



## D 8.1 EARLY EXPLOITATION AND IPR PLAN

---

Partner description of initial plans to exploit the results and the foreground assets produced in the project; identification of the project exploitable assets and their IPRs.

Project title	<b>Collaborative Recommendations and Adaptive Control for Personalised Energy Saving</b>
Project acronym	<b>enCOMPASS</b>
Project call	<b>EE-07-2016-2017 Behavioural change toward energy efficiency through ICT</b>
Work Package	<b>WP8</b>
Lead Partner	<b>WVT</b>
Contributing Partner(s)	<b>ALL</b>
Security classification	<b>PU (Public)</b>
Contractual delivery date	<b>30/04/2017</b>
Actual delivery date	<b>29/04/2017</b>
Version	<b>1.0</b>
Reviewers	<b>PMI, SHF, PDX, EIPCM</b>

## History of changes

Version	Date	Comments	Main Authors
0.1	18/3/2017	DDP (Deliverable Development Plan) – definition of the document structure and the contributions expected from each partner	K. Arvanitis (WVT)
0.2	24/3/2017	Executive Summary, Deliverable Structure	K. Arvanitis (WVT)
0.3	25/3/2017	Electricity: Energy Market Summary	K.Arvanitis (WVT)
0.4	21/4/2017	Gamification Market	S.Herrera (PMI)
0.5	21/4/2017	Electricity Market	K.Arvanitis (WVT)
0.6	27/4/2017	Conclusion	K.Arvanitis(WVT)
0.7	27/4/2017	Contribution received through review process	P.Fraternalli, C.Passini, S.Herrera (PMI), L.Grillo (PDX)
0.8	27/4/2017	Quality Check	G. Meindl (SHF)
0.84	28/4/2017	Minor revisions after document review	K.Arvanitis(WVT)
1.0	29/4/2017	Final check and corresponding revision	J. Novak, S. Chelidonis, M. Melenhorst (EIPCM), K. Arvanitis (WVT)

## Disclaimer

---

This document contains confidential information in the form of the enCOMPASS project findings, work and products and its use is strictly regulated by the enCOMPASS Consortium Agreement and by Contract no. 723059.

Neither the enCOMPASS Consortium nor any of its officers, employees or agents shall be responsible or liable in negligence or otherwise howsoever in respect of any inaccuracy or omission herein.

The contents of this document are the sole responsibility of the enCOMPASS consortium and can in no way be taken to reflect the views of the European Union.



***This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723059.***

## TABLE OF CONTENTS

Executive Summary .....	6
1 Introduction.....	7
2 Initial exploitation markets.....	8
2.1 The electricity market.....	8
2.2 The gamification market.....	12
3 The enCOMPASS assets.....	19
3.1 Consumer portal for energy saving .....	20
3.2 Energy consumption visualizer .....	22
3.3 Gamification engine .....	23
3.4 Adaptive gamification service .....	24
3.5 Board game for energy saving awareness .....	26
3.6 Disaggregation algorithms for electrical energy at medium/low sampling frequency .....	27
3.7 Algorithms for user profiling based on energy consumption behaviours .....	27
3.8 Models of energy consumption based on behavioural, structural and exogenous factors .....	28
3.9 Efficiency exploration console .....	28
3.10 Occupancy detection and inference tool.....	29
3.11 Indoor climate detection and inference tool .....	30
3.12 Human indoor activity detection tool .....	31
3.13 User presence sensing .....	32
3.14 User activity detection engine .....	33
3.15 Algorithms for recommending energy saving actions.....	33
3.16 Smart home automation platform .....	34
3.17 Smart meter and sensor data management component .....	35
3.18 Web services integration bundles .....	36
3.19 Sensor data acquisition module.....	36
3.20 Environment sensor monitoring platform .....	37
4 Preliminary Individual/Joint Exploitation Plans .....	39
4.1 PMI .....	39
4.2 SUPSI.....	40
4.3 EIPCM.....	40
4.4 CERTH/ITI .....	41
4.5 SMOB .....	41
4.6 NHRF .....	41
4.7 SHF.....	42

4.8	NABU .....	43
4.9	SES .....	44
4.10	KAL.....	44
4.11	GRA.....	45
4.12	WVT .....	46
4.13	KTU .....	46
4.14	PDX .....	47
4.15	Joint exploitation plan .....	48
References.....		49

## EXECUTIVE SUMMARY

---

This document is the Deliverable **D8.1 Early Exploitation and IPR plan**, which is specified in the enCOMPASS Description of Action as follows:

*„partner description of initial plans to exploit the results and the foreground assets produced in the project; identification of the project exploitable assets and their IPRs“*

It has **REPORT** type and **PUBLIC** status.

The deliverable represents an outcome of task T 8.2 Business modelling and business ecosystem building. As a first step in this direction, in accordance with the scope defined in the DoA, this deliverable presents the initial definition, description and IPRs of exploitable assets that will result from the enCOMPASS project, alongside with the early individual and joint exploitation plans of the project partners. Based on an initial analysis of the most closely related market segments of relevance to enCOMPASS (energy, gamification) and on the input from the ongoing requirements analysis, an initial set of exploitable assets has been defined and described. This has allowed the definition and alignment of preliminary individual exploitation plans both with potential markets of relevance and with specific assets of interest to the individual partners and for the joint-exploitation of the consortium as a whole.

Given the very early stage in the project development (M6) and the novelty of the enCOMPASS platform and its individual elements under development, the assets and initial exploitation plans presented in this document are preliminary in nature and will be expanded and revised as more specific results and experiences from the project when available (e.g. prototypes, their validation and feedback from presentation to potential customers). In accordance with the DoA, the final (updated) definition of assets and the exploitation plans will be given in D8.6.

Task T8.2 producing this deliverable is strongly connected to other tasks in WP8, in particular to task T8.1 Technology, market and regulatory watch. Furthermore, the outcomes of all other work packages in which the enCOMPASS system and its individual components are defined, developed and validated naturally inform the definition of exploitable assets and exploitation plans. Finally, the results of task T8.2 itself provide an essential input to WP9 Communication and Dissemination, informing the communication and dissemination activities, so that the exploitable enCOMPASS assets can be communicated and disseminated in the most effective way. For an overall description of the task and work package dependencies, please refer to section 3.1.2 of the enCOMPASS Description of Action.

This deliverable is structured as follows:

- Section 1 gives a brief introduction to the purpose of the deliverable and its contribution,
- Section 2 describes the preliminary analysis of the initial exploitation markets,
- Section 3 presents the initial definition of enCOMPASS assets and IPRs,
- Section 4 describes the initial individual and joint exploitation plans.

# 1 INTRODUCTION

---

The enCOMPASS project has been set up to achieve energy saving through behavioral change, which will contribute to CO<sup>2</sup> reduction targets Europe has committed to. The enCOMPASS system will integrate existing technology, product and services of the utility and technology partners, customize and extend them to enable improved and innovative types of offerings. While achieving environmental impact is an important part of the enCOMPASS objectives and KPI's, so as the business impact of the project.

For that reason, the development of a systematic exploitation strategy and plans has been initiated early on in the project. In doing so, the asset-based exploitation strategy has been adopted, where assets are defined as those project results and individual (or combinations of) elements of the enCOMPASS platform, that have a clear exploitation potential. By identifying and describing such exploitable assets early in the project, even if in a preliminary way and subject to change based on the on-going project development and findings (e.g. from prototype evaluations, interactions with target users and presentations to potential customers), this can allow an early and on-going alignment between the different project activities and objectives (e.g. technical, societal) in a way that can ensure and maximize business impact.

Therefore, this deliverable presents the initial results of the definition of the exploitation strategy for the results of the enCOMPASS project, as part of WP8 Impact – Exploitation and Continuation. The contribution of this deliverable is a first assessment of the most relevant markets to be targeted for exploitation and the subsequent identification of exploitable assets for both joint and individual exploitation by the enCOMPASS consortium partners. Informed by this, the initial individual exploitation plans and strategies of the project partners are presented.

This deliverable is the first step towards a new business ecosystem that launches novel business models based on behavioural change solutions, by providing SaaS and PaaS-based access to platform services that combine energy usage data with extracted contextual information (such as occupancy, activity, profiling etc.) correlated into profile models. enCOMPASS facilitates the development of added-value services and new white-label solutions that make behaviour change part of the business strategy of utilities and technology providers.

The business ecosystem will be iteratively set up and defined through the subsequent WP8 deliverables, involving a technology, market, and regulatory watch (*D8.2 Technology and regulatory watch report*), the update of the exploitation plans (*D8.4 Exploitation plan* and *D8.6 Final exploitation plan*), and (in two iterations) and the mapping of relevant actors and stakeholders, analysis of social, environmental and business requirements, and the identification of possible business models (*D8.5 Business ecosystem report*).

The business ecosystem will accelerate the wider deployment and adoption of user-friendly ICT solutions prompting behavioural change and energy efficiency, while ensuring sustainability after the project's life. The assets defined in this deliverable and the individual and joint exploitation strategies of enCOMPASS partners show how the enCOMPASS consortium is working in a committed way towards exploiting the project results and maximizing its business impact.

## 2 INITIAL EXPLOITATION MARKETS

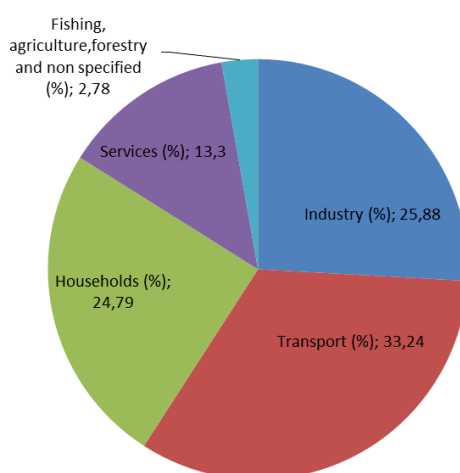
As a goal-directed point of departure for the initial definition of the enCOMPASS exploitable assets and exploitation plans, the focus has been given to two most closely related market segments of relevance to enCOMPASS: the electricity market and the gamification market.

While there are several other markets of interest to enCOMPASS (e.g. Internet of things, home automation, recommender systems), at this early stage the priority was given to providing a strong focus that ensures close alignment between the partners and their integration toward common objectives as the basis for their initial exploitation plans. This focus does not preclude the identification and exploitation of individual assets that are potentially related also to other markets (e.g. sensing and home automation solutions, recommendation services), but rather requires partners to consider what kinds of such assets can be exploited in primary enCOMPASS markets, taking advantage of the synergies and added-value of the enCOMPASS project. In fact, as can be seen in the assets defined in Section 3 and the partner exploitation plans given in Section 4, some of the contributions include exactly such considerations (e.g. home automation assets to be exploited by energy utilities as value-added services for their customers in the electricity market). A more detailed analysis of additional markets is also one of the dedicated goals of tasks T8.1 and its deliverable D8.2, which will then provide the basis for informing the refinement and further development of the enCOMPASS assets and exploitation plans. Since D8.2 is due only at M15, performing the analysis of the primary enCOMPASS markets presented in this section was needed to lay the basis for an initial definition of the assets and exploitation plans for this deliverable (without duplicating and pre-empting the entire scope of analysis of D8.2).

### 2.1 THE ELECTRICITY MARKET

The energy sector is one of the pillars of growth, competitiveness and development for modern economies. Energy consuming end-users range from individuals, different occupancy residential users, small businesses, schools and municipalities to heavy duty industries with increased power demand and transports. Thus, the energy industry includes several heterogeneous stakeholders with different supply chain models and different regulations per country. The enCOMPASS approach focuses on electricity that is consumed in Households, Small Businesses, Schools and public Buildings. The analysis of the final end-use of energy in the EU-28 in 2014 shows three dominant categories: namely, transport (33.2%), industry (25.9%) and households (24.8%) [1].

Figure 1: The final end use of electrical energy in the EU-28 in 2014

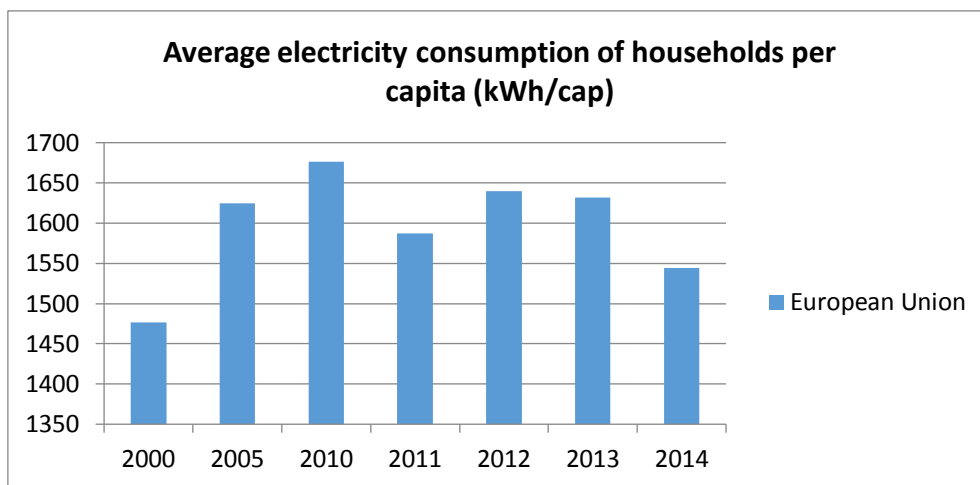




Further analysis for market reasons is given for electric energy consumption in households until year 2014. The market analysis for households on EU level and pilot's level is done with data from EUROSTAT and WORLD BANK, therefore the historical data are found until year 2014, while there are no statistical data for the public buildings and schools among the data libraries for all pilot countries. The average data for schools and public buildings of the respective customers of the 3 utility partner companies are not representing the whole pilot country's market, so the datasets do not contribute to representing the average consumption for each building type.

According to [2], the average electricity consumption of household per capita varies in the past years for the EU-28 countries, as shown in figure 3.

Figure 2: Average electricity consumption of households per capita in EU from 2000 to 2014



For the deliverable report, further analysis is made regarding the households in the pilot countries, and the corresponding electricity indicators. Figure 4 depicts the pilot countries average yearly electricity consumption per capita of households over the years.

