PLEEC
PLANNING FOR ENERGY EFFICIENT CITIES

Deliverable 4.4

Summary report on urban energy planning: Potentials and barriers in six cities

3 November 2015

Authors
UCPH: Christian Fertner*, Juliane Große, Niels Boje Groth
TU Delft: Evert J. Meijers, Arie Romein, Ana Maria Fernandez Maldonado, Roberto Rocco, Stephen Read

* Contact: chfe@ign.ku.dk

SEVENTH FRAMEWORK PROGRAMME

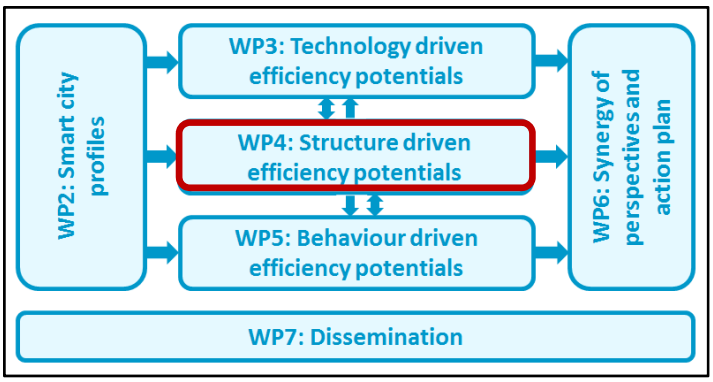
This project is financed by the European Union

www.pleecproject.eu

Abstract

Main aim of report

This is the final report (Deliverable 4.4) of PLEEC's work package 4, dealing with urban / spatial planning and energy. It focuses on the (potential) application of measures and policies in urban planning to improve the energy performance of cities. Summaries and recommendations for each of the six PLEEC cities are given.



WP4 location in PLEEC project

Target group

The main addressees are the PLEEC partner cities, Eskilstuna (SE), Jyväskylä (FI), Santiago de Compostela (ES), Stoke-on-Trent (UK), Tartu (EE) and Turku (FI). However, concepts and ideas discussed here are also relevant for many other cities and this is also emphasized in the report. The Deliverable is therefor also a direct input to Deliverable 6.1, which will provide a general model for the Energy-Smart City. The report can also be used as a more general reference for planning practitioners, researchers and the interested public.

Main findings/conclusions

Based on the case study (Deliverables 4.2) as well as the thematic (Deliverable 4.3) work, a list of 29 spatial planning measures and policies was elaborated. The measures can increase energy efficiency, reduce energy use or increasing the share of renewable energy in a city. The table shows the four sectors, as used in the Thematic Report, and nine related goals.

Sector	Goal
Buildings and the built environment	A. Optimize energy distribution on district level
	B. Climate-oriented urban design
Transportation	C. Reduce travel needs
	D. Promote 'green' transport
Industrial	E. Enable industrial symbiosis by spatial clustering of industrial activities
	F. Improve opportunities for co-generation and linkages to district energy systems
Energy generation	G. Optimise energy distribution systems
	H. Designate areas for renewable energy production
	I. Enable small-scale (households) renewable energy generation

9 goals of spatial planning measures to influence energy use

For each of those goals one or more measures where defined (see section 2.2 in this report). In the main part of this report we analyse the application of these measures in each city and suggest which areas the cities' could work further on.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

In the final section of this report we draw some general conclusions based on WP4 work. We state four general questions (and some remarks to it) which cities should take into consideration when working on their Energy Efficiency Action Plans:

(1) How can spatial planning reduce energy use in our cities? A list with 29 measures.
(2) How do different geographical, regional, cultural or political contexts influence options? The baseline for actions.
(3) How can we measure and monitor its effects? Indicators and rebound effects.
(4) What is the scope of municipal action? Drawing system boundaries.

Four questions to consider for your EEAP

Activities carried out including methodology used

The report is based on material previously elaborated in WP4, including the six case reports (D4.2) and the Thematic Report (D4.3). The report is structured by one chapter for each of the six cities. Each chapter is structured by the general list of measures and tools which was a result of the Thematic Report. In several iterations the list was refined and cities where asked to fill-in information on each measure – is it used in the city? How? With which spatial focus and which time perspective etc.? This list provides a framework to discuss potential energy efficiency measures in each city. Sections 3-9 summarize the findings from each city.

The PLEEC project

Energy efficiency is high on the European agenda. One of the goals of the European Union's 20-20-20 plan is to improve energy efficiency by 20% in 2020. However, holistic knowledge about energy efficiency potentials in cities is far from complete. Currently, a variety of individual strategies and approaches by different stakeholders tackling separate key aspects hinders strategic energy efficiency planning.

For this reason, the PLEEC project – "Planning for Energy Efficient Cities" – funded by the EU Seventh Framework Programme uses an integrative approach to achieve the sustainable, energy–efficient, smart city. By coordinating strategies and combining best practices, PLEEC will develop a general model for energy efficiency and sustainable city planning. By connecting scientific excellence and innovative enterprises in the energy sector with ambitious and well-organized cities, the project aims to reduce energy use in Europe in the near future and will therefore be an important tool contributing to the EU's 20-20-20 targets.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Table of Content

1 Setting energy efficient cities in context

The PLEEC project is about what cities can do to increase energy efficiency, decrease CO2 emissions and increase renewable energy use in their territories. This report presents 29 measures in spatial planning (the focus of Work Package 4) which can contribute to that. However, every measure can only work when it relates to the context – the same applies for learning from each other. Just as important as it is to get to know good practices, it is to get to know the local/regional context and conditions which those practices are functioning in – and the context which is framing its possibilities for transfer and implementation other places.

We will therefore in this first part of the report illustrate broad differences and similarities of the urban structure of the six case cities. However, there are other context features which are not presented here, as e.g. legal system or cultural differences and behavioural preferences.

1.1 Settlement structure and commuting

Figure 1 shows urban areas in Europe and the location of the six cities. Already from this map we can easily see the different regional positions. Santiago or Tartu are rather small and far away from big cities, while Eskilstuna is close to Stockholm and Stoke-on-Trent in the middle of the North-western English metropolitan areas of Liverpool, Manchester and Birmingham. This structure is decisive for e.g. transport and commuting.

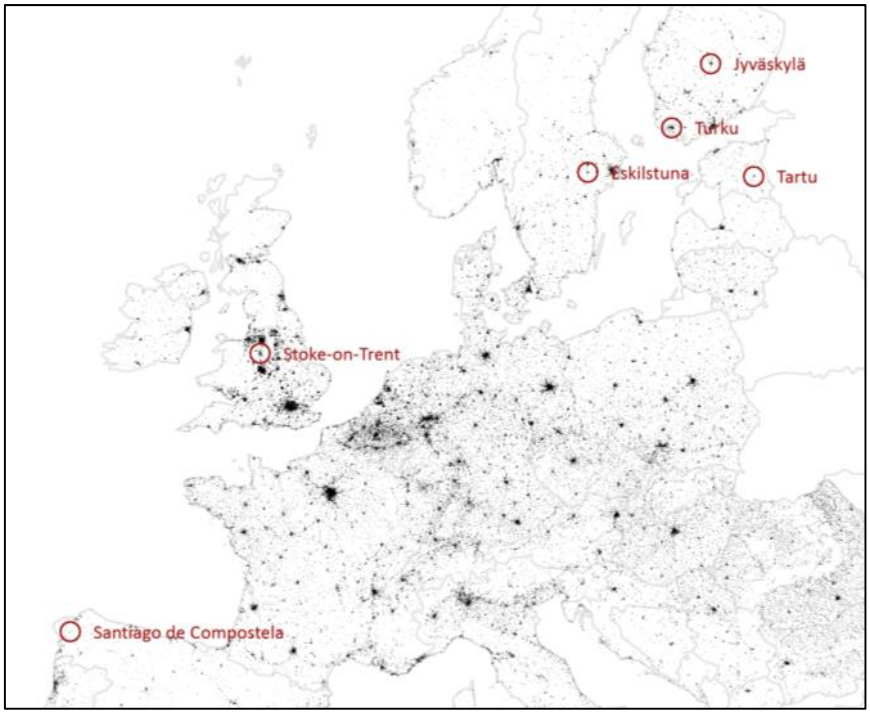


Figure 1: Urban areas in Europe in 2006 and location of the 6 PLEEC partner cities

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

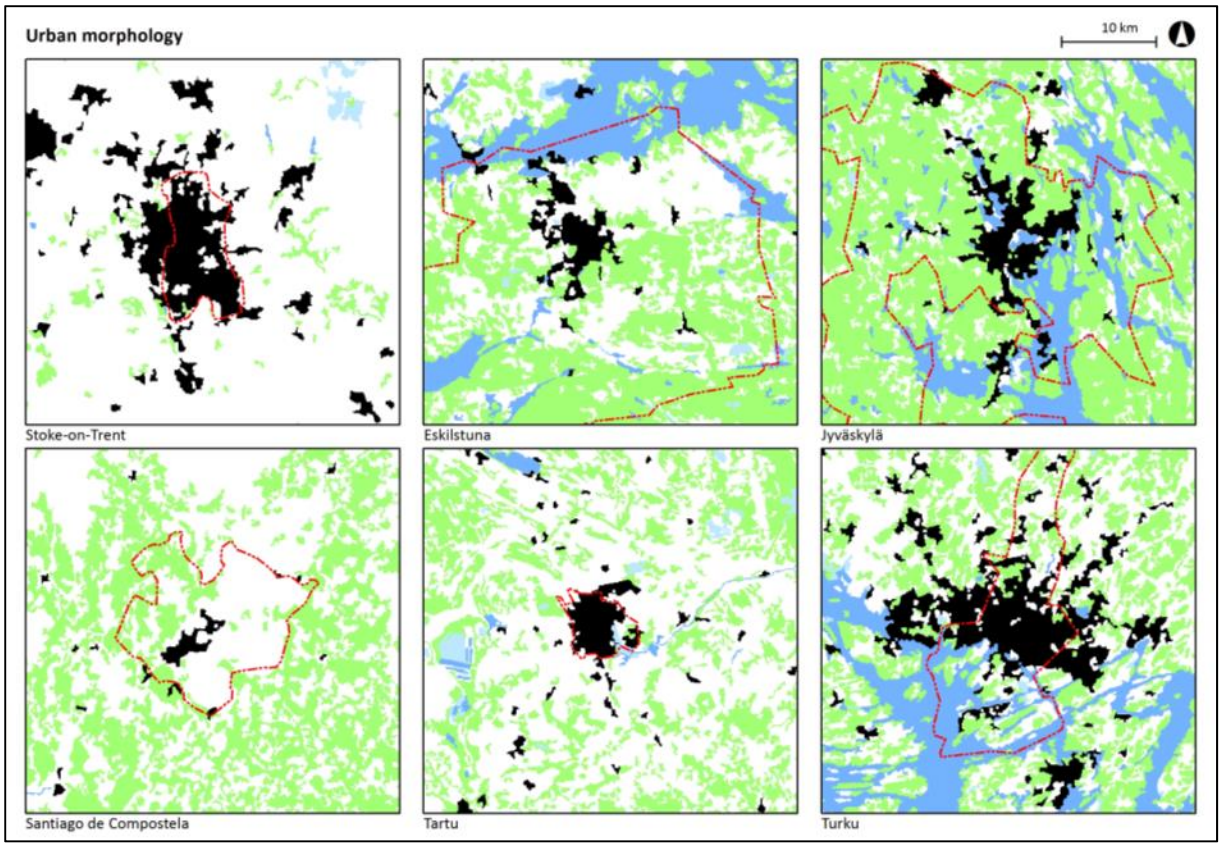


Figure 2: Land use in the 6 PLEEC partner cities (black = built-up; green = forests; white = open space; blue = water; red dotted line = municipal boundary). Data source: (EEA, 2014)

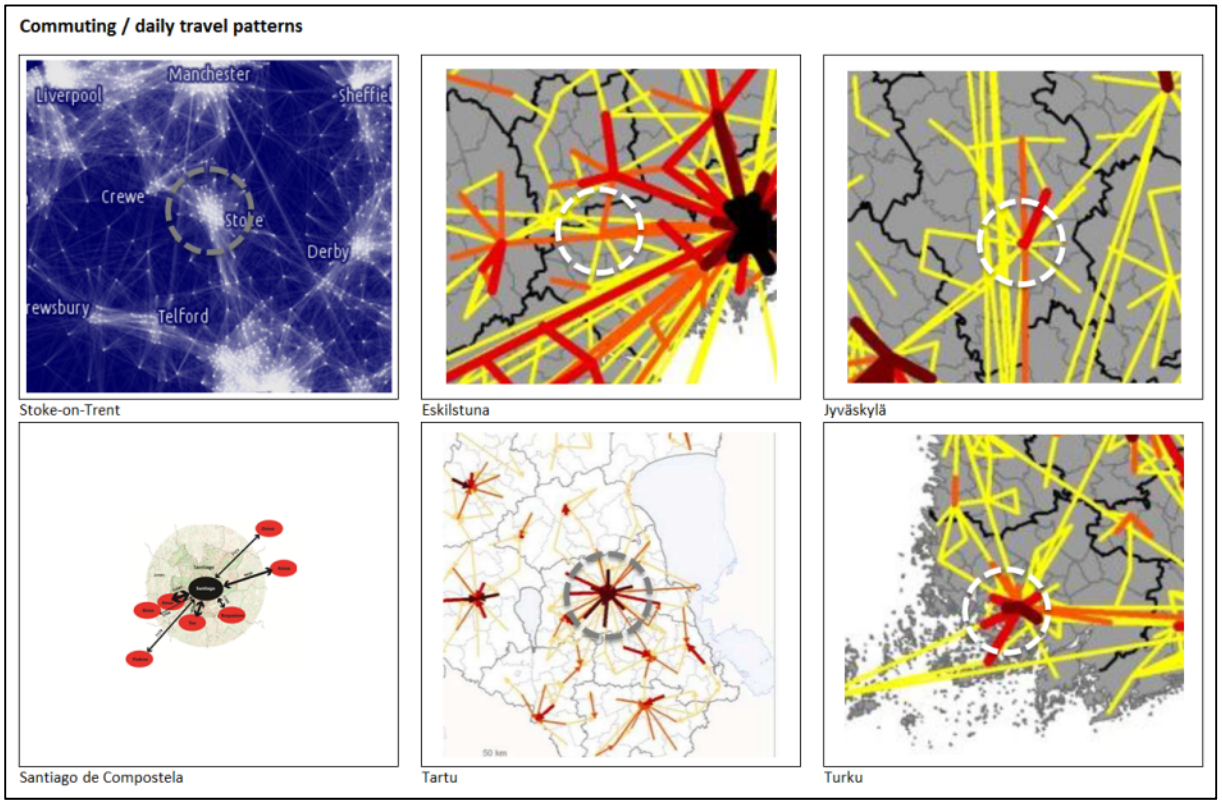


Figure 3: Commuting patterns around the six cities. Data sources: Stoke-on-Trent (Rae, 2014); Eskilstuna, Jyväskylä and Turku (Roto, 2012); Tartu (Novak, Ahas, Aasa, & Silm, 2013); Santiago: Current Transport Plan (Fernandez Maldonado, 2015)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

The urban morphology of the six cities is also very different (Figure 2). In Turku and Stoke-on-Trent the continuous built-up area considerably exceeds the municipal boundaries. Besides that the urban areas has a different extent – not least because of different population numbers – some cities are more compact while others are more fragmented. However, one cannot make a direct reference from the regional urban morphology to the travel patterns in the region, as there are other factors as e.g. infrastructure and the location of work places which play a role. Functional relations can therefore be very different even if morphological structures are similar.

One of the major transport flows in a city is commuting. There was no joint data available to illustrate commuting patterns in the six cities. However, previous studies illustrate general commuting and daily travel patterns in the case cities (Figure 3). The figure shows that especially Eskilstuna and Stoke-on-Trent are part of a bigger commuting region, illustrating the phenomenon of 'regional enlargement'. Regional enlargement occurs especially when regional accessibility improves or when the concentration of jobs[1] in e.g. bigger urban regions makes commuting necessary. The local labour market gets less important while commuting distances increase.

Other flows related to other activities then working (shopping, education, recreation but also goods transport) or flows which are less regular but potentially use high amounts of energy (e.g. long distance travel) would be relevant to look at in an energy perspective, but no comparable data was available. Figure 4 illustrates the modal split for passenger and freight transport in the five PLEEC countries. While the car is the dominant mode of passenger transport in all countries in terms of km-travelled, freight transport modes are more diverse. In Estonia almost half of all freight (measured in tonnes-km-travelled). On the other hand in Spain and the UK the share of rail freight transport is much lower. In the case of Estonia and Sweden the resource extraction industry might play a big role.

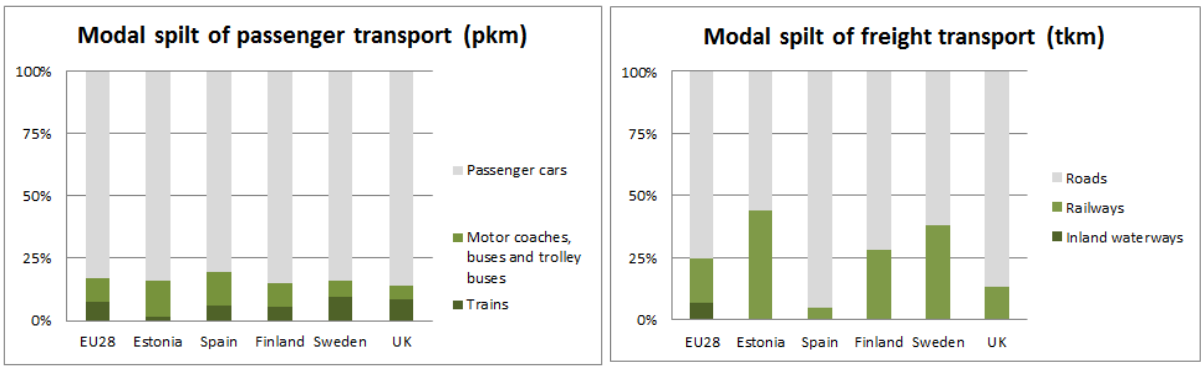


Figure 4: Modal split in passenger and freight transport in EU28 and PLEEC countries in 2013 (Source: Eurostat)

[1] This does not necessarily mean a concentration in the centre of the urban region (e.g. the CBD), but a concentration of jobs in metropolitan areas in general opposite to non-metropolitan areas. Within metropolitan areas a polycentric pattern of jobs can occur (see also Grunfelder, Nielsen, & Groth, 2015).

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

1.2 Population development and energy consumption

Looking at population development and distribution helps us to understand the urban form and the driving forces of energy consumption. All the six case cities are growing in population. In Tartu, where the municipality is stagnating, the urban region is growing, at least until recently. Figure 5 shows population development in the case city (= municipality) and in the wider region[2].

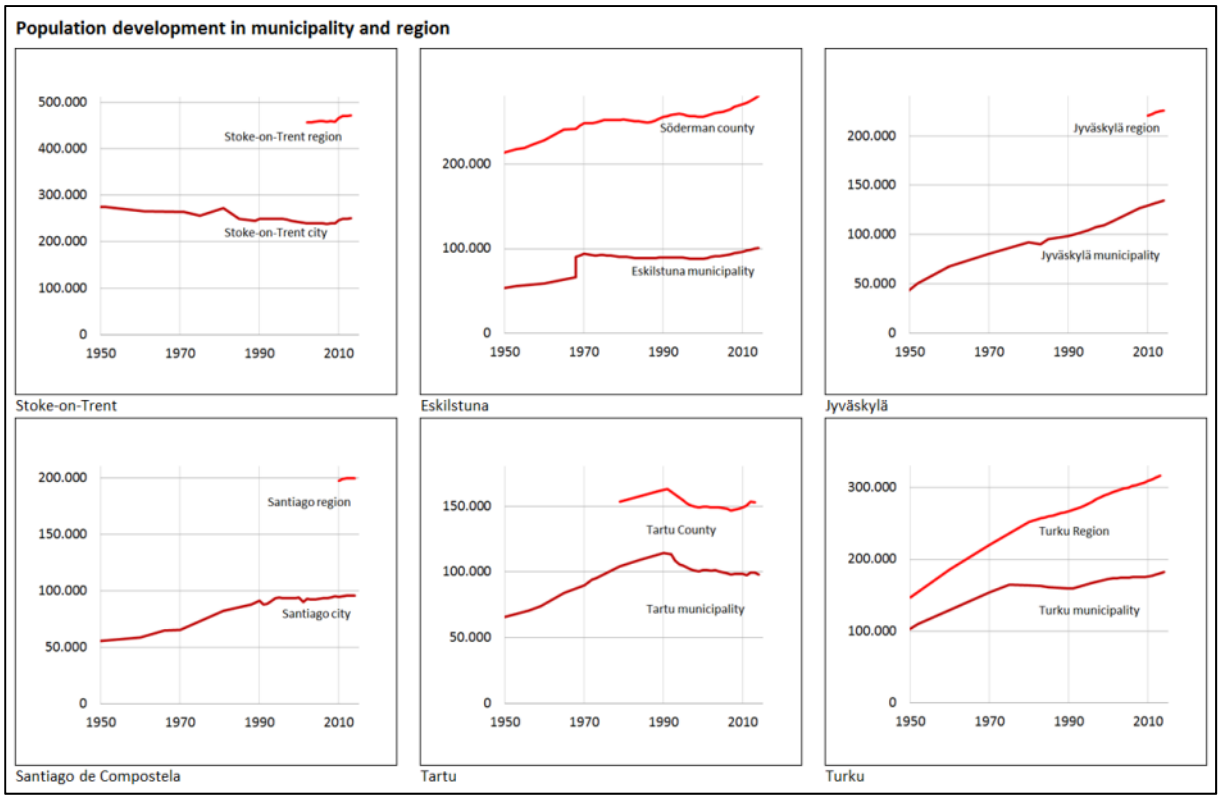


Figure 5: Population development in the municipality and the region since 1950. Data sources: Eurostat, Urban Audit and http://www.populstat.info

The population of the cities is the main driving force for energy consumption. Still, energy consumption per capita is typically lower in cities than in the country side (see Table 1), mainly because of lower energy use for transport and heating and a more efficient use of infrastructure.

