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THE JOURNEY TOWARDS
ZERO CARBON EMISSIONS –
A TRAVEL GUIDE FOR CITIES

TOWARDS SMART ZERO CO₂ CITIES ACROSS EUROPE





▲ Vitoria-Gasteiz
◀ Tartu
▼ Sonderborg

Editorial

Dear SmartEnCity Enthusiasts,

Five years ago, in 2016, SmartEnCity has started, a project funded under the European Union's Horizon 2020 Research and Innovation Programme. Thirty-eight project partners from six countries and five small and medium-sized cities shared the vision to make Smart Zero Carbon Cities a reality in Europe. With joint forces, they worked together with the involvement of the most important stakeholders in the cities, namely the citizens: on achieving a significant reduction of energy demand through cost-effective retrofitting actions, on increasing the use of renewable energy sources and on enhancing smart mobility in their cities.

During the past five years, our three Lighthouse Cities **Vitoria-Gasteiz** (Spain), **Tartu** (Estonia) and **Sonderborg** (Denmark) have developed various intelligent and innovative solutions to achieve these goals. In this booklet, we have collected their **best practices**: all presented solutions have been tested by the SmartEnCity partners and are suitable for replication in other cities. Plus, we are also sharing our **worst practices**, so that certain mistakes can be avoided in the future.

The SmartEnCity actions could not have been that successful if they were not integrated into an overall concept: How does the transition to a Smart City succeed? How do you start the process? SmartEnCity's biggest outcome is therefore the **Cities4ZERO strategy**, which provides a step-by-step guide on how cities can shape their path to zero emissions. Starting from an **Integrated Energy Plan**, there are dedicated steps from planning to realisation, which are presented in detail in the second half of this booklet. Moreover, the two SmartEnCity Follower Cities **Lecce** (Italy) and **Asenovgrad** (Bulgaria) give practical insights into their experiences regarding the application of this method.

As the involvement of **citizens** from the very beginning is the key to success, we share insights from key stakeholders in the project. And to further spread the knowledge of SmartEnCity across Europe, we introduce the **SmartEnCity Network**, a strong community of ambitious cities with the goal of supporting each other.

The SmartEnCity Cities4ZERO methodology has been so successful that it is already being used in other European projects and cities as well. Would you like to be the next? Then consider this booklet as an instruction manual for your city's successful transformation. Via QR-codes, each chapter leads to more detailed information on the SmartEnCity website.

In a way, we thus consider this booklet as a **travel guide** to start the smart zero carbon emission journey in your own city. Have a good trip!



Francisco Rodríguez Pérez-Curiel



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Travel Guide to Smart Zero Cities

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About SmartEnCity Project

Making Smart Zero Carbon Cities a Reality Across Europe

SmartEnCity's vision is to create Smart Zero Carbon Cities that are sustainable and inclusive, that improve their citizens' quality of life, create jobs and wealth, and offer equal growth. To reach this goal, SmartEnCity has developed a systemic approach for transforming European cities into smart and resource-efficient urban environments: the Cities4ZERO strategy is a highly adaptable and replicable method, implemented and tested within the three SmartEnCity Lighthouse Cities **Vitoria-Gasteiz** (Spain), **Tartu** (Estonia) and **Sonderborg** (Denmark) and replicated in the two Follower Cities **Lecce** (Italy) and **Asenovgrad** (Bulgaria).

With the goal to minimise the energy demand and to maximise renewable energy supply, based on this strategy, the Lighthouse Cities have generated innovative solutions in the fields of energy-efficient retrofitting in buildings, integrated infrastructures, sustainable mobility and intelligent use of Information and Communication Technologies (ICT).

Overall, under the coordination of TECNALIA Research & Innovation, 38 partners from six countries are working together to make Smart Zero Carbon Cities a reality in Europe!



SmartEnCity in a nutshell:

- > 3 Lighthouse Cities: Vitoria-Gasteiz (Spain), Tartu (Estonia) and Sonderborg (Denmark)
- > 2 Follower Cities: Lecce (Italy) and Asenovgrad (Bulgaria)
- > 38 project partners from 6 countries
- > Coordinator: TECNALIA Research & Innovation
- > Duration: 78 months (February 2016 – July 2022)
- > EU Funding: 28 Mio. €

Facts & Figures:

- > Retrofitting of 1,847 dwellings and 124,506 m²
- > Benefits for 29,300 inhabitants (population of the three districts)
- > Energy savings of about 27 million kWh/y
- > CO₂ reduction of 20,622 tons/year

Smart Solutions & Worst Practices

On their way to becoming Smart Zero Carbon Cities, the three Lighthouse Cities Vitoria-Gasteiz, Tartu and Sonderborg have generated various innovative solutions in the fields of **energy-efficiency, sustainable mobility** and intelligent use of **Information and Communication Technologies (ICT)**.

In this booklet, you can find examples on how to minimise your city's energy demand and to maximise renewable energy supply. Each solution therefore comes with a short description, followed by facts and figures. The QR codes at the bottom of each page lead to the SmartEnCity website where you can find further information and more details. To help you avoid potential mistakes, each solution also comes with a warning about the hurdles and possible difficulties you might face when starting this specific journey.

The path to success is not always straightforward! We know because we have been there. With this booklet, we therefore want to help you make the right decisions and avoid drawbacks, showing you what works and what doesn't.

Now, have a look and find out which solutions might be the right ones for your city!



"Vitoria-Gasteiz is committed to fostering its urban policies and orienting them towards a more resilient human scale city model that prioritises people, their health, safety and well-being above all else. Innovative approaches, such as the SmartEnCity project, provide an ideal framework with which to confront uncertainties and difficulties in a cooperative way between the different technical partners and stakeholders concerned."

Ana Oregi, Deputy Mayor City of Vitoria-Gasteiz



"It is cooperation between sectors and different stakeholders that really makes a city smart and the SmartEnCity project has offered us great opportunities for these collaborations. Becoming more sustainable in the face of climate issues, hand-in-hand with learning and sharing, means a lot for our innovative and open-minded city."

Raimond Tamm, Deputy Mayor City of Tartu



"SmartEnCity enabled Sonderborg to accelerate its climate actions to become carbon neutral by 2029. The project has engaged citizens and multiple stakeholders in planning and action. The integrated energy initiatives helped our city progress with large scale demonstration of energy efficiency across our housing associations, establishing a new EV charging infrastructure and push a city council decision to replace old diesel buses with 44 new biogas buses. Being a Lighthouse City in SmartEnCity helped Sonderborg gain new competencies, increase its network and open new climate opportunity windows in Denmark and across Europe."

Erik Lauritzen, Mayor of Sonderborg Municipality



Before and after, new façades in Coronación 3. Credits@VISESA.

