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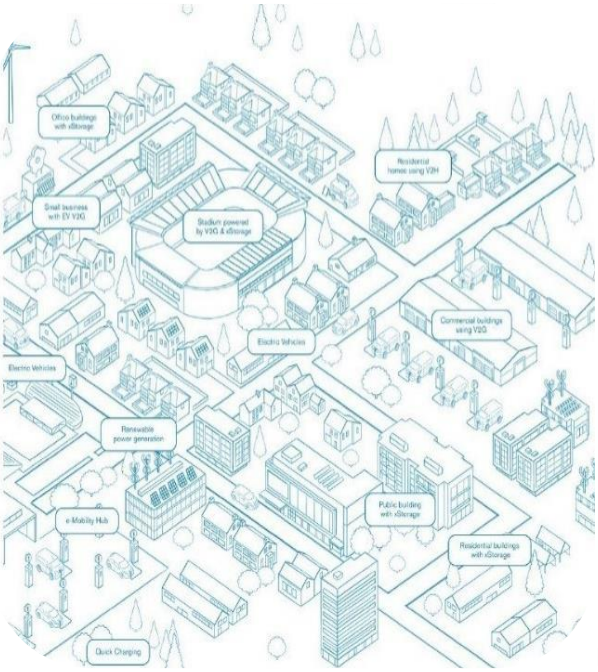
On Smart Cities and Communities

Intelligent Mobility for Energy Transition:

Accelerating towards more sustainable societies

1. EXECUTIVE SUMMARY



The Paris climate conference in December 2015 (COP21) catalysed ambition amongst global leaders and policymakers to take co-ordinated action to address climate change. Europe was arguably at the forefront of that ambition and following the Paris Agreement, the European Commission and Member States set bold frameworks to decarbonise and position the region as a leader in the fight against climate change, especially when it came to clean energy and transportation.

The bold targets Europe set itself were not simply so Europe could be recognised on the world stage as a leader in tackling climate change, it was acting on an imperative. Faced with the challenges of population growth and mass urbanisaiton Europe needed to set the region on a course to a clean energy transition in order to meet those commitments.

No one will dispute the worthiness of achieving a clean energy transition. Getting to the point where most of our energy comes from renewable sources will be nothing short of, in terms of impact and significance a new industrial revolution, and this time a clean industrial revolution.

On top of the environmental gains, the investment in renewable energy will drive job creation and energy efficiency and help bring to market new services and products that can reduce energy costs for end users and empower citizens to manage their energy sustainably.

How to get to this point continues to take up much attention and debate and rightly so. Many frameworks and measures aimed to achieve this have been launched in recent years and encouragingly there is cause to be positive. Compared to 2005, the overall share of renewable production used to meet the energy needs of European citizens has doubled, although this rate of adoption has recently slowed. This loss of momentum could cause several member states and potentially the whole European Union (EU) to miss its 2030 target of at least 32% renewable energy production and, more critically impede the region's clean energy transition.[1]

However, it is the opinion of this paper that the clean energy transition can be accelerated.

It is no surprise a significant blocker to the clean energy transition is that much of industry, especially heavy industry and transportation remains too dependent on fossil fuels. While the political will to change this is not in short supply even the more innovative policy ideas come up against entrenched regulations and frameworks that are not fit for purpose today and hamper the transition.

This paper shows that how with a new way of approaching policy the progress already made can be further exploited to accelerate the transition. The paper gives primary focus to the still untapped full potential of new electrified technologies, what the paper refers to as intelligent mobility technologies which include: electric vehicles, energy storage, smart charging and vehicle-to-grid. It will be illustrated how when fully exploited and complemented by the right supporting frameworks Europe can leap frog its efforts to achieving the clean energy transition.

2. FOREWORD & ENDORSEMENTS

This white paper has been developed by the Intelligent Mobility for Energy Transition (IMET) initiative. This initiative is driven by Nissan Europe and sits within the Sustainable Urban Mobility Action Cluster of the European Innovation Partnership on Smart Cities and Communities established by the European Commission.

The initiative supports the Commission's commitments in the Energy Roadmap 2050 and seeks to build broad support for policy solutions that will help accelerate Europe's clean energy transition.

Andrew Price of Nissan Europe was the primary author of this paper with editorial support from colleague Mary-Jay East. Ana Liesa Sorinas and Diego Carretero Lopez coordinated research and content collection from key contributors with guidance from Anna Domenech, leader of the IMET initiative.

In developing the paper authors have conducted research and interviews with a variety of parties including industry associations, non-governmental organisations, and key energy and transport sector stakeholders.

The arguments and recommendations in the paper therefore represent a cross-industry voice and call to action from a diverse group of stakeholders in Europe.

Particular thanks is given to the key contributors: EURELECTRIC, Innoenergy, European Distribution System Operators (E.DSO), Platform for Electro Mobility, Asociación Española de Fabricantes de Automóviles y Camiones (ANFAC), Smart En, PricewaterhouseCoopers, NHP ESCo, Evectra, NaviParking, GRUPOETRA, The Institute for Energy Diversification and Saving (IDEA), La Asociación de Empresas de Energía Eléctrica (AELEC), and (Asociación Empresarial para el Desarrollo e Impulso del Vehículo Eléctrico) AEDIVE.

Endorsements

Kristian Ruby, Secretary General of Eurelectric

"Europe is on the brink of a decisive decade and our industries, power and automotive, are called upon to deliver on the clean energy transition. We must now ramp up the scale and speed of our cooperation to unlock the untapped potential of the electrification of transport. "Intelligent Mobility for Energy Transition" is an excellent analysis highlighting the nuts and bolts of a system that draws on innovation to enable the clean energy transformation."

Philippe Vangeel, Secretary General of AVERE (The European Association for Electromobility)

"AVERE firmly believes that we must reach the mass uptake of zero emission transport. This report proves once again that we can do so with the full electrification of transport. This roadmap shows how to accelerate the transition in Europe and to decarbonize mobility. It is a must read for all policymakers across Europe for a significant contribution to stop climate change!"

Karen Vancluysen, Secretary General of POLIS

"Cities have a major role to play in the energy transition. By building integrated mobility and energy plans and strategies and leading by example, they can be instrumental in the roll-out of multimodal electric mobility. This White Paper illustrates how the multiplication of the number of electric vehicles (hence movable batteries) and smart charging infrastructure in local authorities can unlock the enormous potential of decentralised local production of clean energy."

