TOWARDS SMART ZERO CO_2 CITIES ACROSS EUROPE

VITORIA-GASTEIZ ✣ TARTU ✣ SØNDERBORG

Deliverable 2.2: Recommendations for updating standards or generating new ones

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Abbreviations and Acronyms

Abbreviation/Acronym	Description
SmartEnCity	Towards Smart Zero CO2 Cities across Europe
WP	Work Package
T	Task
TEC	Fundación TECNALIA
MON	MONDRAGÓN Corporación Cooperativa SCOOP
ACC	ACCIONA Infraestructuras
CAR	Fundación CARTIF
AAU	Aalborg Universitet
TREA	Mittetulundusuhing Tartu Regiooni Energiaagentuur
UTAR	University of Tartu
ET	Eesti Telekom AS (Telia)
DOW	Description Of Work
LH	Lighthouse
KPIs	Key Performance Indicators
EC	European Comission

Table 1: Abbreviations and Acronyms

0 Publishable Summary

Deliverable 2.2. is related to Task 2.3. Standards. This task is included in Work Package 2: SmartEnCity Urban Regeneration Strategy. This Work Package establishes the common framework that will allow the integrated and harmonized deployment of the lighthouse projects in Vitoria – Gasteiz, Tartu and Sonderborg, and replicating their experience in the two follower cities (Asenovgrad and Lecce). The overall objective of this Work Package is the development and consolidation of an integrated and systemic urban regeneration model towards the Smart and Zero Carbon City concept.

The objective of this document is to give an overview in the state of art of existing standards in 6 different disciplines: citizens engagement, building retrofitting, energy supply, mobility, ICTs and BIM management. After this general vision the objective of the deliverable is to select standards which better fit and are applicable to the in to the lighthouse projects implementation measures. Finally, the existing gaps and barriers will be identified for each of the six disciplines mentioned and for each of the projects phases identified: planning, execution and control.

As conclusions and outputs for other work packages this barriers and existing gaps will be summarized as well as the application of existing standards to implementation measures in lighthouse projects. Probably different levels of adequacy to standardization will be noticed in those six disciplines and this might be as well a conclusion: which disciplines admit standardization and which ones do not.

On deliverable 2.2, ACCIONA will lead the work and several partners will be contributing: TECNALIA, MONDRAGÓN, CARTIF, AALBORG UNIVERSITY, TARTU REGIOONI ENERGIAGENTUUR, UNIVERSITY OF TARTU and EESTI TELEKOM.

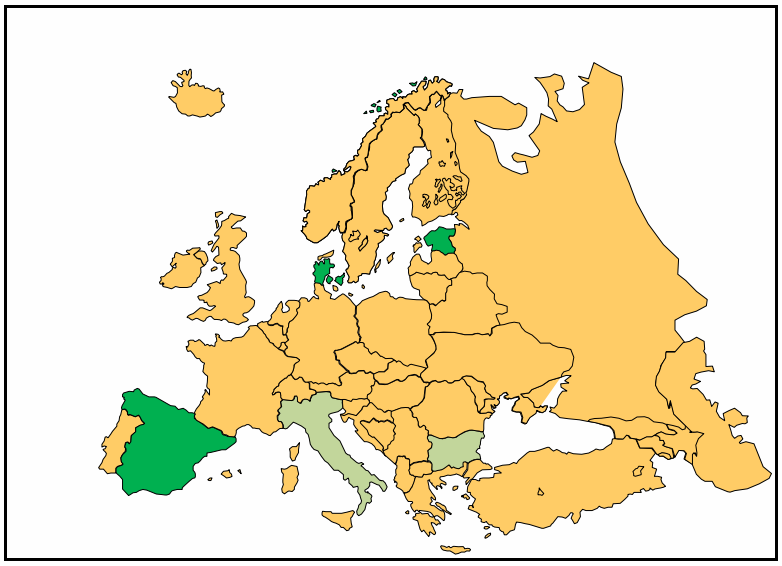


Figure 1: Lighthouse and Follower Cities in SmartEnCity

1 Introduction

1.1 Aim of the task and target group

This deliverable is related to Task 2.3. The objective of this task is to define standards which allow an easy and industrial implementation of the technologies involving the different implementation tasks: Citizens engagement/Building retrofitting processes/Energy supply and Use/Mobility/Information and Communication Technologies/BIM Management.

Detailed analysis of the existing standards will be carried out, identifying how the proposed technologies in the 3 lighthouse cities fit into them, detailing contribution to the standards if needed.

This task is included in Work Package 2: SmartEnCity Urban Regeneration Strategy. This Work Package establishes the common framework that will allow the integrated and harmonized deployment of the lighthouse projects in Vitoria – Gasteiz, Tartu and Sonderborg, and replicating their experience in the two follower cities (Asenovgrad and Lecce). This WP will analyze how to fix the baseline reference for urban renovation strategies, what is the best approach to manage this process and the active integration of citizens on it, what are the available financial mechanisms and how integrating all the components of urban regeneration intervention for smart cities in an Integrated Urban Plan.

The overall objective of this Work Package is the development and consolidation of an integrated and systemic urban regeneration model towards the Smart and Zero Carbon City concept. SmartEnCity will deliver smart city deployment plans oriented to transformation of urban areas through analysis and proposition, in an integrated way, of systemic concepts of energy efficiency (addressing building retrofitting), the evolution towards local energy and sustainable resources, sustainable mobility and information and communication technologies. The starting and focus point of the decision process of the city transformation model will be the citizen involvement.

The regeneration strategy will include: Citizens engagement strategies; Technology and Life Cycle Assessment; Policy and regulations; Standards; Business Models, procurement and funding; Integrated Management and Integrated Planning.

WP3 – Vitoria – Gasteiz LH Deployment, WP4 – Sonderborg LH Deployment, WP5 – Tartu LH Deployment and WP6 – City Information Platform will be developed in parallel and will be based on the results of WP2.

Task 2.6 will need some information concerning standards from the present document. “ D 2.4. City needs and baseline definition” will take into account this analysis on standards. Diagnosis of the cities will be guided by standards in order to define city characterization and the areas of intervention.

Task 3.1, 4.1 and 5.1 might need some information concerning standards from the present document and his appliance in each lighthouse project. “D 3.1. Vitoria – Gasteiz diagnosis and baseline”, “D 4.1. Tartu diagnosis and baseline” and “D 5.1. Sonderborg diagnosis and baseline” could apply the methodology described in D2.4 to LH project and will use standards analysis in order to use them to define city needs and baseline.

This methodology is defined mainly with target group in follower cities. Main indicators will be selected by cities to make city diagnosis are from D 7.1. but there are some indicators coming from standards that could be used by any city and specially follower cities.

1.2 Overall Approach

Several definitions of concepts will be further done in order to clarify the orientation of this document and to dispel doubts about the meaning of each concept. Once this is already clear, a state of art of standards will be done.

Nowadays standards in this field are organized in several disciplines which cover all aspect that can be possibly standardized. In order to fit the research and the state of art to SmartEnCity necessities as much as possible six disciplines will be chosen and the research will be done for each one of them. These disciplines will be: social engagement, building retrofitting, energy supply, mobility, ICTs and BIM management.

An overview of other European projects developed or being developed at this time will also be given in order to provide some background of what is being done in other cities in the continent in Smart Cities work line.

In addition, a selection of standards in every of the six disciplines (social engagement, building retrofitting, energy supply, mobility, ICTs and BIM management) will be done to isolate the ones that fit better in the measures carried out in the three lighthouse projects: Vitoria, Tartu and Sonderborg.

Last but not least, an identification of existing gaps and possible improvements in standardization will be done for each of the phases of the project (planning, execution and control).

Finally, conclusions will be made in order to summarize the results of this research and in order to serve as inputs for further Work Packages.

Several partners will be involved in this research. Nearly all of them will make the same process according to their concrete profile: they will do the state of art of standards according to their specific field of knowledge, they will select the standards that fit better in the planned implementation measures in the three lighthouse cities and finally they will identify existing gaps and possible improvements in standardization for their field of knowledge.

Other partners will be contributing by giving the general background and objectives of the document. Finally, those partners who have more weight in the proposal would be in charge of summarizing all the results and giving the suitable inputs to further Work Packages.

1.3 Concepts

According to the DoA (Description of Action) of SmartEnCity, the proposal of the project is to develop and demonstrate a highly adaptable and replicable systemic approach towards urban transformation into sustainable, smart and resource- efficient urban environments in

Europe. This will be implemented in the three lighthouse demonstrators and will be further refined and replicated developing Integrated Urban Plans in both lighthouse and follower cities.

The ultimate goal of these combined actions is to move European cities towards the Smart Zero Carbon emissions vision. This goal would be achieved through the combined deployment of a number of Europe-wide replicable strategies aimed at:

- Reducing energy demand through the use of innovative technologies in building retrofitting, sustainable and clean transport system, intelligent ICT control and raising awareness in all involved stakeholders.
- Maximizing renewable energy supply, through the use of locally available sources.

This general concept is linked to the EIP SCC vision through planning and implementation in the three lighthouse cities of the following set of measures:

1.3.1 Low Energy Districts

Energy retrofitting of buildings

A context-adaptable systemic approach towards significant reductions in the energy consumption of the building stock will be developed. Key technology issues as well as identified financial and social barriers will be addressed. Energy reduction potential of ICT will be used.

District heating networks

Cost effective implementation scenarios, significant increases in renewable share, efficiency improvements, efficiency improvements linked to intelligent control technologies and residual energy recovery and use are addressed in SmartEnCity.

RES integration management

Identification and use of not realized potential in RES, as well as intelligent management of electric urban infrastructure.

1.3.2 Sustainable mobility

A number of measures dealing with clean energy source promotion in both public and private fleets, as well as intelligent management for improved efficiency, optimized operation, and better integration of clean transport modes in the developing of urban scenarios. Additional issues such as improvements in environmental quality (air quality, noise…) will also be addressed.

1.3.3 Information and Communication Technologies

ICTs considered as cross-cutting, enabling technologies that will be used for monitoring and evaluation of the success of measures, as well as means for management, control and integration of valuable information provided and made accessible to different stakeholders and a tool for social interaction.

1.4 Contributions of partners

The following table depicts the main contributions from participant partners in the development of this deliverable.

Participant short name	Contributions
ACC	Task Leader. Development of general section of the document: introduction, publishable summary, objectives and expected impact and references. In addition, will contribute with knowledge about other similar European projects, management in terms of BIM methodology and writing the conclusions. Coordination of contents on social engagement, building retrofitting, energy supply and consumption, mobility , BIM and national energy systems. Overall content to sections 1,2,3.1,3.2,3.4,3.3.6,4.6,5.6,6,7.4,7.6,8
TEC	Development of contents about European, local or regional smart cities initiatives where lighthouse cities are already involved. Coordination of ICT contents. Overall content to sections 3.4.
MON	Development of contents regarding to building retrofitting and conclusion writer. Coordination of ICT contents. Overall content to sections 3.3.2,4.2,5.2,7.2

CAR	Development of contents regarding to mobility. Overall content to sections 3.3.4,4.4,5.4
AAU	Study of future changes on national energy systems and effects of these standards on them. Overall content to sections 7.7
TREA	Development of contents regarding to energy supply and conclusion writer. Overall content to sections 3.3.3,4.3,5.3,7.3
UTAR	Development of contents regarding to social engagement and conclusions writer. Overall content to sections 3.3.1,4.1,5.1,7.1
ET	Development of contents regarding to ICTs under coordination of MON and TEC. Overall content to sections 3.3.5,4.5,5.5

Table 2: Contribution of partners

1.5 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
D2.4	This deliverable might need some information concerning standards from the present document. “City needs and baseline definition” will take into account this analysis on standards. Diagnosis of the cities will be guided by standards in order to define city characterization and the areas of intervention.
D2.7	This deliverable might need some information concerning the present document. The generic information about similar European projects and about European, regional or local initiatives where Lighthouse cities are already involved will be used for further development in “Integrated and systemic SmartEnCity urban regeneration strategy_v1”. Like ways standardization for planning will need some feedback from BIM management standards from the present document.
WP 3	This work package might need some information concerning standards from the present document and his appliance in Vitoria – Gasteiz lighthouse project for design and implementation phases.

WP 4	This work package might need some information concerning standards from the present document and his appliance in Tartu lighthouse project for design and implementation phases.
WP 5	This work package might need some information concerning standards from the present document and his appliance in Sonderborg lighthouse project for design and implementation phases.
D6.1	This deliverable might need some information concerning standards from the present document. “CIOP Functional and non-functional specifications” will take into account this analysis of standards in order to make suitable specifications according to the applicable standards in LH projects.

Table 3: Relation to other activities in the project

2 Objectives and expected Impact

2.1 Objectives

SmartEnCity aims to contribute to create Smart Zero CO2 Cities across Europe through urban regeneration strategies, integrated urban plans and district integrated interventions. WP2 will help to develop an integrated and systemic urban regeneration model.

T2.3 is focused in the study of standards and the main objective of the deliverable (D2.2 Recommendations for updating standards or generating new ones) is to define standards which allow easy and industrial implementation of the technologies involving 6 different themes: Citizens engagement; Building retrofitting processes; Energy Supply and Use; Mobility; Information and Communication Technologies; BIM management. A detailed analysis of existing standards will be carried out. Identifying how the proposed technologies in the 3 light house cities fit into them and developing contributions for new standards if needed.

2.2 Expected Impact

The present analysis is expected to serve as guideline when selecting indicators. Using these indicators, the cities planners can know the potential features and adverse conditions and defining urban plans or strategies based on the city diagnosis as well as taking decisions about the most suitable interventions for the cities. Those indicators should fit into the selected standards as suitable for SmartEnCity.

Methodology for city diagnosis will be guided by standards in order to define city characterization and the areas of intervention. This methodology will be further applied into LH cities, follower cities and other European cities in order to define the actual state of the areas of intervention. The starting point of the implementation will be set according to this.

3 Standards for Smart Cities

3.1 Definition

First of all what we understand by the concept of standard shall be clarified. Building regulations are the minimum building standards required by law but what we understand by standards are voluntary characteristics that, if a project accomplishes them, would have better performance than the minimum obliged by law.

Standards are documents that set out specifications and other technical information with regard to various kinds of products, materials, services and processes.

Standards provide a basis for mutual understanding among individuals, businesses, public authorities and other kinds of organizations. They facilitate communication, commerce, measurement and manufacturing.

…Standards bring benefits to businesses and consumers in terms of reducing costs, enhancing performance and improving safety. They also help to ensure the compatibility of different components, products and services.

…Standards can be used to enhance safety and performance, improve energy efficiency, and protect consumers, workers and the environment. They complement European and national policies, and make it easier for businesses and other actors to respect relevant legislation.

…Standardization is a key instrument for consolidating the Single Market and facilitating cross-border trade – within Europe and also with the rest of the world. It is a valuable tool for strengthening the competitiveness of European companies, thereby creating the conditions for economic growth.

…. It is important to note that the use of standards is voluntary, and so there is no legal obligation to apply them. (European Comitte for Standardization - CEN, 2016)[1]

Standardization might be done in different levels: International (which might be applied worldwide), Regional (which might be applied in the region where it belongs: for example Europe) and finally National level (which might be applied in the country where they belong).

Usually standards are the adaptation of the higher level standards to particular conditions: regional standards are the adaptation of the international ones to the specific conditions of the region and national standards are the adaptation of the regional ones to the specific conditions of the country. As told, this is usual but is not happening always.

Standards are developed and defined through a process of sharing knowledge and building consensus among technical experts. These experts are organized in Technical Committees (TCs), which are subdivided in Subcommittees (SCs) or Working Groups (WGs). These TCs are included in the structure of the Standardization Organizations (National, European and

[1] Definition of European Committee for Standardization

International, with the respective mirror committees) and work following their internal regulations.

The standardization bodies operate at National (AENOR, AFNOR, BSI, DIN, etc.), Regional (CEN, CENELEC, ETSI) or International (ISO, IEC, ITU) level. Sometimes there are different standardization bodies at the same level, but covering different fields. This is the case of ISO (general), IEC (electrical) and ITU (telecommunications) at International level, or CEN, CENELEC and ETSI at European level in the same way.

There are also different kinds of standardization documents: Standards, Technical Specifications (TS), Technical Reports (TR) and Workshop Agreements (CWA).

At European level, all the members of CEN and CENELEC shall adopt European standards as national standards and have to withdraw any existing national standard which could conflict with them.

3.2 Common disciplines in actual standards

Nowadays, existing standards cover various trends: accessibility, air and space, chemical, construction, consumer products, defense, security and privacy, energy, environment, food and feed, health and safety, healthcare, ICT, Innovation Management, Machinery, Materials, Nanotechnology, Pressure equipment, Services, Smart living and Transport.

Regarding to smart cities mostly all of them cover similar topics: natural resources and energy, transport and mobility, buildings, living and people, government, and economy.

Inside the topic of natural resources and energy, the standardized aspects might be inter alia: climate and geography, air quality, noise, water management, waste management, land use, energy use, location, preserving, maintaining and protecting natural capital…

On the topic of transport and mobility issues raised are inter alia: travel patterns, energy, CO_2, cost, distances… And on the topic of buildings issues raised are inter alia: renovation, retrofitting, building technologies, spatial structures…

Regarding to the topic of living and people treated aspect are, inter alia, population, nationality, household, structure, housing, health, crime, culture and recreation…

Inside the topic of government, the standardized aspects might be inter alia: civic involvement, local administration, education, training provision, local e-government…

And last but not least, on the topic of economy issues raised are inter alia: labor market, economic activity, income, employ, disparities, poverty, production and consumption per sector…

The state of art done below pretends to give a global vision of standardization but focused in those standards that might be useful for SmartEnCity project and which are relevant in the countries where this project will be carried out.

State of art will be done for standards concerning the disciplines in which project implemented measures fit in. Those disciplines are social engagement, urban retrofitting, energy supply, mobility and ICTs.

3.3 State of art of standards in relevant disciplines for SmartEnCity

In order to narrow the research, in the document that concerns us, the state of art of standards will be done only in the six relevant disciplines according to the project's measures: social engagement, urban retrofitting, energy supply, mobility, ICT and BIM management.

3.3.1 Standards of social engagement

Definitions like social, civic, community or citizen engagement, involvement or participation, depending on the country and the language use[2] and the definer (Adler & Goggin, 2005), may have variance in the meaning, but mainly focus on the subject of more or less actively including stakeholders and different interest groups into the process of decision making. Adler and Goggin (2005) have defined civic engagement as "the ways in which citizens participate in the life of a community in order to improve conditions for others or to help shape the community's future". But this is not only a question of terminology, it is also a question of content – what are the aims and how social engagement is being practiced and by whom is the initiative.

In the context of SmartEnCity project goals civic engagement as social change would be the most appropriate, being described as:

> *Civic engagement as social change … focuses on the element of social change inherent in civic engagement: "Civic engagement describes how an active citizen participates in the life of the community in order to help shape its future. Ultimately, civic engagement has to include the dimensions of social change."* (Adler & Goggin, 2005)

Social change itself refers to "the alteration of mechanisms within the social structure, characterized by changes in cultural symbols, rules of behavior, social organizations, or value systems".

In the SmartEnCity project cities are the administrative units that have initiated the action. Thus cities have the ability to empower citizens and other possible stakeholders by targeting the audience correctly and using relevant information channels and engagement methods. There are different levels of participation depending on the aims of the inclusion process. The goal of public participation defined by International Association for Public Participation includes five different levels: informing, consulting, involving, collaborating, empowering. Also the promise to the public varies in this spectrum from "only informing" to the "implementation based on public's decision".

[2] C. Butteriss – Community Engagement vs Civic Engagement vs Public Involvement?

The process is manifold, since there are a different number of stakeholders involved in the process. For different stakeholders the engagement approach may vary.

Social engagement is a soft field in a sense it is dependent on the context. But to assure the quality and replicability of the process there needs to be taken into account some universally accepted guidelines and value basis. The combination of standards like Aarhus Convention, Torremolinos Charter, UN REDD+ Social and Environmental Standards and ISEAL Alliance's Standards can help to utilize this framework.

Aarhus Convention – UNECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters

1. Description of the standard

The Aarhus Convention establishes a number of rights of the public (individuals and their associations) with regard to the environment. The Parties to the Convention are required to make the necessary provisions so that public authorities (at national, regional or local level) will contribute to these rights to become effective.

2. Organization that developed it

The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters was adopted on 25 June 1998 in the Danish city of Aarhus (Århus) at the Fourth Ministerial Conference as part of the "Environment for Europe" process. It entered into force on 30 October 2001.

3. Objectives

The Convention provides for:

- the right of everyone to receive environmental information that is held by public authorities ("access to environmental information"). This can include information on the state of the environment, but also on policies or measures taken, or on the state of human health and safety where this can be affected by the state of the environment. Applicants are entitled to obtain this information within one month of the request and without having to say why they require it. In addition, public authorities are obliged, under the Convention, to actively disseminate environmental information in their possession;
- the right to participate in environmental decision-making. Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organisations to comment on, for example, proposals for projects affecting the environment, or plans and programmes relating to the environment, these comments to be taken into due account in decision-making, and information to be provided on the final decisions and the reasons for it ("public participation in environmental decision-making");
- the right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general ("access to justice").

4. Limitations

- Focus on environmental issues, not too many planning tools

- Methods, terminology and thinking is a bit "old fashioned" (Original text from 1998, but there are updates)
- Participation and engagement tools are old fashioned
- Many problems with urban applicability – culture, society, etc.
- No technological systems and ICT related thinking or chapter

5. Area of application

Mostly development projects, environmental issues.

6. Importance for the project

Most well-known and UN adopted Convention on awareness and participation.

European regional/spatial planning Charter (Torremolinos Charter)

1. Description of the standard

Adopted on 20 May 1983 at Torremolinos (Spain).

2. Organization that developed it

Council of Europe

The 6th Conference of European Ministers responsible for Regional Planning held at Torremolinos in May 1983. The highlight of the Conference was the adoption of the European Regional/Spatial Planning Charter, a pioneering venture in the sphere of European spatial planning. The Charter has since been incorporated in full by the Committee of Ministers of the Council of Europe in a Recommendation to member States.

3. Objectives

The European Ministers responsible for Regional Planning, meeting at their 6th session organised under the auspices of the Council of Europe, considering that:

- regional/spatial planning is an important instrument in the evolution of European society and that the intensification of international co-operation in this field represents a substantial contribution towards a stronger European identity;
- co-operation in this field calls for an analysis of notional, regional and local development concepts with a view to the adoption of common principles, designed particularly to reduce regional disparities and to reach a deeper insight into the use and organisation of space, the distribution of activities, the protection of the environment and the improvement of the quality of life;
- the profound changes brought about in the economic and social structures of the countries of Europe and their relations with other parts of the world demand a critical review of the principles governing the organisation of space, to avoid their being wholly determined by short-term economic

objectives without taking into consideration social, cultural and environmental aspects;
- the objectives of regional/spatial planning need new criteria for the orientation and the use of technical progress, in conformity with economic and social requirements;
- all European citizens should be enabled to participate, in a suitable institutional framework, in the introduction and application of regional/spatial planning measures.

Public participation

Any regional/spatial planning policy, at whatever level, must be based on active citizen participation. It is essential that the citizen be informed clearly and in a comprehensive way at all stages of the planning process and in the framework of institutional structures and procedures.

4. Limitations

- Too much oriented to build environment & architecture
- Low social component
- No participatory methods and tools
- No technical & ICT components of development

5. Area of application

- Spatial planning, urban areas
- Planning legislation

6. Importance for the project

EU level base document for planning and public and transparency.

UN REDD+ Social & Environmental Standards

1. Description of the standard

UN REDD+ Social & Environmental Standards

Reducing emissions from deforestation and forest degradation (REDD+) is a mechanism being developed by Parties to the United Nations Framework Convention on Climate Change (UNFCCC). It creates a financial value for the carbon stored in forests by offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. Developing countries would receive results-based payments for results-based actions. REDD+ goes beyond simply deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks

.

2. Organization that developed it

The UN-REDD Programme

The United Nations Collaborative Programme on Reducing Emissions from Deforestation and forest Degradation (REDD+) in developing countries.

The Programme was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The UN-REDD Programme supports nationally led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including indigenous peoples and other forest-dependent communities, in national and international REDD+ implementation.

The Programme supports national REDD+ readiness efforts in partner countries, spanning Africa, Asia-Pacific and Latin America.

3. Objectives

Standards to support the design and implementation of government-led REDD+ programs that respect the rights of Indigenous Peoples and local communities and generate significant social and environmental benefits.

REDD+ SES were developed through extensive consultations to define high social and environmental performance of government-led REDD+ programs and they provide a comprehensive framework of key issues and elements of quality that can be used consistently across countries while enabling tailoring to the country context.

4. Limitations

- Forestry and primary production oriented
- Developing country oriented

5. Area of application

Natural resources, climate policy, strategic environmental assessment

6. Importance for the project

- “New generation” of participatory thinking, tools and standards
- UN developed, international approach
- Climate policy related thinking
- Integrated thinking

STANDARD - ISEAL Alliance

1. Description of the standard

Tools for participatory process.

The ISEAL Standards-Setting Code covers critical issues that would be considered in the standard-setting process, including how a standard is developed, structured, and governed. It outlines good practice for engaging stakeholders and defining clear and relevant sustainability objectives, as well as other actions that influence the credibility of the resulting standard.

2. Organization that developed it

The ISEAL Alliance is the global membership association for sustainability standards.

3. Objectives

The ISEAL Alliance works to strengthen sustainability standards systems for the benefit of people and the environment.

Its purpose is to define good practice for its current (and potential) members; practices are aimed at developing and increasing the impact of sustainability standards. Its Codes of Good Practice promotes fair and transparent ways of working. Through different programmes, it explores ways to increase the effectiveness and efficiency of standard systems and identify opportunities for scaling up and collaboration.

It defines what makes a standards systems credible and promote learning between established and emerging standard systems. This includes sharing experience and knowledge about how standards monitor and evaluate their impact, identifying trends in the standards movement and exploring ways to increase small producers' access to certification.

Working with governments and business, standards are promoted as crucial tools to meet sustainability targets. It facilitates discussion about new and creative solutions to the challenges of purchasing sustainably sourced products and through its growing community of standard setters, business, governments, researchers and NGOs, it provides opportunities for networking and knowledge exchange. Taking this to the next level, its work in emerging economies sets out to explore how standards can be used to address sustainability issues in Brazil, India and China.

Everything is underpinned by belief that credible standards systems can and do have positive impacts on society and the environment. Alliance is committed to demonstrating and improving those impacts both individually and collective. Through the work it strives to increase the uptake and impact of sustainability standards on a global scale.

At a glance, ISEAL Alliance:

- Encourage shared learning to improve effectiveness of standards systems
- Demonstrate and improve impacts
- Engage current and potential users of standards
- Build awareness and develop strategies for scaling up usage of standards

- Advocate for standards with policymakers

4. Limitations

- Standard for standards
- Not much technological and complex systems approaches

5. Area of application

Standard for standards

6. Importance for the project

21st century thinking and tools for social engagement.

ISEAL has developed a Code of Good Practice for Assuring Compliance with Social and Environmental Standards (the Assurance Code).

3.3.2 Standards of building retrofitting

Introduction

We understand by sustainable building retrofitting to any kind of upgrade at an existing building in order to improve energy and environmental performance, comfort and quality of the space in terms of natural light, air quality, and noise; all done in a way that it is financially beneficial to the owner. Then, the building and its equipment must be maintained to sustain these improvements over time.

The basis of the technical solutions applied in each country is collected in the own regulatory framework. Generally, the rules that control aspects of sustainability tend to have a basic character.
Environmental assessment systems, however, are designed to quantify and control comprehensively all aspects of the sustainability. Finally, construction standards represent the highest levels in the hierarchy of sustainable building normalization.

Figure 2: Sustainable building normalization

Voluntary certification tools

The following voluntary certification labels represent the main evaluation systems and building standards with presence at European level:

Figure 3: Voluntary certification tools at European level

All of them are described below, emphasizing its implementation in building retrofitting.

BREEAM REFURBISHMENT

1. Description of the standard

BREEAM (Building Research Establishment Environmental Assessment Methodology) is a method of evaluation and certification of building sustainability. A BREEAM assessment uses recognized measures of performance, which are set against established benchmarks, to evaluate a building's specification, design, construction and use. The measures used represent a broad range of categories and criteria from energy to ecology.

BREEAM Refurbishment provides a design and assessment method for sustainable housing refurbishment projects, helping to cost effectively improve the sustainability and environmental performance of existing dwellings.

2. Organization that developed it

The Building Research Establishment (BRE) is a world leading multi-disciplinary building science centre with a mission to improve the built environment through research and knowledge generation.

3. Objectives

- To provide market recognition of buildings with a low environmental impact.
- To ensure best environmental practice is incorporated in the planning, design, construction and operation of buildings and the wider built environment.
- To define a robust, cost effective performance standard surpassing that required by regulations.
- To challenge the market to provide innovative, cost effective solutions that minimize the environmental impact of buildings.
- To raise awareness amongst owners, occupants, designers and operators of the benefits and value of buildings with a reduced life cycle impact on the environment.
- To allow organizations to demonstrate progress towards corporate environmental objectives.

4. Limitations

Currently, the scheme BREEAM Domestic Refurbishment for housing is only available in United Kingdom.

5. Area of application

BREEAM International Refurbishment is applicable to all countries except for countries where they are affiliated with an International Partner.

6. Importance for the project

It is a tool with great international recognition and significant presence in Europe.

LEED FOR HOMES

1. Description of the standard

LEED (Leadership in Energy and Environmental Design) is a voluntary, consensus-based, market-driven program that provides third-party verification of green buildings. LEED concentrates its efforts on improving performance across five key areas of environmental and human health: energy efficiency, indoor environmental quality, materials selection, sustainable site development and water savings.

LEED for Homes is designed for new construction and major refurbishments projects and applies to individual homes as well as to multifamily residential buildings.

2. Organization that developed it

The U.S. Green Building Council (USGBC) is a non-profit organization established in 1993 and based in Washington D.C. Is a member of the World Green Building Council, a network of national green building councils in more than ninety countries.

3. Objectives

- To define green building by establishing standards of measurement.
- Promoting integrated design practices.
- Recognizing environmental leadership in building industry.
- To increase the awareness among customers by specifying the benefits of green building.

4. Limitations

Currently there is no great experience in certifying residential building retrofitting at European level.

5. Area of application

LEED applies internationally, is one of the most popular green building certification programs used worldwide.

6. Importance for the project

Is one of the most internationally recognized tools.

DGNB SYSTEM

1. Description of the standard

The DGNB assesses buildings and urban districts which demonstrate an outstanding commitment to meeting sustainability objectives. It covers all of the key aspects of sustainable building: environmental, economic, sociocultural and functional aspects, technology, processes and site.

2. Organization that developed it

The German Sustainable Building Council (DGNB) was founded in 2007 by 16 initiators from various subject areas within the construction and real-estate sectors. The aim was to promote sustainable and economically efficient building even more strongly in future.

3. Objectives

Sustainable building objectives: protecting resources, using energy efficiently and planning future-oriented districts.

4. Limitations

Currently there is no great experience in certifying residential building retrofitting.

5. Area of application

The DGNB Certification System can be applied nationally and internationally.

6. Importance for the project

The DGNB System is based on current European norms and standards.

HAUTE QUALITE ENVIRONNEMENTALE

1. Description of the standard

The Haute Qualité Environnementale or HQE (High Quality Environmental standard) is a French standard for green building, based on the principles of sustainable development first set out at the 1992 Earth Summit.

2. Organization that developed it

The standard is controlled by the Paris-based Association pour la Haute Qualité Environnementale (ASSOHQE). It focuses on research and development as well as on promotional activities.

3. Objectives

HQE pursues sustainable performance objectives while giving substantial importance to the life cycle analysis on a building scale and to the impacts of a project on health, personal comfort and the indoor environment.

4. Limitations

Currently there is no great experience in certifying residential building retrofitting at European level.

5. Area of application

HQE certification is available worldwide: each HQE schemes can be adapted to meet the specific context of any country.

6. Importance for the project

HQE is based on current European norms and standards.

PASSIVHAUS ENERPHIT

1. Description of the standard

Passive House is a voluntary standard for energy efficiency in a building, reducing its ecological footprint.

EnerPHit certifies energy retrofits with Passive House Components. This requires either a maximum heating demand of 25 kWh/ (m^2a) or alternatively the consistent use of Passive House components in accordance with the requirements for PHI certification of components.

2. Organization that developed it

This standard has been developed by The Passive House Institute (PHI), a German independent research institute that has played an especially crucial role in the development of the Passive House concept.

3. Objectives

The main objective is to minimize heat loss by optimizing the thermal performance of the building envelope. This is accomplished with:
- Super-insulation
- Air tightness
- High performance windows
- Minimizing thermal bridges
- Incorporating very high efficiency heat recovery ventilation

4. Limitations

This tool does not cover all environmental impacts of the building, unlike environmental assessment systems.

5. Area of application

Passive House applies internationally and is the world's leading standard in energy efficient construction.

6. Importance for the project

Passive House standard is aligned with the directives of the EU 2020 Action Plan, in order to guide the housing sector towards Nearly Zero Energy Buildings (NZEBs).

MINERGIE

1. Description of the standard

Minergie is a registered quality label for new and refurbished low-energy-consumption buildings.

2. Organization that developed it

Minergie standard is registered in Switzerland and mutually supported by the Swiss Confederation, the Swiss Cantons and the Principality of Liechtenstein along with Trade and Industry.

3. Objectives

- Comfortable buildings which are also beneficial to health.
- High energy-efficiency and drastic reduction of the use of fossil fuels.
- Inexpensive systems providing high long-term value of buildings.

4. Limitations

This tool does not cover all environmental impacts of the building, unlike environmental assessment systems. However, the standard supports additional certification through the ECO label, developed by the Swiss association ECO-BAU. This combination leads to MINERGIE-ECO label.

5. Area of application

Now its main market remains Switzerland, but is performing a strategy of international expansion.

6. Importance for the project

Minergie standard is aligned with the directives of the EU 2020 Action Plan, in order to guide the housing sector towards Nearly Zero Energy Buildings (NZEBs).

There is another range of tools whose implementation has been developed at state level. Among them, the following have their area of influence in some of the locations covered by this project.

Figure 4: Voluntary certification tools at local level

VERDE RH

1. Description of the standard

VERDE acknowledges the reduction in environmental impact of the building, compared to a standard reference building. This building is a model conceived according to the minimum parameters established by law and common practice. VERDE entails the recognition by an independent organization, unrelated to the developer or designer, of the ecological values of a building by applying an internationally approved evaluating method.

VERDE RH born in order to develop a simple tool for evaluating retrofitting interventions carried out in collective housing buildings. Conceived as a diagnostic tool and evaluation. The tool collects the transversal approach of sustainable development, allowing to quantify the environmental, social and economic improvements resulting from the rehabilitation process.

2. Organization that developed it

GBCe (Green Building Council España) is an autonomous organization, member of the World Green Building Council, WGBC, a non-profit International Association. GBC España also works alongside the "International Initiative for a Sustainable Built Environment" Association, iiSBE, based in Ottawa (Canada), representing the Spanish Area.

3. Objectives

- Contribute to the evolution of the building industry/market towards a more sustainable environment.
- Increase social awareness and represent the desire of our modern society to evolve towards a more sustainable building environment in Spain.

4. Limitations

VERDE RH tool does not yet have much presence in real projects.

5. Area of application

Spanish real estate market

6. Importance for the project

The system applies in one of the locations covered by the project.

NORDIC SWAN

1. Description of the standard

Nordic Swan is the official regional label for the Nordic Countries (Norway, Sweden, Denmark, Finland and Iceland) and was established in 1989 by the Nordic Council of Ministers. The Nordic Swan ecolabel covers a whole range of products and processes that can be certified. It is also possible to label hotels and, more recently, some other buildings too.

2. Organization that developed it

Nordic Council of Ministers, the official inter-governmental body for co-operation in the Nordic Region.

3. Objectives

To contribute to a more sustainable environment, and be among the millions of people in the Nordic market who daily make more climate-friendly choices.

4. Limitations

It's a wide range certification and the part concerning sustainable building does not yet have much recognition.

5. Area of application

Applies in Norway, Sweden, Denmark, Finland and Iceland.

6. Importance for the project

The system applies in one of the locations covered by the project.

Finally, the tools described below have been developed in order to attempt harmonization at European level.

Figure 5: Europe-wide tools

CESBA KEY PERFORMANCE INDICATORS

1. Description of the standard

Key performance indicators (KPI) intend to be a European common base for building and neighbourhood sustainability assessment. Their adoption by the regional/national assessment systems facilitates the communication between stakeholders and the comparability of performance results. KPI also support and facilitate the development of future assessment schemes.

2. Organization that developed it

CESBA stands for Common European Sustainable Built Environment Assessment and is a common initiative towards promoting a harmonization of sustainable building assessments for public buildings throughout Europe. The inducement of CESBA is the perception of the variety of sustainable building certification systems in European regions and the need to find a common framework for building assessments.

3. Objectives

- Holistic approach to building and neighbourhood assessment.
- Establishment and discussion of common European Key performance indicators for harmonized indicators.
- Definition of further Reference performance indicators that can be included in the assessment of buildings and their neighbourhoods.

4. Limitations

CESBA does not certify the built environment and is not in competition with other certification systems.

5. Area of application

European Union.

6. Importance for the project

It is an attempt to establish a common European framework for action.

OPEN HOUSE

1. Description of the standard

OPEN HOUSE is an attempt to develop and to implement a common European transparent building assessment methodology, complementing the existing ones, for planning and constructing sustainable buildings by means of an open approach and technical platform.

2. Organization that developed it

OPEN HOUSE consortium is composed by 20 organizations covering 11 countries. It has been configured with a well-balanced contribution of large companies with strong research capabilities, high-tech SMEs, research organizations, end users and policy makers.

3. Objectives

- To define an open and transparent European platform for building sustainability.
- To widely communicate the baseline concept and outline the mechanism for interaction among the project and stakeholders.
- To pave the way for implementing and evaluating the methodology: selection of case studies and mechanisms for decision making.
- To evaluate and refine the methodology by the feedback resulting from case studies and real sustainable public procurement cases and other stakeholders inputs.