Vitoria-Gasteiz's building renovation intervention consisted mainly of envelope retrofitting which involves intervening in the façade and the roof, improving the envelope's insulation and air-tightness, and installing new low-energy windows. In Vitoria-Gasteiz, the Coronación neighbourhood was chosen for this intervention as it was identified as the city's most vulnerable neighbourhood in terms of social issues, stability, habitability, accessibility, and energy efficiency. This district thus reflects the major challenges in terms of retrofitting and implementation of Smart City concepts: very high density, low-medium income, and a relevant social dimension.

The estimated costs for the retrofitting interventions were on average 21,000 € per dwelling, including the connection to the new district heating (DH) network. The final price for the house owners, after discounting the Horizon 2020, Basque Government and Vitoria-Gasteiz Municipality grants, was on average 9,600 €. In addition, the Basque Government and Vitoria-Gasteiz Municipality created a guarantee fund for those that could not afford this investment. Like this, the tenants that fulfilled the required conditions (certain threshold for yearly net income, registration of residency within the demo district, etc.) could apply for this subsidy and get funding up to a 100% of the cost of the retrofitting works.

Investment: 6.8 million € (26 buildings)

Retrofitting Package



Benefits:

- Increased property values
- Increased health, indoor comfort conditions and quality of life
- Increased energy efficiency
- Reduction of energy bills
- Reduction of carbon emissions

Potential for replication:



Facts & figures:

Retrofitted communities	26
Number of participant dwellings	302
Total retrofitted area	22,460 m ²
Savings of energy consumption on retrofitted dwellings	first analyses show savings of up to 50%

Caution:

Local retrofitting companies are usually small and medium-sized and are not used to offer services to public companies. Tendering processes may be complex for them and may be declared null and void if no contenders fulfil requirements. Scheduling explanatory workshops before making the public call and setting a direct communication channel during the tender may solve this issue.





Attractive artworks decorate the retrofitted houses. Credits@Silver Siilak.

TARTU



Smart Retrofitting

The main idea of Lighthouse City Tartu is to turn old Soviet-era panel buildings (khrushchyovkas or hrustsovkas) into smartovkas, i.e. high-quality living environments with a drastically reduced energy consumption. With an average life cycle of 30-40 years, many of the hrustsovkas have already outlived their time and are in dire need of retrofitting. As a response, Tartu piloted a replicable retrofitting solution in 18 hrustsovkas in the city centre, reducing their energy consumption from 270 kWh/m²y to 90 kWh/m²y. The retrofitting included renovation of all technical systems of the house. At the end, every building received an original artwork. The retrofitting included the following measures:

- Insulating the building envelope, attic, and basement
- New triple-glazed windows
- New building front doors to reduce heat loss
- Insulating and reconstructing the roofs
- Renovating the central heating system and installing new radiators
- Installing a new ventilation system with heat recovery
- New smart meters to gather data on water, electricity, and gas consumption
- Setting up a smart home system in each apartment to monitor consumption and control indoor climate
- New energy-efficient lighting in the corridors, basements and outside the building
- Solar panels on roofs
- Original artwork on the façade or next to each retrofitted building

Investment: 15.6 million € (18 buildings)

Benefits:

- Better interior climate (adjustable temperature, fresh air, CO₂ monitoring)
- Increased resource and energy efficiency, smaller energy bills for residents
- Autonomy from fossil fuels and independence of energy supply
- Improved data availability, simple monitoring, and energy consumption feedback
- Increased comfort, behavioural change, and social integration (community feeling)

Potential for replication:



Facts & figures:

Decrease in heating	Before: 166 kWh/m ² Now: 54 kWh/m ²
Decrease in electricity consumption	Before: 39 kWh/m ² Now: 28 kWh/m ²
Output of PV panels installed	664 kW

Caution:

Communication needs to be strong, relevant, and personal at the early stages of the process. Once renovation begins, good communication needs to take place between all parties (constructor, financier, residents) and it needs to be transparent and honest. Residents need to know what to expect and when. When cooperating with SMEs, the sustainability of this cooperation needs to be carefully assessed: does the company have enough resources and is it committed to carry through?



Retrofitted housing association building with roof integrated solar panels and battery storage solution. Credits@ProjectZero.

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Solar Cells with Battery Storage

Solar cell plants are being installed on housing association buildings in Sonderborg. At first, surplus produced solar electricity was sold to the public grid for a low price of maximum 0.05 € per kWh. Therefore, it is better to use the solar electricity directly in the apartments themselves. Instead of connecting the solar cells to the grid, a solar cells-solution with battery storage is being demonstrated. If solar electricity can be stored in batteries and used at a later stage, tenants will be able to save 0.28 € per kWh compared to the normal price for electricity in Denmark.

A battery storage solution is an interesting solution for apartment buildings because solar electricity produced during the day can be stored until the late afternoon or evening, when the electricity consumption is higher. With batteries, the area of solar cells is about 50 % higher compared to the area of solar systems without batteries. Like this, more electricity is produced with CO₂ neutral power. The demonstration project in Sonderborg involves three social housing associations with more than 20 departments. Eleven demonstration projects have been installed by spring 2021. Seven more projects are expected to be installed during summer 2021. Tenants in housing departments voted to approve the investment in solar-battery solutions.

Investment: 5.5 million €

Benefits:

- Better use of solar energy
- More feasible investment in solar systems
- Demonstration of new technology
- Considerable energy savings
- Considerable reduction of CO₂ emissions

Potential for replication:



Facts & figures:

2,500 m ² of solar panels are installed together with the batteries
Battery capacity in total of 2 MWh
Energy savings (with solar and batteries) of 2,950 MWh per year
CO ₂ reduction of 1,250 tons per year
Payback period for the investment is 10–12 years

Caution:

It is difficult but important to dimension and design the correct corresponding size of solar panels and batteries to get a feasible system. It can be a problem to find suitable places to install batteries, close enough to the solar system and distant enough to prevent fire-risks from the battery.



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Smart electric bus with ultra-fast pantograph charger. Credits@Vitoria-Gasteiz City Council.



Smart Electric Buses

The deployment of high capacity and 100% electric public transport is paramount for sustainable mobility and to achieve carbon neutral cities in the near future. In this regard, the Vitoria-Gasteiz City Council, the provincial government and the Basque Government agreed to finance the evolution of the circular bus line with the highest number of passengers in the city (Line 2) into a modern and clean electric bus rapid transit line with 48 bus stops (24 for each direction), four ultra-fast inverted pantographs, seven articulated e-buses and six conventional-size e-buses (18 meters long with a capacity of 139 people and 12 meters long for 90 people). The smart electric bus (acronym BEI in Spanish) will cover a route of just over ten kms with a service frequency of eight minutes and circulating through exclusive lanes for a large part of the route. Moreover, BEI will enjoy priority traffic lights at junctions and will serve key points in the city such as the main hospital, the Basque Government or the Mendizorroza sport and leisure facilities.

