Nantes | Hamburg | Helsinki

Ref. Ares(2017)5877974 - 30/11/2017

mySMARTLife

Deliverable due date: M12 – November 2017

D4.13 Open data and open APIs to the building-level energy savings potential

WP 4, Task 4.5, Subtask 4.5.3

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Project Acronym	mySMARTLife	
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**	
Project Duration	1st December 2016 – 30th November 2021 (60 Months)	
Deliverable	D4.13 Open data and open APIs to the building-level energy savings potential	
Diss. Level	PU	
Status		Working
		Verified by other WPs
	■	Final version
Due date	30/11/2017	
Work Package	WP4	
Lead beneficiary	FVH	
Contributing beneficiary(ies)	HEL,HEN,VTT	
Task description	**Task 4.5: ICT and Urban Platform developments** Energy and district-level components will be developed and up-taken into Helsinki Urban Platform. Currently the Urban Platform consists of over 600 various systems. With Lighthouse, the zone-specific and energy-specific components both to the static open data as well as real-time data (IoT) systems will be implemented. Also, two specific Apps will be developed to demonstrate the value of the new open data and open APIs, and a hackathon will be organised to engage external developers for further data exploitation. - **Subtask 4.5.3**: APIs development to link the domains. Open data and open APIs to integrate and promote the building level energy savings potential will be implemented by FVH in this subtask.	

Date	Version	Author	Comment
16/10/2017	0.1	Timo Ruohomäki (FVH)	First draft
17/10/2017	0.2	Pekka Tuominen (VTT)	Chapter 2, 4
3/11/2017	0.3	Timo Ruohomäki (FVH)	Chapter 3
8/11/2017	0.4	Marja Vuorinen (HEL)	Supportive measures
9/11/2017	0.5	Timo Ruohomäki (HEL)	Minor corrections. Ready for review.
9/11/2017	0.6	Mikko Martikka (HEL)	Minor editing. Ready for review.
26/11/2017	1.0	Timo Ruohomäki (FVH)	Final version, ready for submission.
27/11/2017	1.1	CARTIF	Alignement of contents and final review

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Abbreviations and Acronyms

Acronym	Description
API	Application Programming Interface, a set commands, functions, protocols and objects that programmers can use to create software or interact with an external system
GDPR	General Data Protection Regulation
HSY	Helsinki Region Environmental Services Authority is a municipal body, which produces waste management and water services, as well as providing information on the Helsinki Metropolitan Area and environment. The member cities of HSY are Espoo, Helsinki, Kauniainen and Vantaa.
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
OAI	Open API Initiative
OAS	Open API Specification
OGC	Open Geospatial Consortium
REMA	Rakennetun Ympäristön Energiamalli, acronym in Finnish language for ‘Energy Model of Built Environment’

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1. Executive Summary

This deliverable describes the role of open API's and open data in relation to other actions related to identifying building-level energy savings potential in mySMARTLife Helsinki demonstration cases.

First, the document starts by describing the terms of open data and open API's with their relations to the project activities.

Later on, the document describes the data-driven activities of modelling building stock for evaluation purposes and the various ways to visualize the characteristics of building stock as part of the co-creation and energy advisory activities.

The new Helsinki city 3D-model steering group has agreed to take an "Energy Atlas" to be their lead pilot, providing a platform that was not available in proposal/negotiation phase. In addition to the building level energy savings potential, heat maps (roofs) and solar and geothermal potential can be added to the 3D-model. Also opening the actual consumption of Helsinki social housing company and adding it to the 3D model will take more time than expected.

Considering that an Amendment was requested in September (month 10) and that the process of negotiation and approval can still take several months, it was agreed with the Project Officer to submit an interim report at the original due date, including the description of some of the open data sets and open APIs already developed. In this Amendment, a new due date in month 36 is requested to provide not only this, but the other commitments suggested from the Helsinki city 3D-model steering group.

Thus, the new final due date is requested to be established at month 36, including an additional intermediate report in month 24.

2. Introduction

2.1 Purpose and target group

This deliverable provides an overview on data-driven interventions to define the energy-savings potential on buildings in the Helsinki region. The methods illustrated here are not restricted to demonstration cases only, but naturally those are the main focus.