4. Limitations

Currently this tool is not having the necessary boost to become a reference.

5. Area of application

European Union.

6. Importance for the project

It is an attempt to establish a common European framework for action.

Technical Committees

CEN / TC 350 "SUSTAINABILITY OF CONSTRUCTION WORKS"

1. Description of the standard

CEN/TC350 is responsible for the development of horizontal standardized methods for the assessment of the sustainability aspects of new and existing construction works (buildings and civil engineering works), including horizontal core rules for the development of environmental product declaration of construction products (EPD).

2. Organization that developed it

CEN, the European Committee for Standardization, is an association that brings together the National Standardization Bodies of 33 European countries.

3. Objectives

To provide the horizontal EN-standardised methodology and indicators for the sustainability assessment of buildings using a life cycle approach in a transparent way.

4. Limitations

This global framework does not establish a specific regulation for building retrofitting.

5. Area of application

European Union.

6. Importance for the project

It is an attempt to establish a common European framework for action.

3.3.3 Standards of energy supply and consumption

General background

SmartEnCity actions on energy supply are regulated by European Directives, technical standards and national regulations - all they are driven by EU energy policy.

The **European Union's energy policies** are driven by three main objectives:

- We want secure energy supplies to ensure the reliable provision of energy whenever and wherever needed
- We want to ensure that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses, and industries
- We want our energy consumption to be sustainable, through the lowering of greenhouse gas emissions, pollution, and fossil fuel dependence

European Energy Security Strategy

The Strategy sets out areas where decisions need to be taken or concrete actions implemented in the short, medium and longer term to respond to energy security concerns. It is based on eight key pillars that together promote closer cooperation beneficial for all Member States while respecting national energy choices, and are underpinned by the principle of solidarity

The latest round of EU energy **market legislation**, known as the third package, has been enacted to improve the functioning of the internal energy market and resolve structural problems. It covers five main areas:

- unbundling energy suppliers from network operators
- strengthening the independence of regulators
- establishment of the Agency for the Cooperation of Energy Regulators (ACER)
- cross-border cooperation between transmission system operators and the creation of European Networks for Transmission System Operators
- increased transparency in retail markets to benefit consumers

The third package and other EU legislation also guarantee that **energy consumers** enjoy high standards of consumer protection. All EU citizens have the right to have their homes connected to energy networks and to freely choose any supplier of gas or electricity offering services in their area. They also have the right to access accurate information on their electricity and gas use that can help them reduce their consumption.

There are hundreds of **technical standards** developed by ISO (International Organization for Standardization) and CEN related with energy supply systems. The use of these standards remains voluntary.

European Union Directives are mandatory for Member States and having therefore more impact for activities implemented by SmartEnCity lighthouse cities.

DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources

1. Description of the standard

This Directive establishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. It lays down rules relating to statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from renewable sources. It establishes sustainability criteria for biofuels and bio liquids.

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

Energy efficiency and energy saving policies are some of the most effective methods by which Member States can increase the percentage share of energy from renewable sources, and Member States will thus more easily achieve the overall national and transport targets for energy from renewable sources laid down by this Directive.

- Mandatory national overall targets and measures for the use of energy from renewable sources
- National renewable energy action plans
- Access to and operation of the grids

4. Limitations

This global framework does not establish a specific regulation.

5. Area of application

European Union, all Member States

6. Importance for the project

National targets and national energy action plans will set the framework for energy supply and smart consumption. Access to the grid for suppliers.

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the energy performance of buildings

1. Description of the standard

This Directive promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

Buildings account for 40 % of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions.

Reduced energy consumption and an increased use of energy from renewable sources also have an important part to play in promoting security of energy supply, technological developments and in creating opportunities for employment and regional development, in particular in rural areas

4. Limitations

The requirements laid down in this Directive are minimum requirements and shall not prevent any Member State from maintaining or introducing more stringent measures.

5. Area of application

European Union, all Member States.

6. Importance for the project

Retrofitting of building stock for higher energy performance in three lighthouse cities ae driven by this regulation and from national regulations.

DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning common rules for the internal market in electricity

1. Description of the standard

This Directive establishes common rules for the generation, transmission, distribution and supply of electricity, together with consumer protection provisions, with a view to improving and integrating competitive electricity markets in the Community. It lays down the rules relating to the organisation and functioning of the electricity sector, open access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorisations and the operation of systems. It also lays down universal service obligations and the rights of electricity consumers and clarifies competition requirements

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

In the light of the dysfunction in the internal market in electricity, the European Commission considered it necessary to redefine the rules and measures applying to that market in order to guarantee fair competition and appropriate consumer protection.

4. Limitations

This global framework establish rules for electricity market only

5. Area of application

European Union, all Member States

6. Importance for the project

DIRECTIVE 2009/73/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning common rules for the internal market in natural gas

1. Description of the standard

This Directive establishes common rules for the transmission, distribution, supply and storage of natural gas. It lays down the rules relating to the organisation and functioning of the natural gas sector, access to the market, the criteria and procedures applicable to the granting of authorisations for transmission, distribution, supply and storage of natural gas and the operation of systems.

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

To achieve a competitive, secure and environmentally sustainable market in natural gas, and shall not discriminate between those undertakings as regards their rights or obligations

4. Limitations

This Directive make framework for natural gas, biogas and LNG users and distributors

5. Area of application

European Union, all Member States

6. Importance for the project

DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency

1. Description of the standard

This Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national energy efficiency targets for 2020

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

With Directive will be set the requirements (as a minimum requirements)for member states related with:

- National energy efficiency targets
- Building renovation incl public sector exemplary role
- Central governments purchase only products, services and buildings with high energy-efficiency performance
- Set up an energy efficiency obligation scheme by member countries
- Availability to all final customers of high quality energy audits
- Individual consumption based metering
- Accurate and actual billing

4. Limitations

Limitations depends from Member countries, this Directive are minimum requirements and shall not prevent any Member State from maintaining or introducing more stringent measures

5. Area of application

European Union, all Member states

6. Importance for the project

This document has impact for consumers and for national efficiency targets.

DIRECTIVE 2010/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products

1. Description of the standard

This Directive establishes a framework for the harmonisation of national measures on end-user information, particularly by means of labelling and standard product information, on the consumption of energy and where relevant of other essential resources during use, and supplementary information concerning energy-related products, thereby allowing end-users to choose more efficient products

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

To improve the efficiency of energy-related products through informed consumer choice

4. Limitations

This Directive shall not apply to:

- second-hand products;
- any means of transport for persons or goods;
- the rating plate or its equivalent affixed for safety purposes to products.

5. Area of application

European Union, all Member states

6. Importance for the project

This document have impact for end users on purchasing new more efficient product

DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for the setting of ecodesign requirements for energy-related products

1. Description of the standard

This Directive establishes a framework for the setting of Community eco-design requirements for energy-related products with the aim of ensuring the free movement of such products within the internal market.

Directive provides for the setting of requirements which the energy-related products covered by implementing measures must fulfil in order to be placed on the market and/or put into service.

2. Organization that developed it

European Parliament, Council of the European Union

3. Objectives

Sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply.

4. Limitations

Directive shall not apply to means of transport for persons or goods

5. Area of application

European Union, all Member states

6. Importance for the project

This document have impact for end users on purchasing new more efficient product

ISO 37120:2014 Sustainable development of communities -- Indicators for city services and quality of life

1. Description of the standard

ISO 37120:2014 defines and establishes methodologies for a set of indicators to steer and measure the performance of city services and quality of life. General principles and requirements, when published, and other strategic frameworks.

ISO 37120:2014 is applicable to any city, municipality or local government that undertakes to measure its performance in a comparable and verifiable manner, irrespective of size and location. It covers a lot of topics and energy supply is one of them.

2. Organization that developed it

International Organization for Standardization

3. Objectives

To help city managers, politicians, researchers, business leaders, planners, designers and other professionals to focus on key issues, and put in place policies for more liveable, tolerant, sustainable, resilient, economically attractive and prosperous cities.

4. Limitations

5. Area of application

Smart Cities and Communities

6. Importance for the project

Indicators set on 17 topics, related to measure performance and development of sustainable cities

3.3.4 Standards of mobility

Actions to be implemented in the three lighthouse cities are related to the deployment of electric fleets (taxis, last mile delivery, e-motorcycles, and e-bikes), their related charging infrastructure, and biogas powered buses. Therefore, related standards applying to this section are those dealing with **electro mobility** and **biogas** technology for buses.

Electro mobility

Electro mobility related standards should be classified under one or several of the topics from the list below:

- **Electric Vehicles**: this category includes electric standards and regulations (including safety aspects) for the following elements: power socket and connector, cables, motor, charger, converter, energy storage (batteries). Also, the measurement of EV performance, exhaust emissions and fuel consumption has been included.
- **Charging Infrastructure**: similarly this category includes electric standards and regulations (with safety aspects), but also electromagnetic compatibility for: power socket and connector, cables, methods and mechanisms of payment, charging strategies, authentication
- **Connection to Grid**: the main categories are again electric standards and regulation, safety and electromagnetic compatibility. Elements considered: converters, building/construction requirements, charging location, charging strategies, charging monitoring, smart meter, load management.
- **Communication and connecting protocols**: this category includes security of communication, data protection, protocols for information exchange, transmission media, payment system, roaming

There follows a list of Technical Committees from the most well-known international and European organizations in charge of developing standards. Only those ones applying to the technologies to be deployed in the project have been selected:

- IEC TC 69: Electric road vehicles and electric road trucks
- ISO/TC 22/SC 37 Electrically propelled vehicles
- ISO/TC 22/SC 38 Motorcycles and mopeds
- ISO/TC 22/SC 31 Data communication
- ISO/TC 22/SC 32 Electrical and electronic components and general system aspects
- ISO/IEC JTC 1/SC 17 Cards and personal identification
- CEN/TC 333: Cycles. Standardization in the field of cycles, their components and accessories with particular reference to requirements for safety, testing methods and terminology
- CEN/TC 150 Industrial trucks. Safety

IEC 1982/EN 61982

1. **Description of the standard:**

Secondary batteries (except lithium) for the propulsion of electric road vehicles.

- Part 1: Test parameters
- Part 2: Dynamic discharge performance test and dynamic endurance test
- Part 3: Performance and life testing (traffic compatible, urban use vehicles)

2. **Organization that developed it**

International Electrotechnical Commission

3. **Objectives**

This standard is applicable to performance and endurance tests for secondary batteries used for vehicle propulsion applications. This standard is applicable to lead-acid batteries, Ni/Cd batteries, Ni/MH batteries and sodium based batteries used in electric road vehicles

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

It applies to the use of secondary batteries for electric vehicles.

IEC 60309

1. Description of the standard:

Plugs, socket-outlets and couplers for industrial purposes

- Part 1: General requirements
- Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories
- Part 4: Switched socket-outlets and connectors with or without interlock

The highest voltage allowed by this standard is 690V DC or AC; the highest current, 125 A; and the highest frequency, 500 Hz. The temperature range is -25ºC to 40ºC.

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

This standard assigns colour codes to a range of plugs and sockets of different sizes with different numbers of pins, depending on the current supplied and number of phases accommodated.

4. Limitations

5. Area of application

International

6. Importance for the project

It applies to conductive charging of the electric fleets to be deployed. This standard mainly relates to electric vehicle and charging infrastructure.

IEC 60364-7-722:2015

1. Description of the standard:

Low-voltage electrical installations – Part 7-722: Requirements for special installations- Supplies for electric vehicles

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

This standard applies to:

- Circuits intended to supply energy to electric vehicles
- Circuits intended for feeding back electricity from electric vehicles into the supply network.

The requirements for feeding back electricity from electric vehicles into the supply network are under consideration. Inductive charging is not covered

4. Limitations

5. Area of application

International

6. Importance for the project

It applies to conductive charging of the electric fleets to be deployed. This standard mainly relates to electric vehicle and charging infrastructure.

IEC TR 60783

1. Description of the standard:

Wiring and connectors for electric road vehicles

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

This standard applies to cabling and connectors used in battery electric road vehicles. These recommendations are not applicable to the low tension wiring (e.g. 12 V) for the auxiliary and signalling accessories, such as horn, lighting, signalling lamps, wipers, etc., nor do they apply to connections between cells of the traction battery. Provides general rules for all external wiring and connectors which are used for interconnecting the traction components and sub-systems. The rules are applicable to the heavy current, the light current and the signal harnesses.

4. Limitations

5. Area of application

International

6. Importance for the project

It applies to wiring and connectors of the electric fleets to be deployed. This standard mainly relates to electric vehicle.

IEC 61000-1-2

1. Description of the standard:

Electromagnetic compatibility (EMC)

Part 1-2: General - Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

IEC 61000-1-2:2016 establishes a methodology for the achievement of functional safety only with regard to electromagnetic phenomena. This methodology includes the implication it has on equipment used in such systems and installations.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to safety aspects of the electric vehicle, thus referring to electric vehicle and the related charging infrastructure.

IEC 61140:2016

1. **Description of the standard:**

Protection against electric shock. Common aspects for installation and equipment.

2. **Organization that developed it**

International Electrotechnical Commission

3. **Objectives**

Electric shocks, electrical installations, electrical equipment, electrical components, electrical safety

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

This standard is related to safety aspects of electric equipment and their related installation.

IEC 61204

1. Description of the standard:

Low voltage power supplies, d.c. output.

- Part 3: Electromagnetic Compatibility (EMC)
- Part 6: Requirements for low-voltage power supplies of assessed performance.
- Part 7: Safety requirements

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

Describes a method of specifying requirements for low-voltage power supply devices (including switching types) providing d.c. output(s) up to 200 V d.c. at a power level up to 30 kW, operating from a.c. or d.c. source voltages of up to 600 V.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to the power sockets, connectors, cables, etc., both at the EV and charging point sides.

IEC 61850

1. **Description of the standard:**

Communication networks and systems in substations

- Part 1: Introduction and overview
- Part 2: Glossary
- Part 3: General requirements
- Part 4: System and project management
- Part 5: Communication requirements for functions and device models

2. **Organization that developed it**

International Electrotechnical Commission

3. **Objectives**

The IEC 61850 standard has been defined in cooperation with manufacturers and users to create a uniform, future-proof basis for the protection, communication and control of substations.

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

It applies to communication between the EVSE and the EVSE Backend.

IEC 61851[3]

1. **Description of the standard:**

EV conductive Charging System - Vehicles and Charging Infrastructure.

- Part 1: General requirements
- Part 21: Electric vehicle requirements for conductive connection to an a.c./d.c. supply
- Part 22: AC electric vehicle charging station
- Part 23: D.C electric vehicle charging station
- Part 24: Control communication protocol between off-board d.c. charger and electric vehicle

2. **Organization that developed it**

International Electrotechnical Commission

3. **Objectives**

This standard defines the requirements for "Electric Vehicle Supply Equipment" (EVSE) functions: ac-dc rectification, voltage regulation to a level that permits a managed charge rate, and physically coupling the charger to the vehicle. It also defines several "levels" of charging.

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

It applies to conductive charging of the electric fleets to be deployed. This standard mainly relates to electric vehicle, charging infrastructure, connection to the grid, communication and connection protocols.

[3] For the U.S. auto industry, the governing document for electric vehicle (EV) charging is the Society of Automotive Engineers (SAE) standard J1772.

IEC 62196

1. Description of the standard:

Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles

- Part 1: General requirements
- Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
- Part 3: Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

The focus is on electrical connectors and charging modes for electric vehicles. This standard is based on IEC 61851 which specifies mechanisms such that, first, power is not supplied unless a vehicle is connected and, second, the vehicle is immobilized while still connected

4. Limitations

There's not yet a unique charging connector because there are different electrical grid systems in the world. Japan and North America choose a 1-phase connector on their 100–120/240 V grid (Type 1), while China, Europe, and the rest of the world are opting for a connector with 1-phase 230 V and 3-phase 400 V grid access (Type 2). The SAE and ACEA are trying to avoid the situation for DC charging with a standardization that plans to add DC wires to the existing AC connector types such that there is only one "global envelope" that fits all DC charging stations – for Type 2 the new housing is named Combo 2.

5. Area of application

International

6. Importance for the project

It applies to conductive charging of the electric fleets to be deployed. This standard mainly relates to electric vehicle and charging infrastructure.

IEC TS 61439-7

1. Description of the standard:

Low voltage switchgear and controlgear assemblies. Part 7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations.

2. Organization that developed it

International Electrotechnical Commission

3. Objectives

This standard defines the specific requirements of assemblies as follows:

- Assemblies for which the rated voltage does not exceed 1000 V in case of a.c. or 1500 V in case of d.c.
- Stationary or movable assemblies with enclosure
- Assemblies intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electric energy consuming equipment
- Assemblies operated by ordinary persons
- Assemblies intended for charging stations for electric vehicles

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to charging infrastructure for electric vehicles.

ISO 6469

1. **Description of the standard:**

Electric road vehicles - Safety specifications

- Part 1: On-board rechargeable energy storage system (RESS).
- Part 2: Vehicle operational safety means and protection against failures
- Part 3: Protection of persons against electric hazards
- Part 4: Post crash electrical safety

2. **Organization that developed it**

International Organization for Standardisation

3. **Objectives**

This standard deals with safety specifications related to the on-board rechargeable battery, protection against failures, and protection of persons against electric hazards.

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

This standard applies to the general safety of the electric vehicle.

ISO 7637

1. Description of the standard:

Road vehicles - Electrical disturbances from conduction and coupling

- Part 1: Definitions and general considerations
- Part 2: Electrical transient conduction along supply lines only
- Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

2. Organization that developed it

International Organization for Standardization

3. Objectives

- ISO 7637-1:2015 defines the basic terms relating to electrical disturbances from conduction and coupling used in the other parts of ISO 7637. It also gives general information on the whole ISO 7637 series.
- ISO 7637-2:2011 specifies test methods and procedures to ensure the compatibility to conducted electrical transients of equipment installed on passenger cars and commercial vehicles fitted with 12 V or 24 V electrical systems. It describes bench tests for both the injection and measurement of transients. It is applicable to all types of road vehicles independent of the propulsion system (e.g. spark ignition or diesel engine, electric motor).
- ISO 7637-3:2007 establishes a bench top test for the evaluation of the immunity of devices under test (DUTs) to transient transmission by coupling via lines other than supply lines. The test transient pulses simulate both fast and slow transient disturbances, such as those caused by the switching of inductive loads and relay contact bounce.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to safety issues of the EV

ISO 8713/EN 13447

1. Description of the standard:

Electrically propelled road vehicles. Terminology

2. Organization that developed it

International Organization for Standardization

3. Objectives

This standard establishes a vocabulary of terms used in International Standards generally in relation to electric road vehicles. It is not intended to give definitions of all parts within a vehicle, but focuses on terms specific to electric road vehicles.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to electric vehicles

ISO 8714

1. Description of the standard:

Electric road vehicles - Reference energy consumption and range - Test procedures for passenger cars and light commercial vehicles

2. Organization that developed it

International Organization for Standardization

3. Objectives

This International Standard specifies test procedures for measuring the reference energy consumption and reference range of purely electrically propelled passenger cars and commercial vehicles of a maximum authorized total mass of 3 500 kg and maximum speed greater than or equal to 70 km/h.

4. Limitations

There is no official test cycle to be used on the road for passenger vehicles. The commonly used ones can only be performed on a test bench due to their velocity complexity.

5. Area of application

International

6. Importance for the project

This standard is related to the measurement of EV Performance / Exhaust emission / Fuel Consumption

ISO 8715

1. Description of the standard:

Electric road vehicles - Road operating characteristics

2. Organization that developed it

International Organization for Standardization

3. Objectives

This International Standard specifies the procedures for measuring the road performance of purely electrically propelled passenger cars and commercial vehicles of a maximum authorized total mass of 3500 kg.

The road performance comprises road operating characteristics such as speed, acceleration and hill climbing ability.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to the measurement of EV Performance / Exhaust emission / Fuel Consumption

ISO 12405

1. Description of the standard:

Electrically propelled road vehicles -- Test specification for lithium-ion traction battery packs and systems:

- Part 1: High-power applications
- Part 2: High-energy applications
- Part 3: Safety performance requirements

2. Organization that developed it

International Organization for Standardization

3. Objectives

ISO 12405-1:2011 specifies standard test procedures for basic characteristics of performance, reliability and abuse of lithium-ion battery packs and systems.

ISO 12405-3:2014 specifies test procedures and provides acceptable safety requirements for voltage class B lithium-ion battery packs and systems, to be used as traction batteries in electrically propelled road vehicles.

4. Limitations

Traction battery packs and systems used for two-wheel or three-wheel vehicles are not covered by ISO 12405-3:2014.

5. Area of application

International

6. Importance for the project

This standard is related to the battery performance of electric vehicles

ISO 13063

1. Description of the standard:

Electric mopeds and motorcycles - Safety Specifications

2. Organization that developed it

International Organization for Standardization

3. Objectives

This standard specifies requirements for functional safety means, protection against electric shock and the on-board rechargeable energy storage systems intended for the propulsion of any kind of electrically propelled mopeds and motorcycles when used in normal conditions.

4. Limitations

- It is applicable only if maximum working voltage of the on-board electrical circuit does not exceed 1000 V a.c. or 1500 V d.c.
- It does not provide comprehensive safety information for manufacturing, maintenance and repair personnel.

5. Area of application

International

6. Importance for the project

This standard applies to safety specifications of electrically propelled mopeds and motorcycles.

ISO 13064

1. Description of the standard:

Battery-electric mopeds and motorcycles – Performance

- Part 1: Reference energy consumption and range
- Part 2: Road operating characteristics

2. Organization that developed it

International Organization for Standardization

3. Objectives

ISO 13064-1:2012 specifies test procedures for measuring the reference energy consumption and reference range of electric motorcycles and mopeds with only a traction battery (ies) as power source for vehicle propulsion.

ISO 13064-2:2012 specifies the procedures for measuring the road performance of electric motorcycles and mopeds with only a traction battery (ies) as power source for vehicle propulsion.

The road performance comprises road operating characteristics such as speed, acceleration and hill climbing ability.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard can be useful for the evaluation plan (measurement of energy consumption and range, road performance)

ISO/IEC 14443

1. Description of the standard:

Identification cards -- Contactless integrated circuit cards -- Proximity cards

- Part 1: Physical characteristics
- Part 2: Radio frequency power and signal interface
- Part 3: Initialization and anti-collision
- Part 4: Transmission protocol

2. Organization that developed it

International Organization for Standardization

3. Objectives

Definition of proximity cards used for identification, and the transmission protocols for communicating with it

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is related to the authentication/identification of the EV driver when accessing to the charging point.

ISO/IEC 15118

1. Description of the standard:

Road vehicles - Vehicle to grid communication interface

- Part 1: General information and use-case definition
- Part 2: Network and application protocol requirements
- Part 3: Physical and data link layer requirements

2. Organization that developed it

International Organization for Standardization

3. Objectives

ISO/IEC 15118 specifies the communication between Electric Vehicles (EV), including Battery Electric Vehicles and Plug-In Hybrid Electric Vehicles, and the Electric Vehicle Supply Equipment (EVSE). As the communication parts of this generic equipment are the Electric Vehicle Communication Controller (EVCC) and the Supply Equipment Communication Controller (SECC), ISO 15118 describes the communication between these components.

ISO 15118-1:2013 specifies terms and definitions, general requirements and use cases as the basis for the other parts of ISO 15118. It provides a general overview and a common understanding of aspects influencing the charge process, payment and load levelling.

4. Limitations

ISO 15118 does not specify the vehicle internal communication between battery and charging equipment and the communication of the SECC to other actors and equipment (beside some dedicated message elements related to the charging). All connections beyond the SECC, and the method of message exchanging are considered to be out of the scope as specific use cases.

5. Area of application

International

6. Importance for the project

This standard is mainly focused on communication protocols and should be considered for the definition of the electric fleets monitoring protocols.

ISO 17409[4][5]

1. Description of the standard:

Electrically propelled road vehicles -- Connection to an external electric power supply -- Safety requirements

This standard specifies electric safety requirements for conductive connections of electrically propelled road vehicles to an external electric power supply using a plug or vehicle inlet.

The requirements when the vehicle is not connected to the external electric power supply are specified in ISO 6469-3.

2. Organization that developed it

International Organization for Standardization

3. Objectives

It applies to electrically propelled road vehicles with voltage class B electric circuits. In general, it may apply to motorcycles and mopeds if no dedicated standards for these vehicles exist.

It applies only to vehicle power supply circuits. It applies also to dedicated power supply control functions used for the connection of the vehicle to an external electric power supply.

4. Limitations

- It does not provide requirements regarding the connection to a non-isolated d.c. charging station.
- It does not provide comprehensive safety information for manufacturing, maintenance, and repair personnel.

5. Area of application

International

6. Importance for the project

This standard is related to safety issues of the charging infrastructure

[4] This International Standard does not contain requirements for vehicle power supply circuits using protection by class II or double/reinforced insulation but it is not the intention to exclude such vehicle applications.

[5] Requirements for EV supply equipment are specified in IEC 61851.

ISO 18246

1. Description of the standard:

Electrically propelled mopeds and motorcycles. Safety requirements for conductive connection to an external electric power supply

2. Organization that developed it

International Organization for Standardization

3. Objectives

This International Standard specifies safety requirements for conductive connection to an external electric power supply of electrically propelled mopeds and motorcycles.

4. Limitations

It applies only to on-board charging systems between the plug or vehicle couplers and RESS circuits. This international Standard does not contain requirements for bidirectional power flow. It does not provide comprehensive safety information for manufacturing, maintenance and repair personnel.

5. Area of application

International

6. Importance for the project

This standard is related to safety requirements for mopeds and e-motorcycles charging

CEN EN 1175-1

1. Description of the standard:

Safety of industrial trucks - Electrical requirements - Part 1: General requirements for battery powered trucks

2. Organization that developed it

European Committee for Standardization

3. Objectives

This standard specifies electrical and related mechanical safety requirements for design and construction of the electrical installation in battery powered industrial trucks hereinafter referred to as trucks, with nominal voltages of the truck system up to 240 V.

4. Limitations

5. Area of application

Europe

6. Importance for the project

This standard applies to safety requirements of industrial trucks batteries.

CEN EN 15194

1. Description of the standard:

Cycles - Electrically power assisted cycles - EPAC Bicycles

2. Organization that developed it

European Committee for Standardization

3. Objectives

This European Standard is intended to cover electrically power assisted cycles of a type which have a maximum continuous rated power of 0,25 kW, of which the output is progressively reduced and finally cut off as the vehicle reaches a speed of 25 km/h, or sooner, if the cyclist stops pedaling.

4. Limitations

5. Area of application

Europe

6. Importance for the project

This standard applies to e-bikes. Safety requirements and test methods for electrically power-assisted cycles (EPACs)

SAE J1634

1. Description of the standard:

Electric Vehicle Energy Consumption and Range Test Procedure

2. Organization that developed it

Society of Automotive Engineers International

3. Objectives

Establishes uniform procedures for testing electric battery-powered vehicles. Provides standard tests which will allow for determination of energy consumption and range.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard is applicable for the evaluation of energy efficiency

SAE J1711

1. Description of the standard:

Recommended practice for measuring the exhaust emissions and fuel economy of hybrid-electric vehicles, including plug-in hybrid vehicles

2. Organization that developed it

Society of Automotive Engineers International

3. Objectives

Establishes uniform chassis dynamometer test procedures for hybrid-electric vehicles (HEVs). The procedure provides instructions for measuring and calculating the exhaust emissions and fuel economy of HEV's.

4. Limitations

This standard does not address the methods or equations necessary to calculate the adjusted U.S. Environmental Protection Agency (EPA) label miles per gallon (MPG) (sometimes referred to “EPA 5-Cycle” calculations).

5. Area of application

International

6. Importance for the project

This standard is applicable for the evaluation of emissions and fuel performance.

SAE J1772

1. Description of the standard:

SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler

2. Organization that developed it

Society of Automotive Engineers International

3. Objectives

This standard covers the general physical, electrical, functional and performance requirements to facilitate conductive charging of EV/PHEV vehicles in North America. This document defines a common EV/PHEV and supply equipment vehicle conductive charging method including operational requirements and the functional and dimensional requirements for the vehicle inlet and mating connector.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard relates to electric vehicle and charging infrastructure

SAE J2931

1. **Description of the standard:**

Digital Communications for Plug-in Electric Vehicles

2. **Organization that developed it**

Society of Automotive Engineers International

3. **Objectives**

This SAE Information Report *J2931/6* establishes the requirements for physical and data link layer communications between Plug-in Electric Vehicles (PEV) and the Electric Vehicle Supply Equipment (EVSE).

4. **Limitations**

5. **Area of application**

International

6. **Importance for the project**

This standard relates to communications

OCPP

1. Description of the standard:

Open Charge Point Protocol is an open standard initiated by E-laad (now ElaadNL) which describes a method enabling electrical vehicles to communicate with a central system. OCPP 1.6 is the most recent version released by OCA that incorporates a number of improvements suggested by OCA members who are working with OCPP in the field. Also the 1.6 version is supported by a compliance testing tool for self-testing and by a Certification Program.

2. Organization that developed it

Open Charge Alliance

3. Objectives

OCPP is an application protocol — a language that allows communication between a compliant charge point, and any central network system.

The goal of OCPP is to enable a truly interoperable EV charging infrastructure — an infrastructure that's scalable and easy to operate both for EV drivers and network managers. With the OCPP, customers can integrate charging stations from several vendors into the same IT back-end system. They can also select the most appropriate charging station vendor(s) and the most appropriate IT back-end supplier independently.

4. Limitations

5. Area of application

International

6. Importance for the project

This standard relates to communications

A number of standards under the responsibility of CEN-CENELEC eMobility Coordination Group are currently under development.

Reference	Title	Related Technical Committee
EN 50620 (PR=24105)	Cables for electric vehicles	CLC/TC 20 “Electric cables
FprEN 62752 (PR=25097)	In-Cable Control and Protection Device for mode 2 charging of electric road vehicles (IC-CPD)	CLC/TC 23E “Circuit breakers and similar devices for household and similar applications”
FprEN61980-1 (PR=25038)	Electric vehicle wireless power transfer systems (WPT)-Part 1: General requirements. (Under M/533 on alternative fuels infrastructure)	CLC/TC 69X “Electrical systems for electric road vehicles”
TS 62840-1	Electric vehicle battery swap system Part 1: System description and general requirements (under M/533 on alternative fuels infrastructure)	CLC/TC 69X “Electrical systems for electric road vehicles”
IEC 62840-2	Electric vehicle battery swap system. Part 2: Safety requirements. (under M/533 on alternative fuels infrastructure)	CLC/TC 69X “Electrical systems for electric road vehicles”

Table 4: CEN-CENELEC eMobility Coordination Group standards currently under development

Biogas

Biogas is a mixture of biomethane CH4 (65-70%) and CO2 (30-35%) and small amounts of other gases. It is created by anaerobic digestion of organic wastes such as sewage, manure, food wastes, landfill, etc.…, and it can be utilized as a renewable energy source in combined heat and power plants, as a **vehicle fuel**, or as a substitute for natural gas. Depending on the end use, different biogas treatment steps are necessary. For some applications, where it is important to have a high energy content in the gas, e.g. **as vehicle fuel or for grid injection**, the gas needs to be upgraded. There are different upgrading processes and in all the cases the target is to increase the energy content of the gas by keeping a high proportion of methane concentration while reducing the rest of components (especially carbon dioxide). The main difference in the composition between biogas and natural gas relates to the carbon dioxide content. Carbon dioxide is one of the main components of biogas, while natural gas contains very low amounts. In addition, natural gas also contains higher levels of hydrocarbons other than methane.

In late 2010 the EC addressed a specific mandate (M475) to CEN for the development of:

a) A European standard for a quality specification for bio methane to be used as a fuel for vehicle engines;

b) A Technical Specification or European Norm for a quality specification for bio methane to be injected in natural gas pipelines

In 2013, the European Commission (Directorate General for Mobility and Transport) launched the EU **Clean Fuel Strategy**, which contains an ambitious package of measures to ensure the build-up of alternative fuel stations in Europe.

The package contains **Directive 2014/94/EU**[6] on the deployment of alternative fuels infrastructure in Europe (published in the Official Journal of the European Union in October 2014). Biomethane is included in the list of alternative fuels, together with natural gas.

The Technical Committee CEN/TC 408 — Project Committee is developing a set of quality specifications for natural gas used in transport and for the injection of biomethane into the natural gas grid.

In March 2015, CEN and CENELEC received a standardization request (M/533 - Commission Implementing Decision C (2015)330) on the implementation of the above directive 2014/94/EU.

Several countries have defined **standards for grid injection of upgraded biogas or for utilization as vehicle fuel**.

Compound	Unit	France		Germany		Sweden	Switzerland		Austria	The Netherlands
		L gas	H gas	L gas grid	H gas grid		Lim. Inject.	Unlim. Inject.		
Higher Wobbe index	MJ/Nm^3	42.48-46.8	48.24-56.52	37.8-46.8 46.1-56.5					47.7-56.5	43.46-44.41
Methane content	Vol-%					95-99	>50	>96		>80
Carbon dioxide	Vol-%	<2		<6			<6		≤2[6]	
Oxygene	Vol-%			<3			<0.5		≤0.5[6]	
	ppmV	<100								
	Mol%									<0.5
Hydrogen	Vol-%	<6		≤5			<5		≤4[6]	<12
CO_2+O_2+N_2	Vol-%					<5				
Water dew point	ºC	<-5[1]		<t[4]		<t[5]-5			<-8[7]	-10[8]
Relative humidity	ρ						<60%			
Sulphur	mg/Nm^3	<100[2] <75[3]		<30		<23	<30		≤5	<45

Source: Petersson, Wellinger. "Biogas upgrading technologies-developments and innovations"

Table 5: standards for grid injection of upgraded biogas or for utilization as vehicle fuel

[1] At MOP (Maximal Operating Pressure) downstream from injection point

6 ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/ElectricVehicles/Dir_2014_94_EU_AlternativeFuels.pdf

[2] Maximum permitted
[3] Average content
[4] Ground temperature
[5] Ambient temperature
[6] Mole percentage
[7] At 40 bars
[8] At 10 bars

France, Germany and Switzerland have two levels of requirements for the upgraded biogas with different restrictions applied for the injection of low and high quality gas.

Both in Switzerland and Sweden, the injection of biogas into the natural gas network forms part of a policy to develop **biomethane for vehicles**.

Sweden has one standard that has been defined for **biogas utilized as vehicle fuel: SS 155438:1999** Motor fuels - Methane rich gas as fuel for high speed internal combustion engines - Requirements and test methods

Biomethane is currently supplied extensively as compressed gas from dedicated filling station close to biogas plants, for example in city transport applications. Injection into the NG grid is not yet widespread. The new EU renewables directive (Article 16) aims to ease grid injection and the European standards organization (CEN) has set up a **new Technical Committee (TC408)** to formulate harmonized standards for gas grid injection. The latter should eventually facilitate transport of bio methane to distant customers and filling stations, not only to customers on the local and low-pressure distribution grids.

TC 408 has not yet published any related standard, but is working on the following projects:

FprEN 16723-1 (WI=00408006)

Natural gas and bio methane for use in transport and bio methane for injection in the natural gas network - Part 1: Specifications for bio methane for injection in the natural gas network

prEN 16723-2 (WI=00408005)

Natural gas and bio methane for use in transport and bio methane for injection in the natural gas network - Part 2: Automotive fuel specifications

(WI=00408007
Proposed limit values for contaminants in bio methane based on health assessment criteria

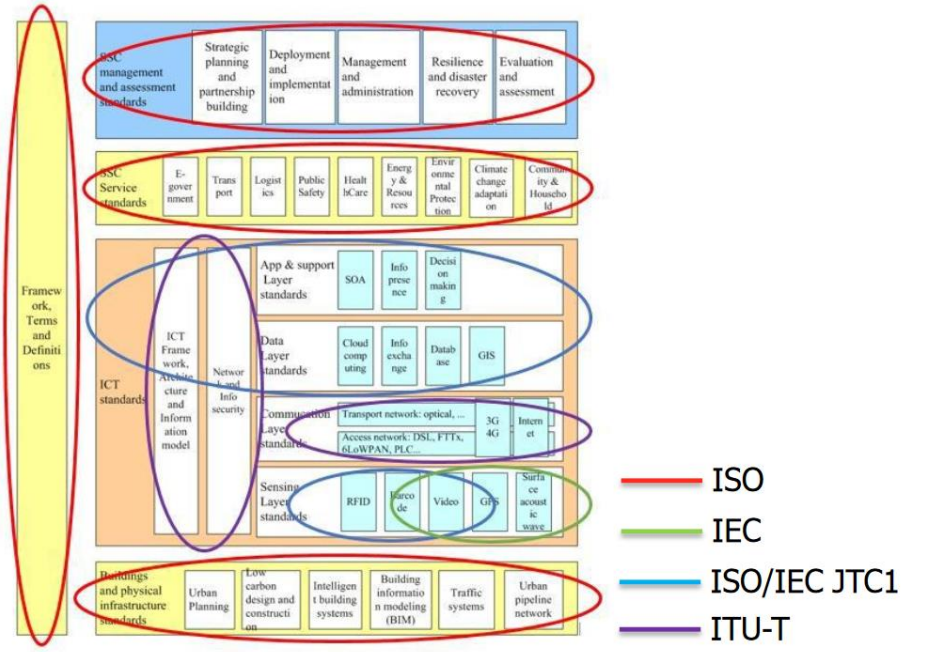
ISO has one TC working in biogas (TC 255) and there's one standard under development:

ISO/AWI 20675: Terms, definitions and classification scheme for the biogas production, conditioning, upgrading and utilization.

3.3.5 Standards of ICTs

The aim of this chapter is to give a general overview of standardization activities that are important to take into account by Smart City planners and will not cover any specific standards in detail.

As the Smart City covers multiple domains and can go into different depth in each of them, standardization in the field has become rather complex. Below there is a sample mapping of standardization activities from a Smart Cities report[7] by ISO and IEC. Some of the most relevant standardization bodies for Smart Cities are ISO[8], ITU[9], OGC[10], ETSI[11], IEEE[12] and BSI[13]. Besides those standardization bodies on the mapping, there are three European Commission initiatives (ESPRESSO[14]; CITYkeys[15]; The Smart Cities Information System[16]) that are covering the Smart Cities field and multiple Industry Groups (TM Forum[17], etc) implementing those standards in practice and sharing their practical knowledge on the domain.



