D7.2 – Detailed Demonstration Activities Management Plan

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EU Project Officer	Stavros STAMATOUKOS
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Consortium Partners	VTT, FVH, CIRCE, Suite5, IGM, KONCAR, ARTELYS, MYTILINEOS, CUERVA, BELIT, URBENER, BEOELEK,
Project Website	beyond-h2020.eu
Cordis	https://cordis.europa.eu/project/id/957020

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EXECUTIVE SUMMARY

The implementation of the demonstration activities of the BEYOND project brings forward the need for the clear definition of dedicated roles and responsibilities which each pilot partner should undertake during the demonstration activities of the BEYOND solutions in the Greek, Spanish, Finnish and Serbian sites. In order to guarantee the smooth running of the demonstration activities on a daily basis, four major key roles and their relations are defined as part of this deliverable, namely: the Pilot Director, the Technical Director, the Commissioner and the End-User. The Pilot Director is responsible for the management of the whole demonstration activities, while the Technical Director assumes the guidance of the technical team during the phase of the installation. The Commissioner holds a critical role in the installation procedure as well as in the interaction with the End-Users, being responsible for explaining them the aspects and the new toolkits of the project. More personalized relationships are expected to enhance the participation of the End-Users to the project. Their useful feedback is critical for further improvements.

Apart from a clear management structure, the smooth and successful implementation of the BEYOND demonstration activities need to be based on a concrete plan that brings forward timings of the different sub-tasks involved, a clear understanding of the demonstration cases and the data assets and BEYOND tools that will be effectively utilized, along with the analysis of boundary conditions, limitations and risks that may affect the validation of each demo case. To this end, the current deliverable focuses on the definition of the respective pilot implementation plans in the four demo sites of the project, by bringing together pilot assets and infrastructures, data assets available and the required BEYOND end-user applications and providing a detailed plan for the pre-validation and demonstration activities of the project in each demo site.

Additionally, the deliverable links to the horizontal technical activities of the project (platform development, testing and deployment) to ensure the avoidance of inconsistencies or aspects that may affect and delay the implementation of the demonstration activities of the project. As it becomes obvious, the implementation of the demonstration activities of the project is expected to be executed according to schedule, while no serious obstacle seems to be present (for the moment being) across all demo sites. As part of T7.2, the relevant plans (per demo site) will be continuously monitored and assessed in order to identify severe issues that may lead to the devising of original plans, towards ensuring the effective validation of the project results and the achievement of the envisaged impact both in energy terms and in the promotion a data economy within an integrated ecosystem of stakeholders related to buildings' operation and involved in building data exchanges.

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INTRODUCTION

Purpose and scope

The primary purpose of this deliverable is to provide an overview of the progress made with regards to pilot demonstration activities. In this context the deliverable presents all pilot related information with attention to the involved demo assets, data assets and the respective demo case for each demonstrator.

Structure of the document

In the first chapter of the deliverable, the methodology for the management of the demonstration activities is provided, together with relevant roles and responsibilities that are to be undertaken by the pilot partners that are managing or operating the demonstration assets.

The second chapter of the deliverable elaborates on a thorough view of the demonstration sites and performs a detailed planning of all related activities with view to the effective pilot implementation and the on-time conclusion of all tasks and sub-tasks that need to take place within the boundaries of each demonstration site. Details about the demonstration cases per demo site are provided, aligning them to the different buildings involved, as well as to the relevant BEYOND end-user applications that will facilitate their realization. An additional plan of engagement and communication activities is also provided per demonstration site, towards ensuring wide participation of building occupants and relevant stakeholders in the validation of the BEYOND solutions.

The third chapter focuses on the horizontal activities of the project, i.e. the technical implementation and deployment activities that are tightly connected to the realization of the demonstration activities and provides a snapshot of their timing and progress so that they do not affect or introduce delays in the corresponding validation activities that will take place in the demonstration sites of BEYOND.

1 Demonstration activities management

1.1 Pilot Monitoring Management Plan

The Pilot Monitoring Management Plan outlines the way the pilot partners run the demonstration activities at each pilot site. It actually answers to the question “What needs to be done day-to-day to keep the demonstration plan up and running”. It should include the standard methods and procedures for executing all tasks successfully. It should also determine job descriptions and responsibilities on every involved personnel along with a reasonable work effort.

If there is no plan, everyday tasks may fall apart, risks may arise with no one knowing how to mitigate them, responsibilities may not be clear, and the bottom line, work may not be done well or even at all. On the other hand, a good management plan helps the project team to accomplish the goals that has been set by:

1. Clarifying the roles and responsibilities of everyone within the project team
2. Splitting the work in reasonable and equitable packages
3. Increasing the accountability and by incentivizing the involved personnel
4. Ensuring that necessary tasks are assigned to appropriate member staffs
5. Bi -weekly Reporting on demonstration plan progress via teleconference

With regards to the latest (no. 5), BEYOND Pilot partners will set up bi-weekly calls to monitor progress of the demonstration activities. In these calls the Pilot Directors will be contributing on the latest developments and will be reporting Pilot site progress to the Pilot Coordinator the Technical Manager of the BEYOND project.

1.2 Roles in the Pilot Demonstration Management Plan

Demonstrations are demanding procedures that should be accomplished by a group of specialized staff in a relatively limited time period. It is necessary in every task to assemble the appropriate personnel and execute the work with high quality, precision and professionalism. Therefore, it is important to clarify roles and declare their activities. In this section, the necessary key roles and their responsibilities will be descripted whereas, on the following sections, every task and procedure will be assigned to one or more corresponding key roles.

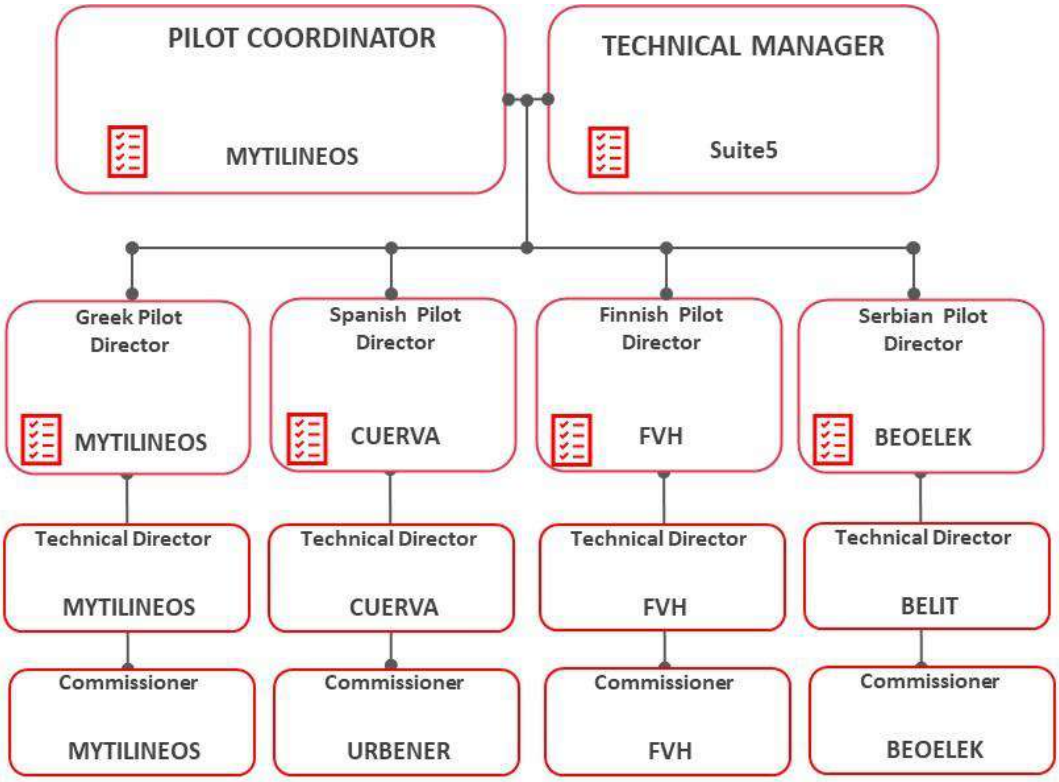

FIGURE 1: OVERVIEW OF ROLES AND MANAGEMENT STRUCTURE FOR THE IMPLEMENTATION OF THE BEYOND DEMONSTRATION ACTIVITIES

Considering the job description of installation procedures, we have resorted to four major key roles: Pilot Director, Technical Director, Commissioner, and End-user. Although end-users are not included to company's staff and have no responsibilities or tasks to accomplish, they are necessarily specified due to their crucial participation and interaction with the final operational system. For every key role description, its activities and responsibilities are presented in parallel with the corresponding competences of the assigned employee.

Pilot Director

Pilot Director is responsible for managing the whole demonstration activities. His role description is very wide and includes all non-technical issues along with managing the technical teams and communicating with end-users. Managing skills and leadership are among the most preferred capabilities of the person that will be responsible for this position.

Main activities/responsibilities:

- Implementation of the proposed installation management plan
- Definition of roles and responsibilities
- Assigning roles to the most appropriate persons
- Inspection and monitoring of installation work plan and technical teams respectively
- Set a communication plan for appointment arrangements with end-users
- End-users engagement

- Assessment of end-user's feedback for further system configuration or optimization

Competences:

- Good management skills
- Good in communication and public relations
- Familiar with pilot projects
- Ability to manage and control groups of technicians
- High level familiarity with the system architecture

Technical Director

Technical Director is by definition responsible for the technical solution. He is assigned to guide the technical teams through every step of installation procedure, interfere with technical issues and troubleshooting. Technical Director should have a unique knowledge of whole integrated system and he is also responsible for training technical staff and propagate knowledge as part of his technical experience to the newly created technical teams. He may be requested to participate in technical staff evaluation and roles definition as well as the general roll out of installations plan.

Main activities/responsibilities:

- Deep understanding of technical solution and system implementation
- Good experience with system's components
- Training of technical teams
- Evaluation of technical staff
- Help technical staff for solving technical problems
- Propose improvements, adjustments to technical solutions based on both end-user's feedback and his own experience.

Competences:

- Excellent knowledge of technical issues and system integrations.
- Familiar with relevant technical projects
- Good knowledge of hardware and software
- Teaching/training skills
- Ability to support technical teams with short response time

Commissioner

Commissioner's key role is to implement the installation and commissioning procedures in every pilot site. Supported by the technical director and associated, when is demanded, by the appropriate technician, commissioner's role is to begin from the scratch and deliver an operational system in every pilot site. He is responsible for installing plug 'n' play devices, for all devices and sensors commissioning and for ensuring that all actions are performed correctly for the integration of data generated by different systems and devices, to the BEYOND Big Data Platform. Moreover, due to the fact that commissioner visits pilot sites, he has a major role on interacting with the end-users and explaining/communing them with system operation.

Main activities/responsibilities:

- Installation of plug 'n' play devices
- Deliver instructions to technician for hard installations
- Commissioning of all system devices.
- Supervision and main responsibility for integrating local data assets to the BEYOND Big Data Platform
- System validation
- Troubleshooting
- System presentation to end-users
- End-user engagement and benefits awareness

Competences:

- Experience in device installations
- First level knowledge on system configuration and software setups:
- Strong technical skills
- Good in public relations

1.3 End-user(s) role in the process and engagement activities

End-user's key role can be divided into two main branches. The former is that end-users provide their property for installing and deploying the pilot system and, the latter, that they interact with pilot system during its operational phase providing the necessary data for system evaluation. The acquired data can further be used for exploiting bugs and provoke necessary improvements and adjustment.

Main actions of end-users are:

- To be engaged and interact with project actions
- Feedback useful remarks

End-users Engagement

Main objective of every pilot activity should be the dissemination of project actions and the exploitation of project benefits and future significance. All the local pilot members, including the Pilot director and the Commissioners, ought to be polite and interact with pilot users explaining them the aspects of the project. They must be ready to explain the project concept and provide pilot end-users with all additional information such as leaflets, brochures and manuals. It is very important that pilot partners receive the End-Users feedback and use it in order to suggest adjustments and improvements for enhancing project dissemination and exploitation.

Therefore, the whole installation management/work plan should be faced with respect and attitude to:

- Interact with end-users and share with them available information during installation processes
- Receive useful feedback for further improvements
- Introduce end-users to future technological perspectives

- Proliferate pilot sites by attracting new groups of end-users

2. Detailed plan of demonstration activities across all BEYOND demonstrators

2.1 The Greek Demo Site

2.1.1 Demo Site Overview

A quick overview of the Greek Demo site is provided below.

Artemidos Building (MYTILINEOS Headquarters in Maroussi)

An office building located in the district of Maroussi hosting approximately 600 employees and covering a total area of 12.000 m^2. The building is powered with electricity only.

FIGURE 2 ARTEMIDOS BUILDING

The following list highlights the most important generic information with regards to the specific demo building of BEYOND:

- Year of Construction: 1985 and two additional structures in 2018
- Recent Renovation: 2011
- Gross Floor Area: 12.000 m^2
- Number of stories: 5 including ground floor
- Operating periods: approximately from 7:00 to 21:00

Marinou Antypa Building (MYTILINEOS offices)

An office building located in the district of Neo Irakleio, hosting approx. 150 employees and 40 visitors (on a daily basis), while covering a total area of 2.101 m^2. The building is powered with electricity only. Pilot buildings included in the Greek pilot are partially already equipped with the required sensors and smart meters/actuators to ensure the smooth operation of the BEYOND framework.

FIGURE 3 MARINOU ANTYPA BUILDING

The following list highlights the most important generic information with regards to the specific demo building of BEYOND:

- Year of Construction: 1993
- Recent Renovation: 2006
- Gross Floor Area: 2.101 m^2
- Number of stories: 4 including ground floor
- Operating periods: approximately from 7:00 to 21:00 h.

Residential Premises

More sophisticated services will be provided to carefully selected buildings that will enable the realization of human-centric energy performance optimization concepts. These Testbeds are located in the region of Attica. The residential premises consist of approx. 50 residential dwellings, hosting approximately 170 residents, familiar with concepts of energy services and smart technologies. The dwellings cover a total area of 2,000 sqm are powered with electricity only. Half of the building premises will set the residential pilot test bed at the Greek demo site.

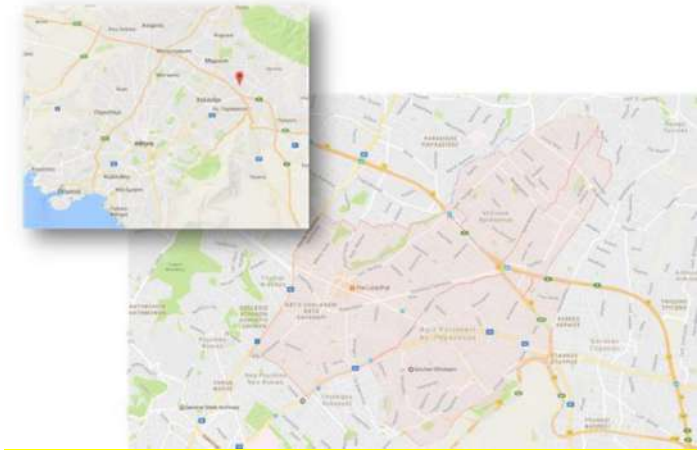

FIGURE 4 MAP OF THE GREEK DEMO

Retailer Portfolio

In addition to the building premises that have been described above and will altogether form the Greek Demonstration Buildings, additional data assets will be included in the Greek Demonstration Activities to enable the realization of added value services for retailer customer portfolio monitoring and optimization. These data assets are already available in Mytilineos' electricity retailing system and involve:

- Number of connections: ~265.000
- Residential & Commercial Customers (High Value Small Medium Enterprises, Major Accounts)
- Smart meters availability: in several residential and commercial premises.
- Total Energy Sales / Consumption of portfolio: ~3.4 TWh

Mytilineos is committed to a 30% reduction in MYTILINEOS' emissions by 2030 and to net zero emissions by 2050 and this is a target that will be further facilitated through the utilization of the BEYOND solution. In fact, BEYOND will further reinforce the services provided by Mytilineos for increasing Energy Efficiency across their portfolio through the provision of energy efficiency related services (net metering, emobility, energy consumption and reduction services, energy tips and suggestions via our communication channels)

2.1.2 Equipment Deployment and Planning for Additional Installations

Data will be foremost collected throughout already existing hardware technologies which are embedded in the demo sites. So far, installations at 10 households have been performed. In these cases, Mytilineos takes care of the pilot communications, addresses the right market players for acquiring data and manages required consents for data collection.

During the next phase of the project, 10 additional installations will be realized as indicated in the Gannt Chart below.

Task / Month	M18	M19	M20	M21	M22	M23	M24
Procurement Process							
Equipment Installation and Configuration							
Troubleshooting and fine tuning							
Data acquisition/ integration; testing & troubleshooting							

FIGURE 5: TIMEPLAN FOR THE INSTALLATION OF ADDITIONAL EQUIPMENT ITEMS IN THE GREEK DEMO SITE

The additional equipment that will be procured and installed in a few number of dwellings that will be further involved in the Greek demo site activities, can be found below.

