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D3.8 - Adaptation of Groningen ICT platform

WP3; Task 3.7

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Abbreviations and Acronyms

Acronym	Description
API	Application Programming Interface
CKAN	Comprehensive Knowledge Archive Network, a web-based open-source management system for storage and distribution of open data.
CPMS	Charge Point Management System
IoT	Internet of Things
ESSIM	Energy System SIMulator
GDPR	General Data Protection Regulation
OUP	Open Urban Platforms (also working group of EIP-SCC)
PED	Positive Energy District
RES	Renewable Energy System
SCIS	Smart Cities Information System
WP	Work Packet





Executive Summary

In Groningen several existing platforms are available to support WP3 and the Monitoring Programme as described in WP5.

Objective of WP3 is delivering Lighthouse demonstration actions in Groningen, two Positive Energy Districts will be designed and validated, Groningen North and Groningen Southeast. These PEDs will be based on the development of high performance buildings (new, retrofitted) with different use (tertiary, residential, shopping malls) combined with very advanced energy systems, mainly based on RES.

Task 3.7 is in charge of developing and integrating services and modules to ensure the performance monitoring objectives and to improve city operation, decision making and citizen engagement (to ensure the interaction between the city of Groningen and its citizens). Open data, interoperability and the compliance of GDPR normative are considered. Advanced data analytics is used to calculate the necessary metrics and Project Indicator, as well as to obtain new insights from the monitoring data collected in the district.

The existing ICT platforms in Groningen are adapted using an open-specifications approach (Subtask 3.7.1). Data from the different demonstrative actions have been integrated and open APIs are implemented. Where necessary new data sources have been integrated via open standards and according to the open specifications selected in WP5.

The resulting Urban Data Platform has enabled analysis of the results, including calculation of the performance indicators outlined in WP5 (Task 5.2). Additionally new services have been integrated based on the open specifications and use of standards (Task 3.7.2). With the addition of these standard interfaces it has opened the existing platforms and their ecosystems for new use cases and services in the future.





1 Introduction

1.1 Purpose and target group

This report constitutes Deliverable "D3.8 Adaptation of Groningen ICT platform" which is the main outcome of the "Task 3.7.1 Existing ICT-Groningen Platform adaptations towards an open-specifications approach".

The main objective of the deliverable is to describe the modifications of the existing ICT platforms to form an Urban Data Platform and to align with the standards and open specifications agreed in the MAKING-CITY project (D5.9 - ICT-City Platforms: common open specifications).

Chapter 2 of this deliverable introduces the Urban Data Platform architecture, chapter 3 describes the existing platforms and chapter 4 then explains how these platforms are integrated to form the Groningen Urban Data Platform.

1.2 Contribution partners

The following Table 1 depicts the main contributions from participant partners in the development of this deliverable.

Partner nº and short name	Contribution
03-GRO	Describing the Groningen Open Data platform. Sections 3.1.3, 3.2.3 and 4.1.3.
04-TNO	Review and the descriptions of TNO ESSIM and HeatMatcher.
09-CGI	Overall document and Energy Islands Platform description.
10-SB	Describing the Sustainable Buildings platform. Sections 3.1.1, 3.2.1 and 4.1.1.
11-RUG	Review

Table 1: Contribution of partners

1.3 Relation to other activities in the project

The following Table 2 depicts the main relationship of this deliverable to other activities (or deliverables) developed within the MAKING-CITY Project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable/ Action n ^o	Relation
D5.2	<i>Project level indicators</i> Specifies the Project level indicators that should be calculated and/or stored in the Urban Data Platform.
D5.5	Data sets: Requirements, collection and protections A high-level description of the data sets stored in the Urban Data Platform





D5.8	<i>Groningen Monitoring Programme</i> Specifies the metrics that are calculated in the Urban Data Platform.
D5.9	<i>ICT-City Platforms: common open specifications</i> Open specifications, including standards and reference architecture for the Urban Data Platform.
D3.9	<i>Services and Modules for Groningen ICT Platform</i> Description of Services and modules built on and into the Urban Data Platform
Task 3.7.1	Platform adaptation
Action 7	Advanced energy metering
Action 8	Demand response/Smart Grid
Action 34	Connection of the charging stations to the local demand response system
Action 35	Open urban platform adaptation
Action 36	Energy data monitoring of PED
Action 37	Integration of new services to the data platform