The three demonstration cases in the project are: 1) Merihaka and Vilhonvuori districts, 2) Kalasatama district, and 3) Viikki environmental house. The following image Figure 1: The Intervention Zones illustrates the demonstration zones:

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Figure 1: The Intervention Zones

2.2 Contributions of Partners

The following table Table 1: Contributions of Partners describes the contributions from partners involved with this deliverable.

Table 1: Contributions of Partners

Participant short name	Contributions
FVH	Main responsibility of the deliverable.
VTT	Definition of modelling methods
HEL	3D –model, Climate Atlas and supportive measures

2.3 Relation to other activities in the project

The following table Table 2: Relation to Other Activities depicts the relationship of this deliverable to other activities (or deliverables) developed as part of the mySMARTLife project.

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Table 2: Relation to Other Activities

Deliverable Number	Contributions
D4.1	Baseline report describes the starting situation of the actions.
D4.11	Practical applications for the urban platform defined in D4.11 Chapter 3 Energy renaissance (link to supportive measures)
D4.4	Report on implementation and performance of innovative smart system appliances and control

3. Open Data and Open APIs

3.1 Definitions

By definition, open data is “data that can be freely used, shared and built-on by anyone, anywhere, for any purpose” (James, 2017). When having a closer look at the mentioned elements of the definition, more detailed requirements can be defined.

Free using means legal openness, being able to get the data, building on top of it and sharing it further. In order to accomplish all this, suitable license terms have to be adopted on the data. Being able to share and build-on, the data must be technically open: there should not be any technical barriers to using that data. As an example, if the data is provided printed on paper, it is very difficult to process it further. The same can apply on file formats: a closed, complex file format with no public documentation and restrictive license terms can make the data unusable even though in theory it is machine-readable.

As addition to the legal and technical requirements, there are also some operational requirements related to open data, especially in a public organization. First of all, opening the data should be included in the document management workflow: data is by default open if there is no any specific reason to keep it private. Naturally there are various reasons why some data must remain private, such as data that is related to an identified person. Secondly, published data must be found: the existence and location of data source should be publicly known. A recommendation is that the city, municipality or government body has a well-maintained public data catalogue that provides a collection of useful data sets, tagged with keywords and other metadata to improve findability. Finally, the open data should be provided in a way that it is understandable. The structure and meaning of the data in question has to be described and documented, providing adequate level of context and backgrounds. Data that cannot be interpreted in the same way its creator intended remains useless.

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While open data often refers to government information which has been made available to the citizens, other types of organizations and citizens can also publish open data.

Open API is a term often referring to the work of Open API Initiative (OAI), which is an expert group working under the governance structure of the Linux Foundation. The OAI focuses on creating, evolving and promoting a vendor neutral description format.

The OpenAPI Specification (OAS) defines a standard, programming language-agnostic interface description for REST APIs, which allows both humans and computers to discover and understand the capabilities of a service without requiring access to source code, additional documentation, or reverse-engineering in the means of inspection of network traffic. It is expected that a consumer could understand and interact with the remote service with only a minimal amount of implementation logic (Open API Initiative, 2017).

3.2 Privacy requirements

The upcoming General Data Protection Regulation (GDPR) includes a more specific definition on what data is considered as personal data and should be managed accordingly. The official enforcement date for the new regulation will be May 25th, 2018 which makes the GDPR compliance a key requirement on data management on the mySMARTLife –project.

The urban platform is a generic data platform and data hub for any kind of data. Therefore it has to be assumed that the data can include information that falls into the category of personal data according to the GDPR. This will cause some technical requirements such as encryption of data, being able to allow the citizen to decide what to use the data for (MyData) and logging relevant actions in order to support auditing requirements and proof of the given consent (Trunomi, 2017).

3.3 Relations to other initiatives

Open Data and Open APIs have numerous relations with other projects in both Horizon2020 and European Regional Development Fund projects. While parallel development is not always an issue and can even lower risks related to technology, findings from the related initiatives have been studied and adopted when relevant.