TABLE 1: EQUIPMENT SPECIFICATIONS FOR THE ADDITIONAL INSTALLATIONS TO BE PERFORMED IN THE GREEK DEMO SITE

Item	Type	Equipment	Device	Measurements	Asset Information (brand, model)
1	Hardware	Ambient Conditions Measuring	Smart Sensor	Humidity, Luminance, Air Quality, Noise Levels, Occupancy	Aeotec Multisensor 6
2	Hardware	Ambient Conditions Measuring	Indoor Air Quality Sensor	Humidity, Luminance, Air Quality	Netatmo homecoach
3	Hardware	Energy Measuring	Smart Plugs	Energy consumption	Fibaro
4	Hardware	Energy Measuring	3-Phase Smart Meter	Energy consumption	Qubino
5	Hardware	Energy Measuring	1-Phase Smart Meter	Energy consumption	Qubino
6	Hardware	Energy Efficiency	Lighting Equipment	-	Philips Hue Gateway
7	Hardware	Collective Measuring	Gateway	Collection of measurements	Smartthings
8	Hardware	e-Mobility Chargers (Domestic)	Wallbox Pulsar Plus	Energy Consumption	Wallbox Pulsar Plus

2.1.3 Pre validation Activities

When gas prices increased to at least five times what they were a year ago, customers were left wondering why their electricity bills were going up despite being even on a renewable energy tariff. Mytilineos as an Energy retailer still need to continue building transparency and trust with their customers. Communicating openly with pilot users about, for example, price changes and what drives them would be a good starting point and a way to start the conversation with customers.

As customer engagement grows, we will see engagement transform and move beyond the transactional relationship of the past, to customers who are active and driving the energy transition. Most energy suppliers today are still at the engagement phase, and energy insights apps as effective engagement tools for starting to build a personalized relationship with the customer. Once we have an engaged customer you can then empower them to act by providing personalised insights and advice, encouraging customers to engage and perhaps change their behaviour to benefit themselves financially, as well as support the wider world regarding energy efficiency and climate change goals.

In order to raise awareness about BEYOND goals and expected results, Mytilineos is actively following the guidelines of the BEYOND Living Lab methodology. Living lab sessions engaging both B2B and B2C external stakeholders have already started by distrusting questionaries and newsletter to the customer base.

In further detail, a series of activities is planned for the following period and prior to the launch of the validation activities of the project towards engaging demo participants in the project activities and reinforcing the active experimentation with and demonstration of the BEYOND solutions. Moreover, within the next 6-month period, extensive testing activities will take place to ensure the smooth integration of the Greek demo data assets to the BEYOND platform and resolve any inconsistencies and malfunctions related to the ingestion, cleaning and mapping of data to the BEYOND CIM, as well as, to the publishing of data assets to the BEYOND marketplace and their preparation for the execution of AI analytics functions. The following Gantt presents a plan of such pre-validation activities:

Task / Month	**M18**	**M19**	**M20**	**M21**	**M22**	**M23**	**M24**
Awareness sessions and material – Pilot Participants							
Internal Living Lab Workshop and interactive sessions for providing feedback on BEYOND platform and AI toolkit functions							

Living Lab Sessions and Live experimnetation for the provision of feedback to the BEYOND Applications							
Extensive testing of BEYOND solutions and bugs/ malfunctions reporting and resolution							

FIGURE 6: GREEK DEMO PRE-VALIDATION ACTIVITIES TIMEPLAN

2.1.4 Pilot Validation Activities Plan

Following the conclusion of the pre-validation activities, the actual the demonstration and validation will commence and will be implemented over 2 distinct phases. A detailed breakdown of the pilot validation activities is provided in the following Gantt diagram:

Task / Month	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
Final configuration and fine-tuning of the BEYOND Platform and End-user Applications															
Continuous integration of data assets															
1st Demonstration run and real-life field testing															
Preliminary Evaluation of BEYOND Impact															
Identification of further improvements (technical and user interface ones)															
Elaboration on the suggested improvements and new release of the platform and applications															
2nd demonstration run and real-life field testing															
Follow-up evaluation of the BEYOND Impact Assessment and Lessons Learnt															

FIGURE 7: TIMEPLAN FOR THE IMPLEMENTATION OF THE VALIDATION ACTIVITIES IN THE GREEK DEMO

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2.1.5 Demo Cases

The demo cases that will be tested in the Greek demo site are described in the following table in combination the demo assets:

TABLE 2: BEYOND DEMO CASES AND ALIGNMENT TO THE PILOT BUILDINGS AND ASSETS

	Demonstrator	GR	GR	GR
	Demo Site	Athens residential buildings	Mytilineos Headquarters	Mytilineos Customer Portfolio
No.	**Demo Cases**			
01	Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings – Data sharing between buildings and ESCOs involved in Energy Performance Contracting			
02	Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies - Data sharing between buildings and Energy Retailers			
03	Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants - Data sharing between buildings, Energy Retailers and ESCOs			
04	Real-time Building Energy Performance and Smart Readiness Certification - Data sharing between buildings, Energy Retailers and ESCOs			
05	Advanced renovation support for accurate energy-efficient design of buildings towards optimized investment decision-making and de-risking - Data sharing between buildings and ESCOs/ Construction Companies			

<u>Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings</u>

This demo case will enable direct data sharing between different types of buildings located in Athens (sharing real-time BEMS, generation and IoT information from devices in buildings) and Mytilineos with the latter taking over the detailed analysis (flexibility extraction) and optimization of building assets, through real-time energy

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consumption optimization (human-centric control of major building loads) with the ultimate aim to increase the energy performance of such buildings with the utilization of the Building Digital Twins Environment for Energy Performance Optimisation, Self-consumption Maximisation and Predictive maintenance (BEPO) hat will be configured by VTT during the project implementation.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 3: BUSINESS SCENARIOS RELEVANT TO THE ENERGY PERFORMANCE OPTIMIZATION AND SELF-CONSUMPTION MAXIMIZATION THROUGH THE APPLICATION OF THE DIGITAL TWIN CONCEPT IN BUILDINGS DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_03	EPC optimization through real-time monitoring and improvement of energy performance of buildings, as well as, through predictive maintenance of building assets

Energy related Use Cases relevant to the Demo Case

TABLE 4: ENERGY USE CASES RELEVANT TO THE ENERGY PERFORMANCE OPTIMIZATION AND SELF-CONSUMPTION MAXIMIZATION THROUGH THE APPLICATION OF THE DIGITAL TWIN CONCEPT IN BUILDINGS DEMO CASE

UC_E_06.3 Energy Performance monitoring in real-time
UC_E_6.5 Continuous optimization of building energy performance and self-consumption maximization through the utilization of the Digital Twin concept

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 5: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
GR_MYT_1	Energy imported from the Grid (kWh)	Metering Device [Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)]
GR_MYT_2	Ambient Sensing and Occupancy Sensing - Residentials	Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity - Light Sensor - Presence)

TABLE 6: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
GR_MYT_1	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_2	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 7: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Expansion of revenues via energy services offering New EPC service provision Detailed analysis and optimization of building assets, through near real-time energy consumption optimization	**Legal:** Compliance to GDPR forms related to access of all pilot user related data. **Financial:** the energy as a service needs to be practically a better offering in comparison to commodity (Kwh) offering. **Business**: requirement to acquire know-how in EPC business aspects and establish commercial agreements with major equipment vendors to support ESCO service offerings. **Technical:** Accuracy of Digital Twin simulation results due to potentially skewed data and data availability
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data connectivity issues to BEYOND platform: Continuous integration and support for the smooth ingestion and mapping of data assets** **Data usage permission from building owners: Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants**	

<u>Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies</u>

The realization of this demo case will be based on the validation of a complete toolbox for energy retailers for comprehensive portfolio analysis, towards optimizing a series of business objectives. In more detail the Building Portfolio Management Optimisation Tool (BPMO), that has been specified in detail in Deliverable D2.6, will utilize smart meter and consumption data from buildings belonging in the portfolio of Protergia, the energy unit of Mytilineos, involved in the demo activities of the project, together with weather data, energy market/ price data and customer data (demographic, location-based, smart home/ IoT data) to offer a holistic view and respective insights over the customer portfolio of the Company (buildings belonging in the portfolio of Mytilineos) towards (i) significantly reducing imbalances caused by forecasting errors, thus avoiding extremely high imbalance charges; (ii) examining advanced billing concepts (e.g. dynamic energy pricing) by segmenting, clustering and analysing consumption behaviours, inferring the elasticity of specific clusters against varying energy pricing levels and deploying highly effective implicit demand

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response strategies, towards optimizing the performance of their portfolio while hedging against non-anticipated imbalances; (iii) monitoring their compliance to Energy Efficiency obligations imposed by the European Commission and adopted by the Member States and designing appropriate portfolio management/ energy efficiency strategies and campaigns to achieve the anticipated targets; and (iv) analysing spatio-temporal patterns of their portfolio, identifying trends and outliers and receiving valuable knowledge for the design and delivery of added value services per individual customer or clusters of them to satisfy their needs for energy cost reduction through targeted innovative energy service bundles.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 8: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_09	Retailers: New revenues through provision of services to Network Operators (Implicit DR) and avoidance of unnecessary charges through imbalance management

Energy related Use Cases relevant to the Demo Case

TABLE 9: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.10 Retailer portfolio analytics for elasticity estimation and extraction of useful insights Elasticity utilization in demand response and imbalance reduction strategies
UC_E_6.11 Elasticity utilization in demand response and imbalance reduction strategies

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 10: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
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GR_MYT_2	Ambient Sensing and Occupancy Sensing - Residentials	Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity - Light Sensor - Presence)
GR_MYT_3	Metering and Demographic Data from Portfolio	Energy usage on a maximum of 4month basis, demographic data such as the location of the premise, the gender of the owner etc.

TABLE 11: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
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GR_MYT_2	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_3	1 record per 15 days	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per day	Greece	Building	Greek	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 12: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Reduction of imbalance charges Better Positioning in energy markets and Optimization of energy transactions through more accurate demand forecasting Advanced billing schemes that reflect individual demand profiles and associated energy costs Reduction of losses that are due to lack in accurate forecasting of portfolio's performance Detailed analysis of retailer portfolio to identify trends and outliers while receiving valuable knowledge for the design and offering of added value services to energy consumers	**Legal:** Compliance to GDPR forms related to access of all pilot user related data. **Financial:** Dynamic pricing requires investments in smart metering across the portfolio **Business/Technical:** Access to Protergias' portfolio data needs to respect confidentiality restrictions
Risks and Mitigation Plans	
Unexpected consumption patterns due to extraordinary events: Dynamic models and algorithms will allow for easy adaptation to new extraordinary events (e.g. Covid 19) **Insufficient data for portfolio analysis:** Over 265,000 customers and connection points already available in the database of Mytilineos	

Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants

Capitalizing on the previous use case, this use case will move one step beyond and will realize advanced and innovative energy service concepts for selected customers of Mytilineos focusing on personalized energy efficiency guidance, demand response, smart home automation and non-energy services for security, comfort and well-being, in collaboration with IGM (ESCO) that will facilitate the transformation of retailers' business model towards a service-oriented one through data sharing and business synergies between Retailers and ESCOs. Data streams from building systems and IoT devices (metering, control, ambience sensing) will be fed into the BEYOND Big Data Platform and Analytics Toolkit towards analysing the flexibility of individual consumers and generating personalized insights on how they can save energy and optimize their energy performance through the respective application that will be developed by SUITE5 (Personalised Energy Analytics Tool for Guidance on

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Energy Performance Optimisation and Human-Centric Control Automation (PEASH)). In turn, targeted guidance will be provided by retailers to consumers, through the collaboration with ESCOs holding the expertise for Energy Efficiency measures, for manual interventions over their devices and loads, while in limited cases, the demo case will experiment with advanced human-centric automation concepts for properly balancing energy consumption with individual preferences regarding comfort, security and well-being.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 13: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_06	End Users (Prosumers/ Building Managers): Energy costs savings with preservation of well-being preferences through the deployment of personalized and advanced human-centric energy services incl. self-consumption
BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 14: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.6 Personalized energy analytics and awareness of energy consumption characteristics
UC_E_06.7 Smart control functions including human-centric features for energy and non-energy services
UC_E_06.8 Consumer-Centric Demand Response Optimization (automation) Smart control functions including human-centric features for energy and non-energy services
UC_E_06.12 Non-energy Services for Comfort, Well-being and Security

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 15: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
GR_MYT_1	Energy imported from the Grid (kWh)	Metering Device [Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)]
GR_MYT_2	Ambient Sensing and Occupancy Sensing - Residentials	Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity - Light Sensor - Presence)
GR_MYT_3	Metering and Demographic Data from Portfolio	Energy usage on a maximum of 4month basis, demographic data such as the location of the premise, the gender of the owner etc.

TABLE 16: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
GR_MYT_1	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_2	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_3	1 record per 15 days	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per day	Greece	Building	Greek	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 17: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Explore new business models that will allow to offer new Energy as a Service models instead of the traditional ones. Expansion of revenues via energy services offering Non energy services provision	**Legal:** Compliance to GDPR forms related to access of all pilot user related data. **Financial:** the energy as a service needs to be practically a better offering in comparison to commodity (Kwh) offering. **Business**: the non energy services provision is not par to the BAU offering of an energy retailer. Lack of understanding/ experience / knowhow in such services provision.
Risks and Mitigation Plans	
Inaccurate demand forecasting: Historical data will be provided to enable the pre-training of analytics models **Low data quality issues:** Appropriate mechanisms wil be provided by BEYOND for cleaning and increasing the quality of the data collected	

Real-time Building Energy Performance and Smart Readiness Certification

This demo case will enable direct and real-time interactions between buildings and their systems (sharing real-time BEMS, generation and IoT information from myriads of devices in their buildings) with energy retailers and ESCOs involved in the project, such as Mytilineos, with the latter taking over the detailed analysis of data streams coming from the building systems regarding energy consumption and occupancy, along with weather data coming from open sources to enable real-time energy performance certification (applying innovative operational rating and appropriate normalization methodologies and approaches) of buildings based on real-life data streams (instead of aggregated data batches), that can point out specific areas of improvement (through energy analytics described in the previous case) and act as an enabler for further optimizing the performance of buildings from an energy point

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 18: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics

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BS_E_02	ESCOs (incl. Energy Retailer): New revenue creation through new services for real-time energy performance certification, complemented by Smart Readiness Certification services
BS_E_06	End Users (Prosumers/ Building Managers): Energy costs savings with preservation of well-being preferences through the deployment of personalized and advanced human-centric energy services incl. self-consumption
BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 19: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.1 Real-time assessment of building energy performance in different spatio-temporal granularities
UC_E_06.1 Enriched building performance assessment including the on-the-fly calculation of Smart Readiness indicators
UC_E_06.6 Personalized energy analytics and awareness of energy consumption characteristics

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 20: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
GR_MYT_1	Energy imported from the Grid (kWh)	Metering Device [Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)]
GR_MYT_2	Ambient Sensing and Occupancy Sensing - Residentials	Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity - Light Sensor - Presence)

TABLE 21: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
GR_MYT_1	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_2	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 22: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Expansion of revenues via energy services offering ESCo service offering	**Legal:** Compliance to GDPR forms related to access of all pilot user related data. **Financial:** the energy as a service needs to be practically a better offering in comparison to commodity (Kwh) offering. **Business**: lack of trust for such offerings by the customers. **Technical:** Applying innovative performance assessment methodologies that are characterized by data-driven approaches, require access to highly granular data
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data connectivity issues to BEYOND platform:** Continuous integration and support for the smooth ingestion and mapping of data assets **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

<u>Advanced renovation support for accurate energy-efficient design of buildings towards optimized investment decision-making and de-risking</u>

This demo case will focus on significantly reducing the gap between predicted and actual energy performance of buildings during the design of renovation projects. Data from selected buildings involved in the Greek demo site and low-level intra-building sensing, metering, actuating data (IoT devices) will enable the definition of accurate occupants' behaviour and comfort profiles (based on baseline personal AI analytics available in the BEYOND toolkit). Such profiles will be made available to IGM in order to introduce them in iterative simulation loops of alternative renovation scenarios of selected buildings (performed through the Renovation Optimisation Decision Support Tool (ROST) developed by VTT), thus replacing generic routines and schedules currently used, with real data coming from the actual operation of the building-to-be-renovated. Additional analytics will be performed over simulation results to identify energy performance outliers and enable further devising renovation approaches and scenarios to achieve (in a highly accurate manner) optimal balancing between anticipated energy performance, renovation project costs and indoor air

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quality/ occupants' comfort. The demo case will validate highly accurate results for the anticipated energy performance of to-be-renovated buildings.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 23: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_01	ESCOs: Reinforcement of the effectiveness and de-risking of the viability of Energy Performance Contracting through reliance on accurate occupancy-related schedules

Energy related Use Cases relevant to the Demo Case

TABLE 24: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_05.1 Accurate building energy performance simulation, considering fine-grained occupancy and comfort profiles of building occupants

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 25: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
GR_MYT_1	Energy imported from the Grid (kWh)	Metering Device [Z-Wave Plus Aeotec Clamp Power Meter - Three Clamps (60A)]
GR_MYT_2	Ambient Sensing and Occupancy Sensing - Residentials	Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity - Light Sensor - Presence)

TABLE 26: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
GR_MYT_1	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N
GR_MYT_2	1 record per hour	Semi-structured	Other	Batch	Y	[1-1-2020 - today]	per hour	Attica Region	Building	English	Raw	N

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

Drivers, Targets, Challenges and Risks

TABLE 27: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Further penetration and attractiveness of EPC Projects Reduction of uncertainty and risks involved in the realization of EPC projects Reduction of the gap between predicted and actual energy performance Facilitating further penetration of the Energy Performance Contracting (EPC) model for ESCOs	**Legal:** Compliance to GDPR forms related to access of all pilot user related data. **Financial:** Limited accuracy of analytics may affect the sustainability of renovation projects **Technical:** Accuracy of simulation results requires high quality data – Incorporation of occupants' profiles in building simulation tools - replacement of generic routines and schedules currently utilized with real-time data from building operations
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data connectivity issues to BEYOND platform:** Continuous integration and support for the smooth ingestion and mapping of data assets **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

2.2 The Spanish Demo Site

2.2.1 Demo Site Overview

A quick overview of the Spanish Demo site is provided below.