Table 1: Final energy consumption per capita, in MWh

Municipality	in city	National average
Eskilstuna	26.5	39.4
Jyväskylä	28.0	54.1
Santiago	9.7*	20.7
Stoke	16.4	24.4
Tartu	13.0	25.3
Turku	35.3	54.1

Data sources: Cities: (Giffinger, Hemis, Weninger, & Haindlmaier, 2014a); Countries: Eurostat 2012
* Excluding transport (National energy consumption per capita in Spain excluding transport is 12.4 MWh)

[2] We used Eurostat Urban Audit's 'Large Urban Zone' as regional defintion. For Eskilstuna, which is not covered by such a definition, Söderman county (NUTS3 region) was used.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

In terms of heating, many cities in Northern Europe have constructed district heating networks, covering large parts of the heating needs of its inhabitants. However, as we can see in Table 2, the use of district heating is not only question related to climate, but also to specific policy decisions. In Scandinavian and Eastern European countries, district heating was actively supported since several decades, while for example in the UK district heating, despite a cold climate, plays no role (yet).

Table 2: Citizens served by district heating, 2013

Municipality	in city	National average
Eskilstuna	65 %	52 %
Jyväskylä	67 %	50 %
Santiago	-	-
Stoke	-	2 %
Tartu	89 %	62 %
Turku	90 %	50 %

Data sources: Cities: (Giffinger et al., 2014a); Countries: Euroheat & Power 2015

1.3 Role of municipalities and planning

As already shown in the previous sections, the municipal boundaries of the six cities cover very different territories regarding the regional urban form. Some municipalities cover the main city and its closer hinterland (Eskilstuna, partially Jyväskylä), others are strictly confined to the central build-up area (Tartu, Santiago) and some have even the continuous built-up area shared between several local administrations (Stoke-on-Trent, Turku).

Table 3: Administrative sub-divisions in PLEEC countries

Country	Main second-tier authority	Local government
Sweden	21 counties	290 Kommuner
Finland	19 regions	320 Kunnat / Kommuner
Spain	17 autonomous communities	8111 Municipios
UK	England, Wales, Scotland, N-Ireland	England: 326 Districts or unitary authorities
Estonia	15 Counties	227 Vald, linn

Many energy issues cross therefore (local) administrative boundaries, especially in urban areas. Table 3 shows the main administrative levels, besides the national level, in the countries of the PLEEC cities. However, planning competences are differently distributed in these countries. In Sweden, Finland and Estonia the municipalities are rather strong, while in Spain the regions (autonomous communities) have core competences in planning in regards to energy. In the UK there is no real regional level in planning; the main second tier in the case of Stoke-on-Trent is England.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

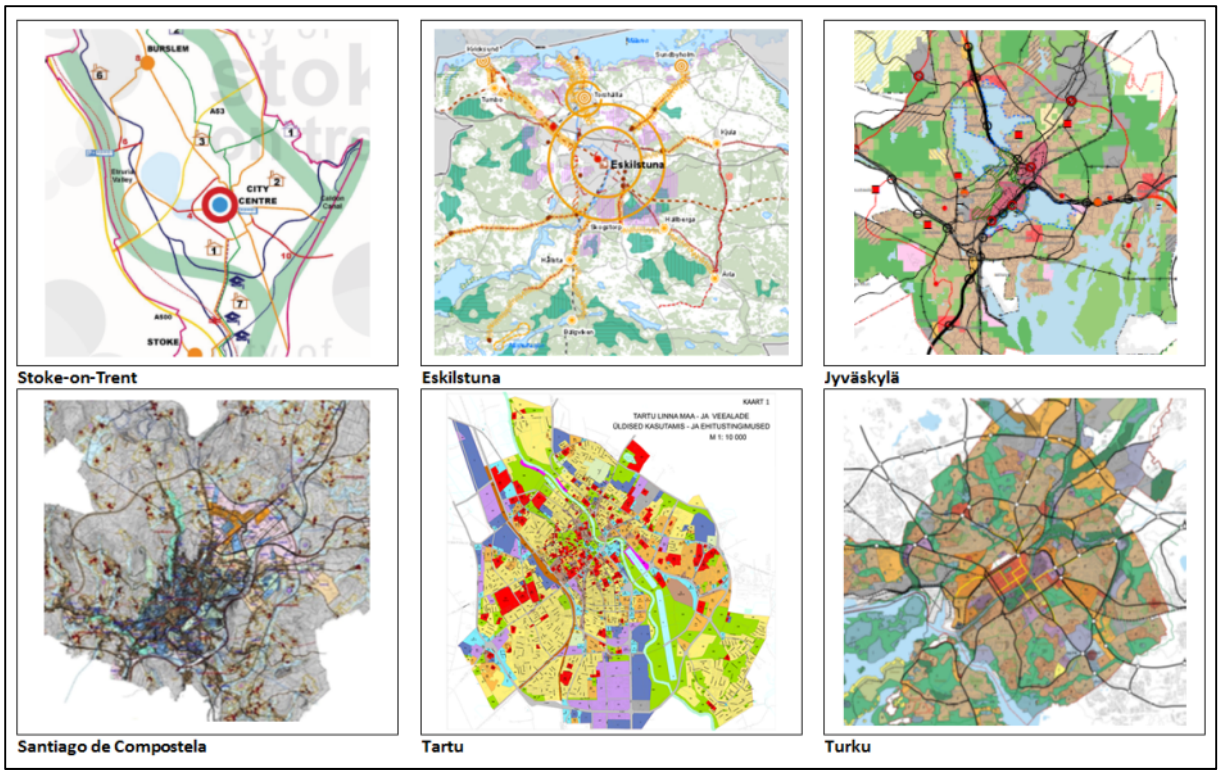


Figure 6: Comprehensive plans of the six cities. Data sources: Newcastle-Stoke Core Spatial Strategy 2006-2026 (2009); Eskilstuna Översigtsplan 2030 (Draft 2014); Jyväskylä General Plan (Draft 2014); Santiago Urban plan 2008; Tartu General plan 2006; Turku master plan 2020 (2009)

The municipal (development) plans are more similar than regional development plans. Usually transport corridors and major zoning are defined. However, as written above, the impact these plans can have is very different, either because of (1) the settlement pattern which could be spread over several municipalities (e.g. Stoke-on-Trent and Turku), requiring a considerable effort of coordination, or because of (2) weak competences at local level (e.g. Santiago, but also Tartu to a certain extent). Eskilstuna and Jyväskylä have probably the best conditions to influence as their municipal territory is covering quite a large area and the municipal level is very strong in both countries. Still, increasing regional commuting is e.g. in the case of Eskilstuna a (energy relevant) topic which goes far beyond municipal borders. Also the need to cooperate is not necessarily a barrier but can also bring together strong actors and increase chances for a greater impact, as shown from the case study reports on Stoke-on-Trent and Turku.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

2 Methods and data

The work presented here is based on the work with the six cities and a general review of literature. The latter led to a list of measures in spatial planning to improve the energy situation of a city. In several iterations the list was refined and cities where asked to fill-in information on each measure – is it used in the city? How? With which spatial focus and which time perspective etc.? This list provides a framework to discuss potential energy efficiency measures in each city. Sections 3-9 summarize the findings from each city. The filled-in tables of all six cities are enclosed in the Annex.

2.1 Case study work

The position and characteristics of the six cities was already presented in the previous chapter. The material was collected in WP4's case study work, outlined in a joint report on conducting the field work (Fertner et al., 2014). Based on the general questions and topics outlined in that report, six case study reports were elaborated in 2014 and 2015.

Table 4: Case cities in WP4 and population numbers in 2014

PLEEC partner (local authority)	**Population in** municipality	large urban zone	NUTS3-region	**Case study reference**
Eskilstuna	100 923	n/a	280 666	(Groth, Große, & Fertner, 2015)
Jyväskylä	134 658	225 877	275 320	(Read & Hietaranta, 2015)
Santiago de Compostela	95 800	199 856	1 133 330	(Fernandez Maldonado, 2015)
Stoke-on-Trent	250 100	472 100	1 107 887	(Rocco, 2015)
Tartu	97 800	153 100	322 052	(Große, Groth, Fertner, Tamm, & Alev, 2015)
Turku	182 072	316 634	470 880	(Fertner, Christensen, Große, Groth, & Hietaranta, 2015)

Data source: Eurostat / Urban Audit and municipalities.

The six municipalities are comparable in population size, all between 100,000 and 250,000 inhabitants (Table 2). However, a look closer at the settlement structure re-

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

veals major differences. While the urban area of Turku is shared between several municipalities, with the City of Turku covering the central part, the municipality of Eskilstuna embraces the full built-up area of Eskilstuna as well as several smaller towns and their rural surroundings.

2.2 List of approaches, tools etc. for urban energy planning in cities

In the thematic report (Meijers et al., 2015) a number of tools and approaches towards urban energy planning was introduced. We focused on the three main sectors of energy consumption (buildings, industry and transport) and in a fourth section on aspects of urban energy generation. Opposite to WP3 in PLEEC, where a review of similar ideas was provided (Vassileva et al., 2015), we focus in particular on their relation to urban structure and spatial characteristics.

After a round of comments from city partners we finalized a list of measure and policies related to spatial planning to influence urban energy. The list was sent out to all city partners and they were asked to fill-in the following information for each measure:

Table 5: Sectors and general goals in spatial planning to influence urban energy

Sector	Goal
Buildings and the built environment	A. Optimize energy distribution on district level
	B. Climate-oriented urban design
Transportation	C. Reduce travel needs
	D. Promote 'green' transport
Industrial	E. Enable industrial symbiosis by spatial clustering of industrial activities
	F. Improve opportunities for co-generation and linkages to district energy systems
Energy generation	G. Optimise energy distribution systems
	H. Designate areas for renewable energy production
	I. Enable small-scale (households) renewable energy generation

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Table 6: Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy …
Buildings and the built environment	**A. Optimize energy distribution on district level**	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Table 7: Measures and policies of spatial planning to influence urban energy (cont.)

Sector	Goal	Measure, policy, tool, strategy …
Transportation	**C. Reduce travel needs**	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)
		C4. Relocate transport intensive industries or power plants (e.g. power plants using biomass to decrease the energy consumption in transport, in Eskilstuna it was estimated that 57% of lorry-rides to bring biomass inputs would be replaced by rail).
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.
		D3. Develop intermodal transport nodes in combination with urban development
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)
		D5. Develop key public transport networks in urban areas
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)
		D8. Avoid development locations that promote long-distance journeys **by car**.
		D9. Imposit maximum parking standards (parking management)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Table 8: Measures and policies of spatial planning to influence urban energy (cont.)

Sector	Goal	Measure, policy, tool, strategy …
Industrial	**E. Enable industrial symbiosis by spatial clustering of industrial activities**	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO2 reduction. Case studies suggest that fuel efficiency doubles.)
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**
Energy generation	**G. Optimise energy distribution systems**	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke-on-Trent are expected to decrease by 10 %.)
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

3 Overview of results

For each city, Work Package 4-researchers from UCPH and TU Delft filled-in some preliminary information based on the case study work. All city partners checked and completed the lists. The cities had different ways to do it, but in all cities several persons (often from different departments) participated in the process.[3] There are a different numbers of measures proposed in the four sectors (see Tables 6-8), between 3 and 13. Figure 7 shows for each of the theme, how many of the proposed measures are already applied in the city to some extent. Although the basis data is quantitative, we choose to give it a more vague legend ('all-about half-none') because it was only a rough evaluation.

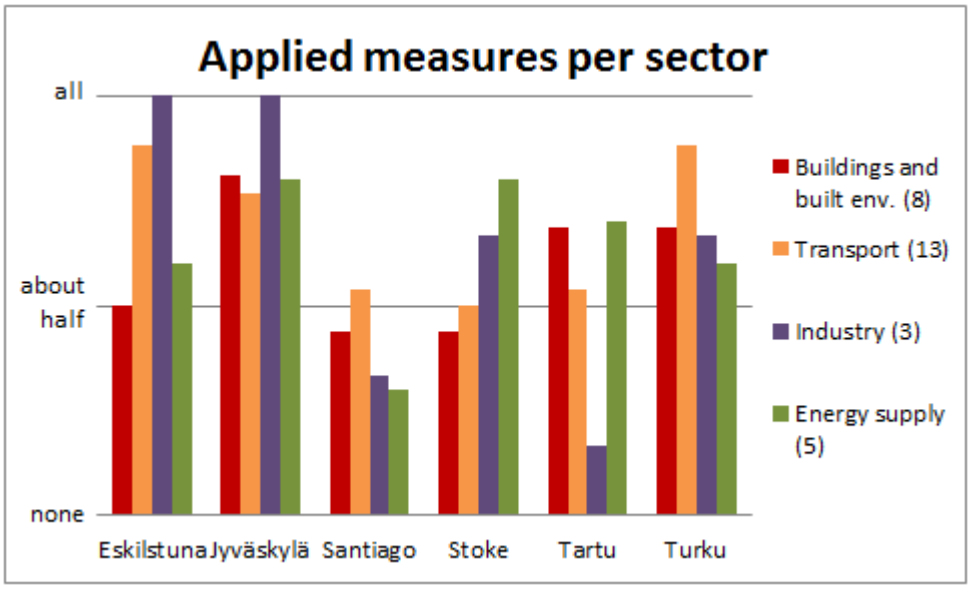


Figure 7: Applied spatial planning measures per sector.

The figure shows that all cities already apply several of the mentioned measures. Eskilstuna, Jyväskylä and Turku apply half or more measures in each sector. However, some measures are very context dependent, so we cannot conclude from this figure if a city

[3] Departments/disciplines represented in the internal list discussions:
Eskilstuna: Urban planning, transport planning, land use planning (all municipality), energy (EEM)
Jyväskylä: Strategy, urban planning, energy (municipality and consultancy)
Santiago: Urban planning (municipality), PLEEC partners from University of Santiago de Compostela
Stoke-on-Trent: Urban planning, transport planning (all municipality)
Tartu: Urban planning (municipality)
Turku: Sustainable development (municipality), energy consultants (Valonia)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

actually has development potential in a particular sector, or if exploits already all possibilities. E.g. further densification to benefit from heating gains is offset by a loss of solar access in Santiago and therefore not an option for the city. In Stoke-on-Trent several proposed measures cannot be implemented (at least not by the city government) because of a different legal and planning system.

These different contexts are also highlighted in the following figures, which show the (potential) foci of all measures in each of the cities. Figure 8 shows how cities prioritize between existing and new areas. The most extreme example is Tartu, which sees only potential in existing urban areas. However, this might also be related to the territorial boundary of the City of Tartu, which ends at the current built-up urban area, while the surroundings are not included. That means within the municipality no green field development can take place anyway.

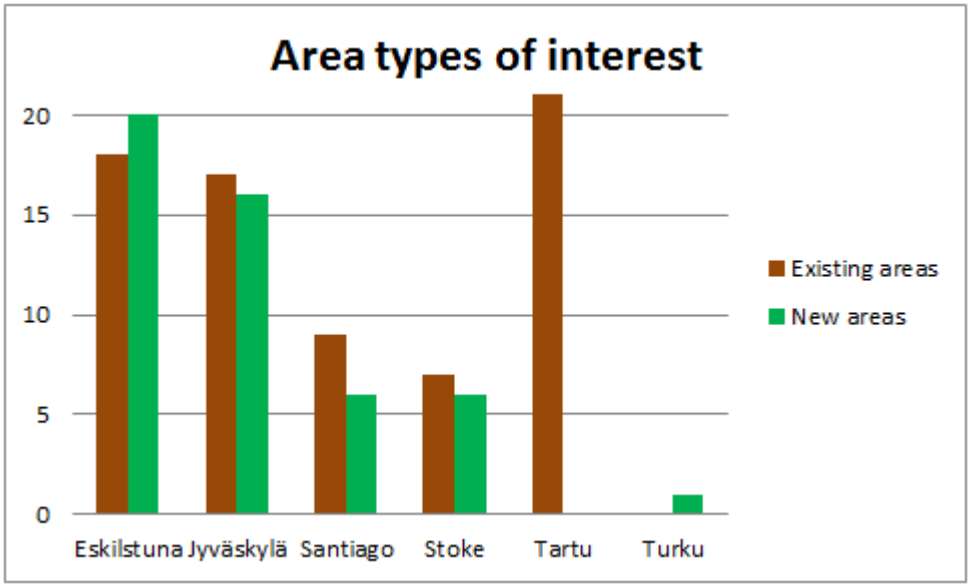


Figure 8: Area types of interest of listed measures. Also other kind of areas where mentioned, e.g. suburb, however, not consistently and therefore not reflected in the chart.

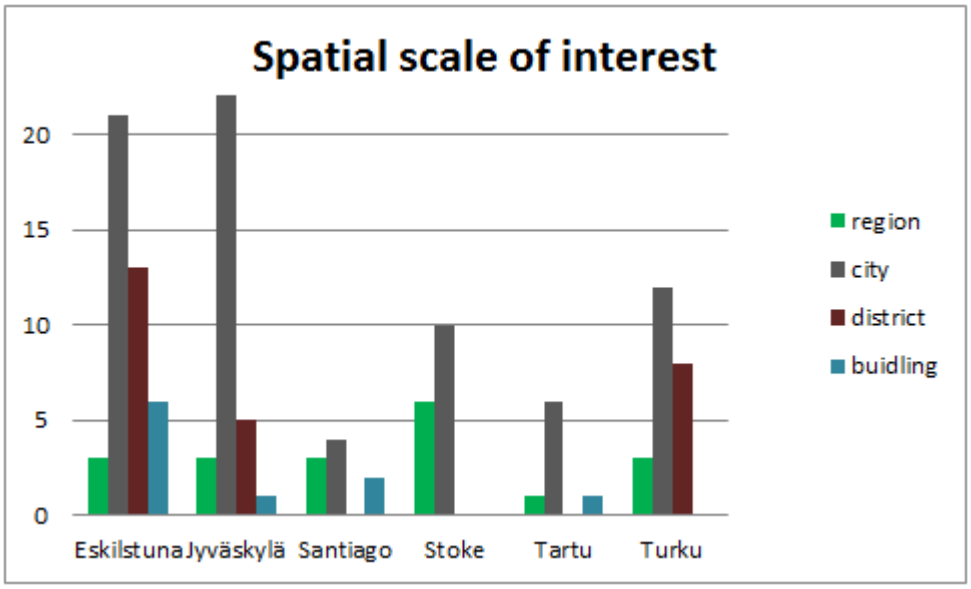


Figure 9: Spatial scale of interest of listed measures

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Most cities see the potential of the listed measures on city scale (Figure 9). In Eskilstuna and Turku district scale plays an important role in the listed measures. A very interesting difference shows Figure 10, where e.g. Santiago sees potential measures mainly to be implemented short term, while for Tartu most measures have a long term perspective. In Eskilstuna both short and long term are equally important.

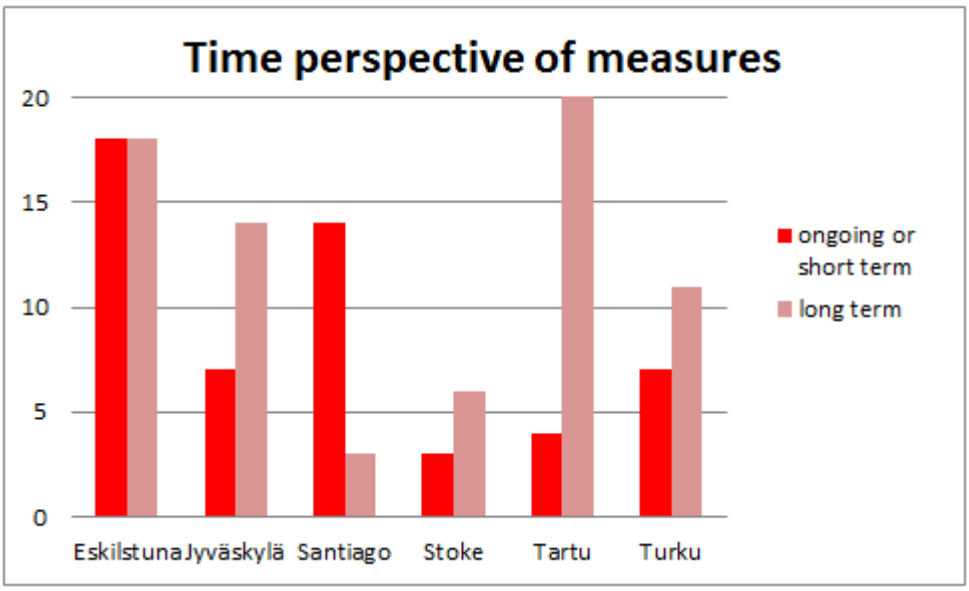


Figure 10: Time perspective of listed measures

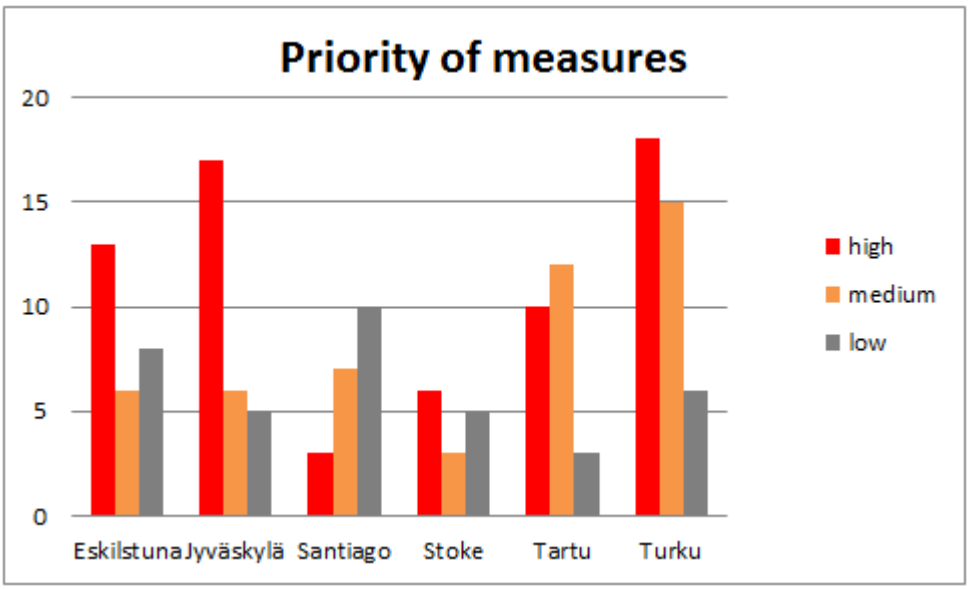


Figure 11: Priority of listed measures

Also an interesting difference can be seen in Figure 11. While in Eskilstuna, Jyväskylä, Turku and Tartu many measures are given a high or medium priority, in Santiago de Compostela and Stoke-on-Trent many are given low or no priority. In Santiago this has probably to do with the nature of many of the measure which come out from a Northern European planning context and climate, while the mixed priorities in Stoke-on-Trent are

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

related to the different legal and planning system as well as other challenges, as e.g. fuel poverty, which are not occurring in the same extent in the other cities.