Figure 3: Pilot countries: the average electricity consumption per capita in households over the years

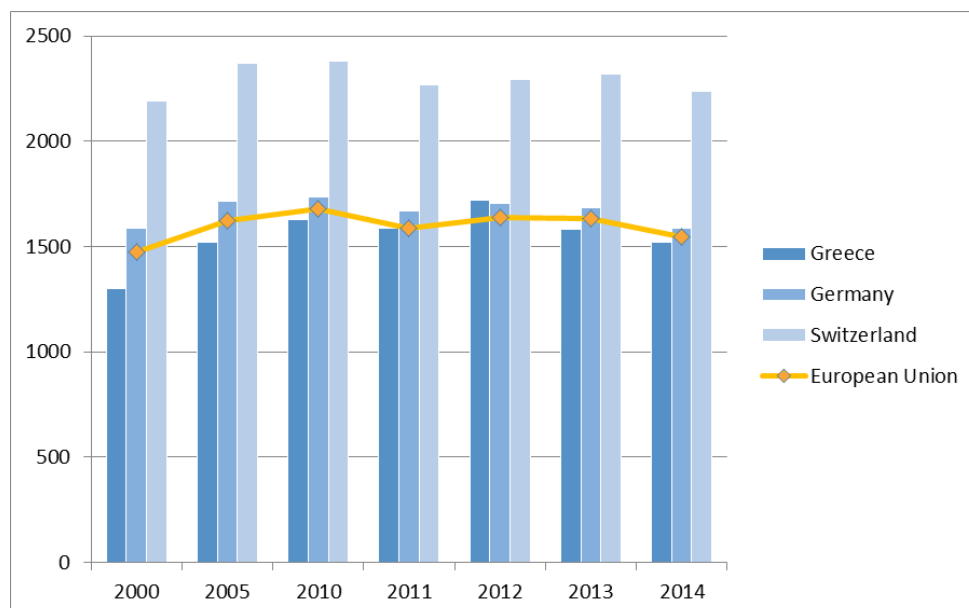
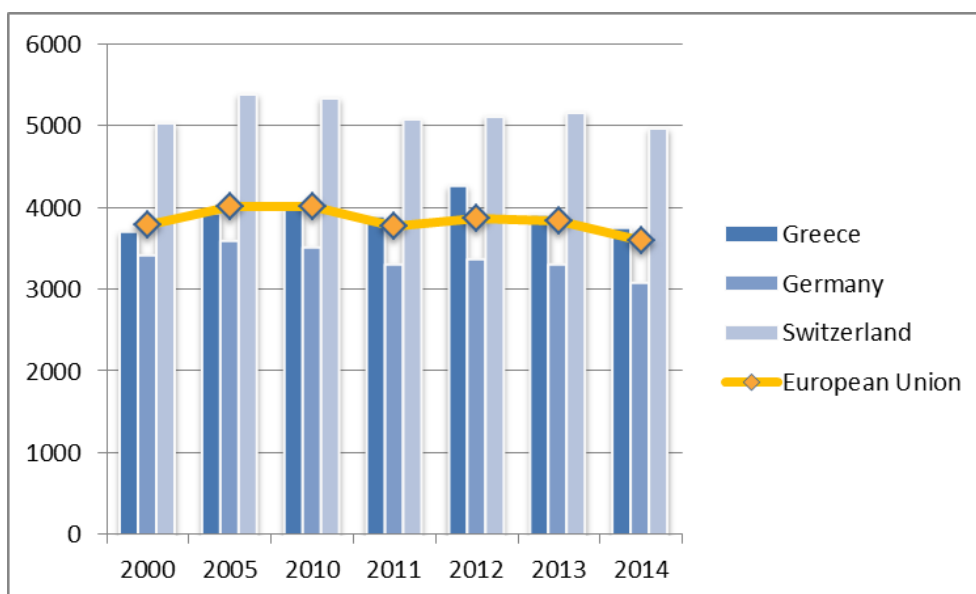


Figure 5 reports pilot country average electricity consumption per electrified household (kWh/hh).

Figure 4: The pilot countries average electricity consumption per household (kWh/hh) over the years



Drilling in to year 2014 according to [2], Table 2 reports the enCOMPASS pilot countries average households' electricity consumption of year 2014 per capita and per household.

Table 1: Pilot countries household average electrical energy consumption analysis

Year 2014	Greece	Germany	Switzerland
[kWh/capita]	1519,811	1585,694	2236,144
[kWh/hh]	3757,884	3079,099	4973,313

Figure 6 shows the disaggregation average values per consumption sector in a pilot country household.

Figure 5: Disaggregation of electrical energy spending in households [kWh]

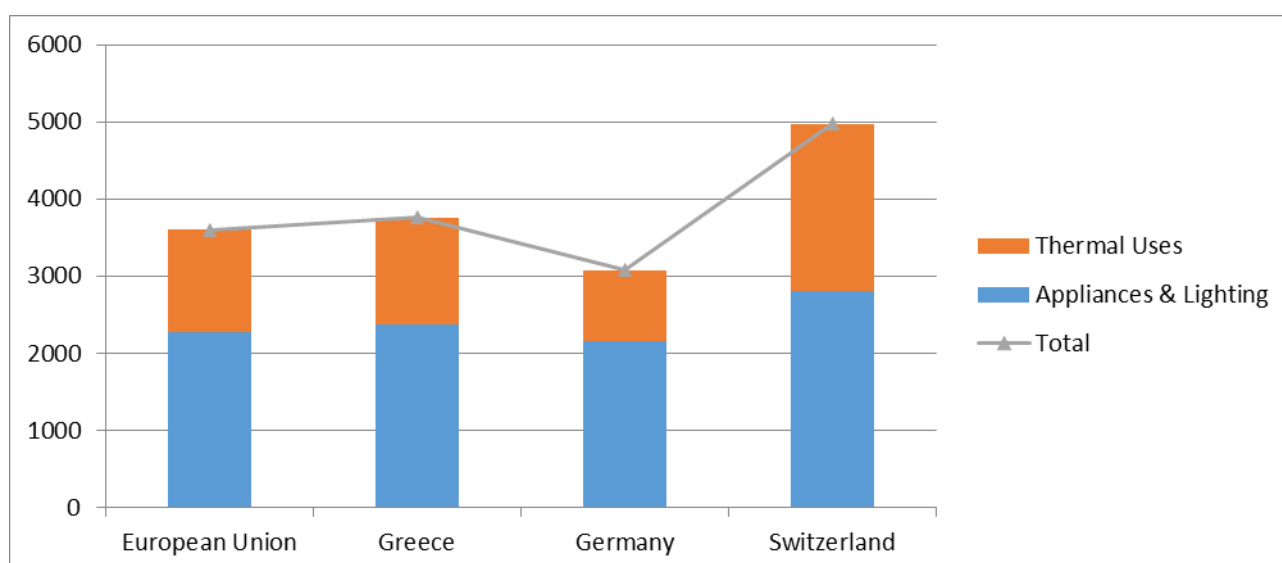
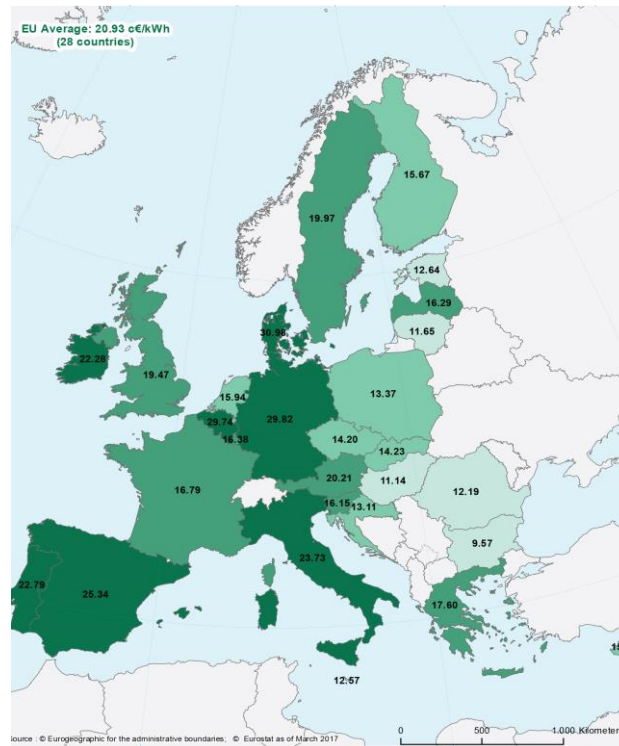


Figure 7 reports the map with the EU-28 total electricity price.

Figure 6: EU-28 total electrical energy price



Combining the statistical sources [3] and [4], table 3 is generated, reporting the total electricity price for households in the pilot countries.

Table 2: The pilot countries electricity cost in [€/kWh]

Electricity Cost [€/kWh]	Greece	Germany	Switzerland
<b>Total Price<sup>1</sup>:</b>	0.177	0.295	0.2132

Table 3 concludes to the table 4 results regarding the total cost per capita and household for the reference year 2014.

Table 3: The average pilot countries electrical energy households spending in €

Year 2014	Greece	Germany	Switzerland
€/capita	269,01 €	467,78 €	476,75 €
€/household	665,15 €	908,33 €	1.060,31 €

<sup>1</sup> Total Price is computed from the sum of Energy, Supply, Network Costs, Taxes and levies  
enCOMPASS D 8.1 Early Exploitation and IPR Plan  
Version 1.0

## 2.2 THE GAMIFICATION MARKET

Gartner defines gamification as “the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals” [6].

The key elements of gamification are:

- Game mechanics exploits elements such as points, badges and leader boards that are common to many games.
- User experience design describes the journey players take with elements such as game play, play space and story line.
- Gamification is a method to digitally engage, rather than personally engage, meaning that players interact with computers, smartphones, wearable monitors or other digital devices, rather than interacting with a person.
- The goal of gamification is to motivate people to perform tasks, change behaviours, develop skills, or drive innovation.
- Gamification focuses on enabling players to achieve their goals. When organizational goals are aligned with player goals, the organization achieves its goals as a consequence of players achieving their goals.

An exemplary case of gamification is Nike+: launched in 2006, it has more than 11 million users and supports a suite of products. In the first year after the launch, Nike+ FuelBand users racked up 409 billion NikeFuel points, which is the equivalent of running 44 million marathons. Similarities and differences exist among **video games**, **rewards/loyalty programs** and **gamification**, which all share some similar constructs, such as points, badges and levels.

Gamification, video games and rewards programs are similar in a few ways:

- They engage "players" voluntarily.
- They use game mechanics such as points and levels.
- They are interactive.
- They incorporate progression to move players to the next level.

But the differences are more important than the similarities.

Video games, rewards programs and gamification engage people on very different levels, and they have entirely different purposes:

- **Games** primarily engage players on a fanciful level to entertain them.
- **Rewards/loyalty programs** primarily engage players on a transactional level to compensate them.
- **Gamification** engages players on an emotional level to motivate them.

Table 5 summarized the difference between the 3.

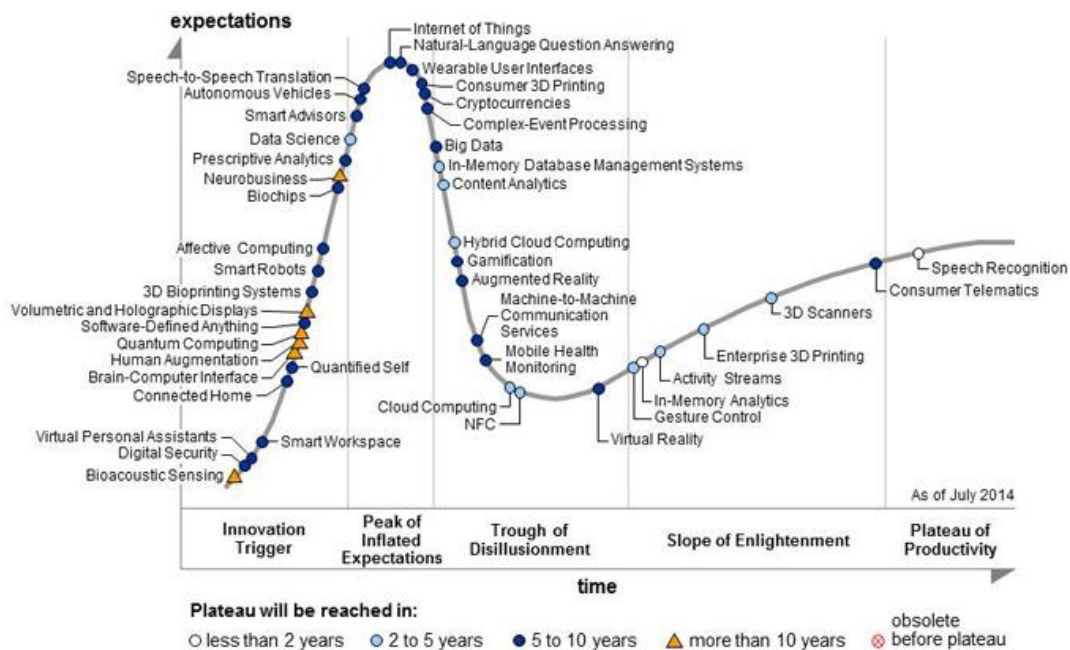
Table 4: Comparison of gamification with video games and reward/loyalty programs [6]

	Gamification	Video Games	Rewards/Loyalty programs
Engagement model	Emotional	Whimsical	Transactional
Value offer	Motivation	Entertainment	Compensation
Value Exchange	Shared values	Player pays provider	Provider pays player

### 2.2.1 Market size, projections and segments

The impact of gamification on businesses and governments is a consolidated reality. On 2014, [2] Gartner placed gamification in its technology hype curve (Figure 7), and predicted that gamification would reach its productivity plateau and maturity by 2020, also forecasted that 50% of corporate innovation would be “gamified” by 2015. Deloitte cited gamification as one of its Top 10 Technology [11].

Figure 7 Gamification in Gartner’s technology hype curve



Enterprise Gamification Consulting on their Gamification Industry Report 2015 [16] identifies 4 dominating key vendors:

- GamEffective
- Infosys
- Bunchball
- Badgeville

It also identifies 4 emerging vendors pushing innovation:

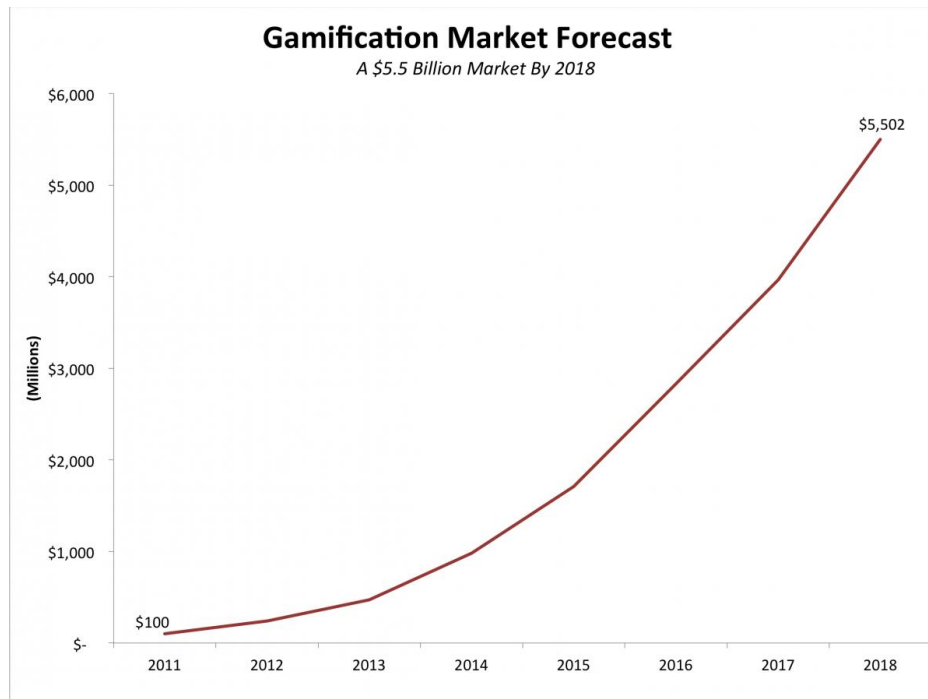
- Funifier
- eMee
- BizPart
- Engage

Finally, it identifies some other important companies as key players such as:

- Mambo.io
- SAP
- Playlyfe
- Gamification-Engine
- TribeCloud

Gamification has become a well-established practice in recent years, the global market for gamification apps and services was estimated around \$400 and \$500 million USD by year-end 2013, around \$2.8 billion USD by 2016, and is estimated **to reach 11.10 billion USD by 2020**, at a CAGR of 46.3% [14]. These figures refer to overall market size, including traditional desktop, mobile, and other applications.