2 Target Urban Data Platform

The existing ICT platforms in Groningen are adapted using an open-specifications approach. Deliverable *D5.9 ICT-City Platforms: common open specifications* describes the specification for what is an Urban Data Platform. Data from the different demonstrative actions are integrated and open APIs are implemented to facilitate data exchange between consortium partners and publication of Open Data to citizens and other interested stakeholders. Figure 1 gives an overview of the Urban Data Platform responsibilities. For a detailed description of the pictured reference architecture, see the deliverable D5.9. In this section we will highlight the relevant responsibilities of the platform for Groningen and WP3.



Figure 1: MAKING-CITY Urban Data Platform reference architecture

2.1 Data Market

The purpose of the data market is to facilitate data consumers finding and obtaining the data relevant for them. For the Groningen Urban Data Platform in the MAKING-CITY project we identified three types of data consumers:

- 1. External observers
- 2. Consortium partners
- 3. Building owners

External observers view aggregated data describing the results of the MAKING-CITY project. This enables them to evaluate and interpret the reports produced as part of the project.

Consortium partners use detailed data for analysis and further calculations, mainly as part of the Monitoring Programme.





Building owners, of which some are consortium partners, have access to the detailed data that is collected from their buildings. This supports citizen engagement initiatives for residential buildings by showing the impact any interventions have on the energy consumption and production of their building.

These groups have different requirements for finding and interacting with the data. Focusing on the external observers and consortium partners, some of the differences are:

- 1. Read-only access for external observers vs. reading and adding data for consortium partners
- 2. Open Data vs. secure access to detailed data
- 3. Aggregated analysis results vs. raw measurements
- 4. Searching for sets of data vs. querying predefined endpoints for a subset of data

For Groningen this results in the following high level split in the Data Market:

- 1. External observers access published data sets via the Groningen Open Data Portal.
- 2. Consortium partners retrieve data via a secure API via the CGI Energy Islands platform.
- 3. Buildings owners have access to dedicated dashboards showing data collected from their buildings only.

Figure 4 shows the relationship of the data consumers, as stakeholders, with the Groningen Urban Data Platform. The internal relationship of the different platforms forming the Groningen Urban Data Platform is described in the rest of this document with a similar diagram with more details in Figure 5.







Figure 2: Stakeholders of the Groningen Urban Data Platform

2.2 Data Management Framework

The core of an Urban Data Platform is receiving and storing data in the Data Management Framework. The Groningen Urban Data Platform will be realised using three existing platforms: Sustainable Buildings platform, CGI's Energy Islands platform and the Groningen Open Data platform. All three platforms already have data management responsibilities in their existing roles. The next chapter will describe how they are integrated to form the Data Management Framework for the Groningen Urban Data Platform and how the responsibilities are divided.

2.3 Security & Privacy

As described in the Data Market section, the security concerns are focused on the access to detailed data for consortium partners.

Privacy concerns are covered by strict limitations on sharing data. Agreements in relation to GDPR are in place to only allow sharing personal data with consortium partners with clear agreement on ownership and purpose. This is especially important in the Groningen monitoring programme, where different partners are responsible for collection, processing and publishing of the data. The city of Groningen is owner of the data and needs to approve any data access when it may include personal data.





The different interfaces enable control of the access to data for which agreements are needed:

- 1. The Groningen Open Data platform will provide access to Open Data only. There is no authentication or authorization to limit data access for data that is published there.
- 2. The dashboards and APIs of the Energy Islands Platform provide access to all relevant detailed data for consortium partners, which can include personal data. Access requires authentication with a personal accounts and authorization is used to limit access to consortium partners with the required agreements in place.
- 3. The dashboards of Sustainable Buildings platform, which may include personal data for some buildings, are only accessible for building owners.

More details about security can be found in section 4.3.

2.4 Platform Management

Platform management will not be altered for the three platforms that are integrated to form the Groningen Urban Data Platform. All three platforms (Sustainable Buildings platform, CGI's Energy Islands platform, Groningen Open Data platform) will be managed by the existing platform owners, as they have done before the start of the MAKING-CITY project.