In the following sections we will go through each cities activity in the four sectors in more detail, identify measures with the biggest potential to work with in the future and list examples which other cities could learn from.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

4 Eskilstuna

4.1 Overall activity in the four themes

Eskilstuna has integrated energy efficiency considerations and measures in a wide range of municipal strategies and plans. Three plans, the Comprehensive Plan 2030 (ÖP 2030, 2012), the Traffic Plan (Trafikplan, 2012) and the Climate Plan (Klimatplan, 2013), outline Eskilstuna's overall strategy and cover energy on in regards of spatial planning. In the theme of **buildings and the built environment**, densification goals and measures as well as principles of compact urban development are introduced in these plans. Specific areas for densification are designated (especially in the already relatively compact cities Eskilstuna and Torshälla), e.g. along roads where open space between the road and the buildings is of sufficient size. This is typical for urban development from 1960s/1970s (see Swedish million housing programme) where much unused green space between apartment buildings was designated.

Densification is mainly focused on the city centre and along the main roads where good transport infrastructure exists already. The municipality is prioritizing general urban development by their location ('from inner to outer'), with first priority within the cities of Eskilstuna and Torshälla, second priority in the smaller transport nodes Kvicksund and Sundbyholm and, as last priority, in the smaller settlements along the main transport axes. Development in the agricultural or open area is generally restricted.

On the **regional scale** the city is engaged in a new cooperation with three neighbouring cities (Västerås, Strängnäs, Enköping) where energy efficiency will be one of the aspects to discuss.

Specific energy planning for housing areas cannot anymore (since 2015) be done by the municipality (in a binding way) because national legislation has deregulated the sector. For example, the municipality is no longer allowed to steer the energy needs of new buildings (when plot sold by the municipality) but has to follow the national level for energy needs in building regulations and contracts (60 kWh). Innovation are difficult to introduce. However, there are efforts going on to introduce the certification system BREEM in Sweden including labelling of whole districts.

Climate oriented design has no priority, as other aspects are often more important (accessibility, existing urban form) and because it is limited what the municipality actually can prescribe. The municipality works though with supporting developers or citizens in their energy efficiency measures, e.g. by providing a solar map for the whole municipality.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

The municipality also works with most measures outlined in the topic **transportation**. (Large) green field development is not promoted, but instead focus of development in former industrial areas and the existing urban fabric is given (also called 'urban healing'). To avoid urban sprawl is a main principle in the Comprehensive Plan. New development, especially in former industrial areas, is developed for mixed use. The relocation of a biomass power plant was recently cancelled, but other ideas on 'greening' transport-intensive industries are still on the table.

Public and green transport (especially bicycling) is a big priority in Eskilstuna's plans. A new travel centre is under development making the shift between different modes of transport easier. The city has the ambition to increase the accessibility of public transport and the Transport Plan is also dealing with missing links of the network. Recent key service and facilities were located within 10 minutes walking from the train station (new university, swimming hall, arena).

Regarding **industry** and spatial planning, the municipality's district energy network plays an important role. Some industrial/commercial clusters arose around the district cooling network. On the other hand, the location of industries in the district heating network also can increase its economic sustainability. However, the municipality cannot force companies to link to the district energy system.

Furthermore, due to the ongoing restructuring of the local industry, the municipality also considers densification in industrial areas.

In the field of energy generation, Eskilstuna has an extensive district energy network (heating, but some places also cooling). The Comprehensive Plan also identifies areas suitable for wind power, however, in this region there are not very good wind conditions. Most wind power development takes place in northern Sweden. On smaller / household scale production Eskilstuna has for example reduced fees for building permissions for passive houses and wind power and, as mentioned earlier, is providing a solar map.

4.2 Measures with biggest potentials for the city to work with

Eskilstuna is already applying a wide range of the measures stated in the list, especially when it concerns the municipality's own activities, which include a wide range of infrastructure including district heating, as well as local urban planning and local transport planning. As a more concrete measure the introduction of an explicit **location policy** (e.g. station proximity) could support energy efficient urban planning in the future. However, as Eskilstuna city is relatively small (radius from the urban centre to the edge of the city is 3 km) this approach has to be adapted to the local context. So far the city is relatively car friendly (which is typical for small cities), while increasing bicycling is in competition with bus use.

The main challenges for Eskilstuna are **regional dynamics** as commuting. However, most recently the city also puts more emphasis on cooperation with neighbouring cities in transport as well as energy related issues – this is certainly something which should

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

be further developed. This is however something which has to be taken on the strategic level and included in future plans. Furthermore, this means also an increased involvement of other actors – not at least citizens – as these challenges lie beyond those which can be tackled in the municipal concern.

Other constrains can challenge the city's ambitious plans in regards to climate and environment. E.g. the "'Riksinteresse Kulturmiljövård' – a Swedish form of "Cultural Heritage" zone, restricts development within the whole urban core of Eskilstuna (because of its industrial heritage), which means that e.g. new urban development is restricted to specific heights, limiting the possibilities of densification. However, most potential for densification might lie in residential areas from the 1960s and 1970s as shown in the next section.

Other **national regulations**, as e.g. a divided market of those who built up new buildings and those who serve them then (no incentives for lifecycle thinking and EE), or new national planning and building legislation which contradict energy efficiency and innovation, also have an influence on the city's possibilities. This strengthens however the need for cooperation with other stakeholders and actors in the municipality and beyond it even more.

4.3 Most interesting examples of policies/measures etc. others could learn from

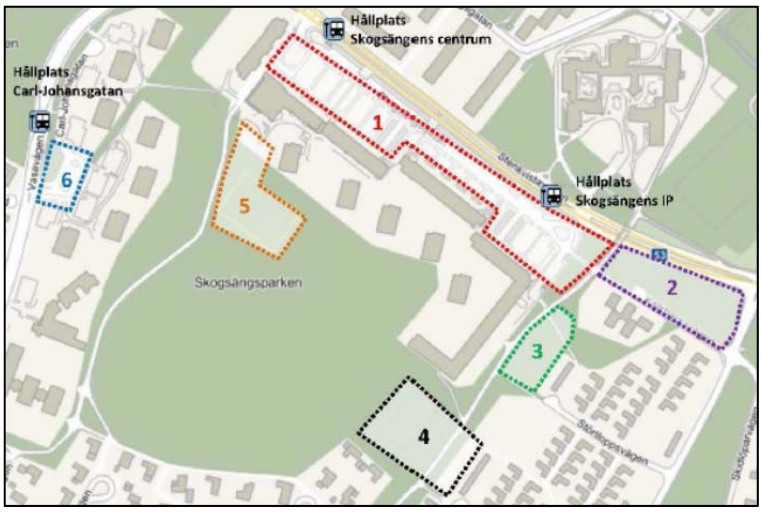
The three planning documents of Eskilstuna (Comprehensive Plan, Transport Plan, Climate Plan) are a showcase for **integrated planning** in regards to energy – not least because they refer to and build up on each other. Even though energy could be highlighted more (for example by way of a future Energy Efficiency Action Plan), the plans very well take up different issues in regards to energy – from urban structure to transport and energy supply. Starting with the later, the city is has recently established a district cooling cluster in the inner city, providing cooling from renewable energy.

Regarding the regional transport infrastructure the city is currently planning for a **new travel centre** as a new intermodal core for sustainable transport. The new centre will combine bus and train services and increase the capacity to handle more travellers which are expected after 2017 when new rail infrastructure on the line to Stockholm will be finished. It will also improve the link between regional and local traffic and improve intermodality.

An interesting initiative in the Comprehensive Plan in regards to urban structure is the **'Urban Healing'** project (see example in Figure 12). It implies a **long-term densification** strategy with a focus on industrial areas and the existing urban fabric by way of new housing where it is helping to connect to the neighbouring districts. The approach includes connections for pedestrians and cyclists and a focus on those housing types which are lacking in the areas. Also the energy use in existing buildings is considered (for example in Lagersberg), combining structural, behavioural and technical aspects.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Eskilstuna municipality aims at densifying several areas within the existing urban area. A first architectural competition is currently (June 2015) ongoing. Proposals for densification of Skogsøngsparken, a housing area in the South of Eskilstuna are collected. The areas include mainly large surface parking spaces (e.g. between a main road and apartment buildings, area no. 1) and residual green areas which have mainly the function to separate housing areas from roads (e.g. area no. 2).



Proposed areas for densification (Eskilstuna Kommun, 2015)


Proposed area for densification, Google Street View June 2011. Area no. 1 in yellow.


Proposed area for densification, Google Street View June 2011. Area no. 2 in yellow.

Figure 12: Example from densification plans in Eskilstuna

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

5 Jyväskylä

5.1 Overall activity in the four themes

Jyväskylä is a small (135 000 population) city. Both its local government and the national government are committed to the compact city concept already for some 25 years. New urban developments have been, and are being, constructed at short distance from the city, but as much as possible in a concentrated manner and in or adjacent to the city's historical centre or other already existing residential and service centres within its urban area. Insofar suburbanisation and urban dispersal have taken place to accommodate the quick population growth in the past decades and due to scattered small house developments led by private initiatives that are less easy to control by local planning.

Due to a municipal merger in 2009, the city extended by five residential and service centres: three were located so closely to the city centre (about 6 - 8 km.) that they certainly belong to Jyväskylä's urban fabric and the two others are suburban centers at a larger distance of 20 - 28 km. These latter two have not grown significantly however, so Jyväskylä is a rather monocentric city. In addition, its current city centre is rather compact. This suits well to the growth of high-tech and service industries that fits in the city's present-day economic policy.

Energy efficiency is explicitly incorporated into planning policies. For instance urban and regional transport planning and land use planning aim to optimise the efficient use of existing infrastructure and reduce energy consumption through controlling urban form. Nevertheless, it is also emphasised that economic objectives, social considerations and image ('Jyväskylä as centre of knowledge and knowledge-based industries') are also important objectives of spatial planning, while on the other hand most energy efficiency considerations are found in other than spatial types of planning.

Buildings and the Built Environment

Jyväskylä's more central compact building stock is judged positively for **CHP/DH systems**, and to some extent purposefully **planned** for that**.** Indeed, CHP/DH plants are ideally located near dense and compact building stocks, in order to limit pipe length and energy loss. Energy efficiency in terms of minimizing fuels costs compared to separate power and heat production has been a major driver for CHP systems. However, below certain thresholds of urban density, i.e. for more scattered urban areas, small to micro scale CHP/DH is nowadays technically feasible, but economically much less feasible. For, the rationale of this planning rests not only on considerations of energy efficiency, but also of economies of scale.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Related to the above, the share of the housing stock in **apartment buildings** to accommodate demographic growth has increased over about the last thirty years. It is, however, suggested that this mainly takes place in the city centre due to both the large share of students in the city's population – with a preference to live in the centre – and a new cycle of demand by suburban post-family households (elderly people) for city centre apartment.

Suburban settlements were purposefully built in the Jyväskylä area from the 1960s to 1980s in order to meet the needs of the fast growing population. But over the past 25 years or so, **building compact and in high densities** in centrally located settlements has become standard. Nevertheless, suburban sprawl has taken place in this recent period as an unintended consequence of a policy of economic growth which attracts 'creative' migrants with car-oriented, suburban 'small-dwelling' lifestyle demands. Street lighting in the Jyväskylä area has been optimized to save energy, not compromising safety, for cost and use efficiency as well as environmental concern.
The **climate-specificity** of Jyväskylä has historically been incorporated into energy efficiency measures. One example is the insulation standards of buildings that historically have been higher than the European standard. The orientation and roof angles of buildings in the latest large scale urban development area Kangas are optimised for **solar energy production** within the framework of a solar energy plan, which is new in Finland. Also One Planet Living Principles are being applied in Kangas for the first time in Finland, along with a variety of other innovative methods such as participation and sense of community, and new solutions to make energy and water consumption more visible and controllable to promote behaviour driven efficiency. **Wind** power has a limited potential inside the city area: a wind power farm is zoned in Maatianvuori, in one of the extensions of the city with the 2009 merger. Further, wind is not relevant as a ventilator in summertime.

Transport

The compact city offers potentials for **cycling** and **walking**, in particular in the city centre. Promotion of non-motorized modes of transport to be achieved by a viable pedestrian and cycling network, has been an explicit objective and there are currently several planning actions and investments to increase walking and cycling. This has been also reflected in planning new urban extensions in the past 10 years in two compact large-scale settlements: Kangas and Lutakko located adjacent to the city centre with both housing and urban services. Moreover, the potentials for cycling and walking are even stronger because about 90% of the jobs in the region are within 3 km of Jyväskylä's city centre.

For commuting trips and trips from home to urban services beyond the range of walking or cycling, Jyväskylä has a well-organised bus system with termini in the city centre. In fact **public transport** – meaning bus services – is a key structuring element of the strategic planning objective to concentrate urban developments in a few settlements. Bus services are not frequent enough, however, to serve sparsely populated areas further away from the city centre. The railway connects to Helsinki (3 hours) and other major centres in Finland.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Despite the potentials, bicycle use for every day purposes is still very limited in Jyväskylä. This is not only due to the Nordic **climate** but also due to a culturally embedded preference for motorcar use. Hence, promoting cycling and discouraging car use is still a useful **recommendation** to local policy makers.

Industry

The policy to develop Jyväskylä into a hotspot of high-tech industries has been accompanied with the development of innovative science park-like clusters associated with the universities. Moreover, small start-ups typically occupy central city locations. However, they offer very limited opportunities for complementary energy and waste input-output flows. Besides these 'new' industries, several traditional industries, including the sizeable forest industries, are modernising and recovering economically. This recovery takes place outside Jyväskylä area, but affects companies located in Jyväskylä that supply services and technology to pulp and paper industry such as Valmet - a leading global developer and supplier of technologies, automation and services for the industry. A system of industrial symbiosis (Korhonen, 2001; see D4.3) based on forest industry by-products along with significant amount of wood fuel procurement from forests are major suppliers of non-fossil fuel (mainly wood) for the city's CHP and DH networks (see *Energy generation* below).

Energy generation

The development of **CHP and DH networks** in Jyväskylä started already in the 1980s, and has developed mainly by investments of the local provider Jyväskylä Energy. The fuel efficiency of CHP is considered to be very high, no less than 85-90% (e.g. Korhonen, 2001). The fuel mix for these systems shows an increasing share of renewable sources (wood fuels and biogas (landfill gas)) and a decreasing use of peat, coal and oil. In 2014, the mix was 52 % of these renewable sources, 37 % peat and 12 % coal and oil, and the aim is to increase the share of renewable fuels up to 70 % in 2020. Wood fuels from forest industry by-products and forests are considered renewable and carbon neutral source of energy. Although their combustion produces CO_2, Finland manages forests for a number of reasons, some environmental sustainability by increasing the size of forests as a net carbon sink. Finally, a major investment in the production of biogas to be used as traffic fuel is under preparation by the waste management company Mustankorkea Ltd.

Companies, municipalities and other organisations are eligible for investment subsidies or feed-in tariffs for small and micro-scale distributed renewable energy production (solar, wind, biomass). **For households**, national level subsidies and tax deductions are offered for improving heat insulation, renewing and repairing ventilation and heating systems, and adopting renewable energy. However, the subsidies are currently at relatively low level and available only for low-income households.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

5.2 Measures with biggest potential for the city to work with

As a conclusion of the studies in WP4, the following headline ambitions for Jyväskylä for the future (2050?) are outlined:

1. To move (gradually) to 100% fossil free and carbon neutral building heating, improving production and consumption efficiencies further and achieving year on year energy demand reduction per unit,
2. To move towards a radical reduction in motorcar use in favour of public transport, cycling and walking
3. To become 100% fossil free and self-reliant in electricity production and to make local responsibility a feature of electricity production-consumption
4. To reduce energy need and demand, i.e. not just increase of energy efficiency.

Against the background of these ambitions the following measures, including not only planning but also behaviour and technology perspectives, are suggested:

a. More extensive use of new renewable energy sources such as biogas for vehicles and solar energy in buildings. This includes an active role for the city in the development of new bio-waste-to-biogas projects and promotion of solar heat and power production in PV modules for households, companies and municipal buildings (with e.g. developing new models and offering planning advice for installing solar heat and power).
b. Replace oil and electric heating with renewable energy sources such as heat pumps in the areas outside district heat network(s).
c. Extend the use of wood fuels and other renewable energy sources in CHP and DH production.

This extension is feasible to a certain point. The acreage of forest in Finland is increasing: its annual growth exceeds the volume of cutting, and the forest absorbs more carbon than it produces. Technical problems prevent 100 % wood fuel use in the CHP plants without renovations (related to fouling and corrosion of boiler parts).

d. Introduce heat pumps whenever excess heat is available (e.g. ventilation exhaust air or waste water)
e. Deepen the energy efficiency planning of buildings and built environment.
    - Incorporate energy efficiency considerations explicitly into general strategic planning
    - Promote dense urban structures and housing by e.g. building more compact urban forms and densify existing built-up areas; promoting apartment buildings while limiting detached housing; and promoting mixed use development with local facilities and services near housing or public transport, i.e. easy to reach without a car.
    - Draft energy plans and guidance for every new urban development area, define aims, means and responsibilities for this
    - Optimise solar access, use of wind, shading and microclimate in both summer- and wintertime by means of well-considered building orientation and design (e.g. size of windows) and of planting trees.
f. Discourage car use and promote public transport, cycling and walking instead. This would include making use of the compact and dense urban form and introducing a holistic set of measures that aim to make everyday transportation without private car as easy as possible. Thereto, the quality, extension (frequency) and mobile information service of public transport and the quality and extension of cycling and walking infrastructure can be further developed. Also, employers can introduce incentives (e.g. electric bikes) and make it easier to reach work-

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

places by bicycle, with an exemplary role for the City of Jyväskylä. Car use is, however, also about culture, making it not only an issue of WP4 but also of WP5, i.e. of changing attitude and behaviour regarding car use.

g. Ambitious energy efficiency goals for new buildings and improvements in existing building stock.
h. Incorporate reduction of energy demand in models of economic and urban development for companies, households and public sector, as part of the resource wisdom framework implemented by the city.
i. Last but not least, find ways to reconcile the economic objectives, good planning practices and desired city image with progressive and holistic energy efficiency planning

5.3 Most interesting examples of policies / measures etc. others could learn from.

a. Introduction or extension of CHP because of its very high level, up to 90%, of fuel efficiency.
   It is exactly for this high level of efficiency that the EU is pushing CHP. In addition, if CHP is combined with the development of smart networks for DH (and district cooling), with a particular role for city planning, energy efficiency of the overall system of production and consumption can be further increased. CHP/DH is also a good (centralised) way of enabling high level of renewable energy use in the city energy and cost-efficiently without high subsidies.
b. Rational and sustainable use of biomass, supporting renewable energy use and carbon neutrality.
c. Energy efficient building methods. There still might be potential for this in other cities, until the upper limit at which problems of over-insulation will start.
d. Implementation of innovative HVAC technologies (ventilation, automation and heating systems) in both new and renovated buildings which can be promoted through city planning and city's building supervision authorities.
e. Smart metering and smart electricity and heat grid developments regarding grid efficiency, minimisation of losses and efficient response to demand.
f. Urban planning based on the compact city concept and the location of services close to customers, aiming to optimise the use of existing transport infrastructure in a way that limits energy consumption for mobility.

Assessment of these policies should take into account the very particular geographical context of Jyväskylä, making some not easily transferable to other cities in highly different contexts. Its monocentric and compact urban form has a relatively long history and is very hard to achieve in a short period of time by cities with an urban form of different kind. In addition, the city is the urban centre of a large sparsely populated region well outside a larger metropolitan system, in the Finnish case the daily urban system of Helsinki. This stems long-distance commuting and the high concentration of jobs around its city centre increases the potentials for cycling. Further, the low population density of its surrounding region means space for a large and still increasing acreage of forest as the source of wood fuel. And last but not least, municipalities are rather autonomous in the Finnish' system of policymaking, and have in many cases the power to decide alone on the main factors influencing their energy production, fuel mix and power grids.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

6 Santiago de Compostela

6.1 Overall activity in the four themes

Santiago is the capital city and seat of the regional government of the autonomous region (*Comunidad Autónoma*) of Galicia. Comunidades autónomas are in charge of planning policies but should follow the national framework. National policy in Spain on energy efficiency for its part leans heavily on EU policy objectives and programmes. Within this framework, Galicia has developed a rather comprehensive policy framework on energy efficiency that implements 'all thinkable' instruments (new technology, equipment and vehicles; management; promotion campaigns; audits etc.), except genuine spatial planning!