Antonio Marqués, Director of Technology and Innovation for GRUPOETRA

"If Europe wants to meet its ambitious environmental targets whilst preserving the quality of life of its citizens and achieving a globally competitive economy, it is mandatory to embed energy transition criteria and technologies within Europe's Intelligent Mobility Systems. Europe needs to build a multimodal mobility system which is based on high quality public transport and complemented by shared, connected mobility modes. And, obviously, all of it must be electric!."

3. BACKGROUND

The purpose of this paper is to illustrate that if the full potential of intelligent mobility technologies is unleashed we can accelerate the transition towards cleaner energy. First, in order to understand all the implications we need to recognise why this transition is necessary and how electrification is already changing what we mean by mobility, extending it beyond how we get from A to B and offering a platform upon which the tipping point to a clean energy transition rests.

COP21: A WATERSHED MOMENT

The Paris climate conference in December 2015 (COP21) marked a pivotal moment for international co-operation on climate change. 195 countries adopted the first-ever universal, legally binding global climate deal: global plan to limit global warming to well below 2°C, whilst pursuing efforts to limit it to 1.5°C.

Against this backdrop the EU was the first major economy to submit its intended contribution to the new agreement laying out two EU Frameworks, the European Framework 2030 and a Climate Neutral Strategy by 2050:[2]

The European Framework 2030: commits to reducing greenhouse gas emissions by at least 40% by 2030 compared to 1990. In addition, it commits to delivering an energy transition ensuring renewable energy represents at least 32% of energy production and targets at least a 32.5% improvement in energy efficiency.[3]

The Climate Neutral Strategy 2050, "A Clean Planet for All": a roadmap to how Europe can lead the way to climate neutrality by investing in realistic technological solutions, empowering citizens, and aligning action in key areas such as industrial policy, finance, or research.[4]

By setting this direction Europe was making a clear statement, namely that the clean energy transition is the holy grail. These critical frameworks were to be complimented by Member States' **National Energy & Climate Plans (NECP)** outlining how govenrments would meet the 2030 targets. Following suit, regions and municipalities across Europe have set out decarbonisation strategies and **Sustainable Urban Mobility Plans (SUMP)** to address climate change.[5]

While COP21 galvanised ambition amongst policymakers and citizens across Europe to decarbonise their communities, now is the time to assess whether all courses of action to deliver these commitments are being taken, and where gaps are identified provoke a co-ordinated and effective policy response.

A DECADE OF DISRUPTION

Undoubtably the world of transportation is in the midst of disruption facing unprecented challenges on multiple fronts. According to the International Transport Forum (ITF) due to population growth and mass urbanisation by 2030 annual traffic is expected to increase by 50% which will lead to an exponential increase in CO2 emissions.[6]

It is also expected that by 2050 4 billion people will live in urban areas which will lead to a significant increase in the demand for mobility. With the current mobility trends and if no policy action is taken the ITF expects that by 2050, CO2 emissions in large cities will increase by up to 26%.[7] This presents a huge challenge for industry and governments.

The need to develop solutions that reduce emissions from our communities while keeping people moving is all too clear and crucially this goes hand in hand with supporting the clean energy transition.

THE CLEAN ENERGY TRANSITION

To achieve the clean energy transition electricity generated from renewable sources needs to become the main "fuel" for societies and even the most energy intensive industries. Here mobility remains both a key challenge and an opportunity.[8]

Against a backdrop in which 70% of Europeans live in cities and generate 75% of EU emissions, cities and municipalities bear a great deal of responsibility for climate change. At the same time they offer a great deal of potential in terms of solutions, operating as test beds and then supporting more rapid adoption.[9] Urban areas can help catapult the clean energy transition by rethinking how mobility and energy policies are developed in the first instance and to do so it is critical to join up urban mobility and energy generation policy development to maximise the decarbonisation benefits.[10]

CLEAN ENERGY TRANSITION

A Clean Energy Transition refers to the move from fossil fuels to renewable sources as the main source of energy. It would reduce energy-related CO2 emissions and contribute to the EU's long-term strategy of achieving carbon neutrality by 2050. (IRENA)

Electric vehicles will be a decisive tool to both decarbonise transport and help achieve this transition. Electric vehicles can replace using petrol or diesel vehicles and their related technologies including recycled or second life batteries for energy storage extend the sustainability offering of this solution. That the battery in an electric vehicle has a life beyond the life of the vehicle presents a great opportunity to rethink how we manage and store energy. Vehicle-to-grid technology also offers a solution that can support more decentralised and renewable energy generation.

GOING BEYOND ELECTRIFICATION: INTELLIGENT MOBILITY

Intelligent Mobility refers to the interaction of electric vehicles, which have increasingly autonomous driving capabilities with the surrounding infrastructure including energy systems. It represents a transformation in the way vehicles are driven, integrated into society and powered.

Electric vehicles play a significant role in moving towards low carbon societies, with electrified vehicles such as plug in hybrid playing an important transitionary role. Additional technologies supporting the transition to low carbon include smart charging, battery storage and vehicle-to-grid.[11] Combined these represent a powerful solution to achieving a clean energy transition and this paper will illustrate why increasing their adoption must be a priority for governments.

TECHNOLOGY EXPLAINER

Electric Battery Storage: Users can store electricity generated from renewable sources in the batteries of an electric vehicle. These batteries can either be in-vehicle, or standalone devices created from recycled or second life or new batteries.

Vehicle-to-grid technology: energy stored inside batteries of electric vehicles can be transferred back out of the vehicle (either to be used or sold back to the grid).

Smart Charging: controlling the power of the charge against network capacity and leveraging renewable energy sources.
(World Economic Forum)

The graphic below provides a visualisation whereby electric vehicles, batteries and energy efficiency technologies are integrated into the wider energy system.

Source: Nissan Europe

4. CLEAN ENERGY TRANSITION: THE OPPORTUNITIES

The environmental gains from increasing the production of renewable energy are well understood but the benefits do not end there. They are spread across economic opportunities arising from more green investment and green jobs, to reduced energy costs for end customers who are empowered to better manage their energy at home through more decentralised systems. This section details the benefits of a clean energy transition, the technologies that will help get us there and highlight the opportunities that arise from making the transition.

