Definition of Smart Energy City

Definition, key elements and indicators

Deliverable 1.2

Becoming a Smart Energy City

State of the art of 6 Transform cities

Deliverable 1.1

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Introduction

This report summarises the work undertaken under the EU-FP7 TRANSFORM project for Work Package 1 (part 1): Becoming a Smart Energy City, state of the Art and Ambition. Part 1 starts with a clear outline of each of the participating cities. The work describes the context in terms of climate, energy assets, ambitions, targets and main possibilities in terms of energy efficiency, flows and energy production. After this first step, the work focuses on the description of what a smart energy city is (this report), what the main Key Performance Indicators (KPIs) are that should be met and how this relates to where the current cities and the living labs are. It describes at the same time the current status of city planning, energy planning tools, and existing energy data. The outline should also include information on energy production, energy flows and energy efficiency, where possible. The work will draw largely on existing Strategic Energy Action Plans, Climate Action Plans and planning documents.

This report establishes a definition of smart cities develops Key Elements, Key Performance Indicators and reports on the state of the art regarding the KPIs for the 6 Transform cities. As specified in the Transform proposal, the objective of the evaluation is to identify previous and existing initiatives as a sort of stocktaking on the way to establishing a smart city transformation pathway for each of the participating cities in the Transform project. The definition of a smart energy city and the key performance indicators will be used throughout Transform the guide the work.

Definition of Smart Energy City

According to Transform a Smart Energy City is defined as follows:

“The Smart Energy City is highly **energy and resource efficient**, and is increasingly **powered by renewable energy sources**; it relies on **integrated and resilient resource systems**, as well as insight-driven and innovative approaches to strategic

planning. The application of **information, communication and technology** are commonly a means to meet these objectives.

The Smart Energy City, as a core to the concept of the Smart City, provides its users with a liveable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy."

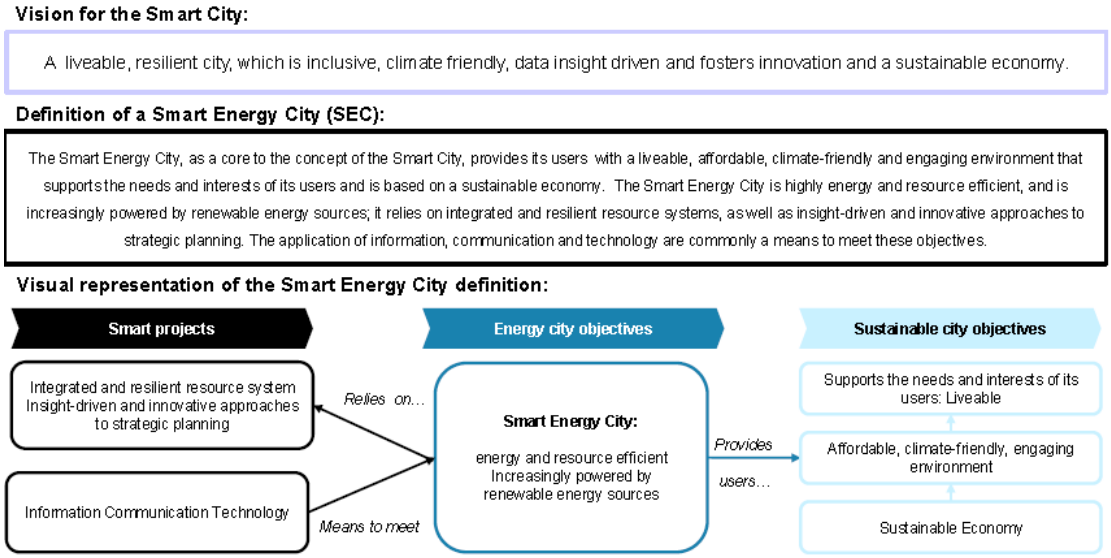

Figure 1. Definition of Smart Energy City and Key elements

Insight in discussion on the definition

Many have tried to defined "smart energy cities" and there is no general consensus on a definition. In particular the definition can be more of less technical and it can be defined at varying degrees of abstraction. In this case the definition has been defined very concrete which can be seen in the evaluation of the key elements. The way the definition has been written it includes the key elements which have been identified directly. So the definition reflects directly the identified 8 key elements. It should also be noted that it has been important for the team that environmental as well as economic and social elements are included in the definition.

