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The Description and Assessment of Good Practices for Smart City solutions

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Contents

Page

Introduction 4

1 Scope 6

2 Normative references 6

3 Terms and definitions 6

4 Description of a good practice for smart city solutions 7
4.1 Introduction 7
4.2 Key facts 8
4.3 Public Value Proposition 9
4.4 Target groups 9
4.5 Required Resources 9
4.6 Required Activities 9
4.7 Required Partners 10
4.8 Finances 10
4.8.1 Revenue Streams 10
4.8.2 Costs 10
4.9 Lessons Learned 11

5 Assessment of a good practice for smart city solutions 11
5.1 Introduction 11
5.2 Information assessment 12
5.3 Individual solution assessment 13
5.4 Replication assessment 13

Annex A (informative) Example of a description of a smart city solution: Implementation of a local pro-photovoltaic building policy in Lyon (France) to build a solar district 15

Annex B (informative) Example of a description of a smart city solution: Battery storage power station, Munich (Germany) 20

European foreword

CWA 17381 was developed in accordance with CEN-CENELEC Guide 29 'CEN/CENELEC Workshop Agreements – The way to rapid agreement' and with the relevant provision of CEN/CENELEC Internal Regulations – Part 2. It was agreed on 2018-03-09 in a workshop by representatives of interested parties, approved and supported by CEN following a public call for participation made 2018-02-12. It does not necessarily reflect the views of all stakeholders that might have an interest in its subject matter.

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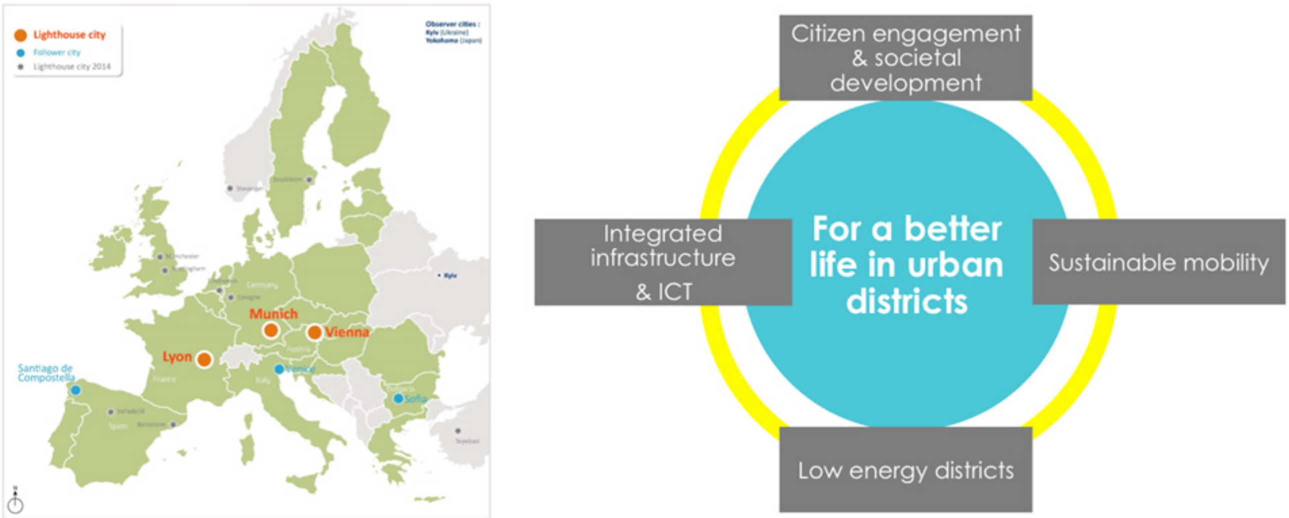
Introduction

Against the background of worldwide urbanization trends coming along with environmental and societal challenges, many organizations, committees, networks and projects have been established and dedicate their work on tackling these challenges in cities and urban areas across the globe. In order to come up with solutions, so-called “good practices” have proved to be an effective means of orientation in initial project stages. Many “good practice” collections have been created in recent years, aiming at demonstrating how certain cities overcame specific challenges in different sectors.

Despite the fact that there are many examples of smart city projects, there are few benchmarks to determine whether they are “good practices” or not. One reason for this is that a definition what “good” means in a city context has not yet been developed. This is mainly because such an assessment requires an individual consideration adapted to the local conditions.
Within the Smart Cities and Communities (SSC) Initiative, the European Commission has carried out nine lighthouse projects so far, which deliver and replicate smart city solutions. One of these projects is SMARTER TOGETHER [1] including the lighthouse cities Vienna, Munich and Lyon and the follower cities Santiago de Compostella, Venice and Sophia. SMARTER TOGETHER aims at deploying in the 3 lighthouse cities a broad set of smart city solutions to improve the life of inhabitants such as solutions to refurbish existing buildings, renewable energy systems, e-mobility services, smart lampposts and data platform operated and controlled cities themselves and used to co-design new services with citizens (see Figure 1).