In order to improve interoperability and ease re-use of the developed work, a decision has been made to implement the SensorThings API from OGC, Open Geospatial Consortium. The urban platform should also be capable of providing ready data for 3D city models, thus support for CityGML version 2.0 is expected to be implemented.

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4. Data-driven Services

4.1 Helsinki 3D Map and city open data services

In mySMARTLife project Helsinki has a goal to open several energy-related datasets in 3D-model and in open access data (*Figure 2: City 3D Visualization Example and Figure 3: Planned Public Energy Data Sets*). The goal is to increase the knowledge of possibilities to increase energy efficiency and renewable energy production especially in renovation stage to help to reach Helsinki's ambitious climate goals. There are several recognized international experiences that show that open energy data motivates all stakeholders to do action when relevant information is available.

The benefits for different target groups are:

1. Data increases building owner's interest on the performance of their buildings when they can compare their consumption and renovation need and they can see the potential for energy improvements
2. Data supports especially smart and clean technology related businesses when the building stock's energy related data can be found easily and used for business purposes. In example businesses can estimate if the roof renovation is coming soon which can be combined with solar panel installation
3. Investors can get better access on the information of building stock, which eases making the financial decisions related to energy renovation projects
4. Data and 3D energy model eases the city planners to concentrate on the most beneficial areas in energy renovation efforts when all the data can be processed simultaneously

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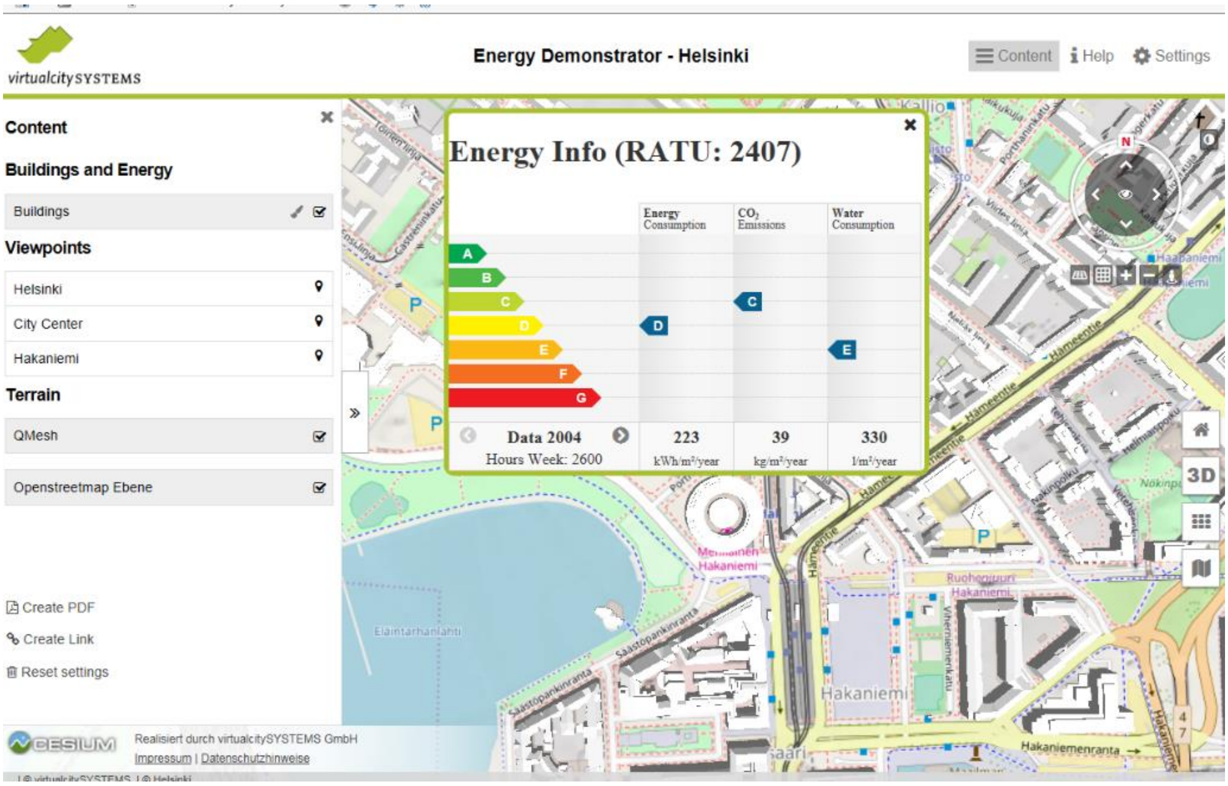