Figure 8: Market trend prediction for gamification (source: BI Intelligence)

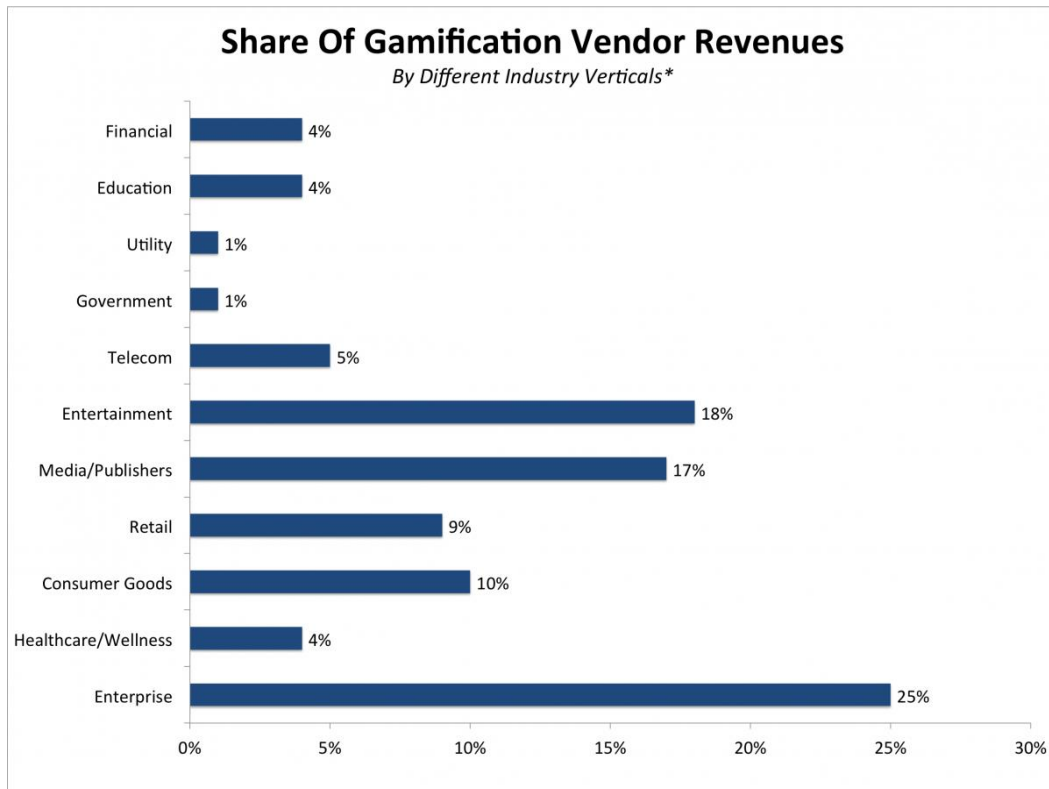


The highlights of the report are as follows [17]:

- The enterprises and corporations have developed a wide range of uses for gamification, from learning and training, to performance management and promoting employee health and wellness, therefore this share of the market is growing.
- The success factors of a gamification project are: an intuitive design for the user interface, a careful development of the game mechanics considering a strong and long-term strategy, and alignment of the gamified experience with the core business objectives that it was implemented for.
- Gamification that generates valuable data equips decision-makers to better understand the user, anticipate opportunities, and proactively resolve issues. Failing in collecting adequate data could lead to the failure of the project, as huge business opportunity would be wasted, especially in behavior tracking projects.
- Wearable computing and 'Internet Of Things' (IOT) are speeding up gamification efforts since sensors and ambient activity tracking allow users to participate in gamification "effortlessly," without having to input data.

The report shows that on vertical markets (Figure 9): Enterprise has the biggest share of the market, followed closely by Entertainment and Media & Publishing, while Retail and Consumer Good represent almost 20% of the market. Healthcare & Wellness has only 4% of the market share, but it is expected to grow in the following years since insurance companies are deploying strategies involving gamification to promote physical activity and wellness among its clients.

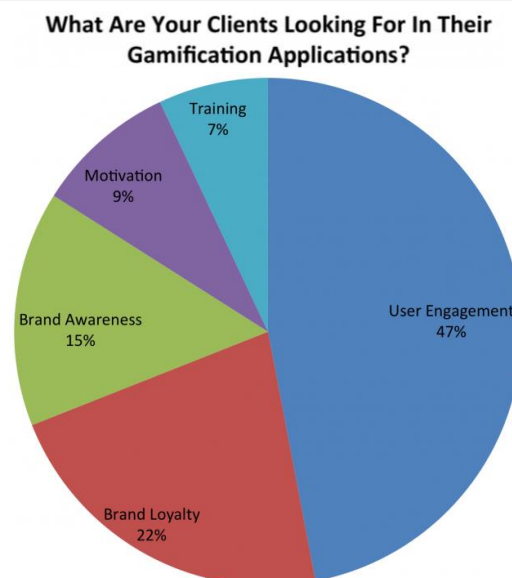
Figure 9: Revenue shares by industry verticals [17]



There are various ends to what gamification is currently used for in the market. The Business Insider report shows that 47% of the projects aim at generating user engagement to activities or communities, 22% search brand loyalty and 15% aim at creating brand awareness. Gamification is used for training only in 7% of the cases, but this number is expected to grow in the coming years, as universities and companies adopt this practice to develop skill in students and employees. Full detail of the purpose segmentation can be observed in .

Figure 10.

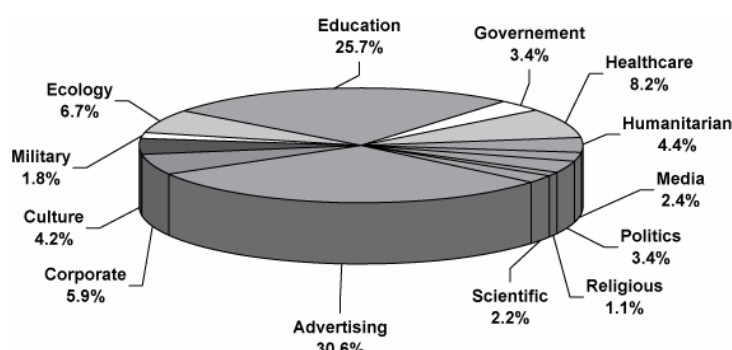
Figure 10: Gamification share by purpose



### 2.2.2 Games with a Purpose / Serious Games

Serious games are often defined as “Games designed to serve purposes other than purely entertainment” [19]. In this context, the notion of serious games becomes a very broad concept, which can embrace a lot of different games, with several applications and main objectives. To clarify the possible applications to serious games, [22] created a market partition that divides the serious games, according to that main purpose, in 13 categories: Education, Ecology, Military, Culture, Corporate, Advertising, Scientific, Religious, Politics, Media, Humanitarian, Healthcare and Government.

Figure 11: Serious games market repartition between 2002 and 2011 (1256 games)



A forecast by Ambient Insight in 2016 [18] divides the serious game market in two categories, according to the approach used for the game: game-based or simulation-based learning. From the point of view of market size and value, this forecast states that game-based learning reached \$2.6 billion in 2016, the five-year compound annual growth rate (CAGR) is a robust 22.4% and revenues will surge to **\$7.3 billion by 2021**. The simulation-based learning market, which includes corporate training games, is also expected to grow, from \$5.1 billion in 2016 to \$8.1 billion in 2019, and will reach **\$11.3 billion by 2021**. Much of the growth will come from apps that target the mobile market [19].

Figure 12: Serious Game Market Forecast [18]

Global Revenues by Learning Product Type***	2016 Revenues in US\$ Millions	2021 Revenues in US\$ Millions	Five-Year CAGR 2016-2021
Simulation-based Learning	\$5,167.87	\$11,310.43	17.0%
Game-based Learning	\$2,661.96	\$7,324.84	22.4%
<b>Total</b>	<b>\$7,829.83</b>	<b>\$18,635.27</b>	<b>18.9%</b>

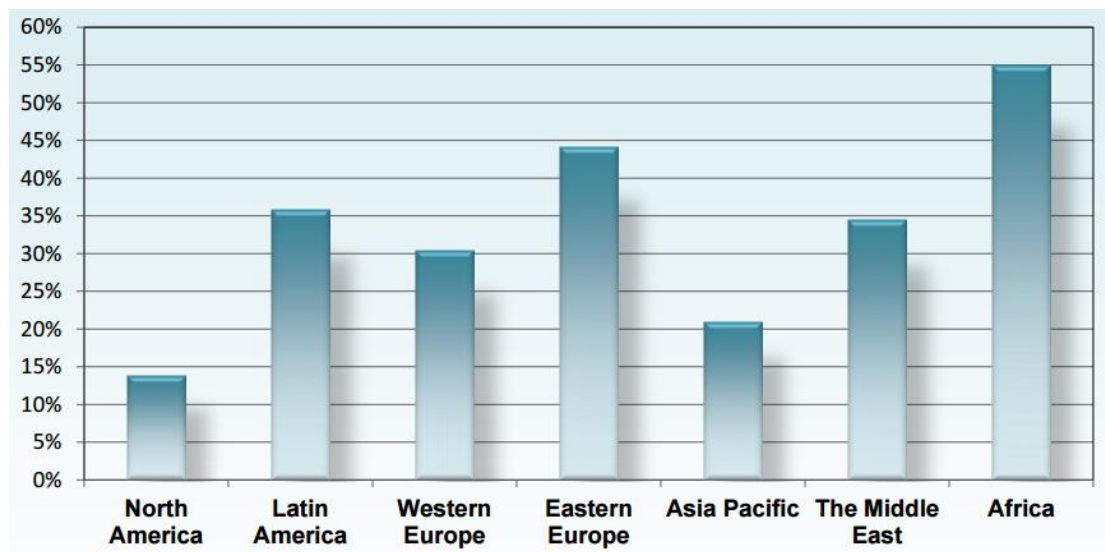
\*\*\* Does not include hardware, tools, or custom services

Investment in the serious game market has been reported to grow every year; for example, in 2011 \$32.5 million went to game-based learning companies. In 2014, game-based learning suppliers across the globe garnered \$106.3 million in funding. An unprecedented \$165.9 million was invested in 35 educational game suppliers during 2015. And a total of \$325.0 million has been invested in 37 game-based learning companies in the first half of 2016.



Different regions in the world present different opportunities. The growth rates presented by Ambient show that Africa and Eastern Europe have the biggest CAGR of all regions with 55% and 44% respectively, followed by Latin America with 36%. North America and Asia Pacific present the smallest growth. The report highlights that 11 countries in Africa and 10 countries in Asia Pacific are mobile-only countries, therefore mobile learning and mobile edugames are the only viable learning technologies in those countries. It is possible that the Asian market growth would remain small due to China's government new policies that require foreign companies to partner with Chinese companies and request government approval for every application.

Figure 13: Serious games CAGR by region in 2016

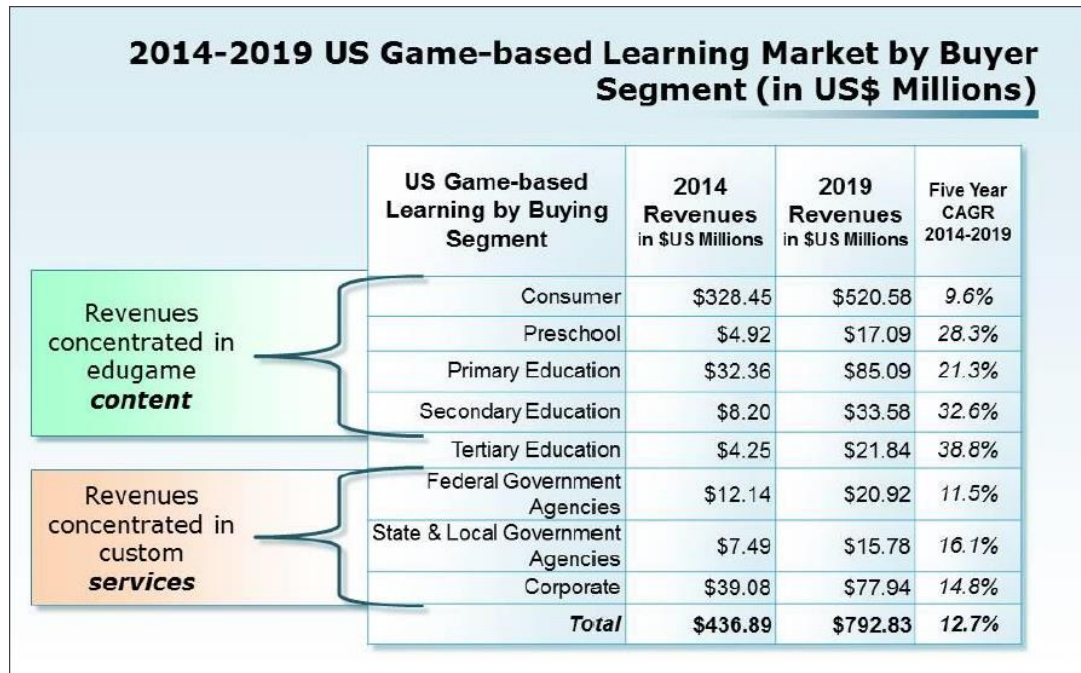


The buyer segments of serious games products and services have different interests and offer different business opportunities. An Ambient report of 2015 divided consumers into 8 segments [18]: consumer, preschool, primary education, secondary education, tertiary education, corporations & businesses, federal government agencies, and state/provincial/local government agencies.

The highest growth rates in the US were in the academic segments. The tertiary segment has the highest growth rate of 38.8%, virtually on par with the global growth rate for that segment. Revenues were quite low in this segment in 2014, but it is estimated to grow over five times to \$21.8 million by 2019. Math educational games are the top best-selling in the secondary education segment, while early childhood learning topics including literacy, numeracy, and basic cognitive skills are dominating in the pre-school and primary segment.

Language learning apps are the top best-selling retail apps in the government and corporate segments. The government segment also invested to develop mobile games mostly for young children on a range of topics including literacy, health, and language learning. Consumer market is the dominating segment, where the most common topics for applications are brain trainers and language learning. Figure 15 shows the segment revenue distribution in 2014 and the forecast for 2019.

Figure 14: US game-based learning market by buyer segment [18]



### 2.2.3 Gamification in the public administration and utilities sector

Government and public administrations aim to increase employee productivity and improve citizen participation and relationships. Gamification techniques have proved effective tools to help citizens and employees to change behaviour, engage in innovation and public utility tasks and develop skills [13]. The city of Stockholm gamified speed cameras into a lottery game to reduce traffic speeds, and the UK's Department for Work and Pensions gamified its suggestion box to allow employees to contribute ideas and trade stock in those ideas for workplace innovation [8].