Source: Report on standardization needs for Smart Cities, ISO/IEC JTC1 SG1

[7] http://www.iso.org/iso/smart_cities_report-jtc1.pdf
[8] http://www.iso.org
[9] http://www.itu.int/en/ITU-T/ssc/Pages/default.aspx
[10] http://www.opengeospatial.org/pressroom/pressreleases/2181
[11] http://www.etsi.org/technologies-clusters/technologies/smart-cities
[12] http://smartcities.ieee.org/
[13] http://www.bsigroup.com/en-GB/smart-cities/
[14] http://espresso.ru.uni-kl.de/
[15] http://www.citykeys-project.eu/
[16] http://smartcities-infosystem.eu/
[17] https://www.tmforum.org/

As presented in the chart above the key for City planners is to have a holistic framework that would cover Buildings and physical infrastructure standards, combined with ICT standards that support all needed Smart Cities standards. Above mentioned bodies, initiatives and consortiums are proposing such frameworks that should conduct the sets of standards and have a great potential to converge and mature into applied standards in coming years.

Most of the standards and/or forums nowadays focus on layered and modular ICT approach as presented in the chart below by ITU[18]. Sensing and Network layers are heavily used also by other industries and are therefore rather well standardized and evolving independently from Smart Cities. Application layer components are also rather well developed and widely used by other industries. Biggest challenge at the moment is Data and Support layer and interoperability between all these modules. There are both connection and semantic challenges to be faced while designing the Smart City.

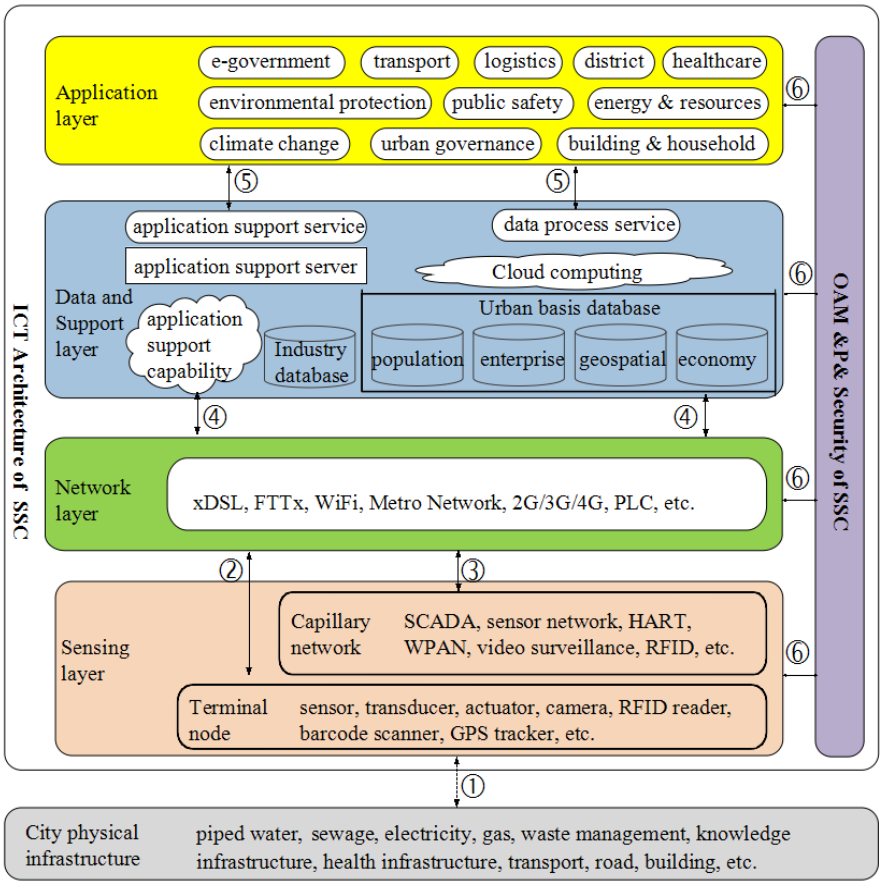


Figure 6: A multi-tier SSC ICT architecture from communications view, emphasizing on a physical perspective

[18] http://www.itu.int/en/ITU-T/focusgroups/ssc/Documents/website/web-fg-ssc-0345-r5-ssc_architecture.docx

These topics will be covered in more detail in ICT work package (WP6) as follows:

- T6.1 Functional and non-Functional specifications
- T6.2 Smart City ICT Architecture
- T6.3 Data models and Data management
- T6.4 Interconnectivity mechanisms
- T6.5 Application development mechanisms
- T6.6 Added value Applications

Besides above mentioned standardization and Industry groups, there are three EC initiatives that will cover the Smart City ICT standardization field. Below there are descriptions of their goals and means. These initiatives are in a very early stage and it is hard at this point of time to evaluate their future defining success – "*Ideas are great, but execution is everything*".

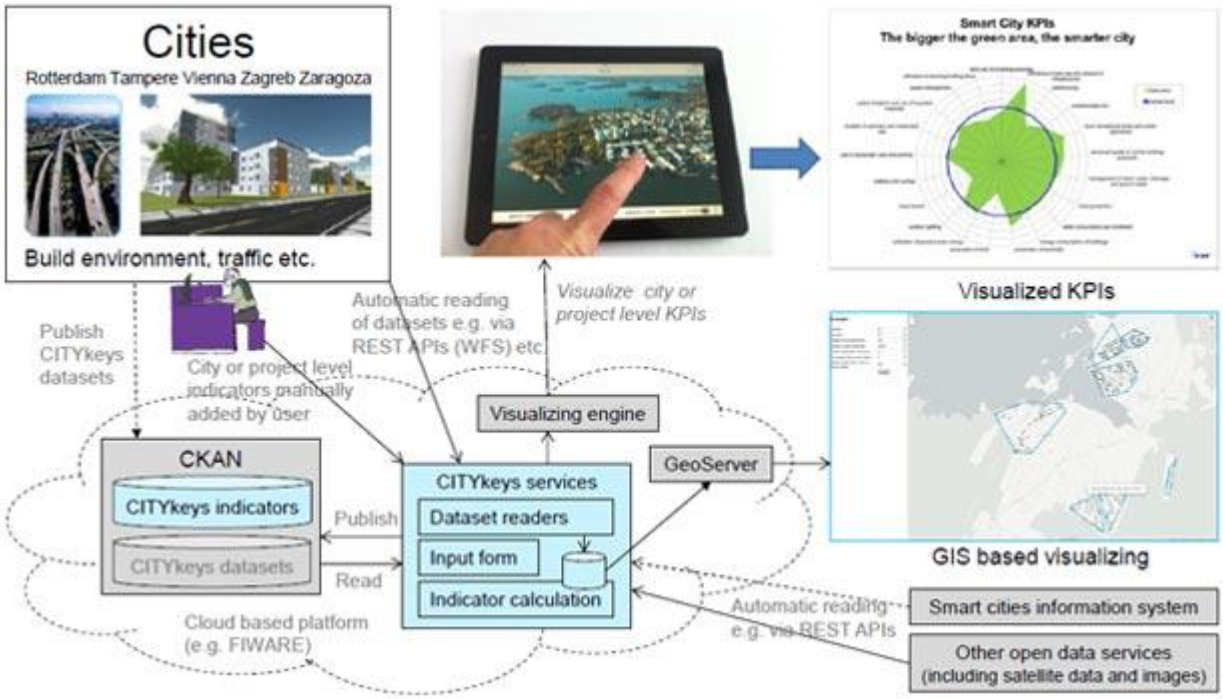
Project ESPRESSO[19]

ESPRESSO wants to define the scope of the project by analyzing sectorial systems, defining use cases and test scenarios, and building a conceptual standardized interoperable framework by evaluating the current standards landscape including gap analysis, and design pilots, which will be used to run test scenarios with the project partner cities to make practical experiences with the currently available set of standards and technologies.

One of the key objectives of ESPRESSO is to identify a collection of open standards that work well together ("conceptual standards framework"), having been proven to help smart cities, and of course to identify gaps and weaknesses in the framework of available standards. We have started by reading a lot of reports from organizations and networks, and now we'd like you to contribute your experience, as a city or community

[19] http://espresso.ru.uni-kl.de/

An overview of the CITYkeys[20] prototype platform



The Smart Cities Information System[21] (SCIS)

Brings together project developers, cities, institutions, industry and experts from across Europe to exchange data, experience and know-how and to collaborate on the creation of smart cities and an energy-efficient urban environment.

Launched with support from the European Commission, SCIS encompasses data collected from ongoing and future projects under the CONCERTO initiative and Smart Cities calls in Horizon 2020

Recommendation from WP6 to the SmartEnCity project in general is to wait a little until these initiatives show their actual direction and execution potential and the go more into details either in these projects or in any other similar initiatives.

Independent from above mentioned EC initiatives, there are few architectural options to cover Smart City ICT systems. Below there is short list and evaluation of these options.

Here is a short overview of architectural options based on the above presented layered approach. Most important is to understand that frameworks should not define the content, but purpose and need of the cities should drive the development of frameworks. There are several approaches that can be taken when building Smart City ICT solution. The main questions the design should address are:

[20] http://www.citykeys-project.eu/
[21] http://smartcities-infosystem.eu/

1. Where to keep the data?
2. How to access the data of multiple cities from a single service?
3. How to authenticate for the service?
4. Are there any limitation for whom with which permissions can see which data?
5. How to integrate new cities in the system?
6. How to provide aggregated data of several cities combined?

The main approaches with their pros and cons are as follows:

Central data bank

Gather all the data we'd like to share in a central database. Each participating city pushes data updates to this central repository through some sort of API. The service then uses its own database to respond to shared data requests.

Pros	Cons
Single endpoint for clients to talk to.	The data is likely not to be very up to date as the partners decide when to update it.
Integrating clients is easy.	The partners have to trust their data to some 3rd party system.
The central database can enforce data quality and integrity.	The system is quite complex to build and operate.
Querying the platform does not put stress on the partnering city platforms.	Depending on the data shared, there may be large amounts of data that needs to be synced to a central database.
Supports caching data centrally.	New city integration is quite complex as one would need to build a system that periodically builds some specific data sets and pushes it to the central service.
The client application do not need to be updated whenever a new city is added.	
The central server can perform data aggregation such as calculating the	

average power consumption across all cities.	
Might be possible to use some existing big data system as base platform.	
Can enable answering a wider range of questions using data-mining methods if more generic data is gathered in this system.	

Separate unified API interfaces

Agree on a common API interface that all the cities implement. Clients then connect to each of the partner systems using a unified interface to request the data they need.

Pros	Cons
There is no platform to build and manage, the partners just have to agree on a common interface.	Clients need to connect and authenticate to a number of systems to access the data.
Each partner stores their own data.	It's unlikely that all the parties are able to implement the interface exactly in the same way so a single piece of client code can talk to all of them equally well.
	Whenever the interface agreement is changed or new queries added, modifications need to be made in each of the systems to reflect it.
	Client code can fail of any of the cities do not implement any of the methods or do it wrong.
	Aggregating data from multiple cities is hard as it can require requests to many systems and aggregating the data on the client not server side.

	Client applications need to be modified whenever a new partner is added to the system to query data from there as well.
	Does not support central data caching.
	Each partner needs to develop an adapter on top of their system that provides a standardized interface that the central service talks to.
	The questions that the API can answer is limited as it's more or less predefined when agreeing on the common data models.

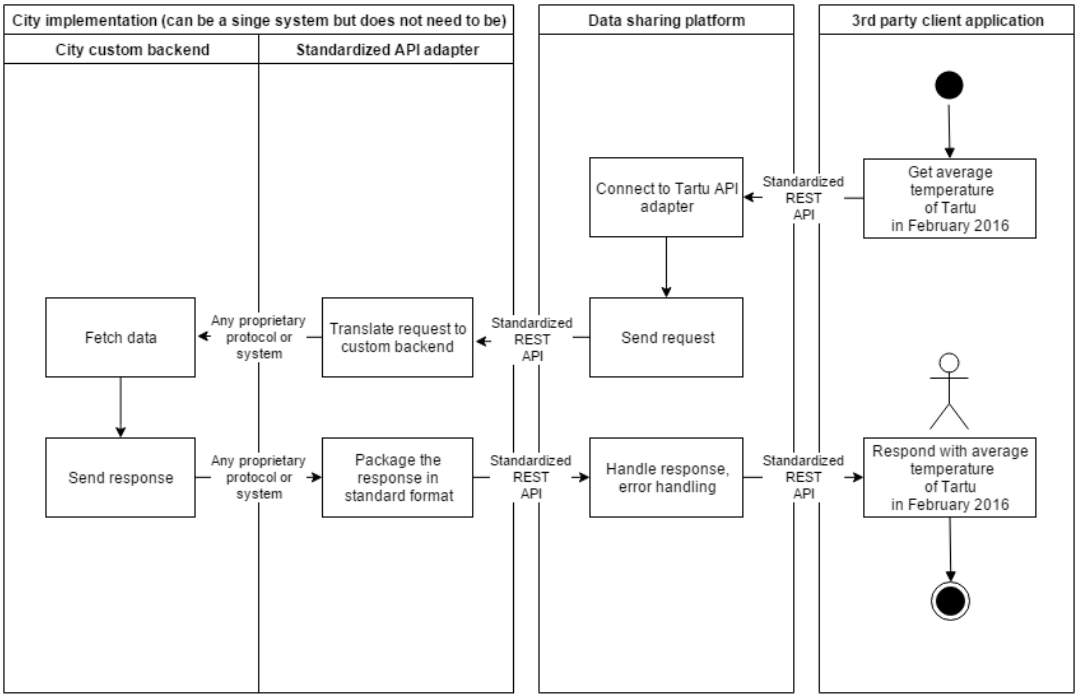
Light proxy server using unified adapter API

Agree on a common API interface that all the cities implement but proxy the requests through a central API service that deals with managing the partnering cities, authentication and data aggregation. The clients talk to a single standardized endpoint.

Pros	Cons
Single endpoint for clients to talk to.	Each partner needs to develop an adapter on top of their system that provides a standardized interface that the central service talks to.
The data is always up to date as it's queried directly from the source.	Partner cities can have difficulties implementing the unified API adapter layer correctly.
Integrating clients is easy.	The questions that the API can answer is limited as it's more or less predefined when agreeing on the common data models.
Supports caching data centrally.	
Each partner stores their own data.	
Central service can enforce data quality and	

formatting.	
The client application do not need to be updated whenever a new city is added.	
The central server can perform data aggregation such as calculating the average power consumption across all cities.	
The central service can handle versioning of the requests so updating some query would not break existing client applications.	
The central service can gracefully handle some partners not implementing any of the queries (so new queries can be added incrementally).	
The system is easier to build and maintain as it mostly acts as a proxy to other services, storing little data locally.	

Data flow



This is the basic data flow between the components for the third proxy server data sharing platform proposition. Basically when some data is requested from the data sharing platform, it talks to the city backend through a standardized REST API interface. We standardize what questions can be asked from the data sharing platform and how it requests this data from the city backend. The actual city backend system can be arbitrary, implemented on any technology and protocols, as long as the adapter is able to speak with it.

Common KPI format

There is no central data sharing platform. The cities decide on a common key performance indicators (KPI) machine-readable file format (JSON, XML etc). Each city generates this periodically (can still be generated dynamically on request) and makes it available for download online. Third party applications can be created that download these KPI indicators from one or several cities and perform additional analysis, comparison, draw dashboards etc (for example our SmartEnCity project website can display a dashboard and comparison of the three pilot cities).

Pros	Cons
There is no platform to build and manage, the partners just have to agree on a common KPI file format.	The platform can only provide the data that has been agreed on in the KPI file format.
The output file is static and can be generated at some interval by the each city platform.	Clients wanting to aggregate data from several cities need to fetch and parse the data from each city separately.
Generating the KPI file can require human input as not all of it can be directly calculated by the system automatically.	
This generated KPI file can be used by the European Commission to evaluate progress.	

Accessing the static data file does not put any stress on the platform.	
It's possible to build third party applications on top of the separate city systems that fetch and aggregate the data, making it available from a single endpoint.	
There is no need to build common API interfaces or adapters, each platform can decide how to generate this static standardized KPIs file.	

Of these approaches many industry players are supporting either the first or the third option, with a preference toward the third. it is believed to be the best choice for the number of positive attributes described above, keeping the integration and data sharing platform simple to build and integrate with, also the data is kept up to date and in its original source.

3.3.6 Standards of BIM management

There are many definitions of BIM (Building Information Modelling). The focus will vary from designers to constructors and operators.

BuildingSmart defines it as follows:

“BIM is a digital representation of the physical and functional characteristics of a building (or any infrastructure). As such, it serves as a shared knowledge resource for information about a building, forming a reliable basis for decisions during its life cycle from inception onward.”

According to NATSPEC (2011) we should distinguish between:

Building Information Model (Product): An object-based digital representation of the physical and functional characteristics of a facility. It serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward.

Building Information Modelling (Process): A collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model. Modelling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts the effective and efficient use of BIM for desired project outcomes and decision support.

The key principal is that BIM is not any single act or process. It is not creating a 3D model in isolation from others or utilizing computer-based fabrication. It is being aware of the information needs of others as you undertake your part of the process.

A BIM model can contain information/data on design, construction, logistics, operation, maintenance, budgets, schedules and much more. The information contained within BIM enables richer analysis than traditional processes. Information created in one phase can be passed to the next for further development and reuse.

We understand by BIM management to develop the management activity in a project by using BIM methodology.

BIM Standards

Nowadays, there are a growing number of standards from various organizations in every country where BIM is starting to be used. The main aim of the organizations behind them is to improve the ability to communicate, re-use and share data efficiently without loss, contradiction or misrepresentation during the lifecycle of a facility.

The main objectives of most BIM guideline documents are:

- To instruct AEC audience in best practice.
- How to handle the creation or use of BIM data.

- How to improve effectiveness and efficiency of activities throughout the lifecycle of the asset.
- How to implement BIM processes.

In this section of the document we have gathered most of the main BIM standards available at the moment around the world. As the BIM sector is still growing and developing, there will probably appear other standards or guidelines that may be of use during the project. The project team will check the publishing of these new standards or new versions during the whole duration of project.

Below are the standards and guidelines divided in international ISO standards and in each country where BIM is being implemented:

ISO INTERNATIONAL STANDARDS

ISO 12911:2012 Framework for building information modelling (BIM) guidance
1. Description of the standard ISO/TS 12911:2012 establishes a framework for providing specifications for the commissioning of Building Information Modelling (BIM). **2. Organization that developed it** The International Organization for Standardization (ISO) **3. Objectives** To provide a framework for the delivery of best practice guidance based on the experience already gained. This framework will provide general guidance that can be applied regardless of location. It will also consider how working practices differ between various countries and provide an overall framework within which local knowledge and good practice can be aligned with effective BIM usage. It is applicable to any range of modelling of buildings and building-related facilities, from a portfolio of assets at a single site or multiple sites, to assets at a single small building and at any constituent system, subsystem, component or element. It is applicable to any asset type, including most infrastructure and public works, equipment and material. BIM processes are applicable across the entire life cycle of a portfolio, facility or component, which can span inception to end-of-use. The main user of the framework is the information manager, who utilizes the framework to assist in structuring an international-, national-project- or facility-level BIM guidance document. The framework can also be used for BIM guidance provided by application providers.

4. Limitations

Not very specific. It gives general definitions and specifications.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 16354:2013 Guidelines for knowledge libraries and object libraries

1. Description of the standard

The aim of ISO 16354:2013 is to distinguish categories of knowledge libraries and to lay the foundation for uniform structures and content of such knowledge libraries and for commonality in their usage. By drawing up a number of guidelines, a guiding principle is provided for new libraries as well as for upgrading existing libraries. Without these guidelines there is an undesirable amount of freedom, so that the various libraries may become too heterogeneous. This would render the comparison, linking and integrated usage of these libraries very complex, if not impossible.

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

The objective of ISO 16354:2013 is to categorize knowledge libraries and object libraries and to provide recommendations for the creation of such libraries. Libraries that are compliant with the guidelines of ISO 16354:2013 may be more easily linked to, or integrated with other libraries

The target audience of ISO 16354:2013 consists of developers of knowledge libraries, builders of translation software or interfaces between knowledge libraries, certifying bodies and builders of applications who must base their work on the knowledge libraries laid down.

4. Limitations

None, for the moment.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 16757-1:2015 Data structures for electronic product catalogues for building services – Part 1: Concepts, architecture and model

1. Description of the standard

Data structures for electronic product catalogues for building services to transfer building services product data automatically into software models -- Part 1: Concepts, architecture and model.

ISO 16757-1:2015 specifies:

- the underlying concepts,
- a generic model specifying the available modelling elements and their relationships,
- a framework for the specification of the Content Parts by describing the elements which are to be provided by these Parts

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

The primary purpose of ISO 16757 is the provision of data structures for electronic product catalogues to transmit building services product data automatically into models of building services software applications. This includes a meta model for the specification of product classes and their properties and a meta model for the product data which is exchanged in product catalogues. Product data has to follow the specifications for their product groups.

This International Standard offers an interface which allows the uniform handling of data about technical, commercial, maintenance, service, as well as geometry, images, video, and text information.

4. Limitations

ISO 16757 is a multi-part standard. Only part 1 is currently available, the rest are still under development.

This standard does not include detailed specifications of what data should be included for particular items (eg fan-coils, pumps, tanks.)

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 29481-1:2016 Building information models – Information delivery manual – Part 1: Methodology and format

1. Description of the standard

Building information models -- Information delivery manual -- Part 1: Methodology and format.

ISO 29481-1:2016 specifies:

- a methodology that links the business processes undertaken during the construction of built facilities with the specification of information that is required by these processes, and
- a way to map and describe the information processes across the life cycle of construction works.

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

This part of ISO 29481 sets out a methodology for the provision of an integrated reference document that describes the processes and data required in the development or management of a constructed facility. It describes how to identify and describe the processes undertaken within that context, the information required for their execution and the results. It also describes in general terms how this information can be further detailed to support solutions provided by software developers, enabling its reuse, and configured to meet national, local and project needs.

ISO 29481-1:2016 is intended to facilitate interoperability between software applications used during all stages of the life cycle of construction works, including briefing, design, documentation, construction,

operation and maintenance, and demolition. It promotes digital collaboration between actors in the construction process and provides a basis for accurate, reliable, repeatable and high-quality information exchange.

4. Limitations

None, for the moment.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 29481-2:2016 Building information models – Information delivery manual – Part 2: Interaction framework

1. Description of the standard

Building information models -- Information delivery manual -- Part 2: Interaction framework

ISO 29481-2:2012 specifies a methodology and format for describing coordination acts between actors in a building construction project during all life cycle stages.

It therefore specifies:

- a methodology that describes an interaction framework,
- an appropriate way to map responsibilities and interactions that provides a process context for information flow,
- a format in which the interaction framework should be specified.

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

This part of ISO 29481 sets out a methodology and format for describing coordination acts between actors in a construction project. It describes how to identify and define the coordination processes undertaken and the information required for their execution. The resulting interaction frameworks enable standardization of interaction in building processes on national, local, and project level. It also gives a format to support

solutions provided by ICT-solution providers. Support of this part of ISO 29481 in different ICT-solutions means that this joins together different process management systems. In doing so, it provides a basis for reliable information exchange/sharing for users, so that they can be confident that the information they are sending or receiving is accurate and sufficient for the coordination activities they need to perform.

ISO 29481-2:2012 is intended to facilitate interoperability between software applications used in the construction process, to promote digital collaboration between actors in the building construction process, and to provide a basis for accurate, reliable, repeatable, and high-quality information exchange.

4. Limitations

None, for the moment.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 55000:2014 Asset management – Overview, principles and terminology

1. Description of the standard

Asset management -- Overview, principles and terminology.

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

ISO 55000:2014 provides an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management.

ISO 55000:2014 can be applied to all types of assets and by all types and sizes of organizations.

This International Standard is primarily intended for use by:

- those considering how to improve the realization of value for their organization from their asset base
- those involved in the establishment, implementation, maintenance and improvement of an asset management system
- those involved in the planning, design, implementation and review of asset management activities; along with service providers.

4. Limitations

This International Standard is intended to be used for managing physical assets in particular, but it can also be applied to other asset types.

This International Standard does not provide financial, accounting or technical guidance for managing specific asset types.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

ISO 16739:2013 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

1. Description of the standard

Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

ISO 16739:2013 specifies a conceptual data schema and an exchange file format for Building Information Model (BIM) data. The conceptual schema is defined in EXPRESS data specification language. The standard exchange file format for exchanging and sharing data according to the conceptual schema is using the Clear text encoding of the exchange structure. Alternative exchange file formats can be used if they conform to the conceptual schema.

2. Organization that developed it

The International Organization for Standardization (ISO)

3. Objectives

It works as an open international standard for the exchange and share of BIM data among software applications used by the various participants in a building construction or facility management project.

A subset of the data schema and referenced data is referred to as a model view definition. A particular model view definition is defined to support one or many recognized workflows in the building construction and facility management industry sector. Each workflow identifies data exchange requirements for software applications. Conforming software applications need to identity the model view definition they conform to.

4. Limitations

The following are outside the scope of ISO 16739:2013: exchange format definitions outside of the domain of construction and facility maintenance; project structure and component breakdown structures outside of building engineering; behavioural aspects of components and other information items.

5. Area of application

International

6. Importance for the project

This standard is international, so it has application in the 3 countries where the demos will be developed. In the case of not existing any regulation concerning this matter in any of the 3 countries, this standard will be used as framework.

DIRECTIVE 2014/24/UE

1. Description of the standard

DIRECTIVE 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC

2. Organization that developed it

The European Parliament and the Counsel

3. Objectives

According to the directive on public procurement, from 2018 it will be necessary to use electronic systems such as communication media and modelling tools, in procurement processes, construction and services. It stablishes the need to make use of building information electronic tools or similar.

It is expected that having different levels of electronic information regarding characteristics in the construction, contracts and services will allow to evaluate the procurement offers under different points of view considering full lifecycles and without giving attention only to the direct costs.

4. Limitations

Its scope is very general; it is not too specific for the use of BIM.

5. Area of application

European Union

6. Importance for the project

This directive will be public in September 2018 and will stablish common framework for all the European countries in the use of the BIM methodology and tools in a project.

UK BRITISH STANDARDS

BS 1192:2007_A2_2016 Collaborative production of architectural engineering and construction information. Code of practice.

1. Description of the standard

Collaborative production of architectural, engineering and construction projects using building information modelling. This British Standard supersedes BS 1192:2007 + A1:2015, which is withdrawn.

This standard establishes the methodology for managing the production, distribution and quality of construction information, including that generated by CAD systems, using a disciplined process for collaboration and a specified naming policy.

It is applicable to all parties involved in the preparation and use of information throughout the design, construction, operation and deconstruction throughout the project lifecycle and the supply chain.

The principles for information sharing and common modelling are equally applicable to building and civil projects.

This standard is also a guide for developers of software applications to enable them to support its

implementation through the provision of configuration files or application add-ons.

2. Organization that developed it

British Standard Institution (BSI). It was prepared by the Technical Committee B/555, Construction design, modelling and data exchange.

3. Objectives

This standard establishes the methodology for managing the production, distribution and quality of construction information, including that generated by CAD systems, using a disciplined process for collaboration and a specified naming policy.

The use of this standard is particularly applicable where technology enabled processes are used to support projects. These processes include:

- automation of 3D model, drawing and document production processes;
- indexing and searching project material;
- filtering and sorting;
- quality checking and document comparisons.

4. Limitations

This standard does not give guidance on the use of different data exchange file formats, the exchange of non-graphic data, structuring nor the exchange of data held as object classes and their instances nor the data structuring appropriate to specialist engineering analyses, nor the definition and use of data held as instance parameters.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BIP 2207 Building Information Management. A standards framework and guide to BS 1192

1. Description of the standard

Building information management. This book is a guide to BS 1192:2007 Collaborative production of architectural, engineering and construction information, the British Standard that is the code of practice that provides a best practice method for the development, organization and management of production information for the construction industry.

2. Organization that developed it

British Standard Institution (BSI).

3. Objectives

It explains in detail the processes and procedures needed to improve the quality of production information. It will help designers prepare the information before passing it to a construction teal to enable a project to be constructed.
The British Standard, BS 1192 is applicable to the preparation and use of information throughout the design, construction, operation and deconstruction throughout the project lifecycle and the supply chain. So anyone specifying or referencing BS 1192 would find this book a great reference tool, whether you are an engineer, contractor, architect, designer or work elsewhere in the construction industry.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don’t have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

AEC (UK) BIM STANDARDS An unified standard for the Architectural, Engineering and Construction industry in the UK

1. Description of the standard

The AEC (UK) BIM Standards builds on the guidelines defined by world-wide standards initiatives including BS 1192:2007, the US National BIM Standard and existing proven internal company procedures.

2. Organization that developed it

BIM Commission

3. Objectives

This document intends to provide platform-independent guidelines for BIM for designers. It is aimed at providing a base starting point for a unified BIM standard.

The standards initiative was formed in 2000 to improve the process of design information production, management and exchange.

4. Limitations

There are areas that are not currently addressed in this version of the BIM Standards, including Integrated Project Delivery (IPD), legal issues and risk mitigation. These areas, while important to BIM, are covered in more detail by other committees and in other documents. The AEC (UK) BIM Standard is intended as a BIM software production standard and provides only basic guidance to these issues, noting cross-references wherever required.

This document does not provide implementation advice as internal situations vary too greatly to determine a conclusive approach. Instead we recommend analysing your own internal requirements before adopting all or part of this standard, consulting with similar companies, professional consultants, user groups or project teams.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling

1. Description of the standard

PAS 1192-2:2013 - Specification for information management for the capital/delivery phase of construction projects using building information modelling.There is currently work in progress on a revision to PAS 1192-2:2013.

2. Organization that developed it

British Standard Institution (BSI). PAS 1192-2 was sponsored by the Construction Industry Council (CIC).

3. Objectives

This document provides information on the management of data produced within a BIM project environment, and supplements the processes and procedures contained in BS 1192:2007. As well as expanding the CDE (Common Data Environment) information contained in BS 1192:2007, also describes documents which should be produced as part of the BIM process, and details roles and responsibilities necessary to implement a BIM process on a project. It introduces new concepts such as employer's information requirements (EIR) – the employer's expression what information they require from the project and the format it should be in, and BIM execution plans (BEP) – the supply chain's response to the EIR showing how it will meet its requirements.PAS 1192-2 focuses specifically on project delivery, where the majority of graphical data, non-graphical data and documents, known collectively as the project information model (PIM), are accumulated from design and construction activities.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

PAS 1192-3:2014 Specification for information management for the operational phase of assets using building information modelling

1. Description of the standard

PAS 1192-3:2014 - Specification for information management for the operational phase of assets using building information modelling

2. Organization that developed it

British Standard Institution (BSI).

3. Objectives

This takes the processes and develops them for use in the operational life of assets. In turn, this leads to the use of new concepts such as organizational information requirements (OIR) – the information which the organization needs to know in order to run the business, the asset information requirements (AIR) – the information the organization needs about the asset it is responsible for, and the asset information model (AIM) – the information or data set which describes the asset.

This is an important document for the FM industry as it sets out the need for comprehensive and accurate information, the AIM, which can be used as the basis for all asset-related decision making. However, it also requires that the AIM is kept up-to-date to accurately reflect the status of the asset.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BS 1192-4:2014 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice

1. Description of the standard

Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice.

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

This British Standard defines a methodology for the transfer between parties of structured information relating to Facilities, including buildings and infrastructure.
COBie (Construction Operations Building information exchange) provides a common structure for the exchange of information about new and existing Facilities, including both buildings and infrastructure. COBie is the UK Government's chosen information exchange schema for federated BIM Level 2, alongside graphical BIM models and PDF documents.
BS 1192-4:2014 defines expectations for the exchange of information throughout the lifecycle of a Facility. The use of COBie ensures that information can be prepared and used without the need for knowledge of the sending and receiving applications or databases. It ensures that the information exchange can be reviewed and validated for compliance, continuity and completeness.
It defines expectations for the design and construction project phases prior to handover and acquisition and the subsequent in-use phase. This code of practice assists the demand side, including employers with portfolio managers, asset managers and facility managers, to specify their expectations while helping information providers, including the lead designers and contractors, to prepare concise, unambiguous and accessible information.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BS 1192-5:2015 A specification for security-minded building information modelling, digital built environments and smart asset management

1. Description of the standard

Specification for security-minded building information management, digital built environments and smart asset management

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

This PAS is available from BSI and outlines security threats to the use of information during asset conception, procurement, design, construction, operation, and disposal. It addresses the steps required to create and cultivate an appropriate security mindset and the security culture necessary to enable business to unlock new and more efficient processes and collaborative ways of working.

The PAS has been developed to integrate a security-minded approach into the construction lifecycle processes as specified in PAS 1192-2 and the asset management processes described in PAS 1192-3.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document.

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BS 7000-4:2013 Design management systems. Guide to managing design in construction

1. Description of the standard

Design management systems: Guide to managing design in construction.

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

This part of BS 7000 gives guidance on management of the construction design process at all levels, for all organizations and for all types of construction projects.

The guidance given applies to purpose-built constructions, equipment and components. It a key document for those who work in and with the construction industry, particularly designers and those managing design. Where general management principles are given, they may be adapted to suit any size of design organization or construction project. The guidance given applies to management of design activities throughout the life-cycle of a construction project, and the principles of the facilities management function.

The revised BS 7000-4 provides the principles and a common reference for company and project protocols, which can also be used in reverse to check that the bases have been covered. By following the protocols and principles in the guide, the design management process will be more efficient and there will be less wastage of time and effort.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BS 8536-1:2015 Briefing for design and construction. Code of practice for facilities management (Building infrastructure)

1. Description of the standard

Briefing for design and construction – Part 1: Code of practice for facilities management (Buildings infrastructure)

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

This British Standard considers matters relating to projects for the delivery of assets/facilities according to defined operational requirements, including maintenance and expected performance outcomes.

BS 8536-1:2015 is part of the BIM level 2 suite of documents developed to help the construction industry adopt BIM by 2016.

A second part (BS 8536-2) will be developed to cover briefing for infrastructures.

The scope of the BS 8536-1 has been recently expanded to include briefing requirements for soft landings, building information modelling and post occupancy evaluation (POE).

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document.

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

BS 8541 Library objects for architecture, engineering and construction. Identification and classification. Code of practice

1. Description of the standard

Library objects for architecture, engineering and construction.

Divided in several parts:

- BS 8541-1: 2012 – Identification and classification. Code of practice.
- This part of BS 8541 gives recommendations for defining format and content for library objects to support project briefing, design, tendering, construction and management of built assets.
- BS 8541-2: 2011 – Recommended 2D symbols of building elements for use in building information modelling.
- This part gives guidance and recommendations for symbols and other graphic conventions for use on drawings for the construction industry. It is primarily intended for those preparing drawings.
- BS 8541-3: 2012 – Shape and measurement. Code of practice
- This part extends the recommendations in BS 8541-1 to cover purposes for characterizing the shape and measurement of construction library objects for use in the building construction and facility domain. It applies to the creation and use of generic objects and manufacturer's product objects.
- BS 8541-4: 2012 – Attributes for specification and assessment. Code of practice.
- This part builds on the recommendations in BS 8541-1 to cover purposes for specifying and assessing attributes for construction library objects for use in the building construction and facility industry. It applies to the design of generic objects and manufacturer's specific products.
- BS 8541-5: 2015 – Assemblies. Code of practice.
- This part gives recommendations covering the transmitting of assemblies of construction library objects for use throughout both the project and in-use life cycle stages. It applies to the provision of generic objects and manufacturers' specific products.
- BS 8541-6: 2015 – Product and facility declarations. Code of practice
- This part gives recommendations on the transmission of product declarations relating to construction library objects and facility declarations (including buildings, infrastructure and built assets). It applies primarily to manufacturer's specific products, but the principles and some examples are also applicable to facility declarations.

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

This British Standard considers matters relating to projects for the delivery of assets/facilities according to defined operational requirements, including maintenance and expected performance outcomes.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

PD 8101:2014 Smart cities – Guide to the role of the planning and development process

1. Description of the standard

Smart cities – Guide to the role of the planning and development process

2. Organization that developed it

British Standard Institution (BSI)

3. Objectives

The purpose of this PD is to provide guidance for ensuring that developments and infrastructure projects are designed and built in a way that facilitates the city's progress towards becoming smarter.

This PD also aims to help the wider development community understand how they might better position their proposals to fit in with the local authority's wider strategic aims and, by adding value to the people and businesses that will be using their development, make it more desirable and profitable.

This PD provides guidance on:

- five key areas where the planning and development process can support smart city aspirations and where smart city approaches can improve the planning and development process; and
- opportunities that can be exploited at the different stages of the planning and development process.

It considers how each stage of the planning and development process could support smart city opportunities and benefit from good practice in smart urban planning and design.

It identifies some key areas where developments and infrastructure projects could be planned and implemented in a way that supports the city as a whole in becoming smarter. It sets out what needs to be

done at each stage, with an indication of where to go for further help.

4. Limitations

None, for the moment.

5. Area of application

It is mandatory in the UK, although its area of application includes other countries that don't have any BIM specifications or guidelines yet and that use it as a reference document

6. Importance for the project

Currently, the British Standards are used as framework for project development in many countries. Even more, some of the ISO standards for BIM are based in the UK standards. So, in the case of not existing a proper BIM standard in the countries where this project is going to be developed, both the BS and the ISO standards will be taken into consideration.

USA

NATIONAL BIM STANDARD

1. Description of the standard

National standard related to goals and activities of the BuildingSMART

2. Organization that developed it

National Institute of Building Sciences, National BIM Standard-United States Project Committee

The primary focus of the NBIMS is to provide standards to facilitate the efficient life-cycle management of the built environment supported by digital technology. This is accomplished through prescribing effective, repeatable elements and mechanisms in the creation, exchange, and management of building information modeling (BIM) data. These elements and mechanisms include reference standards of technology, classification systems, and conformance specifications; information exchange standards describing processes and exchange requirements for specific tasks during different parts of the building life-cycle; and practice standards that outline processes and workflows for data modeling, management, communication, project execution, and delivery, and even contract specifications.