Figure 2: City 3D Visualization Example

Data	Source	Will be published	Challenges
1. Building renovation history	Facta building registry	Feb 2018	Some old data in paper format
2. Hekan apartment buildings heat, electricity and water consumption	Heka Ltd.	Feb 2018	
3. Energy certificate registry	www.energiatodistusrekisteri.fi	2018?	Building ID's needed
4. Public service buildings consumption	HEL Buildings and public areas div.	End of 2018	Energy monitoring renewed
5. Calculated energy consumption of all buildings	VTT	Feb 2018	
6. Calculated energy saving potential in one area (Merihaka)	VTT	Feb 2018	
7. Heat loss images of Helsinki's roofs reanalysis	HSY, kartta.hsy.fi	Feb 2018	Don't fit directly in buildings
8. Large scale waste heat potential of buildings	Metropolia study	2019	Preliminary study done, needs more accurate info
9. Solar energy potential and visualization	HSY+3D, kartta.hsy.fi	Feb 2018	
10. Thermal imaging of facades in one neighbourhood (Merihaka)	HEL environmental services	Winter 2018	Right weather needed (cold+dry)

Figure 3: Planned Public Energy Data Sets

4.2 Climate Atlas

In previous EU-funded projects HSY has produced the following datasets including all buildings in Helsinki:

1) Solar power potential: solar irradiation on the roofs, suitable locations for PV installations and estimated yearly electricity yield
2) Roof heat loss thermal map
3) Green roofs: existing (built and spontaneous) and potential

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These datasets listed above are freely available through HSY open data interface and can also be utilized e.g. by the Helsinki 3D model.

Furthermore, all the new energy data produced in the project will be added to HSY map service kartta.hsy.fi. A new, user friendly, visual and functional 2D-application called Climate Atlas is developed, based on the existing service. This application will present all the energy and climate related open data in Helsinki and in the surrounding metropolitan area. It focuses on city wide datasets and works side by side with the 3D model.

In 2017, the development of the Climate Atlas has been started in collaboration with an ICT provider. In October 2017, the first version of Climate Atlas was in customer test, and it will be launched in the 1st quarter of 2018. In 2018, the service will be further developed to meet the needs of different user groups. Also, the data generated in mySMARTLife project will be processed to spatial data in building level, visualized and added to the Climate Atlas.

4.3 Using Modelling for Studying Energy Use in Building Stock

Both 3D Map and Climate Atlas services are linked to REMA calculation model developed by VTT. The REMA tool was created for information management and for evaluating the impacts of repairs to be made to individual buildings and the building stock as whole.

The model will help to analyse a variety of technological scenarios, evaluating factors such as the technological potential for reducing carbon dioxide emissions from the building stock. The tool has also been used to outline cost impact scenarios for the most effective measures.

The REMA model uses as inputs the energetic properties of each building type and sub-type in Figure 2. For existing buildings, the combined living area of the type is included and a linear annual decrease in that area over time due to demolitions or abandonment. For new buildings, a linear increase in the amount of each particular building type is assumed over time until it is replaced with a newer building type. In this case, REMA is used to provide a reference level of energy efficiency for buildings of various type and age that can then be visualized in a map view. REMA is also used to produce forecasts of energy savings in the building stock with energy improvements included in renovations.

The building stock is slow to renew, so decisions concerning the energy efficiency of buildings have long lasting implications. REMA helps choose the appropriate measures for buildings built in various decades and using various methods so as to improve their energy efficiency and reduce their carbon dioxide emissions. For example, the impact of improving the external shell of a building or changing the heating system on carbon dioxide emissions may vary enormously.

