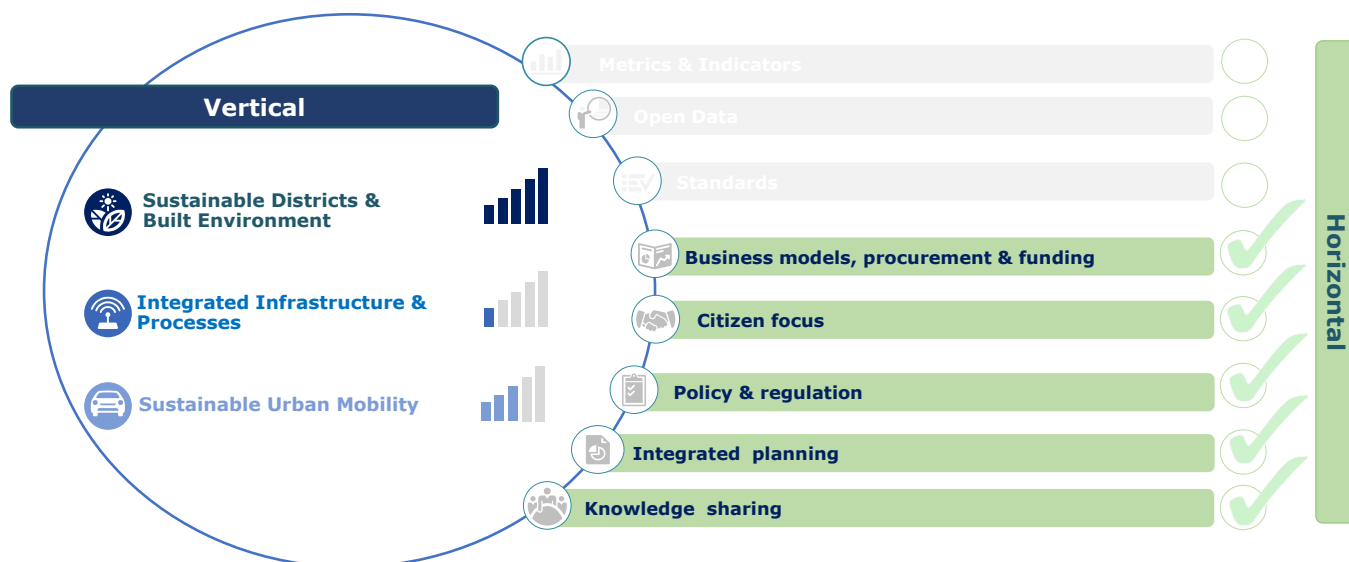
Another key issue for Växjö is to make public transport and cycling more attractive. New cycle paths and investments in public transport have contributed to an increase of sustainable travel patterns.

The municipally owned housing companies are striving to make their building stock more and more energy efficient, both when building new houses and when renovating old ones. Some of these investments have received financing from the EU (FP6-Concerto and FP7-Smart Cities).

<b>Starting year</b>	1996
<b>Type of integrated solution</b>	Sustainable Districts
<b>Scaling or Replication</b>	No
<b>Key actors / stakeholders</b>	Public Authority, Industry, University
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	The entire city
<b>Link</b>	<a href="http://www.vaxjo.se/english">http://www.vaxjo.se/english</a>

## Level of integration

The programme integrates **sustainable urban mobility components, the built environment and energy consumption** through several initiatives that build an alternative to the use of fossil fuels. The infrastructure becomes more efficient and sustainable by introducing incentives to invest in energy efficient solutions.



## Business case

Fossil Fuel Free Växjö is a programme including cooperation between the municipality, Linnaeus University, companies, and NGOs. The Fossil Fuel Free Växjö programme was worked out through intensive dialogue with local NGOs, companies, the university and citizens. The Mayor and Vice Mayor of Växjö have taken the lead and full responsibility for the project, giving it a very high status both within the municipal administration and in society as a whole. **To ensure environmental improvement and efficient work, the key actors use a management system to follow-up the targets in the Environmental Programme.**

Three success factors of the programme are identified by the key stakeholders. First of all, all political parties agree that environmental issues, especially those concerning climate change, are very important. Political commitment and unity are therefore key factors in implementing the initiatives. Växjö was one of the first cities to sign the Covenant of Mayors. Additionally, the broad cooperation between NGOs, companies, the university and the citizens has been of major importance. Växjö has managed to receive funds for many of the actions carried out under its fossil free programme. Some of these funds have come from the national government, and others from the European Union.

Since Fossil Fuel Free Växjö is a programme covering everyone and everything within the geographical borders of Växjö, and it is constantly supplemented with new actions, it is not possible to define a budget or total cost for it. Therefore it is also difficult to say the total amount or share of national and international contribution, except for some specific projects. Some actions are carried out solely by private actors, while other actions are carried out by public actors (with or without national or international co-funding).

The city has received a lot of foreign visitors who want to learn and be inspired by the overall vision and initiatives. Växjö is a good example of how to deal with ambitious and sustainable visions. In February 2007, Växjö received the Sustainable Energy for Europe Award within an energy campaign run by the European Commission. The reason for this was that the concept of Fossil Fuel Free Växjö could be replicated on any other European city. **The replicability potential is of a high level, but it also depends on having a strong commitment and a shared vision.** Also, many cities in and outside Sweden have the same, or similar, climate policies, but that does not necessarily mean that the goals will be fulfilled as in Växjö.

## Community & Citizen Focus

First of all, citizens and communities benefit from the programme in terms of **improved knowledge about their own energy consumption and overall behavior.**

Second, citizens played a key role in setting the ambitious goals of the Fossil Fuel Free Växjö programme. The initiatives were agreed upon through a series of **roundtables** involving politicians and stakeholders but most notably citizens. As a result, the influence of citizens and local community groups is a vital part of local decision making relating to clean energy.

By engaging the community, Växjö City Council has helped to ensure that clean energy has become part of the mainstream within their community. The partnership approach of the City Council has led to increased cooperation in the entire community for CO<sub>2</sub> reduction activities. For example the association called "Sustainable Småland" is very important when it comes to the involvement of the business sector.

## Impact

The City has got on very well in terms of using renewable energy sources. In 2014, **60% of the energy consumption was based on renewable energy sources such as biomass, hydro power, geothermal and solar energy.** In the residential sector, the use of renewable energy is 85%, and the public sector and industrial sector are well over 70%.

In the transport sector, there is still a lot to be done, but thanks to biofuels being blended into the gasoline and diesel, and the increased use of biofuels in the public transport and by many transport companies, **15% of the energy in the transport sector was based on renewable sources.** During 2015 and for the future, trends indicate an increase of renewable energy sources, both for heating, power and transports.

One of the expected goals of the programme was to reduce fossil carbon dioxide emissions per inhabitant by at least 65% by the year 2020 and by 100% by the year 2030 compared to 1993. **Since 1993, the emissions of fossil carbon dioxide have been reduced by 48% per inhabitant.** Within the public and commercial sector, the emissions have been reduced by 75%, in the residential sector by 81% and in the industrial sector by 86%. This is primarily due to a massive increase in the use of biomass for district heating and the extension of the district heating grid. In the transport sector, emissions decreased by 17% per inhabitant between 1993 and 2014.

In general, it can prove difficult to measure the economic impact of the Fossil Fuel Free Växjö programme. The economic savings could be a combined result of less energy and new fuel. But it can be shown that the economic growth and CO<sub>2</sub> emissions have decoupled from each other. **The economic development did in no way suffer from the shift to biomass-based energy.**



## The solution in context: Smart City – Växjö

### About the smart city vision in the city

Many of the negative effects of climate change today affect more “exposed” areas, including parts of Sweden. The average temperature in Sweden has risen more than the world average and the rise in the winter is higher than in the summer. The increase of rain and snowfall may lead to more floods and a rise of the sea level also affects the Swedish coasts. More frequent Autumn and Winter storms may lead to continuous consequences for the forestry.

Based on these negative forecasts, **the Environmental Programme for the City of Växjö is an overall strategy taking responsibility in terms of reducing the effects of climate change.** The Environmental Programme is composed by three main initiatives:

- Living Life, focussed on consumption and refuse issues;
- Our Nature, focussed on water and nature conservation issues;
- Fossil fuel free Växjö, i.e. the initiative mentioned in this section.

In light of this, the City of Växjö is one of the **frontrunners of the sustainable agenda** in Europe. In 2000, Växjö won the international environmental award for excellent atmospheric protection and in 2007 it was awarded the Sustainable Energy Europe Award by the European Commission.

<b>Name of City</b>	Växjö
<b>Country</b>	Sweden
<b>No of Inhabitants</b>	< 100,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Waterfront Toronto, Canada

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2001, the Governments of Canada and Ontario and the City of Toronto came together in a historic collaboration to harness the full potential of Toronto's waterfront. Each level of government committed \$ 500 Mln (€ 336 Mln) and development control of their waterfront lands to establish a new agency – Waterfront Toronto – with a mandate to build a sustainable and integrated waterfront for the people of Toronto, Ontario and Canada.

**The project is one of the largest integrated infrastructure projects in North America and one of the largest waterfront redevelopment initiatives undertaken in the world.** Waterfront Toronto is delivering a leading edge city-building model that seeks to place the town as a leader among cities globally in the 21st century.

A central aim of the waterfront revitalization is **to create solid infrastructure** that could bring economic and social benefits to the whole city. Following this approach, several innovative solutions have been implemented focusing especially on: **sustainable development, excellence in urban design, real estate development, and advanced technology infrastructure.** Among these ICT-enabled innovations, there is the creation on the waterfront of Canada's first open-access, ultra-high speed broadband network, offering industry-leading internet connection speeds for a capped fee and neighbourhood-wide Wi-Fi access. Moreover, in partnership with IBM Canada and Element Blue LLC, a powerful cloud-based community platform has been established in order to use data to support smarter decision making for waterfront residents and businesses including: decisions on daily commute, energy and water consumption or health.

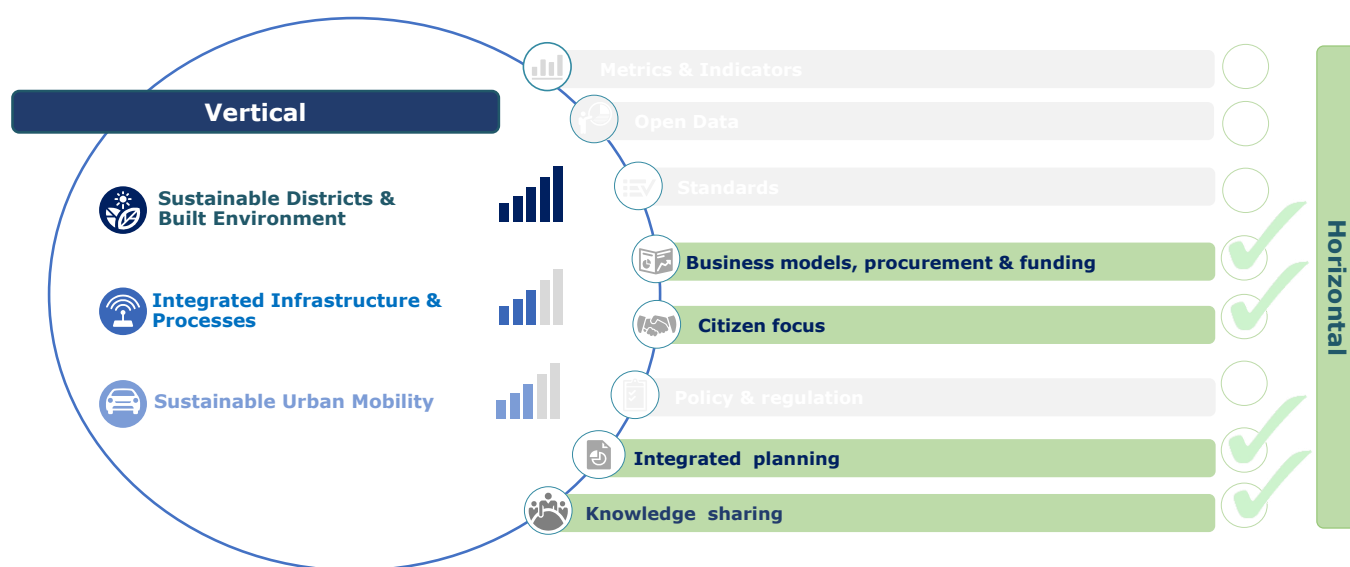
<b>Starting year</b>	2001
<b>Type of integrated solution</b>	Sustainable districts
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry.
<b>Budget</b>	Approx. € 1.2 <sup>20</sup> Bn
<b>Number of impacted users</b>	Approx. 40,000
<b>Link</b>	<a href="http://www.waterfronttoronto.ca/">http://www.waterfronttoronto.ca/</a>

<sup>20</sup> The conversion rate used for this case study is 1€=1,5 CAN \$



## Level of integration

**Waterfront Toronto is a highly integrated solution.** Concerning urban mobility, the area benefits from dedicated pedestrian and bike developments, as well as general traffic and mobility plans. A state-of-the-art signal system (IBM developed) that gives transit priority to electric streetcars and at the same time allows cars to move better, has been deployed. Regarding sustainable district and the built environment, **Minimum Green Building Requirements (MGBR)** were developed to help achieve this objective. The requirements mandate high performance buildings, smart technologies, and passive design, building upon the Canada Green Building Council's LEED rating system. Waterfront Toronto requires a minimum of LEED Gold level under the MGBR. Finally, in terms of ICT infrastructure, Canada has set up its first open-access, ultra-high-speed broadband community network. Through this, **residents and businesses have the ability to choose from a variety of content and service providers for Internet, IPTV (Internet Protocol Television), VOIP (Voice Over Internet Protocol), safety and security systems, using also a dedicated community platform.**



## Business case

The three orders of **government pledged \$ 1.5 Bln (€ 1 Bln)** as seed capital to help catalyze waterfront revitalization. By April 2015, 91% of the original \$ 1.5 Bln in government funding has been fully invested in waterfront revitalization.

The Agency's remaining programme will be funded by the City of Toronto and the Province of Ontario. Although the funding coming from the various levels of government be fully utilized, the Agency continues to engage and report to its tri-government partners, keeping them informed on the implementation progress of all projects in accordance with the established policies and processes. The current forecasts for the total support of the waterfront revitalization include **\$ 1.5 Bln (€ 1 Bln) in government seed funding, \$ 79 Mln (€ 53 Mln) in additional government supported investments, and approximately \$ 321 Mln (€ 216 Mln) in revenue that has already been generated by Waterfront Toronto, for a total of \$ 1.9 Bln (€ 1.2 Bln) in capital investment.**

In 2015-2016 the total government funding is estimated to make up 54% of the Agency's total estimated revenue and the balance of 46% will come from Waterfront Toronto generated revenue (potential sources of revenues include: traffic tolling, cruise ship terminal concessions, and development charges). Consequently, the Corporation will increase its reliance on Waterfront Toronto generated revenue compared to 2014-2015, when an estimated 80% of the Corporation's total revenue was contributed by governments and only 20% came from generated revenue. The increased current reliance on Waterfront Toronto generated revenue to balance the budget escalates the potential exposure to market variables for the Corporation. As anticipated, **with less reliance on government contributions and to ensure financial sustainability, the Agency will be required to start shifting its business model to one with an increased dependence on business development and revenue opportunities.**

In consideration of this, the managing body's business model is now predicated on the ability to phase development in order to allow land sale revenues to pay for incremental infrastructure investments required to remediate and service lands for development. This business model always assumed a borrowing requirement, since the cash generated from the land sale transactions is typically realized only after the infrastructure is completed and these land sales are the sources of reinvestment in the waterfront.

The Agency, now beyond the mid-point of its legislative mandate, is currently evolving its governance model as a prerequisite to the delivery of the remainder of the mandate and objectives set out by governments in legislation. In order to deliver on the tri-government mandate, the Agency is currently in discussions with the three orders of government and is seeking tri-government consent to establish an operating line of credit and the ability to encumber its assets to manage future anticipated working capital shortfalls.

Regarding the replication potential of the solution, **most guiding principles of Waterfront Toronto can be applicable in other large-cities and countries, where unused large city areas may be enhanced following similar integrated and technological-driven approaches.** There are numerous examples of other waterfront revitalization projects around the world, but few of them reach comparable levels of cross integration

## Community & Citizen Focus

Waterfront Toronto is committed to **effective two-way communication with the public.** Responsible decision-making requires considering the input received from public consultations in the context of other factors such as budgetary constraints, and ultimately make decisions that are in line with the initiative's strategic direction as mandated by the Government of Canada, the Government of Ontario and the City of Toronto.

When Waterfront Toronto is considering a project of significant public interest, it identifies and notifies interested parties in a timely manner through public notice, and provides individuals and groups with sufficient information so that they can meaningfully consider the project. At the same time, the managing body provides an opportunity for interested parties to make their views known. The process and structure of consultation varies depending on the project.

**In addition to consulting with the general public, Waterfront Toronto also consults with case-by-case interested and affected stakeholders.** For most of the specific implementation projects, a **Stakeholder Advisory Committee (SAC)** is established to provide an ongoing forum for advice, feedback and guidance at key points during the planning and urban design process. In general, SACs are comprised of representatives from interested and affected stakeholders and organizations as well as those with specific expertise related to the project. Typically, membership includes representatives for the community through neighborhood associations, condominium boards and/or residents at large; representatives for business through business improvement associations and/or trade associations; and representatives from special interest groups such as cycling associations, environmental groups, and heritage and cultural associations. SACs provide a valuable role by:

- **Acting as a sounding board** to share and discuss findings;
- **Providing guidance**, critiques and suggestions on proposed approaches, concepts and materials;
- **Providing a sense of the broader community's reactions;**
- Providing a **forum** for two-way communication

## Impact

Between **April 2001** and **March 2015**, Waterfront Toronto invested about **\$ 1.5 Bln (€ 1 Bln)** for pre-construction planning and implementation of revitalization projects, either directly or through arrangements for infrastructure investment by other public sector agencies. By 2013, the total investment had generated **\$ 3.2 Bln (€ 2.1 Bln)** in economic output for the Canadian economy and 16,200 full time years of employment. In addition, it has resulted in revenues of **\$ 348 Mln (€ 233 Mln) to the federal government, \$ 237 Mln (€ 160 Mln) to the provincial government, and \$ 36 Mln (€ 24 Mln) to the City of Toronto.**

With regards to environmental impacts, several projections have been made. A **CO<sub>2</sub> reduction of 29% has been estimated for the area.** Energy and transport account for the greatest share of carbon reduction, followed by landfilled waste, materials and potable water use. Additionally, at least **50% of waste from construction or demolition projects has been diverted from landfill with a future planned target of 75%.** Water conservation is also considered as a key pillar for the whole waterfront strategy. A reduction by approximately 40% in potable water use for indoor flow and flush equipment is planned. Moreover, 100% of water used for landscape installations must come from non-potable sources.

Relevant social impacts are also included in the solution. New trails and promenades have been created in the area in order to enhance the access to the waterfront, affordable housing (minimum of 20% of residential units plus 5% included as low-end-of-market units) has been or is planned to be built.



## The solution in context: Smart City - Toronto

### About the smart city vision in the city

Toronto has both the assets and the liabilities that come with being Canada's largest city, and in June 2014 the Intelligent Community Forum named Toronto **Intelligent Community of the Year** at its international annual awards in New York City. Major carriers offer high-quality broadband to 100% of residents, and its five major universities and multiple colleges have attracted 400,000 students and helped ensure that Toronto has more residents with undergraduate degrees than London, UK.

Several other projects and solutions besides the Waterfront are currently underway or have been completed across the city, especially in relation to public-private collaborations through which the city is pursuing an ICT-powered future. An example is represented by the **MaRS Discovery District**, which provides several services from housing to incubation, acceleration and investment services to start-ups. Similarly, the Ryerson University Digital Media Zone gives entrepreneurs space and services to translate ideas into initial commercial success. The Centre for **Social Innovation** does the same for social innovators and its successful model has led to operations across four locations in two countries.

**Name of City** Toronto

**Country** Canada

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): 3  
Global Cities Index – Bloomberg (2014): n.a.  
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# ***Smart technologies for the built environment***



## Bigbelly Smart City Waste Management Philadelphia, U.S.

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Bigbelly offers an **enterprise approach to smart and connected waste management**. In fact, the Bigbelly compactors are solar-powered and tackle the issues of waste concentration and efficient deployment of staff for its street collection. The bins are designed with a built-in compactor, which, once litter is thrown away, **compresses the waste to allow up to eight times the amount of litter to be accommodated prior to emptying**. This in itself **reduces the frequency of collections of each bin**.

In addition, the solution is also fitted with technology to reduce unnecessary collection journeys to half empty units: each Bigbelly Solar Compactor is fitted with the **CLEAN** (Collection Logistics Efficiency And Notification) **software solution**. When the bins are full, a sensor sends a signal across the inbuilt wireless system to the waste department for notification that collection is imminent, so managers can optimize collection routes in real-time. The Wi-Fi system simply sends an e-mail or SMS message to the department and the collection workforce is deployed into action.

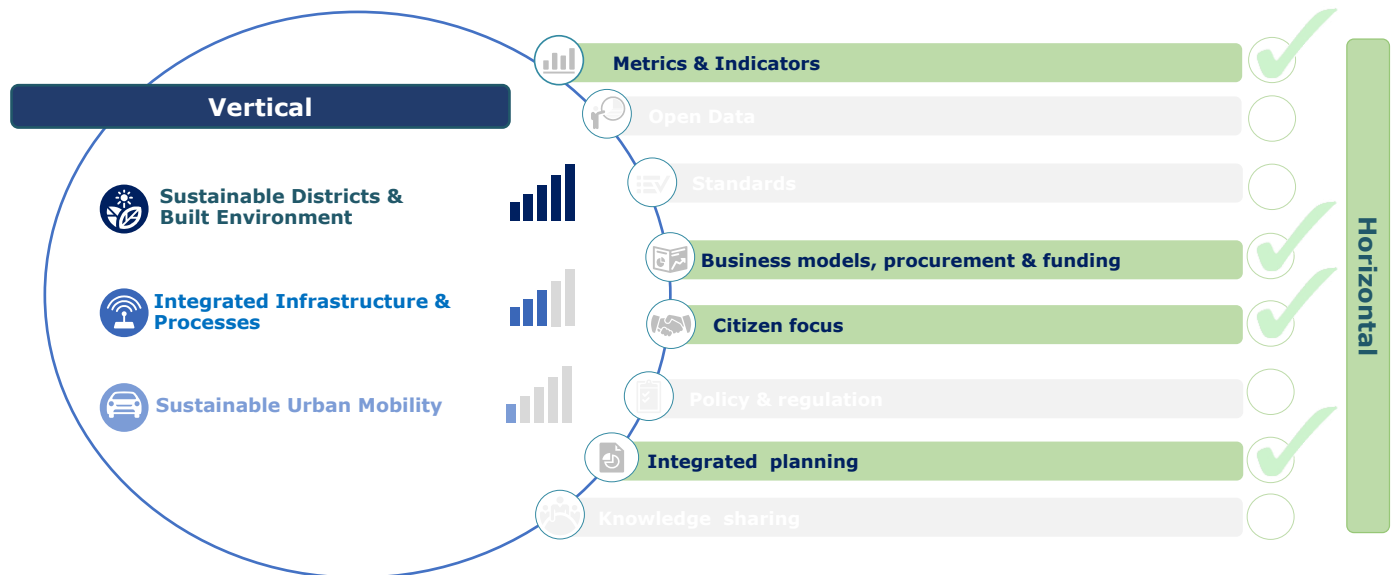
This solution exemplifies how aspects related to energy, i.e. PV technology, mobility, i.e. optimised waste collection logistics, and ICT, i.e. sensors and communication, can be successfully integrated to contribute to a sustainable urban development.

<b>Starting year</b>	2009-2013
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industry
<b>Budget</b>	€ 1.9 Mln <sup>21</sup>
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://bigbelly.com/">http://bigbelly.com/</a>

<sup>21</sup> The conversion rate used for this case study is € 1 = \$ 1.06

## Level of integration

Bigbelly integrates aspects from **ICT and energy efficiency**, while contributing also to **improve urban mobility**. Sustainable urban mobility is increased thanks to the CLEAN software installed in every machine in the field sending a wireless signal to a central server where staff can see which containers are full, so managers can **optimize collection routes in real-time reducing traffic and CO<sub>2</sub> emission**. The solution is solar powered; rubbish-compacting bins therefore integrate renewable and sustainable energy. For these reasons Big Belly is a solution displaying good integration.



## Business case

Bigbelly Solar was founded in 2003 in Newton, Massachusetts by an MBA student at Babson College. Today the popular idea has been implemented in large urban centers such as Boston, Chicago, New York and Philadelphia. There are two principal **social issues** that the company is addressing within the large waste management problem faced by society: 1) improving and reducing the logistical inefficiencies that many cities incur in trash collection 2) cutting GHG emissions related to waste, originating during collection by trucks and also at a later stage on the landfills, as compacted trash emits lower methane amounts.

Bigbelly has a **strong win-win value proposition for cities**. It reduces the cost of trash collection by lowering the frequency of required collection by compacting trash and by optimising truck logistics. Positive effects include also reduced cases of overflowing trash bins. **The customers are mainly city governments**. Large companies or private trash collectors could also use the system to reduce costs. The channel to customers is through distributors. **The revenue streams are licenses for technologies and software**. So the cities or clients pay to use the system, which is then implemented by Bigbelly and operated by a contracted third-party. The **cost structure** is characterized by high fixed costs, including the manufacturing of the bins, the solar technology, network infrastructure and assembly. Also the software development has to be considered. There would also be high maintenance and support costs to ensure the systems stay functional. Otherwise there are low variable costs, as little labor is needed once the system is sold.

More specifically, each BigBelly Solar Compactor costs around € 3,400-3,600 whilst the recycling kiosk is around € 700. In addition to this up-front investment, other costs incurring during the lifetime of the solution are<sup>22</sup>:

- **Battery replacement**, needed after five years and estimated to be \$ 500 per unit;

<sup>22</sup> Evans School of Public Affairs (2013) Benefit-Cost Analysis of BigBelly Solar Trash Compactors in City of Seattle Parks

- **Maintenance costs due to graffiti and vandalism**, at an average cost of \$ 20 per year per trash can<sup>23</sup>;
- **Training costs**, for the employees that would be responsible for collecting garbage in low use parks, although this figure is difficult to estimate.

The solution does not include any specific place limitations; however, **the solution is more sustainable in dense medium-large cities**. One barrier that might limit replication is the high cost of the solution, approximately 40 times more expensive than traditional garbage bins. The solution is also made available as a service with payment of a monthly fee rather than high initial investment costs

## Community & Citizen Focus

There is **no direct involvement of the community** in the decision making of the solution's adoption schemes. However, attention towards citizens and users influenced the design of the compactors. It is in fact the final user that interacts with the solution. Moreover, it seems that thanks to positive citizen response, **Bigbellies have increased the ability to keep the city clean and increase recycling**.

## Impact

The most significant impacts include:

- **Immediate and ongoing savings:** Due to the lower collection demand that reduces the operating cost and associated vehicle fuel use and emissions;
- **Increased waste recycling:** The solution makes it possible to divert waste from landfills, avoiding fees and creating new revenue streams from the recycled material flows.

However, the benefits of the solar-powered compactor deployment go beyond the cost-savings described above:

- **Reduced truck traffic:** Avoiding some collection trips per week keeps collection vehicles off the streets and thereby reduces congestion, traffic and road wear;
- **Reduced litter:** The compactors are enclosed, which decreases litter and improves the cleanliness and appearance of public spaces;
- **Pest-resistant:** The compactors' enclosed design prevents rodents, birds and other pests from accessing the trash;
- **Reduced CO<sub>2</sub> emissions:** Reduced collection trips lead to reduced fuel consumption and associated greenhouse gas emissions;
- **Discourage household dumping:** The limited size of the insertion hopper makes illegal dumping of household or commercial trash more difficult;
- **Advertising revenue potential:** Philadelphia is considering potential revenue from selling advertising space on the compactors and recycling units.

<sup>23</sup> The City of Seattle's report on anti-litter efforts indicated that the cost of maintenance for the 25 installed Big- Belly Solar compactors was \$500 over the course of the one year pilot (City of Seattle Office of City Auditor, 2011)





## The solution in context: Smart City – Philadelphia

### About the smart city vision in the city

In 2011 the Philadelphia City Planning Commission adopted the **Citywide vision**, which, together with 18 District plans, forms **Philadelphia 2035**, a guide on how to develop the city in the next two decades. With a strong will to build upon the city's strengths, which were identified to be a strong metropolitan centre, diverse and authentic neighbourhoods, and industrial-legacy areas, the city clustered its future development efforts around three themes: Thrive, Connect and Renew.

The Connect section is focused on **the public services related to mobility and utilities**. Among the objectives related to these fields is the goal **to divert 70% of the solid waste** from landfills through reuse, recycling and composting. This is the context that favoured the introduction of 500 solar-powered compactors and 210 single-stream, sidewalk recycling cans to replace 700 wire wastebaskets throughout Philadelphia's City Centre.

**Name of City** Philadelphia

**Country** United States of America

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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<http://bigbelly.com/>



## Bremen Building Management System Bremen, Germany

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2003 the city of Bremen developed a **Centralized Concept** in order to unify more than 1,200 municipal facilities under a unique building control system.

The need addressed by the introduction of the system was to **cut energy consumption** and **improve efficiency**. Moreover, by introducing the system the city of Bremen managed also to achieve significant cost savings.

After the evaluation of a series of software possibilities, it was decided to implement the **Wonderware solution**. This solution consolidated the existing systems under a central management platform. Thanks to the implementation of this system, it is now possible for each supervisor working from any location to **solve problems that might arise from any buildings located across the City of Bremen in real time**.

It is worth mentioning that, to obtain this kind of system integration, one important challenge was to make data and information consistent in format, allowing for sharing and reporting among the regional supervisors.

In short, the solution adopted by the City of Bremen is based on two main pillars:

- **Cutting energy consumption:** Optimize the efficiency of the heating systems;
- **Consolidating the building management system (BMS).**

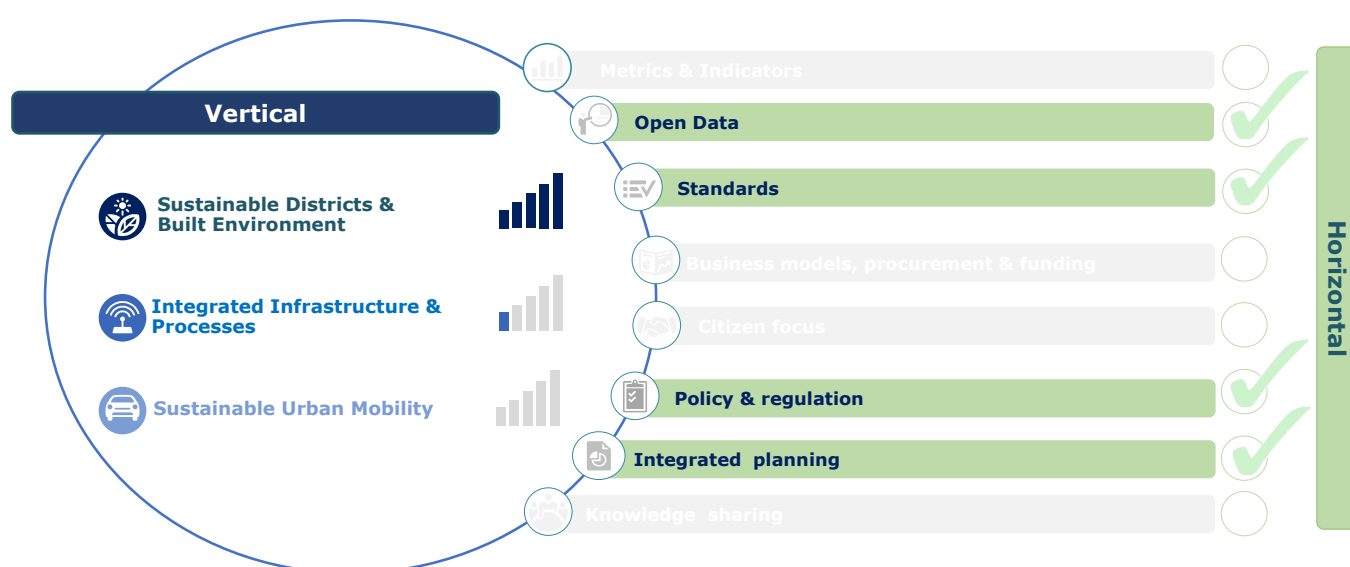
<b>Starting year</b>	2003
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 550,000
<b>Link</b>	<a href="http://www.immobilien.bremen.de/sixcms/detail.php?gsid=bremen02.c.730.de">http://www.immobilien.bremen.de/sixcms/detail.php?gsid=bremen02.c.730.de</a>

## Level of integration

The solution can be considered as integrated since it uses an **advanced ICT infrastructure for managing in an efficient and cost saving way** a large number of buildings spread across the city's districts. More specifically, the BMS makes it possible to **control energy consumption** of more than 1,200 buildings around the city and it definitely **contributes to energy cost savings**.

Indeed, the implementation of a central server facilitated an increase in coordination and avoided financial waste. In particular, important savings occurred for employees and engineers and their learning process, since they started using only one IT language, instead of the different ones that were needed before. Finally, considering the technical side, it is important to mention the smartness of the software employed, which shares information and enables integrated data transfer between all the different control buildings involved.

The consequent consistency in data gathering and structuring **makes information processing quicker and more transparent to the local and regional entities**, who need to interpret and reuse data in order to implement policies.



## Business case

During the first phase, the Bremen had the city's property service company (*Immobilien Bremen Anstalt des öffentlichen Rechts*) elaborate both an assessment of the current energy consumption use and a **future roadmap**, in order to emphasize all the possible **cost-effective heating solutions**.

The company identified the Wonderware solution as the best option available to optimize energy consumption through a single operator interface able to record data and increase overall efficiency. The software collects data and produces reports for each building's performance.

In this way, more than **1200 municipal properties** have been unified under a single open building management system. Six controls facilities are in charge of managing these buildings, while the supervision of the whole property is committed to five geographical districts and regional supervisors, which can access each heating system from a single and centralized location.

Wonderware solutions are **currently deployed across different cities** in the world for different purposes. One of the most relevant examples of the application of a Wonderware solution is represented by Carson City.

## Community & Citizen Focus

The project is absolutely **citizen oriented**, both for the solution itself, in line with the city's energy consumptions optimization policies, and for the **sustainable environmental benefits derived from a lower energy consumption**.

Furthermore, the common standards and the single interface implemented allow to increase transparency and citizens' trust of the city system they are part of.

## Impact

The benefits obtained from the solution are in particular linked with the following main impacts. First of all, the main goal of energy consumption optimization has been reached, since a **15-18% decrease has been registered**. Furthermore, the perimeter of control of the solution increased to more than 1,200 municipal properties. **The assumed cost savings generated from the adoption of the system amount to approximately € 30,000 per year.**

Plus, financial resources have been saved also thanks to the software solution implemented: indeed, as mentioned above, the employees and engineers involved now only need to learn one IT communication language.

Finally, concerning the qualitative results, the transparency of energy administration improved, since the regional entities can now have direct access to the **open building management system reports**.



## The solution in context: Smart City – Bremen

### About the smart city vision in the city

The city of Bremen is the second most populous city in Northern Germany. Bremen is part of the **European Innovation Partnership on Smart Cities and Communities**.

Furthermore, the University of Bremen is very active in research projects linked with **smart city policies**, in particular in the field of energy. The aim of this pilot is to improve the quality of life. The German University, in cooperation with the University of Trento, tested the intelligent control system KNX to **achieve energy savings** by controlling both lighting and heating.

In June 2013, as a part of an overall strategy, Bremen launched *Bremen and Bremerhaven, bike it!* (partially financed by European Development Fund for the development of tourism). Thanks to a geolocalization system, the initiative allows users to discover touristic points of interest and attractive bike routes.

<b>Name of City</b>	Bremen
<b>Country</b>	Germany
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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- **First image source: Smart Cities council**  
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## Climate Street Amsterdam, Holland

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In order to meet the ambitious smart city strategy goals of the City of Amsterdam, the municipality of Amsterdam has launched several smart city initiatives. An example of one of these initiatives is the smart development of Utrechtsestraat, also known as **Climate Street**. This street became one of Amsterdam Smart City's pilots in June 2009. A number of technologies were introduced in the street over a period of two years. Smart meters, energy displays and smart plugs were installed in the workspaces of entrepreneurs.

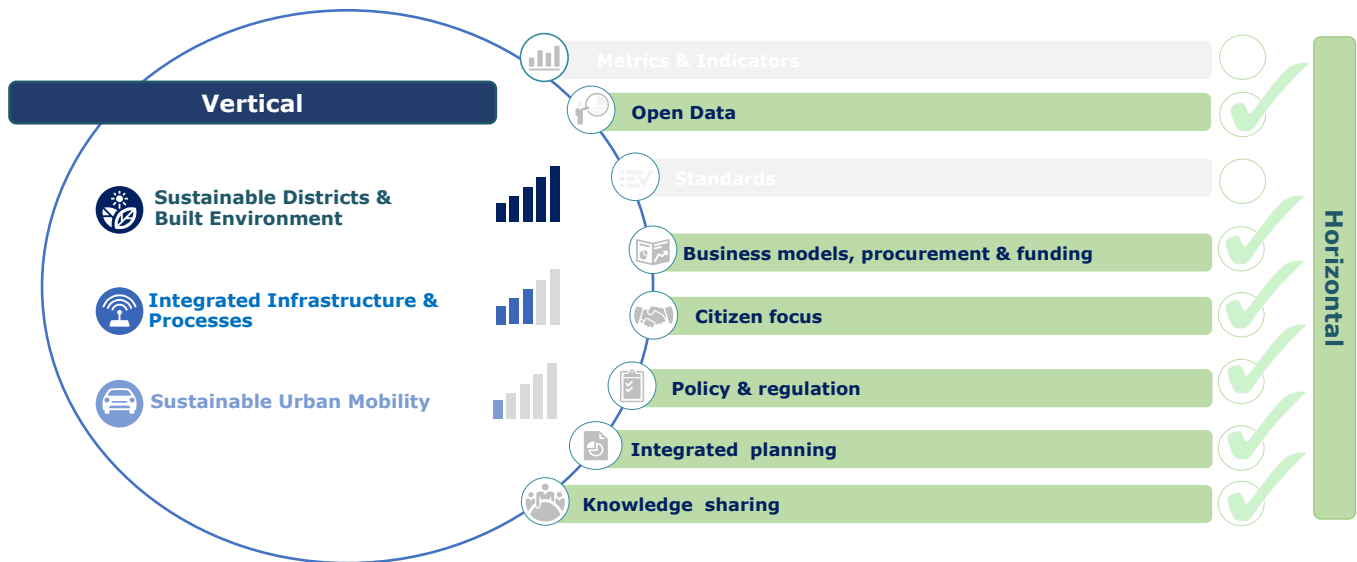
At the beginning of the pilot, a base line point was established to measure the current CO<sub>2</sub> and NO<sub>2</sub> levels in the street. This base measurement served as a starting point for the introduction of the various solutions. These various sustainable initiatives were focused on three main areas: **empowerment of entrepreneurs** (through energy scans, mapping out saving potential and implementation of smart meters and smart plugs), **improvement of public spaces** (e.g. energy saving lighting, tram stops powered on solar energy and solar-powered waste bins), and **logistics** (waste collection using electric vehicles, clustering).

The goals of the pilot were four-fold: 1) **to create a sustainable platform in a city centre environment**, 2) **to record user insights**, as well as 3) **insights into collaboration and implementation processes** and 4) **to stimulate sustainable entrepreneurship** amongst SMEs.

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industry
<b>Budget</b>	€ 4 Mln for the first phase of the overall Amsterdam Smart City Project (2009-2011)
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://amsterdamsmartcity.com/projects/detail/id/9/slug/climate-street">http://amsterdamsmartcity.com/projects/detail/id/9/slug/climate-street</a>

## Level of integration

As is evident from the list above, the climate street features many different types of projects. Quite a few of them are solutions integrating **ICT** with **built environments** and **logistics with the aim of reducing energy consumption**. Hence, Climate Street connects issues within sustainable urban mobility, public space and logistics.



## Business case

The Dutch dedicated themselves to coordinated partnerships and cooperation among the different public and private stakeholders who otherwise would independently be pursuing smart projects. The city of Amsterdam has been instrumental in getting organizations to come together and contribute data to support their Smart City initiatives. Over 40 entrepreneurs and business owners on The Street worked together to invest in and implement a range of energy efficiency tools, such as: **smart meters, data management tools and conservation kits as well as a bundled procurement process**. The Amsterdam Smart City Office in the City of Amsterdam coordinates the different collaborations in the street with the aim of improving economic growth and resource-efficiency. Amsterdam Smart City itself is one of the six projects of **Amsterdam Living Lab**. The main initiators of Amsterdam Living Lab are the University of Amsterdam, Waag Society (a Dutch institute for art, science and technology), Novay (research institute) and the Amsterdam Innovation Motor (initiated by the municipality and the ministry for economic affairs to stimulate innovation in the area).

The street had already initiated a first venture into testing a new technology: in 2008, **waste collecting** company Van Gansewinkel selected the street to **test electrically-powered waste collection vehicles**. The company had sought to test these cars in a typical Amsterdam street. To set up that test, Van Gansewinkel contacted the shopping street manager and the entrepreneurial association of the Utrechtsestraat. The project was therefore initiated by Van Gansewinkel and other local SMEs located in and around the street.

The organization Club of 30 was contacted by Amsterdam Smart City to coordinate the project management of the pilot for Amsterdam Smart City. The Club of 30 is a project and innovation organization that makes (operational) business processes sustainable. The project is also supported by a group of private partners: Vodafone, Amsterdam City, Home Automation Europe, Plugwise, JCDecaux, Philips, TNT, L.A.J. Duncker and TAUW.

**The first phase** of the whole Amsterdam Smart City Project (2009-2011) had a budget of approximately € 4 Mln and **was partly funded through the European Regional Development Fund** (€ 1.56 Mln). Local entrepreneurs and businesses are financing the establishment of the different sub solutions (data management systems, waste systems etc.)

According to available information, **Climate Street has been replicated in the city of Cologne**, where a series of energy saving projects are being implemented in one particular street. The focus is on energy efficiency and climate protection.

## Community & Citizen Focus

The focus of Climate Street lay in three main areas: **entrepreneurs, the public space and the logistics**. A group of 40 enthusiastic entrepreneurs were selected as the frontrunners group. They all actively wanted to participate in making the Utrechtsestraat area more sustainable. The frontrunner group was closely involved in the project and acted as a test team and sounding board of the various sustainable initiatives.

**Climate Street in Amsterdam was a test bed for entrepreneurs to install their respective smart solutions in a city environment.** The surrounding community could then interact and use the solutions and provide useful feedback. In this way, communities are allowed to some extent to shape the city's smart solutions through their feedback and comments.

A case study about the community (mainly small businesses and entrepreneurs) concluded that **involving users and stimulating bottom up innovation is very complex and that Living Labs should not only seek a connection to (communities of) users, but that investments should also be made to understand how to stimulate this kind of innovation from a top-down (project) perspective** - i.e. through public-private partnerships. The Climate Street case also illustrates how users, in this case entrepreneurs, are configured in such a way that innovative ideas are precluded. In order to stimulate bottom up innovation, Living Labs should allow daily life dynamics a role in their projects; daily life complexities should be allowed to become part of the socio-technical network.

## Impact

During the closing party – an open house event on the street – the energy reduction results of Climate Street were presented. **CO<sub>2</sub> emissions were reduced by 8%** (energy saving) and **10%** (saved by switching to green energy) respectively. Another positive point was that people in the street did not notice the significant change from the changing in lighting and overall energy saving. Furthermore, approximately 50% of the SMEs on the street began to use the sustainable waste concept. Overall, Amsterdam achieved a reduction in the **annual CO<sub>2</sub> emissions** of the shopping area **from 3,400 tons in 2010 to 1,276 tons in 2012**.

The pilot's brochure illustrated ongoing efforts to make the street more sustainable, as well as a number of learnings: some technologies still required implementation, logistics needed optimization and entrepreneurs should become more energy aware. Identified as essential to these processes was an increase in the **stimulation of collective action**. The general statement by the organizing actors was that to further the success of the pilot, **entrepreneurs should take back the responsibility for the implementation of the sustainable technologies**.





## The solution in context: Smart City – Amsterdam

### About the smart city vision in the city

The Amsterdam Smart City Project was developed to **accelerate climate and energy projects within the city of Amsterdam**. The Smart City Project aims to **save energy and reduce CO<sub>2</sub> emissions** and, at the same time, **promote innovative and sustainable economic growth**. The Smart City Project aims to **test new smart technologies** and **facilitate sustainable choices**. After pilot testing each smart city initiative, the city will implement the most effective initiatives on a large scale. The Smart City Project is therefore tightly connected to the New Amsterdam Climate Plan. The aim of the Climate Plan is to ensure that all the city's organisations are climate-neutral. Furthermore, another ambition is to **reduce CO<sub>2</sub> emissions by 40% from 1990 to 2025**.

**Name of City** Amsterdam

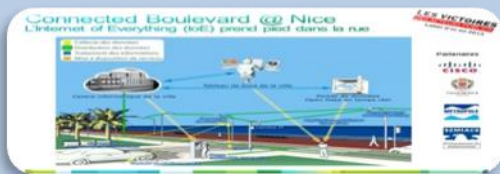
**Country** Holland

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **13**  
Global Cities Index – Bloomberg (2014): **26**  
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- › **First image source:** glech strategies  
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- › **The solution in context image source:** the blues joint  
[\\_https://thebluesjoint.files.wordpress.com/2015/03/amsterdam-rosse-buurt.jpg/](https://thebluesjoint.files.wordpress.com/2015/03/amsterdam-rosse-buurt.jpg/)



## Connected Boulevard Nice, France

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The city of Nice attracts about 10 Mln visitors per year and is one of Europe's top tourist destinations. In order to continue to attract visitors and also improve the quality of life of its citizens, Nice launched its **Connected Boulevard project** as a way of **developing an open and extensible smart city platform in 2013**.

The Connected Boulevard is a one-year proof-of-concept taking place in an area of 800m x 400m around Boulevard Victor Hugo in Nice. **It demonstrates how applying the Internet of Things (IoT) can support the city management in general, and deliver better services to the public.**

The solution involves a communication infrastructure based on Cisco routers, which offers a WiFi coverage serving both to collect data from over 200 sensors and to connect passers-by to internet for free. The solution also includes a platform transforming raw data collected from sensors into meaningful information to be shared with end-users. It is to be noted that the **real-time data** (in a specific format to operate at the scale of an urban area with big data) is owned and analysed by the city, according to demands and needs. Four types of city services have been created: **traffic flow and parking control, public lighting management, waste management and monitoring of the environmental quality.**

To support each of these services, applications have been developed as described below:

- An application enables drivers to find available parking spaces. It **facilitates car parking** and subsequently **improves the traffic flow**. In other words, it counteracts traffic jams;
- An application **automatically adjusts the streetlights' intensity**. It increases traffic safety for all road users and security especially for pedestrians;
- An application identifies **waste bins** that need to be emptied and facilitates city agents' (e.g. street cleaners) daily work;
- An application enables tourists and visitors to be informed about touristic sights and points of interest.

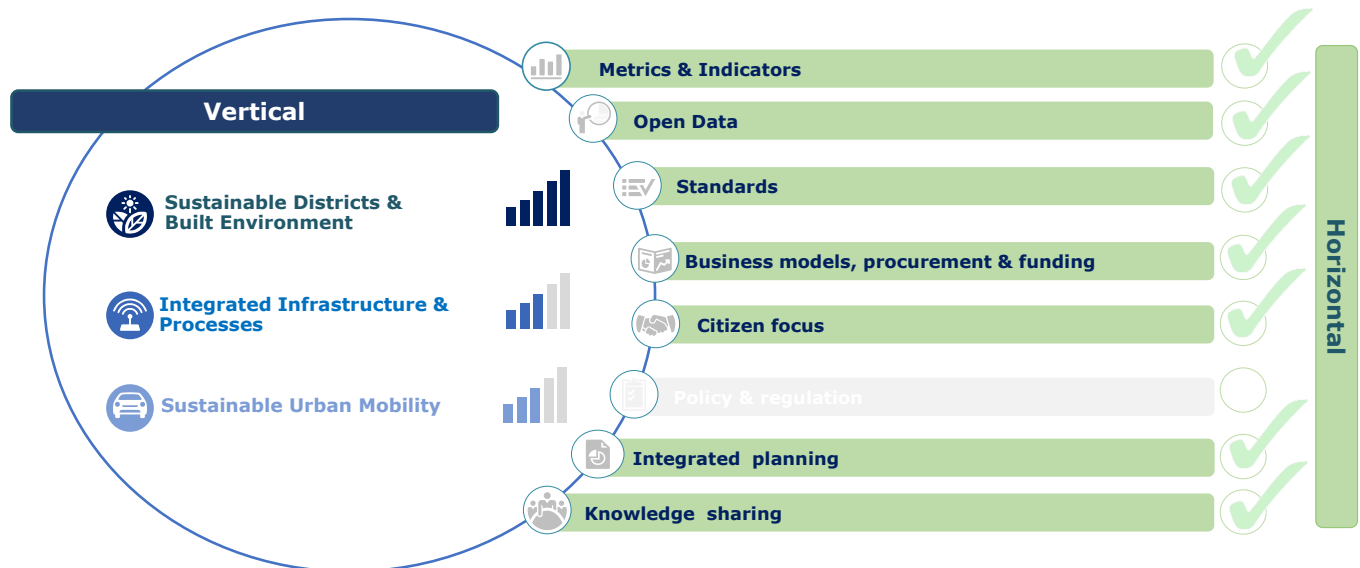
The Connected Boulevard therefore serves citizens, tourists and agents employed by the city of Nice.

<b>Starting year</b>	2013
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 0 for the City Council, € 100,000 from Cisco
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="https://www.nice.fr/fr/nice-2020">https://www.nice.fr/fr/nice-2020</a>

## Level of integration

The Connected Boulevard integrates **ICT, urban mobility and environment**. Sustainable urban mobility is supported by the application, which **facilitates parking space usage**. The environment benefits from many aspects. An **ICT platform** and **IoT applications** reduce traffic congestion (hence air pollution and noise levels) as well as light pollution.

For these reasons, the project in Nice can be classified as a solution with significant integration of all three areas. The uniqueness of this solution also relies on the different fields covered (waste, security, lighting, etc).



## Business case

The partnership behind the Connected Boulevard is composed of Cisco and ThinkGlobal, an economic grouping consisting of SUDE, editor of innovative services for smart cities, Citelum specializing in urban lighting, PrismTech a company specialising on connectivity for IoT applications, Urbiotica, a sensors manufacturer (e.g. for the Connected Boulevard garbage bins) and Semiacs, dealing with parking solutions.

This was mainly a pilot project, which was relevant for Cisco and the project partners to understand how this kind of infrastructure can be rolled-out and deployed at a higher scale. No payback was expected by Cisco for the € 100,000 the company invested. The implementation of this service was useful to understand how revenues (additional parking tickets) and savings (e.g. linked with street lighting) generated thanks to the Connected Boulevard could finance similar future solutions.

With regards to the parking revenues, it should be noted that timestamps usually cover only 15% of the actual parking time. The other 85% represent cases where drivers are not paying for a parking ticket, mostly because of the time "lost" finding and paying at a ticket machine. Hence, the intelligent parking solution directing them to a free parking spot considerably increases the revenues gained from car parking.

With regard to savings, the financial gains coming from smart urban lighting are estimated to be significant. Depending on the case, at least 20% of energy savings are estimated, with a potential of up to 80%.

Besides, **open innovation** was used for developing the Connected Boulevard solution, creating no additional costs for maintaining the infrastructure. After the completion of the Connected Boulevard in Nice, **Cisco implemented similar projects in other cities**, including Barcelona,

## Community & Citizen Focus

The city administration, citizens, city agents and visitors mutually benefit from the integrated services that Connected Boulevard provides. The parking solution is both advantageous for the citizens of Nice and its visitors. The **smart lighting system** profits all users of the road. Furthermore, the **waste**

**collection** contributes to easing the work of the sanitation workers and also improves the appearance and cleanliness of the city. The free WiFi service is especially interesting for tourists that do not have access to 3G or 4G networks but may also be beneficial for the citizens of Nice. In addition to that, the applications that offer an augmented reality experience provide services for tourists (additional information on sights of interest etc.) and citizens (e.g. the application Digital Graffiti which makes it possible to place digital objects (text, URL, ...) in real life spaces). Ultimately, the Connected Boulevard benefits all, especially citizens and users of the connected area around Boulevard Victor Hugo, and notably tourists.

However, no specific organisation has been put-up specifically to engage citizens in the decision process.

## Impact

The Connected Boulevard **increases the citizens' quality of life, improves city services, and offers business opportunities**. Businesses profit from the open project that allows them to freely integrate new solutions and equip and cover a new sector of the Boulevard.

The attractiveness of Nice as a tourist destination is also enhanced considerably with the Connected Boulevard solution.