The Transform team covers 6 different cities in Europe, with different economics and different social contexts. Specifically for the energy sector the cities are also very different in energy use, energy efficiency and energy production. At the planning level the cities also have very different traditions in city planning, energy planning and of specific relevance to the Transform project, very different traditions in monitoring and data collection.

Key Elements & indicators

The second task of the evaluation was to identify and decide on Key Elements of the smart energy city definition. However, as described above the key elements was identified in an integrated process with defining the smart energy city. Besides trying to determine elements holistically covering environmental, economic as well as social issues, it was also desired to be able to measure the energy issues consistently across different cities qualitatively and quantitatively. It was also desired to keep the number of key elements low to keep the data collection and analysis as simple as possible. The 8 elements determined are outlined below.

List of 8 Key Elements:

- Resource system integration (6)
- Access to energy services (2)
- Resilience (4)
- Energy Efficiency (5)
- Renewable Energy (4)
- Active and engaged users (6)
- Sustainable Economy (3)
- Smart Governance (5)

Definition of Key Performance Indicators

The Third task of the KPI evaluation was to define a form that could be used to assess the Key Elements in a qualitative way. Again a main idea was that the

number of indicators should be manageable. Ideally the target was to have 10 Key Performance Indicators, however this was not possible. With 3-4 indicators per element the resulting number would be 20-30 indicators which were still regarded as manageable taking into account that not all cities needed to provide information for all indicators. The total number of indicators for each element is highlighted in brackets in the above list of Key Elements. In total, there are 35 indicators. The indicator “access to affordable energy services is shown in Figure 2. The full list of indicators is provided in the first reporting from the cities in Appendix A.

1. Key Element definition – Access to energy services

Access to reliable, affordable and sustainable energy services for all energy users, which includes electricity, heating, cooling and gas. Affordable energy is defined as total energy bills not amounting to more than 10% of total household income. The Smart Energy City uses strategies and future planning to increase the affordability of energy to all its citizens, while decreasing future price risks. Furthermore, the City may offer new services to its inhabitants to help decrease individual energy use, and maximise efficiencies.

KPI Categories	KPI (Level 1/rough)	(Level 2)	(Level 3)	(Level 4/smart)
2.1 Access to affordable energy services	Decision to develop strategy to improve access to energy services, incl. Electricity, heating and/or cooling networks.	Develop and publish city strategy to increase accessibility to energy services, incl. Electricity, heating, and/or cooling networks.	Imp. of City strategy to increase accessibility energy services ((incl. pilot projects - public, private and PPP)	City-wide-roll-out of projects to increase access to energy services, and extended cooperation in form of PPP as well as public and private initiatives on-going
	Quant. Measure suggested: % households connected to energy services (adjusted to which energy services are measured and according to the energy system in each individual city) Define goal: ex. 100% households connected to available energy services			
	Low affordability of people's	Develop and publish programme to	Imp. of programme to address low	City-wide-roll-out of programmes for making

	access to energy services and/or decision to develop programme to address low affordability.	address low affordability	affordability (incl. pilot projects - public, private and PPP)	affordable access to energy services.
	Quant measure suggested: % of citizens with energy cost below 10% in share of income (percentage can be adjusted according to what is appropriate for each city).Define goal: ex. <1% of citizens			

Figure 2: Illustration of the background to evaluating the indicator “access to affordable energy services” associated with the key element “access to energy services”.