<u>Cuerva Headquarters</u>

CUERVA Headquarters are located in Churriana de la Vega (Granada). It is outside the Spanish distribution network. CUERVA has access to all the relevant information, they can install any device that could be interesting for the purposes of the project. Finally, CUERVA is the retailer for the building consumption.

- There is a PV plant monitored by CUERVA.
- Five EV Chargers also monitored by CUERVA.
- Office areas that can be useful for the demo cases assigned.

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The following list highlights the most important generic information with regards to the specific demo building of BEYOND:

- Surface: 495.3 m^2 (ground floor 354.1 m2 + upper floor 141.2 m2)
- Number of people usually work in the building: 70 approximately
- Number of floors: 2
- Number of rooms:
  - Ground floor: 2 meeting rooms; 2 large separate rooms; 1 office
  - Upper floor: 3 meeting rooms; 1 large room; 1 small room
- Period of daily use: Monday to Thursday 8:00 to 18:00 h. and Friday 8:00 to 14:00 h.

FIGURE 8 CUERVA HEADQUARTERS LOCATION

Industrial Area Profitegra

A portion of the distribution network operated by CUERVA in the region of Granada is used as the main electricity infrastructure to set the Granada Smart Grid Living Lab owned by CUERVA and Turning Tables. The MV distribution grid is connected directly to the HV network by a substation also operated by CUERVA. This distribution network feeds the Profitegra Industrial Park.

In Profitegra, over 40 companies of different sectors (industrial, manufacturer, food operators, waste treatment, recycling, etc.) are located

FIGURE 9 PROFITEGRA INDUSTRIAL PARK

Currently, the industrial park is connected to a 132/66/20 kV substation operated by CUERVA and has an installed power of 4,5MW (12900 MWh consumed yearly).

In terms of renewable energies, around 500kWp of self-consumption PV installed in the industries whose inverters are monitored by CUERVA. Moreover, the MV network of the industrial park is highly monitored, thus providing high resolution data.

On the other hand, the industrial park is fed by a gas network and several of the companies established includes thermal demand (both heating and cooling) to carry out their industrial processes.

The following list highlights the most important generic information with regards to the specific demo area of BEYOND:

- 132/66/20 kV Substation operated by CUERVA.
- High resolution data in the MV network
- 60 industrial supply points
- 4.5 MW of contracted power, 12900 MWh consumed yearly
- 3 MW increase expected in the next years
- Around 500 kWp of PV installed in the industries. All the inverters are monitored by CUERVA
- A complete digital twin model of the Medium Voltage Grid for the whole Industrial Park is available
- Smart metering technologies to monitor RES generation & storage at the distribution network
- SCADA & GIS data will be made available to create a lake of electrical data from the local network

Urbener Headquarters

Urbener Headquarters are located in Zaragoza. They have a system for measuring the consumption of the air conditioning system in real time. The main power connection is 3-phase. And the annual consumption is 15.317 kW. Energy uses in Urbener's offices are for lighting, air conditioning and for the use of computers and devices necessary for work. Moreover, there are two outdoor air conditioning units located on the roof of the building. These two outdoor units are connected to a duct system distributed throughout the office. The outdoor units that Urbener has are of the Hitachi brand, one is the RAS-3/4/5FSVNE model, while the other is the RAS-5FSVNME model. Urbener has installed different devices in four areas of the office.

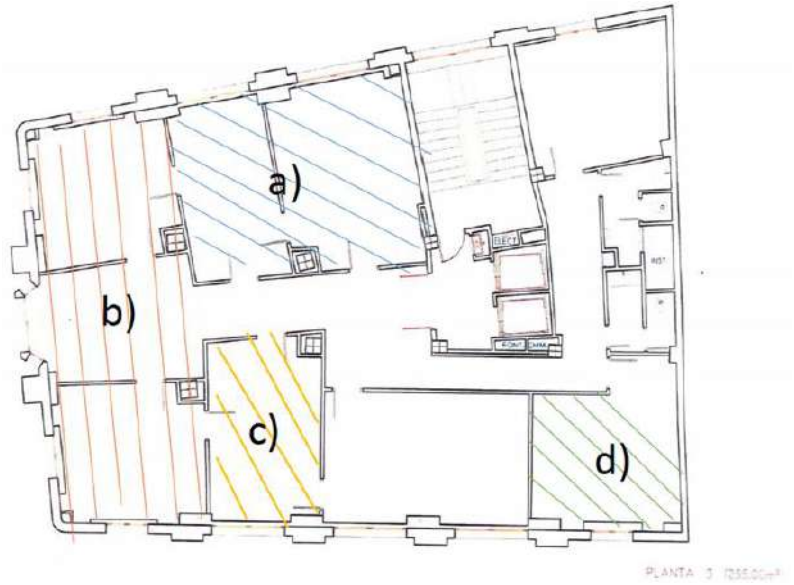

FIGURE 10 URBENER HEADQUARTERS

The following table shows the departments and the number of people working in each zone and the number of hours they are in each zone.

TABLE 28 URBENER HEADQUARTERS 1

ZONE	NUMBER OF PEOPLE	WORK HOURS
a) Office 1	4	8
b) Office 2	5	8
c) Office 3	Meeting room	-
d) Office 4	1	7

- **Installed devices**
  - INTESIS gateway model INMBSHIT016O000.
  - Raspberry Pi 4 model B 2 GB
  - Z-Wave. Me RaZberry 2 module
  - Aeotec Clam p Z-Wave Plus Power Meter (x2)
  - Aeon Labs Multisensor 6 - Z-Wave Plus (Temperature - Humidity) (x5)

The gateway is intended for the control of Hitachi indoor units, specifically up to 16 units. It is connected to the H-Link bus of the outdoor unit. This enables bidirectional

control and monitoring of Hitachi VRF (Variable Refrigerant Volume) systems from a device that functions as a Modbus master.

The Z-wave, when linked to the raspberry, enables automation, in this case, of the air conditioning.

The two Z-Wave Plus Aeotec Clam p Power Meter are connected to a circuit board. One of them is connected to the general circuit, while the other is for the climate. The one for the general circuit is connected the device clamp to one phase of the main power supply at the circuit breaker beach. That of the climate circuit is connected one of the clamps of the device to the circuit breakers corresponding to the outdoor air conditioning unit 1 that distributes the air in zones a) and d); while the other clamp is connected to the outdoor air conditioning unit 2 that distributes the air in zones b) and c) of the office. This allows the electricity consumption to be measured in real time with 99% accuracy.

The multi-sensors measure the humidity and temperature of the room in which they are installed, as follows: 2 in zone a), 1 in zone b), 1 in zone c) and 1 in zone d).

The following image shows where are located the devices

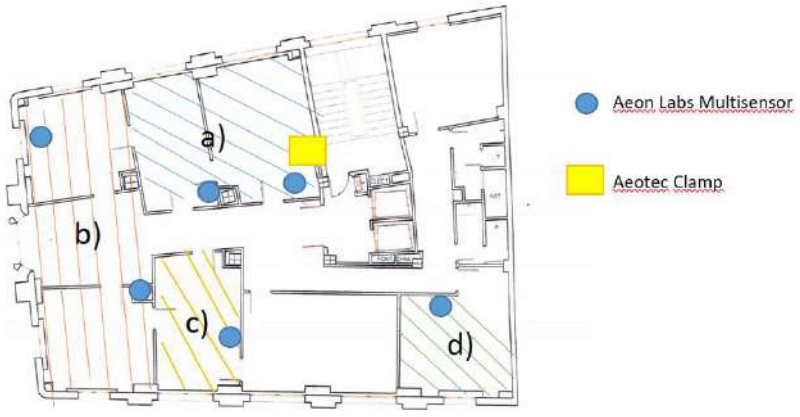

FIGURE 11 LOCATION OF THE DEVICES

Retailer Portfolio

In addition to the building premises that have been described above and will altogether form the Spanish Demonstration Buildings, additional data assets will be included in the Spanish Demonstration Activities to enable the realization of added value services for retailer customer portfolio monitoring and optimization. These data assets are already available in Cuerva's electricity retailing system and involve:

- Number of connections: 15,000
- Residential & Commercial Customers (High Value Small Medium Enterprises, Major Accounts)
- Smart meters availability: Smart meters are available across all customers of Cuerva. The meters measure the active and reactive power exported and imported per quadrant, with consumption, production and total balance

(consumption-production) measurements. Granularity of 15 minutes. Historical available since 2020. All this data is stored in the Azure Datalake of CUERVA and some of it is processed in SQL Server for quick access..

2.2.2 Equipment Deployment and Planning for Additional Installations

In both demo sites data will be collected thanks to sensor and measurement equipment already installed, as well as databases already created, therefore it will not be necessary to install additional equipment.

2.2.3 Pre validation Activities

In order to raise awareness about BEYOND goals and expected results, Cuerva and Urbener are actively following the guidelines of the BEYOND Living Lab methodology. Living lab sessions engaging both B2B and B2C external stakeholders have already started by distrusting questionaries and newsletter to the customer base.

In further detail, a series of activities is planned for the following period and prior to the launch of the validation activities of the project towards engaging demo participants in the project activities and reinforcing the active experimentation with and demonstration of the BEYOND solutions. Moreover, within the next 6-month period, extensive testing activities will take place to ensure the smooth integration of the Spanish demo data assets to the BEYOND platform and resolve any inconsistencies and malfunctions related to the ingestion, cleaning and mapping of data to the BEYOND CIM, as well as, to the publishing of data assets to the BEYOND marketplace and their preparation for the execution of AI analytics functions. The following Gantt presents a plan of such pre-validation activities:

Task / Month	M18	M19	M20	M21	M22	M23	M24
Awareness sessions and material – Pilot Participants							
Internal Living Lab Workshop and interactive sessions for providing feedback on BEYOND platform and AI toolkit functions							
Living Lab Sessions and Live experimnetation for the provision of feedback to the BEYOND Applications							
Extensive testing of BEYOND solutions and bugs/ malfunctions reporting and resolution							

FIGURE 12: SPANISH DEMO PRE-VALIDATION ACTIVITIES TIMEPLAN

2.2.4 Pilot Validation Activities Plan

Following the conclusion of the pre-validation activities, the actual the demonstration and validation will commence and will be implemented over 2 distinct phases. A detailed breakdown of the pilot validation activities is provided in the following Gantt diagram:

Task / Month	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
Final configuration and fine-tuning of the BEYOND Platform and End-user Applications															
Continuous integration of data assets															
1st Demonstration run and real-life field testing															
Preliminary Evaluation of BEYOND Impact															
Identification of further improvements (technical and user interface ones)															
Elaboration on the suggested improvements and new release of the platform and applications															
2nd demonstration run and real-life field testing															
Follow-up evaluation of the BEYOND Impact Assessment and Lessons Learnt															

FIGURE 13: TIMEPLAN FOR THE IMPLEMENTATION OF THE VALIDATION ACTIVITIES IN THE SPANISH DEMO

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2.2.5 Demo Cases

The demo cases that will be tested in the Spanish demo site are described in the following table in combination the demo assets:

TABLE 29: BEYOND DEMO CASES AND ALIGNMENT TO THE PILOT BUILDINGS AND ASSETS

	Demonstrator	ES	ES	ES	ES
	Demo Site	Cuerva HQs	Profitegra Industrial Park	Urbener HQs	Cuerva Customer Portfolio
No.	**Demo Cases**				
01	Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies - Data sharing between buildings and Energy Retailers				
02	Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants - Data sharing between buildings, Energy Retailers and ESCOs				
03	Real-time Building Energy Performance and Smart Readiness Certification - Data sharing between buildings, Energy Retailers and ESCOs				
04	Optimal VPP configuration and Consumer-Centric Demand Response Optimization Module – Data sharing between buildings and aggregators as well as between aggregators and DSOs				
05	Informed decision-making on building-relevant energy infrastructure sizing and planning (electricity grid) - Data sharing between buildings and DSOs				

Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies

The realization of this demo case will be based on the validation of a complete toolbox for energy retailers for comprehensive portfolio analysis, towards optimizing a series of business objectives. In more detail the Building Portfolio Management Optimisation Tool (BPMO), that has been specified in detail in Deliverable D2.6, will utilize smart meter and consumption data from buildings belonging in the portfolio of Cuerva, together with weather data, energy market/ price data and customer data (demographic, location-based, smart home/ IoT data) to offer a holistic view and

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respective insights over the customer portfolio towards (i) significantly reducing imbalances caused by forecasting errors, thus avoiding extremely high imbalance charges; (ii) examining advanced billing concepts (e.g. dynamic energy pricing) by segmenting, clustering and analysing consumption behaviours, inferring the elasticity of specific clusters against varying energy pricing levels and deploying highly effective implicit demand response strategies, towards optimizing the performance of their portfolio while hedging against non-anticipated imbalances; (iii) monitoring their compliance to Energy Efficiency obligations imposed by the European Commission and adopted by the Member States and designing appropriate portfolio management/ energy efficiency strategies and campaigns to achieve the anticipated targets; and (iv) analysing spatio-temporal patterns of their portfolio, identifying trends and outliers and receiving valuable knowledge for the design and delivery of added value services per individual customer or clusters of them to satisfy their needs for energy cost reduction through targeted innovative energy service bundles.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 30: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_09	Retailers: New revenues through provision of services to Network Operators (Implicit DR) and avoidance of unnecessary charges through imbalance management

Energy related Use Cases relevant to the Demo Case

TABLE 31: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.10 Retailer portfolio analytics for elasticity estimation and extraction of useful insights Elasticity utilization in demand response and imbalance reduction strategies
UC_E_6.11 Elasticity utilization in demand response and imbalance reduction strategies

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 32: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
ES_CUERVA_5	"GIS - Geographical Information System"	Full geographical information of the demo site
ES_CUERVA_6	DERs Location	All the distributers energy resources located in the grid.The information is full available
ES_CUERVA_7	Active Power consumption (MWh)	Historical data or energy consumption
ES_CUERVA_8	Real time generation data	Real time generation data from the inverters in the supply points
ES_CUERVA_9	Historical generation data	Historical data regarding generation in the supply point
ES_CUERVA_11	General information of the customers in Cuerva retailers portfolio	National classification of economic activities, contracted power, tariff, location, power contracted recommendations, billings, consumption

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ES_CUERVA_12	Cuerva Headquarters electric consumption	Consumption in the building
ES_CUERVA_13	Cuerva Headquarters EV chargers information	Consumption of the vehicle connected to the charger
ES_CUERVA_14	Cuerva Headquarters generation information	Voltage, Current, Active and Reactive Power from the inverters

TABLE 33: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
ES_CUERVA_5	Static	Structured	Text	Batch	N	2022-	N/A	Spain	Network	Spanish	Raw	N
ES_CUERVA_6	Static	Structured	Text	Batch	N	2022-	N/A	Spain	Network	Spanish	Raw	N
ES_CUERVA_7	Records per hour	Structured	Text	Batch	Y	2020-today	Per hour	Spain	Network	English	Raw	N
ES_CUERVA_8	Records per 3 mins	Structured	Text	Near real-time	Y	2020-today	Per 3 minutes	Spain	Network	English	Raw	N
ES_CUERVA_9	On demand	Structured	Text	Batch	Y	2020-today	On demand	Spain	Network	English	Raw	N
ES_CUERVA_11	Static	Structured	Text	Batch	N	N/A	N/A	Spain	Whole retailers portfolio	Spanish	Raw	