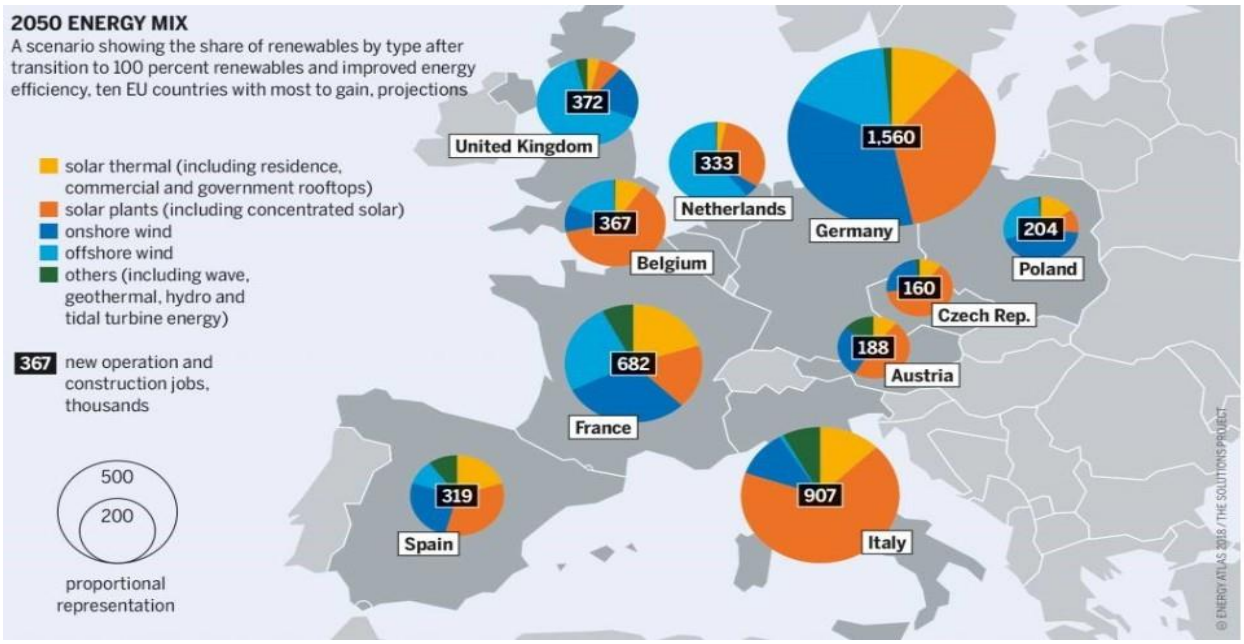
Environmental and Health Benefits

Increasing renewable energy generation coupled with pervasive electrification of transport will significantly reduce greenhouse gas emissions and reduce the use of the earth's natural resources. Ensuring emissions-intensive sectors such as power generation and transport can drastically reduce their emissions will deliver huge benefit to improving the environment and ensuring global commitments are met.

The combined environmental and health benefits are clear, moving towards renewable sources of energy will make cities and communities less polluted and healthier places to live. A report by the European Environment Agency illustrated that most citizens in European cities are exposed to harmful fine particulate matter concentrations. This resulted in an estimated 422,000 premature deaths in 41 European countries in 2015, of which around 391,000 were in the EU 28 Member States.[12] Delivering a clean energy transition must be seen through the lens of a public health priority requiring the concerted effort of authorities, industry and health experts.

Socio-Economic Benefits

A clean energy transition would deliver key economic gains including net job creation, increased affordability of electricity for end-users, and ultimately improve the industrial competitiveness of Europe. According to the European Commission, there are approximately 4 million 'green jobs' in the EU. This total includes around 1.4 million jobs in the energy sector related to renewable technologies and 900,000 jobs related to energy efficiency activities.[13] The accompanying Figure forecasts the 2050 Energy Mix as well as the expected associated job creation per Member State.[14]



Source: Energy Atlas

A study by the European Association of Electrical Contractors (AIE) predicts approximately 200,000 jobs will be created within the electricity sector by 2030 as a result of a shift to electro-mobility. These numbers are expected to increase with further energy and climate action. Considering job creation opportunities alone should be enough to incite governments to act to ensure it is their citizens who benefit from these jobs. As investments in Europe replace imports of fossil fuels, industries will gain competitiveness from the early-mover advantage, thus adapting to the clean energy transition will help protects jobs and job opportunities longer term.[15]

The affordability of energy for end-consumers would also improve due to more energy efficient systems such as smart meters and cost reductions as investments are increased in renewable technologies. Overall energy investment, driven by the end-use sectors, will continue to increase and deliver economies of scale resulting in cost savings for households and businesses. Meanwhile, energy efficiency systems will prompt demand reductions further reducing energy costs. The transition will have a strong beneficial impact on security of energy supply by decreasing costlier net energy imports and increasing the mix of energy sources.

Ultimately Europe's long-term industrial competitiveness will be strengthened by the transformation to a low-carbon economy. The European Commission's "A Clean Planet for All" strategy outlines the necessary economic transformations required which engage all economic sectors to achieve the transition to a climate neutral economy by 2050. The strategy seeks to ensure a common approach across the EU in order to consolidate an open and competitive energy market, avoid relocation risks and loss of competitiveness. This is a welcome strategy that if successful will strengthen Europe's position on the global stage as leading the way to show how a clean energy transition does not need to hamper industrial success but can underpin industrial and economic advancements.

Drivers of the Clean Energy Transition

The global energy market is in a disruptive phase with traditional production based on fossil fuels and renewable energy production being pursued at differing rates and levels of commitment. However, there is a window of maximum opportunity to bolster the clean energy transition and ensure that a fundamental and nonreturnable shift takes place. According to the World Economic Forum, new technologies are ushering in an evolution of the energy and electricity system; from a traditional centralised model to a more decentralised, flexible system leveraging renewable energy generation and storage.[16] Key drivers of the decentralised energy disruption include the decrease in cost and increased marketability of distributed energy generation and storage technologies, as well as the growing demand for electric vehicles. Further, technological advancements such as smart metering and smart grids have enabled interoperability between technologies supporting decentralisation and more effective energy management.

The electricity design proposals included in the "Clean Energy for All Europeans" represent an important step towards positioning consumers as active players in the market, as well as evolving the energy system to decentralisation.[17] In addition, the EU Emissions Trading System has set powerful market signals which have

EU LEGISLATION SUPPORTING THE CLEAN ENERGY TRANSITION

Trans-European Networks for Energy (TEN-E)

The EU is helping to build and fund new energy infrastructure projects all over Europe, as part of its Trans-European Networks for Energy (TEN-E) strategy. The implementation of the TEN-E strategy is expected to bring a €600 billion increase in socio-economic benefits in terms of: avoided generation costs; more competitive wholesale prices, and; growth and jobs.