3. Objectives

To improve the DCO process using standardized, machine-readable information.

4. Limitations

It is intended to be the first of many parts. When all sections are combined, this will be a very large document which will make it difficult to be useful.

The development of additional best practice documentation for each Tetralogy topic is the challenge and goal for future versions of NBIMS.

5. Area of application

United States of America

6. Importance for the project

This document may be used as reference during the project.

HONG-KONG

BIM PROJECT SPECIFICATIONS

1. Description of the standard

This BIM Standard establishes a process for adopting BIM on building projects. Clients, project managers, architects, engineers, quantity surveyors, contractors, manufacturers and facility managers can produce a BIM Project Specification with reference to this document.

2. Organization that developed it

Hong Kong Institute of Building Information Modelling

3. Objectives

This BIM Standard is intended to be used to define the scope of work for a BIM process, the responsibilities of the project participants and the deliverables from the BIM Process for the overall benefit of the project and the owner.

This BIM Specification is the first part of a two-tier structure. This first part, aims to provide general guidelines for BIM applications on a building project. It helps the building practitioners to define the BIM scope.

4. Limitations

The future Part B of this standard will provide specific guidelines for how Part A can be achieved through specific software functionalities and settings.

5. Area of application

Hong Kong

6. Importance for the project

This document may be used as reference during the project.

AUSTRALIA

NATIONAL GUIDELINES FOR DIGITAL MODELLING

1. Description of the standard

The NATSPEC National BIM Guide is a suite of documents that can be used to implement BIM on a project. To work effectively, the documents should be compiled in a coordinated way and read in conjunction with each other.

The documents in the suite are the NATSPEC National BIM Guide and Project BIM Brief Template. These two documents work in tandem.

2. Organization that developed it

NATSPEC, the National Building Specification

3. Objectives

Its main objective is to motivate the AEC industry towards BIM use.

The National BIM Guide is the central reference document that defines roles and responsibilities,

collaboration procedures, approved software, modelling requirements, digital deliverables and documentation standards for projects in general. It also provides guidance on a number of uses for BIM.

The NATSPEC Project BIM Brief Template provides a means of documenting client requirements regarding BIM for individual projects. It has places to enter descriptive details of the project such as its location and to specify what BIM deliverables and uses the client expects. It is also used to record what standards from the NATSPEC BIM Reference Schedule are to apply. Like other briefing documents, it outlines the scope of services required for the project and allows the project team to formulate an effective response.

The intent of the Guide's structure is to allow each edition of the National BIM Guide to function as a core reference document and to confine all editing to the Project BIM Brief. This allows the National BIM Guide to be tailored to individual projects while allowing it to be progressively upgraded in response to users' needs from edition to edition within a consistent, recognizable framework.

4. Limitations

Lacks of tangible tools.

5. Area of application

Australia

6. Importance for the project

This document may be used as reference during the project.

NEW ZEALAND

NATIONAL BIM HANDBOOK

1. Description of the standard

The BIM Handbook provides a solid framework for deciding whether to use BIM and outlines processes to operate it efficiently. It also introduces a common language around BIM.

2. Organization that developed it

The creation of this Handbook has been driven by the Building and Construction Productivity Partnership and the Ministry for Business Innovation and Employment.

3. Objectives

Their aim has been to create a New Zealand-centric document that:

- promotes the use of BIM throughout the project life cycle
- creates a common language for the industry to use
- clarifies the briefing process for designers and constructors
- improves the level of coordination in both design and construction phases
- promotes a more proactive approach to Facilities Management
- creates a clear path for the future development of the industry.

The NZCIC document defines design phases and deliverables. It is intended that Handbook be used in conjunction with the NZCIC guidelines. The two documents may be combined in the future.

4. Limitations

The Handbook does not cover every aspect of BIM in detail. Its primary focus is on the design and construction phases of the building life cycle. To realize the maximum benefits of BIM, the information/data created during the design and construction phases must be fed into facilities and asset management systems.

5. Area of application

The building and construction sector in New Zealand.

6. Importance for the project

This document may be used as reference during the project.

NORWAY

STATSBYGG BIM MANUAL

1. Description of the standard

This document is designated as the “Statsbygg Building Information Modelling Manual - version 1.2”, and is also referenced by the acronym “SBM1.2”. The acronym “SBM” is used to reference the most recent version of the manual at any given time.

SBM1.2 contains Statsbygg’s generic requirements for Building Information Modelling (BIM) in projects and at

facilities.

Key Features:

- The result of government initiative.
- Compulsory use for state projects.
- Guidelines for BIM in projects and the property asset management.
- Based on experiences and feedback on previous versions.
- Strong on strategic planning.

2. Organization that developed it

Statsbygg.

3. Objectives

The purpose of SBM is to describe Statsbygg's requirements in respect of Building Information Models (BIM) in the open Industry Foundation Classes (IFC) format– both generic requirements and discipline specific requirements. The requirements may be supplemented or altered during operational projects.

SBM is not intended to be a CAD manual – i.e. requirements relating to the production of CAD drawings (plans, sections, elevations, etc.). It does not describe BIM processes as such – however certain aspects of BIM processes are mentioned in context with requirements relating to BIM deliverables.

Also, SBM does not describe legal contractual conditions – however, clauses, chapters or the entire manual may be specifically assigned a legal role in individual projects by the project management.

4. Limitations

The Handbook does not cover every aspect of BIM in detail. Its primary focus is on the design and construction phases of the building life cycle. To realize the maximum benefits of BIM, the information/data created during the design and construction phases must be fed into facilities and asset management systems.

5. Area of application

Norway.

6. Importance for the project

This document may be used as reference during the project.

FINLAND

SENATE PROPERTIES BIM REQUIREMENTS

1. Description of the standard

The Senate Properties is not a certified standard although is compulsory to use it on state projects for architectural design. It is a multi-volume guide including discipline specific appendices.

The entire set of "Senate Properties' Building Information Model Requirements 2007" consists of the following documents:

- Volume 1. General part
- Volume 2. Modeling of the starting situation
- Volume 3. Architectural design
- Volume 4. MEP design
- Volume 5. Structural design
- Volume 6. Quality assurance and merging of models
- Volume 7. Quantity take-off
- Volume 8. Use of models for visualization purposes
- Volume 9. Use of models in MEP analyses

2. Organization that developed it

Senate Properties

3. Objectives

Its intention is to develop a customer---orientated & cost---effective working method.

4. Limitations

The documents do not take a stand on the stages of the construction process nor on the forms of project organization or implementation. A project manager from Senate Properties or a client representative hired by the company (for example, a construction or modelling consultant) oversees the work and is responsible for all parties fulfilling their obligations defined in the contract and complying with these requirements.

5. Area of application

Finland

6. Importance for the project

This document may be used as reference during the project.

COMMON BIM REQUIREMENTS 2012

1. Description of the standard

The publication series "Common BIM Requirements 2012" is the result of a broad-based development project entitled COBIM. "Common BIM Requirements 2012" is based on the BIM Requirements published by Senate Properties published in. As a result, the updated Series 1-9 and new Series 10-13 were released in Finnish on March 2012.

2. Organization that developed it

The update project was funded by Senate Properties in addition to several other real estate owners and developers, construction companies and software vendors. BuildingSMART Finland participated also in the financing of the project.

3. Objectives

The aim is to produce an operating culture for the use of BIM in building projects and BIM-based maintenance.

"Common BIM Requirements 2012" covers targets for new construction and renovation, as well as the use and facility management of buildings. The minimum requirements for modelling and the information content of models are included in the modelling requirements. The minimum requirements are intended to be observed in all construction projects wherein the use of these requirements is advantageous. Besides the minimum requirements, additional requirements can be presented on a case-specific basis. Modelling requirements and content must be presented in all design contracts in a binding and consistent manner.

4. Limitations

None at the moment.

5. Area of application

Finland and other countries like Estonia.

6. Importance for the project

This document may be used as reference during the project.

SWEDEN

BYGGHANDLINGAR 90

1. Description of the standard

Administrative guidelines in order to develop a working method for the use of BIM at a national level.

2. Organization that developed it

Swedish Standards Institute

3. Objectives

The aim is to produce an operating culture for the use of BIM in building projects and BIM-based maintenance.

4. Limitations

- Some aspects abstract & conceptual.
- Often referred to but of little importance.
- Lacks concrete examples.
- Lacks strategic insight.

5. Area of application

Sweden

6. Importance for the project

This document may be used as reference during the project.

DENMARK

BIPS

1. Description of the standard

The Bips is a government initiative for the Commission for Digital Construction. It includes multiple documents:

- 3D Working Methods
- 3D CAD Manual
- Layer and Object Structures

The 3D Working Method 2006 publication, along with the associated 3D CAD Manual is the first Danish instruction that specify a common coherent working method for all the parties to a construction project, so that 3D models can be created, exchange and re-used throughout the entire project.
3D Working Method 2006 and 3D CAD Manual prescribe the methods and guidelines and sets the standards for 3D modelling activities, and is thereby intended to support model-based work processes based on IT tools that are currently available for the construction industry. The document states how 3D models can be used to rationalise and qualify parts of the construction process.

2. Organization that developed it

Bips, Digital Construction

3. Objectives

- To specify a common and coherent working method for all parties to a construction project so that 3D models can be created, quality assured, exchanged and re-used throughout all phases of the project
- For the common working method to be supported by known and forthcoming CAD systems' technical capability.
- To indicate how the parties to a construction project should handle and exchange building models in a manner that adds rationality to the design process on a construction project.

4. Limitations

None at the moment.

5. Area of application

Denmark

6. Importance for the project

This document may be used as reference during the project.

ICT SERVICES SPECIFICATION

1. Description of the standard

This ICT-services specification applies to new construction, rebuilding and extensions to existing buildings, renovation, maintenance of buildings and landscaping.

Requirements are set in ”Bekendtgørelse nr. 118 af 6. February 2013”, which applies from April 1, 2013.

This ICT-services specification defines the extent of the services in sections 2.2, 8.1, 8.2 , 8.4, 8.5, 8.6, 8.7, 8.10 and 8.20 in ”Description of Services, Building and Planning 2012.” (YB 2012). The services in section 8 are integrated in the phase model, as clearly as possible, thus determining the digital delivery of each phase.

This ICT-services specification and the appendices subsequently stated must be part of the call for tenders of planning services for each construction project, and must subsequently be included in the consultancy agreement. The ICT-technical specifications, appendices 1-5, must be completed by consultants, and approved by the client at the start of the project.

In addition, relevant ICT requirements must be included in the call for tenders of the construction project, thus determining requirements for additional designs by suppliers and contractors, and the digital handover.

Appendices for this ICT-services specification:

1. ICT-technical communications specification
2. ICT-technical specification for measuring and modelling existing buildings
3. ICT-technical CAD specification
4. ICT-technical tender specification
5. ICT-technical handover specification, universities or office buildings
6. IDM DK-GOV-Area

2. Organization that developed it

Standard for construction projects ordered by The Danish Building & Property Agency (Bygningsstyrelsen) of the State of Denmark. Bygningsstyrelsen (BYGST) is a Danish governmental institution, and as such requires the use of Information and communications technology (ICT) in construction projects.

3. Objectives

To promote the use of ICT and Building Information Modelling (BIM) in the construction industry, to obtain higher quality and efficiency throughout the planning and construction phases, including the operation and maintenance phase.

4. Limitations

None at the moment.

5. Area of application

Denmark

6. Importance for the project

This document may be used as reference during the project.

SPAIN

uBIM GUIDE

1. Description of the standard

This document is a standard user's guide that includes the fundamental guidelines for the effective development of building information models or BIM models. This guide is an adaptation of the Finnish COBIM (Common BIM Requirements 2012) prepared by Building Smart Finland in 2012, which has been adapted to the Spanish case, according to the national regulations and current standards and using a multidisciplinary team of experts in each one of the chapters included.

The BIM users guide consists in the following documents:

- General Part
- Current state
- Architectural design
- Facilities design
- Structural design
- Quality assurance
- Measurements
- Visualization
- Facilities analysis
- Energetic analysis
- Project management
- Facility management
- Construction

2. Organization that developed it

BuildingSMART Spanish Chapter

3. Objectives

The aim of this document is to provide a standard guide of easy adaptation and in constant evolution in order

to bring together and coordinate all the disciplines involved in the making of BIM models with guarantees of accuracy suitable for its effective use in the sector.

4. Limitations

They are not certified standards, so its use is not mandatory.

5. Area of application

Spain

6. Importance for the project

This document may be used as reference during the project.

4 Standards that will be applied in SmartEnCity

In this section of the document, applicability of the selected standards in the state of art of each discipline will be checked for each of the LH cities.

4.1 Standards of social engagement

The aim of the SmartEnCity project is to change people's attitudes for a more sustainable future. All the LH cities acknowledge that changes in behaviour are the key to the sustainability of project's outcomes. In the field of social engagement according to the cities involved the aims are[22]:

- Vitoria – Citizens are at the core of the smart city concept, as it is not possible to become smarter without engaging them in the decision making. Citizens play therefore a key role on the definition of strategies covering ICTs, Mobility, Energy and urban environment, working together with public bodies, the private sector and research agents.
- Tartu – Engaging the citizens in creating a high-quality living environment that inspires environmentally aware decisions and new patterns of behaviour.
- Sonderborg – Engaging the citizens as co-designers of the Smart Zero Carbon Sonderborg ambition based integrated solutions; comprehensive learning and the introduction of new ICT based energy information.

Since the aim of the project is not a mere information sharing and applying new technologies, but changes in attitudes and people's behaviour that empower the more technical aspects of the project, the engagement process should involve an engagement and learning aspect.

The process of social engagement should include the following main steps:

- Defining the purpose, sustainability, scope, forms of and resources for social engagement.
- Creating a roadmap for better coordination of activities of social engagement.
- Defining the interest groups and stakeholders.
- Producing comprehensive information materials, disseminating them and providing the public with the information.
- Assessing the quality and effectiveness of the engagement process, monitoring and evaluating and reflecting on the results.

The social engagement developing process in the context of smart cities may have something to learn from the European Innovation Partnership on Smart Cities and Communities (EIP-SCC). They have published a document "Principles and enablers for citizen engagement: the experience from the European Innovation Partnership on Smart Cities and Communities" that have specific focus on citizens in the context of smart cities.

Applicable standards in the context of social engagement:

[22] SmartEnCity Network Lighthouse Cities

Level	Standard
International/European	Aarhus Convention Torremolinos Charter UN REDD+ Social and Environmental Standards ISEAL Alliance
Vitoria	-
Tartu	Good Practice of Involvement
Sonderborg	ZERO-platform

Aarhus Convention
The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) aims at contributing to the right of every person to live in an environment that is adequate to the person's health and well-being and guaranteeing **the rights of access to information**, **public participation in decision-making**, and **access to justice in environmental matters**. Access to information means granting the access to environmental information and collecting and disseminating environmental information. Public participation includes defining the public concerned, informing the public concerned and providing necessary information, allowing the public to participate in the decision-making, setting up the appropriate procedures for effective public participation, setting sufficient time-frames for the process. Access to justice provides the right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general.

European regional/spatial planning Charter (Torremolinos Charter)
Regional/spatial planning gives geographical expression to the economic, social, cultural and ecological policies of society. Man and his well-being as well as his interaction with the environment are the central concern of regional/spatial planning, its aims being to provide each individual with an environment and quality of life conducive to the development of his personality in surroundings planned on a human scale. Torremolinos Charter defines four fundamental objectives: - Balanced socio-economic development of the regions; - Improvement of the quality of life; - Responsible management of natural resources and protection of the environment; - Rational use of land. The implementation of regional/spatial planning **objectives should be co-ordinated between the various sector**s, **co-ordinated and co-operated between the various levels of decision-making** and the equalisation of financial resources (and at different spatial levels). All the regional/spatial planning policies must be based on **active public participation of citizens**.

UN REDD+ Social and Environmental Standards

Although the UN REDD+ Social and Environmental Standards have been designed to assess the impact – enhance benefits and reduce risks – of REDD+ programme, the Social and Environmental Principles and Criteria (SEPC) that has been developed as proposed guiding framework on this matter can also be used as the basis for developing social engagement principles and strategies. The SEPC contain three principles focused on social issues, one on social and environmental policy coherence, and three on environmental issues. The principles are overarching, fundamental, active statements about the achievement of a desired outcome. For every principle there are different set criteria – the conditions that need to be met by UN-REDD Programme funded activities to contribute to the achievement of the principle.

- Principle 1 – Apply norms of democratic governance, as reflected in national commitments and Multilateral Agreements.
- Principle 2 – Respect and protect stakeholder rights in accordance with international obligations.
- Principle 3 – Promote sustainable livelihoods and poverty reduction.
- Principle 4 – Contribute to low-carbon, climate-resilient sustainable development policy, consistent with national development strategies, national forest programmes and commitments under international conventions and agreements.
- Principle 5 – Protect natural forest from degradation and/or conversion.
- Principle 6 – Maintain and enhance multiple functions of forest including conservation of biodiversity conservation and provision of ecosystem services.
- Principle 7 – Avoid or minimise adverse impacts (direct and indirect) on non-forest ecosystem services and biodiversity

ISEAL Alliance

ISEAL is the global leader in defining and communicating what good practice looks like for sustainability standards through guidance and credibility tools such as the Codes of Good Practice.

The ISEAL Credibility Principles (Figure 26) underpin effective practices for sustainability standards systems, supporting those systems to achieve more positive social, environmental and economic impacts, while decreasing negative impacts.

The engagement strategy being developed during the SmartEnCity project can take into account these ten ISEAL's Credibility Principles to maximise the project outcomes and their future replication in the field of social engagement:

Figure 7: ISEAL's Credibility Principles

ISEAL also provides instructions how to set up standards themselves and also assessing the impacts of social and environmental standards systems. The Standard-Setting Code focuses on the standards development process, as well as on the structure and content of the standard. It captures the good practices that should be followed in standards development for any sector or product to ensure the standard is credible, effective and achieves its objectives. It supports the development of standards that are relevant and transparent and that reflect a balance of stakeholder interests. The Impacts Code helps standards systems to better understand the sustainability results of their work, as well as the effectiveness of their programs. It supports standards systems to measure and improve the results of their work and to ensure that standards are delivering their desired impact. The purpose of the new Assurance Code is to provide guidance for high quality assurance that supports sustainability and improves the effectiveness of different verification and certification models. It helps to ensure accurate results from assessments of compliance and to encourage the use of assurance to support learning.

4.1.1 Vitoria

In Vitoria there is no detailed programme that is being followed in order to carry out the actions of social engagement. On a country level there is an Act of Transparency, Access to Public Information and Good Governance that has broadened the access to public information and is aimed at active publicity.

Transparency, Access to Public Information and Good Governance Act
The Transparency Act has a three-fold purpose[23]: expand and strengthen transparency in public activity, which is set forth as an obligation at every level of the public administration and public agencies; recognise and guarantee access to information, which is regulated as a far-reaching right; and establish the good governance obligations to be met by public officials, as well as the legal consequences of noncompliance, which become a requirement of responsibility for all those carrying out public activities.

Actions according to the DOW regarding citizen engagement in Vitoria:

- Defining stakeholders and interest groups.
- Collecting information about the neighbourhood.
- Engagement and participation of stakeholders and interest groups, key players (workshops etc.).
- Co-creating the dynamics with agents and neighbours (workshops design and implementation).
- Identifying key social needs and finding solutions to cover them.
- Elaborating the „Common goal setting plan" and defining the "early adopter" community of the Vitoria-Gasteiz LH Deployment.
- Recruiting the rest of the citizens and co-creating engagement accelerating strategies.

4.1.2 Tartu

In Tartu there is no detailed programme that is being followed in order to carry out the actions of social engagement. Although on a country level there is defined a list of steps in order to provide suggestions on engagement practices. The "Good Engagement Practices" are a partnership and cooperation document, which includes eight recommended principles, that places great importance on the clarity of goals, openness of relationships, and dedication to goals. Its focus is on administrative agencies in the preparation of strategic documents. Thus it can provide an overall scheme, but in a context of SmartEnCity project's aims and goals it may lack focus on empowering the community.

[23] Open Government Partnership (Spain)

Good Practice of Involvement
In Estonia “Good practice of Involvement” regulates the good practice of social engagement. It consists of seven chapters that define the process of public engagement, interest groups and the public engaged, designing public engagement and notifying of participation possibilities, cooperation with interest groups and public in different stages, information channels for public consultation, feedback and notifying of consultation results and assessment of the whole process.

Actions according to the DOW regarding citizen engagement in Tartu:

- Collecting information (socio-economic conditions, consumption levels, community behaviour).
- Developing and testing and evaluating social innovation models for changing citizen behaviour and their adaptation to new technologies in Tartu.
- Developing of motivation schemes as well as testing and evaluating social innovation models.
- Improving the overall citizen engagement model.

4.1.3 Sonderborg

The citizen engagement actions will be based on the citizens and stakeholder “ZERO-platform” developed by the ProjectZero organisation already since the year 2007 involving all major stakeholders of the Sonderborg community. In 2010 the EU commission awarded ProjectZero as the number one EU role-model for Energy society actions.

ZERO-platform
Citizen participation in Sonderborg aims to motivate people for a strong participation. It is aimed at real change in people’s behaviour. In 2008 ProjectZero invited local citizens to join what became the ZEROfamily learning program. The ZEROfamily project offered training and education in low carbon and sustainable lifestyle for Sonderborg citizens (workshops, etc.). The outcome was created based on mainly awareness and change of light bulbs. In 2010 the ZEROhome program was created based on the best practice learning from the ZEROfamily program. The ZEROhome program took important lessons learned from the ZEROfamily program and applied them on a larger scale of homes and families. The program is focused on assisting the 18,600 private house owners in Sonderborg to find the best solutions for energy retrofit of their average 65 years old homes. The focus of involving important stakeholders included: ● To help answering the house owners question “what needs to be done”, the ZEROhome program offered a free energy review/consultation carried out in their homes. During the

consultation the energy consumption was reviewed, improvement opportunities and cost discussed and an action plan defined.

- Next step was to connect the house-owners with qualified craftsmen to get the job done in a qualified way. To secure the ZEROhome-program, ProjectZero together with the technical college and vocational school (EUC Syd) has implemented a craftsmen training program to improve their energy understanding and energy consulting competences.

ProjectZero has developed specific participation programs for different segments (citizens living in their own homes, with house association flats, living in privately owned flats) and their related stakeholders.

Actions according to the DOW regarding citizen engagement in Sonderborg:

- Specifically, for the SmartEnCity project will be established the Sonderborg SmartEnCity Stakeholder Forum, which will be the main platform for citizens' and stakeholders' engagement. The Forum will develop the action plan and measures for engagement for the SmartEnCity demonstration area.
- Stakeholders and interest groups will be identified in six fields of actions (demonstration and community, building retrofitting, renewable energy sources, mobility and replication) and grouped in the specific activities of engagement and implementation.
    - Demonstration area community – establishing stakeholders and possible co-operation.
    - Building retrofitting – developing strategies and perspectives of job and business creation, etc.
    - Renewable Energy Source – developing strategies and perspectives of business development.
    - Mobility – developing strategies and perspectives of business development.
    - ICT (as a management and registration tool) – developing citizens' information strategies and forum together with citizens; involving end-users in strategies and activities for data collection and for end-user management strategies; developing strategies and perspectives of business development.
    - Replication of the results – developing replication strategies and activities.

4.2 Standards of building retrofitting

In order to apply the standards in building retrofitting, there would be a common level that covers the three lighthouse projects, where a combination between BREEAM environmental Assessment System and Passivhaus building standard would be interesting, within the European regulatory framework.

The main reason for this proposal is that both are tested and successful tools to designing and constructing sustainable buildings, with thousands of examples built all over Europe.

Besides that, both have specific assessment categories about building retrofitting and are entirely complementary. While BREEAM assess and improve the environmental performance of buildings on a holistic level, for example with considerations about the lifecycle of the materials, water consumption or waste management, Passivhaus is concerned with energy efficiency.

At local level, it could be possible to implement another certification tools, such as Verde RH in Vitoria-Gasteiz or Nordic Ecolabel in Sonderborg.

CITY		STANDARDS	
		REGULATORY FRAMEWORK	VOLUNTARY CERTIFICATION TOOLS
COMMON		▪ **DIRECTIVE 2012/27/EU** on energy efficiency ▪ **DIRECTIVE 2010/31/EU** on the energy performance of buildings	▪ **BREEAM** Refurbishment Domestic Buildings ▪ **EnerPHit** certified retrofits with Passive House components
SPECIFIC	VITORIA	▪ **CTE (2013)** Technical Building Code ▪ **Law 8/2013** of Rehabilitation and Regeneration	▪ **VERDE RH** Residential ▪ **BREEAM ES** Residential
	TARTU	▪ **Building Act 2003**	
	SONDERBORG	▪ **Danish Building Regulations 2010** (BR10)	▪ **Nordic Swan** Ecolabel for buildings

Table 8: General view of standards application in building retrofitting

Within the common application framework for all lighthouse projects, main features of European regulation and proposed voluntary certification tools are described below:

Regulatory framework

These would be the main aspects included in the European reference standards:

▪ **DIRECTIVE 2012/27/EU** on energy efficiency

- 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.

- 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.

▪ **DIRECTIVE 2010/31/EU** on the energy performance of buildings

- EU countries make energy efficient renovations to at least 3% of buildings owned and occupied by central government.

- EU governments should only purchase buildings which are highly energy efficient.

- EU countries must draw-up long-term national building renovation strategies which can be included in their National Energy Efficiency Action Plans.

Voluntary certification tools

BREEAM Refurbishment Domestic Buildings BREEAM®
The BREEAM Refurbishment scheme is designed to help building owners and occupiers to save operating costs, reduce the environmental impacts of refurbishments and to increase the sustainability of existing building stock. The scheme has been initially designed for the UK market taking account of UK climate market regulations, policy and existing and potential finance schemes including the New Green Deal. It has been designed to work cost effectively at a single dwelling level as well as large scale refurbishment level in a way that helps those providing a quality service to differentiate themselves. It can be adapted internationally for use by National Scheme Operators.

BREEAM Domestic Refurbishment incorporates the majority of environmental performance measures proposed for evaluation in CEN/TC 350 standards, together with a significant number of the social performance measures.

In addition to the overarching principles of BREEAM, the BREEAM Domestic Refurbishment scheme has been developed in accordance with the following set of principles:

- Promote low cost, sustainable refurbishment.
- Recognize the limitations of existing buildings including their inherent built form and location.
- Drive market transformation by promoting best practice and innovation in the refurbishment of existing buildings.
- Provide a holistic environmental assessment that works effectively across different building and project types.
- Recognize the different starting points of our existing building stock.

The performance of an BREEAM-assessed project is quantified by a number of individual measures and associated criteria stretching across a range of environmental issues:

Section	Issue
Management	Home Users guide
	Responsible Construction Practices
	Construction Site Impacts
	Security
	Protection and enhancement of ecological features

Section	Issue
Health & Well-being	Daylighting
	Sound Insulation
	Volatile organic compounds (VOCs)
	Inclusive Design
	Ventilation
	Safety

Section	Issue
Energy	Improvement in Energy Efficiency Rating
	Energy Efficiency Rating post refurbishment
	Drying Space
	Lighting
	Display Energy Devices
	Cycle Storage
	Home Office
	Primary Energy Demand
	Renewable Technologies
	Energy Labelled White Goods

Section	Issue
Water	Internal Water Consumption
	Water Meters
	External Water Consumption

Section	Issue
Materials	Environmental Impact of Materials
	Responsible Sourcing
	Insulation

Section	Issue
Waste	Household Waste
	Refurbishment Site Waste Management

Section	Issue
Pollution	Surface Water Runoff
	Flooding
	Nitrogen Oxide Emissions

Section	Issue
Innovation	Exemplary performance

EnerPHit certified retrofits with Passive House components

Certification criteria for refurbished buildings

If the certification criteria for a Passivhaus are met when refurbishing a building then it is possible to certify the building as a "Quality-Approved Passive House" based on the same criteria as for new buildings.

However for various reasons it is often difficult to achieve the Passivhaus standard for older buildings with reasonable effort. The use of Passivhaus technology for all relevant building components in existing buildings does lead to considerable improvement in respect of thermal comfort, structural protection, cost-effectiveness and energy requirements.

Buildings that have been refurbished using Passivhaus components and largely with exterior wall insulation can be certified to the EnerPHit standard as evidence of quality assurance and to verify achievement of the specific energy values.

The designation EnerPHit+i is used if more than 25 % of the opaque exterior wall surface has interior insulation. It will be likely that moisture analysis will be needed where opaque elements are insulated internally.

The standard has slightly relaxed certification criteria as indicated below:

Criteria	Passivhaus	EnerPHit
Specific Heat Demand	≤ 15 kWh/m².yr	≤ 25 kWh/m².yr
Primary Energy Demand	≤ 120 kWh/m².yr	≤ 120 kWh/m².yr

Limiting Value	$n50 \leq 0{,}6^{-1}$	$n50 \leq 1{,}0^{-1}$

Calculating the Energy Balance

As with new build projects the energy balance of the refurbished building must be verified using the Passive House Planning Package (PHPP). For calculation of the specific space heat demand both the monthly as well as the annual method can be applied, see Outline Specification for further details.

4.2.1 Vitoria

Regulatory framework

- **CTE (2013) Technical Building Code**

Current energy efficiency requirements for buildings in Spain are established in the Basic Document DB-HE "Energy Saving" of the Technical Building Code (CTE 2013). In DB-HE 2013, minimum requirements on existing buildings which are retrofitted or rehabilitated are referred to global Weighted Energy Demand of heating and cooling (WED). WED is calculated as the sum of energy demand of heating and 0,7 times the energy demand of cooling (0,85 for areas located outside the Iberian peninsula). It is established that the WED of an existing building that undergoes an important rehabilitation (affecting more than 25% of the surface of the building envelope) must be less than the energy demand of the reference building.

- **Law 8/2013 of Rehabilitation and Regeneration**

This Law aims to promote energy efficiency and address the challenges caused by climate change. It recognizes the opportunity to change production model parameters to environmental, social and economic sustainability by creating green jobs, specifically those related to renewable energy and rehabilitation policies and energy.

The law also establishes the basic provisions of a Building Assessment Report (BAR). In addition to assessing the conservation status of the buildings, the BAR provides information about the degree of compliance with current regulations on accessibility, and includes the Certification of Energy Efficiency. The Report is required for residential apartment buildings more than 50 years old that have not already passed a Technical Building Inspection.

Voluntary certification tools

VERDE RH Residential

VERDE RH borns in order to develop a simple tool for evaluating retrofitting interventions carried out in collective housing buildings. Conceived as a diagnostic tool and evaluation. The tool collects the transversal approach of sustainable development, allowing to quantify the environmental, social and economic improvements resulting from the rehabilitation process.

The criteria evaluated by VERDE RH Residential are:

- Plot and location
- Energy and atmosphere
- Natural resources
- Indoor air quality
- Service quality
- Social and economic aspects
- Innovation

BREEAM ES Residential

BREEAM ES Domestic Buildings is the Spanish scheme of environmental assessment and certification of residential buildings, new, refurbished or renewed, including single houses and housing blocks.

This certification tool assess the sustainability of a building according to ten categories:

Section	Issue
Management	Commissioning
	Construction site impacts
	Buildings User guide

Section	Issue
Health & Well-being	Daylighting
	Acoustic performance
	Lighting
	Private area housing
	Adaptable housing

Section	Issue
Energy	CO2 emissions
	Low or zero carbon technologies
	Energy sub-metering
	Energy efficient building systems
	Display Energy Devices
	Internal lighting

Section	Issue
Transport	Public transport network connectivity
	Proximity to amenities
	Office in house

Section	Issue
Water	Water Consumption
	Leak detection
	Water re-use and recycling

Section	Issue
Materials	Embodied life cycle impact
	Materials re-use
	Responsible Sourcing
	Robustness

Section	Issue
Waste	Construction site waste management
	Recycled Aggregates
	Recycling facilities
	Waste composting

Section	Issue
Pollution	Refrigerant use and leakage
	Flood risk
	Nitrogen Oxide Emissions
	Watercourse pollution
	External light and noise pollution

Section	Issue
Land use and ecology	Site selection
	Protection of ecological features
	Mitigation/enhancement of ecological value
	Footprint

Section	Issue
Innovation	Exemplary performance

4.2.2 Tartu

Regulatory framework

- **Building Act 2003**

This regulation provides the requirements for construction works, building materials, construction products, building design documentation and as-built drawings of construction works, and establishes the basis and procedure for design work, building work, the use and the registration of construction works, the sanctions for violations of this Act, and the organization of public oversight and construction oversight.

Voluntary certification tools

No local voluntary certification tool has been found.

4.2.3 Sonderborg

Regulatory framework

- **Danish Building Regulations 2010 (BR10)**

The relevant sections of the Danish Building Regulation 2010 including the energy requirements to existing buildings undergoing renovation are:

The energy requirements to existing buildings undergoing renovation are to the individual building elements. Buildings elements are both construction elements and windows in the building envelope and installation elements e.g. ventilation system, boiler or heat pump.

There is no specific energy requirement on building level to existing buildings undergoing renovation e.g. to the final energy consumption of the building.

The Danish energy requirement to existing buildings in case of major renovation is based on the sum of component requirements to the building elements in the building envelope and to the installation. If the renovation is performed as smaller tasks the same requirements are also valid.

Voluntary certification tools

NORDIC SWAN Ecolabel for buildings

The following are the main requirements of this assessment tool:

1. Overall requirements for the license applicant

These requirements are about the general description of the building and the responsibility for the construction process.

2. Energy and indoor environment

Energy: there are criteria and points for the air tightness, energy consumption, light sources, low-flow showers and taps.

Indoor environment: This section covers the ventilations requirements, daylight factors, illumination intensity, and demand-controlled lighting.

3.Material requirements

- Chemical building products. A material safety data sheet has to be made, a classification, certain substances are prohibited; there is an obligation how these products must be handled.

- Chemical substances permanent building products. There is a list of substances that are prohibited.

- Timber and fibre-based materials. The wood material has to be derived from sustainable sources (certified forests).

- Other requirements on building products, materials and interiors. These are requirements for cladding and roofing, windows and exterior doors, containers, waste recycling stations.

4. Quality management and control of the construction process

- Requirements on the construction process. There are a lot of obligated requirements in this section. They concern management of building waste, measurement of waste fraction protection from damp, approved water installations, inspections during construction and of the finished building, and a quality control.

- Quality management. There must be a quality management system that takes care of providing information to parties involved in the construction process, laws and regulations, complaints etc.

5. Instructions to residents/property managers. A general information and maintenance plan has to be prepared.

4.3 Standards of energy supply and consumption

Standards and regulations of energy supply have common level for all three lighthouse cities.

As the base of regulations of energy supply the European Energy and Climate Change Policy is setting realistic and achievable goals for 2020 as a first step of energy transition. To reduce energy consumption by 20%, and emissions by 20%, increase share of renewable resources up to 20% and biofuels up to 10%. More ambitious goals are set on 2030 Climate and Energy Framework: reducing emissions by 40%, increasing the share of RES 27% and improve energy efficiency 27%.

Directives and standards mentioned in section 3.3.3 have linked with activities in three Lighthouse cities in SmartEnCity project.

EU countries have different available resources and their own unique energy markets therefore the steps for achieving goals are different.

Energy efficiency Directive 2012/27/EC sets that Member State shall set an indicative national energy efficiency target, based on either primary or final energy consumption, primary or final energy savings, or energy intensity.

Directive have influence to change the “consumer behavior” of several categories of actors:

- **Public bodies** would need to buy energy-efficient buildings, products and services, and refurbish 2% of their buildings each year, respectively 3% in the later stage, to drastically reduce their energy consumption.
- **Energy utilities** would have to encourage/invest at end users to cut their energy consumption through efficiency improvements such as the replacement of old boilers or insulation of their homes.
- **Industry** would be expected to become more aware of energy-saving possibilities, with large companies required to undertake energy audits every 3 years.
- **Consumers** would be better able to manage their energy consumption thanks to better information provided on their meters and bills.
- **Energy transformation** would be monitored for efficiency, with the EU/Energy Community proposing measures to improve performance if necessary, and promoting cogeneration of heat and electricity.
- **National energy regulatory authorities** would have to take energy efficiency into account when deciding how and at what costs energy is distributed to end users.
- **Certification schemes** would be introduced for providers of energy services to ensure a high level of technical competence.

Renewable Energy Directive 2009/28/EC sets for EU countries to adopt national renewable energy plans (NREAP) with targets for 2020. In their national action plans, they explain how they intend to do this. The plans cover:

- individual renewable energy targets for the electricity, heating and cooling, and transport sectors
- the planned mix of different renewables technologies

- policy measures to achieve national targets including cooperation between local, regional, and national authorities
- any planned statistical transfers and/or joint projects with other countries
- national policies to develop biomass resources
- measures to ensure that biofuels used to meet renewable energy targets are in compliance with the EU's sustainability criteria

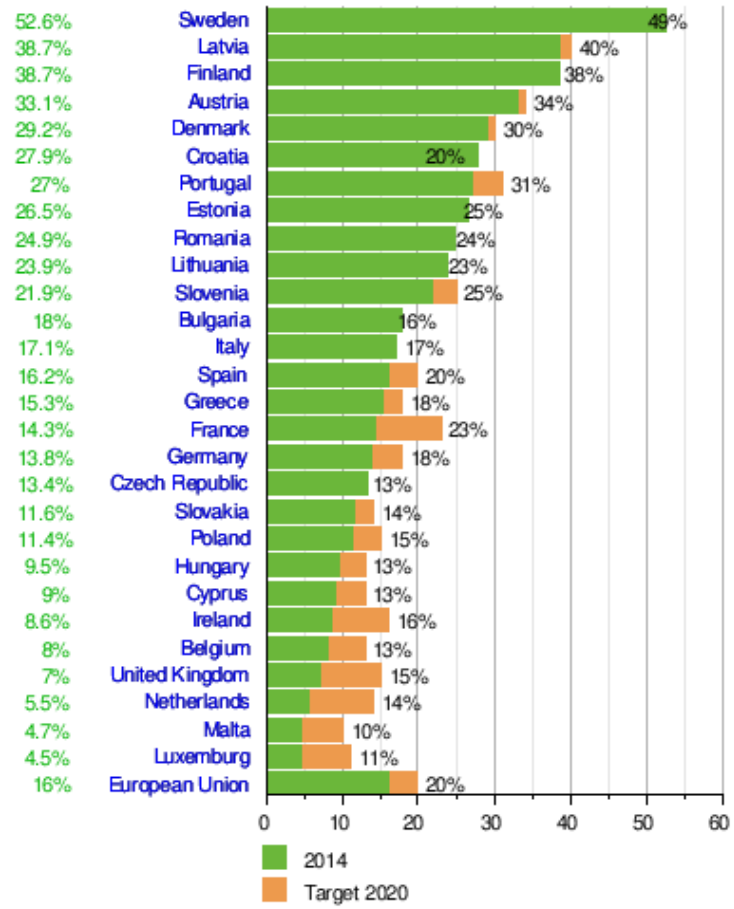


Figure 9: National RES targets and RES share in EU countries

Directives for common rules for internal market of electricity (2009/72/EC and gas (2009/73/EC) will set common regulations for market actors. Through common energy market rules and cross-border infrastructure, energy can be produced in one EU country and delivered to consumers in another. This keeps prices in check by creating competition and giving consumers choices when it comes to their energy supplier.