ES_CUERVA_12	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_13	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_14	Records per 3 min	Structured	Text	Near real-time	Y	2020-today	Per 3 minutes	Spain	Building	Spanish	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 34: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Reduction of imbalance charges Better Positioning in energy markets and Optimization of energy transactions through more accurate demand forecasting Advanced billing schemes that reflect individual demand profiles and associated energy costs Reduction of losses that are due to lack in accurate forecasting of portfolio's performance Detailed analysis of retailer portfolio to identify trends and outliers while receiving valuable knowledge for the design and offering of added value services to energy consumers	Legal barrier to the collection of data from third parties, and users. Obtaining reliable data with sufficient granularity to be able to carry out quality analysis, and reliable forecasting.
Risks and Mitigation Plans	
Unexpected consumption patterns due to extraordinary events: Dynamic models and algorithms will allow for easy adaptation to new extraordinary events (e.g. Covid 19) **Insufficient data for portfolio analysis:** Over 15,000 customers and connection points already available in the database of Cuerva and lots of historical data for experimentation purposes	

<u>Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants</u>

Capitalizing on the previous use case, this use case will move one step beyond and will realize advanced and innovative energy service concepts focusing on personalized energy efficiency guidance, demand response, smart home automation and non-energy services for security, comfort and well-being that will facilitate the transformation of retailers' business model towards a service-oriented one. Data streams from building systems and IoT devices (metering, control, ambience sensing) will be fed into the BEYOND Big Data Platform and Analytics Toolkit towards analysing the flexibility of individual consumers and generating personalized insights on how they can save energy and optimize their energy performance through the respective application that will be developed by SUITE5 (Personalised Energy Analytics Tool for Guidance on Energy Performance Optimisation and Human-Centric

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Control Automation (PEASH)). In turn, targeted guidance will be provided for manual interventions over their devices and loads, while in limited cases, the demo case will experiment with advanced human-centric automation concepts for properly balancing energy consumption with individual preferences regarding comfort, security and well-being.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 35: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_06	End Users (Prosumers/ Building Managers): Energy costs savings with preservation of well-being preferences through the deployment of personalized and advanced human-centric energy services incl. self-consumption
BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 36: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.6 Personalized energy analytics and awareness of energy consumption characteristics
UC_E_06.7 Smart control functions including human-centric features for energy and non-energy services
UC_E_06.8 Consumer-Centric Demand Response Optimization (automation) Smart control functions including human-centric features for energy and non-energy services
UC_E_06.12 Non-energy Services for Comfort, Well-being and Security

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 37: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
ES_CUERVA_12	Cuerva Headquarters electric consumption	Consumption in the building
ES_CUERVA_13	Cuerva Headquarters EV chargers information	Consumption of the vehicle connected to the charger
ES_CUERVA_14	Cuerva Headquarters generation information	Voltage, Current, Active and Reactive Power from the inverters

TABLE 38: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
ES_CUERVA_12	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_13	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_14	Records per 3 min	Structured	Text	Near real-time	Y	2020-today	Per 3 minutes	Spain	Building	Spanish	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 39: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Explore new business models that will allow to offer new Energy as a Service models instead of the traditional ones. Expansion of revenues via Non energy services provision	Compliance to GDPR forms related to access of all pilot user related data. Obtaining reliable data with sufficient granularity to be able to carry out quality analysis, and reliable forecasting.
Risks and Mitigation Plans	
Inaccurate demand forecasting: Historical data will be provided to enable the pre-training of analytics models	

Real-time Building Energy Performance and Smart Readiness Certification

This demo case will enable direct and real-time interactions between buildings and their systems (sharing real-time BEMS, generation and IoT information from devices in buildings) with Cuerva, with the latter taking over the detailed analysis of data streams coming from the building systems regarding energy consumption and occupancy, along with weather data coming from open sources to enable real-time energy performance certification (applying innovative operational rating and appropriate normalization methodologies and approaches) of buildings based on real-life data streams (instead of aggregated data batches), that can point out specific areas of improvement (through energy analytics described in the previous case) and act as an enabler for further optimizing the performance of buildings from an energy point

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 40: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_02	ESCOs (incl. Energy Retailer): New revenue creation through new services for real-time energy performance certification, complemented by Smart Readiness Certification services
BS_E_06	End Users (Prosumers/ Building Managers): Energy costs savings with preservation of well-being preferences through the

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	deployment of personalized and advanced human-centric energy services incl. self-consumption
BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 41: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.1 Real-time assessment of building energy performance in different spatio-temporal granularities
UC_E_06.1 Enriched building performance assessment including the on-the-fly calculation of Smart Readiness indicators
UC_E_06.6 Personalized energy analytics and awareness of energy consumption characteristics

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 42: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
ES_CUERVA_12	Cuerva Headquarters electric consumption	Consumption in the building
ES_CUERVA_13	Cuerva Headquarters EV chargers information	Consumption of the vehicle connected to the charger
ES_CUERVA_14	Cuerva Headquarters generation information	Voltage, Current, Active and Reactive Power from the inverters

TABLE 43: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
ES_CUERVA_12	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_13	Records per 15 min	Structured	Text	Near real-time	Y	2020-today	Per 15 minutes	Spain	Building	Spanish	Raw	N
ES_CUERVA_14	Records per 3 min	Structured	Text	Near real-time	Y	2020-today	Per 3 minutes	Spain	Building	Spanish	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 44: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Expansion of revenues via energy services offering ESCo service offering	Compliance to GDPR forms related to access of all pilot user related data. Lack of trust for such offerings by the customers. Obtaining reliable data with sufficient granularity to be able to carry out quality analysis, and reliable forecasting.
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

Optimal VPP configuration and Consumer-Centric Demand Response Optimization Module

The realization of the demo case is based on the validation of a novel module for aggregators that will facilitate the management of demand and flexibility profiles in order to forecast and decide upon the optimal management of flexibility sources (demand, generation, storage, EVs). Smart metering data from building customers of Cuerva, IoT and sensing data from prosumer premises, local generation data, local storage data, EV charging stations data, weather data, along with information provided by Cuerva regarding flexibility requirements and characteristics will comprise the main inputs for the AI analytics that will be performed within the Flexibility-based VPP Configurator and DR Strategy Optimisation Tool (FLEXopt), which will embed all functionalities pertaining to the tool chain for segmenting and classifying flexibility profiles at different spatio-temporal granularity and clustering/ managing them in order to establish optimal Virtual Power Plant (VPP) composition for the delivery of grid services to DSOs. Its main innovation will be that rather than matching the assumed flexibility profile to a generic class and then extracting flexibility estimations, it will cluster and segment flexibility sources and profiles based on their actual, locally estimated flexibility (incorporating where available detailed information about low-level devices existing at the demand side and how they are used by consumers).

Smart metering data provided by local prosumers, together with distributed generation data (PV) and SCADA information from the DSO (Cuerva) will be jointly analysed to extract accurate demand and generation forecasts (in the short- and mid-term) and estimate anticipated events in the distribution network and the required flexibility to effectively address them. Such flexibility requirements will be communicated to the local aggregator (URBENER), together with smart metering,

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distributed generation and local storage information, allowing for (i) analysis of the flexibility that can be provided by each type of DER at different spatio-temporal granularity, (ii) segmentation and classification of the different types of flexibility according to their characteristics and capability to provide alternative services to the grid operator, (iii) optimal clustering of local flexibility sources and formulation of dynamic VPPs to address evolving distribution grid needs and requirements. Dynamic VPP schedules for flexibility activation will be communicated back to the DSO (CUERVA), allowing for the optimal scheduling of the distribution network operation with these additional flexibility amounts in hand. In turn, the DSO will generate the appropriate signals towards local prosumers and DERs (when required) to enable the provision of the available flexibility with the ultimate target to increase network resilience and operational efficiency, maximize RES integration, minimize power losses, increase power quality and safeguard network availability against anticipated congestions, imbalances or voltage violations.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

Table 45: Business Scenarios Relevant to the Demo Case

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_05	Network Operators: Cost-effective planning of network operation, OPEX reduction and avoidance of peak loads and network congestion through accurate estimation and utilization of flexibility offered by building assets
BS_E_07	Prosumers/ Building Occupants: Creation of new revenues through flexibility provision for ancillary services
BS_E_08	Aggregators: Improved profitability through utilization of the unleashed flexibility potential of the building sector

Energy related Use Cases relevant to the Demo Case

Table 46: Energy Use Cases Relevant to the Demo Case

UC_E_5.5 Energy Network-wide flexibility availability estimation
UC_E_5.6 Flexibility-based operational planning of energy networks
UC_E_6.8 Consumer-Centric Demand Response Optimization (automation)
UC_E_6.7 Smart control functions including human-centric features for energy and non-energy services
UC_E_6.9 Flexibility Analytics and VPP Configuration

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

Table 47: Data Assets Involved in the Demo Case

Data Asset Description		
ID	**Data Asset Title**	**Description**
ES_CUERVA_10	General information about Cuerva retailers in the industrial park	National classification of economic activities, contracted power, tariff, location, power contracted recommendations, billings, consumption

Table 48: Characteristics of the Data Assets involved in the Demo Case

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
ES_CUERVA_10	Static	Structured	Text	Batch	N	N/A	N/A	Spain	Profitegra Industrial Park	Spanish	Raw	N

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Drivers, Targets, Challenges and Risks

TABLE 49: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Enable optimized, non-intrusive flexibility activation and definition of Demand Response strategies New Market Actors (aggregators) to support network operation Unleash the huge flexibility potential of the building sector and provide a cheap flexibility source to network operators. Detailed analysis and optimization of building assets, for the provision of flexibility services to network operators	Compliance to GDPR forms related to access of all pilot user related data. Missing concrete remuneration schemes and market models for flexibility provision by small prosumers. Demand Side aggregators need to gain traction and prioritized in flexibility service markets, against traditional flexibility sources Extraction of accurate flexibility profiles and advanced clustering of flexibility profiles segmented and classified at different spatio-temporal granularity Obtaining reliable data with sufficient granularity to be able to carry out quality analysis, and reliable forecasting.
Risks and Mitigation Plans	
Inefficient cooperation between involved partners due to lack of communication: Use of BEYOND data contracts in order to streamline collaboration and exchange of information, between already committed partners **Flexibility market is not developed in the demo country:** Regulatory framework is favourable. DSO to assess the feasibility of building-oriented flexibility services, since market concepts are not involved in BEYOND **Data provided might not result in flexibility needs:** Demo buildings are already equipped with devices and assets that allow the generation of data for the extraction of flexibility. Further installations will be performed if needed.	

<u>Informed decision-making on building-relevant energy infrastructure sizing and planning (electricity grid)</u>

As part of this demo case, electricity grid planning algorithms that simulate the operation of the networks in appropriate horizons (related to regulatory regimes and asset lifetimes) will be developed to automatically calculate grid reliability, performance and quality metrics based on different infrastructure and assets installation setups, their characteristics and planned/unplanned events. The algorithms will incorporate functionality to assess the performance of the networks under various demand and generation uncertainties. Optimization algorithms will be

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appropriately configured to enable the study of optimal planning and sizing of grid assets such as new connections, charging points for EVs and battery storage, needs for expansion or enhancement , considering also needs for further investments. The algorithms will have the capability to embed all information arising from Cuerva (DSO) systems, flexibility analytics, short-, mid- and long-term forecasting analytics for demand and generation (referring to the buildings belonging in the Cuerva Portfolio and for which smart meter data will be made available – approx. 16,000 customers), along with batch static data coming from well-known repositories of open building data (statistical information about the building stock) in order to perform a comprehensive simulation-based analysis of performance and reliability metrics (utilizing the BEYOND Distribution Grid Planning and Infrastructure Sizing Tool (DGPIST)) in specific parts of the electricity grid under alternative penetration scenarios for new energy infrastructure and assets that will be generated to satisfy the needs of the grid operator.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 50: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_04	Network Operators: Avoidance of costly investments through evidence-based, data-driven sizing of energy networks

Energy related Use Cases relevant to the Demo Case

TABLE 51: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_5.3 Simulation-based network performance assessment
UC_E_5.4 Optimized sizing of network assets

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 52: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
ES_CUERVA_5	"GIS - Geographical Information System"	Full geographical information of the demo site
ES_CUERVA_6	DERs Location	All the distributers energy resources located in the grid.The information is full available
ES_CUERVA_7	Active Power consumption (MWh)	Historical data or energy consumption
ES_CUERVA_8	Real time generation data	Real time generation data from the inverters in the supply points
ES_CUERVA_9	Historical generation data	Historical data regarding generation in the supply point
ES_CUERVA_1	Voltage (V)	Voltage at the supply points and the boundary points

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ES_CUERVA_2	Active power (MW)	Active power at the supply point
ES_CUERVA_3	Reactive power (MW)	Reactive power at the supply point
ES_CUERVA_4	Grid topology	Full grid topology of the demo site
ES_CUERVA_10	General information about Cuerva retailers in the industrial park	National classification of economic activities, contracted power, tariff, location, power contracted recommendations, billings, consumption

TABLE 53: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
ES_CUERVA_5	Static	Structured	Text	Batch	N	2022-	N/A	Spain	Network	Spanish	Raw	N
ES_CUERVA_6	Static	Structured	Text	Batch	N	2022-	N/A	Spain	Network	Spanish	Raw	N
ES_CUERVA_7	Records per hour	Structured	Text	Batch	Y	2020-today	Per hour	Spain	Network	English	Raw	N
ES_CUERVA_8	Records per 3 mins	Structured	Text	Near real-time	Y	2020-today	Per 3 minutes	Spain	Network	English	Raw	N

ES_CUERVA_9	On demand	Structured	Text	Batch	Y	2020-today	On demand	Spain	Network	English	Raw	N
ES_CUERVA_1	Records per 15 min	Structured	Numerical	Near real-time	Y	2020-today	Per 15 minutes	Spain	Network	English	Raw	N
ES_CUERVA_2	Records per 15 min	Structured	Numerical	Near real-time	Y	2020-today	Per 15 minutes	Spain	Network	English	Raw	N
ES_CUERVA_3	Records per 15 min	Structured	Numerical	Near real-time	Y	2020-today	Per 15 minutes	Spain	Network	English	Raw	N
ES_CUERVA_4	Static	Structured	Text	Batch	N	N/A	N/A	Spain	Network	Spanish	Raw	N
ES_CUERVA_10	Static	Structured	Text	Batch	N	N/A	N/A	Spain	Profitegra Industrial Park	Spanish	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 54: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Reduction of unnecessary network expansion investments Optimal sizing of new assets to be introduced in relation to the building sector Provision of insights for investments and relevant incentives, for driving evidence-based policy making	Accuracy of long-term predictions relying on assumptions and future penetration scenarios may lead to inaccuracies
Risks and Mitigation Plans	
Data availability with regards to future penetration scenarios: Partners will rely in already defined strategies. BEYOND tools will incorporate the required flexibility to address alterations in such scenarios. **Limited interest by policy makers to step on BEYOND results to incentivize investments:** BEYOND will perform the required actions and demonstrate the data-driven approach and results towards relevant target groups to increase their interest and assess the possibility of incentivizing relevant investment schemes for buildings.	

2.3 The Finnish Demo Site

2.3.1 Demo Site overview

In the context of the BEYOND project, Forum Virium Helsinki (FVH) represents the Finnish demo partner whose role is foremost to access the facility data and make it available to other project partners via APIs. For the provision of demo sites, FVH has identified potentially three commercial buildings as well as some residential buildings located in the Smart City District of Kalasatama for the Helsinki pilots. The demo sites consist of the KYMP House (Kaupunkiympäristötalo) which is the City of Helsinki's Urban Environment Division building, the Viikki Environmental House (Viikin Ympäristötalo) which is a high-performance (energywise) office building in Helsinki, and Stadia Vocational School. These commercial buildings are selected so that they provide intra-building sophisticated services for energy performance optimization.

Additionally, demo activities in Finland will include apartment buildings in the Kalasatama district which are defined as smart grid ready buildings. Energy consumption data (district heating) and near real-time sub-metered electricity data is expected from these residential buildings which can set a sound basis for district level planning. There is already permission for accessing the data of ten buildings and data acquisition activities are still in progress. Apart from that, FVH provides resources

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and knowledge on southbound data connectivity and processing required to collect the data from building level BAS and/or BEMS systems in a secure manner. The datapoints will be enhanced with metadata and context to be as much self-explanatory as possible when provided to the platform. More details about the main demo buildings are provided in the following paragraphs:

Urban Environmental House

The first core infrastructure available in Finnish demo site is the City of Helsinki's Urban Environment Division (KYMP) building. Built in 2020, the **KYMP House** has a floor area of 35,629 m² and is located in Työpajankatu 8, Kalasatama which is Helsinki's Smart City District. This demo infrastructure has a building automation system based on Schneider Ecostruxure that will be interfaced so that relevant datapoints (> 12,000 data end points – BACnet and KNX) will be forwarded to the platform and data analytics toolkit according to the consent of building owner, with the support of the SenseHel open-source software service and app to manage data consent and service associations on zone and space level.