With Connected Boulevard, EU 20-20-20 targets are addressed, namely by **reducing energy consumption** (e.g. smart lighting) and reducing green house gases emissions. Moreover, the Connected Boulevard also contributes to reducing light pollution. Besides, it improves citizens' comfort, security and safety at night.

Furthermore, IoT may serve as a way to counteract social exclusion of certain societal groups, since the services provided by the Connected Boulevard are accessible to anyone who owns a smart device (smartphone, tablet, etc.).



## The solution in context: Smart City – Nice

### About the smart city vision in the city

Nice is already well positioned as an experimental territory in the world of "smart cities". A ranking published in 2015 by Research Jupiter placed Nice in 5<sup>th</sup>, place just behind Barcelona, New York, London and Singapore in a world ranking of smart cities. This ranking is based on the capacity deployed on the **use of smart electricity networks (smart grids), the management of road traffic and street lighting, as well as the expertise developed around these issues.**

Other smart city projects in Nice include:

- **Environmental monitoring:** Monitoring and communication of environmental parameters to citizens (air, water, noise, etc), offering consultation to citizens in order to bring in their voice, and educational activities for the general public;
- **NiceGrid:** Intelligent solar energy district;
- **Internet of parks:** Winner of the 2015 TM Forum Hackathon, an early-stage project which ultimately aims at creating an automated robot that cleans parks, steered by the crowd

Widespread deployment of near-field communication-enabled devices, e.g. Spot Mairie (device set up at the biggest commercial centre in Nice for consulting with a public servant at the city hall, in order to do one's affairs without having to visit the city hall directly).

<b>Name of City</b>	Nice
<b>Country</b>	France
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Districlima Network Barcelona, Spain

→ Replication potential		→ Economic impact	N.a.
→ Complexity		→ Environmental impact	
→ Citizens' involvement		→ Social impact	

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2002, Barcelona decided to implement the **first heating and cooling network in the Forum area** which is currently being expanded to cover part of the energy needs expected in the 22<sup>nd</sup> district. What makes the **DISTRICLIMA network** unique is that it uses steam generated during the recovery of municipal solid waste carried out by **TERSA** to generate hot and cold water (with absorption machines) for climatization, resulting in significant primary energy savings. **DISTRICLIMA** was the first of its kind in Spain and was created in 2002; it is an **urban heating and cooling network supplying heat, air conditioning, and clean, warm water, and it went online in 2004**.

The heating and cooling system Districlima is being implemented in three phases: the first was finished in 2004 when the Forum area started to be serviced by using their sustainable hot and cold water system, pioneered in Spain.

The second phase consisted in **installing an underground heating and cooling network** to connect the **Districlima plant**, located at the Fòrum, to the UOC's headquarters in the 22<sup>nd</sup> Barcelona district. This allows them to provide service to both business and private residences that are interested in connecting to the system.

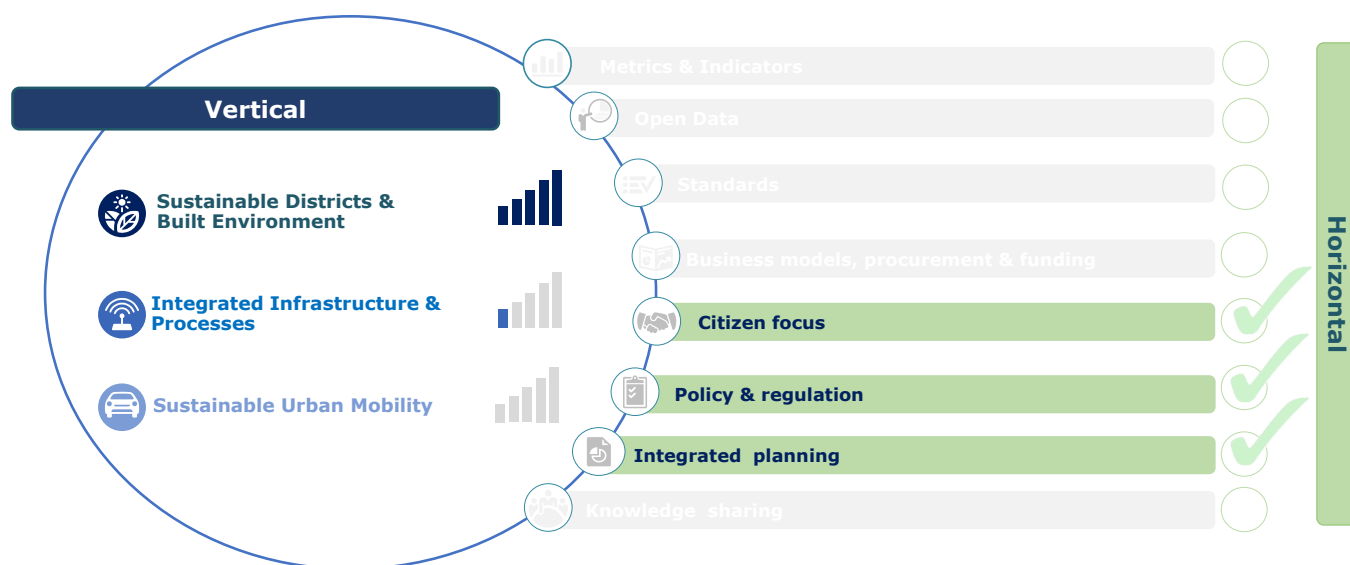
The third phase of the network, which will start soon, consists in **crossing Diagonal Avenue and constructing a second Districlima plant on Tànger Street**, which will broaden the service area

<b>Starting year</b>	2002
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, Energy Diversification and Conservation Institute and the Catalan Energy Institute.
<b>Budget</b>	€ 47 Mln
<b>Number of impacted users</b>	Companies (SMEs or Large Corporations), Public Entities, Barcelona's citizens
<b>Link</b>	<a href="http://www.districtlima.com">http://www.districtlima.com</a>



## Level of integration

The solution is characterized by an **extensive network of pipes that provide cooling and heating services** to the private residences and businesses located in the area. Moreover, the solution embeds a necessary ICT infrastructure that enables the correct functioning and management of the whole system. Therefore, **Districlima can be seen as a solution integrating sustainable districts and built environment elements with an ICT infrastructure.**



## Business case

The objective of this project is to establish an urban network in a big population area from an efficient perspective that could follow these principles: lower energy consumption, job creation, CO<sub>2</sub> emission savings, and a decrease in water consumption.

**The overall expenditure for the construction of the system amounted to € 47 Mln.** The solution is a public-private partnership where the beneficiaries of Districlima are Companies (SMEs or Large Corporations), Public Entities and Barcelona's citizens. Therefore, the Districlima public-private partnership was established by different shareholders to build and operate the network: Cofely España SAU (50.8%), Tractament i Selecció de Residus, TERSA (20%), Sociedad General de Aguas de Barcelona, S.A. (19.2%), IDAE (Institute for Energy Savings and Diversifying) (5%) and ICAEN (Catalan Institute of Energy) (5%).

The first project developed by the company, under a 25-year concession, was a district heating and cooling network in the new urban development around the 2004 Universal Forum of Cultures. Furthermore, local administrations (Ajuntament de Barcelona and Generalitat de Catalunya) have invested around 25% of the overall cost. According to Cofely (2004), **the project's total turnover amounts to € 75 Mln.**

In the organizational model of Districlima each stakeholder has a specific role: Cofely España is responsible for engineering the new system, TERSA is in charge of managing the waste valorization plant, AGBAR manages the water distribution network, IDEA and ICAEN are responsible for funding and strategic advisory. Thus, **through public-private collaboration, it is possible to respond intelligently to the needs of the city**, implementing a model and adding a new dimension in regards to the relationship between urban planning, building and energy.

Currently, examples of replication of the same or similar systems adopted in Barcelona are located especially across Northern Europe (e.g. Helsinki). **No cities in temperate climates have adopted a similar system so far.** Besides the environmental conditions, a potential barrier could also be related to the initial high costs. However, the benefits overcome the costs in the long run. In order to reduce the

initial capital expenditure it is necessary to implement the solution during the urban regeneration or development of a densely populated area.

## Community & Citizen Focus

The interests of the citizens are focused on **saving CO<sub>2</sub> emissions** and on reducing pollution. The interests of the beneficiaries are to benefit with lower energy costs than conventional solutions.

## Impact

Thanks to the highly efficient nature of the system, Barcelona saves more than 50GWh in primary energy, which equates an **annual saving of 10,000 tonnes of CO<sub>2</sub> emissions**. The implementation of a new centralized climatization network in the district of La Marina really strengthens Barcelona's commitment to this technology, and the new development projects include connections to all suitable municipal buildings from the district heating network.

The high efficiency of the system enabled **52% of savings in fossil energy**. The network also obviates **health risks, eliminating cooling towers over the rooftops of the city, reduces the overall power consumption** of the city and is an economical tractor, **creating local stable employment**. On the other hand, the connected buildings benefit from some increased energy efficiency ratings and gain useful spaces.

This also removes some of the maintenance costs, breakdowns and future replacements of these devices. It also makes architectural solutions possible, eliminates the noise and vibrations, the presence of combustible gases or potentially dangerous items, and finally it provides the power expansions with little additional investment. The City will have the security of supply provided by the multiplicity of plants and, it will benefit from a safe, economic and sustainable service.



## The solution in context: Smart City – Barcelona

### About the smart city vision in the city

Barcelona's goal is to **become a self-sufficient and sustainable city**. One of the ways to achieve this goal is by actively **developing centralized climatization systems** using residual energy sources. Centralized climatization systems provide buildings or shopping centres with thermal energy in the form of hot and/or cold water for its climatization needs, and this energy is generated in a centralized production plant.

The buildings being supplied are connected to the plant through a series of pipes that channel thermal fluids controlled and regulated from the central office. Two large district heating networks are currently being developed in Barcelona: covering the area of the 22<sup>nd</sup> district and the Forum (DISTRICLIMA) and the other, the Zona Franca free trade area and the district called Marina del Prat Vermell (ECOENERGIES).

**Name of City** Barcelona

**Country** Spain

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **17**  
Global Cities Index – Bloomberg (2014): **24**  
The Economist – City Competitiveness rankings (2013): **55**

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- Replication potential
- Complexity
- Citizens' involvement



→ Economic impact

→ Environmental impact

→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The 3e-HOUSES project can be characterized as a European funded project with the objective to install **ICT technologies in social housing**. Through efficient use of new technologies and services in focusing on energy efficiency in private homes, the ambition was to improve sustainability impacts and cost savings. More specifically, the innovative set of services included in the project were:

- **Real time monitoring and management of energy consumption;**
- **Integration of renewable energies;**
- **Creating the resources to lower energy consumption.**

The three types of services were also tested in two pilot locations in Sant Cugat del Vallès (Spain) and Leipzig (Germany). Two replicators in Bristol (UK) and Langenfeld (Germany) have also been established within the project frame. In Bristol, 100 social houses participated from April 2012 until May 2013.

The main objective of this project was **to improve the sustainability in European social housing**, by the **ICT-based centralized monitoring and management of the energy consumption and production**, and to provide decision makers with the **necessary tools to be able to plan energy saving and peak reduction measures**.

The specific objectives of the 3e-HOUSES project were: definition of methodologies; pilots design; pilots monitoring; pilots implementation; pilots validation; replication of two pilots; results and impact analysis; dissemination and promotion.

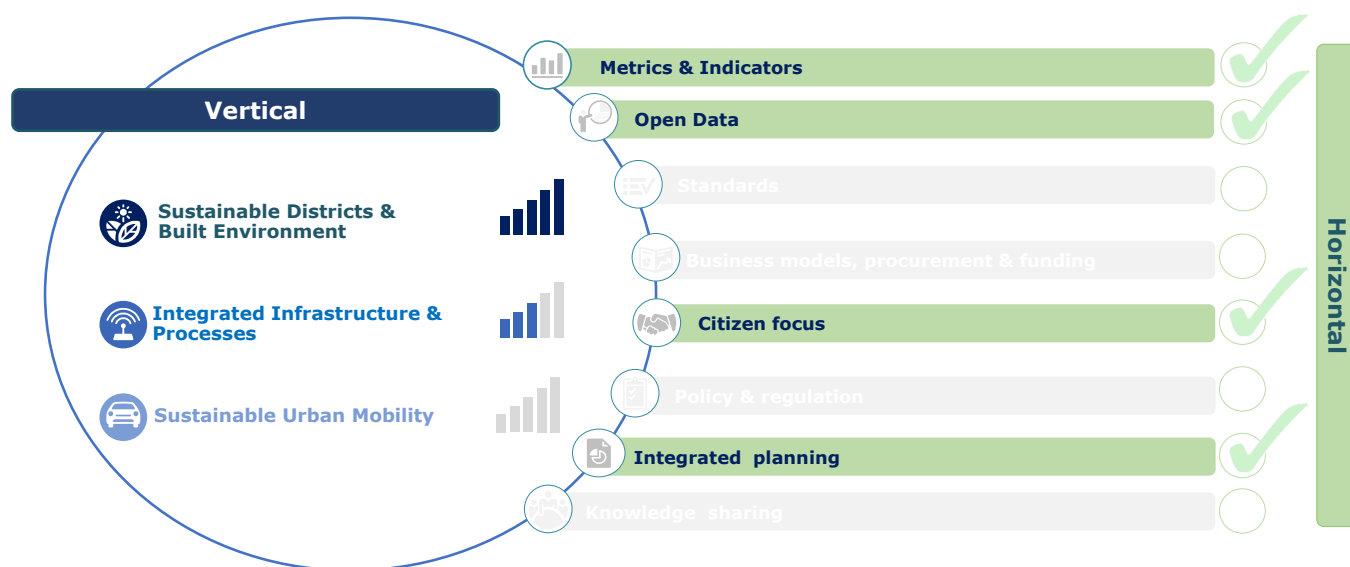
These services allowed the integration of renewable energy and other sources of distributed energy. The project contributed to a **reduction of around 20% of energy consumption in social buildings**. The different pilots also documented very different learning about behavioural change in the context of new energy technologies and the use of smart building technologies and sophisticated citizen interaction methods.

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes, within the overall 3e-HOUSES project
<b>Key actors / stakeholders</b>	Public Authority
<b>Budget</b>	€ 4 Mln of which a maximum of € 2 Mln granted by the EC
<b>Number of impacted users</b>	Approx. 300
<b>Link</b>	<a href="http://kwmc.org.uk/projects/3ehouses/">http://kwmc.org.uk/projects/3ehouses/</a>

## Level of integration

The 3e-HOUSES project concept contains three phases: **a design phase, an implementation phase, and a dissemination phase** in order to create, establish and monitor 4 demonstration pilots, based on the integration of **ICT technologies** such as innovative control and monitoring systems, as well as **Renewable Energies (RES)** within social housing. The data integration is focused on providing real time monitoring and control of energy consumption through the provision of information with an overall aim to **reduce consumption**.

Hence, an interaction is created between the intelligent devices and the users, allowing the users to increase their knowledge of their energy consumption and therefore change their patterns of energy use.



## Business case

The 3e-HOUSES project was a **European CIP ICT PSP** funded project. The solution involved a number of private and public entities, joined into a Consortium. Setting up the 3e-HOUSES solution (which includes pilots in Spain, Bulgaria, UK and Germany) required approximately **€ 4 Mln in investments, of which 50% has been sustained by the EU funds and 50% through the consortium's own resources**.

For each of the pilot actions to be carried out in each of the places, there is a group of organizations (including the necessary stakeholders in the value chain) that cooperate in order to fulfil the project goals for each of the pilot actions. Concretely, for each of the pilot actions, 3e-HOUSES project gathers the public authority responsible for the public building/space where the pilot will be tested, together with the supplier of the innovative solutions and usually an organization responsible for the energy efficiency initiatives for the involved public authority.

The 3e-HOUSES project has been developed as a pilot test, to gather information and develop recommendation on possible future uses of the technology. No commercial asset has ever been developed, nor it has ever been the purpose of the project to generate any direct revenues.

## Community & Citizen Focus

Experience shows that participants are more likely to be actively engaged in the project if they understand the objectives of the project and the importance of energy efficiency.

The effectiveness of the 3e-HOUSES project is very much determined by how well the residents are able to use the smart metering system. Therefore the project has made an effort to **raise awareness of the importance of energy efficiency**.

The project has done so by providing ongoing support through visits, calls and workshops. Newsletters and other information were sent to participants to keep them updated and engaged in the project.

The 3e-HOUSES design in the UK transported the energy data collected in the home over the internet and into a SQL server based at Toshiba Research Labs. An application has been written by KWMC that uses this data to display the energy use in a graphical and easy-to-use interface. Participants could log onto this application over the internet and see where the energy is being used, and so how their money is being spent.

## Impact

As a result of this work across the two pilots and two replicators, the 3e-HOUSES project demonstrated an enormous range of impacts.

One pilot saw a very small increase in energy use, whereas others saw reductions in excess of the 20% target. This variety of results demonstrates the complexity of undertaking behaviour change projects such as this, and underlines the importance of getting behind the data to understand participants' contexts and motivations. In the final report the UK pilot determined a **5% reduction on electricity consumption and a 27% reduction in gas consumption from heating**. The overall project across all replications in Europe estimated a total reduction in energy of around 12%. This is the total reduction on all measured areas of energy consumption.

Interim results showed that the users of the solution get relevant information about their energy consumption that give them the ability to evaluate their consumption and make rational decision. Also, **the users are empowered by the new information.**

Overall the families have increased their awareness of energy consumption allowing them to change their behaviour. Qualitative data collected from day-to-day communication with project managers have shown that several families have seen significant changes in their everyday routines. Some decreased their use of the washing machine, others are remembering to turn off lights, TVs and play stations. It shows how the project can change everyday routines on energy consumption to the better.

The social changes in behavioural patterns also benefit participants economically. Cutting down energy consumption is naturally reflected on energy bills. Participants have thus seen significant drops in their monthly bills.



## The solution in context: Smart City – Bristol

### About the smart city vision in the city

Bristol is a **leading green city** and the only UK city to be shortlisted for the **European Green Capital Award**, but like most cities, mitigating and adapting to climate change and increasing energy resilience, whilst ensuring sustainable growth, are big challenges. The city wants to become a smart energy city, and therefore, as part of CSE's contribution to Bristol 2015 European Green Capital, an established forum, Bristol Smart Energy City Collaboration, will create a roadmap to realise that ambition over the next 5 years. **The vision is that by 2020 Bristol will have a public-interest organisation in charge of the overall coordination of smart city**, particularly in terms of the distribution and supply of heat and power across the city. This will benefit both the residents of Bristol and the businesses. The most important aspect is to build up capabilities and systems to access, manage and interpret local energy supply and demand data. In a longer perspective, this will enable co-ordinated city and neighbourhood-scale interventions to:

- **Balance heat and power demand and supply;**
- **Curb energy waste and reduce peak demand;**
- **Improve the financial value of renewable heat and power generated in the city;**
- **Cut down network losses and manage system constraints;**
- **Provide commercial leverage in the energy market.**

**Name of City** *Bristol*

**Country** *UK*

**No of Inhabitants** *100,000 < x < 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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## Klimastrasse Cologne, Germany

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The **Klimastrasse** (i.e. Climate Street) project in the Nippes district of Cologne is one of the projects of the Cologne SmartCity initiative, managed by the municipality, the local energy provider RheinEnergie AG and a network of industry, businesses and citizens. The focus of the Klimastrasse project, which is managed by the local energy provider RheinEnergie AG, is to test the following solutions:

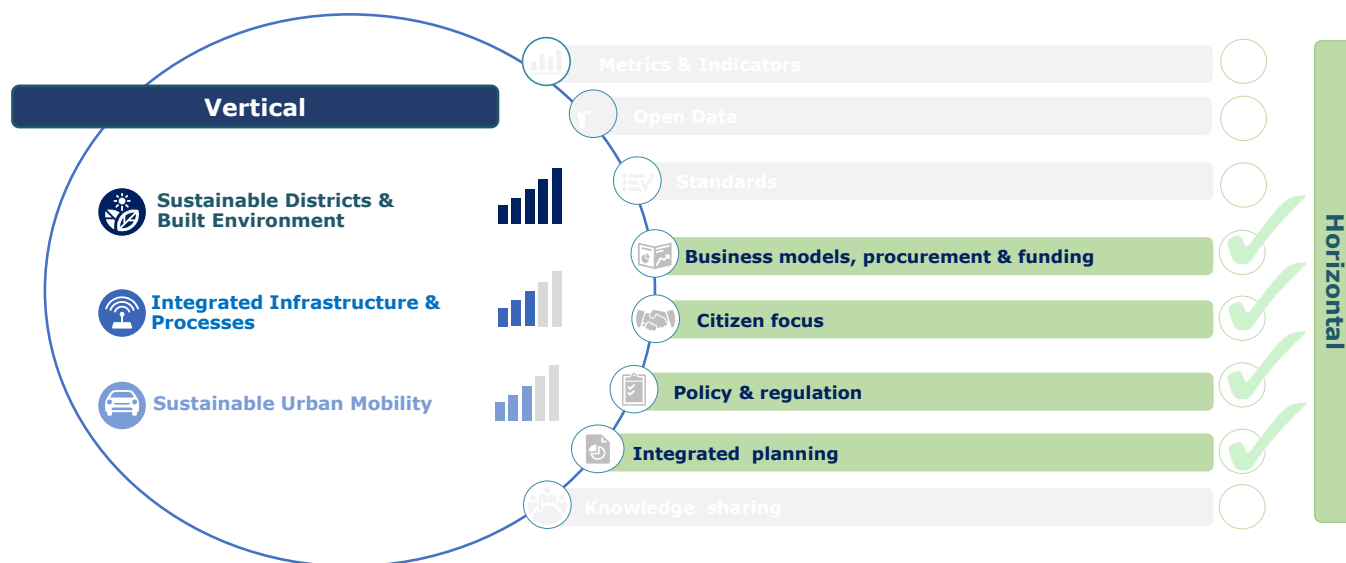
- **Optimized air building insulation** (roof, facade, windows, etc);
- **Renewable energy** (photovoltaic);
- **Storing energy;**
- **Innovative use of electricity** (LED street lighting, smart meters);
- **Intelligent energy management for the home** (smart home for heat, light, electricity, security);
- **Installation of additional measurement technology** for better monitoring of power grids;
- **Charging stations for electric mobility** (car and pedelec);
- **Use of electric vehicles;**
- **Waste management;**
- **Sensoring of environmental data and visualisation for the public.**

The project started in 2014, with a preliminary pilot phase carried out in January 2013. The Climate Street project is going to continue through demonstrations for three years onward.

<b>Starting year</b>	2014
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Local energy provider, Public Authority, Industry
<b>Budget</b>	€ 1.7 Mln
<b>Number of impacted users</b>	Approx. 35,000
<b>Link</b>	<a href="http://www.smartcity-cologne.de/klimastrasse">http://www.smartcity-cologne.de/klimastrasse</a>

## Level of integration

The Climate Street project, as depicted in the following figure, covers all three vertical/technological priority areas of the EIP-SCC Strategic Implementation Plan. The Climate Street features in fact charging stations for cars along with a plan for **future alternative means of transportation** such as the **electric cycles (Pedelec)**, integrating **sustainable mobility with built environment**. Sustainable district and built environment and integrated infrastructures are also addressed through the use of smart meters and building insulation. Integrated planning and policy and regulation are the horizontal priorities addressed by the project. Policy and regulation and integrated planning are ensured by the important commitment of the local policy makers and energy providers (the local energy provider RheinEnergie AG steers the initiative).



## Business case

The Climate Street project is meant to demonstrate that, given the present stage of **technology development, a climate friendly energy management is possible**. A central aspect behind the project implementation is the participation of citizens and businesses. The City of Cologne believes that a **successful strategy implying new technologies and long-term changes in behaviours** towards most efficient **energy consumption** patterns is only possible when people/businesses can be convinced that these new technologies also have economic benefits that can improve the economy and human well-being.

The project does not feature an explicit business model in itself. The core project activity is **to pilot and test new technologies in energy efficiency and sustainable development** (i.e. energy consumption). Business models are relevant for the individual small businesses and industries involved in the project. Stores, public offices, can save on energy bills, repaying investment in retrofitting lighting systems. The City of Cologne may benefit in the long term from the use of LED lightings for the city hall of the Nippes district in Cologne, part of the Climate Street project. Industries, as KölnLed and others, involved in the project, can repay investment in the initiative through services and installation of LED lighting.

The Climate Street project in Neusser Straße provides the opportunity to test new products and services **reducing energy consumption**. Funded with € 1.7 Mln grants by RheinEnergie AG (of which € 600,000 allocated to the smart meters roll out), the Climate Street project is an example of a community-embedded demonstrator or test bed for smart city solutions. It also aims at promoting collaborations between private companies. This should ideally promote long-term partnerships, the development of innovative ideas and new business models for the future.

## Community & Citizen Focus

The Climate Street project is a pilot on making **new technologies part of the everyday life of citizens and small businesses** (e.g. shopkeepers) living and operating in the street and in the surrounding district. It showcases smart solutions to the public, asking for feedback to the companies responsible for the solutions and policymakers.

The project is **part of a complex strategy**, i.e. over twenty different projects with which the municipality of Cologne aims at showing how a future smart City might look. More specifically, the projects are meant to implement the city's long term strategy of tackling climate change, as shown by the SmartCity Cologne platform (<http://www.smartcity-cologne.de/>), in which several energy related facets of climate change are taken into account: from **optimal building insulation** and **maximum heat efficiency up to the charging stations for electric vehicles**, and low-energy street lighting. A broad group of stakeholders is involved in the SmartCity Cologne platform projects: policy makers, private citizens, academia, industry, local business owners and associations

All the involved stakeholders (e.g. citizens, industries) may benefit from the project outcomes: **rational energy consumption, cost savings and support for meeting climate targets; roll out of new technologies and effective business models**. The initiative provides benefits for everyone in the city, contributing to changes in lifestyle in the direction of energy savings.

## Impact

15 different local companies are **saving up to 70% of their energy costs/electricity** costs having shifted to LED lighting. The streetlights have also been refitted with LED lights.

Based on estimations, the installed LED lighting has generated savings for **64% of the lighting power**. The potential environmental impact for all SMEs in the street is **saving approximately 2,216 tons of CO<sub>2</sub> per year**.

Furthermore, the installation of smart meters in a sample of households is a test to make residents aware of energy consumption, helping them to avoid unnecessary energy consumption.

It has been estimated that smart home applications in the street, i.e. smart meters, new heating and energy systems, etc. are lowering heating and electricity costs for users by 7%.



## The solution in context: Smart City – Cologne

### About the smart city vision in the city

The initiative Smart City Cologne is the result of a shared commitment between the City of Cologne and RheinEnergie AG, the regional energy provider in the Rhineland. Both partners were jointly involved and called for the development of this broad platform. Many other companies are involved through their know-how, technology, commitment or financial resources.

**Climate change, sustainability** and **technical innovation** are the three facets of Smart City Cologne to actively shape the future of the city. They support, unite and coordinate demonstrative and innovative projects while calling for efficiency and rational energy consumption. This is done in the areas of housing, employment, mobility, health, safety, supply and ICT. Smart City Cologne searches for innovation and breaks new ground: together, the parties want to try and see how new techniques and new forms of cooperation, communication and participation develop. In doing so, they support innovations while being particularly focused on climate protection. Smart City Cologne lives through networking and exchanges: networking and interaction are the key to gain new ideas and approaches.

**Name of City** Cologne

**Country** Germany

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## School Energy Management System Lisbon, Portugal

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2008, the Portuguese Ministry of Education and Science in collaboration with Parque Escolar, a public company, and the City of Lisbon decided to launch a project in three pilot schools in Lisbon. The initiative is part of the **Connected Urban Development (CUD) program**, created by **Cisco** as part of the Clinton Global Initiative to **reduce global carbon emissions**.

The CUD was developed thanks to the participation of Cisco Internet Business Solutions Group and researchers from the Massachusetts Institute of Technology. The aim of the initiative was to **reduce operating energy cost by installing permanent ICT systems**. Parque Escolar decided to partner with Cisco, Schneider Electric, Verdiem and EDP-Energias de Portugal for the finalization of the project.

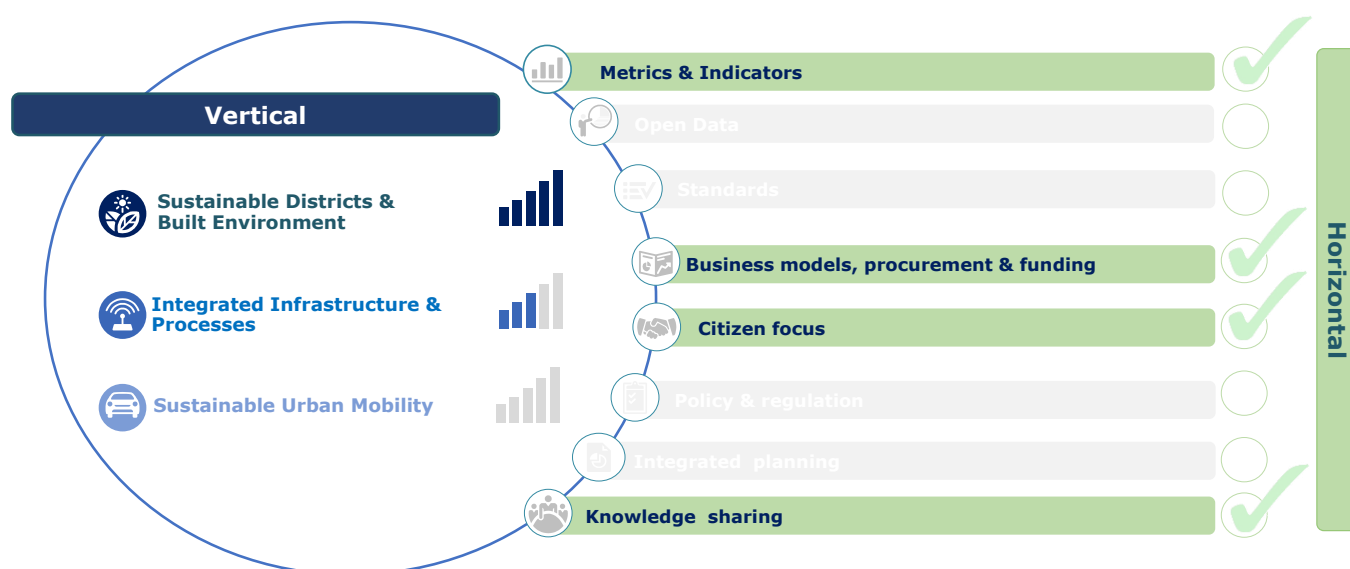
The three schools chosen for the project were: Fonseca Benevides, D.Dinis and Rainha D.Amélia accounting for approx. 1,000 students, 200 faculty and staff members and more than 6,600 m<sup>2</sup> of classrooms, offices as well as other public spaces, for each school.

<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, Ministry of Education and Science
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 1,200 students and staff members per schools
<b>Link</b>	<a href="https://www.cisco.com/c/dam/en/us/products/collateral/switches/catalyst-4500-series-switches/parque_escolar_epe_external_case_study_fnl_02_13_13.pdf">https://www.cisco.com/c/dam/en/us/products/collateral/switches/catalyst-4500-series-switches/parque_escolar_epe_external_case_study_fnl_02_13_13.pdf</a>

## Level of integration

The solution can be considered integrated especially across **ICT** and the **built environment**. The system is based on a unified IP network of all the main sources of energy consumption for updated energy monitoring and management. The system **integrates technologies from the different partners in the project**. More specifically, Cisco's EnergyWise is integrated into Schneider Electric's EcoStruxure architecture. Verdiem provides the **Surveyor software for monitoring and optimizing the energy use** of all the ICT devices. Cisco provides also the network system for the schools consisting of switches, routers and wireless access points.

The Verdiem' softwares help managing the energy consumption for the whole network consisting in total of 600 PCs, 120 Cisco IP phones, 150 wireless access points and the video surveillance system. Each device is then classified according to location, type and department in which it is used. Verdiem's Surveyor software integrates Micorsoft System Center as well as other client management solutions. The main approach for **reducing energy consumption consists of scheduling the use of lighting, ICT equipment and the ventilation system (HVAC)** according to the use of the buildings. By managing the HVAC and the lighting system it is possible to keep the temperature at a good level as well as to optimize the lightings. Another core goal of the initiative is to raise awareness by showing data, statistics and benchmarks to students and staff in each school.



## Business case

According to the results achieved in one of the schools, the use of the ICT system enabled a **reduction of 25% in energy consumption** with **savings of around € 10,000 per year**. It is estimated that if the system were applied to all schools in Portugal, the overall savings on ICT devices would amount to € 3 Mln.

The stakeholders that took part in the initiatives were both public and private. On the one hand, the Portuguese Ministry of Education and Science launched it in cooperation with the public company Parque Escolar. On the other hand, private companies including Cisco, Schneider Electric, Verdiem and EDP-Energias de Portugal took part by providing the necessary know-how and solution. The whole solution was funded thanks to the **capitals provided by the Clinton initiative**. Similar examples of other initiatives involving a comprehensive and integrated approach to energy efficiency in public buildings are the Smartspaces project developed in 11 EU countries and the Smart Build project implemented in 9 pilot sites across Italy, Slovenia and Greece.

## Community & Citizen Focus

The community and citizen focus of the initiative is highlighted by the possibility to involve students as well as school staff by raising their awareness in relation to energy saving measures. Students from technical schools are also encouraged to take an active role in the configuration of the solution by using it

as a point of departure for their final year project. Also, several students involved in the programme were inspired by the initiative and modified their behaviour outside school hours. In addition, they showed interest in achieving a career in environmental sciences at university.

## Impact

The goal of the initiative is **to reduce energy costs** in all the three pilot schools and present a possible solution that could be then expanded to the whole network of school buildings in the country. The success of the programme is reported by looking at the savings achieved in one of the pilot schools with **25% less energy consumption** and **€ 12,000 saved each year**. Also, the impact of the solution can be evaluated in terms of its success in raising awareness among students and school staff in relation to **sustainable** and **energy saving** behaviours as well as the **overall reduction in CO<sub>2</sub> emissions resulting** from the better management of energy consumption.



## The solution in context: Smart City – Lisbon

### **About the smart city vision in the city**

Lisbon's efforts to become **a leading Smart City in Europe** were expressed by the then mayor Antonio Costa in 2010 who committed to making **the city one of Europe's top cities in terms of innovation, creativeness and competitiveness**. Four years after, in 2014, Lisbon was the first city in Europe to allocate a **participatory budget of EUR 1 Mln to the development of start-up incubators networks** in the historic centre. The participatory budget started with 1,000 citizens in 2008 and reached 17,000 in 2011 showing the high involvement of the community. This initiative resulted in the creation of more than 600 jobs and in the establishment of a network involving incubators as well as large industrial groups and potential investors. Several tourist applications were created within this framework as well as the launch of the city's open data initiative.

Even though Lisbon is still at the beginning of establishing itself as a leading Smart City, it can already account for several other achievements in the field. Some examples are represented by Lisbon Start-Up, a major incubator, and Fab-Lab, digital fabrication laboratories for creating new products using rapid prototyping tools and machines. Overall Lisbon's Smart City strategy can be regarded as **focusing on the enhancement of entrepreneurship and ability to attract investors, improvement of the city's management structure and an increase in citizens' participation in the governance decisions**.

**Name of City** *Lisbon*

**Country** *Portugal*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.



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([www.cunard.com](http://www.cunard.com))



## Smart District Heating - CELSIUS Gothenburg, Sweden

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

One of the key ways to maximize carbon savings in cities is to **maximize the unused energy saving potential** by **tackling ways to effectively and efficiently recover energy losses**. The CELSIUS project is a European multi-city project which has a clear strategy and a pro-active approach to deployment of heating and cooling technologies, which will result in even more cities committing to the **CELSIUS roadmap** by the end of 2016.

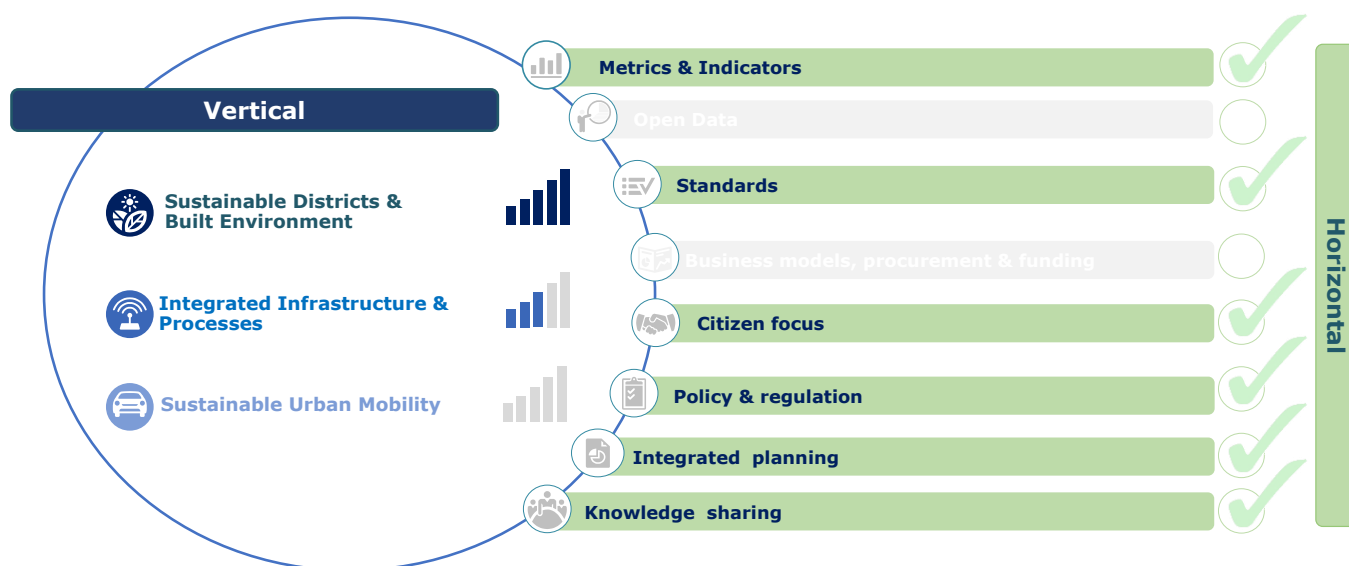
CELSIUS is the largest winning projects in the Smart Cities & Communities 2011 call. The four-year project is coordinated by the City of Gothenburg and presents best practice solutions in the area of **smart district heating and cooling by taking a holistic approach to overcome technical, social, political, administrative, legal and economic barriers**. The project brings together excellence and expertise from five European cities with complementary energy baseline positions: Cologne, Genoa, London, Gothenburg and Rotterdam. The consortium includes technical expertise from leading energy utilities organization as well as international renowned research and innovation organisations. Through the delivery of 12 new ambitious and innovative demonstration projects in and the additional more than 20 already in operation, the **CELSIUS project covers all aspects of urban heating and cooling systems**, including technical and deployment innovation and approaches to financing and stakeholder engagement.

The CELSIUS project runs a series of related and complementary demonstration projects which illustrate the range of opportunities that exist for using district **heating and cooling networks to maximize the efficient use of primary and secondary energy sources within a city**. It will play a leading role in enabling cities to make a cost effective transition to a low carbon and resource efficient economically competitive city.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority
<b>Budget</b>	€ 26 Mln for the total project
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://celsiuscity.eu/">http://celsiuscity.eu/</a>

## Level of integration

The solution is intrinsically integrated, as it is an ICT controlled energy flow management solution. It incorporates **integrated technologies with the purpose of ensuring a better management of energy** and a **better energy performance** and infrastructure of the districts included in the project. **ICT technologies** monitor and measure primary and secondary energy flows allowing them to be efficiently redirected.



## Business case

The four-year project is coordinated by Göteborg Energi and is publicly owned by the City of Gothenburg. The solution is therefore public driven.

CELSIUS presents best practice solutions in the area of smart district heating and cooling by taking a holistic approach to overcome technical, social, political, administrative, legal and economic barriers.

The real strength of the CELSIUS project is the diverse combination of cities of **differing sizes and very different starting positions** but all sharing a common goal and passion for mitigating climate and to do this partly through investing in **intelligent district heating and cooling networks**. The variety of CELSIUS cities shows that a range of different cities can deploy a district heating system.

The total cost for the demonstrators is € 26 Mln, of which the cities themselves will provide € 17 Mln. The requested EU funding enables these activities to start laying the foundation for the successful large-scale deployment of the CELSIUS City Concept across Europe and beyond 2020. District heating and cooling solutions are generally more capital intensive than conventional energy sources. The main driver of the high cost is the initial investment in the network of hot water pipes, to overcome the above mentioned challenge to replication.

The European Investment Bank (EIB) will be supporting the CELSIUS project in developing the strategy for large scale roll out. It will look at how European Structural Funds and financial instruments, such as **JESSICA**, could play an important role in enabling deployment at the scale and speed that the CELSIUS project is aiming for. The market rollout strategies will identify what needs to be done to address the barriers and so create a fully functioning market with considerable city demand for its products and services.

The objective of the CELSIUS concept and demonstrators is a **return of investment of 10-15 years** (except for the large demonstrators).

In addition to this there is also the need to define, develop and test business models that allow a fair price to be agreed, for example with industrial waste heat suppliers, for supplying waste heat to a network.

The solution **is already implemented as a pilot project in Koln, Rotterdam, Genoa and London** in order to find out if the goals can be achieved in different contexts. One of the goals with CELSIUS was to recruit 50 new CELSIUS cities and to provide them with relevant support, advice and guidance to help gain support for, establish, construct or ultimately grow district heating and cooling systems in their cities.

There is one major limitation and challenge to the replication of CELSIUS: the lack of thermal grid coverage in many European cities. To reverse this, there is a need to develop new, innovative and financially competitive thermal grid concepts; state-of-the-art solutions have already been developed in Gothenburg, Sweden, and the learning and experiences of these needs to be shared more widely.

Also, one of the most important challenges that needs to be addressed if the EU is to deliver rapid deployment of **large-scale district heating systems** is the political one. It is fundamental to the agenda that there is strong political commitment and support for the role that these systems have in enabling cities to **become more energy and carbon efficient**.

## Community & Citizen Focus

The solution will stimulate demand in the energy sector by strengthening the European energy industry in terms of **low-carbon emissions**. The end users will benefit from the introduction of district energy networks and the integration with industrial parks with the aim of **minimizing energy loss in terms of reduced energy bills**.

## Impact

Deploying the CELSIUS project on a larger scale in multiple cities will massively stimulate markets for relevant enabling technologies. Suppliers of heat pumps, turbo-expanders etc. will see a rise in demand affecting positive economic impacts, including rises in employment and wages.

Consumers of energy in general like commercial and industrial actors and private end users should also see positive economic outcomes as energy bills are reduced.

CELSIUS has a clear strategy and a pro-active approach to deployment, which will result in even more cities committing to the CELSIUS roadmap by the end of 2016. When fully implemented in these cities, this will lead to at least a 100 TWh reduction in the use of primary energy annually. This will reduce the **CO<sub>2</sub> emissions** by approximately 20 Mln tonnes per year. CELSIUS aims to be a corner stone in the large scale deployment of smart energy cities that will support the **EU's 20-20-20 goals**.

One of the main objectives of CELSIUS is to **demonstrate a cost-effective and very energy efficient heating and cooling system for replication and massive roll out, while ensuring a healthy urban environment recovering waste energy in energy efficient and smart way and favouring the integration of renewable energy**. Potentially, there is a total primary energy reduction of 4,500 TWh/year, and 900 Mln tCO<sub>2</sub> reduction per year. The CELSIUS initiative launched in this project is designed to be institutionally sustainable in the longer term and thus to continue to play a major role European energy policy in the future.

The goal of CELSIUS is to commit another 100 cities at the end of 2026, decreasing primary energy use by at least 600 TWh annually. This will make a significant impact, by decreasing the use of primary energy use throughout Europe by 5%.



## The solution in context: Smart City – Gothenburg

### About the smart city vision in the city

Gothenburg is Sweden's second largest city with a population of a half a million. It is situated on the west coast of Sweden at the mouth of Göta Älv River and is the largest of the seaports in the Nordic countries. After its foundation in 1621, shipping and trade dominated the industry in the city. In the 19th century, Gothenburg developed into a modern industrial city that continued on into the next century with the development of major companies such as SKF and Volvo. Today, Gothenburg has a highly diverse industrial structure and is the heart of a large and growing business region. Gothenburg is also home to many students and researchers, as the city includes both the University of Gothenburg and Chalmers University of Technology.

**The City of Gothenburg's vision is "A sustainable city", where the goal is to achieve a fair and sustainable level of CO<sub>2</sub> emissions per capita by 2050.** The way to get there is to further reduce both regulated emissions and emissions of fossil CO<sub>2</sub>. In order to achieve a sustainable and globally fair level of emissions, each inhabitant of Gothenburg needs **to reduce their emissions of greenhouse gases to a fifth compared to the present level.** A transition to **energy efficient and fossil-free solutions** requires new technological solutions, courageous decisionmakers and climate-aware consumers. Gothenburg is a member of the EU initiative "Covenant of Mayors", which aims to meet and exceed the **European Union's objective of a 20% CO<sub>2</sub> reduction by 2020.**

**Name of City** Gothenburg

**Country** Sweden

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Smart Street Sant Cugat, Spain

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2011, Sant Cugat started to build the first Smart Street in Catalonia to try different **ICT solutions for the urban context, the environment and for the management of mobility services**. The vision for the successful implementation of the Sant Cugat Smart Street has been inserted in the **2011-2020 Strategic Plan**.

Four major pillars are at the base of the technological solutions deployed in Sant Cugat, namely: the **access to information** (available for all actors and stakeholders involved; feedback and continuous improvement), **communication** (deployment of an extensive communication network), **deployment of sensors** (efficient measurement systems, reduced costs and easier maintenance), **intelligent systems** (support for decision making, interpretation of data).

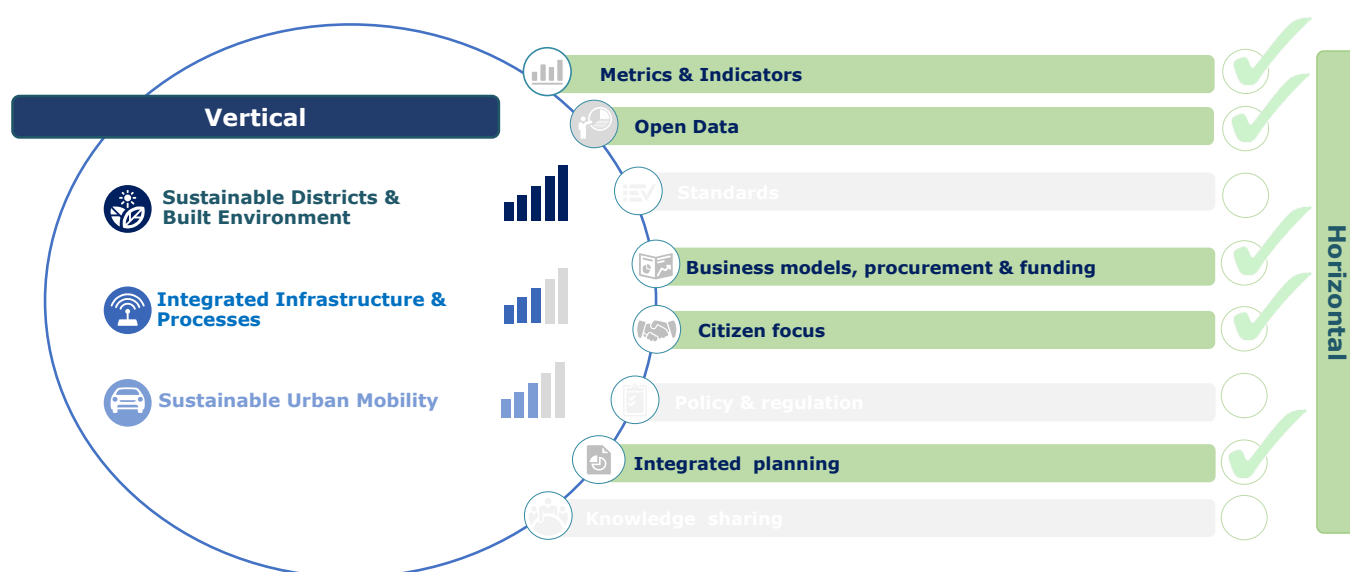
The solution has been developed via a public-private partnership with the Municipality of Sant Cugat directly collaborating with private companies. Moreover, citizens have been actively collaborating by proposing new ideas. Collaboration across different departments inside the city administration has also been enhanced.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 320,000
<b>Link</b>	<a href="http://smartcity.santcugat.cat/?lang=en">http://smartcity.santcugat.cat/?lang=en</a>

## Level of integration

Sant Cugat's Smart Street integrates aspects from **ICT, urban mobility and environment**. **Sustainable urban mobility** is increased by developing a sensorized system for vehicles in order to achieve **traffic efficiency** and **avoid traffic jams**. Moreover, a sensor network monitoring system has also been deployed in parking and outdoor areas.

The environment benefits from many aspects. Solar-powered rubbish compactors have been deployed in city garbage containers, therefore helping to reduce the collection frequency. Irrigation systems for urban green areas operate based on **remote sensors that track temperature and humidity, saving water and energy consumption**. Lighting in pedestrian areas also runs using motion sensors, and its intensity is regulated based on location, time of day and other factors.



## Business case

The development of Sant Cugat is carried out by the City Council and private companies. New innovative companies have deployed their solutions in Sant Cugat. Two of them are winners of the Living Labs Global Award in the category of Sant Cugat. The Smart Street is a real life laboratory for companies to demonstrate they are able to integrate, communicate and share data with other management systems, so the city can take advantage of the integration and synergies created. The main objective of the City administration is to **monitor** and **control the efficiency** of the services implemented on the street, and to evaluate **integrated solutions in a centralized platform** with sufficient capacity to serve future technology deployments.

A **collaborative public-private arrangement** is at the heart of the model: private companies invest 100% of the cost of deployments, and the city assists with technical personnel and labour resources. The **cost of implementing the solution has been zero for the city budget**. The City Council has contributed to the project with the technical and manpower resources, while companies have provided supplies and installation of all technology solutions following a **win-win scheme**. The access to the right channel for financing proved to be easy. The model used for the Smart Street based on PPP is currently adopted by the city council for deploying other innovative solutions across the city.

The solution doesn't present any place specific limitations and can be replicated also in other contexts. Similar Smart Street solutions have already been replicated across Europe. Some examples include Klimastraße in Cologne or Climate Street Amsterdam.

## Community & Citizen Focus

The development of Smart City Sant Cugat Strategic Plan goes further than a mere technology project. This new model has the objective to rethink the city as a connected and sustainable entity, where citizens

participate actively in the decision of the council and where all solutions are focused on improving the quality of life as follows:

- **By integration:** The projects and solutions related to Smart City developments are seeking solutions and alternatives that may be shared by different departments in order to save costs and to achieve better goals to the public.
- **By communication 2.0 between government and citizens:** The interaction model proposes an open, flexible and scalable dialog in the city, capable to promote people, municipal government and businesses in listening and providing innovative answers to the roadmap.
- **By knowledge management and creative talent support:** The new municipal administration has a commitment to society, where transparency can effectively manage and move forward the best ideas and contributions of citizens in behalf of Sant Cugat competitiveness.

## Impact

The estimated savings for municipal services amount to **more than 30% of street lighting energy consumption and 28% for the waste collection budget**. The success of the solution can also provide the conditions for promoting the economic competitiveness of the city, based on **new technologies** and companies with entrepreneurial talent.

In terms of environmental impacts, the solution enabled to **cut lighting pollution by 70%** and **increase recycling by 44%**. The solutions displayed in the Smart Street increased also the level of services for citizens, therefore carrying relevant social impacts. It was estimated that 7 out of 10 citizens evaluated the quality of services as superior compared to the past.





## The solution in context: Smart City – Sant Cugat

### About the smart city vision in the city

A central milestone in the development of a smart city vision in the city of Sant Cugat has been represented by the **Strategic Plan launched in 2011-2020** and focusing on providing an efficient, sustainable and more liveable city for citizens. Following the Strategic Plan, the City Hall established a sustainable high-tech zone (smart street) where to implement a series of innovative measures. Several projects resulted from the initiative, including: the **implementation of a guided vehicle parking, an intelligent garbage refuse collection point, a street lighting system sensitive to presence, an irrigation system dependent of the humidity levels and a pedestrian crossing equipped with light-based sensors**, among others.

Moreover, Sant Cugat has also been one of the first cities promoting the **City Protocol Society**. The City Protocol Society is an international forum including city councils, industry, research organisations and other agencies cooperating together in order to foster the sustainable transformation of urban spaces. Several large international corporations such as INDRA, Microsoft, Abertis or Telefonica; and prestigious academic centres – ESADE, UPF, and London School of Economics are already part of the consortium.