Figure 1 — Cities involved in SMARTER TOGETHER and key topics addressed within this project [2]



One of the first steps in the project was the collection of good practices in order to learn from other cities in the sectors of (e-)mobility, refurbishment, district heating, data and data standards, processes and methods, business models, as well as governance and participation. The identified good practices had been transferred into a project wiki and are accessible to all project members.

The following study consists of five sections. Scopes and references are asserted in the first and second chapters. The third chapter includes working definitions of relevant terms. In chapter 4 a standardized approach for the description of a "good practice" is presented. The fifth and final chapter describes different approaches to assess a smart city solution by making use of the information gathered in chapter 4.

1 Scope

This CEN Workshop Agreement (CWA) defines requirements to describe and assess good practices of Smart City Solutions.

This document is intended to support the decision-making of smart cities in the interest of their citizens, and of those who advise them, such as companies providing products and services, consultants, and associations.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
Smart City
A smart City is a city that increases the pace at which it provides social, economic, and environmental sustainability outcomes. Smart Cities respond to challenges such as climate change, rapid population growth, and political and economic instability by fundamentally improving how they engage society, apply collaborative leadership methods, work across disciplines and city systems, and use data information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment.

[SOURCE: ISO/DIS 37122:2018, definition 3.1]

3.2
Good Practice
Method, technique, process or product that has been proven to work well and is able to produce good results, and is therefore recommended to be implemented

[SOURCE: FAO Good Practices Template [2], modified]

Note 1 to entry: Methods,techniques, processes or products described as good practice have usually been tested over time and validated, in the broad sense, through repeated trials before being accepted as worthy of adoption more broadly.

3.3
Solution
approach that solves one or more city issues and meets the needs of various city users

[SOURCE: adapted from ISO 37154:2017, definition 3.6, modified]

3.4
Indicator
parameter, or value derived from parameters, which points to, provides information about, and/or describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value

[SOURCE: European Commission 2018 [3]]

4 Description of a good practice for smart city solutions

4.1 Introduction

The aim of describing a smart city solution is to capture existing knowledge about successful methods, projects and activities with regard to city development and to make this knowledge available for future reuse and replication. Through mutual learning, cities are able to evaluate the opportunities they have. This means, it is possible for them to build on existing experiences of others that faced similar challenges to increase the life quality and improve the process performance.

To make use of these experiences, good practices have to be identified and documented in a structured way. However, good practices are often not sufficiently described, which means that their descriptions lack relevant information that complicates a further use.

The following template provides guidance in describing good practices for all types of smart city solutions. Cities and solution providers can follow this template to document a good practice fully in a structured way. Each item of the description is supported by explaining elements (such as general description, potential topics, and examples). The template is one result of the Smarter Together research project, funded under the Horizon2020 framework program of the European Union. The CWA picks up on the activities of the associated research partners and the lighthouse cities Munich, Vienna and Lyon to identify and collect existing good practices in selected focus areas. The structure was developed further with a focus on the notion of value creation for the public. For this, a template has been developed that is inspired by the Business Model Canvas from business model research. The template describes how a good practice is able to create public value and what the essential components are for this. Taking this value perspective, a good practice can be described by the following items of description:

- Key Facts
  - Short description
  - Classification of the Project
  - Solution Environment
  - Background Details
  - Solution Details
  - Further Information
- Value Proposition
- Target Groups
- Required Resources
- Required Activities
- Required Partners
- Finances
  - Revenue Streams

  - — Costs

- — Lessons Learned

4.2 Key facts

In this section, relevant information is collected that give an overview about the smart city solution and its specific context. The purpose of this section is to provide basic information about the solution and to illustrate the specific circumstances in which it has been implemented.

Short Description: In the beginning the solution shall be described briefly. The short description points out the essential characteristics and defines the purpose. This can be seen as a summary of the topics addressed in the sections 4.3 to 4.8.

Classification of the Project: The purpose of this section is to give a short and concise overview on the circumstances of the good practice, which makes the good practices easier to compare. Therefore, the following three main characteristics of the good practice shall be defined:

1) *City/ Region*: name the city or the region where the good practice is implemented

2) *Implementation year:* give the year when the good practice went operational

3) *Sector:* choose all sectors the project intended to affect, e.g. Energy, Mobility, ICT, Waste, Water, Air, Security, Health

4) *Scale of the Project:* the scale of the project shall be defined, e. g. Individual site, Neighbourhood, District level, City Level, Beyond City Level.

Solution Environment: Each good practice has been established under specific conditions. To provide this context and the individual environment, the supporting and limiting factors shall be described. These can be the size of the city or remarkable characteristics in terms of aspects such as urban development, demographic structure or topographic conditions. Other relevant aspects could be the legal considerations or ecological factors.

Background Details: Information shall be provided about the trigger of the implementation of the good practice. This can include the goals and objectives that have been pursued by means of the solution. Furthermore, the needs and main challenges that are addressed by the solution shall be named.