"Clean Energy for all Europeans"

New electricity market design rules intended to modernise the energy market and empower consumers as active contributors to the clean energy transition. The new rules seek to support the evolution to a less centralised and more digitalised and sustainable energy system which will open up electricity markets to renewables, energy storage and demand response.

fostered commitment from the power sector to invest in clean electricity.[18]

As demand for energy storage technologies increases, an equally critical aspect of Europe's clean energy transition relates to ensuring the sustainable production of and sourcing of batteries and raw materials for these technologies. The Commission's "Strategic Action Plan on Batteries" will strengthen the region's transition by reducing the carbon footprint of battery production while increasing Europe's industrial competitiveness[19].

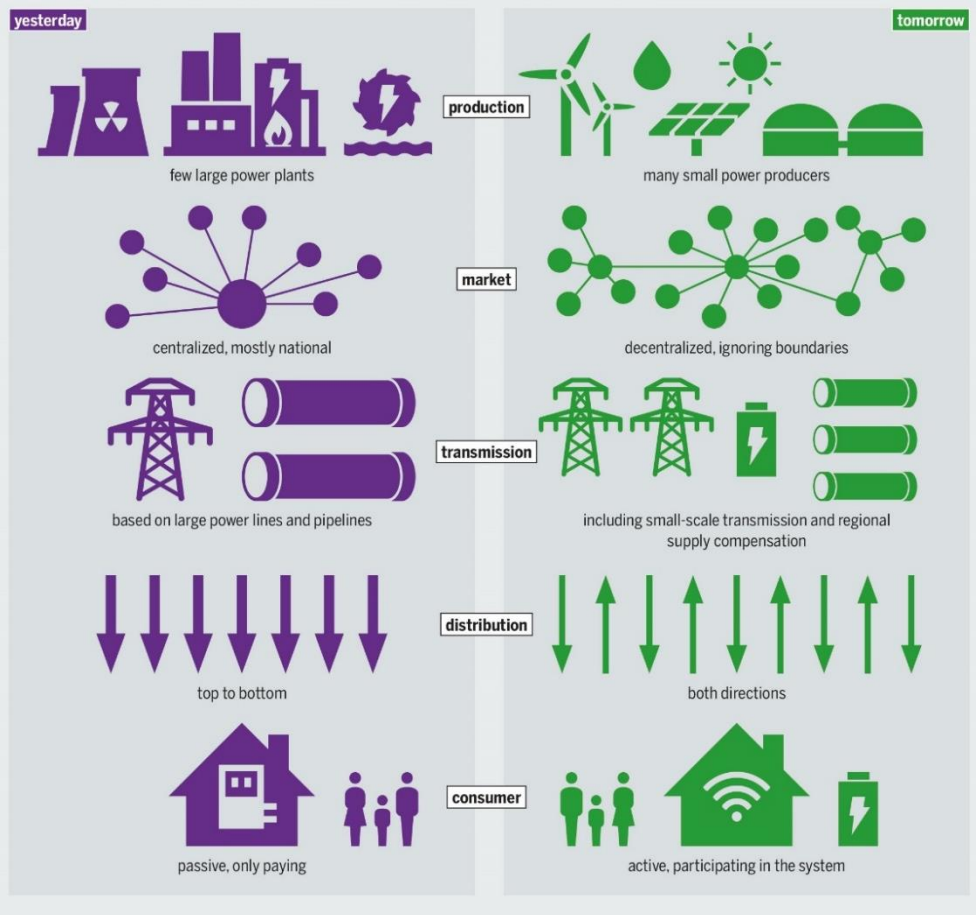
The following section describes the opportunities presented by a decentralised energy system and energy efficiency technologies to support a low carbon transition.

DECENTRALISED ENERGY SYSTEMS

Decentralised energy systems refer to a market that enables energy to be generated or stored by small, grid-connected devices close to where it is deployed using smart grid technologies balancing supply and demand (IEA)

Decentralised Energy Systems

An International Energy Agency report has highlighted how the rise of decentralised and renewable variable power generation combined with trends such as the growing role of electric vehicles, storage and demand response offer opportunities for sustainable local energy solutions.[20] Energy experts attribute a clear link between energy system decentralisation and delivering a clean energy transition. This is down to a more flexible power system leveraging smart grids and demand response enabling a higher share of variable renewables. Included below is an illustration comparing a centralised and decentralised energy system.[21]



Source: Energy Atlas

The influx of decentralised renewable energy sources and smarter distribution systems provide opportunities for new players in energy markets who can accelerate a clean energy transition. Renewable energy companies, Distribution System Operators (DSO) and utility providers are increasingly leveraging these technologies to offer end-users lower electricity prices via solar solutions, smart meters, battery storage or smart home and building energy management.[22] Consequently, end-users are becoming empowered and actively engaged in their energy management and using renewable technologies to reduce their electricity demand from the grid and more emission-intensive energy sources.

The Role of Electro-Mobility

The benefits of more widespread electric vehicle ownership compared to vehicles with internal combustion engines to reduce vehicle emissions are well understood. However, reducing the emissions produced whilst driving will only solve part of the emissions problem: the decarbonisation of energy generation must take place simultaneously. With the right systems, infrastructure and incentives in place an increase in electric vehicle ownership can directly aid the transition towards a new model of a clean, decentralised energy system. Consortium projects like MEISTER are providing very useful demonstrations for policymakers across Europe to both accelerate the adoption of and maximise the benefits from electro-mobility and energy efficiency technologies.

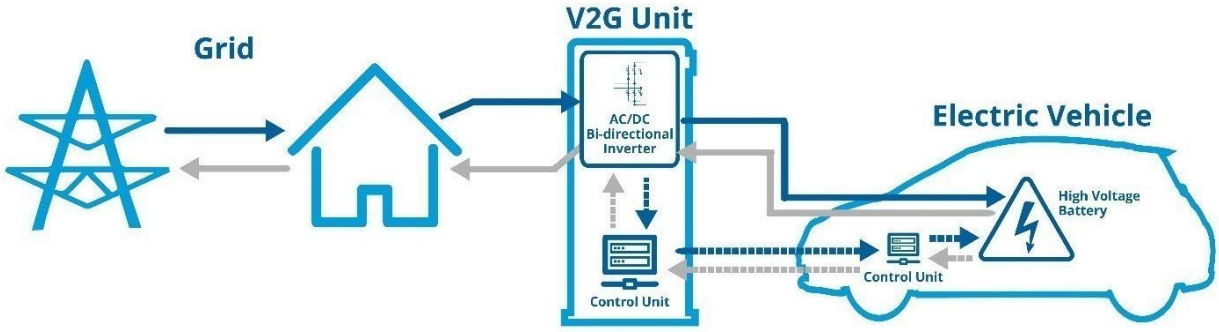
Co-funded by the EU under the Horizon 2020 programme **MEISTER** is a pilot project developed by a consortium of public entities, industry and research centres with experience in electro-mobility, IT systems and renewable energy. The project will deliver a set of tools to foster large scale electro-mobility adoption by:

(1) Demonstrating business models to lower installation and operation costs of charging infrastructure;
(2) Optimising usage of infrastructure by the smart combination of charging and parking services;
(3) Integrating electric vehicles within Sustainable Urban Mobility Plans, and;
(4) Providing interoperable platforms and services to users for convenient and barrier-free charging access.