Some other examples of gamification in the public and utilities sectors include:

- The **Gaming for Good** initiative, a partnership between Al Gore's Climate Reality Project and PSFK, where people designed innovative gaming applications to address sustainability and climate change challenges, generating more than 60 entries from around the world
- British Gas's **EnCon CITY®** educational initiative, which illustrates the benefits of conservation by teaching players how energy is consumed and where it might be wasted
- Danish energy firm Vestforbrænding and advertising agency Anew created a pizzeria whose output depended on the amount of energy being saved by local residents. Consumers were first sent information on steps they could take to reduce energy usage, and energy consumption was then measured over a period of time. The less energy the consumers used, the more free pizzas were available at the pizzeria.
- San Diego Gas and Electric and Simple Energy launched the **San Diego Energy Challenge** in which consumers could compete against each other to reduce their energy consumption during the summer months, when air conditioners, pool pumps and other seasonal devices can put significant strain on the energy system.

### 3 THE ENCOMPASS ASSETS

The enCOMPASS project is building a platform supporting energy saving with a novel holistic approach that integrates user-centered visualisation of energy consumption data with context-aware collaborative recommendations for energy saving, intelligent control and adaptive gamified incentives enabling effective and sustained behavioural change.

To successfully exploit project outcomes, the main results and elements of the enCOMPASS platform with high exploitation potential have been identified and described as enCOMPASS Assets. In this respect, assets are individual elements of the enCOMPASS platform (or combinations thereof) with a specific exploitation potential; they can include software applications and components, as well as vertical applications and the platform as a whole.

In this initial version of the exploitation plan, we give an overview of the enCOMPASS assets, as identified at this stage of the project including the preliminary asset description and associated IPRs. The assets are project outcomes based on extending, customizing and integrating specific technologies and components into exploitable assets. Table 6 gives an overview of the initial list of enCOMPASS assets.

Table 5: Overview of enCOMPASS assets

Asset name	Short characterization	Main partner
Consumer portal for energy saving	Web-based platform with user engagement in energy saving integrating consumption visualization with gamification and behaviour change for utility customers, optimized for mobile and tablet U/I devices.	PMI
Energy consumption visualizer	Intuitive, user-friendly visualization of energy consumption empowering consumers to understand their energy consumption and its impact, and stimulating energy saving through visual metaphors and integration of behavioural change techniques	EIPCM
Gamification engine	Rule-based engine that maps actions into a variety of rewards and achievements and can provide a back-end service for various kinds of gamified apps	PMI
Adaptive gamification service	Engine for generating personalized gamified incentives based on user type and context	EIPCM
Board game for energy saving awareness	Cooperative board game promoting and stimulating energy saving	KAL
Disaggregation algorithms for electrical energy at medium/low sampling frequency	Algorithms which disaggregate smart metered energy consumption data by the type of end-use consumption	SUPSI
Algorithms for user profiling based on energy consumption behaviours	Algorithm which creates a typical profile of a user based on disaggregated energy consumption data and on physical and social characteristics of consumers and their dwellings	SUPSI
Models of energy consumption based on behavioural, structural and exogenous factors	Estimation of energy consumption for heating, based on the information on customer profiles, household characteristics and past behaviour	SUPSI
Efficiency exploration console	Advanced interface for exploring the impact of energy consumption reduction at different levels (household, building)	SHF
Occupancy detection and inference tool	Service implementing algorithms that can identify and inference human presence inside a building space based on data from various motion sensors	CERTH
Indoor climate detection and inference tool	Software tool estimating indoor comfort conditions based on the integration of sensor-generated and human-triggered input	CERTH

Human indoor activity detection tool	Software module fusing data from various sensors and system services to recognize the class of actions the user is performing	CERTH
User presence sensing	Mobile app for user presence and movement sensing	CERTH
User activity detection engine	Rule-based engine for analysing sensor and smartphone data to infer user activity levels	CERTH
Algorithms for recommending energy saving actions	Algorithms capturing usage patterns and recommending energy saving actions from sensor-generated and aggregated consumption data, and user context data	GRA
Smart home automation platform	Components and services for data fusion and processing from smart meters and home sensors, intelligent control of smart home devices	SHF
Smart meter and sensor data management component	Software component for acquiring and consolidating energy consumption and sensor monitoring data by utility companies	SMOB
Web services integration bundles	Components for integrating specialized applications and components together over a bus-like infrastructure	SMOB
Sensor data acquisition module	Components for acquisition of data from smart meters, home automation sensors and mobile apps	SHF
Environment sensor monitoring platform	A multi-sensor environment sensor monitoring platform with a wireless communication networking infrastructure, suitable for both smart home and outdoor applications,	PDX

### 3.1 CONSUMER PORTAL FOR ENERGY SAVING

#### 3.1.1 Asset description

The gamified consumer portal for energy saving is a web platform, optimized for mobile and tablet UIs, that presents the customer's bill in an interactive way allowing the user to get more information about their consumption and increases user engagement in energy saving by adding gamified element in the platform. In principle, the application can be considered applicable to any customer-facing web or mobile platform; for the sake of enCOMPASS, the asset description will be focused on the bill application of an energy utility or of a multi-utility company.

The core business drivers of the consumer portal are:

- Inducing a better relationship with the customers (high value of the driver: quest for legitimacy and reputation).
- Providing customers with easy and understandable access to their energy consumption data (smart meter data).
- Raising customers' individual and collective awareness of more sustainable energy consumption.
- Improving customers' behavioral patterns, such as energy consumption; (high value of the driver: economic sustainability).
- Acquiring and dispatching useful information for operations optimization, such as input about quality of service, household profile, behavioral patterns, and energy saving recommendations in stress periods; (high value of the driver: operational needs).

#### 3.1.2 Task producing the asset and IPRs

The consumer portal will be based on the gamification engine component of the enCOMPASS platform, which will be integrated as a back-end service.

The tasks relevant to its production are:

- Task 2.1 User-centered requirements specification and design of behavioral interventions
- Task 2.2 Platform design and specifications
- Task 3.1 Energy consumption and sensor data collection

- Task 4.1 Privacy-preserving user activity type profiling and matching
- Task 4.3 Collaborative recommender for energy saving
- Task 5.2 Energy consumption visualization and feedback

The core contributions to this asset will be shared among the consortium partners, the lead partner being PMI. IPRs will be settled among the exploiters and the contributing parties based on the actual final structure of the asset and its internal usage of the foreground produced by the Project, following the rules established in the Consortium Agreement.

### 3.1.3 Target customers and users

This sub-section offers a preliminary description of possible target customers and users for the Consumer portal.

Customer / user	Benefits
Energy Utility Customers	Obtain a one-stop application for managing all the interactions with the energy utility Obtain easy and understandable access to one's consumption data (smart meter data) Be rewarded for the interactions, virtually (leader board, badges), and materially (redeemable points) Receive feedback on one's behaviors in terms of energy consumption sustainability Optimize energy consumption, reduce bills without reducing quality of service and comfort level Improve one's status in the community as a "green" energy consumer
Energy Utility commercial and administrative personnel	Improve timeliness of bill settling by customers (e.g., by integration of online payment and rewarding of user's online activity, timeliness, etc.) Obtain commercially useful data
Energy Utility operations managers	Better understanding/forecast of energy demand and therefore improve operational efficiency Improve regulatory outputs Obtain data on quality of service
Energy Utility customer relations managers	Improve customer's awareness about energy consumption behaviors Establish a friendly interface to customers Improve the image of the company Differentiate image from competitors Exploit green values in the communication with the customers Exploit social sharing of achievements among customers to build a friendly corporate community
Energy Utility financial managers	Reduce operation and maintenance costs thanks to better demand management
Municipalities	Promote energy saving actions through integrating municipal incentive instruments in cooperation with the energy utilities into the platform

## 3.2 ENERGY CONSUMPTION VISUALIZER

### 3.2.1 Asset Description

The enCOMPASS energy consumption visualizer will provide an intuitive, user-friendly visualization of energy consumption that is easy to understand and that supports behavior change for energy saving. To achieve this, the consumption visualizer will employ visual metaphors that go beyond the commonly employed histograms and disaggregation pie charts, creating more effective means for user awareness and understanding of the impact of consumption, and stimulating the users to save energy. To this end the visualizer will employ visual metaphors that help to make abstract numerical data easily understandable for a wide range of users. Furthermore, the visualization will be linked to gamification elements and proven behavioral change techniques and support different types of users.

The enCOMPASS energy visualizer will be exploitable beyond the specific enCOMPASS pilots in other similar contexts in which energy consumption needs to be visualized and reduced through behavioral change (see 4.3.1.2). The visualizer will be realized in a modular way that allows it to be embedded in existing service offerings (e.g. pre-existing apps of utilities, or smart home automation providers), or offered as a separate service (e.g. public display in an office environment). The final decision on these modalities will be taken based on the assessment of the actual trial results and exploitation activities in the project.

### 3.2.2 Target Customer and Users

Customer/User	Benefits
Utilities	Utilities can offer their customers consumption visualizations as part of existing customer portals or mobile apps. The context-aware behavioral change techniques linked with the visualization (e.g. gamification) can support energy demand management (e.g. reducing consumption at peak hours), supporting the reduction of infrastructure investments. Furthermore, with increased competition on the energy market and electrical energy becoming a commodity, additional customer services are becoming a point of a competitive advantage for customer retention.
Consumers	Consumers can make use of the easy-to-understand visualizations to keep track of their consumption, and reduce their energy expenses, as well as contribute to global CO <sup>2</sup> reduction targets and more sustainable lifestyles (e.g. the LOHAS market segment).
Businesses and governmental organizations using office buildings	Providing insight into energy consumption behavior at the team level has proven to be successful in reducing energy consumption in an office environment. The enCOMPASS energy consumption visualizer that will have been tested in multiple real-world settings and three climatic zones, will have demonstrated how it can help to reduce yearly energy costs, as well as strengthens the environmentally aware image of the organization.
Smart home automation service providers	The consumption visualizer can be embedded with existing apps and web portals, offering the customers insight into their consumption. The goal-setting and gamification mechanisms increase engagement and usage of the apps, adding to the perceived added value of the service offered.
Pilot owners	The energy consumption data, combined with the usage data of the visualizer provides pilot owners insight into the potential of energy consumption visualizations to increase awareness and reduce energy consumption, facilitating long-term strategic planning (e.g. on solutions to reduce energy costs and CO <sup>2</sup> footprint for building owners, or decisions on service offering for utilities).
Academic community	Even though consumption visualizations have been used and tested in

	different settings, little is known about metaphor-based visualizations, about visualizations adapted to the energy context-of-use, and about the effect of combining visualizations with gamification and goal setting. Design and validation results provide valuable insights for the development of behavioral change solutions for energy saving.
--	--

### 3.2.3 Task Producing the Assets and IPRs

The energy consumption visualizer is developed in Task 5.2 Energy consumption visualization and feedback. EIPCM will hold the IPR to the developed visualizations. Exploitation will be based on licensing to third-parties, and based on non-commercial exploitation in academic research (e.g. new research projects).

## 3.3 GAMIFICATION ENGINE

### 3.3.1 Asset description

The gamification engine is a rule-based back-end engine that maps actions into a variety of rewards and achievements. It keeps track of user participation and controls whether the user has reach the predefined levels of progression to access novel items within the gamified application.

The engine handles the following gamification elements:

- Actions: are abstract occurrences that can be emitted by a variety of sources, such as building sensors (e.g. switching off an appliance, reaching a set temperature, saving a set amount of energy), and users (execution of a recommended action, in-game actions, manual data input, etc.).
- Points: a defined amount of point is award to the user by executing actions in the game, the amount of points for each action is configure by the utility manager.
- Badges: Badges are social recognition elements, that are award to users as they make progress in the energy saving activities and reach sustainable behaviors, badge can be group into thematic areas to emphasize them such as energy saving, engagement, profiling, etc.
- Goals: are weekly or monthly energy saving targets set automatically or manually by the users, by analyzing the consumption the engine award points if the target reduction was reached.
- Rewards: can be immaterial (scores, badges) or material (coupons, redeemable goods).

The engine has a plug-in architecture, and provides a configuration interfaces so that actions, achievements, rewards and rules can be customized without programming by the building or utility manager.

### 3.3.2 Task producing the asset and IPRs

The gamification engine is the core for the awareness applications and the whole platform, the relevant task to the engine is:

- Task 2.1 User-centered requirements specification and design of behavioral interventions
- Task 2.2 Platform design and specifications
- T 5.3 Adaptive gamification for behavior change
- T 5.4 Hybrid digital-physical energy games for behavior change
- T 6.2 Architectural design, data model, and reusable components
- T 6.3 Integration and customization

IPRs will be settled among the exploiters and the contributing parties based on the actual final structure of the asset and its internal usage of the foreground produced by the Project, following the rules established in the Consortium Agreement. The core contributors are PMI and its third party WebRatio.

### 3.3.3 Target customers and users

Customer / user	Benefits
Energy Utility Customers	Be rewarded for the interactions, virtually (leader board, badges), and materially (redeemable points) Receive feedback on one's behaviors in terms of energy consumption sustainability Optimize energy consumption, reduce bills without reducing quality of service and comfort level Improve one's status in the community as a "green" energy consumer
Energy Utility customer relations managers	Improve customer's awareness about energy consumption behaviors Establish a friendly interface to customers Improve the image of the company Differentiate image from competitors Exploit green values in the communication with the customers Exploit social sharing of achievements among customers to build a friendly corporate community
Municipalities	Promote energy saving actions through integrating municipal incentive instruments in cooperation with the energy utilities into the platform

## 3.4 ADAPTIVE GAMIFICATION SERVICE

### 3.4.1 Asset description

The adaptive gamification service in enCOMPASS is a further development of the adaptive gamification model that was developed in the context of a German national project in the health domain (Kolegea++) and on a rule-based engine that maps actions into achievements and assigns virtual or real-life rewards. The service is novel in that it provides context-dependent incentives that can trigger actions such as reading energy saving tips, inspecting consumption visualizations, or providing subjective energy awareness data. The incentives are context-dependent in the sense that the user's energy consumption and context information (e.g. awareness level, smart home sensor data), and previous interactions with the enCOMPASS applications are processed in order to deliver suitable incentives or triggers that are likely to draw user's attention to current energy consumption and concrete energy saving actions.

Such adaptive gamification services are not yet present in commercial services and offer opportunities for further commercial exploitation. When made available as a SaaS solution, a license-based or usage based payment model can be employed, while distributing revenues over partners involved.

### 3.4.2 Target Customer and Users

Customer/User	Benefits
Gamification solution providers	Adaptive gamification has the potential of sparking the user's interaction with the gamified services. The adaptive gamification service can be exploited in a range of behavioral change application scenarios, such as e-health apps (e.g. physical activity, smoking cessation support), sustainable mobility apps, or other resource conservation apps. The added-value of the adaptive gamification service is the ability to trigger the user at the right moment that increases the chance of the users adopting the desired behavior (e.g. (5)).



