TOWARDS SMART ZERO CO_2 CITIES ACROSS EUROPE

VITORIA-GASTEIZ ✣ TARTU ✣ SØNDERBORG

Deliverable 2.1: Review of regulatory gaps and recommendations to facilitate city transformation processes

WP2, Task 2.2 Policy & Regulation

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Abbreviations and Acronyms

Abbreviation/Acronym	Description
SmartEnCity	Towards Smart Zero CO2 Cities across Europe
WP	Work package
D	Deliverable
ICT	Information and Communications Technologies
RES	Renewable energy sources
DH	District heating
EV	Electric vehicle
ICE	Internal combustion engine
CIOP	City information open platform
SOC	State of charge

Table 1: Abbreviations and Acronyms

0 Publishable Summary

This report is deliverable 2.1 of the SmartEnCity project, and describes which potential barriers for successful implementation of the demonstrator projects in SmartEnCity that the involved partners anticipate. A key objective of this report is to exchange information on barriers and best practices for the transition to a smart city and adoption of innovative technologies. Barriers and best practice examples as potential solutions have been identified in a questionnaire filled out by the stakeholders in the demo projects (WP3, WP4 and WP5) in the three 'Lighthouse Cities': Vitoria-Gasteiz in Spain, Tartu in Estonia and Sønderborg in Denmark. The projects and the anticipated barriers as well as recommendations are categorized in the five topics: Urban retrofitting, Energy supply, Mobility, ICT and Social engagement and these are summarized below.

Urban retrofitting

Major identified barriers for urban retrofitting are the structure of ownership and property laws, which in many cases lead to split incentives for energy renovations for example between owners and tenants. Also in some less attractive areas of cities the real estate market can make it difficult to obtain mortgage loans for energy renovations. Some of the 'Lighthouse Cities' stakeholders recommend to bring down these barriers by participatory processes and information to engage citizens and property owners in the project and to follow best practices, involve government city council and private stakeholders. They also recommend the creation of a guarantee fund for financial support of neighbours with lower incomes and transparency and social partners engagement in all phases of the project.

Another aspect of urban retrofitting is the cost effectiveness of the projects. One of the stakeholders points out that the EU-legislation and building codes have a unilateral focus on the energy consumption of the single building. This enforces investments in buildings to fulfil the standard, regardless that surplus energy might be available in the area and could be used. If it is legally possible a solution to this might be to add flexibility to the building standards by making it possible to avoid fulfilling the zero-energy standard in specific areas if certain conditions are present (e.g. minimum volume of available surplus heat for next 20 years).

Energy supply

In the current market situation the RES-technologies, though the gap is narrowing, can still not compete with carbon based technologies. Shifting support schemes and tax rules donot allways grant the different RES-technologies for the environmental benefits they provide and make the market situation insecure for investors. This problem however can only be solved at EU and national level by harmonized and long lasting legislation that give clear incentives for investors.

Environmental legislation and civic protests can make it difficult to find enough sites for RES-plants in order to meet the demand for sustainable energy. A local anchoring of the projects with a clear vision of local climate targets for the city could raise the level of awareness and acceptance amongst citizens. Shares in the projects reserved for locals could ensure that a large part of the economic benefits go to the neighbours affected. Also care for the design

and aesthetics of the plants in order to integrate them better in the cityscape/landscape might raise the general acceptance.

District heating can in many cities be a good technology achieving massive fuel savings but there is a minimum number of buildings that need to be connected to the DH to make it economically viable. The public sector should support the system in order to ensure that operation of the district heating will be guaranteed for a number of years.

Mobility

Though not the full solution to sustainable transport the introduction of EV´s are without doubt of big importance. Barriers to the introduction of EV´s are, though the recent development is promising, still the price and lack of range (range anxiety) and in some places lack of charging infrastructure. An important part of the solution is to grant the vehicles for the environmental benefits they provide by tax exceptions or support schemes. On a city level authorities should encourage the use of EV´s over conventional cars by positive discrimination of EV´s by for example free on-street parking rate for EV´s and exception of road tolls. City authorities should reserve special lanes for EV´s or let them drive in the bus lane. The cities should set up a charging infrastructure with good coverage. To limit shopping center traffic a delivery system of E-vans and cargo bikes could be set up as it has been done in the city of Gothenburg, Sweden.

Further reduction of energy use for transport could be achieved by the promotion of the use of public transportation, and biking and walking. This could be done by creating logistic micro hubs with EV´s and rental bikes in connection to public transport and consider the possibility to bring bikes on board trains or metros in order to promote the combination of public transport and biking. The overall use of bikes should be encouraged by establishing safe bike lanes and routes and create space for safe bike parking.

ICT

A basic condition for ICT is the Data Protecion Act which in many cases limits the use of data for example monitoring of the energy use inside buildings. Developers of ICT should address concerns on privacy and cyber security: Digital technology should be simple, easy to use, and without obstacles, and only do the things that it can do well, leaving people in control to do the things they enjoy doing.

The lack of a sufficient number of professionals is a critical issue for some technologies entering into the market which may also affect the quality of the implementation. Cooperation between several organisations or cities on development of much needed digital platforms or services to avoid isolated projects and harvest the benefits of scale could be a way to improve the quality of ICT and bring down the costs.

Social engagement

Social engagement of the citizens of cities and other actors is vital to the succesfull transfomation to SmartEnCities. Lack of information at the level of both decision makers and practitioners may hinder the implementation of energy-efficiency measures. Information asymmetry as in the landlord/tenant problem also affects spread and adoption of energy efficiency measures.

Citizens may consider certain measures as a decrease in their quality of life (e.g. shifting from individual to collective transport).

A large number of measures may require the coordination of different actors from different sectors/functions, resulting in a divergence of interests (e.g. landlord-tenant problem).