The tender for the purchase of the buses and the associated infrastructure was awarded in March 2019. The first e-bus unit along with the pantographs was deployed by July 2020; the model presented was the Irizar ie-tram 12m long version powered by a motor of up to 180 kW with lithium-ion batteries. Thirteen e-buses that will replace 12 diesel buses that currently give service to Line 2 are expected to enter into operation by summer 2021.

Investment: 42.3 million €

Benefits:

- Reduction of CO₂ emissions
- High capacity, smart and more efficient (dedicated lanes) public transport
- Traffic noise reduction
- Charging and ICT infrastructures that allow further replication to other lines
- Increase in the visibility and acceptance of EVs

Potential for replication:



Facts & figures:

Number of 100% electric buses	13
Number of customers	about 250,000 passengers/month
New kms of dedicated bus-lanes	8 km
Estimated saving of CO ₂	1,304 tn/yr (strong increase expected in near future due to 100% RES electricity supply)

Caution:

Citizen complaints due to perceived impairments to traffic (congestions during public works) and parking provision (fewer parking places in areas with a deficit in parking availability for residents to provide dedicated bus lines). A way to overcome this is by increasing communication and answering to citizens' complaints one by one through the mobility forum and other participatory channels in the city council. Also, it helps to compensate some parking places by creating new spaces or changing parking orientation (to increase capacity) at nearby locations. Finally, street design might help to decrease congestion at certain crossings.



Regular and electric bike sharing station. Credits@Mana Kaasik.



Electric Bike Sharing System

As of June 2021, the bike sharing system of Tartu consists of 750 bikes (2/3 electric and 1/3 regular) in 83 bike sharing stations across the city and neighbouring areas. It was launched on 8 June 2019. The bike sharing system expands annually with new docks and bikes added and nearby municipalities of Tartu getting interested in expansion.

The aim of the public bike sharing system is to encourage the use of cycling as a means of transport and to provide a viable alternative to cars. The city bikes are a part of the public transport system of the City of Tartu and a bus period ticket allows the user to also use those bikes free of charge for the first hour. The city bikes have proven extremely popular – as of June 2021, 1.8 million bike trips have been made and nearly a third of Tartu's citizens have registered as users.

The bike sharing system is supplied by the Canadian company Bewegen Technologies Inc that won the public procurement organised in 2018.

Investment: 2.5 million €

Benefits:

- Reduction of car use and traffic, decreasing the need for parking spaces
- Reduction of carbon emissions and noise
- Autonomy from fossil fuels
- Improvement of mobility and health of citizens
- Greener and cleaner urban environment

Potential for replication:



Facts & figures:

CO ₂ reduction (total since beginning)	< 730 tons
Number of trips made	< 1.8 million trips
Distance ridden (total since beginning)	< 4.9 million km

Caution:

The registration to the service should be verified via a personal ID (via an ID card or something similar). This helps prevent the creation of fake accounts, incorrect registration information, etc. The launch of the system needs to be planned carefully – in Tartu, the number of registrations exceeded expectations five-fold, which caused problems with the web service back office, bike circulation and distribution.



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Smart biogas buses carry bikes, charge mobile phones, and offer free web access. Credits@ProjectZero.

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New Biogas Bus Fleet

The ProjectZero masterplan created a burning platform for replacing old diesel buses with a green solution. An analysis showed that biogas buses were the best choice for Sonderborg due to the relatively big size of the municipality, the required charging frequency and the investment cost in charging infrastructure. As biogas is considered zero-carbon, the new bio-bus concept is a zero carbon mobility solution, reducing the area's carbon emissions by 2,660 tons of CO₂.

The new bio-buses were implemented in summer 2017, facilitating several features: forty-four new energy-efficient buses fueled by biogas; improved digital services notifying users of departures etc. on apps and displays at major hubs; each of the new buses can carry four bikes, allowing a combined trip; new biogas fuel charged at a centrally located service station.

The higher costs are covered by the city council and the municipal budget.

The buses within Sonderborg's municipal borders are operated on a political "business" model whereby the city council subsidises the ticket price as a part of the public transport system in Sonderborg. Buses are operated by the Umove company.

Investment: The biogas buses are leased for a period of eight years, starting 2017. The leasing is approximately € 55,000 more expensive per year than conventional diesel buses, but the socio-economic benefits outweigh this extra cost (e.g. no emissions from biogas buses).

Benefits:

- Green mobility solution voicing a clear green citizen transport message
- Improved citizen facilitation with integrated biking and information system
- Support to Sonderborg's Roadmap2025 transition
- Charging infrastructure supports further scaling of gas for cars/trucks
- Catalysed production of local biogas

Potential for replication:



Facts & figures:

44 biogas buses in operation since June 2017:	<ul style="list-style-type: none"> ▪ 2.5 million km driven every year, fuelled by 900,000 m³ gas ▪ CO₂ reductions of 2,600 tons per year
Separate gas-charging site established:	<ul style="list-style-type: none"> ▪ 44 individual charging stations established at separate new built site allowing the charging to take place when the buses are not in operation ▪ private and industry owned gas driven vehicles can charge gas from a close by gas station

Caution:

From an energy system and carbon point of view, electricity fuelled buses would have been a better choice. However, transport distances in Sonderborg and the cost of establishing the charging infrastructure combined with the bus batteries still being immature in 2016/2017 led to the best choice being biogas.



Smart City Platform to collect and analyse (energy) data. Credits@Estudios GIS.

VITORIA-GASTEIZ



Smart City Platform

Vitoria-Gasteiz obtains the necessary ICT infrastructure to achieve full comparative knowledge of the project interventions via two different methods:

- 1 Low level sensors measuring temperature, relative humidity and CO₂ installed in dwellings to determine the comfort conditions of tenants along with energy consumption measuring devices (on a real time 24x7 basis). The necessary wireless (4G) routers and wired networks are configured and deployed to assure that data are seamlessly redirected and stored in the platform databases. To monitor the operation conditions of the electric buses (BEI), on-board acquisition devices are installed to gather and transmit relevant information on routes, usage, recharge operations, etc. The monitoring of energy consumption in public municipal buildings is acquired by tapping into utility meters.
- 2 A City Platform was implemented to manage the information obtained from the interventions. Software services are deployed to store, interoperate, normalise, analyse, and display the data acquired from the city. The platform is the backbone for data storage, data analysis, visualisation and display, user and roles definition, security, and access services (both operator and other systems), GDPR compliance, and all necessary functionalities to build added value services for future city elements that will be integrated into the platform.