Utilities	The combination of the adaptive gamification service with the metaphor-based energy consumption visualizer provides utilities with novel features that help them better manage customer energy demand through behavior change. The adaptive alerts also provide a value-added service that can be marketed to customers in different application scenarios (e.g. reminders for optimizing energy costs or ensuring home safety). When combined with smart home solutions, new business-to-business (e.g. schools, public building users) or business-to-consumer (e.g. residential users) value propositions can be developed targeted at either existing utility customers, or as separate service offerings for new customers.
Consumers	The adaptive gamification service improves the user experience in that it reduces the obtrusiveness of the triggers delivered to stimulate behavioral change, without compromising the effectiveness of the application to help reduce energy consumption. Rather than requiring frequent interaction with the application, the context-aware service provides suitable triggers at the suitable moment to alert user awareness and motivate user action in a goal-directed way. This ensures customer satisfaction and increases the likeliness of their energy saving results.
Smart home automation service providers	As employing the adaptive gamification service is likely to yield an increased exposure to energy consumption feedback and energy tips, users are more likely to achieve energy reductions, which supports marketing efforts of smart home automation providers to prove the return on investment of smart home solutions to their customers, especially when this has been proven in the three enCOMPASS pilot settings and associated climatic zones.
Pilot owners	The adaptive gamification service yields an increased exposure to persuasive messages that will encourage saving energy. The pilot owners get evidence for the effectiveness of the enCOMPASS applications with the adaptive gamification service, supporting decisions on novel service offerings for their customers (utilities) or energy efficiency strategies with cost reductions (public building owners). As the adaptive gamification service is a relative novelty on the market, utilities in enCOMPASS can use the fun-to-use enCOMPASS gamified application in their marketing efforts to recruit new customers.
Academic community	Academically, the validation of adaptive gamification under real-world conditions in three pilot scenarios and three climatic zones helps to understand the role of context-aware triggers in attracting the attention of the users to behavioral change apps intended to save natural resources. The pilot results can result in follow-up proposals and research projects, to extend the knowledge to e.g. new application scenarios, building types, or different sources of context data.

### 3.4.3 Task Producing the Assets and IPRs

The tasks involved are:

- Task 5.3 Adaptive gamification for behavior change
- Task 4.2 Context-aware user and building modelling

IPR for the adaptive gamification service lies with EIPCM, for the rule-based gamification engine with WebRATIO (POLIMI 3rd party) and for the context model used by the adaptive gamification service with GRA. The exploitation for the individual components can be performed by corresponding partners holding the IPR, while for the exploitation of the integrated asset the IPR will be shared and defined in a multi-lateral exploitation agreement, following the rules established in the Consortium Agreement.

## 3.5 BOARD GAME FOR ENERGY SAVING AWARENESS

### 3.5.1 Asset Description

This asset represents the cooperative board game for promoting and stimulating energy saving. It will support the involvement of consumers and stakeholders to the project and will also grant strong support to the dissemination goals in the form of a boxed board game titled FUNERGY (FUN + ENERGY).

The game will be developed as a cooperative game, with players playing cards to reach different goals, in order to “climb” altogether up to the A+++ level of the “energy class”.

The game set will be composed of a deck of 60 high quality cards with custom graphics, the scoring tokens and the rule book. The deck will contain different type of cards showing different behaviors and tools each with an “energy value” from 1 (the best) to 9 (the worst). Some cards, showing the enCOMPASS logo are “wild”. They have a variable value depending on the answers to questions than can be accessed through an APP. A QR code on these cards will let the players connect to the gamification engine developed by PMI.

The scoring tokens are large cardboard circles of different diameter representing different level in the “Energy class”, from G (the lowest) to A+++ (the highest).

Each token has a different value representing the energy consumption and this value is also the goal of every game round. At the beginning of the game, the G token is placed in the middle of the table.

The players play their cards adding the energy level to a common total in order to reach exactly the limit indicated on the scoring token. When they reach the goal, they put a new token on top of the previous one creating, round after round, a sort of “pyramid” leading to the highest possible level. If they exceed the limit, they lose cards. If one player loses all the cards, the game is over. The objective of the game is to reach the highest possible level, altogether.

As the enCOMPASS cards are “wild”, they must be used in the right moment. These cards have a range of values that can be increased answering a question. The QR code printed on the card let the player access the questions through an APP that’s part of the gamification engine developed by PMI.

The board game will convey the idea that energy saving is something that must be achieved cooperating. There is no single winner in this game. Players always “win”, but they can learn how to play the cards in a more clever way to achieve a better result

The game also promotes the image of the project and can be used as a valuable dissemination tool.

### 3.5.2 Task producing the assets and IPRs

The core contributors to this asset will be Kaleidos Games (KAL) a board game publisher based in Milano (ITA).

The tasks relevant to its production are:

- Task 2.1 User-centered requirements specification and design of behavioral interventions
- Task 5.1 Behavioural determinants of energy consumption
- Task 5.3 Adaptive gamification for behaviour change
- Task 5.4 Hybrid digital-physical energy games for behaviour change

All the IPRs will be of Kaleidos Games (KAL) and usage rights should be transferred to third parties by licensing, e.g., for defining branded versions of the game or distribution in specific countries.

### 3.5.3 Target customers and users

Customer / User	Benefits
Energy Utility Customers	Have a playful experience for children, family and friends. Get useful information of sustainable energy behavior, tailored for both adults and kids. Be rewarded for the playing the game, virtually (leader board, badges), and materially (redeemable points).

Energy Utility customer relations managers	<p>Improve the image of the company</p> <p>Possible distribution of the game to customers.</p> <p>Differentiate image from competitors.</p> <p>Exploit green values in the communication with the customers.</p> <p>Exploit social sharing of achievements among customers to build a friendly corporate community.</p>
Municipalities	<p>Improve the municipality image and citizen relations by distributing the game as award for desired kind of energy saving behavior and actions</p> <p>Promote green values in communication with the citizens.</p> <p>Differentiate image from other municipalities, making the municipality more attractive for new citizens and/or green business.</p>

### 3.6 DISAGGREGATION ALGORITHMS FOR ELECTRICAL ENERGY AT MEDIUM/LOW SAMPLING FREQUENCY

#### 3.6.1 Asset description

These algorithms process energy consumption at the main meter and disaggregate it into end uses. Current algorithms require both signatures of individual appliances and high frequency measurements. The produced asset will operate at frequencies comparable with the available data (15 minutes) and with reduced information on the appliance signatures

#### 3.6.2 Target customer and users

Power utilities will be using the algorithms to understand better the customer behaviour. Individual customers will be using the algorithm output to learn about their potential for energy saving

Customer/User	Benefits
Power utilities	Power utilities will be using the algorithms to understand better the behaviour of their customers. This will enable the utilities to understand, for instance, if the installed base of washing machines (e.g.) is, on average, above or below the current standards for energy efficiency.
End users	End users can have access to the disaggregated data of their consumption to understand where the highest potential for energy savings resides.

#### 3.6.3 Task producing assets and IPR

Task 3.4 Disaggregation of energy use is the producer of this output and SUPSI is the main contributor, carrying the IPR.

### 3.7 ALGORITHMS FOR USER PROFILING BASED ON ENERGY CONSUMPTION BEHAVIOURS

#### 3.7.1 Asset description

Based on disaggregated energy consumption data and on physical and social characteristics of consumers and their dwellings, the algorithm creates a typical profile of a user, by means of clustering techniques.

### 3.7.2 Target customer and users

Customer/User	Benefits
Power utilities	Power utilities will be using the algorithms to understand better the stratification of their customer base in different cluster, This type of analysis also allows utilities to understand the impact of tariff changes.
Municipalities	Municipalities can use this information to understand what type of “consumption pattern” takes place in their buildings. Comparisons with other similar situations will be possible, providing indications for potential change and improvements.
School administration	As above

### 3.7.3 Task producing assets and IPR

Tasks 4.1 Privacy-preserving user activity type profiling and matching and 4.2 Context-aware user and building modelling produce this asset, the lead partner being SUPSI. The IPR will be shared among the consortium partners, following the rules established in the Consortium Agreement.

## 3.8 MODELS OF ENERGY CONSUMPTION BASED ON BEHAVIOURAL, STRUCTURAL AND EXOGENOUS FACTORS

### 3.8.1 Asset description

On the basis of the information on customer profiles, on household characteristics and on past behaviour the energy consumption for heating is estimated. The asset is used when no direct measurement of energy for heating can be obtained.

### 3.8.2 Target customer and users

Customer/User	Benefits
End users	End users can obtain rough estimates of their energy costs for heating even in absence of a metering infrastructure. The information will be nevertheless affected by a certain degree of uncertainty.
Municipalities	As above
School administration	As above

### 3.8.3 Task producing assets and IPR

Tasks 4.1 Privacy-preserving user activity type profiling and matching and 4.2 Context-aware user and building modelling produce this asset, the lead partner being SUPSI. The IPR will be shared among the consortium partners, following the rules established in the Consortium Agreement.

## 3.9 EFFICIENCY EXPLORATION CONSOLE

### 3.9.1 Asset description

This advanced interface explores the impact of energy consumption reduction at different levels whereby building managers and utilities can analyse the energy consumption and system effectiveness and set saving goals/incentives.

The efficiency exploration console will provide an overview on the actual “unused” potential of energy consumption reduction to the utility or building manager. To achieve this, the efficiency exploration

console will employ all findings from all components and subsystems implemented in the project, validate them and correlate them with the impact of consumption and the tradeoffs between comfort and sustainability. Furthermore, the efficiency exploration console will be linked to gamification elements and proven behavioral change techniques (e.g. goal-setting) and support different building types and user groups.

### 3.9.2 Target customer and users

Customer/User	Benefits
(Pilot owners)	Raise awareness to each utility and/or building manager about the potentials for improving energy efficiency. Create awareness on the business aspect of higher levels of energy efficiency.
Academic community	
Municipalities	
Smart home automation service providers	The efficiency exploration console can be introduced as an add-on for current home automation and home energy saving solutions. As an added-value service for helping utilities and business managers finding better ways of acquiring customers and occupants for all sorts of activities to improve energy efficiency.

### 3.9.3 Task producing assets and IPR

Task 6.3 is the producer of this output. SHF is the main contributor and carries the IPR. Contributions of other partners will be honoured appropriately, as part of multi-lateral exploitation.

## 3.10 OCCUPANCY DETECTION AND INFERENCE TOOL

### 3.10.1 Asset Description

Human presence and movement detection will be covered through this tool. The purpose of this service is to provide the algorithmic approach on human presence identification inside a building space. This information will be utilized later on by the activity tracking module. Presence detection would also help identify the best moments to push energy saving recommendations to the users for better energy management.

Data will be extracted from various infrared motion sensors so that they can be processed and translated to the actual occupancy inside a specific space. CERTH intends to build upon recently developed solutions (such as in the Adapt4EE and INERTIA projects) and extend them based on the enCOMPASS requirements.

### 3.10.2 Target Customer and Users

Customer/User	Benefits
Pilot owners	Raise awareness to each building occupant about their occupancy/presence patterns inside building spaces. Provide security to potential threats from intruders.
Academic community	
Municipalities	
Common citizens	
Healthcare sector entities	
Tourist industry (e.g. Hotels)	
Public transport entities (e.g. Airports)	

Exhibition centers	A particular interest exists in exhibition spaces for human occupancy and movement detection. Such tracking could be used for targeted marketed purposes (e.g. by evaluating which exhibit has the highest number of interested people etc.)
ESCOs	The occupancy tracking tool can be introduced in current home automation and home energy saving solutions as an added-value service for helping occupants understand their movement patterns inside an indoors environment. It could also be promoted as a tool that delivers higher levels of spaces' security.
Smart home automation service providers	

### 3.10.3 Task Producing the Assets and IPRs

The tasks relevant to the production of the occupancy detection and inference solution are:

- Task 3.1 Energy consumption and sensor data collection
- Task 3.2 Privacy-preserving presence sensing and activity detection

The core contributor to this asset will be CERTH. As such, IPRs will be of CERTH and usage rights will be transferred to third parties by licensing, wherever it seems appropriate.

## 3.11 INDOOR CLIMATE DETECTION AND INFERENCE TOOL

### 3.11.1 Asset Description

This software tool will be based on both sensor-generated and human-triggered input, in order to estimate the indoor comfort conditions. Exogenous data, such as meteorological conditions and endogenous variables, such as user's feedback, context and activity type inference will be used for this purpose. Evaluating the perceived comfort conditions inside building spaces will result in defining the optimal set points needed to be applied to climate control systems.

In order to realize this solution, data from environmental sensors (e.g. luminance, CO, CO<sub>2</sub>, humidity) will be fused with data coming from human feedback mechanisms through smartphones.

### 3.11.2 Target Customer and Users

Customer/User	Benefits
Pilot owners	Occupants will be encouraged to engage in air-quality improvement behaviors. Productivity is expected to increase. Also, healthcare needs are expected to decrease in working environments. Healthcare sector entities are expected to be particularly interested in such solution, as their building spaces are exposed to higher risks of air-based contamination.
Academic community	
Municipalities	
Common citizens	
Healthcare sector entities	
Tourist industry (e.g. Hotels)	
Public transport entities (e.g. Airports)	
Various retail entities (e.g. shops)	
ESCOs	Such businesses can provide a holistic solution that focuses on improving indoor climate conditions; by combining the tool with an intuitive smartphone-based user interface, users will have higher incentive in exploiting the benefits of the tool.
Smart home automation service providers/Home Energy Management Systems providers	

### 3.11.3 Task Producing the Assets and IPRs

The task relevant to the production of the indoor climate detection and inference solution is:

- Task 3.3 Indoor climate detection

The core contributor to this asset will be CERTH. As such, IPRs will be of CERTH and usage rights will be transferred to third parties by licensing, wherever it seems appropriate.

## 3.12 HUMAN INDOOR ACTIVITY DETECTION TOOL

### 3.12.1 Asset Description

Human indoor activity detection will be covered by this software module, which will be part of the final energy disaggregation module (SaaS), delivered in T3.4. The purpose of this tool would be to fuse data from various sources; at first, it will utilize the presence detection mechanisms discussed before (Presence tracking tool) in order to detect human occupancy/movement patterns. Then, it will correlate this information with data from smartphone sensors and energy-related data from smart meters, to enable the creation of user-specific presence and energy profiles in shared spaces. Surveys will be conducted on users' daily routines and will enable matching of delivered profiles with these activities, in order to identify which types of energy consuming or energy efficient actions are being performed by each user. As a result, the system will recognize the class of actions the user is performing (rest, work, cooking etc.).

Data preservation mechanisms will play an essential role in the Occupancy Detection & Inference Tool. Data coming from the various installed sensors, as well as energy usage data from smart meters would be stored and processed as anonymized information in order to comply with current EU data privacy legislation.

The implementation of the aforementioned software module will be achieved through a C++ back-end service which will hold the rule-based engine for sensor and smartphone data analysis and automated activity classification. One of the most common techniques that could be used in such problems is the Hidden Markov Models.

### 3.12.2 Target Customer and Users

Customer/User	Benefits
Pilot owners	Better understand the most energy intensive practices inside the building and how they are related to each specific user. Improve energy savings throughout the community/household premises. Promote green thinking and awareness in the members of community/entity. Particular interest could also exist in identifying activities that have implications on health and fitness of the occupants.
Academic community	
Municipalities	
Common citizens	
Healthcare sector entities	
Tourist industry (e.g. Hotels)	
Public transport entities (e.g. Airports)	Utilities are expected to be interested in services that can increase energy savings in their customers' premises.
Utilities	
ESCOs	Provide a solution that can be promoted as an energy-saving building automation product. Differentiate image from competitors, by providing a state-of-the art, user-oriented solution.
Smart home automation service providers/Home Energy Management Systems providers	

### 3.12.3 Task Producing the Assets and IPRs

The tasks relevant to the production of the human indoor activity detection solution are:

- Task 3.2 Privacy-preserving presence sensing and activity detection
- Task 4.1 Privacy-preserving user activity type profiling and matching

The core contributor to this asset will be CERTH. As such, IPR will be of CERTH and usage rights will be transferred to third parties by licensing, wherever it seems appropriate.