FIGURE 14 THE KYMP HOUSE

The corresponding BEM system monitors all major electric loads, heating, air conditioning, lighting, and domestic water (hot & cold) as a centralized control unit. Additionally, there are some integrated sensors which measure CO2, temperature, ventilation flow values, and heating flow values. Heating and ventilation are controlled via sensor input and clock. Lights are controlled via KNX by clock, presence and ambient (constant lighting levels at rooms with windows). The data is partially available in real-time via Nuuka Open API. Furthermore, the building is designed to have smart grid readiness characteristics and smart grid integration is planned for the sake of demand elasticity.

The Viikki Environmental House

The second optional infrastructure available in Finnish demo site is the Viikki Environmental House. Built in 2011, Viikki Environmental House has a floor area of 6,800 m² and is located in Viikinkaari 2. This demo infrastructure has a building automation system based on Schneider Ecostruxure that will be interfaced so that relevant datapoints (> 2,500 data endpoints) will be forwarded to the platform and data analytics toolkit according to the consent of building owner, with the support of

the SenseHel open-source software service and app to manage data consent and service associations on zone and space level.

FIGURE 15 THE VIIKKI ENVIRONMENTAL HOUSE

Viikki Environment House is a high-performance office building in Helsinki. Part of the energy consumed in the building is produced on-site: the solar panels placed on the façade and roof cover 572m² and produce 20% of the energy consumption along with four wind turbines. The energy needed for heating water and interior spaces is supplied by Helsinki's district heating network. The cooling is supplied through a cost-free borehole water system that consists of 25 boreholes each 250 m deep and making 95% of the cooling energy renewable. Additionally, there are some integrated sensors which measure CO2, temperature, ventilation flow values, and heating flow values. Heating, ventilation and lighting are controlled via clock.The live data can be accessed via data dump.

The building automation system manages the building's indoor conditions such as heating, ventilation and air-conditioning. Another control system, including Siemens Siestorage electricity storage, manages the electricity production and use. The storage is connected to other building energy loads and greed (on demand) to enable better optimisation and provide the nearby public e-car charger with solar energy.

Stadia Vocational School

Stadia Vocational School is an office and school building located in Vallila, a few minutes' walk from Kalasatama Smart City District. The building of Stadia Vocational School was constructed in 1946 and has a floor area of 25 000m². The building is powered with district heating and cooling, and electricity.

FIGURE 16 STADIA VOCATIONAL SCHOOL

The corresponding BEM system was manufactured by Buildercom and installed in 2016. The building's automation system has been implemented by Siemens Building Technologies Oy's DDC-based control and monitoring equipment. Cold and warm water meter and main electricity meter data is provided from BEM via Nuuka API. Heating, air conditioning, lighting, and domestic water are controlled via clock. Furthermore, there are integrated sensors for measuring CO2 level, temperature, ventilation flow values and heating flow values. The data is accessible via data dump. Lights are controlled via clock and (electricity network) on demand. The smart grid integration is considered for demand elasticity.

2.3.2 Equipment Deployment and Planning for Additional Installations

Data will be foremost collected throughout already existing hardware technologies which are embedded in the demo sites. In this case, Forum Virium Helsinki takes care of the pilot communications, addresses the right market players for acquiring data and manages required consents for data collection. Additionally, FVH will make sure that the data is interoperable for the sake of integration to the platform. See a full list of key hardware and software components in demo sites in D2.5.

Additionally, FVH has installed visitor counters (AXIS M3065-V network cameras) procured by the SYNERGY project to all main entries at Stadia Vocational school for calculating the building occupancy profiles and utilization rates. We might need some additional setup in case the gateway fails to provide the data. Otherwise, no further installations are planned at the moment.

However, there might be a need for Expert services to complete additional data requests from demo sites, e.g. in cases where the original building automation programming is incomplete or there are other technical glitches preventing the data acquisition. FVH will be evaluating and planning the required procurement in the upcoming months to ensure that required data for demo cases are available when the platform is ready. Additional requirements can be foreseen as the energy services evolve throughout the project.

GANTT for API management subcontracting

Task / Month	M18	M19	M20	M21	M22	M23	M24
Procurement Process							
Equipment Installation and Configuration							
Troubleshooting and fine tuning							
Data acquisition/ integration; testing & troubleshooting							

2.3.3 Pre validation Activities

In order to raise awareness about BEYOND goals and expected results, Forum Virium Helsinki will plan dissemination activities accordingly so that the best communication channels are considered to reach different stakeholders. The dissemination activities will include organization of seminars, roundtables, questionnaires, and workshops to ensure firstly the highest possible out-reach rate of the target audience and secondly, retaining the most relevant feedback or input for the development of the BEYOND solution.

The dissemination activities have been oriented towards B2B stakeholders in case of city authorities, ESCOs, construction companies and building/ facility managers; and B2C stakeholders in case of building occupants and consumers. The first round of B2B engagement sessions have already been held by distributing questionnaires amongst city authorities and urban planners as well as workshop organizations. The second round of dissemination activities are going to be mostly B2C oriented in which seminar(s)/ webinar(s) are planned to increase awareness about the BEYOND project for occupants and building managers.

Last but not least, Forum Virium Helsinki will establish BEYOND Living Lab activities in order to incorporate user-driven innovation methodology and agile development alongside the technical developments. The Living Lab activities will be oriented to obtain feedback from major stakeholders and to create opportunities for further exploitation and replication of the project results.

The following Gantt presents a plan of such pre-validation activities:

GANTT for pre-validation activities

Task / Month	M18	M19	M20	M21	M22	M23	M24

Awareness sessions and material – Pilot Participants							
Internal Living Lab Workshop and interactive sessions for providing feedback on BEYOND platform and AI toolkit functions							
Living Lab Sessions and Live experimnetation for the provision of feedback to the BEYOND Applications							
Extensive testing of BEYOND solutions and bugs/ malfunctions reporting and resolution							

FIGURE 17: FINNISH DEMO PRE-VALIDATION ACTIVITIES TIMEPLAN

2.3.4 Pilot Validation Activities Plan

Following the conclusion of the pre-validation activities, the actual the demonstration and validation will commence and will be implemented over 2 distinct phases. A detailed breakdown of the pilot validation activities is provided in the following Gantt diagram:

Task / Month	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
Final configuration and fine-tuning of the BEYOND Platform and End-user Applications															
Continuous integration of data assets															
1st Demonstration run and real-life field testing															
Preliminary Evaluation of BEYOND Impact															
Identification of further improvements (technical and user interface ones)															
Elaboration on the suggested improvements and new release of the platform and applications															
2nd demonstration run and real-life field testing															
Follow-up evaluation of the BEYOND Impact Assessment and Lessons Learnt															

FIGURE 18: TIMEPLAN FOR THE IMPLEMENTATION OF THE VALIDATION ACTIVITIES IN THE FINNISH DEMO

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

2.3.5 Demo Cases

Forum Virium Helsinki facilitates the roll-out and implementation of five demonstration use cases in Helsinki. This involves data collection of smart metering devices, installed & existings IoT sensors, building energy management (BEM) systems, and demographic data from hundreds of buildings in order to support urban planning via the application of

- Building Digital Twin and AI Analytics for energy performance optimization and predictive maintenance improvement
- Crystal City Simulation Tool for informed, evident, and optimized energy policy-making by providing higher accuracy demand forecasts to the impact assessment tool
- Renovation Decision Support Tool for optimized investments planning of renovation projects by Energy Service Companies (ESCOs) and reduction of risks associated with Energy Performance Contracting (EPC) models.

In total, there will be four different demo assets available for Finnish demo case. The assets will be optimally deployed based on the purpose and scope of each use case and accordingly the accessibility of required resources (mainly data).

Stadia Vocational school

- Powered by district heating, cooling, and electricity by Helsingin Energia Oy
- Individual datapoints for heating and electricity are available
- Visitor counter cameras installed for calculating building occupancy

Urban Environment House

- Schneider Ecostruxure energy management system
- Smart electricity metering
- Smart water metering

Viikki Environmental House

- Trend building automation system
- Electrical energy metering in major systems
- Siemens Siestorage and DEMS electrical storage system, 45 kWh
- solar panels with 60 kW_{pp} production capacity

Residential buildings from Kalasatama

- Smart metering electricity metering at flat and KNX group level.
- Provided data aggregated to larger data groups to meet privacy needs of residential data.

The demo cases that will be tested in the Finnish demo site are described in the following table in combination the demo assets:

TABLE 55: BEYOND DEMO CASES AND ALIGNMENT TO THE PILOT BUILDINGS AND ASSETS

	Demonstrator	FI	FI	FI	FI

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

	Demo Site	KYMP House	Vikki Envir. House	Stadia Vocational School	Kalasatama residential buildings
No.	**Demo Cases**				
01	Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings – Data sharing between buildings and ESCOs involved in Energy Performance Contracting				
02	Predictive Maintenance Improvement through Digital Twins and Enhanced AI Analytics – Data sharing between buildings and ESCOs				
03	Real-time Building Energy Performance and Smart Readiness Certification - Data sharing between buildings, Energy Retailers and ESCOs				
04	Informed and Evident policy making (predictive modelling) at urban and macro-level enabled by detailed Impact Assessment for Holistic Energy Optimization – Data sharing between buildings and City Authorities				
05	Advanced renovation support for accurate energy-efficient design of buildings towards optimized investment decision-making and de-risking - Data sharing between buildings and ESCOs/ Construction Companies				

Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings

This demo case will enable direct data sharing between different types of buildings located in Helsinki (sharing real- time BEMS, generation and IoT information from myriads of devices in buildings with more detailed data generation capabilities as presented before) and taking over the detailed analysis and optimization of building assets, through real-time energy consumption optimization (human-centric control of major building loads – for the wellbeing of the occupants) and self-consumption maximization (real-time matching of demand and supply utilizing the flexibility offered from the demand side) with ultimate aim to increase the energy performance of such buildings with the utilization of the Building Digital Twins application that will be configured by VTT during the project implementation.

The demo case will involve the Building Digital Twins Environment for Energy Performance Optimization, Self-consumption Maximization and Predictive Maintenance (BEPO) which aims to to provide analytics and services for optimizing

the operation and energy management of buildings in real-time. This building analytics and management toolbox will comprise a set of following features

- Monitoring in real-time the energy performance of buildings as a whole but also at individual systems level;
- Analyzing energy performance of building against the needs and requirements of building occupants;
- Supporting of energy management decision-making for optimizing it;
- In presence of RES, storage and other flexibility sources, the toolset will allow for the design of appropriate flexibility control strategies in order to maximize self-consumption and, thus, reduce energy costs, without compromising key occupants' comfort and well-being.

The toolset will be based on the Digital-Twin model, which is created based on a mix of existing mathematical & physical model of the building which will be trained based on real-life measurement data (indoor temperature, energy consumption of single consumption points, building automation data, IoT sensors data and weather data) along with data referring to the geometry of the building, the thermal properties of building envelope elements and flexibility analytics delivered through the analysis performed in the Analytics Toolkit of BEYOND.

This toolset will complement the developments of T5.3, with focusing on real-operation, appropriately extending the existing Digital Twin Model with context-aware flexibility profiles of occupants in the built environment, resulting from WP4.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 56: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_03	EPC optimization through real-time monitoring and improvement of energy performance of buildings, as well as, through predictive maintenance of building assets

Energy related Use Cases relevant to the Demo Case

TABLE 57: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_6.3 Energy Performance monitoring in real-time
UC_E_6.5 Continuous optimization of building energy performance and self-consumption maximization through the utilization of the Digital Twin concept
UC_E_6.6 Personalized energy analytics and awareness of energy consumption characteristics

Data Assets Involved in the Demo Case.

There are several data assets covering the aspects of the demo site buildings' contextual/environmental and energy profiling data. However, it is important to keep in mind that not all of the data assets are available from all of the demo sites, due to the different nature and variability of the demo sites. Frequency, format and velocity of data collection varies considerably between demo sites. The building automation systems provide thousands of data points that are not listed here since not seemed to be applicable at the moment, but it can be later included on the need basis. This is also the case with the Stadia Vocational School.

TABLE 58: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
FI_FVH_1	Temperature	Room Temperature in Vikki Environmental House
FI_FVH_2	Incoming Air temperature	Incoming air temperature in Vikki Environmental House
FI_FVH_3	Motor drive Setting	Motor drive Set Value (0-100%) in Vikki Environmental House
FI_FVH_4	Convector water intake temperature	Incoming cooling water temperature
FI_FVH_5	Stadia Vocational School	Visitor counter

TABLE 59: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

FI_FVH_1	Records per 15 min	Structured	Text	Near real-time	Y	2013-today	Per 15 mins	Finland	Building	English	Raw	N
FI_FVH_2	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_3	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_4	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_5	Records per 60s	Structured	Other	Near real-time	Y	2021-today	Per 60 seconds	Finland	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 60: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Analysis and optimization of energy usage of buildings and based on occupancy rate EPC optimization through the visualization of the real-time energy performance and provision of reliability indicators to monitor energy performance of buildings Enabling assessment and design of control strategies for efficient management of energy flows as well as energy assets flexibility Energy costs savings with preservation of well-being preferences through the development of personalized and advanced human-centric energy services incl. self-consumption Achieving profitability and long-term sustainability by offering simplified visualizations and insights on energy consumption patterns to energy consumers and energy suppliers	**Legal:** Availability of data due to regulatory or unforeseen technical obstacles on data sharing. General feasibility challenges in taking new developments to production environment in city context and end-user acceptance in terms of new technological solutions
Risks and Mitigation Plans	
Getting consents to gather data from residential buildings as well as district level data from retailers. Actions have already been taken to ensure the availability of data and avoid delays derived from regulatory processes. **Identification of right stakeholders in case of ESCOs and setting attractiveness measures to engage end users will arise challenges in terms of confirming the corresponding users' requirements and evaluation of BEYOND solution. FVH will start detailed planning of engagement activities to onboard the right audience as soon as possible.**	

Predictive Maintenance Improvement through Digital Twins and Enhanced AI Analytics

This demo case will enable direct data sharing between different types of buildings located in Helsinki (sharing real-time BEMS and IoT information from myriads of

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devices (sensors, actuators) in buildings with more detailed data generation capabilities as presented before) and FVH, with the latter taking over the detailed analysis and optimization of building assets, through predictive maintenance services (enabling accurate fault diagnosis and characterization over critical systems and equipment, probability assessment of fault occurrence, early prediction of faults and facilitate increased reliability and efficiency of building assets). Analysis and optimization of building assets relies on the Building Digital Twins application that will be configured by VTT in T6.1 during the project implementation.

The Demo Case will utilize the Building Digital Twins Environment for Energy Performance Optimization, Self-consumption Maximization and Predictive Maintenance (BEPO)

The aim of the BEPO toolbox is to provide analytics and services for optimizing the operation and energy management of buildings in real-time. This building analytics and management toolbox will be enhanced with predictive maintenance features for large energy consuming equipment and systems installed in buildings to support energy management decision-making and optimization.

In this sense, the BEPO toolset will leverage the baseline predictive maintenance analytics of BEYOND (WP4) and further enriching them to address low-level identification of various mechanical faults or discrepancies, anomalous behaviors and defective equipment/ materials, Indoor Air Quality (IAQ) violations, while recommending optimized maintenance actions, which will be based on the prediction of future equipment performance.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 61: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_03	EPC optimization through real-time monitoring and improvement of energy performance of buildings, as well as, through predictive maintenance of building assets

Energy related Use Cases relevant to the Demo Case

TABLE 62: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_6.4 Predictive maintenance of HVAC systems

Data Assets Involved in the Demo Case.

There are several data assets covering the aspects of the demo site buildings' contextual/environmental and energy profiling data. However, it is important to keep in mind that not all of the data assets are available from all of the demo sites, due to the different nature and variability of the demo sites. Frequency, format and velocity of data collection varies considerably between demo sites.

The building automation systems provide thousands of data points that are not listed here since not seemed to be applicable at the moment, but it can be later included on the need basis. This is also the case with the Urban Environment House (The KYMP House).