Benefits:

- Real-time information on comfort conditions in the dwellings
- Impact calculation of the energy retrofitting of the houses based on real data
- Direct citizen engagement with local news of interest
- Forecast of energy demand based on customer comfort preferences
- High level visualisation of indicators and KPIs online and in real time

Potential for replication:



Facts & figures:

Number of dwellings monitored	302
Number of sensors installed in dwellings	750
Number of municipal buildings identified in the Geographic Information System (GIS)	412
Number of electric buses monitored	13

Caution:

Dwelling sensing systems must be as fool-proof as possible, as there is no control on what happens to the devices once they are installed and left in the premises.



Investment: 1.25 million €

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The Baltics' first district cooling plant. Credits@AS Fortum.

The construction works of Fortum Tartu's district cooling plant and network were completed in May 2016 and the first customer to join the network was one of the largest shopping malls in Tartu. The initial cooling network was 1.6 km long and partially covered the Tartu SmartEnCity pilot area.

The cooling plant is located next to the river Emajõgi, allowing to use river-cooled chillers that are a part of the high-performance production solution. Water from the river is used for free cooling from October to April. At the moment, the length of the current district cooling network in the downtown area is about six km. The district cooling project decreases the need of electricity up to 70% annually compared to local cooling solutions. The decrease in electricity use will benefit the environment by reducing CO₂ emissions up to approximately 70%.

The district cooling system uses free solar energy from PV panels to cover a part of the cooling system's energy demand. As such, the use of fossil electric energy for producing hot water with electric boilers will be replaced with residual heat and electricity produced by PV panels. The solution will meet consumer demands for thermal indoor comfort and domestic hot water while retaining high energy efficiency and a share of renewable energy.

Investment: 6.4 million €

TARTU



District Cooling with Residual Heat

Benefits:

- Connecting a (commercial) property to the district cooling network removes the need for refrigeration equipment and additional cooling units on rooftops
- Increased resource and energy efficiency
- Autonomy from fossil fuels and independence of energy supply
- Reduction of carbon emissions
- Reduction in the usage of F-gases (fluorinated greenhouse gases)

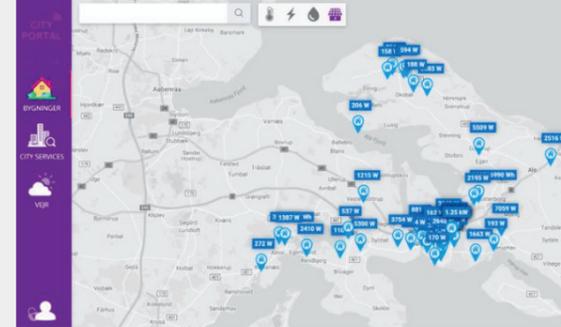
Potential for replication:



Facts & figures:

Produced energy		2017	2018	2019
Electricity from PV panels	MWh	20.10	49.00	53.10
Share of solar energy from total energy consumption	%	6.00	8.30	10.40
Production of cooling energy	MWh	1,539.00	3,010.00	2,868.00

Caution: Cooling station services are mostly dependent on the market, which can be unpredictable. Early agreements with future clients are therefore very important.



Smart City Platform offering public data on energy consumption and production, availability of EV chargers and more. Credits@ProjectZero.

Sonderborg's long term vision is to build a digital ecosystem for city data and services by integrating various data inputs and sensor systems together into one city ICT platform, where anyone could add their own value services. Sonderborg's ICT solution is a Telia Smart City service, localised for Sonderborg city and partner's needs, also called City Information Open Platform (CIOP). The CIOP includes two strictly separated parts: the Open Data portal and the My Data portal.

The CIOP is still in its development phase. However, there is a significant number of stakeholders already involved and connected to the Open Data portal side, providing publicly available data (energy related data of housing associations; public buildings such as schools, swimming pools, etc; availability of electric vehicle chargers; parcel boxes; other).

To log in to the My Data portal, one needs a Danish national NemID authentication, which is available to all Danish residents without the need for a separate user-account. After logging in, a person or organisation can see all the data related to them and the data that is shared or delegated to them. In addition, an "Energy Manager" tool has been developed, allowing households to keep track of their annual energy consumption, see their yearly emission footprint, receive advice on how to improve their energy efficiency and subsequently lower their CO₂.

Investment: 1 million €

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City Information Open Platform

Benefits:

- Centralised data gathering
- Open data exchange and access which promotes transparency
- Monitoring possibilities (energy consumption, energy production, emissions, etc.)
- Creating awareness in various stakeholder groups (citizens, public and private organisations, educational organisations, etc.)
- Fostering innovation and new opportunities for collaboration

Potential for replication:



Facts & figures:

Public buildings showing various live data such as heating, electricity and water consumption and PV production	45
Buildings from three different housing associations showing live data on consumption and production of energy	24
EV charging stations showing availability of the charging points	15
Live weather information	

Note: The CIOP is still under development and the figures above are being constantly improved as new connections are taking place.

Caution: The CIOP was initially created for Lighthouse City Tartu. The My Data portal log in had to be adjusted to fit the Danish standards. Having a solution developer from another country not fully aware of the country's specific authentication measures could lead to delays. However, having a strong national partner can help with this process.



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Worst Practices

The journey to becoming a Smart Zero Carbon City is not an easy one. Therefore, the SmartEnCity Light-house and Follower Cities also made some negative experiences that they would like to share so that others can learn from them and avoid making the same mistakes in the future.

Vitoria-Gasteiz

Topic: Citizen Engagement

Worst Practice: "At first, we had an information office located outside our demo site. However, this did not work in reaching out to or engaging with our citizens."

Advice: "Location is key. You need to make your information activities happen directly in your demo district. For example, place an information office at the heart of the demo area if you want to engage the people living there."

Topic: Citizen Engagement

Worst Practice: "A lack of retrofitted sample buildings in the early stages of the project made it difficult for us to explain its advantages and benefits to the residents. This complicated citizen engagement and the successful adhesions for the project."

Advice: "Make sure you have a few real-life examples for demonstration purposes in the early stages of the project to convince your citizens: create a demo within the demo and use it to "sell" your project!"

Sonderborg

Topic: Citizen Engagement

Worst Practice: "An important energy saving measure for our retrofitted buildings could not be approved in time due to the schedule of the annual tenants meeting, which is usually a set date once per year."

Advice: "You need to be aware of specific timing and procedures for your stakeholder's decision making processes and promote/influence the process in due time. At those meetings, you need to be well-prepared, with strong and convincing arguments."