**Name of City** Sant Cugat

**Country** Spain

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **17**  
Global Cities Index – Bloomberg (2014): **24**  
The Economist – City Competitiveness rankings (2013): **55**

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## Vienna Citizens' Solar Power Plant Vienna, Austria

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

By investing in **community-funded renewable energy power plants** (solar, wind and potentially others), Vienna citizens have the opportunity to participate in the **development of renewable energies** in their region. This solution has been developed by Wien Energie, the electric company owned by the Municipality of Vienna. In 2012 Citizens' Solar Power Plants marked the beginning of the dawn of this scheme for Vienna, and showed the city's clear commitment to developing solar energy.

On 4<sup>th</sup> May 2012 the first citizen solar power plant solution opened on the site of the Donaustadt in the north of Vienna, with 2,100 photovoltaic modules and an output power of 500 kWp. The energy of this plant is fed into the Vienna power grid and provides electricity for approximately 200 local households. To date 21, citizen solar power plants have been realised in and around Vienna; locations include Donaustadt, Leopoldau, Simmering, Liesing, Wien Mitte, Hietzing, Bisamberg, Oberwaltersdorf, etc. All solar panels of the Citizens' Power Plants have been sold out in a very short time, showing a strong interest by the citizens in this solution.

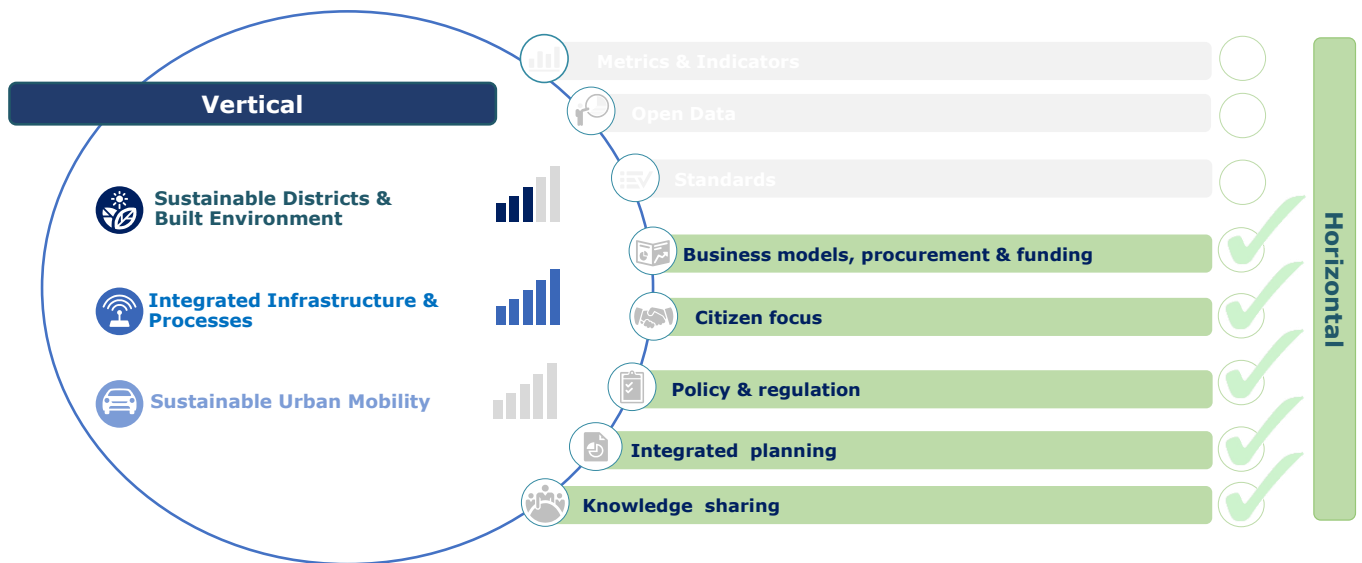
Due to the success of the scheme, the Municipality of Vienna, by means of its owned electric company, is also branching out into wind energy from 2015. This is the first time a **participation/crowdfunding model** of this kind has been implemented in an urban area, and it has proven economical even without subsidising feed-in tariffs.

<b>Starting year</b>	2012
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority (via the city's electric company), public or private actors that rent the land or the roof for the plants and citizens.
<b>Budget</b>	€ 20 Mln from citizens for photovoltaic power plants € 5 Mln from citizens for wind power plants
<b>Number of impacted users</b>	Approx. 18,000
<b>Link</b>	<a href="https://smartcity.wien.gv.at/site/en/projekte/umwelt-klimaschutz/buergerinnen-solarkraftwerk/">https://smartcity.wien.gv.at/site/en/projekte/umwelt-klimaschutz/buergerinnen-solarkraftwerk/</a>

## Level of integration

The whole project can be seen as an example of **integrated solution across Sustainable Districts and ICT infrastructure**.

The citizen solar power plants represent **a good solution for distributed renewable power plants, helping in GHG emission reduction, renewable energy deployment and citizen participation**. Furthermore the related **ICT infrastructure** is applicable to both the electric company and citizens, allowing them to monitor the production levels of the power plants. Citizens can constantly be updated with information and productivity details of the power plants they own, through the website or dedicated mobile apps.



## Business case

The majority of citizens in Vienna live in flats. There are many hurdles and burdens for tenants/flat owners to take part in renewable energy development. Problems include:

- Complex ownership structures;
- Approval procedures;
- Downscaling investment options;
- No technical expertise;
- Conservation of buildings with historical heritage and value.

The **Sale & Lease participation model** used by the electric company overcomes in Vienna overcomes these hurdles and provides a simple, profitable and secure option for interested people to participate in solar development.

All Vienna residents and any private individual living in Austria can get involved in the citizens' renewable energy power plant by buying a solar energy panel or a wind power plant share to support the conversion to renewable energy in Vienna.

Wien Energie is in charge of building the turnkey photovoltaic/wind power plants and operating them.

For solar energy power plants, citizens can buy whole or half panels at a price of € 950 or € 475 respectively. Wien Energie rents the panels from the individual purchasers, who then receive an **annual profit of 2.25%** on their investment. The annual "rent" is paid directly to their accounts once a year. Once the service life of the photovoltaic plant ends after approximately 25 years, Wien Energie repurchases the panels and the amount originally invested is returned to the citizens. Citizens own 100% of the photovoltaic power plants, while the electric company is in charge of building the turnkey photovoltaic power plants, operating them, selling the produced energy and paying annual profits to citizens.

Regarding wind energy power plants (made up of 15 wind turbines), citizens can buy whole shares at a price of € 950 respectively, for each of the two developed wind power plants 2,579 shares were available. Wien Energie rents the shares from the individual purchasers, who then receive an **annual profit of 2.25% on their investment**. The annual “rent” is paid directly to their accounts once a year. Once the service life of the wind plant ends after 20 years, Wien Energie repurchases the shares and the amount originally invested is returned to the citizens. Regarding wind power plants, due to some legal constraints citizens own 51.1% of the wind power plants, while the electric company owns the 49.9% and is in charge of building the wind power plants, operating them, selling the produced energy and paying the citizens the annual profit.

## Community & Citizen Focus

The Citizen Power Plant enables citizens to invest in renewable energy. The project highlights several factors important to citizens of Vienna:

- **Adding local value;**
- **Enhancing quality of life in the city;**
- **Encouraging ecological awareness and climate protection;**
- **Enhancing independence of power imports;**
- **Income returns.**

In other words, the citizens of Vienna are able to be involved in setting the agenda and pace for Vienna’s renewable energy policy. Furthermore, they are actively **reducing local pollution levels while making a sound investment**.

This case shows the relevance that citizens may have in supporting the development of renewable energy and of a sustainable and clean future.

## Impact

The Citizen Solar Power Plant received an enormous response at its launch, and the first batch was sold out in 26 hours, producing a level of demand that was not expected. At the moment, around 21 Citizen Solar Power Plants are up and running supplying more than 2,500 households with electricity. That is the equivalent of around 2,000 tonnes less of CO<sub>2</sub> emission/year.

Similarly, the two wind power plants produce electricity for around 5,600 families, with a reduction of CO<sub>2</sub> emissions of 5,100 tonnes of CO<sub>2</sub>/year

These power plants are only one part of the energy strategy in Vienna. Wien Energie plans to obtain **at least 50% of its energy supply from renewable sources by 2030**. Green energy is produced close to consumers to minimise transmission losses and reduce dependency on electricity imports.

The switch in energy production from traditional to renewable (i.e. coal power plants to wind/solar power plants) will also contribute to better air quality in Vienna and surroundings.



## The solution in context: Smart City – Vienna

### About the smart city vision in the city

**Smart City Vienna is a long-term initiative by the city of Vienna** to improve the design, development and perception of the federal capital. Smart City Vienna looks at a cross-section of the city, covering all areas of life, work and leisure activities in equal measure, and includes everything from infrastructure, energy and mobility to all aspects of urban development.

Smart City Vienna has set itself the task of consistently and continuously modernizing the city in order **to reduce energy consumption** and emissions significantly without having to forego any aspects of consumption or mobility. Smart City Vienna stands for the **"intelligent city"**, intelligent and innovative solutions, and responsible and sustainable use of resources.

Smart City Vienna comprises first and foremost the aim of resource preservation. Development and modification processes in the sectors of energy, mobility, infrastructure and building management are set to dramatically reduce **CO<sub>2</sub> emissions by 2050**.

Wien Energie has set itself the **goal of increasing the share of renewable energies in electricity production to 50% by 2030**.

For this purpose, it is essential to make much more efficient use of the required input energy. It is the first big task of the present Smart City framework strategy of the City of Vienna to highlight ways and means in which Vienna can contribute to the attainment of the major European climate and energy objectives (for 2020, 2030 and 2050). Potentials towards these goals still exist to a high degree, although Vienna, due to ambitious plans and decades of consistent action, has already achieved much in the fields of climate and environmental protection. However, the responsibility for future generations above all motivates us to continue our pursuit of ambitious goals in the context of the EU energy and climate objectives for the period until 2050.

**Name of City** Vienna

**Country** Austria

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **1**  
Global Cities Index – Bloomberg (2014): **17**  
The Economist – City Competitiveness rankings (2013): **29**

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## Waste Water Management System Copenhagen, Denmark

→ Replication potential		→ Economic impact	N.a.
→ Complexity		→ Environmental impact	N.a.
→ Citizens' involvement		→ Social impact	N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Copenhagen, also known as the **Venice of the North**, is essentially built on and around the surrounding water, making the latter the main natural and renewable resource of the city. Consequently, an efficient wastewater management system is what the city aims to achieve and it is one of the key success factors of its sustainable growth.

The Copenhagen **Waste Water Management System** is organized in closed pipes underground, exploiting the gravitation pull that makes waste water drain off from ground floors to sewers.

The increase of urban development and the resulting need to expand underground sewer mechanism, together with the negative effects of climate change, increased the pressure on central treatment plants.

Ramboll Management Consulting Group played a strategic role by **setting up a smart and sustainable waste water system**, making it possible to avoid drastic measures while exploiting the full potential of drainage systems. The initiative was launched in 2008 and it basically consisted in cleansing a larger amount of water thanks to a smart system of integrated pumping stations and valves. These ones are automatically closed and opened, according to specific signals coming from radars and sensors connected to the whole mechanism.

<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry.
<b>Budget</b>	€ 215,000 <sup>24</sup>
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://www.ramboll.com/projects/group/copenhagen-wastewater">http://www.ramboll.com/projects/group/copenhagen-wastewater</a>

<sup>24</sup> The conversion rate used for this case study is 1€=7,46 DKK

## Level of integration

The solution is significantly integrated. In addition to its **main purpose of waste water treatment, the system also enables the production of heating**. The excess sludge originated from the water treatment process is burned in a specific incineration plant.

The resulting ash and gas from the incineration process are used to cover **77% of the energy consumption** of the treatment plants. Additional heat resulting from the process is also distributed to houses via the district's heating grid. Moreover, the whole system involves an advanced system for closing and opening the pumping stations automatically, exploiting rain radars. For these reasons the solution can be seen to include elements of both infrastructure integration and sustainable districts.



## Business case

In 2008, hydraulics and water-quality models for waste water plants and drainage systems were built up.

After this first phase, in 2010, the optimum scenario was calibrated in order to integrate sewer system and treatment plants with the automatic opening and closing mechanism of pumping stations and valves. The waste water was projected to flow into large, central treatment plants, and it also has been demonstrated that this choice generates lower costs per treated cubic meter of waste water, compared to the same process carried out in decentralized treatment plants.

The project can be deemed to be economically sustainable, and has implied significant savings both in terms of **waste reduction** and **cost-effectiveness of the solution**.

**The value of this whole phase of the initiative amounted to almost € 215,000.**

The solution was financed by the city of Copenhagen, which commissioned the initiative to Ramboll Management Consulting Group in partnership with Lynetten and Damhusåen's treatment plants.

The key success point of this initiative is the integration between sewer systems and wastewater treatment plants. It combines the use of existent advanced technologies. Furthermore, this system makes it possible to both manage current scenarios and prevent future (negative) ones. Similar solutions are currently being developed in other areas. One of the main countries for the application of this kind of solution is Germany.

## Community & Citizen Focus

The treatment plants involved meet the standard set for wastewater treatment, in line with national requirements and the Urban Waste Water Directive. Plus, in order to preserve citizens' wellbeing, avoiding health risks, **the treatment plants are located far away from housing areas**.



The Waste Water Management System in Copenhagen is seen as an answer to achieving better environmental sustainability, which is one of the main challenges the community is facing.

This smart initiative is taking place in a democratic paradigm, since its advantages benefit all private households, enterprises and institutions in terms of creating a healthier and safer environment.

## Impact

An intelligent waste water handling system means a greater capacity to treat waste water, **a reduction in pollution** thanks to a larger amount of cleansed water, and a smart mechanism which exploits integrated technologies, by creating a connected natural resource management system.

In 2014, Copenhagen was awarded the European Green Capital title for its innovative social, economic and environmental policies, which improved the citizens' quality of life. The waste water treatment was one of the 12 indicators the city of Copenhagen was evaluated on, since water and energy were declared as the two most essential services to provide the city with.



Image source: visitdenmark [www.visitdenmark.it](http://www.visitdenmark.it)

## The solution in context: Smart City – Copenhagen

### About the smart city vision in the city

According to the declaration of the **Eco-metropole of the world** (City of Copenhagen, 2007), Copenhagen aims to demonstrate global leadership in the field of green urban environment management.

In addition to the waste water case, Copenhagen qualifies as a smart city also for other policies and practices. Indeed, city council declares that Copenhagen is on track **to become the first carbon neutral city in the world by 2025, with a decrease of CO<sub>2</sub> consumption to under 1.2 Mln tonnes** (compared to the current level of 2.5 Mln tonnes). The four focal points of Climate Plan 2025 are **energy consumption, energy, mobility and city administration**.

Finally, as part of an initiative by the European Commission, Copenhagen has been nominated **European Green Capital 2014**, in particular thanks to its focus on environmental improvement and green growth, which it has committed to for the last 20 years.

These results are not accomplished by the city alone: the citizens are engaged in these objectives and particularly motivated to pursue common goals in order to perceive an increase in their quality of life.

<b>Name of City</b>	Copenhagen
<b>Country</b>	Denmark
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): <b>15</b> Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): <b>15</b>

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## Water management System Mumbai, India

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The City of Mumbai has recently set up a water-metering system to **ensure and optimise water distribution to its population**. The innovative system, distributed by Itron Inc., features the deployment of several water meters that can be read remotely. The scheme manages to guarantee tap water to half of the city's 13 Mln residents for a few hours a day, avoiding any theft or leak.

About 50% of Mumbai's potable water is lost, compared to an average of 34% worldwide and about 10% for the most efficient water systems.

In addition, the solution includes the implementation and maintenance services and training of the meter readers of contractors to ensure the success of the deployment of the advanced metering solution project in India.

**Metering helped the Municipal Corporation of Greater Mumbai find leaks and discouraged waste, thereby putting a value on a shared resource.** In practice, Mumbai residents fill cisterns daily to assure a 24-hour water supply.

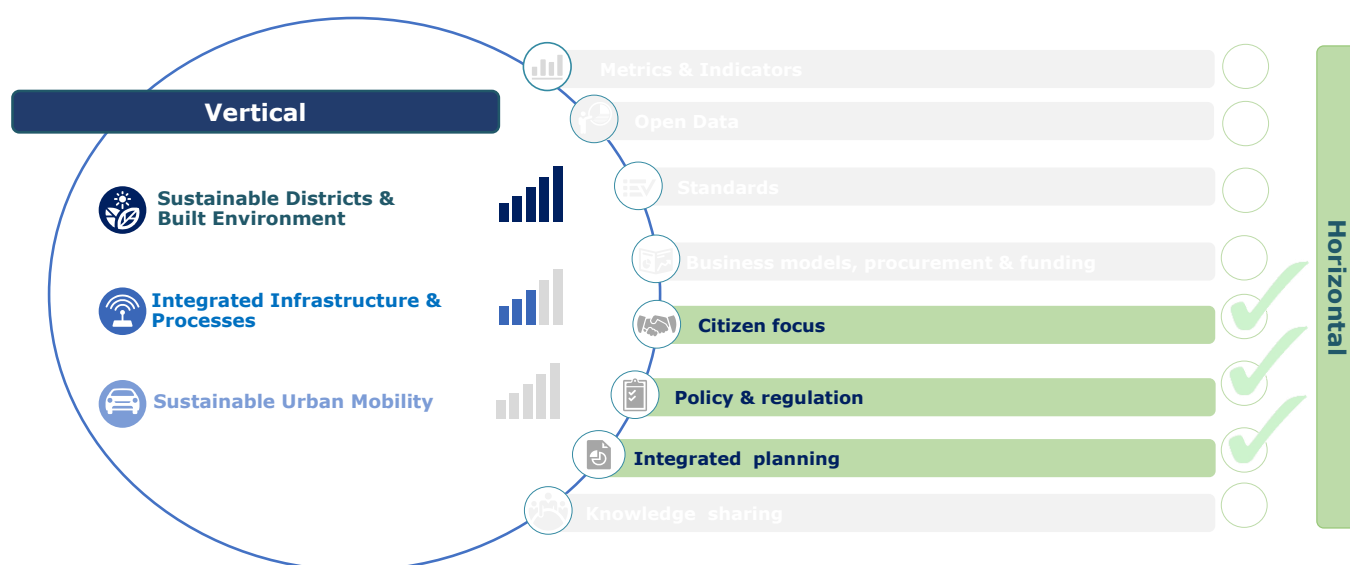
In 2013, Marcel Regnier, Itron's chief operating officer for water, said that *"the target was, with the same level of resource and the same capital investment, to provide water to a larger portion of the population"* (Bloomberg, 2013). Initial results show a **"significant" improvement in supply** and new customers, although it's too early to quantify this.

The solution was selected after **a pilot in early 2009**, when the Mumbai municipality awarded Itron a pilot phase for approximately 3,000 residential and business meters, all of which were equipped with radio frequency (RF) modules. Over six months, Itron successfully ran the automated meter reading (AMR) pilot in partnership with Pratibha, Axelia and Unity, which were responsible for sourcing and maintaining the AMR water meters.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart technologies for the built environment
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry.
<b>Budget</b>	€ 26 Mln
<b>Number of impacted users</b>	Approx. 7 Mln users
<b>Link</b>	<a href="http://www.smartmeters.com/itron-smart-water-meters-reducing-water-loss-in-india/">http://www.smartmeters.com/itron-smart-water-meters-reducing-water-loss-in-india/</a>

## Level of integration

The solution includes **120,000 advanced automated meters, 40,000 standard meters, mobile collection equipment and software, which is used to collect, measure and analyze water usage.** With 120,000 advanced meters deployed in New Delhi, the project will be India's largest mobile advanced metering system when completed. The water meters are equipped with EverBlu Cyble AMR modules and a complete meter reading system including handheld terminals and AnyQuest Mobile AMR software. This system allows the collection of historical daily consumption data, GPS functionalities, alerts for fraud attempts and leakage events.



## Business case

Itron was selected after a six-month pilot in collaboration with Larsen & Turbo, a consultancy. **Funds for this civic project** are made available under the **Pooled Municipal Debt Obligation Facility**, set up in 2006 with the participation of several banks to promote and finance infrastructure projects in urban areas on a shared risk basis. The Union budget has increased the corpus of this facility from Rs 5,000 crore (€ 0.7 Bln) to Rs 50,000 crore (€ 7 Bln).

Concerning **smart metering** and **integrated water management**, the 2011-2012 budget for the upgrade and installation of smart meters was **€ 26 Mln** (MGCM, 2012).

**The solution has been replicated.** Itron has also been awarded another contract by a leading Indian infrastructure development company, SPML, to provide 90,000 advanced meters in the Malviya Nagar, Vasant Vihar and Mehrauli areas of New Delhi.

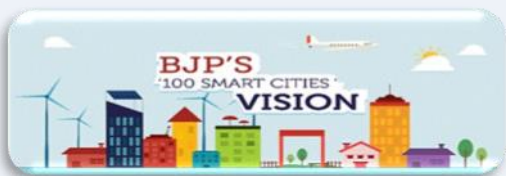
**The advanced meters have also been applied in Europe.** Apa Nova București will deploy Itron-manufactured water meters over the next four years to high-consumption customers and in multi-family buildings in a bid to allow the utility to better manage and conserve water resources. The Romanian water utility, which has a service base of 2 Mln customers across Romania's capital and largest city, Bucharest, said it also wants to upgrade its metering infrastructure to improve the accuracy of billing and improve customer service.

## Community & Citizen Focus

The solution provides tap water to half of the city's 13 Mln residents. About 50% of Mumbai's potable water is lost, compared to an average of 34% worldwide and about 10% for the most efficient water systems.

## Impact

In a Bloomberg report of March 2013, Itron Inc. declared that the smart meters, together with an integrated central ICT management platform installed in Mumbai, reduced water losses by half, corresponding to 700 Mln litres (150 Mln gallons) a day of water wasted or leaked by broken pipes.



## The solution in context: Smart City - Mumbai

### About the smart city vision in the city

In the last period, the city's development authority has decided to develop all upcoming hubs in the **Mumbai Metropolitan Region as smart cities**. UPS Madan, metropolitan commissioner at the Mumbai Metropolitan Region Development Authority (MMRDA), said, *"The idea is that when any brand new area is developed as a greenfield development, then we should have components of a smart city in it. It is much easier to make a greenfield project a smart city than retrofitting these components in existing areas."*

The MMRDA is planning to develop **five growth centres** – Vasai-Virar, Bhiwandi, Greater Kalyan, Greater Panvel and Pen-Alibaug – in the Mumbai Metropolitan Region along the proposed 126 km Virar-Alibaug Multi Modal Corridor.

**Name of City** Mumbai

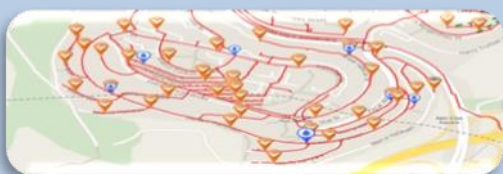
**Country** India

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Water Network Monitoring & Management Jerusalem, Israel

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The background of the SCC solution is that **water leak detection** is one of the key means for **reducing water losses in urban water distribution networks**. As most leaks remain under the surface, utilities find it difficult to reduce water loss and to properly assess pipe condition. **Current leak detection technologies are lacking in terms of reliability, accuracy and return on investment**. For example, Existing fixed sensors are not optimal due to issues such as noise loggers that have limited sensitivity for small leaks up to 165 Feet and low specificity. The **primary challenges** of working with correlating sensors are: 1) **high attenuation and dispersion of acoustic waves in branched pipes of different diameters** 2) **high sensitivity to artefacts such as sporadic water consumption that create artefacts** 3) **interpretations of correlation logger's results require expert analysis and experience to identify leaks and discriminate it from artefacts**.

Water supply has always been a major problem in Jerusalem, as attested to by the network of ancient aqueducts, tunnels, pools and cisterns found in the city. Because rain only falls in winter and largely in the northern part of Israel, water engineering is important for the country's survival and growth.

In such a context, the city of Jerusalem reduces water waste in urban water distribution network through a smart water leaks detection system. **The system is able to monitor the water distribution network, avoiding unexpected costly pipe bursts**. The solution uses technology from Aquarius Spectrum, a portfolio company of Council Associate Partner Hutchison Kinrot and TaKaDu's web-based service company.

**Starting year**

2011

**Type of integrated solution**

Smart technologies for the built environment

**Scaling or Replication**

Yes

**Key actors / stakeholders**

Public Authority, Industry.

**Budget**

€ 1.5 Mln

**Number of impacted users**

Entire city

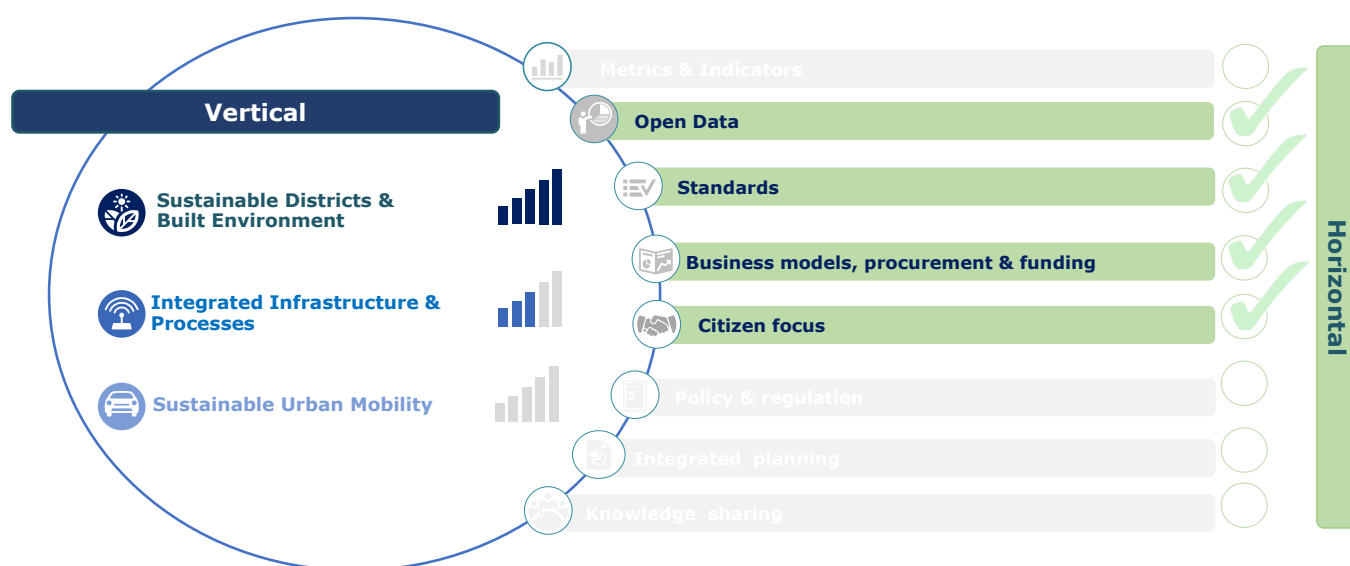
**Link**

<https://www.haqihon.co.il/?nodeId=13>

## Level of integration

The water network monitoring solution portal provides an example of **integration of sensors with infrastructure** (urban pipes network) **and use of ICT** (3G cellular communication and GPS based time synchronization that transmits data to the server for signal analysis and results presentation via web browser).

The solution integrates information from sensors that are installed on fire hydrants above the ground or pits in a complex urban pipe network. The sensors feature 3G cellular communication and GPS-based time synchronization that transmits data to the server for signal analysis and result presentation via a web browser. The system features automatic leak detection based on proprietary multiband correlation algorithms and statistic artifact rejection. Information on leaks and sensors is presented as layers on a web-based interactive map and the Utility GIS system. The system suggests the next actions to be taken.



## Business case

The solution is funded partially by the Israeli Government Grant for the introduction of innovative technology **to reduce carbon emissions** and by the Hagihon company, which was founded in 1996 by the Jerusalem Municipality and operates as an independent corporation by authority of the Water & Sewage Corporations Law.

Hagihon became officially independent from the Municipality of Jerusalem in 2003. In 2014, Hagihon, TaKaDu (a global leader in integrated water network management) and Aquarius Spectrum signed a three-year contract extension. This is following a four-year period in which Hagihon used TaKaDu's integrated water network solution **to improve its operational efficiency, and ensure high quality water provision to about 1 Mln residents of the City of Jerusalem.**

The contract signed with Aquarius Spectrum for detecting leaks in the municipal water supply system is worth NIS 6 Mln (about € 1.5 Mln).

Aquarius Spectrum's system technology has been deployed in water utilities of three cities in Israel, the Town of Mevasert Yerushalaim, the Town of Abu Gosh and Netanya.

The TaKaDu solution, which makes it possible to monitor the pipe network remotely (cloud-based solution) using data-driven technologies, has also been applied in Europe (Spain, UK and Portugal). In Spain, in 2013, TaKaDu announced the winning of a tender extension with the Spanish water utility, Udal Sareak.

## Community & Citizen Focus

Water resource scarcity is one of the next challenges for the coming years. Consumers, e.g. citizens, and providers, are key to ensuring a rational use of this precious and scarce resource. This solution mainly



focuses on the business community. Utilities are generally conservative when it comes to adopting innovation. The implementation of the solution teaches the importance of incentives to water utilities to become more efficient.

## Impact

One of the **main goals** of this proactive water leak detection system is to reduce water waste in urban water distribution networks: the technologies developed and manufactured helped the city of Jerusalem **cut its water losses to below 10% (annually, 200 Mln m<sup>3</sup>)**.

The system, which covers over 1,100 km of water pipe networks in Jerusalem and Netanya, has already successfully detected and reported numerous suspected leaks. From the full scale installation, which commenced in October 2014 with 1,400 sensors installed (out of the 2,700 planned) and 420 km covered (out of the 900 km planned) there were:

- 51 hidden leaks reported and 39 repaired;
- 15 private-network leaks discovered, making it possible to inform affected customers;
- 123 malfunctioning accessories revealed and replaced;
- **2.5% drop in water losses (reduction from 6%).**



## The solution in context: Smart City – Jerusalem

### About the smart city vision in the city

On 6<sup>th</sup> May 2015, Jerusalem City Hall hosted the finale of the **#JerusalemApp Smart City Contest**, which brought together **172 app ideas to improve transport and urban infrastructure, tourism, recreation and culture, access to municipal services, city appearance, and enhancements for the Jerusalem residency card.**

The Jerusalem City Master Plan provides a sustainable development pathway able to respect its many different communities, ethnic groups and religions: being a member of the CLEI global network (Local Government for Sustainability), **Jerusalem plans to reduce CO<sub>2</sub> emissions by 20% by 2020.** The strategy for Jerusalem City features several initiatives to respond to the 2020 goals: the City Plan caters to wastewater treatment and renewable energy actions as well as diverse sustainable initiatives in the urban mobility field. Furthermore, the Plan provides for the separation of solid waste, recycling and biodiversity preservation.

**Name of City** Jerusalem

**Country** Israel

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

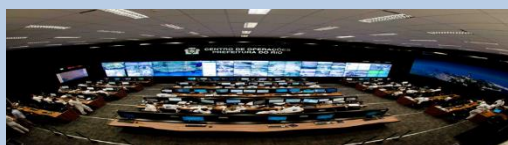
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# INTEGRATED INFRASTRUCTURE & PROCESSES



## ***Intelligent city services***



## Center of Operations Rio de Janeiro, Brasil

→ Replication potential		→ Economic impact	N.a.
→ Complexity		→ Environmental impact	N.a.
→ Citizens' involvement		→ Social impact	N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The establishment of the Rio Operations Centre was initiated on the basis of the catastrophic flooding and landslides that occurred in the city in 2010. The main objective of the center is to support initiatives in relation to **city safety** and **strengthen incident response** by collecting, integrating and analysing different types of information gathered from both public authorities and private sources. This information is provided by rain gauges, radar sensors, bus GPS systems, images, social networks, and other types of information. Incidents may range from public utility problems and public transit issues to emergencies and disasters.

Rio's operations center takes advantage of powerful databases, data integration software, communications technologies and analytics software for predicting accurately where and when flooding will occur. It acts as an **operational hub** for coordinating safety and security at large events, such as the Carnival, the 2014 World Cup, and the 2016 Summer Olympics. The center uses social media, news outlets, and sirens to inform and provide the citizens of Rio with instructions about incidents and traffic jams. The center is also in charge of the provision of routine information services (traffic flow, vehicle accident information, and commuter wait times).

The center has **three official tasks: 1) collect information from multiple sources and sensors located in the city; 2) analyse and investigate existing information with the aim of making operational decisions; and 3) disseminate existing information to the population** in order to alert citizens if any disaster or incident occurs.

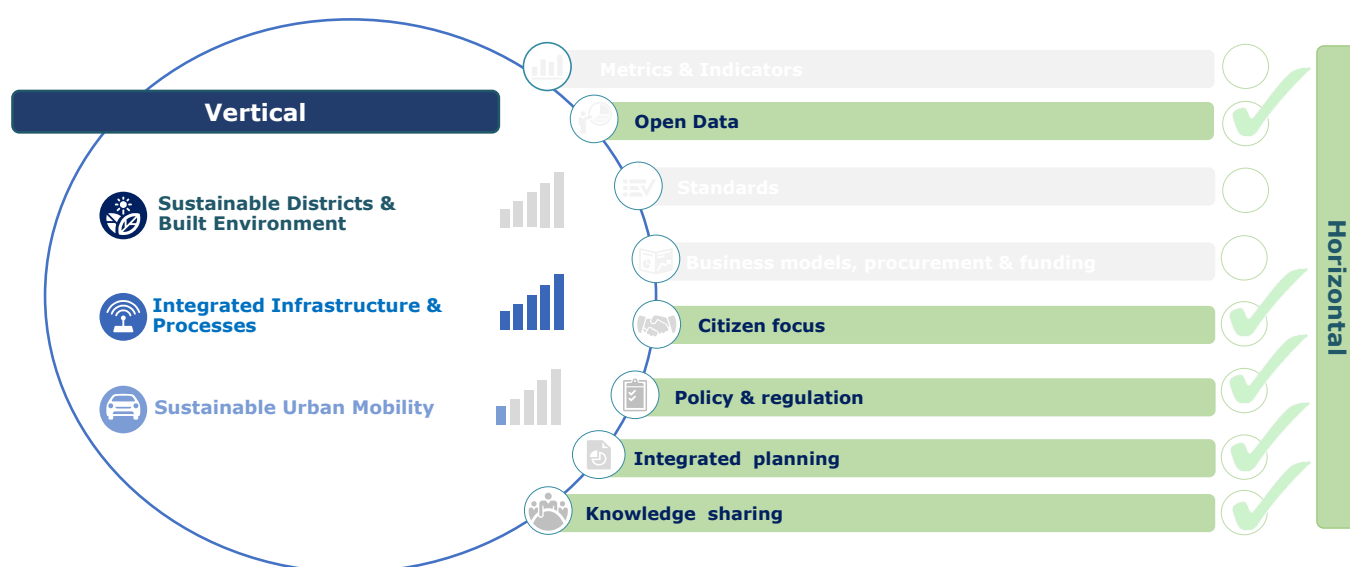
The city will make a significant amount of their data freely available to the public and will also be creating an **open-data policy**, so that all useful information will be available to the population for personal or commercial use (such as application developers). For this project, layers of APIs and data dictionaries will be used so that information can be easily searched.

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	€ 13 Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.rio.rj.gov.br/web/corio">http://www.rio.rj.gov.br/web/corio</a>

## Level of integration

The solution improves planning, resilient management, mobility and infrastructure through open data systems. The **Operations Center collects several types of data to monitor and coordinate major city events**. Furthermore, The Operations Centre helps to **cut down on CO<sub>2</sub> emissions** throughout the city as the updates and advisories help reroute traffic around congestion and accidents, meaning that cars, buses, and trucks are spending less time idling in avoidable traffic jams. While city buses are tracked and equipped with cameras, so too are the garbage trucks that serve the city which contributes towards making sure less garbage is accidentally missed and reducing the amount of garbage ending up in the bay.

Connecting agencies at a central level allows Rio to coordinate communications and actions to respond to events that affect citizens.



## Business case

The solution is based on a public-private partnership between The City of Rio de Janeiro and IBM. The city of Rio de Janeiro manages the Rio Operations Centre. The centre is in **charge of the day-to-day operations and coordination with city and state agencies**. IBM provides the necessary data and ICT systems.

The Centre of Operations is a manifestation of a huge cultural change for the city as an organisation, which was used to working towards individual, siloed aims, rather than towards a strategic, coordinated vision. In that sense, the Centre of Operations is as much about **supporting strategic organisational change as it is about the ability to optimise the city's disaster response**.

The implementation process was run through a tight collaboration with the representatives of Rio de Janeiro. The Mayor held regular meetings with representatives of the Centre, wanting to remain informed on the details of the projet.

Rio de Janeiro's city government funded the Rio Operations Centre. The assets are now owned by the Operations Centre, under the control of the city government's executive branch. The Centre of Operations is funded by € 13 Mln.

The Rio Operations Center is one of the **seven pilot projects** (other pilots include 3 US cities, 1 Polish, 1 Vietnamese, and 1 Chinese) that are part of IBM's Smarter Cities Challenge. Since its launch in 2010, IBM has advised (and in some cases awarded grants to) over 100 cities in how they can address some of their more challenging issues in a way that is more efficient and sustainable through the usage of these smarter technologies.

Zhenjiang, a city of about 3 Mln people in eastern China, bought the new system to manage public transportation. It also bought a custom analytics program to help predict and alleviate traffic jams along bus routes.

## Community & Citizen Focus

The Rio Operations Centre has a mission to **keep the citizenry informed** at all times. Radio stations transmit directly from the Centre, and the Centre has a Twitter handle **to disseminate pertinent incident information in real time**. Citizens can also Tweet requests for information from the Centre. All final information is publicly available. This media and Operations Centre outreach means that citizens of Rio de Janeiro can see the direct, day-to-day impact of the Centre on their own lives, both from an emergency response perspective and as a tool to aid travel within the city.

A final and important aspect of the Operation Centre's public accessibility is the ability to have alerts available to Brazilians on the move during their day. Updates, information and warnings are available via the website and social media apps like Facebook and Twitter, but not everyone are using these apps. For this reason all the same updates are sent out to all citizens in the affected area through SMS messages, making it so that even a person still using a monochromatic display cell phone (think the greenish-grey phone displays) can still receive vital messages such as incoming storms, evacuation orders, and evacuation routes on their mobile phones.

In terms of citizen and community involvement, **the population of Rio provides the data needed for the solution to run efficiently, but is not involved in the development process of the solution.**

## Impact

Rio Operations Center has setup performance indicators to be able **to track what is succeeding and what can be improved**. However, the data is not yet available, so actual estimates of the impact have not been determined.

The solution has created a fully integrated collection and connection of the city's public services (and some private ones), which has cut down on administrative burden.

The Operations Center connects more than 50 city agencies and their specific data. In the future, this will result in more cooperative and efficient relationships among the city agencies. Also, faster dissemination of traffic and transit information to commuter, buses and taxis has resulted in smoother traffic flow and better travel experience for commuters and users of public transportation.

The Center recently hired **business intelligence analysts** to study city behavior in the hope of **making improvements in the environmental field**. The Center is working on city and environmental management plans, and wants to partner with NASA to exchange information about climate change.



## The solution in context: Smart City – Rio De Janeiro

### About the smart city vision in the city

According to a report that looks at international examples of smart cities, published by the UK government,<sup>25</sup> when the current city government came into administration in 2009, Rio faced significant challenges. The city was one of the most violent in Brazil, and there were significant political and economic challenges. Rio also had the lowest health and primary care capability in the country. The new administration made a very strong fiscal re-alignment in the first two years of government. The previous budget was not seen as sustainable and the city was unable to meet its operational needs. The first fiscal action was to cut all spending in the city by 20%, and to re-negotiate all City contracts. The city leadership claims that this re-focusing of priorities was a **key enabler for developing new, more effective ways of operating the city, and incorporating new smart city technologies.**

Whilst there is no formal smart city strategy in place, **Rio is becoming the hub for digital start-ups in the country.** Furthermore, the level of investment in terms of construction is higher than any other city in Brazil. The city's main focus here is on growing their creative economy, which is a key strategic goal.

**Name of City** *Rio de Janeiro*

**Country** *Brazil*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): **56**  
The Economist – City Competitiveness rankings (2013): **76**



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→ Replication potential		→ Economic impact	N.a.
→ Complexity		→ Environmental impact	N.a.
→ Citizens' involvement		→ Social impact	N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In July 2012 over 200 participants, representing 33 cities, 20 major businesses, 14 universities and 20 other organizations, convened in the Barcelona workshop to learn about, discuss, and infuse life into the idea of a City Protocol Society.

**City Protocol is a collaborative innovation framework** with the aim of supporting city-centric solutions that bring quality and value to citizens. More specifically, City Protocol is a new open, global, and progressive working framework for cities worldwide to assess and **improve performance in environmental sustainability, economic competitiveness, quality of life, and city services**, by innovating and demonstrating new leadership models, new ways of engaging society, and **by leveraging new information and communication technologies (ICT)**.

The City Protocol has five fundamental goals:

- **To facilitate and foster a new science of cities;**
- **To establish a cooperation framework among the city council**, academia, companies, organizations and people/society;
- **To lead and pave the way for cities' futures;**
- **To understand the common driving forces of urban evolution and find common game-changing solutions;**
- **To find innovative and economical opportunities and synergies**, and deliver value adding products and services.

According to the vision description, it seeks to define a common systems view for cities of any size or type, and then embraces or develops protocols that will help innovators create – and modern cities deploy – cross-sectoral solutions that can connect and therefore break city silos. City Protocol aims at working across diverse cities by interconnecting them and ultimately creating the **"Internet of Cities"**. With City Protocol, innovators enjoy a robust market for their solutions, and cities enjoy solution choice, reduced cost and risk, and increased collaboration and learning – all while supporting the development of a Science of Cities.

The overall project, City Protocol Society, was promoted June 2012 in Barcelona. More than 50 cities, companies and academic institutions around the world have shown interest in participating. After two days of intense work, the society met again in San Francisco in October 2012 where it defined the project, its objectives and its vision.

As one of the founding cities, Barcelona has a leading role in the city protocol and one of the focus areas is on mobility. Here the City Council of Barcelona supports the development of an important and stable industrial network in the mobile sector and develops the mobility as a future integrated and enhancer technology of the innovative projects.

Barcelona City Council fully shares the conviction that ICT is a decisive drive for the city's economy and the performance of knowledge in all disciplines, professions and industries. It is also understood to be a key element in itself as a new way of creating wealth based on the immediacy of the outcomes, the excellence of the services provided to the citizens and the encouragement of creative and innovative activities.

In particular, Barcelona developed the **MES (Mobility, e-Administration and Information Systems) Governance Measure**. This includes the development of mobility as a future technology, integrating and promoting the Barcelona citizens digital identity project. This work is supported by the open source sensor and actuator platform, Sento. **Sento** is designed as a cross-platform that shares information between heterogeneous systems and easily integrates legacy applications. Finally, one of the initiatives under the City Protocol umbrella is the **Urban Platform of Barcelona**. This initiative was triggered by a partnership between the City of Barcelona and Cisco. It integrates sensor technology in several areas of the city, enabling quick responses to changes in, for example, traffic or energy infrastructure

<b>Starting year</b>	2012
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes, within the overall City Protocol project
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://cityprotocol.org/">http://cityprotocol.org/</a>

## Level of integration

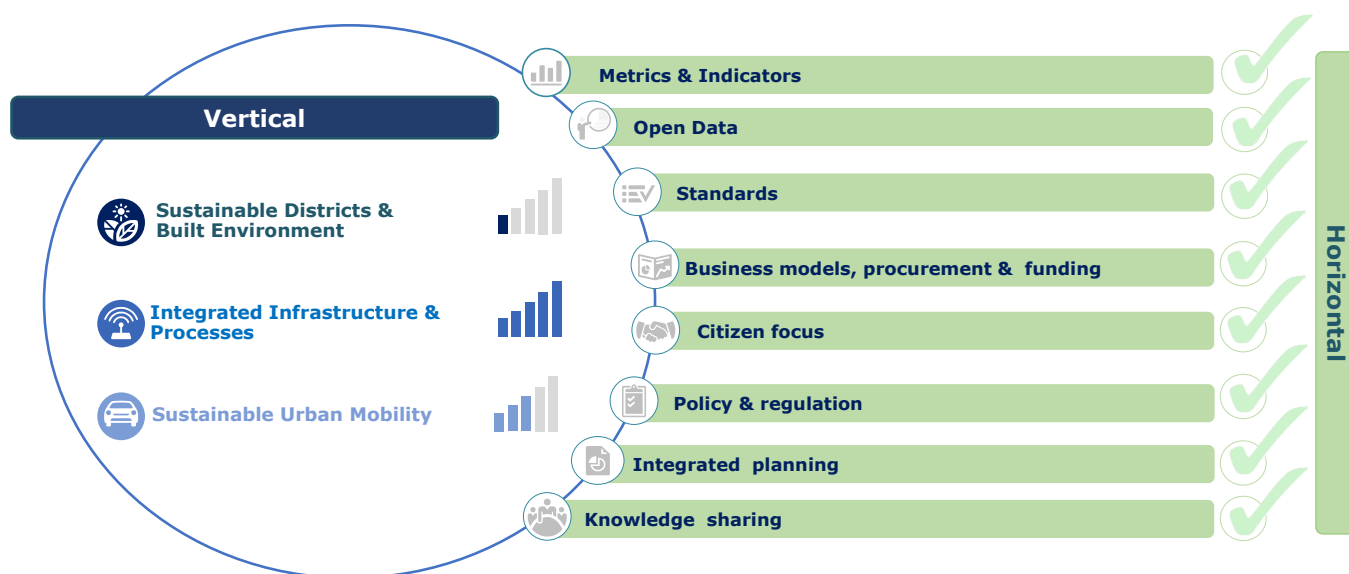
City Protocol is a **collaborative** and **integrating framework** that presents new ways of engaging society, developing new business models and introducing ICT with the purpose of assessing and improving performance in environmental sustainability, economic competitiveness, quality of life, and city services. By including a strong focus on environmental sustainability, City Protocol enables also the development of initiatives in the sustainable districts and built environment domain.

City Protocol aims at working across diverse cities by interconnecting them and ultimately creating the "Internet of Cities". Particular focus areas include:

- The **Internet of Things (IoT)** applied to cities;
- A network of city subsystems working together as a holistic living system;
- A network of cities learning and evolving together in competitive and cooperative ways;
- A network of city-centered groups aligning their work into one scientific and interoperable framework.

In terms of support towards integrated solutions, the following ongoing task groups stand out:

- **Common Data Model – Buildings Energy+Emissions:** The CDM-BEE aims at developing a common description of buildings that can be used by various city stakeholders, local authorities, and all relevant service providers. This common description of buildings will facilitate the deployment of urban services based on it, and it relies on a data model.
- **Open Sensor Platform:** It allows the integration of all the information collected by the sensors deployed in a city. Sensor platforms can help break down the silos in which individual sensor solutions are built and enhance efficiency in sensor management.
- **Urban Metabolism Information Systems:** It aims to develop a shared, city-led protocol for managing information in ways that make it easy to continuously track and draw 'flows' for the core urban subsystems identified in City Anatomy. (This includes transport/mobility but also includes all other flows of key resources and/or people and goods).



## Business case

The City Protocol Project is a unique initiative in the field of SCC solutions. It aims at promoting sub-projects through the sharing of a common vision across cities.

The official launch of the City Protocol Society at the November 2012 Smart City World Congress in Barcelona set out the roadmap for the society to be fully operational as a non-profit international association by the fall of 2013. More than 200 cities, private sector companies and not-for-profit organisations are currently members.

Membership is open to cities, commercial organizations, academia and non-profit organizations interested in game-changing city transformation, because the whole cycle of innovation can only be enabled by a solid, trust-based, cross-sector partnership.

The solution is financed through 75% private funds and 25% public funds. The City Protocol will move worldwide city thinking forward effectively and remain appealing and available to a wide range of cities and smart city communities. City Protocol will create a community of reflection, a sharing space and an opportunity to build complete or partial solutions to allow the emergent new generation to benefit from and further develop solutions for a sustainable city – like the Urban Platform solution.

**City Protocol is an open, global, and progressive working initiative for cities worldwide to assess and improve performance in environmental sustainability, economic competitiveness, quality of life, and city services, by innovating and demonstrating new leadership models.** It is developed as a collaborative innovation framework, where cities, societies, organisations, and companies can contribute. City Protocol does not seek to generate revenues, but rather to support projects that potentially could. As a result, there is no business case at City Protocol level, but there may be at single project level.

## Community & Citizen Focus

City Protocol does not explicitly have a community or citizen focus, but the overall goals are to **create a better quality of life in cities** across the globe. In this sense, a significant part of the protocol focuses on communities and citizens.

The overall goals of City Protocol are to be met with a **citizen-oriented and multi-scale approach** that considers the city as an ecosystem. For the same reason, while membership is limited to institutions and cities, all Task Force activities are open to interested individuals and non-member organizations willing to contribute as participants to the development of city initiatives in the Task Force or to just be part of the City Protocol knowledge community.

## Impact

City Protocol involves reports, standards, certification systems, service definitions, best practices and recommendations to turn cities into more innovative and sustainable environments. This is possible thanks to the use of technology in different fields including information, communication, energy, mobility, construction and waste management. Governments, councils, planners and developers looking to transform urban centres into smart cities may put the protocol into practice.

Actual social, economic or climate impacts are not collected across the many projects shared on the platform. However, the individual projects themselves are likely to collect data on their impacts. This goes for the Urban Platform project, which collects data on urban infrastructure e.g. traffic congestions, energy flows etc.

What City Protocol does track is the evolution of membership to the Protocol. At the moment, 10 city projects are shared in the community across 80 organizations in 37 countries, along with a total of 300 experts offering their knowledge and insight.

The idea of sharing methods and solutions that utilize ICT to create better quality of life for citizens is thus spreading across the globe.



## The solution in context: Smart City – Barcelona

### About the smart city vision in the city

Barcelona is a **pioneering Smart City** that has created a sustainable and long-term smart city strategy and vision to be achieved by 2020. The objective is to establish a **self-sufficient and zero-emission city** containing productive neighbourhoods, as well as human speed and encouragement. The smart city strategy underlines the importance of citizens' quality of life, social and urban improvement, value creation in every neighbourhood, and the encouragement of all its urban potential in the sustainable development and green economy. The vision includes projects of different areas, thanks to technology and innovation. Overall, the vision tries **to achieve an improvement in the services** that the City council provides to the citizens as well as a better management and general knowledge of the city.

**Name of City** Barcelona

**Country** Spain

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **17**  
Global Cities Index – Bloomberg (2014): **24**.  
The Economist – City Competitiveness rankings (2013): **55**

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## City Services Smart Platform Carson City, US

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Wonderware is a leading software at global level for **on-site and remote monitoring, control and reporting of process operations**. The solution deploys state-of-the-art supervisory control and data acquisition (SCADA) as well as human machine interface (HMI) systems. The innovative approach here was to **extend the use of industrial software to the sphere of municipal operations**.

The introduction of the Wonderware solution enables a secure management of the whole infrastructure through a single integrated platform. Furthermore, by leveraging **new virtualisation technologies** as smartphones and tablets, the information is available on time and everywhere. The benefits are lower development costs and optimised resource allocation, especially in terms of trouble shooting, with positive effects on overhead costs and operation reliability.

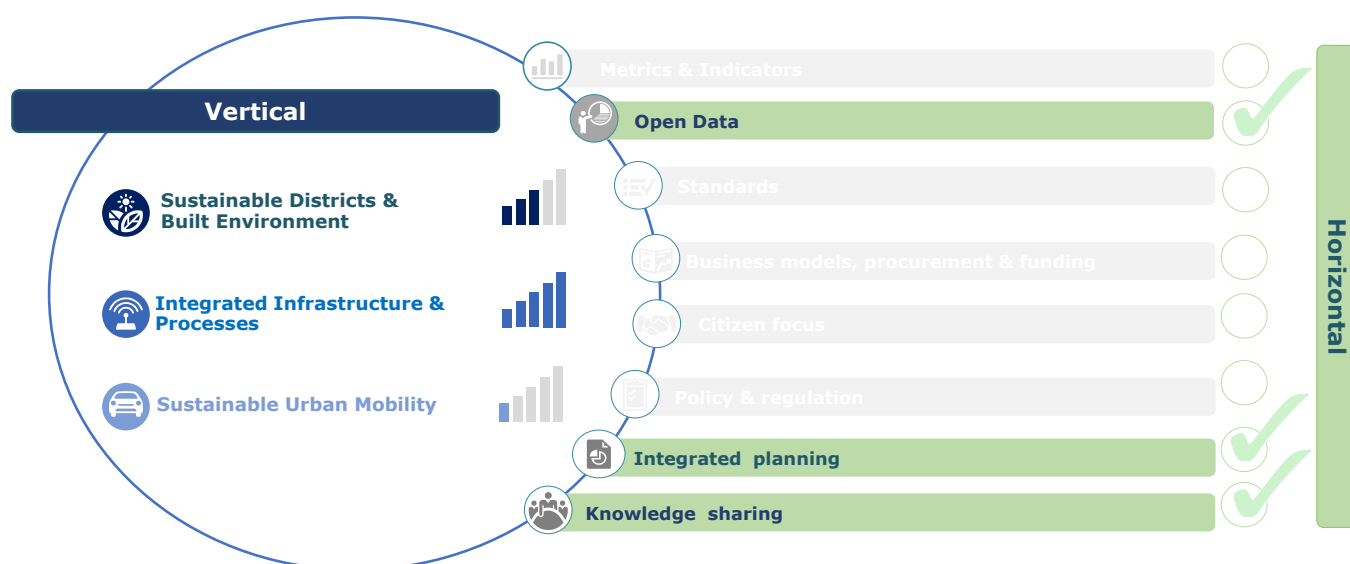
<b>Starting year</b>	1992 for waste water recycling and 2012 for other services
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry, academia
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 167,000
<b>Link</b>	<a href="http://carson.org/index.aspx?page=163">http://carson.org/index.aspx?page=163</a>

## Level of integration

The solution developed in Carson City can be considered as **integrated across mobility, sustainable district and integrated infrastructure**. Carson City Public Works' operation with Wonderware solutions dates back to 1992, when the technology was used to run water purification and wastewater recycling facilities. The flexible, open and scalable architecture, which can be integrated with virtually every control software and hardware, favoured the extension to cover additional services: **waste, energy generation, transport (traffic lights) and service truck fleet management**.