“Not my business”: Integrated solutions are required covering urban planning, buildings licensing, energy infrastructures, transport, water and waste management, but these domains are often classified under different departments, all having their own targets and budgetary constraints.

Politicians tend to think and act on the short term, whilst transformation towards a sustainable city may take decades. Additionally, actions against climate change do not result in direct benefits for the implementer (“*Tragedy of the commons*”).

Some of these barriers may be overcome by an intense communication campaign to show the benefits to join the projects, and to involve the citizens by participatory processes where it makes sense and by the creation of a political consensus agreement. Opening up for local economical ownership by shares in for example RES-projects where large returns must be expected might also raise the citizens acceptance and support of the projects and the overall environmental targets.

1 Introduction

SmartEnCity´s main objective is to develop a highly adaptable and replicable systemic approach towards urban transformation into sustainable, smart and resource-efficient urban environments in Europe. The approach will be defined in detail, laid out and implemented in the three 'Lighthouse Cities': Vitoria-Gasteiz in Spain, Tartu in Estonia and Sønderborg in Denmark. This report is deliverable 2.1 of the SmartEnCity project, and describes which potential barriers for successful implementation of the demonstrator projects in the 'Lighthouse Cities' that the involved partners anticipate.

This report identifies some of the major barriers for smart and resource-efficient urban environments in Europe. The barriers do not exist in isolation but are often interlinked. When there is one barrier it often reinforces another barrier. For example when trying to introduce district heating, if users have limited knowledge, then there are ownership barriers, acceptance barriers etc.

1.1 Purpose and target group

Lessons learnt from the three 'Lighthouse Cities' will in this report be shared with follower cities and other european cities. The purpose is to identify major barriers for a sustainable city transformation across Europe and best practices to overcome these barriers.

1.2 Contributions of partners

Participant short name	Contributions
VIS	Answers to questionnaire
MON	Answers to questionnaire
FED	Answers to questionnaire
CCA	Answers to questionnaire
TAR	Answers to questionnaire
FTAR	Answers to questionnaire
ET	Answers to questionnaire
ZERO	Answers to questionnaire
SONF	Answers to questionnaire
VG	Answers to questionnaire
ACC	Review of the report
AAU	Review of the report
IBS	Review of the report

Table 2: Contribution of partners

1.3 Relation to other activities in the project

The following Table 3 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the SmartEnCity project and that should be considered along with this document for further understanding of its contents.

Deliverable Number	Contributions
D3.3 – 3.8	Input on anticipated barriers from demonstrator projects in Vitoria-Gasteiz
D4.3 – 4.11	Input on anticipated barriers from demonstrator projects in Tartu
D5.3 – 5.7	Input on anticipated barriers from demonstrator projects in Sønderborg
D2.6	Output for D2.6 on regulatory gaps and recommendations to facilitate city transformation processes

Table 3: Relation to other activities in the project

2 Objectives and expected Impact

This report is deliverable 2.1 of the SmartEnCity project, and describes which potential barriers for successful implementation of the demonstrator projects in SmartEnCity that the involved partners anticipate.

2.1 Objective

In WP2 “SmartEnCity Regeneration Strategy” in the SmartEnCity project, a key objective is to exchange information on barriers and best practices for the transition to a smart city and adoption of innovative technologies.

2.2 Expected Impact

On city level the ambition is, that the proposed best practices will help to speed up the tranformation processes under the current legislational and market conditions. Lessons learnt from the three ‘Lighthouse’ cities will in this report be shared with follower cities and other european cities.

The hope is that the mapping of barriers will raise awareness within local businesses, NGO´s, public authorities and the political system from local to EU levels and initiate changes in legislation and support schemes in order to drive forward Smart Zero CO2 Cities across Europe.

3 Overall Approach

The overall approach of this report is an overview of the three 'Lighthouse Cities' and the main barriers for city transformation identified by the stakeholders in the demonstrator projects. For example the private company Vikingegården from Sønderborg points out that the current variation in electricity prices (that are kept very stable by the Danish environmental tariff the PSO) give no real incentive to use the intelligent chargers for EV´s that they have developed and which are being introduced in Sønderborg as one of the demonstrator projects.

In this report barriers are defined widely as current or presumed conditions for example within the market, policy, legislation, sociology or technical issues that work against the implementation of the demonstrator projects in each of the three lighthouse cities and thus SmartEnCity´s main objective of urban transformation into sustainable, smart and resource-efficient urban environments in Europe.

The barriers identified by the demonstrator projects stakeholders are supplemented by an overview of regulatory gaps or barriers for city transformation in the EU-legislation to get an overview of some of the major common European barriers for SmartEnCities.

3.1 Structure and method

Barriers and best practice examples as potential solutions have been identified in a questionnaire filled out by the stakeholders in the demo projects (WP3, WP4 and WP5) in the three 'Lighthouse' cities: Vitoria-Gasteiz in Spain, Tartu in Estonia and Sønderborg in Denmark. In the relative short time frame of this report directing questions on barriers directly to the demonstrator projects was seen as a quick way to get a general overview of potential barriers for SmartEnCity transformation at the local level – a bottom up approach.

The questionnaire was answered in spring 2016 in the early stages of the SmarEnCity project. Because of this some of the barriers are more based on assumptions or risk assesment than actual experience.

In chapter 4.1 - 4.3 input from questionnaires answered by the relevant project partners on the assumed main barriers for the the specific demonstrator projects are shown in schemes for each project.

General barriers identified by 'Lighouse Cities stakeholders' that are not directly related to specific projects are summarized in chapter 4.4.

Chapter 4.5 gives an overview of barriers based on literature studies on EU-legislation within the four topics: Urban retrofitting, Energy supply, Mobility and ICT – a top down approach.