Solution Details: In this section relevant information on the solution implemented within the good practice and the approach shall be described. This can include the citizen participation, the planning time, the implementation time as well as other milestones related to the implementation of the good practice. A more detailed description of the solution (e.g. Smart Lighting), in technical, economical or ecological terms should also be considered.

Further Information: In some cases, the description template is not sufficient to convey and clarify all details. For this, additional sources of information, references and contact persons should be collected in the end of this section.

4.3 Public Value Proposition

Description: A good practice creates value for the public in a sustainable way. In other words, solutions that are considered good practices are used to offer and deliver public value to the citizens of a city. The value proposition shall describe how a good practice contributes to the improvement of life quality in terms of social, ecological or economic aspects. A value proposition can be delivered in different ways. It can be any kind of physical artifact (e.g. building, square, vehicle), service (e.g. sharing offering) or method (e.g. participation process, training programs). The value proposition clearly shall define how a citizen benefits from the smart city solution.

Potential topics: Improvement of life quality, Meeting citizen needs, Solution to problem.

Examples: A solution could be the improvement of air quality by reducing harmful emissions (e.g. reducing CO_2 emissions by 5 percent).

4.4 Target groups

Description: Smart city solutions do not address all citizens of a city in the same way. Most good practices are specific solutions for a defined purpose. Therefore, the target group shall be defined properly to make sure that their needs are met. The definition of the target group should be as precisely as possible. A target group could be defined based on its demographic characteristics but also based on other commonalities (location, profession).

Potential Topics: Common characteristics, Description.

Examples: Car owners in the city center, students.

4.5 Required Resources

Description: For the successful implementation and operation, a smart city solution requires various resources. The required resources part shall describe all relevant assets that are needed to provide and operate the solution and to create value for the citizens. Resources can be physical components, supporting infrastructure, digital infrastructure, knowledge and data. Resources only shall refer to the city's responsibilities. In most cases there are different resources used during the implementation and the subsequent operation e.g. different kinds of data is required during these phases. Here it is of benefit to list the resources separately.

Potential topics: Urban space, Knowledge, Data, Expertise, Materials.

Examples: Specific features of a building site or the data about the volume of traffic in a street (e.g. 200 vehicles per hour).

4.6 Required Activities

Description: The required activities part shall describe what a city needs to do to provide and operate the solution described, which means it shall be described what activities are needed to create value for citizens. These activities could be for example organizational and administrative processes, logistics operations, communication activities or maintenance work. In most cases, there are different activities across the implementation phase and the operation phase of the solution. The implementation phase requires activities that address the planning and research about how the solution can create value while the activities during the operation phase are required to deliver value to the citizens.

Potential topics: Operational activities, Planning activities, Administrative activities.

Examples: Lawn care of recreation area.

4.7 Required Partners

Description: A smart city promotes the ideas of society engagement, the use of collaborative leadership methods and interdisciplinarity aiming to deliver better services and quality of life for citizens. Therefore, cities require collaborations with numerous partners from the public and private sectors to provide and implement a solution. In many cases, private companies manage and operate a smart city solution. Other partners involved could be scientific institutions, universities, planning offices, clubs or advertising agencies. In most cases, there are different partners required for the implementation phase and the operation phase. Therefore, they shall be listed separately. The partners can be described based on their activities and resources with which they contribute to the implementation and operation of solution.

Potential Partners: Companies; Scientific institutions, Governmental institutions.

Examples: Private bike sharing provider, Landscape architecture office.

4.8 Finances

4.8.1 Revenue Streams

Description: This paragraph shall contain the relevant revenue streams. Citizens pay for the value that is offered to them directly (public transit, library, parking) or in an indirect way (taxes). Sometimes revenues are derived from temporary sources such as government funds. Another option is that there is not a direct revenue stream but it is expected that the implementation of a smart city solution leads to indirect effects that increase other revenue streams such as higher tax revenues from companies or tourism. In this section, all revenue streams shall be mapped that are related to the solution. The revenue streams of a solution can consist of continuous and discontinuous elements.

Expected Return on Investment (RoI) period: The period of time the revenue streams of the good practice will take to cover the implementation costs shall be described (for example using the following scale: < 5 years, 5-10 years, 10-15 years, >15 years).

Potential Topics: Taxes, Government fund.

Examples: Funded research project, taxes.

4.8.2 Costs

Description: Each solution can have different cost drivers. Costs can for example arise from involving partners, conducting activities or providing resources. Therefore, the aspects identified in the sections 4.4 to 4.6 could provide some guidance for the definition of relevant cost drivers. These costs shall be listed in this paragraph. In most cases implementation and operation costs should be listed separately.

Initial Invesment: The investment costs of the solution shall be described (for example using the following scale: < 50,000, 50,000-250,000, 250,000-500,000, 500,000-1,000,000, 1,000,000-5,000,000, >5,000,000).