The platform's mobile reporting application (SmartGlance) is of particular importance: having access to **real-time status information, alarm notification and the historisation of performance capabilities** increased the department's situational awareness and operational readiness. By granting instant and remote access to KPIs and critical process information, the platform reduces the need for operator mobility and related costs.

An especially relevant example of a successful solution is related to its application to the traffic system. Currently, the software is implemented in 70 intersections (with traffic signals) across 3 counties. Thanks to the system, Carson City's maintenance staff is able to constantly monitor traffic light conditions in the city borders as well as beyond. Similarly, the solution **helps to manage the city's solar power plant, which provides 748,000 KWH of renewable power each year**. Moreover, 83 Mln litres of water are delivered each day.



## Business case

Increasing urbanisation poses new challenges for governments and communities with regard to short and long-term maintenance of aging infrastructure, minimisation and resolution of traffic problems, increasing energy demand and costs. In this perspective, remote monitoring, i.e. real-time availability of infrastructure status, as well as control can become particularly attractive. This is especially true for realities like Carson City Public Works, which is responsible for the operation of the municipal services as well as for the ones of three neighbouring counties.

In contexts where distances are significant, solutions like the ones presented above, can have significant economic impact. In fact, Carson City Public Works reported **15% reduction in operations staff hours** due to saved drive time. Unfortunately, specific information related to costs and benefits of the solution are not readily available.

The solution carries also a **significant replication potential**. Multiple cities across the world have adopted the same or similar systems. Some of the most relevant are: Bremen, Toronto, Zaragoza, Nanjing.

## Community & Citizen Focus

The implementation of the Wonderware solution indirectly impacts the community through the better provision of the municipal services presented above.



## Impact

Again, the impact of the solution is more related to the staff and operational quality of Carson City Public Works than to the community. The following positive aspects were reported:

- **Increased operation reliability and disaster recovery processes;**
- **Reduced administration and overhead costs;**
- **Reduction of drive time for staff by 15%, leading to better resource allocation.**



## The solution in context: Smart City - Carson City, US

### About the smart city vision in the city

Carson City does not have a specific smart city agenda at the moment. This is not surprising, considering its rather small size and the low number of inhabitants. However, in its mission statement the city identifies the preservation of its heritage and the enhancement of its quality of life as priorities. The presented solution can be thus seen from this perspective as an action to support its public workers. Furthermore it contributes **to improving efficiency, quality of service and the overall sustainability in Carson City.**

An additional initiative in line with the transition to a smart city is its community knowledge campaign: #CarsonProud. The programme celebrates cultural and traditional characteristics, with the objective **to increase citizen engagement**

**Name of City** Carson City

**Country** United States of America

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Energy Matching Infrastructure – eHub Leuven, Belgium

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

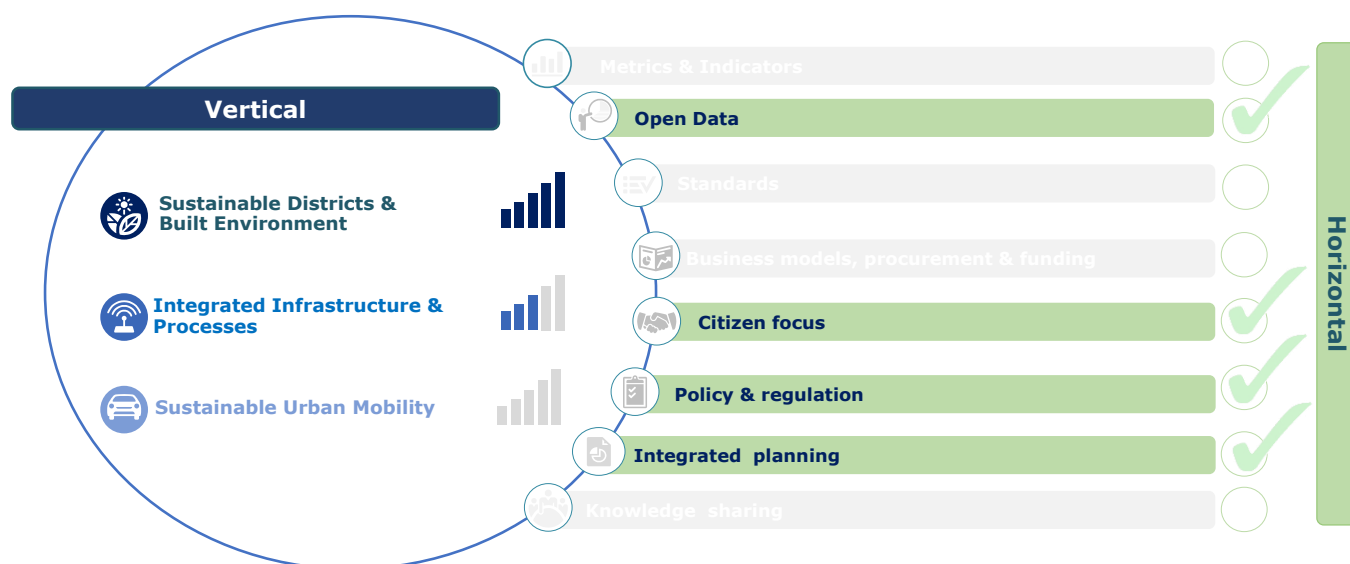
The E-Hub project was co-funded by the European Union's 7th Framework Programme. E-Hub developed a solution based on a **control system** for **integrating and optimising on-site renewable energy resources** within a local community: an intranet energy simulation platform has been produced using the programming language Matlab.

The **Multi Commodity Matcher** was tested in the district of Tweewaters in Leuven, Belgium, where the energy management system was applied in a full-scale demonstration. Tweewaters is a unique inner-city development, which is one of the largest inner-city developments in Belgium. It consists in total of 1.200 dwellings, commercial spaces, offices and other functions covering an area of 11ha in the city centre of Leuven. A key feature of this solution is the biomass fired cogeneration unit: this integrated ICT component was the centre of the energy supply: the unit is expected to provide **80% of renewable heat** and **100% of renewable electricity** to the entire district.

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 16 Mln for the E-hub project and about € 1 Mln for the deployment in Leuven
<b>Number of impacted users</b>	Approx. 106 homes and 9 businesses
<b>Link</b>	<a href="http://www.e-hub.org/tweewaters-demonstration.html">http://www.e-hub.org/tweewaters-demonstration.html</a>

## Level of integration

The E-Hub solution integrates the **ICT and energy domains**. The main integrated service component is the simulation platform, which is based on **matching supply and demand in energy**. The tool allows municipalities, DSOs (Distribution System Operators) and other parties to assess the possibilities (and limits) of a smart energy system in achieving energy efficient or energy neutral districts.



## Business case

As previously mentioned, the E-Hub project was co-funded by the European Union's 7<sup>th</sup> Framework Programme. The overall project budget amounts to **€ 16 Mln**, while the implementation in Leuven is estimated to be around € 1 Mln and includes **private capital**.

A Multi Commodity Gateway for the agent-based control system was installed in each unit of the district. This control box collects various data flows and forwards them to a (remote) central server that manages the interpretation and control of the energy flows. Through 2014 the energy behaviour of the area was monitored live, thereby identifying technical and financial output for the Tweewaters business case.

A key aspect is that the business model must be understood by users as well as suppliers, meaning new business models and service concepts must be attractive to both. Currently, the marginal price of electricity is determined by demand and supply on a national level. Consumers typically pay a flat tariff, but this is expected to change to **Time of Use (ToU) pricing, critical peak pricing or even real-time tariffs**. The future business model will include groups of energy consumers, producers and prosumers (both producers and consumers). On a district level, the match between the supply and demand will be managed by the Multi Commodity Matcher, using an automated pricing mechanism. This type of flexibility will stimulate new energy market business models. As a district is connected to the national grid, its price range will also affect the local electricity prices in the district.

At a European level, activities of energy efficiency services (ESCO) are subject to the obligations laid down by European Law (Electricity Law and Gas Law). Key important common rules stem from Directive 2003/54/EC – on the internal market in electricity – and Directive 2003/55/EC – on the internal market in natural gas. These directives establish common rules for the generation, transmission, distribution and supply of electricity and natural gas. Member States must implement these obligations in their own legislation. However, incentives and other support instruments are important to promote local generation of energy and new energy services. The E-Hub project focused on both the **quantity-based market instruments** (Quota obligation, Tendering such as Agent Based Technology) and **price-based market instruments** (Feed in tariff and premium tariff, Fiscal incentives such as Balance Responsible Parties – trade the energy by day-ahead or by intraday market mechanisms).

## Community & Citizen Focus

The social obligation of producing efficient energy for the district while minimising the demand presented challenges such as: loss of comfort from reducing too much heat and meeting the requirements of social and comfort standards. One third of Belgium's energy demand standards were achieved. The project's social objectives were to lower energy prices and provide transparency of communication. This type of business model also required the distributors of heat and electricity to be transparent and open.

## Impact

The deployment of E-Hub in Leuven **involved around 10% of the overall inhabitants** of the Tweewaters district. The main challenge associated with the solution implementation was the difficulty of synchronizing a research project with an actual construction and operation of a commercial area. The results showed that users may have limited knowledge of sustainability, however they are generally committed to a process of behavioral change.

The district of Tweewaters has received several awards. In 2013, after being awarded the **BREEAM** 'Outstanding' certificate, the area received the BRE award. Both the district and the specific building where the solution was implemented, received a nomination for the Global Cleantech Cluster Association (GCCA) Later Stage Award and the European Corporate Social Responsibility Award (CSR). Further indications of the projects success are emphasized by the fact that Leuven Climate Neutral 2030 and the Flanders in Action (VIA) programme are using it as a model project.



## The solution in context: Smart City – Leuven

### About the smart city vision in the city

In 2011, the city of Leuven launched the **Leuven Climate Neutral 2030** initiative. In a joint collaboration with key stakeholders and its inhabitants, the city will focus on working towards a climate neutral urban environment and society. According to the Baseline Emission Inventory for Leuven, the main problem is that "over 60% of CO<sub>2</sub> emissions are related to energy consumption in buildings." In particular, buildings such as office buildings, university campuses, hospitals and a large portion of the existing housing stock of particularly old dwellings are in need of energy saving renovation and comfort improvement.

As the need for reducing energy consumption in buildings is not only an environmental issue but also a financial barrier, homeowners and tenants have become reluctant to engage into renovation. This has prompted the city of Leuven to intensely focus on developing a supporting scheme aimed at removing these barriers such as STEP-UP<sup>26</sup>. The common approach at district level will be to create advantages of scale of a financial, organisational and technical nature. In order, to secure good strategic governance the city will apply tactics that can enable inhabitants to engage in energy saving renovation. The city thus intends to make a significant advancement by developing the necessary policy and guidance instruments to increase renovation rates on its territory.

**Name of City** Leuven

**Country** Belgium

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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[http://www.e-hub.org/pdf/definitive%20E-Hub%20brochure\\_HR.pdf](http://www.e-hub.org/pdf/definitive%20E-Hub%20brochure_HR.pdf)
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<sup>26</sup> Step-Up: European initiative. It provides cities in the EU with financial support to realise certain innovations in terms of energy policy.



## Future City Glasgow Glasgow, United Kingdom

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Glasgow City Council's Future City Glasgow (FCG) programme is a **€ 30 Mln programme** that is investigating the role that technology, data and connected assets can play in making life in the city smarter, safer and more sustainable.

The programme is focusing on **4 key service** challenges that affect Glasgow and its citizens on a day-to-day basis: **Health, Public Safety, Transport, and Energy.**

FCG has been in operation since April 2013 and is funded by Innovate UK (formerly the Technology Strategy Board), the UK Government's innovation agency. Glasgow secured the funding via competition with 29 other UK cities.

There are **3 separate but connected work-streams** within the FCG programme:

- **Glasgow Operations Centre (GOC):** an integrated traffic and public safety management system;
- **Open Glasgow:** an initiative ensuring that the huge amount of data generated by citizens and public bodies are, firstly, available to a wide range of users and, secondly, usable in a smart way;
- **City Demonstrator Projects:** different types of projects targeting a wide spectrum of areas from energy efficiency in buildings to mobility and street lighting.

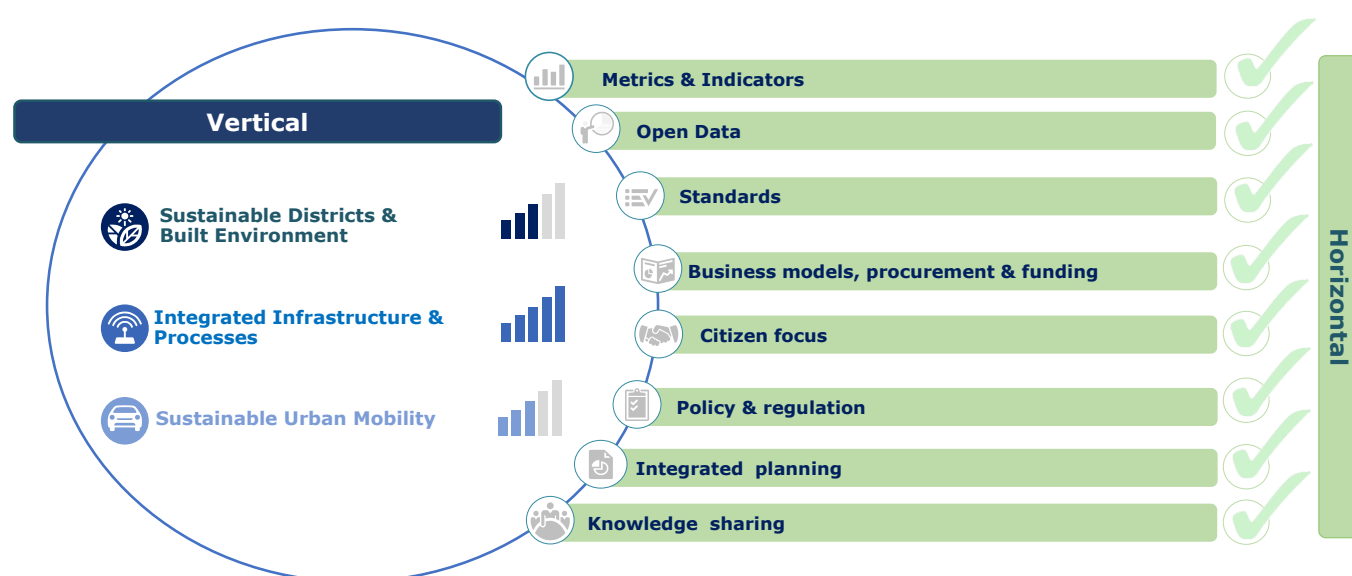
<b>Starting year</b>	2013
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, academia, industry
<b>Budget</b>	€ 34 <sup>27</sup> Mln
<b>Number of impacted users</b>	Approx. 87,000
<b>Link</b>	<a href="http://futurecity.glasgow.gov.uk/">http://futurecity.glasgow.gov.uk/</a>

<sup>27</sup> The conversion rate used for this case study is 1€=1,099 £

## Level of integration

The overall level of integration of the multiple solutions that make up the project implementation is ensured by the strategic coordination of the project itself. In brief, the solutions show the following integrations:

- **Open Glasgow** (City Data Hub): the workstream delivered a range of products including: a City Data Hub, the Open Glasgow web site, an Open Data Catalogue, an Open City Dashboard, MyGlasgow App, Hackathons and Citizen Engagement activities;
- **Active travel**: stakeholder engagement to collate requirements from citizens through the integration of online mapping tools and sources of active travel information to the above apps;
- **Energy efficiency**: improve Energy Efficiency – through the use of integrated technology to promote and enhance energy efficiency in buildings and housing in Glasgow;
- **Social transport**. The purpose of the Integrated Social Transport project is to develop a scheduling and route optimisation solution to improve services for clients with transport requirements in Glasgow.
- **Street lighting**: this workstream covers elements of both Sustainable Districts & Built Environment and Integrated Infrastructure across ICT, Energy, Mobility. The objectives of the Intelligent Street Lighting workstream are to improve lighting quality in the city, public safety in the city and efficiency of lighting maintenance – the use of alerts from lighting equipment to improve the efficiency and effectiveness of lighting maintenance resources.



## Business case

The **project investment** is approximately **€ 34 Mln (£ 24 Mln)**. It was originally founded in 2013 by the Technology Strategy Board (now Innovate UK), the UK government's technology board, following the launch of a nationwide competition for a large-scale future city demonstrator in 2012.

In preparing a Feasibility Study outlining delivery of the Glasgow Future Cities Demonstrator, consideration was made of anticipated benefits for citizens, businesses and organisations across Glasgow – as well as identifying benefits that could apply to other urban areas or the UK.

For example, the Glasgow Operations Centre (GOC) is one of three integrated work-streams progressed via the **Future City Glasgow programme**. The GOC is a 'state-of-the-art' integrated traffic and public safety management facility and, in being developed by the FCG programme, was subject to business case and benefits model assessment. This was initially considered as two separate developments (i.e. a traffic management centre and a CCTV monitoring centre). However, early engagement with stakeholders identified added value in developing an integrated operations centre, as follows:



- **Co-location of Public Space CCTV** (monitored by Community Safety Glasgow) and Traffic Management (managed by Glasgow City Council); Glasgow's Resilience and Safety Team; and Police Scotland Intelligence Unit.
- Use of both **CCTV** and **Traffic Management systems/infrastructure** utilising HD cameras and an associated communications network.

The Future City Glasgow project is linked to the Future Cities Catapult based in London. This is a global centre of excellence on urban innovation, and is intended to be a place where cities, businesses and universities come together to develop solutions to the future needs of cities.

## Community & Citizen Focus

Community engagement and capacity building are a fundamental element of the Future City Glasgow programme. The community and citizen focus relies on three work-streams:

- **OPEN Glasgow.** An extensive programme of Hackathons, mobile engagement hubs, community mapping and 'coding for kids' has facilitated links to citizens across Glasgow.
- The second FCG work-stream, the **Glasgow Operations Centre**, has been collaboratively designed for use by partners within an integrated service delivery framework. Glasgow City Council, Community Safety Glasgow, and Police Scotland have all had significant involvement - from design and planning to service development and delivery. All partners fully understand that the core aim of the Glasgow Operations Centre is to ensure the safety and well-being of citizens and visitors and the smooth running of the city's transport infrastructure.
- The third FCG work-stream, the **City Systems Integration Demonstrators**, was centred on needs-led and user-supported pilots designed to test Smart City responses in areas such as Active Travel, Energy Efficiency, and Intelligent Street Lighting and Social Transport.

Many of the companies that the FCG Demonstrator is engaged with are national and multi-national companies that cross borders in their operations and help disseminate learning across wider networks. Evaluation and learning arising from the Future City Glasgow programme is being used as a building block of the overall City strategy to smart city

## Impact

Some notable achievements of the Future City Glasgow are outlined below:

- **OPEN Glasgow** is demonstrating how **Open Data** and **Big Data** provide opportunities to connect, analyse, visualise and publish data sets in ways that provide new insight into the operation of the city.
- At the very heart of OPEN Glasgow, the **City Data Hub** has almost 380 data sets, published with support from 60 partner agencies. This is the highest number of Open Data sets made available by any UK city outside of London.
- The **City Data Hub** has provided businesses with better market intelligence to help create economic growth.
- It has led to improved stakeholder engagement and partnerships within the city; providing a platform for engagement, which involves all stakeholders in the city (public sector, private sector, academic sector, voluntary sector, citizens).
- Digital public services. The launch of the My Glasgow app (July 2012) has enhanced the city offering by providing a "report it" facility via a mobile channel. Citizens can report issues that affect their local area such as pot holes and fly tipping. This has proved a positive experience with 75% of customers saying they would be happy to use this type of technology for other contact needs.



## The solution in context: Smart City – Glasgow

### About the smart city vision in the city

In Autumn 2014, Glasgow, along with other Scottish cities participated in a **Smart Cities maturity Model and Self-Assessment Tool**, a system through which it is possible to:

- Assess where cities currently are on the journey to being a smart city;
- Decide where they want to be by 2020 aligned to strategic priorities;
- Identify investments and adjustments required to get there.
- Consider whether any parts of each city's forward programme would be better advanced in collaboration with other cities and wider partners.

Information derived from the self-assessment process has been used by Glasgow (and the six other Scottish cities) to inform a '**Scottish Cities Investment Roadmap**'. Published in May 2015, this outlines activity that Scottish cities can advance collaboratively and was used to inform application(s) for **European Structural Funds 2014-2020**. This work has progressed significantly during the latter part of 2015 with Glasgow contributing as follows:

- Glasgow is **lead partner for the Scotland's 8th City project**, i.e. the Smart City ERDF Strategic Intervention. This is a £ 10 Mln grant (combined with city investment of approximately £ 15 Mln) to support development in each city. Data and digital technology are the cornerstones in developing Smart City critical enabling infrastructure;
- Glasgow leads the **Smart and Sustainable** theme for the Scottish Cities Alliance, a partnership between seven Scottish and the Scottish Government.

<b>Name of City</b>	Glasgow
<b>Country</b>	United Kingdom
<b>No of Inhabitants</b>	100,000 > x > 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Integrated Security and Emergencies Center Madrid, Spain

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Following the terrorist attack in March 2004 in Madrid, public authorities and citizen opinion converged to highlight an inefficient security system, characterized by a significant lack of coordination between the several forces needed. Indeed, the different emergency entities (police, ambulance service, fire department) used to provide aid independently, since there was not a single unified system able to give distinct emergency responses.

After the mentioned event, the City Council of Madrid focused on the creation of a **centralized platform** that could allow better **emergency management**; therefore public authorities established the so-called **Centro Integrado de Seguridad y Emergencias de Madrid (CISEM) (Madrid Integrated Security and Emergencies Center)**.

Three elements make CISEM a smart and successful solution: the **real-time visibility** of all the emergencies across the city, the integrated system, which permits a proactive prevention of incidents and the consequent better assessment of resources and actions.

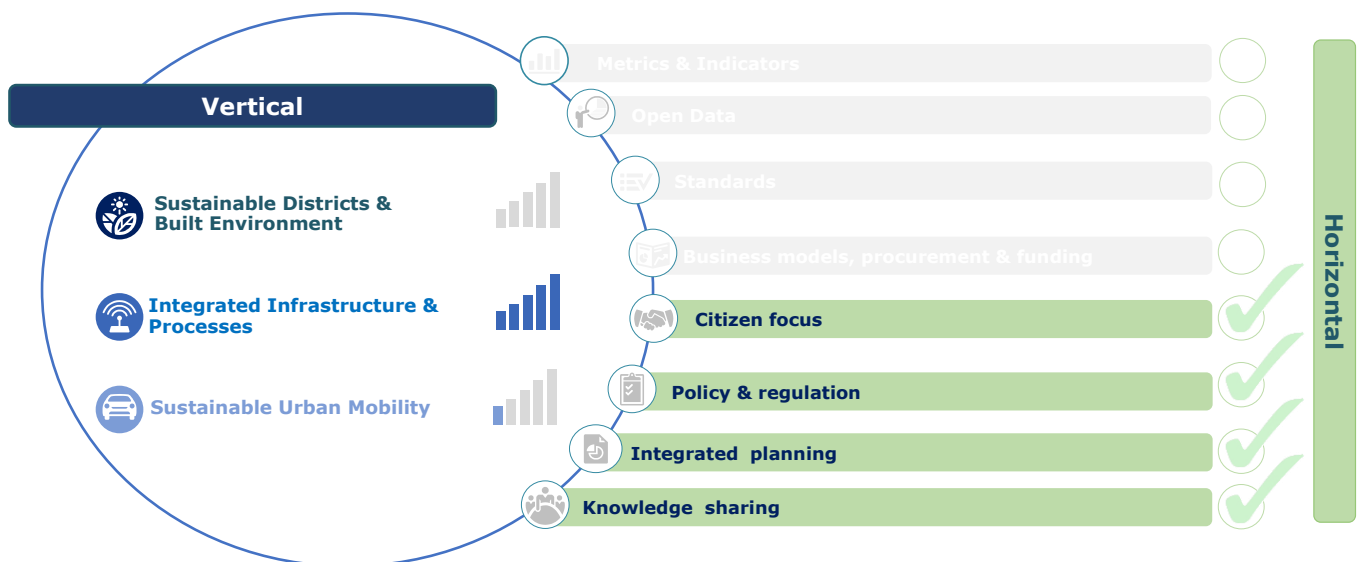
Thanks to CISEM a series of important results were achieved in terms of **increasing efficiency of resources, improving response times and optimizing the service quality**.

<b>Starting year</b>	2004
<b>Type of integrated solution</b>	Intelligent city services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, Civic and Regional entities
<b>Budget</b>	€ 20 Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www-07.ibm.com/innovation/my/exhibit/documents/pdf/City_of_Madrid.pdf">http://www-07.ibm.com/innovation/my/exhibit/documents/pdf/City_of_Madrid.pdf</a>

## Level of integration

The solution can be considered as integrated across **ICT** and **mobility**. The technological concept behind the service follows both top-down and bottom-up coordination mechanisms. The calls for traffic, security, sanitary or fire emergencies are coordinated from this central system, which collects and turns signals to the emergencies' units required for the specific needs. The CISEM is physically organized in two command emergency centers, four mobile coordination and almost 1000 vehicles allocated for the incidents and connected with one central vehicles service.

Communication is crucial in planning an effective coordination of responders. Therefore, much attention was paid to **creating a tool aiming to keep all agencies in contact**. In particular, a multi-layered communication infrastructure has been linked to existing telephony systems, satellite communications, a private radio network and 3G wireless networks to ensure continuous communication (e.g. IBM Web Sphere® Everyplace® Connection Manager provides secure access to CISEM resources by automatically selecting the best available network and encrypting all communications, whereas IBM Tivoli® Directory Integrator adds an additional layer of access security). IBM has also built a flexible and **powerful SOA platform** aiming to maintain a high level of consistency across all the emergency units involved. In particular, IBM Web Sphere Integration Developer and IBM Web Sphere Process Server manage information flows, as well as business processes. Moreover, through IBM DB2®Every Place and IBM Web Sphere Everyplace Deployment it is possible to disseminate information swiftly to all field units. Thanks to this software, CISEM's managers can adapt to fast-changing needs without the disruption of crucial services.



## Business case

The key elements of the model are the **improvement in efficiency**, the simultaneous increase of **service quality and delivery**, and the **cost-effectiveness of the solution**.

The partnership involved in the Centro Integrado de Seguridad y Emergencias de Madrid is formed by the Municipality of Madrid, teamed with IBM and IBM Business Partner Indra, the business actors that implemented the central command platform. A partnership has also been established with city and regional public entities in charge of managing the emergencies, in particular with Madrid and other metropolitan city police forces, the paramedic assistance service, the mobility traffic service, the city and regional fire department and the civil guard.

To sum up, the intelligent platform, that involves public operators as well as citizens, is absolutely compliant with the paradigm of a safer city. One of the most relevant smart features is the **forecasting dimension**, in addition to the monitoring of the actual scenarios one.

This future dimension contributes to reduce human interactions and waste of resources, which public mobility entities previously employed to reach different points around the city, without a proper coordination. Forecasting and feedback systems work together in order to record the emergency response time and the quality of the service provided, by matching few variables, as **"Incident location", "Type of incident", "Estimated arrival time of the different resources"**.

Finally, it can be considered a virtuous self-assessment mechanism, since the feedback monitoring dimension allows to prevent emergencies and the produced indicators guide to improve the whole performance.

CISEM is an innovative centre in the field of emergencies and response worldwide and therefore has been replicated elsewhere. Similar projects have been implemented by DG ECHO of the European Commission, to prevent and react to humanitarian emergencies in developing countries. CISEM has also contributed to the development of iSafety, software which covers all the aspects related to emergency response.

## Community & Citizen Focus

As clarified above, the project was launched by the City Council of Madrid, with the purpose of **improving the city emergencies response capabilities**.

The CISEM benefits all citizens, both for the high quality service provided and the optimization of the assets employed. Thus the system contributes **to reduce waste of resources** and better invest the available ones.

Citizens perceive a higher level of safety, since the coordinated response from emergencies bodies is unique. Furthermore, the City Council of Madrid gives visibility of the project implemented, contributing **to increase public awareness regarding the more and more measurable objectives accomplished**.

## Impact

The results obtained ranged from the response time, which has become 30% faster after the smart platform implementation, **the decrease of the 15% in crime**, to the improved cost-effectiveness, thanks to the joint cooperation of actions.

The qualitative drivers that made it possible to pursue the quantitative targets expressed above are:

- **Coordinated and integrated planning between all the different entities** involved;
- **Improved response times**, better-planned actions leading to better quality service;
- **Increased efficiency and optimisation of resources**;
- **Standardization of protocols and procedures**;
- Analysis and integration of multiple information and calls coming from different users;
- **Processing of a unique response**;
- Shared use of IT systems and physical resources to handle more emergencies simultaneously.

These results have substantially increased citizen satisfaction towards the public administration, as well as their positive attitude to adapt behaviours to the new system, deepening their community engagement.



## The solution in context: Smart City – Madrid

### About the smart city vision in the city

Madrid is the third European metropolitan area, and is ranked 20<sup>th</sup> European safest city, according to the **Safe Cities Index 2015**, edited by the Economist Intelligence Unit. The city has also subscribed to the Covenant of Mayors, the European action plan which aims at a **20% CO<sub>2</sub> emission reduction target, by 2020**.

Another important initiative the city has undertaken toward smarter policies is Madrid Smart Lab, also launched by the Madrid City Council, aiming at supporting **innovative ideas**. A special focus of this project is on the improvement of urban mobility and citizens' quality of life. **Madrid City Lab** is a sort of innovative hub, created to help entrepreneurs match their business ideas with the final purpose of bringing them closer to city issues, ultimately contributing to a better urban environment.

**Name of City** Madrid

**Country** Spain

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): **15**  
The Economist – City Competitiveness rankings (2013): **47**

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## Interoperable Open Platform – iScope County Zadar, Croatia

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

iScope is an EU financed project with the aim of creating an open platform for **the development of three different Smart City services**. The project started in 2012 with a time span for development of three years. It was tested in several European cities and regions including County Zadar in Croatia.

The goals of the project are: **develop a toolkit based on 3D UIM** (Urban Information Models) for **web services, develop smart services** for improving policy design for energy efficiency and noise levels, promote the mobility of disabled individuals through smart services, test smart services in different network ecosystems and implement safe privacy models for users' data. Overall, the main services focuses on **enhancing the mobility of old and disabled citizens, energy efficiency, mapping of noise**.

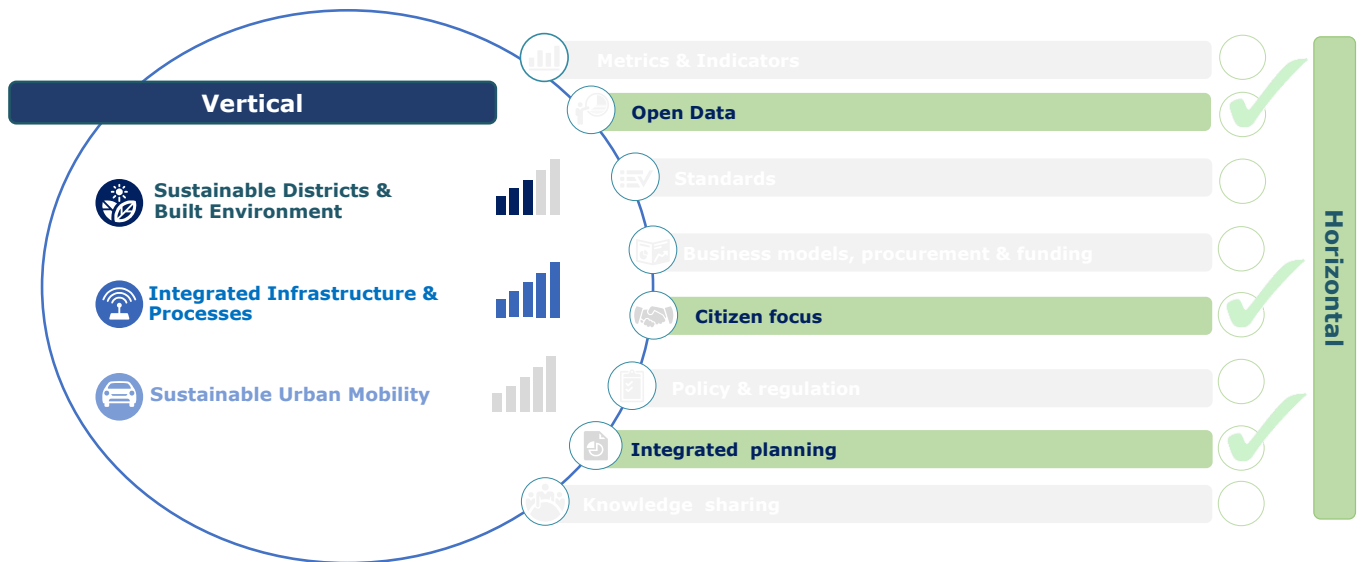
More specifically, these solutions target three groups of users; those with disabilities requiring functionalities for spotting barrier free zones or those needing a voice guiding, city administrators and officials focusing on energy saving measures, city administrations assessing the impact of noise.

<b>Starting year</b>	2012
<b>Type of integrated solution</b>	Intelligent city services
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	€ 4 Mln
<b>Number of impacted users</b>	Approx. 200 citizens and 10 operators in the city
<b>Link</b>	<a href="http://www.iscopeproject.net">www.iscopeproject.net</a>



## Level of integration

The system can be considered as an **integrated solution** since it combines elements related to the use of **ICT technologies** for **controlling energy consumption**, therefore promoting the use of sustainable sources. ICT is also used to support the development of pedestrian routes for people with different types of disabilities that otherwise could have problems in orientating themselves across the city.



## Business case

The project was **financed by the CIP/ICT PSP of the European Commission** with a total budget of **€ 4 Mln.**

The consortium is composed of several public and private partners including city institutions, firms, universities and research centres for a total of 20 partners. The solution carries good replication potential and is currently being tested in other cities across Europe including among the others: Newcastle and Vienna.

## Community & Citizen Focus

A central point in the development of the iScope project in Zadar as well as in the other pilot cities and regions is represented by the **involvement of citizens**. An example of this is the iScope Crowdsourcing, and, more specifically, the **Architectural Barriers Survey**. The goal of the survey is to enable citizens to create a database with the architectural barriers located in the city via uploading pictures and comments. Thanks to the creation of this database it will be then possible to develop pedestrian routes and maps. The solution will target not only people with disabilities but it will also focus on a wide range of people from the elderly to those with temporary motion difficulties. In addition, thanks to mobile technologies, people could act as sensors measuring noise levels across the city, therefore creating a real time mapping of environmental noise areas.

## Impact

The aim of the solution is to provide citizens in Zadar with smart services for improving the quality of their lives, especially in regards to those with disabilities. However, the overall impacts of the project have not been defined yet. Some of the foreseen impact areas regard: **local governments** and their capability to better tackle issues related to **energetic sustainability** and noise. Thanks to the solutions implemented via the I-scope project it will be possible to record impacts including the environmental, social and economic domains. Moreover, the direct participations of citizens in the project constitute also an important element, especially regarding the possibility to enable people to design solutions impacting directly on the quality of their own lives.



## The solution in context: County Zadar

### About the smart city vision in the county

County Zadar is a Croatian region located along the Adriatic coast and accounting for approximately 170,000 inhabitants. The region occupies a strategic position in the Mediterranean sea and counts also on developed infrastructures and qualified labour force. Within the region the city of Zadar occupies a leading position. Zadar is considered as one of the leading cities in Croatia regarding innovation and the use of new technologies. Among the main smart city projects that are current been developed it can be accounted the new Intelligent Transport System (ITS) with the **aim of connecting and developing synergies among intermodal transportation means, logistics** as well as connections to the new port of Gaženica. The broader goal of the project is to reduce pollution and improve safety and traffic volumes. The total costs for the project will **amount to € 25 Mln** and will be financed thanks to **EU structural funds**.

In the next 3 to 5 years, the city is planning additional smart city projects focusing on **public lighting, energy efficiency, water management and education**. Other priorities also include smart services like e-city and e-health. The overall goal is **to improve the quality of life of citizens, boost energy saving and improve environmental conditions**. In order to realize these projects, the city is planning to increase public-private partnerships.

<b>Name of the region</b>	County Zadar
<b>Country</b>	Croatia
<b>No of Inhabitants</b>	$100,000 < x < 500,000$
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Neighbourhood Urban Observatory Bilbao, Spain



→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Neighbourhood Urban Observatory is a tool for the analysis and diagnosis of the urban development and social situation of the different neighbourhoods of the city. It provides a quick picture of the needs and demands in the city's neighbourhoods, which can help to **streamline the decision-making process**, to the better define of the policy agenda and ultimately improve effectiveness in the city management.

For this purpose, the Neighbourhood Urban Observatory takes into account wide use of ICT tools and applications, in order to keep up with the demands of today's (information) society, with the aim of supporting the following actions:

- To **set up a new online service processing portal** (the new [www.bilbao.net](http://www.bilbao.net));
- To **provide new social media (2.0) tools**, e.g. the profiles of 35 out of 39 neighbourhoods are accessible on Facebook and Twitter;
- To **embed a GIS web application in order to publish, visualise and allow consultation of geographically referenced information**;
- To **feature a newly designed city administration intranet called TADELKA** (the Basque word for 'Working in Partnership'), which provides fully transparent data and information of the cities operation for their public officials.

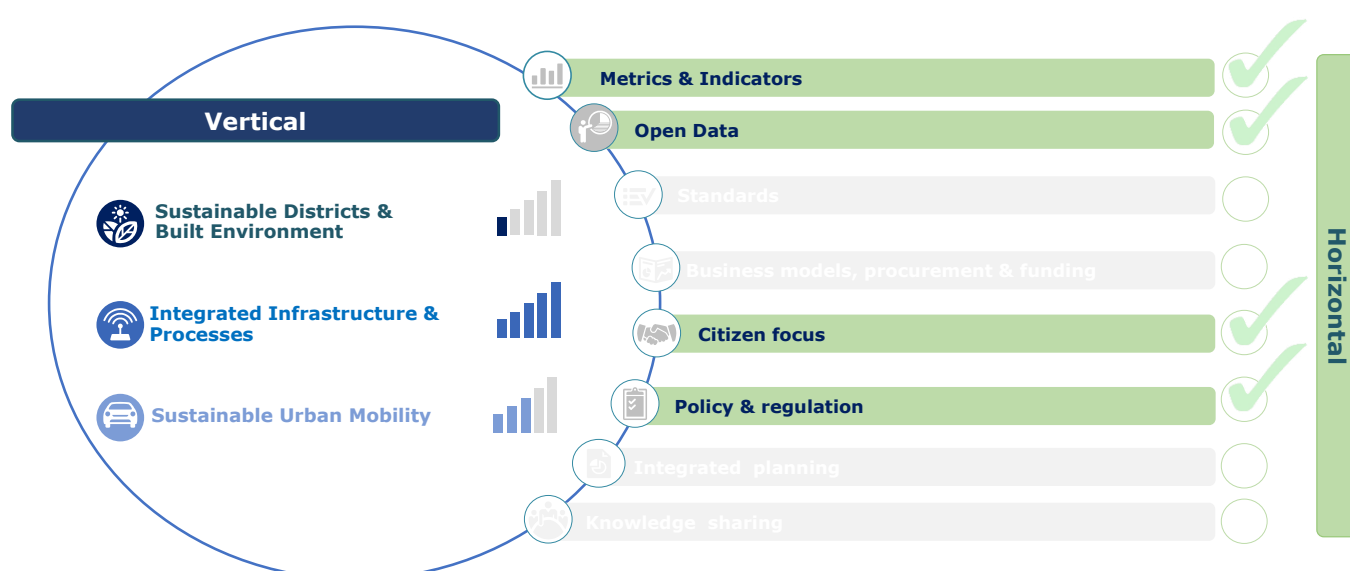
In a nutshell, the Bilbao Urban Neighbourhood Observatory is an instrument that enables detecting local needs that are centrally relevant for the sustainable development of the city of Bilbao. It also makes it possible to monitor the evolution of the quality of life in the city and its neighbourhoods.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Intelligent City services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, ICTs providers
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="https://www.bilbao.net">https://www.bilbao.net</a>

## Level of integration

The Bilbao solution is successfully integrating ICT with the sustainable mobility and the sustainable district domains. The integration happens through several channels:

- The **Bilbao Open Data web service**, which currently allows downloading and reuse of 163 datasets on transportation, car parks, city facilities, demography, tourism, economic-financial indicators, district environmental measures. In 2015, the Bilbao City Council has become the first public institution in Spain to obtain the certification from AENOR, the Spanish Association for Standardisation and Certification, an official acknowledgement of its maturity and management in the field of open data. The opening up of data means making public data available to any institution or person for their subsequent analysis, dissemination and reuse, thus promoting transparency in management and the generation of wealth and added value.
- The **Bilabo spatial data infrastructure for enhanced information**. The solution provides a geoportal source of spatial information within the municipality and featured with key tools to support decision-making, such as map-based data searches, analysis and editing. The solution integrates other municipality online services, e.g. transport network, to support public information services.



## Business case

The Neighbourhood Urban Observatory is **funded** through **the City's budget**. A proxy variable to the quantification of the budget spent on the solution can be assumed from the average expenditure for "aplicaciones informatica" (item 645 of the Bilbao budget) of about € 100,000/year (Bilbao, 2011-2015) used to contract external expertise, technology providers and other services. Furthermore, a total of € 225,862 has been used to contract external expertise, technology and other services to develop initiatives as the Bilbao++ program (in the field of improving techniques and instruments for public expenditures management). Part of the budget of the Bilbao++ was used to fund the Neighbourhood Urban Observatory.

With its Government Plan 2011-2015, including 10 new strategic axes and the respective objectives, actions and budgets, the Bilbao municipality aims at **facing the priority of public finance monitoring and control**, in order to create an economic context prone to the creation of new job opportunities.

In 2008 the Bilbao Urban Neighbourhood Observatory has signed an agreement with the Deusto Social Innovation Unit at the University of Deusto (Spain) to set up the Observatorio Urbano de Barrios de Bilbao, a five-years development process to monitor the evolution of the life quality of the city and its neighbourhoods (metropolitan area). The Observatorio Urbano de Barrios de Bilbao reached on 2014 its 5<sup>th</sup> edition.

## Community & Citizen Focus

In 2013, this solution received a special award for accessibility, due to the solution specific design “to meet the needs of the majority of disabilities (physical, visual, hearing and cognitive), and also the needs of older people. People with hearing and vision impairments in particular have also been involved in the development” (European Union, 2013).

## Impact

As is the case of other portals (POPSIS, 2011), their impact in opening up high added-value datasets can be modest and their direct short term economic effects have been so far limited. Instead, their largest impacts to date are indirect: the portals in fact can stimulate creativity and innovation and pave the way to unanticipated value creation, improving citizens engagement in policy processes.

In the case of the Neighbourhood Urban Observatory, the aim and expected impacts of the solution were **to increase decision making capabilities**, and **policy management**, by providing a quick picture of the demands of the different areas across the city.

The results in terms of better policy management were reflected in a citizens’ survey in 2012 on their perception of the future of Bilbao in general, and in the municipal public management in particular.

90% of the population had a good or very good opinion on the quality of life in the city. A total of 61% of (interviewed) citizens considered that Bilbao has improved over the last few years and 64% are of the opinion that it will further improve in the future. One of the most significant data of this ‘city-climate-check’ is the positive acknowledgement of Bilbao’s citizens and businesses towards the public management during this city’s transformation, where 22% rated it as favourable.



## The solution in context: Smart City – Bilbao

### About the smart city vision in the city

The city of Bilbao has come a long way since the 1980s, when it was immersed in a deep crisis and economic decline, one that the city has managed to overcome through innovation and adapting well to new and changing circumstances. The success of Bilbao is largely attributed to its integrated and **holistic approach to its economic, social and physical transformation**. The Bilbao City Council has been instrumental in regenerating and transforming the city from an obsolete and dilapidated industrial urban area into a **knowledge-based economy**.

Bilbao has shown that strong leadership and a commitment to a systematic and long-term plan, based on solid processes and supporting infrastructure, are key factors to the success of a city's transformation.

<b>Name of City</b>	<i>Bilbao</i>
<b>Country</b>	<i>Spain</i>
<b>No of Inhabitants</b>	<i>100,000 &lt; x &lt; 500,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Demo Norway Smart Grid Rogaland Province, Norway

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Lyse is a Norwegian multi-utility company spanning energy services, infrastructure and telecom/IT. Established as a group in 2000, Lyse is owned by 16 municipalities in Sør-Rogaland. The Smart Generic Gateway solution offered by the group – and already deployed across the Rogaland region – covers ICT-based **energy efficiency solutions** for residential and public buildings such as **home energy management systems** and secure redundant communications paths from services and devices. In difference to other gateways, this solution includes **welfare technology** and **security and safety** services from the beginning and integrates products and services for different customer needs.

The smart gateway leverages **real-time data** from the meter to visualize power consumption on customers' mobile phones or tablets, e.g. as a "wattmeter", helping them to understand in detail what drives their power consumption and how they can reduce it. It is also possible to integrate the energy consumption data to IPTV services in the household. The smart gateway further enables grid operators to flexibly control demand in areas of critical supply conditions or grid capacity limitations, as it can manage more customers and it is more detailed than the switch in the meter.

The **smart gateway solution** offered by Lyse has emerged from a business model innovation process which supported the groups transformation from specific utility provision to multi utility and demonstrates the emergence of ecosystem based service models. This smart gateway is an example of a mature integrated solution, which so far can be identified as having three phases:

- **Phase 1:** Proof of concept and ongoing experimentation in "welfare technology" services and "security" services to be offered as part of the gateway solution;
- **Phase 2:** Wide scale roll-out of 160 smart gateway systems across the Rogaland region in connection with further investigation and innovation working with the parallel smart grid project "Demo Norway" by 2017;
- **Phase 3:** Scaling of concepts and solutions across Europe as part of the SCC project Triangulum.

All phases run in parallel and provide both scaling and replication opportunities.

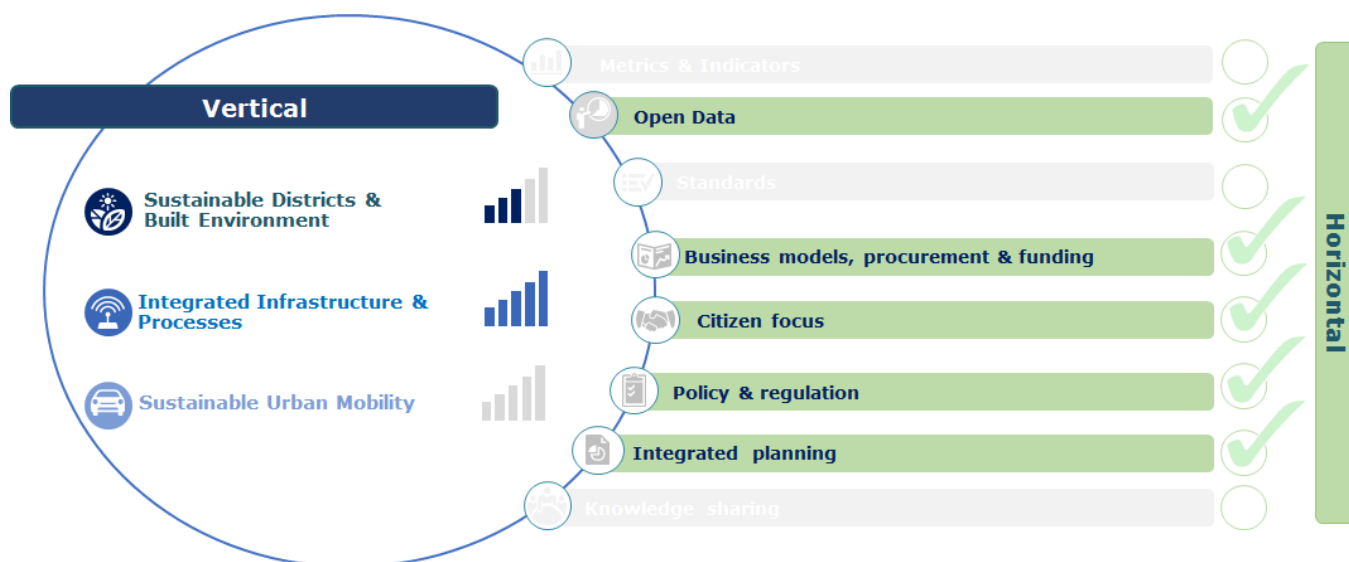
<b>Starting year</b>	2015
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industry
<b>Budget</b>	€ 250 <sup>28</sup> Mln
<b>Number of impacted users</b>	Approx. 70,000
<b>Link</b>	<a href="http://smartgrids.no/english">http://smartgrids.no/english</a>

<sup>28</sup> The conversion rate used for this case study is 1€=9,48 NOK



## Level of integration

The Smart Generic Gateway System provides **ICT based energy efficiency solutions** for the built environment. The gateways are both installed in private and public buildings. Smart-enabling buildings and communities will provide a large range of **real time data** that can contribute significantly in achieving goals in areas such as emission reduction, energy consumption and grid management. The solution informs and empowers citizens and communities to reduce their energy consumption.



## Business case

Lyse Energi A/S, a multi-utility company which is owned by 16 municipalities within the Region, is responsible for the installation of the gateways. Lyse provides infrastructure (electrical grid, district heating grid, fiber optical grid, gas grid) energy (hydro power, biogas, heating/cooling) and services (TV-services, VoD, alarm, Home automation and Welfare technology based services)

The business model itself can be categorized as an ecosystem that is open to other providers of services as well as to integration of devices from other companies, thus creating an **open platform**. One example is the integration of a new smart door product from Nordan, that works with the Smartly ecosystem.

In recent years, the power sector has demonstrated an increasing interest in exploiting new business opportunities related to the introduction of a smarter transmission grid. The Smart Grid may provide a dynamic platform for delivery of services and involvement of residential consumers in the same way made possible in the telecommunications industry. The introduction of AMR technology in all Norwegian households is the first indicator of the adoption of a Smart distribution network.

The project is made possible by a 12-year long investment period in fibre infrastructure, amounting to € 250 Mln, which already connected the first 70,000 households in the Rogaland region.

**The system is highly replicable.** This is due to the use of standards, which enables replication in other market segments. The gateway uses internet as its main carrier, but if internet is not available, the mobile network can be used. All gateways have SIM-cards installed to offer communication redundancy.

The system has been replicated in small scale in Oslo, Fredrikstad, Aukra, Tau and is also being tested in a couple of other regions. Additionally, Stavanger – main city in the Rogaland region - is part of the EC funded project Triangulum project (the project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 646578). The Triangulum project is demonstrating how a system innovation approach based around the European Commission's SCC Strategic Implementation Plan can drive dynamic smart city development.

## Community & Citizen Focus

The Smart solution includes apps (iOS, Android) as well as home displays. These are useful tools to involve citizens, providing information, advice and the possibility to interact with the services.

The smart gateways are engaging the end users in **improving their quality of life on a daily basis** through efficient communication and service management. Specifically, they make the user more aware and engaged, meaning that customers will demand socially and environmentally responsible practices, place a higher value on convenience and experience, and use more complex criteria for their purchasing decisions.

## Impact

Based on the project period, no actual impact can yet be measured. However, the solution may result in significant economic impacts and improvements within **energy efficiency** due to the generic nature of the solution. Lyse has run some pilot projects (Proof of Concept and Proof of Context pilots) to test the qualitative features of services and products. The welfare technology pilot in the Lyse context has already increased the feeling of safety, increased security, social adaption, and better mastering and control of new technologies of the elderly.