With EU legislation will be achieved that energy companies cannot exclude competitors from access to pipelines and also guarantee fair trading on wholesale markets and prevent price manipulation.

On citizen level, regulations take into account that citizens have the right to have their homes connected to energy networks and to freely choose any supplier of gas or electricity in their

area. They also have the right to access accurate information on their electricity and gas use that can help them reduce their consumption.

Smart meters help the consumers adapt their energy usage (volume and time) to different energy prices throughout the day, saving money on their energy bills by consuming more energy in lower price periods. With smart metering systems, smart grids reach consumers and suppliers by providing information on real-time consumption.

A 2014 Commission report on the deployment of smart metering found:

- close to 200 million smart meters for electricity and 45 million for gas will be rolled out in the EU by 2020. This represents a potential investment of €45 billion
- by 2020, it is expected that almost 72% of European consumers will have a smart meter for electricity. About 40% will have one for gas
- the cost of installing a smart meter in the EU is on average between €200 and €250
- on average, smart meters provide savings of €160 for gas and €309 for electricity per metering point (distributed amongst consumers, suppliers, distribution system operators, etc.) as well as an average energy saving of 3%.

Actions in three Lighthouse cities linked with standards on energy supply:

4.3.1 Vitoria

In Spain national targets of RES are described on Spain's National Renewable Energy Action Plan 2011-2020.

In Spain, the target means that renewable sources must account for at least 20% of final energy consumption by 2020

The Basque Country has set own regulations to fulfill NREAP requirements.

Vittoria-Gasteiz will implement several actions on energy supply linked with standard mentioned above. Actions consist of building up of demo foundations for a Zero Carbon district through the optimal investment on energy reduction measures and complementing the heating supply with a biomass based efficient heating network. A biomass district heating network will be deployed with estimated installed power is 5.300kW. For the distribution network, a 2 pipe system has been chosen.

Integrating of the management of the district heating that will be deployed in the demo site with the management of the electrical network will make more efficient the use of energy. Not only energy consumption data will be collected, but also information about thermal comfort and weather conditions in order to asses to energy savings and suggest better energy practices.

Smart metering and data analysis with HEMS (Home Energy Management System), BEMS (Building Energy Management System) and DEMS (District Energy Management System) can contribute for more efficient energy supply.

4.3.2 Tartu

Estonian National Renewable Energy Action Plan set RES share as target for 2020 to 25%.

City of Tartu actions on energy supply will consist of construction of District cooling station and installation of PV panes on station. Station with capacity of 13 MW will produce cooling from RES. The district heating and cooling system to be tested in Tartu will be based on a heat pump that, installed to return the flow of the district cooling system, will produce heat for the district heating system by using residual heat from cooling. The proposed district cooling system will use free solar energy from PV panels to cover a part of the cooling system's energy demand. The solution will meet consumer demands for thermal indoor comfort and domestic hot water while retaining high energy efficiency and share of renewable energy.

The Retrofitting of building (to ambitious goal 90 kWh/m2 year) will include smart metering of heat and electricity and based on its energy and inside climate management system. Also, it includes installation of PV panels on rooftop of buildings to contribute energy demand of consumers. Production of hot water will be switched from gas to District heating based on biomass.

4.3.3 Sonderborg

Denmark national targets set by National Energy Action Plan for Renewable energy in Denmark:

Target of energy from renewable sources in the gross final energy consumption in 2020 is set up to 30%.

Moreover, Sonderborg Municipality has as an official strategy to become a Zero CO2-emission community in 2029 with respect of all activities within the municipality area. This goal with the establishment of a public-private partnership called ProjectZero, involving key stakeholders such as Sonderborg Municipality, and leading industrial (e.g. Danfoss) energy (DONG Energy) and financial partners (Nordea).

To increase the RES-supply as a cost efficient strategy of reducing CO2- emissions from the energy consumption for buildings major focus of the retrofitting of buildings in Sonderborg demonstration project.

It includes also using of PV panels and well smart metering system for energy consumption.

Converting the overall district heating system of Sonderborg from 50% to 100% Renewable Energy Source supply, is goal from strategy and with SmartEnCity project pilots share of 73 % will be achieved.

4.4 Standards of mobility

Most of the standards related to **electric mobility** that have already been identified in section 3.3 are of direct application in the three LH cities. These standards usually address more than one category from the 4 selected ones.

Regarding **electric vehicles**, applicable standards will be those ones including recommendations for power socket, connector, cables, charger, converter, batteries, and in general, all the elements that belong to the physical structure of the vehicle and the associated charging infrastructure. Safety aspects will have a special relevance.

After the implementation phase of the project, a performance evaluation will be done in order to ensure the project objectives and impacts are achieved. EV performance, exhaust emissions and fuel consumption related standards will be taken into account.

Due to the variety of vehicles to be deployed (from e-bikes to light trucks) it is expected that all charging modes will be of application (from low AC charging to DC fast charging) though probably mode 3 will be the most frequently used (IEC 61851-1), closely followed by mode 2 (mainly for e-bikes and e-motorcycles). Standards related to **charging infrastructure**, including electromagnetic compatibility and safety issues will be of application.

Connection to the grid related standards will only be considered to a limited extent as they are not within the main scope of this study.

Communication and connecting protocols have a special relevance as they include communication security (between vehicle and charging point and with the backend system), data protection, protocols for information exchange, payment system, roaming, user identification, etc.

Though all standards already included in section 3.3 are related to **electro mobility** and have a specific interest for SmartEnCity project, a non-exhaustive list including those ones which are more clearly addressing the mobility actions to be implemented should consider:

IEC 60364-7-722, IEC 60783, IEC 61851, IEC 62196, IEC 61439-7, ISO 6469, ISO 8713, ISO 8714, ISO 8715, ISO 12405, ISO 13063, ISO 13064, ISO 14443, ISO 15118, ISO 17409, ISO 18246, CEN EN 15194, CEN EN 1175-1, SAE J1711, SAE J1772, OCPP.

Biogas related regulations that apply to both Tartu and Sonderborg are those ones dealing with biogas transportation and distribution, mainly gas grid injection specifications.

The next subsections show the specific situation and plans for the three lighthouse cities regarding sustainable mobility actions.

4.4.1 Vitoria

Vitoria-Gasteiz city current state in terms of sustainable mobility consists of one fast charging point and 15 regular charging points which are already available in public parking areas, shopping centres, stadiums, etc. By the end of 2.014 the pool of electric cars in the city consisted in 12 vehicles.

Thanks to SmartEnCity project, sustainable mobility related actions will comprise the introduction of 83 new electric vehicles (22 taxis, 15 private cars, 10 e-motorcycles, 10 e-bicycles, 13 light trucks, 13 light vans) and 100 new charging points (20 private, 6 in taxi stops, 26 in the last mile logistic hub and 10 in the multimodal bike hub).

Mobility actions are aligned with the current strategy of the city, which is aiming at reducing the number of conventional vehicles inside the city center by promoting the uptake of more eco-friendly vehicles with a strong emphasis in the professional drivers (taxis, couriers, lorries, business load delivery). As a specific contribution to the district intervention, biomass delivery will be performed with an electric vehicles fleet.

4.4.2 Tartu

Estonia has been the first country in the world to construct and extensive charging network for electric cars. There are 165 public fast chargers in the country, 11 of them are located in Tartu. There are 70 registered electric cars in Tartu (45 owned by public institutions and 25 in private use). There are also 22 electric vehicles which already offer taxi service in the city. There is a service offering electric car rental (2 rental points). There is no bike sharing system present in the city.

Thanks to SmartEnCity, Tartu aims to introduce 53 new electric vehicles in the city with 8 rental cars, 14 taxis, 15 private cars and 16 e-bicycles. The related charging infrastructure will consist of 10 new charging points (4 for rental cars and bicycles, 5 for public charging and 1 that uses old EV batteries for re-charging)

Current buses network accounts for 50 buses, being 5 of them CNG and the rest diesel fueled. SmartEnCity will allow the integration of 60 new biogas buses in the current fleet, as well as a bike sharing system of 450 bicycles.

Currently 12% of Tartu's CO2 is produced by transport fuels, whereas 95% of transport fuels are used by private cars. The transport plan of the City of Tartu foresees that the share of transport modes alternative to cars should be increased in a way that the share of cycling, pedestrian traffic and public transport would make up to 75% of all transport modes in the city by 2020.

The introduction of biogas for public buses is one of the objectives of Tartu City Transport Development Plan 2012-2020.

Biogas use for buses is still quite limited and there are some issues that need to be solved before biogas is accepted and used as a fuel in a larger scale.

- There's a need to increase capacity so that biogas can be produced in an efficient and secure way.
- Infrastructure for the distribution of biogas must be built or arranged. Infrastructure already built for natural gas can be used for biogas
- Depots, buses and other operational facilities must be adapted to biogas.

Project Baltic Biogas Bus (2.009-2.012) has helped Tartu to progress in the development and introduction of biogas for use in urban public transport.

4.4.3 Sonderborg

During the 1970s the first oil crisis led to the construction of a several dozen of biogas plants within a few years in the 1980s in Denmark. Though these initial plants were not very profitable, since 1.988 considerable efforts have been invested in developing biogas technology through successive biogas development programmes accomplished, financed and supported by the government. Then, in 2009 the Danish government decided to set as a goal that 50% of the manure produced in Denmark should be used to produce green energy by 2020. This is expected to be reached by implementing further biogas plants on Danish territory.

It was not until early 2012 that the first gas buses started to run in Denmark. Biogas came right afterwards, in cities like Fredericia, Holstebro, Copenhagen.24 Sonderborg and Skive municipalities follow suit.

Denmark accounted for 40 biogas buses in 2015. Now, thanks to SmartEnCity project, Sonderborg alone will introduce new 38 biogas buses.

As regards electro mobility, Sonderborg plans to introduce 18 new electric vehicles addressed to private individuals, companies and public partners. 30 intelligent “Evergreen” rechargers will be installed and will be operating on low cost wind electricity tariffs in night time, weekends, etc. Charging of EV will be carried out according to wind electricity production from the Lillegrunden offshore wind park. These charging stations will be a supplement to existing 4 non-intelligent public recharging stations.

The regulation of electric vehicles is currently under political debate, so it’s unsecure what will be the future framework conditions for electro mobility in Denmark. But with the official plans for 50% (now 40%) wind energy penetration in the electricity sector, it is necessary to create motivations among mobility users for electro mobility. Seen in such a context it is likely that many more electric vehicles will be operating in Sonderborg within the timeline of SmartEnCity project.

[24] http://www.folkecenter.net/gb/news/world/biogas-buses-in-denmark/

4.5 Standards of ICTs

There are multiple ICT standards that would suit for each of the Light House Cities as described in chapter 3.3.5. As Cities and their use cases are different, there also will be different standards in each of the cities. By technical means, all of the cities in SmartEnCity project and in any new developments could adapt to any of the Architectural Options described in chapter 3.3.5. While in greenfield developments decision which option to choose has less impact, then in retrofitting projects like SmartEnCity reusing existing technology investments is also important and therefore this decision should be considered carefully.

Choosing the right standards to be applied in each of the Light House Cities is a fourth step in the process, right after identifying the City's characteristics, needs and ICT requirements as described by ISO and IEC in their Smart Cities preliminary report[25] and will therefore be part of WP6 tasks T6.2 to T6.5.

4.5.1 Vitoria

Possibility of application of the standards to corresponding measures implemented in the project in Vitoria-Gasteiz will be treated in WP 6.

4.5.2 Tartu

Possibility of application of the standards to corresponding measures implemented in the project in Tartu will be treated in WP 6.

4.5.3 Sonderborg

Possibility of application of the standards to corresponding measures implemented in the project in Sonderborg will be treated in WP 6.

4.6 Standards of BIM management

In order to apply the standards in BIM Management, there would be a common level that covers the three lighthouse projects, where a combination between the ISO standards and the Directive 2014/24/UE within the European regulatory framework would be interesting. In addition, depending on the country where the lighthouse project is being implemented, **other standards and guidelines may be also taken into consideration**, whether if they are new developed standards or any other one already existing that may be of use during the project.

The main reason for this proposal is that all these standards are tested and successful tools to designing and constructing sustainable buildings, but at the moment there are not many examples of its use in Europe.

In the following table are displayed all the international and local standards that could be possibly implemented in this project:

CITY		STANDARDS REGULATORY FRAMEWORK
INTERNATIONAL ISO		▪ ISO 12911:2012 ▪ ISO 16757-1:2015 ▪ ISO 29481-1:2016 ▪ ISO 29481-2:2016 ▪ ISO 55000:2014
COMMON		▪ DIRECTIVE 2014/24/UE
SPECIFIC	VITORIA	▪ uBIM Guides
	TARTU	▪ Common BIM Requirements 2012 · Model Design for the Project Manager, Tallinn University guide
	SONDERBORG	▪ bips ▪ ICT Services specification

Table 10: General view of standards application in BIM Management

Regulatory framework

These would be the main aspects included in the International and European reference standards:

- **ISO 12911:2012**

Framework for providing specifications for the Commissioning of Building Information Modelling (BIM).

4.3 …guidance document that results from implementation of this Framework. The enterprise is supported when the objectives for using BIM (BIM guidance Framework section 1: Outcomes) is reviewed and approved at the principal level. Design management (BIM guidance Framework section 2: Controls) is supported by reviewing and implementing the management policies needed. Since these policies are keyed into the overall objectives, the dialogue between the design manager and the principals is supported. Design teams can review and implement the input requirements (BIM guidance Framework section 3: Controls) as this defines what they shall do. Again, since these requirements are keyed into the management policies, the dialogue between the design teams and design manager is supported.

- **ISO 29481-1:2016**

This part of ISO 29481 sets out a methodology for the provision of an integrated reference document that describes the processes and data required in the development or management of a constructed facility. It describes how to identify and describe the processes undertaken within that context, the information required for their execution and the results. It also describes in general terms how this information can be further detailed to support solutions provided by software developers, enabling its reuse, and configured to meet national, local and project needs.

ISO 29481-1:2016 is intended to facilitate interoperability between software applications used during all stages of the life cycle of construction works, including briefing, design, documentation, construction, operation and maintenance, and demolition. It promotes digital collaboration between actors in the construction process and provides a basis for accurate, reliable, repeatable and high-quality information exchange.

- **ISO 29481-2:2016**

This part of ISO 29481 sets out a methodology and format for describing coordination acts between actors in a construction project. It describes how to identify and define the coordination processes undertaken and the information required for their execution. The resulting interaction frameworks enable standardization of interaction in building processes on national, local, and project level. It also gives a format to support solutions provided by ICT-solution providers. Support of this part of ISO 29481 in different ICT-solutions means that this joins together different process management systems. In doing so, it provides a basis for reliable information exchange/sharing for users, so that they can be confident that the information they are sending or receiving is accurate and sufficient for the coordination activities they need to perform.

ISO 29481-2:2012 is intended to facilitate interoperability between software applications used in the construction process, to promote digital collaboration between actors in the building construction process, and to provide a basis for accurate, reliable, repeatable, and high-quality information exchange.

- **ISO 55000:2014**

Series of standards that comprises 3 separate documents:

1. ISO 55000, Asset Management – Overview, Principals and Terminology
2. ISO 55001, Asset Management – Management Systems – Requirements
3. ISO 55002, Asset Management – Management Systems – Guidelines for the application of ISO55001

<u>ISO 55001:</u>

The scope of the Asset Management System must be defined.

There are three main requirements:

- Leadership and commitment:
  - The Asset management policy, the Strategic Asset Management Plan and the objectives are established and compatible with organizational objectives,
  - The Asset management system requirements are integrated into the organization's business processes,
  - Communication of the importance of effective AM and of confirming to the Asset Management System requirements
  - Cross-functional collaboration,
  - Continual improvement,
  - That support and other management roles demonstrate leadership and

- That risk management is aligned with the organization's risk management approach.

An AM Policy must be established that is appropriate to the organization, provides a framework for seeing objectives and satisfying them, as well as continuous improvement. It must be consistent with the organization's plan and policies, be appropriate to the organization's assets and operations, be available, communicated and periodically reviewed, updated if needed.

Top management must also ensure that roles, responsibilities and authorities are assigned, communicated and effectively executed to:

- Establish and update the SAMP,
- Ensure the AM System delivers,
- Ensure it complies to the ISO itself,
- Ensure the AM System is suitable, adequate and effective,
- Establish and update AM plans (as needed) and
- Ensure reporting on performance of the AM System to top management.

ISO 55002:

Asset Management – Management Systems – Guidelines for the Application of ISO 55001

- **DIRECTIVE 2014/24/UE**

Article 22, Rules applicable to communication

4. For public works contracts and design contests, Member States may require the use of specific electronic tools, such as of building information electronic modelling tools or similar. In such cases the contracting authorities shall offer alternative means of access, as provided for in paragraph 5, until such time as those tools become generally available within the meaning of the second sentence of the first subparagraph of paragraph 1.

Article 90, Transposition and transitional provisions

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 18 April 2016. They shall forthwith communicate to the Commission the text of those measures.

2. Notwithstanding paragraph 1 of this Article, Member States may postpone the application of Article 22(1) until 18 October 2018, except where use of electronic means is mandatory pursuant to Articles 34, 35 or 36, Article 37(3), Article 51(2) or Article 53.

Notwithstanding paragraph 1 of this Article, Member States may postpone the application of Article 22(1) for central purchasing bodies until 18 April 2017.

4.6.1 Vitoria

All around the world, there are a variety of BIM standards, but in Spain, the use of this methodology is very recent and is still in a developing stage. In this matter, in 2015, the Ministry of Public Works announced in a congress in Madrid the creation of a public - private workgroup to work in the development of the measures of implementation of the BIM methodology in Spain following the European Directive 2014/24/UE.

Besides of not having an official regulatory framework, there are some pioneering experiences of BIM implementation on the part of institutions and public administrations. The Spanish chapter of the international association BuildingSmart who promotes the use of open BIM is formally constituted since November 2014 and has been a key actor to stimulate the use of the national BIM involving all the actors of the sector, public and private. They have also developed the only existing documents related to BIM implementation are the uBIM guides by adapting the Finnish COBIM to the Spanish AEC sector.

Also, the Spanish Association of Normalization and Certification (AENOR), that develops technical procedure and certifications, is an honor member of the Building Smart Spanish and constituted in 2012 the Committee of Normalization AEN/CTN 41/SC13 for the Organization of models of information relative to the building and civil works. This technical workgroup serves as the voice of Spain in the forums where the BIM processes are being harmonized, both in Europe (CEN/TC 442) and in the international area (ISO/TC 59/SC 13). The committee is also used as the platform in which to promote the networking between all the sectors of the national industry involved in the BIM process. One of its immediate objectives is the draft of a UNE Report on the state-of-art of BIM that may be used as guidance by the professionals of the AEC sector.

For the lighthouse project in Spain, the recommended standards or guidelines to use are: the uBIM guides of the Building Smart Spanish Chapter as they are based on the Finnish COBIM 2012 and the ISO directives as common framework for the three demos and based on the British standards. When the Spanish BIM commission delivers any document it will also be taken into consideration for the project.

- **uBIM GUIDES**

Document 9. Use of the models for Facilities Analysis

This document is focused in the analysis carried out by the facilities designer on the available BIM Models as a base. This analysis is centered in the building, the individual type, the spaces or the facilities systems.

Document 10. Energy analysis

This document defines the requirements to use the information models for the energy analysis during the design, construction and use phases.

Document 11. Management of a BIM Project

The purpose of this manual is to describe how the information modelling benefits the project management and how, as a design method, it has to be used from the perspective of the project manager and the BIM coordinator during all the building process in a project.

Document 12. BIM for maintenance and operations

This document introduces the BIM Management as a process that covers the whole lifecycle of a building. From the to the property, the management establishment of the objectives for the data management, to the design, construction and operation phases, the delivery of the as-built models and update of the model during the operation and management of the buildings.

4.6.2 Tartu

The Estonian design market is formed mostly by small and medium enterprises, most of them concentrated in a single design discipline. Several of them have been using BIM software for their own discipline for many years (architects, structural, HVAC) but still presenting .dwg format as a rule for design management. Some of the bigger companies are adopting and integrating BIM for all basic design disciplines. Quality between them varies, both their engineering and BIM capability quality.

- **COBIM MODEL FOR THE DESIGN OF GENERAL GUIDELINES: COBIM 2012**

The guide was published in Finland in 2012. The COBIM 2012 manual has been translated to Estonian and can therefore guide the facts and the principles inherent in the Finnish construction industry. Given the geographical proximity of Finland and Estonia and the similarity in the construction sector, the guide is heavily customizable taking into account the Estonian circumstances. This document is used as a starting point for the adoption of BIM technology in Estonia.

Series 1---9 are revised versions of Senate's present guidelines. Series 10---13 are completely new. Series 14 will be written later since it connected to upcoming regula4on. A preliminary version is likely to exist by June 2013.

Series 10, Energy Analysis:

- Series 10 describes tasks during design and construction that are essential from the viewpoint of **management** of energy efficiency and indoor climate, as well as commissioning and maintenance phases which are relevant from a result verification viewpoint.
- The utilisation of BIM enables a more systematic and transparent, and efficient, means to steer the energy impact of design that can be achieved by traditional methods. However the most important benefit is that it assures that the information used in the calculations is correct.
- The requirements support the implementation of the Finnish 7/2012 energy regulations. In addition to tasks related to the building permit, requirements are set for utilization of BIM in energy analysis all the way from the early project stages down to the building start-up.

Series 11, Management of a BIM project:

- Series 11 deals with
  - Project management and
  - Utilizing BIM from the client's point of view
- Information modelling tasks of project management are described as procedures as well as design, implementation and control measures.
- Information modelling tasks are divided into stages according to the General Project Management Task List.
- BIM deliverables and analysis that are used to support decision-making on a project-specific basis have been described at each stage of the project.

- **MODEL DESIGN OF THE PROJECT MANAGER, QUALITY HANDBOOK**

The Tallinn Technical University has carried out various national guidelines and instructions for a BIM implementation plan. The guidelines relate mainly to modelling inputs, outputs and techniques, but the process has so far focused on existing manuals.

4.6.3 Sonderborg

The Danish government launched a so-called competitiveness package in 2002, called "Will to grow". One of the objectives of this package was to increase productivity and competitiveness in the Danish construction industry by means of improved utilization of ICT (EBST, 2005, p. 3). The Digital Construction initiative is a part of this package, executed in cooperation with public clients, the Bips organization and a number of consortiums.

Digital Construction is a governmental initiative which involves that from the 1st of January 2007, state clients are required to make a number of demands related to ICT. These demands are supposed to ensure increased productivity by means of improved knowledge-

sharing between different actors in the construction industry. ICT tools should support a smooth process without breaks and loss of information through the whole lifetime of the construction project – from the initial design phase to the operation and maintenance phase of a building.

The government's ICT demands are:

1. Use of classification
2. Use of project web
3. Use of 3D Building Information Models
4. Electronic tendering
5. Delivery of digital as-built and FM-data

This Government demands of the use of information and communication technology (ICT) in public building projects are applicable for:

- GOV and local GOV projects over 700.000 EUR
- Projects over 2,7 mill EUR, with loans or grants from GOV authorities

Since April 2013 open BIM has been mandatory in state, regional, municipality, and social housing projects.

Call for tender and bid

- Tender documents should be available electronically and contain a specified bill of quantities, where the consultant has specified the quantities that contractors should base their bid on. The specified bill of quantities becomes mandatory from 2009.
- The specified bill of quantities should be based on the new Danish construction classification system, DBK. Works and project specifications should be based on the Bips B 100 standard.
- At the actual bid, the bidding contractors upload their bid via a portal on the Internet. The tender takes via this portal as the client makes the submitted bids public simultaneously.

Project web

- Parties participating in a public construction project should share project data and exchange documents, drawings and specifications via a project web on the Internet.
- All the construction project's most important actors should have access to the project web – and they should act in conformity with a common code of conduct concerning data discipline and cooperation.
- Contractors and workmen should have access to the project web on site via a 'digital on-site hut' and should be able to print drawings in A3 format. Designers should adapt their drawing formats accordingly.

3D models

- Architects and consulting engineers should make 3D visualizations and simulations for idea and project competitions when it is considered that this will contribute significantly to a demonstration of the architectural and technical qualities of the proposals. This is a mandatory requirement for construction projects exceeding DKK 20 million.
- Architects and consulting engineers should use 3D models for design when an overall assessment of economy and utility value calls for it. This is a mandatory requirement for construction projects exceeding DKK 20 million.
- 3D models used in design should comply with a number of requirements to content, levels of information etc. in the different phases, which the client should specify for each individual project. The models should be interchangeable in IFC format, unless otherwise agreed.
- 3D models facilitate the re-use of geometrical data and data on properties in subsequent phases. Models and CAD files should be made available for the contractor.

Electronic hand-over

- Participants in construction projects totaling DKK 15 million or more should electronically hand over the data relevant for operation as demanded by the client.
- The client determines which of the project participants should be included in the electronic hand-over and appoints the Party responsible for the transfer in connection with the hand-over.
- The client chooses whether electronic hand-over should take place in the form of XML files and their matching documents, as a 3D model or by entering the data directly in the property manager's FM and operational systems.

- **THE BIPS ICT SPECIFICATIONS**

It consists of 6 parts: ICT Specifications for Construction (The clients Basic specifications and Project specific paradigm) + ICT Technical Specifications: (for the involved parties to agree upon)

- ICT Technical Communications Specification

  Party responsible, Data structure, Document Management, Metadata, Classification, Project web, E-mail, Data format

- ICT Technical CAD Specification

  Model coordinator, Model production, Model use, Drawing production, Simulations, Consistency control, Visualization, Data extract, Common and Skill model, Model coordination and exchange, IFC-model, Data format

- ICT Technical Tendering Specification

  Tending platform, Electronic tendering manager, Structure of the tender documents and Specifications, Bills of quantities

- ICT Technical Handover Specification

  Scope of digital O&M documentation, Digital handover manager, purpose, format, method and time of digital handover, Data structure, O&M documentation, Data model, Digital snagging lists, IFC-model

- ICT Technical Project Organization

  Project ICT parties, roles and IT systems

Also, for the past 25 years, the bips CAD manuals have supported companies and users in the construction industry in their efforts to cooperate in a standardized way and efficiently – from 2D practice, Layer structure, Drawing standards and CAD-data exchange – to 3D building models and object oriented use, collaboration with and exchange of models, data extract a.s.o.

- **ICT SERVICES SPECIFICATION, Bygningsstyrelsen**

YB 2012, clause 2.2: ICT Management

The ICT manager must ensure the following:

- That the ICT-technical specifications, Appendix 1 -5 are completed and revised, including obtaining clients approval;
- That the ICT-technical specifications are available on the project web, and made applicable to the parties working with CAD and building models;
- That startup meetings are held, in which the parties review the ICT technical specifications;
- That the requirements of the ICT technical specifications are met, including for quality assurance;
- That guidelines for classification are prepared;
- That Discipline models are compiled into a confederate model during each phase; and,
- Those relevant requirements for suppliers' and contractors' design are included in the call for tenders.

YB 2012. clause 3.3.2 and 8.4:

- Project documentation, drawings and reports according to YB 2012, clause 3.3.2, Engineer, Plumbing HVAC and electrical:

- Documentation for the project´s energy consumptions, to meet the energy requirements of Danish building regulations.
- Statutory Danish energy calculation must be generated on the basis of the confederate model.
- Drawings must be generated from the discipline model.
- File formats: PDF, may be supplemented with med 2D DWF

5 Existing gaps and possible improvements

5.1 Social engagement

Vitoria has not defined overall practices and methods for social engagement on a city level, neither has Tartu. Sonderborg, on the other hand, has defined and implemented the ZERO-platform according to what citizen engagement has been conducted and is going to be implemented. Below are described the generic standards' focuses, gaps and possible improvements in the context of social engagement in order to unify the overall framework. Standards brought here are relevant in all steps in a sense all the activities from planning the social engagement activities to execution, but as well as control should take into account these principles in defining the best framework and achieving the results.

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
Aarhus Convention	- Access to environmental information, - Public participation in decision-making, - Access to justice	- Focus on environmental issues, not too many planning tools. - Methods, terminology and thinking are a bit "old fashioned". - Participation and engagement tools are old fashioned. - Many problems with urban applicability – culture, society, etc. - No technological systems and ICT related thinking or chapter.	Planning, execution	Adopting the principles of Aarhus Convention in developing and implementing social engagement strategies, but adding more focus to the social component, adding more contemporary participation and engagement tools. Homogenizing principles and definitions.
Torremolinos Charter	- Socio-economic development - Improvement of the quality of life - Responsible management of resources - Rational land use - Co-ordinating between the various sectors - Co-ordinating and co-operating between the various levels of decision-making - Active public participation	- Too much oriented on built environment & architecture. - Low social component - No participatory methods and tools. - No technical & ICT components of development.	Planning, execution	Adopting the principles of Torremolinos Charter in developing and implementing engagement strategies, but adding more focus to the social component and developing participatory methods and tools. Homogenizing principles and definitions.

UN REDD+ Social & Environmental Standards	Principles focused on social issues, social and environmental policy coherence and environmental issues	- Forestry and primary production oriented. - Developing country oriented.	Planning, execution, control	Adopting universal principles in social engagement strategies focusing on social issues and social and environmental policy coherence that are relevant also in developed countries. Homogenizing principles and definitions.
ISEAL Alliance Standards	Codes of Good Practice, Standard-setting Code, Impacts Code, Assurance Code, Credibility Principles	- Standard for standards. - Not much technological and complex systems approaches.	Planning, execution, control	Applying the ISEAL's Codes of Good Practice, codes and Credibility Principles in defining social engagement strategies and assessing the impacts. Homogenizing principles and definitions.

5.2 Building retrofitting

Once identified the most appropriate standards for implementation in the project, there are some aspects that could difficult the deployment and others that could be subject to improvement.

At global level, the main difficulty would be the adaptation of the standard BREEAM Refurbishment Domestic Buildings in those places, outside the UK, where there is no National Scheme Operator. This is the case of Estonia, where it could be studied the implementation through the standard BREEAM International Refurbishment and Fit-Out.

Below are detailed the existing gaps and possible improvements concerning the proposed standards with possibility of simultaneous application in all lighthouse projects.

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
BREEAM® **Refurbishment Domestic Buildings**	**Management**	Home User Guide's scope	Control	Include a monitoring plan in order to know the real performance of the refurbished building
	Health & Well-being	Inclusive Design. Accessibility requirements	Planning	Adaptation to local accessibility regulations
	Energy	Energy efficiency requirements	Planning	Adaptation to Passive House requirements

	Water	Design of water recycling system	Planning	Combine the collection and re-use of grey water and rainwater with local hygienic and sanitary regulations
	Materials	Choice of materials with a low environmental impact	Planning	Use of Passive House Component Database: http://database.passivehouse.com/en/components/
	Waste	Storage inside the building of non-recyclable and recyclable household waste	Planning	Explore other options such as pneumatic waste collection
Certified retrofits with Passive House components	**Certification criteria:** ▪ Specific Heat Demand ≤ 25 kWh/m².yr ▪ Primary Energy Demand ≤ 120 kWh/m².yr ▪ Airtightness n50 ≤ 1,0^{-1}	Ambitious goals and possible conflict with the profitability of the energy system.	Planning	Setting up a working group with all stakeholders in order to reach a consensual solution.

5.3 Energy supply and consumption

From analysis of standards and regulations from sections 3.3.3. and 4.3.3 will follow some gaps and possible improvements of existing regulations for better and efficient use of energy as one precondition for living heathy and wealthy.

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
Renewable Energy Directive 2009/28/EC	Three lighthouse cities	National targets not yet achieved	planning/execution	Better motivation for municipalities and regions, More support measures/awareness
EED (2012/27/EC	All lighthouse cities	Individual metering of electricity and heat	planning	Awareness raising, communication and engagement
Directives	All lighthouse	Small number	planning	More motivational

for common rules for internal market of electricity (2009/72/EC and gas (2009/73/EC	cities	of installed Smart meters		measures, rising of awareness
same	All lighthouse cities	Data accessibility from operators	planning	Better rules and obligation for sharing data
General, EED (2012/27/EC)	All lighthouse cities	Awareness and knowledge of consumers on EE	Planning, execution	Communication tools and engagement

5.4 Mobility

After having performed an analysis of all electro mobility related standards, together with a view on the specific application for each city, a number of gaps/needs have been identified and are listed below. They have been classified in several categories:

- Electric vehicle
- Charging infrastructure
- Connection to grid
- Communication

Identified gaps mainly related to “electric vehicle”

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
ISO 12405-3. Safety performance requirements. **Related to electric car batteries** **Other similar related standards are:** **ISO 11428**	Three LH cities	Missing a common label to guide operators during maintenance and emergency situations, in order to guarantee their safety	Planning	Need to agree on a commonly adopted standard, at least at local level.

IEC 60784 **IEC 60073** **SAE J2936**				
ISO 8714 Energy consumption and range. Test procedures **ISO 8715 Road operating characteristics** **Related standard: SAE J1711 Measuring the Fuel Economy**	The three LH cities	Missing a precise calculation method for the car range	Control	Define a new and effective standardized Driving Cycle
SAE J1711 **SAE J1634** **SAE J2991 (under development)** **Related to range prediction and state of charge**	Three LH cities	Lacking a good precision in range prediction	Control	Definition of a unique methodology to predict driving range
IEC 61851-1, -21, -22 **Charging modes**	Three LH cities	Need to guarantee a safe and reliable charging at home. Missing safety restriction for Mode 1 charging (overheating risks when charging cars)	Planning, Execution	Mode 1 can be ok for motorcycles, but there should be a way to ensure safe charging for electric cars (new standard or review of current one)
IEC 62196-2 **Connectors**	Three LH cities	Need to guarantee the connection of the vehicle to all AC charging stations	Planning	Select a common choice. EU proposal 2013/0012: Type 2 for cars, type 3a for scooter and LEVs

IEC 62196-3 **Connectors**	Three LH cities	Need to guarantee the connection of the vehicle to all the DC charging stations	Planning	Two solutions coexisting: Combo 2, CHAdeMO. Choose one, at least at local level.
IEC 61851-1 **ISO/IEC 15118** **Communication**	Three LH cities	Need to guarantee a sufficient and secure communication between the EV and the EVSE (EV Supply Equipment)	Planning, Execution	Choose a unique solution (too many still present)

Identified gaps mainly related to “charging infrastructure”

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
IEC 14443 **Identification**	Three LH cities	Need to identify users in a simple and universal way	Execution	Definition of a common standard that simplifies identification.
IEC 61850 **Communication** **Other related standards: GSM, UMTS, GPRS, OCPP**	Three LH cities	Need to guarantee a sufficient and secure communication between the EVSE and the EVSE backend	Execution	Current existing standards are insufficient. Define a new one that covers the gap
IEC 60364-7-722 **Safety** **Other related standards:** **EN 60079-10** **EN 50014** **EN 50018**	Three LH cities	Need to guarantee a safe installation and use of Fast Charging Points in petrol stations	Planning, Execution	Define a specific regulation

Identified gaps mainly related to “connection to grid”

Generic Standard	Demo focused	GAP	Phase where is relevant (Planning/Execution/Control)	Propose of improvement
NA (Metering)	Three LH cities	Need to obtain reliable measures from	Execution	Definition of a related standard

		DC metering		
IEC 61850 **Smart Charging and Load Management** **Other related standards:** **ISO 9506** **SAE J2836**	Three LH cities	Need to guarantee the exchange of information between the EVSE Backend and DSO	Execution	Need to define an effective and common standard
IEC 61851	Three LH cities	Need to ensure a "grid-safe" but sufficiently fast charging procedure	Planning	Define such procedure establishing maximum power limits

Identified gaps mainly related to "communication"

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
NA	Three LH cities	Guarantee the possibility to pay for charging in all public charging stations	Planning, Execution	Create a standard to cover the gap
NA	Three LH cities	Guarantee users privacy	Planning, Execution	Create standard/define procedure

5.5 ICTs

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
	EU	Visible Roadmap of technology development for EU	Planning / Execution / Control	Independent and open Think-Tank where technology mergers and new standardization needs are discussed together with practical knowledge sharing.
	EU	Identity management	Planning / Execution / Control	Besides Facebook and Google identification services, one "official" pan-European Identity would increase the trust for digital

				services.
	EU	Privacy level definitions	Planning / Execution / Control	As privacy is one of the most important bases for ICT service development, it is challenging to define pan-European technical solution with many privacy policies in mind for EU. With leveled privacy approach, some countries/companies can be more innovative and others protect more of your privacy.
	EU	Interoperability framework	Planning / Execution / Control	To avoid over-regulations on standards, general interoperability rules could be defined, leaving still room for different technical standards to be used for solving concrete use-case's.
	EU	Wider cooperation between EU Rolling Plan for ICT Standards and Industry Groups (TM Forum, etc)	Planning / Execution / Control	Practical value of each paper is the key for a paper to be widely used in the future.