Best practice examples can potentially overcome some of the barriers. In chapter 5 of this report, best practice examples mainly based on input from the 'Lighthouse Cities' stakeholders and supplemented with findings based on literature studies are listed.

Finally opportunities and ideas for best practices and proposals for change in regulations, new regulations and new incentives are listed.

4 Main barriers identified by 'Lighthouse Cities'

Below follows short descriptions of the three 'Lighthouse Cities' and their demonstrator projects within the SmartEnCity project. Input from questionnaires answered by the relevant project partners on the assumed main barriers for the specific demonstrator projects are shown in schemes for each project *Ref/1*. Each barrier is categorized in type of barrier by *PLAN*.

General barriers that are not directly related to specific projects are summarized in chapter 4.4.

4.1 Vitoria-Gasteiz

Vitoria-Gasteiz the administrative capital of the Basque Country, in northern Spain, has a population of 240.000 inhabitants, in an extension of 276.81 km^2. A compact, moderately dense city, Vitoria-Gasteiz has an extensive background in planning and implementation of environmental policies and as a result was awarded the prize as 'European Green Capital' in 2012. A flat and walkable city sorrounded by a "green belt" and often regarded as a model in sustainable mobility planning, Vitoria-Gasteiz is commited to become a Carbon neutral city by 2050. Within this city strategy to become greener, energy efficiency, renewable energy, low carbon mobility and smart infrastructures are key elements towards which the city commits significant ressources.

4.1.1 Demonstrator projects

D3.3 Building retrofitting interventions completed

Different retrofitting projects in individual buildings will be carried out in order to achieve substantial energy savings. The task will come to a conclusion with the end of construction works and gathering of construction certificates to ensure measures have been put in place.

Level of barrier	*Main barriers*	*Type of barrier*
Local, national	The structure of ownership (mostly family owned apartments) and property laws in Spain, which means that apartment owners have large decision capacity and there is a need for agreement in the apartment block / community of owners before reaching any decision to undertake integral building refurbishment projects, and to connect to the district heating	Legislation
Local, national and EU	Data Protecion Act versus Monitoring energy behaviours inside houses.	Legislation

D3.4 District heating network deployed and in use

During this task, district heating facility as well as electric grid and thermal control technologies at home, building and district levels will be developed and established.

Level of barrier	*Main barriers*	*Type of barrier*
Local	Energy awareness is generally low in Spain. Information and engagement of neighbours is needed for acceptance of the district heating concept, for the location of a biomass boiler room, associated landscaping works and biomass loading processes.	Sociological
Local	Sizing of the district heating (DH): There are a minimum number of buildings that need to be connected to the DH to make it economically viable.	Technical/Economical
Local	The deployment of a district heating is a relatively new concept in Spain, and ownerships and exploitation of the system, which needs political decisions regarding involvement of the public sector, can delay the project.	Political

D3.5 EV vehicle purchased completed vehicles in operation

The objective is to reduce the number of ICE vehicles inside the city centre by promoting the deployment of more eco-friendly vehicles with a strong emphasis in the professional drivers (taxis, couriers, lorries, business load delivery) that need to keep driving within the city centre while the city environment is protected.

Level of barrier	*Main barriers*	*Type of barrier*
Local	Engagement of taxi drivers to undertake a structural change in their main service tool (their cars) due to the limited range that will not allow to do their most profitable services (Taxi services to Bilbao Intl, Airport)	Technical/sociological
Local	Lack of charging infrastructure.	Technical
Local, regional	Lack of safe parking for e-bikes, e-cargo bikes.	Technical

D3.6 EV charging infrastructure deployed and in use

The objective of this measure is to update and improve the charging infrastructure for EV´s by the deployment of different professional and private EV charging points. The idea is to create or reinforce the needed recharging infrastructure before the purchasing of the new EVs planned according the D3.5. As supporting infrastructure for the E-Taxis, new charging points at different taxi-stops will be deployed during the first year of the project.

Level of barrier	*Main barriers*	*Type of barrier*
National	According to national law the public can not offer private custommers charging of vehicles neither for free or by payment. There needs to be a private company acting as a “charging operator/manager”. This will lead to an added extra cost for the private custommers.	Legislation

D3.7 Last mile logistic electric infrastructure deployed and in use

The objective is to avoid heavy traffic of trucks and lorries in the city centre and bring down emmissions. Two different models of EV´s (light trucks and light vans) will be purchased and a hub for last mile delivery will be established.

Level of barrier	*Main barriers*	*Type of barrier*
Local, regional	Engagement of commercial drivers to undertake a structural change in their main service tool (their cars or vans) due to a lack of experience with the limited range of EV´s.	Sociological/technical

D3.8 ICT infrastructure deployed commissioned and CIOP in use

The opbjective of this project is the deployment of the ICT infrastructure that is needed for data harvesting, monitoring and evaluation in Vitoria-Gasteiz Urban Management System. Also specific infrastructure needed for the deployment and operation of the City Information Open Platform (CIOP) will be set up.

Level of barrier	*Main barriers*	*Type of barrier*
Local, national and EU	Data Protection Act versus Monitoring energy behaviors inside houses	Legislation

4.2 Tartu

Tartu is the second largest city in Estonia, with a population of 100.000 and a total area of 38.86km^2. It is home of several knowledge intensive organizations such as University of Tartu, Estonian University of Life Sciences and Tartu Science Park. Tartu is known for its extensive implementation of smart technologies in the urban environment. Tartu implemented public Wi-Fi areas throughout the city and was the first city to enable a mobile payment system for street parking in 2000. Paperless government was implemented in 2003 and, e-elections in 2005, and a fully electric taxi service and charging grid was implemented in 2012.