3 Existing platforms

The Urban Data Platform for Groningen will be made up out of existing platforms that are already operational. Meaning they have a Technology Readiness Level (TRL) of at least 7, which fits with the objectives of the MAKING-CITY project. The Technology Readiness Level (TRL) is the best metric to assess the performance maturity of a given technology. MAKING-CITY is an Innovation Action whose objective is to demonstrate, at large scale, technologies that are close or even into the market. Thus, MAKING-CITY technologies are at TRL 7 or higher, and their integration will demonstrate the PED concept.

TRL 1 Basic	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
principles	technology	experimental	technology	technology	technology	Prototype	System	actual system
observed	concept	proof of	validated in	validated in	demonstrated	demonstration	complete and	proven in
	formulated	concept	lab	relevant	in relevant	in operational	qualified	operational
		_		environment	environment	environment		environment

Figure 3: TRL levels as defined in the MAKING-CITY Grant agreement, part B, Annex I

This section describes the existing platforms and their history before the MAKING-CITY Project as well as highlighting some of the technology used to build these platforms.

3.1 Background

The existing platforms that together will form the Urban Data Platform are:

- Sustainable Buildings platform
- CGI's Energy Islands platform
- Groningen Open Data platform

In following paragraphs a high level description of the individual platforms is given. In chapter 4 the integration of the platforms forming the Urban Data Platform is described.

3.1.1 Sustainable Buildings platform

Sustainable Buildings is a company from Groningen that focuses on making buildings sustainable. Sustainable Buildings' philosophy is aimed at making buildings energy-efficient and their mission is to provide buildings with an innovative and affordable cloud-based energy management system to accelerate the transition to sustainability.

The Sustainable Buildings platform combines several techniques and technologies. The platform is capable of obtaining delayed meter data from the electricity and gas meters in buildings, which are retrieved from the measuring companies, using the API's provided by them. In addition to this delayed data source of measuring companies, the platform is capable of receiving real-time data from supported meters. That capability allows showing energy consumption and generation data with a resolution as small as 10 seconds.

The collected data is processed by the Sustainable Buildings platform and is displayed in an online application, where building owners can monitor and analyse the energy consumption of their buildings.

On top of passive energy data collection and visualization, the platform also supports manual and automated control of actuators for both smart heating and lighting solutions.

3.1.2CGI's Energy Islands platform

3.1.2.1 CGI's vision on the energy transition

Throughout the world, the global energy system is in transition. The transformation from fossil fuels to sustainable energy is a necessary reality. To help drive forward this reality, however, requires the ability to manage the dynamic changing landscape emerging within the energy market. For example, in a





renewable energy system, solar, wind and geothermal sources play primary roles in the transition. Yet these forms of energy are typically distributed instead of centralized, and are intermittent and difficult to predict due to weather conditions. In addition, new energy consuming devices are appearing on the market, such as electric vehicles and heat pumps, which have different energy requirements than traditional energy devices and can, potentially, double our electricity consumption. Other possible scenarios are energy-generating buildings and new energy chains.

One thing is certain: an entirely new energy ecosystem is emerging where energy flows will be bidirectional, predictions will be crucial, and management will be transferred to local levels of society.

The transition to a low-carbon society therefore requires a new energy system. A system that ensures that the network is not overloaded and can process the supply and demand for energy. To emphasize balancing energy production and consumption at a local level CGI developed the local energy systems concept of 'Energy Islands'.

CGI's Energy Islands concept promotes distributed generation of sustainable energy in a neighbourhood or village at the least possible loss of grid power. Moreover, supply and demand are in balance as much as possible, reducing the risk of 'blackouts' in the network.

Different energy islands remain connected. In the case of a positive energy balance with locally produced energy, the surplus energy is available for consumption outside the energy island. On the other hand, in case energy consumption exceeds local production, shortages are supplemented from the outside the energy island. In the ideal model energy surpluses and shortages are limited and balanced between connected energy islands.

3.1.2.2 Energy Island Ansen

To demonstrate this vision and pilot the Energy Islands platform, CGI worked together with the village of Ansen in the Netherlands.

The ambition of the local energy corporation 'energieKansen' is to make the energy system of the about 200 households in the village, energy neutral. The first phase consisted of the placement of solar panels on two farms generating a total of 250000 kWh of electricity. This covers about a quarter of the total energy need of the village. Additional solar panels and experiments with other renewable energy sources are planned.