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The REMA model can support the owners of major real estate properties, building management companies, contractors and the city authorities in planning an energy strategy for the buildings under their management. This can mean things such as renovation plans, decisions concerning new buildings and installation of integrated energy infrastructure such as heat pumps or solar panels.

As an energy model, REMA can be categorized as a bottom-up model of energy use in the building stock. In the context of the building stock, top-down methods estimate energy use in buildings based on variables that pertain to the whole buildings sector. Bottom-up methods, on the other hand, calculate the total sum of energy consumption in the building stock based on limited distinct categories of buildings and their respective sizes and energetic properties, sometimes called archetypes. In REMA buildings are categorized as shown below. (Tuominen et al. 2014).

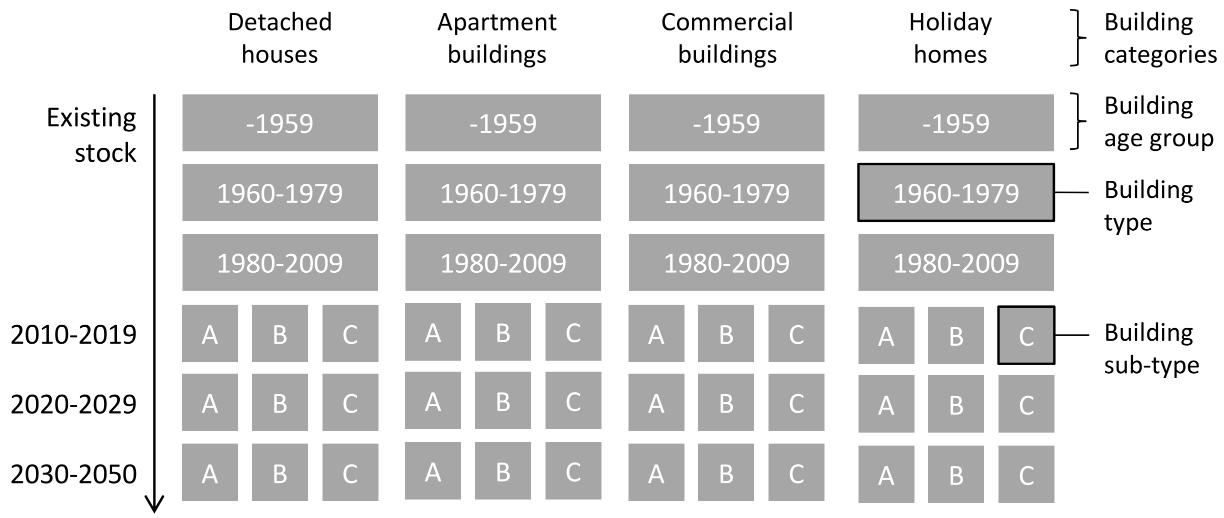

Figure 4: Existing and future building stock categorized

In the figure above, building age refers to all building types of the same age, whereas building type only refers to a certain category of building of a certain age.

Energy models of the building stock use different types of inputs depending on the type of the model. Different strengths, weaknesses and capabilities result from the choice of modelling approach. For instance, the level of detail in the model can vary greatly depending on the selected methodology, which is also true for the inputs required. Typically input data includes information such as physical properties of the buildings, number of occupants, appliances and equipment in use, historical energy consumption,

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climate conditions and economic variables. This information can be very detailed or rely on aggregated values such as averages.

Bottom-up models contain varying amount of detail concerning the composition of the energy consumption totals. They can be based on the energy consumption in different end uses, individual buildings or groups of buildings. These data are summed using the representative weight of each category of energy consumption in the sample. (Tuominen 2015)

In REMA future developments are estimated using annual rates of new construction, renovations and removals from the building stock. This approach can be used to create varying scenarios for the development of the building stock and its energy use. Typically the REMA model can be used to support the owners of major real estate properties, building management companies, contractors and the city authorities in planning an energy strategy for the buildings under their management. This can mean things such as renovation plans, decisions concerning new buildings and installation of integrated energy infrastructure such as heat pumps or solar panels. More advanced analysis is possible by adding a dynamic layer to energy modelling allows creating scenarios that develop on their own according to modelling parameters to find optimum solutions (Tuominen et al. 2017) or by analyzing the cost-effectiveness of proposed energy efficiency measures (Tuominen et al. 2015).