4.2.1 Demonstrator projects

D4.3 Building retrofitting complete

The objective of this project is to develop a retrofitting model in a demo area. The main aim of the retrofitting model is to significantly increase the energy efficiency of the buildings, provide a stable interior climate through temperature control and ventilation and increase the aesthetic appeal of panel buildings. Linked to the renovation smart automated solutions and monitoring systems will be installed to track energy consumption and further boost energy savings for example through intelligent control of the ventilation system.

Level of barrier	*Main barriers*	*Type of barrier*
Local	Higher cost of building retrofitting than expected.	Economical
National	Reaching the promised energy consumption level (90kWh/m2/y) requires complex technical solutions which could make the renovation unreasonably expensive.	Technical/economical
	Situation on the design and construction market appears to be unfavorable and there will be lack of capacity in case of design and/or construction companies. It could also mean that the prices for construction designs and construction works appear to be unreasonably high.	Market
EU/national	State aid issues might arise in case of financing the retrofitting with EU and national funds.	Legislation

D4.4 District heating and cooling system commissioned and deployed

The objective of this project is to introduce a district cooling system that produces heat for the district heating system by using residual heat which will lead to significant energy savings. This solution will be accompanied by smart meters so to collect real-time data on consumption.

Level of barrier	*Main barriers*	*Type of barrier*
Local	Due to complex technical solution the combined district heating and cooling system might not be constructed and managed properly and will not produce expected outcome.	Technical

D4.5 Street light commissioned and deployed

The objective of the project is to establish a smart street lighting system with intelligent controlling that will lead to significant energy savings.

Level of barrier	*Main barriers*	*Type of barrier*
Local	New technical solutions for city lighting (incl. different sensors) might not work properly and the results are poorer than expected.	Technical
National	Market situation appears to be unfavorable and public procurement for LED lamps could fail.	Market

D4.6 EV vehicles purchased and in operation

The objective of the project is to introduce EV vehicles for renting, taxis and private use.

Level of barrier	*Main barriers*	*Type of barrier*
EU	SmartEnCity financing scheme for EV-vehicles would be too complex and hard to put into practice. No agreements reached at central level to bring along feasible financing scheme Lack of interest in private sector (inc. taxi companies) to purchase EVs	Financing/legislation
Local	Uber Taxi service could change the situation on taxi market and existing taxi companies will lose their competitiveness and will not invest in EVs	Market
Local	Lack of interest in private sector (inc. taxi companies) to purchase EVs.	Economical/sociological

D4.7 Gas buses purchased and in operation

The aim of the project is to introduce 100% biogas fueled busses in the citys public transportation system.

Level of barrier	*Main barriers*	*Type of barrier*
National	Market situation appears to be unfavourable and public procurement for gas buses could fail due to lack of interest or unreasonably high prices.	Market

D4.8 Mobility infrastructure set up and in operation

The aim of the project is to establish public charging points for EV´s and a system to reuse EV batteries.

Level of barrier	*Main barriers*	*Type of barrier*
National	Market situation appears to be unfavorable and cost of construction and operation of public EV fast chargers could be unreasonably high.	Market
National	The system to reuse EV batteries appears to have higher costs than expected and therefore could be unreasonable for OÜ Takso to put it into practice.	Technical/economical
Local	Business model of EV rentals would not be attractive for partners from private sector.	Market

D4.9 Bike sharing system set up and in operation

The aim is to set up a system of general bike sharing and make electric bicycles for rental available in EV-rentals.

Level of barrier	*Main barriers*	*Type of barrier*
Local	City of Tartu will not manage to engage enough funds to finance the construction of bike sharing system.	Financing

D4.10 Participatory transport planning tool developed and in operation

A participatory planning tool will be implemented.

Level of barrier	*Main barriers*	*Type of barrier*
Local	New technical solution for the participatory planning tool might not work properly and the results could be poorer than expected	Technical
Local	Market situation appears to be unfavorable and public procurement for participatory planning tool could fail due to lack of interest or unreasonably high prices.	Market/sociological

D4.11 ICT infrastructure commissioned and deployed, CIOP in use

The opbjective of this project is the deployment of the ICT infrastructure that is needed for data harvesting, monitoring and evaluation in Tartu´s Urban Management System. Also specific infrastructure needed for the deployment and operation of the City Information Open Platform (CIOP) will be set up.

Level of barrier	*Main barriers*	*Type of barrier*
Local	New ICT solutions might not work properly and will not cover all related needs.	Technical

4.3 Sønderborg

Sønderborg is the sixteenth largest municipality in Denmark with approx. 77.000 inhabitants, and is included in Region Syddanmark (Southern Denmark Region). Danfoss one of Denmarks largest industrial companies, has its headquarters and extensive production facilities in the Sønderborg area. The area also holds an extensive agriculture, mainly focusing on pig farming, and has some of the most beautiful natural resorts of the country with a stretch of coast of approx. 200 kilometers and vast forests. The city of Sønderborg established in 2007 the 'ProjectZero roadmap' for the municipality to become carbon neutral 2029, achieving Zero CO_2 emissions for all activities in the Municipality area of Sønderborg.

4.3.1 Demonstrator projects

D5.3 Building retrofitting complete

The aim of the project is energy savings by retrofitting of the residents owned housing SAB, SOBO an B42. The project is part of the social housing companies retrofitting implementation plan with an added extra energy saving dimension. Around 35% of Sønderborgs population lives in similar cooperative owned residential buildings so the potential for energy savings is substantial. As some of the identified barriers for energy savings in the scheme below suggests the potential energy savings from retrofitting of the building mass in general should be weighed against other options for obtaining energy savings.