5.6 BIM Management

Generic Standard	Demo focused	GAP	Phase where is relevant	Propose of improvement
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE** ▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016** ▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**	▪ uBIM Guides ▪ Model Design for the Project Manager, Tallinn University guide	*Lack of official standards in the countries*	Planning and Execution	Use of the existent guidelines in the countries and use the generic standards as reference.
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE** ▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016**	▪ uBIM Guides ▪ Model Design for the Project Manager, Tallinn University guide	*Legal issues*	Control	As at the moment there is no legislation regarding BIM in the both countries, and ISO standards are applicable in any country, they will be used as reference in legal matters.

▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**				
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE** ▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016** ▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**	▪ uBIM Guides ▪ bips documents ▪ ICT Services specification ▪ Common BIM Requirements 2012	*Business related aspects*	Planning and execution	As at the moment there is no legislation regarding BIM, and ISO standards are applicable in any country, they will be used as reference in legal matters.
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE** ▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016** ▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**	▪ uBIM Guides ▪ bips documents ▪ ICT Services specification ▪ Common BIM Requirements 2012	*Knowledge issues: formation of teams*	Execution	As at the moment there is no legislation regarding BIM, and ISO standards are applicable in any country, they will be used as reference in legal matters.
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE** ▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016** ▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**	▪ uBIM Guides ▪ bips documents ▪ ICT Services specification ▪ Common BIM Requirements 2012	*Use of different modelling tools*	Planning and Execution	As at the moment there is no legislation regarding BIM, and ISO standards are applicable in any country, they will be used as reference in legal matters.
▪ **Common BIM Requirements 2012** ▪ **DIRECTIVE 2014/24/UE**	▪ uBIM Guides ▪ bips documents ▪ ICT Services specification	*Technical barriers*	Planning, Execution and Control	As at the moment there is no legislation regarding BIM, and ISO standards are applicable in any country, they

▪ **ISO 12911:2012** ▪ **ISO 29481-1:2016** ▪ **ISO 29481-2:2016** ▪ **ISO 55000:2014**	▪ Common BIM Requirements 2012			will be used as reference in legal matters.

6 Deviations to the plan

According to several comments done by contributors, it shall be said that in the present document has not been possible to particularize as much as contributors would have liked in LH projects.

The idea of the structuration of the document would have been to make a general state of art of standards and then make a selection of the most suitable ones for each of the LH projects according to the implementation activities developed.

As far as the submission date of this Deliverable, LH projects have not enough been defined or specified as we are on the first steps of the project so it was quiet difficult to make a selection of standards suitable for something that is not already enough defined.

Maybe further on in the project this work will be useful and maybe it might be slightly re-done by further Deliverables related to each of the three LH projects. This would facilitate the realization of this task due to the further knowledge of specification that people implied in implementation of the activities in each of the cities will have.

This appreciation is not only valid for LH WP but also valid for other WP like CIOP case, for example, where the lack of definition of itself on the current moment has hampered the work on Standard on that topic.

7 Conclusions and outputs for other WPs

7.1 Social engagement

Social engagement centers on how to empower citizens in the decision making, actively including stakeholders and different interest groups into the process of decision making. This needs systematic and coordinated activities. Social engagement is a continuous and time-consuming process. In different countries and cities, the traditions, values, expertise and experiences may vary. Although these are important to take into account, for replicating the results, the process of social engagement should have a framework that includes some basic values and common understanding. Internationally acknowledged standards provided here can be used to provide the necessary context for developing a uniform practice.

- Aarhus Convention – aims at contributing to the right of every person to live in an environment that is adequate to the person's health and well-being and guaranteeing the rights of access to information, public participation in decision-making, and access to justice in environmental matters.
- Torremolinos Charter – aims at balanced socio-economic development of regions and improvement of the quality of life. During this its emphasis is on coordination and cooperation on multiple levels, including active public participation of citizens.
- UN REDD+ Social and Environmental Standards – provide principles focused on social issues, social and environmental policy coherence and environmental issues that can be used in developing the framework for social engagement.
- ISEAL Alliance standards – ISEAL provides instructions how to set up standards themselves and also assessing the impacts of social and environmental standards systems. ISEAL's Credibility principles underpin effective practices for sustainability standards systems, supporting those systems to achieve more positive social, environmental and economic impacts, while decreasing negative impacts. Thus these principles can be adapted to the social engagement framework.

The application of proposed standards in LH cities is universal, though the level of citizen engagement in the three LH cities varies. This needs homogenizing definitions and principles under which social engagement is put into practice. Under WP2 is developed a framework of citizen engagement strategies (D2.6) that could encompass this bottleneck, by integrating the principles of state of art standards and the local context and practices (including the activities defined in the DOW for every city).

Results provided here are relevant in providing the description of generic city in the field of social engagement (D2.4). Also providing connections between many other WP2 tasks and results under which citizen engagement strategies and deployment plans (D2.6) are being developed in parallel to the citizen engagement activities defined and developed in WP3, WP4 and WP5.

7.2 Building retrofitting

Nowadays there are many standards that allow rigorously assess building retrofitting. Main differences between them lie in their area of application, local or global, and the scope of its analysis.

Focusing on voluntary certification tools, in a common level that covers all lighthouse projects, a combination between BREEAM Refurbishment Domestic Buildings and EnerPHit certified retrofits with Passive House components would be a suitable choice in order to carry out a common strategy for all lighthouse projects, within the European regulatory framework.

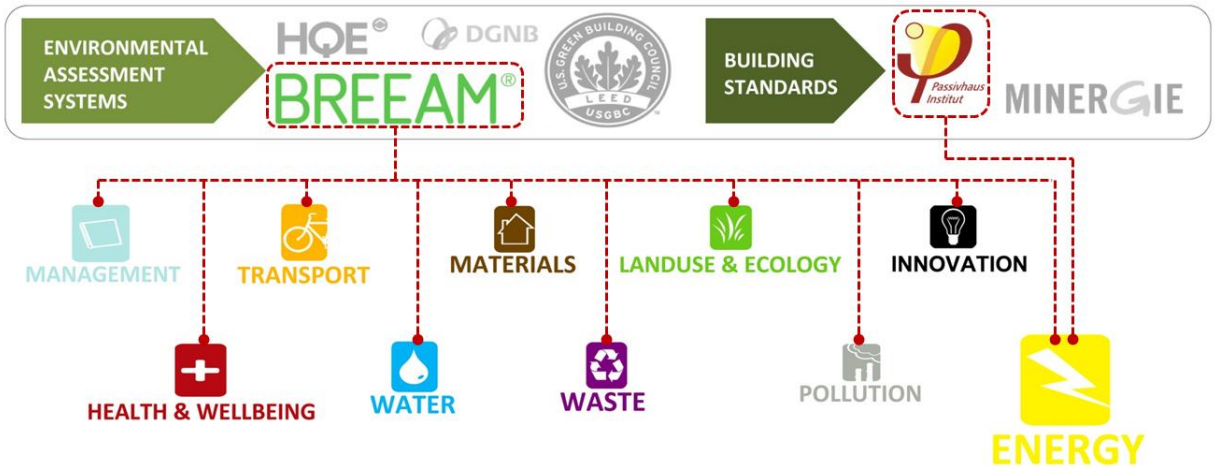


Figure 11: Proposed voluntary certification tools

The main reason for this proposal is that both are tested and successful tools to design and construct sustainable buildings, with thousands of examples built all over Europe. Besides that, both are entirely complementary.

BREEAM Refurbishment scheme is designed to reduce the environmental impacts of refurbishments and to increase the sustainability of existing building stock. It has been initially designed for the United Kingdom market, taking account of UK climate market regulations, policy and existing and potential finance schemes. But now it can be adapted internationally for use by National Scheme Operators.

Its main principles are:

- Promote low cost and sustainable refurbishment.
- Recognize the limitations of existing buildings.
- Drive market transformation by promoting best practice and innovation in the refurbishment of existing buildings.
- Provide a holistic environmental assessment that works effectively across different building and project types, and
- Recognize the different starting points of existing building stock.

Regarding the Passivhaus certification criteria for refurbished buildings, called **Enerphit**, it is concerned with energy efficiency. This standard requires that the building fulfills a set of requirements, such as:

- The building must be designed to have an annual heating and cooling demand with no more than 15 kilowatts per square meter per year in case of new construction, and 25 kilowatts per square meter per year in case of building retrofitting.
- Also the total primary energy consumption must not be more than 120 kilowatts per square meter per year, and finally
- The building must not leak more air than 0.6 times the house volume per hour.

On the other side, it has been identified a set of key aspects in the implementation of the proposed standards:

- **It is crucial the involvement of local stakeholders** in order to fit the standards to the specific features of each project.
- The scope of the assessment must be holistic, including all the elements involved in building retrofitting process, taking into account the accessibility, comfort, environmental impact, economic profitability, etc.
- It is also important to point out that the **regulation at local level can make necessary adjustments** in the implementation of the standards.
- Finally, the **connection and feedback between all lighthouse projects** can contribute to improve the proposed standards and make progress in the consolidation of a global tool at European level.

7.3 Energy supply and consumption

This section will summarize patterns and development directions on energy supply in the three lighthouse cities in relation with standards and regulation.

The **European Union's energy policies** are driven by three main objectives:

- We want secure energy supplies to ensure the reliable provision of energy whenever and wherever needed
- We want to ensure that energy providers operate in a competitive environment that ensures affordable prices for homes, businesses, and industries
- We want our energy consumption to be sustainable, through the lowering of greenhouse gas emissions, pollution, and fossil fuel dependence

The concentration of end users in urban areas has supported the constant increase of energy consumption. It has supported the innovation and development of energy technologies like natural gas networks, cogeneration, lighting bulb, district heating, combustion engine etc. Cities have been the promoters of electricity as a clean source of energy and have optimized most of their services to be based on that.

Standards and regulations described in 3.3.3 will support and are the framework for achieving the objectives of energy policy and will lead more sustainable energy supply in

communities including lighthouse cities. In SmartEnCity three lighthouse cities will implement several actions in WP3, WP4, WP5 for increasing the sustainability of energy supply.

The directions on development on energy supply in cities are:

Firstly, development of district heating (DH). These directions include establishing DH networks in new countries and cities, develop DH networks more wider area. Is include also integrated energy sources as input for heating networks like, rest heat from industry and from cooling networks, biomass, using heat pumps as efficient way of energy conversation. Also developing low energy DH idea.

Secondly, local energy generation, mostly with using of solar energy in buildings. Movement to nearly- zero energy buildings and in general energy retrofitting of buildings will lead wider using of on-site energy production (by PV panels, solar thermal systems, wind energy using and using of heat-pumps).

Smart metering will help to reduce energy consumption for household and therefore meet the target to keep energy consumption as much as possible low and lead to demand based consumption.

Lighthouse cities have different base and their own local (heating energy) energy markets therefore the steps for achieving goals for sustainability on energy supply are different.

7.4 Mobility

In order to summarize all the previous research done on mobility side, in the following text some conclusions are going to be presented.

Mobility standard cover several disciplines related to it. On this research focus has been done to mobility types that will be employed in SmartEnCity project. This is why the treated topics are the following: electric vehicle (charging infrastructure, connection grid, communication) and biogas.

Several relevant standards have been identified in those topics. Most of them might be directly applicable in electric mobility for LH cities but it will be not as easy in case of biogas. Vitoria will not be implementing this technology but Sonderborg and Tartu will.

As general conclusions, electricity and biogas are relatively new forms of mobility and standardization on their side is still under development. Especially in the case of biogas. Standardization requests and mandates have been done by EC but meanwhile several countries such as France, Germany, Sweden, Switzerland, Austria or The Netherlands have developed their standards for grid injection of upgraded biogas or for utilization as vehicle fuel.

For electric vehicles, safety aspects will be the most relevant ones in relevant standardization. After the implementation phase, EV performance, exhaust emissions and fuel consumption related standards will be taken into account.

Due to the variety of vehicles to be deployed, all charging modes will be of application and standards related to charging infrastructure including electromagnetic compatibility and safety issues will be the ones to consider. Communication and connection protocols will have special relevance.

For the demos, Vitoria-Gasteiz's case is clearly focused in electro mobility, Tartu has already quite implemented electro mobility but there are some issues that need to be solved before reaching biogas implementation and finally in Sonderborg case, biogas has quite been implemented but there is an uncertainty of electric mobility future in Denmark.

Finally, according to the different disciplines of standardization identified on this topic it should be said that:

- Regarding **electric vehicles**, there are several deficiencies that should try to be solved: need of definition of a common standard to guide operators during maintenance and emergency situations, need of definition of an effective standardized driving cycle, need of definition of a unique methodology to predict driving range, need of definition of a way to ensure safe charging for electric cars (without overheating risks), need to guarantee the connection of the different types of electric vehicles to the AC (Alternating current) and DC (Direct current) charging stations and need of guaranty of sufficient and secure communication between the EV and EV supply equipment.
- Regarding **charging infrastructure**, the deficiencies that should be solved are: need of definition of definition of an universal way to identify users, need to define new standards which covers the insufficiency of existing one about secure communication between EVSE (Electric Vehicle Supply Equipment) and EVSE backend and need of a specific regulation for safe installation and use of fast charging points.
- Regarding **connection to grid**, there are several deficiencies like lack of standard to obtain reliable measures from DC metering, the lack of standards to guarantee the exchange of information between EVSE backend and DSO (Distribution System Operator) and the lack of procedure to establish the maximum power limits to ensure "grid-safe" but sufficient fast charging procedure.
- Regarding **communication**, the needs that need to be filled are the lack of standards covering the guaranty of possibility to par for charging in all public charging stations and the lack of standards covering the guaranty of privacy of users.

7.5 ICTs

ICT contributions do not fit the focus on WP2, are more focused on WP6. Telia's opinion as ICT expert was to focus those sections of this manner because of the lack of definition of ICT solutions on WP6 at this time of the project.

Those issues will be further treated in WP 6 as already said in this document said in the document.

7.6 BIM Management

According to the previous research driven regarding BIM management what must be said is that in Denmark there are existing standards which might be used in Sonderborg demonstrator while in the case of Spain and Estonia (Vitoria-Gasteiz and Tartu) there are no existing country standards that might be applied in those demos.

Obviously international framework can be applied in all the demos but several alternatives have been proposed also for the cases where there are no national standards. Such as using as model or reference standards from other countries that are internationally recognized as suitable (this is the case of British ones or Nordic ones, depending on the geographical and regulatory conditions of the demo and which ones may be more suitable).

Guidelines are also available in several cases. They are not standards as we understand but may give some indications of how to proceed when implementing BIM management system.

Anyway BIM is a current trend in architectural and urban projects so there are high probabilities that during the project new standards on this sense are developed in all levels (national, European and international) so this must be taken in consideration to use them in further SmartEnCity phases.

The main problem of BIM implementation is its novelty. There is a general lack of regulatory framework and of knowledge by people implied in the process. These are two issues that, as said seem that might be solved during the following years but that their resolution is still in progress. Current tendency is to favor BIM implementation and further on it will probably become of mandatory use at least for public projects and in a more future time probably for private projects also.

Project progress might be aware of these probable changes in order to update the application of this discipline to the different demos of SmartEnCity.

7.7 Future standards and the national energy systems

7.7.1 Purpose of this section

The purpose of this section is to introduce some of the key elements of the future energy system (in 2050) of each of the three countries (Spain, Estonia, Denmark) and to make some general connections between the selected standards in this report, presented above, with the different elements. The elements include for example energy efficiency, renewable energy adoption and so on. The section does not qualify how closely the standards would deliver the different energy system outcomes and does not suggest other standards that could address the different elements. It is simply to clarify how the selected standards and their purpose are consistent with the key energy system changes that need to occur to achieve the future energy system.

Firstly, this section describes the likely changes that will occur from today's energy system to the future energy system. The description provides some general main conclusions about the most likely changes to the national energy system in a general level – which can be applied to Denmark, Spain and Estonia. The changes that are described are based on previous research that the AAU Energy Planning research team, and other researchers, have done on highly renewable energy systems over the previous 20 years for numerous countries in Europe including Denmark.

Secondly, based on the likely changes that will occur in each country in the energy system, described in part one, the standards, as described above in this report, are linked and grouped in a generic fashion with the particular energy system changes in which they are relevant. It should be understood that these linkages are based on a high level review of the standards and the specific details within the linkages have not been described in detail. It should also be noted that the linkages do not signify that the standards are actually addressing wholly the aspect they are linked with.

7.7.2 Cities within the wider energy system

The standards that have been described for the topics above (social engagement, building retrofitting, energy supply, mobility, ICTs, BIM management) will be utilized to deliver particular changes at the city level, for example the "BREEAM standard" will deliver energy renovations in buildings that lead to improved energy efficiency. These standards have been selected since they will best deliver the goals of SmartEnCity in the certain focus areas e.g. low energy districts, sustainable mobility, information and communication technologies. All these focus areas aim to upgrade the energy system to a renewable energy system.

Cities do not exist in isolation but are connected with a wider national energy system; therefore the initiatives guided by the standards will have an impact on the wider energy system. For example, through implementing energy retrofitting of buildings this impacts the

energy demand in the system which affects the energy supply and so on. Currently, the energy system is changing as a whole, partly through city level initiatives, and also in the wider system. Therefore, standards should also change over time to keep up with these energy system changes, and should be focused and designed according to the changing energy system to ensure that the energy system is designed and operated appropriately. This section provides an initial attempt to illustrate how the standards are in line with the needs of the future energy system.

7.7.3 Specific energy system changes

In Figure 12 below the traditional energy system dominated by fossil-fuels is shown in 1). The Figure shows the linkages between the energy sectors and it shows that the sectors are mostly separate independent energy sectors. The Figure also shows the future energy system 2) based on high penetration of renewable energy. This system diagram shows that the system will require a highly interconnected system with numerous interactions between the sectors which is largely due to the fluctuating nature of renewable energy. All of the main changes in the future energy system are labelled from A to J and are described further in the text below. The extent in which each of the countries has achieved the system change is also presented below.

The likely changes described below should be seen as the recommended and most beneficial changes in the energy system which help to achieve a highly renewable and low resource demanding, low-carbon, and cost-effective energy system in the future. The changes are recommended based on their socio-economic cost in the entire energy system. The changes are not based on business economic analysis for specific energy sectors, technologies or business initiatives. The section also describes some aspects about the future energy system where the importance of the change is less certain. I.e. It is not understood whether the change will lead to significant benefits.

1) Traditional fossil-based energy system **2) Renewable energy system**

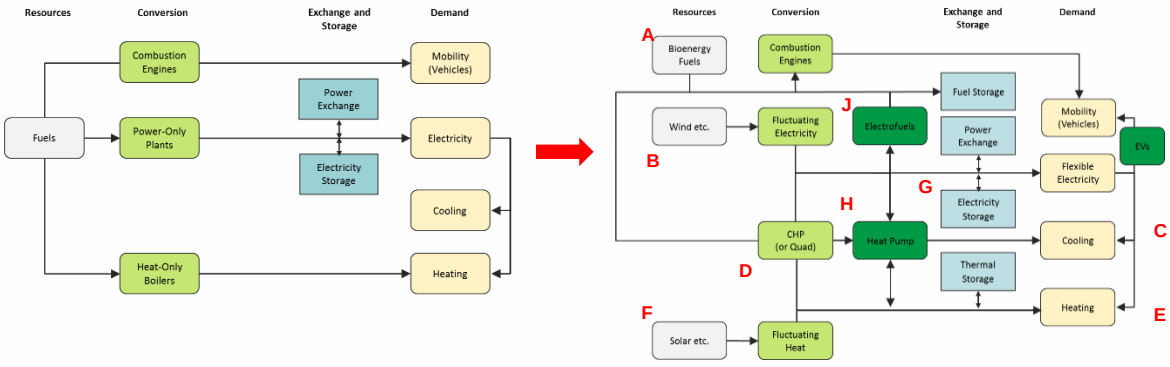


Figure 12: Energy system flow diagram for the traditional energy and the future energy system in 2050 [1,2]

Description of most likely changes in the future energy system

The changes in the energy system that are viewed as necessary for a successful transition to a highly renewable system are presented in Table 6 below.

Table 6: General energy system changes that will be required in the future renewable energy systems in each country. And an indication of the extent to which each country has progressed towards each element.

	System change	Description of system change	Progress of each country
A	**Greater interconnection between energy sectors [1–6]**	Today's energy system is mostly based on individual and independent energy sectors that operate separate from the other energy sectors. For example, the transport sector operates separately from the electricity sector. The future energy system will need to become **more integrated**, for a variety of reasons but an important one is that fluctuating renewable electricity will be variable and to increase its uptake the electricity will need to be utilised not only in the electricity sector but integration must occur between electricity, heating, transport and gas which will lead to lower socio-economic costs, CO2 emissions and a faster transition. Biomass will become an important resource in the future but it is a limited resource globally, and it plays a vital role in sequestering carbon when growing. Therefore, the energy system must be integrated in order to reduce primary energy demand thus lowering lower biomass demand.	Estonia: minimal Spain: minimal Denmark: medium
B	**High penetration of renewable electricity [7,8]**	As the prices for fossil fuels increase and CO_2 emissions rise it is important that **renewable electricity will be increased** to become the dominant form of electricity in all of the countries, especially offshore wind and solar PV. These technologies provide many benefits to the system and are becoming more mature and cost-effective over time.	Estonia: minimal Spain: medium Denmark: medium

	System change	Description of system change	Progress of each country
C	**Energy conservation [9–12]**	A very important element to help switch to a renewable energy system is to **conserve energy in the form of thermal and electric energy**. A large proportion of energy consumed in each of the countries is in residential and non-residential buildings therefore buildings have a large potential for helping the energy system. This reduces biomass demand, lowers system costs, and delivers other benefits. Thermal energy can be conserved by renovating old buildings which saves energy but also enables lower temperature heating to be supplied as well. It is unlikely that new buildings will be built fast enough to replace old buildings in the renewable energy transition thus focus should remain on old buildings. By conserving energy in the buildings this leads to lowering the total energy needed, lowering the peak energy needed, and in the case of thermal energy by lowering the temperature at which heat is required through more efficient buildings, and increasing the retention of heat in the building envelope. Total thermal energy should be reduced to the point where the cost of supplying heat to the buildings is cheaper than doing more renovations. Electrical energy is conserved via behavioural change and new more efficient and smart technologies. Energy should also be conserved in industry and transport. Transport energy can be saved via improved urban planning, mobility planning and modal shift to public transport and bike infrastructure	Estonia: minimal Spain: medium Denmark: medium
D	**Increased district heating and cooling** [13–17]	District heating provides many benefits to the energy system and it is likely that **district heating will expand in all the countries**. District heating helps to interconnect the energy sectors and it will save energy for power plants and industry since it can utilise excess heat in these sectors and it will save energy consumed in individual boilers since these will no longer be needed. District cooling will also play a more substantial role due to its energy efficiency improvements. Increased district heating and cooling requires long-term investments which need to be encouraged.	Estonia: minimal Spain: minimal Denmark: medium
E	**Low temperature district heating** [18,19]	Another benefit from having district heating and improving the thermal performance of the buildings is that **low temperature heat can be supplied**. This allows lower consumption of primary energy and leads to lower losses in the district heating system. It also means that district heating can be expanded further distances than higher temperature district heating.	Estonia: none Spain: none Denmark: none
F	**High penetration of renewable thermal energy** [20,21]	**District heating enables numerous energy system benefits**. One of which is to inject renewable thermal energy into the heating system. District heating can help utilise heat production from waste incineration and industrial excess heat production, geothermal heating, biogas production (supply of heat), and solid biomass such as straw. Waste heat from industry and power plants is already enough to supply European heat demands. Since biomass will be a limited resource, CHP should be decreased over time and non-biomass renewable heat will be increased in the district heating.	Estonia: minimal Spain: minimal Denmark: medium
G	**Energy storage** [22,23]	With a more interconnected energy system there will **need to be greater energy storage**. Today energy is stored in fossil-fuels and it is easy to access in each energy sector – hence they may operate independently. In the future energy system, the renewable energy will not be controllable and will need to be stored in thermal, chemical, gaseous and liquid storages when it is available. In the interconnected system this energy can be utilised in the different energy sectors, for example liquid fuel can be utilised in transport.	Estonia: minimal Spain: minimal Denmark: medium

	System change	Description of system change	Progress of each country
H	**Increase in heat pumps** [16,24]	It is likely that numerous buildings will not be cost-effective to connect to district heating. For these buildings it has been shown that it is very **cost-effective to install heat pumps at the building level**. These can utilise renewable electricity and if the buildings are well-insulated the heat pumps can be operated flexibly to heat buildings at different times. Utilising biomass in boilers will not be feasible since biomass availability will be limited. Heat pumps can be supplemented with solar thermal for hot water as well.	Estonia: minimal Spain: minimal Denmark: minimal
I	**Electric vehicles [7,9]**	**Electric vehicles will be a vital contribution** to the energy system for numerous reasons. Firstly, they provide a useful link between the electricity and transport sector which helps the energy system. Secondly they save primary energy due to the higher energy conversion performance from well-to-wheel compared to fossil fuel-driven ICE vehicles.	Estonia: minimal Spain: minimal Denmark: minimal
J	**Electrofuels** [9,25–27]	**Electrofuels should be produced** which are cost-effective and resource-effective transport fuels. In the future it is likely that biomass will be utilised but it will be a limited resource. Biomass consumption should be limited as far as possible and when it is consumed it should be utilised where it is most beneficial, which is as a carbon source for electrofuel transport fuels or for producing synthetic gas.	Estonia: none Spain: none Denmark: none

Other issues

The energy system is complicated and there are numerous uncertainties about how exactly the system will be transitioned from the system today to the system in the future. This means that there are some remaining issues that need to be discussed since it is uncertain what their role will be in the future system. Some of these other issues are discussed in Table 7 below.

Table 7: Others issues that are less certain in the future energy system

System change	Description of system change
Flexible demand [7]	The future energy system will definitely need flexibility between the demand and supply side. Most flexibility will be in the demand side. This means that buildings could play a role in being flexible. However, it is more beneficial for the energy system if the flexibility is created in other areas of the system. For example, through utilising large-scale energy storages for thermal energy, transport fuels, and gas. Utilising these storages allows more energy to be stored and to be delivered at a later time. Buildings have a limited amount of energy that is flexible therefore their role in providing flexibility should not be a main focus.
On-site electricity production [28]	With new renewable energy technologies being dependent on distributed resources such as the sun and wind this means that they can be located anywhere. It is proposed that energy production units can be installed on the buildings since that are where some demand is located. However, this is unnecessary within the interconnected energy system. These units should be located where it is most cost-effective and beneficial for the system – which could be on the buildings but not necessarily. Buildings should remain connected to the grids in the system because the system will need to operate together. If buildings operate separate from the system, i.e. by utilising energy storage such as electric batteries, this can cause suboptimal outcomes and raise costs.

System change	Description of system change
Individual boilers [29]	Today individual boilers are installed in numerous buildings. These could be converted to biomass but biomass will be a limited resource and its consumption should be in an energy sector where it is most beneficial, transport fuels or gases for example. Therefore, utilising biomass in boilers in buildings should be limited. Where district heating is not feasible then heat pumps should be utilised as opposed to boilers.
Biofuels [9,25]	Biofuels are being promoted today in the form of biodiesel and bioethanol, as well as hydrogen fuels. Biofuels require a high amount of biomass and land and it is not feasible to convert large amounts of fossil fuels to biofuels in a sustainable way. In addition, hydrogen is an inefficient method for fuelling vehicles. Hydrogen should be used for producing upgraded biogas or for producing electro fuels that have a higher energy content.

7.7.4 What are the current linkages between the standards and the future energy system?

In this section some general connections are made between the standards selected in this project and the different elements that are required in the future energy system. The linkages between the standards have not been assessed in detail and are based only on their content in which appears to fit into the area. The purpose of the linkages is simply to demonstrate that these standards provide some direction towards the future energy system.

Table 8: Affiliation of standards with future energy system changes

Label	Energy system change	Relevant standard disciplines	Relevant standard(s)	Brief description of relevance of standard(s)
A	**Greater interconnection between energy sectors**	Standards on BIM management	All	A BIM model can contain information/data on design, construction, logistics, operation, maintenance, budgets, schedules and much more. The information contained within BIM enables richer analysis than traditional processes. BIM could help analyse interconnections between energy sectors at building or neighbouhood level.
B	**High penetration of renewable electricity**	Standards of energy supply -	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency	**DIRECTIVE 2009/28/EC -** It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. **DIRECTIVE 2012/27/EU** - 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.).

Label	Energy system change	Relevant standard disciplines	Relevant standard(s)	Brief description of relevance of standard(s)
C	**Energy conservation**	Standards on social engagement	Arhus Convention Torremolinos Charter UN REDD+ ISEAL Alliance Transparency Act (Vitoria) Good Practice of Involvement (Tartu) Zero-platform (Sonderborg)	Social engagement and behaviour change is critical to achieve energy conservation. The aim of the project is not a mere information sharing and applying new technologies, but changes in attitudes and people's behaviour that empower the more technical aspects of the project the engagement process should involve a learning aspect.
		Standards of energy supply	DIRECTIVE 2010/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products	**DIRECTIVE 2010/30/EU** - establishes a framework for the harmonisation of national measures on end-user information, particularly by means of labelling and standard product information, on the consumption of energy and where relevant of other essential resources during use, and supplementary information concerning energy-related products, thereby allowing end-users to choose more efficient products
		Stnadards of building retrofitting	DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the energy performance of buildings BREEAM® EnerPHit Certified Retrofit Passive House Institute	**DIRECTIVE 2012/27/EU** - 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.). **DIRECTIVE 2010/31/EU** EU countries must draw-up long-term national building renovation strategies which can be included in their National Energy Efficiency Action Plans. **BREEAM** - The BREEAM Refurbishment scheme is designed to help building owners and occupiers to save operating costs, reduce the environmental impacts of refurbishments and to increase the sustainability of existing building stock. **EnerPHit** - Buildings that have been refurbished using Passivhaus components and largely with exterior wall insulation can be certified to the EnerPHit standard as evidence of quality assurance and to verify achievement of the specific energy values. **BREEAM ES Residential** - BREEAM ES Domestic Buildings is the Spanish scheme of environmental assessment and certification of residential buildings, new, refurbished or renewed, including single houses and housing blocks.

Label	Energy system change	Relevant standard disciplines	Relevant standard(s)	Brief description of relevance of standard(s)
			CTE (2013) Technical Building Code (Vitoria) Building Act 2003 (Tartu) Danish Building Regulations 2010 (BR10) (Sonderborg)	**VERDE RH Residential** - VERDE RH borns in order to develop a simple tool for evaluating retrofitting interventions carried out in collective housing buildings **NORDIC SWAN Ecolabel for buildings** - Energy: there are criteria and points for the air tightness, energy consumption, light sources, low-flow showers and taps. **CTE (2013) Technical Building Code (Vitoria)** - In DB-HE 2013, minimum requirements on existing buildings which are retrofitted or rehabilitated are referred to global Weighted Energy Demand of heating and cooling (WED). **Building Act 2003 (Tartu)** - This regulation provides the requirements for construction works, building materials, construction products, building design documentation and as-built drawings of construction works **BR10 (Sonderborg)** The relevant sections of the Danish Building Regulation 2010 including the energy requirements to existing buildings undergoing renovation are: The energy requirements to existing buildings undergoing renovation are to the individual building elements.
		Standards on ICTs	All	ICTs considered as cross-cutting, enabling technologies that will be used for monitoring and evaluation of the success of measures, as well as means for management, control and integration of valuable information provided and made accessible to different stakeholders and a tool for social interaction.
D	**Increased district heating**	Standards on social engagement	Arhus Convention Torremolinos Charter UN REDD+ ISEAL Alliance Transparency Act (Vitoria) Good Practice of Involvement (Tartu) Zero-platform (Sonderborg) DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy	Social engagement and change is critical to achieve energy conservation.The aim of the project is not a mere information sharing and applying new technologies, but changes in attitudes and people's behaviour that empower the more technical aspects of the project the engagement process should involve a learning aspect. **DIRECTIVE 2012/27/EU** - 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.).

Label	Energy system change	Relevant standard disciplines	Relevant standard(s)	Brief description of relevance of standard(s)
			efficiency	
E	**Low temperature district heating**	Standards of energy supply -	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources	**DIRECTIVE 2009/28/EC -** It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.
F	**High penetration of renewable thermal energy**	Standards of energy supply -	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources	**DIRECTIVE 2009/28/EC -** It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.
G	**Energy storage**	Standards of energy supply -	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources	**DIRECTIVE 2009/28/EC -** It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.
H	**Increase in heat pumps**	Standards of energy supply -	DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency	**DIRECTIVE 2012/27/EU** - 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.).
I	**Electric vehicles**	Standards on mobility	Electric vehicle standards Charging infrastructure standards Connection to grid standards Communication and connecting protocols	**Electric vehicle standards**: power socket and connector, cables, motor, charger, converter, energy storage (batteries). Also, the measurement of EV performance, exhaust emissions and fuel consumption has been included. **Charging infrastructure**: electromagnetic compatibility for: power socket and connector, cables, methods and mechanisms of payment, charging strategies, authentication **Connection to grid:** Elements considered: converters, building/construction requirements, charging location, charging strategies, charging monitoring, smart meter, load management. **Communication and connecting protocols:** includes security of communication, data protection, protocols for information

Label	Energy system change	Relevant standard disciplines	Relevant standard(s)	Brief description of relevance of standard(s)
				exchange, transmission media, payment system, roaming
J	**Electro fuels**	Standards on mobility	FprEN 16723-1 (WI=00408006) FprEN 16723-2 (WI=00408005) Part 1 & 2 Natural gas and bio methane for use in transport and bio methane for injection in the natural gas network	Biogas can be upgraded to provide biomethane, an alternative for natural gas which can be injected into the gas grid, and to provide transport fuels either in the form of biomethane
		Standards on energy supply	DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources	**DIRECTIVE 2009/28/EC -** It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.

7.7.5 Summary

Overall the standards that have been selected in this report, when implemented at the city level, will lead to greater energy efficiency and adoption of renewable energy technologies which is crucial for the future energy system. However, although each of the elements above has been linked with one or more standards, it does not necessarily mean that the elements are being addressed significantly. There are likely numerous standards, not included in this report, that address the specific elements mentioned above in more detail and more directly. Standards for building retrofitting are well represented in this report. But for other elements which have become more relevant in recent years, such as implementing low temperature district heating, the standards that are relevant to these elements are linked only at a high level in terms of energy efficiency or energy supply in this report; not specifically related to the element itself.

8 Annex - Relevant projects in the line of SmartEnCity

It would be useful to take a look to other relevant European Projects related to city renovation at district level in order to explain the tendencies in this kind of interventions.

8.1.1 Similar European Projects

SEMANCO

SEMANCO, Semantic Tools for Carbon Reduction in Urban Planning	
Programme	FP7
Coordinator	La Salle Centro Universitario
Duration	36 months (September 2011 - August 2014)
Web page	http://www.semanco-project.eu/
Figure	**Figure 13: Semantic Energy Information Framework integrated platform**
Objective	The SEMANCO project identified that many cities in Europe and in the world have issued climate change policies and set targets for reduction of CO2 emissions, but their implementation in urban planning practice remains a major challenge. Devising effective decision systems which support CO2 emissions reduction demands a systems approach which enables different actors (policy makers, planners, engineers, consultants, and inhabitants) to correlate a diversity of problems, spanning across distinct domains and geographic scales.
City renovation at district level approach	The technological approach of SEMANCO is based on the integration of energy related open data structured according to standards, semantically modelled and interoperable with a set of tools for visualizing, simulating and analysing the multiple relationships between the factors determining CO_2 production. A Semantic Energy Information Framework is developed to model the energy-related knowledge planners and decision makers need. The tools interoperating with the framework will support systems innovation and include available technologies, enhancements to existing open source platforms, and new technological solutions.

Table 9: Main data (SEMANCO European Project, 2014)

SmartKYE

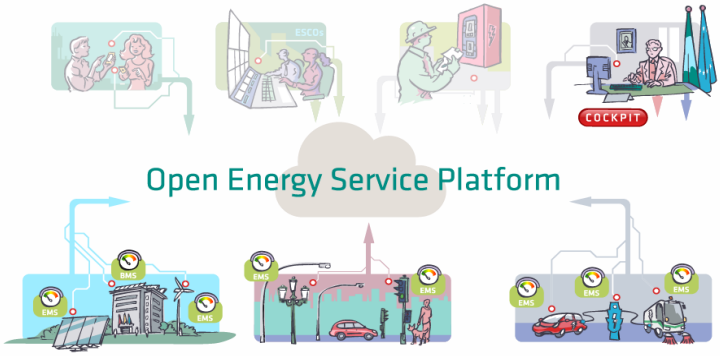
SmartKYE, Smart grid KEY neighbourhood indicator cockpit	
Programme	FP7
Coordinator	ETRA I+D
Duration	30 months (October 2012 - March 2015)
Web page	http://smartkye.eu/
Figure	 **Figure 14: SmartKYE Open Energy Service Platform scheme**
Objective	The SmartKYE project proposes the development of an advanced, integrated, management system which enables energy efficiency in neighbourhoods from a holistic perspective. To that end, the Energy Management Systems (EMS) deployed in a typical district that is consuming or producing energy, and which nowadays normally count with an isolated ICT management solution, will be able to share data and services through and open platform among themselves and to external third party applications. This enables the design and development of higher level applications (SmartKYE cockpits) that are able to process real-time data and generate valuable analytics to affect the business and Monitoring and Control strategies that operate a district (or a subset of the energy services deployed).
City renovation at district level approach	The deployment of the open platform proposed by SmartKYE provide a more granular and accurate tool to respond to emergency situations without actually interrupting the service. In this way, to avoid an overload, the grid operator could request to reduce the consumption from public lighting, or electric vehicle points of charge; it could request the generation of energy in the case of facilities with their own generators, or the access to previously stored energy, etc. On the other hand, the more granular solution proposed by SmartKYE also enables a finer control of different Qualities of Service managed by ESCOs. SmartKYE targets specifically public authorities responsible of a number of public services demanding energy. These services can be run by ESCOs (as it is the case for most electric vehicle sharing systems) or directly by the local authority. In any case, it is the responsibility of the district operator to grant the efficiency (also from the energy point of view) of such public services. Thus, the SmartKYE cockpits will offer public authorities with a high level view of the energy and business processes on going in a neighbourhood.