To better inform future additions of energy production and storage it is important to have insight in the current energy consumption and production. The Energy Islands platform has been created for this exact purpose. It is connected to the 2 solar parks and several of the households to monitor the energy balance and enable the next step towards an energy neutral Ansen.

3.1.2.3 A PED as an Energy Island

The focus of the MAKING-CITY project is the creation of Positive Energy Districts (PED). The concept of a PED very much aligns with an Energy Island and the requirements of the monitoring program are a good fit for the existing Energy Islands platform. For this reason adapting the platform for use in MAKING-CITY and integration in the Groningen Urban Data Platform was the logical next step.

3.1.3 Groningen Open Data platform

The municipality of Groningen is connected to the Civity Data platform which is a widely used open data platform in the Netherlands. The most important goal of this platform is to share and use the potential of (open) data by governmental, commercial and knowledge institutes.

Currently Civity Data platform Groningen contains only public datasets. The datasets are open to all users. There is no secured, closed environment for privacy, or sensitive data. In the current situation, public datasets are semi-automatic uploaded by an ETL-script from the municipality servers to the Civity Data platform.





In the future situation, when privacy- and sensitive project data will be uploaded to the Civity Data platform Groningen, a second secured Civity Data platform environment is highly recommended. The IT-processes, as established by the municipality of Groningen, must be followed by the information design of the secured Civity Data platform itself, as well as its data streams and data connections.

Url: https://groningen.dataplatform.nl/

3.2 Technology

3.2.1 Technology of the Sustainable Buildings platform

The Sustainable Buildings platform combines multiple technologies and techniques to offer a single platform for end users.

By scraping the APIs of the measuring companies, the platform retrieves the meter data from the buildings. This meter data is then processed and stored in a time series database for scalable storage.

Real-time data from supported sensors, which are deployed in some of the buildings, is collected using a message queue, and is processed and stored in real-time.

For the Making City project, the platform has been adapted to also be capable of collecting data from the Plugwise plugs, which are installed in the terrace houses to measure the electricity consumption of the individual wall sockets. In addition to this, a message queue and historical API were developed and configured in order to share the collected energy data with the Energy Islands platform.

3.2.2 Technology of the Energy Islands platform

The Energy Islands platform is based on an architecture CGI has used for earlier platforms with the goal to operationalise advanced data analytics. This architecture enables immediate action based on analysis of real-time data. For example, analysis of office usage from sensors in buildings and predictive maintenance of industrial equipment spread out over a large area.

The platform is cloud native, taking full advantages of the provided scalability of the services provided by the Microsoft Azure cloud. This includes an Azure IoT Hub to securely connecting devices, Azure Stream Analytics to enable high throughput event processing and Azure Synapse for advanced data analytics on large data sets.

3.2.3 Technology of the Groningen Open Data platform

The Groningen Open Data platform is based on CKAN, FIWARE and Drupal software (open source) which allows the downloadable of datasets as well as programmatic access by API's (also IoT API's). To ensure the findability of the datasets, the metadata and download link is automatically harvested by national open data sites and subsequently publicised.





4 Integrated Urban Data Platform

The different existing platforms together form an Urban Data Platform as described in *D5.9 ICT-City Platforms: common open specifications.*

This section describes the roles of the existing platforms and how they are integrated. Figure 4 shows the relationship between the different platforms forming the Urban Data Platform, which is explained in more detail in this section. It also shows the relationship between the stakeholders and the different platforms, which was explained in section 2.



Figure 4: Relationship of the platforms forming the Groningen Urban Data Platform and its stakeholders

4.1 Platform of platforms

The Groningen Urban Data Platform is not a new platform, but consists of the existing platforms integrated using standards and open specifications. Each of the platforms has a specific role within the larger Urban Data Platform.

4.1.1 Sustainable Buildings platform

Advanced building energy measurement platform enabling analysis of energy consumption and production of a building. For MAKING-CITY all participating buildings will be connected to obtain detailed energy measurements.

The platform uses the AMQP-protocol in combination with a RabbitMQ message queue in order to exchange new sensor data with the Energy Islands platform. In addition to this, a REST API has been created for enabling the on-demand querying of historical data.