## 3.13 USER PRESENCE SENSING

### 3.13.1 Asset description

This mobile app will process all data on user presence and movement sensing. The purpose of this service is to support the algorithmic approach on human presence identification inside a building space. Presence detection and the data corresponding is necessary to help identify the best moments to push energy saving recommendations to the users for better energy management.

Data will be extracted from various infrared motion sensors so that they can be processed and translated to the actual occupancy inside a specific space and correlated with the energy consumption optimization algorithms.

### 3.13.2 Target customer and users

Customer/User	Benefits
Pilot owners	Raise awareness to each building occupant about their occupancy/presence patterns inside building spaces. Provide security to inhabitants in case of danger or crisis. Support rescue activities.  Support all activities of municipalities in correlation with improvement of energy efficiency.
Academic community	
Municipalities	
Common citizens	
Healthcare sector entities	
Tourist industry (e.g. Hotels)	
Smart home automation service providers	The user presence sensing tool can be introduced in current home automation and home energy saving solutions as an added-value service for helping occupants understand their movement patterns inside an indoors environment. It could also be promoted as a tool that delivers higher levels of spaces' security.

### 3.13.3 Task producing assets and IPR

Task 3.2 is the producer of this output. CERTH is the main contributor and carries the IPR. Contributions of other partners will be honoured appropriately, as part of multi-lateral exploitation agreements, following the rules established in the Consortium Agreement.



## 3.14 USER ACTIVITY DETECTION ENGINE

### 3.14.1 Asset description

This engine is rule-based and analyses sensor and smartphone data to infer user activity levels building on the user presence sensor and the sensor data acquisition module, both described above. The purpose of this engine is to utilize the presence detection mechanisms discussed before in order to detect human occupancy/movement patterns. Then, it will correlate this information with data from smartphone sensors and energy-related data from smart meters, to enable the creation of user-specific presence and energy profiles in shared spaces. Surveys will be conducted on users' daily routines and will enable matching of delivered profiles with these activities, in order to identify which types of energy consuming or energy efficient actions are being performed by each user. As a result, the system will recognize the class of actions the user is performing (rest, work, cooking etc.).

Data preservation mechanisms will play an essential role in the user activity detection engine. Data coming from the various installed sensors, as well as energy usage data from smart meters would be stored and processed as anonymized information in order to comply with current EU data privacy legislation.

### 3.14.2 Target customer and users

Customer/User	Benefits
Academic community	Provide data and information on each building occupant about occupancy/presence and behavioral patterns inside building spaces. Create data base on historic user patterns for long term validation and optimization purposes.
Municipalities	
Tourist industry (e.g. Hotels)	
Smart home automation service providers	The user activity detection engine can be introduced in current home automation and home energy saving solutions as an added-value service for helping utilities understand their customers movement patterns inside an indoors environment.

### 3.14.3 Task producing assets and IPR

Task 4.2 is the producer of this output. CERTH is the main contributor and carries the IPR. Contributions of other partners will be honoured appropriately, as part of multi-lateral exploitation.

## 3.15 ALGORITHMS FOR RECOMMENDING ENERGY SAVING ACTIONS

### 3.15.1 Asset Description

One of the energy saving use cases of the enCOMPASS project is to provide energy saving activity recommendations for end-users of the system. This requires the development of algorithms that are able to capture usage patterns from sensory and aggregated consumption data from the smart-metered institutions and/or homes, as well as contextual data, identify the usage patterns that are effective in terms of energy saving and provide recommendations in such cases when energy saving potential is identified. The purpose of the development of such algorithm(s) is to build in into home automation and energy saving solutions that can communicate with the end-users to provide them with energy saving recommendations,

or even to perform automatic energy saving actions without human intervention or confirmation for better energy management.

### 3.15.2 Target Customer and Users

Customer/User	Benefits
Pilot owners	Recommend energy saving activities to end users to help them in better energy management.
Academic community	
Municipalities	
Common citizens	
Healthcare sector entities	
Tourist industry (e.g. Hotels)	
Public transport entities (e.g. Airports)	
ESCOs	The developed algorithms for energy saving recommendations should be integrated into home automation and home energy saving solutions as an added-value service for helping end-users in better energy management.
Smart home automation service providers	

### 3.15.3 Task Producing the Assets and IPRs

The tasks relevant to the production of the development of energy saving recommendation algorithms are:

Task 4.2 Context-aware user and building modelling

Task 4.3 Collaborative recommender for energy saving

The core contributor to this asset will be Gravity R&D. As such, IPRs would be of Gravity R&D's and usage rights will be transferred to third parties by licensing, wherever it seems appropriate.

## 3.16 SMART HOME AUTOMATION PLATFORM

### 3.16.1 Asset description

This software tool will process both sensor-generated and human-triggered input, in order to automatically steer all hardware implemented to optimize the indoor energy consumption conditions. Deriving from smart meters and home sensors the data will be evaluated and processed through algorithms for intelligent control of smart home devices. Exogenous data, such as meteorological conditions and endogenous variables, such as user's feedback will be used for this purpose. Evaluating the perceived comfort conditions inside building spaces will result in defining the optimal set points needed to be applied to climate control systems.

In order to realize this solution, data from environmental sensors (e.g. luminance, CO, CO<sub>2</sub>, humidity) will be fused with data coming from energy consumption measuring sensors and human feedback mechanisms through smartphones.

### 3.16.2 Target customer and users

Customer/User	Benefits
Pilot owners	Raise awareness to each Flat/building occupant about their consumption patterns inside building
Academic community	

Municipalities	spaces in relation to their actual behavior.
Common citizens	The Smart Home automation platform can be introduced to other utilities to improve their overall energy performance.
Utility companies	
Smart home automation service providers	The Smart Home automation platform can be introduced in current home automation and home energy saving solutions as a powerful control center software.

### 3.16.3 Task producing assets and IPR

Task 6.3 is the producer of this output. SHF is the main contributor and carries the IPR. Contributions of other partners will be honoured based on level of contribution, as part of multi-lateral exploitation agreements.

## 3.17 SMART METER AND SENSOR DATA MANAGEMENT COMPONENT

### 3.17.1 Asset description

Acquiring and processing energy consumption and sensor monitoring data is a key action at the core of the enCOMPASS platform. Energy and sensor data processing is a repetitive task that can be launched on hourly, daily, weekly or monthly basis. However, a higher frequency of energy and sensor data acquisition and processing is a key factor in delivering accurate data for correct decision making and appropriate saving recommendations.

This is the reason to individuate the task of processing energy consumption and monitoring data as a reusable component in the architecture of the enCOMPASS platform. The Smart Meter and Sensor Data Management Component (SMSDMC) is a software component for acquiring and consolidating energy consumption and sensor monitoring data by utility companies.

The primary usage of the SMSDMC component is within the enCOMPASS platform, but there are no technical issues to reuse this component outside the platform.

### 3.17.2 Target customer and users

Customer/User	Benefits
Utility companies	Utility companies delivering electricity, gas or water can integrate the Smart Meter and Sensor Data Management Component (SMSDMC) into their data processing application stack. Based on the strength of Big data technology, this component will deliver fast and valuable data processing to utility companies that will be able to learn in real time about users energy consumption.
Property management service providers	Property management service providers can run SMSDMC as a standalone application, integrated or not into their IT infrastructure, as a fast data processing engine for computing energy consumption and sensor data from their managed locations. Further they can use the results for planning energy saving action or for real time recommendations to their tenants.
Schools, administrative and public buildings	Schools, administrative and public buildings administrators can run SMSDMC as a standalone application for computing and energy consumption and sensor data from their managed buildings in order to recommend short term

	energy saving actions and educate the personnel or the pupils on the long term.
Smart Home solution providers	Smart Home solution providers can add SMSDMC into their application stack in order to benefit from the Big data processing when deploying Smart Home solutions on large scale projects.

### 3.17.3 Task producing assets and IPR

The asset is produced by Tasks 6.3 Integration and customization and Task 6.4 Testing and quality assessment. SMOB is the partner producing this component and will carry the IPR and usage rights will be transferred to third parties by licensing, wherever it seems appropriate.

## 3.18 WEB SERVICES INTEGRATION BUNDLES

### 3.18.1 Asset description

A critical objective regarding the development of an integrated platform is assembling it from existing components and adapting the components to the enCOMPASS requirements. Integration Bundles of web services are assets resulting from composing the enCOMPASS platform starting from components delivered by software developing partners. The Web Services Integration Bundles (WSIB) are intended to run over an Enterprise Service Bus (a set of rules and principles for integrating specialized applications and components together over a bus-like infrastructure). Mainly an integration by-product, the integration bundles can be extended or adapted and therefore becoming a valuable asset for utility companies regarding further enCOMPASS platform extension.

### 3.18.2 Target customer and users

Customer/User	Benefits
Utility companies, Municipalities, Smart Home solution providers	Utility companies, municipalities and Smart Home solution providers can deploy Web Services Integration Bundles (WSIB) running on an Enterprise Service Bus server for integrating and orchestrating existing applications and services communication to the Smart Meter and Sensor Data Management Component. Furthermore, following specific software customizations WSIB component can be accommodated to integrate various applications running on the client IT infrastructure at web service level.

### 3.18.3 Task producing assets and IPR

The task that will produce the asset are Tasks 6.3 "Integration and customization" and Task 6.4 "Testing and quality assessment". The core contributor is SMOB.

## 3.19 SENSOR DATA ACQUISITION MODULE

### 3.19.1 Asset description

This component acquires data from smart meters, home automation sensors and mobile apps. It is the "heart piece" of any future energy data and efficiency optimization activity or system. All customer action concerning energy consumption monitored by any sensor will be covered through this tool. The purpose of this service is to provide the complete set of relevant data per flat or building in a harmonized way, to allow monitoring, judgement and other follow-up actions. This module would also help to identify the best moments to push energy saving recommendations to the users for better energy management.

Data will be extracted from various sensors so that they can be processed and translated to the actual consumption of energy inside a specific space.

### 3.19.2 Target customer and users

Customer/User	Benefits
Pilot owners	<p>Raise awareness to each Flat/building occupant about their consumption patterns inside building spaces.</p> <p>The data acquisition module can be introduced to other utilities</p>
Academic community	
Municipalities	
Common citizens	
Utility companies	
Tourist industry (e.g. Hotels)	
Smart home automation service providers	<p>The data acquisition module can be introduced in current home automation and home energy saving solutions as an added-value service for helping occupants understand their allover energy consumption patterns inside an indoors environment</p>

### 3.19.3 Task producing assets and IPR

Task 3.1 is the producer of this output. SHF is the main contributor and carries the IPR. Contributions of other partners will be honoured appropriately, as part of multi-lateral exploitation.

## 3.20 ENVIRONMENT SENSOR MONITORING PLATFORM

Assets resulting from enCOMPASS are expected to be those project outcomes which will extend and enrich PDX' roadmap and portfolio. Specifically, existing "PE IoT STONE Multisensor platform" PDX HW and SW products will leverage the project and originate new HW/SW or extended capabilities to match the enCOMPASS specific needs.

### 3.20.1 Asset Description

The "PE IoT STONE Multisensor platform" provides an Environment Sensor Monitoring platform, suitable for both smart home and outdoor applications, combined with a wireless communication networking infrastructure. The platform integrates PDX network technology with non-PDX sensors and provides a complete end-to-end solution, starting from the environment sensor nodes, passing through the wireless transport network and arriving to the data-collecting engine and database management.

It integrates two sub-systems:

- Network connectivity system: based on PE.STONE core network technology, providing wireless 6LoWPAN IPv6 MESH 433MHz, 868MHz and 915MHz Network connectivity
- Third party environmental sensors: Humidity, Pressure, Temperature, luminance, motion, etc.

As part of the enCOMPASS activities, the platform will be customized and/or extended to match the project specific needs for indoor use. The following is a list of assets which will result from enCOMPASS:

- **Indoor Smart Sensor Node**

The Indoor Smart Sensor Node is a battery powered wireless device allowing easy placement in any environment. It is housed in a plastic case wall mounting, to open for convenient battery replacement. It uses ultra-low power standby mode ensuring long time operation, and can also be powered by external wall power supply to support extraordinary high sampling frequencies.

The Node includes sensors measuring absolute pressure, relative humidity, temperature, luminance and presence/movement.

- PE Smart Gateway is a devices & network coordinator, and data concentrator. It manages all Smart Sensor Nodes. Although being already part of PDX portfolio, PE Smart Gateway features will be extended to include the management of PE Indoor Smart Sensor Nodes. It will synchronize them and collect data; it will route and forward back to Nodes any commands coming from the CMS.
- PE Smart CMS (Central Management System) is designed to be used via web and easily integrated into customer applications. It offers device management and equipment inventory functions, network management functions, alarm and notification management, and the possibility to set direct commands and scheduled activities. It will be upgraded to extend its capabilities to the management of PE Indoor Smart Sensor Nodes.

### **3.20.2 Target Customer and Users**

The PE IoT STONE Sensor Platform is a B2B solution. It is designed for utility companies, hardware manufacturers, system integrators or developers to design and develop their end user applications to complement their offer.

### **3.20.3 Task Producing the Assets and IPRs**

The core contributor and IPR owner is PDX. The main project tasks relevant to the production of the PE IoT STONE Sensor Platform are:

- T2.2 Platform design and specifications
- T 3.1 Energy consumption and sensor data collection
- T 3.3 Indoor climate detection
- T 4.4 Adaptive indoor climate control
- T 6.2 Architectural design, data model, and reusable components
- T 6.3 Integration and customization
- T 7.5 Pilot in the Swiss case study

## 4 PRELIMINARY INDIVIDUAL/JOINT EXPLOITATION PLANS

---

This section describes the preliminary individual exploitation plans of the enCOMPASS partners and outlines the initial approach to the joint exploitation. Even though the exploitation plans already contain concrete exploitation activities at this early stage, the plans will be iteratively refined and extended once the enCOMPASS assets take shape and are validated in real-world settings in the pilots. Furthermore, feedback from presentations to and interactions with potential customers will also inform the further development and revision of the initial exploitation plans. In accordance with the DoA, updates of the exploitation plans will be provided in *D8.4 Intermediate exploitation plan* and *D8.6 Final exploitation plan*.

### 4.1 PMI

PMI has extensive experience matured through its participation in community-empowered projects such as PHAROS, SmartH2O, and CUBRIK; PMI is also leading an urban innovation project (**Campus Sostenibile**), where the community of university students, researchers, start-ups, and teachers of the main Universities in Milan join forces to promote novel sustainability tools and practices<sup>2</sup>. PMI also currently hosts a grant from the ERC (COBHAM) on the topic of behavioural energy efficiency, which has strong synergies with enCOMPASS. enCOMPASS activities and results will be offered to such a large community for evaluation and uptake. PMI will participate in enCOMPASS to strengthen its position as one of the leading European institutions in the social media analysis and sustainability fields, with a special focus on the use of social networks and data for solving societal challenges such as environment protection, resource efficiency, and urban life improvement, as well as gamification, serious games, and crowdsourcing. At the scientific level, PMI will pursue the exploitation of the enCOMPASS results for the definition of an innovative methodology for the assessment of energy performances at different levels based on data obtained by social media and consumption monitoring.