Level of barrier	*Main barriers*	*Type of barrier*
National	Difficult to obtain mortgage loans for energy renovations in some areas (typically intensifies the further you go from the city center).	Market
National	The Danish Building Code sets the standard for new buildings as almost zero-energy houses: This enforces investments in buildings to fulfil the standard, regardless that surplus heat from for example industries might be available and could be used (but is instead cooled away, this includes waste heat), OR it is possible to produce heat from other energy sources cheaper than the investment costs to fulfil the zero-energy standard.	Legislation
National	Solar cells and solar thermal installed on individual buildings counts as part of the building's 'energy frame', which defines how much energy different types of buildings are allowed to use. This is not the case if solar cells and solar thermal are set up as large common plants.	Legislation

D5.4 38 biogas-busses in operation

Municipal biogas buses put in operation monitored and evaluated.

Level of barrier	*Main barriers*	*Type of barrier*
Local	The municipality has initiated a bidding process with an expected surplus of cost for the new green busses compared to conventional busses. It is a risk that this expected surplus will be exceeded.	Economic
Local	The municipality is in process of establishing a gas-charging station. It is a risk that this might be more expensive than expected and exceed budget-limits.	Economic
International	Higher gas-prices will also imply increased cost, however it is not expected that gas-prices will increase more than petrol.	Market
Local	The busses are expected to be in operation during late summer of 2017. There is a small risk that supply of busses can be delayed, but only for a few months.	Technical
Local	It might also impact the Green Buss initiative negative, if the biogas-plant at Blans is delayed or stopped, as there is a strong narrative connection between the biogas-production and its use in transportation.	Other

D5.5 Increasing RES–supply for district heating to 100%

The objective of the project is to increase RES-supply for district heating to 100%. The aim is to achieve this by the construction of a near coastal offshore wind park connected to the district heating net by large heat pumps and the introduction of thermal control technologies at home, building and district level.

Level of barrier	*Main barriers*	*Type of barrier*
EU, national and local	Environmental barrier for large heat pumps in relation to heat source e.g. seawater (this is the case in Sønderborg) and groundwater.	Environmental/legislation
National	In many cases large heat pumps are not economically viable due to taxes on electricity and the fact that biomass is cheaper (heat pumps are not granted for the flexibility they bring into the energy system).	Taxes/market
National	Near coastal windfarms are cheaper to build and operate than offshore windfarms but still more expensive than land based windfarms. The Danish support schemes for wind energy pays the same amount per MWh for near coastal windfarms as for land based windfarms, thus making some near coastal windfarms unfeasible in spite of the good wind resources.	Economical
Local (depending on specific location)	There are many environmental issues mainly concerning marine- and birdlife in the near coastal waters limiting the possible sites for near coastal wind farms.	Environmental
Local to regional	Near coastal windfarms are in Denmark defined as windfarms as close as 4 kilometers from the coast. This makes the visual impact much greater than offshore windfarms often situated 20 kilometers from the coast or more. Large parts of the coastal landscape can be visually affected. Denmark has a long tradition for protection of the coastal areas and civic protests against near coastal windfarms are almost certain even from many environmentalists.	Sociological/environmental

D5.6 Intelligent rechargers in operation together with E-vehicles + non intelligent public rechargers

Existing and new E-vehicles are in operation and a network of public intelligent and non-intelligent rechargers established and in operation.

Level of barrier	*Main barriers*	*Type of barrier*
National	The PSO tariff will equalize the price of electricity, which means that there are no economic incentives to use electricity when production is cheapest.	Tax
National	It is not possible for everyone to pay for electricity on an hourly basis.	Technical
Local	Most plugs do not send information about the SOC (state of charge) of the car to the charger.	Technical

D5.7 ICT Sønderborg platform in operation

The opbjective of this project is the deployment of the ICT infrastructure that is needed for data harvesting, monitoring and evaluation in Sønderborg´s Urban Management System. Also specific infrastructure needed for the deployment and operation of the City Information Open Platform (CIOP) will be set up.

Level of barrier	*Main barriers*	*Type of barrier*
National	The PSO tariff will equalize the price of electricity, which means that there are no economic incentives to use electricity when production is cheapest.	Tax
National	It is not possible for everyone to pay for electricity on hour basis.	Technical

4.4 Overview of main barriers for demonstrator projects

Here follows a summary of the major barriers identified by the 'Lighthouse Cities' categorized in topics. The barriers are based on the answers to the questionnaire. *Ref/1/.*

4.4.1 General market barriers for Smart city transformation

Cost-effectiveness perception

Several causes and reasons can affect the cost-effectiveness perception of measures to be implemented: technology maturity (subsidies to support technology maturing periods have shown lack of success), market uptake (some new products may be economically competitive only if sold with significant scale). Cost effectiveness studies performed at current energy prices however does not consider full benefits of measures (for example, more precise accounting of environmental externalities such as impact on air quality and health would favor electric vehicles).

High risk of investments

Risks related to performance of new products or systems not sufficiently tested in the market, or related with measures that involve extremely variable costs/prices.

High up-front costs

Often high up-front investment capitals cannot be obtained from financial institutions, even when they show interesting returns.

4.4.2 Urban retrofitting

Ownership/proporty laws

The structure of ownership and property laws can in many cases be a barrier to the retrofitting of buildings. Split incentives between owner and tenants or disagreement between owners of appartments within a buliding can make it difficult to carry through large investmensts with a long span of payback. For certain measures, even despite the fact that during half of its lifetime all the savings would constitute profit, people might still be averse to invest if they do not know whether they will continue to live in the same building during the next 10-20 years.

The situation in the real estate market

The real estate market can make it difficult to obtain mortgage loans for energy renovations in some areas that are less atractive (typically intensifies the further you move from the city center).

Unilateral focus on the single building

EU and national legislation focuses mainly on the energy consumption of the single building. This enforces investments in buildings to fulfill the standard, regardless that surplus energy might be available in the area and could be used. Or it is possible to produce the energy for the building cheaper in large common RES-plants.