Potential Topics: Material, Labour, Energy.

Examples: Energy costs and maintenance cost of a smart street light.

4.9 Lessons Learned

Description: During the implementation process new information, knowledge and experience is gained. These insights are not necessarily connected with chapters 4.2 to 4.8. Instead, the lessons learned could contain general success factors identified or barriers faced by some of the stakeholders during the implementation. These insights shall be summarized and documented to facilitate the further replication of the solution described.

Potential Topics: Barriers, Success factors, Corrective actions.

Examples: Lack of shared sense regarding detailed key project aims and final project scope with key stakeholders.

5 Assessment of a good practice for smart city solutions

5.1 Introduction

For decision-makers in cities, it is crucial to understand how solutions can be applied and what effects they have on the city and its citizens. Therefore, it is an understandable wish that city representatives would like to have more insight into the specific benefits of a solution. The term “good practice” in the context of smart cities indicates that such a solution provides a substantial and positive impact; however, there is no standardized assessment approach to obtain theses insights.

In the Smarter Together research project, the following aspects that complicate an assessment of smart city solutions were identified:

— It is a complex task to compare similar solutions since in most cases there are not sufficient comparable information.

— The term smart city solution is very broad, which makes it difficult to define universal criteria for a quantitative assessment.

— Each city has different needs, problems and objectives. Therefore, solutions are perceived and applied very differently in cities.

Considering these limitations, the following approach should be applied to analyse and assess a solution. Based on the description of a tentative good practice in chapter 4 different perspectives can be taken to gain a deeper understanding about the applicability and suitability of a solution for a city.

The following three different components of the assessment approach shall be applied:

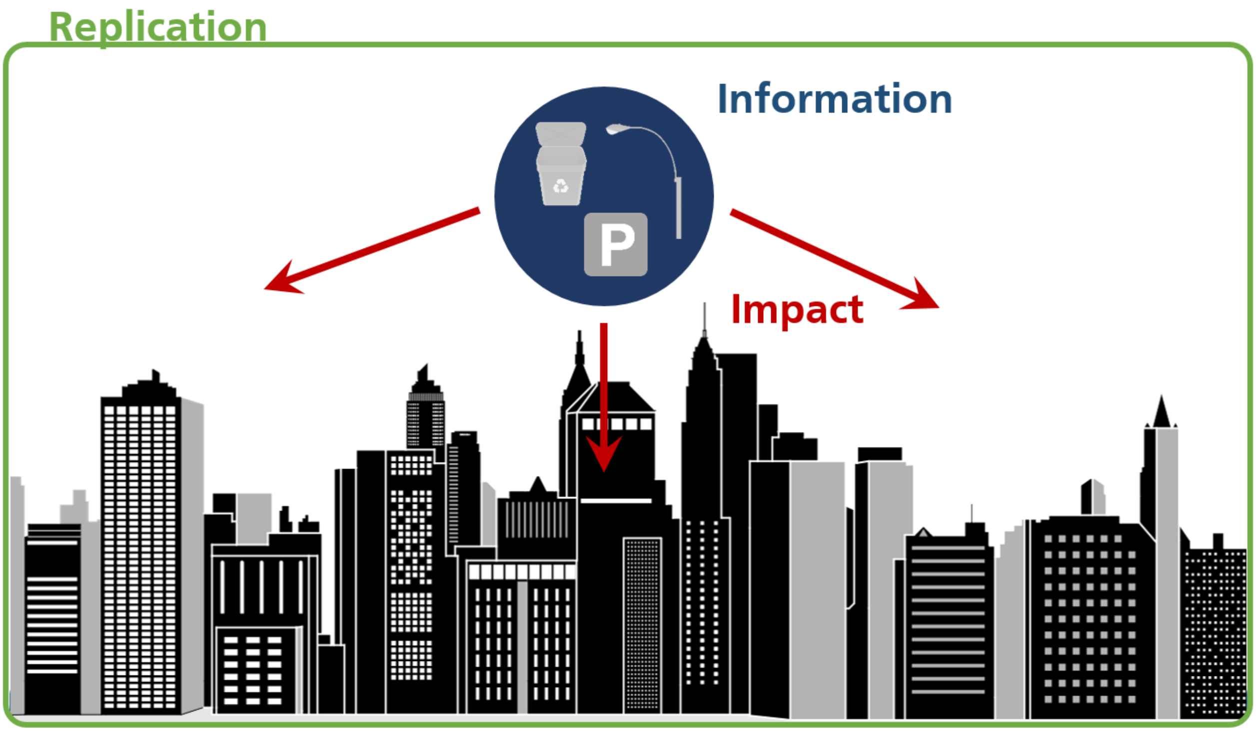
— Information assessment

— Individual solution assessment

— Replication assessment

The figure below shows the relation and the perspective of the three components. The Information assessment (blue) focuses on the availability and quality of the relevant information needed for the replication of a solution. The Individual solution assessment examines the impact of a solution in quantitative terms and the Replication assessment is dedicated to the framework conditions necessary to implement a smart city solution.