Topic: Technology Readiness Level (TRL)

Worst Practice: "Our initial plan was to implement a line of electric buses, but due to high costs of establishing the charging infrastructure and the bus battery technology still being immature at the time, a different solution (in this case, biogas buses) had to be chosen."

Advice: "You need to collect all the important information about planned activities (e.g. regarding TRLs) beforehand to avoid potential obstacles later on."

Tartu

Topic: Involvement of small and medium-sized enterprises (SMEs)

Worst Practice: "We included various SMEs as full partners in the project intending to further exploit their innovations in the future. However, SMEs have tight budgets and they very much depend on external resources. Because of that, a continuation of their developed solutions was not possible."

Advice: "You need to discuss the needs and the plans of your partnering SMEs beforehand to avoid conflicting expectations. Consider engaging them as subcontractors instead of as full partners if you are uncertain about the situation."

Worst Practices



Topic: Budget planning

Worst Practice: "The budget planned for the development and installation of a new smart home system turned out to be much too low due to rising costs of hardware and software products. Therefore, several add-on functionalities could not be realised due to a lack of budget, and consequently, development was delayed."

Advice: "Make sure that your budget planned during the proposal phase is realistic and that it takes into account cost increases, possible delays as well as inflation costs."

Asenovgrad

Topic: Citizen Engagement

Worst Practice: "We planned a public meeting with citizens to discuss the financing of several improvements to the urban environment of their neighbourhood, but only very few citizens participated."

Advice: "It is better to include citizens already at the design stage of planned implementations and not only when it comes to construction or financing."

Topic: Quality of construction works

Worst Practice: "The company that carried out the construction and installation works at a neighbourhood delivered bad quality, took longer than planned and did not pay attention to the needs of the people living in that area."

Advice: "You need to have constant control over your contractors, monitoring their quality and progress as well as the effects on your residents. Otherwise, it can reflect badly on your municipality and prevent citizens from agreeing to future renovations."

Lecce

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Topic: Citizen Engagement

Worst practice: "The process for the SmartEnCity Integrated Energy Planning foresees the involvement of different stakeholders. When Lecce published the invitation for a respective workshop, many participants (companies, ESCOs, universities, municipal employees, associations, etc.) confirmed their availability. However, citizens were not involved."

Advice: "From the very beginning, you need to create a dedicated contact channel with your citizens, for example, through associations. Citizens may not be technical experts, but it is important to include their point of view, considering that a lot of the actions are related and in connection with their daily life."

Topic: Network replicability

Worst practice: "One of the project's objectives is to promote the replicability of the SmartEnCity Integrated Energy Planning process at national level. Therefore, a group of ten Italian cities has been identified to observe the process and to get inspired. However, these cities are not able to replicate the activities on their own due to a lack of expertise and funds."

Advice: "From the beginning of the project, you need to build up a steering committee to better engage network cities in this replication process, supporting national coordinators in exploiting all the activities related to the topic of Smart Cities."

Read more





▲ Lecce
▼ Asenovgrad

The Journey – Strategy and Implementation

Every Smart City once had to start somewhere. So did the three SmartEnCity Lighthouse Cities Vitoria-Gasteiz, Tartu and Sonderborg! With this second part of the booklet, we therefore want to take interested cities by the hand and show them what the individual steps are on the journey towards becoming a Smart Zero Carbon City.

At the heart of this journey lies the **SmartEnCity Cities4ZERO** strategy, a step-by-step methodology for the Smart Zero Carbon City transition. It guides cities through the process of developing the most appropriate strategies, plans and projects as well as achieving the commitment of key local stakeholders for an effective transition – all from an integrated planning approach.

The **Integrated Energy Planning Process (IEP)** as the first step of this strategy forms the baseline for a successful start of the decarbonisation journey and was **replicated** in the two SmartEnCity Follower Cities Lecce (Italy) and Asenovgrad (Bulgaria). But besides strategic planning, it is crucial to also **involve the citizens** from the very beginning.

If you feel like your city could need a little bit more hands-on support, then join the **SmartEnCity Network**, a strong community, providing advice and support for cities willing to start their own transformation.

The aim of the overall Cities4ZERO strategy is to support European cities on their journey towards decarbonisation, mainly targeting small and medium-sized cities. As the SmartEnCity Network slogan states, **“You don’t have to be a capital city to make a major difference!”**



“Despite every city, every street, every square being the result of a unique configuration of urban elements, those tend to share common challenges among cities worldwide. Let’s be inspired by what other cities have faced before, let’s adapt solutions to our specific context; let’s replicate!”
Koldo Urrutia Azcona, Author of the Cities4ZERO strategy, TECNALIA Research & Innovation

“A Smart Zero Carbon City (SZCC) is a resource-efficient urban environment where carbon footprint is nearly eliminated; energy demand is kept to a minimum through the use of demand technologies that save energy and promote raised awareness; energy supply is entirely renewable and clean; and resources are intelligently managed by aware and efficient cities, as well as both public and private stakeholders”.

SmartEnCity Project



“The methodology developed in the project, based on the experiences of the Lighthouse Cities, was crucial to support the energy planning activities and roadmaps development for Lecce. The analysis of the baseline and the identification of the key future actions can be considered as milestones on the way towards reducing CO₂ emissions by 40% until 2030.”
Serena Pagliula, Project Manager of SmartEnCity for Lecce Municipality



“SmartEnCity has been a great experience for us. Applying the Lighthouse Cities’ solutions to local conditions will contribute to the sustainable development of Asenovgrad and will help us to make our city a better place to live.”
Georgi Angelov, Head of Department “Project Management and International Cooperation”, Municipality of Asenovgrad



The Strategy – Cities4ZERO

Cities4ZERO is a step-by-step methodology for local authorities, able to guide them through the process of developing the most appropriate plans and projects for an effective urban transition; all from an integrated, participatory and cross-cutting planning approach. The Cities4ZERO Strategy consists of **16 steps** that are structured **in three stages**. Stage A deals with the development of the **city strategy towards decarbonisation**, while Stages B and C **develop the Key Projects** identified in Stage A:

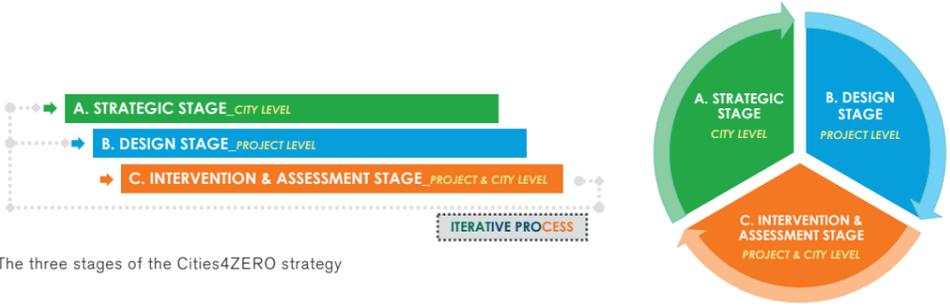


Figure 1: The three stages of the Cities4ZERO strategy

A Strategic Stage (STEPS 1 to 6)

A **strategic planning framework** enabling city administrations to perform an effective transition towards the Smart Zero Carbon City (SZCC), including:

- Key **city stakeholders' engagement** and institutional analysis.
- **Analysis and diagnosis** of city strengths and opportunities.
- **Co-visioning** process for urban transformation towards energy transition, including potential future scenarios.
- Development of **Strategic Plans** to deploy that vision and **identification of Key Projects**, ensuring commitment of engaged stakeholders and municipal support.