4.4.3 Energy supply

Sizing and business models for district heating

In many areas or cities district heating is a new technology, and ownerships and exploitation of the system, which needs political decisions regarding involvement of the public sector, can delay the project. There is a minimum number of buildings that need to be connected to the DH to make it economically viable.

Environmental legislation and civic protests limitting sights for RES-plants

In historical parts of the cities posibilities for installing RES-energy supply might be limited because of conservation interests and in open land environmental legislation can minimize possible sights for large scale RES-plants such as windfarms or solar power plants. Civic protests against such plants are also common.

Barriers in the tax systems or support schemes

RES-technologies though improving can still not compete with conventional power plants in the current market. The new technologies are not allways granted for the environmental benefits and flexibility they provide.

4.4.4 Mobility

Alternative fueled vehicles can not yet compeed on market basis

Market situation appears to be unfavourable in short term, since oilprices are currently low and the vehicles are still relatively expensive. Cost effectiveness studies performed in current energy prices however do not consider full benefits of measures (for example, more precise accounting of environmental externalities such as impact on air quality and health would favor electric vehicles).

Range of EV´s

Engagement of commercial drivers to undertake a structural change in their main service tool (their cars or vans) due to a lack of experience with the limited range for EV´s.

Lack of infrastructure

Lack of charging infrastructure or safe parking places for E-bikes can limit the use of E-vehicles.

Intelligent chargers

There are no real time electricity prices which could potentially be an incentive to charge vehicles in situations with surplus of electricity from fluctuating RES-supply.

4.4.5 ICT

Data protection legislation

EU and national data protection legislation versus monitoring can in many cases limit the use of data for example monitoring of the energy use inside buildings.

Lack of professionals

The lack of a sufficient number of professionals specialized in ICT-solutions is a critical issue for Smart City technologies entering into the market, which may also affect the quality of the implementation.

4.4.6 Social engagement

Information asymmetry

Lack of information or information asymmetry at the level of both decision makers and practitioners may hinder the implementation of energy-efficiency measures. For example information asymmetry or lack of information about available technologies, and their economical and environmental benefits/disadvantages might affect the spread and adoption of energy efficiency measures.

Perception of quality of life

Citizens may consider certain measures as a decrease in their quality of life (e.g. shifting from individual to collective transport).

Divergence of interests between actors involved

A large number of measures may require the coordination of different actors from different sectors/functions, resulting in a divergence of interests (e.g. landlord-tenant problem).

Institutional failures, related to city authorities

Politicians tend to think and act on the short term, whilst transformation towards a sustainable city may take decades. Additionally, actions against climate change do not result in direct benefits for the implementer ("*Tragedy of the commons*").

"Not my business": Integrated solutions are required covering urban planning, buildings licensing, energy infrastructures, transport, water and waste management, but these domains are often classified under different departments, all having their own targets and budgetary constraints.

4.5 Regulatory gaps in EU-legislation

Common to all cities within member states of the European Union is of course the EU-legislation which is implemented in the national legislations in different ways. The input from the 'Lighthouse Cities' is in this chapter supplemented by an overview of the major EU-directives that regulate the topics: Urban retrofitting, energy supply, mobility and ICT. Though this legislation is above city level the hope is that the mapping of barriers will raise awareness within citizens, businesses, NGO´s, public authorities and the political system from local to EU levels and initiate changes in legislation and support schemes in order to drive forward Smart Zero CO2 Cities across Europe.

Below follows short descriptions of the EU-directives and their impact on SmartEnCities transformation. The mapping of the impact and effects of the legislation is based mainly on EU-Commission public evaluation reports with input from a wide range of stakeholders such as industry, businesses, NGO´s, citizens etc. and partly on relevant research reports. Directives and major associated gaps and barriers are sumarized in a scheme in the end of this chapter.

4.5.1 Urban retrofitting

The Energy Performance of Buildings Directive (2010/31/EC)

Buildings contribute to around 40 % of total energy consumption in the EU and the sector is growing. It is therefore one of the sectors where massive energy savings could and should be achieved. The 2010 Energy Performance of Buildings Directive establishes that energy performance certificates are to be included in all advertisements for the sale or rental of buildings. EU countries must establish inspection schemes for heating and air conditioning systems or put in place measures with equivalent effect and all new buildings must be nearly zero energy buildings by 31 December 2020 (public buildings by 31 December 2018). EU countries must set minimum energy performance requirements for new buildings, for the major renovation of buildings and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls, etc.) EU countries have to draw up lists of national financial measures to improve the energy efficiency of buildings. *Ref./2/.*

The directive is a driver for minimizing the overall energy consumption of buildings and cities but still there are some critical points to be made. As an input for the revision a Public Consultation on the review of Progress on the 2020 Energy Efficiency Objectives have been conducted. *Ref./3/.* The stakeholders have identified barriers or gaps in the existing EU legislation and made new proposals. Two of the main points are:

- The Energy Performance of Buildings Directive lacks a long term binding target for existing buildings that could further incentivize renovation of the building mass.
- The Directive has a unilateral focus on the energy consumption of the single building. Future legislation should have a more holistic approach focusing on the whole value chain covering efficient technologies, district heating, smart metering and billing.

4.5.2 Energy supply

The Renewable Energy Directive (2009/28/EC)

Transition to a renewable energy supply is mainly regulated by the Renewable Energy Directive. The Directive establishes an overall policy for the production and promotion of energy from renewable sources in the EU. It requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020 – to be achieved through the attainment of individual national targets. All EU countries must also ensure that at least 10% of their transport fuels come from renewable sources by 2020. *Ref./4/.*

The main conclusions of the Public Consultation on the review of Progress on the 2020 energy efficiency objectives on the subject of energy supply is that a completion of the internal market for energy is needed eliminating national barriers and creating a flexible energy system with integration of renewable energy. *Ref./3/.* Other important points in the review are:

- Lack of mandatory energy efficiency requirements for new power plants and heating distribution systems.
- Current restrictions regarding the development and improvement of European networks of interconnections should be overcome to foster market integration.
- Lack of common standards for smart grid solutions including energy buffering and storage.