The municipality of Santiago carries little weight of what in fact is its own policy with regard to energy efficiency for two reasons. First, municipal spatial development plans exist in Santiago since 1940, but energy efficiency considerations have not been incorporated explicitly as yet. In fact, these considerations have not been priority until very recently and are still weak in the current 2008 municipal General Plan of Urban Development. For, the Plan was mostly elaborated during the economic boom period before 2007 when there were no pressing economic reasons for energy efficiency policy. Additionally, municipalities in Spain have very limited legal power to 'dictate' energy efficiency policies. Instead, they have a shared responsibility with the regional governments, also for policy areas that have considerable energy saving potentials, like public transport and urban planning.

Building and the Built Environment

Land use in the historic inner city of Santiago gradually intensified during most of the 19th and 20th century by increasing building heights and depths, and decreasing open spaces in between buildings. Growth and changes that eventually led to the creation of urban expansions occurred in Santiago considerably later than in several other Galician cities with more rapid growth of industrial and port sectors, hence leading to rather dense use of the space in the historic area. Alongside, a second feature of this process of **densification** has been the increase of the share of **multi-family residential buildings** in the housing stock of the centre. . Typified by relatively mild winters and, also relatively, many hours of sunshine in spite of generally clouded skies (still most hours of all PLEEC cities), the limited gain in energy use for heating due to the growing number of multi-family accommodations is more than offset by the reduction of solar access due to increasing density of built-up area.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

All in all, the specific climatic context has been hardly utilized in energy efficiency policies, insofar such explicit policies have been formulated and pursued in the first place. Long housing blocks in the historic centre are predominantly N-S oriented and, correspondingly, individual dwellings E-W: no explanation is presented in the case study. Today, **climatic-related considerations** like orientation of building with regard to wind or solar and 'green' are not explicitly contemplated in municipal urban development planning. This is not just a disqualification of policy: there is little to improve in the city centre, if only because it is an UNESCO monument, hence facing strict levels of protection.

Overall, the impacts of Codes or Acts on energy efficiency of buildings in Santiago is both limited very and recent. A few consecutive codes have existed at least since the 1950s, but the two major **urban expansion** projects outside the historic centre since then, El Ensanche (The Extension) and As Fontiñas, were for their largest parts effectuated in decades – mid 1970s to end 1990s – of incompatibility of legislation. Nowadays, the construction of new buildings and in some cases refurbishment of existing ones, with the exception of built heritage, are mandatory by law to meet 'bioclimatic' criteria and implement energy saving measures and methods, including e.g. insulation, placement of thermal installations, and generation and use of solar energy, in order to fulfil the energy reduction objective established by the 2006 Spanish Technical Building Code (CTE). Due to its recent date, it is only the latest extension of the city's built-up area, Santa Marta at its south side, that has been within its jurisdiction. In case of renovation of buildings in the historic city, the specialised legal body 'el Consorcio' is responsible for maintenance and conservations of their bioclimatic features.

Transport

Energy efficiency can benefit most by policies and measures regarding transport. First, a **compact growth of urban fabric policy** has characterised municipal General Plans until the current one of 2008. Consequently, the size of the urban fabric has extended uninterruptedly but spatially rather continuous since the 1960s. Of the three above mentioned sizeable urban expansions, only As Fontiñas, at the east side of the city, is discontinuous, i.e. separated from the major part of its built-up area by several main traffic routes. Furthermore, these expansions – at least the two oldest ones - were developed according to typical features of Spanish urbanism, i.e. high **residential density mixed with commercial functions**, the latter at walking distance from home for many inhabitants.

Only in the past two decades, Santiago faces suburbanisation, involving rather large-scale house-building programmes in neighbouring municipalities. The current edition of the General Plan is said to still aim at controlling the city's suburban dispersal, but also puts aside the previous compact city considerations. Both features seem contradictory but can go together if of importance at different scales. Together, these urban development principles and policy still have the potential to **keep travel needs at local scale low**, although the case of Jyväskylä shows that this not necessarily means significance use of bicycle or shank's pony rather than the car. Furthermore, the reduction of importance attached to compact city considerations by the 2008 General Plan may increase rather than decrease local travel needs.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

As to **use of the car vis-à-vis cycling, walking or public transport**, two opposing policy strategies can be observed. Previous measures to reduce car use by improving the pedestrian infrastructure and other measure are downgraded in the current General Plan while, on the other hand, the 2011 Plan for Sustainable Urban Mobility includes a public bicycle plan with dispensers in the historic city, a programme to create a better walkable city centre, and construction of two low-price modal shift nodes – parking garage + bus to city centre. In addition, the initiative Smart IAGO includes a plan for intelligent parking management.
By and large, transport-related **policies** to reduce energy use have **not been very successful**: interventions in the inner city street network to make it more walkable have only taken place in the pedestrian historic core, the city centre bike scheme was abolished because hardly used (many streets are narrow, busy with pedestrians, hilly and cobbling), very few people use the P+R terminals because the bus system is so poor that many prefer to pay for parking in the city, and a first pilot of intelligent parking management has only started this year (2015).

Industry

Industry is of no importance whatsoever in the economy of Santiago. The recent but rapid industrialisation in Galicia as a whole has left out Santiago. Historically, the city is a centre of education, religion and culture. Recently, its economic structure has been supplemented with tourism and public administration; it became the capital city of the region in 1978. Hence, there is little or no energy efficiency to gain from polices regarding industry. On the other hand, the assignment of Santiago to regional capital has, together with improvements of the road network and augmented level of car ownership has increased commuting over a considerable distance.

Energy generation

Initiatives to generate energy on a local level are almost exclusively limited to the campus of the University of Santiago de Compostela, guided by the university's Energy Efficiency Plan (POE). These include the implementation of a system that co-generates heat and electricity, solar energy in one building and a geothermal heat pump in a new building. Besides, a geothermal heating system was implemented in the building of the regional parliament of Galicia. The impact of extending these systems is, however, limited in the first place: due to the mild climate there is relatively little demand for cooling and heating of buildings.
In the area surrounding Santiago, wind energy was generated. All together, these are very limited initiatives on a city scale. Furthermore, national state's austerity programme recently abolished all subsidy programmes for renewable energy generation.

6.2 Measures with biggest potential for the city to work with

a. Parking policy: parking should be made much more expensive - parking fees are still very cheap now - and restraint should be exercised regarding the reduction of the deficit of parking places observed by the local government (over 10.000…), in particular in the historic city.
b. Improve public transport system: higher frequencies, connections better adjusted to demand based on travel patterns.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

c. Improve coordination and assignment of house building programmes with neighbouring municipalities, attempting to slow down the growth of commuting flows to Santiago.

6.3 Most interesting examples of policies / measures etc. others could learn from.

It is concluded by the author of the case study that "Santiago doesn't do much". Indeed, many policy initiatives are in a very initial stage, are not very promising due to specific local conditions, or simply failed. So, apart from the preference for a compact urban pattern, no other examples are identified. The most obvious advantageous condition that limits energy use in Santiago cannot be transferred to other cities: the mild climate and the preference.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

7 Stoke-on-Trent

7.1 Overall activity in the four themes

For now, the main, statutory planning document that sets out the broad framework for (planning of) the future development of Stoke-on-Trent -on-Trent is the Core Spatial Strategy. This is a joint strategy with the neighbouring local planning authority of Newcastle-under-Lyme. It is accompanied by several Supplementary Planning Documents, including the 'Urban Design Guidance' and the 'Sustainability and Climate Change' documents. The Strategy's general guidance aims at encouraging environmental, social and economic sustainability.

More recently, it is at the heart of the National Planning Policy Framework (2012) that a 'low carbon future' ought to pervade both plan making and decision taking at the local level. Local authorities are the main protagonists, central government interferences are limited. A vehicle for the local authorities in Stoke-on-Trent -on-Trent, the new Local Plan, again jointly with Newcastle-under-Lyme - is in the making yet and is expected to be adopted in 2018. This Local Plan is to become key for many future activities in several of the four themes.

Building and the Built Environment

In Stoke-on-Trent -on-Trent, energy efficiency is indeed a top priority. A handful of sector-specific schemes attempt to improve this efficiency of either the buildings or the behaviour of all sorts of actors – from industries to households. The objectives of energy efficiency schemes are primarily economic and social rather than environmental, and spatial planning is a rarely used instrument to achieve their objectives. For instance, the primary objective of the main urban development project of Stoke-on-Trent -on-Trent, transforming Hanley into the single first-level service centre of its six towns, is to create an identifiable urban centre with agglomeration effects that attracts new investor. Hence, more can still be done to incorporate energy efficiency considerations in **planning of the urban built environment**.

As to housing, the Zero Carbon Homes (ZCH) scheme sets the goal that all newly built homes meet specific standards by 2016. The major problem regarding the **contribution of housing to the low carbon future is**, however, not new-build houses but the large size of the housing stock of privately owned single-walled Victorian houses that are extremely difficult to bring up to modern efficiency standard. In fact, both the size of this legacy of Stoke-on-Trent's industrial past and the insufficient resources of local government - financial and legal - makes this an impracticable objective, in spite of recent

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

clearance of a considerable amount of the older housing stock. Reducing mismatch on the housing market and social impacts of fuel poverty have been more important objectives of this clearance than improving energy efficiency as such.

Interesting against the background of insufficient local public financial resources is the Green Deal is a scheme, introduced by the central government that took office in 2010, in order to deliver energy saving measures to each household with an electricity meter that is **being paid for by the households themselves**. A two-stage independent assessment of an applying household maps out the actual energy use and may (!) result in tailor-made recommendations for efficiency improvements, a plan how the work will be done (by an authorised Installer), and a finance plan. Green Deal finance plans are offered by approved providers – most often (green or low-carbon) energy companies - who access a line of credit from the Green Deal Finance Company (GDFC) that was deliberately set up to lend money to Green Deal providers. The finance plan involves a loan, plus interest, that will be refunded by means of the reductions on the energy bill rather than up-front. It is being acknowledged by some commentators as an innovative tool, but criticised by others for being least subservient to those households – the low-income ones - that most need reduction on the energy bill. In particular these households are not willing to contract long-term debts for investments in a dwelling they will almost certainly leave at some point, not inconceivable before the loan is entirely paid off.

New apartment buildings, to achieve higher levels of energy-efficiency in housing, are under investigation. The main difficulty to overcome is the limited demand for apartments outside Britain's largest city centres due to both cultural norms and these buildings bad image. However, the planned upgrading of Hanley to the major service centre of Stoke-on-Trent may convert this into a more attractive urban area, with a positive impact on demand for housing in apartment buildings.

Climate oriented-urban design is not a big issue in Stoke-on-Trent. In fact, there are neither specific policies nor clear examples of measures or tools to make use of solar or aeolian energy to generate energy. The same holds for possible general strategies to adapt in an energy-efficient way to specific climatic conditions.

Transport

As to **travel needs** as energy user, the historic reality of distribution of mixtures of local services across the six towns of Stoke-on-Trent -on-Trent have kept distances from home to many services, facilities and jobs short for many people. The programme to upgrade Hanley to the major service centre of this polycentric municipality is first and foremost based on economic objectives, but is expected to have a negative effect on the travel distances. i.e. it will increase local travel needs. The city council had actually started relocating its own offices, jobs and services. However, the new coalition cabinet following recent elections have more of a six towns approach than concentration on Hanley, and by only half occupy the Smithfield development in that town.

Furthermore, many people will bridge these longer distances by car: the polycentric structure makes public transport planning difficult and municipalities in the UK in general have too little authority to plan their own bus system. Bus companies are private and it is these private companies rather than the city that has this authority - with the

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

exception of the largest cities: in the case of Stoke-on-Trent it is planned in a way that leads to low frequencies and long waiting times at terminals. Last but not least, a growing mismatch of the spatial distribution of homes, jobs and services aggravates one of the main problems of Stoke-on-Trent: social deprivation, in this particular case mobility poverty for those who cannot afford a car. Car ownership is indeed relatively low in Stoke-on-Trent.

Another way to reduce travel needs, in particular by car, is the combined development of **intermodal public transport modes and adjacent dense urban developments**. In Stoke-on-Trent, the development of the station into a HST one is under discussion and high density urban development around the station and the city centre bus terminal are planned. The main objective, again, is economic - developing into a 'connector' between larger UK urban areas and, hence, supporting the growth into a UK core city - rather than improve energy efficiency. What is more, increase of energy efficiency due to these plans is debatable.

The development of **cycling** infrastructure in Stoke-on-Trent is a success story in recent years, but started from a low base. Boosted by the completion of two routes of the national cycle network through the city and the designation of Cycling City in 2008, has yielded quite a length of new cycling-adjusted infrastructure and a threefold increase of cycling in the city. '**Permeability measures'** for streets in new urban developments is a challenge when adjacent sites are developed by different private developers at different times.

Industry

Since the mid-20th century, modern history of Stoke-on-Trent -on-Trent has been marked by the decline of manufacturing industry, accompanied with serious social and economic deprivation, and difficulties to transform to a post-industrial service-based economy. Notwithstanding these trends, manufacturing (pottery) and engineering are still significant in its urban economy, and have even managed to modernize. Pottery consumes much energy, but also produces excess heat for other uses. As one of the very first city in the UK, Stoke-on-Trent has secured funding to deliver a **DH network system**. Furthermore, opportunities for further expansion of DH are created by the LEP's (Local Enterprise Partnership's) Strategic Economic Plan seems to maximise clustering of industries in Stoke-on-Trent -on-Trent and its region, and by the foundation of an important think tank for innovative energy efficient heating systems. Nevertheless, there are still opportunities to explore for improvement of re-use of industrial excess heat.

Energy generation

The city itself plays a limited part in energy generation. It is most probable that electricity comes from the national grid, hence mostly produced somewhere else and giving the city little opportunities to control local responsibility, if felt necessary, for green energy and energy security. Its DH network produces heat, but is in fact more about distribution than production of energy. For the near future however, it has been decided to invest in expansion of the DH network to be fuelled by locally geothermal energy. The benefits are both environmental – savings of CO_2 emission – and economic – lower heat costs for users, including businesses, and new jobs.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

7.2 Measures with biggest potential for the city to work with

- There is no CHP initiative yet – indeed a major European issue – but the potential for such a high efficiency system are promising.
- Pursuing Spatial planning that encourages dense built up form and reduces local travel distances, rather than a sprawling spatial distribution

7.3 Most interesting examples of policies / measures etc. others could learn from

- The Green Deal, provided that the city that is interested in such a tool is conscious of the critical notes raised about the investment and refunding scheme in the UK. In the UK, the take-up has indeed remained low. In fact, in light of both this low take-up and of concerns about industry standards, in July 2015 the new UK government has decided to stop funding the Green Deal Finance Company in a move to protect taxpayers. Green Deal plans that are in place will continue as normal.
- Innovative pool for 'good practices' connected to local knowledge base. This pool, or think tank, offers really good potentialities for innovative, out-of-the-box ideas and measures to contribute to higher levels of energy efficiency. "Motivation to turn the disadvantageous situation into an advantage"
- LEPs as an important tool to discuss energy issues between local government and the private sector. A matter of concern, however, is the lack of civil society – at least in practice - in these discussions.
- Furthermore, Stoke-on-Trent is different from the other case cities because of its historic polycentric structure. For example, the current policy aim to develop the town of Hanley to a large central settlement could increase rather than reduce the need to travel because functions which formerly where provided in the local town centres will then be moved to one central location while the settlement structure still stays polycentric.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

8 Tartu

8.1 Overall activity in the four themes

In terms of **buildings and the built environment** Tartu pursues the goal to optimize energy distribution on the district level ambitiously in all areas. Though, some of the guidelines are given from the national planning those are specified and include additional measures in city planning documents, for example to include energy considerations in general strategic spatial development and facilitating the development of compact urban forms.

In terms of climate oriented urban design there appears to lie some potential for optimization, since for example planting of trees is guided by esthetical standards. The measures are rather general (e.g. member of Covenant of Mayors) and the measures have lower priority.

In the field of **transportation**, Tartu delivers measures both to reduce travel needs and to shift towards 'green' transport. Reduction of travel needs is basically intended by densification within the city borders and development of the central city part. The currently developed new Master Plan pays also special attention to the densification of the city center, especially the riverbank. Green transport is promoted by the improvement of the public transport system, especially by better connections to the surrounding settlements and the introduction of alternative renewable fuels like biogas and electricity. At the same time the city has to cope with uncontrolled private urban developments in its fringe, determining indirectly the development of the transport system.

Up to now there are no remarkable measures addressing **industrial** energy use mentioned. This is partly owed to the fact that Tartu has no big industries and also due to a lack of planning guidelines from the national level.

In the field of **energy generation** the city provides already a well advanced and comprehensive district heating network. Though, besides a municipal owned biogas plant, the city counts on private activities for the generation of renewable energies, which is also part of the city planning strategies. Thus, there are no large scale areas dedicated for the generation of renewable energy.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

8.2 Measures with biggest potentials for the city to work with

Big potential for Tartu lies probably in the limitation of urban sprawl as uncontrolled residential developments in its fringe which generate high travel needs. Though, the city's capabilities to address these challenges are limited due to the strong private property rights and the tight city boundaries, thus, coordinated development with the neighbouring municipalities is required.

Further potential lies in the exploitation of large scale renewable energy generation that could serve a substantial share of the city's energy demand, since Estonian energy generation is currently mainly based on non-renewables. High potential lies furthermore in guidelines for the building stock including refurbishment of the existing buildings.

8.3 Most interesting examples of policies/measures etc. others could learn from

The city planning documents of Tartu aim comprehensively on densifying the city by preserving inner city green spaces at the same time to avoid urban sprawl. The compactness of the core city is reflected in the high share of non-motorized inner city transportation, walking is the main mode of transportation.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

9 Turku

9.1 Overall activity in the four themes

The city started to have a strong focus on climate and environment with their Environment Programme from 2009 (City of Turku, 2009). In 2014 the city adopted a new strategy leading to the development of a Roadmap for climate, energy and resource wisdom which is planned to be adopted by the city council during 2015. One of the main aims is to be **carbon neutral by 2040**. However, the city is also explicitly focusing on economic growth, but intends to combine this with the climate and environmental goals under the headline of 'green growth'.

More specifically regarding energy efficient **buildings and the built environment**, local development plans as e.g. for the new area of Skanssi include guidelines for energy solutions. However, the possibilities to demand specific energy solutions are limited, although there are options regarding the district heating grid.

The city **regional scale** is covered by the Regional Structure Plan 2035, a joint vision of Turku and its neighbouring municipalities adopted in 2012. A main aim of this plan is to limit urban sprawl and promote denser housing areas. These ambitions will be developed in more detail in the coming General Plan 2029 for the city, to be adopted in 2016.

Climate-oriented urban design is not yet general principle (although it is intrinsic in some older urban development). However, in new areas as Skanssi or in areas under urban renewal (e.g. Castle town) this is under consideration.

Regarding **transportation**, the Regional Structure Plan 2035 (and the upcoming General Plan 2029) is guiding the development with particular focus on a sustainable urban form to reduce transport needs and promote green modes of transport. Current public transport projects include the development of a light rail system and the adoption of electric buses. A plan to promote walking and cycling is currently (June 2015) under revision. The city also engages in a new car-sharing project.

In regards to **industry** the city has launched the concept of Smart Energy Business Parks in 2015. A first pilot, the 'Bluetech Park' for resource efficient maritime industries, is currently planned. Different energy efficiency measures and combined heat and power concepts are in use in some industries in the city, but mainly as pilots.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

In regards to urban **energy supply** the city has an extensive district heating system which is planned to shift to renewable energy in the future. The city has also a smaller district cooling system. Combinations between different public works and services, as e.g. excess heating from waste water treatment which is used to heat the swimming hall, are in place. However, production of renewable energy – both on a large scale but also on household scale – is still on a low level, but planned to increase significantly until 2035.

9.2 Measures with biggest potentials for the city to work with

The city is setting ambitious goals in its climate and energy policy. Areas which could be additional put focus on are

- Support of renewable energy production especially on small/household scale
- Further focus on climate-oriented urban design, considering sun and wind conditions to increase comfort in urban space as well as decrease energy use for heating in buildings
- Planning for multi-modal transportation, combining all kinds of transport, with a focus on public transport, biking and walking but also including limited car transportation in combination with those.