Table 10: Main data (SmartKYE European Project, 2015)

FASUDIR

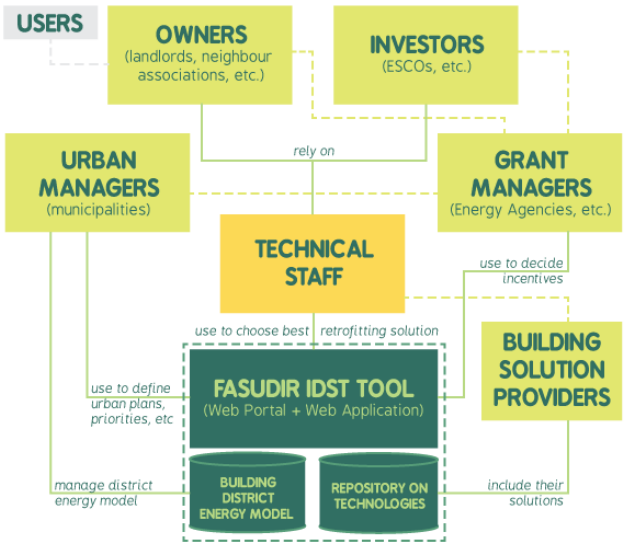
FASUDIR, Friendly and Affordable Sustainable Urban Districts Retrofitting	
Programme	FP7
Coordinator	Fundación Tecnalia Research & Innovation
Duration	36 months (September 2013 – August 2016)
Web page	http://fasudir.eu/
Figure	 **Figure 15: FASUDIR's decision making methodology scheme**
Objective	The FASUDIR project aims to develop new business models and financial supporting tools, to support the necessary building-retrofitting market mobilization in Europe to fulfil EU-targets in 2020 and 2050. The key instrument will be the Integrated Decision Support Tool (IDST), developed to help decision makers to select the best energy retrofitting strategy to increase the sustainability of the whole district. With stakeholder feedback loops, training, and validation in three diverse urban areas, the IDST will ensure robustness and applicability in the entire value chain.
City renovation at district level approach	The IDST will be based on a decision making methodology, designed to select and prioritise energy efficiency retrofitting interventions. It will implement existing and new cost-effective solutions, for significant sustainable improvements in the rehabilitation of urban districts. Taking into account the different European urban typologies and the priorities of the decision makers, the methodology will support retrofitting actions that are deployed as a unique intervention, but also scheduling sequential interventions in the most cost-effective way. This methodology will focus on the initial stage of the retrofitting process at district level, in which the retrofitting framework is established, with the definition of strategies and technological solutions. Ultimately, the IDST will allow selecting the optimal, off-the-shelf technologies and strategies for each specific energy retrofitting project in terms of sustainability as a whole (environmental, economic and social).

Table 11: Main data (FASUDIR European Project, 2016)

PROFICIENT

PROFICIENT	
Programme	FP7
Coordinator	TNO
Duration	48 months (September 2012 – August 2016)
Web page	http://www.proficient-project.eu/
Figure	
Objective	Create large business opportunities for SMEs in the construction sector by exploiting the newly emerging process of Collective Self-Organised (CSO) housing for constructing and retrofitting energy-efficient residential districts. PROFICIENT responds to the EU-wide trend of self-organised housing process in order to boost the quality and the scale of energy-efficient buildings. Self-organised housing process -through which a group of homeowners carries out new construction and retrofitting projects on a district scale- reflects a raising awareness towards sustainability and the increasing self-managing capability.
City renovation at district level approach	The project aim will be achieved through developing a new business model for a “SME network of product and service providers” which will realise value-chain integration in energy-efficient housing market. This business model will enable SMEs to operate, in flexible collaboration with the end-users, on multiple network levels across the EU to jointly develop and implement integrated solutions, and to provide the end-users with a greater certainty of total cost of ownership and lifecycle performance. PROFICIENT will also generate a new business plan for each SME player to implement the network business model. The focal point will be the business plan for local ESCOs to take the coordinating role in energy-efficient district projects. The focus of the demonstration activities is threefold. First, the guidelines: their utility and nature. Second, elaborate on the stakeholders that are addressed by these guidelines. Last but not least, link the guidelines within a potential field of application: the use of BIM and semantic web as tools to support the actions related to the design, as well as the e-market place as the interface for the whole CSO Housing process.

Figure 16: PROFICIENT webpage

Table 12: Main data (PROFICIENT European Project, 2016)

COOPERATE

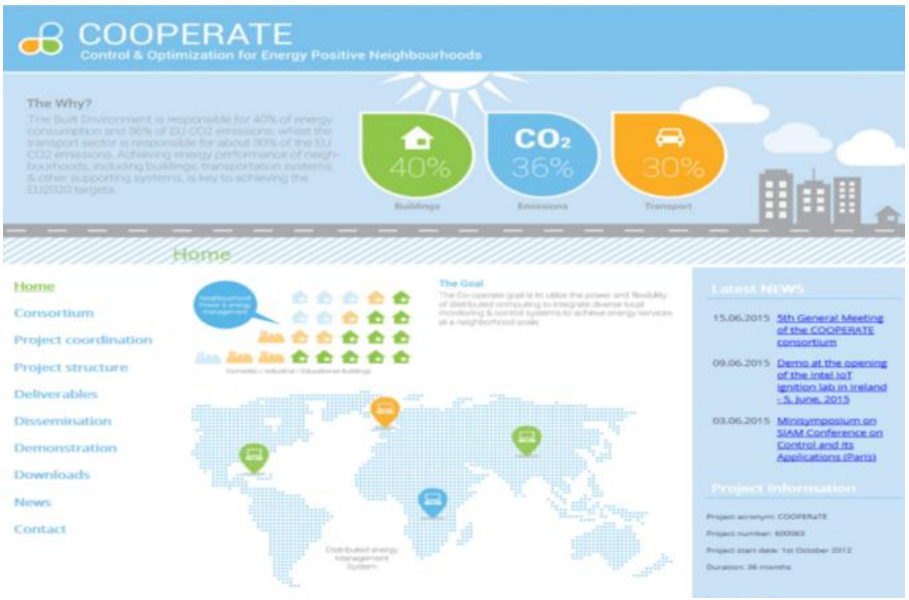
COOPERATE, Control and Optimisation for Energy Positive Neighbourhoods	
Programme	FP7
Coordinator	RWTH Aachen University
Duration	36 months (October 2012 – October 2015)
Web page	http://www.cooperate-fp7.eu/
Figure	
Objective	Demonstrate the impact and benefits of ICTs to improve the energy management of a neighbourhood, and their environmental performances through an online Neighbourhood Management System, helping people to optimise their energy consumption while keeping them connected into a new concept of local community.
City renovation at district level approach	The goal is utilise the power and flexibility of distributed computing to integrate diverse local monitoring & control systems to achieve energy services at a neighbourhood scale, by allowing for interoperability at the data level & by leveraging existing cloud solutions via common communication one can produce a loosely coupled integrated solution which is likely to be adopted. Substantial validation of the project objectives in two demo sites, in order to demonstrate how the proposed platform and services move the two neighbourhoods towards energy positivity. Reduction in energy consumption and in CO2 emissions through local generation, in the order of 10% - 15% within both of the test sites. Regarding scientific, Economic & Societal impact, the project targets barriers to adoption, hence impact, and demonstrates the benefit of ICT in improving energy & environmental performance at the neighbourhood levels.

Figure 17: COOPERATE webpage

Table 13: Main data (COOPERATE European Project, 2015)

R2CITIES

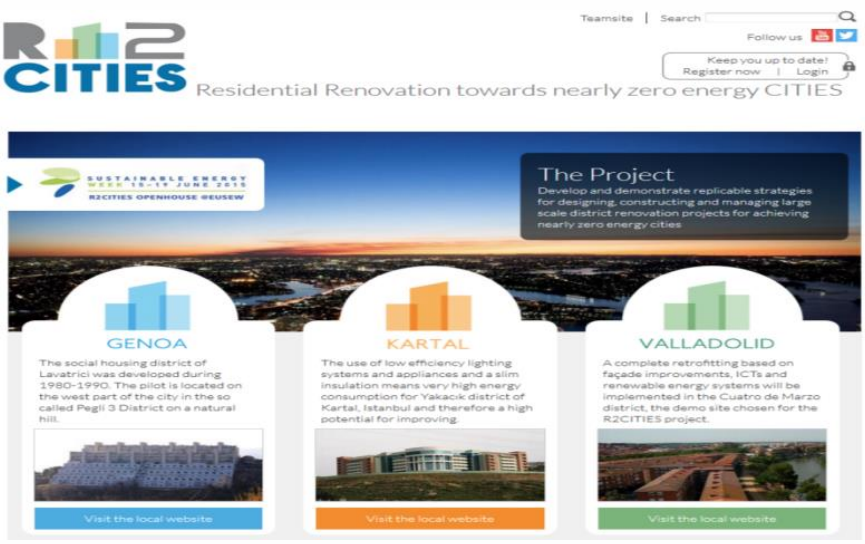
R2CITIES, Residential Renovation towards nearly zero energy CITIES	
Programme	FP7
Coordinator	Fundación CARTIF
Duration	48 months (July 2013 – July 2017)
Web page	http://r2cities.eu/
Figure	 **Figure 18: R2CITIES demonstrators**
Objective	R2CITIES aims to develop and demonstrate an open and easily replicable strategy for designing, constructing, and managing large scale district renovation projects for achieving nearly-zero energy cities.
City renovation at district level approach	To achieve its purpose, R2CITIES developed a demonstration and dissemination framework of innovative strategies and solutions for building energy renovation at district level, based in (i) three demonstrations of residential district retrofitting, in different countries, climate conditions and user's habits; (ii) an ambitious dissemination programme focused on public and professional audiences; (iii) several studies of cost-effective solutions for the holistic improvement of the energy performance of buildings at district level; (iv) deployment of a rigorous measurement and verification of energy performance and savings plan for each demonstration, taking into account standard protocols as IPMV; and (v) a market and replication deployment plan, in order to ensure the project impact at business level, and a results exploitation strategy suitable for achieve a wide impact. Three demo sites are addressed for demonstrating the framework and associated impacts by developing real cases going beyond current market standards but ensuring the replicability of the concepts deployed. R2CITIES be far away from current expensive and standalone pilots that have failed into reaching the market. Valladolid, Genoa and Kartal municipalities provide three demo sites for a very ambitious renovation of three residential districts, involving more than 57,000 m2, more than 700 dwellings and more than 1,500 users, with a potential of energy consumption reduction of 60%.

Table 14: Main data (R2CITIES European Project, 2016)

DIMMER

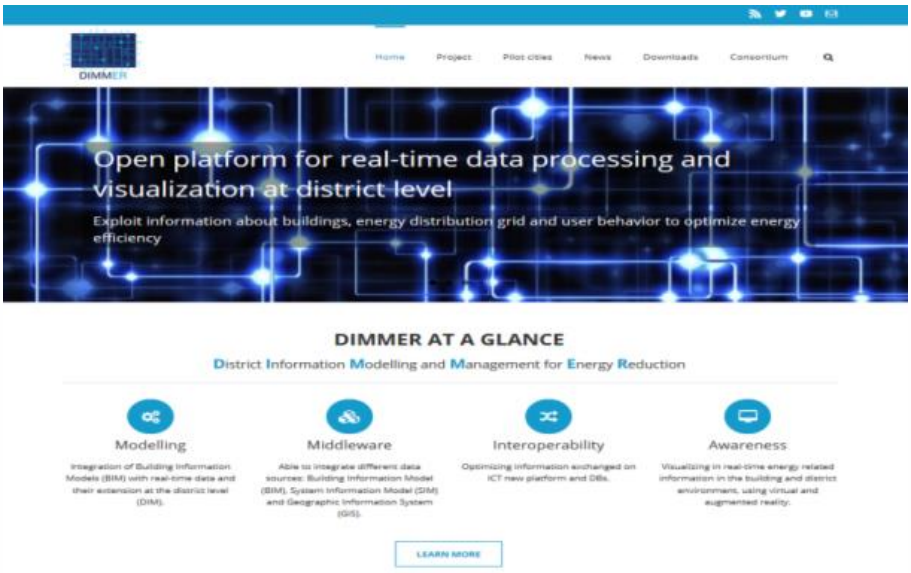
DIMMER, District Information Modelling and Management for Energy Reduction	
Programme	FP7
Coordinator	Politecnico di Torino
Duration	36 months (October 2013 – October 2016)
Web page	http://dimmer.polito.it/
Figure	 **Figure 19: DIMMER webpage**
Objective	Integration of Building Information Models (BIM) and district level 3D models (DIM) with real-time data from sensors and user feedback to analyse and correlate buildings utilization and provide real-time feedback about energy-related behaviours. Open access with personal devices and Augmented Reality (AR) visualization of energy-related information to client applications for energy and cost-analysis, tariff planning and evaluation, failure identification and maintenance, and energy information sharing.
City renovation at district level approach	In order to validate the DIMMER innovative system, both public (university campuses, schools) and private buildings included in mixed-up (mixité) urban districts are considered in two different cities, in the North and South Europe, Turin (IT) and Manchester (UK). As most energy usage of buildings throughout their life cycle is during the operational stage (80%), the project gives special attention to existing and historical buildings The expected results are a consistent reduction in both energy consumption and CO_2 emissions by enabling more efficient energy distribution policies, according to the real characteristics of district buildings and inhabitants as well as a more efficient use and maintenance of the energy distribution network, based on social behaviour and users attitudes and demand.

Table 15: Main data (DIMMER European Project, 2016)

CELSIUS

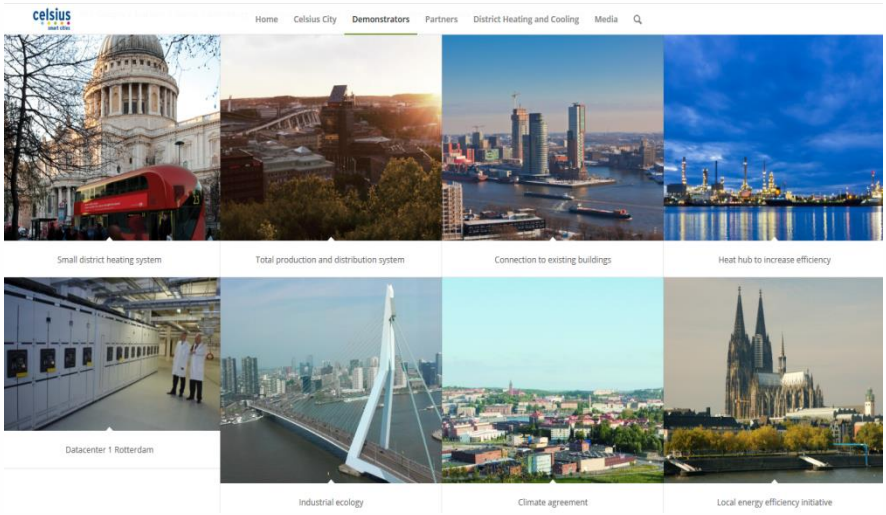
CELSIUS	
Programme	FP7
Coordinator	City of Gothenburg
Duration	42 months (June 2012 - December 2015)
Web page	http://celsiuscity.eu/
Figure	 **Figure 20: CELSIUS demonstrators**
Objective	The CELSIUS project aims to increase the deployment and operation of intelligent district heating and cooling systems across Europe and support cities to develop secure, affordable and low carbon heat supplies for its citizens and businesses. As part of this the CELSIUS project wants to maximise the use of waste or secondary heat that is produced within a city by capturing and then using it in its district heating systems.
City renovation at district level approach	One of the goals with CELSIUS is to recruit 50 New CELSIUS Cities and to provide them with relevant support, advice and guidance to help gain support for, establish, construct or ultimately grow district heating and cooling systems in their cities. New CELSIUS Cities believe that intelligent district heating and cooling systems have a role to play in the evolution of the city's energy systems, and they have committed to actively engage and collaborate with the CELSIUS project in pursuing the cities' heating and cooling objectives. The support that the CELSIUS project can provide will fall into four basic offerings and each of these will be designed in a way that reflects the needs of the CELSIUS cities. It will provide, within the resource constraints of the project, CELSIUS cities with the most relevant support, advice and guidance for the position that they are in as a city to help them either gain support for, establish, construct or ultimately grow district heating and cooling systems in their city. This support for CELSIUS cities will be broadly based around the following four offerings: Demonstrators, CELSIUS Toolbox, Specialist Workshops and Expert Group.

Table 16: Main data (CELSIUS European Project, 2015)

REMOURBAN

REMOURBAN, REgeneration MOdel for accelerating the smart URBAN transformation	
Programme	H2020
Coordinator	Fundación CARTIF
Duration	60 months (January 2015 – December 2019)
Web page	http://www.remourban.eu/
Figure	**Figure 21: REMOURBAN lighthouse cities**
Objective	REMOURBAN aims to develop and validate in three lighthouse cities - Valladolid (Spain), Nottingham (UK) and Tepebasi/Eskisehir (Turkey)- of a sustainable urban regeneration model that leverages the convergence area of the energy, mobility and ICT sectors in order to accelerate the deployment of innovative technologies, organisational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas. The urban renovation strategy will be focused on the citizens, because they become the cornerstones to making a smart city a reality and will not only be the most affected by the improvements but also they will be the common factor of each of them.
City renovation at district level approach	The main objective will be achieved by (i) developing a sustainable urban regeneration model, considering a holistic approach, which supports the decision making of the main stakeholders for addressing wide renovation and city transformation processes; (ii) validating the urban regeneration model by means of large scale interventions on several cities called lighthouse cities; (iii) guaranteeing the replicability of the model at European level; (iv) deploying an intense activity focused on generating exploitation and market deployment strategies to support the commercial exploitation of the project outcomes; and (v) deploying a powerful communication and dissemination plan which integrates a citizen engagement strategy and will disseminate the benefits of the project to a wide variety of audiences.

Table 17: Main data (REMOURBAN European Project, 2016)

TRIANGULUM

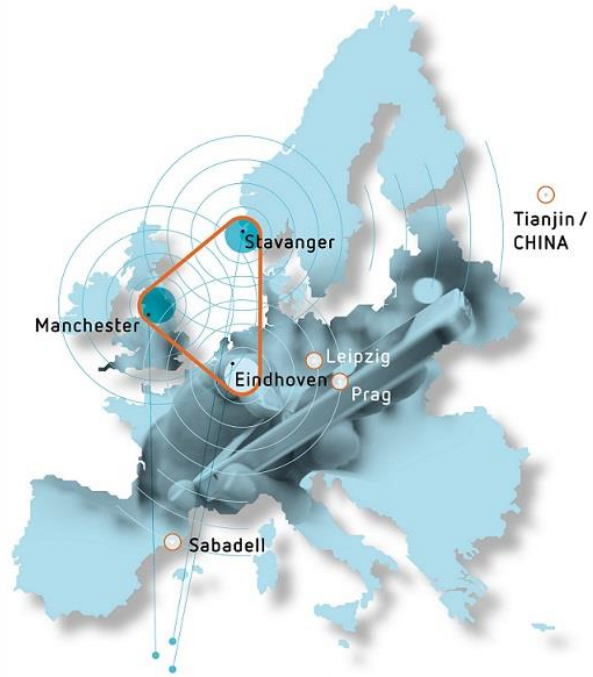
TRIANGULUM, Demonstrate·Disseminate·Replicate	
Programme	H2020
Coordinator	Fraunhofer Institute for Industrial Engineering IAO
Duration	60 months (February 2015 – January 2020)
Web page	http://triangulum-project.eu/
Figure	 **Figure 22: TRIANGULUM**
Objective	The three point project Triangulum is one of the three European Smart Cities and Communities Lighthouse Projects, set to *demonstrate, disseminate* and *replicate* solutions and frameworks for Europe's future smart cites. The flagships cities Manchester (UK), Eindhoven (NL) and Stavanger (NO) will serve as a testbed for innovative projects focusing on sustainable mobility, energy, ICT and business opportunities.
City renovation at district level approach	An exceptional feature of the project is the ICT architecture and smart city framework that will be developed in the flagship cities and rolled out in the follower cities. A modular approach will enable flexible (business) solutions that address individual challenges and requirements of our cities and their stakeholders. Several districts will be transformed into sustainable living environments during the course of the project. Actuations about smart mobility (electric vehicles, recharging infrastructures…), about building renovation, about autonomous energy grid and about information exchange will be held out. Citizen's engagement and dissemination will be key aspects as well in order to favor replication in follower cities and other cities of smart city framework.

Table 18: Main data (TRIANGULUM European Project, 2016)

GrowSmarter

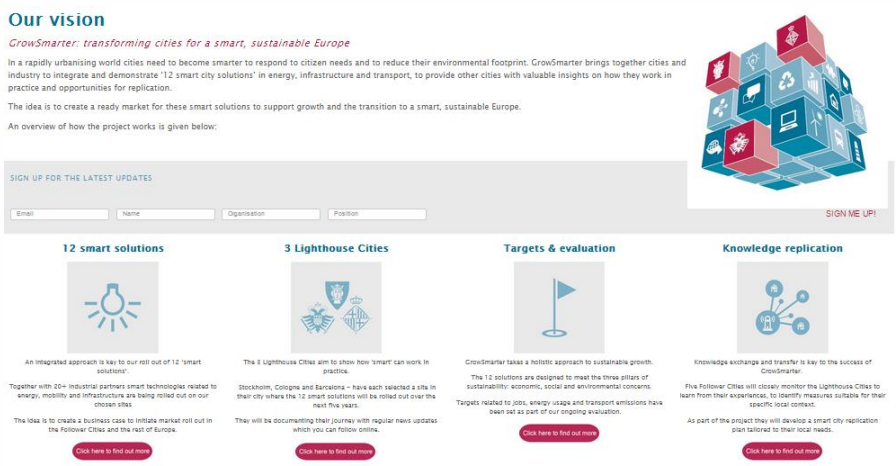
GrowSmarter, Transforming cities for a smart sustainable Europe	
Programme	H2020
Coordinator	City of Stockholm
Duration	60 months (January 2015 – December 2019)
Web page	http://www.grow-smarter.eu/home/
Figure	
Objective	GrowSmarter aims to stimulate city uptake of 'smart solutions' by using the three Lighthouse cities (Stockholm, Cologne and Barcelona) as a way to showcase 12 Smart City solutions: from advanced information and communication technology and better connected urban mobility, to incorporating renewable energy sources directly into the city's supply network.
City renovation at district level approach	The 12 Smart City solutions are split into three areas of action: low energy districts, integrated infrastructures and sustainable urban mobility. In the area of low energy districts, solutions will revolve around smart building shell refurbishment, smart building logistics, smart energy-saving tenants and smart local energy management. In the area of integrated infrastructures, solutions will revolve around smart street lighting, waste hear recovery, smart waste collection and big data management. In the area of sustainable urban mobility, solutions will revolve around sustainable delivery, smart traffic management, alternative fuel driven vehicles and smart mobility solutions.

Figure 23: GrowSmarter vision of transforming cities

Table 19: Main data (GrowSmarter European Prject, 2016)

OptEEmAL

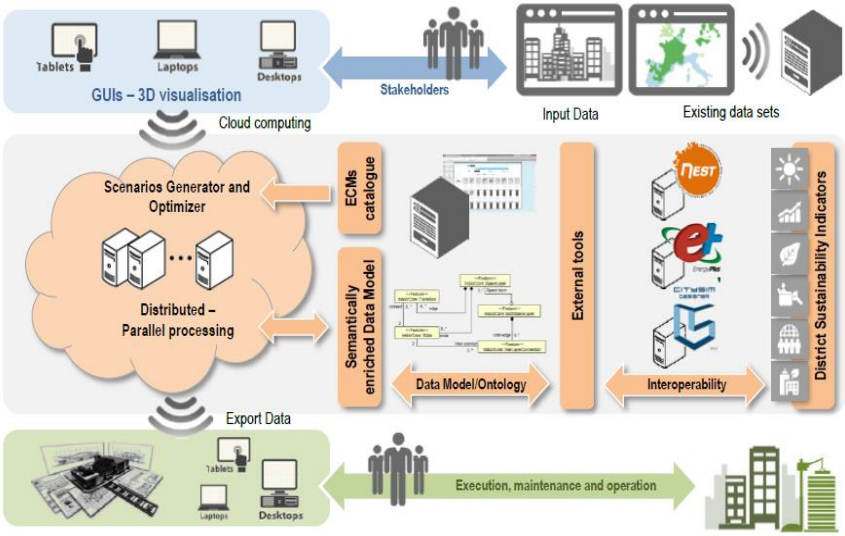
OptEEmAL, Optimised Energy Efficient Design Platform	
Programme	H2020
Coordinator	Fundación CARTIF
Duration	42 months (September 2015 – February 2019)
Web page	https://www.opteemal-project.eu/
Figure	 **Figure 24: OptEEmAL platform conceptual scheme**
Objective	OptEEmAL aims to develop an Optimised Energy Efficient Design Platform for refurbishment at district level, which will deliver an optimised, integrated and systemic design based on an Integrated Project Delivery (IPD) approach for building and district retrofitting projects, reducing time delivery and uncertainties, resulting in improved solutions when compared to business-as-usual practices.
City renovation at district level approach	This main objective will be deployed through the development of a holistic and effective services platform for District Energy Efficient Retrofitting Design integrating interoperable modules and tools able to provide services for diagnosis, scenarios generation (according to stakeholders priorities), energy/cost/ environment/social evaluation, scenarios optimisation and data export. The reinforcement of the presence of all involved stakeholders through an Integrated Project Delivery approach that will allow them being articulated through a collaborative and value-based process to deliver high-quality outcomes. Moreover, the development of an integrated ontology-based District Data Model that will contain key information in the fields of energy, comfort, environment (LCA), economic, social wellbeing and urban morphology. Finally, the development of an Energy Conservation Measures catalogue (ECM) including technical, operational, maintenance and cost information giving valuable and consistent outputs to the design and district operation and maintenance stages.

Table 20: Main data (OptEEmAL European Project, 2016)

CITyfiED

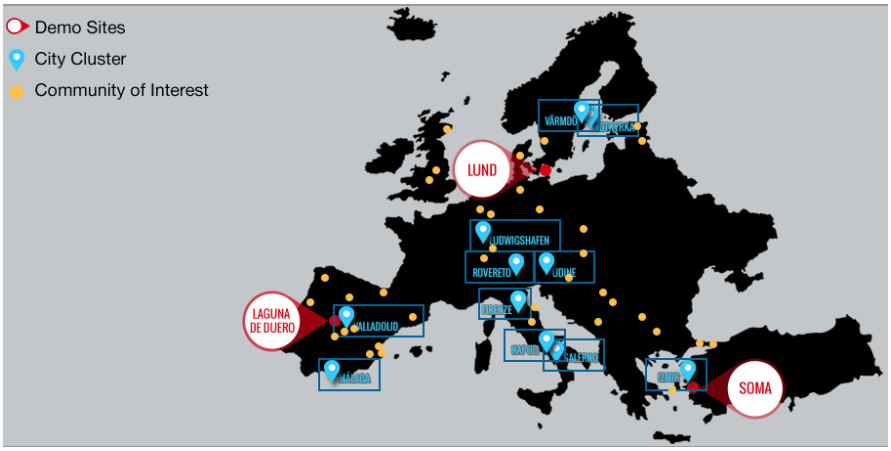
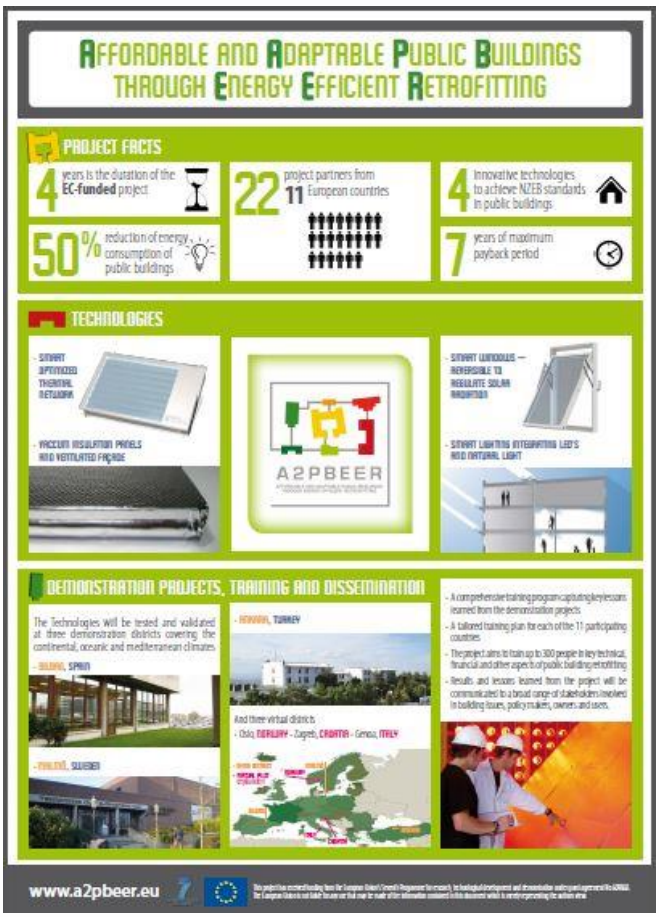
CITyfiED, RepliCable and InnovaTive Future Efficient Districts and cities	
Programme	FP7
Coordinator	Fundación CARTIF
Duration	60 months (April 2014 – March 2019)
Web page	http://es.cityfied.eu/
Figure	 **Figure 25: CITyfiED influence map**
Objective	The CITyFiED project objective is to develop a systematic, replicable and integrated strategy to convert European cities and urban ecosystems in smart cities for the future. The strategy is focused in reducing energy demand and greenhouse gases emissions and also growing renewable energies use developing and implementing innovative technologies and methodologies for building retrofitting, Smart grids and heat grids connected to ICT and mobility.
City renovation at district level approach	A great number of cities and stakeholders will be implied in order to maximize the potential impact. Actuations will carry out 3 main improvements: building retrofitting, district heating and cooling systems and technological solutions for low voltage electricity distributed generation. A systematic methodology for this type of interventions will also be achieved to facilitate replication. The final objective is to promote the reduction of energy consumption and cities with “near zero emissions”. According to this, technological availability for building retrofitting, district heating implementation, cogeneration integration, renewable energies and waste energy recover will have a key role. Last but not least, a spreading labor will be carried out. It will be addressed not only to practitioners and academics but to citizens in general. It will focus on energy in buildings aspects but also in complementary aspects like mobility in order to modify user’s behavior towards a more sustainable conscience.

Table 21: Main data (CITyfiED European Project, 2016)

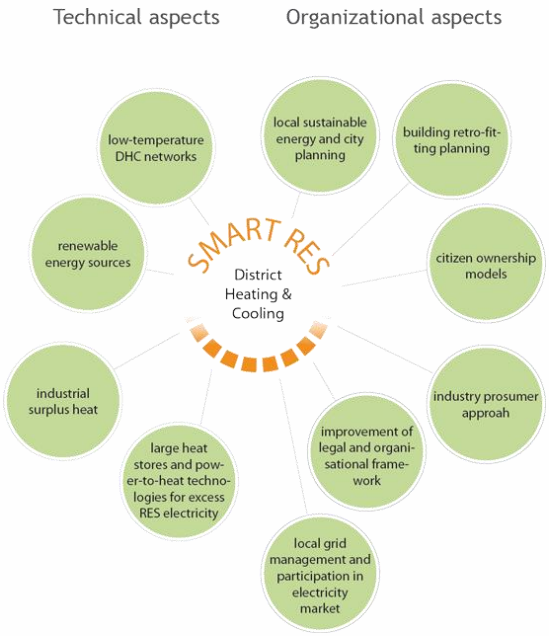
A2PBEER

A2PBEER, Affordable and Adaptable Public Buildings through Energy Efficient Retrofitting	
Programme	FP7
Coordinator	Fundación Tecnalia Research & Innovation
Duration	48 months (September 2013 – August 2017)
Web page	http://www.a2pbeer.eu/
Figure	 **Figure 26: A2PBEER poster**
Objective	A2PBEER is a four year research project partially financed by the European Union 7th Framework Programme and seeks to develop a cost effective, "energy efficient retrofitting" methodology for public buildings, drawing on the expertise of over 2o partners from 11 European countries. The company Tecnalia is the lead partner for this project. A higher impact will be achieved through interventions in non-residential buildings, as their energy consumption is 40% higher than in residential buildings. Public buildings represent more than 30% of the non-residential buildings in the EU.
City renovation at district level approach	A2PBEER partner, will develop an initial systemic energy efficient buildings' retrofitting methodology for the three demonstration sites with the intention to provide a retrofitting methodology to be replicated into Public Buildings in Europe. This will take advantage of synergies derived from interventions at

	the district levels. Three public buildings located in Bilbao Spain, Ankara Turkey and Malmo Sweden have been chosen to serve as demonstration districts. The chosen sites represent the three main climatic regions of Europe – Oceanic, Mediterranean and Continental. A range of innovative technologies will be developed and deployed at these sites with a view to achieving a highly efficient integrated retrofitting methodology that can be replicated throughout the European Union. Moreover, the replicability of A2PBEER results will be further validated through the deployment at three virtual pilot sites covering additional climatic areas and end-users. These include a diverse range of public buildings such as a library building, office buildings and a hospital. The results of the project will be translated into high quality training courses for industry professionals around Europe.

Table 22: Main data (A2PBEER European Project, 2016)

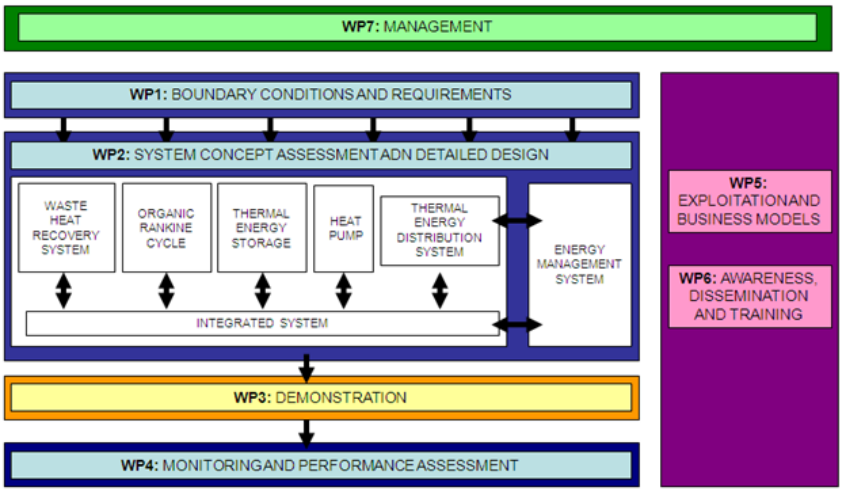
SmartReFlex

SmartReFlex, Renewable District Heating and Cooling	
Programme	Intelligent Energy Europe Program
Coordinator	Ambiente Italia
Duration	36 months (March 2014 – February 2017)
Web page	http://www.smartreflex.eu/en/home/
Figure	 **Figure 27: SmartReFlex technical and organizational aspects diagram**
Objective	The SmartReFlex project aims at increasing the diffusion of smart and flexible district heating and cooling (DHC) systems, basing on high shares of

	renewable energy sources (RES), in European cities. In order to reach this aim, a mixed project consortium was created, including regional authorities, DHC utilities and consultancy partners, which specific high-level skills on RES DHC and on energy planning at local level. 6 regions in 4 countries (DE, IE, IT, ES) will implement legislative and organizational measures for promoting high-RES DHC, also benefitting from the know-how transfer by Denmark. These measures include: improvement in regional legislation, supporting the implementation of high-RES DHC; integration of high-RES DHC in heat planning at regional and local level; creation of cooperatively-owned companies for managing high-RES DHC systems; study, planning and supporting of new high-RES DHC projects at local level.
City renovation at district level approach	The project aim is to increase the diffusion of smart and flexible district heating and cooling systems including high shares of renewable energy sources (high-RES DHC) in European towns and cities. Stimulation of the creation, organization and management of a process that will lead to the market introduction in European cities of high-RES DHC is sought. This applies to both new and existing systems and grids. The approaches in this process include, for instance: Improvement in regional legislation and framework, facilitating and supporting the implementation of high-RES DHC; Integration of high-RES DHC in heat planning at regional and local level; Creation of cooperatively-owned companies for managing high-RES DHC systems; Study, planning and supporting of new high-RES DHC projects at local level. Local communities – residents, commercial and industrial enterprises; District heating and cooling suppliers, utilities, contractors; Component suppliers, service providers and other professionals and Policy makers at all levels can benefit from the products and services. District heating and cooling (DHC) systems can significantly contribute to achieving national and European Union energy policy objectives. Among many other benefits, the systems facilitate the efficient use of energy and allow for large-scale integration of renewables in urban areas. Major benefits that generate lower CO2 emissions. A distinguishing feature of the district heating concept is that a variety of fuels can be used as energy source for the heat production, even at the same time. District heating can be described as an infrastructure of pipe lines connecting consumers to a central production unit. From here, hot water is sent out for the purposes of heating and hot water consumption. It may cover residential as well as commercial and industrial demands. Like district heating, district cooling offers environmentally friendly solutions tailored to local conditions, exploiting the flexibility of the district heating infrastructure. Denmark is very successful when it comes to energy planning, energy efficiency and integration of renewable energy sources in DHC systems. Therefore, Denmark has been chosen as “the coaching country” in our project. Around 50% of the Danish heat demand is covered by green and smart district heating.