4.5.3 Mobility

In the White Paper – Roadmap to a Single European Transport Area – Towards a competative resource efficient transport system – (European Commisions, 2011) *Ref./5/.* Goal number one concerns urban transport: “Halve the use of ‘conventially fuelled’ cars in urban transport areas 2030; phase them out in cities by 2050; achieve essentially CO_2-free city logistics in major urban centres by 2030”

Part of the solution to a more sustainable urban mobility is technical developments in vehicles and fuel technology. Two important directives promoting sustainable fuels and vehicles are the The Clean Vehicles Directive and The Alternative Fuels Infrastructure Directive described below.

The Clean Vehicles Directive (2009/33/EC)

The Clean Vehicles Directive 2009/33/EC aims to stimulate the market for clean and energy efficient vehicles by requiring various procurers to take account of lifetime environmental and energy impacts when purchasing road transport vehicles. *Ref./6/.*

In 2015 an evaluation of the directive was published by the European Commission. *Ref./7/.* Some of the main points are:

- There is a lack of a clear definition of Clean Vehicles (minimum requirements). Which vehicles are the most beneficial in terms of achieving sustainable mobility?
- Some of the parameters have a bias for diesel vehicles - this might be bad for the local air quality in cities.

- The evaluation recommends introducing a standard to take in to account the Well-To-Wheels emissions to make sure that the environmental impact of the fuel from production to consumption is taken in to account.

The Alternative Fuels Infrastructure Directive (2014/94/EU)

The Directive requires Member States to develop national policy frameworks for the market development of alternative fuels and their infrastructure; Foresees the use of common technical specifications for recharging and refueling stations and paves the way for setting up appropriate consumer information on alternative fuels, including a clear and sound price comparison methodology. *Ref./8/.*

The infrastructure for alternative fuels today varies across the EU. There is a lack of harmonized infrastucture which leads to a fragmentation of the common market because of lack of common standards. The Directive is a driver for the setting up of a sustainable fuel infrastructure across Europe which is an important condition for the wider introduction of sustainable vehicles. An important lack in the legislation however is *Ref./9/*:

- Lack of common standards for sustainable fuels make the environmental benefits unclear.

Other measures

Key researchers in the the field of sustainable mobility have made the assesment that technological developments of sustainable fuels and vehicles are of key importance but that they will only constitute around half of the needed reduction in CO_2 emissions. *Ref./10/.* Many European development strategies favours increased mobility thus working against the needed CO_2 reductions. Future strategies and legislation should also aim to bring down the the level of transportation by increased use of communication technology, spatial planning and design of cities, modal split and accesibility based on sustainable transport etc.

4.5.4 ICT

The General Data Protection Regulation (GDPR)

The General Data Protection Regulation (GDPR) is a Regulation (entered into force on 24th. of May 2016) by which the European Commission intends to strengthen and unify data protection for individuals within the European Union. The Commission's primary objectives of the GDPR are to give citizens back the control of their personal data and to simplify the regulatory environment for international business by unifying the regulation within the EU. *Ref./11/.*

The new legislation increases the responsibility and accountability for those processing personal data – through data protection risk assessments, data protection officers, and the principles of ‘data protection by design’ and ‘data protection by default’. This could be seen as a barrier since it increases demands and investments in good data protection practices. The consequences of the legislation are yet to be seen but the intention has been to enable Big Data (including Smart Cities technologies) services in Europe by establishing a clear common legal framework and could potentially be a driver for SmartEnCities.

4.5.5 Overview

Urban retrofitting	
Main legislation: The Energy Performance of Buildings Directive (2010/31/EC)	
Barriers and gaps *Ref./3/*	- Lack of long term binding targets for existing buildings that could further incentivize renovation of the building mass. - More holistic approach focusing on the whole value chain covering efficient technologies, district heating, smart metering and billing.
Energy supply	
Main legislation: The Renewable Energy Directive (2009/28/EC)	
Barriers and gaps *Ref./3/*	- Lack of mandatory energy efficiency requirements for new power plants and heating distribution systems. - Current restrictions regarding the development and improvement of European networks of interconnections should be overcome to foster market integration. - Lack of common standards for smart grid solutions including energy buffering and storage. - Legislation should allow more active and informed consumer participation than today and allow new actors such as aggregators.
Mobility	
Main legislation: The Clean Vehicles Directive (2009/33/EC)	
Barriers and gaps *Ref./7/*	- Lack of a clear definition of Clean Vehicles. - Bias for diesel vehicles is potentially bad for the local air quality in cities.
Main legislation: The Alternative Fuels Infrastructure Directive (2014/94/EU)	
Barriers and gaps *Ref/.9/*	Lack of harmonized and clear standards for the production of alternative fuels makes the environmental benefits unclear.
ICT	
Main legislation: The General Data Protection Regulation (GDPR)	
Barriers and gaps	Challenging to harvest and use data in a way that is secure and respects the individuals right to privacy. Data Protecion Directive versus monitoring energy behaviours inside houses

5 Recommendations to facilitate city transformation processes

5.1.1 Opportunities and best practice examples identified by demonstrator projects and litterature studies

Correction of market failures

The EU and national political systems should work for the correction of market failures. Precise accounting of environmental externalities such as impact on air quality and health would favor the implementation of sustainable solutions. Environmental aspects that are not included in current market dynamics should have a stronger weight in public procurements.