Further Lyse is working on the **CO<sub>2</sub> reduction** figures that can be calculated based on the roll-out of this solution. CO<sub>2</sub> reduction targets are mainly related to the following points:

- **Energy efficiency:** This is by far the most efficient way to reduce CO<sub>2</sub> emissions. Since Norway has a very high share of renewables in our energy mix, the energy saved from renewable sources can be reused in areas like EV-charging, battery based ships/busses and electrification of the Oil&Gas operation in the North Sea.
- **Enabling EV-charging:** Charging of EVs in Norway represents challenges for the grid, especially in the Winter-time. The gateway offers energy security in the household, thus making EV charging more reliable for end users.



## The solution in context: Smart City – Stavanger

### About the smart city vision in the city

The region has a long tradition of public-private partnerships and innovation and is also the **energy capital of Europe**. Stavanger, the biggest city in the region, holds the European status as smart city lighthouse (among only nine cities in Europe), and is the Norwegian Smart Care Cluster on welfare technology. Furthermore, the region has a **high level of digital service development** and provision, due to its high-speed digital infrastructure (where a speed of 1GB in/out is becoming increasingly common in households).

The region is regarded as **one of the most innovative in Norway**, and has been appointed the best business region in Norway (NHO) for ten years in a row. Hence, the region has developed a practice for close triple helix cooperation among businesses, academia and public sector. The region aims at a high degree of knowledge transfer between sectors and areas of business, such as subsea to space, space to health, offshore to onshore services. As an example, Greater Stavanger Economic Development is established with the aim of maintaining the link between academia, public sector and private sector in order to strengthen the ability to create value across sectors.

**Name of City** Stavanger

**Country** Norway

**No of Inhabitants** 100,000 < x < 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
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#### What's The Problem

We hear about greenhouse gas emissions and the need to reduce them. The first step is to understand where they originate.



## Urban EcoMap San Francisco, US

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The UrbanEcoMap is an **Internet-based information tool** that gathers and presents smart climate change information for citizens and agencies. The information consists of **data on carbon emissions from transportation, energy and waste** within neighbourhoods, organized by ZIP codes. UrbanEcoMap makes it possible for the individual to see the collective results of individual climate change actions. Additionally, the ambition is to **empower the people to make responsible environmental choices** and create competition among neighbourhoods to reduce their carbon footprint.



Image source: [https://www.flickr.com/photos/cisco\\_pics/](https://www.flickr.com/photos/cisco_pics/)

locally available tools and resources to reduce their carbon footprint.

Urban EcoMap in San Francisco collects and provides information at a **neighbourhood level**, organized by ZIP codes. Two specific information opportunities are given to residents and communities through UrbanEcoMap:

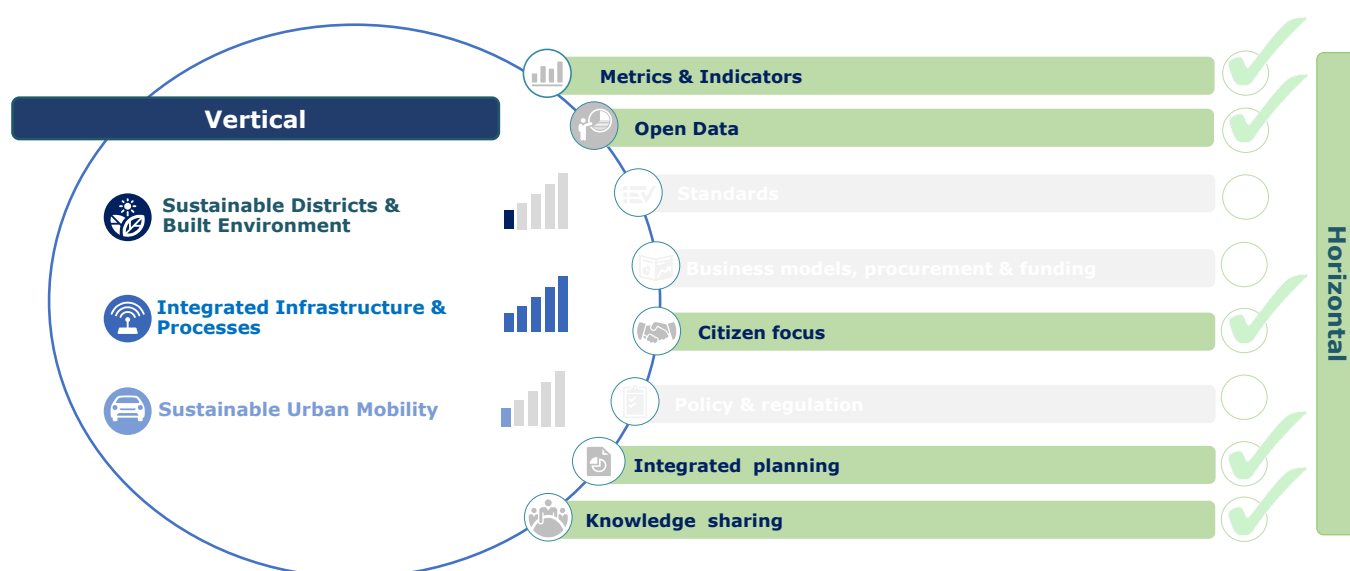
- **Discover Your City's Neighborhoods:** On a micro level, residents can see their GHG contributions in the areas of transportation, energy and waste with the aim of empowering neighbourhoods to identify specific energy consumption issues and take specific actions to fight climate change.
- **Take Climate Action:** Citizens can also take action to help decrease carbon emissions in their region, their particular ZIP code, and their city. The assumption is that through the development of a better understanding of the effort required to make various changes, the associated costs or financial benefits, and the environmental impacts, residents are able to make better-informed decisions and promote change with others via social networking.

The Urban Services Platform is based on an **EcoSystem approach**. EcoSystem encompasses an eco-centric set of technologies and standards that allow for interoperability of **"eco applications"** and devices. Much like the Internet, it is a multi-layer stack of standards that defines how applications and devices consume and share information. Applications publish (contribute) eco-data to EcoSystem, and other applications can then discover and consume it.

<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Intelligent City Services
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, ICTs providers
<b>Budget</b>	€ 377,000 <sup>29</sup>
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://sfgov.org/">http://sfgov.org/</a> <a href="http://urbanecomap.org">http://urbanecomap.org</a>

## Level of integration

The solution combines ICT and data management in order to improve conditions within **transportation, environmental sustainability, energy and waste.**



## Business case

The business model of the pilot must be characterised as a public-private partnership. Begun in fall 2008, the pilot project is a collaborative effort involving Cisco IBSG—the global strategic consulting arm of Cisco—and San Francisco’s Department of the Environment (SF Environment), Arup, CH2M HILL, NASA and the Swiss Federal Institute of Technology Zurich.

The participating organizations are jointly applying an Urban Services Platform approach which means that visionary cities and the ICT industry are moving towards the same target: **to reduce carbon emissions through information and citizen and business empowerment.** Cities produce 80% of greenhouse gas (GHG) emissions worldwide. Therefore, UrbanEcomap attempts to target the cities in order **to inform citizens about energy consumption and energy reduction** because the cities present the largest opportunity for innovation and social behaviour changes. As the cities move from educating people about climate change to taking action to mitigate climate impacts, they need technology, process, and culture to help enabling a shift to climate-friendly social behaviour. San Francisco was the first city to implement Urban EcoMap.

**The total cost** of implementing the solution was **\$ 400,000**. Financing came from Cisco Corporate Affairs as part of its \$15m commitment to the Clinton Global Initiative. Furthermore, funding was obtained by the City of San Francisco executives from a range of public functions.

<sup>29</sup> The conversion rate used for this case study is 1€=1,060\$

In the future, the Urban EcoMap San Francisco will address mobile applications, user-generated content, and access to **real-time information pertaining to personal energy usage, transportation, and consumption behaviour**. The city of Amsterdam and Cisco rolled out the Urban EcoMap also in 2009. Hence, the programme has been a catalyst for cities from Vancouver, London, Seoul, Charlotte and many others to develop their own city wide strategies for sensing and data visualisation.

## Community & Citizen Focus

Urban EcoMap's goal is to help spur a shift to climate-friendly behaviour in cities. Citizens want to see the collective results of their individual climate-change actions.

Urban EcoMap allows citizens to see the impact of their climate-change activities, while also motivating people and creating competition among neighbourhoods:

- **Brings the issue of climate change home** by providing information about carbon sources and environmental solutions on a local level;
- **Conveys the message that "solutions are closer than you think"** by offering easy access to resources that suggest effective options;
- **Provides a decision-making platform** for individuals to set explicit goals according to personal effort, cost savings, and environmental impact;
- **Creates confidence** that, by taking these small steps, individuals are contributing to the big solution by providing feedback on cumulative benefits / results;
- **Provides the ability to inspire others to take action;**
- **Allows citizens to compare their cities' climate-change actions** with those of other cities.

The central idea is that behavioural change starts with knowledge and insight in the actual consequences of one's actions especially in terms of their GHG emissions from transportation, energy consumption and waste. This awareness of GHG emissions and the related tips for reducing it, should spur people to take small steps in a greener direction.

## Impact

The programme has been a pilot in both Amsterdam and San Francisco. Therefore, it is too early to measure tangible outcomes for economic, environmental and social measures.

The Urban EcoMap has no imminent impact in itself, but has a very large potential impact on **reducing GHG emissions**. Citizens contribute immensely to the overall emission of carbon and greenhouse-gasses. The great potential impact lies in the population of around 750,000 people in San Francisco that could all make greener choices on the basis of the Urban EcoMap.

Additionally, a web-based platform like the Urban EcoMap raises awareness on individual emission, and emphasises the possibilities of making greener choices on everyday life.



## The solution in context: Smart City – San Francisco

### About the smart city vision in the city

The San Francisco Sustainable Development programme was developed on the basis of positive experiences from creative and collaborative partnerships. These partnerships have generated major sustainable design components of signature projects like the Transit Center, Treasure Island, Candlestick Park/Hunters Point, and the Eco-District framework for a sustainable San Francisco. The work within the programme is work illustrating a major focus and commitment to exploration and innovation. The work extends emerging trends around systems thinking and ecological planning, design, and development to San Francisco planning opportunities. Additionally, the ongoing work supports connection, community, and sustainability in the context of climate change.

The City of San Francisco is also a **frontrunner in relation to recycling and waste management**. Its residents separate their garbage into the categories of recycling, compost, and landfill waste. Further on, the city is making a **huge effort to encourage their citizens to participate in energy conservation** by providing them with mobile and web access to precise, near real-time energy data and advice on how they can save. Finally, the city has established more than 100 charging stations around the city to promote the use of hybrid and electric cars and reduce automobile-related pollution and greenhouse gas emissions.

**Name of City** San Francisco

**Country** United States

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): **22**  
The Economist – City Competitiveness rankings (2013): **18**

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## WindyGrid Chicago, Illinois, US

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

WindyGrid is **hub housing information from city departments in real time**, gathering about 7 Mln rows of data per day. The SmartData Project — through its publicly available open-source build — is meant to be a template for cities to provide predictive analytics systems of their own.

As described on the Harvard Kennedy School web site: "*WindyGrid is a computer application, designed for City personnel, that makes Chicago's **big data easily and strategically accessible in one place**. It is quite a bit more complex than a thermometer: as a geographic information system, the application presents a unified view of City operations—past and present—across a map of Chicago, giving key personnel access to all of the city's spatial data, historically and in real-time. This includes data categories such as 911 and 311 service calls, transit and mobile asset locations, building information, geospatially-enabled public tweets, and other critical information. WindyGrid provides three main functions for City staff: situational awareness and incident monitoring, historical data retrieval, and real-time advanced analytics.*" (Harvard Kennedy School, 2015)

**Starting year**

2012

**Type of integrated solution**

Intelligent City Services

**Scaling or Replication**

Yes

**Key actors / stakeholders**

Public authorities, academia

**Budget**

€ 950,000<sup>30</sup>

**Number of impacted users**

Entire city

**Link**

<https://data.cityofchicago.org/>

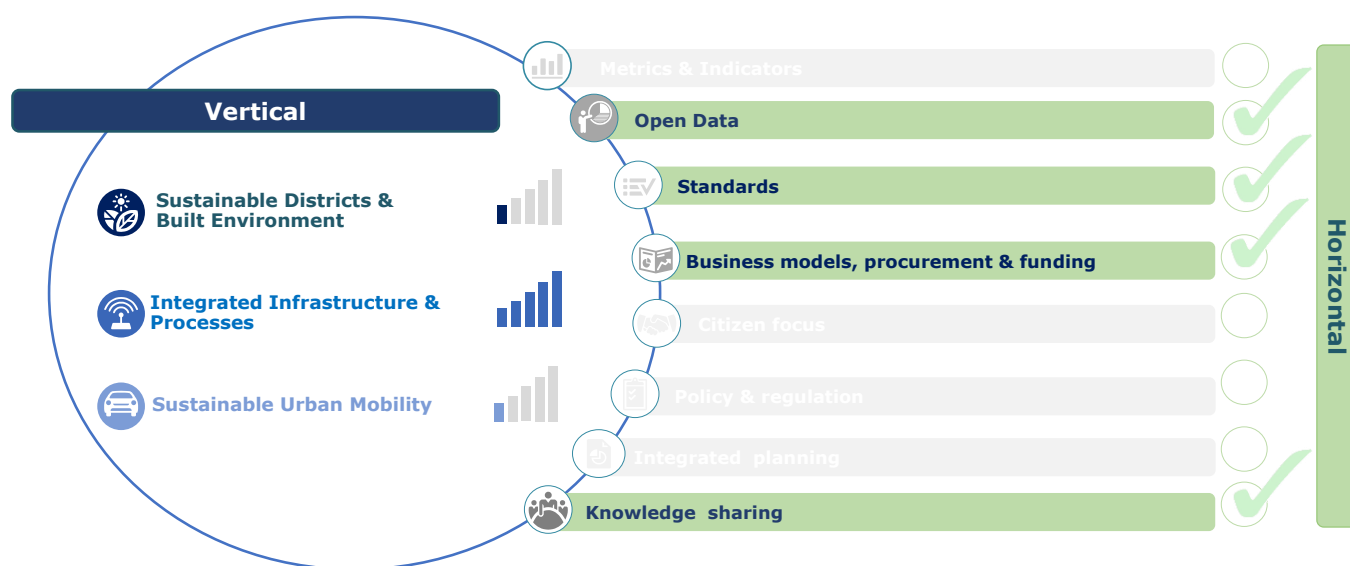
<sup>30</sup> The conversion rate used for this case study is 1€=1,060\$



## Level of integration

The WindyGrid solution provides the **integration between ICTs applications** and city **management, including transportation**. In fact, the solution is a platform combining data model structured and unstructured data, enabling City personnel to integrate many disparate data sources – e.g. 911 calls, 311 (non-emergency) service calls, crime statistics, building and business permits, real-time location of city vehicles, accident management weather and geospatially-enabled tweets. Data are organized and managed into the WindyGrid's single, user-friendly graphical interface. The platform can potentially offer new insights into municipal operations across departments, helping personnel make fast, informed decisions to better respond to situations.

This mapping application enables users to visualise, on a single graphical interface, the operational situation of the city in real time or over time, thanks to location-based information such as accident history at a crossroads and the ensuing list of emergency calls, CCTV camera video flows, tweets by the public, etc. (La Fabrique de la Cite, 2014)



## Business case

The WindyGrid solution is part of the Chicago's SmartData project which will build the **first open-source**, predictive analytics platform – aggregating and analyzing information to **help leaders make smarter, faster decisions and prevent problems** before they develop.

The city of Chicago Department of Innovation and Technology received grants under the Broadband Technology Opportunities Program of ARRA for Sustainable Broadband Adoption and the support of Public Computer Centres. The Smart Chicago Collaborative helps the City administer all of the projects under this funding.

Chicago has a corporate partnership with IBM to do some basic research. The Smart Chicago Collaborative has McArthur Foundation support, which helps to fund some of the City's projects.

In any case, many of the longer term roles in the City are funded through the City's budget. It is financed primarily by philanthropic funds (mainly the McArthur Foundation, the Chicago Community Trust). In particular the windy grid solution was funded with a \$ 1 Mln grant (€ 0.9 Mln) from Bloomberg Philanthropies.

## Community & Citizen Focus

From a user's perspective, the application begins with a home page that gives them the ability to specify searches by data type, time, and location (at either a given geographical point or customized general area). This means that by performing a search, users can instantly understand the history of car crashes

at a given intersection, or visualize in real-time the volume of 311 calls happening within the radius of a given incident.

## Impact

The city officials who use WindyGrid send requests and receive alerts/automatic updates. With its unified GIS, Windygrid has been particularly useful for events such as the NATO summit (2012), when it was used to assist Chicago's Office of Emergency Management and Communications.

Furthermore, as reported by the Harvard Kennedy School web site (Harvard Kennedy School, 2013), *"City Staff has used WindyGrid to monitor several other major events, including the 2012 Gay Pride Parade. WindyGrid also allowed the head of the Department of Streets and Sanitation to work with public safety agencies to get streets open more quickly. The application has become an important tool for the management and maintenance tasks associated to Chicago's many annual events, including the St. Patrick's Day Parade, Taste of Chicago, and Air and Water Show"*.

**WindyGrid** has also been particularly useful for **organising predictive maintenance of the city**, as witness the part it played in the Automated Preventive Rodent Baiting Program, launched in October 2013. By facilitating the development of an algorithm that could identify and analyse the 31 types of 311 calls that corresponded to signs of an infestation (broken water pipes, problems with garbage collection, etc.), the WindyGrid platform enabled the municipality to predict rodent activity seven days in advance and to intervene effectively upstream.

The same approach has been used to identify black spots in road accidents.



## The solution in context: Smart City – Chicago

### About the smart city vision in the city

As stressed in the UK Department of Business, Innovation and Skills review, International Case Studies on Smart Cities, Chicago has been active in the smart city space since 2011.

Despite this relatively short period, strong political leadership and well-aligned governance structures have allowed the City to take significant steps in achieving their goals. Investment in open superfast broadband infrastructure, community engagement and inclusion projects, as well as projects specifically aimed at **fostering technology innovation**, are all part of the City's aspiration to create the '**City-as-a-Platform**' where products and services can be built on city owned resources

**Name of City** Chicago

**Country** United States of America

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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# ***Integrated Infrastructure & Processes***

- Replication potential
- Complexity
- Citizens' involvement



- Economic impact
- Environmental impact
- Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The City of Glendale's Advanced Metering Infrastructure (AMI) project, implemented by the municipally owned utility - Glendale Water and Power (GWP) - involves system-wide deployment of **advanced electricity** and **water meters**, use of **customer systems** and in-home displays, installation of **distribution automation equipment systems** and management of distributed energy and water storage. The project aims to **reduce peak loads**, overall electricity and water use, as well as operations and maintenance costs while **increasing system efficiency and reliability**.

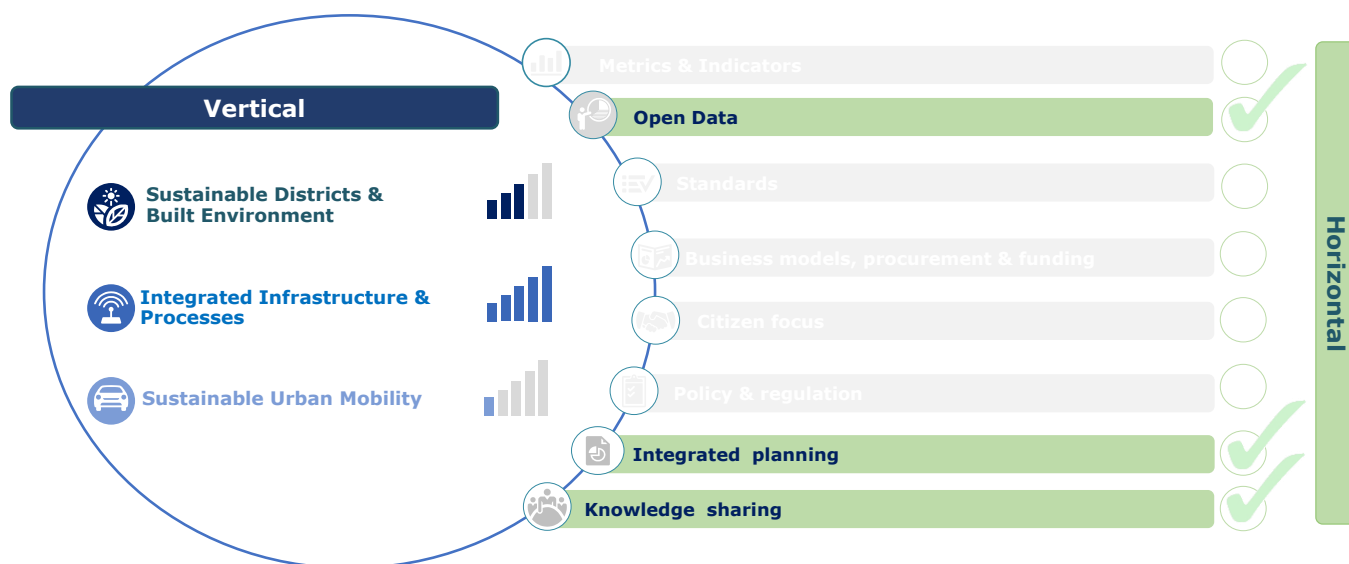
The project is centred on the implementation of secure wireless communications in order to allow customers to view their electricity consumption through online portals and displays at any time and also to enable Glendale officials to effectively manage, measure, and verify targeted demand reduction during peak periods. In addition to the AMI deployment, Glendale is enhancing feeders with distribution automation equipment in order to improve their operational efficiency and reliability.

Glendale's solution is not just smart metering and efficient distribution: additional components successfully put in place include **"advanced electricity service options"** with **in-home digital displays** and **interactive web portals** with dedicated user-friendly "apps", facilitating two-way information exchange providing the ability for customers to view their consumption and manage their bills, the implementation of demand response programs. As well, electric vehicle charging stations have been deployed to understand and manage the effects of increased loading on the distribution system. Glendale also deployed smart water meters in a parallel and separate project, which leveraged the communications and meter data management systems for **electric grid modernization, resulting in cost savings** for the utility and its customers. Project goals include improving operational efficiencies and cost savings from automated metering services, reducing capital requirements from fewer vehicle purchases, increasing revenues from more accurate meter reads and less electricity theft, faster restoration of services following outages, better electric distribution efficiencies and lower line losses from automated voltage controls, and lower electricity costs from reductions in peak demand.

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Municipal Utility, Industry
<b>Budget</b>	More than € 48.1 Mln, which includes federal funds of € 18.9 Mln
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://www.glendaleca.gov/government/departments/glendale-water-and-power">http://www.glendaleca.gov/government/departments/glendale-water-and-power</a>

## Level of integration

The project can be regarded as an example of a strongly integrated solution across the **ICT infrastructure** and the **built environment**, involving several steps of the utility value chain spanning from increasing the awareness and involvement of customers, automate the distribution systems, **increase the efficiency** and **reliability** of the operation and maintenance activity of the electricity and water systems. Furthermore, the deployments of the electric vehicle charging stations to assess the effects of increased loading on the distribution system opens to future the integration of sustainable urban mobility models.



## Business case

Originally developed in 2009 as an energy smart grid implementation project, the Glendale AMI solution rapidly evolved into an integrated multi-utility smart grid example. City-owned Glendale Water and Power (GWP) has completed its energy and water smart meter installation and is implementing a suite of new offerings to improve operational efficiencies and help save energy and manage electric and water bills.

Taking advantage of a € 18.9 Mln initial federal public seed funding (through the U.S. SGIG – Smart Grid Investment program - funded by the American Recovery and Reinvestment Act and administered by the U.S. Department of Energy) the municipal utility - first in the Nation to sign such kind of agreement with the Department of Energy - has been able to replace over 85,000 electric meters and 35,000 water meters with smart meters and to develop on top of these a new set of integrated services which exceed just energy matters. The **total project cost is € 48.1 Mln partially covered**, as written above, with **federal share funds by the Smart Grid Investment Program (SGIG) of € 18.9 Mln**.

The replacements fall in line with the municipal utility's goal: to cost-effectively provide customers with reliable, sustainable water and power while helping them conserve natural resources and manage energy costs. The utility expects the AMI system will provide a six-year payback through operational cost savings alone. The integrated Glendale Smart Grid Solution has been built on three main pillars including a:

- Wireless field area network with high reliability and performance, strong security, and ability to support multiple utility and municipal services;
- Single vendor for backhaul of smart electric and water meter network;
- Use of existing city infrastructure such as dark fibre and city light poles, scalable as additional capacity and coverage is needed.

## Community & Citizen Focus

Glendale is committed to effective two-way communication with the public and consultations have started since the very beginning of the initiative already in 2009. Outreach began with press-releases, newsletters and direct mailing and evolved then in numerous public meetings, open houses and “coffee in the park” public gatherings. Even though initial strategic setting and implementation efforts have followed mainly a top-down flow in the set-up stages of this initiatives, constant involvement of the community has been going on, in order to also adjust progressively actual implementation of the integrated solution.

GWP’s strategy was to implement their **smart grid vision in three phases**:

- **Phase 1:** An enterprise data center upgrade, territory-wide AMI for power and water, a two-way communications infrastructure between the utility and each customer premise
- **Phase 2:** Customer-facing demand response programs and solutions to provide visibility into utility usage, and to empower and encourage resource conservation
- **Phase 3:** Advanced distribution automation applications across the utility’s service territory.

Several items made GWP’s situation unique. First, its smart grid plans were extensive and it had limited resources to implement and support a smart grid program that was comprehensive and more ambitious than many of the programs proposed by larger utilities. Second, as a municipal utility, GWP also saw the opportunity to consider how its project could be leveraged by and benefit other city departments.

## Impact

Glendale's smart grid deployment benefits include **reduced carbon emissions, improved system reliability, enhanced security**, theft and **tampering deterrence and detection**, and support for EVs and smart appliances. The initiative also contributes to GWP's goal of holding down rates while conserving water and energy. Smart grid implementation gives GWP customers new tools to better manage their energy and water use and make informed choices that save money and help the environment. Through in-home displays and GWP's secure Internet portal, customers have access to their usage to help them conserve and participate in pricing plans that fit their lifestyles. Meter reading is done remotely, saving money and the municipal utility can pinpoint outages and service problems much faster, allowing GWP to restore service more quickly. GWP project could potentially add **€ 18.2 Mln** in positive value, with an 11.5% internal rate of return; in detail the impacts are:

- **Reduced meter reading and customer service costs:** Glendale realized a € 2.7 Mln in annual cost savings - a 51% reduction in annual costs - from lower meter reading and customer service operations since 2010
- **Reduced operating and maintenance costs:** Glendale expects significant operational savings from enterprise computer system improvements, customer programs and distribution automation programs. Total annual system benefits could exceed € 7.58 Mln by the tenth year of operation
- **Satisfied customers and energy consumption behaviour change:** GWP’s customer systems programs are received favourably by users, 83% of the in-home program participants are using the information provided through their in-home displays and say they have changed their energy consumption behaviours and reduced energy and water use. GWP estimates the 46,000 customers participating in its AMI-enabled home energy reports and web portal program are saving as much as 5,700 megawatt-hours of electricity per year
- **Behavioural demand response pilot project:** GWP recently partnered with software-as-a-service provider Opower to launch a pilot that notifies customers of “peak events” and asks them to reduce energy consumption during peak hours. To date GWP has called three peak events as part of this pilot which have produced an average overall load reduction of 4.1% during peak hours across 38,000 homes, all without offering a pricing incentive
- **Reduced greenhouse gas emissions and criteria pollutants:** A Glendale contracted study suggests carbon dioxide reductions will approach 60,000 tons a year once programs reach full implementation. Reductions result from customer care and metering (i.e. reduced truck rolls), customer demand management programs, and power delivery improvements (i.e., load balancing, voltage monitoring, and fault detection)



## The solution in context: Smart City – Glendale

### About the smart city vision in the city

Glendale has had a long-standing commitment to the environment and to providing better and more efficient services through virtuous implementation of technological solutions. From promoting green building materials to developers, all the way to bringing fresh organic produce to residents, the City of Glendale is always committed towards responsible and sustainable living and working. With a population of over 200,000, the city is the third largest city in Los Angeles County and the seventeenth largest in the state of California.

The public-owned company GWP has been recognized as a **Reliable Public Power Provider (RP3)**; the RP3 designation is awarded to US public utilities that provide customers with the highest degree of reliable and safe service, while GWP's managing board was also awarded the **GridWeek Leadership 2010 prize for Smart Grids**. GWP's smart city vision totally embeds full infrastructural integration as the key asset for assuring sustainability and increasing of the efficiency and reliability of the electricity and water systems.

**Name of City** *City of Glendale*

**Country** *California – USA*

**No of Inhabitants** *100,000 < x < 500,000*

**Smart City Rankings** *Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.*



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## E-Energy Mannheim Mannheim, Germany



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

As one of the leading nations in terms of smart city initiatives, Germany created the E-Energy funding program, which linked **energy-saving technologies** with communications systems. E-energy resulted in the development of a group of smart cities across the country. Mannheim is considered as Germany's first smart city. Within the framework of E-energy, the city created the concept of **Model City of Mannheim** (*Modellstadt Mannheim*, MoMa) and installed broadband power lines (BPL) to connect every household in the city to its cutting-edge smart energy network.

The "MoMa" project attempted **to investigate and support a paradigm shift in the energy system**. The project focused on integrating a high load of intermittent energy sources and decentralized generation into the existing city grid in order to, first of all, improve efficiency and, second, to raise awareness of renewable energy amongst consumers. The Model City Mannheim project provided an energy Internet which intelligently controlled and regulated the entire electricity system, from power generation via the grid to power consumption. It is the first city in Germany where all households are connected to the same smart grid.

Through BPL systems, the power grid was turned into a **real-time communications platform** that connected all households. The 3,000 participating households were equipped with devices that intelligently controlled appliances and connected them to the grid. The encrypted data was sent to the customer's password-protected web portal as well as to the utility company MVV Energie.

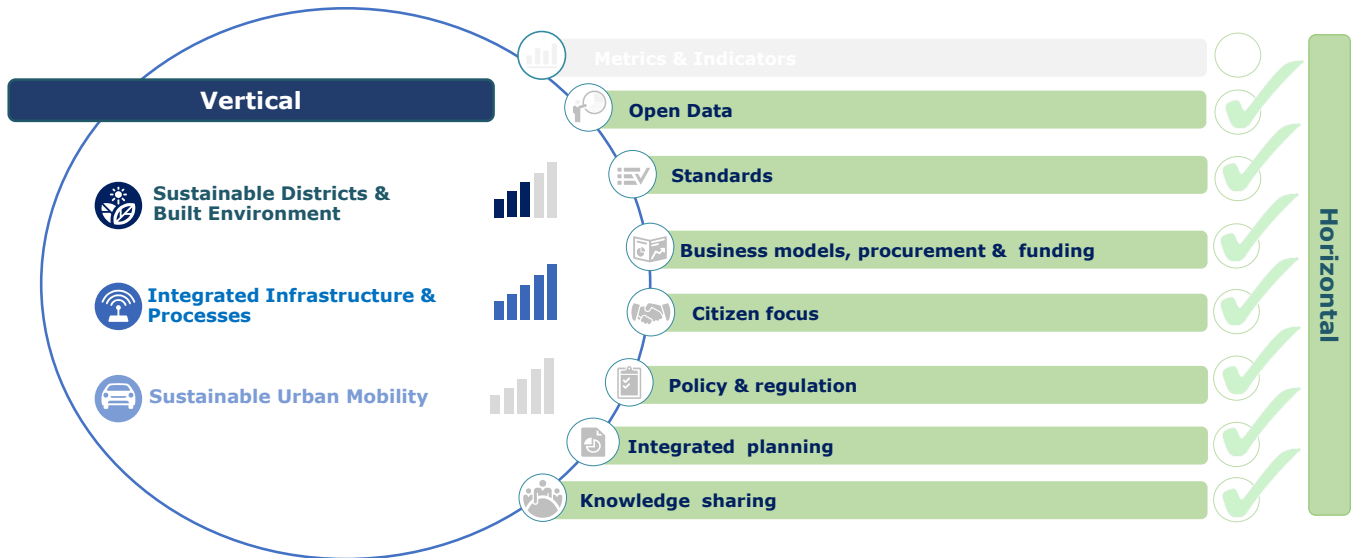
The aim of the **E-Energy project was to combine the energy production of the household**, i.e. through rooftop solar panels, with the energy production of major energy companies. This ensured a minimum loss of energy because of the households' proximity to de-centralized energy suppliers. It also created many new energy suppliers on the market.

The E-Energy programme began in 2008 and ended at the end of 2013.

<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industry
<b>Budget</b>	€ 5,5 Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.e-energy.de">http://www.e-energy.de</a>

## Level of integration

The solution focused on the potential of new technologies and ICT systems in order to boost both **energy efficiency**, **CO<sub>2</sub> emission reduction** and **energy consumption awareness in cities**. Hence, the solution also addressed the efficiency and security of energy supply.



## Business case

The solution was based on a joint initiative of the Federal Ministry of Economics and Technology and the Federal Ministry for the Environment.

The energy company, MVV Energie, had the daily project responsibility of driving the solution forward. The solution must be characterized as an **industry-led solution**. Other actors were also included in the solution and the specific sub-projects: DREWAG – Stadtwerke Dresden GmbH, IBM Deutschland GmbH, Power PLUS Communications AG, Papendorf Software Engineering GmbH, University of Duisburg-Essen, ISET, ifeu Heidelberg GmbH and IZES GmbH. The Model city of Mannheim (MoMa) had a specific focus on business models and incentive systems for energy market participants enabling marketable solutions.

The budget of the solution was **€ 5.5 Mln**. The project was both **public** and **private financed (33% from public funds and 67% from private financing)**.

The project concentrated on an urban conurbation with a high penetration rate in which renewable and decentralized sources of energy are used to a large extent. Within the framework of the E-Energy project, a representative large-scale trial was conducted both here and in Dresden to demonstrate the project can be applied and translated to other regions. The trial used new methods **to improve energy efficiency, grid quality, and the integration of renewable and decentralized sources of energy** into the urban distribution network.

E-Energy was part of a nation-wide incentive programme. Within the project the solution was replicated in the city of Dresden. Parts of the project (different tariffs communicated by app systems) were also replicated at Liander, Netherlands.

## Community & Citizen Focus

The radical context of this initiative was **to shift the consumer or citizen from passive consumer to prosumer**.

Electricity was offered to customers close to the point of generation and directly when the power was generated. This avoided transporting power (and associated power loss), and included the use of decentralized energy storage units. Proactive users in the energy market ("prosumers") geared their power consumption and their power generation towards variable pricing structures. Furthermore, real-

time information and energy management components aimed to help the customer contribute to even greater energy efficiency.

Households further **benefitted from new technologies including the 'Energy Butler' gateway**, which monitors the grid to obtain real-time pricing information from the utility and connects many household appliances including dishwashers, fridges, and tumble dryers.

Allowing individual households to monitor their own energy consumption and to gain access to an online portal in which further details on energy production and consumption created an **increased awareness and focus on renewable energy and reducing energy consumption**.

The Energy Butler gateway relayed dynamic pricing information back to the consumer, giving them greater control over their energy consumption, as well as relieving stress on the grid by shifting the use of certain appliances to off-peak periods. Business and industrial clients also connected their cooling facilities and air conditioning systems to the project.

## Impact

The E-Energy project in Mannheim tried to **prioritize renewable energy**. Because renewable sources of energy are so unreliable — the wind doesn't always blow during peak consumption times — the system's feedback helped keep energy use and production balanced. After first pre-trials had already delivered promising results on individual technological components, the large field test was set to take the overall Mannheim infrastructure to the grid. The pre-defined goal was not only to examine the interplay between all components, but also to analyse the field test consumer behaviour in terms of price elasticity.

A final field test demonstrated a high acceptance for the dynamic tariff and proved that households react to a price increase of a 100% with an **average shift in consumption of about 11%**. At certain times of the day, shifts of up to 35% have been measured.

The increase in energy suppliers created a whole new energy marketplace, where the cost of energy is based on competition and market forces. This competition was enabled by a better interconnection of consumers, suppliers, operators etc. in the energy market. A rule of thumb is that energy prices are lower when a lot of wind and solar energy is available in the grid. This inclines consumers to consume when renewable energy is available, and to reduce consumption when it is not, which is environmentally beneficial. The price on energy is also lower when the demand for it is i.e. during the night. All in all, this creates new perspectives on how we perceive energy production and consumption.

The final evaluation showed that consumer behaviour can be changed. Participants of the project started to shift the use of electricity in times with high feed in of renewables (because of different tariffs) and lessen when the feed in is low. During the project people learned about the possibilities of changing their daily use of electricity and the chances to lessen their costs of the purchased electricity.



## The solution in context: Smart City – Mannheim

### About the smart city vision in the city

Smart City Mannheim, MoMa, has been developed on the basis of the government-funded 'E-Energy' programme. The key objectives of the projects were to demonstrate **potential of renewable energy** and how it can be **optimally integrated into a grid**. In addition to PPC (a leading provider of communication systems), other partners in the project include MVV Energie and IBM. Using PPC's Broadband Powerline, the power grid is turned into a communications platform that connects households, decentralised generators and measuring devices in one system. 3,000 households will be equipped with intelligent energy and data devices. The encrypted data collected from the devices will be sent to the customer's password-protected web portal as well as to utility company MVV Energie. Thus, the data is easily available for both the households and the energy provider.

Mannheim is also smart in its recycling system: there is a collection system for all rubbish and scrap. Most of this waste is collected near houses: the rest can be taken to recycling stations. This rubbish is recycled into combined heat and power in a power station. The slag of the station is recycled too. The municipal enterprise Wastewater Management in the City of Mannheim has held Quality and Environmental Management Certifications (EN ISO 9001, EN ISO 14001) since 2003. As **a strategic goal**, they want to **produce 100% of their energy needs by themselves**: currently the production rates are 100% for heat and 60% for electricity.

**Name of City** Mannheim

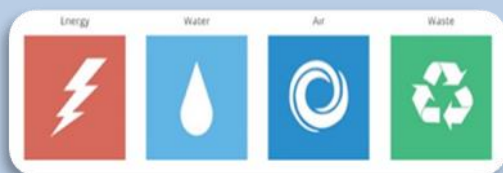
**Country** Germany

**No of Inhabitants** 100,000 < x < 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
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## Envision Charlotte Charlotte North Carolina, US

- Replication potential
- Complexity
- Citizens' involvement



- Economic impact

- Environmental impact

- Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Envision Charlotte is a US non-profit partnership aiming at **making Charlotte's urban cores the most environmentally sustainable in the nation**. The Envision solutions focus on environmental sustainability, combined with a **pro-business approach**, which benefits the regional economy and achieves results through perpetual, formal stewardship of defined resources in the environment in the areas of: **Energy, Water, Air and Waste**.

As a primary focus of Envision there is the commitment to reduce Charlotte's energy that is wasted in commercial buildings within Charlotte's 1.94 square-mile I-277 inner-belt loops by using **innovative technologies to encourage energy efficiency and changes in consumer behaviour**. The initiative deploys a combination of digital smart grid and building automation technologies, as well as energy tracking tools, to provide building owners and office workers with near real-time information about the buildings' collective energy use. It also suggests specific actions office workers can take to **reduce energy consumption**.

Another key objective of Envision is to build a public-private approach to energy efficiency that can be replicated in commercial buildings in cities across America.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry, academia
<b>Budget</b>	€4,9 <sup>31</sup> Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.envisioncharlotte.com/">http://www.envisioncharlotte.com/</a>

<sup>31</sup> The conversion rate used for this case study is 1€=1,060\$

## Level of integration

The Envision Charlotte solutions **are spread across four pillars: air, energy, water and waste**. All the measures carried out in the various sectors rely on a **network of buildings**, with about 900 square metres of office space. The integration of the measures is ensured by the governance of the solution, a board with organizations, universities, building owners, utilities and local government, e.g. Duke Energy, Charlotte Center City Partners, Cisco, Verizon Wireless, U.S. Green Building Council, Intelligent Buildings and UNC Charlotte. The solutions focus on specific programs in a manageable geographical area with specific resource metrics and measurement capabilities. The solution encompasses the following initiatives:

- Mobilizing a community of building owners, managers, engineers, tenants and workers to work collaboratively **to reduce energy consumption and contribute to the 20% reduction goal** for the community, e.g. through digital displays showing energy performance;
- **Shifting to cleaner generator technologies in buildings;**
- Partnering with waste management companies, building owners, managers, engineers and workers to **reduce materials used during daily activities, reuse materials more efficiently and increase recycling;**
- **Tracking and reporting water usage** in Uptown buildings.



## Business case

Envision Charlotte is a charitable organization. The Board of Directors includes representatives from leading corporations, universities, and government. Duke Energy and Cisco team up with Charlotte Centre City Partners and the city of Charlotte to encourage commercial building owners in uptown Charlotte to participate in Envision. The following are the organizations that have already been contacted and expressed interest in participating in the initiative:

- **Bank of America**, which is headquartered in Charlotte, and controls approximately 7 Mln square feet;
- **Wells Fargo**, which has its eastern bank headquarters in Charlotte, and controls approximately 3 Mln square feet;
- **The city of Charlotte and Mecklenburg County**, which controls approximately 1.4 Mln square feet;
- **Duke Energy**, which is headquartered in Charlotte, and controls 1.3 Mln square feet.

There is no cost to participate in Envision: Charlotte Commercial building owners can participate in the initiative at no cost. The energy saved is expected to eventually more than offset Duke Energy and



**Cisco's investment of \$ 5.3 Mln (€ 4.9 Mln)** to deploy the initiative, 80% of which come from Duke Energy and 20% from Cisco.

The Envision Charlotte efforts are not unnoticed. The solutions have been involved in the Global Smart City and Community Coalition, providing a sound basis for replication to other cities as Chicago and Austin, Texas, along with other international partners.

## Community & Citizen Focus

The Envision Charlotte strategy to involve citizens and businesses indicates that stakeholder alignment is essential in constructing a Smart City. In its commitment **to reduce energy, save water, eliminate waste and improve air quality**, Envision Charlotte relies heavily on individuals and companies involvement. Envision has created the Champion Program to train people on how they can make a difference in their workplace, and connect them with likeminded champions to make a real difference in Charlotte.

There are a number of challenges associated with implementing a large-scale stakeholder's involvement initiative, i.e. including public buy-in and funding and budget constraints. In the case of Charlotte, for example, creating a public-private partnership and getting large corporations involved has helped the program become successful.

In terms of lessons learned, as stressed by Pierre Brunet with Veolia, a company helping Charlotte toward their vision, ***"a smart city is about smart operations and smart citizens. Coaching is critical. It's not just providing data in real time, but also providing coaching on how to reduce consumption, for example."***

## Impact

The goal of the initiative is to reduce energy use by up to 20% and avoid approximately 220,000 metric tons of greenhouse gases by 2016. In the specific it aims:

- To **reduce energy use in Uptown Charlotte by 20% in five years;**
- To **track and report water usage in Uptown buildings;**
- To **deploy innovative programs** that **reduce energy use** and help to promote cleaner air in Charlotte;
- To **reduce materials used** during daily activities, reuse materials more efficiently and **increase recycling.**

These programs are aimed at **reducing the amount of waste going to landfill. 98% of 65 buildings** in city center Charlotte were voluntarily connected with smart energy meters. In addition, large interactive kiosks, available in those buildings, show total electricity consumption on a real time basis to drive awareness. In 2014 Envision Charlotte Announces uptown Charlotte energy savings of 8.4%. Charlotte's efforts in energy alone have saved citizens more than \$10 Mln since the program's inception in 2011.



## The solution in context: Smart City – Charlotte

### About the smart city vision in the city

According to the 2010 census, Charlotte has a population of more than 750,000, making it the 18<sup>th</sup> largest city in the US. The city's high concentration of commercial office buildings also facilitates smart grid connectivity and consumer education on ways to **reduce energy** that is wasted in commercial buildings.

The Envision: Charlotte initiative builds on the Charlotte region's economic development "energy capital USA" initiative that was announced by North Carolina Governor Beverly Perdue, city and business leaders in April 2009. Today, the region is home to more than 175 energy companies, employing more than 13,000 people.

In the U.S. city of Charlotte, in North Carolina, Bank of America, Wells Fargo bank, Duke Energy, Charlotte Center City Partners and consultancy Intelligent Buildings, LLC, along with other key community stakeholders, have set up a non-profit organization to run its Envision Charlotte programme. The first pillar of the programme, Smart Energy Now, is run as a partnership between the city administration, the electric and water utilities, office building owners and managers, mobile operators and technology vendors. Initiated in October 2011, the project is **improving energy efficiency in office buildings** with more than 10,000 square metres in downtown Charlotte by supplying the occupants with near real-time information on their energy usage.

**Name of City** Charlotte

**Country** North Carolina

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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- › **The solution in context image source: Envision charlotte**  
(<http://www.envisioncharlotte.com/>)



## Fiber Optics Smart Grid Chattanooga, Tennessee, US

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Electric Power Board (EPB) of Chattanooga - Tennessee, **is one of the largest publicly owned providers of electric power in the United States**, covering about 600 square miles and serving about 170,000 customers across the States of Tennessee and Georgia.

As outlined by the US Department of Energy, the (EPB) smart grid solution involves the deployment of a fiber optic network as the primary means of communication for all smart grid equipment, an **advanced metering infrastructure (AMI) system**, an **energy management web portal**, and **distribution automation (DA)** equipment on over half of EPB's circuits.

The project also delivered time-based rate programs to customers to create incentives for peak load and overall bill reductions. The EPB smart grid project has enabled a new kind of partnership with customers aimed at **reducing peak loads, overall electricity use, and operations and maintenance costs**. "The distribution system upgrades increase operational efficiency, reduce line losses, and improve service reliability for customers" (US DoE, 2014).

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart grid
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry
<b>Budget</b>	€ 213 <sup>32</sup> Mln
<b>Number of impacted users</b>	Approx. 100,000
<b>Link</b>	<a href="https://epb.com/content/smart-grid">https://epb.com/content/smart-grid</a>

<sup>32</sup> The conversion rate used for this case study is 1€=1,060\$

### Level of integration

The smart grid solution deployed in Chattanooga achieves a **high level of integration between ICT**, in particular **fiber optic networks, energy savings** and information provided directly to users. The fiber optic network infrastructure provides EPB with expanded capabilities and functionality to optimize energy delivery, system reliability, and customer service options. The project deployed approximately 170,000 smart meters, providing AMI coverage for all EPB customers. This advanced metering system integrated in a fiber optic network managed by a central platform, features restoration, notification and remote service connect/disconnect elements, to enable EPB responding to outages and user requests more efficiently.



## Business case

**Total project cost** was \$ 226,707,562 (€ 213 Mln), of which 49% coming from US Federal budget, while the rest was raised by revenue bonds. **Costs for the advanced metering infrastructure** installation have been \$ 41,861,000 (€ 39 Mln) among residential, commercial and industrial users. **Costs for the communication** networks and data systems have been \$ 36,978,920 (€ 34.9 Mln) for the backhaul communications description (the backhaul network for the AMI system is a fiber optic network) and the meter communications network (meter communication between meters occurs through an unlicensed 900MHz radio spectrum system). Head end server costs (\$ 7,188,000, € 6.7 Mln) include an interactive system that takes a high volume of data from the smart meters in near real-time. In terms of scaling up and replication – while the same implementation scheme of the solution is being followed in other cities in the area - there is also a strategic plan to deploy further on the project integrating new components, i.e. to reach full automation of distribution system.

## Community & Citizen Focus

The EPB's Smart Grid project involves the installation of advanced metering systems and communications infrastructure. In doing so it enables customers to view their energy consumption at their convenience through systems such as Web portals, providing time-based rate programs to customers.

Furthermore, the EPB's Smart Grid project also enables communities to enhance the capabilities that smart fiber optics can deliver. With the **Gig City** programme, the municipality tries to **attract creative minds to the area with contests and financial incentives tied to social media**, for example trying to involve minority and women-owned business groups through schemes that give them incentives to submit bids.

## Impact

The impacts of the smart grid are wide and range from environmental to economic benefit:

- As a result of the infrastructure implemented, the automotive industry has invested in the city creating **2,000 new direct jobs**, and online retail distribution centres are also investing along with start-up tech oriented businesses. Over 20 large industries have signed up to 'time-of-use' tariffs which are saving those businesses collectively **\$ 2.3 Mln a year (€ 2,1 Mln)**.
- **EPB** has achieved **\$ 1,6 Mln (€ 1,4 Mln)** in annual operational cost savings through automation of meter reading.
- Furthermore, avoided manual switching costs have saved the utility approximately \$ 40,000 annually (€ 36,000).
- The automated switching has significantly reduced the need to send staff into the field during and after storms to identify damage locations, isolate the damage, and restore the unaffected sections.
- Increased distribution system reliability:
  - Voltage control allows EPB **to reduce peak demand** by up to 30 megawatts per month, resulting in \$ 2 Mln in wholesale demand savings annually.
  - Over the last years, EPB has experienced a 42% improvement in the System Average Interruption Duration Index (SAIDI) and a 51% improvement in the System Average Interruption Frequency Index (SAIFI).
  - Reduced costs from theft: EPB lowered operations costs from remote meter reading and more frequent identification of electricity theft.



## The solution in context: Smart City – Chattanooga

### About the smart city vision in the city

The city's smart vision builds on the National smart energy investment strategies. As outlined by the U.S. Department of Energy, "the American Recovery and Reinvestment Act of 2009 (Recovery Act) provided the U.S. Department of Energy with \$ 4.5 Bln to modernize the electric power grid and to implement Title XIII of the Energy Independence and Security Act (EISA) of 2007." This gave the stimulus to two larger initiatives, **the Smart Grid Investment Grant (SGIG) Program and the Smart Grid Demonstration Program (SGDP)**, which were originally authorized by EISA, and later modified by the Recovery Act. The DOE Office of Electricity Delivery and Energy Reliability were responsible for managing these five-year programs. The two programmes have the following characteristics:

- **The SGIG focuses on deploying existing smart grid technologies, tools, and techniques** to improve grid performance today;
- **The SGDP explores advanced smart grid and energy storage systems** and evaluates performance for future applications. Other smart grid programs funded through the Recovery Act include Workforce Training for the Electric Power Sector, interoperability and cyber security and the Renewable and Distributed Systems Integration Program.

<b>Name of City</b>	Chattanooga
<b>Country</b>	Tennessee, USA
<b>No of Inhabitants</b>	100,000 < x < 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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([https://www.smartgrid.gov/files/EPB\\_Final\\_Project\\_Description\\_-\\_20140422\\_reformatted\\_0.pdf](https://www.smartgrid.gov/files/EPB_Final_Project_Description_-_20140422_reformatted_0.pdf))
- › **First image source:** Chattanoogaig  
(<http://www.chattanoogaig.com/>)
- › **The solution in context image source:**  
(<http://www.google earth>)



## Hengqin Smart Grid Hengqin New Area People's Republic of China



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Hengqin New Area is located in Hengqin Island, which is in the south of Zhuhai City in Guangdong Province, adjacent to the island of Macau and overlooking Hong Kong.

According to the Hengqin New Area Master Plan, Hengqin will be developed as an **"open island"** connecting Hong Kong and Macau, into an economically prosperous and lively "vigorous island", a knowledge-intensive, information-developed "smart island" and a resource-saving and environment-friendly "eco-island". The city will use **environmentally-friendly** and **low carbon materials**, adopt a centralised cooling system and implement eco-friendly and efficient treatment solutions of urban waste.

To achieve Hengqin New Area Master Plan the city needed to improve the electricity grid by implementing a smart grid. The smart grid will enable the city to meet its **"five-nine" goals**<sup>33</sup> and ensure it can withstand the risk of large area blackouts. In addition the implementation of the smart grid will facilitate the city in attaining its **energy-saving** and **emission reduction goals**.

A number of smart energy management pilot projects are being developed in Hengqin New Area including: **distributed energy consumption, micro-grid construction, intelligent power transmission and transformation, power distribution network construction, intelligent power consumption and intelligent support platform construction**.

The high voltage smart power grid is expected to be built into a 220kv double ring substation network with four 500kv stations centred in Jialin station with four stations including Qinyun station (3 x 100 MVA<sup>34</sup>), Jinhai station (3 x 100 MVA), Feitian station (3 x 100MVA) and Fuxiang station (2 \* 100MVA). Qinyun substation is situated in the southern part of Zhuhai power grid in Xiangzhou district. Its scope is to supply north Hengqin mountain, which is the residential community, central business district and high-tech industry zone in the south of Maliuzhou.

The first smart grid substation to be built was 220kv Qinyun substation. It was also the first **"3C Green Grid"** (Computer, Communications and Control) standardised digital substation of China Southern Power Grid Company and is a pilot project in "3C green power grid" of Guangdong Power Grid Corp.

Each substation has an auxiliary system with a unified interface and transmission protocol, which facilitates the comprehensive treatment of information and also provides linkages between the automatic fire station and fire alarm systems, heating, ventilation and air conditioning systems. The substation has a digital intelligent power system that enables information to be shared across the grid. An online detective and evaluation system has been implemented at each substation so that important primary equipment such as transformers and high-tension switches can be detected online and evaluated in a timely manner.

<sup>33</sup> "five-nine" goals means power supply reliability will reach 99.999%.