These solutions will be demonstrated in pilot sites in Malaga, Berlin and Gothenburg.

Renewable energy production is subject to the fluctuations that occur naturally with wind and solar energy. Utilising the batteries in electric vehicles through energy storage or vehicle-to-grid (as pictured below) is a powerful but currently underused solution: store excess energy in the vehicle when supply is high, and use that stored energy when production is low.[23] Using the electric vehicle battery in this way would mean the timing of energy production and energy consumption can be de-coupled. The ability to use batteries in electric vehicles or second life batteries as storage units represents a readily available solution.

Further, these batteries whether new or second life can be connected to solar panels enabling households and businesses to be energy positive: producing more energy than they consume with the ability to charge devices or even an electric vehicle.



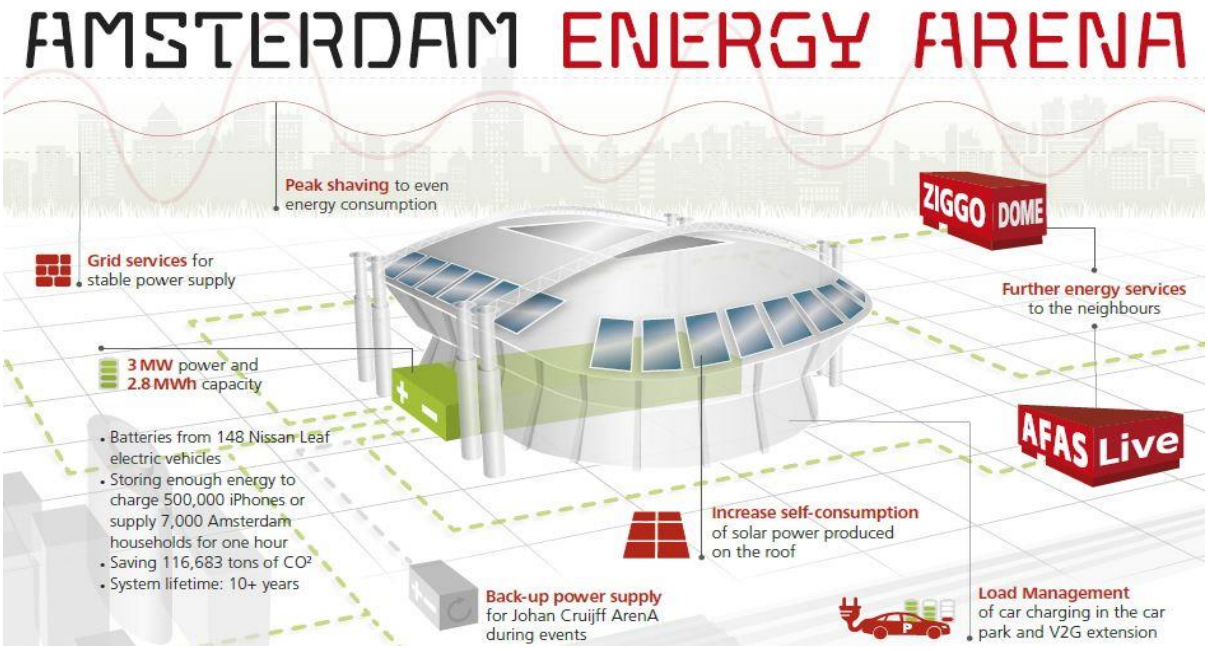
Source: CENEX

Leveraging vehicle-to-grid solutions also supports the localisation of energy production on a micro level as energy stored in electric vehicle batteries is supplied back to the grid. By reducing the distance between generator and consumer in this way, it also means less infrastructure is needed and stress on existing infrastructure is reduced avoiding costly investments from governments. Consequently, the resiliency and efficiency of grids are improved and energy costs can be reduced.[24] For consumers and business, vehicle-to-grid services enable them to near effortlessly generate revenues by selling their excess energy back to the grid.

There is clearly an advantage to getting the right framework in place so that consumers and business can integrate their energy production, energy storage and mobility in this way. Two examples (to the right and below) demonstrate the benefits of this in practice and this paper would argue that incentivising this behaviour on scale will help quicken the pace of the energy transition.

SECOND LIFE BATTERY TECHNOLOGY POWERING ENERGY POSITIVE HOMES IN THE NETHERLANDS

Nissan partnered with For Your Energy Freedom (4YEF) building Positive on the Meter houses that will generate more energy than they consume. Thirty three newly built houses are equipped with a static storage unit in a newly developed area in Voorhout, The Netherlands. The storage units are made from electric vehicle battery modules which store the solar energy produced during the day for use in the evening and night. In addition the housing development promotes car sharing with electric vehicles.



A collaboration between Nissan, Eaton, The Mobility House and the Johan Cruyff ArenA has delivered the largest European energy storage system using second life and new electric vehicle batteries in a commercial building. These batteries are replacing diesel generators and are providing backup power to the stadium and surrounding community.

Source: Nissan Europe

5. BLOCKERS TO A CLEAN ENERGY TRANSITION

Achieving a clean energy transition requires an overhaul of the current energy infrastructure and regulatory frameworks. There are a number of regulatory, social and industrial blockers impeding Europe's long-term strategy of carbon neutrality by 2050. The following section uncovers the shared blockers faced by increasing electro-mobility and achieving the clean energy transition. While recognising progress has been made in some areas there remains a need for greater co-ordinated policy action to overcome the more structural obstacles.

Digital Immaturity of Energy Infrastructure

The European Commission estimates that €200 billion is needed during the current decade until 2030 to deliver the Commission's Trans-European Networks for Energy (TEN-E) strategy in order to upgrade Europe's infrastructure in areas such as transmission grids and smart metering.

Technologies critical to delivering this transition derive maximum benefits from a digitally-underpinned infrastructure allowing real-time communication between devices, distribution service operators and utilities. The current energy infrastructure across Europe is not digitally mature and fails to support these critical requisites. The European Commission estimates that €200 billion is needed until 2030 to deliver the Commission's Trans-European Networks for Energy (TEN-E) strategy in order to upgrade Europe's infrastructure in areas such as transmission grids and smart metering.[25] Taking the European Commission at its own estimate the scale of investment needed is significant and requires long-term commitment. It will be important to ensure the upgrade of infrastructure is spread across Europe and not concentrated in pockets leaving other areas behind.