9.3 Most interesting examples of policies/measures etc. others could learn from

From an energy governance perspective, Turku is very actively trying to involve other actors, including companies and citizens. The city has also follows a very broad approach by initiating a wide range of different actions which all should contribute to its climate goals. These include

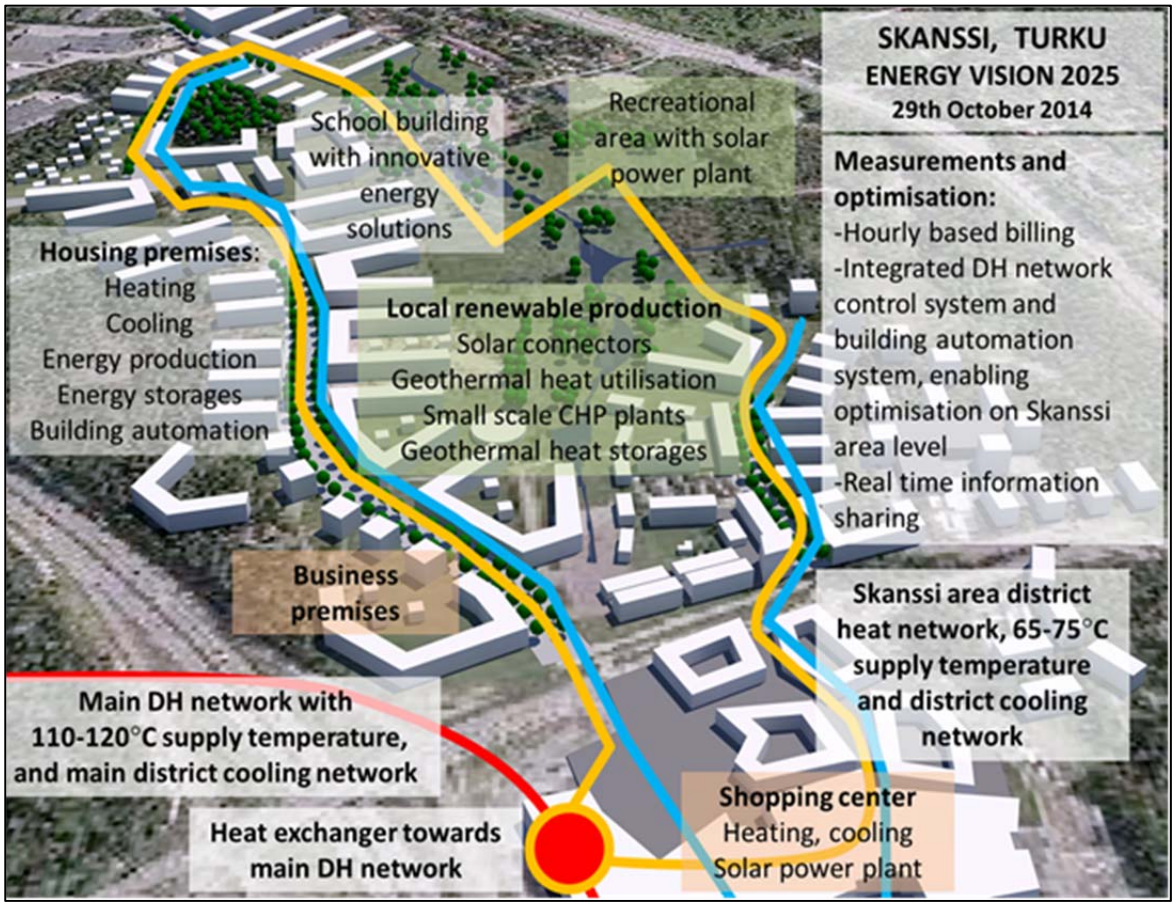
- co-operation between sectors, but also neighbouring cities
- Public procurement
- ESCO and other new investment methods to be used
- energy efficiency integrated in the renovation and building projects as one of the most important factors, including life-cycle analysis and costs
- energy efficiency in planning, including mobility management
- energy audit plan for the next 5 years, including a realisation plan for the improvement suggestions
- reporting, monthly energy consumption monitoring, evaluation
- training, eco-support network
- communication inside the city as well as for the public
- advisory board for energy efficiency

A very interesting project to follow from an urban planning point of view is the development area of Skanssi, a few kilometres south of the centre. The Skanssi area is planned as a pilot area with an integrated energy supply and demand system, mainly operating self-sufficiently. The diffusion of such technologies of decentralised energy supply systems can trigger new forms of settlement structures. The spatial requirements of district heating systems favouring compact city development in a big scale get weakened, enabling energy efficient heating of small scale settlement clusters.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Skanssi is a new urban development planned by the City of Turku. The area will be built on a green field which is however surrounded by different kinds of urban development already and close to existing infrastructure.

The innovation of the project lies however in its energy vision. It includes a low temperature independent district heating network which supplies the whole district. At the same time the system will be connected with energy production and storage units in the single buildings, developing into an integrated energy system. Also renewable electricity production and use will be integrated in the concept, including a range of optimisation and information systems.



Vision for the energy supply in Skanssi in 2025 (Vaittinen 2014)

Figure 13: Renewable energy supply of the new urban area of Skanssi, based on low temperature district heating combined with local renewable energy generation

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

10 Conclusions towards general models for the Energy-Smart City

In this final section we will draw some general conclusions based on WP4 work. We state four general questions (and some remarks to it) which cities should take into consideration when working on their Energy Efficiency Action Plans:

Table 9: Summarizing WP4 findings in four general questions

(1) How can spatial planning reduce energy use in our cities? A list with 29 measures.
(2) How do different geographical, regional, cultural or political contexts influence options? The baseline for actions.
(3) How can we measure and monitor its effects? Indicators and rebound effects.
(4) What is the scope of municipal action? Drawing system boundaries.

(1) How can spatial planning reduce energy use in our cities?
A list with 29 measures.

Based on the thematic review (Meijers et al., 2015) a number of tools and approaches towards urban energy planning was introduced. The review shows that urban planning can contribute to better energy efficiency in all three main sectors:

- Households/Buildings: Compact built-environment, energy efficient housing orientation and street layout, new housing areas accompanied by energy plan
- Transport: Urban structure lowering travel needs and favouring public transport (Transport oriented development), cycling and walking (street layout and compact city) and limiting car traffic (parking management
- Industry: Some cities still have a major industrial sector and urban planning can support the use of local potentials for synergies in energy generation

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Furthermore, urban planning can also support an increase in renewable energy production, e.g. by establishing district heating and cooling networks in dense urban areas and enabling small scale solutions (e.g. clusters using heat pumps) in less dense areas. Mixed used areas can support the efficiency of district heating systems.

After a round of comments from the six city partners we finalized a list of 29 measures and policies related to spatial planning to influence urban energy which were also discussed in relation to each city in this report.

(2) How do different geographical, regional, cultural or political contexts influence options?
The baseline for actions.

But there are also limitations to what urban planning can achieve. Every measure can only work when it relates to the local/regional context, which is framing a city's possibilities for the implementation of measures. This includes the legal system, cultural differences or behavioural preferences. In WP4 we focused in particular on differences in urban structure, that means its spatial functioning and management.

The six PLEEC partner cities are very different in this regards. E.g. Santiago and Tartu are rather small and far away from big cities, while Eskilstuna is close to Stockholm and Stoke-on-Trent is located between Liverpool, Manchester and Birmingham. This structure is decisive for transport and commuting as also the case study report showed (see PLEEC D4.2 reports).

Also the coverage of the municipal territory is crucial. Eskilstuna and (partially) Jyväskylä cover the main city and its closer hinterland. Tartu and Santiago are strictly confined to the central build-up area. Stoke-on-Trent and Turku have even the continuous built-up area shared between several local administrations. There is no 'ideal context', rather have different cities different challenges to face and also different opportunities. Sharing knowledge and best practice has to be informed by this.

(3) How can we measure and monitor its effects?
Indicators and rebound effects.

In PLEEC an indicator framework ('Energy-Smart Cities-Model') to monitor the energy performance of cities was developed including about 50 indicators (Giffinger, Hemis, Weninger, & Haindlmaier, 2014b). Based on that, we analysed and benchmarked the energy situation of Danish municipalities in a spin-off project called 'Energy-Smart Cities-DK', financed by NRGi/Kuben Management (Fertner & Groth 2015).

Energy consumption has been reduced in the recent decade, especially in rural areas, although urban areas are still using least energy per capita. Technical infrastructure for heating is advanced. District heating is steadily increasing, covering more than 60 % of all households and heat pumps are increasingly popular in rural areas (3 %). However, there are also some counteracting trends. Floor area is increasing, more than population. And although Denmark has a well-functioning public transport system and a strong cycling culture, car transport is stable or even increasing. The average km per car (vkm)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

are decreasing in urban areas, however, the number of cars is increasing in the same time.

These are partially rebound effects (Fertner & Große, 2016), where the efficiency gains by improving one system are out-balanced by the use of these (energy in our case) in another system. E.g. if urban planning contributes to reduced energy use (e.g. for space heating) rebound effects related to general societal trends (e.g. more single households) can occur and outbalance efficiency gains. A major question is therefore the scope of e.g. a municipal energy action plan.

(4) What is the scope of municipal action?
Drawing system boundaries.

When the City of Copenhagen will be reach its ambitious aim of being carbon neutral in 2025 (City of Copenhagen, 2012), we will have come a big step forward. However, energy is not only consumed directly (e.g. in the form of electricity or fuel).

A large portion of energy consumed by citizens of the developed world, is consumed indirectly, that means e.g. in the form of material or food, which consumed energy and emitted greenhouse gases during the production process. Figure 14 shows different arenas wherein a municipality can act. The most efficient actions can be achieved in the municipal concern, however, if we aim at long term sustainable development it is crucial to work with citizen's direct and indirect energy consumption. Indirect energy consumption has not been a focus in PLEEC, but some cities as Jyväskylä and Turku aim at a broader perspective with their 'one planet living' approach.

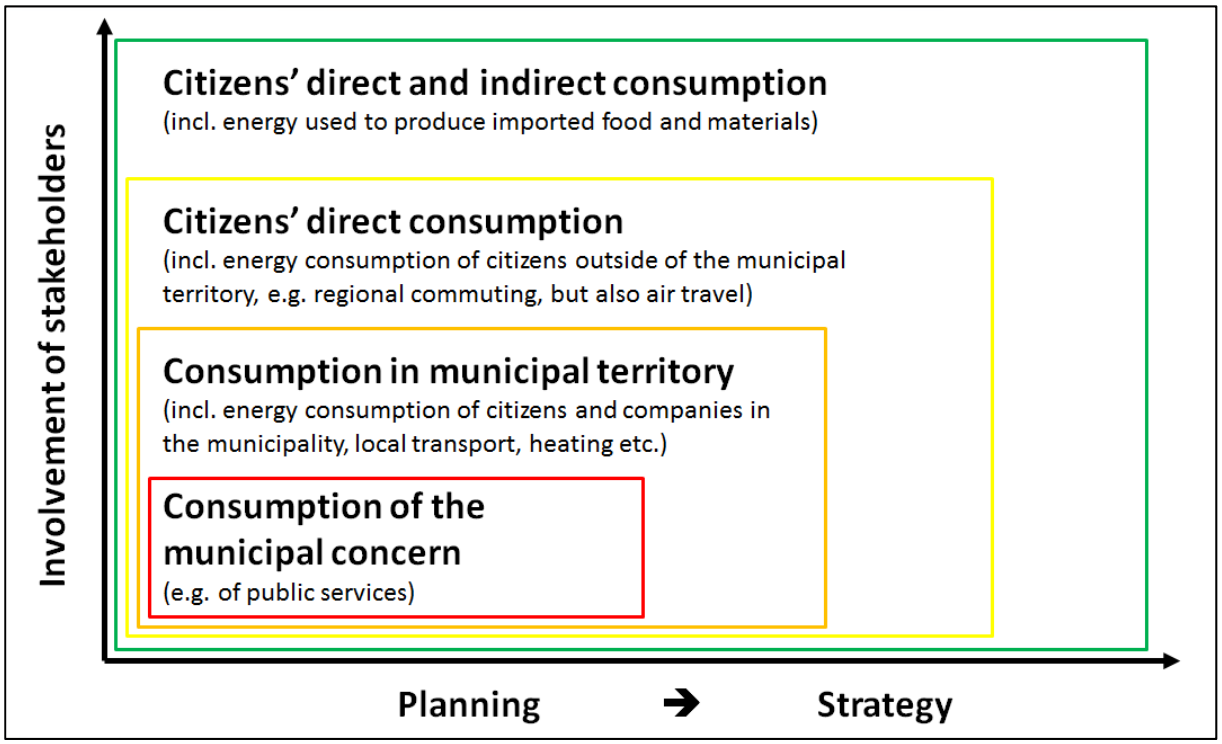


Figure 14: The scope of the EEAP can concern different stakeholders and approaches

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

The borders between the different approaches are however less sharp in reality. E.g. some actions in the red box can also have influence on the wider scale (e.g. sustainable food policy in local public schools can influence citizens' general nutrition habits and therewith influence their indirect energy consumption). There are also several dimensions or gradients along the boxes besides stakeholder involvement and planning/strategy, including complexity, ease of decision-making, dependency, uncertainty, overall benefits, data needs, overlap of strategies etc. Figure 15 shows some notes on that emerged during the PLEEC workshop in Tartu in September 2015. However, the framework can be used to map current and future ambitions.

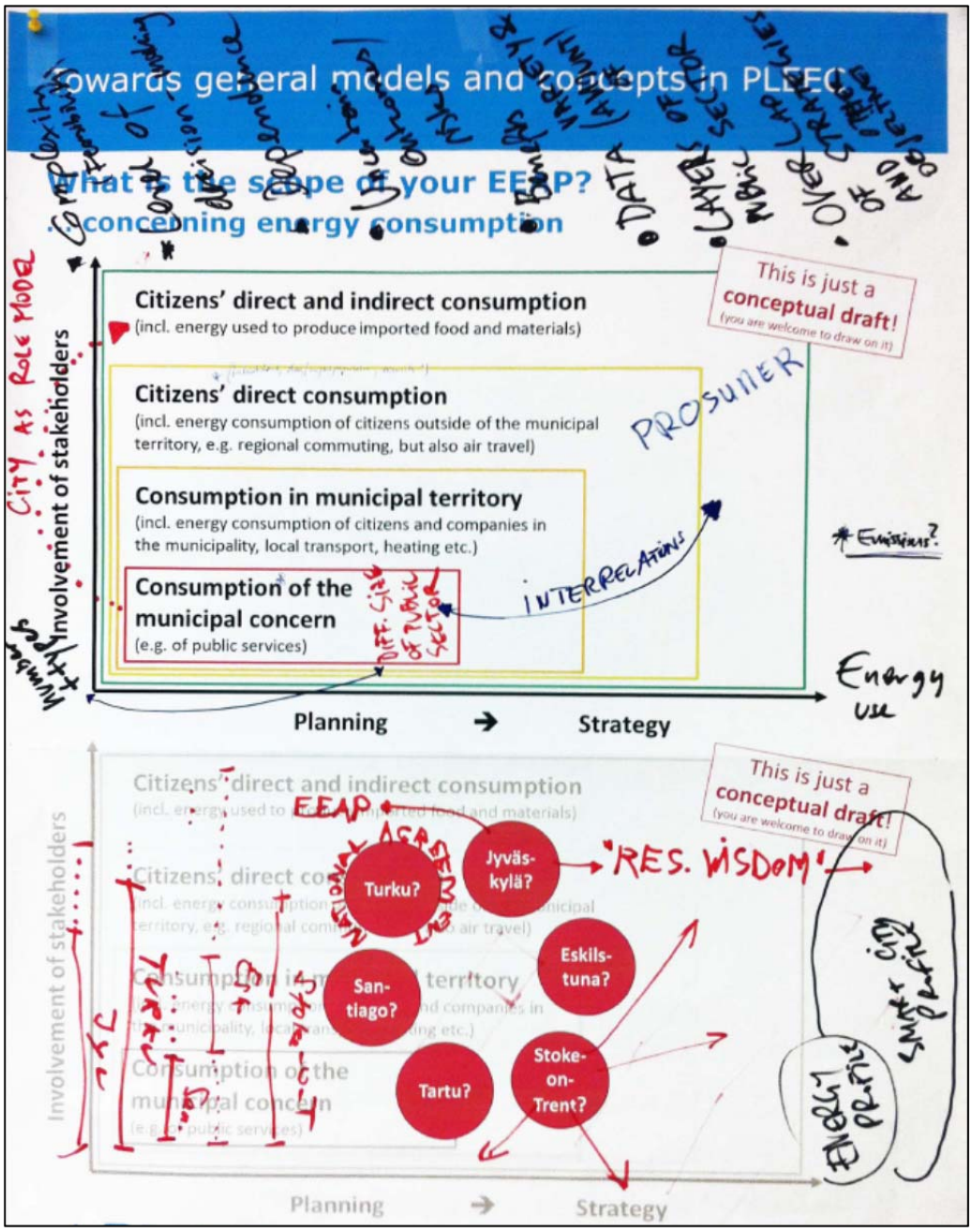


Figure 15: The scope of the EEAP – more dimensions and self-assessment of city partners (from workshop at Tartu meeting, 23 September 2015)

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

11 References

City of Copenhagen. (2012). *CPH 2025 Climate Plan. A green, smart and carbon neutral city*. The Technical and Environmental Administration. Retrieved from www.kk.dk/climate

City of Turku. (2009). *City of Turku's Climate and Environment Programme 2009-2013*. Approved by the City Council on 26 October 2009.

EEA. (2014). *Corine Land Cover Data Version 16*. The European Topic Centre on Land Use and Spatial Information: www.eea.europa.eu/data-and-maps, last accessed September 2014.

Eskilstuna Kommun. (2015). *Arkitekttävling Skogsängen: Uppgift, redovisning och utvärdering*.

Fernandez Maldonado, A. M. (2015). *Urban energy planning in Santiago-de-Compostela*. EU-FP7 project PLEEC, Deliverable 4.2 (4). Retrieved from http://www.pleecproject.eu

Fertner, C., Christensen, E. M., Große, J., Groth, N. B., & Hietaranta, J. (2015). *Urban energy planning in Turku*. EU-FP7 project PLEEC, Deliverable 4.2 (3). Retrieved from http://www.pleecproject.eu

Fertner, C., & Große, J. (2016). Compact and resource efficient cities? Synergies and trade-offs in European cities. *European Spatial Research and Policy*.

Fertner, C., Groth, N. B., Große, J., Read, S., Rocco, R., Meijers, E., … Mashayekhi, A. (2014). *Framework for reports on urban energy planning in 6 case cities*. EU-FP7 project PLEEC, Deliverable 4.1. Retrieved from http://www.pleecproject.eu

Giffinger, R., Hemis, H., Weninger, K., & Haindlmaier, G. (2014a). *Energy Efficiency Indicators - Empirical results accross key fields and cities*. EU-FP7 project PLEEC, Appendix to Deliverable 2.4. Retrieved from http://www.pleecproject.eu

Giffinger, R., Hemis, H., Weninger, K., & Haindlmaier, G. (2014b). *Methodology for monitoring*. EU-FP7 project PLEEC, Deliverable 2.4. Retrieved from http://www.pleecproject.eu

Große, J., Groth, N. B., Fertner, C., Tamm, J., & Alev, K. (2015). *Urban energy planning in Tartu*. EU-FP7 project PLEEC, Deliverable 4.2 (2). Retrieved from http://www.pleecproject.eu

Groth, N. B., Große, J., & Fertner, C. (2015). *Urban energy planning in Eskilstuna*. EU-FP7 project PLEEC, Deliverable 4.2 (1). Retrieved from http://www.pleecproject.eu

Grunfelder, J., Nielsen, T. A. S., & Groth, N. B. (2015). Changes to urban form and commuting patterns: trends in two Danish city regions. *Geografisk Tidsskrift-Danish Journal of Geography*, *115*(2).

This project is financed by the European Union

Laskowski, K. (2013). *DHC Country by Country 2013*. Vienna: 36th Euroheat & Power Congress.

Meijers, E. J., Romein, A., Stead, D., Groth, N. B., Fertner, C., & Große, J. (2015). *Thematic report on urban energy planning: Buildings, industry, transport and energy generation*. EU-FP7 project PLEEC, Deliverable 4.3. Retrieved from http://www.pleecproject.eu

Novak, J., Ahas, R., Aasa, A., & Silm, S. (2013). Application of mobile phone location data in mapping of commuting patterns and functional regionalization: a pilot study of Estonia. *Journal of Maps*, *9*(1), 10–15. http://doi.org/10.1080/17445647.2012.762331

Rae, A. (2014). *Travel to Work in England and Walse*. Retrieved from _http://ajrae.staff.shef.ac.uk/img/eng_ttw_all_blue_300px_labels.png_

Read, S., & Hietaranta, J. (2015). *Urban energy planning in Jyväskylä*. EU-FP7 project PLEEC, Deliverable 4.2 (6). Retrieved from http://www.pleecproject.eu

Rocco, R. (2015). *Urban energy planning in Stoke-on-Trent*. EU-FP7 project PLEEC, Deliverable 4.2 (5). Retrieved from http://www.pleecproject.eu

Roto, J. (2012). *Demographic trends in the Nordic local labour markets* (No. 978-91-87295-02-7). Nordregio Working Paper 2012:13.

Vassileva, I., Campillo, J., Dahlquist, E., Klementavicius, A., Juraitis, R., Marinov, M., … Vieites, E. (2015). *Technical state-of-the-art innovative solutions*. EU-FP7 project PLEEC, Deliverable 3.1. Retrieved from http://www.pleecproject.eu

This project is financed by the European Union

SEVENTH FRAMEWORK PROGRAMME

Annex: Filled-in tables with measures by city partners

The six tables (one for each city) with list of measures and information provided by city partners are enclosed as annex to this report.

An Excel file with all tables can be found on the PLEEC homepage (www.pleecproject.eu) in the internal partner section (Login necessary) in folder WP4\Deliverables.

