UPGRADING SMARTNESS OF EXISTING BUILDINGS THROUGH INNOVATIONS FOR LEGACY EQUIPMENT

Deliverable 7.5

Exploitation Plan v1

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Abbreviations and acronyms

Abbreviation	Definition
ABL	Albertslund kommune
CERTH	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS
D1	Day One
DSO	Distribution Network Operator
EB	Enerbrain
EC	European Commission
EDP	CNET Centre For New Energy Technologies Sa
GA	General Assembly
HVAC	Heating Ventilation and Air Conditioning
IoT	Internet of Things
IRPs	internal reporting periods
OdinS	Odin solutions S.L.
PC	Project Coordinator
RWTH	RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN
SAM	Served Addressable Market
SCML	Santa Casa Da Misericordia De Lisboa
SOM	Serviceable Obtainable Market
TAM	Total Addressable market
TSO	Transmission Network Operator
TUG	TECHNISCHE UNIVERSITAET GRAZ
VITO	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V.

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Executive Summary

D7.5 focuses on the preliminary analysis of the results that each project partner, either individually or jointly with other beneficiaries, is expected to generate in the Smart2b project.

The approach adopted was based on a detailed analysis of each Key Exploitable Result (KER), identifying the main characteristics, the possible business case, the competitive advantage over alternative solutions, the IP position and the partners involved. The methodology adopted leverages on the experiences and best practices provided by the Horizon Results Booster initiative.

This had a two-fold objective: on one side, the possible application scenarios for each KER have been analysed, aiming to potential individual exploitation strategies. On the other, the basic components of the whole Smart2b platform have been identified in view of the definition of the licensing agreements between KER owners and lead exploitation partner(s).

In this sense, this deliverable contains the description of 18 KERs from Smart2B partners, each of which has been thoroughly analysed and further commented by D1. Since some KERs contain partners' specific strategic considerations, in this public version of the document some sensitive information are not shown.

For each KER table, the approach was to guide each partner in the definition of the key features of the KER, then stimulating the discussion on several business-oriented topics, with the goal to identify possible application and exploitation routes.

The main achievements of this initial work on the definition of the exploitation strategy are:

- The identification, analysis and discussion of the main project KER;
- The mapping of each KER in the complete system architecture, which will help in the definition of the licensing/use agreements for the exploitation of the whole Smart2B platform;
- The identification of the main business and IP related weak points to be further analyzed in the next month, to better determine the exploitation potential of the various KERs;
- A list of actions to be performed by each KER owner, with the support of D1, to clarify the potential of each KER;

Finally, initial thoughts about the main exploitation route for the entire platform have been proposed, which will pave the way to the work that will be done for the second release of the Exploitation Plan.

1. Introduction

This Deliverable is the first of three releases focussed on the definition of the exploitation plan for the whole Smart2B platform and its individual Key Exploitable Results (KER).

The concept of Key Exploitable Result refers to each individual result achieved by single (or group of) partner within the project, and which could have its own individual market potential. The combination of the individual KERs in a full-fledged platform is the main project goal, which will lead to the definition of the main project exploitation strategy (D7.7 and D7.8).

The analysis of the KERs involves processing key business and IP information as value proposition, competitive analysis, business case definition, identification of customers, analysis of the freedom to operate, identification of possible approaches to IP protection and the definition of the role of additional partners in the exploitation route.

To achieve this goal, the work has been structured in three progressive stages of analysis - each guided by different rationales:

1. This first document (D7.5) is intended to map each KER to be developed by the project partners (individually or jointly with other partners), accompanying the KER description with a preliminary analysis on the exploitation potential. Besides, an initial discussion on the possible exploitation routes for the whole platform is triggered.
2. The second document (D7.7, with expected submission date at M24) will be devoted to the identification of the main exploitation route for the whole platform and to initiate the discussion on the licensing agreement for the use and exploitation of the KER that are needed to operate the platform. Besides, an in-depth analysis of those KER with highest individual exploitation potential will be carried out.
3. The third document (D7.8, submission deadline M36) will describe the final approach adopted for the exploitation of the project results, including the agreements between the KER owners and the lead exploitation partner(s).

To this scope, this deliverable is organized as follows:

- Chapter 2 is devoted to the description of the methodology adopted for the identification and analysis of the KER.
- Chapter 3 described the KERs gathered from partners, together a preliminary analysis on their context of use and its innovation potential.
- Chapter 4 introduces a preliminary outline on the possible exploitation strategies for the whole platform, which will serve as a blueprint for the discussion to be held in the coming weeks.

2. Methodology

2.1. The Approach

In order to identify and analyse all the project's KER, every partner was provided with a document containing a table to be filled out in a guided way, containing the instructions for completing each section and a general methodological introduction explaining the scope of the work.

Regarding the general introduction of the shared table, this defined the objective of the work and the individual steps needed to achieve it, where the twofold objective was both a contribution to the preparation of the D7.5 and an opportunity to study and validate the market feasibility of each project outcome (*i.e.*, KER).

Hereunder, an overview about the approach driving these set of activities under the exploitation plan is provided:

1. **What, in short, is the purpose of this work?** To understand whether the single results generated by the project can have an impact to the market. And, ultimately, to help them understanding their specific market potential.

   In conclusion, at the end of these 3 phases (i.e., the same phases described in the introduction. Please see section 1 at the previous page) we will have an exploitation plan for those results which:

   - Address a clear need of a sizeable amount of users;
   - Have the freedom to operate (*e.g.* there is no prior art hindering the market access);
   - Are protected in terms of IP (or at least protectable);
   - Overall, are willing to explore its own market potential.

     For what concerns the so-called KER Table, the template and the specific instructions provided to each partner to be filled in are provided below.

2. **What is an Exploitable Result?** A Key Exploitable Result is an individual result achieved by each partner within the project and which could have its own individual market potential, including the complete Smart2B platform.

3. **How the work has been organized?** The entire process has been divided into 3 phases: 1) collection of all KERs to be generated during the project (the current phase); 2) along with the Smart2B platform, a further analysis of the KERs aiming to reach the market through a more in-depth data gathering (D7.7); 3) preparation of business plan and exploitation plan for the above mentioned KERs (D.7.8).

4. **Data collection process.** This was the first stage where the initial inputs from partners have been collected through the standard table shown in Figure 1 at the end of the section.

5. **How is the KERs analysis organized?** The KERs table have been initially analysed by D1 and then interviews have been carried out with each partner, followed by a set of additional questions to fine tune possible elements of the table. Finally, comments and suggestions have been provided to guide the further analysis of the KER in the second release of the Exploitation Plan (D7.7).

   The parameters that drove this first analysis phase and the KERs' preliminary assessment were mainly:

   - Relevance of the Problem-Solution fit;
   - Competitive advantage over alternative solutions.

   This means that the most "advanced" KERs are those already demonstrating the capability to propose an effective solution for a real problem.

   In other words, if there is a strong market potential, the KER is ready to move on to the next step.

6. **What happens after that.** For those KERs that have met the two requirements mentioned above, a further interaction will be done in the next months to clarify specific aspects, as for instance the competitive advantage, the business model, the revenue model and the freedom to operate.

   Key criteria to analyse the KER at this stage will relate to 1) market size and 2) business case, which would allow a KER to move "directly" to the third phase, where the Business plan and exploitation plan will be prepared (D7.8).

   According to the above-mentioned information, the following table shows the insight each partner was asked to provide with the aim to both identify/map and then analyse all the exploitable results of the Smart2B project.

   The information collected from these tables have been included in this deliverable 7.5.

Table 1 – KER table template provided to each partner

KER Name: _____		
N	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**
About your result		
1	**Your KER**	Please describe your Key Exploitable Result and its main performances in few words. (MAX 1000 characters)
2	**TRL**	Please indicate what is the current technology readiness level (TRL) of your KER, from 1 to 9. If you have any doubt on the right TRL identification, please check: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf
About the business		
3	**Problem**	Please briefly describe the problem you intend to solve with your KER.

		When identifying the problem, please think about your end users, i.e., those who live this pain and that will be willing to adopt your solution. (MAX 1000 characters)
4	**Alternative solutions**	Please describe how the same problem is currently solved. Which solutions are currently available on the market? (MAX 1500 characters)
5	**Unique Selling Point**	Unique Selling Point: please briefly describe what makes your solution stand out from the competition. Please, be careful not to confuse Unique Selling point with Solution and Value Proposition! • Solution: what we offer to the market • Value Proposition: what benefit do we promise to the consumer, thanks to our solution. • Unique Selling point: what is the unique/main feature of my solution (i.e., this is the distinguishing element between us and the competitors). (MAX 500 characters)
6	**Partners**	Is there any partner already involved (or you will need to) in order to finalise the product? If yes, please list them also explaining their role.
The market		
7	**Customer**	Please try to briefly answer to the following question: What is your target customer? (MAX 1000 characters)
Intellectual Property and FTO		
8	**IPR Background**	What is the Background IPR (please specify the type of IPR and the owner)? (MAX 500 characters)
9	**IPR KER**	What is the IP protection strategy for this KER? (Please, specify how you intend to protect each achievement and who will be the owner(s))? (MAX 500 characters)
10	**FTO analysis**	Have you already carried out a Freedom to Operate Analysis for this KER? If so, please provide a preliminary overview of the main findings. (If you are unclear about the content of an FTO analysis, please refer to the link below: https://intersectjobsims.com/library/fto-analysis/ (MAX 1500)
Risks		
11	**Critical Risk**	Identify the critical risks that can kill the KER. (MAX 1000 characters)

2.2. IP Management in the Consortium Agreement

Since several KERs are jointly owned, we believe it's worthwhile pointing out the main provisions contained both in the Grant Agreement and in the Consortium Agreement.

Indeed, for properly addressing the IP Management of joint owned KERs within the project, we refer to the Article 26 and 28 of the Smart2B Grant Agreement with the additions set out in Article 8 of the Consortium agreement.

In particular, the **Article 26** is about the Ownership of the Results and the whole set of rules to be observed by each partner, especially in case of joint ownership.

Starting from the definition of "Result" and "joint ownership" the article specifies that in case of Joint ownership a written agreement must be signed between the joint owners.

That agreement shall include the definition of the share of ownership of each partner and the terms for accessing, using, exploiting and transferring the ownership.

In the same Article, the following topics are addressed:

- Rights of third parties;
- Agency ownership to protect results;
- Consequences of non-compliance.

Besides, **Article 28** of the Grant Agreement defines the key obligations of the partners in terms of exploitation of the results.

Finally, **Article 8** of the Consortium Agreement reinforces the provisions of Article 26 of the Grant Agreement, further defining the rules for managing, protecting, using and exploiting the results generated during the project both in case of individual and joint ownership.

It also states the rules related to:

- Transfer of results, namely how the transfer can be executed, how to make the other party aware of that, etc;
- Dissemination, including how information can be disclosed, confidentiality measures, use of logo/name and trademarks, etc.

3. Partners' KER Tables

3.1. Overview: Smart2b Platform Map

As a starting point, we sketched a visual map representing the system architecture and the role/position of the individual KERs.

The aim here is to facilitate the identification of the role of the partners and of the IP they generate within the project, at the same time paving the way to the discussion on the possible agreements for the use and exploitation of the KERs as components of the commercial Smart2b platform.

All KERs are colour-coded according to the partner that has generated them, as highlighted in the column on the right side of the following picture.