Figure 2 — Relation of the three assessment components



5.2 Information assessment

The first component to assess a solution is to assess it in terms of the availability and quality of the relevant information needed for replication or further use. The description of the solution (chapter 4) shall be complete and consistent, since benefiting from a good practice means mainly benefiting from valuable information about the solution. The information is complete, when they facilitate the decision-making based on the description. However, to identify the indicators that help to evaluate the completeness and consistency of a solution remains an individual task. The indicators shall be defined in a way that they provide insight to what extent the information content makes it possible to achieve the intended purpose.

Application: This type of assessment should be used for comparisons in an early stage to find out which solutions meet the fundamental requirements regarding the information availability to be pursued further. In addition, an information assessment can be used to establish individual quality indicators for the collection of information about good practices in a city.

Approach: The following four steps should be fulfilled to conduct the information assessment. The questions support the implementation of each step.

1) Definition of the objective to be achieved by means of the solution

   — What is the contribution of the solution for the strategic goals of the city?

   — What is the role of the solution in the smart city strategy?

2) Definition of information requirements for each part of the description

   — Which information is required in each part of the template to fully describe the solution?

— Is it possible to meet the information requirements considering the availability of information?

3) Definition of indicators to assess the information in each part of the description

— What indicators can be derived from the defined information requirements?

— How can the indicators be evaluated to draw conclusions?

4) Assessment

— The assessment shall be based on steps 1-3.

5.3 Individual solution assessment

The aim of this assessment is to measure the impact of a solution quantitatively after the solution has been implemented. For this, it shall be clearly defined for what purpose the solution has been implemented. Furthermore, to conduct such an assessment a city shall be well aware of the current status of its overarching goals or its smart city strategy. Based on this knowledge and the *Public Value Proposition,* the specific contribution of the solution towards the aspired goal is formulated. From this, indicators can be derived that serve as basis for the assessment. The indicators shall represent the value that a solution provides to the city. If these indicators meet or exceed this formulated contribution, the solution can be considered as a good practice. The assessment requires that there is sufficient data about the starting conditions before the implementation of the solutions takes place.

Application: The following three steps should be fulfilled to find out if a solution achieves the desired effect after its implementation. The questions support the implementation of each step.

Approach*:*

1) Definition of objective to be achieved by means of the solution

— What is the contribution of the solution for the strategic goals of the city?

— What contribution is expected from the solution towards the goals of the city?

2) Definition of indicators to assess the impact of the solution

— What indicators can be defined to assess the impact of the solution?

— What data is needed to properly assess the impact of the solution?

3) Assessment

— The assessment shall be based on steps 1-2.

5.4 Replication assessment

The replication assessment aims to examine the specific suitability of a solution for a city. Instead of focusing on the impact, in the replication assessment the framework conditions shall be analysed to find out if a solution can be implemented and used in a city. For the assessment, information should be obtained from almost all areas of the description. It is a qualitative assessment that regards all internal and external requirements.

The internal requirements should comprise the *Resources*, *Activities*, *Partners* and *Finances*. From this assessment a conclusion can be drawn, whether a city has the capabilities to implement and operate the solution.

The external requirements should be obtained from reviewing the *Key facts*, the *Public Value Proposition*, the *Target groups* and the *Lessons learned*. The actual framework conditions of the city shall be compared with the solution description to find out, whether the solution can be implemented and unfold the desired effect in the city.

Application: The following three steps should be fulfilled to find out if an existing solution can be replicated to another city or within the same city with a different local context. The questions support the implementation of each step.

Approach (internal/external):

1) Analysis of internal requirements

   — Which resources and capabilities have to be provided to be able to implement the solution?

   — What internal resources are available and what partners are needed?

2) Analysis of external requirements

   — What conditions need to be met to replicate the solution successfully?

   — What are relevant drivers and barriers that affect the replication?

3) Definition of indicators to assess the replicability of the solution

   — What indicators can be derived from the internal and external requirements? What are the crucial indicators to assess the replicability?

4) Assessment

   — The assessment shall be based on steps 1-3.

Annex A
(informative)

Example of a description of a smart city solution: Implementation of a local pro-photovoltaic building policy in Lyon (France) to build a solar district

Key facts

Short Description

Lyon-Confluence is a large-scale urban redevelopment project in Lyon, France developed by a public company controlled by the city of Lyon. In order to make real-estate developers and architects design and build low energy buildings equipped with photovoltaic (PV) systems in this area, a local building policy has been set-up by the public company in charge of this urban redevelopement. By the end of 2018, this local pro-PV policy led to the installation, in the city centre, of 29 architecturally integrated PV systems for a total power of 2 MWp.