B Design Stage (STEPS 7 to 11)

Development of Key Projects identified in Stage A, according to the Strategic Plans of the city, paving the way for tangible interventions towards the SZCC, including:

- **Project prioritisation and selection** based on city needs.
- **City transformation framework** with policies, plans, best practices, regulation, etc.
- **Funding & financing** mechanisms.
- **Citizen Engagement strategies** for project development.
- **Project design and tools**.
- Project **implementation plan** & indicator systems.

C Intervention & Assessment Stage (STEPS 12 to 16)

Implementation of Key Projects identified in Stage A and designed in Stage B, finally transforming the urban environment, including:

- **Intervention works**, solutions deployment, and commissioning.
- **Monitoring, maintenance**, and users training.
- Interventions' **performance and impact assessment**.
- Post management and communication through **City Information Open Platforms**.
- Project and strategy **validation**.
- **Up-scaling** of successful experiences.

This step-by-step methodology is a **circular process** that cyclically iterates when felt partially obsolete to **readjust the focus of Strategies, Plans and Key Projects** towards the final decarbonisation goal, according to the co-formulated city vision.

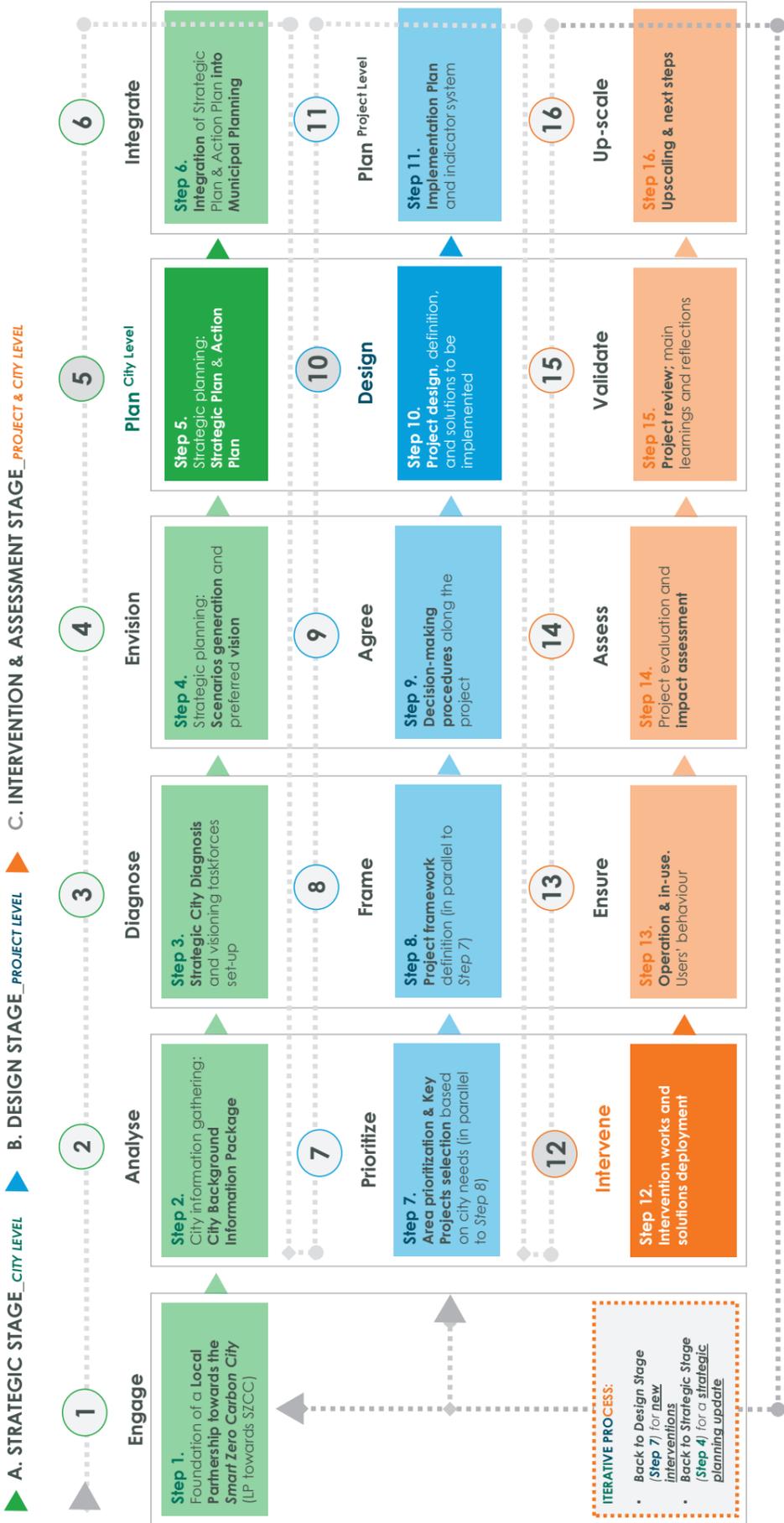


Figure 2: Cities4ZERO overall process: 16 steps entailing the co-design of a City Strategy (Stage A) and the co-development and implementation of Key City Projects (Stages B and C)



The Start – IEP Planning Process

Cities4ZERO Foresight: An Integrated Energy Planning Process (IEP)

The decarbonisation of cities requires complex strategic planning; it needs **system level thinking and changes**. Local governments increasingly realise this, but challenges remain while developing policies regarding the tools, involvement of stakeholders and obtaining commitment from the whole community. To **overcome these challenges**, SmartEnCity introduces **participatory foresight methods** as part of the overarching Cities4ZERO framework.

This participatory process focuses **on bringing together stakeholders** to gather future intelligence, achieve unified scenarios and a common vision for future urban decarbonisation strategies. It helps to mobilise joint actions, which will contribute greatly to shaping the cities' integrated energy plans and roadmaps.