4.1.2Energy Islands platform

For the Groningen Urban Data platform, the Energy Islands platform is connected to the Sustainable Buildings Platform to receive building measurements. Additional analysis are added to calculate the metrics required by the Monitoring Programme for Groningen. And finally, analysis results are exported for publication on the Open Data Platform of Groningen.

To enable secure access to the metrics as well as enable additional calculations in external systems (see section 5) a secure API is added. This API will follow the SensorThings API standard as prescribed in *D5.9 ICT-City Platforms: common open specifications*.

The addition of an interface base on the open standard to the Energy Islands platforms improves the interoperability and makes it a more open platform for the future.

4.1.3 Open Data Platform of Groningen

Using the existing interfaces, data can be published into the Groningen Open Data Platform and made available as Open Data via the Open Data Portal of Groningen. Besides receiving data from the Energy Islands Platform no changes are planned for the Open Data Platform.

4.2 Functionality

4.2.1 Services

The Urban Data Platform consists of several modules and services. The services together with the modules within the platform provide the functionality required for the Monitoring Programme of the MAKING-CITY project. Deliverable *D3.9 Services and Modules for Groningen ICT Platform* describes the use cases and components in more details.



Figure 5: The Services and Modules of the Groningen Urban Data Platform

This deliverable will focus on the Modules of the different platforms that receive, store and process the data in the Urban Data Platform.





Service or module	Description
SB EMS	SB Energy Management System (SB EMS) provides visibility into the energy usage for the participating buildings in MAKING-CITY.
TNO ESSIM	A simulator created by TNO that will model the energy system of the entire PED and calculate project level indicators. See also section 5.1.
El Insights dashboard	Dashboard showing metrics specifically designed to drive future decisions on demand optimization.
El Metrics dashboard	Customizable dashboard showing detailed data for consortium partners.
Groningen Open Data Portal	Portal where Open Data can be viewed and downloaded. (<u>https://groningen.dataplatform.nl)</u>
El Metrics	Module that provides the SensorThings API interface for services and consortium partners to securely retrieve data from the Urban Data Platform.
El Connectivity	Module that enables connectivity to the Sustainable Buildings platform as well as offering an interface for TNO ESSIM to publish simulation results. This interfaces follows the SensorThings API standard.

Table 3: Service and modules relevant for integration into an Urban Data Platform

4.2.2Data

The main purpose of the Urban Data Platform is to store data for the Monitoring Programme. The data requirements of the Monitor Programme can be divided in the following layers.

- PED level data the Project Level Indicators as defined in *D5.2 Project level indicators*, where possible calculated from the collected metrics
- Building level data metrics about, among other things, energy consumption and production per building.
- Meter level data telemetry collected from meters and sensors in the buildings. To obtain all the required building data, multiple meters are needed per building.

Each of the layers is calculated based on the information in the layer below it, visualized in Figure 6. The size of the layers in the figure represents that amount of data, increasing from top to bottom. See also Table 5 for the actual size and other characteristics of the layers.







Figure 6: The data stored in the Urban Data Platform related to the Monitoring Programme requirements

Table 4 describes the different data layers. Details about the data collection and calculations can be found in *D5.8 Groningen Monitoring Programme*.

Layer	Collection and calculation	Accessed via
Meter	Collected by the Sustainable Buildings platform. The data required to calculate Building metrics is forwarded to the Energy Islands platform.	Sustainable Buildings platform
Building	All building metrics described in the Monitoring Programme. Some of the building metrics directly reflect the metered data, others require calculations on top of the metered data.	Energy Islands platform
PED	Project level indicators about the PED. These are calculated by the TNO ESSIM simulator that has a model of the full PED energy system. This simulation uses the available building metrics to extrapolate accurate metrics for the whole PED. Results are first stored back in the Energy Islands platform which exports selected metrics and project indicators for the publication as Open Data to the Groningen Open Data Platform.	Open Data Platform of Groningen

Table 4: Groningen Urban Data Platform data layer descriptions

The building and meter level data can include personal data. This data is collected and can only be used for MAKING-CITY. As mentioned in section 2.3, the city of Groningen is the owner and GDPR agreements are needed before access to this data is given.

The different data layers also have different characteristics which results in different requirements around storage and processing for the different platforms. Table 5 gives an overview of these characteristics.



owners request.

project.