This project is financed by the European Union
SEVENTH FRAMEWORK PROGRAMME

Eskilstuna

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	ESKILSTUNA: Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre...)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner
Buildings and the built environment	A. Optimize energy distribution on district level	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	Yes. Comprehensive plan 2030/general plan 2030 as well as traffic plan and climate plan. Comprehensive plan (approved 2013 and base for the detailed development plans). In the long-term perspective perhabs even in the regional city network of the four cities Eskilstuna, Västerås, Strängnäs and Enköping (start-up phase).	regional, city and district (building)	existing and new areas	ongoing and long-term 2030, climate aspects long-term 2050	high	Three strategic documents where worked out together and show the future development until 2030: The comprehensive plan, the traffic plan and the climate plan. The comprehensive plan 2030/general plan 2030 contains strategies (e.g. compact, dense and diverse city), principles (e.g. densification principles) as well as describtions (e.g district heating, heat pumps as well as solar energy) where the city does not have anyrådighet due to national legislation. the comprehensive plan 2030 also shows areas for the location of wind power. The urban planning department has started working in line with those strategies on a strategic level (bedömning and prioritising of urban planning projects) as well as a planning level (detailed development plans mostly within the urban fabric). Within the regional city network of the four cities Eskilstuna, Västerås, Strängnäs and Enköping, energy efficiency will be one of the aspects discussed for co-operation (start-up phase). When it comes to strategic traffic infrastructure projects there are plans about the double rail line from Stockholm to Strängnäs as well as the refurbishment of the station in Kvicksund. The traffic plan and climate plan goes in line with the comprehensive plan.
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	No. Not used due to national regulations. But some approaches on district/building level	building scale	existin and new	long-term	medium	Kfast jobbar med planer på hur vi ska energieffektivisera och vilken energi vi ska använda, men det blir ju ganska naturligt då vi använder fjärrvärme då sådant finns framdraget. Vi använder ju beräkningsmodeller vad gäller hur vi ska energieffektivisera inom fastigheterna. Deregulation of energy planning and the national regulation of energy efficiency for new buildings (BBR) since 2015. Cities are not allowed to regulate energy use within spatial planning (detailed development plan). We only can describe and recommend, but nothing more. The municipal housing (Kfast) working with eco-labelling for new buildings (miljöbyggnad guld) for example the swimming hall. There is also an on-going project aiming to adapt the Breem-concept to Swedish circumstances and then to work with eco-labelling at a district level. Those eco-labels contains some energy related aspects as well. There are also som municipal-owned housing district pointed out for EE-measures, first of all was Lagersberg, now the work continuous with other districts.
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	Yes. Comprehensive plan/general plan 2030. Vision for the city centre. In the city centre, but not always in the "suburbs" depending on the existing building structures and the intended mixture just there. Kind of "cluster-building" in countryside-nods is described in the comprehensive plan.	city, district scale	existing and new areas, city centre	ongoing, short-term and long-term 2030	high	Density is integrated in the comprehensive plan/masterplan 2030. The vision for the city centre will contain one strategic part related to densification and height of buildings . Following the main principle in the comprehensive plan 2030, planning projects within the urban fabric, especially within the city centre are prioritised. The comprehensive plan 2030 will have a monitoring system in order to be better able to follow up the development.
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	Yes. This is one of the densification principles in the comprehensive plan/general plan 2030 and will be more concretisesed in the vision for the city centre. The Planning department is working in line with that in some ongoing projects.	city, district scale	existing areas, suburbs, city centre	ongoing, short-term and long-term 2030	high	Various strategies on urban transformation, e.g. "urban healing", building to the edge of the streets, transformation parking spaces, industrial areas
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)	Yes.	district scale	existing areas, suburbs, city centre	ongoing, short-term and long-term 2030	medium	see densification principles in the comprehensive plan 2030. On wide streets, bicycle lanes are built whereby the street section becomes smaller for cars and more comfortable for cyclists.
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	Not really used in the possible extend. Not prioritised due to the lack of possibilities to steer EE in the binding planning process (local development plans) . Partly discussed in the Climate plan (2020 and 2050).	building scale	not used	not used	low	
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)	In a little scale mostly in the countryside and in relation to solar access (location of new houses on the "right" side of hills) Within the existing urban fabric other aspects can be prioritised. For the urban fabric, there is a solar map available to all citizens to show exactly what areas that get which amount of solar radiation.	building scale	new areas	no special time-perspective	low	Intresting in relation to A5! Due to the fact that most of the city planning is done within the existing city and we are not allowed to regulate energy aspects that precise, we mostly prioritise indirect methods as compactness, densification... The solar map is used in the municipal energy advise available for all citizens. Mostly used in order to find suitable location for houses in the countryside and avoiding location at the north side due to shadowing
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)	In a little scale mostly in the countryside and in relation to cold winds (location of new houses)	building scale	new areas	no special time-perspective	low	Mostly used in order to find suitable location for houses in the countryside due to cold northern winds.
Transportation	C. Reduce travel needs	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	Yes, but not in the same extend as densification. A mixture of different functions mainly in special nods is discussed in the comprehensive plan. The development of larger settlements is not promoted on greenfields, but within former industrial areas and within the existing urban fabric. Kind of nods like small villages in the countrysides.	city, district scale	existing and new areas	long-term 2030	low	We had a large area about 5 minutes from the city centre where we now have planned for 1000 apartments.
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	Yes. Comprehensive plan/general plan 2030. We use the principles in the general plan when it comes to location proposals and approvals for new housing areas. The main principle in the comprehensive plan is to avoid urban sprawl and instead building within the existing urban fabric.	city, district scale	new areas	short-term and long-term 2030	high	Se gärna filmen om ÖP för att få en snabb intro http://www.eskilstuna.se/framtid (skrolla ner för att se video-fönstret)
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	Yes. Comprehensive plan/general plan 2030 and planning programs for former industrial areas.	city, district scale	existing and new areas	short-term and long-term 2030	high	We have a map in the comprehensive plan showing the urban fabric within a 800 m distance till Livsmedelsbutiker that help us in the planning and location of new livsmedelsbutiker.
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)	No.	city	existing areas	long-term	low	Relocation kan vara intressant för andra funktioner, som t ex omlastningscentraler m m. Saknar strategier för transport of goods (t ex transport till och från industriområden samt för omlastning till tåg) När det gäller kraftvärmeverket i Väster och ny lokalisering gällde det bara Hetvattenpannan (CFB) (fliespannan). Hetvattenpannan har nu i stället renoverats. Det nya Kraftvärmeverket i Kjula hade ersatt hetvattenpannan i Väster och kompletterat det befintliga kraftvärmeverket i Väster. Därmed hade Eskilstuna kommun haft två kraftvärmeverk.
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	Yes. Comprehensive plan/general plan 2030 and transport plan.	city, district, city centre	existing and new areas	ongoing, short-term and long-term 2030	high	Some example are the new university, simming hall and the arena located within 10 minutes for pedestrians from the station ar the city centre.
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	Yes. Comprehensive plan/general plan 2030 and transport plan.	city, district scale, city centre	existing and new areas	ongoing, short-term and long-term 2030	high	Some example are the new university, simming hall and the arena located within 10 minutes for pedestrians from the station ar the city centre.
		D3. Develop intermodal transport nodes in combination with urban development	Yes. New station as a travel centre planned. Planning ongoing for the station in Kvicksund one of the nodes along the Mälaren. Transport plan, Comprehensive plan	region, citym destrict, city centre	existing and new areas	long-term 2030	low	Railstations such as main station and Kvicksund are high prioritized. When it comes to buss stops, bycycle parking is arranged nearby buss stops in order to make it easier to switch from bike to buss. City banan in Stockholm with regional impact.
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	Yes. In the transport plan we have 800 m distance from nearest buss stop.	city, district	existing areas	ongoing, short-term and long-term 2030	high	We are working primarily with densification within the existing urban fabrics, often within the city centre with good access to public transport.
		D5. Develop key public transport networks in urban areas	Yes. A bus system was adapted with better timetable along two main lines which went very well. Work with a public transport plan is ongoing with regional connections and four main lines (stomlinjer) with extra good access. Tänk spår men buss.	region, city	new and existing areas	ongoing, short-term and long-term 2030	medium	
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Yes. Transport Plan and bycycle plan, Gehl report as a part of the vision for the city centre showing the pedestrian perspective.	city centre	existing and new	ongoing, short-term and long-term 2030	high/medium	Dessa vägar ska vara prioriterade före bilvägar! – planera först för gående och cyklister och lägg bilstrukturen sedan! I vår trafikplan har vi gått ifrån bilen som norm. Numera ska det planeras enligt följande turordning: Gående & cyklister - Hållbara transporter (buss + tåg) - Bil Gående är medium och cyklister är high. Specifika åtgärder för gående sällan. Kunskapsstråket för gående, gångzonen, Eskilstuna plusset. Gehl-rapporten Stadsliv och stadsrumsstrategier.
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)	Yes. Cykel plan an ongoing work with missing links.	city	existing and new	ongoing	medium	Depending from place to place. Includes even permeability for cars where it is needed.
		D8. Avoid development locations that promote long-distance journeys **by car**.	Yes. Comprehensive plan is the base for our so called Planbesked where people intrested to build get a bedömning for there proposals. Developments including new jobs can be difficult in the political way. Easier for housing.	city	new areas	ongoing and long-term 2030	high	Läget I sig för ny bebyggelse är viktigt också! Huvudprincipen och det viktigaste redskapet för att skapa en långsiktigt hållbar kommun är att begränsa stadens utbredning genom att förtäta den inifrån och ut. I vår ÖP har vi följande turordning för ny bebyggelse 1. Förtätning inom städerna (parkeringsplatser på mark, stadsläkningsprojekt, lucktomter, m m) enligt förtätningsprinciperna i ÖP:n 2. Växa i pärlband och noder längs med kollektivtrafikstråk 3. I strategiska lägen utanför städerna komplettera befintlig bebyggelse
		D9. Imposit maximum parking standards (parking management)	Yes. We have a flexible parking norm with a maximum number. Leading system for parking areas in the city centre, showing how much/less the parking areas are used at the moment (monitoring as well). Work with a parking policy is ongoing.	city districts	new areas	ongoing	high	Flexible parking norm with economic impact: more sustainable transport solutions less costs for parking lots. Work with a parking policy is ongoing.
Industrial	E. Enable industrial symbiosis by spatial clustering of industrial activities	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO2 reduction. Case studies suggest that fuel efficiency doubles.)	Yes inom kommunkoncernen. Tänket finns vid lokaliseringar som en del av ESEM:s verksamhet. Var behöver man energi, var kan det tillföras? Exempel 1: Våtmark och rötning i anslutning till reningsverket för avloppsvatten, gasen leds sedan vidare till biogasmacken. Nära placering intill varandra, så att långa ledningar undviks. Exempel 2: Samverkan i Strängnäs kommun mellan Lantmännen och ESEM för deras torkningsprocess för spannmål - fjärrvärme i stället för oljepanna. Utvecklingspotential finns enligt ESEM både inom och utanför kommunkoncernen.	city	existing and new areas	ongoing	high	ESEM undersöker alltid möjligheterna till detta, men det måste finnas ekonomi i det så att det blir en intressant lösning för både intressenter och ESEM, då ESEM inte är ensam aktör på marknad. Ny lagstiftning inom området: Om det byggs något nytt inom fjärrvärmenätet, så behöver det kollas om det inte finns spillvärme att använda i närheten. Det ingår som en del i ansökan om miljötillstånd. Exempel framtid: Soptippen och överbliven gas som bör kunna förgasas och sedan användas biogasprodukation.
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)	Yes. "Kluster" i form av industriområden och större anläggningar (t ex travbanan) som försörjs med fjärrvärme/närvärme. Möjligheterna har undersökts och diskussioner förts med organisationer som har potential att föra in energi, men det har stoppats av lönsamhetsskäl. Just nu har vi ingen som levererar energi till nätet. Some clusters when it comes to district cooling networks.	city, district	existing and new areas	ongoing	high	Industrisektorn förändras och därmed även behoven. Där det är möjligt undersöks möjligheter att förtäta inom befintliga industriområden. Economically intresting to locate industries within the existing district heating system.
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**	Yes. Alla industriområden är anslutna till fjärrvärmenätet. I Kjula, det nyaste industriområdet, är det förberedd med en panna för att möjliggöra närvärme när det kommer in industriverksamhet.	city (fjärrvärme), district (fjärrkyla)	fjärrvärme (befintliga och nya) fjärrkyla (befintliga)	ongoing	hög	ESEM erbjuder anslutning till fjärrvärmenät, men privata aktörer bestämmer själva om erbjudandet är intressant. Fjärrvärmenätet byggs ut i mån av intresse och ekonomi. Fjärrkyla finns stor potential i.
Energy generation	G. Optimise energy distribution systems	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	Yes. District heating system is already covering the main part of the urban areas, but conflict in new areas with energy efficient buildings. Vi har t ex fjärrvärme som kompletteras med närvärmeanläggningar t ex vid travbanan.	city	existing areas and new areas	ongoing	hög	Organisationen ser kontinuerligt över möjligheter att slå ihop fjärrvärmenätet m m. Så fort det finns ekonomi i det kommer det förmodligen även att göras på regional nivå. Samtidigt finns det en konflikt vid förtätning inom fjärrvärmenätet och förnybara energier (värmeproduktion) och låg/noll/plusenergihus. I villaområden med hög andel bergvärme är det inte längre intressant att ansluta till fjärrvärme. Hur får man till ett bra samspel mellan förtätning inom befintlig bebyggelsestruktur/fjärrvärmenät och förnybara energier? Vid varje intresseförfrågan tittar ESEM mycket brett på frågan om olika energilösningar innan energilösningen presenteras. Ekonomin är mycket styrande.
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.	Yes. The comprehensive plan 2030 shows areas suitable for wind power. Eskilstuna municipality bought wind mills to supply the city administration with electricity (50% of total use) but due to procurement rules the location could not be chosen. There aren´t very good wind locations in the Eskilstuna region and therefore the windmills are built in the northern parts of Sweden.	city	countryside	windmills built 2015 otherwise 2030	medium	Energikombinat ses över hela tiden. Tankar finns att kombinera kraftvärme och biogas. Det krävs dock i dagsläget helt enkelt högre elpriser för att kunna få sätta igång olika projekt.
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.	no information	no information	no information	no information	no information	Behöver höra med VA-chefen.
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	no. Solar panels are not that usual here due to the large district heating network. Solkartan visar hus som har bra förutsättningar utifrån solstrålningen och orienteringen.	no	no	long-term	low	Solceller för elproduktion är intressanta att titta på, men fortfarande svårt på grund av det ekonomiska utgångsläget.
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	Yes. Reduced fees for building permissions for passive houses and wind power	building scale	existing and new areas	not discussed	low	Not intresting for housholds due to the electricity prices. Värmepumpar kan bli mer intressanta framöver jämfört med fjärrvärmeanslutning på grund av elpriser. Just nu dock ingen stor fråga. Lotta: I think more small scale energy production would increase the households awareness of energy as a concept.

Jyväskylä

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	JYVÄSKYLÄ Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre…)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner
Buildings and the built environment	**A. Optimize energy distribution on district level**	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	Energy efficincy considerations are rather deeply and explicitly incorporated into planning policies, for instance urban and regional transport and land-use planning to positively reduce energy demand through controlling urban form. However, energy effciency considerations are often combined with, or subordinated to ecomomic and social considerations (see K3). The planning policy is to build compact forms with public transport and all municipal projects conform to this. At the same time sprawl is a result of economic growth (and related policies), which includes competition with other centres and people who have car oriented, suburban lifestyle demands. This by-product of economic policy has been pushed by development demands (expansion of developed land along with rises in land value). The positive news is that suburban expansion has slowed down with a new cycle of older people returning to the compact centre and releasing houses for newcomers.	city & region	existing and new areas	from short to long term	high: to offset the tendency of residential urban dispersal (sprawl) and to optimize the efficiency of current infrastructure use and energy use.	General principles for planning regarding district heating which are usually implicitly considered: Plan areas so that the heated building volume (and thus the energy need) per th needed district heat network length is maximized (average threshold in Finland is 0,5-1 MW per kilometre); in the ideal situation CHP/district heat plant is near dense and compact building stock; CHP electricity production is feasible only when there is enough heating load (e.g. in Finland 3-10 MW upwards), depending heavily on the feed-in tariffs and subsidies available.
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	The rationale / viability of DH systems rests on economies of scale. J. 'protects' this by keeping a high proportion of houses connected. It does so by imposing stringent requiremesnt on the use of alternative heating methods, and by concentrating houses in compact areas (estates) to limit retivulation lengths of the DH network. New housing developments, compact and close to the city centre, are planned in … with the aim to maximise DH and transport efficiency. Also the efficiency of water supply (energy needed for pumps) is considered in planning.	city	existing areas and new suburbs	medium-term	high due to the ambition to optimize the energy efficiency of built environment and efficiency of DH, connected to CHP.	
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	Bound to the demographic growth of the city, the share of apartment buildings has increased over the decades. Currently from 1000 new apartments built annually, 200 are small houses. After compact city policy, apartment buildings are prioritised, especially for existing but also for new areas. The recent demographic development increases the share of apartment buildings as retired people move to the city centre and existing small houses are released to the market. But In Kangas (D18-19) for instance, (large and affordable) apartments only provide 10% of the housing stock.	city, district	existing and new areas	all terms	high: fits in compact city policy…	
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	Compact city policy of building as far as possible in a concentrated manner in or adjacent to the historical centre.	city	existing and new areas	long-term: connected to new urban evelopments	see A2	
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)	Compact city policy is a leitmotiv of urban planning already for some 25 years now. Concern for cost and use efficiency translates quite well into energy efficiency as compact and highly central settlements reduce energy demand, increase efficiencies and offer potentials for cycling and walking as alternatives. The case study does not explicitly elaborate compactness on the level of individual streets and buildings, but keeping the size of open spaces as limited as possible is a prerequisite for it…	city+fringe	existing and new areas	long-term: connected to new urban developments	see A2	
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	Due to 'extreme' climate conditions, energy issues have been dealt with historically. For instance insulation standards have been higher than the European one, and energy efficient DH and CHP production using local fuels has been developed since 1970s.	city	existing and new areas	long-term	high: the supply of local fuel still 'allows' further of use in DH and CHP.	
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)	"Factors like housing orientation, urban heat gain, hard surfaces (?) and vegetation contribute to heating and cooling efficiency"… For Kangas (D18-19), a solar energy plan has been made in which the orientation and roof angles of buildingshave been optimised for solar production. Inside the buildings, spece reservation for solar energy systems are deisgned.	city	existing and new areas	short to long-term: connected to new urban developments but also for existing areas	high: opening buildings to the sun to optimise passive solar heat use is considered when planning the lots and building sites	
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)	no specific mention to use of wind as 'ventilator'	district	all	short	medium: wind blocking towards north is considered, but less than opening to south and sun (B2)	
Transportation	**C. Reduce travel needs**	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	The compact city policy with regard to new (city sponsored…) housing and business premises has been concentrated in the last 10 years in two relatively large-scale areas, Lutakko (an old industrial site) and Kangas.Kangas is intended to provide high-quality housing in a socially and demographically balanced and diverse living an working environment. Over all, use of energy-efficient transport modes is an explicit objective.	city+fringe	new suburbs	long-term: connected to new urban developments	high: energy efficiency is explicit and important policy goal	
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	Between 1960s and 1980s, new suburbs were built at 'long distances' from city centre => urban dispersal. Recently, this is being 'corrected' by a countervailing compact city policy. This planning response is reflected in re-engineering and re-use of urban structures (incl. disused industrial and defunct public transsport infrasturture), and in focusing all municipal residential development effort on a small number of relatively high density in-fill projects in central locations.	city	existing and new areas	medium to long-term	high: as long as stocks of available land and obsolete urban structures are available	
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	see D6: explicit mention of houses and jobs, not of other urban facilities and services…	city, as close to the centre as possible	existing and new areas	long-term	medium: travel distances within J. are relatively limited anyway	
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)	Impossible at short-term (to move the existing plants), to be considered at long-term developments. Already train used for coal (which represents only a small share of fuels) but local fuel (wood, peat) logistics are usually offered only by road transportation. Wood fuels from forests are not usually able to be transported by train (no rails in the woods) and come from relatively close. Also existing infrastructure and zoning is an obstacle for new plant locations.	n/a	n/a	n/a	low: not relevant and impossible at short term (not economically/technically viable)	
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	an integrated part of compact city policy and transport planning, although the concept of TOD is not explicitly mentioned in the case study.	city+fringe	existing and new areas	all terms	high: to offset the tendency of fuel-use due to urban dispersal (sprawl)	
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	Master Plan (2012): land-use in J. would in the first place concentrate in areas where citizens can make use of several options of mobility and where the services are already available at a reasonable distance; i.e. not exclusively city centre.	city+fringe	existing areas	adopted in 2012; time perspective not mentioned	high: to offset the tendency of fuel-use due to urban dispersal (sprawl)	The new Jyväskylä Master Plan is from the year 2014 and contains the same policy. Do you mean the regional Structure Plan 20X0 (from 2012) here?
		D3. Develop intermodal transport nodes in combination with urban development	Public transport is a key (structuring) element of the stratgic plan to concentrate all development in existing centres. But there is no mention in this respect of intermodal nodes, it seems to be based on bus services only.	city+fringe	existing centres	all terms	medium: to reduce private car use	Public transport in the surrounding fringe is not frequent enough to serve alone in sparcely populated areas. Obviously there are no railways available either. Only biking and walking are allowed in the city centre.
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	Present planning (represented in Structure Plan) aims to maintain compactness as far as possible and to rationalise and concentrate land-use and transport development within the existing centres of the whole functional area of J. (see D20)	regional (J. + two neighbouring municipalities)	both suburbas and city centre	all terms	high: to offset the tendency of residential urban dispersal (sprawl)	Raising the comment from Stephen Read: New economic developments tend to be smaller scale (Soho type) and better suited to the compact centre. Jyväskylä is a "10-minute" city, where accommodation is located in the centre, too.
		D5. Develop key public transport networks in urban areas	Public transport is a key (structuring) element of the strategic plan to concentrate all development in existing centres	city+fringe	existing areas and new suburbs	long-term: connected to new urban developments	high: to offset the tendency of fuel-use due to urban dispersal (sprawl)	
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Policy to locate buildings (homes and jobs) as far as possibnle in a concentrated manner in or adjacent to the historical centre reinforces the possibility [maximise the potentials] for a viable cycling and pedestrian network in that centre. Kangas (D18-19) is also intended to have an attractive pedestrian and cycling environment and the opportunity to live a car-free live.	city	city centre and adjacent areas	short to medium	high: currently several planning actions and investments to increase walking and cycling.	E.g. new fast biking routes are under development; one is to be built on an old unused railway track.
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)	see D6.	city	city centre and adjacent areas	short to medium	see D6.	Possibilities to increase permeability in the compact city centre are limited. We optimize street lighting to save energy, not compromising safety, however.
		D8. Avoid development locations that promote long-distance journeys **by car**.	Is a planning objective, to be achieved by combination of compact city policy and investments in public transport system as major structuring element of that policy. Major development in 10km radius.	regional and city level	all contexts	long-term	high: to offset the tendency of fuel-use due to urban dispersal (sprawl)	
		D9. Imposit maximum parking standards (parking management)	Less parking space demanded for new apartment buildings - less parking space allocated in centre than in fringe. In student housing and elderly housing less parking space allocated as well.	district	all contexts	all terms	high	
Industrial	**E. Enable industrial symbiosis by spatial clustering of industrial activities**	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO2 reduction. Case studies suggest that fuel efficiency doubles.)	The policy to develop J. as a technological growth centre has resulted in a few innovative Science Park-like clusters, and there are plans for some more of these developments. The opportunites for complementary energy and waste output-input flows are highly limited in these types of clusters	city+hinterland	new areas	long-term	low: little opportunites for industrail symbiosis in science parks	
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)	Jyväskylä is developing to the direction of a technological, service and education growth centre, and traditional energy intensive industries are now concentrated more outside J. region to Äänekoski (new very large biorefinery) and Jämsänkoski. There are no major energy intensive industry developments in the city region now. Previously steam from Jyväskylä CHP plant was used in the Kangas paper mill (now closed). Industrial heat from plywood mill is used as a districit heat for buildings in Säynätsalo.	city+hinterland	all	long-term	increasing use of renewable energy sources is of high priority, but the potential for industry clustering in this sense is low	
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**	A lot of this has already been done for the existing industries and currently the potential for new industrial energy intesive industry developments in the city area is low. See answers above on F1.	n/a	n/a	n/a	Low: see answers on F1.	
Energy generation	**G. Optimise energy distribution systems**	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	J. has developed a CHP and DH systems already since 1980s.The local energy provider Jyvaskyla Energy has invested in production plants of CHP and DH networks, and keeps services reliable and prices competitive. The fuel mix shows an increasing share of renewable sources [wood chips and biogas (landfill gas)] and decreaing use of coal, oil and peat; the intention is to continue this trend. [2014: 52% wood chips and biogas, 37% peat, 12% coal and oil]. See D5. In city planning, the possibility for district heat is considered for every planned and renewed area.	city+hinterland	all contexts	long-term	high: fuel efficiency of CHP is high (see j43-44) and renewable energy sources still abundantly available	Usual comparison is that the fuel efficiency of CHP is up to 90 % whereas the efficiency of non-CHP thermal electricity production is 30 – 40 %
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.	A solar energy plan has been made for Kangas area in which building orientation and rooftop angles are optimised for solar energy production. A wind power farm is zoned in Maatianvuori (Korpilahti).	district+city	existing and new areas	short and medium	medium: but low need for new production sites	A major investment for production of biogas to be used as traffic fuel is under preparation b the waste management company Mustankorkea Oy.
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.	Heat pumps as a renewable energy source have demonstrated significant growth rates in the past few years in building heating. Jyväskylä Energy Ltd has plans to install exhaust air heat pumps to five buildings owned by the city housing company and a district cooling unit using absorbtion technology is planned for the Kangas area as a pilot.	district, building	existing and new areas	short to medium	medium: not very much potential currently from excess heat sources, apart from exhaust air in buildings without ventilation heat recovery	
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	see B2.	city	existing and new areas	long-term: connected to new urban developments	medium: use of solar heat is expected to grow in the coming years, but potential for production is limited.	
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	At national level, there is a system of subsidies and other steering policies for small and micro-scaled distributed renewable energy production (solar, wind, biomass), incl. a basic energy subsidy for small houses for low-income households (see cell J49). Unknown which, if any, legal or institutional barrier had te be removed first…	national (see J49)	existing areas	since 2009; n.d. on perspective	high: systemic efficiencies like this one are required to offset increased residential energy use due to urban sprawl	The same policy is implemented in the whole country: the subsidies come from the state budget. However, when it is economic to use energy from a CHP, people do so. Legal barrier (taxation) for energy transmission from house to house within the same area should be removed - this hinders e.g. distribution of solar energy at the moment.