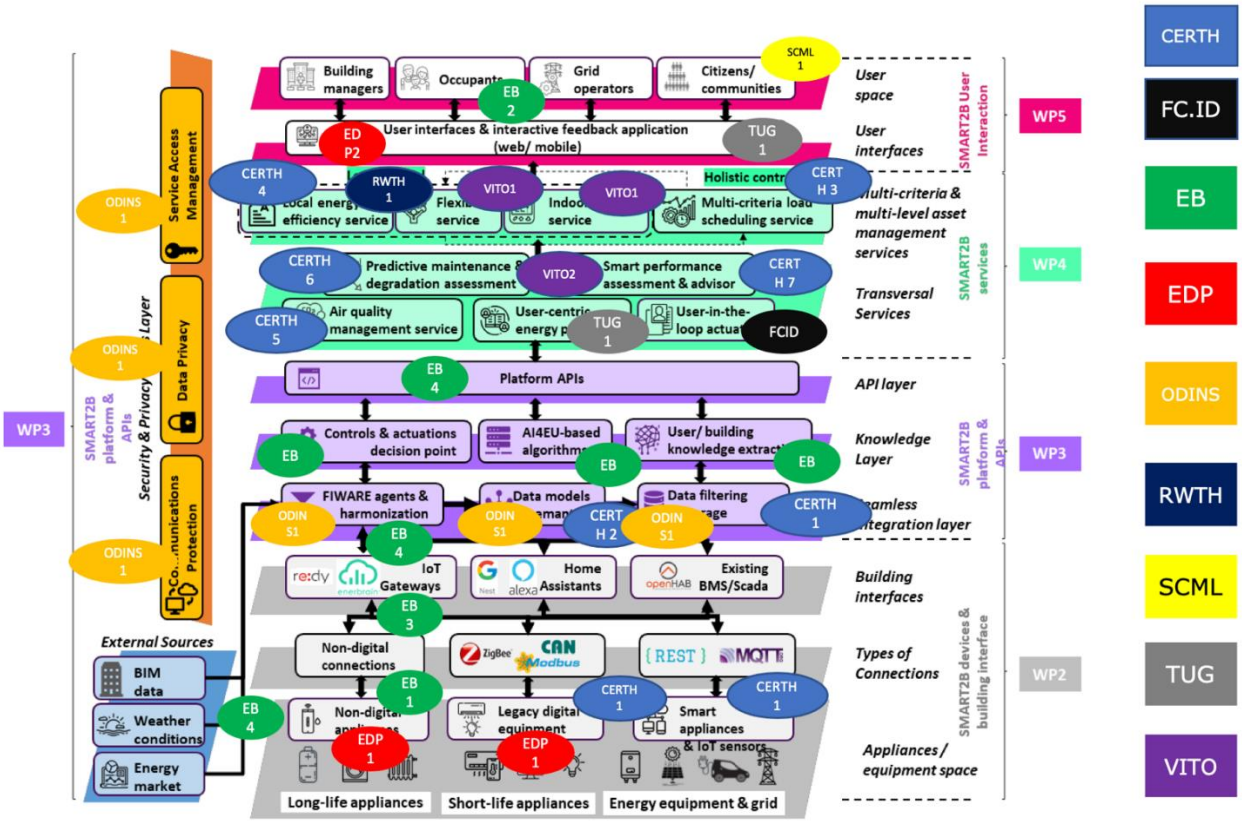

Figure 1 : The KERs representation within the Smart2b platform

In the following sections the KER Tables will be presented, dividing the project partners in three groups: Business, Research and Other Institutions. In particular, Business Partners are the companies that are involved in the project, and which have a direct commercial interest in the project results they are generating. They differ from Research Partners, as the latter are generating IP that will most likely licensed to companies for exploitation purposes, unless some individual KER show potential for internal exploitation through the launch of a start-up company. Finally, Other Institutions include the end users in the Consortium, which will host the pilot projects and that will benefit from the installation of the Smart2B solution.

3.2. Business Partners

In this first section, the business partners' KER are listed and commented, also through a Question (Q) and Answer (A) approach. While most questions have been already addressed, there are still few that will be tackled in the next release of the Exploitation plan.

As per proposal definition, we consider as business partners under the Smart2B project these listed below:

- EDP
- Enerbrain
- OdinS
- Day One

3.2.1. EDP KER Tables

EDP provided two different KER tables, respectively related to:

- Smart2B devices ;
- Gamification model.

Hereunder the two tables are presented, each one followed by a specific section to comment on it each followed by a commentary section providing some suggested inputs for implementation.

Table 2 – 1st KER table provided by EDP

1.KER Name: Smart2B devices			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**OTHER COMMENTS**
		About your result	
1	**Your KER**	*The **Smart2B devices** will be based in the development the EDP re:dy platform. EDP gateways will be to develop capacities for integrating, **real-time computing** and actuating over a wide range of **legacy equipment and appliances** available in buildings, thus enhancing interoperability. The developed solution will be tested and demonstrate libraries of edge/fog computing and machine learning algorithms to create smart adaptive solution.*	*Q: Is there a "one size fits all" Smart2B device that dialogues with legacy equipment? A: Re:dy system is an EDP already available commercial system, that includes several parts: gateways, plugs, meters, etc.* *Q: If you have to develop a specific Smart2B device for each legacy equipment/appliance, what level of customization do you expect? For example, will you design a Smart2B device for fridges or for Philips fridges or for a specific Philips fridge?* - *Is there any specific set of features that the "legacy equipment/appliance" must*

			have in order to be interoperable with the Smart2B device?
2	**TRL**	*TRL 6 – technology demonstrated in relevant environment*	*Q: Is this the current or target TRL?* *A: Current* *Q: Do you have any prototype already available for a specific application? We understand from point 6 below that you already have some commercial gateway available. Will you design/implement new gateways in the project or you will mostly work in the software/communication part improving the existing ones?* *A: Only improve, and eventually adapt new feature accordingly to the defined use cases.* - *In case you have to develop bespoke Smart2B devices for every application, how do you decide for which application you will reach TRL6 in the project?*
About the business			
3	**Problem**	*This KER will try to solve the problems related with monitoring and controlling existing building equipment in real-time, and to facilitate interoperability between devices and platform.*	- *Do you have even a rough assessment on the share of legacy equipment vs connected equipment in buildings?* - *Do you also have an idea on how this will evolve over time, in particular due to the replacement of old equipment with new one?*
4	**Alternative solutions**	*There are devices in the market with similar capabilities. Shelly is one of the manufacturers identified that provides solutions for home and buildings smart automation. Smart Energy Lab (third party of EDP NEW, on this project) is working on a datalogger solution called SEL Box that can be an alternative solution in this project.*	

5	**Unique Selling Point**	*The unique Selling point is mainly related with the relationship between the capabilities of the developed devices vs cost of acquisition/production and its possibility to integrate a wide range of different legacy equipment, appliances and IoT sensors/actuators with a wider set of building communication interfaces.* *Furthermore, the developed Devices will also include specific onboard intelligence that is tailored to accommodate heterogeneous characteristics of the EU building sector with the differentiation between residential and non-residential buildings.* *Finally, the testing Phase in the Smart2B Pilots will allow to validate and prove the strengths of these devices under real operation and improve customers confidence about their capabilities to improves the smartness of buildings.*	*If we want to develop an in-depth exploitation plan on this KER we need to make a thorough assessment of the competitors (Shelly and others) and point out the key strengths of the Smart2B devices. From what we understand, the Smart2B devices are designed to be cheaper, more flexible and smart, but these values should be more quantitatively defined.*
6	**Partners**	*EDP, including its third parties SEL and EDP C, will work together with EB and OdinS in T2.2 to extend the current communication protocol to other standard protocols that facilitate 2-way communication of the already available commercial EDP gateways.*	*Q: Do we understand it correctly that the Smart2B hardware belongs to EDP while part of the software (in particular the communication protocol) is shared with EB and OdinS?* *A: EB and OdinS will develop Smart2B devices to non-residential buildings while EDP will develop for residential buildings.*
		The market	
7	**Customer**	*The target customers will be residential and non-residential building owners, managers, and users*	*Do you also have an idea on how this will evolve over time, in particular due to the replacement of old equipment with new one?* *Q: Did you already identify a customer segment that is likely to become the early adopter?* *A: Actually, EDP system is already in the market but only for "solar consumers" (those who have PV system installed)*

Intellectual Property and FTO			
8	**IPR Background**	*Soft IP: Company know-how.* *EDP C (EDP third-party) will be the owner*	
9	**IPR KER**	*The solution architecture will be shared with technical consortium partners for validation and a high-level description may be further shared but the source code or algorithms within will remain private.*	
10	**FTO analysis**	N/A	
Risks			
11	**Critical Risk**	*Limited interoperability between devices and platform in the building interface* *Devices update unable to go beyond the state of the art* *Communication problems between Gateways and new devices*	- *We will further analyse these risks (also referring to the risk assessment carried out at WP level) in the next iteration of the Exploitation Plan, also adding commercial, organizational and environmental risks.*

Comments and suggestions

In order to figure out whether there are other exploitation possibilities for this KER outside the Smart2B platform, it would be important to address the following issues:

- To analyse alternative use cases for the KER outside the Smart2B platform. For instance, would it make sense to sell the device to make legacy white goods (e.g. washing machine) smart?
- In case alternative use cases are identified, carry out an in-depth market analysis to search for competitive solutions already available in the market, with the goal of defining the possible competitive advantage of the KER.
- For the identified application scenarios/use cases, make sure that the KER has the freedom to operate through an in-depth prior art research.
- Since the KER is being developed in cooperation with other partners, define:
    - Who will take care of the final system integration and commercialization.
    - Under which agreement the other KER owner will license their share of the KER to the system integrator.

Table 3 - 2nd KER table provided by EDP

2.KER Name: Gamification model			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**COMMENTS**
		About your result	
1	**Your KER**	The gamification model will be designed to increase user engagement with the Smart2B interactive application, by guiding the user's attention to different aspects of energy consumption behaviour based on simulations of new revenue streams by forming CECs.	Q: Do you imagine this gamification approach only applied through the Smart2B platform or also as a "stand-alone" product? A: The gamification model developed will be adapted to Smart2B solutions. However, the model will try to solve the problems related with user's lack of engagement after the initial period, that are similar to any other similar platform. So, I think the concept could also be used by another "platform"
2	**TRL**	TRL 6 – technology demonstrated in relevant environment	
		About the business	
3	**Problem**	The main goal of gamification is to improve user engagement and motivation in the smart energy context, addressing the following issues: • How to overcome the consumers "initial enthusiasm peak", keeping the user engaged so that continue to use the app and value the service. • Lack of knowledge about consumers energy consumption and associated environmental impact. • Reduce peak-load hours and increase self-consumption production • Lack of indoor air quality and user's comfort	
4	**Alternative solutions**	There are others gamification models already in the market, also applied in	Q: Did you already analyse such best practices,

		the energy context (more details will be provided).	identifying what has worked and what we could improve? A: Not yet. This task only begins in March 2022. - What do you believe could be unique in the gamification approach we propose (this also includes better user experience, social interaction, etc.)? A: We will follow a user centred approach to develop the gamification model, allowing us to improve the user experience and also help us to overcome the consumers "initial enthusiasm peak", keeping the user engaged.
5	**Unique Selling Point**	The Gamification model will be developed as part of the whole Smart2B ecosystem (including devices, platform and services) in order to upgrade of smartness of existing buildings, also making use of aggregation of flexibility, encouraging energy communities.	
6	**Partners**	EDP, including its third parties SEL and EDP C, will work together with FC.ID, RWTH and TUG to develop gamification model.	
The market			
7	**Customer**	The target customers will be residential and non-residential building owners, managers, and users.	
Intellectual Property and FTO			
8	**IPR Background**	Soft IP: Company know-how. EDP will be the owner	
9	**IPR KER**	The solution architecture will be shared with technical consortium partners for validation and a high-level description may be further shared but the source code or algorithms within will remain private.	
10	**FTO analysis**	N/A	
Risks			

11	**Critical Risk**	Incompatible requirements between parts of the Smart2B system (devices, platform, services) and lack of interoperability The developed model doesn't offer a good user experience that allows the expected user engagement	

Comments and suggestions
Since the gamification model is developed together with TUG team, please refer to their KER table's comment provided in the section 2.3.4.