Development of tool to provide cities with insight

The specific difficulty was in being able to evaluate and determine specific performance of a city. In the case where a performance can be measured in a straight line from 0 to 100% it is relatively easy to determine and monitor it. However, to really assess the performance of a city in these cross sectorial areas it was determined that such an evaluation format was not sufficient. A format developed by The Climate Group et al, 2011 [1] was then considered where a performance was measured on a scale from level 1 to level 4. In this format it is possible to define what should have been achieved to fulfil a level 1 performance and what should be achieved to fulfil a level 2 performance and so forth up to level 4.

[1] Information Marketplaces – The New Economics of Cities, The Climate Group, Arup, Accenture, Horizon, 2011

To illustrate this we can use “implementation of smart meters”. In this case it would appear relevant to look at the implementation of the smart meters ie level 1: 25% implementation of smart meters, level 2: 50% etc. But this does not take the planning process into account. The political and strategic work in developing a “smart meter strategy get it politically accepted may be harder and take longer time than the physical installation of smart meters. This has been some of the considerations, which have been taken into account in developing the method. In some cases, however it is possible to connect the levels 1-4 directly to specific measurable targets. Initially it was the aim to connect the Level 1-4 tool to specific measurable targets. But it turned out to be very difficult and in some cases impossible to defined measurable targets. The issue was not only that it was difficult to measure the process towards a quantitative target.

From insight to implementation

Figures below show the link between the Smart Energy Definition, the key elements and the indicators, with the overall TRANSFORM process. Figure 3 shows the role of the state of the art reports and the baseline analysis in the process of becoming a smart energy city, through the Transformation Agenda, which will provide the agenda for necessary improvements. Both state of the art report and baseline report provide insight and a stand point per city.

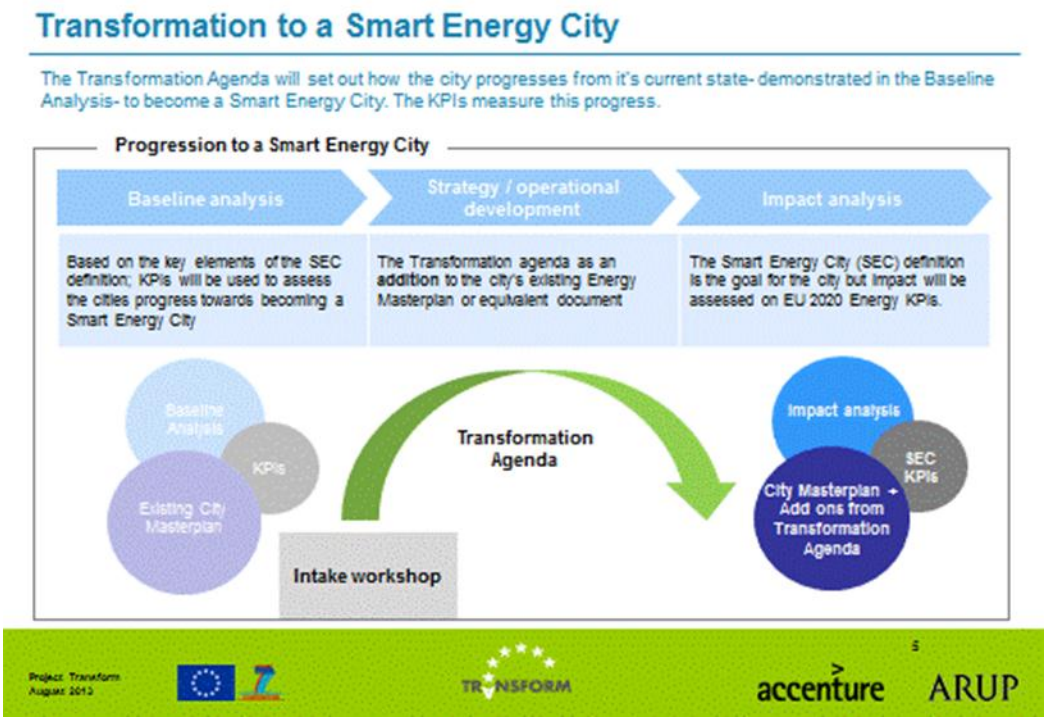

Figure 3. Illustration of the Transform progress including the positioning of the City Baseline Analysis

Figure 4 shows the relation between definition and workflow of the TRANSFORM process. Through the Intake Workshop, the state of the art reports and the baseline reports will be used to filter out themes and enabling themes that cities will work on to get closer to the smart energy city goals. Ability to implement is crucial: the methodology to indicate this ability is shown in figure 4, through a PESTLEGS analysis.