Santiago

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	SANTIAGO DE COMPOSTELA: Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre...)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner	other comments (TUD)
Buildings and the built environment	A. Optimize energy distribution on district level	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	Muncipal spatial development plans since 1940, but no incorporation of explicit energy efficiency considerations. Those considerations were not priority until last years.	Muncipal spatial development plans don´t incorporate explicit energy efficiency considerations.	Muncipal spatial development plans don´t incorporate explicit energy efficiency considerations.	The time perpective of the actual city planning is 2020. The future document that rules city planning should incorporate energy efficiency considerations	medium, regional and local policies cover broad array of other instruments to achieve energy efficincy	We find this meausure highly interesting	Autonomias are in charge of planning policies but should follow national framework. National policy on energy effciency for her part leans heavily of EU policy objectives and programmes. Galicia has developed a rather comprehensive policy framework on energy efficiency (although weak in the current PXOM...!), implementing 'all thinkable' instruments (new technology, equipment and vehicles; management; promotion campaigns; audits etc) except ... genuine spatial planning! Municipalites in Spain have no legal power to 'dictate' energy effciency policies - hence, there are no key local policy documents on that issue - but have a shared responsibilty with the autonomias for policy areas with large energy saving potential like public transport and urban planning.
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	Urban expansion by means of new residential areas adjacent to (El Ensanche, southside) and separated by railroad from (Fontinas, eastside) historic city. But no mention of energy plan. State regulations require the construction of energy efficient buildings (zero emission bulidings) from 2018.	National	Every building context(existing areas, new areas, refurbishment and rehabilitation)	Short term - 2018	low, mild climate and recent construcion of	We find this meausure highly interesting	All new buildings construction, and in some cases of refurbishment, are under mandatory laws about implementation of renewable energies and technics for insulation (except the heritage buildings), in order to fullfill the enegy reduction established by the spanish Technical build code.
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	Trend in A4 accompanied with trend towards multi-family residential buildings. However, the impact on energy efficiency is assessed negative because gain by less heating is more that offset by reduction of solar access.	City	existing area	trend, no policy	low, because diificult to achieve. It would imply partly demolition of houses and is contrary to policy to restore population density of historic city		
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	A4 + A5: Trends (no delibarate policy!) in inner city in 19th and 20th century: intensification of use of urban space = increasing building height and depth and decreasing open spaces in-between. This densification of building structure had a negative (!) effect on energy efficiency of urban fabric of inner city (see A3).	City	Existing areas	2020	low; density of urban pattern is already high in most of the city		
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)	Since mid 20th century, compact and protective (of built cultural heritage) inner city policies. Nevertheless: 'unwanted' trends since 1980s: suburbanisation within municipality and to neighbouring municipalities => decreasing and ageing population, and increasing vacancy and deterioration of housing stock in inner city = unchanging compactness in historic centre, expanding urban fabric and decreasing average population density. The former PXOM (1989) had as objective to promote / restore residential use of historic centre, but the current PXOM (see B2) embraces a completely different (expansionist) type of urban growth than previous compact city considerations.	City	New areas	2020	low: compact urban form has been explicit policy objective. This has been abondaned in current PXOM, but real estate crisis has slowed down suburbanisation.	We find this meausure highly interesting	The last PXOM (2008) aims to achieve the compacy of the urbanizated areas, at city and municipality levelIn order to avoid the tipical dispersion of the uilt-up areas grown up around the cities, keeping this growth under control making it more efficient.
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	S. has a oceanic climate with mild temperatures, generally clouded skies and highest rainfall in Spain. Nevertheless, also the highest average of hours of sunshine per day (5.3) of all PLEEC cities. Climate-conscious energy stratgeioes not mentioned. However, rehabilitation of the historic heritage regulation requires certain types of energy efficiency materials and messures (e.g. roof insulation)	City	Historical area	Long term	medium: mild climate limits demand for energy for heating and cooling of buildings, but solar energy available.		All new buildings construction, are under the rules established by the spanish "technical build code", which follow criteria about bioclimatic construction and other in order to take advantage of the climate context to decrease the energy demand
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)	Predominant N-S orientation of long housing blocks with corresponding E_W orientiation of individual dwellings; logic of this orientation is not mentioned. See last column A1: there is no 'independent' dedicated energy efficiency policy on municipal level. Furthermore, the current General Plan on Urban Development (PXOM, 2008), elaborated during economic boom period before 2007 when there were less pressing economic reasons for energy efficicny policy, does not contemplate neither size, types and location of 'green' nor orientation of buildings towards wind and solar access.	City	Every building context(existing areas, new areas, refurbishment and rehabilitation)	2020	medium: solar energy is relatively limited (although more than in other PLEEC cities) due to frequent cloudiness		All new buildings construction, are under the rules established by the spanish "technical build code", which follow criteria about bioclimatic construction and other in order to take advantage of the climate context to decrease the energy demand
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)	n.d. about wind, let alone about wind in relation to buildings	City	Every building context(existing areas, new areas, refurbishment and rehabilitation)	2020	medium: mild climate		
Transportation	C. Reduce travel needs	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	Two new, quite large residential areas have been developed in resp. the 1970s (El Ensanche) and 1990s (Fontinas) according to the typical features of Spanish urbanism, i.e. high residential density mixed with commercial functions.	region	suburbs	short	Medium: urban expansion of S. is already concen-trated in two large size settlements. Priority depends on urban form of suburbaisation in the region		
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	The two recently developed residential areas (El Ensanche and Fontinas;see A2 and C1) are located resp. adjacent to and seprated by the railroad from the historic centre. Both expansion fit in the compact urban growth / continuity of urban fabric policy that characertised PXOM until the current one (2008).	region	suburbs	short	see C1		
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	The two recently deveoped residential areas (El Ensanche and Fontinas;see A2 and C1) are set uo according to the typical feaatures of Spanish urbanism of high resoidential density mixed with commercial functions, i.e. at walking distance from home. .	city	suburbs	past	low: this is alreay typical for Spanish urbanism		
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)	no mention of such a policy	no mention of such a policy	no mention of such a policy	no mention of such a policy	no mention of such a policy		
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	Current PXOM (see B2) dates back to boom period of Spanish economy (until 2007-8) and incorporates an expansionist type of urban growth, putting aside the previous compact city considerations. It does not contemplate energy effciency promotion by increasing the population living close to high-quality transit nodes. There is no mention in the report of concentrations of sevices and jobs near such nodes. The reasoning in the Plan for Sustainable Urban Mobility attempts to open up existing urban development (particularly El Ensanche, Fontinas, university campus) by better public transport, i.e. the reverse order...	city	Every building context(existing areas, new areas, refurbishment and rehabilitation)	2020	low: policy may be relevant for future urban develop-ments, but such nodes -with room for new develop-ments in its im-mediate surroun-ding - are not existing now in S.	We find this meausure highly interesting	
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	no such policy mentioned. On lower spatial level, neigbourhood commercial functions are included in the recent residential developments of El Ensanche and Fontinas	city	suburbs	past	low: this is already typical for Spanish urbanism		
		D3. Develop intermodal transport nodes in combination with urban development	Plan of Sustainable Urban Mobility (2011) includes plan for two low price modal shift nodes: parking garage + bus to city centre. There is also a project to project to unite in one space and building the train station and bus station (urban bus and metropolitan bus)	regional	New areas	2020	see D1		
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	no mention of such a policy	no mention of such a policy	no mention of such a policy	no mention of such a policy	see D1		
		D5. Develop key public transport networks in urban areas	Plan of Sustainable Urban Mobility (2011) includes plan for two low- price modal shift nodes: parking garage + bus to city cente.	city	suburbs	short	high: high level of preference of car use, leading to congestion in historic city. But additional mesures to influence car-based attitude also needed.		
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Previous PXOM had a objective to improve the pedestrian infrastructure, meeting places (?), and links between different parts of the city, eliminating (reducing?) car traffic. Plan for Sust. Urban Transport includes public bicycle plan with dispensers in historic city, campus and Fontinas. Does not prosper: lack of bicycle lanes, frequent rainfall, hilly terrain, car drivers do not respect cyclists and prefeence of car use even for short distances.	City	Every building context(existing areas, new areas, refurbishment and rehabilitation)	2020	low regarding cycling. Due to 'unsolvable' obstacles against bicycle-use: hilly terrain and frequent rainfall		
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)	Local planning has focused on the regeneration of the pedestrian historic city. The Plan for Sustainable Urban Mobility (2011) aims to create a [...] walkable city, but interventions in the street network are not mentioned.	City	exiting city	short	low		
		D8. Avoid development locations that promote long-distance journeys **by car**.	no explicit mention, but the expansionist type of urban development advocated by the current PXOM suggests the opposite. Indeed, the surface of the urban fabric has expanded permanently (although spatially rather continuously) since the 1960s and traffic congestion (due to growing employment base since proclamation to capital city of Galicia (1978) and increasing car ownership) since the 1980s.	City	New areas	2020	medium: the current 'real estate crisis' already dimishes residential developments that provoke longer com-muting distances.		
		D9. Imposit maximum parking standards (parking management)	The initiative SmartIAGO initiative, profiling S as the first integral smart city project for a World Heritage city, includes the introduction of intelligent parking management.	City	Existing areas	2018	high		
Industrial	E. Enable industrial symbiosis by spatial clustering of industrial activities	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO2 reduction. Case studies suggest that fuel efficiency doubles.)	The actual PXOM (2008) has designed industrial areas in the north of the city to improve transport communications and general sharing infraestructures	City	new industrial areas	2020	low: economic base of S stands on three pillars: education, culture/religion/tourism and pubic administration =>. indusrty plays a minor, if any role in urban economy		
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)	n/a	n/a	n/a	n/a	n/a		
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**	n/a	n/a	n/a	n/a	n/a		
Energy generation	G. Optimise energy distribution systems	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	The Energy-Efficiency Plan (POE) by the Santiago de Compostela University (USC) has implemetned a district heating system that co-generates electricity and heat (for heating and sanitary hot water)	campus	existing area	POE was prepared at end of 1990s but extended recently = long term	depends on the success of this small scale initiative		
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.	POE (see G1) installed thermal solar energy in one of the university buildings. However, it is unclear if this a pilot project (incl. educational purpose) or large-scale production?	building - campus	existing area	POE was prepared at end of 1990s but extended recently = long term	medium: mild climate limits demand for energy for heating and cooling of buildings, but solar energy available.		
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.	POE built a facility with geothermal heat pump in a new university building, i.e. a heat pump but not fed by excess heating of industrial or domestic processes...	building - campus	existing area	POE was prepared at end of 1990s but extended recently = long term	medium		Another case is the building of Parliament of Galicia. In 2008 was implemented the Energy efficiency action plan in this building in order to decrease its energy demand. An geothermal system was implemented to cover de energy demand in a particular area of the buliding.
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	n/a	n/a	n/a	n/a	n/a		
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	n/a	n/a	n/a	n/a	n/a		