3.2.2. EB KER Tables

Enerbrain provided a single table containing the whole set of KER, which also includes comments that will be addressed in the next release of the deliverable.
The table 4 is hidden to keep the internal information confidential.

Table 4 - KER table provided by EB

KER name: EB's whole set of results			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
		About your result	

Comments and suggestions

3.2.3. OdinS KER Table

OdinS has focussed on the analysis of the integration layer which oversees the platform interoperability among user-oriented services and the building equipment.

Table 5 – KER table provided by OdinS

KER Name: Smart2B Platform from WP3			
N	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
		About your result	
1	**Your KER**	Developing a cloud-based Seamless Integration Layer to enable the transparent interoperability among user-centric services and the building equipment/systems integrated from building scenarios. This layer will be composed by a set of FIWARE agents and harmonization mechanisms, a set of Data Models, Automatic Semantics, Filtering and Storage, and a Security & Privacy Cross Layer (enabling Communications Protection, Data Privacy, Service Access Management). The Seamless Integration Layer will collect monitored/controlled data from IoT devices and other third-party building systems, as well as external data sources in order to extract building/user pattern knowledge and will enable seamless integration of artificial intelligence algorithms to facilitate the implementation of user-centric multi-criteria services.	Q: This is a sort of "operating system" for the Smart2B solution, right? A: we have redirected the focus of this KER to using the contributions of OdinS in WP3. All these components would form that "operating system". Q: How does this KER integrate EDP's and EB's proprietary platforms? A: (OdinS) We at OdinS do not use the EDP/EB platforms in our market products. Thus, we consider the Smart2B platform as a separate entity.
2	**TRL**	Target TRL6	Q: Is this the target or the current TRL? A: TRL6 would be the target.
		About the business	
3	**Problem**	The IoT is a heterogeneous and dynamically changing market. Companies rushed to provide their products and services in order to obtain the biggest market share before other vendors could pass them. As a consequence, the IoT is ridden with vendor-specific solutions	

		and products that do not foster the interoperation and transparent integration of new ICT products or services. As a consequence, SMEs and low-profile ICT vendors face a high entry-wall in order to integrate their products and solutions without access to proprietary vendor-specific products or services.	
4	**Alternative solutions**	**Amazon Web Services** (AWS) is the main market leader with regards of number of services provided and the number of connected devices for the IoT paradigm — at both edge and cloud. The **Microsoft Azure** platform is a collection of cloud services that connect, monitor, and control billions of IoT assets which is managed by Microsoft. **Google Cloud** is one of the top IoT service providers around the world, making it easier to build connected devices. It provides Cloud IoT Core as its flagship IoT solution for creating secure and innovative solutions. **PTC Things Worx** is an IoT platform which is designed for enterprise application development. It helps in managing the development lifecycle for IoT applications. **IBM Watson** is an IoT platform which is pretty much taken among developers already. Backed by IBM's hybrid cloud PaaS (platform as a service) development platform, the Bluemix, Watson IoT enables developers to easily deploy IoT applications. **Samsung Electronics Artik**, which provides end to end IoT platform for the next generation products and services. Samsung Artik is known for providing complete security to your products which often gets neglected.	Q: These large companies are making available platforms for allowing users to manage different IoT devices from a multitude of manufacturers. This seems to be the same value proposition that is being proposed through this KER, right? Can you please explain how you position this KER with respect to the alternatives? A: these propositions employ vendor-locking mechanisms and vendor-specific protocols and communication technologies that do not foster the integration of third-party services and solutions through open standardized protocols or interoperable solutions. On the other hand, the Seamless Integration Layer proposed as this KER employs open standardized mechanisms such as HTTP RESTful APIs standardized by the IETF, and NGSI-LD, standardized by the ETSI.
5	**Unique Selling Point**	The main disadvantage of the alternative solutions (Point 4) is the reduced flexibility to be integrated with other ICT platforms developed by different companies to exchange massive data using security and privacy preserving mechanisms in order to develop a complex solution as the one proposed in the Smart2b project.	Q: What makes your solution more "flexible" than the other platforms available? A: The use of openly standardized protocols and solutions, foster the seamless integration of third-party solutions through well-known mechanisms.
6	**Partners**	**CERTH, FC.ID, Enerbrain**	

		The market	
7	**Customer**	The Seamless Integration Layer could be employed in market-ready solutions and services commercialized in EU countries and also in other countries such as EE.UU, Japan, etc. To do that, OdinS would collaborate with different companies with commercial experiences in public/private buildings management in each country. In particular, OdinS could collaborate with PPS Providers, energy-efficient ICT companies, sensors/gateways manufactures, HVAC/Façade manufactures and building installing/maintaining companies.	Q: Are you planning to develop and sell this platform as a core part of the Smart2B system or also as a separate product for other applications? A: We plan to develop and sell this secure Seamless Integration Layer as a separate product from the Smart2BB system. Q: If so, do you expect to allow some sort of priority to the Smart2B platform? A: TBD. We have not determined a level of priority in the commercialization of either Smart2B or the contributions by OdinS.
		Intellectual Property and FTO	
8	**IPR Background**	OdinS has background in intellectual properties and patents for the exploitation and commercialisation of previous innovative products in the market of Smart Building and Smart Cities. • Method and system for flexible configuration of remote control and monitoring devices. • System, device and method for obtaining encapsulated objects. • Procedure for predicting the energy consumption of environmental air conditioning in buildings. • Integral control, security and domotic system in intelligent buildings. • System and telematic method for safety in the circulation of vehicles. • Electronic remote station device for remote control. • Method and system for the efficient use of resources and presence control in classrooms.	
9	**IPR KER**	OdinS would have the role of manufacture provider of sensors, gateways and building data management platform. For this	Q: Did you already reach any agreement with the other partners involved in the project

		reason, OdinS would belong to the category of Manufactures under a business model of "Pay per Service". OdinS can provide hardware products and software platform to improve energy efficiency, greenhouse gases emissions reduction and air quality comfort. OdinS expects to commercialize the Smart2B results contributed by OdinS based on the integration with OdinS IoT hardware, ICT services and applications.	for the use and exploitation of their IP/the shared IP? A: Since we have switched the KER focus from the whole Smart2B platform to the secure Seamless Integration Layer (WP3), we consider that contracts or agreements with other partners are not necessary.
10	**FTO analysis**	FTO will be carried out in the next project phase	
		Risks	
11	**Critical Risk**	• Risk of innovation: PaaS is new business model and, therefore, the available data is insufficient in showing how a PaaS business model will perform over time. Furthermore, PaaS has been commonly been applied to consumer goods such as clothes, furniture or vehicles. Then, there will always be a risk associated to the will to go one step forward and propose new business model that anticipates the future sustainable administration requirements. • External parties involved in the Business Model: An innovative business model based on data sharing will involve a higher sum of parties compared to a traditional vendor-locking model. This could be an advantage because it increases the collaboration and value proposition, but also will include complexity to the proposal.	

Comments and suggestions

Since it is clear that there is an exploitation opportunity for this KER outside the Smart2B platform, it would be important to address the following issues:

- To identify and analyse the alternative use cases/application scenarios for the KER outside the Smart2B platform.
- In case alternative use cases are identified, carry out an in-depth market analysis to deepen the competitive landscapes analysis, with the goal of defining the possible competitive advantage of the KER.

- For the identified application scenarios/use cases, carry out a freedom to operate analysis through an in-depth prior art research.
- Verify and define how this KER could practically be integrated by clients current environment.
- Who is your paying customer and why should it be willing to pay for your KER?

3.2.4. Day One KER table

In this section, the table compiled by Day One is provided. Even if Day One is not responsible of the production and development of technical results directly included in the platform, it has a role in the identification of the market opportunities for the various KERs as well as in the definition of the optimal exploitation and go to market strategy for the individual KERs and the whole Smart2b platform.

Table 6 - KER table provided by Day One

KER Name: 1) Market readiness assessment and 2) Market entry strategy		
N	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**
		About your result
1	**Your KER**	For each KER, D1 carries out a strategic marketing analysis to identify: • The main characteristics of the KER and their relevance to the target end-users • The use-case, business case and value proposition • The competitive advantage over direct and indirect competitors • The market attractiveness (TAM, SAM, SOM, growth rate and regional trends) • The business model definition • The exploitation strategy to take the KER to the commercial level
2	**TRL**	The TRL definition does not apply to this KER
		About the business
3	**Problem**	KER are usually technology-based, and seldom the KER owners have the full knowledge of the relating market potential and possible application scenarios and use cases. Besides, especially when KER owners are research institutions, the full range of possible exploitation approaches is not known, leading to sub-optimal choices for the development, IP protection and exploitation strategies.
4	**Alternative solutions**	In some cases, research institutions and R&D units of companies can leverage on internal marketing and business departments to support them in these activities.
5	**Unique Selling Point**	D1 is uniquely positioned to take low TRL technologies to the market, owning a mix of competencies which span from deep tech, marketing, business and IP protection.
6	**Partners**	Obviously, we work together with other KER owners to support them in the marketing and business development activities.
		The market
7	**Customer**	-
		Intellectual Property and FTO

8	**IPR Background**	We leverage on our internal know-how which is vastly based on Design Thinking, Business Modelling and Business Planning competencies.
9	**IPR KER**	There is no viable IP protection approach for this KER
10	**FTO analysis**	The FTO analysis is not relevant to this KER
Risks		
11	**Critical Risk**	The main risks are: - Misleading market analysis and customer validation due to lack of meaningful data; - Oversimplified business case analysis which leads to poor understanding of the customer willingness to adopt/pay; - Missing key competitors or new entrants with competitive solutions that undermine the market appeal for the KER; - Difficulty in reaching IP agreements between KER owners, which leads to the impossibility to define proper exploitation strategies.

3.3. Research Partners

In this section, the research partners' KER are listed and commented, again through a Question (Q) and Answer (A) approach. While most questions have been already addressed, there are still few that will be tackled in the next release of the Exploitation plan.

The research partners include:

- CERTH
- TUG
- RWTH
- VITO

3.3.1. CERTH KER Tables

CERTH provided 7 KER tables regarding each result they are working on.

At the end of this section – after the KER tables list - a box summarizing the main inputs and comments to aid their future development will be presented.