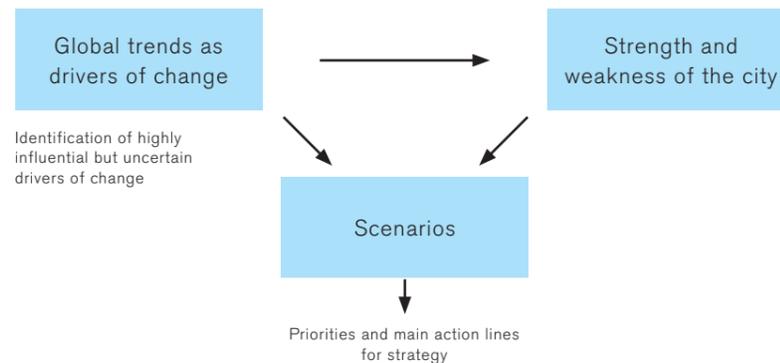


Figure 3: Cities4ZERO Foresight process from SWOT. Scenario analysis that informs strategy.

Practical toolbox to use Cities4ZERO planning process steps

Phase	Steps
Phase 1: Setting up the Scene	<ol style="list-style-type: none"> 1. Set up the Integrated Energy Planning Steering Group 2. Set the strategic question (e.g. "How can we make our city carbon neutral by 2030?") 3. Analyse/review the base situation, city characterisation, context analysis 4. Identify and assess the driving forces of change: <ul style="list-style-type: none"> ▪ Uncertain + highly relevant = uncertain trends with a high impact that should be analysed as background information in future scenario-building workshops. ▪ Likely + highly relevant = certain trends with a high impact that should be used as general background information in urban planning. 5. Determine main strengths and weaknesses Tip: SWOT and PESTLE analyses are valuable tools and even pre-conditions to provide input into city visioning. They can be prepared together with the stakeholders or before the scenario-building and visioning workshops and then be validated together with them.

	<ol style="list-style-type: none"> 6. Attract relevant stakeholders: <ul style="list-style-type: none"> → Municipality technicians → Politicians → Industry leaders → Research experts (university, research centres, innovative industry) → Landowners & other promoters → Citizens' associations → Consultants → Product developers → Suppliers 7. Prepare for the workshop
Phase 2: Scenarios of the Future	<ol style="list-style-type: none"> 8. Introduce the purpose 9. Get the stakeholders on the same page 10. Establish scenario logics 11. Create groups 12. Create different scenarios 13. Conclusions 14. Develop the scenarios: through discussions, the most attractive and realistic scenarios will guide the vision development further on. <p>The diagram is a 2x2 matrix. The vertical axis represents 'High consumer awareness' at the top and 'Low consumer awareness' at the bottom. The horizontal axis represents 'CO₂ aims will not be achieved' on the left and 'CO₂ aims will be achieved' on the right. The quadrants are numbered 1 (top-right), 2 (top-left), 3 (bottom-left), and 4 (bottom-right).</p>
Phase 3: Shared Vision	<ol style="list-style-type: none"> 15. Develop a preferred vision 16. Move to a strategic planning
Phase 4: Strategies and Actions	<ol style="list-style-type: none"> 17. Organise a follow-up event 18. Share results 19. Specify next steps Stay in constant contact with your stakeholders!

Figure 4: Scenario matrices from Tartu's integrated energy planning process, showing most impactful but uncertain trends.





Lecce Foresight Workshop 9 July 2019. Credits@Lecce Municipality.

The Implementation – Follower City Lecce

By participating in SmartEnCity, Lecce Municipality hoped to improve its quality of life by reducing GHG emissions with the help of the valuable experiences provided by the project's three Lighthouse Cities.

Lecce Municipality started its SmartEnCity journey towards a low-emission and climate-resilient future by **analysing and studying the first five-steps of the methodology developed in the project**, to help with the definition of its own Integrated Energy Plan (IEP) and its related roadmaps:

Step 1 – “Engage” Lecce Municipality created a local working group within the Public Work office, including municipal employees and external experts, with the support of RINA. The creation of this cooperative task force was fundamental to ensure good results along the entire process: the mix of expertise and knowledge between the city and its local stakeholders enabled effective management of all aspects related to the project.

Step 2 - “Analyse” was carried out to define the city's characteristics based on six domains, covering the most relevant sectors: local conditions, energy supply and consuming patterns, building stock and retrofitting needs, urban mobility, ICT infrastructures and services, as well as citizens and stakeholders' engagement. **The examples provided by the Lighthouse Cities were important to better understand the type of data to be collected** to obtain a precise baseline of Lecce.

Step 3 - “Diagnose” Lecce's strategic question was “How can we reduce the CO₂ emissions by 40% until 2030?”.

Step 4 – “Envision” The realisation of a SWOT analysis with the identification of Lecce's strengths, weaknesses, opportunities and threats in the main four sectors (energy, mobility, ICT and governance), alongside an identification of Smart City trends, represented the main activities to organise the **Future Scenario Development Workshop**. The event in-

involved more than 40 stakeholders coming from public institutions, university, public and private companies and associations. **Learning from Lighthouse Cities' experiences was fundamental** to organise an effective workshop where a scenario was voted as the most desirable for Lecce by 2030: “Collaboration and information: the first steps towards change”.

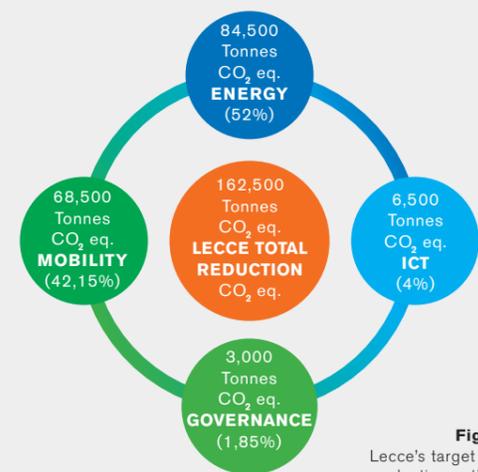


Figure 5: Lecce's target of CO₂ reduction until 2030

Step 5 – “Plan” The definition of the IEP was the most delicate phase of the process. It was realised through a list of new and innovative actions, more detailed in the roadmap, for a sustainable and efficient use of natural resources per sector, tailored to both the interests of the Municipality and the solutions offered by the stakeholders involved in the process. The realisation of Lecce's IEP and roadmaps was guided not only by the analysis of the Lighthouse Cities' templates, but also by a **solid collaboration with the local working group**, also inspired by the results of the Future Scenario Development Workshop, that gave a strong and real perspective about which solutions could be implemented and how to realise them.



Asenovgrad Scenario Formulation Workshop held as part of the foresight experience. Credits@Municipality of Asenovgrad.