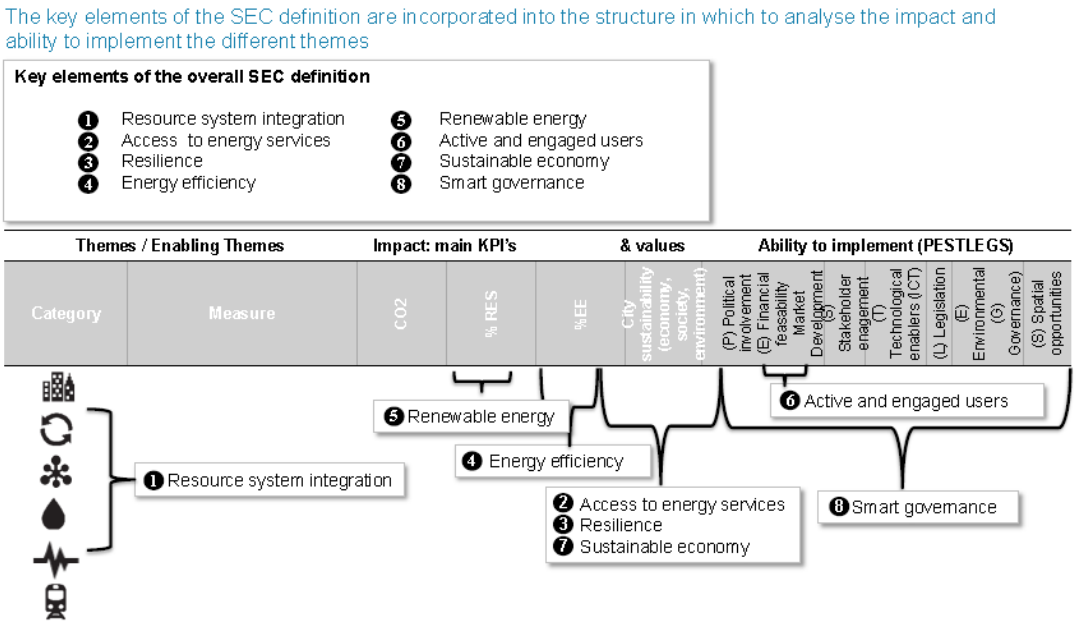

Figure 4. Connecting the definition, key elements and indicators to the TRANSFORM workflow for the Transformation Agenda.

Use of the tool, Workflow

The Level 1-4 tool was used by the team involved in part 1 lead by the City of Copenhagen. DTU/CPH lead the creation of the questionnaires, collection of data and development of the city reports.

1) The process began with DTU/CPH producing a draft questionnaire to be issued to the cities. For more specific information on the KPI questionnaire see Appendix A.

Several telephone meetings and video conferences were carried to determine the format. The format for the final draft of the questionnaire was reviewed by the other active parties in part 1: Accenture and Arup.

2) A blank questionnaire was then issued to each of the cities.

3) Once the data was received from the cities, it was clear that the data where difficult to evaluate and specifically it was difficult to compare the results between the cities.

4) The questionnaire was then shortened in text and a new simpler format produced and the data transferred to the new format. The new format of the questionnaire was returned to each city for fine tuning.

5) The key information from the questionnaire is presented in a 2 page format for each city, attached directly after this report.