TABLE 63: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
FI_FVH_1	Temperature	Room Temperature in Vikki Environmental House
FI_FVH_2	Incoming Air temperature	Incoming air temperature in Vikki Environmental House
FI_FVH_3	Motor drive Setting	Motor drive Set Value (0-100%) in Vikki Environmental House
FI_FVH_4	Convector water intake temperature	Incoming cooling water temperature
FI_FVH_5	Stadia Vocational School	Visitor counter

TABLE 64: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

FI_FVH_1	Records per 15 min	Structured	Text	Near real-time	Y	2013-today	Per 15 mins	Finland	Building	English	Raw	N
FI_FVH_2	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_3	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_4	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_5	Records per 60s	Structured	Other	Near real-time	Y	2021-today	Per 60 seconds	Finland	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 65: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Enabling evidence based predictive maintenance EPC optimization through energy performance monitoring and predictive maintenance scheduling of buildings assets and end-user acceptance in terms of new technological solutions	General feasibility challenges in taking new developments to production environment in the demo sites
Risks and Mitigation Plans	
Identification of right stakeholders in case of ESCOs and setting attractiveness measures to engage end users will arise challenges in terms of confirming the corresponding users' requirements and evaluation of BEYOND solution. FVH will start detailed planning of engagement activities to onboard the right audience as soon as possible.	

Real-time Building Energy Performance and Smart Readiness Certification

This demo case will enable direct and real-time interactions between buildings and their systems (sharing real-time BEMS, generation and IoT information from myriads of devices in their buildings) with energy retailers and ESCOs involved in the project (Mytilineos, Cuerva, BEOELEK and IGM), with the latter taking over the detailed analysis of data streams coming from the building systems regarding energy consumption and occupancy, along with weather data coming from open sources to enable real-time energy performance certification (applying innovative operational rating and appropriate normalization methodologies and approaches) of buildings based on real-life data streams (instead of aggregated data batches), that can point out specific areas of improvement (through energy analytics described in the previous case) and act as an enabler for further optimizing the performance of buildings from an energy point of view. In Finnish context, FVH provides the data from Finnish buildings and systems to the ESCOs involved in the project. Also, it will be investigated if the Helsinki city data model can be enriched with selected eDEC and SRI scores calculated in the project. SRI and eDEC modules are developed in T6.4.

The Demo Case will utilize the Energy Performance (assessment) and Smart Readiness Certification Tool (EPSRC).

The aim of EPSRC Tool is to support the continuous assessment and certification of the Smart Readiness status of buildings (as a whole but also at individual systems level), analyze it against the needs and requirements of the occupants and visitors, define spatio-temporal outliers that significantly affect energy performance and support energy management decision-making for optimizing it. The penetration of Energy Performance Contracts and the introduction of novel services for the building sector, require a more dynamic framework that will allow educated and evidence-

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based decision making on investments to be made, along with different investment incentives for different levels of energy performance certification levels over the building stock, through the utilization of more granular data coming from the buildings.

Tailored tools and services are required towards the building sector allowing for their real time energy certification and investment optimisation through the utilization of enhanced Display Energy Certificates that will allow for the buildings' compliance with energy efficiency commitments. In this sense, business actors like aggregators and retailers need to have access to detailed information about buildings towards evaluating their smart readiness and assessing their capabilities for getting involved in flexibility transactions and control strategies that are associated with innovative automation concepts. To this end, they need appropriate tools and methods to support the continuous assessment and certification of the Smart Readiness status of buildings. Such detailed information about building systems and other devices available, will need to be processed and analyzed in order to enable the calculation of a variety of metrics that altogether contribute to the assessment of the smart readiness of the building and the presentation of individual analyses in appropriate graphical user interfaces (GUIs) that point out to the overall score, but also to the performance of the building in separate metrics that affect its smart readiness levels. The latter will point out to specific improvements that need to be performed (in terms of retrofitting) towards enhancing the smart readiness level of the building and making it more attractive for revenue creation through flexibility provision (or at least for the provision of innovative smart energy services for energy savings).

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 66: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_02	New revenue creation through new services for real-time energy performance certification, complemented by Smart Readiness Certification services

Energy related Use Cases relevant to the Demo Case

TABLE 67: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_6.1 Real-time assessment of building energy performance in different spatio-temporal granularities
UC_E_6.2 Enriched building performance assessment including the on-the-fly calculation of Smart Readiness Indicators

Data Assets Involved in the Demo Case.

There are several data assets covering the aspects of the demo site buildings' contextual/environmental and energy profiling data. However, it is important to keep in mind that not all of the data assets are available from all of the demo sites, due to the different nature and variability of the demo sites. Frequency, format and velocity of data collection varies considerably between demo sites. The building automation systems provide thousands of data points that are not listed here since not seemed to be applicable at the moment, but it can be later included on the need basis.

TABLE 68: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
FI_FVH_1	Temperature	Room Temperature in Vikki Environmental House
FI_FVH_2	Incoming Air temperature	Incoming air temperature in Vikki Environmental House
FI_FVH_3	Motor drive Setting	Motor drive Set Value (0-100%) in Vikki Environmental House
FI_FVH_4	Convector water intake temperature	Incoming cooling water temperature

TABLE 69: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
FI_FVH_1	Records per 15 min	Structured	Text	Near real-time	Y	2013-today	Per 15 mins	Finland	Building	English	Raw	N
FI_FVH_2	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N

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FI_FVH_3	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_4	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 70: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Support energy management decision making with the help of real-time energy performance monitoring services complemented by Smart Readiness Certification services Enhancing smart readiness levels by pointing out spatio-temporal outliers in terms of energy performance and proposition of solutions such as retrofitting to increase flexibility	Accuracy of simulation results due to potentially skewed data and data availability from demo sites Getting access to flexibility data due to scattered ownership of RES
Risks and Mitigation Plans	
Identification of right stakeholders in case of ESCOs and setting attractiveness measures to engage end users will arise challenges in terms of confirming the corresponding users' requirements and evaluation of BEYOND solution. FVH will start detailed planning of engagement activities to onboard the right audience as soon as possible.	

Informed and Evidence-based Policy-making (predictive modeling) at Urban and Macro-level enabled by detailed Impact Assessment for Holistic Energy Optimization

This demo case will capitalize on the baseline industrial data analytics in order to enhance the forecasting capabilities and simulation accuracy of the Crystal City tool of Artelys, towards providing better informed evidence to the Helsinki City Authority (represented by FVH) for optimized energy policy making. Instead of forecasting the future energy performance of buildings (which constitute the major energy demand in urban contexts) based on high-level and low granularity metering data, this demo case will focus on equipping the Crystal City tool with building demand forecasts of higher accuracy to enhance its predictive capabilities and, thus, allow the tool to provide a more accurate representation of the environmental and energy state in specific urban contexts, subsequently enabling the better informed identification of local energy/ sustainability requirements and the design of more realistic policy measures to achieve mid- and long-term sustainability objectives. Demand (and generation) forecasting models for different types of buildings will be made available to the impact assessment tool (together with batch statistic data from well-known repositories of open building data and the Smart Urban Platform containing data about more than 36,000 buildings in the city area), to enable a more representative and realistic population of the tool's impact assessment (simulation) models and, subsequently, more accurate and robust predictions of the impact achieved by alternative policy scenarios designed for the city of Helsinki with the ultimate objective to support them in making the optimal decision for the timely and effective satisfaction of energy and sustainability objectives set out in action plans for the mid-

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and long-term. The impact assessment tool is developed in T5.1 and demand (and generation) forecasting models for different types of buildings is developed in T4.2. The latter will provide input to the impact assessment tool and the analysis will be run by Artelys based on data received from FVH.

The Demo Case will utilize the EPUL (Impact assessment tool for energy policy making at urban Level) Tool, Artelys's Crystal City tool, impact assessment module, demand and generation forecasting module

The aim of EPUL Tool (stepping on ARTELYS Crystal City) is to help local authorities to elaborate their Sustainable Energy and Climate Action Plan (SECAP) and make investment decisions that will enable them to meet the European Union's commitments in terms of reducing GHG emissions at a lower cost while improving the quality of life of the inhabitants.

The forecasting capabilities and simulation accuracy of the Crystal City Tool will be enhanced by the baseline industrial data analytics developed in WP4 in order to provide better informed evidence to local decision makers (urban level) for optimized energy policy making.

Demand (and generation) forecasting models for different types of buildings will be made available to the EPUL tool, to enable a more representative and realistic population of the tool's impact assessment (simulation) models and, subsequently, more accurate and robust predictions of the impact achieved by alternative policy scenarios designed by city authorities with the ultimate objective to support them in making the optimal decision for the timely and effective satisfaction of energy and sustainability objectives set out in local authorities' action plans for the mid- and long-term.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

Table 71: Business Scenarios Relevant to the Demo Case

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_11	More effective decision-making for urban planning and evidence-based realistic target setting for their transformation to smart and sustainable ecosystems, through advanced forecasting of demand in buildings

Energy related Use Cases relevant to the Demo Case

Table 72: Energy Use Cases Relevant to the Demo Case

UC_E_5.7 Urban planning optimization and SECAP target-setting

UC_E_5.8 SECAP target monitoring and revision

Data Assets Involved in the Demo Case.

There are several data assets covering the aspects of the demo site buildings' contextual/environmental and energy profiling data. However, it is important to keep in mind that not all of the data assets are available from all of the demo sites, due to the different nature and variability of the demo sites. Frequency, format and velocity of data collection varies considerably between demo sites. The building automation systems provide thousands of data points that are not listed here since not seemed to be applicable at the moment, but it can be later included on the need basis.

TABLE 73: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
FI_FVH_7	Electricity consumption	Electricity consumption in the buildings of the Kalasatama district
FI_FVH_8	Air quality	Indoor Air Quality in floor/room level. 2.5PPM and 10PPM
FI_FVH_6	Hot water consumption	Total hot water consumption in the buildings of the Kalasatama district
FI_FVH_10	Helsinki Energy and Climate Atlas	The Helsinki Energy and Climate Atlas (https://hri.fi/data/en_GB/showcase/helsingin-energia-ja-ilmastoatlas)

TABLE 74: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
FI_FVH_7	10000 events per minute	Structured	Text	Near real-time	Y	2020-	per minute	Helsinki area (10 residential buildings)	Building	English	Raw	N
FI_FVH_8	500 events	Structured	Text	Near real-time	Y	2020-	per minute	Helsinki area (10	Building	English	Raw	N

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	per minute							residential buildings)				
FI_FVH_6	500 events per minute	Structured	Text	Near real-time	Y	2020-	per minute	Helsinki area (10 residential buildings)	Building	English	Raw	N
FI_FVH_10	Solar energy potential -Heating demand prediction - Geoenergy potential -Energy data of buildings	Structured	Text	Batch	Y	Depending on the type of data assets (from 2015 and in case of prediction till 2050)	-	Helsinki area	City or Per housing company (varies based on the type of data assets)	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 75: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
More effective decision-making for urban planning through the provision of a tool for monitoring the implementation of actions included in the SECAP and measure their impact Evidence-based realistic SECAP target-setting towards accelerating the transformation to smart and sustainable cities Shifting the investments towards low carbon policy decisions by offering tools for impact assessment of different scenarios on the level of GHG emissions	General feasibility challenges in taking new developments to production environment in city context Technical readiness of modules for integrating the data with different spatial and temporal granularity
Risks and Mitigation Plans	
The most potential risk lies in the maturity of the technological solutions as well as the ability to correctly address functional user requirements and real world uncertainties. Detailed planning and continuous auditing of needs and functionalities should be addressed with relevant stakeholders. **Accuracy results from impact assessment tools derived from the complexity of the city's ecosystem and ensuring that right elements and right stakeholders are addressed when it comes to energy performance decision making. FVH will start detailed planning of engagement activities to onboard the right audience as soon as possible.**.	

<u>Advanced Renovation Support for accurate Energy-efficient Design of buildings towards Optimized Investment Decision-making and De-risking</u>

This demo case will focus on significantly reducing the gap between predicted and actual energy performance of buildings during the design of renovation projects. BEMS data from the buildings involved in the Finnish demonstrator (offered by the portfolio of buildings managed by City of Helsinki) and low-level intra-building sensing, metering, actuating data (IoT devices) will enable the definition of accurate occupants' behaviour and comfort profiles (based on baseline personal AI analytics available in the BEYOND toolkit). Such profiles will be made available to IGM in order to introduce them in iterative simulation loops of alternative renovation scenarios of selected buildings (performed the respective Renovation Decision Support tool developed by VTT), thus replacing generic routines and schedules currently used, with real data coming from the actual operation of the building-to-be-renovated. Additional analytics will be performed over simulation results to identify energy

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performance outliers and enable further devising renovation approaches and scenarios to achieve (in a highly accurate manner) optimal balancing between anticipated energy performance, renovation project costs and indoor air quality/ occupants' comfort. The demo case will validate highly accurate results for the anticipated energy performance of to-be-renovated buildings. On the other hand, it will validate significant benefits for IGM (as an ESCO) through facilitating further penetration of the Energy Performance Contracting (EPC) model for ESCOs, allowing for the reduction of uncertainty and respective risks of EPC business models, due to the reduction of the performance gap between predicted and actual energy performance of buildings, which in many cases can lead to a total project failure, since ESCOs fund such projects themselves and are paid back by the savings achieved; so any significant deviation between actual and predicted values of savings may drastically affect the payback and overall (investment) success of renovation projects.

The demo case will involve the Renovation Optimization Decision Support (ROST) Tool. The aim of ROST Tool is to facilitate the accurate energy-efficient design of buildings towards optimized investment decision-making when renovating the building.

The respective tool will utilize occupants' behavior and comfort profiles resulting from WP4 and introduce them in iterative simulation loops of alternative renovation scenarios of selected buildings, thus replacing generic routines and schedules currently used in similar commercial products with real data coming from the actual operation of the building to- be-renovated.

Additional analytics will be performed over simulation results to identify energy performance de-efficiencies and enable further optimisation of renovation approaches and scenarios to achieve optimal balancing between anticipated energy performance, renovation project costs and air quality and occupants' comfort.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

Table 76: Business Scenarios Relevant to the Demo Case

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_01	Reinforcement of the effectiveness and de-risking of the viability of Energy Performance Contracting through reliance on accurate occupancy-related schedules

Energy related Use Cases relevant to the Demo Case

TABLE 77: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_5.1 Accurate building energy performance simulation, considering fine-grained occupancy and comfort profiles of building occupants
UC_E_5.2 Building energy passport configuration for tracking renovation actions and increasing transparency building assets and performance

Data Assets Involved in the Demo Case.

There are several data assets covering the aspects of the demo site buildings' contextual/environmental and energy profiling data. However, it is important to keep in mind that not all of the data assets are available from all of the demo sites, due to the different nature and variability of the demo sites. Frequency, format and velocity of data collection varies considerably between demo sites. The building automation systems provide thousands of data points that are not listed here since not seemed to be applicable at the moment, but it can be later included on the need basis. This is also the case with the Urban Environment House (The KYMP House).

Table 78: Data Assets Involved in the Demo Case

Data Asset Description		
ID	**Data Asset Title**	**Description**
FI_FVH_1	Temperature	Room Temperature in Vikki Environmental House
FI_FVH_2	Incoming Air temperature	Incoming air temperature in Vikki Environmental House
FI_FVH_3	Motor drive Setting	Motor drive Set Value (0-100%) in Vikki Environmental House
FI_FVH_4	Convector water intake temperature	Incoming cooling water temperature
FI_FVH_9	BEMS Data	Temperature, Incoming air temperature, Motor device setting, Convector water intake temperature from the KYMP House

Table 79: Characteristics of the Data Assets involved in the Demo Case

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

FI_FVH_1	Records per 15 min	Structured	Text	Near real-time	Y	2013-today	Per 15 mins	Finland	Building	English	Raw	N
FI_FVH_2	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_3	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_4	Records per 5 min	Structured	Text	Near real-time	Y	2013-today	Per 5 mins	Finland	Building	English	Raw	N
FI_FVH_9	Records per 5-15 min	Structured	Text	Near real-time	Y	2011-today	Per 5-15 mins	Finland	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 80: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Strengthening the uptake of the Energy Performance Contracting (EPC) for ESCOs, renovation project managers and city decision-makers De-risking the viability of EPC through reliance on accurate occupancy-related schedules Implementation of simulation tools for finding the most cost-optimal renovation measures and increasing awareness on the energy performance of buildings	Limited accuracy of analytics may affect the sustainability of renovation projects Accuracy of simulation results requires high quality data – Incorporation of occupants' profiles in building simulation tools - replacement of generic routines and schedules currently utilized with real-time data from building operations
Risks and Mitigation Plans	
Availability of data for renovation support tools due to detailed granularity of required input information. The demo assets are selected so that they present a good profile in terms of data accessibility	

2.4 The Serbian Demo Site

2.4.1 Demo Site Overview

A quick overview of the Serbian Demo site is provided below.

Six Buildings District Heating

The Serbian Pilot Site consists in three buildings: two residential buildings (GeneralaŠtefanika, apartments from 29-31; and Generala Vladimira Kondića, apartments 5-7-9) and the Danilo Kiš elementary school.