Stoke

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	STOKE-ON-TRENT: Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre...)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner
Buildings and the built environment	**A. Optimize energy distribution on district level**	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	No examples mentioned in the case study. Achieving the highest standards of energy effciency is a top priority of the current core planning policy document of Stoke-on-Trent (SoT). However, the considerations for the main spatial development ambition - creating a single first-level urban core (see C1) - are first and foremost economic in nature rather than related to energy efficiency. On the other hand, a handful of sector-specific schemes to improve energy efficiency of either behaviour or buildings by organisations, companies, industries and households (Green Deal, criticised!) are based on financial and fiscal, administrative or informative instruments rather than to spatial planning policy. In terms of impacts, it is concluded in the case study that much more needs to be done regarding incorporation of energy efficicncy into new, innovative ways of urbanisation.	city* / SoT + Newcastle-under-Lyme (*: city = the six towns)	existing area	rarely mentioned; if mentioned short-term	high: this incorporation should at least be considered in planning of a major develop-ment like a new urban core	The vehicle for this is the new local plan for the area, a Local Plan being is in the early stages of being produced jointly with neighbouring local planning authority Newcastle-under-Lyme: http://www.stoke.gov.uk/ccm/content/planning/planning-general/local-development-framework/joint-local-plan.en
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	The industrial past has left SoT a legacy of a large but poor housing stock of single-walled and privately owned Victorian terraced houses which are extremely difficult to bring to modern standards of energy efficiency. The city has tried hard but "the scale of the problem defeats her" because it lacks legal tools and financial resources. Interventions to improve energy efficiency of homes - more efficient technologies, insulation etc. - in the social housing stock has resulted in much more adequate performance. Zero Carbon Homes (ZCH) scheme ensures (?) that all newly built homes are prepared to meet zero carbon emission standards by 2016. For larger housing estates, council pushes district CHP as the norm, but no such schemes are in place yet. Intentions are good, but costs inhibits developers from pursuing these.	city	existing area;	ZCH: 2016	high, but in particular for old estates and primarily taking into account energy and environmental considerations.	The energy efficiency performance of new-build housing is regulated by national building regulation standards, enforced locally. The vehicle for the energy supply planning is the new local plan for the area, a Local Plan being is in the early stages of being produced jointly with neighbouring local planning authority Newcastle-under-Lyme: http://www.stoke.gov.uk/ccm/content/planning/planning-general/local-development-framework/joint-local-plan.en . The Local Plan making process has to demonstrate that planned housing, and its energy supply, is ensured to be viable & deliverable. The National Planning Policy Framework that local planning is required to follow includes low carbon future as a core principle.
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	Instead, a transformation scheme that included demolition of low energy effcient housing stock was carried out (!). This contributed to the overall energy effciency of the city, but was stopped in 2012 without warning.	region (North Straffordshire)	existing area	already stopped	high: to substitue for demolished old houses	Again the Local Plan is the vehicle. The Housing Market Renewal Pathfinder programme did clear large amounts of older housing stock, we'd like to investigate the density of housing where new build has occurred - we have data to interrogate for this. Apartments are not the cultural norm in mid sized cities of the UK. Outside of large City Centres, apartments (also referred to as flats) do not have the same level of market demand. Poor designed 'tower block' type flats in the 2nd half of the 20th C haven't helped the image of apartments/flats. The Local Plan making process has to respond to evidence of housing market assessment, including the demand and viability of different types of housing, but also housing land availability to meet local housing need which provides pressure for higher density housing. The lack of a strong attractive City Centre reduces the demand for high density housing within walking distance, tackling this issue will help to increase the demand and viability of apartment and dense housing, including refurbishment of non-residential buildings for apartments.
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	no mention to such a public policy. A local society advocates the preservation of the six towns and the original urban structur and defends densification and local job creation in each town rather than the emergence of a new radial structure with one urban core.	Region (Stoke-on-Trent and Newcastle-under-Lyme)			medium: to combat the danger of sprawl within the polycentric configuration	Local Plan again is the vehicle (region scale, existing area, and timescale: adoption of plan 2018). National Planning Policy Framework requires wider considerations such as local character and distinctiveness which means high density not always appropriate. Relative low land values don't help incentivise high density, especially with increasing car dependency orientated development.
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)		Region (Stoke-on-Trent and Newcastle-under-Lyme)			medium: the oppostion of the preservation society against creation of a new urban core suggests that that will be associated with dilution of urban form.	As above, breaking cycle of increasing car dependency critical to this. How to stimulate this healing of the urban form, in the face of demand for economic development often in car dependent form is a challenge.
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	Climate and climate-conciousness appear no issue in policies.	Region (Stoke-on-Trent and Newcastle-under-Lyme)	Existing areas and new developments			The existing adopted joint Core Spatial Strategy for Newcastle-under-Lyme and Stoke-on-Trent contains a Sustainability and Climate Change Policy which encourages development to positively address the impacts of climate change and deliver a sustainable approach. The associated Supplementary Planning Document takes forward the policy within the Core Spatial Strategy and provides detailed guidance for delivering measurable improvements to the sustainability of the built environment.
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)		Stoke-on-Trent and Newcastle-under-Lyme	New developments			No specific policies. The Core Spatial Strategy for Newcastle-under-Lyme and Stoke-on-Trent contains policies on Design Quality and Sustainability and Climate Change. The Newcastle-under-Lyme and Stoke-on-Trent Urban Design Guidance Supplementary Planning Document provides general guidance for encouraging environmental, social and economic sustainability. At a National level the Government's Standard Assessment Procedure (SAP) is used for assessing the energy performance of dwellings and it is a legal requirement that an Energy Performance Certificate (EPC) is produced for each new dwelling erected. Local Plan is the vehicle to improve these policies (region scale, timescale: adoption of plan 2018)
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)						No specific policies. The Core Spatial Strategy for Newcastle-under-Lyme and Stoke-on-Trent contains policies on Design Quality and Sustainability and Climate Change. The Newcastle-under-Lyme and Stoke-on-Trent Urban Design Guidance Supplementary Planning Document provides general guidance for encouraging environmental, social and economic sustainability. At a National level the Government's Standard Assessment Procedure (SAP) is used for assessing the energy performance of dwellings and it is a legal requirement that an Energy Performance Certificate (EPC) is produced for each new dwelling erected. Local Plan is the vehicle to improve these policies (region scale, timescale: adoption of plan 2018)
Transportation	**C. Reduce travel needs**	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	A current policy aims to develop the town of Hanley to a larger settlement (seeD2). However, this will increase rather than reduce the need to travel due to the specifc polycentric context of SoT	city, region and supra-region	new developments in the existing town of Hanley	long-term	no priority; it is assessed that this will increase rather than reduce the need to travel due to the specifc polycentric context of SoT	For the new Local Plan to consider, Stoke-on-Trent and Staffordshire Strategic Economic Plan has growth of Stoke-on-Trent into a larger 'core city' of the UK, rather than dispersing development across Staffordshire, particularly rural areas. Co-operating with surrounding local planning authorities to accommodate wider region's demand for housing key.
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	Concentrating new developments in the town of Hanley. There are, however, no indications of a deliberate policy to locate new developments within or adjacent to the towns.				Low: this policy combats sprawl, but sprawl is relatively limited - "strong sense of localism" (see C3).	as above
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	Such short distances is a historic reality due to the spread of services across the six twons of SoT. It is, however, inefficient and undesirable because it inhibits investments in economic development. Hence, the opposite of policy C3. is about to start; i.e. concentration of first-level services in a single new urban centre (Hanley, see D2) leading to increasing mobility from the other towns.	city	Hanley city centre	long-term	difficult: assess-ment of energy vs. economic objectives	National Planning Policy Framework supportive of this type of development
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)						There has been some work in Stoke-on-Trent to localise the biomass supply chain, in particular making use of biomass from parks and open spaces maintenance.
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	As a recently acknowledged Core City by the central government (see G1), SoT works on a planning policy to develop as a 'connector' between larger UK urban areas. This is based on a new HS train station that is now under discussion. If that station will be realised, it offers opportunities for TOD. The daily numbers of passengers that make use of the current train station are far too low, however.	region	HS station usually in new areas	long-term	high: HS station is considered a major engine of regional economic growth	Stoke-on-Trent and Staffordshire Strategic Economic Plan has growth of Stoke-on-Trent into a larger 'core city' of the UK, but not formally included as a Core City by Government yet. HS train service will stimulate TOD to support the growth into a core city.
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	Historically, SoT is a polycentric 'federation' of six separate towns (and some 80 villages), of which SoT is the one with the main railway station. Services and jobs are spread across these towns and people have a strong sesne of localism, implying very short commuting and shopping distances. The city council wishes to develop a two-level hierachy of service centres by transforming the town of Hanley into the single first level urban core, including public functions, office space and residential developments. It has started this development by relocation its own services and jobs. Accessibility by public transport is a problem, however, because of the inefficiency of the bus services, which is in itself due to urban sptial patchwork of the polycentric federation.	city/region	new city centre	long-term	High priority, but limited control and power by the city council over map and time tables of servcies of private bus companies. These are not always in the interest of the deprivated section of population.	
		D3. Develop intermodal transport nodes in combination with urban development	As a recently acknowledged Core City by the central government (see G1), SoT works on a planning policy to develop towards a 'connector' between larger UK urban areas, highly depending on the new HS train station that is now still under discussion.	regional	new area	long-term		Following national policy framework, we require significant developments to include a travel plan, including measures such as sustainable travel information packs for new residents, and workplace travel plans to promote use of sustainable transport options.
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	n.d.. In fact, the opposite - suburban sprawl by middle classes is more likely to happen. For now, there are no such public transport nodes; bus terminals and train station are distributed across the towns.					Highest density development in the City is planned around the train station (University Quarter, and increasing student accommodation in Stoke Town) and around City Centre bus station.
		D5. Develop key public transport networks in urban areas	no signs of such a policy					Difficult with private sector led public transport network. Bus services in England are operated by private bus companies, and (outside London) are not (currently) regulated by local councils. However, we work with them to help them improve services in the city. There is the start of decentralisation of transport powers, and the idea of local transport authorities regulating the private transport operations has been suggested, first for Manchester. Where possible we ensure our highway network includes bus priority - a policy in the adopted Core Spatial Strategy. Bus Stations and stops are managed and have been improved by the Council.
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Between 2008 and 2010, a three-year Cycle Town programme was carried out. All togther, 160 km. of bike lanes have been constructed in the past 15 years.	city	existing areas	short-term	medium: limited use because of low level of bicycle-ownership	From a low base, cycling is a quiet success story for Stoke-on-Trent in recent years. Completion of the National Cycle Network route 5 and 55 through the city was followed by designation as a Cycling City in 2008 by Cycling England. This extra funding enabled a step change in cycling facilities and promotion, branded as Cycle Stoke, and saw a 40% increase at cycle monitoring sites across the city. Changes in cycling levels indicate that, even with some challenging topography cycling can be increased dramatically with targeted investment, with cycling in and out of the City Centre now triple the level 10 years ago. Stoke-on-Trent now has over 180km of cycling infrastructure, with over 100km away from roads including greenways along former railways, canal towpaths and river routes. The cycle map also has around 240km of advisory routes on streets that are less busy than main roads, many are traffic calmed, and many have a 20mph speed limit. Many of these routes have restrictions to motorised traffic but are fully open to cyclists, thanks to permeability measures through road closures to rat running motor vehicles, and contraflow provision for cycles in motor traffic one-way systems.
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)						Cycle network delivery has included 'permeability measures'. Getting streets in new development, in particular housing, to be permeable is a challenge when adjacent sites are developed by different private developers at different times. The Etruria Valley Enterprise Area Supplementary Planning Document seeks to ensure development in that area is permeable and tackles severance in this central valley.
		D8. Avoid development locations that promote long-distance journeys **by car**.	Not actively avoided, job opportunities in some parts of SoT have been reduced following the closure of industry and access to new job opportunities would require more home-to-work travel	city region			high: car-ownership is limited, limiting the general accessibility of jobs, shops etc.	Local Plan again is the vehicle (region scale, existing area, and timescale: adoption of plan 2018). A healing the City approach, building on current policy of targeted regeneration in core of City would concentrate development rather than the "donut-ing" of development that has occurred over the last 20 years.
		D9. Imposit maximum parking standards (parking management)					low: car ownership is limited	National Planning Policy Framework not supportive of maximum standards, but encourages appropriate levels of parking to avoid parking problems on streets.
Industrial	**E. Enable industrial symbiosis by spatial clustering of industrial activities**	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO2 reduction. Case studies suggest that fuel efficiency doubles.)	Information about industry in the case study stresses its decline in the second half of the last century, including the appearance and growth of areas of deprivation, and the difficulties of SoT to transform its economy towards a post-industrial service-based one.				low: hardly waste producing industry left.	Whilst there has been a decline in industry, manufacturing and engineering are still significant in Stoke-on-Trent. Work of the LEP should encourage symbiosis.
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)						LEP Strategic Economic Plan http://www.stokestaffslep.org.uk/documents/ seeks to maximise the clustering of industries in Stoke-on-Trent and Staffordshire. The policy of mixed use development rather than mega areas of industrial zoning may go against clustering?
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**						DHN project below will be looking to heavy energy consuming industries to make use of waste heat.
Energy generation	**G. Optimise energy distribution systems**	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	Cities acknowledged as Core Cities can make City Deals with the central government, i.e. agreements to give the city control over policies that affect their area and to decide how public money should be spent on these. In 2013, SoT put forward a successful proposal for the UK's first low carbon district heating network system, hence delivering a new and local approach to energy production. The Local Enterprsie Partnership (SoT + Strafforshire council) received a grant (2014) from central gvmnt to contribute to the Powerhouse Central Project. Project aims to promote (economic?) growth and prosperity by a string of interlinked actions connected to energy production, conservation and innovative technology. About 20 of the total available 113 million pound will be spent on a DH network fuelled by deep geothermal energy. Benefit: lower heat costs for businesses, savings of 10,000 tons of CO2 annually and jobs.	city	PM	PM; still only a proposal	high: expected benefits are lower heat costs for businesses (in a city that urgently aims to attract new jobs) and saving of 10.000 tons of CO2 annualy	Not just limited list of 'Core Cities' can make City Deals, all Local Enterprise Partnerships have secured growth deals, with funding from the national Local Growth Fund.
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.						Development of geothermal heat generation part of district heat network project. Increasing number of private applications, and installations of solar farms in surrounding agricultural land. Use of roof space for solar encouraged within the City.
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.						Heat pump technology not as common in the UK, some public buildings have pioneered - for example see WP3 Stoke Local Centre case study.
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	The Green Deal initiative (national) promotes use of solar panels (and other ways to reduce fuel debt)	city	existing houses	initiated in 2010; longer-trm than 2020	mixed: advocated by some, heavily criticised by others	
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	little signs of such barriers. Civic society is alive and kicking in the UK, and local policy makers are cooperative vis-a-vis charities, trusts and the like. The city council of SoT local seems no exception. The Green Deal even promotes hoisehold-scale production	city	existing and new houses	no limit	low: there are little barriers	

Tartu

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	TARTU: Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre...)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner
Buildings and the built environment	A. Optimize energy distribution on district level	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	In the spatial planning we follow National Masterplan and planning guidlines set by Ministry of Interior. In addition to national documents will be taken in to account in planning process several development documents of city level (City Development Plan, Transport Development plan etc.). National Masterplan is an indicative document.	National, city	New and existing areas	2030+	medium	
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	The area of central heating is determined by City masterplan. In building level conditionas are settled in designing criterias.	City and building	New and existing areas	2035+	high	
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	The city is working on it's masterplan with intent to densify the centre of the city. (On national level there is an initiative and financial support to support the construction of rental apartment buildings in city areas to develop rental market.)	City	New and existing areas	2035+	high	
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	Large part of the center was destroyed in WW2 and now has large green areas. Densification is done to avoid sprawl of the city.	City	New and existing areas	2035+	high	
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)	Tartu is a most densely populated city in Estonia. In the city center is set a principle that buildings are built as close together as possible. Main principle set by state is that there must be ensured at least 3 hours of sunlight in a day. In case of streets we follow national standards (compulsory). Densification is regulated also by the city building act. There is fixed how many m2 of land must be per flat.	National, city	New and existing areas, city centre	2035+	high	
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	Tartu has signed Alborg Commitments and is also a member of Covenant of Mayors. In April 2015 was submitted SEAP for Tartu City.	International, national, city	New and existing areas	2035+	medium	
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)	The planting of trees depends on planning documents and is mostly done in esthetical reasons. Still Tartu is rich in greenery. Optimization of solar access is not fixed in planning documents.	National, city	New and existing areas	20135+	medium	
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)	The planting of trees depends on planning documents and is mostly done in esthetical reasons. Still Tartu is rich in greenery.Optimization of wind ventilation is not fixed in planning documents.	City	New and existing areas	2035+	low	
Transportation	C. Reduce travel needs	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	Goal for Tartu is to densify the city within current borders and not have new settlements on the border or next to. But still developments on private land are dictated by landowner and not the city.	City, region	New areas	2035+	high	
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	End-use of land has been identified in Master Plan of the city, but there is a possibility to change an aim of land.	City , neighbourhood authorities	New areas	2035+	high	
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	The strategy is in use in planning for apartment buildings in central region of Tartu.	City	New areas	2035+	high	
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)	Relocation of power plant would mean rebuilding of district heating system. The location of power plant was chosen for the location of the consumers. Power plant is privately owned.					
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	In surrounding areas of Tartu the private development is mostly dictating the need for public transportation. New settlements and developments take into account accessibility to communications like electricity, gas and roads.	City	New and existing areas	2035+	medium	
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	The strategy in taken into account in next masterplan.	City	New and existing areas	2035+	medium	
		D3. Develop intermodal transport nodes in combination with urban development	The aim of the city is to reduce a number of cars in the city and promote cycling and public transport (train for intercity movements). Targets have been fixed in the city transport development plan.	National, city	New and existing areas	2020	medium	
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	Bus stop distance from home standard in Tartu is 300m	City	New and existing areas	2035+	medium	
		D5. Develop key public transport networks in urban areas	The city is working in cooperation with surrounding parishes to lengthen city bus lines to surrounding newer developments.	City, neighbourhood authorities	New and existing areas	2035+	high	
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Next five years Tartu will add 100 km of light traffic lanes. Light traffic lanes will connect neighbouring parishes with Tartu.	City	New and existing areas	2020	high	
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)	Walking is main mode for transportation. Any change in street layout should not reduce walking. Tartu is even planning to widen sidewalks in a couple of streets on the account of car lanes.	City	New and existing areas	2020	high	
		D8. Avoid development locations that promote long-distance journeys **by car**.	The city is working in cooperation with surrounding parishes to lengthen city bus lines to surrounding newer developments.	City	New and existing areas	2035+	medium	
		D9. Imposit maximum parking standards (parking management)	Requirements on parking are in building level fixed in designing criterias. In the city center parking is paid. In suburbian areas is parking for free. Some parking principles are fixed in the city transport development plan.	City	New and existing areas	2020	medium	
Industrial	E. Enable industrial symbiosis by spatial clustering of industrial activities	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO_2 reduction. Case studies suggest that fuel efficiency doubles.)	Clustering of industrial activities is not fixed in development documents either in local and national levels. The main driver is here EU directive 2008/98/EU article 5.					
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)	District heating in Tartu is belonging to private company (Fortum) and feasibility of production is monitored by national Competition Authority who is confirming prices on heat.					
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**	In Tartu there is no big industries. Tartu Waste Water Company (owned by the city) established biogas production and co-generation of heat and electricity for own needs.					
Energy generation	G. Optimise energy distribution systems	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	District heating system is covering large areas.	City	New and existing areas	2035+	medium	
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.	The sites can be mostly private activities. Municipally owned waste water company has built a biogas plant and future developments are in order.	City	New areas	2035+	low	
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.	The sites can be mostly private activities. Municipally owned waste water company has built a biogas plant and future developments are in order.	City	New and existing areas	2035+	medium	
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	The city has a research document of possibilities of using renewable energy resources in the city area. The principles are taken into account in city planning activities and construction of new buildings.	National, city	New and existing areas	2035+	low	
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	Ground heat and solar energy research and possibilities have been mapped. Local barriers are mostly set by environmental reasons (like possible contamination of ground water from ground heating pumps)	City	New and existing areas	2035+	medium	

Turku

Measures and policies of spatial planning to influence urban energy

Sector	Goal	Measure, policy, tool, strategy	TURKU: Does the city already apply such a policy? (If yes, how does it work? If no, why not?)	At which scale (regional, city, district, building)?	In which built-up context (existing areas, new areas, suburbs, city centre...)?	What is the time perspective of it (short-term 2020, long-term)?	Which priority has such a policy (high, medium, low)?	other comments from city partner
Buildings and the built environment	**A. Optimize energy distribution on district level**	**A1. Incorporate energy efficiency considerations into general strategic** spatial development plan(s), probably considering the city-regional scale (e.g. the project 'Heat Road Map Europe 2050' recommends the combination of district heating in dense urban areas and heat pumps in scattered built up areas.)	Included in City Strategy and integrated in development plans and practice.	city	all	Goals for 2020 / 2030 / 2035 / 2040	high	
		A2. Energy plan for the housing estate (The planning of new housing estates should be accompanied by an energy plan according to which decisions on energy supply (e.g. DH, HP, SP, SC) and energy efficiency of the buildings (e.g. insulation) are settled.)	Townplans include guidelines on energy solutions. In the new area of Skanssi this is a major development topic too. However setting rules on the energy sources for new housing is complicated. Some restrictions can be made for certain areas for instance within district heating grid.	city / district	all	ongoing	medium	
		A3. Promote apartment buildings and dense housing, limited detached housing (An otherwise identical household consumes 54% less heating energy in an apartment than in a single-family home, tough the gap is narrowing due to new building regulations.)	In Regional Structure Plan 2035, the aim is to make more compact city, new higher buildings in old areas. New general plan will be made next year aiming to year 2029.	city / district	all	New city general plan aims to 2029	high	
		A4. Densify existing built-up areas (can reduce infrastructure costs per person)	Regional Structure Plan 2035. New general plan will be made next year aiming to year 2029 and defines the areas more precisely.	city	all	ongoing	high	
		A5. Build more compact urban forms: less wide streets, less distance between buildings. (can reduce infrastructure costs per person)	In some cases under consideration.	district	all	continous	medium / low	
	B. Climate-oriented urban design	**B1. Translate general measures** in such a way that the local **urban and climate-specific context** are utilised to the max. (Climate-conscious development: adapt general strategies to specific climatic circumstances.)	Specially in the Skanssi area and old Castle town area. It's difficult to put rules what energy source new housing have to use. Some destrictions can be made. A project on this is ongoing in Skanssi area.	district	district	ongoing	medium	
		B2. Optimise solar access / shading (trees, streets and building orientation) (What is optimal depends on the latitude and climate. There are some rules of thumb, e.g. on housing orientation and tree planting, however, often compromises with other urban design considerations have to be found – What do you prioritize?)	Is not in the plans or building rules yet, but under discussion / preparation and piloting (in Skanssi)	district	district	future	medium / low	
		B3. Optimise wind ventilation / wind blocking (trees and buildings) (Again this depends on the climate, but also on the surrounding topography. Height and density of buildings can affects possibilities for wind ventilation or protection from cold winds. Particularly useful in warmer climates, but less in colder climates, where this may lead to a blocking of solar access. In colder climates, planting trees to the north, or to block winds, can be beneficial as well.)	Is not in the plans or building rules yet, but under discussion / preparation	district	district	future	low	
Transportation	**C. Reduce travel needs**	**C1. Promote larger settlements** to provide opportunities for self-containment and a good mix of uses. (Larger urban areas provide more opportunities to reduce the need to travel, and to use energy-efficient transport modes. Expansion of larger urban areas is generally preferable to development in smaller towns or dispersing development across a number of smaller settlements.)	Part of Regional Structure Plan 2035 and upcoming general plan 2029	all	all	continuos	high	
		C2. New development should ideally be located **within or immediately adjacent** to larger towns and cities.	Part of Regional Structure Plan 2035	all	all	continuos	high / medium	
		C3. Foster mixed use development. Key local (neighbourhood) facilities and services should be located within walking distance of homes in a neighbourhood. (This not only reduces travel distances (and hence, encourages walking and cycling), but also provides support for shops and services to remain economically viable.)	Part of Regional Structure Plan 2035 and upcoming general plan 2029	all	all	continuos	high	
		C4. Relocate power plants using biomass to decrease the energy consumption in transport. (57% of lorry-rides to bring biomass inputs are replaced by rail in Eskilstuna.)	Big question at the moment, the power plant will be built in the same site than the old coal power plant, options are lorries or boats, train also possible. The power plant is a CHP and delivers most of the district heat.	regional	exixting areas	2017	high	
	D. Promote 'green' transport	**D1. Locate major new urban developments** (employment, leisure, retail, housing) near public transport nodes and/or close to existing centres (Transit oriented development)	Part of Regional Structure Plan 2035 and upcoming general plan 2029	all	all	immediate and up to 2035	high	
		D2. Locate key services and facilities that serve the entire city or region (shopping centres, hospitals, libraries, educational institutions etc.) within the urban fabric and make sure they are very well accessible by public transport.	Part of Regional Structure Plan 2035 and upcoming general plan 2029. New hospital and educational institu under planning phase	all	all	immediate and up to 2035	high	
		D3. Develop intermodal transport nodes in combination with urban development	Transport hubs in the city center, Kupittaa / Science Park and LogiCity are part of city-planning. In the new areas of Skanssi and Linnakaupunki this is also a major topic.	city	see column D	immediate and up to 2035	high/medium	
		D4. Increase density of development, particularly in areas adjacent to major public transport nodes (Rule of thumb: 10-minute walk, 800 meter radius; this should be consistent with local norms, accommodation needs and liveability objectives.)	Part of Regional Structure Plan 2035 and upcoming general plan 2029	all	all	immediate and up to 2035	high	
		D5. Develop key public transport networks in urban areas	Work on light rail, electric buses and other public transport	city	exixting areas	2025	high	
		D6. Develop walking and cycling infrastructure (pavements, shortcuts, separate cycling lanes, parking facilities for bikes).	Plan for development of cycling and walking under updating. Some bigger projects and many small projects under implementation.	regional and city scale plans - projects on all scales	All	Ongoing and continuous	high/medium	
		D7. Increase the 'permeability' of the network of streets to encourage walking, cycling and public transport use. (Also pay attention to social safety.)	Some bigger projects and many small projects.	all	all	Ongoing and continuous	medium	
		D8. Avoid development locations that promote long-distance journeys **by car**.	Part of Regional Structure Plan 2035 and upcoming general plan 2029	all	all	immediate and up to 2035	high / medium	
		D9. Imposit maximum parking standards (parking management)	Carsharing-project	city	city centre	future	medium / low	
Industrial	**E. Enable industrial symbiosis by spatial clustering of industrial activities**	**E1. Clustering in space of industrial activities** with complementary energy and waste material outputs and inputs to achieve industrial symbiosis. (Very substantial benefits, not just in terms of energy saving, but for instance also in terms of CO_2 reduction. Case studies suggest that fuel efficiency doubles.)	Smart Energy Park area/concept launched in 2015. Bluetech Park under planning for resource-efficient maritime industries. Smart Energy Park under discussions / feasibility planning.	regional / city	both suitable old and new areas	immediate and up to 2035	high / medium	
	F. Improve opportunities for co-generation and linkages to district energy systems	**F1. Spatial clustering of industries** to improve opportunities for co-generation of energy and/or support district heating systems (Scale advantages in energy generation, and district heating systems are more feasible in case there is a big industrial consumer present)	Project on two-way-heating-system. Some industrial modifications in use.	all	all / pilots	immediate and up to 2035	medium / low	
		F2. Encouraging heavy energy consuming industries to introduce **combined heat and power** and/or to **combine with local district heating/cooling**	Some industrial modifications in use.	pilots	pilots	future	low	
Energy generation	**G. Optimise energy distribution systems**	**G1. Implement district energy systems** to profit from combined heat and power production (CHP). (Local (district) heating systems help utilize heat production from waste incineration and industrial excess heat production, as well as integration of geothermal/wind/biogas/biomass production. In Turku, the CHP plant cuts fuel consumption by one-third. Energy costs for firms in Stoke are expected to decrease by 10%.)	District heating system covering large areas (90 % of households in Turku), district cooling system is expanding	all	all	ongoing	high	
	H. Designate areas for renewable energy production	**H1. Designate areas for large-scale production** sites of hydro/wind/solar/geothermal/ biomass/ biogas energy generation.	Project on this in Skanssi area	district / city	Skanssin and other pilots	immediate and up to 2035	high	
		H2. Introduce heat pumps in public works whenever excess heating is available (e.g. waste-water) combined with district cooling when relevant.	done with waste water plant, and ibetween football hall and swimming hall	city	all as appropriate	immediate and up to 2035	high / medium	
	I. Enable small-scale (households) renewable energy generation	**I1. Implement planning guidelines to optimise solar access** of houses to foster households' use of solar panels. (See measures B)	started in some townplans	city / district	Skanssi and Castle Town	immediate and up to 2035	medium	
		I2. Remove institutional and legal local barriers for household-scale production of energy (heat pumps, solar).	work ongoing on national level	all	all	future	medium	