<sup>34</sup> MVA: Megavolt amperes (one Mln volt amperes)



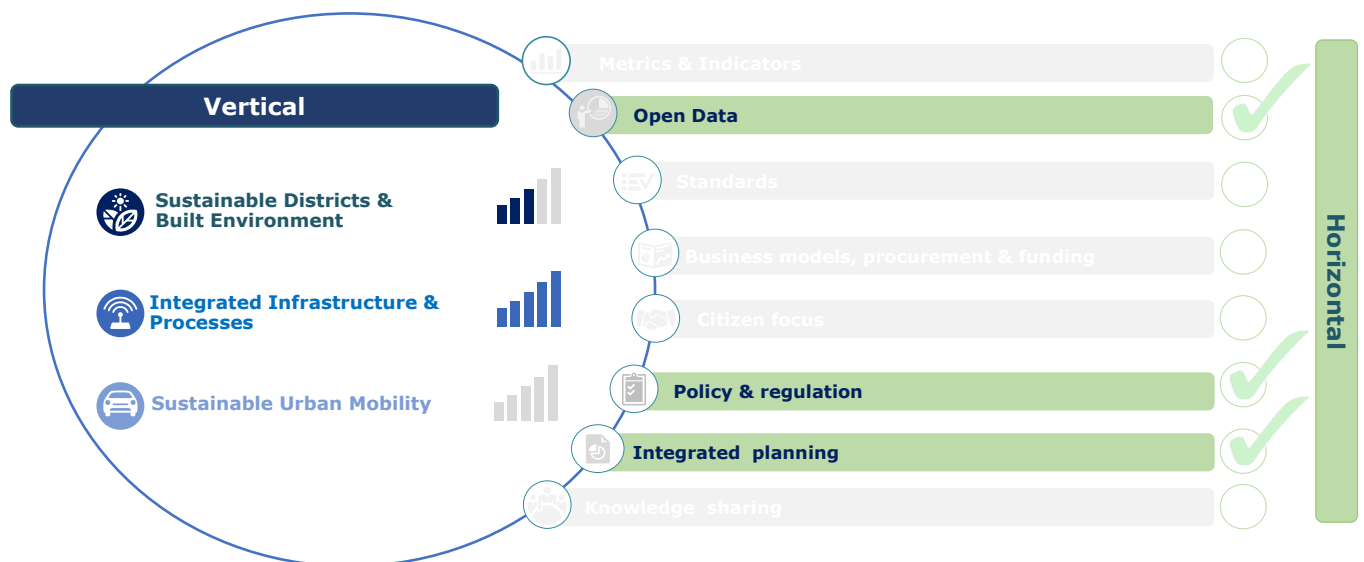
<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart Grid
<b>Scaling or Replication</b>	Scaling has been achieved and replication is planned
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	Total budget not known; € 48.5 Mln, was made for the four 180,000 KVA main transformers, nine 220 kV lines and twelve 110 kV lines
<b>Number of impacted users</b>	Approx. 6,300
<b>Link</b>	<a href="http://en.hengqin.gov.cn/index.htm">http://en.hengqin.gov.cn/index.htm</a>

## Level of integration

Hengqin New Area's green intelligent transformer substations integrate aspects from **ICT, energy and environment**. The solution is part of a **smartgrid** that **aims to improve the electricity grid and prevent the area from the risk of large area blackouts**.

The environment benefits from many aspects. Qinyun power substation is equipped with 344 blocks of 230W polycrystalline silicon photovoltaic modules and the direct current produced by solar panels is conveyed through grid-connected inverter and then transformed into 380V triple phased/50Hz or 220V single phased/50Hz alternative current. The solar photovoltaic power system on the roof of the substation uses only solar power, so it is both energy-saving and eco-friendly.

For these reasons the project in Hengqin New Area can be classified as a solution with significant integration of ICT, energy and environment.



## Business case

The smart grid project was funded by Guangdong Power Grid Corporation, a State Owned Enterprise. A **total investment of € 48.5 Mln<sup>35</sup>**, was made for the four 180,000 KVA main transformers, nine 220 kV lines and twelve 110 kV lines.

<sup>35</sup> The conversion rate used for this case study is 1€=6,90REB



## Community & Citizen Focus

The smart energy management pilot projects are led by the government, with the final decision-making authority vested in the central and local governments and regulators.

From desk research, it appears there are no channel for citizen's feedback and participation in the design of the smart grid project.

## Impact

The evaluation of smart energy power grid is measured against the **"3C green transformer" index**, which has five indices, namely land use, energy, water, material, and environment.

In 2013, the Southern Power Grid Company of China held a Scientific and technological achievements appraisal meeting of "Research and application of key technology in intelligent operation control of 3C green substation". The technical expert group, led by Han Yingduo, academician of the Chinese Academy of engineering, agreed that many innovative achievements of 220 kV Qinyun smart substation had met the "3C green transformer" index standards. The technical expert group noted that a number of pioneering innovations had been incorporated in the solution and the overall development of the smart energy power grid had reached an international advanced level.

Since Qinyun smart station has been operational **it has also reached a 100% of all its targets** - correct rate of protection, telemetry, etc. and has achieved all its objectives.

The smart energy power grid not only meets the rapid growth of Hengqin New Area's demand for electricity but has also further enhanced the capacity of China Southern Power Grid to supply electricity to Macau.

According to the Zhuhai Power Supply Bureau, the rooftop solar photovoltaic system alone could generate more than 75,000 kWh per year **generating economic benefits of more than RMB 40,000 (€ 5,800) per year.**



## The solution in context: Smart City – Hengqin New Area

### **About the smart city vision in the city**

Hengqin New Area covers an area of 106.46 square kilometres and the island is made up of one town, three communities and 11 villages and has a population of 7,000 people. Hengqin New Area is the only place in Mainland China connecting Hong Kong and Macau via road and bridge. It is at the centre of Southeast Asia and China and is an economically booming region. Hengqin is one of about a dozen special economic zones on the mainland that offer tax and other regulatory incentives to lure investment from overseas investors. By 2013, it has attracted RMB 226 Bln (€ 32.8 Bln) of investment since the city's establishment in 2009.

Hengqin New Area has forests, wetlands and oceans, which provides the city with a natural advantage for producing renewable energy from wind, solar and water. 70% of the land is reserved with prohibited or restricted construction areas. All new buildings in Hengqin New Area are constructed to meet green building standards. As part of the first group of pilot smart cities in China, Hengqin's goal is to be a provincial **front-runner in terms of intelligent and green transportation, digital infrastructure construction and e-commerce applications**. The municipal government has signed strategic partnership agreements with Digital China Holdings<sup>36</sup>, Singapore-based IDA International, China Telecom, China Mobile and China Unicom, HP Global Outsourcing Service Chinese Hub to help Hengqin achieve its smart city objectives. Hengqin New Area has implemented the following Smart Cities and Communities (SCC) solutions that have had a positive impact for the well-being of its citizens:

- **Investment in ICT infrastructure:** The city has built an urban fibre and wireless broadband network. The build out of the network infrastructure is enshrined in law to ensure that each neighbourhood and each family can connect to the Internet through a high speed broadband network. New ICT regulations have been established to encourage enterprises to develop innovative business such as IPTV, mobile TV, internet video, etc.
- **Creation of Cloud Computing Data Centres:** The cloud computing data centres will connect Hengqin with Hong Kong, Macau and the surrounding region with the objective of creating a cloud computing data centre hub to collect and process regional information.
- **Establishment of an integrated Transportation Centre:** The Transportation Centre comprises a transport services data platform to enable interconnection with the city's traffic management system, public transport management system, vehicle operation monitoring system, sea transport management system, air transport management system, clearance service systems, logistics systems and other transportation-related service platforms.
- **Formation of an integrated City Management Service Centre:** The City Management Service Centre enables the city to interconnect the urban planning system, traffic management system, digital city management system, security management system, environment management system and other city services' management systems. The plan is to build a city service management database that will enable citizens to see how the city is being run.
- **Creation of an integrated Public Service Centre.** The Public Service Centre collects public information such as taxes, social security, medical care, education, employment, hotel, restaurant, water, power, gas, public transport etc. The plan is to provide an open public data platform to give citizens and other stakeholders access to public service information that complies with privacy laws and regulations.

<sup>36</sup> Digital China Holdings is a Chinese company, listed on the Hong Kong stock exchange, which has rolled out Smart-City strategy and signed a strategic cooperation framework agreement with 25 cities in China.

<b>Name of City</b>	<i>Hengqin New Area, Zhuhai, Guangdong Province</i>
<b>Country</b>	<i>People's Republic of China</i>
<b>No of Inhabitants</b>	<i>&lt; 100,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## Integrated Smart City Grid Yokohama, Japan

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In 2010, the City of Yokohama set out the Yokohama Smart City Project (YSCP), a five year pilot in three Yokohama city districts, involving private companies and consultants (e.g. Accenture, Toshiba, Meidenko, Hitachi, Panasonic, TEPCO, Tokyo Gas, and Nissan).

The project includes several initiatives, all related to **the efficient use of energy in the built environment and for mobility purposes:**

- **Community Energy Management System (CEMS)**, aiming at controlling renewable energy by absorbing variations in a local community's power consumption through the integration of stationary batteries.
- **Energy Management for Detached Houses**, realizing visualization of energy consumption and demonstrating the demand response (DR) function integrated with CEMS
- **Energy Management for Commercial Buildings** which optimizes energy supply to an entire building
- **Energy Management for Factories**, conducting optimum control of energy for an entire factory
- **Chargeable and Dischargeable electric vehicles**, by conducting automated settings for charging and discharging based on PV output, electric consumption and electric vehicles usage patterns

In a nutshell, the initiatives include the use of photovoltaic generation and hydrogen as a fuel, the stimulation to the use of demand responsive energy consumptions patterns, the introduction of community bicycles and electric vehicles sharing schemes, the use of biomass to generate power, and the introduction of building energy management systems

<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry, academia
<b>Budget</b>	€ 560 <sup>37</sup> Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.city.yokohama.lg.jp/seisaku/kyosou/yport/yport-e/pdf/ref-04.pdf">http://www.city.yokohama.lg.jp/seisaku/kyosou/yport/yport-e/pdf/ref-04.pdf</a>

<sup>37</sup> The conversion rate used for this case study is € 1=¥ 133

## Level of integration

The Yokohama Smart City Project is specifically dedicated to **the integration of energy and transport**, by **using ICTs**. In fact, each of the energy management systems embedded in the solution considers its respective environment in managing energy and transport.

There are a number of different types of energy management systems: for houses, for residential complexes, for apartments, integrated building energy management systems, and energy management systems which optimally control factory operation, integrated building energy management systems for office buildings and commercial facilities.

In such a context, the **Community Energy Management System CEMS** brings together elements including the **electric vehicles (EV)** for charging and discharging verifications, charging stations, and the SCADA storage batteries that contribute to system stabilization, which will form the nucleus of next-generation transport systems, and offer optimal management of energy at the level of the community as a whole.



## Business case

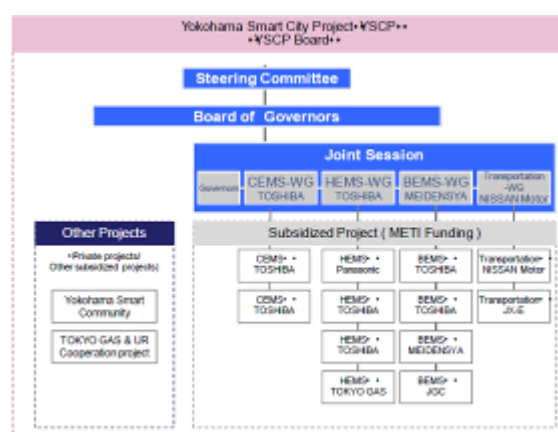
With the objective to make effective use of the outcomes of the initiatives, in April 2015 the City of Yokohama established the Yokohama Smart Business Council as a public-private collaboration.

The picture shows the governance structure of the smart city projects, in which the public and private sector collaborate on the basis of subsidized projects.

The initiative is part of a nationwide political framework, which aims to achieve energy efficiency, security, conservation and – at the same time – abandon the dependency from nuclear power.

The development of the integrated Smart City Grid is expected to cost approximately ¥ 13 Bln (~ € 100 Mln). Public funding from the national government covers approximately two-thirds of the investment. The remaining part is sustained by private companies.

The reported costs cover both the design and the development of the project. Being a *demonstrative experiment*, the aim is not to recover costs (nor to produce revenues), but rather to develop new systems and technologies. It is expected that at least some of the costs would be covered thanks to increased efficiency, however these savings have not been estimated.



## Community & Citizen Focus

Citizens' involvement plays an important role in the projects. In fact, **lifestyle reforms** are explicitly mentioned as part of the project, to the extent that it is acknowledged that peoples' everyday's lives; their behaviour and culture, represent an important aspect to save energy and reducing emissions.

The steps to involve citizens and communities are the following:

- **Planning and awareness-raising activities**
- **Experimental introduction of an energy monitoring project**
- **The introduction and improvement of incentives and systems to change behaviour**
- **Verification of the effect of the incentives** and evaluation of the degree of change in consumers' behaviour Conducting its business on an open basis, subject only to the requirements of appropriate levels of individual and commercial confidentiality and security

## Impact

According to the 2015 review of the initiative (YSCP review, 2015), "the Yokohama Smart City Project is implementing 15 projects involving cooperation between the municipality, 34 private companies, and the general public. Home energy management systems (HEMS) have been introduced to 4,200 households, solar panels generating 37MW have been installed in the city, and 2,300 electric vehicles (EV) have been introduced, significantly in advance of targets in each case. As Mr. Nomura, Executive Director of the City of Yokohama Climate Change Policy Headquarters, pointed out, of the four Smart City Projects underway across Japan, it is only Yokohama that has introduced HEMS in units of thousands".

On 2015, a demand responsive survey conducted among customers revealed that when customers are presented with an electricity rate menu, they have resulted in a maximum reduction of 20% in power demand in peak demand periods, and 70-80% of households are economizing on their electricity charges.

**Three methods** have been used **for improving energy consumption patterns**: (1) **Persuasion**, (2) The provision of **information** enabling consumers to **understand how much they can save** (known as "Shadow Billing"), and (3) in addition to **information provision**, the offering of incentives that ensure that consumers do not lose out.

The figure below shows the result, in which over a sample of 1,800 households, it was demonstrated that offering incentives more than doubled the total energy consumption in peak demand.

Policy (Treatment)	Opt-in rate		Net reduction in peak demand		Total reduction in peak demand
Persuasion to opt in	16.3%	X	26.2% (***)	=	4.4% (***)
Persuasion + Provision of information	30.7%	X	13.5% (***)	=	4.2% (***)
Persuasion + Provision of information + Offering of incentives	47.6%	X	15.7% (***)	=	7.8% (***)

\*\*\* 1% statistical confidence level



## The solution in context: Smart City – Yokohama

### About the smart city vision in the city

The city of Yokohama is actively engaged in SCC solutions. In such a context, the City is collaborating with the private sector (Accenture, Tokyo Gas, Toshiba, Nissan Motor, Panasonic, Meidensha, TEPCO, etc.) to work on various projects such as **introduction of renewable energy, energy management** of households, buildings and local communities and **next generation transportation systems**.

Yokohama is the second largest city in Japan, and its development is characterised by rapid urbanization, which determines significant urban challenges in terms of **energy use, traffic jams, and pollution**.

One of the side-effects of the rapid urbanization process is the significant increase in the volume of total greenhouse gas emissions. This is the reason why, among the objectives of the Yokohama Smart City Project, there is also the achievement of a better management of energy use and mitigate climate change.

**Name of City** Yokohama

**Country** Japan

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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<http://www.city.yokohama.lgf>
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<http://jscp.nepc.or.jp/>





## Island EcoGrid Bornholm, Denmark

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

EcoGrid started in 2011 with the goal to **develop a demand management market on the island of Bornholm**. 1900 households with heat pumps or electric heating and 20 commercial customers were linked to an artificial real-time electricity market. Partially retrofitted with solutions by Siemens and IBM, e.g. smart meters, remote controls and web based platforms, the 2000 "smart" customers react to electricity price stimuli, which are adjusted in 5-minute steps, activating or switching-off deferrable loads. EcoGrid Bornholm 2.0 will be rolled out from 2015 to 2019.

The EcoGrid-solution aims to **demonstrate the applicability of smart grids which are a hot topic in modern power networks**, especially where stability is at stake due to high renewable energy penetration, as in Denmark.

Contrary to current (Nordic) electricity markets, which operate on a 1-hour time frame and have minimum capacity requirements (10MW), the innovative concept enables a responsive balancing market based on small consumers.

If implemented on a national and international level, real time electricity markets could have extensive impact. It is thus worth to mention main potential benefits: i) **forecast error minimisation through last-minute integration of generation and consumption** ii) **increase in demand-side balancing services and consequent reduction of costly generation-side capacities** iii) **prioritisation of economic load-shifting resources rather than load-shedding** iv) **promotion of locational pricing and network decongestion**.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry
<b>Budget</b>	€ 21 <sup>38</sup> Mln (13 Mln EcoGrid 2.0)
<b>Number of impacted users</b>	Approx. 2,000
<b>Link</b>	<a href="http://www.eu-ecogrid.net/ecogrid-eu/the-bornholm-test-site">http://www.eu-ecogrid.net/ecogrid-eu/the-bornholm-test-site</a>

<sup>38</sup> The conversion rate used for this case study is 1€=7,46 DKK



## Level of integration

The solution integrates smart building technologies and ICT to create a **real time energy market** and **optimise the power system, maximising the deployment of renewables**.

Ecogrid Bornholm is based on a bidirectional flow of electricity and information between producers and consumers, and thus relies on the integration of ICT into the power network. Also, the solution emphasizes the advantage of ICT on citizen empowerment and built environment.



## Business case

Ecogrid is characterized as a public-private driven business model. The public needs the solution to integrate more renewable energy/incorporate more power consumption in existing grid. On a more concrete level, the private business sector develops the solutions.

Ecogrid Bornholm involves multiple national and international partners, of which the key stakeholder are energinet.dk, the national transmission system operator of the Danish electricity and gas transmission network, and Oestkraft, the local distribution system operator. Oestkraft, which is the daily operator of the solution, is an energy company owned by the municipality of Bornholm. Siemens, IBM, Insero, Uptime IT and TNO serve as technology suppliers, whereas Danish Technical University (DTU) and Copenhagen Business School bring new knowledge and research results into the project. Oestkraft and Energinet.dk is both partners in EcoGrid EU Consortium.

**The solution's budget** (EcoGrid Bornholm 2) is **€ 21 Mln**, with **50% being funded by the EU through its 7th Framework Programme on Research, Technology Development and Demonstration**. The remaining **50% is self-financed by the private partners**.

**Second phase**, EcoGrid Bornholm 2.0, will be running from 2015 to 2019 **is financed by 98 Mln DKK** (€ 13 Mln) of which DKK 53 Mln is a grant from the national EUDP programme which supports development and demonstration of new innovative energy technologies. The rest is funded by the project partners.

The solution's main goal is **to facilitate the transition from a day-ahead to a real-time market**. To do so it removes current entry barriers for small producers to access the balancing market.

Also, the purpose of the EcoGrid EU Consortium is to develop the EcoGrid Bornholm-solution in order to replicate the solution on a European level and not just on a Danish/Nordic level.

With the purpose to replicate the solution, the real-time market concept was designed based on existing power exchanges and balancing markets, although for the moment it is operated as a separate entity. If proved effective, the implemented approach could contribute to solve the issue of grid congestion and

stability, reducing or deferring the need for grid modernisation with consequent socio-economic benefits. The solution has not yet been replicated, but there have been a work package regarding replication in the project.

## Community & Citizen Focus

A user focus of the solution played an important **role in involving 2000 users on a voluntary basis**, i.e. almost 10% of the customer base on Bornholm. In fact, the identification of a successful strategy to ensure an effective recruitment of 1900 households and 20 commercial activities was thematised at a very early stage of the project. A first interview to screen promising means to engage potential “customers”, resulted in the promotional campaign’s clear focus on social and environmental benefits rather than on financial ones. Generally the undertaken recruitment campaign can be divided according to addressed focus groups and the means deployed:

- General public through press releases
- Early adopters by opening a demonstration house “Villa Smart”
- Customers with electric heating via personal emails and calls.

Especially, at later stages of the engagement it proved important to offer support through the availability of a hot line. Since the recruitment was very effective and faster than the technological retrofit of the households, it was critical to regularly update the community about the status of the solution to avoid loss of interest. This is still done through announcement on the web-site EcoGridBornholm, an electronic newsletter and presence in the local media, i.e. radio and newspaper.

## Impact

The final environmental results of EcoGrid 1.0 and recommendations from the project were presented at a conference at DTU in September 2015. The findings showed that there is a significant peak load reduction potential: the activation of flexible consumption with a five-minute real-time signal reduced the total peak load of the EcoGrid participants by approx. 670 kW or 1.2% of the peak load on Bornholm. Households, having equipment that controlled their heating system to respond automatically to price signals, accounted for 87% of the peak load reduction.

The tested solutions are technical solutions that are expected to be implemented on the general market after 2020, however the project indicates that the **amount of renewable energy can be increased with 8%.**

Hence, a final customer survey showed that 70% of the respondents (900 households) gave a positive rating to the overall EcoGrid project and that almost 80% would like to participate again in a project such as EcoGrid.

Another insight from the project so far is that raising the customer awareness of the benefits of demand side participation in the power market is not only relevant in the short term. Information about actual profit potential due to high price volatility close to real-time operation is important for citizen motivation.



## The solution in context: Smart Island – Bornholm

### About the smart city vision in the city

Denmark has the goal **to generate 50% of its electricity from renewables by 2020**. Bornholm goes a step further with the vision to be carbon neutral by 2025. Since the Bright Green Island strategy was adopted in 2007, sustainability, innovation and green technologies are at the centre of the community to achieve sustainable businesses, good living, a smart island and a green destination.

With **75% of its energy produced by REs** (64% by wind, 10% by biomass and 1% by PV) and the possibility to disconnect the island from the national power grid, Bornholm is an ideal setting for a wide range of Danish and international experiments and demonstration projects, focusing on smart grids, electric cars, solar panels and energy-efficient construction just to name a few.

**Name of City** Bornholm

**Country** Denmark

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Island Integrated Smart Grid Jeju Island, South Korea

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

In June 2009, the South Korean government chose Jeju, one of South Korea's nine provinces that is situated on the largest island, to serve as pilot site for developing and installing a comprehensive Smart Grid vision. South Korea aims at **making this test-bed the largest Smart Grid community worldwide**, making it possible to test the most advanced technologies and research results related to Smart Grid, and also experimenting new business models. Furthermore, the Jeju Smart Grid test-bed may serve as the basis for commercially exploiting and exporting Smart Grid technologies. Jeju Smart City is intended to contribute to make South Korea one of the technological forerunners in the Smart Grid industry. The Jeju Island smart grid project makes up five different sectors:

- **Smart Power Grid System:** Interoperable Smart Grid;
- **System, including an automatic grid protection and recovery;**
- **Smart Place System:** A two-way communication system between the energy consumers and providers with automatic Energy Management to encourage efficient and smart usage;
- **Smart Transportation System:** Charging infrastructure for an electric vehicles service system;
- **Smart Renewable System:** Renewable power generation infrastructure at a large scale (including solar, wind, biomass, waves, etc.) integrated through power storage devices;
- **Smart Electricity Service System:** Development of various pricing schemes and consumer power trading.

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart grid
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	Government: € 14.5 <sup>39</sup> Mln; Private: € 68 Mln
<b>Number of impacted users</b>	Approx. 35,000
<b>Link</b>	<a href="http://www.smartgrid.or.kr/10eng3-1.php">http://www.smartgrid.or.kr/10eng3-1.php</a>

<sup>39</sup> The conversion rate used for this case study is 1€=1,060\$

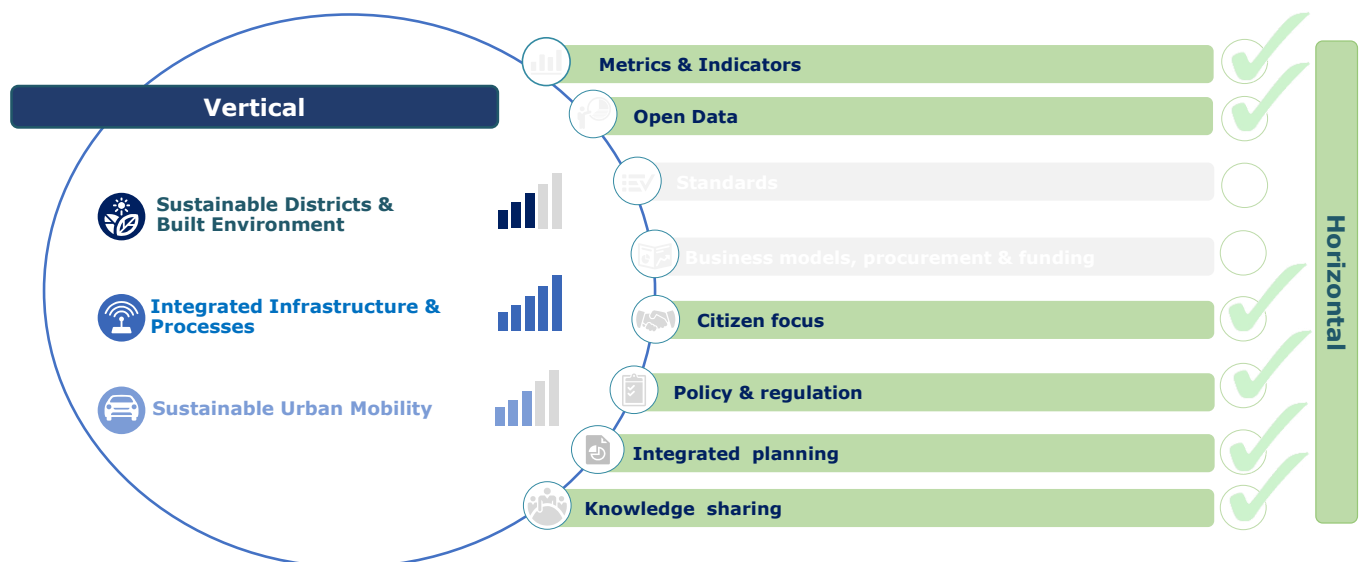
## Level of integration

The Jeju Smart Grid solution integrates **ICT**, applications with **energy monitoring** and **optimization** (users from residential and business sectors). ICT infrastructure for smart grid must be digital, capable of two-way low latency communication, and designed to be highly reliable.

For telecommunication network providers involved in smart grids projects, the main challenge is therefore to **optimise and monitor the communication network performance**, and to deal with **exploding amounts of data**, while **ensuring that ICT infrastructure** does not compromise stability and security of the grid.

The Jeju smart grid involves multiple companies and requires **real-time monitoring** and management of Mlns of widely distributed managed objects and devices, including meters, feeder automation devices, and distributed generation assets.

KT Corporation (Korea Telecom) and SKTelecom currently use the island as test bed for automated metering infrastructure (AMI). The infrastructure is both connected to mobile and fixed networks, as well as to the suppliers of electricity, water and gas. The AMI infrastructure aims at improving reliability of services, and in addition to that reducing waste and costs.



## Business case

The Jeju Smart Grid test-bed is an undertaking jointly managed by the South Korean government and private companies, including SK Telecom, LG Electronics, Hyundai Heavy Industries and national utility Korea Electric Power Corporation (KEPCO). All in all, 12 consortiums are involved in the Jeju project, representing 170 companies from the fields of power production, communication, the automobile industry and home appliances.

Four out of these 12 consortia focus on new business model opportunities for the Smart Grid environment. The business model that is to be developed is innovative in the sense that it envisages an energy sector to perform an energy service provider role and including demand-side management from the consumer side, empowering them to become "prosumers".

**The budget** for the test-bed makes up **€ 82 Mln**, of which **18% (€ 14.5 Mln)** are financed **by the South Korean government** and **82% (€ 68 Mln)** by the involved private partners.

## Community & Citizen Focus

The Jeju solution is able to include and integrate the general public into the project, foremost via the smart metering system.

The incentive-based demand-response service allows energy consumers to actively be drivers of **energy efficiency**, and helps them to **save costs**. The service includes a consulting service and allows the consumer to analyse the individual electric power usage pattern. Hence, businesses and consumers are able to **monitor and control the energy consumption of their buildings**.

The next stages after the Jeju test-bed experimentation, expanding the Smart Grid network to metropolitan areas and further to the entire country, eventually enable to raise awareness and transmit knowledge to the consumers. By doing so, citizens and businesses are empowered to make smart energy consumption choices.

## Impact

There are several impacts envisioned by Jeju Smart Grid. First of all, energy efficiency is expected to be increased through the improvements made to the power quality and reliability. The AMI system and related technologies are moreover a **cost-effective solution** for operating the system. In addition to that, considerable cost savings are expected through the gains expected in load management, which is a form of demand side management (DSM) (the process of balancing the supply of electricity on a given network by adjusting the demand-side).

Consequently, also positive environmental impacts are expected, ranging from the **reduction of greenhouse gases emissions** to spurring the use of **green energies**. With regard to economic impacts, new value will be created through the added services (e.g. demand-side management, etc.), and the electricity market trading is expected to be facilitated, hence generating additional revenues. Ultimately, a new market will be established by introducing two-way power trades with considerable means on the consumer side to control their energy consumption. Jeju Smart Grid may therefore help to make South Korea a growth engine and precursor in the green energy field.

Beyond that, the smart metering system enables users to base choices on facts and transforms consumers into active prosumers. The solution therefore **reduces energy costs for consumers** and **encourages active participation** in the battle against climate change.



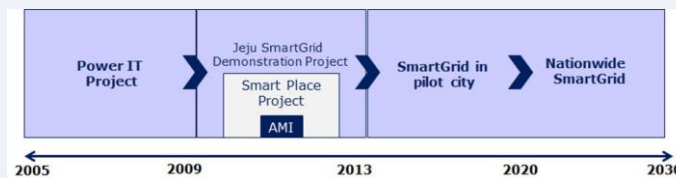
## The solution in context: Smart City – Jeju Island

### About the smart city vision in the city

South Korea accepted the challenge to **address the global issue of climate change**, and as part of their climate change programme, the country has integrated the solution of a **national Smart Grid roll-out** in its **national infrastructure strategy**. The initial phase started in 2005, with the Power IT Project, a research project focussing on developing core component technologies for applying IT solutions to the power system. Then, the developed solutions were to be tested in the Jeju Smart Grid Demonstration project, a test-bed for a number of smart grid technologies and use cases.

The final phase of the South Korean Roadmap encompasses the deployment of AMI in selected urban areas in South Korea until 2013 and finally the nation-wide deployment between 2020 and 2030.

The overall plan of the South Korean Smart grid deployment is summarised in the following chart:



**Name of City** Jeju Island

**Country** South Korea

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.



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## IssyGrid Issy-les-Moulineaux, France

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

IssyGrid is a **smart-grid demonstration project** that aims to **reduce energy use at the neighbourhood level** in the French town of Issy-les-Moulineaux.

The IssyGrid living lab consists of 14 interrelated information systems that connect households, office towers, streetlights, electric vehicles, a power distribution station and a photovoltaic power forecasting system. It has initially been implemented in three office buildings (Galeo, Tour Sequana and EOS). In addition to that, about one hundred homes as well as the public lighting of three streets in the Seine West district are connected to the smart grid since 2012.

Smart meters, implemented by the French electricity distribution system operator (DSO) in July 2013, gather data on the **global energy consumption** of all **connected households in real-time**.

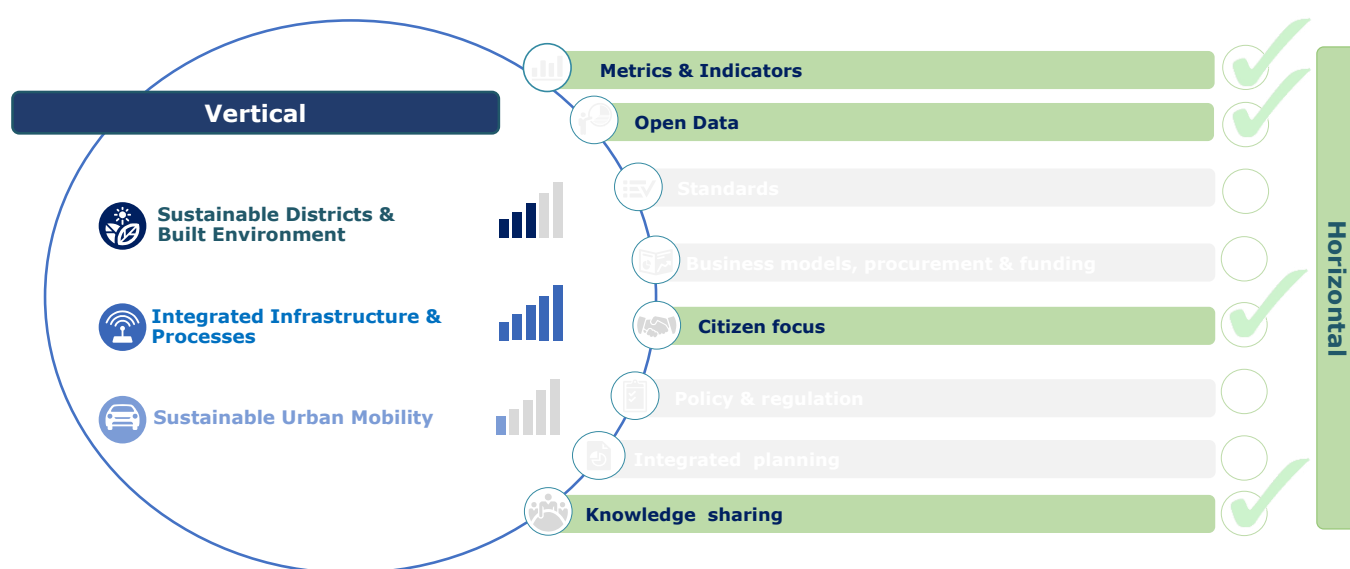
The information system monitors the consumption and production of energy in the connected neighbourhood. It enables the analysis of energy production and consumption in order to recommend and encourage consumers, in partnership with the DSO, to consume energy at **"the right time" in order to reduce peak demands and avoid energy shortages**. Users are able to compare their consumption data with those of similar consumers and get advice on how to consume in a smarter way.

<b>Starting year</b>	2012
<b>Type of integrated solution</b>	Smart grid
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	€ 2 Mln divided between partners (funding is private)
<b>Number of impacted users</b>	Approx. 10,000 users
<b>Link</b>	<a href="http://IssyGrid.com/en/">http://IssyGrid.com/en/</a>

## Level of integration

The IssyGrid solution allows the **integration of ICTs technologies**, e.g. cloud applications, with built environment (buildings) towards the direction of energy savings. The solution first phase started in 2012, when Bouygues Immobilier, a major property developer in France, implemented an energy-saving building. The next step was to **develop energy-efficient buildings in the neighbourhood**, counting on the partnership of corporate partners, e.g. Microsoft, Alstom, and local utilities. The solution in this first phase consisted in the installation of monitoring systems (heating, lighting, hot water) in the buildings (residential and business), with a remote control system hosted in cloud environment, to monitor data and information.

The next steps of the solution include the **installation of smart public lighting, adapting street light level to road traffic volumes** and **electric vehicles, integrated with the energy grid**, in order to **evaluate the impacts on the energy grid carrying capacity**.



## Business case

IssyGrid is a private initiative by Bouygues Immobilier, which teamed up with stakeholders mastering all strategic and technical skills required for the implementation of a smart grid (Alstom, Bouygues Energie et services, Bouygues Telecom, EDF, ERDF, Microsoft, Schneider Electric, Steria, Total, IJENKO, NAVIDIS, EMBIX, and SEVDIL) and the City of Issy-Les-Moulineaux. Behind the backdrop of ERDF's vision to make smart metering a reality for all French households - see Linky - this initiative is in line with the French vision of sustainable energy solutions.

In order to best exploit the project benefits, the circle of partners will be widened **in order to increase the area where the solution is deployed**. Also, it is planned to promote the **use of big data and cloud, produce public open data** and reinforce security of confidential data that has been gathered.

Furthermore, the new value created at the neighbourhood will be quantified, and further deployment of innovative technologies (including smart objects) and services to the benefit of residents and companies are envisaged.

Ultimately, the intention of the IssyGrid consortium is to achieve sustainable implementation and economic models that can be replicated in other cities.

## Community & Citizen Focus

IssyGrid is expected to enhance the participation of citizens and businesses towards an energy transition: individual users are provided with extensive information on their own energy consumption patterns. In addition, the system compares their consumption to that of similar users and gives advice on how to

improve their energy usage in a smart way. Hence, the solution creates a basis for individuals to make smart and green decisions, leading to the reduction of their energy use.

Moreover, IssyGrid has major educational and social significance based on the information provided to users. It not only raises awareness amongst the general public, but also empowers citizens to base their decision on their individual data and sound analysis.

## Impact

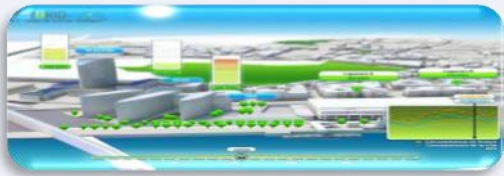
The primary goal of IssyGrid is to reduce energy consumption (and related bills) of a neighbourhood thanks to thorough communication to residents and employees about their energy consumption data. This should impact on the consumption patterns, namely encourage to consume less and at the right time, while incorporating new energy uses and at the same time increasing **awareness on energy efficiency** and **smart energy consumption**.

In addition to that, local production of renewable energies is integrated into the public network through the use of energy storage. Hence, this lays the basis for decreasing greenhouse gases emissions via a better energy production management.

Additionally, IssyGrid aims to help anticipate changing energy prices and to provide inputs for the territory development. It optimises the use of urban space by introducing of new services to citizens, e.g. lighting is adapted to the traffic and to the hours of the night. Thus, the project contributes to increasing the **overall territorial attractiveness** and **reducing the cost** and **increasing the efficiency of public infrastructures**.

IssyGrid also opens up prospects for job creation (for the operation of the smart grid new competencies will be required with focus on IT-centered skills around system design, architecture, security as well as data management) and is a test bed for disrupting the classical demand-supply economic model and counteracting information deficits and, in addition to that, creating a long-term energy regulatory framework.

Families involved in the IssyGrid project have managed to **reduce their energy consumption and bills by 10 to 20%**.



## The solution in context: Smart City – Issy-les-Moulineaux

### About the smart city vision in the city

Issy-les-Moulineaux is developing many Smart City solutions and is already a national reference as regards its economic dynamism and its exemplary use of ICT. For more than 15 years, Issy-les-Moulineaux's citizens have benefitted from the following innovative e-services and applications:

- **IssySpots:** augmented reality application with a directory of 500 places of interest
- **Les Flux d'Issy:** smartphone application with real-time news flow on Issy-les-Moulineaux
- **PaybyPhone:** user-friendly system for paying your parking place by mobile phone
- **QR codes & Patrimony:** QR codes on the historical information panels in the city enabling to learn more about the patrimony
- **Issy's Fort History at your fingertips:** interactive trail on the history of the Fort of Issy, accessible on Smartphone
- **Open Data:** open data initiative of the City, including maps and API
- **Digital Fort:** Eco-district where technology serves the environment

IssyGrid is one additional solution developed besides these eservices and applications that ultimately want to create a Smart City. It aims at ensuring that the City will meet the European Union's climate and energy targets for 2020. IssyGrid will also enable the City to strengthen the integration of smart services towards citizens and of new usages (e.g. electric vehicles), to reinforce the electrical distribution network and to contribute to the City's High Quality Environmental (a French standard for green buildings) policy.

<b>Name of City</b>	Issy-les-Moulineaux
<b>Country</b>	France
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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<http://base.5facades.com>



## London Underground energy recovery London, UK

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The **London Underground** is a **world-wide famous transport infrastructure**. It plays an essential role in the London and **surrounding areas transportation system**. It serves in fact a large part of Greater London and parts of the nearby counties of Buckinghamshire, Hertfordshire and Essex. The London Underground network is among the oldest rapid transit system in the world, incorporating the world's first underground railway, the Metropolitan Railway, which opened in 1863 and is now part of the Circle, Hammersmith & City and Metropolitan lines.

According to the Transport for London feasibility report (TfL, 2014) the city of London population is growing rapidly. By 2031, there will be an extra 1.8 m people living and working in London. This will correspond to an extra demand making necessary additional London Underground trains. As a result, demand for Transport for London (TfL) services – Underground, Overground, Docklands Light Railway and Trams – is growing too. In 2013-14, London Underground alone **carried over 1.25 Bln customers**.

In such a context, it is expected that the consequence of increasing capacity is an increase in energy demand. The additional demand for energy should be offset, in the strategic view of the planning authorities, by **optimising energy consumption**.

Moving along this direction, in the London Underground Victoria Line a five week trial was successfully carried out in 2015. The trial applied the Alstom's inverting substation technology for transferring regenerative braking energy back to the grid.

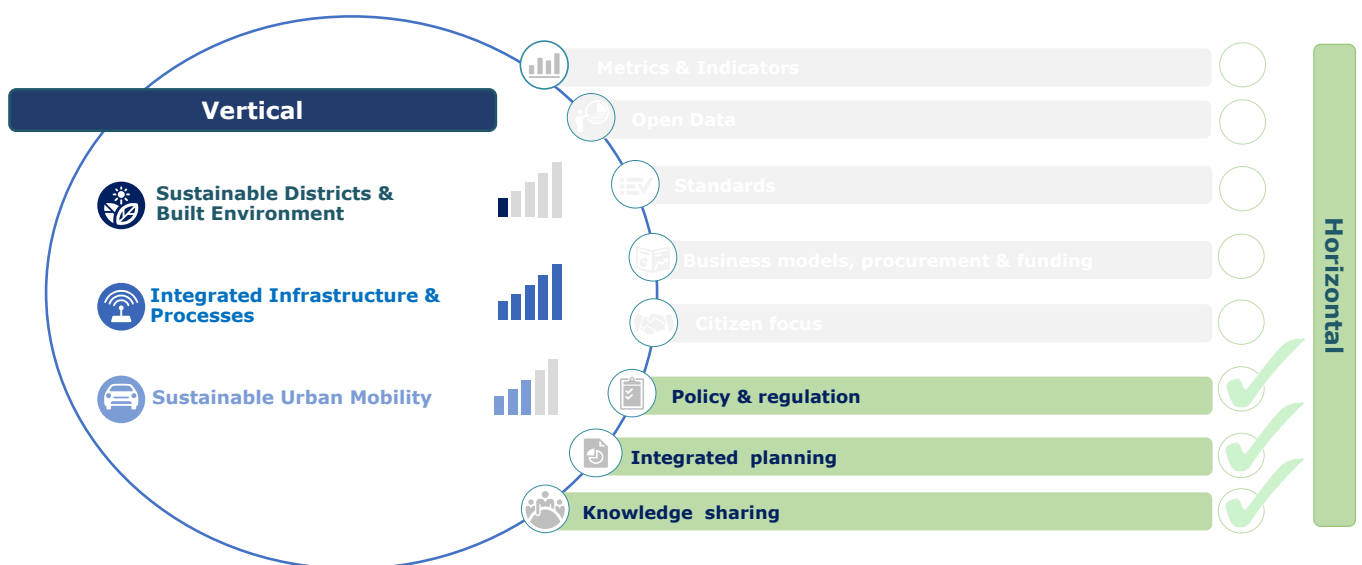
<b>Starting year</b>	2014
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry.
<b>Budget</b>	€ 1 <sup>40</sup> Mln
<b>Number of impacted users</b>	Approx. 1.25 Bln passengers (2013-2014)
<b>Link</b>	<a href="https://tfl.gov.uk/info-for/media/press-releases/2015/september/recycling-energy-from-tube-trains-to-power-stations">https://tfl.gov.uk/info-for/media/press-releases/2015/september/recycling-energy-from-tube-trains-to-power-stations</a>

<sup>40</sup> The conversion rate used for this case study is 1€=0,70£

## Level of integration

The London Underground energy recovery solution (HESOP, as for Harmonic and Energy Saving Optimiser) **allows the integration between smart grid and transportation infrastructure**. The energy retained is in fact re-used along the infrastructure grid intelligent redistribution, i.e. where it is needed. The trial has successfully converted and transferred kinetic energy of trains lost during braking into electrical energy for accelerating trains elsewhere on the line or to the grid.

The energy retained during brakes can be potentially available for the overall transport infrastructure. In such a way, it could be possible to address one of the most important problem affecting the London Underground infrastructure: cooling the underground temperature. London Underground could already make good use of regenerative braking by adding the residual energy that is currently wasted in braking resistors to prevent tunnel temperatures rising. In fact, operating a regenerative braking system can return power to the rails while the train is braking so that other nearby trains can use it for accelerating, reducing in such a way the amount of heat generated.



## Business case

Through a tendering bid, Alstom was awarded a contract by UK Power Networks Services to supply the Harmonic and Energy Saving Optimiser (HESOP) energy recovery system for the Victoria Line of the London Underground. **The contract is worth about € 1 Mln**, and involves a trial to invert substation technology from 2014 until 2015 at the Cloudesley Road substation.

HESOP is already in use with the Paris Transport Authority (RATP) and is installed at the Pablo Picasso station on light rail line T1.

## Community & Citizen Focus

Citizens and community involvement happens in the context of the more general strategy to tackle climate change and enhancing the environment.

More specifically, Transport for London identifies and communicates its vision of its purpose and intended outcomes for citizens and service users by (TfL, 2015):

- The Mayor developing and publishing a **Transport Strategy** reflecting national and local priorities.
- The **Budget** and **Business Plan** reflecting the Transport Strategy and allocating resources accordingly.
- Reviewing on a regular basis the implications of the Transport Strategy for its governance arrangements.

- Ensuring that those making decisions are provided with information that is fit for purpose – relevant, timely and gives clear explanations of technical issues and their implications.
- Conducting its business on an open basis, subject only to the requirements of appropriate levels of individual and commercial confidentiality and security.

## Impact

The impacts of the London Underground trial have been the following:

- The Victoria Line regenerative braking combined with other new technology on trains, signalling and power systems, has **cut the energy required to run services by 34%** (five week trial);
- The results indicated that 1 Megawatt hour (MWh) of energy can be captured per day - enough to power 104 homes per year;
- On an annual basis, the trial can provide **saving valuable** in the order of magnitude of **€ 8.5 Mln**;
- Applied to the overall London Underground's **energy costs can be reduced by 5%**, as well as reducing the heat generated by trains braking in tunnels and thus the energy required to operate cooling systems.





## The solution in context: Smart City – London

### About the smart city vision in the city

London is one of the major hotspots in Europe and in the world in terms of **innovation** and **ability to adapt to new changes and challenges**. The city is a leading place worldwide for the **introduction of new technologies in different fields**.

London Datastore receives 25,000 visits each month with more than 450 transport apps created from it, making the city an important centre for open data. **Sustainable mobility** is achieved in different ways, including: **Congestion Charging**, using recognition via number plates, an intelligent road network management system and the possibility to use credit or debit cards for paying on public transports. The citizens of London are also deeply involved in the policy making process with the Talk London community created by the Greater London Authority. The aim of the initiative is to use technology and data to **stimulate citizen participation** in decisions through online discussions, polls or surveys. The involvement of the municipality to foster the city's smart growth also encompasses fields like **energy, utilities, health and safety**.

**Name of City** London

**Country** United Kingdom

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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## Malaga Integrated Smart Grid Malaga, Spain

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Málaga's SmartCity Project is among Europe's largest **eco-efficient initiatives** carried out in a city. It aims to **increase energy efficiency, reduce CO<sub>2</sub> emissions and boost the use of renewable energy sources**.

State-of-the-art technologies are rolled out in **smart metering, communications, network automation, generation and storage, and smart recharging infrastructure for electric vehicles**.

The city of Malaga is employing the technologies installed as an integrated smart grid. These technologies also enable the testing of new equipment, operating models and consumption management systems. Research focus is on the analysis of efficiency indicators, advanced grid operations, remote meter management services, cyber-security, energy-saving measures for residential and large customers as well as buildings, in addition to the integration of renewables, storage and e-mobility within the city grid.

The first phase was deployed in the *Playa de la Misericordia* district of Malaga. It involved approximately 300 industrial, 900 service and 12,000 domestic customers.

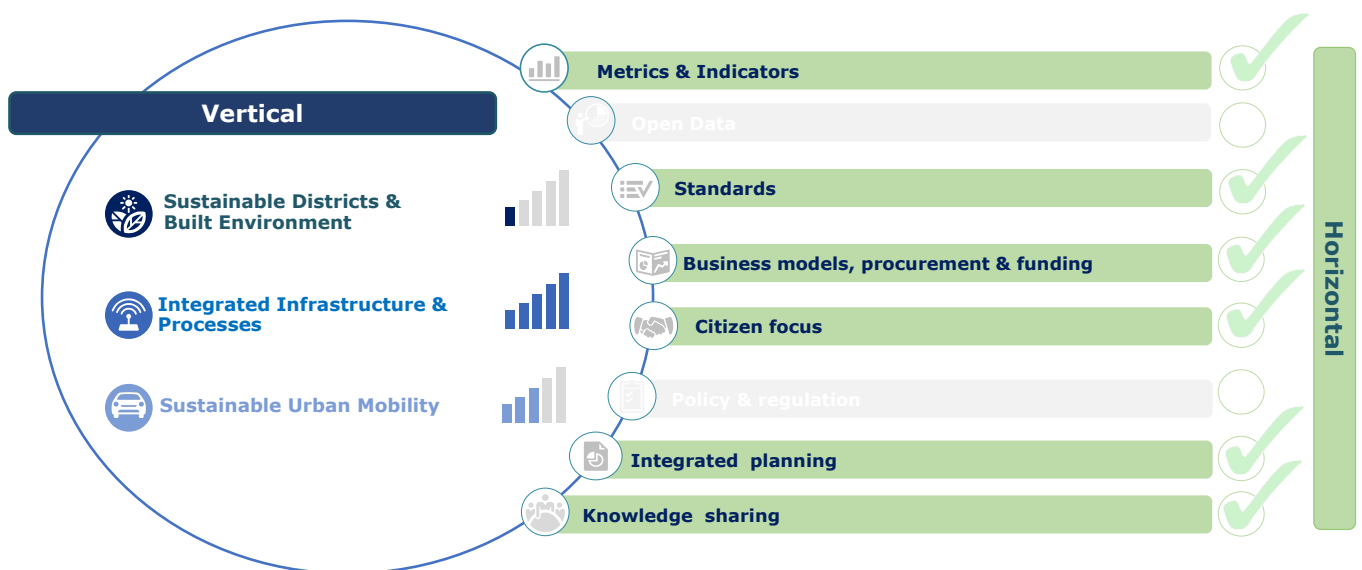
<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart Grid
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Industries, City, research centers
<b>Budget</b>	€ 31 Mln for the first stage
<b>Number of impacted users</b>	Approx. 50,000 inhabitants, distributed among 300 industrial, 900 service and 12,000 domestic customers
<b>Link</b>	<a href="http://www.malaga.eu">http://www.malaga.eu</a>

## Level of integration

The Malaga Smart city is a fully integrated solution across **mobility, the built environment** and **integrated infrastructure**.

Both energy production and mobility are managed through a **smart grid** at a local scale with integration of **renewable energy electricity** and **EVs respectively**. The grid is constituted of two electrical substation connected to a wastewater treatment plant, thanks to 10 medium voltage lines the electrical power is then distributed to the area involved.

The whole grid is supported by a telecommunications infrastructure supporting broadband power lines communication and 3G connecting to the communication network of Endesa already in place. Additionally, along one of the city's main avenue photovoltaic streetlamp units integrating also wind turbines have been installed. All the lamps installed are connected to the grid units located in the area. Another key element of the Smart City Malaga solution is represented by the deployment of recharging stations for electric vehicles supporting also a vehicle-to-grid component.



## Business case

The Smartcity Malaga project was launched in 2008, with the first phase of Smartcity Málaga consisting of a € 31 Mln project headed by Endesa in partnership with Enel, also involving additional 9 companies and 14 research centers.

Over the last years, Smartcity Málaga has highlighted the feasibility of a new energy management model for cities. It has resulted in attracting new R&D projects within the smart grids and electric vehicles domain, such as Zem2All and Green eMotion.

75% of the project has been funded by the ERDF. The remaining cost of the investment is sustained with funds provided by the Junta de Andalucía and the Ministry of Science and Innovation's Centre for the Development of Industrial Technology (CDTI).

The project is funded by public grants, at EU and national level, and it has not to generate revenues in order to repay any investment, but is rather an R&D project.

## Community & Citizen Focus

One of the key aspects of the project was **boosting the involvement of end-users**. As a result, all residential customers targeted by the project have in their premises the smart meters and operated from remote. This remote management system is the one that Endesa is rolling out in Spain. Consumers gain **active, real-time feedback on their consumption, profiles, impact on the system and emissions and can interact with predefined functions aimed at promoting responsible consumption**.