Urban retrofitting

- Participatory processes and information to engage citizens and property owners in the project. Follow best practices, involve government city council and private stakeholders.
- Creation of a guarantee fund for financial support of neighbours with lower incomes.
- Transparency and social partners engagement in all phases of the project
- Set up requirements to facilitate the connection to the district heating or establishing conditions on the funding which make connection a pre-requisite.
- Backup of the public sector to ensure that operation of the district heating will be guaranteed for a number of years. Countries such as Denmark have specific regulations for the ownership and exploitation of the DH installations, to engage the public sector and give some confidence and guarantees to the users.
- Take a more holistic approach to urban retrofitting not solely focusing on the energy frame of the single building, but the overall energy consumption of cities and districts and the most cost-effective way to bring down energy consumption/or obtain RES-supply.

Energy supply

- Environmental externalities should be taken into account when comparing the economy of RES- and conventional technologies. This could be done by adding a tax on carbon emissions.
- Implement support schemes for RES-technologies to make them feasible until they can compete with conventional power plants.
- Different technologies should be granted according to their environmental impact in their whole lifespan and their expected role in the future RES-energy system.
- Support schemes should have a long continuity in order to promote trust of investors.
- Introduce and develop different kinds of energy storage systems to make better use of peak production from RES-plants. Electrical driven heat pumps are an example of such a technology.
- Raise local acceptance of RES-plants by local anchoring of the projects. A clear vision with local climate targets for the city could raise the level of awareness and

mandatory shares for locals ensure the economic benefit for the neighbors affected. In Denmark at least 20 % of shares in a wind turbine project is by law offered to the neighbors within 4,5 kilometers from the project as a general rule. This however is not enough alone to secure local acceptance so it should be followed by other initiatives to further develop local ownership and acceptance.

Mobility

- Positive discrimination of EV´s by for example free on-street parking rate and exception of road tolls as in Madrid and Oslo. Reserve special lanes for EV´s or let them drive in the bus lanes as in Sevilla.
- Set up delivery system of E-vans and cargo bikes as in Gothenburg, Sweden, to limit shopping centre traffic.
- Introduce car sharing of EV´s like the concept DriveNow in Copenhagen and other European cities.
- Create logistic micro hubs with EV´s and rental bikes in connection to public transport as has been done in Barcelona, Milan and London and consider the possibility to bring bikes on board trains or metros as in Copenhagen in order to promote the combination of public transport and biking.
- Encourage the the use of bicycles by establishing safe bike lanes and routes and create space for bike parking.
- Communication, dissemination and information to engage users and owners in the possibilities of EVs.
- Reinforce the deployment of charging infrastructure.

ICT

- Clarify standards and regulations. This has to some extent been done at the EU-level by the General Data Protection Regulation.
- Cooperation between several organisations or cities on development of much needed digital platforms or services to avoid isolated projects and harvest the benefits of scale.
- Take a user centered approach to make SmartEnCities more livable cities.
- Adres concerns on privacy and cyber security: Digital technology should be simple, easy to use, and with few obstacles, and only do the things that only it can do well, leaving people in control to do the things they enjoy doing. *Ref./12/*

Social engagement

- Intense communication campaign to communicate economic incentives and environmental benefits to join the projects.
- Citizen engagement and political consensus agreement.
- Creation of a guarantee fund for financial support of neighbours with lower incomes.
- Open up for local economical ownership by shares in projects.
- Set up a SmartEnCity board of the departments covering urban planning, buildings licensing, energy infrastructures, transport, water and waste management to harmonize targets and promote cooperation.

5.1.2 Proposals for change in regulations, new regulations and new incentives

Urban retrofitting

- If legally possible: Add flexibility to the building standards for both existing and new buildings by making it possible to avoid fulfilling the zero-energy standard in specific areas if certain conditions are present (e.g. minimum volume of available surplus heat for next 20 years).

Energy supply

- Set up mandatory energy efficiency requirements for new power plants and heat distribution systems.
- Harmonized support schemes for RES in the EU. Different technologies should be granted according to their environmental impact in their whole lifespan and their expected role in the future RES-energy system.
- Current restrictions regarding the development and improvement of European networks of interconnections should be overcome to foster market integration.
- Introduce an energy market with real time energy prices to regulate demand on fluctuating RES-energy supply.
- Introduce flexible district heating, electricity, gas, heating, cooling and mobility systems

Mobility

- Make a clear definition (with minimum requirements) of “clean vehicles” based on the environmental impact of the vehicle in its lifespan.
- Make a clear definition (with minimum requirements) of alternative fuels that are sustainable
- Take legal measures to bring down the level of transportation by increased use of communication technology, spatial planning and design of cities, modal split and accesibility based on sustainable transport etc.

6 Deviations to the plan

No deviations to the plan.

7 Outputs for other WPs

Effects on other WPs

This report gives input on barriers for demonstration projects in WP 3, 4 and 5. At a later stage in the project, the content of this report could be elaborated in WP 3, 4 and 5 e.g. by mapping which actors are/or should be involved in bringing down these barriers.

Interdependencies with other Deliverables

The identified barriers and recommendations in this deliverable are input for D2.6 Integrated Planning.

8 References

/1/ *Answered questionnaires from 'Lighthouse Cities' demonstrator projects, spring 2016*

/2/ *European Commission, 2014: Public Consultation on the review of Progress on the 2020 Energy Efficiency Objectives*

/3/ *European Commission homepage 23-05-2016:*

https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive

/4/ *European Commission 2011: White Paper – Roadmap to a Single European Transport Area – Towards a competative resource efficient transport system.*

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/6/ *European Commission 2015: Ex-Post Evaluation of Directive 2009/33/EC on the promotion of clean end energy efficient road transport vehicles*

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/11/ *European Commission 2016: The EU Data Protection Reform and Big Data – Factsheet*

/12/ *Arup and CEDI 2016: Growing Smart Cities in Denmark – Digital technology for urban improvement and national prosperity*