Table 7 - 1st KER table provided by CERTH

1 KER Name: Filtering Rules for Common Anomalies in Domestic Appliances Data [Task 3.2]			
N	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
About your result			
1	**Filtering Rules for Common Anomali**	This tool comprises a set of data anomalies detection models and mitigation rules, to ensure an adequate pre-processing of raw measured data, establishing a solid basis for more advanced (e.g., WP4)	Q: Do you imagine that this tool could be extended in the future to other platforms and/or markets also requiring a pre-processing data system? (For example, the healthcare sector)

	es in Energy Data	data-driven services.	A: Filtering is always needed as a functionality; the specified tool will implement both generic mitigation approaches (which could be applied to healthcare as well) but also more energy/appliance centric ones. Q: Is this tool applicable to the whole domestic framework or a specific set of rules must be defined for each data source? A: Similar (generic) rules can be applied to different data while some other (more advanced) models may be trained based on specific data (e.g., only indoor temperature) so they can only be effectively utilised only on these specific data features (e.g., only on indoor temperature).
2	**TRL**	TRL 2 – technology concept formulated	Q: How long does it take to reach TRL 6? A: We foresee we will need the entire duration of the task (i.e., around M30 of the project)
		About the business	
3	**Problem**	Detect anomalies and filter/cleanse faulty registries in the collected dataset for efficient machine-learning models training and statistical data analysis, specifically for domestic appliances electric and power data; as well as energy data at a building level. End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies	Q: Is it typical in the software industry to buy/use/adapt filtering tools already developed by third parties? Or for every new application the data filtering tool must be developed from scratch? A: Filtering is always needed as a functionality (anomalies are always present when measuring raw data), the specified tool will implement both generic mitigation approaches (which could be applied to other sectors/domains as well) but also more energy/appliance centric ones that we need to investigate if they are applicable elsewhere.
4	**Alternative solutions**	Usually, such tools do not come as standalone mechanisms. Several filtering mechanisms have been developed as a pre-processing module for trainable ML and analytics models. However, commercialisation of such	Q: Do you think it makes sense to develop a tool that could be also sold as a standalone product? A: Could be BUT usually these tools come as a part in all-in-one

		models for domestic appliances electric and power data; as well as energy data at a building level as standalone services is quite limited if not zero (at least to the best of our knowledge).	packages in data management suites / platforms and not as standalone. Q:In your opinion, what is the main limitation that alternative solutions faced in marketing themselves as standalone products? What could make it possible in your case? A: Commercialising filtering tools for appliance device data may be relevant to appliance manufacturers (mostly) or BMS developers. These tools are quite domain and data dependent, so they are a functional part of a continuous pipeline similar to the one formed in WP3 (Task 3.1 -> Task 3.2 -> Task 3.3 -> Task 3.4)
5	**Unique Selling Point**	Lightweight filtering models focusing on domestic appliances electric and power data; as well as energy data at a building level able to be embedded into micro-processing platforms (i.e., automation gateways).	
6	**Partners**	OdinS will be responsible for granting access to harmonised data which will be used for training our annotation models as well as create data-filtering rules.	
The market			
7	**Customer**	End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies	
Intellectual Property and FTO			
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	

10	**FTO analysis**	FTO will be carried out in the next project phase	
Risks			
11	**Critical Risk**	Availability of poor data from the monitored pilots Late/Delayed availability of data from the monitored pilots	

Table 8 - 2nd KER table provided by CERTH

2 KER Name: Automated Semantic Annotation of Energy Data [Task 3.2]			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
About your result			
1	**Automated Semantic Annotation of Energy Data**	This tool comprises a set of features correlation and semantic annotation models, to ensure effective dataset slicing and knowledge graphing for more advanced (e.g., WP4) data-driven services.	Q: Do you envisage that this tool could be extended in the future to other platforms and/or markets also requiring a pre-processing data system? (For example, the healthcare sector) *A: This tool depends on the defined ontologies so it can be extended to other cases on the same domain but needs to be reconfigured (hyperparameter readjustment) if we would like to move a different domain rather than energy and buildings.* Q: Is this tool applicable to the whole domestic framework or a specific set of rules must be defined for each device's category? *A: See my replies in the previous table*
2	**TRL**	TRL 2 – technology concept formulated	Q: How long does it take to reach TRL 6? *A: See my replies in the previous table*
About the business			

3	**Problem**	Most of the current technology is based on human centred annotation, very often completely manual. Manual annotation is difficult, time consuming and expensive. Convincing millions of users to annotate big amounts of data (tabular or numerical) requires a lot of resources and may be of uncertain outcome. Therefore, there is the need of training the system without manually producing annotated material. End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies	Q: Do you think that your tool will be applicable to other sectors, apart from the Smart2b platform? *A: See my replies in the previous table* Q: Do you have any preliminary quantitative data about the current market dimension? In other word: how big is the market that you eventually would serve with your standalone service. *A: N/A*
4	**Alternative solutions**	Most of the available solutions is based on supervised learning, i.e., they require user-defined annotated corpora. Producing such corpora can be difficult and time consuming. If the annotation ratio is poor/limited and the dataset is large, then the performance of supervised annotation may be also poor; resulting substantial statistical work (data synthesis) with uncertain outcome.	Q: Do you think it makes sense to develop a tool that could be also sold as a stand alone product? A: Similar to the previous table: Could be BUT usually these tools come as a part in all-in-one packages in data management suites / platforms and not as standalone.
5	**Unique Selling Point**	The envisioned tool will be highly generic (limited assumptions on the application domain) based on information from different harmonised sources (T3.1) to provide some seed annotations using unsupervised (clustering/compression and association) pattern recognition models. This will then bootstrap learning which in turn will provide more annotations. In synthesis we start with a simple methodology which requires limited annotation and move on to produce further annotation to train more complex modules. Basically, the system keeps on bootstrapped-loops until there is no more information to discover or the user decides to interrupt the cycle.	
6	**Partners**	OdinS will be responsible for granting access to harmonised data which will be used for training our annotation models	

		as well as create data-filtering rules.	
The market			
7	**Customer**	End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies	
Intellectual Property and FTO			
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	
10	**FTO analysis**	FTO will be carried out in the next project phase	
Risks			
11	**Critical Risk**	Availability of poor data from the monitored pilots Late/Delayed availability of data from the monitored pilots	

Table 9 - 3rd KER table provided by CERTH

3 KER Name: Multi-Criteria Micro-Grid Scheduler for Cost Reduction [Task 4.1.1]			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
About your result			
1	**Your KER**	The main functionality of this KER is devoted to the implementation of an optimization method in the sense of **Model Predictive Control** for load scheduling operating in cloud level and utilizing the available services for energy consumption among/into the micro-grid.	Q: Do you envisage that this Model could be extended in the future to other platforms and/or markets apart from the energy consumption one? A: Well after some readjustments of course. We envision RL for this case which is a widely used approach for several control and decision problems but every time it requires some (even minor) tweaking before its utilisation; especially when moving from one domain to another one where states, control actions, rewards may (most likely) change.

2	**TRL**	TRL 3 – experimental proof of concept	Q: How long does it take to reach TRL6? A: See my replies in the previous table
		About the business	
3	**Problem**	Understanding building energy consumption behaviour based on the knowledge transfer from the fusion of extensive data collected from smart sensors is an essential step to optimize building energy consumption. This problem is directly connected with the optimal building resource allocation of end-user patterns utilizing hourly or daily smart device profiles. Therefore, with the exploitation of high volumes of data, in the smart-grid context a cost reduction method can be adopted to perform on-line optimization of schedules for building energy management systems. Artificial-Intelligence and Deep reinforcement learning can be performed to cope the cost minimization or the peak load reduction problem as this technique is capable to learn an optimal behaviour, while the global optimum is not known. End-users domains: energy supplier, DSOs, ESCOs, building operators, building managers and occupants	Q: Is this algorithm potentially applicable to other energy management platforms other than Smart2B? A: Yes of course, if the application (i.e., scheduling of energy profile at a building level) is the same. Otherwise, we need again a little tweaking.
4	**Alternative solutions**	The optimal scheduling of the micro-grid system is a complex constraint nonlinear optimization problem and regarded as the main tool for a reliable and economical operation of the system. Various optimization techniques, such as dynamic programming, stochastic dynamic programming, linear programming, mixed-integer programming have been proposed to solve this nonlinear optimization problem. However, the drawbacks of these traditional programming optimization methods include falling into local optimum, slow convergence rate, and inability to deal with nonlinear optimization problems.	Q: In terms of performance, what would be the added value that you propose with respect to the alternatives already available? For instance, can you claim your approach would turn into increased energy efficiency? Do you have any data on the poor performance of existing approaches? Under which circumstances (use cases) do existing approaches fail? A: Our approach envisions flexibility and tariffs as important indexes to optimize in an aggregated manner (at a building level). No commercial solutions exist at the moment on this matter (at least to the best of our knowledge) / only literature publications and some open-sourced gits.

5	**Unique Selling Point**	Reinforcement Learning based agent operating in cloud for robust operation in urgent dynamics; aiming to conceive an on-line optimization for the scheduling of electricity consuming devices in buildings and/or aggregations of buildings.	
6	**Partners**	VITO and RWTH will collaborate with CERTH to model the smart-grid dynamics that will allow for applying the policy training mechanism	
		The market	
7	**Customer**	End-users domains: energy supplier, DSOs, ESCOs, building operators, building managers and occupants.	
		Intellectual Property and FTO	
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	
10	**FTO analysis**	FTO will be carried out in the next project phase	
		Risks	
11	**Critical Risk**	Poor data or delayed availability of data and simulation models	

Table 10 – 4th KER table provided by CERTH

4. KER Name: Multi-Agent Coordinated Ecosystem for Smart Appliance Energy Management [Task 4.1.2]			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
		About your result	
1	**Your KER**	This KER is responsible for the energy efficiency at a local-low level. This includes the optimization process of the controllable devices in order to assure that they consume energy as close as possible to the desired scheduling, while also the restrictions indicated by Task 4.1.1 (KER: Multi-Criteria Micro-Grid Scheduler for Cost Reduction) are	Q: Do we understand it correctly that the smart management of the appliances is carried out at the scheduler level (previous KER), while this KER is about controlling the single appliances? In this sense, can we derive that there is not much innovative content in this specific KER, although it is a

		fulfilled.	crucial component of the Smart2B system? A: Task 4.1.1 (Scheduler) provides the optimized total energy for the building. This KER is related to how to prioritize among different appliances and user-necessities in order to serve all user requirements while maintaining thermal comfort and convenience without violating the total energy consumption from Task 4.1.1. So, I would say that innovation resides at both building and device levels.
2	**TRL**	TRL 3 – experimental proof of concept	
		About the business	
3	**Problem**	This problem includes the production of proper actions at building (high-level) or device level (low-level) completing the framework of energy management into the micro-grid scheme. A set of coordinated agents will be incorporated that will be responsible for: control (switch on/off); weather data (temperature, humidity, solar irradiation etc); measurements from smart metering system and signals from utility company; policy configurations. The management and optimization process is implemented through parallel agents operations / actions performed simultaneously to ensure a global optimum. Basically, these actions will distribute the consumption rate into different devices, which are controllable, based on defined policy.	
4	**Alternative solutions**	Several algorithms exist for energy management in smart grids in the literature. Both offline algorithms that assume that all information (e.g. predictions) is available beforehand, as online algorithms which respond to real-time events. These algorithms use optimization techniques such as integer, quadratic, dynamic and stochastic programming, evolutionary algorithms, etc. to reduce peak loads,	

		balance supply and demand, and minimize energy losses and energy costs. For online algorithms often a Multi-Agent System (MAS) is used consisting of several intelligent agents that are capable of reacting autonomously to changes in their environment.	
5	**Unique Selling Point**	Robust (fault-tolerant) and replicable agents for the management/control of various loads with different device profiles (shiftable or stationary)	
6	**Partners**	VITO and RWTH will collaborate with CERTH to model the smart-grid dynamics that will allow for applying the policy training mechanism	
The market			
7	**Customer**	End-users domains: energy supplier, DSOs, ESCOs, building operators, building managers and occupants.	
Intellectual Property and FTO			
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	
10	**FTO analysis**	FTO will be carried out in the next project phase	
Risks			
11	**Critical Risk**	Large number of included devices may result in heavy computational burden which in turn can affect embedding the solution at a device/gateway level	