Shoring up long-term policy vision and building public support

"From a regulatory perspective, the energy sector has witnessed a high level of activity at the European level. Three consecutive packages were adopted aiming to harmonise and liberalise the EU internal energy market. In addition, the climate and energy package set ambitious targets for 2020 in terms of emissions reduction, penetration of renewables and energy efficiency. More recently, the Commission has defined the 2050 roadmap and the 2030 targets as an intermediate step in energy and climate policy to achieve sustainable economic growth. Unfortunately, the objectives pursued by the climate and energy policy of the EU – environmental sustainability, security of supply and competitiveness – are difficult to achieve simultaneously and even more if they are supported by market forces only." - InnoEnergy

At the European, national and city level, ambitious climate and renewable energy objectives, including "A Clean Planet for all," National Energy and Climate Plans and Sustainable Urban Mobility Plans have been agreed. These plans go in the right direction to support a clean energy transition through emissions reduction and renewable energy goals. However, many of these strategies lack clear, concrete milestones which would support planning and benchmarking by industry and governments. Without a clear understanding of interim milestones and supporting measures from governments, industry is less effective at allocating resources to develop and market solutions critical to achieving decarbonisation goals. This makes it challenging for involved stakeholders to plan and allocate investments into renewable energy and energy efficiency technologies with confidence.

A general lack of social awareness regarding how individuals can themselves make a positive contribution to the energy transition needs to addressed to capitalise on the collective efforts of communities and community based action. While several European Social Surveys highlight that addressing climate change is and will remain a key issue for European citizens across the region there is a lack of awareness as to how individuals and organisations can themselves contribute to a clean energy transition.[26] Policies to accelerate a low carbon transition cannot effectively be implemented without public support as the change is reliant on consumers and organisations taking an active role in energy generation, storage and

consumption.[27] Given the multitude of city networks across Europe, there is ample opportunity for cities and communities to leverage existing forums such as EUROCITIES to share expertise on how to best motivate consumers to actively participate in the clean energy transition.

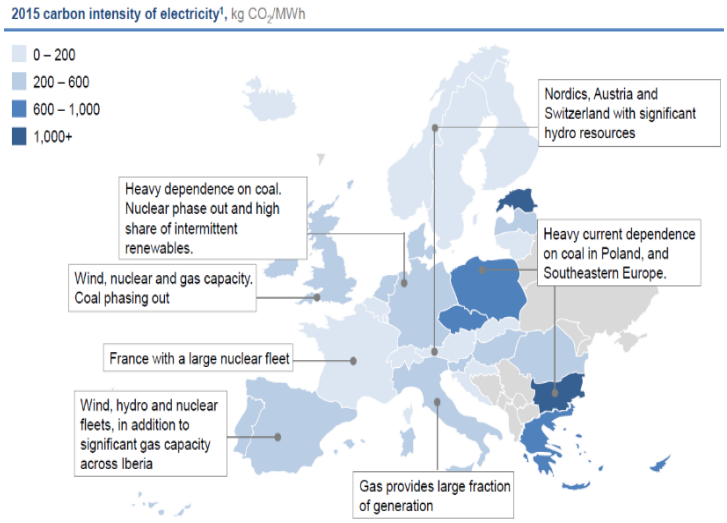
Long-term Investments vs Quick-Returns

To achieve the clean energy transition a key shift needs to take place in the approach to supporting new market entrants, future proofing infrastructure and supporting energy producers to switch to renewables. This can only be delivered if it is supported by clear long-term policy commitments that steer towards the clean energy transition end goal. The current investment climate favors quick-returns whereas the high-cost technologies underpinning a clean energy transition often require longer-term investments to support their extended product development lifecycle and the higher cost of these technologies and required materials.

The interoperability between renewable energy technologies and energy infrastructure will be critical to maximising benefits and at present there is insufficient cooperation between industry and government to ensure that technologies being developed can be easily integrated into future energy infrastructure. By not working collaboratively, authorities and industry risk investing in the development of non-compatible solutions and missing opportunities to share investment costs.

Making that big shift

Traditional sources of power such as coal, oil and nuclear have powered industry for decades. Transitioning towards more renewable sources takes time and investment, as well as requiring significant reskilling of employees. Without assistance from authorities the costs for power companies to make this transition remains extremely high. According to InnoEnergy, while the established, larger energy players are more likely to have the resources to fund this transformation, although this is by no means a given, the smaller and medium sized energy producers will struggle to afford the requisite investments required to transition.



Source: Eurelectric

The accompanying Figure developed by Eurelectric as part of their “Decarbonisation Pathways” study illustrates the current energy generation mix for cities across Europe, highlighting the vast variations between cities and countries as a whole and the level of required production shift.[28]

Identifying the needle in the haystack: unpicking the regulation

It can appear that there are a myriad of regulatory blockers that can cause delays to investment and limit the use of available technology to enable a clean energy transition. Frameworks governing energy vary drastically by country across Europe representing a disharmonised regulatory environment limiting industry’s ability to market innovative technologies and achieve scale. Equally variable can be the level of ambition across Member States to deliver a low carbon transition further complicating a coordinated approach. Whilst it can be expected that states may advance at different stages it is not sustainable to have alternate levels of commitment to the end goal. The leadership and policy direction must be aligned across

Europe and not subject to political trends or electoral cycles. While the new Electricity Market Regulation and Electricity Market Directive seek to address key blockers to a decentalised energy system the directive must still be transposed by Member States' authorities at the national and local level.

In some Member States and localities it is not possible for consumers to become active participants in a decentralised energy system and this should be addressed as a priority. For instance, in Spain and Portugal national regulations prohibit sharing energy back to the electricity grid. This disincentivises new energy market entrants offering efficiency technologies such as smart metering, as well inhibiting a key driver that would otherwise incentivise consumers to assist in the transition. In other countries such as the Netherlands, it is possible to share energy back to the grid but this operation can still result in double network charges for consumers who are essentially taxed twice preventing any economic gains from charging at a low tariff period and discharging back to the grid at peak times. Projects like GrowSmarter are critical in demonstrating to authorities the need for co-ordinated energy and mobility legislate to address these blockers.