4.4 Supportive measures

Participation and interaction have been important activities for the city of Helsinki in the past, and attention to these areas has increased even more recently due to the organisational reform and the new city strategy. The new forms of civic participation, defined as city activism or urban activism are also taken in account.

Between the city of Helsinki and local businesses the cooperation in climate-related matters has been organized in the form of climate partners network. It fosters cooperation to reduce emissions that affect the climate as well as the cooperation to make companies smarter. More detailed and more actual data will help the businesses to meet their goals in the future.

The new city strategy seeks to make Helsinki the world’s most functional city, to ensure sustainable growth and to provide good everyday life for all its residents. New strategy includes the goal to render Helsinki carbon neutral by 2035. Helsinki aims to reduce emissions by 60 per cent by 2030.

Smart, liveable and carbon neutral city can be achieved in collaboration between citizens, decision-makers and businesses. City 3D model with its energy data aims to help achieving these new goals.

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Utilising the 3D model in energy advising

The 3D model and its possibilities to visualise energy saving potentials are demonstrated in mySMARTLife project. The visualisations can be utilised in planning and decision making by different stakeholders such as property owners, management companies, contractors and city planners.

As mentioned in Chapter 4.2 the energy data of building performance and characteristics is added to the city 3D model. The model provides a reference level when comparing the performance of one's own building with a computational performance of a similar building in the model. One can also get an estimate of for example solar power potential of the buildings.

In order to find out the best use cases for the 3D model and the energy related data in energy advising it is necessary to know the needs of residents concerning energy issues. City of Helsinki has a lot of experience in how to engage and involve people as explained in D4.1 Baseline report, Chapter 7 Identification of existing actions for citizen engagement and their success rates.

During the mySMARTLife project a series of info evenings and workshops are organized in Merihaka area as part of Action 32 Smart District-Level Energy Renaissance Strategy and Action 40 Implementing Energy Advisor, as described in more detail in D4.4 Chapter 3 to find out more about the needs of the residents and possible ways to utilise the 3D model. Progressively the model is presented and introduced in the first info evening followed by workshops to develop the services and use cases further with the residents according to their needs and ideas.

A survey was conducted regarding the 3D model and its use at the Lähiöfest festival (suburban living festival) in Helsinki on the 30th of October amongst the festival visitors. The results (25 answers) showed that most of the respondents had never used the model before but would most likely be using it in the future, e. g. to visualise energy savings or to compare building performances.

As part of the co-creation efforts, a living lab space was set up in the Kalasatama district in 2015 as part of the Smart Kalasatama –project. The space is located within the district and has attracted people living in the neighbourhood participating in planning events. From 2015 to 2017, a total of 76 events and larger workshops have been organized with over 2.300 people participating. The space and approach has also interested visitors, the Kalasatama activities have been demonstrated to over 1.300 visitors during that time.

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5. Conclusions

The current report provides a description of data-driven activities of modelling building stock for evaluation purposes and the various ways to visualize the characteristics of building stock as part of the co-creation and energy advisory activities.

REMA model is presented as a valuable tool to analyse a variety of technological scenarios, evaluating factors such as the technological potential for reducing carbon dioxide emissions from the building stock. This tool, developed by VTT, has also been used to outline cost impact scenarios for the most effective measures. Typically the REMA model can be used to support the owners of major real estate properties, building management companies, contractors and the city authorities in planning an energy strategy for the buildings under their management.

In the end of the first year of the mySMARTLife project, the planned actions have already resulted to a clear view on the requirements of data and API's in order to set up the monitoring mechanisms. The data to monitor the impact of the project is getting ready and will be ready to be visualised on the existing city services, such as the Climate Atlas. The workflows and quality of data will be improved in the upcoming years of the project. Facility owners will be encouraged to open more data, thus leading to a more complete understanding of the energy consumption of buildings. The project includes several activities related to identifying the energy savings potential from a sensor-level to the simulations. After the project, the city will have a better tool to both manage their own initiatives and influence the citizens to act locally.

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