Table 11 – 5th KER table provided by CERTH

5 KER Name: Air Quality and Infectivity Assessment for Proactive Ventilation [Task 4.2.2]			
N.	TOPIC	INPUT REQUIRED FROM BENEFICIARIES	Comments
About your result			
1	**Your KER**	• Based on available (external sources) or collected (during the project) datasets and white-box models (based on ANSI/ASHRAE 62.1.2013) this task will deliver a python-based, data-driven, predictive model (e.g., deep-	

		learning CNN or LSTM networks) capable of forecasting indoor CO2 (and correlated air-infectivity) appropriately within a specified horizon; considering the number of occupants and the available ventilating appliances. • Adapt the developed DeepML tool to the integration requirements of Task 4.3 (services layer integration) as well as Task 6.1 (holistic integration).	
2	**TRL**	TRL 3 – experimental proof of concept	Q: How long does it take to reach TRL6? A: See my replies on the previous tables
		About the business	
3	**Problem**	Assess and predict indoor air-quality in terms of CO_2 and volatile organic compounds – depending on the air-volume of closed space – to provide data about the air quality, specifically from domestic appliances electric and power data; as well as energy data at a building level. End-users: data-analysts, Artificial-Intelligence service developers, machine-learning engineers End-users domains: building operators, health organisations, sensor manufacturers	Q: Is this algorithm potentially applicable to other energy management platforms other than Smart2B? A: Yes, of course, if the application is the same. Otherwise, we need again a little tweaking.
4	**Alternative solutions**	Indoor air quality (IAQ), as determined by the concentrations of indoor air pollutants, can be predicted using either physically based statistical models that are driven by measured data. Statistical methods are practically useful when all possible relationships of the variables that could affect the target pollutant are unknown. Also, statistical models rely on existing data measurements, they cannot be applied to predict indoor air quality in buildings that have not been constructed if a representative database does not exist. Machine learning models have drawn attention, establishing themselves as a solution that can replace the more classical statistical models in time-series forecasting. Machine learning methods, including adaptive boosting	Q: In terms of performance, what would be the added value that you propose with respect to the alternatives already available? For instance, can you claim your approach would turn into increased indoor quality? Do you have any data on the poor performance of existing approaches? Under which circumstances (use cases) do existing approaches fail? A: To the best of our knowledge there is no commercially available solution that assess infectivity at the moment. So, the added value is the core functionality of this tool which is related to forecasting indoor infectivity levels for respiratory diseases (e.g., COVID-19).

		(AdaBoost), artificial neural network (ANN), random forest, stacking ensemble, and support vector machine (SVM), produce promising results for air quality index level predictions.	
5	**Unique Selling Point**	We propose a gray box model, which will deliver a predictive non-linear, capable of forecasting indoor CO2 and correlated air-infectivity, considering the number of occupants and the available ventilating appliances.	Q: Do you imagine this solution as a stand-alone one, apart from the Smart2b platform? A: Yes. Off course we might need a transient period to transfer knowledge from Smart2B data to other dwelling cases (e.g., larger m2 areas with different numbers of maximum occupants or different use e.g., gyms)
6	**Partners**	-	
		The market	
7	**Customer**	End-users: data-analysts, Artificial-Intelligence service developers, machine-learning engineers End-users domains: building operators, health organisations, sensor manufacturers	
		Intellectual Property and FTO	
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	
10	**FTO analysis**	FTO will be carried out in the next project phase	
		Risks	
11	**Critical Risk**	Availability of poor data from the monitored pilots Late/Delayed availability of data from the monitored pilots	

Table 12 – 6th KER table provided by CERTH

6 KER Name: Expected Useful Time Forecasting for Predictive Maintenance [Task 4.2.3]			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
		About your result	
1	**Your KER**	• Based on available (external sources) or collected (during the project) datasets this task will deliver a	

		python-based, data-driven, predictive regression model (e.g., deep-learning convolutional or LSTM networks) capable of forecasting indoor failures occurrence and/or ultimately the expected useful life (EUL), focusing on critical infrastructure (e.g., HVACs, DHWs). • The absence of appropriately annotated datasets may (most-likely) require synthetic data generation and data augmentation techniques to be adopted to enrich limited datasets that may become available from the project monitoring phase. • Adapt the developed DeepML tool to the integration requirements of Task 4.3 (services layer integration) as well as Task 6.1 (holistic integration).	
2	**TRL**	TRL 3 – experimental proof of concept	Q: How long does it take to reach the market? A: Could be 1 year after the project finishes (certifications, patenting, polishing code for efficiency).
		About the business	
3	**Problem**	Predict when a machine or any of its components will fail in order to perform maintenance just before failure is predicted to occur, preventing actual failure and associated downtime, specifically from domestic appliances electric and power data; as well as energy data at a building level End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies, health organizations	Q: Are you targeting a specific appliance/equipment or this approach is more general? A: We are targeting the most energy intensive loads that consider rotating components and electric motors (e.g., HVACs) Q: Is this intended only for legacy equipment? Many modern appliances/equipment already own self-diagnostic capability. A: We do not intend to implement self-diagnostic tools which actually depend on specific quite elaborate sensory data but predictive diagnostics; these target legacy appliances where measurements come from external sensors usually limited to energy

			measurements only. Q: Is there any minimum set of data that you need to carry out the predictive diagnosis? A: Energy measurements (power analysers preferably). Q: Would your system provide an early warning or would it also activate a recovery system? A: Early warning is the main functionality to proactively schedule maintenance activities. Regarding recovery in legacy appliances, I am not aware of such a mechanism rather than technicians maintenance.
4	**Alternative solutions**	Predicting the remaining useful life of machinery, infrastructure, or other equipment can facilitate preemptive maintenance decisions, whereby a failure is prevented through timely repair or replacement. This allows for a better decision support by considering the anticipated time-to-failure and thus promises to reduce costs. A more accurate solution is promised by machine learning models, where forecasts incorporate deterioration processes and environmental variables through sensor data. Machine learning has recently received great traction for RUL as the flexibility of these models facilitates a superior prognostic capacity. However, machine learning largely functions as a black-box method and its forecasts thus forfeit most of the desired interpretability	Q: Could you explain what makes you stronger than the alternatives currently available (those you mentioned in the column)? In order to evaluate the competitive advantage, it's important to consider also some quantitative data about their performances and your expected ones. A: We do not intend to implement self-diagnostic tools which actually depend on specific quite elaborate sensory data but predictive diagnostics; these target legacy appliances where measurements come from external sensors usually limited to energy measurements only.
5	**Unique Selling Point**	We propose a structured-effect neural network for regression with non-linear models (i.e., ANNs) fitting a Weibull distribution for EUL forecasting.	Q: Do you think you would be able to develop a system that could be also sold as a standalone product? A: Yes
6	**Partners**	-	
The market			

7	**Customer**	End-users: data-analysts, visual analytics modules developers, Artificial-Intelligence service developers, machine-learning engineers End-users domains: appliance manufacturers, sensor manufacturers, building operators, public energy authorities and agencies, health organizations	
Intellectual Property and FTO			
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH	
10	**FTO analysis**	FTO will be carried out in the next project phase	
Risks			
11	**Critical Risk**	Availability of poor data from the monitored pilots Late/Delayed availability of data from the monitored pilots	

Table 13 – 7th KER table provided by CERTH

7 KER Name: Smart Readiness Advisor for Smart Dwelling/Building Renovation [Task 4.2.5]			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
About your result			
1	**Smart Readiness Advisor for Smart Dwelling/Building Renovation**	Smartness of a building refers to the ability of the building or its systems to sense, interpret, communicate and actively respond in an efficient manner to changing conditions in relation to the operation of technical building systems or the external environment (including energy grids) and to demands from building occupants. The Smart Readiness Advisor aims to make the added value of building smartness more tangible for building users, owners, tenants and smart service providers.	Q: Can you better explain the nature and objectives of this KER? Is this the overarching software/User Interface of the Smart2B platform? A: No, this is not the User Interface of the Smart2B platform. This is a tool that will be used to advise the facility managers on how to improve the building's SRI. Off course it can be interfaced with the GUI layer to inform the end-users appropriately.
2	**TRL**	TRL 2 – technology concept formulated	
About the business			

3	**Problem**	Create healthier and more comfortable buildings with a lower energy use and carbon impact. Raise awareness about the benefits of smart buildings, in particular from an energy perspective, stimulate investments in smart building technologies, support the uptake of technology innovation in the building sector.	
4	**Alternative solutions**	Energy Performance Certificates (EPCs), Level(s), Building Renovation Passports (BRPs), Digital Logbooks and Building Information Modelling (BIM)	
5	**Unique Selling Point**	Energy savings on site, resulting from better control of the buildings' temperature settings. Improved indoor air quality, compared to traditional controls, which leads to raising the occupants' well-being, with a significant impact on their health. Automated fault detection and diagnosis, which improves the maintenance and operation of technical building systems. Information on building operation to the occupants.	
6	**Partners**	VITO	
		The market	
7	**Customer**	End-users: Building Users, owners, tenants, smart service providers, Real estate agents End-users domains: Building operators, public energy authorities and agencies, technical chambers	
		Intellectual Property and FTO	
8	**IPR Background**	IPR Type: Copyright IPR owner: CERTH - VITO	
9	**IPR KER**	IPR Type: Copyright (potentially Patent) IPR owner: CERTH - VITO	
10	**FTO analysis**	FTO will be carried out in the next project phase	
		Risks	
1	**Critical**	Availability of/ Delayed rich	

1	**Risk**	information from the surveyed pilots about the existing hardware and software automation infrastructure.	

Overall comments and suggestions

Considering the high volume of data provided by CERTH team and the fact that many of these comments are relevant and worthwhile to several KERs, hereunder a table showing all the comments (blocks on the left side, named **Comments**) and which KER table they may refer to (blocks on right side, named with the Ker number concerned – e.g. K1 to indicate that we are referring to the KER table n.1) is provided.

Table 14 – Comments on CERTH's KERs

No.	Comments	K1	K2	K3	K4	K5	K6	K7
1	Being filtering always needed as functionality, could this solution in the future be applied to other platforms industries, that require a pre-processing data system? Beside the S2B project (energy equipment and short life appliance) for energy and the mentioned healthcare, do you see any possible application on other industries as Manufacturing (aircraft, automobiles, chemicals, clothing, computers, consumer electronics, electrical equipment, furniture, heavy machinery, real estate, ..).	X						
2	Is it typical in the software industry to buy/use/adapt filtering tools already developed by third parties? Or for every new application the data filtering tool must be developed from scratch? And which is the setup flow and timing for a new application?	X		X				
3	Above a stand-alone solution, do you envisage potential partnership to integrate the tool as a part in all-in-one packages in data management suites / platforms?	X	X	X		X	X	
4	List any possible alternative application scenario where your solution could be successfully implemented or integrated.	X	X	X	X	X	X	X
5	If the business case proves to be valuable, carry out an in-depth market analysis (analyse the value expected, replacing the existing solution), identifying: ○ providers of similar solutions ○ their specifications and performance ○ their status of development	X	X	X		X	X	X
6	Do you have the freedom to operate "FTO" (there is no prior art hindering the market access) or do you need to run it?	X	X	X		X	X	X
7	Is the solution protected in terms of IP (or at least protectable).	X	X	X		X	X	X
8	Being the tool of Automated Semantic Annotation depending on defined ontologies and extendable to other cases on the same domain but with a reconfiguration (hyperparameter readjustment) needed, could this solution in the future be applied to		X					

	other platforms industries, that require a pre-processing data system? Beside the S2B project (data model and sematic and data filtering and storage) for energy and the mentioned healthcare, do you see any possible application on other industries as Manufacturing (aircraft, automobiles, chemicals, clothing, computers, consumer electronics, electrical equipment, furniture, heavy machinery, real estate, ..).							
9	Do you have any preliminary quantitative data about the current market dimension? In other word: how big is the market that you eventually would serve with your standalone service and address a clear need of a sizeable amount of user, using the framework TAM (Total Addressable Market), SAM (Served Addressable Market), SOM (Serviceable Obtainable Market)?	X	X	X		X	X	X
10	Being the Model Predictive Control an algorithm as optimization method for load scheduling operating in cloud level and utilizing the available services, could this solution in the future be applied to other platforms industries, that require a pre-processing data system? Beside the S2B project (multi criteria load scheduling service) for energy and the mentioned healthcare, do you see any possible application on other industries as Manufacturing (aircraft, automobiles, chemicals, clothing, computers, consumer electronics, electrical equipment, furniture, heavy machinery, real estate, ..).			X				
11	Based on the collected information, target estimation and features developed or expected of the KER, identify the competitive advantage of the solution to build up the Value Proposition (improved comfort for occupants, reduced energy consumption, cost optimization, ..).	X	X	X	X	X	X	X
12	The Multi-Agent Coordinated Ecosystem for Smart Appliance Energy Management is responsible for the energy efficiency at a local-low level. Being the smart management of the appliances carried out at the scheduler level, while this KER is about controlling the single appliances and in this sense, without taking an innovation in itself, is it feasible to analyze any other potential innovative aspect (algorithm, control device, adaptivity ..) to raise to exploit commercially the KER and to patent?				X			
13	Being based on available (external sources and dataset) the data-driven, predictive model, capable of forecasting indoor CO_2 (and correlated air-infectivity), how is the solution scalable and integrable with other energy management platforms and which what effect in term of time, cost, features?					X		