**WebRatio (third-party of PMI)** creates solutions for corporate customers exploiting its expertise on Model-Driven Development, with utility sector being one of the four prime markets. WebRatio is the inventor of the OMG standard Interaction Flow Modeling Language (IFML) and OMG active member; it invests 25% of its turnover in R&D. WebRatio will exploit the results of enCOMPASS for expanding its reach in the **multi-utility market**, by monetizing novel services relying on the **gamification of the resource consumption**.

POLIMI is fully committed in exploiting some of the enCOMPASS assets in its ongoing and future activities:

- The **Sensor data acquisition module** will be generalized to multiple heterogeneous inputs and reused in research and technology transfer activities related to data stream processing, Internet of Things architectures, data fusion for natural resource management, and social network data mining for expert-based and community-based crowdsourcing. Activities and contacts in this direction are already ongoing in the PENNY H2020 project, where POLIMI is partner.
- The **Adaptive gamification module**, the **Consumer portal for energy saving** and the **Board game for energy saving awareness** will be generalized into a horizontal Gaming Framework, so to make it applicable to general purpose gamification projects. Specifically, POLIMI plans to use a generalized version in other utilities and public administration sectors besides energy (e.g., water, waste, transport). Both funded projects and projects with industrial customers will be approached with a demo purposely constructed to show the power of the gamification concept in animating the community of customers via educational games, achievements, challenges and redeemable points.

---

<sup>2</sup> <http://www.campus-sostenibile.polimi.it/>  
*enCOMPASS D 8.1 Early Exploitation and IPR Plan*  
Version 1.0

The development of **disaggregation algorithms** for the identification of the end-use patterns will be generalized into a fully-automated, non-intrusive software, which can be potentially used by other energy utilities as well as in other sectors, such as water or gas.

## 4.2 SUPSI

SUPSI will exploit the outcomes of enCOMPASS to integrate novel user profiling algorithms and social behavior models into advanced algorithms for decentralised smart grid management it has been developing for the past 5 years. It will also exploit the enCOMPASS platform in the development of methodologies for local energy plans in Canton Ticino and the rest of Switzerland, in collaboration with Swiss public administrations and utilities.

For SUPSI, the exploitable assets from the enCOMPASS projects include the **disaggregation algorithms** for electricity consumption, the **user profiling algorithms** based on energy consumption behaviour, and **energy consumption models** based on behavioural, structural, and exogenous factors. The produced assets will enrich SUPSI's portfolio and allow for the use of this knowledge to generate scientific publications in order to maintain and expand the scientific visibility of SUPSI in the area of Energy research.

Additionally, SUPSI seeks to initiate or join technology transfer projects, bringing aforementioned algorithms that were developed and validated in real-world contexts as part of the enCOMPASS project.

## 4.3 EIPCM

The results of the project will be exploited to strengthen EIPCM's position as an internationally recognized centre for applied research in the areas of participatory systems and citizen's behavioral change, gamification, user-centered design and knowledge visualization. The enCOMPASS platform will be exploited in research, teaching and technology transfer on participatory systems and gamification for sustainability and social innovation. The enCOMPASS solutions for stimulating behavioural change will be exploited within the energy saving domain and beyond (e.g. e-learning, e-health) as a novel way to engage users in persuasive systems.

EIPCM will, in collaboration with other partners, bring enCOMPASS results to follow-up H2020 project proposals, incorporating lessons learnt from the validation, and increasing technological readiness of the project's contributions and in particular from EIPCM's main assets:

- The **Energy visualizer** will be exploited to initiate and acquire new research projects for further development of the visualization methods and solutions for behavioural change in the field of energy efficiency. In particular, EIPCM will promote the Energy visualizer to utilities from its existing network, as an enabling service for the development of value-added services for their customers. Although as a non-profit organization EIPCM doesn't pursue commercial purposes, from such applied research projects would allow it to gather further data for scientific analysis from the usage of developed solutions in different real-world contexts. The obtained results and experiences from enCOMPASS validation activities will also be used to transfer the developed visualization to other domains (e.g. water, waste or food sustainability) as part of national, European and industry-funded research projects. The Energy visualizer will also be integrated into teaching activities of the EIPCM strategic cooperation partner University of Applied Sciences Stralsund.
- The **Adaptive gamification service** will be exploited on one hand to promote this to utilities from its existing network, as an enabling service for the development of value-added services for their customers (see above). On the other hand, EIPCM will pursue exploitation of this asset through the transfer of lessons learned on the effectiveness of the developed solutions into other application domains, where it has already been active previous projects (e.g. e-learning, e-health, social innovation).



EIPCM will also participate in the exploitation of the integrated enCOMPASS **Consumer portal for energy saving** and the **Board game for energy saving awareness** by using them as demonstration showcases for new projects and in teaching activities of EIPCM's members.

#### 4.4 CERTH/ITI

The main approach of CERTH/ITI to the exploitation strategy for enCOMPASS project results and advances will be based on a multi-scale approach with central axis the academia, research and industry. The Institute is also committed to reuse the developed algorithms in future R&D initiatives.

CERTH/ITI plans to participate in various spin-off commercial companies capable of exploiting its research. Being responsible for the collection and analysis of energy consumption and sensor data, as well as of human activity recognition within enCOMPASS project, CERTH/ITI plans directly after the end of the project to further develop and commercialize the results and experiences gained regarding these issues through aforementioned spin off companies. This concerns in particular CERTH's own assets, where CERTH will be the primary IPR owner: **Occupancy detection and inference tool, Indoor climate detection and inference tool, Human indoor activity detection tool, User presence sensing and teh User activity detection engine.**

CERTH/ITI will also communicate enCOMPASS in relevant events on national and European scale, by presentations in international scientific conferences, workshops and exhibitions, web based publishing and small seminars and talks organized for special audiences.

CERTH intends to promote the value proposition of the tools to the pilot users and entities (such as NGOs, Utilities, Cleanweb SMEs), having the goal to attract a large number of their customers to consider paying for them. Other channels to promote the developed tools could include online advertising, flyers, brochures developed within the project and social media campaigns. Licensing costs would be critical in these cases and should be considered according to the user (e.g. free for research purposes).

#### 4.5 SMOB

SMOB takes as a long-term objective to exploit the results of enCOMPASS project by: creating new software assets and new revenue streams from the enCOMPASS platform and specifically from the **Smart meter and sensor data management component**; improving the quality of the internal processes regarding both technology and project management; using the technical gaining for improving other ongoing projects therefore being able to further transfer the benefits to the local business ecosystem.

For its exploitation strategy, SMOB primarily targets utilities and municipalities. For utilities, the employed strategy is to demonstrate the value and ROI of incorporating **Smart meter and sensor data management component** and **Web services integration bundles** into existing their administrative portal. The strategy for municipalities involves the development of cooperative incentive models with utility companies, in order to induce energy saving actions by the inhabitants of the municipality.

#### 4.6 NHRF

Being responsible for the pilot library building in Athens, NHRF will support the development and validation of the enCOMPASS platform. NHRF will promote and extend the results of the pilot implementation to its internal environment and to the more than 100,000 yearly visitors of the building from the academic and professional community. It will raise energy consumption awareness in the broader governmental sector in Greece (Ministry of Education, General Secretariat for Research and Technology, regional authorities, local administrations) who are strongly motivated in reducing energy costs in public buildings, by demonstrating enCOMPASS results. NHRF will further provide toolkits and information to Small and Medium Enterprises

and Environmental Service Providers. enCOMPASS will be used as a pilot to be taken-up by SMEs, Trade and Professional Associations in the Energy Sector and Local Public Administrations. NHRF as a nationwide infrastructure may also be used as a cloud infrastructure provider for future expansion or local implementations of enCOMPASS in Greece. NHRF will communicate enCOMPASS in relevant events on national and European scale.

The role of EKT/NHRF in the business plan/exploitation of results will be supportive to the other partners, and more specifically:

- EKT/NHRF will support technology transfer activities through its active role in the Enterprise Europe Network, the largest Network for innovation and entrepreneurship in the world (>600 partner organizations in >60 countries). As coordinator of the Greek node (Enterprise Europe Network-Hellas), EKT/NHRF will:
  - Support partners in identifying markets that could be suitable for their technologies (based on market analysis, identification of competitors, mapping of interest through experts from diverse countries);
  - Bring the consortium partners in contact with potential users of their technologies (academic community, municipalities, healthcare sector entities, tourist industry public transport entities, exhibition centers, etc.) from other countries through well-established European networks;
  - Promote their profiles through the online matching platform of Enterprise Europe Network, as well as through focused Brokerage Events and Company Missions;
  - Promote the technologies through the specific Sector Groups of the Network (Intelligent Energy & Environment).
  - It should be noted that the Enterprise Europe Network supports approximately 2.500 Partnership Agreements (business, technology) per year (in Greece: approximately 120 PAs per year).
- In the case of establishment of spin-off, EKT/NHRF will support with guidance/signposting on national/regional schemes for incubation/acceleration; Opportunities for pilot commercial products will be also explored (Proof-of-Concept competitions; LIFE+ programme, etc.). EKT/NHRF has an extensive experience as National Contact Point for H2020 & COSME programmes, as well as Key Account Manager for approximately 15 SME Instrument beneficiaries.
- EKT/NHRF will bring the consortium partners in contact with diverse stakeholders that could greatly contribute to the exploitation strategy of the partners, e.g. the Hellenic Agency for Local Development and Local Government S.A. (potential users), as well as with investors (e.g. NBG Business Seeds).

## 4.7 SHF

SHF is Germany's leading municipal multi-utility provider in exploiting leading-edge technology for energy efficiency, responsible for the first administrative district in Germany fully equipped with smart metering. Being responsible for the pilot in Haßfurt, SHF will closely collaborate with the city of Haßfurt to develop and implement the integration of the enCOMPASS approaches and toolkits into the municipal vision on renewable energy production and energy efficiency and will actively advertise the enCOMPASS apps broadly to the citizens of Haßfurt. SHF will also disseminate the project results to its broad network and national associations and communicate enCOMPASS in relevant events on national and European scale.

All produced assets will enable SHF to create new business based on additional services for the customers besides the classic supplying business, including new tariffing models (e.g. load based, efficiency based or else) promoted through online and offline advertising, flyers, brochures developed within the project and social media campaigns. This includes in particular the **Smart home automation system** produced and marketed by SHF within enCOMPASS, and its integration with services of the **Consumer portal for energy saving**, such as the **Energy visualizer** and the **Adaptive gamification service**. The exploitation strategy will

be based on the use of the know-how generated in this project to maintain and expand the visibility of SHF in the area of “Energiewende” (Germany’s transition from nuclear and carbon energy production towards renewable energy sources).

Additionally, SHF will connect with other energy supplying companies, offering to provide these assets and services for use in their real world applications to secure their market position. Last but not least the outcomes of enCOMPASS will be exploited in technology transfer projects and future research projects.

Expected returns include:

- *Extended service offerings to private customers in Hassfurt*

Based on the enCOMPASS results and assets produced, SHF will create new versions of its Smart Home Starter Kits for consumption and optimization of energy, water and gas which customers can buy or rent or lease. Another approach could be “software as a service” where customers only pay for a periodic data use. In addition “rewarding” activities could become reality if customers achieve certain energy saving goals, they had agreed upon with the utility in the beginning.

- *Extended service offerings to business customers:*

SHF will create new versions of SmartBusiness/Facility Starter Kits which customers can buy or rent or lease. Another approach could be advanced contracting or “software as a service” where customers only pay for a periodic data use maybe combined with monitoring assistance.

Outside Haßfurt, SHF will create and sell/ rent/ lease systemic open-source solutions for and to other utilities (energy, water, gas) which could be either individual or white-labelled.

## 4.8 NABU

As the largest citizen environmental association in Germany. It will also use the enCOMPASS platform and the generated knowledge on stimulating behavior change to increase the impact of its on-going sustainability awareness campaigns and to increase the impact of its participation in energy and environmental policy-making processes in Germany. The main assets and results of the project will be exploited to strengthen NABU’s position as an internationally recognized environmental organization, which is exploring innovative ways for resource efficiency and sustainability.

Reflecting its role in the project, NABU will support the exploitation of specific enCOMPASS assets in its current and future activities:

- The **integrated enCOMPASS platform** will be exploited in future research projects and project proposals of NABU in collaboration with other partners. Furthermore, NABU will disseminate the asset by distributing information into its vast networks and communities (more than 620,000 members and sponsors and about 37,000 active volunteers) and showcasing the platform in relevant upcoming events as well as in NAJU events (NAJU is the Children & Youth Organization of NABU).
- The asset **Board game for energy saving awareness** will be distributed within NABU’s networks, partners (e.g. Birdlife) and members. For this purpose, we are planning to present the game and other related results of the project as potential tools for energy saving (**Consumer portal for energy saving, Energy visualizer**) at relevant upcoming events.
- NABU will promote the results and insights gained by enCOMPASS through its active engagement for energy policies and inform policy makers, environmental organizations, business partners and the wider public about the project findings in order to strengthen energy efficiency, renewable energy production, smart grids and collective awareness for sustainability issues among consumers.

NABU is engaged in different platforms and communities with other environmental organizations like WWF, Greenpeace and BUND, with a number of industrial associations and associations of the civil society like DGB, Mieterbund (tenants' association) and consumer protection organizations. NABU will also promote the results and insights in the German KOPERNIKUS-Projects.

NABU will actively support the exploitation activities of all consortium partners by increasing their reach through aforementioned channels and thus facilitating the consolidation of the project results after finishing the project.

## 4.9 SES

SES is a local multi-utility supplying electricity of the Sopracenerina region in Canton Ticino. It is currently exploring the market for multi-utility smart metering (electricity, water, gas). SES covers more than 70,000 customers with 88,000 metering points located in Canton Ticino, Switzerland.

SES will exploit enCOMPASS to develop innovative multi-metering solutions for the citizens. SES is the partner in charge of the Swiss pilot and will perform the validation of the impact on its own business and will consider commercial agreements with the technology providers for deploying the enCOMPASS **Consumer portal for energy saving** broadly to the citizens of Canton Ticino.

Smart metering enables SES to optimize periodic readings and to reduce the costs associated with meter readings in remote locations, which is typical in the network of SES customer. Indeed, in Canton Ticino, there are many small villages up in mountain valleys, which are rather hard to reach (travel intensive). The availability of a large (in relation to the user base) smart metering infrastructure for SES is an opportunity to generate a number of additional customer-oriented services, aimed at increasing the trust and friendliness of the customer relationships. Moreover, the previous SmartH2O project has already demonstrated that the smart metering infrastructure for electricity can be used to manage and transmit data related to other utilities, such as water and, in the near future, gas. One of the strategic pillar of SES is therefore to offer, in the future, services as a multi-utility company (electricity, water and gas).

Smart metering for electricity consumers has been long a priority for SES. As of now, SES has installed roughly 10,000 smart electricity meters for residential households, along with 4,000 for consumers with a high demand in energy (industries, businesses, etc.). Therefore, about 15% of all SES meters are "smart".