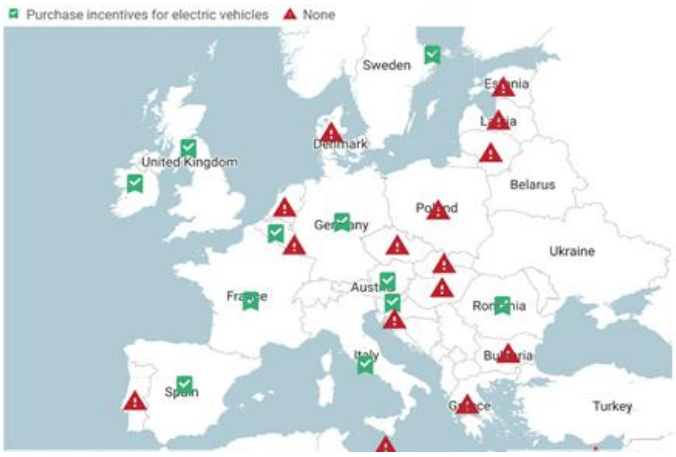
GrowSmarter
Transforming cities for a smart, sustainable Europe

GrowSmarter is a lighthouse project funded by Horizon 2020 in which Barcelona, Stockholm and Cologne demonstrate 12 smart city solutions in energy, infrastructure and transport. In Barcelona, the project involves setting up a network of charging terminals for electric vehicles at the headquarters of Nissan Iberia. It also integrates photovoltaic panels, second life electric vehicle batteries, two vehicle-to-grid chargers, combined with an e-carsharing service for employees to demonstrate the positive impact of these technologies on the urban environment. These projects are meant to make the clear case to regulators and authorites to make legislative changes to the energy market.

Similarly, regulations limit service aggregators and DSO operators from participating in the wholesale energy and ancillary services markets. DSO operators have a critical role in supporting a clean energy transition as they can enable new services and empower established and emerging parties and consumers to play an active role in the energy system. For example by rolling-out smart meters and by integrating prosumers' electricity into the grid.[29] Meanwhile, aggregators provide various grid services such as frequency regulation, operating reserve capacity and more by optimising and allocating the portfolio of distributed energy resources.[30] Presently these market participants are restricted by fees, administrative and contractual hurdles limiting their ability to offer critical ancillary services such as grid balancing and the pooling of large numbers of small loads such as those supplied by vehicle-to-grid services via aggregators.

Increasing our electric vehicle car park

While electric vehicle adoption has increased it still represents a small fraction of the total fleet in Europe – only 2.5% in 2018.[31] Promoting electric vehicle uptake will significantly aid efforts to drive the clean energy transition as it will increase the availability and access of energy storage and vehicle-to-grid technologies, which can be powered by renewable energy, to a greater number of consumers. Currently uptake of electric vehicles is hampered by consumer uncertainty over whether choosing an electrified vehicle will be the best choice economically. Until price parity between electric vehicles and their diesel and petrol equivalents is reached it is vital that incentive programmes are multi-annual and not cancelled when there are changes in political leadership.

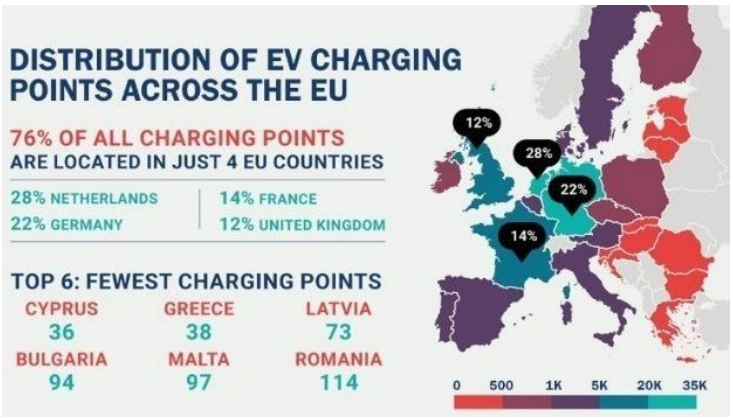


Source: ACEA

In 2018 a decrease in the sale of electric and plug-in-hybrid vehicles in the UK was attributed to a significant reduction in the consumer purchase incentive.[32] Inconsistent application or start and stop incentive programmes damages consumer confidence and creates uncertainty, in this way it undermines efforts in the clean energy transition.

Unsurprisingly the inconsistent support across Member States has created a very uneven demand for electric vehicles. The above accompanying Figure developed by the European Automobile Manufacturers' Association (ACEA) demonstrates the variation in purchase incentive support for electric vehicles between Member States. The ACEA study also highlights the direct positive impact financial incentives have on increased electric vehicle purchase.[33]

However, focusing on incentives alone is not enough and investing in charging infrastructure remains pivotal. Currently there is a patchwork of infrastructure across Europe, as shown by the below Figure. This is due to the lack of EU-wide minimal, concrete, binding and enforceable deployment targets which has stymied investment into charging stations by private and public entities.[34] While critical to fostering demand for electric vehicles since its development in 2014, the Directive on Alternative Fuels Infrastructure did not establish a common protocol, open standards and transparent fees for infrastructure.[35]



Source: ACEA

Excessive bureaucracy surrounding the installation of charging points must be overhauled. Electro-mobility engineering consultancy, EVECTRA, have highlighted that before launching a single charging point in Spain time-consuming procedures to get a permit must be completed with the respective entities and public administrations which include a swathe of actors: the Local Municipality, DSOs, the Ministry of Roads, the Ministry of Industry and the respective Energy Retailer. Such overcomplicated processes disincentivises installation. This issue exists across Europe and has been largely attributed to the lack of technical expertise on charging infrastructure by authorities coupled with the current bureaucracy associated with numerous bodies needing to review and approve each charging point application.

Consumers can face excessive hurdles when it comes to charging their vehicle. They can be required to register with multiple operators, often in turn requiring differing and non-interoperable technology (RFID cards, apps, keys, etc). The UK has published plans to make sure all new chargers take credit card payment by Spring 2020 to help address this and this action should be mirrored across Europe.

6. RECOMMENDATIONS

As outlined the opportunities and potential from the clean energy transition are vast, it has been demonstrated how intelligent mobility technologies particularly electric vehicles, battery storage and vehicle-to-grid can aid efforts in achieving this transition but there remains shared obstacles to overcome. This paper calls on authorities to urgently consider the following recommendations.