14	Being based on available (external sources and dataset) the data-drive, predictive regression model, capable of forecasting indoor failures occurrence and/or ultimately the expected useful life (EUL), how is the solution scalable and integrable with other energy management platforms and which what effect in term of time, cost, features?						X	
15	Being the Smart Readiness Advisor solution to advise the facility managers on how to improve the building's SRI (smartness more tangible for building users, owners, tenants), how it scalable and integrable on different contest (healthcare, hotel, plant, public building, ..) and which what effect in term of time, cost, features?							X
16	Define Business Model (Canvas framework): value proposition; revenues streams and cost structure; clients, communication and channels on market side; partners, resources and activities on operation side.	X	X	X	X	X	X	X

3.3.2. TUG KER Table

In this section, the TUG contribution is shown, then followed by the comments and input suggested to further improve the development of the KER described.

Table 15 – KER table provided by TUG

KER Name: Interactive applications, comprising dashboards, users' feedback, and gamification components.			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
About your result			
1	**Your KER**	Interactive application for different actors (e.g., occupants, building managers, citizens/communities, grid operators) to simplify the control of equipment and devices and provide information on overall energy performance. It will also incentivize smartness upgrades via community-based gamification methods.	Q: Is this KER linked closely to Smart2B project or can it be adapted to other contexts? A: it can be adopted to other contexts.
2	**TRL**	Start TRL: 6 End TRL: 8	Q: How long does it take to reach TRL 8? A: our best estimate: 24months
About the business			

3	**Problem**	• Users have difficulty in controlling and monitoring legacy and smart systems in an integrated, easy, and user-friendly way. • Users do not engage in the controlling and monitoring of legacy equipment and/or do not optimize their settings. Hence energy savings potentials are not realized	Q: What is the problem? Do they have difficulty to control or there is no way to control in an integrated way today? A: we need to understand the right level of interaction (do certain people want to interact daily/weekly/…?). What can they control (how smart is the building) and what do they want to control?
4	**Alternative solutions**	Financial incentives, such as variable tariffs, could also induce a change in user behaviour, but would do so with substantially higher costs to consumers.	Q: Are there alternative solutions offering the same function? What are they? A: we are not aware of other solutions
5	**Unique Selling Point**	• Web and mobile app for different contexts of use • Integration of interactive user feedback & variable levels of interaction for improving user convenience. • Gamification components to incentivize smartness upgrades and energy-saving without compromising comfort and satisfaction • Dashboards to summarize and display overall energy performance • Developed using a user-centred approach to meet users' needs	Q: Do you envisage a possible use of your app apart from the Smart2B project? Could it be sold as a stand-alone product able to be connected/integrated in different context? A: our (and FC.ID) intention is to develop open source technologies. We use our app in several projects (national and European) but we don't plan to commercialize the app.
6	**Partners**	*FC.ID, RWTH, TUG, EDP*	Q: Are you generating a completely new IP or is your app based on an existing IP? A: we agreed on making the app open source.
	The market		
7	**Customer**	Building occupants, (commercial and residential) building managers, citizens in general, communities and grid operators.	Q: How could you reach them? Q: Do you plan one cross-sectoral app for everyone or do you plan a different one depending on/tailored to the specific user category?

			A: There will be different options for different user groups (like visualization for end-user or building operators)
Intellectual Property and FTO			
8	**IPR Background**	TUG: Open-Source app GameOpSys (https://github.com/tug-cps/GameOpSysApp)	Q: Are you going to generate a shared IP with the partners involved in this KER development? Am I right? A: Yes… there will be one "app"… but again, this app is open source.
9	**IPR KER**	We believe that the application will be offered freely to the clients that buy the Smart2B solution.	
10	**FTO analysis**	FTO will be carried out in the next project phase	
Risks			
11	**Critical Risk**	End users do not adopt the application.	

Comments and suggestions:

Since the overall approach to be adopted by the KER owners is to make the KER available as open-source software, the whole effort will be on ensuring access to the source code to internal and external developers, as well as the required support for deployment/implementation of the required parts of the code (gamification, dashboard, etc.).

Therefore, key aspects to be considered are:

- How and where to make available the KER;
- How to maintain and update the software;
- What license agreement should be proposed (*e.g., MIT, GNU, Apache, etc.);*
- If/How to ensure support to users or developers;
- How to ensure interoperability with several development and deployment framework;
- How to possibly foster community participation.

3.3.3. RWTH KER Table

In the RWTH KER table, the answers to the comment in the right columns are already integrated in the content provided by the partner (column in the centre).

Table 16 – KER table provided by RWTH

KER Name: Adaptive controller as local energy-efficiency service for the Smart2B platform			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
		About your result	
1	**Your KER**	An adaptive, learning based controller for the control of nonlinear dynamic systems is developed. A learning based, adaptive controller uses machine learning to identify the system dynamics and is continuously updated to adapt to changing system behaviour, e.g. changing conditions of use. Furthermore, it has variable control parameters and a mechanism for setting the parameters. This allows reacting to external boundaries like dynamic power prices or availability. The chosen mechanism in our case is the concept of learning-based control. Within the framework of Smart2B, the learning-based controller will be used in HVAC systems with continuous control signals like valves and temperature set points. Nevertheless, the controller can be applied to any technical process which is stable for controller sample rates >1s. Within the scope of WP 4.1.2 the controller is expected to be trained and tested on open source building energy system models. These models can be provided, for example, by Boptest (https://github.com/ibpsa/project1-boptest) or Energym (https://bsl546.github.io/energym-pages/index.html). Since the controller can be implemented and executed cloud-based and on local devices, it can be sold as stand-alone product.	Q: Are you able to control a specific type of device or are you going to introduce a sort of general controller able to manage all of them? Q: Learning based control: what is the data sources you intend to use? Q: Do you think that your system could be sold on the market as a stand-alone product, apart from its use in the Smart2B platform?
2	**TRL**	In 3-4 years after project completion, TRL 8 can be achieved.	Q: How long does it take to reach the market (TRL 8-9)?
		About the business	
3	**Problem**	The increasing complexity of building energy systems and the need to integrate services related to energy usage, demand side management and user comfort poses new tasks for control theory. This means that new non-linear complex	Q: Do you envisage other possible applications apart from that of Smart2B project? Or is your

		controlled systems are emerging, in which rapidly changing and difficult to measure parameters and strong interaction between all channels of the control system occur. Such controlled systems can no longer be adequately controlled with fixed controllers. Adaptive controllers have an advantage here over conventional, fixed controllers. But the latter achieve an optimal system behaviour only for a specific operating point or a specific operating range. Here we go in Smart2B with self-adaptive controllers using machine learning which can achieve an optimal system behaviour over the entire operating range. The developed controller can be applied to various use-cases and scenarios and is therefore expected to be applied and tested in other projects as well.	system suitable only for the Smart2B scenario?
4	**Alternative solutions**	On the market the common solution are still fixed controller which is mainly a PID controller. Advanced control methods exist, but regarding the state-of-the-art one must accept that the built environment is lacking technological advance. Most of the used control loops are still feedback control loops, e.g. on/off, proportional, PI, and PID, while advanced methods are only focus of recent research**.** The control concepts that exist on the market no longer fulfil their task optimally in complex systems, but they are easy to implement, stable and do not produce catastrophic results, so they are still firmly on the market. The adaptive, learning-based controller can exploit forecasts and deal with multi-input-multi output systems. Due to its foreseeing behavior, thermal storage and the inertia of buildings are also considered in the operation strategy. Therefore, it is better suited for complex, renewable energy systems, which rely on fluctuating energy sources. It is expected that the proposed controller saves a significant amount of energy compared to the state-of-the-art control strategies.	Q: What is your innovation with respect to the state of the art? The ability to integrate/combine/elaborate data from different sources otherwise incompatible? Q: How would you measure your competitive advantage? For instance, are you proposing increased energy efficiency?
5	**Unique Selling Point**	The unique selling point is the integration in the Smart2B context so that the adaptive controller is connected to a cloud based model predictive control and a wide portfolio of HVAC components and smart home devices.	

6	**Partners**	No. CERTH is working on a similar approach, which will be used to generate price signals or power budgets for the adaptive, learning based controller to follow. Therefore, cooperation and exchange with CERTH during the development is planned.	Q: We have received an apparently similar KER from CERTH, are you somehow cooperating with them?
	The market		
7	**Customer**	The research results can be used by component manufacturers, manufacturers in the field of building automation and system integrators.	
	Intellectual Property and FTO		
8	**IPR Background**	All software and models as described in the publications to be found in the publication list: http://www.eonerc.rwth-aachen.de/cms/E-ON-ERC/Forschung/~dmvf/Publikationen/?lidx=1 as well as all public project reports at the time of the project start. In Addition to the described publications and software projects, all publicly available websites and tools developed and hosted by the contractor are part of the Background IP. The landing pages are available here: All software tools available on https://ebc-tools.eonerc.rwth-aachen.de/	
9	**IPR KER**	RWTH has an own IP Management. The Innovation Managers advise throughout the entire innovation process according to the employee invention processes.	
10	**FTO analysis**	FTO will be carried out in the next project phase	
	Risks		
11	**Critical Risk**	• We do not get enough data or not sufficient access to the demo sites to test the controller in the field • The controller cannot cover all the needs of the Smart2B concept	

Comments and suggestions

The approach is certainly smart and has relevant application opportunities.

Our suggestions for understanding whether this KER has also individual exploitation opportunities are:

- Still in the energy management application scenario, do you envisage any possible application of your KER outside the Smart2B platform (avoiding any possible conflict of interest/competition)? For instance, could be this KER implemented in domestic temperature controllers (like Netatmo) to make them smarter?