Table 23: Main data (SmartReFlex European Project, 2016)

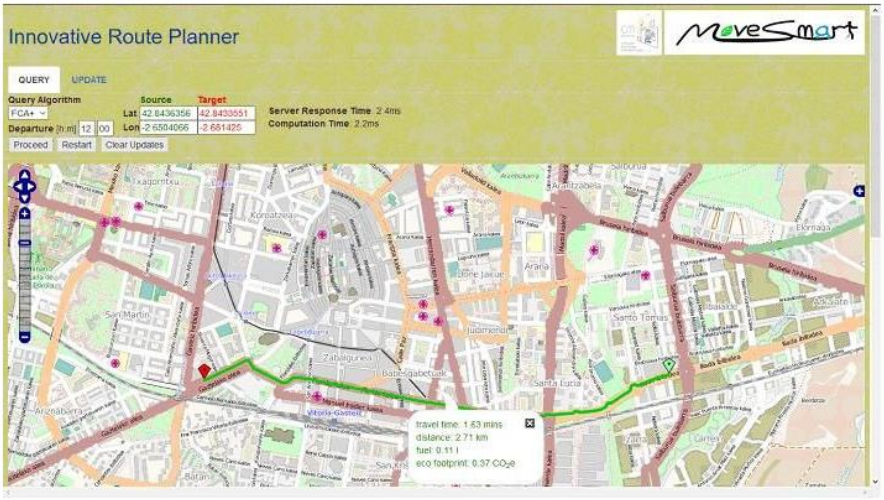
PITAGORAS

PITAGORAS, sustainable urban Planning with Innovative and low energy Thermal And power Generation from Residual And renewable Sources	
Programme	FP7
Coordinator	GRAZ
Duration	48 months (November 2013 – October 2017)
Web page	http://pitagorasproject.eu/content/home
Figure	 **Figure 28: PITAGORAS work organization scheme**
Objective	One of the sources with the highest potential is the recovery of waste heat. Industries are throwing away large amount of energy. It is said that as an average value, a 40% of the consumed energy in industries is waste heat. The PITAGORAS project focuses on the efficient integration of city districts with industrial parks through smart thermal grids. Technologies and concepts for low and medium temperature waste heat recovery, considering as well integration with renewable energy sources (RES), and heat (and power) supply to cities will be developed and demonstrated. As many of the technologies and concepts considered in the PITAGORAS project are not yet widely regarded as a reliable heating energy source (even they are already proven technologies), the application of these measures often fail even before cost issues are discussed. To change this negative view best practice projects are essential. In this context, the two demonstration plants that will be built and monitored will be essential.
City renovation at district level approach	The overall objective of the project is to demonstrate a highly replicable, cost-effective and high energy efficiency large scale energy generation system that will allow sustainable urban planning of very low energy city districts. The following systems and concepts will be developed: Waste heat recovery systems, Organic Rankine Cycle for heat and power generation, Seasonal thermal energy storage system, Solar thermal energy and Innovative tools for efficient energy management of the system. The concept of the project will be demonstrated at two different European cities: Brescia (Italy) and Graz (Austria).

	Demonstration plant in Brescia: medium/high temperature waste heat recovery (≈600ºC) from a steel foundry and ORC unit (2,1 MWe) for heat and power generation. It will be connected to the existing city district heating network. Demonstration plant in Graz: Large scale solar thermal plant (≈10.000m2) with seasonal thermal energy storage (≈40.000m3). The system will use as well the waste heat from nearby industry and it will be connected to the existing city district heating network.

Table 24: Main data (PITAGORAS European Project, 2016)

MOVESMART

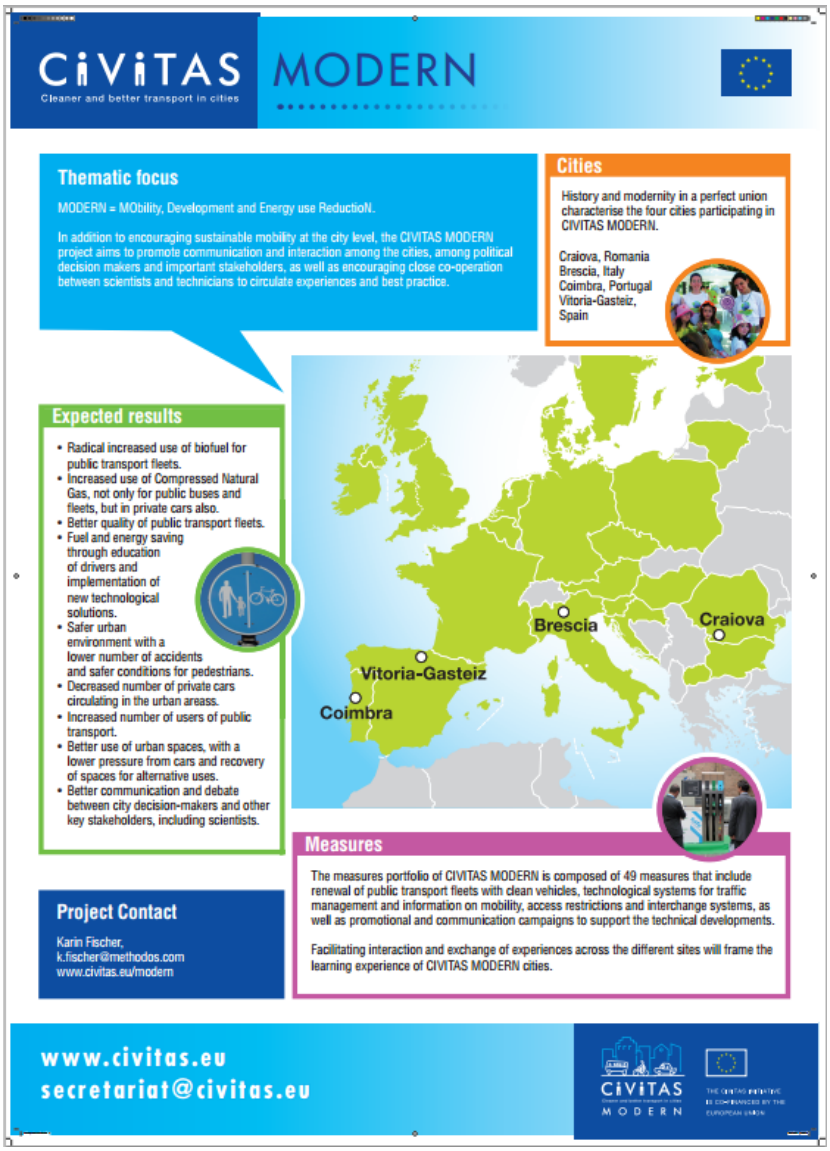
MOVESMART, Renewable Mobility Services in Smart Cities	
Programme	FP7
Coordinator	Ayuntamiento de Vitoria – Gasteiz / Vitoria – Gasteizko Udala
Duration	36 months (November 2013 – October 2016)
Web page	http://www.movesmartfp7.eu/
Figure	 **Figure 29: MOVESMART Innovative Route Planner**
Objective	MOVESMART aims at providing time-dependent route planning and renewable personal mobility services using a set of crowd-sourcing tools for collecting real-time information by multimodal travelers. The core of MOVESMART is a hierarchical urban-traffic infrastructure that is hosted and maintained by a cloud architecture. MOVESMART envisions the server-based creation and maintenance of time-dependent urban-traffic metadata as well as live-traffic logging, hosted in an urban traffic knowledge base (UTKB).
City renovation at district level approach	MOVESMART addresses the problem of providing time-dependent route planning profiles in large-scale urban traffic networks by integrating the use of public transport, supporting electro-mobility and car-sharing/-pooling, exploiting an extensive ad hoc traffic monitoring infrastructure and a traffic

	prediction mechanism for foreseen future incidents, based on a novel crowd sourcing platform. This exploitation of fixed and ad hoc sources of real time traffic sensing information provides proper alerts for emergent (either reported, or predicted) incidents to the involved end users and appropriate contingency plans for the predicted/reported disruptions. To overcome the existing weaknesses for storing and maintaining traffic information, as well as in providing efficiently time dependent route plans, MOVESMART will employ a novel approach, based on the creation and maintenance of time dependent pre-processed urban traffic information that will allow the fast response to route-planning profile queries. Due to the quite demanding computational requirements for the creation and maintenance of this pre-processed information, our choice is to create an UTKB that resides in a cloud of urban traffic servers, and all the pre-processed data updates will be handled centrally by this UTKB. The token is then passed to the portable navigation devices (either in-car devices, or smartphone applications), which submit route-planning profile queries to be handled consequently locally according to the end user's particular preferences and the available options he or she is given. In order to deal with disconnection issues of the portable navigation devices MOVESMART will also provide a synchronization procedure that will periodically feed the local devices with updates of time-dependent snapshots provided by the UTKB. It also maintains the appropriate traffic-information data structures kept in the Urban Traffic Knowledge Base.

Table 25: Main data (MOVESMART European Project, 2016)

CIVITAS MODERN

CIVITAS MODERN, Mobility, Development and Energy use ReductioN	
Programme	FP7
Coordinator	Local Council of Craiova Municipality
Duration	48 months - CIVITAS Plus (2008 – 2012)
Web page	http://civitas.eu/content/modern

Figure	 **Figure 30: CIVITAS MODERN poster**
Objective	The MODERN cities are well aware that the success of transport policy and mobility improvements is not only a question of technical factors but crucially dependent on a culture of clean mobility. They are conscious that single interventions have limited impact and therefore chose for an integrated package of 42 measures that are part of a large-scale programme. CIVITAS MODERN combines the large-scale application of existing and commercially available technologies with activities that make use of advanced methodologies. The interventions include for instance the replacement of the public transport fleet with cleaner vehicles, systems for traffic management and info-mobility or state-of-the-art promotional campaigns. Besides promoting sustainable mobility measures and interaction among the participating cities, CIVITAS MODERN specifically focuses on encouraging strong cooperation among scientists and technicians to learn from experience and best practice throughout Europe.
City renovation at district level	MODERN has been the occasion to conjugate strategic planning to operational demonstrative measures. It has improved each city's project

approach	management skills, enhanced the ability to cater relationships and leveraged technical knowledge to a higher degree. The commitment of Craiova, Brescia, Coimbra and Vitoria-Gasteiz to implement a bold set of integrated measures to reduce the car dependency and the dependency on fossil fuels, optimizing the use of energy and limiting emissions has been fulfilled. The most salient innovations can be summarized as follow: urban planning, e-ticketing, innovative energy sources, cities collaboration.

Table 26: Main data (CIVITAS MODERN European Project, 2012)

PLEEC

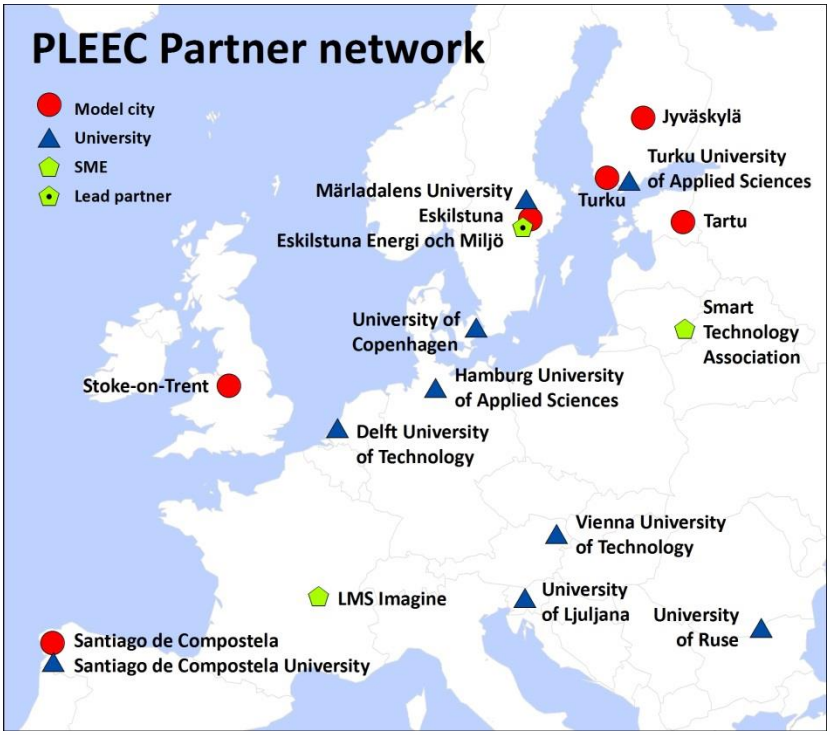
PLEEC, PLanning for Energy Efficient Cities	
Programme	FP7
Coordinator	Eskilstuna Energy Miljö
Duration	36 months (April 2013 – March 2016)
Web page	http://www.pleecproject.eu/
Figure	
Objective	The main objectives of the PLEEC project are: • To assess the energy saving solutions and potentials for a comprehensive city planning. • To demonstrate how integrative planning is more efficient than separate measures. • To create Energy Efficiency Action Plans guiding the cities on their way to become energy smart.

Figure 31: PLEEC partner network

	• To develop a synergized model on energy efficiency and sustainable city planning. • To identify the future research agenda on the issue of energy smart cities.
City renovation at district level approach	The PLEEC project also acknowledges that the planning system has a major role to play in delivering energy efficiency solutions. By analyzing the planning system within each partner city, the project seeks to identify both successes and obstacles in tackling energy efficiency. The findings will identify the key aspects of urban planning that each partner city should focus on to deliver energy efficient potential. The potential of new technology to deliver improvements in energy efficiency is a key component of 18 | Planning and Development Planning and Development | 19 the PLEEC project. Industry and experts in the field will lead on identifying new innovative technical solutions to address to reduce energy use across each partner city.

Table 27: Main data (PLEEC European Project, 2016)

URBACT

URBACT, Connecting cities Building successes	
Programme	ERDF co-funded
Coordinator	-
Duration	URBACT I (2002 – 2006) URBACT II (2007 – 2013) URBACT III (2014 – 2020)
Web page	http://urbact.eu/
Figure	 **Figure 32: URBACT topic diagram**
Objective	URBACT III programme will be organized around four main objectives: • Capacity for Policy Delivery: To improve the capacity of cities to manage sustainable urban policies and practices in an integrated

	and participative way. • Policy Design: To improve the design of sustainable urban policies and practices in cities. • Policy Implementation: To improve the implementation of integrated and sustainable urban strategies and actions in cities. • Building and Sharing Knowledge: To ensure that practitioners and decision makers at all levels have access to knowledge and share know-how on all aspects of sustainable urban development in order to improve urban development policies. To reach these objectives, URBACT III will develop three types of interventions: • transnational exchange, • capacity-building, • capitalization & dissemination.
City renovation at district level approach	For more than ten years, the URBACT programme has been the European Territorial Cooperation programme aiming to foster sustainable integrated urban development in cities across Europe. It is an instrument of the Cohesion Policy, co-financed by the European Regional Development Fund, the 28 Member States, Norway & Switzerland. URBACT's mission is to enable cities to work together and develop integrated solutions to common urban challenges, by networking, learning from one another's experiences, drawing lessons and identifying good practices to improve urban policies. Following the success of the URBACT I and II programmes, URBACT III (2014-2020) has been developed to continue to promote sustainable integrated urban development and contribute to the delivery of the Europe 2020 strategy. URBACT uses resources and know-how to strengthen the capacity of cities to deliver integrated urban strategy and actions on the thematic according to their challenges. The main target participants include practitioners, city managers, elected representatives and stakeholders from other public agencies, the private sector and civil society.

Table 28: Main data (URBACT European Project, 2016)

BALTIC BIOGAS BUS

BALTIC BIOGAS BUS	
Programme	Baltic Sea Region Programme 2007-2013
Coordinator	Västerås Public Transport
Duration	BALTIC BIOGAS BUS (2009 – 2012) MORE BALTIC BIOGAS BUS (2013 – 2014)
Web page	http://www.balticbiogasbus.eu/web/
Figure	

	Figure 33: BALTIC BIOGAS BUS logo
Objective	• Extended use of biogas for city buses will lower emissions, improve inner city air quality and strengthen the role of public transport in an efficient strategy to limit the impact from traffic on climate change. • The project will generate strategies and policies to introduce biogas as well as analyse necessary measures in biogas production, distribution and bus operations. • Activities will be executed to facilitate further expansion. • Presenting cost effective solutions on biogas production as well as distribution and use in buses. The monitoring of economic and environmental impacts will demonstrate a renewable fuel for transport with excellent environmental performance. • The knowledge and experience from the project will form a bridge into the next generation of renewable fuels involving hydrogen. Consequently the project will analyse positive synergies in mixing biogas with hydrogen to get the most out of both renewable fuels.
City renovation at district level approach	The Baltic Biogas Bus project is a EU-funded project aiming to encourage cities and regions around the Baltic Sea to use biogas as a fuel for public transport. Increased use of biogas in urban traffic will reduce emissions of fossil carbon dioxide and also help reduce other air emissions and noise. The project has resulted in numerous reports and real life case studies in the eight participating cities in the Baltic Sea Region: Bergen, Oslo, Stockholm, Helsinki, Tartu, Kaunas, Rzeszów and Wismar. The outcomes confirm that using biogas for public transport bus fleets creates new opportunities for local jobs, supports energy security of the region and may substantially contribute to reducing climate gas emissions and other environmental impacts from public transport. Biogas is a completely renewable energy source and ideal for buses in urban traffic from a climate perspective. The biogas buses also contribute to cleaner air in cities thanks to very low emissions of particles and nitrogen oxide. Biogas is produced from household waste, sewage and agricultural waste. To allow for the biogas to be used as a transport fuel, it needs to be upgraded in an upgrading facility. Thereafter, the gas can be distributed to the bus depot via pipelines or by tanker.

Table 29: Main data (BALTIC BIOGAS BUS European Project, 2014)

8.1.2 European Projects where Lighthouse cities are already involved

Some of the lighthouse cities are already involved in other European Projects.

In the field of energy supply, we can highlight the participation of Vitoria-Gasteiz in PIME'S and POLIS, while relevant partners of this city demo project (VISESA and EVE) have coordinated and participated in TetraEner. Meanwhile, PlanEnergi from Sonderborg has participated in SUNSTORE4 and is now involved in SmartReflex (see above).

In the field of building retrofitting VISESA is participating in FosterREG (coordinated by Tecnalia), while Project ZERO from Sonderborg is involved in reFURB.

Several projects are interrelating mobility and ICT. To sum to the previously mentioned CIVITAS MODERN and MOVESMART, Vitoria-Gasteiz is participating in ICT4EVEU and Naviki. Tartu is a partner in a more transversal approach to ICT based integrated infrastructure (UPSIDE), while Project ZERO from Sonderborg is involved in a research much more focused on the home energy end-user (UserTEC). IBS, partner in Tartu demo project, is also participating in the development of a Smart City platform (ESPRESSO).

Finally, there are two projects focused in facilitating urban planning processes: Vitoria-Gasteiz has participated in LC-FACIL, an URBACT network to foster sustainable urban planning, while Tartu has been a pilot city to implement PLEEC methodology to energy efficiency urban planning (see above).

Energy supply

PIME'S

PIME'S, CONCERTO communities towards optimal thermal and electrical efficiency of buildings and districts, based on MICROGRIDS	
Programme	FP7, CONCERTO
Coordinator	ROGALAND FYLKESKOMMUNE
Duration	48 months (December 2009 - November 2014)
Web page	http://www.pimes.eu/
Objective	PIME's is a CONCERTO joint proposal from Salburua community in Vitoria (ES), Dale community in Sandnes (NO) and Szentendre community in Szentendre (HU). The three communities will work together on RTD, demonstration and dissemination in order to maximise the effect of the measures implanted and the impact of the individual projects.
City renovation at district level	The proposal unites around some central principles, being the implementation of large scale solar thermal and associated heat storage, the

approach	application of intelligent energy management through microgrids and the development of new ESCO models by increase ownership of the inhabitants.
SmartEnCity	The Vitoria-Gasteiz CONCERTO project is located in the eastern part of the city, and includes the construction of an apartment building with 171 social housing units in the new Salburua district, and the integral refurbishment of a 30-unit building block in the adjacent neighbourhood of Zaramaga, which was developed as a social housing district during the 1960s. Both buildings have in common the engagement of occupiers or owners in order to explain and make them aware of the CONCERTO initiative and the particular characteristics of the building. They are informed on how to maximize the benefits of the energy efficiency and renewable energy interventions, not only in terms of their quality of life in relation to living in comfortable and efficient buildings, but also regarding the associated economic and environmental benefits.

Table 30: Main data (PIME'S, 2016)

POLIS

POLIS, Identification and mobilisation of solar potentials via local strategies	
Programme	IEE
Coordinator	Ecofys Germany GmbH
Duration	36 months (September 2009 – August 2012)
Web page	http://www.polis-solar.eu/
Objective	POLIS is a European cooperation project that focuses on implementing strategic town planning and local policy measures to utilize the solar energy capability of structures in European cities. The aim of the project is to identify and evaluate current practices in solar urban planning, and unite the key responsible parties of this process to create a more cohesive planning and legislation practice for solar developments.
City renovation at district level approach	The physical structure of a building and its position within the urban pattern is clearly integral to its solar energy capabilities. Availability and orientation of external surface area is a crucial factor in the design of active solar systems and also important for the reception of passive solar energy. More than any other renewable energy integrated solar energy relies on the qualification of the built environment.
SmartEnCity	Within the Vitoria-Gasteiz solar Action Plan the following long-term targets were set : • Identification of the realistic solar potential at municipal level by 2012. Integration of solar requirements in the Urban Master Plan and Energetic Ordinance by 2015. • Mobilization of 10% of the assessed solar potential in the existing industrial area of the city by 2015.

	• Main focus areas of the Action Plan will be existing and new developments in Lakua District (376 Has. of surface, mainly residential use) and the industrial area of Jundiz (710 Has.). The most important stakeholders for the implementation of the Action Plan are the City council and its different departments.

Table 31: Main data (POLIS, 2012)

TetraEner

TetraEner, Optimal balancing of demand and supply through RES in urban areas.	
Programme	FP7, CONCERTO
Coordinator	Ente Vasco de la Energía (EVE)
Duration	60 months (November 2005 – November 2010)
Web page	http://www.polis-solar.eu/
Objective	The TETRAENER project is based on the premise of creating residential communities where external energy dependency is reduced by optimising the supply/demand balance through an improvement in energy efficiency and the use of renewable energy sources, together with demand monitoring and control applications.
Energy supply at district level approach	These communities can offer a series of synergies with regard to the priorities set out in the CONCERTO initiative: Large-scale integration of renewable energy sources: biomass installations, high efficiency solar thermal systems, photovoltaic-solar systems, wind installations integrated in residential areas, and harnessing of Lake Lman as a heat source in Geneva.Eco-buildings: Passive solar energy harnessing criteria, targets of maximum energy efficiency, integration of RES and application of innovative legislation.
SmartEnCity	EVE (coordinator) and VISESA (partner) are partners of Vitoria-Gasteiz demo project.

Table 32: Main data (TetraEner, 2010)

SUNSTORE4

SUNSTORE4, Innovative, multi-applicable-cost efficient hybrid solar and biomass energy large scale (district) heating system	
Programme	FP7
Coordinator	Marstal Fjernvarme

Duration	60 months (November 2005 – November 2010)
Web page	http://sunstore4.eu/
Objective	The district heating grid in Marstal (Denmark) is demonstrating the integration of a 100% renewable energy plant, based on solar energy and biomass energy (willow wood chips from energy crops), including a compressor heat pump using CO2 as refrigerant and electricity production from biomass through an ORC unit. Based on this experience, the SUNSTORE4 project aims to assess the feasibility of such a plant in other EU countries.
Energy supply at district level approach	-
SmartEnCity	Planenergi Fond is also partner of Sonderborg demo project.

Table 33: Main data (SUNSTORE4, 2011)

Building retrofitting

FosterREG

FosterREG, Fostering public capacity to plan, finance and manage integrated urban REGeneration for sustainable energy uptake	
Programme	H2020
Coordinator	Tecnalia Research & Innovation
Duration	24 months (June 2015 – May 2017)
Web page	http://fosterreg.eu/
Objective	FosterREG aims at enhancing public capacity at local, regional and national levels to plan, finance and manage integrated urban regeneration for sustainable energy uptake, through capacity building, promotion and articulation of effective multilevel coordination, and national as well as European network strengthening. These objectives will be achieved through public stakeholders' engagement in joint analysis and knowledge development activities, as well as creation and dissemination of targeted training materials and activities across Europe.
Building retrofitting at district level approach	Main focus: Integration of energy efficiency measures within urban regeneration plans, with especial emphasis on building retrofitting while promoting synergies with other sectors such as transport and land-use planning.

	Multilevel coordination (European, national, regional and local) of public authorities in the reduction of EU energy consumption. Capacity building for civil servants at national, regional and local level in relation with policy design, planning, financing and management of energy efficiency measures within urban regeneration plans. Implementation of the Energy Effciency Directive, in particular Articles 4 and 7.
SmartEnCity	VISESA and EVE are also partners of Vitoria-Gasteiz demo project.

Table 34: Main data (FosterREG, 2016)

reFURB

reFURB, REgional process innovations FOR Building renovation packages opening markets to zero energy renovations	
Programme	H2020
Coordinator	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V
Duration	36 months (April 2015 – March 2018)
Web page	http://go-refurb.eu/
Objective	Renovation by the private housing sector towards increased energy efficiency is seriously lagging behind. As more than sufficient technological solutions are available, focus must be on removing non-technological barriers. One of the ways to solve this is the use of '1-stop shop concept.' Many initiatives have already been put into practice. Some of these projects were successful, but several were not. They often lack an understanding of the concerns and demands of the house-owners.
Building retrofitting at district level approach	REFURB 2.0 will bridge the gap between supply and demand side by: • developing a holistic approach to the renovation process in which technology combinations trigger step-by-step deep energy renovation of existing, private residential buildings towards NZEB-standards. • accommodating the technology solutions to the decision-making psychology and 'language' of residential house-owners; this will provide the drivers for empowerment and mobilisation of house-owners for deep renovation. • developing a quality and performance protocol to build trust on the demand side.
SmartEnCity	Project ZERO (partner) is the agency in charge of Sonderborg Zero CO2 Plan, and partner responsible of Sonderborg demo project.

Table 35: Main data (reFURB, 2016)

Integrated infrastructure

ICT4EVEU

ICT4EVEU, ICT services for Electric Vehicle Enhancing the User experience	
Programme	FP7
Coordinator	Comunidad Foral de Navarra
Duration	39 months (January 2012 – March 2015)
Web page	http://www.ict4eveu.eu/
Objective	ICT 4 EVEU is a project born with the aim of deploying an innovative set of ICT services for electric vehicle (EV) in different and complementary pilots across Europe. The scope of the ICT services is the integration of different management systems operating on the existing EV infrastructures in the cities where the pilots will be run, so that related services are deployed making use of these interconnected infrastructures.
Integrated infrastructure approach to urban mobility	The pilot will support the interaction among different kind of vehicles: cars and vans, motorbikes, bicycles, pedestrians and public transport system EVs, etc.Among the technologies used in the project there will be different types of charging points, the integration of management systems for them, different kinds of EVs, devices for the users, etc. The project will also deal with the creation of a cooperation network among the cities in the pilots to foster collaboration in smart electromobility topics. Summarising the pilot counts with a strong consortium, an interesting scope and all the tools to become ICT 4 EVEU a successful approach in electromobility.
SmartEnCity	Pilot 2 (Pamplona and Vitoria-Gasteiz, Spain) includes the development of a general management system of electric vehicle infrastructures assuring mobility in an area of 100 Km among the cities of Vitoria and Pamplona, as well as value added E-energy services for the EV drivers, with a double approach, urban and interurban, so the services will be deployed taking into account both of them.

Table 36: Main data (ICT4EVEU, 2016)

Naviki

Naviki, Energy Efficiency through Web 2.0 Bicycle Navigation and Communication	
Programme	IEE
Coordinator	Munster University of Applied Sciences
Duration	32 months (May 2011 – January 2014)

Web page	https://www.naviki.org/
Objective	The Naviki project aims at promoting cycling in European cities and touristic areas by rolling out a European internet platform for navigation, communication and planning in the field of cycling. Naviki addresses a range of national, topical and demographic target groups, from individual users (cyclists, motorists, tourists) to municipalities, corporations and organisations.
Integrated infrastructure approach to urban mobility	With the help of Naviki partners like municipalities, regions, touristic associations and many others are able to offer their users and citizen a special service, to inform and communicate in a modern way and to make their location more attractive to cyclists. Cities or organisations interested in using the Naviki navigation platform in their regions are invited to contact the project coordinator to receive more information.
SmartEnCity	CEA is also a partner of Vitoria-Gasteiz demo project.

Table 37: Main data (Naviki, 2016)

UPSIDE

UPSIDE, User-driven Participatory Solutions for Innovation in Digitally-centred Ecosystems	
Programme	FP7
Coordinator	CYBERFORUM EV
Duration	36 months (July 2013 – June 2016)
Web page	http://www.upside-project.eu/
Objective	The project aims at promoting the development of cooperation frameworks and synergy linkages between research, innovation activities within the companies, urban development policies and open user-driven innovation ecosystems “which are close to the interests and needs of cities and their stakeholders, including citizens and businesses, and which may bridge the gap between short-term city development priorities and longer term technological research and experimentation.”
Integrated infrastructure approach to urban services	Building on the priorities of the cities involved in the project and the market potential, the UPSIDE partners will focus on the following areas: health, including ambient assisted living, intelligent transport systems / mobility public services (e- and m-Government), energy, with a common viewpoint of developing user-driven participatory solutions that use the ICT specializations within each of the partner regions. The cities shall contribute to the faster development of technologies and markets not only through policy support but also by providing the right scale for test beds, which are needed in order to optimize different applications and scale up pilot projects to ensure real-life deployment.

SmartEnCity	Tartu City Government has supported the development of a pilot test bed in the Tartu area and act as a stake- holder of such a test bed. Tartu City Government has also contributed to the definition of a region digital agenda, building on its existing digital policies.

Table 38: Main data (UPSIDE, 2016)

UserTEC

UserTEC, User Practices, Technologies and Residential Energy Consumption	
Programme	Innovation Fund Denmark
Coordinator	Aalborg University
Duration	60 months (April 2013 – March 2018)
Web page	http://sbi.dk/usertec
Objective	The housing sector has been identified as the sector with the largest potential for energy savings. Yet in spite of great technical progress, a large part of the savings is yet to be realized. The potential of energy savings is primarily related to the residents' practices, for example higher expectations of comfort, lacking understanding of the building technologies and technologies that are not adapted to user needs. To achieve energy savings, future energy efficient technologies have to meet users' needs to a greater extent and support their practices in a sustainable direction. This requires deeper understanding of different user practices and their relations to energy consumption.
Integrated infrastructure approach to energy savings	The goal of WP2 "Information and Communication technology and user feedback" is to integrate end-user perspectives in the smart technology development, thereby bringing design decisions closer to actual user practices and enabling user perspectives to drive innovation. WP2 focuses on the communication between construction companies, technology designers and utilities regarding user needs and user conceptualizations.
SmartEnCity	Aalborg University (coordinator) and Project ZERO (partner) are partners of Sonderborg demo project

Table 39: Main data (UserTEC, 2016)

urbanAPI

urbanAPI, Interactive Analysis, Simulation and Visualisation Tools for Urban Agile Policy Implementation	
Programme	FP7
Coordinator	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V
Duration	39 months (September 2011 – November 2014)
Web page	http://www.urbanapi.eu/
Objective	In the context of European initiatives to improve policy as a more transparent and understandable process, the urbanAPI project aims to support activities such as issue identification, policy analysis, consultation, decision and evaluation in urban planning and land management policy. For this purpose, a policy metamodel, a formalised vocabulary, a set of rule languages to define data integration and abstract simulation models are introduced. Furthermore, the urbanAPI approach will transpose elements of agile ICT development to the urban policy making process: Multiple activities can run in parallel, and all activities are kept synchronized. In such a process, risks are identified earlier, conflicts are understood better, and that knowledge gained in one activity can directly be used in all other activities.
Integrated infrastructure approach to urban governance	The urbanAPI toolset allows the fast development and deployment of participative policy support applications for decision support, conflict management, analysis and visualisation. Such developments collectively provide vital decision-making aids for urban planners in the management of the territory, support policy makers for the associated responsibilities in political negotiation, and enable wider stakeholder engagement regarding the future development of the territory.
SmartEnCity	CEA is also a partner in Vitoria-Gasteiz demo project.

Table 40: Main data (urbanAPI, 2015)

ESPRESSO

ESPRESSO, Systemic standardisation approach to empower smart cities and communities	
Programme	H2020
Coordinator	OPEN GEOSPATIAL CONSORTIUM (EUROPE) LIMITED
Duration	24 months (January 2016 – December 2017)
Web page	http://espresso.ru.uni-kl.de/

Objective	ESPRESSO focuses on the development of a conceptual Smart Cities Information Framework, which consists of a Smart City platform (the so-called Smart City enterprise application) and a number of data provision and processing services to integrate data, workflows, and processes in applications relevant for Smart Cities within a common framework.
Integrated infrastructure approach to smart city	To build this framework, the project will identify relevant open standards, technologies, and information models that are currently in use or in development in the various sectors. It analyzes potential issues caused by gaps and overlaps across standards developed by the various standardization organizations and provides guidelines on how to effectively solve those issues.
SmartEnCity	IBS is also a partner in Tartu demo project.

Table 41: Main data (ESPRESSO, 2016)

Social engagement, governance and planning

LC-FACIL

LC-FACIL, working group to facilitate the implementation of integrated sustainable urban development according to the Leipzig Charter	
Programme	URBACT
Coordinator	Leipzig City
Duration	21 months (September 2009 – May 2011)
Web page	http://urbact.eu/lc-facil
Objective	LC-FACIL working group was set up as a "local testing ground" and brings in the partner cities' experience with strategies and instruments on integrated, sustainable urban development, which shall help to define a tool according to the local needs. The ideas of the Leipzig Charter, to reach a sustainable urban development by means of a city-wide integrated approach and by a focus on deprived neighbourhoods, was to be underlined by this non-binding tool for cities.
City renovation at district level approach	The main focus of the project is to interrogate the current status of implementation of integrated sustainable urban development socially (e.g. integration, labour market, skills), economically (e.g. mobility, cities as engines of regional growth), in physical renewal and environmental aspects (e.g. climate change).
Vitoria-Gasteiz	The Local Action Plan has developed an evaluation system, studying some indicators and testing them in one of the city plans: the Mobility and Public Spaces Plan.

Table 42: Main data (LC-FACIL, 2012)

Table 43 summarizes the different fields of work of the projects in which LH cities and other local partners have been involved.

Partner	Project	Energy	Retrofitting	Mobility	ICT	Governance
VITORIA-GASTEIZ						
AVG	PIME'S (FP7)	X				
AVG	Modern (CIVITAS)	X		X		
AVG	POLIS (IEE)	X				X
AVG	LC-FACIL (URBACT)					X
AVG	MOVESMART			X	X	X
AVG + CEA	ICT4EVEU (ICT PSP)			X	X	
CEA	Naviki (IEE)			X	X	
CEA	urbanAPI (FP7)				X	X
VIS	FosterREG (H2020)	X	X			X
VIS + EVE	TetraEner (FP7)	X				
TARTU						
TAR	PLEEC (FP7)	X				X
TAR	UPSIDE (FP7)				X	X
TREA	Meshartility (IEE)	X				X
TREA	RE-GREEN (Interreg IVC)		X			X
IBS	ESPRESSO (H2020)				X	X
SONDERBORG						
ZERO	reFURB (H2020)	X	X			
ZERO + AAU	UserTEC (Innov. Fund Denmark)	X			X	X
PLAN	SUNSTORE4 (FP7)	X				
PLAN	SmartReflex (IEE)	X				X

Table 43: LH cities local partners involved in R&D projects

8.1.3 Local smart city projects where Lighthouse cities are already working on

Regarding to other initiatives in smart city line, the three lighthouse projects have different levels of implication in this topic.

From the beginning of 2016, **Vitoria-Gasteiz** City is coordinating all municipal departments to evaluate the current state of electronic services and elaborate an integrated e-government strategy, as the first stage for a Smart City Strategy. Anyway, there have been several projects during last years to improve the ICT infrastructure and services of local

administration, and the development of new smart solutions in the fields of urban planning, mobility, or environment.

The Plan against Climate Change 2010-2020 defines city strategy for improving energy efficiency and reducing CO2 emissions. The report Vitoria-Gasteiz: carbon neutral city. 2020-2050 scenarios evaluate energy supply and consumption patterns and propose a roadmap towards zero CO2 for the city of Vitoria-Gasteiz. PIME's and POLIS projects are framed within this strategy.

The Urban Mobility and Public Space Plan (2008) is the framework for several projects aimed to integrate smart solutions to improve urban mobility management (CIVITAS Modern, MOVESMART, ICT4EVEU, NAVIKI).

Vitoria-Gasteiz displays a leader role in urban environment management. The city has been engaged in several initiatives and projects: LIFE IRRIGEST (2012-2015), EU Cities Adapt (2012-2013), MILES Managing Information for Local Environment in Sri Lanka (2003-2006), GMES Global Monitoring for Environmental and Security (2003-2005), LIFE Divers Information, Competitiveness and Sustainability in Urban System (2002-2004).

Finally, Vitoria-Gasteiz has participated in LC-FACIL URBACT II Network (2010-2011), aimed to adapt urban planning tools to Leipzig Charter principles on integrated planning and deprived areas intervention. The regeneration of the old quarter of the city was financed in the framework of the Urban Initiative Programme (2007-2013 ERDF).

About **Tartu** there are several planning documents or strategies developed by the municipality regarding to future development of the city.

a) Development strategy Tartu 2030
b) Development plan of the City of Tartu 2013-2020;
c) Comprehensive plan of the City of Tartu;
d) Tartu City Transport Development Plan 2012–2020;
e) Tartu City Water Supply and Sewerage Development Plan 2012-2025;
f) Tartu City bicycle traffic development plan, Hendrikson & Ko, 2006;
g) Tartu City Energy Development Plan Phase II;
h) Environmental noise reduction action plan for Tartu city;
i) Sustainable Energy management Action Plan 2015-2020

Special mention needed by **Smart City Tartu** presented by Deputy Mayor Jarno Laur in UNECE[26]. There are several topics in which this initiative is carrying out actions: Smart administration, E- and M- services for citizens, energy and smart city lab. Main issues are sustainability in energy, mobility, resources consumption and waste fields and ICT integration (with special emphasize in this last one) in the city's normal operation.

In the case or **Sonderborg** there are no other smart city projects where the city is already involved but hopefully SmartEnCity will be the catalyst to initiate this process beyond the replication strategies.

[26] United Nations Economic Commission for Europe.

9 Annex – References

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