The Serbian Pilot Site is located in the Stepa Stepanović neighbourhood, 5 km from the city centre of Belgrade. This neighbourhood covers 42 hectares of land, of which 434,000 m2 are residential and business space. It consists in 44 buildings with 4,616 apartments, 146 business premises, 1,430 garages, with 3,300 open parking places, one elementary school and one kindergarten, parks, green areas, sport grounds, playgrounds, and other accompanying public facilities.

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FIGURE 19 STEPA STEPANOVIĆ NEIGHBOURHOOD

FIGURE 20 SERBIAN PILOT BUILDINGS: GENERALA ŠTEFANIKA BUILDING (LEFT), GENERALA VLADIMIRA KONDIĆA (RIGHT), DANILO KIŠ ELEMENTARY SCHOOL (DOWN AT THE CENTRE)

Data will be gathered from 2 Substations and 6 Apartments from Generala Štefanika building (apartments 29-31), Generala Vladimira Kondića (apartments 5-7-9). There are existing devices in the residential apartments deployed in the previous MOEEBIUS and HOLISDER projects that included baseline data, already collected at real-time on hourly bases for the Process Control Units (Outdoor temperature (°C)) and the Primary and Secondary Heat Meters, which are:

- Cumulative Heat energy (kWh)
- Flow temperature (°C)
- Return temperature (°C)
- Cumulative flow (m3)
- Power (kW)

The baseline data collected 3 years ago in the framework of the HOLISDER project has been updated until 2021 to be used at the BEYOND project. The deployed equipment in the MOEEBIUS project is illustrated in following figure.

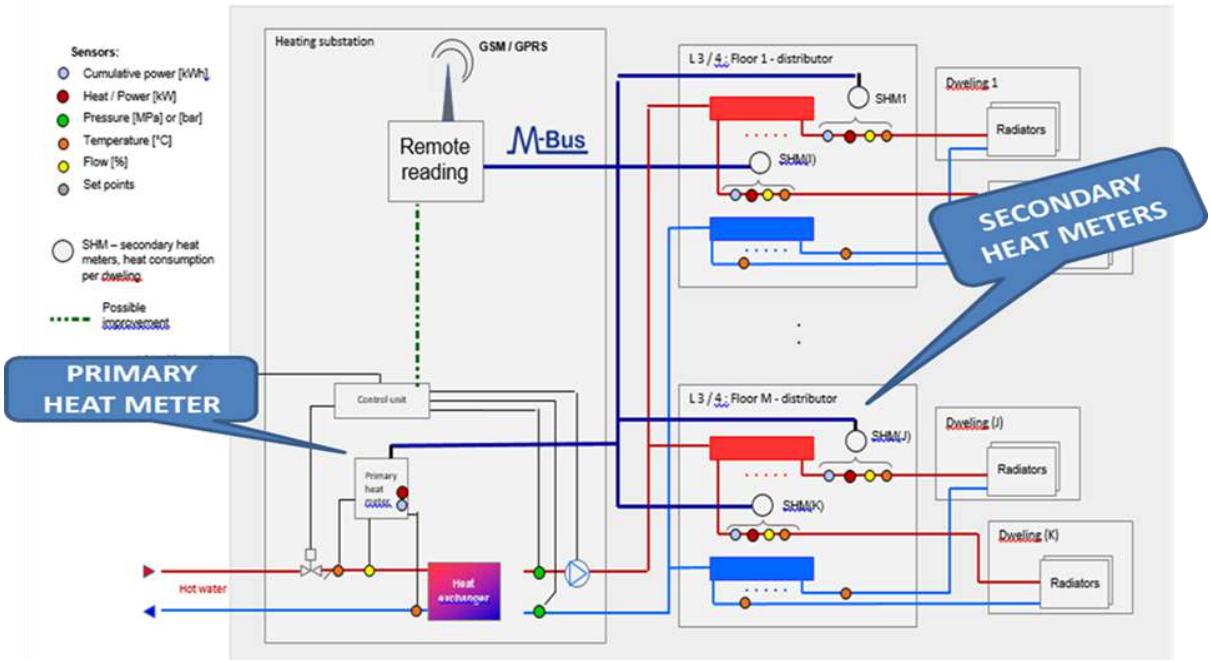

FIGURE 21 DEPLOYED DEVICES FROM MOEEBIUS PROJECT

This equipment got an addition under HOLISDER project when additional sensors were added in the apartments are depicted in detail in following table. The deployed equipment from the MOEEBIUS project is the one with the data availability of 3 years, and the new deployed equipment under the HOLISDER project is the one with recent available data.

Retailer Portfolio

In addition to the building premises that have been described above and will altogether form the Serbian Demonstration Buildings, additional data assets will be included in the Serbian Demonstration Activities to enable the realization of added value services for retailer customer portfolio monitoring and optimization. Metering,

energy use and demographic data from over 330,000 customers of BEOELEK in the city of Belgrade (spanning residential and tertiary buildings of any type) will be integrated to the platform to enable optimized portfolio management and design of better billing strategies.

2.2.2 Pre validation Activities

In order to raise awareness about BEYOND goals and expected results, BEOELEK is actively following the guidelines of the BEYOND Living Lab methodology. Living lab sessions engaging both B2B and B2C external stakeholders have already started by distrusting questionaries and newsletter to the customer base.

In further detail, a series of activities is planned for the following period and prior to the launch of the validation activities of the project towards engaging demo participants in the project activities and reinforcing the active experimentation with and demonstration of the BEYOND solutions. Moreover, within the next 6-month period, extensive testing activities will take place to ensure the smooth integration of the Serbian demo data assets to the BEYOND platform and resolve any inconsistencies and malfunctions related to the ingestion, cleaning and mapping of data to the BEYOND CIM, as well as, to the publishing of data assets to the BEYOND marketplace and their preparation for the execution of AI analytics functions. The following Gantt presents a plan of such pre-validation activities:

Task / Month	M18	M19	M20	M21	M22	M23	M24
Awareness sessions and material – Pilot Participants							
Internal Living Lab Workshop and interactive sessions for providing feedback on BEYOND platform and AI toolkit functions							
Living Lab Sessions and Live experimnetation for the provision of feedback to the BEYOND Applications							
Extensive testing of BEYOND solutions and bugs/ malfunctions reporting and resolution							

FIGURE 22: SERBIAN DEMO PRE-VALIDATION ACTIVITIES TIMEPLAN

2.2.3 Pilot Validation Activities Plan

Following the conclusion of the pre-validation activities, the actual the demonstration and validation will commence and will be implemented over 2 distinct phases. A detailed breakdown of the pilot validation activities is provided in the following Gantt diagram:

Task / Month	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
Final configuration and fine-tuning of the BEYOND Platform and End-user Applications															
Continuous integration of data assets															
1st Demonstration run and real-life field testing															
Preliminary Evaluation of BEYOND Impact															
Identification of further improvements (technical and user interface ones)															
Elaboration on the suggested improvements and new release of the platform and applications															
2nd demonstration run and real-life field testing															
Follow-up evaluation of the BEYOND Impact Assessment and Lessons Learnt															

FIGURE 23: TIMEPLAN FOR THE IMPLEMENTATION OF THE VALIDATION ACTIVITIES IN THE SERBIAN DEMO

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2.2.4 Demo Cases

The demo cases that will be tested in the Serbian demo site are described in the following table in combination the demo assets:

TABLE 81: BEYOND DEMO CASES AND ALIGNMENT TO THE PILOT BUILDINGS AND ASSETS

	Demonstrator	RS	RS
	Demo Site	Stepa Stepanovic Buildings	BEOELEK Portfolio
No.	**Demo Cases**		
01	Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings – Data sharing between buildings and ESCOs involved in Energy Performance Contracting		
02	Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies - Data sharing between buildings and Energy Retailers		
03	Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants - Data sharing between buildings, Energy Retailers and ESCOs		
04	Real-time Building Energy Performance and Smart Readiness Certification - Data sharing between buildings, Energy Retailers and ESCOs		
05	Informed decision-making on building-relevant energy infrastructure sizing and planning (district heating network) - Data sharing between buildings and District Heating Network Operators		

Energy Performance Optimization and Self-Consumption Maximization through the application of the digital twin concept in buildings

This demo case will enable direct data collection from the Serbian demo buildings (sharing real- time BEMS, generation and IoT information from devices in buildings with more detailed data generation capabilities as presented before) and taking over the detailed analysis and optimization of building assets, through real-time energy consumption optimization (human-centric control of major building loads – for the

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wellbeing of the occupants) and self-consumption maximization (real-time matching of demand and supply utilizing the flexibility offered from the demand side) with ultimate aim to increase the energy performance of such buildings with the utilization of the Building Digital Twins application that will be configured by VTT during the project implementation.

The demo case will involve the Building Digital Twins Environment for Energy Performance Optimization, Self-consumption Maximization and Predictive Maintenance (BEPO) which aims to to provide analytics and services for optimizing the operation and energy management of buildings in real-time.

The toolset will be based on the Digital-Twin model, which is created based on a mix of existing mathematical & physical model of the building which will be trained based on real-life measurement data (indoor temperature, energy consumption of single consumption points, building automation data, IoT sensors data and weather data) along with data referring to the geometry of the building, the thermal properties of building envelope elements and flexibility analytics delivered through the analysis performed in the Analytics Toolkit of BEYOND.

This toolset will complement the developments of T5.3, with focusing on real-operation, appropriately extending the existing Digital Twin Model with context-aware flexibility profiles of occupants in the built environment, resulting from WP4.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

Table 82: Business Scenarios Relevant to the Demo Case

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_03	EPC optimization through real-time monitoring and improvement of energy performance of buildings, as well as, through predictive maintenance of building assets

Energy related Use Cases relevant to the Demo Case

Table 83: Energy Use Cases Relevant to the Demo Case

UC_E_6.3 Energy Performance monitoring in real-time
UC_E_6.5 Continuous optimization of building energy performance and self-consumption maximization through the utilization of the Digital Twin concept

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 84: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
SR_BEOELEK_4	Outdoor temperature	Outdoor temperature [°C]
SR_BEOELEK_5	Room temperature	Ambiental air temperature [°C]
SR_BEOELEK_6	Room relative Humidity	Room Humidity [%]
SR_BEOELEK_3	DH Energy Consumption, secondary side	District heat consumption data (MWh), for 170 apartmants, in total
SR_BEOELEK_7	Network analyzer - electric meter three phases	Electric Consumption
SR_BEOELEK_8	Network analyzer - electric meter one phase	Electric Consumption

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TABLE 85: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
SR_BEOELEK_3	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Floor distributor for dwelling	Building	English	Raw	N
SR_BEOELEK_4	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_5	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_6	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_7	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_8	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 86: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
New EPC service provision Detailed analysis and optimization of building assets, through near real-time energy consumption optimization	Compliance to GDPR forms related to access of all pilot user related data. Acquisition of know-how in EPC business aspects and establish commercial agreements with major equipment vendors to support ESCO service offerings.
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

Building Portfolio Management Optimization for Energy Efficiency through Portfolio Energy Analytics and better-suited Billing Strategies

The realization of this demo case will be based on the validation of a complete toolbox for energy retailers for comprehensive portfolio analysis, towards optimizing a series of business objectives. In more detail the Building Portfolio Management Optimisation Tool (BPMO), that has been specified in detail in Deliverable D2.6, will utilize consumption data from buildings belonging in the portfolio of BEOELEK to offer a holistic view and respective insights towards (i) significantly reducing imbalances caused by forecasting errors; (ii) examining advanced billing concepts (e.g. dynamic energy pricing) by segmenting, clustering and analysing consumption behaviours,; and (iii) analysing spatio-temporal patterns of their portfolio, identifying trends and outliers and receiving valuable knowledge for the design and delivery of added value services per individual customer or clusters of them to satisfy their needs for energy cost reduction through targeted innovative energy service bundles.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 87: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics

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BS_E_09	Retailers: New revenues through provision of services to Network Operators (Implicit DR) and avoidance of unnecessary charges through imbalance management

Energy related Use Cases relevant to the Demo Case

TABLE 88: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.10 Retailer portfolio analytics for elasticity estimation and extraction of useful insights Elasticity utilization in demand response and imbalance reduction strategies

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 89: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
SR_BEOELEK_1	DH Energy Consumption	District heat consumption data (MWh) STEPA NEIBRHOOD
SR_BEOELEK_4	Outdoor temperature	Outdoor temperature [°C]
SR_BEOELEK_5	Room temperature	Ambiental air temperature [°C]
SR_BEOELEK_6	Room relative Humidity	Room Humidity [%]
SR_BEOELEK_2	DH Total Energy Consumption, primary side	District heat consumption data (MWh) for 2 buildings
SR_BEOELEK_3	DH Energy Consumption, secondary side	District heat consumption data (MWh), for 170 apartmants, in total

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

SR_BEOELEK_7	Network analyzer - electric meter three phases	Electric Consumption
SR_BEOELEK_8	Network analyzer - electric meter one phase	Electric Consumption

TABLE 90: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
SR_BEOELEK_1	1 record per hour	Structured	Text/ Numerical	Batch	Y	2017-	Per hour	Belgrade, Stepa Neibrhood	District	English/Serbian+P30	Pre-processed	N
SR_BEOELEK_2	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_3	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Floor distributor for dwelling	Building	English	Raw	N
SR_BEOELEK_4	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_5	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_6	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_7	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

SR_BEOELEK_8	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 91: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Advanced billing schemes that reflect individual demand profiles and associated energy costs Detailed analysis of retailer portfolio to identify trends and outliers while receiving valuable knowledge for the design and offering of added value services to energy consumers	Dynamic pricing requires investments in smart metering across the portfolio
Risks and Mitigation Plans	
No foreseen risks	

Personalized Energy Analytics and Energy Efficiency Optimization Guidance, including Human-Centric features for well-being of occupants

This demo case will realize advanced and innovative energy service concepts for selected customers of BEOELEK focusing on personalized energy efficiency guidance and non-energy services for security, comfort and well-being. Data streams from building systems and IoT devices (metering, control, ambience sensing) will be fed into the BEYOND Big Data Platform and Analytics Toolkit towards analysing the flexibility of individual consumers and generating personalized insights on how they can save energy and optimize their energy performance through the respective application that will be developed by SUITE5 (Personalised Energy Analytics Tool for Guidance on Energy Performance Optimisation and Human-Centric Control Automation (PEASH)).

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 92: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_06	End Users (Prosumers/ Building Managers): Energy costs savings with preservation of well-being preferences through the deployment of personalized and advanced human-centric energy services incl. self-consumption

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BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 93: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.6 Personalized energy analytics and awareness of energy consumption characteristics
UC_E_06.7 Smart control functions including human-centric features for energy and non-energy services
UC_E_06.12 Non-energy Services for Comfort, Well-being and Security

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 94: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
SR_BEOELEK_4	Outdoor temperature	Outdoor temperature [°C]
SR_BEOELEK_5	Room temperature	Ambiental air temperature [°C]
SR_BEOELEK_6	Room relative Humidity	Room Humidity [%]
SR_BEOELEK_3	DH Energy Consumption, secondary side	District heat consumption data (MWh), for 170 apartmants, in total
SR_BEOELEK_7	Network analyzer - electric meter three phases	Electric Consumption
SR_BEOELEK_8	Network analyzer - electric meter one phase	Electric Consumption

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

TABLE 95: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
SR_BEOELEK_3	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Floor distributor for dwelling	Building	English	Raw	N
SR_BEOELEK_4	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_5	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_6	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_7	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_8	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 96: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Explore new business models that will allow to offer new Energy as a Service models instead of the traditional ones. Expansion of revenues via energy services offering Non energy services provision	Compliance to GDPR forms related to access of all pilot user related data.
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

Real-time Building Energy Performance and Smart Readiness Certification

This demo case will enable direct and real-time interactions between buildings and their systems (sharing real-time BEMS, generation and IoT information from devices in buildings) with BEOELEK, with the latter taking over the detailed analysis of data streams coming from the building systems regarding energy consumption and occupancy, along with weather data coming from open sources to enable real-time energy performance certification (applying innovative operational rating and appropriate normalization methodologies and approaches) of buildings based on real-life data streams (instead of aggregated data batches), that can point out specific areas of improvement (through energy analytics described in the previous case) and act as an enabler for further optimizing the performance of buildings from an energy point

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 97: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services
BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_02	ESCOs (incl. Energy Retailer): New revenue creation through new services for real-time energy performance certification, complemented by Smart Readiness Certification services

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

BS_E_10	Retailers: Increased profitability and long-term sustainability through the transformation of their business-as-usual to data and intelligence-driven Energy-as-a-Service offerings

Energy related Use Cases relevant to the Demo Case

TABLE 98: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_06.1 Real-time assessment of building energy performance in different spatio-temporal granularities
UC_E_06.1 Enriched building performance assessment including the on-the-fly calculation of Smart Readiness indicators