- List any possible alternative application scenario where your adaptive controller could be successfully implemented (*e.g.,* control of industrial plants, monitoring of patients in Intensive Care Units, etc.).
- If you identify a possible application scenario for your KER, then we advise you to carry out an initial business case analysis, analysing the value you expect to bring in such scenario by replacing the existing solution.
- If the business case proves to be valuable, carry out an in-depth market analysis, identifying:
    - Providers of similar solutions
    - Their specifications and performance
    - Their status of development
- Define a competitive positioning for the technology under development:
    - Based on the collected information and on the estimation of the target performance of our KER, identify the competitive advantage of the solution (e.g. improved comfort for occupants, reduced energy consumption, etc.).
- If the competitive positioning shows that the technology provides an added value:
    - Create connection with system integrators who can help you further develop and integrate the technology in their solutions.

3.3.4. VITO KER Tables

Vito team provides two tables each related to the specific KER they are working on. Hereafter the two inputs are presented.

Table 17 – 1st KER table provided by VITO

1 KER Name: Flexibility and indoor comfort service			
N.	TOPIC	INPUT REQUIRED FROM BENEFICIARIES	Comments
		About your result	
1	**Your KER**	Within the Smart2B project a flexibility and indoor comfort service will be developed and demonstrated that is part of a VITO BEMS. The **BEMS** (Building energy management system) combines flexibility characterization/modelling functionality and, forecasting functionality (e.g., of non-controllable load consumption, or PV generation, etc) with optimization functionality. Based on the forecasts and the available flexibility, it will determine an optimal consumption plan and corresponding control commands to steer the flexible assets accordingly. It will be able to handle and aggregate the flexibility of a heterogeneous and diverse set of flex assets (like heating/cooling, hot water	Q: We understood from other partners' KERs that there are at least other 3 platforms/BEMS (EDP, EB, ODINS). How does your BEMS interoperate with such platforms? A: In the Smart2B project we will develop a flexibility and indoor comfort service. Based on inputs from other WP's these services will provide an optimal consumption plan/flexibility (flexibility service) and a comfort service for the indoor temperature (indoor service) that can be used via an API in control applications. Through API's these services can be used in the Smart2B platforms. These services

		generation, thermal and electrical storage, smart whitegoods etc.). It will be able to communicate both the determined optimal consumption plan as well as the associated flexibility that could be activated if needed. BEMS is based on a combination of various optimal control approaches, including data driven approaches such as reinforcement learning and data supported, model-based, approaches such as model predictive control. This is combined with state-of-the-art forecasting with VITO's automated hyperparameter optimization and automated grey-box model creation. The BEMS combines multiple energy vectors, particularly thermal energy as embodied in the indoor comfort service as well as thermal energy, electricity, and mobility as manifested in the flexibility management service.	are also part of VITO's internal BEMS system but the demonstration of this BEMS is not part of the Smart2B project.
2	**TRL**	**Flexibility Management Service** (TRL6->TRL7) will provide the building with Demand Response capabilities so that it can be used for demand-side management and consequently provide load balancing for DSOs and TSOs. Thermal storage capacities within the building play an important role here. Models for simulating the thermal behaviour of buildings and HVAC will be used. Comfort related constraints set by the occupants should not be jeopardized. For the data-driven model-based optimisation of the energy systems a mature Python tool is used (TRL6). The tool is based on machine learning scikit-learn (TRL 6) and will be demonstrated in an operational environment at TRL7. **Indoor comfort (TRL5->TRL6)**: The indoor comfort service will use RC models to provide the state-of-charge of indoor temperature of the considered building/room. This type of models has been used in H2020 projects such as FHP, TEMPO, AmBIENCe, RES4BUILD projects (see http://fhp-h2020.eu/ , https://www.tempo-dhc.eu/ , http://ambience-project.eu/ and https://res4build.eu/) by VITO with	Q: Can you please briefly describe how the Indoor Comfort algorithm interacts with the Flexibility Management Service? A: The flexibility and indoor climate service will make use of data provided by the demo sites to develop and train the models. Furthermore, the flexibility service will receive as inputs information from the following transversal services: user-centric energy profiling (T4.2.1) and energy forecasting (T4.2.1).

		good results. Starting at a TRL5, a final TRL6 is expected.	
About the business			
3	**Problem**	Flexibility, which is the ability to reduce or increase or (partially) advance or postpone the consumption of energy in order to better exploit a fluctuating availability, is a major asset in a modern energy system with a high share of renewables. Current energy management systems however focus on energy efficiency instead of flexibility. Also, flexibility from various energy vectors (heating, cooling, electricity use, mobility, etc.) is rarely combined to exploit synergies. The problem that BEMS is going to solve is to combine flexibility from various energy vectors for maximum flexibility without compromising thermal comfort, and to employ this flexibility to advance a desired objective, such as cost optimal use of energy, maximum use of local energy, minimum carbon intensity, and so on. Smart2B's innovation is on the synergies between the several multi-criteria & multi-level asset control services for optimizing the usage of the available assets at an overarching cloud and local level. The energy efficiency and flexibility services, which closely interact with the multi-criteria load scheduling service focus on sometimes contradictory aspects (efficiency, flexibility and user's perceived comfort and satisfaction). Minimal interaction and human intervention are required, unless crucial for managing legacy equipment which requires manual regulation.	
4	**Alternative solutions**	Although companies and researchers claim to optimize energy efficiency and flexibility in buildings using advanced adaptive techniques and controls such as model predictive control (MPC) or reinforcement learning (RL), a true orchestrated control is not yet commercially available. Flexibility is only	Q: We have seen several utilities claiming to implement DR approaches. What would be the benefit for them implementing VITO's approach? A: A lot of the companies and products on the market are using

		affected through simple top-down control (load shedding, curtailment), but is not yet established as a tradable good.	rule-based approach and often are working in combinations of energy systems and in silos (e.g. PV + Battery, PV + EV, PV + electric boiler). Our approach is using a model predictive control approach. MPC allows the current timeslot to be optimized, while keeping future timeslots in account. The latter is more appropriate for complex energy systems and changing energy systems e.g. Heat pump with electric vehicle and battery system, smart charging of EV's.
5	**Unique Selling Point**	• Model-predictive holistic multi-objective approach, combining multiple energy vectors, multiple constraints, and complex objectives. • An active demand side management system for buildings based on a state-of-the art, proven and demonstrated technology–either available as technology transfer (source code license) or SaaS. • Flexibility Trading data model and interaction scheme that goes beyond offering Demand Response services; communicating the consumption plan and flexibility allows for an optimal coordination among buildings in an energy community, and allows other grid and market stakeholders in a more reliable problem prediction and a more effective flexibility activation request. • Flexibility service and artificial intelligence for accessing buildings and system flexibility is one of the main spearhead technology roadmaps at VITO. We are capable to keep on stimulating your innovation for the coming 5 to 10 years based on our long-term roadmap and make it future proof for multiple energy systems and technologies	

		with field tested components based on the latest scientific insights. • VITO –acting as your technology provider -delivers flexibility and indoor comfort service algorithms and components -including training -to be implemented in the software solution provider's product.	
6	**Partners**	Building energy management systems: access to data and systems for testing models and providing data to the flexibility and indoor comfort service.	
		The market	
7	**Customer**	The BEMS is intended to seamlessly integrate with various IoT systems to exchange data and control actions with actual devices based on local objectives and financial incentives adding VITO's intelligent optimization to energy management systems of interested vendors. The integration within Smart2B will be implemented via the Smart2B platform and will serve as a test case for similar integrations. Optimization objectives and flexibility valuation in the Smart2B case will be received from the multi-criteria & multi-level asset control trajectory, demonstrating the BEMS adaptability (to objectives such as, e.g., minimum cost, maximum self-consumption, least carbon intense generation, etc.). The functionality will be offered to commercial BEMS manufacturers and providers to extend their legacy functionality: helping them to accelerate the enrichment of their current product and service offering and strengthen their competitive position and market share.	
		Intellectual Property and FTO	
8	**IPR Background**	The needed functionalities and framework have been developed in a range of finalized and running European research and demonstration projects with background where VITO is the sole owner of the technology and the algorithms/models. No background	

		claiming is declared in the Consortium Agreement of the Smart2B project for VITO.	
9	**IPR KER**	VITO has its own IP protection strategy that is embedded in the DNA of the company. The developed services are part of a long-term technology roadmap which includes fundamental research, applied research and a valorisation phase. The execution of this roadmap is continuously evaluated and monitored within VITO (and with market information) in order to bring the developed products and services from the research and demonstration projects to the actual market. Where possible patents will be filled to protect the underlying methods and technology.	Q: Are you cooperating with any partner in the Consortium to develop the flexibility or the indoor comfort solution? A: The flexibility service will receive as inputs information from the following transversal services: user-centric energy profiling (T4.2.1), energy forecasting (T4.2.1), data from the demo sites which is provided by other partners. The development of these services is done by VITO only.
10	**FTO analysis**	A FTO analysis is not yet made for the services. The BEMS market is expected to see a large growth, driven by several reinforcing factors. **Firstly**, there is the need to electrify heating and transport on pursuit of reaching the ambitious emission reduction targets. **Secondly**, the directive to offer consumers more dynamic tariffs that lead to a growth of Implicit demand response (DR) business cases. **Thirdly** there is the increasing need of local and real-time flex activation e.g., to support local grid management, or to offer system level services in a local grid-secure manner.	
		Risks	
11	**Critical Risk**	For the development of these services, it is essential that adequate measurement data from the pilot demo sites is available for testing and validation of the developed models and algorithms. It is crucial because the vast diversity of intra-building equipment is an important barrier to successfully deploy the offered BEMS functionality. Specifically, there is a need for automated discovery and configuration, including automated learning.	

Apart from the integration of this KER into the Smart2B platform, from an initial analysis of this KER, we believe that there could be an interesting opportunity for it from a market perspective.

Thus, in order to further explore and develop this potential, the following activities are suggested:

- Conduct an application scenario analysis with the aim of understanding which context could represent the best road to beat (e.g., upgrade existing utilities' flexibility services).
- Starting from a first mapping of the main potential customers/users of this KER, carry out a market segmentation aiming to define your potential target customer (i.e., a reliable sample that could be indeed willing to benefit of your sw).
- Identify what type of software is currently adopted by these previous-selected utilities.
- When identified, try to identify and write down the whole bunch of activities required to integrate your sw with their pre-existent systems.

Table 18 – 2nd KER table provided by VITO

2 KER Name: Smart performance assessment & Advisor		
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**
		About your result
1	**Your KER**	The KER will be the Smart Performance Assessment & Advisor. It will provide the building users with data-driven insights in the current smartness of the building, suggest improvement actions to increase the potential upgrading of the building in line with the SRI definition, and show their economic and environmental impacts. The insights raise awareness and nudge occupants towards energy efficient behaviour, and to support informed investments in smart and energy-efficient technologies. **COMMENTS and QUESTIONS:** Q: From what we understand there are two users of this KER: 1) occupants and 2) building managers/ESCO, right? A: Ideally, yes, but we will further define and determine this aspect in task 1.2. Q: CERTH is working on a Scheduler algorithm as well as a Multi-agent system for controlling appliances and equipment which supports users reducing energy consumptions. Is your KER somehow interacting with such KERs? How does VITO incorporate CERTH's work on the SRI? A: I'm not aware of this, but CERTH is also involved in the task of developing SPA&A. We will further align.
2	**TRL**	Smart Performance Assessment & Advisor will be developed and demonstrated in all pilots at TRL7.
		About the business
3	**Problem**	The assessment will be based on actual monitoring or metered data on the performance of the applied ICT technologies in each building to validate from a theoretical to a real and dynamic building performance assessment. This service focuses on a semi to fully automated SRI

		assessment & advisor, reducing (or eventually fully eliminating) the on-site inspection efforts SRI assessor or expert. **COMMENTS and QUESTIONS:** Q: So the SRI can be evaluated only after the Smart2B platform is developed in the specific building and starts collecting data on the building energy performance? A: No, SRI can still be assessed based on the checklist approach by the assessors based on the building status from design phase. However, the operational data can be used to assess the in-use performance, and this will be further explored in a few restricted set of domains/impact categories in SPA&A.
4	**Alternative solutions**	Current other solutions are the checklist methods (simplified and full versions), which require on-site visits and manual completion of SRI assessment forms by trained experts.
5	**Unique Selling Point**	The assessment method will be based on actual monitoring or metered data, and the actual performance will be assessed dynamically, instead of just a static evaluation in the design phase. It should be mentioned that this assessment method is not considered as competitor to the traditional assessment methods, but rather an addition. In the long run, with the evolution of BACS/TBS, buildings might be able to self-report their functionality levels and quantify the impact.
6	**Partners**	Demo sites managers: data collection, testing the methods and providing feedback Front end developer: building dashboard
		The market
7	**Customer**	Building owners and facility managers
		Intellectual Property and FTO
8	**IPR Background**	VITO, together with other partners, developed the SRI assessment methodology in the framework of the first and second SRI technical support study. The SRI methodology remains the IP (copyright) of the European Commission. VITO holds IPR on building (energy) performance assessment tools and algorithms, and smart control algorithms for buildings and technical building systems. **COMMENTS and QUESTIONS:** Q: Who are the other partners with which VITO has developed this KER? Are these first and second technical support studies carried out within the Smart2B project? A: CERTH, FC.ID. No they are not, these are the studies carried out for EC, thus the SRI remains the IP of EC.