Classification of the project

1) *City/ Region*: Lyon, France

2) *Implementation year:* the first version of the local building policy was realeased in 2003 with regular updates until 2018

3) *Sector:* Building

4) *Scale of the project:* The scale of this project is a district of the city of Lyon in France called Lyon-Confluence. This district covers an area of 150 ha with approx. 500.000 m2 of existing building and 1.000.000 m2 to be built by 2030.

Solution Environment

Lyon-Confluence is a redevelopment area located in the city centre of Lyon, one of the largest French conurbations with a dynamic economy. Therefore, real estate developers compete to buy land plots to build buildings. This high demand from the building industry makes possible the implementation of such an innovative building policy.

Background Details

The goal of the Lyon-Confluence urban project is to redevelop a former industrial area of 150 ha in the city centre of Lyon in France and to build 1.000.000 m2 of new dwellings, offices and shops by 2030. On top of this global objective, this project has very ambitious targets in terms of sustainability that are described in a Sustainable Action Plan design with the World Wide Fund for Nature (WWF) within the One Planet Living initiative. One of the most ambitious goals set in this action plan is the Zero Carbon objective defined as follow: the 1 million m2 of floor area of new buildings to be built in the area by 2030 should not lead to any increase of the CO2 emissions of the area.

Solution details

This local building policy is a specific guideline that contains several requirements related to Sustainable Development each real estate developer involved in the building design competition has to comply with.

Presently, the requirement relatd to energy that lead to the installation of many PV systems is the following: "Buildings must be positive energy buildings so that the renewable energy produced on-site shall cover the total energy consumption of all usages".

Such a requirement led to the installation of 29 building integrated PV system for a total of 2 MWp such as for instance the 190 kWp PV system of the HIKARI building design by Kengo Kuma and built by Bouygues Immobilier (see following figure).

Figure A.1 — HIKARI, a 12.300 m2 positive energy block located in the Lyon-Confluence area designed by Kengo Kuma (architect) and Bouygues Immobilier (real estate developer) with a 190 kWp PV system [4]

Further Information

Additional sources:

— www.lyon-confluence.fr

References:

— Book: Gaiddon, B., Kaan, H., Munro, D., 'Photovoltaics in the Urban Environment, Lessons Learnt from Large-scale Projects', ISBN 978-1-84407-771-7, Earthscan, London, 2009

— Article: Gaiddon, B., De l'Epine, M., Valentin, M., Vignali, E., Lapray, K., Zanni, O., 'Pro-PV local building policy – State of progress of the Lyon-Confluence solar city project', proceeding of the 32nd European Photovoltaic Solar Energy Conference, Munich, 2016

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Public Value Proposition

SPL Lyon-Confluence aims at developing this urban area to offer inhabitants and users a high quality of life. The public value proposition of the local pro-PV building policy is to benefit from the construction of new buildings to increase the amount of energy from renewables and thus reduce CO2 emissions, reduce the amount of nuclear waste and increase air quality.

Target groups

This local pro-PV building policy addresses several target groups:

— Real-estate developers: the compliance with this local building policy is a condition of the land sell agreement they sign with SPL Lyon-Confluence. Thus, as they have to fulfil all requirements set by SPL Lyon-Confluence to buy the land plot on which they plan to build a building, real-estate developers are the first target group addressed by this local policy.

— Building owners: There are different kinds of building owners in the Lyon-Confluence area (individuals that own a flat, social housing companies, companies, financial institutions, etc.). They are all directly addressed by this local building policy as they buy a part of one building, one entire building or several buildings and therefore also pay part or the entire PV system price. In come cases, they also benefit from the financial revenue generated by the PV system.

— Inhabitants and building users: in addition to the value proposition of this local building policy, inhabitants and building users can also benefit from the locally produced energy, especially when the PV production can be self-consumed.

Required Resources

To be implemented, this local building policy requires one or several land plots, as for instance a former industrial area. The best situation is when the city owns the land and when it is located in an economically attractive area where real estate developers can be challenged such as a city centre or a piece of land located closed to railways, metro or tram station.

Required Activities

In order to implement such a local pro-PV policy, a city needs to include in the requirement set to real estate developers selected for the construction of buildings, in addition to standard requirements such as general building requirements (total area, number of flats, surface of office places, etc.) and architectural requirements (shape, orientation, colour of materials, height, etc.), specific requirements in term of share of the building yearly electricity consumption covered by PV. This obligation to install PV systems linked with the land sell agreement is the key success factor of this smart city solution. This could be only a small share of the building yearly electricity consumption or the entire energy consumption if the objective is to build a positive energy building. Of course, this specific requirement can be extended to the share of renewable in the heat consumption of the building and can also include other requirements such as the embedded energy and the pollution emissions of building material used for the construction of the building.

Required Partners

To successfully implement such a local building policy, a city needs the cooperation of following partners:

— Energy consultants: their task is to assist the city in the definition of specific requirements set in the land sell agreement such as the share of renewables in the electricity consumption of buildings.

— Real estate developers: they are also key partners for the successful implementation of the local pro-PV building policy. In this context, their task is to design and build optimized and cost effective PV systems.