The utility has yet to offer specific services for smart-metering customers. enCOMPASS results will enable SES to develop and evaluate such specific services in pilot settings. SES is committed to offering the enCOMPASS **Consumer portal for energy saving** as a value added service to their customers after the end of the project.

## 4.10 KAL

KAL is a boardgame publisher and a game concept developer whose main activity concerns the production and distribution of games. KAL has already been involved in the development of gamification projects, like DROP (developed in FP7-project Smart H2O). enCOMPASS will permit KAL to produce a new game title for the innovative market of sustainability and serious games (the asset **Board game for energy saving awareness**). This will strengthen its position as an innovator player in the gaming market, addressing existing and novel customers, including editors of educational products. KAL will also explore novel business models through sales of "white label" game concepts to companies, e.g., utilities, who want to improve their customer relationships using loyalty programs and gamification and the development of hybrid traditional-digital games, to appeal the market of end-users and families with a mix of tradition and innovation.

The strategy is to demonstrate the value of the gamification approach, creating a strong engagement to the main goals of the enCOMPASS project in a fun way. enCOMPASS yields new business opportunities by licensing the board game concept, or by defining a partnership for cross-selling the board and digital games, as the has been designed to be 100% language independent, in order to be distributed virtually everywhere in Europe. Only the rules need to be translated in different languages. All the other components have a color or number code, that is totally language independent.

The following actions and strategies will be pursued by KAL for the segment-based exploration of potential users and customers:

- **Large urban utilities or small territorial utilities**  
The strategy is to demonstrate the value and ROI of the enCOMPASS holistic approach to customer's relationship, which embraces both gamification of the energy consumption monitoring and serious games for brand and customer relationship management. The presence of a board game, target to families, is a clear distinctive factor, which may be used in several ways by an utility: as a reward item redeemed by the users of the gamified platform after a given achievement, as a standalone customer loyalty tool, as a product in an ecommerce section of the customer portal, etc. Marketing actions include the building of a full-fledged edition of the board game and its field trial. Such an edition will be shown to utilities inside the project.
- **Digital game developers**  
The strategy towards digital game developers is the extension of their offer to the market of "cleanweb", "green" applications, through a clear differentiating factor: a physical game coordinated with their digital game. These companies could enter a new market by developing games that complement the enCOMPASS board game concept, for example branded for a specific utility company. This business opportunity can be pursued by licensing the board game concept, or by defining a partnership for cross-selling the board and digital games.
- **Municipalities**  
The strategy for this kind of actor involves communication and PR campaigns involving the distribution of the board game as a means of promotion of and/or reward for sustainable behavior and socially aware energy consumption. This can be integrated into existing communication activities of the municipality such as local municipal events and media campaigns. This opportunity can be pursued by licensing the board game concept or by defining a partnership with the game provider for the promotion of the board game.

#### 4.11 GRA

Gravity Research & Development Zrt. is a mid-size, highly innovative SME and recommender system technology provider with a horizontal product and customer portfolio across several application domains for online businesses (retail, auction, classifieds, travel, dating). Utilizing our recommendation technology on the new application domain of energy industry is a great potential for Gravity to extend its client base.

Since the arena of online recommender solution providers is quite dense, Gravity R&D is interested in finding new and undiscovered application domains for its technology. Through the enCOMPASS project, GRAV can raise awareness of relevant stakeholders to recommender systems in general and the synergy of those with utility companies, energy providers, in particular. As a result, additional turnover is expected, which will help Gravity to increase its market presence and overtake competitors. Finally, the project supports the recruitment of talented co-workers who can be retained after the completion of the project in the data mining/software development teams in the company.

Exploitation of the algorithms, as assets from the enCOMPASS project, can be performed in various ways. One of the options is to have strategic partnership with one or more smart home automation service provider companies, integration of the developed algorithms into their system and to commercialize it as standard or additional value-added feature of their services.

We are convinced that the developed algorithms will bring additional value to the end-users by saving on the energy costs, therefore it can also be a differentiating feature for smart home automation solution providers to integrate the developed algorithms into their system. The licensing model can be different, based on the agreement: it can be white-labelling or with the explicit indication of Gravity as license holder.

The large-scale validation set-up employed in enCOMPASS allows not only for optimization of the performance of the algorithms, but also to assess their added value. Once the added value of such recommendations is measured, the license cost can be calibrated accordingly. Also, establishing a spin-off company with such a smart home automation service provider could be also envisaged for the joint exploitation of the IPR.

#### 4.12 WVT

WVT is one of the largest independent providers of electric power in Greece. The company's business model is to provide the end customers with value added services in order to build solid and long term customer relationships. The company's business model strategy is based on providing energy saving tools and energy efficiency services increasing the total customer engagement coefficient. WATT+VOLT is going to implement and integrate the results of the enCOMPASS approach in order to expand its market share by increasing the customer engagement and providing more value added services to gain a competitive advantage.

Exploitation of the enCOMPASS engagement, energy saving and smart home tools (e.g. **Consumer portal for energy saving, Gamification engine, Energy visualizer**) as market products will be applied in different project stages as they become available. This will result in raising awareness on the company's existing customers, building demand side management revenues or gaining market share. Indirect exploitation will be achieved with marketing the tools at services level (PaaS or SaaS) within the existing WVT and ESCO's partnerships. Furthermore, combining the existing company's strategies with the enCOMPASS customer engagement toolset could be exploited in the near future serving the Gas Market end users.

The full available enCOMPASS platform could be formed in a structured product as "SaaS" or "PaaS" or white label product or Fully Customized that could be sold by WVT with a revenue sharing model for the involved partners to third parties worldwide, combining several pricing models (e.g. license based pricing, module based pricing, usage based pricing, effort based pricing). The ultimate strategy will depend on the results from the enCOMPASS pilots and the final joint exploitation plan.

#### 4.13 KTU

Kaunas University of Technology Social Responsibility Research Center is well known as active institution in the dissemination of ideas of social responsibility, developing responsibility for future entrepreneurs as society as a whole. The Centre will exploit and disseminate enCOMPASS results via its network of academic, public and governing institutions and communicate enCOMPASS in relevant national and European events.

The enCOMPASS assets will be used as background for preparation of scientific project's, project proposals, as well as further research in the area concerned. All the assets and results of the project will be exploited to strengthen KTU position as higher education institution and to develop School of Economics and Business as one of the internationally recognized excellence centres for research and studies.

The assets and results will be exploited in interdisciplinary studies and professional development of academic staff focused on the strength of the technological university. As strategy of School of Economics and Business is to become an interdisciplinary research-based institution with impact for business and society and to become a strong regional player meeting challenges of development of sustainable society.

Exploitation strategies that will be pursued by KTU include:

- Informing on innovative results and actions the academic society and target audience (persons from residential and public sectors)
- Engaging national organisations, institutions and individuals to feed in and get input from the project's findings
- Promoting findings and results in order to ensure that the effects will have a sustainability after the ending of the project.
- Maximizing the visibility of the project's outcomes in order to reach the largest size possible of informed end users and promote the project through several mean, such as websites and events focused on relevant subjects.

#### 4.14 PDX

Paradox Engineering intends to exploit the results of the enCOMPASS project by including its outcome in the Company's technology and product roadmap. The company will benefit from accelerated availability of new developments in line with its strategic and technology directions. Paradox Engineering's roadmap already includes developments in the directions of Smart Building and Home Area Networks. Paradox will propose the outcome of the enCOMPASS project to its existing customers in Switzerland and abroad, intending to perform an upselling action which will boost cities and customers' evolution towards increased sustainability. It will also help stakeholders and operators to reach higher end-user engagement as the way to reach increased energy efficiency and sustainability more effectively. Current customers and partners include cities, system integrators and utility companies in Switzerland, France, Italy, Germany, Spain and other countries in Europe; US; Middle East; Asia and Japan – locally and globally. The outcome of the project will also be part of the continuous exchange with Paradox Engineering's shareholder, Minebea Group Co. In its position of Internet of Things and connected technologies advisor and main designer for Minebea Group, Paradox will foster the adoption and incorporation of the enCOMPASS outcome in a number of technology projects in Minebea with its global impact.

Assets resulting from enCOMPASS are expected to be those project outcomes which will extend and enrich PDX' roadmap and portfolio. In particular, the identified Environment sensor monitoring platform, based on existing "PE IoT STONE Multisensor platform" will leverage the project and originate new HW/SW and extended capabilities that will allow PDX to gain competitive advantage on the market.

The indoor smart sensor node component starts from PDX's existing IoT STONE Multisensor Platform, which addresses both outdoor and indoor applications, and will be customized and extended to match the enCOMPASS project specific needs for indoor use and specifically for battery powered indoor use. The resulting node will be part to the PDX portfolio and, together with the PE Smart Gateway and PE Smart CMS, it will be offered either as pure smart home solution (thus extending PDX' range of solutions to home applications as well) or integrated with the PE Smart Urban Network and its multiple smart applications, and leveraging on its network infrastructure, strengthening the perception of PDX as a smart building and home area networks solution provider among their customers.

#### 4.15 JOINT EXPLOITATION PLAN

The integrated enCOMPASS platform will be marketed primarily based on two models: platform-as-a-service (PaaS) and software-as-a-service (SaaS). Three alternative scenarios are foreseen:

1. Deployment as a whole in a SaaS model (incl. all or a selected set of services and end-user applications)
2. Deployment as a basic infrastructure for enabling development of new or customized applications for other domains(PaaS)
3. Deployment of only a set of individual services and applications (SaaS). A license-based revenue model will be employed, based on the actual usage of the platform and the selected modules or services.

A license-based revenue model will be employed, based on the actual usage of the platform and the selected modules or services. Both project partners and third-party clients can flexibly configure enCOMPASS services and offer them as white-label / OEM solutions to their customers. Revenues are generated from such licensing model, with fees depending on usage and on chosen services. For those modules that are related to a specific partner's service offerings, license contributions will be paid to the module owner based on usage metrics or via a shared revenues model.

The details of such joint exploitation of the integrated enCOMPASS platform will be assessed based on the individual exploitation plans, when the first results of the enCOMPASS trials are available. They will be reported in the final exploitation plan, when all the exploitation potential and business factors of enCOMPASS have been examined in depth.

Furthermore, beyond the joint exploitation of the integrated enCOMPASS platform, also multi-lateral joint exploitation of individual assets by a smaller number of contributing partners (e.g. for specific components, algorithms or modules involving only a few partners) is foreseen, as already outlined in the definitions of the IPR for the individual assets. Details will be reported in the intermediate and final exploitation plan, as the list of exploitable assets is updated and refined. Such flexibility in the different forms of joint exploitation is enabled by the chosen asset-based exploitation approach that allows versatile exploitation modalities: the exploitation of both individual assets as well as compositions of assets can be targeted for specific customer groups in addition to the platform as a whole. Such a strategy is also especially suited for European projects with multiple partners with different degrees of integration of their contributions in specific elements of the platform. Beyond the joint exploitation of the platform as a whole by the consortium, it allows for flexible arrangements of multilateral cooperation (and IPR regulations) between partners in the exploitation of individual assets that are most related to their exploitation interests.



## REFERENCES

---

- [1] [http://ec.europa.eu/eurostat/statistics-explained/index.php/Consumption\\_of\\_energy#End-users](http://ec.europa.eu/eurostat/statistics-explained/index.php/Consumption_of_energy#End-users)
- [2] <https://www.wec-indicators.enerdata.eu/household-electricity-use.html#/electricity-use-per-capita.html>
- [3] <https://www.wec-indicators.enerdata.eu/household-electricity-use.html>
- [4] [http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity\\_price\\_statistics#Electricity\\_household\\_consumers](http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics#Electricity_household_consumers)
- [5] <https://www.strompreis.elcom.admin.ch/PriceDetail.aspx?placeNumber=5113&OpID=712&Period=2017&CatID=4>
- [6] "Redefine Gamification to Understand Its Opportunities and Limitations", Gartner Report, April 2014.
- [7] "Gamification Opportunities for Utilities and Corporate Sustainability", Gartner Report, November 2012.
- [8] "Understand How and Why to Use Gamification for Certain Government Activities", Gartner Report, February 2014.
- [9] "Business Model Games: Driving Business Model Innovation With Gamification" Gartner Report, Jan 2013.
- [10] "Gamification in 2012: Market Update - Consumer and Enterprise Market Trends", Wanda Meloni, Wolfgang Gruener, publish by: M2 Research
- [11] "The Future of Gamification, Anna Anderson and Lee Rainie", <http://www.pewinternet.org/2012/05/18/the-future-of-gamification/>
- [12] "Can Gamification Boost Digital Bill Pay? Peter Wannemacher", August 19, 2014, [http://blogs.forrester.com/peter\\_wannemacher/14-04-28-2014\\_north\\_american\\_digital\\_banking\\_trends\\_forresters\\_take\\_on\\_whats\\_happening\\_and\\_what\\_strateg\\_0](http://blogs.forrester.com/peter_wannemacher/14-04-28-2014_north_american_digital_banking_trends_forresters_take_on_whats_happening_and_what_strateg_0)
- [13] "Gamification: Green tech makes energy use a game—and we all win, by Rob Pegoraro Feb 29 2012, <http://arstechnica.com/features/2012/02/gamificationgreen-tech-makes-energy-use-a-gameand-we-all-win/>
- [14] "Gamification Market [(Consumer Gamification, Enterprise Gamification) by Deployment (On-Premise, On-Demand); Application (Marketing, Sales, Hr, Support, and Development); Size (SMB, Enterprise)
- [15] "Gamification market [Gamification market by solution (consumer driven and enterprise driven), applications (sales and marketing), deployment type (On-Premises and cloud), user type (large enterprise, SMBs), industry and region - global forecast to 2020
- [16] "Gamification Industry Report 2015 [Enterprise-Grade Gamification, Engagement, Behavior Modification Platform Evaluation, Comparison, and Ranking
- [17] "Playing to Win: Mobile Gamification Done right, Author: Brandon Workman, Publish Date: July 2013. From: Business Insider <http://intelligente.businessinsider.com>
- [18] "The 2016-2021 Global Game-based Learning Market. Author: Sam S. Adkins. Published: July 2016. From: Ambient Insight <http://www.ambientinsight.com>
- [19] "The 2014-2019 Global Edugame Market. Author: Sam S. Adkins. Published: July 2015. From: Ambient Insight <http://www.ambientinsight.com>
- [20] <http://venturebeat.com/2013/08/16/with-a-mobile-boom-learning-games-area-1-5b-market-headed-toward-2-3b-by-2017-exclusive/>
- [21] <http://gsvadvisors.com/wordpress/wp-content/uploads/2012/04/GSV-EDUFactbook-Apr-13-2012.pdf>
- [22] "Djaouti, Damien, et al. "Origins of serious games." Serious games and edutainment applications. Springer London, 2011. 25-43.
- [23] "Fogg, B. J. (2009). A behavior model for persuasive design. In Proceedings of the 4th International Conference on Persuasive Technology" - Persuasive '09 (p. 1). Claremont, California, USA: ACM. <https://doi.org/10.1145/1541948.154199>
- [24] <http://www.bfe.admin.ch/energiestrategie2050/index.html?lang=en>
- [25] "Gartner's 2014 Hype Cycle for Emerging Technologies Maps the Journey to Digital Business", Garner Press Release, Aug. 2014. <http://www.gartner.com/newsroom/id/2819918>