## Impact

The project results in a **saving of over 25% in electricity consumption** thanks to the implementation of **energy efficiency systems** for commercial and residential customers and a **20% decrease of CO<sub>2</sub> emissions**, which is more than 4,500 tons of annual emissions were avoided. Additionally, approximately 42% of participants managed to cut by 10% their home energy consumption by using energy efficiency kits that enabled them to manage energy use via smart phones. Moreover, thanks to the use of low energy streetlamps it was also possible to record **energy savings of 65%**.

For the city, the Smartcity Malaga project has meant the introduction of a large-scale laboratory for future smart grid technology, which has turned Malaga into a window into the world of these technologies. The city has received numerous visits to its Monitoring and Control Centre, an office located on the "Antonio Banderas" promenade, in the heart of the area where visitors can see how the project is progressing. It also houses a data processing centre for monitoring the key performance indicators (KPIs) of the project.



## The solution in context: Smart City – Malaga

### About the smart city vision in the city

Given environmental concerns of the city of Malaga, this **wide-scale solution comes to be one of the largest real implementations of new technologies** and best practices in the **field of smart grids**, representing also an answer to the energy requirements as mandated by the **European Union's 2020 strategic goals**.

It has also to be noticed that the city of Malaga is one of the leading centres in the south of Spain concerning innovation. It has been honoured with the title of **"City of Science and Innovation"** and it also hosts the Technological Park of Andalusia which includes more than 500 firms in different fields from transportation to information and communication technology.

By investing into Smart Cities technologies the Municipality hopes to turn the city into a European Silicon Valley with the capability of attracting talents and investments in R&D from different parts of the world. Additionally, the city of Malaga is also involved as coordinator in the project *Smart Costa del Sol* which includes several municipalities in the region, focusing on further improving energy efficiency.

<b>Name of City</b>	Malaga
<b>Country</b>	Spain
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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## MeRegio Smart Grid Baden Württemberg Region, Germany

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The research-and-development project MeRegio in Goeppingen and Freiamt ran from October 2008 to November 2012. At its core was the **ICT integration in all parts of the energy value chain** in order to meet the demand for efficient and decentralised energy systems. The MeRegio Project Plan was divided into 4 functional phases namely; **Measuring, Controlling, Storing and Trading**. The objective has been to develop regions with power supply systems that are optimized with respect to their greenhouse gas emissions. This integrated solution was based on three specific components:

- **E-Energy marketplaces** (for energy products, system services, and other services) for producers of electricity, end customers, and intermediaries for coordinating the supply and demand of energy and complementary services
- **A sophisticated and innovative energy infrastructure**
- **A powerful information and communication infrastructure** that links the physical infrastructure to the marketplace and controls it according to the specific market situation at hand.

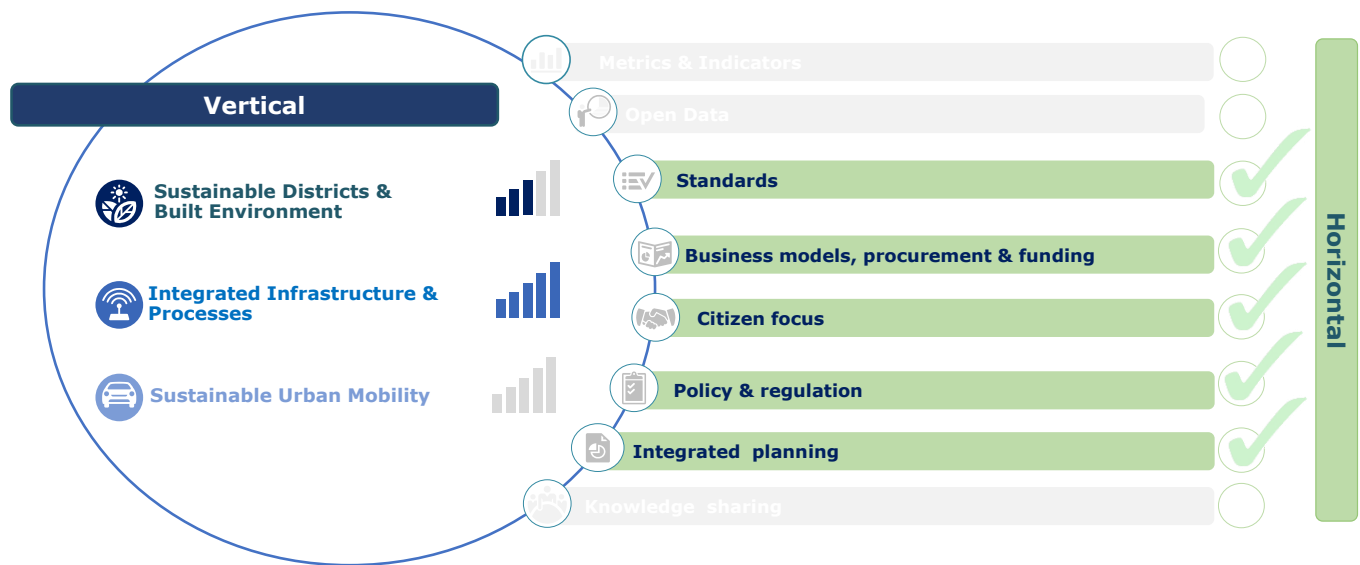
Within the MeRegio project the whole value chain was represented, including: **"intelligent" household appliances** (e.g. fridges or freezers), **decentralized control devices, smart meters**, the installation of new secondary technique in the grid, the use of meter data for improved network control and finally the better integration of decentralized generation units into the existing energy system, were examined. Within the project, simulation components were developed and applied to analyse many different design features of the MeRegio concepts. Simulations were directly coupled to the pilot region (online simulations) and simulations that do not influence real participants (offline simulations). These simulations comprised different market mechanisms, network management concepts and business models as well as tests that cannot be implemented in a real environment, such as power outages or extreme weather events. Long-term effects of decentralization on the development of the power plant mix were investigated within an **energy system model**. Additionally, short-time aspects and their influence on the generation mix were considered. Power grid simulation tools were used to analyse the influence of new network control strategies and to identify how many additional decentralized capacities can be linked at a grid node.

<b>Starting year</b>	2008
<b>Type of integrated solution</b>	Smart Grid
<b>Scaling or Replication</b>	No
<b>Key actors / stakeholders</b>	Industry, Public Authority, Research Institutions
<b>Budget</b>	€ 21 Mln
<b>Number of impacted users</b>	Approx. 500 users
<b>Link</b>	<a href="http://www.meregio.de">http://www.meregio.de</a>

## Level of integration

The project integrated conventional power plants, distributed combined **heat and power plants (CHP)**, distributed **energy storage systems**, as well as **renewable energy sources** like wind turbines and photovoltaic systems at both the system and customer levels. In order to integrate these devices at system level and to provide various system services, such as idle load or balancing power, innovative ICT control strategies were developed. The smart grid then connected to smart buildings, devices and to smart mobility solutions of the future.

At the customer level, demand response was achieved via different regional energy marketplaces for the allocation of energy and ancillary services resulting in dynamic rates, control signals for home appliances, and an overall power management. These services relied heavily on **ICT technologies** integrated into home appliances, mobile phones and information displays.



## Business case

The solution was mostly driven by the industry. The main actor driving the solution was the project coordinator EnBW (Energie Baden-Württemberg AG). They formed a partnership with a group of private companies: ABB, IBM Deutschland, SAP, Systemplan and KIT (Karlsruhe Institute of Technology). All project partners were simultaneously involved in complementary projects funded by public sources.

MeRegio was supported by the Federal Ministry of Economics and Technology (BMWi). Furthermore, Karlsruhe Institute of Technology which is an internationally leading university, including a research center on energy systems and on ICT, contributed with insights and knowledge as scientific partner.

**The overall budget** of all partners contributing to the project was **€ 21 Mln**. The solution was also co-funded to a significant extend by the Federal Ministry of Economics and Technology (BMWi). This funding was allocated in the program E-Energy which had a **total budget of around € 140 Mln** (governmental and own funds) and supported six model regions in Germany.

The solution has not been replicated by other due to the importance of the specific regulatory framework in the case of Goeppingen and Freiamt.

## Community & Citizen Focus

MeRegio introduced a **customer-oriented Smart Grid Pilot**, which empowered users to have more information and control with their energy consumption. Information displays, smart appliances and a mobile energy display means that the consumer is always in control of his consumption. Additionally the dynamic price signal plus an energy storage device makes it possible to purchase energy at better rates and store it for future use. This saves money for the consumer.

## Impact

Different market platforms were used to offer opportunities for new business relations between the individual market players. The market platform was intended to enable the **trading of energy products and services**. In various "sub" market places different mechanisms to align demand, generation and network capacity were being applied, e.g. dynamic tariffs, to motivate the consumers to move their load, or auction models that combine the interests of several decentralized generators in trading their generation capacities. Customers could realize load shifting and **savings in a range between 10% and 15%**.

Important part of the purpose of the solution the project was to boost awareness on energy efficiency topics in public and also specialized on different customer segments (households, middle sized industry and public sector).

Additionally, the aim of the solution was to **use energy intelligently, increase energy-efficiency and reduce CO<sub>2</sub> emissions**. The permanent exchange of data guarantees that electricity is always produced, fed and used as required (energy on demand). In particular, regional differences in electricity prices were taken into account for the first time.

The project focused on developing technical and economic concepts, which implement the three components and put them to work in a pilot region with about 1000 participants at the towns of Göppingen and Freiamt (Baden Württemberg / Germany). The objective of the solution is to motivate regions **to actively reduce their greenhouse gas emissions and promote specific measures to cut CO<sub>2</sub> production**. One of the final results did show a better integration of renewables and reduction of CO<sub>2</sub> emissions.





## The solution in context: Smart Region – Baden Württemberg

### About the smart city vision in the city

Baden Württemberg is not a smart city but a **smart region**. There is no official vision for the region. But the academic and research institutions in Baden-Württemberg are addressing three challenges in particular, as a result of the energy revolution leading to a profound transformation of the energy system. Baden Württemberg intends to support this process of transformation, by addressing the development of **new technologies**, training of the appropriate professionals and the necessity for a successful dissemination of smart grids knowledge of the social and economic contexts in which they are used.

In this overall framework it makes perfect sense for Baden Württemberg to support the MeRegio project.

**Name of City** *Baden Württemberg Region*

**Country** *Germany*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** *Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
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[www.germany.travel.de](http://www.germany.travel.de)

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

## Short description of the integrated solution

The ambitious project Nice Grid is the first smart solar district demonstration solution implemented in France. Based in Carros in the Alpes-Maritimes region, the **Nice Grid project developed a smart electricity grid** that harmoniously integrates a high proportion of **solar panels, energy storage batteries** and **intelligent power meters installed** in the homes of volunteer participants.

By giving energy users the opportunity to manage their own power consumption and budget, Nice Grid intends to turn passive consumers into active "pro-sumers" (producer-consumers).

Granted funding under France's first **"Future Investments Programme"**, the Nice Grid smart solar district demonstrator is comprehensively testing the smart grid concept by implementing the Linky smart meter, other innovative technologies and existing power infrastructures.

The principal objective of NICE GRID is to **optimize the production, consumption and storage of electricity on a district level** with a large influx of photovoltaic electricity intermittently on the low voltage (LV) network in the municipality of Carros. This optimization allows a district to enjoy electric independence for several hours: this is known as *islanding*. Nice Grid is testing programs of dynamic load management covering the following use cases:

- **Reduction of power demand:** final goal is to reduce the power demand in the network. This type of operation can be used on Distribution System Operator (DSO) and/or a Transmission System Operator (TSO) request to prevent electrical constraints on the network, to help supply demand balance and to prevent customers from power outages.
- **Management of PV panels' mass production and improvement of network flexibility:** a massive insertion of DER (Distributed Energy Resources) on the LV (Low Voltage) network may induce localized network constraints (voltage, current intensity). The targeted solution triggers consumption and storage, in an anticipated way, near the constrained points in order to prevent network reinforcement, over-voltage and minimize PV inverter disconnections (to maximize PV production).
- **Encourage residents to adopt smarter habits according to network state:** Nice Grid brings together residential customers whose homes are equipped with smart meters and, in some cases, solar panels and/or individual batteries, and business customers who chose to take part.

**Starting year** 2011

**Type of integrated solution** Smart Grid

**Scaling or Replication** Yes

**Key actors / stakeholders** Industry and households

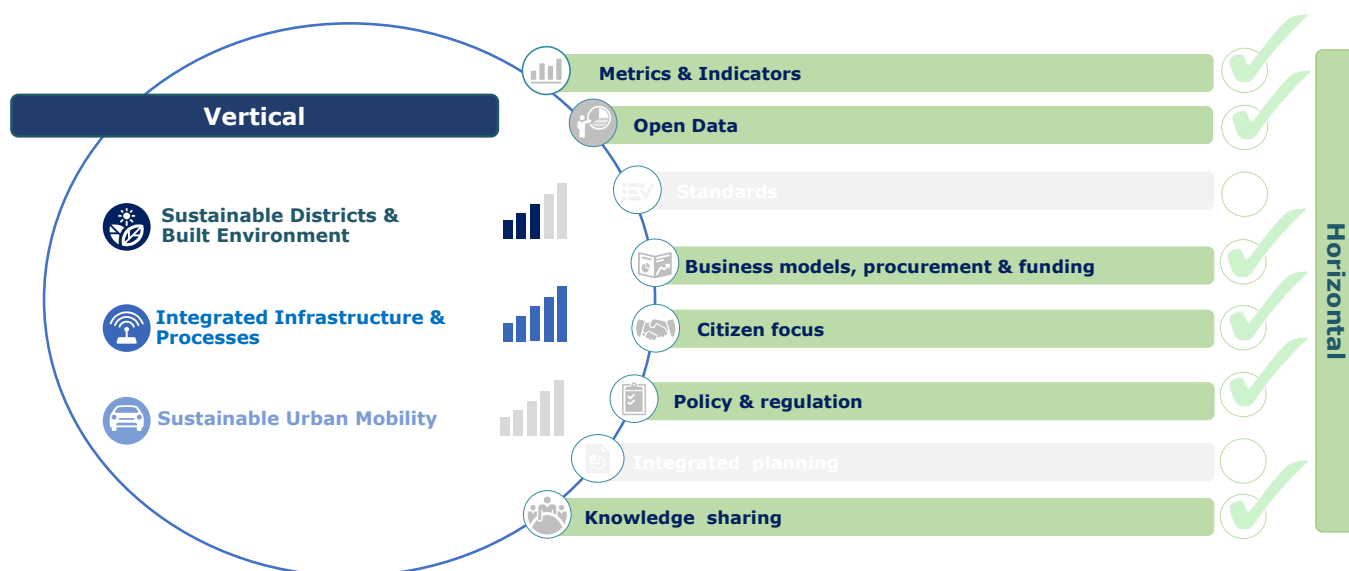
**Budget** € 30 Mln

**Number of impacted users** Approx. 1,500

**Link** <http://www.nicegrid.fr/>

## Level of integration

The whole project can be considered as an **integrated solution combining the sustainable district & built environment domain** with integrated infrastructure & processes. In addition, several enabling factors have been leveraged to allow the successful development of the technologies building up the entire solution.



## Business case

Nice Grid is one of the **6 demonstration solutions** developed within the project **"Grid4EU"**, funded by the European Commission. **Grid4EU aims to lay the groundwork for the development of "tomorrow's electricity grids"**.

Nice Grid, developed in the **city of Carros**, (Provence Alpes Côtes D'Azur area - **PACA**, French South East) has been funded also **by the French government and ADEME** (French Agency for Environment and Energy Management).

The project addresses one of the main problems of the region. Indeed, PACA region produces less than the half of its electric consumption and is considered as an **"electric peninsula"**, this means that the local production is insufficient to meet the demand, thus, significant part of the consumed electricity is imported from other regions.

Therefore, the PACA area is exposed to the risk of load shedding for about 1500 hours per year, mostly in Winter and Summer.

Nice Grid solution has contributed to secure and improve the electric supply quality in this region by:

- **Designing a significantly sized smart grid** (over 1.500 users) with a massive integration of photovoltaic production and storage devices enabling to test several distributed resources control levels, until the islanding.
- **Quantifying the impact of coordinated actions over the grid capacity to absorb the transited energy**, while maintaining the quality and security expected on the regional Grid which is another challenge for the grid management.
- **Favouring the emergence of new consumers' sustainable behaviours, testing the supply-demand adjustment according to network flexibility constraints and deposits.**

The Nice Grid consortium brings together 9 partners under the supervision of ERDF: Alstom, EDF, SAFT, Armines, RTE, Daikin, NetSeenergy, Socomec and Watteco.

The project received public funding at EU and national levels:

- **€ 7 Mln** granted by the European Commission;
- **€ 4 Mln** loan by ADEME (a French public agency for renewable energies) within the framework "Investments of the future"<sup>41</sup>.

Furthermore, ERDF funded the project with **€10.7 Mln funded by ERDF and the other partners financed the remaining amount of circa €8 Mln as R&D activities**, being able to exploit the tax credit and incentives for R&D defined by the French law<sup>42</sup>.

The final purpose of the pilot project was merely to demonstrate that the energy management system was effective; therefore, this project was not meant to generate any revenues or to repay any investment, except for the **€ 4 Mln loan by ADEME**.

## Community & Citizen Focus

The local residents participated on voluntary basis to the Nice Grid project by contributing to the harmonious integration of solar-generated energy in their local grid system. Their participation is important to enable more effective management and control of the demand for electricity and thereby reduce greenhouse gas emissions. Whether residential users, business owners or operators of apartment buildings, these volunteers will no longer be just consumers, but "pro-sumers".

More than 300 homes have become active participants in the Nice Grid experiment by shifting their power consumption and installing equipment such as solar panels, batteries, or control equipment.

## Impact

Nice Grid project is still ongoing, but the evaluation of the actual impacts has been carried out and the results concerning the environmental, economic and social impact are described below.

In relation to environmental impacts *Winter participants* reduced, on peak demand days, their power consumption by 21% on average, between 6:00 and 8:00 PM.

*Summer participants* adapted their consumption to the local energy production. Time of Use pricing with "Solar Bonus" in summer days allowed customers to consume an additional 22% of locally-generated PV energy (load shifting).

In households who tested the *Smart Water Tank* offer (storage through the water tank during the afternoon in Summer days), a difference of 56% on average was recorded in their consumption between a solar day and a "normal" day between the hours of 12:00 noon and 4:00 PM. The "Smart Water Tanks" increased the share of energy consumption during high PV production period (12 AM to 4 PM) from 16.7% to 25.1%, with negligible impact on the daily consumption, thus preventing grid constraints.

For companies, feedback shows that the Winter load reductions in the region of 10% were possible without employees experiencing the slightest discomfort and without company organisation being significantly modified. This lack of inconvenience is a positive factor as far as acceptability is concerned. Companies were pleased with their participation in the experiment and felt that they had contributed to the best of their abilities towards **reducing peak loads**. Whatever the group (remote-control/behaviour) or the load reductions achieved (winter/summer), the companies felt that the efforts they made to reduce their consumption were bearable. Taking all companies together, load reductions were considered to be part of the fight against waste, a fight which required a better understanding of how equipment uses energy, how the buildings work and greater awareness on the part of employees.

The tariff designed for participating customers allow them to save around € 15-30 per customer per summer. However this was decided from the beginning to incentivize participation of residential customers.

In the long run, participants appreciate the opportunity to reflect on and to prepare for difficulties in energy supply, by identifying in advance the levers to use and the technical and organisational solutions to implement.

Above and beyond the load reductions, companies noted a certain number of positive effects from their participation in Nice Grid, in particular their integration into a network, a better understanding of their energy consumption and a closer working relationship with their energy supplier.

<sup>41</sup> Investissements d'avenir: <http://www.gouvernement.fr/investissements-d-avenir-cgi>

<sup>42</sup> <http://www.pwc.com/gx/en/industries/pharmaceuticals-life-sciences/publications/tax-news-french-rd-tax-credit-system.html>

Moreover, participation in the experiment was directly valorised, not just in terms of CSR but also with regard to external communication, particularly in relation to customers who are sensitive to environmental issues.



## The solution in context: Smart City – Carros

### About the smart city vision in the city

Carros is a Municipality in the Alpes-Maritimes department in south-eastern France and is part of the **Urban community of Nice Côte d'Azur** which is the former "intercommunal" structure gathering the city of Nice (France) and some of its suburbs.

Established on 1 January 2012 as France's first metropolitan area, the Métropole Nice Côte d'Azur is home to over 535,000 inhabitants spread between the coastline and the peaks of the Mercantour in the Alps. Over 46 municipalities are part of the urban area, notably Nice, France's 5<sup>th</sup> largest city, Carros, the most significant industrial zone, and Cagnes-Sur-Mer, with its Technopolis hub dedicated to high technology companies.

As a **pioneer in contactless NFC (Near Field Communication) mobile services** and in the **smart city concept**, the metropolitan area has undertaken deep changes, looking to technology, innovation and sustainable development.

The Métropole Nice Côte d'Azur is also France's number one tourist destination after Paris. For some time now, its economy has largely been based on **services with high added value**. The metropolis has also positioned itself as a key international centre of economic attractiveness, business and decision-making in the Mediterranean area, Europe, and on an international level. The area offers a wide array of different site locations for technological or industrial activities, with speciality areas ranging from cleantech to flavouring via digital, multimedia, artistic design, logistics and services.

Carros is the perfect choice as the location for Europe's first smart solar district project. Indeed, the Alpes-Maritimes is situated at the end of the distribution network, which gives it a structural weakness in its electrical power but it has significant sources of renewable energies, and particularly solar.

**Name of City** Carros

**Country** France

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
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- › **Grid4EU project website**  
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- › **First image source:** NiceGrid website  
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## PowerMatching City Hoogkerk, the Netherlands

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Located close to Groningen in The Netherlands, PowerMatchingCity is a living test field for **smart grids**. The integrated solution in Hoogkerk tries to anticipate how future energy infrastructure will look like. A first phase of the project, focused on technological aspects, started in 2009 with 25 households being smartly connected to the power grid. In 2011 the users were extended to 40 and linked to the network, initiating the second phase of PowerMatching City. The latter lasted until the beginning of 2015 and looked primarily at market mechanisms at the base of smart grid operation and at the development of sustainable business models.

From a technological perspective the solution comprises:

- **Various decentralised power generation units including microCHP and PV systems**
- **A central PowerMatcher software**, which automatically balances demand and supply from a variety of sources
- **Smart meters and appliances as hybrid heat pumps**, washing machines and electric vehicles, that react to availability of energy and **real-time electricity price adapting their consumption**.

It is worth mentioning, that besides involving the households, which directly interact with the system and thus play a central role in its development and functioning, PowerMatching City created a favourable environment for industry, net operators and power suppliers to develop smart grid solutions. The ultimate goal is to create an environment where electricity and heat can be flexibly exchanged between the various parties involved.

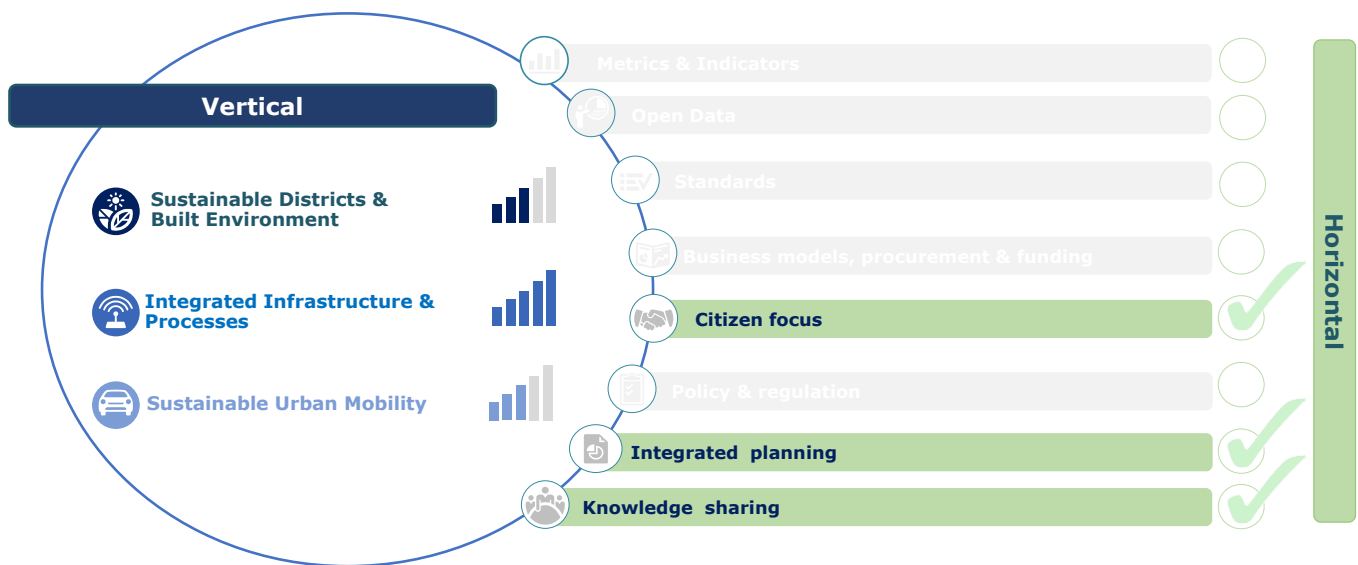
<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industries
<b>Budget</b>	€ 5 Mln
<b>Number of impacted users</b>	Approx. 40 households
<b>Link</b>	<a href="http://www.powermatchingcity.nl">http://www.powermatchingcity.nl</a>

## Level of integration

The PowerMatchingCity solution integrates the decisions of the stakeholders (residents and energy providers) through a **system operator**, a **smart control mechanism**, which maintains in **balance supply and demand of energy**.

All the participants in the initiative have access to innovative equipment that is intelligently controlled and that ensures optimum living comfort. Smart meters provide the residents with information about their own **energy consumption** and generation, which they can compare with the rest of the street. The households all received a tablet with the energy monitor installed on it. The energy monitor displays all the energy flows in the home and overviews of the historical usage. Solar panels, smart washing machines and electric scooters charged with renewables are allocated to the participants.

The smart operating system connects the local and central energy systems, offering discounts to residents that adapt their consumptions to their forecasts.



## Business case

There is very limited information available about the economics of the solution and its budget. PowerMatching City II was **cofounded** through the Dutch **state programme IPIN** (Innovation Programme Smart Grids), while phase I was financed through the EU research **programme FP6 INTEGRAL**.

Smart grids are a very hot topic in the energy sector, as they hold the potential to allow higher shares of renewable energies and to be an economically attractive solution in terms of grid modernisation. The savings would originate partly from avoided or deferred investment and maintenance costs, partly from more competitive wholesale purchases.

Because of this, a clear task of PowerMatching City was to identify attractive and sustainable business models for smart grid operations. Examples of questions addressed included how to calculate costs of energy and how to bill consumption, as well as what effect virtual electric vehicle charging has on prices and operation. Essentially, two main models were identified:

- **Smart cost savings** – focuses on minimising energy costs within the smart grid.
- **Sustainable together** – maximises the sustainability of the network's energy mix.

The key in both is the most effective utilisation of the unlocked flexibility. To do so however, fair distribution of benefits among all stakeholders, i.e. consumer, energy suppliers and network operators, is necessary.

The **project budget is about € 5 Mln**, shared approximately by 50% between subsidy and private money.

## Community & Citizen Focus

In both phases, households and people played a central role in the system as they interacted with the ICT infrastructure. In fact, although the market can incentivise different behaviours through variable pricing, it is the persons that live and operate within the system that ultimately take decisions. In order to maximise the users' involvement, all the participating households were thus equipped with dashboards, to enable them to monitor their real-time energy consumption.

## Impact

When looking at **smart grids**, managing an effective energy exchange between the parties while benefiting all is the primary challenge. It was reported that PowerMatching City demonstrated higher flexibility than predicted by previous studies and that balancing the grid was easier than forecasted.

However, these statements are not quantified yet. According to a study carried out within the project's implementation, economic benefits that could arise from smart grid implementation in the Netherlands range between **€ 1-3.5 Bln in total**.

The developed solution acted as a demonstration springboard for companies to test their products and services without needing to develop a new platform on their own. This was expected to favour an innovative environment and to lead to substantial know-how transfer and start-up creation.

Further, it is anticipated that the experience acquired will contribute to develop industrial standards for smart grid appliances. This will positively affect connection costs and improve overall economic performance of smart grids. PowerMatching City was incorporated in the UN 'Sustainia 100' list (an annual guide to 100 innovative and sustainable solutions) in autumn 2012.



## The solution in context: Smart City – Groningen

### About the smart city vision in the city

Hoogkerk is part of the municipality of Groningen, whose government is working closely with universities and companies to affirm the city as a **"Smart Users' City"**. In the focus of the development are the areas of smart energy systems, smart healthy ageing and smart facilities. Especially with regard to the latter, the city of Groningen chose to foster innovation granting open access to data about energy, waste, parking and transport.

The efforts Groningen is spending to develop itself were acknowledged by the European Commission in 2014, when Groningen was recognised as one of the three most innovative cities in Europe, together with Barcelona and Grenoble.

**Name of City** Groningen

**Country** The Netherlands

**No of Inhabitants** < 100,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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## Smart Grid Newcastle New South Wales, Australia

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Smart Grid, Smart City program was included in the plan from the Australian government to invest in new and promising smart grid technologies. The project was implemented from 2010 till 2013, with the goal of **determining whether there were potential benefits for Australia resulting from the use of these new technologies**. The cities chosen for the initiative were located in several areas in the east part of the country with Newcastle and Sydney CBD being the main focal points.

The program was coordinated and developed by Ausgrid a state owned electricity infrastructure company that won the bid from the government. The initiative, one of the largest worldwide, involved the testing of in-grid and customer focused technologies, assessing the effect of distributed generation and distributed storage solutions. It also examined how customers could contribute to demand management. Overall, a smart grid can be defined as a standard grid deploying a set of **ICT systems** for managing equipment in order to gain precise, automatic and rapid results. More in details; **smart grid technologies** enable the monitoring and prediction of energy demands and supply across the network as well as a more efficient use of labour, materials and the possibility to interact with customers.

The smart grid project tested in Australia can be considered as an example of integrated solution with ICT systems used for improving energy efficiency in different households located across the country.

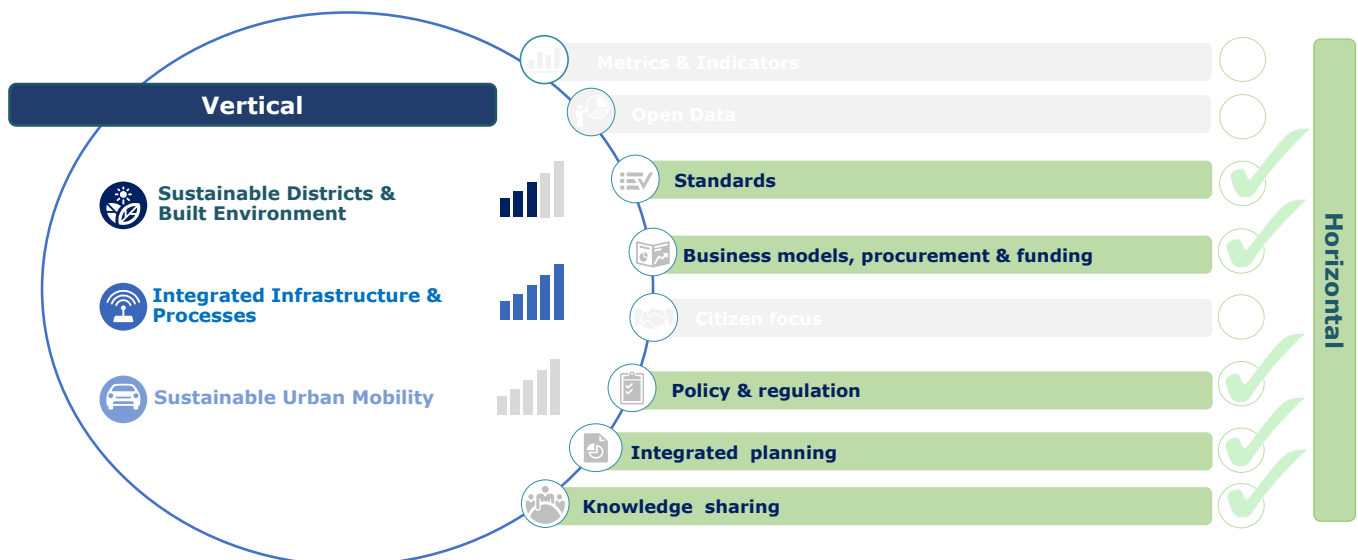
<b>Starting year</b>	2010
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes - Smart grid replication involving Smart meter is being developed in Victoria state.
<b>Key actors / stakeholders</b>	Public authority, Industry, University
<b>Budget</b>	€ 66 <sup>43</sup> Mln of public fund plus € 325 Mln of private funds.
<b>Number of impacted users</b>	Approx. 17,000
<b>Link</b>	<a href="http://www.newcastle.nsw.gov.au/">http://www.newcastle.nsw.gov.au/</a>

<sup>43</sup> The conversion rate used for this case study is 1€=0,66 AUS \$

## Level of integration

The installation of grids included a combination of projects which trialled grid-facing smart technologies within Ausgrid's distribution network. The intent of this phase was to integrate smart grid technologies with already existing infrastructure at various points on the electrical network. The smart grid technology projects included:

- **Active Volt-VAr Control**, an automated voltage regulating and reactive power controls to measure and maintain acceptable voltages and high power factor at all points in the distribution network under varying load conditions;
- **Fault Detection, Isolation and Restoration**, automation technologies used to quickly and precisely detect fault conditions, isolate faulty equipment and restore power to customers by operating remotely controlled switches;
- **Substation and Feeder Monitoring**, a collection of technologies which monitor the network state (voltage, current and frequency) and condition of assets within the electrical distribution network utilising a common ICT platform;
- **Wide Area Measurement**, a measurement devices capable of providing high speed, time-synchronised samples of network data, including voltage, current and frequency, called synchrophasors. Once deployed at strategic points on the transmission and distribution networks, incoming data from these devices can be used to accurately and dynamically measure the state of the power system from a wider-area perspective.



## Business case

The main goals of the Smart Grid, Smart City project were to: **demonstrate the possibility to scale the initiative, foster public awareness about sustainability, collect data for further adoption across the country**, spot potential synergies with other infrastructures like gas or water.

The main rationale followed in regards to the locations selected was the possibility to have a comprehensive representation of geographic, climate, demographic and electricity network features across the country. Newcastle was chosen for its regional and suburban features and for its demographic and socioeconomic characteristics reflecting a typical Australian town. The main focus in the program was on residential customers since they make the largest group of users in Australia and are those more focused on the quantity of energy to use during the day.

Following the programme of Newcastle, smart metering has also been implemented in the state of Victoria, where more than **2.75 Mln meters have been installed in homes and businesses**, making smart meters the standard meters in Victoria. Similar programmes have also been implemented across the EU, in particular in Denmark, the UK, Germany, France and Italy. **The aim of the EU is to roll out nearly 200 Mln smart meters for electricity and 45 Mln for gas by 2020, providing 72% of European consumers with a smart meter for electricity and 40% with one for gas.**

The programme started in 2010 and was funded by the Australian Government (Dept. of Resources, Energy & Tourisms) for a **total of amount of € 66 Mln to the whole consortium** including Ausgrid as well as other private and public players from IBM Australia to Energy Australia, Sydney University and Newcastle University. Additional funding resources were provided by the partners involved in the trial for a total of € 325 Mln in both cash and technical support.

## Community & Citizen Focus

A central role in the program was given to the **focus on customers' behaviours**. For this reason two trials were conducted. On the one hand, a network trial was carried with the aim of **evaluating the impact of technologies** based on smart metering with fixed customers' tariff and operators. The products surveyed ranged from an online portal to an in home display and sub-metering devices.

On the other hand, a retail trial survey was conducted for measuring the impact of alternative tariffs on customers. Besides these two trials a customer research survey was also carried for analysing customers' experience and for mapping different household energy consumption and demographic structure. A total of 8,000 participants took part in two customer surveys with 1,700 people responding to the first one and 2,500 to the second one (including 1,000 from the previous one).

Based on these trials, the *Smart City, Smart Grid* report found the potential for a **net economic benefit of up to \$ 28 Bln over the next 20 years from the deployment of smart grid technologies** in **Australia**. Consumer behaviour change with respect to electricity consumption (to better manage any future growth in peak demand) is a key aspect in achieving such economic benefit. In this respect, the introduction of smart meter infrastructure with dynamic tariffs, besides moderating peak demand growth, has the ability to reduce (in real terms) future electricity bills for many consumers, including those 'passive consumers' who choose not to make behavioural changes, adopt dynamic tariffs or deploy distributed generation and storage devices (this is true for both residential and business consumers).

## Impact

A first assessment of the **impact of smart grid solutions was estimated to be around € 13 Bln benefits** for the whole economy. The main advantages came from **Fault Detection Isolation and Restoration technologies** that enabled to spot and repair potential faults in the network. Also, the use of online tools for monitoring electricity usage combined with alternate and smart meter pricings improved electricity management in the different household; therefore regulating daily electricity consumption. The outcome from the project constitute a base point that could be used by Australian policy makers in order **to implement smart grid technologies on the wider national scale** in the near future. An example is already represented by the adoption of smart metering in the Australian state of Victoria mentioned above in scaling & replication.





## The solution in context: Smart City – Newcastle

### About the smart city vision in the city

Newcastle aims at **becoming one of the most innovative cities in Australia**. For this purpose the **Newcastle 2030 plan** has been established by the city council in order to **create a shared vision for the city's future perspectives**. Within this framework a strong focus is given to topics that could enable the city to become smart, liveable and sustainable. The main areas of growth go in the direction of urban mobility, with an upgrade of the public transport system, the creation of new cycling routes and a new pedestrian access mobility program.

Other key developments are registered regarding built environment with a focus on energy saving measures but also more inclusiveness of citizens in the decision making process with the possibility to **address the main social, economic and environmental issues** by actively involving the population. The Newcastle 2030 project itself was developed thanks to the involvement of more than 1.500 citizens participating at community events and meetings for shaping the city's vision from 2009 till 2013. Environmental focus with enhanced carbon management and a reduction in emission is also included in the plan along with an upgrade in the lighting system.

**Name of City** Newcastle

**Country** Australia

**No of Inhabitants**  $100,000 < x < 500,000$

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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- **The solution in context image source:** Newcastle Convention Bureau  
<http://www.newcastleconventionbureau.com.au/>





## Smart Power - Intelligent Network of Urban Infrastructures Hamburg, Germany

→ Replication potential		→ Economic impact	N.a.
→ Complexity		→ Environmental impact	N.a.
→ Citizens' involvement		→ Social impact	N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The idea at the base of this project is that a smart network composed of decentralised CHP units, storage capacity and flexible consumers can **increase energy efficiency, optimise resource availability and achieve higher shares of renewable energy**.

Started in 2011 and led by the public utility Hamburg Energie, in cooperation with two leading German universities and representatives of the city, Smart Power Hamburg builds upon the following key concepts: i) **decentralised CHP units achieve very high efficiency** when both electricity and heat can be used, ii) **storage enables to decouple the usage of the one energy carrier from the other and thus to satisfy customer demand** iii) **consumption/generation flexibility can be offered as an energy service on the market**.

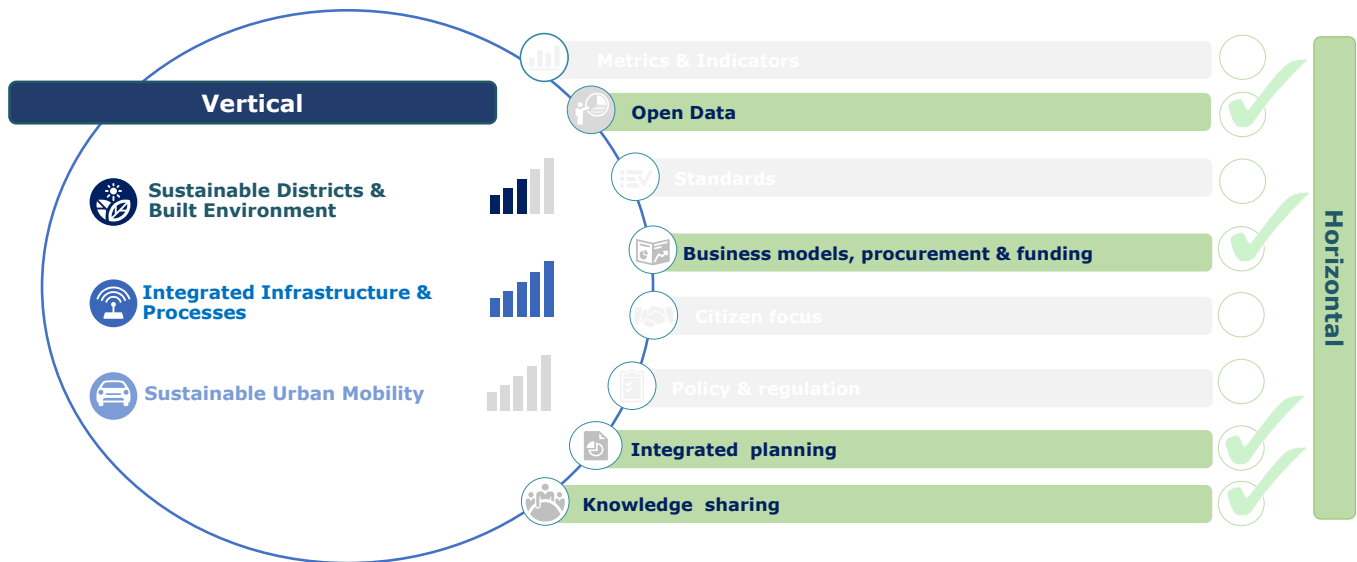
At the heart of such a system is an ICT network which enables communication between the single parties, allowing to develop synergies and optimise the overall performance. Thus, the system can export to and import from the electricity grid, according to its need. This balancing capacity can be commercialised on the energy market, generating cash flows, besides enabling higher integration of intermittent renewable energies.

Cornerstones of the project are the simulation of the network operation, the equipment of selected public, commercial and industrial real estate sites with smart meters, the connection of the CHP units, the development of the communication platform and of the control algorithm and of potential business models. Finally, the virtual power plant network has been monitored under a one-year pilot operation.

<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, University, Agency for City Development and Environment
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	N.a.
<b>Link</b>	<a href="http://www.smartpowerhamburg.de/">http://www.smartpowerhamburg.de/</a>

## Level of integration

The solution can be considered as integrated since it exploits an **ICT system** applied to **improving energy efficiency** in both private and commercial buildings. One of the main objective of Smart Power Hamburg is in fact the development of an open and scalable IT platform to interface and operate the various units, satisfying requirements of robustness, security and future technological evolution.



## Business case

The solution has been financed by the Ministry of Economy and Technology, within a framework for R&D on **energy efficiency** (EnEff:Wärme), and **Hamburg Energie**, the city's public utility. There is no detailed business model or replication examples available for the project, although there is a clear intention to deploy the expertise acquired through **Smart Power Hamburg in future integrated city planning processes**.

Furthermore, a central objective of the project is to develop sustainable business models that will enable free competition on the market of electricity provision and the inclusion of decentralised generators. For this purposes economic, financial and legal boundary conditions need to be investigated.

The system flexibility and the storage devices of the Smart Grid can generate revenues, by taking part to the balancing services national market and offering reserve capacity or other regulation services (primary, secondary and tertiary reserves).

Thus, the project investigates the potential of **cost-effective** and innovative heat storage into existing infrastructure, such as local heat networks and/or swimming pools. An additional source of income or **reduced expenses** for the operators of the CHP units could be the lower tax expenses in case of self-consumption due the avoided usage of the transmission and distribution lines.

## Community & Citizen Focus

Obviously for this concept to be sustainable in the long-run the identified business cases need to be attractive for both the operators of the decentralized CHP units as well as for the operator of the central platform. Hence, a certain degree of user-focus is included in the study although one cannot speak of community involvement.

## Impact

According to the webpage of the German research framework for **energy efficiency increase the project reached 75% of its completion**. Thus, there is no reported impact available yet.



## The solution in context: Smart City – Hamburg

### About the smart city vision in the city

The commitment of the city of Hamburg towards the environment was internationally acknowledged with the European Green Capital Award in 2011. The latter is granted based on a series of criteria which range from integrated environmental management to energy performance, from local transport to eco innovation and sustainable employment.

The **goal to cut CO<sub>2</sub> emission by 40% within 2020** and **by 80% within 2050** compared to the levels of 1990 is just one indicator of the city's focus on increasing its sustainability. In 2014 the city signed a MoU with Cisco which gives Hamburg access to the company's Smart+Connected Communities™ framework. Together they will develop Hamburg's digital agenda, building on the Internet of Everything and innovative technologies to improve mobility, efficiency, safety and sustainability, ultimately meliorating the quality of life of the residents.

With HafenCity, a leading urban development project in Europe, the former port and industrial area is being transformed into a new space for mixed use that will accommodate thousands of residents, workers and visitors. Smart buildings and integrated e-mobility as well as car-sharing models are planned. In addition, virtual citizen service solutions, environment and infrastructure sensing, deployment of smart street lighting and smart traffic systems to detect incidents earlier and optimise traffic flows are being implemented within a smart city pilot.

At the heart of the city's social life and economy, the harbour itself will be transformed during the next years. **Intelligent parking spaces** and control systems for trucks and loaders, integrated traffic management systems and smart street lighting will all contribute to the development of the smartPORT.

**Name of City** Hamburg

**Country** Germany

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): **46**

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## UCSD Microgrid San Diego Microgrid, US

→ Replication potential



→ Complexity



→ Citizens' involvement



→ Economic impact



→ Environmental impact



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The University of California, San Diego (UCSD) is widely known as one of the **most "green" university** in US. In particular, UCSD started several years ago an important path **to a carbon-neutral campus**. Counting on the ability to leverage government funds and to make strategic partnerships, UCSD was able to develop **a pioneering microgrid in 2006**.

The microgrid played a vital role in the solution adopted by UCSD that aims at **creating a sustainable campus**. It enables the different premises to disconnect from the regional power network and operate on **"island mode"**. Moreover, by installing the microgrid the University of San Diego already managed to achieve substantial monthly economic savings amounting to approximately € 750,000, **reducing the power bill by 50%**.

The solution strength is the system's harmony: it is an integrated system composed by energy sources, energy storage and a control system working together. Additionally, all the data related to the microgrid have been made open online in order to foster transparency and also stimulate innovation.

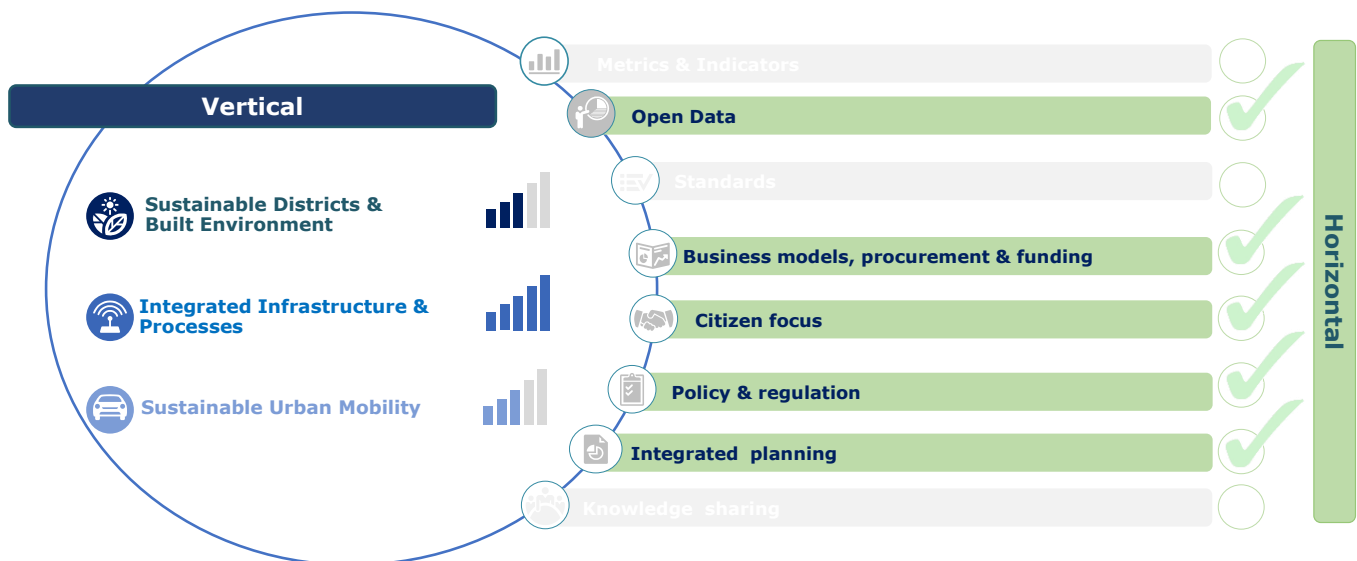
<b>Starting year</b>	2006
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authority, Industry, University.
<b>Budget</b>	€ 7.3 Mln (microgrid only)
<b>Number of impacted users</b>	Approx. 45,000 students, faculty, staff, visitors
<b>Link</b>	<a href="http://sustain.ucsd.edu/highlights/microgrids.html">http://sustain.ucsd.edu/highlights/microgrids.html</a>

## Level of integration

UCSD microgrid can be considered as a **fully integrated solution**. It is formed by an interconnection of various power generation, storage and consumption assets. UC San Diego has a 42 MW microgrid which self generates **85% of its own annual electricity load** and **95% of its heating and cooling load**. Distributed energy resources include a pioneering 2.8 MW fuel cell utilizing Directed Biogas from the local wastewater treatment plant, 2.2 MW of Photovoltaics, 2.5 MW/5 MWH of advanced energy storage, and 6.1 Mln gallons of thermal energy storage that are fully integrated and operate in seamless conjunction with an EPA Star Award 27 MW Combined Cooling Heat & Power Plant. UCSD owns and maintains a 69 kV substation, ninety-six 12kV underground feeder circuits and four 12kV distribution substations throughout the 1200 acre campus.

UCSD has twenty-six RWE (Germany's second largest utility) Level 2 and 3 DC fast chargers under funding from the CEC AB 118 program. NRG has entered into an agreement with UCSD to install additional 2nd Life EV battery system to augment their two PV-DC Fast Chargers in addition to eight Vehicle-to-Grid EV charging stations in conjunction with Honda and Nissan. The existing twenty-five ECotality Level 2 EV Charging stations will be upgraded with eVgo and ChargePoint systems in 2016. Additionally, BMW has installed 108 kWh of additional 2nd Life EV batteries. When completed, UCSD will possess one of the largest, most diversified portfolio of EV chargers at any university in the world.

The smart interconnection of these multiple assets, which ultimately represents the microgrid, is guaranteed through the software PI System, a platform that interfaces the different technologies. By enabling the **acquisition, storage and processing of real-time data**, communication within and control of the system is achieved, and thus the optimisation towards a **least-cost, least-carbon energy supply**.



## Business case

The UCSD microgrid represents an interesting and well-managed approach to R&D solutions from a business and funding perspective. In fact, the university managed to establish itself as a state-of-the-art demonstration site for integrated decentralised energy solutions. The approx. **€ 7.3 Mln microgrid is owned by UCSD** and was **funded to about 50% through grants from the California Energy Agency** since 2008. The subsidies were leveraged to attract additional private and public investments and thus finance the remaining gap. To cater these, the demonstrative nature of the project, the short permitting processes possible because of the microgrid's state property and especially the visibility ensured to the manufacturers and technology providers played a central role. Examples in this sense are the U.S. Environmental Protection Agency Energy Star Award and the 2013 nomination Energy Grand Champion by the regional utility SDG&E.T

A **different business model was adopted for the fuel cell**. The latter is in fact owned by Biofuels Energy LLC, which installed the equipment in 2011 co-funding it through € 7.18 Mln incentives by the State of California Self Generation Program. The company operates the fuel cell, selling electricity to UCSD through a 10-years power purchase agreement (PPA).

Interventions in the built environment and its intelligent interconnection and control can represent additional sources of income as well: in 2013 the university received a **€ 6.7 Mln check from SDG&E for the implementation of 30 energy efficiency projects** from 2010 to 2012. Also the buildings' demand management is a service that the university could potentially commercialise on the capacity market. Finally, to promote the use of electric vehicles and integrate these into the microgrid control strategy, UCSD is considering to establish an attractive leasing plan for staff and students with a plan for charging on campus.

Even though there are no current replication cases the solution carries a good potential for adoption in cities or universities both in the US as well as abroad.

## Community & Citizen Focus

Although one cannot speak of a citizen-centred approach when the microgrid was designed, the university is working to make all the data related to the microgrid openly available on the web. Besides achieving transparency, this shall also stimulate innovation and further improvement through third party involvement.

Further, end-user behaviour is increasingly being integrated into the control strategy of the microgrid, e.g. when considering the charging of EVs or the consumption in the buildings.