Duration of the MAKING-CITY

As long as data is relevant.



Layer	Data	Source	Resolution	Size per month	Retention
Meter	Telemetry	~200 meters	10 seconds to an hour	~5GB	Duration of MAKING-CITY project. Longer only on building

15 minutes

to a day

Month to

one value

~100MB

~1MB

10 buildings

2 PEDs

Table 5: Groningen Urban Data Platform data characteristics per layer

More information about the services using the stored data can be found in D3.9 Services and Modules for Groningen ICT Platform.

4.3 Security

Building 30 metrics

50 Project Level

Indicators

PED

4.3.1 Authorization

Authorization is based on the following user groups identified for the Groningen Urban Data Platform:

- 1. External observers
- 2. Consortium partners
- 3. Building owners

External observers, like everyone else, have access to the Open Data published to the Groningen Open Data Portal.

Groningen consortium partners have access to all the metrics and source data via the EI Metrics API and EI Metrics Dashboard.

The building owners have access to the data collected from their houses/offices via the Sustainable Buildings dashboard.

4.3.2 Authentication

When access to data is limited to authorized users it is necessary to know the identity of the user. The following interfaces therefore require authentication:

- 1. El Metrics API consortium partners can access the developer portal website using a personal account and generate an API key. Each request to the API needs to include the API Key to retrieve the data stored as metrics for the MAKING-CITY project.
- 2. El Metrics Dashboard personal accounts for the consortium partner (uses the OAuth2 protocol).
- 3. Sustainable Buildings EMS personal accounts for building owners.
- 4. El Insights personal accounts for the consortium partner (uses the OAuth2 protocol).

As Data Owner the Gemeente Groningen can revoke access by removing an accounts permissions, which also makes any API Keys generated using that account invalid.





5 External systems

For some of the services provided on top of the Urban Data Platform are provided by other systems connected to the platform. This section will describe the main purpose of the connected systems and any modifications needed to the existing platforms to connect them. More information about these systems and their use cases can be found in deliverable *D3.9 Services and Modules for Groningen ICT Platform*.

The services discussed are:

- TNO ESSIM
- Charge point management system (CPMS)
- TNO HeatMatcher

5.1 TNO ESSIM

A simulator by TNO that will model the energy system of the entire PED and calculate project level indicators and enable comparing different scenarios for the PED in the future.

TNO ESSIM will use two interfaces with the Urban Data Platform:

- 1. Retrieving energy consumption of participating buildings in the PED to use as realistic energy profiles for simulations.
- 2. Publish simulation scenario results to the Urban Data Platform as the basis for PED Project Indicators and future PED scenarios.

Information retrieval will use the EI Metrics API of the Energy Islands Platform. This gives TNO secure access using the SensorThings API standard. Storing information back into the platform will use the same standard and security measures, but connect to the EI Connectivity module of the Energy Islands Platform via the SensorThings API Observations interface.

5.2 Charge point management system (CPMS)

Several EV charging poles are located in the PEDs and information from them is collected by a CPMS. The CPMS is a data platform itself, but is not owned by a consortium partner and therefore an external system to the Urban Data Platform. Data will be imported in the Urban Data Platform using the SensorThings API Observations interface and exports of the charging logs from the CPMS.

5.3 TNO HeatMatcher

The TNO HeatMatcher is directly connected to energy systems within a building and can collect relevant energy consumption or flexibility information itself. For the monitoring programme Sustainable Buildings is able to obtain all relevant measurements via their own meters, so a HeatMatcher in a building will not be added as a source of measurement for Sustainable Buildings.





Conclusions

The existing platforms in Groningen are integrated to form an Urban Data Platform for Groningen that conforms to the specifications of *D5.9 ICT-City Platforms: common open specifications*. The integrated platform enables services described in *D3.9 Services and Modules for Groningen ICT Platform* and supports the Monitoring Programme described in *D5.8 Groningen Monitoring Programme*.

The integration has also led to improvements for all platforms including new APIs conforming to open standards. With these open interfaces the platforms and related services like TNO ESSIM can now connect to other existing and future services using the SensorThings API standard.

The integrated Urban Data Platform shows how the use of existing platforms can together provide the services required to meet the monitoring and data analysis demands of the energy transition.