Becoming a Smart Energy City – State of the art of 6 Transform cities

Based on an evaluation of the city reports, it can be concluded that some issues can be considered in relation to a further development of the forms. The following section will provide some conclusions about the experiences.

Introduction

The work in part 1 can be described as a sort of process where a mirror is hold up by each of the participating cities, where they can examine their own current performance across a range of sectors, and thereby see what needs to be improved in order to get to a well-defined state of being a smart energy city. The idea of the Transform project is not to compare the results or performance between the 6 cities.

The Baseline Analysis which is also carried out in part 1 provides a **snapshot in time** of each city. This is a **reference point**, from which the Transformation Agenda will define the process to become **A Smart Energy City**. The Key Performance Indicators then provide a set parameters or metrics against which a city can monitor their progress towards being a smart energy city (see fig. 1).

The findings of the KPI evaluation are summarised in a series of six summary reports; one per city. These are the **KPI reports**; the starting place from which the cities will begin their transition to Smart Energy Cities.

As well as providing a point of reference, each city will be able to use their KPI report in their intake workshop. The evaluation will help them to decide the areas they would like to focus their transformation efforts on.

Current status of the KPI reports

As of August 2013, five of the six cities have fully completed the KPI reports. Data from Vienna are based on a more aggregate evaluation of which level they have achieved, but there is currently no detailed information to support the evaluation.

Main analysis considering state of the art reports

Based on an evaluation of the city reports, it can be concluded that some issues can be considered in relation to a further development of the forms. The following section will provide some conclusions about the experiences.

Issues related to the role of the KPI's include:

- In the city reports there is in some cases a mix of information, where the KPI concept both are used in relation to both planning targets and performance indicators in relation to policies and transformation agendas

- Can KPI reports from cities be considered as a baseline for the transformation agenda?
- How can we use the KPI's in relationship to measure transformation agendas?
- Can the KPI's be directly linked to KPI's that are measured by the models that will be developed later in part 3 of the Transform project

The KPI forms can both work in relation to internal clarification in the cities and for cross cutting comparison and guidance for other cities, and this point should be made more clear. However, the questionnaires have been filled out by the cities themselves. They have not been filled out by the part 1 team. Most cities (Copenhagen, Amsterdam, Genoa, Lyon) have also decided which levels their city should be places for each of the indicators. The levels 1-4 have not been decided for these cities by the part 1 team. This is different for Hamburg where the part 1 team have decided the levels for each indicator based on the information provided by the city. In the case of Vienna only the levels have also been decided by the city without providing the background for the decided levels for each indicator. In any case, the part one team has not made any attempt to compare the information provided by the cities with the other cities. It is expected that both the information provided in the questionnaires and decision on current performance for each of the cities will be fine-tuned during the Transform project.

It can also be discussed what is the role of measuring the performance level is. It might be valuable to set targets for all cities in terms of how they could be more advanced over time (even when being at level 4). It is also important to reflect strong as well as weak points in the city forms since this will provide a good reflective and consistent basis for the SWOT analysis. This has been done at varying degree and Lyon is a good example of reflective feedback.

More specific Issues:

- Important to balance the description of the supply system and technologies with demand, consumers and governance

- Include references to planning documents and other official reports
- Consider both energy system issues and the broader economic context

Feedback to methodology

City feedback issues

Examples of key common issues in the city reports are:

- Digital systems and big data platforms are highlighted, new opportunities
- Smart meters are rolled out in most cities
- Detailed energy plans exist including targets for renewable energy
- Public Private Partnership about investments are expected, but few details are given about how to align social and private perspectives and how to create a market

Weaknesses of the city reports include:

- Active citizen participation and challenges are not well covered
- Affordability and extra costs of clean energy, how is the city going to pay?
- Implementation of energy efficiency e.g. in buildings
- Relationship to green economy strategies
- City quality of life issues

State of the art reports (see appendix A)

★ Amsterdam
★ Copenhagen
★ Hamburg
★ Genoa
★ Lyon
★ Vienna