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 99: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
SR_BEOELEK_1	DH Energy Consumption	District heat consumption data (MWh) STEPA NEIBRHOOD
SR_BEOELEK_4	Outdoor temperature	Outdoor temperature [°C]
SR_BEOELEK_5	Room temperature	Ambiental air temperature [°C]
SR_BEOELEK_6	Room relative Humidity	Room Humidity [%]
SR_BEOELEK_2	DH Total Energy Consumption, primary side	District heat consumption data (MWh) for 2 buildings
SR_BEOELEK_3	DH Energy Consumption, secondary side	District heat consumption data (MWh), for 170 apartmants, in total

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SR_BEOELEK_7	Network analyzer - electric meter three phases	Electric Consumption
SR_BEOELEK_8	Network analyzer - electric meter one phase	Electric Consumption

TABLE 100: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
SR_BEOELEK_1	1 record per hour	Structured	Text/ Numerical	Batch	Y	2017-	Per hour	Belgrade, Stepa Neibrhood	District	English/Serbian+P30	Pre-processed	N
SR_BEOELEK_2	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_3	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Floor distributor for dwelling	Building	English	Raw	N
SR_BEOELEK_4	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_5	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_6	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N
SR_BEOELEK_7	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

SR_BEOELEK_8	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Apartment	Building	English	Raw	N

Drivers, Targets, Challenges and Risks

TABLE 101: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Expansion of revenues via energy services offering ESCo service offering	Applying innovative performance assessment methodologies that are characterized by data-driven approaches, require access to highly granular data
Risks and Mitigation Plans	
Data availability and technical readiness level at demo sites: Demo buildings have a high technical readiness level **Data usage permission from building owners:** Agreements for involvement in the project are already in place – Continuous engagement of owners and occupants	

Informed decision-making on building-relevant energy infrastructure sizing and planning (district heating network)

District heating network planning algorithms that simulate the operation of the network in appropriate horizons (related to regulatory regimes and asset lifetimes) will be developed to automatically calculate network performance and congestion metrics based on different infrastructure and assets installation setups, their characteristics and planned/unplanned events. The algorithms will incorporate functionality to assess the performance of the networks under various demand and generation uncertainties. Optimization algorithms will be appropriately configured to enable the study of optimal planning and sizing of network assets such as new connections, needs for expansion or enhancement, considering also needs for further investments. The algorithms will have the capability to embed all information arising from BEOELEK (network operator) systems, flexibility analytics, short-, mid- and long-term forecasting analytics for demand and generation (referring to the buildings belonging in the BEOELEK Portfolio and for which metering data and more detailed IoT and smart metering/ sub-metering data will be made available – approx. 330,000 customers), along with batch static data coming from well-known repositories of open building data (statistical information about the building stock) in order to perform a comprehensive simulation-based analysis of performance metrics (utilizing and further enhancing the DHC Route Optimizer tool of Artelys for the delivery of the District Heating Network Planning and Infrastructure Sizing Tool (DHCO)) under alternative network reinforcement and planning scenarios.

Below is a list with all relevant Business Scenarios to be tested in this Demo Case.

TABLE 102: BUSINESS SCENARIOS RELEVANT TO THE DEMO CASE

BS_D_01	Data owners increase the value of their data through added value services

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BS_D_02	Data owners gain new operational insights through the analysis of their data
BS_D_03	Data owners create new revenue streams through trading their data
BS_D_04	Maximization of service offerings by gaining access to more data
BS_D_05	Data consumers improve operations through increased outreach to external data and analytics
BS_E_04	Network Operators: Avoidance of costly investments through evidence-based, data-driven sizing of energy networks

Energy related Use Cases relevant to the Demo Case

TABLE 103: ENERGY USE CASES RELEVANT TO THE DEMO CASE

UC_E_5.3 Simulation-based network performance assessment
UC_E_5.4 Optimized sizing of network assets

Data Assets Involved in the Demo Case.

The demo case requires several datasets- Data Assets - to be available in order to data implement it an validate it. A list of each data asset description is presented below.

TABLE 104: DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Description		
ID	**Data Asset Title**	**Description**
SR_BEOELEK_1	DH Energy Consumption	District heat consumption data (MWh) STEPA NEIBRHOOD
SR_BEOELEK_2	DH Total Energy Consumption, primary side	District heat consumption data (MWh) for 2 buildings
SR_BEOELEK_3	DH Energy Consumption, secondary side	District heat consumption data (MWh), for 170 apartmants, in total

TABLE 105: CHARACTERISTICS OF THE DATA ASSETS INVOLVED IN THE DEMO CASE

Data Asset Features												
ID	**Volume**	**Variety**	**Type**	**Velocity**	**Historical Data Availability (Yes/No)**	**Temporal Coverage**	**Temporal Resolution**	**Spatial Coverage**	**Spatial Resolution**	**Language**	**Veracity**	**Dependency to Other Sources (Yes/No)**
SR_BEOELEK_1	1 record per hour	Structured	Text/ Numerical	Batch	Y	2017-	Per hour	Belgrade, Stepa Neibrhood	District	English/Serbian+P30	Pre-processed	N
SR_BEOELEK_2	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Heating Substation	District	English	Raw	N
SR_BEOELEK_3	1 record every 30 mins	Structured	Text/ Numerical	Batch	Y	2019-	Per 30 minutes	Floor distributor for dwelling	Building	English	Raw	N

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

Drivers, Targets, Challenges and Risks

TABLE 106: DRIVERS, TARGETS, CHALLENGES AND RISKS OF THE DEMO CASE

Drivers and Targets	Challenges
Reduction of unnecessary network expansion investments Optimal sizing of new assets to be introduced in relation to the building sector Provision of insights for investments and relevant incentives, for driving evidence-based policy making	Accuracy of long-term predictions relying on assumptions and future penetration scenarios may lead to inaccuracies
Risks and Mitigation Plans	
Limited interest by policy makers to step on BEYOND results to incentivize investments: BEYOND will perform the required actions and demonstrate the data-driven approach and results towards relevant target groups to increase their interest and assess the possibility of incentivizing relevant investment schemes for buildings.	

This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement n° 957020.

3 Deployment & Demonstration of BEYOND Integrated Platform and Applications

Following the BEYOND system testing activities carried out in the context of T7.1, the deployment of the BEYOND Integrated platform and the offered End-users tools/applications will take place, followed by the verification and validation activities in the project's demo sites. In this direction, this chapter presents the development plan for the BEYOND platform and associated end user's tools/apps, the integration and verification plan (running in parallel) and finally the validation plan of the developed solutions in the project's demo sites.

3.1 Development and Technical Verification Plan

As shown in the figure below, the beta release of the BEYOND integrated platform (and the offered Marketplace), has been released on M16, complemented by the draft release of the BEYOND Baseline Data Analytics. The first stable release of the BEYOND platform will be delivered on M20, in parallel with the first version of the BEYOND End user tools/applications (also delivered on M20). Regarding the latter, activities will focus on the verification of the tools and their forthcoming new releases to verify their performance, as part of the project's iterative and agile approach. Once the first version of the BEYOND platform is released, activities will also focus on the release of the BEYOND Private Infrastructure validating its seamless communication with the BEYOND Cloud based Platform. The verification (i.e., prevalidation) of the developed solutions, entails the testing of the BEYOND solutions upon their release, including the cloud-based platform, the private infrastructure, the analytics toolkit, as well as the developed BEYOND end-user's tools.

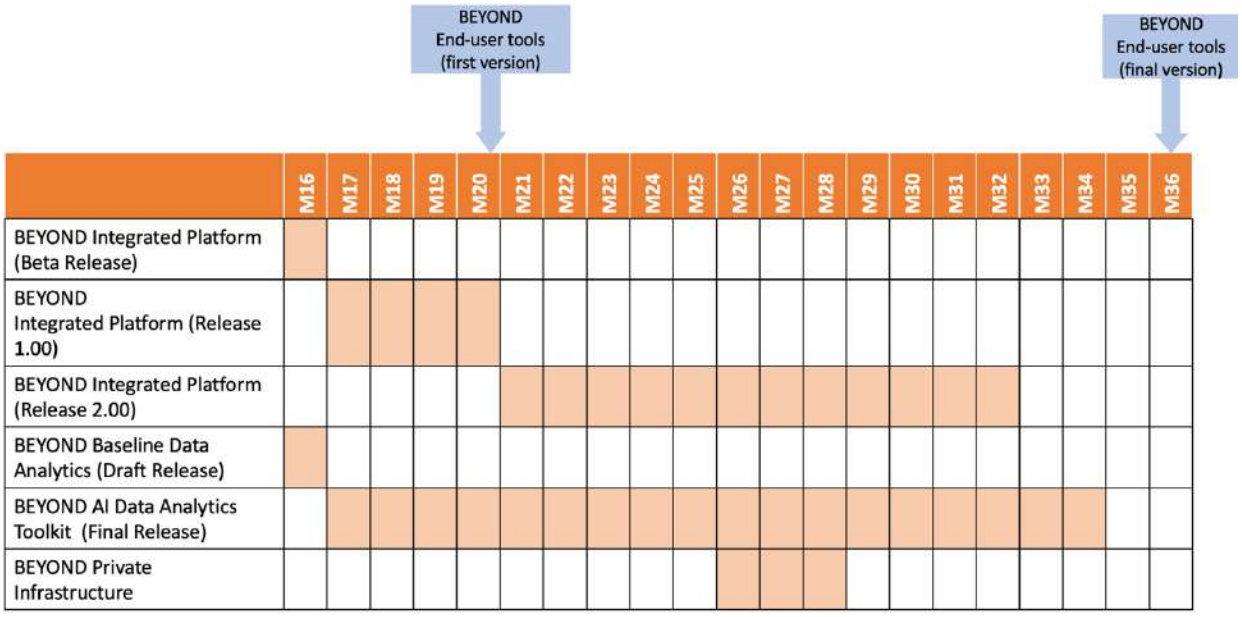

FIGURE 24: BEYOND TECHNICAL DEVELOPMENT PLAN

The verification of the BEYOND Analytics toolkit starts at M17, upon its draft release up to M34 when the final version will be released; with the activities focusing on adjusting the pretrained analytics sets based on the data collected from the demonstration sites and their adaptation to meet each demo-site needs. The system's verification aims to verify that the BEYOND developments (i.e., the cloud-based platform, the pretrained analytics and the end-user's tools) comply with the requirements and specifications set out in WP2, as well as in WP5 and WP6 where the BEYOND End-user tools are built, while testing will be carried out to ensure their problem-free functional operation.

The development and verification plan takes into consideration the overall technical roadmap of the project, along with the various needs for acquiring and installing the required equipment (e.g., (sensors, actuators, gateways etc.) in the project's demonstration sites that will serve the data collection requirements. As such, two different deployment strategies are foreseen, with the first concentrating on the deployment and release of the BEYOND platform, the offered Marketplace and developed applications; while the second focuses on the equipment installation needs at the different demo sites that will enable and facilitate the data collection process supporting both the demo sites baselining activities and validating the BEYOND solution operation in real-life conditions during the pilot roll-out and demonstration activities performed in the context of T7.4.

3.2 Deployment Plan

The deployment plan focuses on both the BEYOND components (including the Cloud based platform, the Private Infrastructure, and the End-user's tools) and the required equipment installations at the project's demonstration sites. As shown in the following figure the deployment of the BEYOND Cloud based platform and its associated components will take place until M32, when the second (and final) version of the BEYOND Integrated platform will be released; the BEYOND Private infrastructure will be deployed in M26 till M28, while the deployment of the BEYOND End-users' tools will be undertaken between M20 (when their first version will be released) up to M36 when their second release is planned.

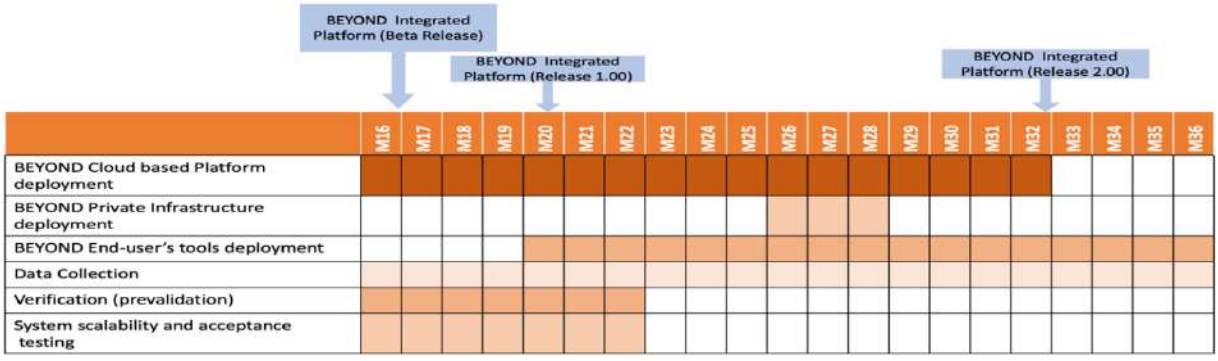

FIGURE 25: BEYOND DEPLOYMENT PLAN

3.3 Integration and Validation Plan

The BEYOND integration and validation activities will emphasize on the activities that need to be performed both for the BEYOND platform (including its offered Marketplace and End-user tools/apps), as well as for the equipment to be installed in the demo sites. Once the system's integration activities are concluded, the actual large-scale demonstration activities of the project will be initiated to validate the BEYOND solutions' technical applicability, also evaluating its impact. The BEYOND solution integration activities will aim to ensure an effective communication among the BEYOND platform, the End-user's tools/applications and the demo site's legacy systems and equipment, addressing the underlying data collection requirements of each demo site. At this point, the developer of each End-user tool is expected to validate any data issues applicable to their tool, ensuring that the data ingestion, sharing and trading processes adhere to the required parameters, while certifying the required quality of the data for the BEYOND demonstration purposes.

The validation process will start once the technical verification task is finished, focusing on identifying the data available in the demo sites' legacy systems and will carry on by further refining the data requirements. In parallel the BEYOND End-user's tools will be fine-tuned, following an agile methodology during the development of their draft version due in M20, and which will carry on till their final release in M36.

4 Conclusions

This document is reporting the demonstration management approach towards the technical deployment and effective validation and evaluation of BEYOND system during the demonstration activities in the Greek, Spanish, Finnish, and Serbian pilot sites. More particularly, and to keep a track on the progress, specific roles with responsibilities and competences have been introduced and assigned to specific partners per pilot site.

The report stepped on the work initially performed as part of Deliverable D2.5 - Ex-Ante Pilot Audits and Pilot Deployment Plan and further elaborated on detailing the demonstration activities and their time plan for the upcoming months of the project. The report analyses extensively the demonstration activities to be performed per demonstration site of the project, by detailing the demonstration cases of the project, the data assets involved, the BEYOND solutions that will be utilized and the challenges and risks involved in the realization of each demonstration case. Moreover, individual schedules are provided per demo site with regards to the installation of additional IoT devices or sub-contracting activities for API management, while special emphasis is given on the planning of the B2B and B2C living lab activities, prior to the launch of the actual project validation phase. From the report it becomes obvious that no critical bottlenecks or delays are expected, either on the technical side, or on the demo side for the prompt launch of the demonstration activities. The analysis performed by the involved partners reveals an alignment of timeplans that effectively follow the preceding activities that refer to the technical implementation, testing and deployment of the BEYOND Platform and the End-User Applications.

The information and timeplans included in this report will consist in the base ground for the effective management, monitoring and assessment of the validation activities of the project during the 1st phase of the pilot roll-out. The document will be updated in M22 of the project to report on the BEYOND Deployment Activities and update respectively the validation timeplans to address any unforeseen delay or bottleneck identified in the meantime.

It is worth mentioning that the pre-validation activities plan that has been reposted per pilot partner follows also the guidelines of the BEYOND Methodology where Living lab sessions engaging both B2B and B2C external stakeholders have already started by distrusting questionaries and newsletters to the customer base.

Following the conclusion of the pre-validation activities, the actual demonstration and validation will commence and will be implemented over 2 distinct phases: a 1st run demonstration activities will serve as the means for further optimizing the BEYOND results and facilitating the effective execution of the 2nd phase by incorporating lessons learnt and any optimization needed to address performance issues, usability improvements and previously non-identified user needs that may be revealed during the 1st run.

Overall, this report provides the basis for the monitoring of the demonstration activities, and it can be used as a guideline for the following tasks of the WP7. Thus, in a first stage it will be useful for monitoring any procurement and pre-validation/ engagement activity involved in the overall planning, to ensure the smooth launch of the demonstration activities. Later, it can be used to monitor the validation and testing activities to be performed in the second half of the project.

5 References

BEYOND D2.1 – End-user & Business requirements analysis for big data-driven innovative energy services & ecosystems – a

BEYOND D2.5 – Ex-Ante Pilot Audits and Pilot Deployment Plan

BEYOND D2.6 – BEYOND Framework Architecture including functional, technical and communication specifications – a

BEYOND D8.2 – BEYOND Living Lab Activities Plan and Evaluation Report – b