1. COMBINE POLICY POWER – PROPERLY INTEGRATE ENERGY AND MOBILITY FRAMEWORKS

As shown, supporting electro-mobility will bolster efforts to achieve a clean energy transition. Policy making between mobility and energy must no longer be dealt with separately or in isolation. Specifically, an integrated policy approach would seek to maximise the synergies between:

- Energy storage and energy efficiency technologies such as vehicle-to-grid services which support grid stabilisation and self-consumption;
- Energy infrastructure and smart electric vehicle charging infrastructure;

At present, there are two directives under discussion at the EU level which can expedite the role of renewable energy technologies and electro-mobility in supporting a clean energy transition:

⇨ Fast-track the transposition of the *"Clean Energy for All Europeans" Electricity Directive* at national and local levels to efficiently deliver a harmonised, decentralised energy system. To ensure these rules align to the nuances of each market and technological developments, authorities must routinely engage industry to address key technical blockers limiting the benefits of these technologies and guarantee infrastructure interoperability. A more agile approach by energy ministries and authorities is critical to leveraging emerging technologies which will accelerate Europe's clean energy transition.

⇨ Prioritise the update and ratification of the "*Alternative Fuels Infrastructure Directive".* It must ensure legislative instruments governing the installation and maintenance of infrastructure are based on clear, binding and enforceable targets which make a distinction between the requirements of urban and rural areas. Further, clear guidance should be in place related to minimum EU-wide deployment targets with a common protocol, open standards and transparent fees.

2. PROMOTE DECENTRALISED ENERGY STORAGE AND DISTRIBUTION

Provide an incentive structure that encourages decentralised energy generation, storage and consumption. Remove barriers including legislative, taxation and regulatory that prevent the economic case for consumers to adopt innovative solutions and sustainable energy practices such as vehicle-to-grid services.

Specific ways in which renewable energy technologies can be incentivised for consumers, business, utility companies and commercial developers include:

- Purchase subsidies aligned with the positive environmental potential of the technology (smart meters, vehicle-to-grid systems, solar panels, energy storage systems) for sales, installation, maintenance and repair.
- Tax incentives. Fixed tax deduction in alignment with environmental impact; variable tax incentives based on amount of energy sent back to grid;
- For commercial developers, building codes should mandate or incentivise the installation of renewable and energy efficiency technologies as well as smart charging points in new commercial buildings.
- Use public authority buildings as demonstrations of how smart technology can be used to drive down electricity costs and decentralise energy usage.

These actions must be supported by wider efforts to create a competitive and sustainable battery manufacturing industry in Europe. This will help ensure green investment and green jobs are located in

Europe and will complement European policy ambitions on the circular economy by favouring second life battery usage over imports of new batteries from outside Europe.

3. FACILITATE 100 PER CENT ELECTRO-MOBILITY

Whilst consumer demand for electric vehicles has increased over time, it is clear that the greater the rate of uptake, the faster the transition can be fully realised. In order to achieve this, public authorities should seek to utilise both financial and non-financial incentives to drive change:

- Target mid-range electric vehicle models for financial incentives to drive uptake in mass-market segments.
- Tax-based incentives applied both to electric vehicle purchase and charging infrastructure development have the benefit of helping alter consumer behaviour without being dependent on available public funds. Strong consideration should be given to introducing fiscally-neutral “Bonus Malus” schemes by which buyers of electric or low emission vehicles receive an attractive rebate (bonus) which is paid for by taxes (malus) levied on the purchase of gasoline and diesel cars with CO2 emission values exceeding a set limit.
- Utilise low emissions zones within urban areas to drive behaviour change. In particular, public authorities should make very clear the exclusion of electric vehicles from any financial costs of entering such areas, thereby putting electric vehicle ownership as a clear advantage to those in such areas.
- To lead by example public authorities should drive change in their workforce and increase the amount of electrified vehicles in public fleets including buses and taxis.

4. SMART CHARGING ARCHITECTURE

Prioritise smart charging architecture across Europe. By mandating the installation of smart charging, the impact of electric vehicles on the electricity system will be reduced and better managed while the use of clean, renewable electricity can be maximised. To accomplish this, Member States and municipalities must:

- Provide support and simplify procedures for smart charging installation and keep the pace on installing charging infrastructure.
- Promote the interoperability between charging networks to enable chargers to be controlled by approved third parties (such as DSOs and aggregators) that can gather data that is used to support smart energy management.
- Develop robust cyber security standards to mitigate the risk that smart charging presents to the stability of the grid, in addition to protecting individual consumers. As electric vehicle uptake and smart charging increases, the risks will evolve in parallel.
- Existing standards must be extended to cover vehicle integration with smart grid and home energy management systems.

5. SUPPORT SCALING-UP – ENSURE GOOD IDEAS DO NOT GET STUCK IN PILOT-PHASE

Costs associated with the research and development and subsequent marketing of new renewable energy and energy efficiency technologies represent significant, long-term investments for industry. In order to effectively scale the benefits of these technologies across the region it will be increasingly critical for government and authorities to provide public support to help commercialise mass market solutions that will assist the clean energy transition by:

- Increasing investment in private-public sector collaboration on renewable energy R&D;
- Allocating funding for innovative start-ups developing renewable energy or energy efficiency technologies;
- Developing a public funding mechanism providing financial support levels for Member States to align with their current energy source mix and levels of capital to fund their production evolution.

Funding should also be allocated for pilot projects to bridge the gap between demonstrators and mass market uptake. Testing renewable energy generation, energy efficiency technologies and energy infrastructure is critical to refine interoperability and assess impacts. Further, by partnering with

businesses public authorities have the ability to clearly demonstrate to consumers the capabilities and benefits of electro-mobility and energy efficiency technologies. Supporting the commercialisation of innovative solutions by creating effective links between demand side innovation policies and supply-side policy tools such as public funding schemes will be critical.

6. ENCOURAGE CONSUMERS TO BECOME ACTIVE PARTICIPANTS

So much of the clean energy transition relies on changes to consumer behaviour: where they get their energy from, how they store it, what vehicles they drive, and their relationship with energy providers. It is the joint responsibility of industry and government to ensure consumers are well informed about the energy and mobility choices they make. Empowering consumers in this way will help accelerate the clean energy transition through more collective efforts.

Communication campaigns and initiatives should focus on:

- *Illustrating the role of a decentralised energy system and how consumers can play a part in it.*
- *Explaining the financial benefits available through integrating electric vehicle ownership with home energy usage*. In particular, the total cost of ownership and maintenance of owning an electric vehicle over a vehicle powered by diesel or petrol and how combined with solar panels and home energy storage there is the potential to lower energy bills and achieve energy positive housing.
- *Celebrate success across borders*: encourage cross-border initiatives to promote successful projects. Several cities and communities have launched successful initiatives as part of their Sustainable Urban Mobility Plans to raise awareness and motivate consumers into becoming active energy system participants. Sharing, replicating and encouraging further ambition on these successes via city networks and regional forums can be an incredibly effective way to catalyse and sustain momentum across borders.

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