Finances

Revenue Streams

The implementation of this local pro-PV building policy does not generate any direct revenue stream for a city. The main revenue stream that will be generated for a city remains the one that comes from the selling of the land, with or without any additional requirement. The expected ROI period is assessed at around 10 years which is the time period between the preliminary infrastructure work and the selling of the land to real estate developers. There may be additional indirect revenues such as specific taxes related to PV systems and the use of the local distribution grid that depend on the local tax system in force.

Costs

Such a local pro-PV building policy can be used to develop many PV systems in an urban area at very low cost for a city. The only additional cost that may comes from the implementation of this specific measure could be the cost of the energy consultant that may be necessary to help the city to define energy requirements to be included in the land sell agreement such as the share the electricity consumption covered by the PV production.

At the time of writing, the total investment from real estate developers triggerd by this pro-PV policy is assessed at approx. 4,000,000 €, which is the installation cost of all PV systems installed in the area. In this case, the PV system investment cost is supported by building owners. Thus, it is included in the price of flats and office places. In Lyon-Confluence, this cost represents less than 1% of the investment paid by building owners:

— 10.000 m2 building block with 150 kWp PV system,

— Flat price: 3000 €/m2 (low value),

— PV system price: 300.000 € (high value),

— PV system price is 1% of the flat price (pessimistic value).

Lessons Learned

Barriers and success factors

Such a local pro-PV building policy affects the price of flats or office places in a limited way but also the financial margin of real estate developers. This is why this should be first tested with a real estate developer willing to innovate and on an economically attractive area where real estate developers will have no difficulty to sell their buildings.

Also, such a local pro-PV building policy is really challenging to implement when the city does not own the land. In this case, except for specific local legal framework, it will be complicated to set to the real estate developer an obligation to equip its buildings with PV systems. This is also why this smart city solution is easier to implement on new buildings rather than existing buildings, except if the city owns one or several buildings and want to sell them to an investor. In that case, a similar process can be implemented: the building sell contract can include an obligation to install a PV system.

Corrective actions

SPL Lyon-Confluence discovered that it was difficult to know whether or not each PV system was operating optimally on the long-term. This lack of visibility on the actual amount of energy produced by each PV system led SPL Lyon-Confluence to include in its list of requirements the obligation, for real estate developers, to also install a monitoring system for each PV system. The city then signs a legal agreement with each PV system owner that defines conditions of use of the production data, which is mainly to assess the amount of energy produced in the Lyon-Confluence area by PV systems with a specific visualisation tool called “Confluence Monitoring System” developed within the SMARTER TOGETHER project.

Annex B
(informative)

Example of a description of a smart city solution: Battery storage power station, Munich (Germany)[1]

Short description

The battery storage in Freiham is a physical element of Stadtwerke München's (SWM, municipal utility company) virtual power plant (see figure below). The battery storage unit has a capacity of approximately 1 MWh and creates a central grid feed-in point for surplus energy from distributed private generation units (such as photovoltaic installations).

The virtual power plant interconnects and centrally controls a large number of medium-sized to small power generation plants at different locations. This networked solution optimizes the demand-driven deployment of generation capacity in a way comparable to conventional power plants.

Figure B.1 — Battery storage in Freiham (Image from Stadtwerke München)

[1] Description of a smart city solution that is based on an adaption of the description as presented in chapter 4. Therefore the description items have partly different names and not all description items are listed.

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Public value proposition

The battery storage power station enables local electricity producers to participate in the supra-regional energy market. It also plays a part in increasing the use of power generation from renewable sources, as well as helping to stabilize the power grid. Optimal use can be made of surplus energy from distributed plants by feeding it into the battery storage unit. Discrepancies between local electricity demand and local power generation due to the time of day – where electricity is produced by photovoltaic installations, for example – can thus be balanced out.

The battery storage power station was completed in November 2017 and has been operational since the start of 2018.

Components/required resources

Technical description

— Dimensions: Size of a 40-foot shipping container

— Space required: Are there any safety-related specifications regarding building clearance etc.? Yes, including prescribed noise prevention measures (emissions), for example.

— Are there any ground plans? These are irrelevant, as the battery storage unit is a customer-specific one-time installation.

— Standards: Compliance with safety and environmental standards etc. is required. Since the battery storage unit is a customized solution, there are currently no product standards.

— Total electric output: 850 kW

— Capacity: 1 MWh

— Technology: Lithium-ion (li-ion) technology

Design specifications

Are there any urban design specifications?

The battery storage unit stands on the premises of the Freiham heating plant and is shielded from public streets. For this reason, there was no need to make provision for any special urban design specifications.

Interfaces

Are there any interfaces to other projects?

Suitable interfaces to SMARTER TOGETHER projects are in place thanks to the integration of local municipal photovoltaic installations on schools in the project area. These interfaces are important especially in the context of monitoring and data capture.