## Impact

Already to date the microgrid contributes to lower costs and GHG emissions of the regional energy mix. The university is however working to integrate the variable cost of electricity into the solution's control system within the near future, thus allowing **to optimise its generation, storage and consumption** as well as its import from and export to the regional grid. This together with the planned tenfold expansion of the controlled building equipment will substantially improve the demand management service, the university is already capable of offering to SDG&E. UCSD is the utility's biggest DSM customer, with the capacity to shed 6 MW to 10 MW.

Moreover, by installing the microgrid the University of San Diego already managed to achieve substantial **monthly economic savings amounting to approximately € 750,000**, reducing the power bill by 50%. Specifically in relation to environmental savings it is calculated that the UCSD microgrid via electric vehicles implementation achieves a well-to-wheel emission target of 51g of CO<sub>2</sub>/mile (a 79% improvement compared US standards). Moreover, the microgrid has an approximately 25% lower Greenhouse Gas Emission than the California's energy mix. The solution carries also relevant social impacts by allowing students to have a practical on-campus learning experience and to develop a business-oriented approach towards sustainability.

### **About the smart city vision in the city**

Recently, the region's cities' and counties' governments, together with residents and businesses, tried to answer to the question how San Diego should look like in 2050. The leading themes around which the vision rotates are healthy environment and communities, a vibrant economy, and innovative mobility and planning.

The solution presented is in line with some of the consultation outcomes. Indeed, **the microgrid contributes to reduce the energetic impact on the environment**, through intelligent, decentralised and renewable power generation, and promotes new modes of mobility, especially through the near-zero emission and electric vehicles deployed at UCSD. Further, the solution is a space to demonstrate the readiness of technological innovations with the goal to improve the economy in a sustainable way.

It is worth to mention, that to achieve the Regional Plan the public was comprehensively involved, drawing upon various consultations techniques as workshops, social media and visualizations. A specific plan was developed to connect with commonly hard-to-reach communities like tribal nations, minorities and low-income population.

**California is committed to facilitate the commercialisation of zero emission vehicles, with the objective to have 1.5 Mln ZEVs on the roads by 2025.**

**Name of City** *San Diego*

**Country** *United States of America*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** *Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
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## Vehicle2Grid Amsterdam, Netherlands

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Vehicle2Grid programme started in Amsterdam and Lochem in 2014 with an implementation plan spanning over three different phases. The first stage was launched in Lochem in 2014 with few selected households participating in the test. The second stage involved connecting electric cars in Amsterdam. The final stage set for 2016 will connect the whole neighbourhood of Nieuw-West.

The aim of the project is to show **how e-mobility, local renewable energy and the electricity grid can be connected and enforce each other via ICT**. The core elements of the project are: demonstrate the benefit that smart solar energy management can bring to both home energy and also info-mobility, **improve the optimization of self-generated renewable energy, vehicles and e-mobility** as key elements in circular energy economy, enabling lower-capacity grid while having energy availability, show the value of information management for energy transition along with the possibility to have more space in the network for e-mobility.

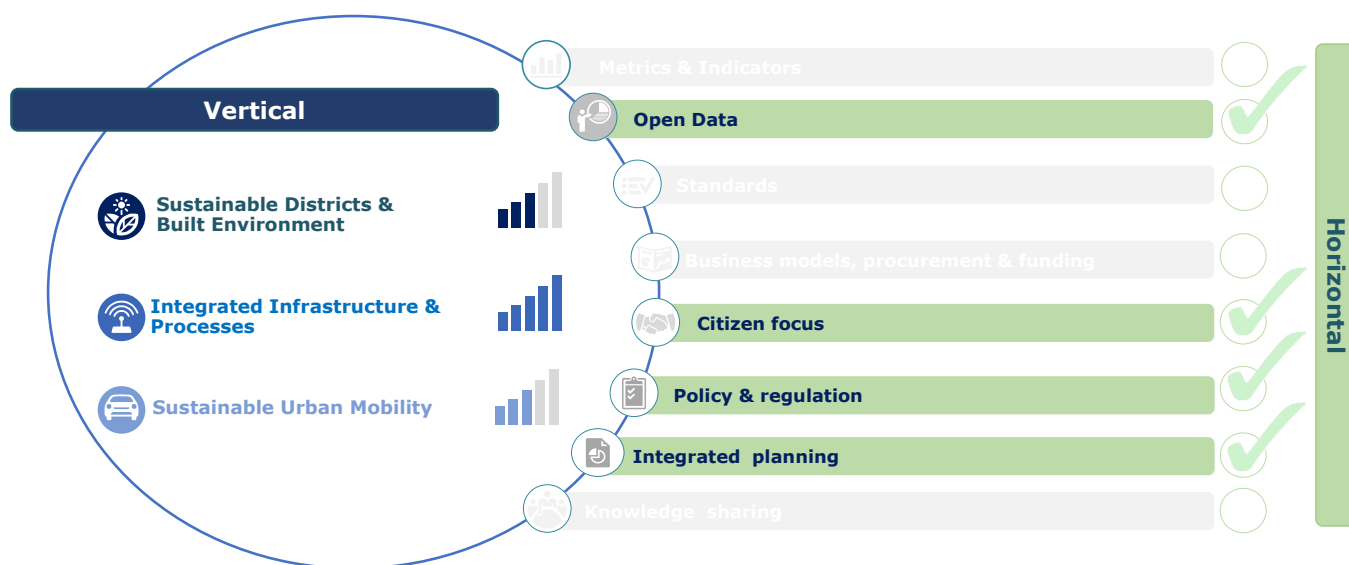
The project has been supported financially and technically by several partners spanning from Liander to Mastervolt. The project is also supported by Amsterdam Smart City which is an initiative promoted by the Municipality of Amsterdam and directly focused on promoting projects in the Smart City domain. Citizens have been also directly involved in the Vehicle2Grid via the provision of access to households' facilities for testing.

<b>Starting year</b>	2014
<b>Type of integrated solution</b>	Smart grid
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry.
<b>Budget</b>	€ 1.6 Mln
<b>Number of impacted users</b>	Approx. 100,000
<b>Link</b>	<a href="http://www.amsterdamvehicle2grid.nl/">http://www.amsterdamvehicle2grid.nl/</a>

## Level of integration

The solution can be considered as fully integrated across **ICT, urban mobility and the built environment**. A central aspect in the solution is played by locally produced energy (e.g. from solar panels). Especially in relation to locally produced solar energy it has been calculated that production exceeds households consumption during most of the year.

The reverse occurs during the evening and early morning. Based on these considerations the Vehicle2Grid project **allows to store energy exceeding demand in vehicles in order to consume** it in the morning or evening, therefore reducing the dependence of the grid. Similarly, the energy surplus could be also stored and used for household appliances. Moreover, the solution includes the development of an open platform for connecting data from households with data from cars or charging stations. The aim is to create an open data mechanism that could boost the creation of new apps related to sustainable energy or urban mobility.



## Business case

The solution has been funded for a total of € 1.6 Mln and involves several large partners including Amsterdam Smart City, Mastervolt, Liander and Resourcefully implements. The partners assist the development of the solution by providing technical and economic support. The projects represent the first Household Smart Energy Network, even though it carries a potential for replication it has not been replicated in other locations.

## Community & Citizen Focus

Citizens are involved in the project since they are the final users of the energy produced and stored via the Vehicle2Grid system. Moreover, they have also been actively involved by providing household facilities for testing the project during its different phases.

## Impact

Even though the solution is still in its early phases it has already produced some relevant achievements. While in 2013 approximately **83% of the energy consumed originated from the grid**, one year after it was calculated that **73% of the energy consumed was self-generated**. Thus the Vehicle2Grid programme enabled to generate, store and produce the energy locally, reducing dependence on the grid network. There are no data available in regards to the economic impact of the solution. However by reducing the dependence on the grid the solution can also enable **relevant economic savings**. Similarly, social issues are also addressed by the Vehicle2Grid project; the goal is to improve the environmental vocation of citizens therefore also **enhancing the quality of life in the city**.



## The solution in context: Smart City – Amsterdam

### About the smart city vision in the city

Amsterdam is currently **one of the major European cities at the forefront of the implementation of Smart Cities solutions**. One of the most important initiatives promoted by the Municipality is the **"Amsterdam Smart City Project"**. The project aims at **promoting collaboration among local public entities, businesses, residents and academic institutions**. The initiatives and solutions carried out via the "Amsterdam Smart City Project" are divided into five thematic areas: **mobility, economics, residential living, social wellbeing, placemaking**. Some of the projects implemented under this framework include: the development of Buiksloterham neighbourhood or the City-Zen Programme.

The "Amsterdam Smart City Project" initiative can be included in the wider Structural Vision Amsterdam 2040. **The core of the vision for 2040 include:** a more intensive use of already existing space in the city, **enhancement of public transport, investments in recreational and green spaces, investments on green energies**.

<b>Name of City</b>	Amsterdam
<b>Country</b>	Holland
<b>No of Inhabitants</b>	> 500,000
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): <b>13</b> Global Cities Index – Bloomberg (2014): <b>26</b> The Economist – City Competitiveness rankings (2013): n.a.

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# ***Smart City Platform***



## MK:Smart Milton Keynes, UK

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Milton Keynes is one of the fastest growing cities in the UK. It is predicted to grow significantly over the coming years: its economy has a Gross Value Added (GVA) of € 10 Bln and could reach € 16.4 Bln by 2026 (Oxford Economics, 2012). Such growth has the potential to increase employment at the rate of over 2,600 jobs per year, or an additional 42,000 jobs by 2026 (MK Council Employment Technical paper, 2012).

The MK: SMART project is a comprehensive approach to developing Milton Keynes as a smart city by putting in place an innovation programme, which includes a sophisticated **ICT infrastructure**, an **Innovation Hub** for business, a Citizen Innovation programme, and education and training programmes, including initiatives targeted at local schools.

The project gathers **real-time information** from a range of sources across the city and provide innovative analysis tools to enable much more efficient use of transport, water and energy infrastructure. The collaborative project see the development of a "**MK Data Hub**", a state-of-the-art data acquisition and management infrastructure capable of collecting large-scale city data relevant to how the city functions. Specifically, the hub have access to data streams from both key infrastructure networks, such as energy, transport and water, and other relevant sensor networks, including weather and pollution data.

Building on the capability provided by the MK Data Hub, the project innovate in the areas of transport, energy and water management, tackling key demand issues. The IoT and connected devices landscape address some of the societal challenges facing cities, both today and in the future. These include areas such as **utilities (energy and water) and transport systems**. They also allow the center to utilise vast data sources in order to inform health initiatives (for example, how to deal with an ageing population) as well as helping to inform policy makers who are responsible for city wide decisions.

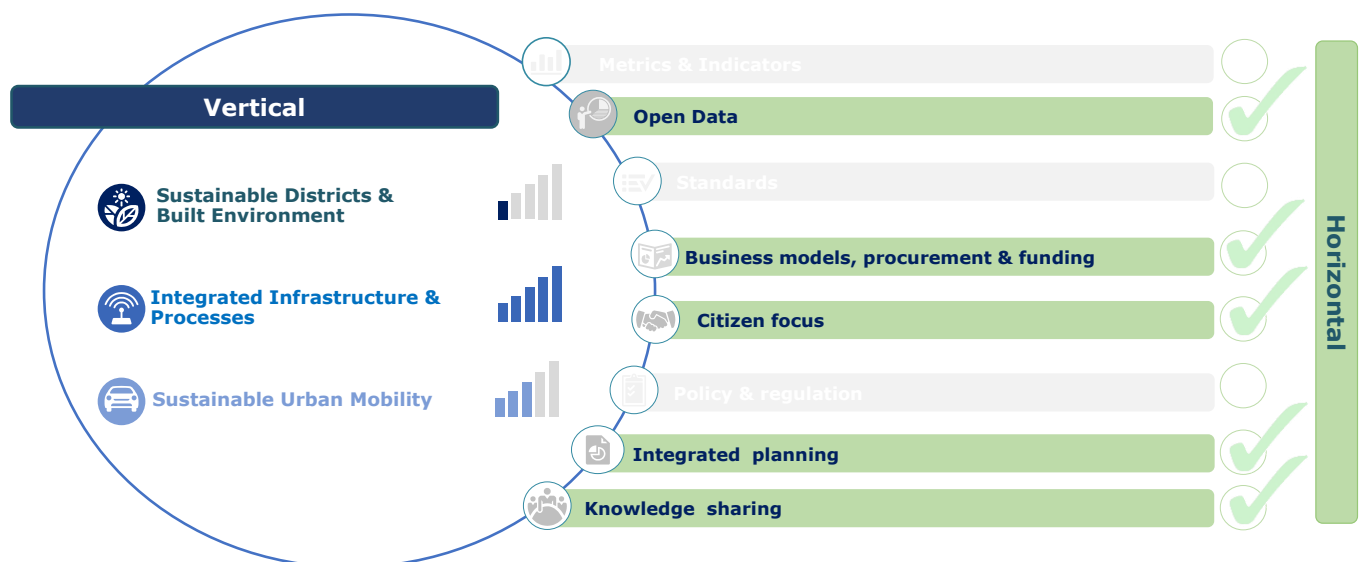
In addition to technical solutions, MK:Smart also comprises:

- **ambitious education, business and community engagement activities**, including an integrated programme of business engagement, aimed at supporting businesses that wish to take advantage of the innovation capabilities developed in MK:Smart with an Innovation and Incubation Centre (IIC) at University Campus Milton Keynes (UCMK), which provide training in data-driven business innovation and the digital economy, as well as hands-on support for business development, demonstration facilities, and an incubation space;
- a **smart city education programme** engaging a wide range of audiences, from local schools to higher education students and businesses. This programme provide advanced training covering digital technologies, business innovation and urban services to empower students and practitioners with the skills and competences needed to participate in the creation of a smart city;
- **engagement activity** to involve citizens in the innovation process, not just through an outreach programme, but also by engaging the community in innovation-centric decision-making processes through the establishment of a Citizen Lab.

<b>Starting year</b>	2014
<b>Type of integrated solution</b>	Smart City Platform
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry, University.
<b>Budget</b>	€ 22 <sup>44</sup> Mln
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.mksmart.org">http://www.mksmart.org</a>

## Level of integration

As depicted in the following figure, the project covers all the three vertical/technological priority areas of the EIP-SCC Strategic Implementation Plan and most of the horizontal/transversal ones. The project involves an **(open data) ICT infrastructure (MK Data hub)** and include applications and **digital solutions** in the **energy, transport and water domain**. Through the business engagement and education programme, there is a clear citizen focus in it and knowledge sharing is ensured.



## Business case

The **pioneering MK:SMART project**, supported by an **€ 11 Mln** grant from the Higher Education Funding Council for England's (HEFCE) Catalyst Fund, is being match-funded by a number of partners. The **€ 22 Mln initiative is led by The Open University**, which brings together a higher education and industry partnership, namely: the University of Bedfordshire, University of Cambridge, Milton Keynes Council, British Telecom, E.ON, Anglian Water, HR Wallingford Ltd., the TSB's Satellite Applications Catapult, Community Action MK, Fronesys, Graymatter and Playground Energy.

The overall aim this initiative is helping to secure the future economic growth of Milton Keynes.

<sup>44</sup> The conversion rate used for this case study is 1€=1,099 £

## MK:Smart – City Data Hub

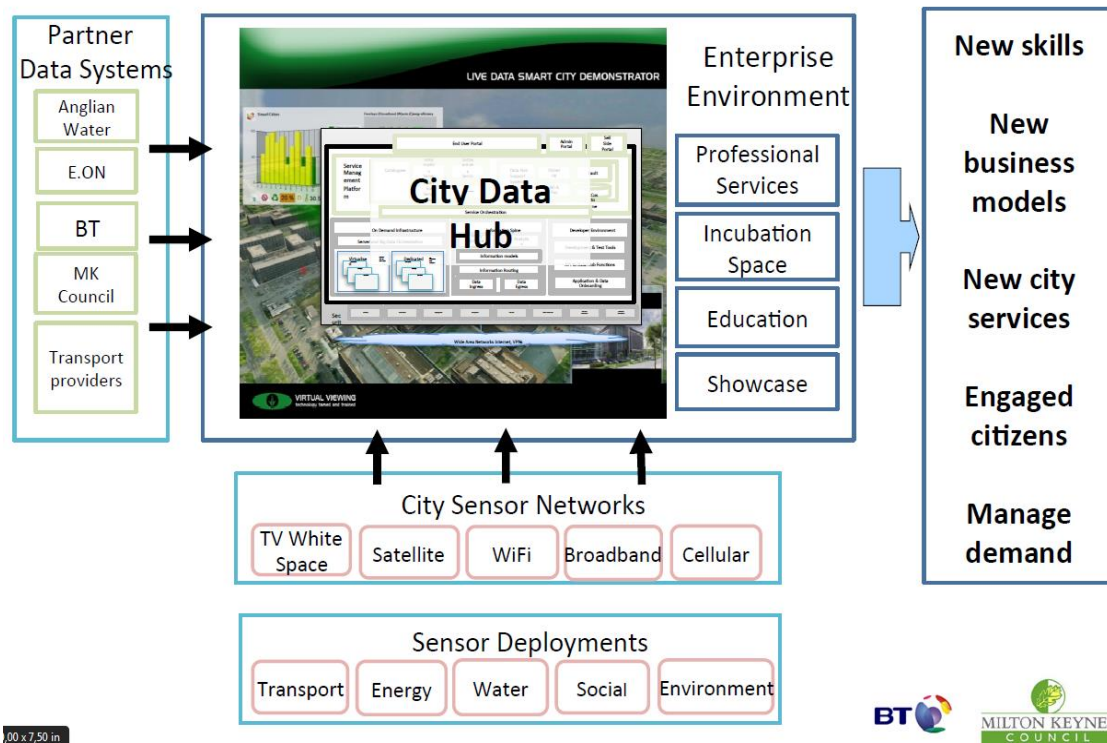


Image source. Mk smart [www.mksmart.org](http://www.mksmart.org)

The city wants to support its future growth by putting in place an integrated innovation and support programme, which **leverage large-scale city data to sustain and accelerate economic growth**. At the centre of this programme is the MK Data Hub, a state of the art data acquisition and management infrastructure, which curate and make available a variety of data sources relevant to how the city functions, including: **local and national open data resources**; **data streams from both key infrastructure networks** (energy, transport, water) and other **relevant sensor networks** (e.g., weather and pollution data); **satellite data**; and **data crowdsourced** from social media or through specialised apps. In particular, the MK Data Hub makes it possible to implement radical new solutions for managing demand, a key enabler to ensure that the city's capacity to reach forecast growth potential of 64% by 2026 can be effectively and sustainably realised.

Data informs analytics at different levels of detail to support intelligent planning and usage of resources across city systems.

Innovative solutions are realised to reduce the cost of data-driven application development. For example, sophisticated data curation mechanisms add value to the 'raw data' in the MK Data Hub, by automatically enriching these with provenance and quality information, and by linking them to other relevant data sources.

In addition, a series of **APIs** (application programming interfaces) are developed giving 'application-friendly' access to information available in the MK Data Hub, in a variety of formats. This layer effectively represents the interface with application developers, as well as the main support for interoperability between the MK Data Hub and other systems.

In the context of the existing energy infrastructure, the work on energy management in MK:Smart has two overarching goals: i) **to develop and demonstrate innovative energy services enabled by the smart analytics capabilities of the MK Data Hub** and ii) **to demonstrate the business value of the MK Data Hub for the energy sector**.

Specifically the work focuses on the following areas:

- **Open Energy Map** – collecting, collating and analysing Milton Keynes energy data from various sources to create a living Open Energy Map that empower local communities and business to better understand energy trends in their areas.



- **Electric Vehicles** – collecting data about driving behaviour of Electric Vehicles (EVs) in Milton Keynes to understand real-world energy demand of EVs and devise energy management strategies to minimise electricity consumption.
- **Electricity Demand Shifting** – working with households with solar PV micro-generation to develop digital tools to help people maximise self-consumption of locally generated electricity by shifting demand to periods of peak generation.
- **Smart Grid Dynamic Demand Response** – developing novel data-driven approaches to enable people and communities to manage their energy consumption during peak demand periods in order to decrease the growth in energy demand that is threatening the stability of electric grids in the current infrastructure.

All these activities feed into and make use of the data management and analytics services of the MK Data Hub.

Due to the agreement of the research project, any form of money exchange by data providers and end users is not allowed during the research period; therefore, at least during the research phase of the project, no revenue streams are generated.

However, before the research project ends, through the development of a sustainability project roadmap, consortium' partners expectation is to create a **parallel commercial offer** to deploy alongside the current project system. This commercialisation phase is expected to take place by the end of 2016; by then, industry players believe to have outcomes that would justify the investment, in order to have by 2017 the Return on Investment.

In this respect, two main Business Models are currently under discussion:

- **Offer MK Data Hub as a platform** and take a trading commission on whatever trade happen across the data hub.
- **Offer MK Data Hub as a management service** and take a service management fee (e.g. in case the city is willing to put in place its own infrastructure and operate it for the benefit of the city).

In both cases, the MK data hub is going towards becoming a **market place/trading environment** where data providers and end users can meet, and where data are traded as assets. In this way, data providers would be facilitated to publish their data set into an environment where they can assign terms and conditions and privacy policy to them. Eventually they can assign value to that data stream and get revenues from it.

In Milton Keynes alone, the Smart Cities revolution has the potential to increase employment at a rate of 2,600 jobs per year, in a sector estimated to be worth € 450 Bln globally by 2020.

## Community & Citizen Focus

The MK Smart initiative has established an online community asking for citizen inputs on sustainable solutions. The ambition is to turn the best ideas from citizens into real projects.

Additionally the MK:Smart initiative aims to **educate citizens and businesses on sustainability**. In particular, they distribute Data Sensing and Analytics Teaching Kits in local schools, set up a Postgraduate Certificate in New Enterprise Creation at University Campus Milton Keynes (UCMK), and produce and deliver an educational programme for businesses and business students.

**The MK Data Hub makes available vast amounts of information** to businesses and academia to facilitate the **creation of new products** and **improved services** and contribute towards the Milton Keynes economy.

## Impact

The MK: SMART project is expected to deliver up to 20% in water savings, **50% less traffic congestion, a 2.8% reduction in electric consumption and 2% gas reduction**, BT's website claims. The project aims to be a strong example of how communications technologies can be used to reduced the pressure on resources and cut carbon emissions.

No results have been documented from the MK:Smart project when it comes to sustaining sustainable growth in a rapidly expanding city area so far.



## The solution in context: Smart City – Milton Keynes

### About the smart city vision in the city

Established in 2014, the current smart city vision of Milton Keynes is based on the **MK Future City Programme**, the programme behind city's smart city projects, which addresses barriers to housing and economic growth and provide the capabilities to enable business and service innovation, including through the integration of multiple city systems.

At a broader scale, MK's vision embraces **low-carbon sustainable living** and **envisages an open innovation environment** in which creativity flourishes and in which cultivate innovative approaches to community engagement, business growth, low carbon urban transport, and ICT innovations making the city an attractive and thriving location for business and investment.

This approach is underpinned/supported by:

- **An Economic Development Strategy** that promotes the knowledge economy, skills and inward investment;
- The city's **Low Carbon Living Prospectus** which set out ambitious targets to reduce carbon emissions supported by a smart grid infrastructure.

<b>Name of City</b>	<i>Milton Keynes</i>
<b>Country</b>	<i>UK</i>
<b>No of Inhabitants</b>	<i>100,000 &lt; x &lt; 500,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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- › **The solution in context image source:** independent  
[www.independent.co.uk/](http://www.independent.co.uk/)



## Smart Santander Urban Platform Santander, Spain

→ Replication potential		→ Economic impact	
→ Complexity		→ Environmental impact	
→ Citizens' involvement		→ Social impact	

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

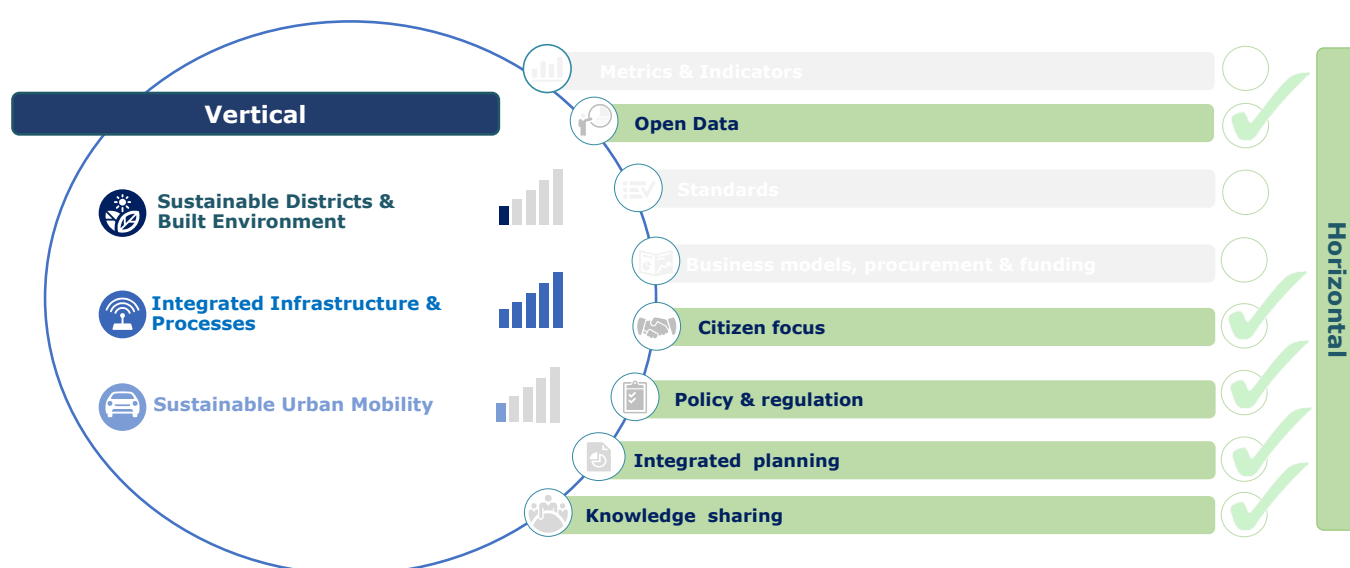
The project Smart Santander is a city wide experiment started in 2009 and aimed at installing approximately 20,000 devices across the urban area of Santander in order **to collect relevant data** including among the others free **parking lots, water consumption, status of filling of garbage bins**. The goal of the municipality is to use the different information collected via the deployment of the sensors in order to improve the city's management and reduce budget costs across different areas from **urban mobility** to **waste collection** and **energy resources**. Additionally, via this project the municipality hopes also to transform the city into a living lab capable of attracting talents and also enable companies to test technologies and new innovative solutions.

The whole project involves also other European cities where a smaller number of sensors has also been installed including: Guildford, Belgrade, Lubeck

<b>Starting year</b>	2009
<b>Type of integrated solution</b>	Smart City Platform
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry, University
<b>Budget</b>	€ 8.4 Mln public EU funding
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://www.smartsantander.eu/">http://www.smartsantander.eu/</a>

## Level of integration

The solution can be considered as integrated across the domains of **integrated infrastructure, sustainable district & built environment and sustainable urban mobility**. A total of 20,000 devices have been installed within a perimeter of 1 km in the city. The sensor deployed is managed via a central platform which gathers information coming from the different sources and distributes them to the relevant departments in charge for that specific area. More specifically, each sensors is connected to a gateway receiver (a total of 15 gateways have been deployed across the city) which is then connected to the central platform via fiber – optic cables. Thanks to the information collected from the devices the Municipality of Santander managed to take actions throughout several domains **from urban mobility to waste collection**. Several apps for smartphones have been also implemented in the city thanks to the data gathered via the deployment of the sensors. Some examples of these type of apps are the SmartSantander RA, providing bus location and schedule (15% of the residents downloaded it), Smart Parking Apps providing information on free parking slots and City Pulse which enables residents to report incidents or other relevant issues for the city's administrators.



## Business case

The Smart Santander project started in 2009 and involved a total of 25 among companies and institutions. Some of the most relevant players in the consortium of companies and institutions were: the University of Cantabria playing the central role of coordinator of the different project phases, Telefonica which provided the ICT infrastructure for processing the information collected from the different sensors, the Municipality monitoring the successful development and implementation of the project. The **overall budget for the project was € 8.4 Mln** of which € 6 Mln funded by the EU plus the remaining part supported by the different stakeholders involved in the consortium among which the Municipality of Santander

Even though the part of the project supported by the European Union ended after a period of 3 years the Municipality of Santander decided to develop a wide range of related initiatives in order to continue supporting research in the field as well as boost entrepreneurship in the area. Among the most relevant it can be accounted. The creation of the Center for Demonstration and Entrepreneurship Santander Smart City along with the Center for Research in Smart Cities of Santander were created in order to make the city more attractive for companies willing to invest in the Smart Cities domain along with supporting the development of new projects.

## Community & Citizen Focus

The citizens of Santander have been involved and informed about the different phases of the project. By involving the citizens it has been possible to collect relevant information as well as feedback from end

users therefore heavily contributing to the final success of the whole initiative. Additionally, in 2013 an online platform called "Santander City Brain" was launched in order to involve the community in the creation of new projects that could benefit the entire city along with suggesting improvements on current public services.

## Impact

Different impacts have already been recorded in relation the Smart Santander project. Thanks to the deployment of sensors the city managed to **save approximately 25% of the costs on electricity bills** and **20% on waste collection**. Additionally, traffic congestion has been also reduced in the city center by 80% along with public irrigation in parks by 25%. The launch of new mobile applications has also enabled a stronger communication between the Municipality and the citizens of Santander (approximately 42,000 people downloaded mobile apps generated thanks to the SmartSantander project). Overall the whole city management has been also optimized with an increased efficiency of public services and also an increased attractiveness of the city for companies and talents.



## The solution in context: Smart City – Santander

### About the smart city vision in the city

The municipality of Santander is deeply involved in fostering the smart city vision for the city. The **“Plan director de innovación”** has been established in order to tackle the most relevant issues related to the promotion of innovation in the city. More specifically, the aim of the plan is to:

- **Promote the Santander Smart City** and focus on the evolution of the Smart Santander project;
- **Improve entrepreneurship** in the area in order to generate an ecosystem that could allow local entrepreneurs and start-ups to flourish and create added value for the whole city;
- **Upgrade the services offered** by the public administration by promoting the use and application of ICT technologies, and the promotion of e-government services therefore improving the management of the city administration and also reduce the bureaucratic burden on citizens.

Within the above-mentioned framework several projects, besides Smart Santander, have been launched in the city. Some examples are represented by the Outsmart or Smart Search projects.

<b>Name of City</b>	<i>Santander</i>
<b>Country</b>	<i>Spain</i>
<b>No of Inhabitants</b>	<i>100,000 &lt; x &lt; 500,000</i>
<b>Smart City Rankings</b>	Europeansmartcities3.0 ranking: n.a. UN Habitat - City Prosperity Index (2012): n.a. Global Cities Index – Bloomberg (2014): n.a. The Economist – City Competitiveness rankings (2013): n.a.

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- › **First image source:** SmartSantander  
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- › **The solution in context image source:** Spiegel  
[www.spiegel.de](http://www.spiegel.de)





## Urban Platform Barcelona, Spain

→ Replication potential



→ Economic impact



→ Complexity



→ Environmental impact



→ Citizens' involvement



→ Social impact



Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

Urban Platform is a transversal **ICT platform that interconnects the entire city** and makes it possible to integrate current and new public services with the aim of **improving efficiency** in their management and quality of the **services offered to citizens**. The platform will enable the management of different resources in an efficient way, including **water, public services, temperature regulation, CO<sub>2</sub> emissions, civil works, humidity and energy efficiency**. Barcelona City Council has designed and promoted the Urban Platform in order to enable information generated by many sensors distributed around the city to be gathered, used and disseminated. This platform will support Barcelona City Council in taking decisions in real time, in order to meet the needs of governing the city and improve the quality of life of its citizens. This platform can acquire and process quickly and efficiently information on the run, allowing to analyse and relate events in order to produce simulations and anticipate several problems that might affect the city (including emergency situations), furthermore this solution provides a replicable and open sourced IT architecture model for the city.

The Urban Platform is composed by three layers:

- A **bottom layer**, collects the raw data produced by the city, and is composed by four groups of **different kinds of data**: a sensors and actuators platform called Sentilo (currently providing measures for 2,200 parameters), the City Council's information systems data (people, procedures, etc.), data coming from the city's information systems (infrastructures, mobility, etc.) and data from Social Networks and Web 2.0. At March 2016, only in Barcelona city, 1,800 Sentilo sensors/actuators are connected and up to 780 Mln transactions have been processed, Sentilo has been designed and implemented, with the support of Barcelona City Council, as an open source sensor and actuator platform designed to potentially fit in the Smart City architecture of any city who is searching for openness and easy interoperability. At the moment Sentilo sensor solution is running at the moment beside the metropolitan area of Barcelona also in Terrassa, Reus, Cambrils, Tarragona and Dubai.
- The **City Operating System**, which represents the intelligence component of the Urban Platform. This layer is based on three elements: a City Model that pilots the City Operating System, a universal repository in which gather and store all historic information of the city and a manager of information treatment processes that applies intelligence to the set of stored information.
- A top layer, formed by applications and control centres aimed at visualising the data and finding useful applications for it.

The Urban Platform relies on the city telecommunications network which integrates the entire city's Fiber Optic and Wi-Fi networks of Barcelona. In addition to being the corporate municipal network used by the City Council departments, the telecommunications network also provides free Wi-Fi connectivity to the citizens, with more than 500 access points already in operation throughout the city.

Currently, Sentilo, the first layer of the solution seems to be completed and operating. Regarding the other two layers, the process is ongoing and for the second layer (City OS) the tendering phase is in conclusion; the full go-live of the solution is expected for April 2017

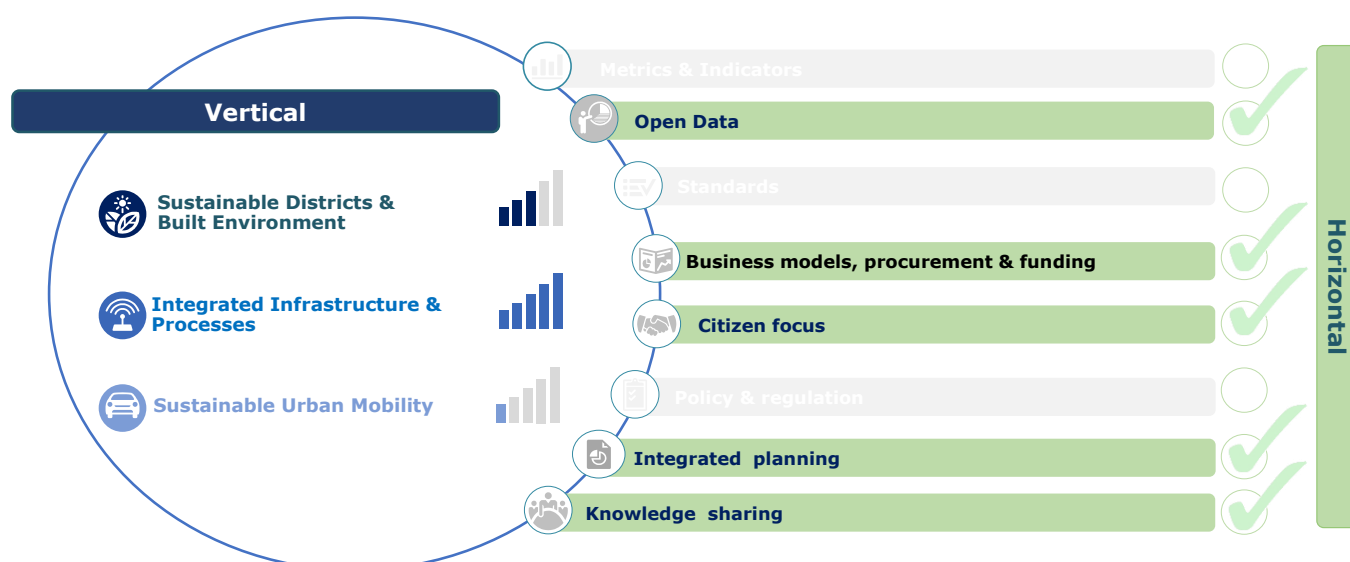
<b>Starting year</b>	2011
<b>Type of integrated solution</b>	Smart City Platform
<b>Scaling or Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public Authority, Industry
<b>Budget</b>	N.a.
<b>Number of impacted users</b>	Approx. 500,000
<b>Link</b>	<a href="http://smartcity.bcn.cat/en/bcn-smart-city.html">http://smartcity.bcn.cat/en/bcn-smart-city.html</a>

## Level of integration

A city becomes truly “smart” when it lets data and logic flow across its different domains, the **urban platform** project provides a transversal solution that makes it possible to achieve an exportable, modular (uncoupled), standard and open model that connects, standardizes, automates and integrates processes across domains.

This platform has been designed to support as many urban needs as possible, enabling many and different services both public than private and from third parties, from this will results several social, environmental and economic impacts and will help Barcelona City Council take decisions in **real time**, in order to meet the needs of governing the city and **improve the quality of life of its citizens**.

This platform has the capacity to acquire and process information on the running of the city quickly, effectively, and efficiently and in a sustainable manner it has smart systems that allow it to analyse and relate events so it can produce simulations and anticipate any problem that might affect the city (including emergency situations).



## Business case

Barcelona’s Smart City Strategy is currently composed by about **122 projects classified into 22 programmes** that cover all areas of the city management, from Lighting, Water and Waste Management to Innovation and many others. Within Barcelona’s Smart City Strategy it is worth highlighting the

importance of horizontal and open technological solutions and platforms applied in a transversal way to all city services. This helps achieve the goal of breaking from silos in information and solutions by enhancing efficiency and coordination.

For this reason Barcelona has **2 transversal projects** – the telecommunications network and the urban platform. They are of extreme importance due to their transversal and horizontal nature, allowing for many vertical solutions to be integrated into them.

Barcelona urban platform has been developed through the public-private collaboration between the **City Council** and **technological ICT providers** (Cisco, IBM, Accenture, DGS, Cellnex Telecom, Opentrends, Abertis and Indra and many other local ones) allowing the development of functional technological applications to improve the efficiency of services received by citizens. The urban platform is coupled with an operating system enabling the city government to utilize the data for decision making processes. Enabling enlightened decisions for the government should result in energy reductions and smarter allocation of resources. Barcelona is using the experience of ICT technological companies, to, together, define and build the City OS. The best suited method to such needs is CCPP (Contract collaboration between the public and private sectors), that allows competitive dialogue.

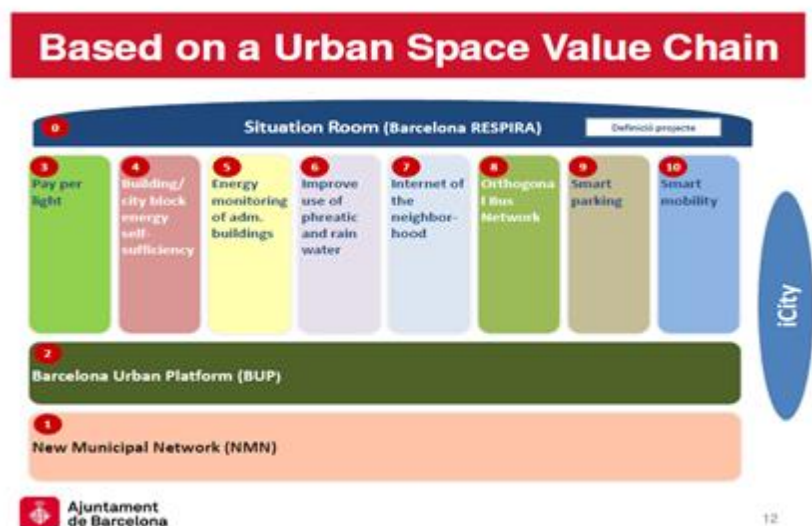
Another major component of the Urban Platform is on the access to **public data on transportation, energy consumption, water conditions** and a range of other information. This will enable increased government accountability for the public and media and enable other third parties to participate in the creation of new smart solutions.

## Community & Citizen Focus

Barcelona's vision is geared clearly at the citizen – for improved citizens' welfare and quality of life and economic progress. Its mission reads: "Barcelona is orienting its city evolution strategy towards to guarantee quality of life for its citizenry, social and urban improvement and added value in its neighbourhoods, fostering all its urban potential towards sustainable development and green economy, in favour of an energetically self-sufficient city and where nature holds a prominent role for the balance of the city. A connected city with a high-speed interconnected metropolitan area, that guarantees the region evolution and the improvement of its inner cities."

The technology is clearly seen as an enabler to:

- **make urban mobility more efficient and sustainable**
- **create environmental sustainability**
- **increase business-friendliness and attract investment and capital**
- **support integration and social cohesion**
- **achieve communication and proximity with people**
- **provide knowledge, creativity and innovation**
- **foster transparency and democratic culture**
- **support universal access to culture, education and health care**



This is also reflected in the vision and implementation of the urban platform. The platform enables "GO" (Open Government) a program geared towards citizen engagement which features a web platform aiming to bring transparency of the municipal government to citizens and publishes all data publicly. GO promotes the creation of services based on public information allowing allows citizens to communicate with municipal representatives and give their opinions, assess municipal policies and become involved in the different participatory processes established in the city, on any topic that affects it. The open data

enables and accelerates the development of new smart city solutions, as smaller companies will have data they could otherwise not collect. The next steps of the Smart City Strategy include rethinking the city's systems to achieve more sustainable urban, social and economic development, and working towards the transformation of Barcelona into a city of productive, self- and eco-efficient neighbourhoods regenerated at zero emissions, inside a high-speed interconnected metropolitan area.

During this process, Barcelona aims to actively involve the citizenship in a participative way, thereby promoting the concept of civic innovation. With this purpose in mind, a complete informational campaign will be launched in order to guarantee that every citizen understands the aim of the strategy and the projects it contains, as well as how they can get involved with many of them. The most powerful tool the city plans to use for this campaign will be the Barcelona Smart City website, which presents all information about the Smart City concept and how it is being implemented in Barcelona.

## Impact

Barcelona seeks to become a self-sufficient, hyper-connected, zero emissions city. ICT is key to reaching this goal as it enables the city to manage resources efficiently and reduce the impact of urban infrastructure on the environment. With the urban platform, the city can also capture information in real time, allowing for quicker decision making and response times. The result is a more sustainable, resilient city.

The city has set out the following **goals to be achieved by 2020**:

- **20% reduction of total energy consumption** from municipal services
- **20% water consumption reduction**
- 15,000 additional sensors installed in the city
- 30,000 consumption energy measures installed in 100 municipal buildings
- 1,000 measures to remotely control irrigation in municipal parks
- 1,000 environmental measures in civil works
- 5,000 parking spaces monitored.

The urban platform will allow to integrate current and new public services with the **aim of improving the resilience of the systems**, the efficiency in their management and quality of the services offered to citizens. Another relevant impact is the elimination of the departmental silos of information **enhancing data sharing, integration and efficiency and coordination among the several involved actors**. Cost reduction will also be achieved by the deployment and maintenance of sensors and processes that deliver information using a unified catalogue, thereby minimizing duplicity of data and infrastructure.

Furthermore the urban platform installation will help the city save energy and reduce pollution thanks to sensors monitoring water levels for irrigation, garbage containers, parking, people flow, energy efficiency in city buildings, civil works, etc. Moreover, the intelligence processes engine will make it possible to provide contingency plans for situations such as heavy snow or urban flooding.



## The solution in context: Urban platform – Barcelona

### **About the smart city vision in the city**

Regarding the concept of Smart City implementation, Barcelona could be considered **as a pioneering city based on a long term transformational vision**. The strategy focuses on guaranteeing citizen living quality, social and urban improvement and trying to add value to the neighbourhoods, encouraging all the potential in sustainable development and green economy. Barcelona's vision encompasses projects of different areas, thanks to technology and innovation, in order to achieve a better management and general knowledge of the city as well as an improvement in the services that the City council provides to the citizens.

The Urban Platform links incredibly well to the overall smart city vision of Barcelona. The scale of the data collection will create big opportunities for **increased efficiency** in various aspects of the city. From efficient garbage collection, to smart street lighting to management of parking spaces and so on.

**Name of City** *Barcelona*

**Country** *Spain*

**No of Inhabitants** *> 500,000*

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): **17**  
Global Cities Index – Bloomberg (2014): **24**  
The Economist – City Competitiveness rankings (2013): **55**

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## Valencia Smart City Platform Valencia, Spain

→ Replication potential



→ Economic impact

N.a.

→ Complexity



→ Environmental impact

N.a.

→ Citizens' involvement



→ Social impact

N.a.

Assessment based on feedback provided by the solution's representative as well as on the available sources analysed by the study team.

### Short description of the integrated solution

The Valencia Smart City Platform (VLCi Platform) is an initiative unveiled by the Valencia City Council in November 2013. It was the logical continuation of an overall strategy, through which the municipality aimed at **improving urban governance** in the fields of **innovation, efficiency and transparency**, in the perspective of **increasing citizen awareness and their participation to the political decisions**.

The initiative is supported by the InnDEA Foundation, which is a body established by the Valencia Town Council with the aim of **supporting and encouraging development in the city by innovation** in its various forms.

The VLCi Platform has been designed to enable the city to manage information on municipal services on the basis of the use of a technological solution developed in partnership with Telefonica I+D, and based on the European Fi-Ware standard.

In a nutshell, the VLCi Platform collects several key indicators related to the city management and urban public services (transport management, air quality, waste collection, public lighting, local police). The platform is designed **to obtain data from a wide variety of sources and devices distributed around the city**, and to process the resulting data in order to generate information for the management, monitoring and governance of the city. Data and information come from two types of sources: field elements (devices, smart smartphones, etc.) and information systems or controls (other platforms and proprietary systems).

Ultimately, the VLCi Platform is deemed to improve transparency towards citizens with respect to public policies; to **increase the efficiency of municipal services** thanks to updated information; to measure public services impacts and allows for the comparison between cities using similar indicators. The VLCi also aims at **improving the governance model; encouraging a greater participation of civil society, organizations and companies in the municipal service provision**.

<b>Starting year</b>	2013
<b>Type of integrated solution</b>	Smart City Platform
<b>Scaling &amp; Replication</b>	Yes
<b>Key actors / stakeholders</b>	Public authorities, industry, University
<b>Budget</b>	€ 4.8 Mln (VAT included, at the rate of 21%)
<b>Number of impacted users</b>	Entire city
<b>Link</b>	<a href="http://inndeavalencia.com/?lang=en">http://inndeavalencia.com/?lang=en</a>



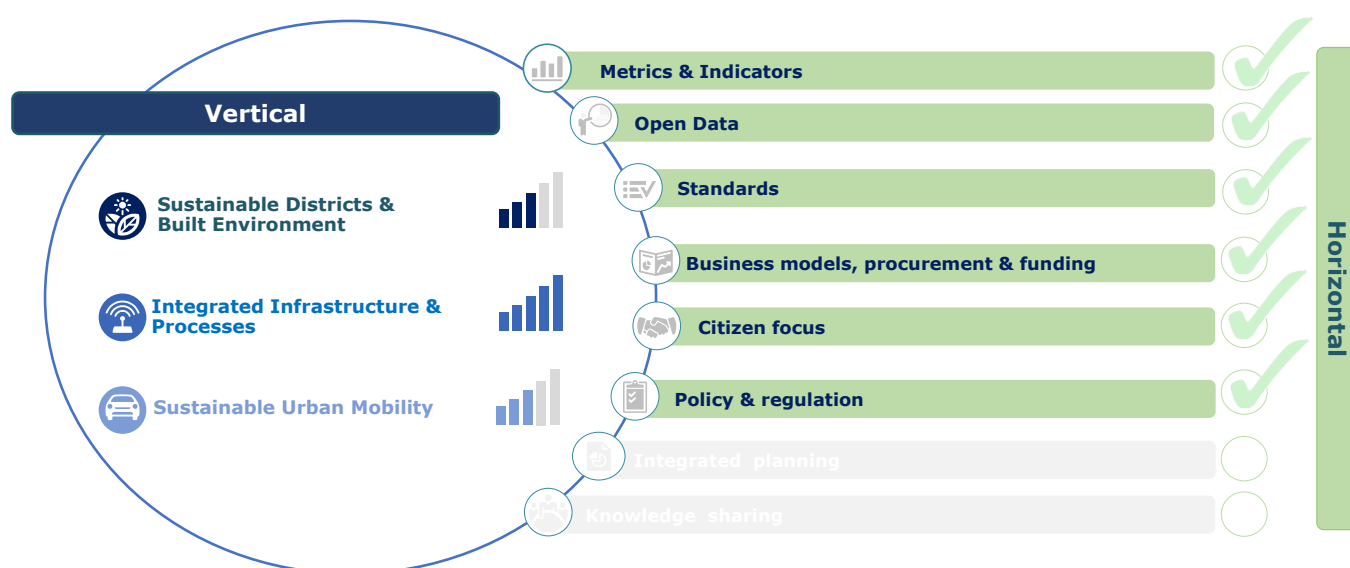
## Level of integration

The level of integration concerns two components: 1) **the Valencia Smart City Platform range of services** and 2) **the adoption of a common standard for data collection and evaluation**.

Concerning the former aspect, the VLCi Platform allows the following features:

- **the integration and management of the information of the various City Council services**, e.g. traffic, street lighting, gardens, local police, pollution, cleaning, waste collection and weather;
- **the elaboration of key indicators related to the public services** (350 indicators, which represent the informative basis of the software and monitor and integrate data on municipal services);
- **the coordination with other administrative management tools**.

Concerning the latter aspect (the use of standard), it is important to stress that in 2013, the Valencia City Council chose to implement the VLCi Platform using the European open standard Fi-Ware. The integrated indicators meet the "ISO37120 Sustainable Development of Communities: Indicators for City Services and Quality of Life" certificate, the first ISO standard on city metrics (Valencia has also achieved a platinum certification of 99 indicators of the World Council on City Data). This allows for an integration of information and the comparison between the performance of Valencia and other cities that would follow the same standard. Additionally, thanks to engaging in an Open Data policy, the platform increases the level of information available to citizens, entrepreneurs, companies and developers, creating opportunities for internet developers and local businesses.



## Business case

The contract to carry out the implementation of the urban platform was awarded through a public open tender. The Information and Communication Technologies service of the Valencia City Council opened a public tender for the development of an integrated City Platform in November 2013. Among seven companies which presented their proposal, the VLCi Platform was assigned to Telefónica, the Spanish incumbent for telecommunication services. Telefónica has designed the first comprehensive smart city management solution.

The assignment is based on a four year contract between Telefónica and the City Council. **The budget of the four year contract amounts to a total of € 4.8 Mln** (including a VAT at the rate of 21%). It is estimated that the contract will generate savings outweighing cost of the services. Therefore, it is expected that on the long-term the project will prove to be financially sustainable.



The project is managed and coordinated by a team composed of experts belonging both to the municipality as well as Telefónica. The Project Manager is appointed by the Information Technologies and Communications Service of the Municipality and is responsible for overseeing the smooth deployment of the solutions included in the project.

## Community & Citizen Focus

Citizen participation and focus represents an important aspect of the urban platform. In fact, among the set of indicators (key categories) which are going to be collected, the citizen's indicators category plays a relevant role. Citizen indicators category is mainly related to the measurement of the perception and citizen satisfaction with city services. The other two main categories are city indicators (Strategic indicators which provide socioeconomic information of the city) and municipal services management indicators (to measure the administrative and operational status of each service activity, along also with the quality of service delivery).

## Impact

The likely impacts of the solution address the following domains:

- **Strengthening the relationships between city government and R&D and innovation agents in the city** (including universities, technological institutes, SMEs, big companies, business associations, entrepreneurs). The solution is in fact deemed to promote innovation and entrepreneurship by facilitating the development of new local business and ideas, and motivating the use of ICT in local trading;
- **Improving the citizens quality of life**, by optimizing the response of basic and social services and providing greater efficiency and quality in the management of urban services;
- **Ensuring more transparency and access to information in the management of public policies**. Major interoperability among all the municipality's services should foster citizen participation, to the extent that improved services may ask for more commitment;
- **Open Data policies could represent the pre-condition to the development of innovative applications**;
- **Facilitating and streamlining the decision-making process** through the circulation of information provided by the platform.



## The solution in context: Smart City – Valencia

### About the smart city vision in the city

Valencia plays an important role in Spain, due to its significant economic activity and strategic position in the Mediterranean corridor. With a GDP of 97,333 Mln Euro and a population of 800,000 inhabitants, Valencia is the third city in Spain as far as economic activity is concerned (Ajuntament de Valencia, 2014).

The **Valencia Smart vision strategy up to 2020** is based on three pillars: 1) **smart growth**: based on knowledge and innovation economy, 2) **sustainable growth**: effective use of resources, greener and more competitive, 3) **Inclusive growth**: high level of employment delivering social and territorial cohesion.



**Name of City** Valencia

**Country** Spain

**No of Inhabitants** > 500,000

**Smart City Rankings** Europeansmartcities3.0 ranking: n.a.  
UN Habitat - City Prosperity Index (2012): n.a.  
Global Cities Index – Bloomberg (2014): n.a.  
The Economist – City Competitiveness rankings (2013): n.a.

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