		Q: Can you please elaborate on the EU Commission's role and ownership of the IP? A: Please find more information on this website, in terms of EC's position: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en
9	**IPR KER**	VITO has its own IP protection strategy that is embedded in the DNA of the company. The developed services are part of a long-term technology roadmap which includes fundamental research, applied research and a valorisation phase. The execution of this roadmap is continuously evaluated and monitored within VITO (and with market information) in order to bring the developed products and services from the research and demonstration projects to the actual market. Where possible patents will be filled to protect the underlying methods and technology.
10	**FTO analysis**	FTO will be carried out in the next project phase
		Risks
11	**Critical Risk**	1. First off, the whole assessment will be primarily based on the monitoring data, if there is insufficient data delivered by the case study operators, the exercise can not be carried out. 2. Secondly, it is critical to define suitable methods and KPIs to properly quantify the impact and further clearly deliver digestible/understandable insights to the end users on the smartness of their buildings. 3. Lastly, one big challenge to be tackled is how to derive scores on smartness from actual measurements. This will require the definition of a benchmark of non-smart performance, and will most likely require normalization of the measurements to make different results comparable to each other, especially when considering user behaviour. The process of defining such suitable benchmark might be a bottleneck for market adoption of the automated assessment methods.

Comments and suggestions

Also in that case it came out clearly that there could be a relevant market opportunity that could be seize. In order to investigate it, the suggestion for that moment is to focus the effort on the business model definition and in particular:

- Who is the user and who is the customer for this KER?
- Identify who is the paying customer for this KER - if any – and find out why it should pay for it.
- Is it possible to envisage a marketplace where following the SRI calculation a suggestion on HOW to improve it is provided? (i.e., several suppliers are automatically identified).
- Define what could be (if any) the main adoption barrier of that innovative solution from those identified as target customer.

- Since the KER is not intended to replace but rather to run alongside the current manual system, reflect on and identify a more specific unique selling point: what is the "added value for the customer" deriving from the adoption of your solution? Precision increase, higher speed or lower costs, etc.?
- Definition and agreement of rights and rules disciplining how IP must be managed and exploit within the partners involved in this KER development.

3.4. Other institutions

In this section, the partners that can't be classified as Business Partners or research partners are shown. In particular, this category includes Albertslund Kommune (ABL) and Santa Casa da Miserocórdia de Lisboa (SCML).

3.4.1. Albertslund KER Table

Albertslund contribution is hereafter provided. Comments after the table are not provided due to the role covered by the partner, acting as an end user providing feedback rather than developing single components of the whole Smart2B platform.

Table 19 – KER table provided by Albertslund

KER Name: EDP re-dy system		
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**
		About your result
1	**Your KER**	Deploying the Smart2b solutions will allow for the individual control of each of the 96 elderly flats thus allowing for a more granular building management. The overall objective will be to demonstrate the smartness upgrade of the ARH by integrating 75% of the available legacy equipment (i.e. washing machines refrigerators, coffee machines and dish washers) through the *Smart2B platform*.
2	**TRL**	**User centric energy profiling and energy forecasting (TRL6->TRL8)**: aims at predicting the individual user energy profile and providing optimized and data-driven load forecasting models. TUG as well as RWTH have developed two mature and Python-based frameworks (TRL6 and TRL7) including several machine learning techniques (TRL6 and TRL7) for predicting energy profiles on a user and building level. Within Smart2B, the frameworks and machine learning techniques will be further developed, demonstrated and qualified at TRL8.
		About the business
3	**Problem**	1. *Who to control legacy equipment, without disturbing the end users normal behaviour and* way of living, turning OFF and turning ON equipment. *2.* Challenge the question about surveillance and monitoring in a private home. How to use the data to change behaviour? 3. The interaction between the overall system and the end user. What does the end user have of benefits from the energy system.

4	**Alternative solutions**	*1. There are currently no alternative solutions. Normally it is the technical equipment, which is controlled (heat-system, HVAC, light-control).* *2. The problem is currently not solved for the elderly home in Albertslund.* *3. Alternative solutions could be an overall dashboard that is interactive with the user.* *4. A user action can seen as an energy saving real time trend.*
5	**Unique Selling Point**	
6	**Partners**	*EDP providing the EDP re-dy system.*
	The market	
7	**Customer**	*The target customers are managers-operators of buildings'* legacy equipment (i.e. washing machines refrigerators, coffee machines and dish washers).
	Intellectual Property and FTO	
8	**IPR Background**	*EDP has the IPR*
9	**IPR KER**	*EDP can answer this question*
10	**FTO analysis**	Not applicable
	Risks	
11	**Critical Risk**	*Critical risks:* *1. The EDP re-dy system can't be integrated into the overall energy management system.* *2. Effects in terms of electricity and/or money savings are too small for justifying installing the EDP re:dy system.*

3.4.2. SCML KER Table

SCML inputs are presented in the table below. Then, the comments to improve their results are summarized in the box following the KER table.

Table 20 – KER table provided by SCML

KER Name: YoungSmart2B program			
N.	**TOPIC**	**INPUT REQUIRED FROM BENEFICIARIES**	**Comments**
	About your result		
1	**Your KER**	The young Smart2b program is a pedagogic manual on energy sustainability designed and built with the input of the children and	Q: Do you think this manual could be sold beyond the Smart2B project? A: Don't know yet.

		young people participating in the project. The Manual will be constructed and tested with the activities that are being carried out with the end-users and validated by them.	- Q: In which countries would it be most interesting to distribute it? A: Maybe the best way is starting by the partner countries involved in the pilots. Asking them if they are interested in promoting the youngSmart2B program (manual) in their countries/cities (local schools eventually). Q: Have you thought about how you could disseminate it? Whether in paper or digital format? Do you intend to distribute it for free or paid? A: We could put the youngSmart2B program in the different sites, as for example: SCML webpage, Smart2B project site, also EDP NEW… It could be disseminated in both ways, however, I prefer digital format (pdf or e-book). To decide whether distribute it for free or paid, it must be clear firstly the interest of social community about the program
2	**TRL**	TRL1 Basic Principles observed TRL3 Experimental proof of concept	Q: How long does it take to have the manual ready to be distributed? A: One year, maybe a little more. Firstly, we need to design the program, secondly to test it with the young people (during 6 or 8 months) third to make the amendments after the feedback of the young people (2 months), and finally implement the youngSmart2B program as a routine.
About the business			
3	**Problem**	We will try to promote environmental literacy and, above all, to address energy saving issues among young people and children, which are not very aware to these issues in everyday life. This question is not always addressed in the institutional context (SCML residences) and schools. We will try to turn them into ambassadors of energy sustainability.	Q: Do you imagine that this manual could also be distributed in schools, or would this require an adaptation of the content? A: Probably, the manual requires some adaptations of the content. The SCML team, could try to test the program also in one school, and made two versions of the manual (one version based in pilot, another based in school).
4	**Alternative solutions**	This content to explain what energy is already exists for teachers and children in television contexts or manuals, but they do	

		not focus on the sustainability of buildings and do not evoke savings in everyday life. The specificity of the young Smart2b program is that it will be built with the help of the young people and children, promoting their social participation and environmental inclusion.	
5	**Unique Selling Point**	Not applicable.	
6	**Partners**	EDP	
The market			
7	**Customer**	Social organization, NGO, schools	
Intellectual Property and FTO			
8	**IPR Background**	-	
9	**IPR KER**	-	
10	**FTO analysis**	Not applicable	
Risks			
11	**Critical Risk**	First: Young people and children, who come from very difficult and unstructured family contexts, may not adhere to the program due to emotional issues and/or psychological demotivation. Secondly: some participants may come back to their families and abandon the project.	

Comments and suggestions

- The youngSmart2B program (pedagogic manual on energy sustainability) is possibly thought to be sold beyond the S2B project? Which are the users and sector targets?
- Being the manual a product marketable by itself (beside any agreed royalties with other partners), did you define already the countries to distribute, the publishing house and the distributor partner?
- Define the Unique Selling point: what is the unique/main feature of my solution that makes your solution stand out from the competition (i.e., the focus on the sustainability of buildings and the savings in everyday life, promoting social participation and environmental inclusion, compared to what already exists for teachers and children in television contexts or manuals).

4. Conclusions and Next Steps

During the first 6 months of the project, 18 KERs have been analysed, which showed a relevant exploitation potential both for the whole platform and also when considered individually.

For each KER, several key issues have been discussed focussing on aspects as:

- Business case definition and analysis;
- Identification of competitive positioning and advantage;
- IP protection and freedom to operate analysis;
- Business model definition.

The outcome of this deliverable will pave the way to a further analysis of the KER which own more market potential, for which potential use cases and business cases outside the Smart2B platform will be identified.

Besides, while this deliverable is totally focussed on the identification of the individual KER developed by the project partners, it's clear that the main goal of the project is to deliver a full-fledged platform able to reach a broad range of customers in the widest possible geographical markets.

In this sense, we recognise that a strong effort will be needed in the coming months to roll-out the exploitation plan for the full platform which addresses:

1. The identification of the lead exploitation partner, namely the entity that will take the technology to TRL9 after the end of the project and will take care of the go-to-market phase.
2. The establishment of licensing agreements for the use of the KER by the exploitation partner.

The first point is surely the most challenging, as the goal is to align the industrial vision of the enterprises in the Consortium in a coherent business plan which maximises the chances to have an effective global impact with the Smart2B platform.

In this sense, the choices to make will relate to:

- The plausibility of the creation of a Joint Venture/Startup participated by the industrial partners of the Consortium (EDP, ODINS, EB, D1). The main challenges will be on structuring this entity aligning the interests of companies located in 3 different European Countries, ensuring appropriate commercial, manufacturing, distribution and logistics operations and funding.
- Pursuing individual exploitation strategies, with the enterprises involved in the project owning country-based priority/exclusivity of commercialization. While this seems to pose less organizational/strategic challenges, the downside relates to the difficulty to reach markets which are outside the scope of those in which the industrial players in the Consortium are more active.

The next phase of the work in WP7 will be focusses on taking these strategic decisions, that will be instrumental to define the final project exploitation strategy.