Location recommendation/location specifications

Are there any location specifications? Can recommendations be made about the location?

Suitable provision must be made for fire prevention, noise emission prevention and prescribed clearances. From a technical perspective, a location with a suitable infrastructure (with regard to the electricity grid) is advantageous and, indeed, necessary. Given SWM's heat and power generation location, these conditions are met. In other locations, it would be necessary to ensure that integration in the local medium-voltage grid is as simple as possible. Locations in the vicinity of grid stations, for example, are therefore ideal.

Areas of application

— Deployment on the German electricity wholesale market should mean that around 600 kW is available from the battery storage. Involving the unit in the electricity wholesale market will help to stabilise the electricity grid. Usage of the battery storage unit (charging and discharging) is managed by the grid operator – in this case the transmission system operator TenneT.

— Approximately 250 kW should be available to absorb surplus electricity volumes from photovoltaic installations. Municipal utility SWM offers photovoltaic system operators a contract governing participation in the virtual power plant. This contract between SWM and the photovoltaic system operators essentially governs the purchase of and compensation for electricity delivered.

— In accordance with this contract, the photovoltaic system operators receive higher income for their surplus electricity than if the same electricity were fed back into the grid without such a contract. In the latter case, the system operators would receive only 80 percent of the otherwise customary feed-in tariff.

— By contrast, the participation agreement gives photovoltaic systems operators compensation in line with the direct marketing strategy which is being promoted.

— However, if electricity from the battery were to be returned to the photovoltaic system operators at times when the photovoltaic system does not meet their own electricity demand, this return delivery would have to be supplemented by all taxes, levies and shared costs, because, for legal purposes, this would be tantamount to supplying a regular end user with electricity from the public grid. For this reason, the possibility of delivering electricity from the battery storage unit to photovoltaic system operators has been delayed until energy industry regulations have been amended accordingly (Status 2016).

Planning process/required activities

What factors must be taken into consideration during first-time planning?

— Lifetime, cost planning, sustainability, disposal.

— The most important aspect probably remains the cost-effectiveness of a battery storage unit, which, regrettably, remains negative in all cases.

Finding a suitable location

What factors must be taken into consideration during first-time planning?

— Space requirements

— Delivery

— Clearances, noise emissions

— Protection against vandalism

Permits

What permits must be obtained?

— Construction permit, fire prevention, certain technical acceptance protocols, electrical and mechanical safety permits

— Prequalification for participation on the electricity wholesale market

Construction order

What factors must be taken into consideration regarding the construction order?

Any such considerations must be aligned with the given location and project.

Commissioning

What factors must be taken into account during commissioning?

— Schedule sufficient time and capacity

— Plan and/or make suitable provision for maintenance (e.g. maintenance agreements)

— Ensure acceptance of electrical and mechanical safety, fire prevention measures, noise prevention measures, functional testing

Required partners

— Manufacturer: Siemens

— Owner and operator (today/in the future): SWM

— Maintenance: SWM (possibly with external support)

Are there any other stakeholders?

The City of Munich is a stakeholder, not least because of the financial support provided within the framework of the supervision and integration of the battery storage unit in the SMARTER TOGETHER project.

Finances

Revenue streams

How will revenue streams be created? On what do revenues depend? (revenue framework)

— Via participation agreements: Photovoltaic system operators receive income for surplus electricity.

— Electricity fed into the battery storage unit is sold by SWM on the electricity market in response to demand.

— Since electricity prices on the wholesale market have deteriorated significantly since 2016, revenues are considerably lower than originally planned. The battery storage unit is therefore less cost-effective, to the detriment of the operator (SWM).

Costs

Set-up costs/one-time costs

What investments are necessary?

A breakdown of actual costs will be provided upon completion of the project.

Running costs

What running costs are expected?

Operating costs: Annual running costs are incurred for maintenance, servicing and marketing. The figures are based on data from manufacturers and empirical values (e.g. the VDI 2067 standard). An assumed annual inflation rate of 1.5 percent is factored into the calculated operating costs.

Target groups

Who do we want to reach? For whom will this project add value?

— SWM and consumers, thanks to a more stable grid

— Photovoltaic system operators, thanks to the ability to feed in surplus energy

Annex

<table>
<tr><th colspan="2">Complementary information for replication assessments</th><th>Target figures</th></tr>
<tr><td rowspan="4">Battery storage power station</td><td>Volume of energy fed in</td><td>Charging and discharging processes take place at short notice.
Evaluation of accounting data will be available in the subsequent year.</td></tr>
<tr><td>Number of payments made to contractual partners for feed-in activities</td><td>The contractual partners (TenneT and customers of the virtual power station) do not share in the cost of the battery storage unit. These contracts and statements are based on independent parameters. The data is customer-specific and will not be published.</td></tr>
<tr><td>Share in securing the power supply</td><td>Not relevant</td></tr>
<tr><td>Number of corrective actions</td><td>n.a.</td></tr>
</table>

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