The Implementation – Follower City Asenovgrad

As a Follower City, Asenovgrad has made a lot of experiences and learnings from SmartEnCity project. Asenovgrad benefited most strongly from its participation in the project through:

- the **knowledge and experience sharing** with other European small to medium-sized cities that care about sustainability and are conscious about their carbon footprint,
- the **examples of the Lighthouse Cities** where specific solutions have been implemented and tested in practice which provide a good starting point for replication under Asenovgrad conditions,
- the SmartEnCity **Foresight Methodology** and
- the SmartEnCity **Integrated Energy Planning** (IEP).

With the help of the six steps of the IEP (engage, analyse, diagnose, envision, plan, integrate), Asenovgrad was able to update and enrich previous policy documents. Based on that, Asenovgrad prepared and fulfilled a detailed planning of the foresight experience process. The result has been an **Integrated Energy and Climate Plan (IECP)** that has been successfully integrated into the **Plan for Integrated Development of the Municipality** – a master planning document that incorporates all sectors and fields of municipal development. The final version of the document was voted for by the Municipal Council on 27 January 2021.

During the planning process, specific efforts have been directed towards **stakeholder engagement** by organising participatory workshops and discussion rounds about the sustainable development of the municipality. Together, concrete scenarios for the future development have been formulated and priority areas have been identified and included in the **Asenovgrad Energy and Climate Roadmap 2020 – 2027** with concrete investment projects, required investments and a timeline for implementation. The roadmap is linked to the Asenovgrad IECP and forms the basis for meeting its targets and commitments.



Another Foresight Workshop in Asenovgrad. Credits@Municipality of Asenovgrad.

The practical experiences of the SmartEnCity Lighthouse Cities have thus provided a valuable contribution to Asenovgrad's roadmap, where specific already implemented solutions have been included for future replication, as well as to the sustainable development of Asenovgrad as a whole.

Read more



Read more



The Key – Citizen Engagement

„I strongly suggest you include the citizen and stakeholder engagement in your formal planning processes, like master planning, roadmap and climate action planning – all society sectors should be represented! An early engagement will strengthen the motivation and make the plan more robust.“



Peter Rathje,
ProjectZero –
Lighthouse City
Sonderborg



Merit Tatar,
The Institute of
Baltic Studies –
Lighthouse City
Tartu

„You yourself need to get in touch with the people directly if you want to reach them – don't rely on passive or impersonal communication. You need to get into a dialogue, explain the benefits and new technologies in an easy to understand language. Provide trainings and information materials. Making the citizens feel understood is the key.“

Ivanka
Pandeliëva-
Dimova,
Sofia Energy
Centre –
Follower City
Asenovgrad



“The personal one-to-one contact with citizens is very important. Asenovgrad Municipality refurbished 28 residential multifamily buildings by having bilateral meetings with representatives of the owner's associations to go through the administrative process and to choose a contract. Citizens need to feel support from the municipality in their energy related ambitions.“

„I encourage you to involve citizens, starting from the young generation. Spark their interest and thus create the “future green citizens and energy communities” – Perhaps, talk about Smart Cities at the school yard! Maybe, children will go home and even tell their parents about it.“



Sara Botto,
RINA S.p.A. –
Follower City
Lecce

“I suggest to first focus on a few “early adopters” amongst your citizens. These could be a few selected residents that are already interested or ideally even in favour of the implementation. Take them on board at an early stage, explain the benefits to them in detail and then have them help you by convincing their neighbours naturally, as part of their daily conversations. Real and easily understandable examples like this are crucial in engaging citizens!”



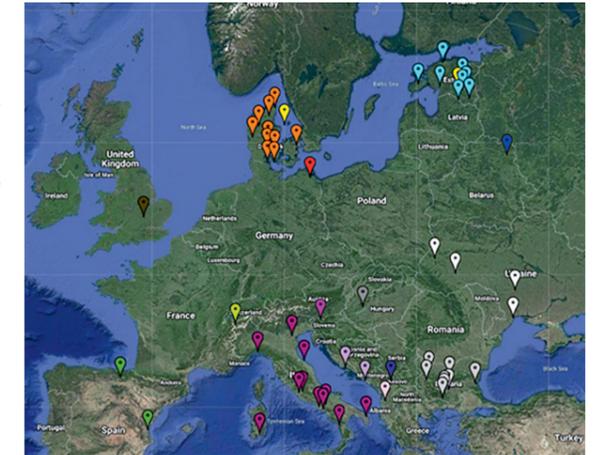
Alberto Ortiz
de Elgea,
VISESA –
Lighthouse
City Vitoria-
Gasteiz

The Community – SmartEnCity Network

The SmartEnCity Network has been established with the goal of enabling committed and ambitious cities to become smarter and more energy efficient based on an integrated approach for mobility, energy and ICT infrastructure. As part of the network, its members **share their experiences, knowledge, challenges and best practices** and believe in open innovation and co-creation.

The SmartEnCity Network in a nutshell:

- **58 small and medium-sized** (mostly) European cities committed to developing and implementing new smart zero carbon solutions,
- sharing efforts and best practice experiences with each other, derived from concrete actions.



Map of SmartEnCity Network member cities. Credits@Google Maps.

In addition to the European-wide network, the **five core SmartEnCity countries** (Denmark, Estonia, Spain, Bulgaria and Italy) have initiated **national networks** as well (see yellow pins on the map). They continue to engage cities on a national level, presenting the SmartEnCity methods and solutions and discussing how those can be adapted to their own national settings.

The **SmartEnCity Network Platform** serves as a learning hub, enabling interested stakeholders to learn more about different city solutions and initiatives, i.e. smart buildings, smart urban mobility or citizen engagement, and to read about latest network news or relevant events. Furthermore, a dedicated **SmartEnCity Network Bulletin** has been created which is published every other month, highlighting different city solutions, scientific articles, Smart City methodologies, funding opportunities, etc.

„SmartEnCity project has been a good platform for sharing experiences, introducing environmentally friendly and smart solutions at the local government level. Pilot projects led by local authorities in different cities have shown that the public sector can and must be a driver of innovation. These fierce examples will inspire and create a better and greener tomorrow.“

Kertu Vuks,
Vice-Mayor Elva
Municipality, Estonia



„Being a part of the SmartEnCity Network has enabled us to learn more about Smart City solutions across Europe and exchange experiences with other cities. The Energibyerne, on the other hand, is facilitating national city know-how, helping us collaborate with other cities on a national level. This is leading to much needed action-based opportunities which will push us in the green transition.“

Marie-Louise Lemgart,
Chief Energy and Climate Advisor,
Hoje-Taastrup Municipality, Denmark



Project Partners **SmartEnCity**



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