A Gaming and Social Networking Platform for Evolving Energy Markets' Operation and Educating Virtual Energy Communities

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Final version of business modeling, dissemination and exploitation of results

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Glossary of Acronyms

Acronym	Definition
API	Application Programming Interface
AUW	Aggregated Users' Welfare
BMC	Business Model Canvas
BMS	Building Management System
BO	Business Opportunity
CAPEX	Capital Expenditure
CBE	Competence Based Education
CBSM	Community Based Social Marketing
C&I	Commercial & Industrial
CRM	Customer Relationship Management
CS	Charging Station
DMP	Data Management Plan
DR	Demand Response
DoA	Description of Action
DSM	Demand Side Management
DSO/TSO	Distribution/Transmission System Operator
EC	Energy Community
ECC	Energy Consumption Curve
ECC	Exploitation Coordination Committee
ECFA	Energy Community Formation Algorithm
EC-RTP	Energy Community Real Time Pricing
EDAM	Energy Data Asset Marketplace
EE	Energy Efficiency
EIDaaS	Energy Information Distribution as a Service
EMS	Energy Management System
EP	Energy Program
ESCO	Energy Services Company
ESP	Energy Services Provider
ESS	Energy Storage System
EV	Electric Vehicle
FRTP	Flexibility Real Time Pricing
GDPR	General Data Protection Regulation
GSMaaS	Gamified Social Marketing as a Service
GSRN	Green Social Response Network
HetFlex	Heterogeneous Flexibility
InEC	Innovation & Exploitation Committee
ICT	Information and Communications Technology
ILP	Individual Learning Plan
IPR	Intellectual Property Rights
KPI	Key Performance Indicator
LCMS	Learning Content Management System

LO	Learning Object
MPEC	Mathematical Programming with Equilibrium Constraints
M&V	Measurement & Verification
NGO	Non-Governmental Organization
NPC	Non Player Character
OPEX	Operational Expenditure
ORDP	Open Research Data Pilot
OSN	Online Social Network
P&L	Profit & Loss
P-RTP	Personalized Real Time Pricing
P2P	Peer-to-Peer
QoS	Quality of Service
QoE	Quality of Experience
RAT	Research Algorithms Toolkit
RABIT	Research Algorithms and Business Intelligence Tool
R&I	Research and Innovation
ROI	Return On Investment
S/W	Software
SaaS	Software as a Service
ToU	Time of Use
VA	Virtual Association
VEC	Virtual Energy Community
VPC	Value Proposition Canvas

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Document History

This deliverable includes the final version of SOCIALENERGY's business modeling and innovative value propositions based on the initial market analysis described in D6.1 (M6) and the intermediate version of business modeling work, which has been reported in D6.2 (M15). It also includes the final version of the dissemination and exploitation-related achievements of the consortium. Finally, a clear roadmap towards H2020 objectives and beyond accompanied with SOCIALENERGY's lessons learned are also included.

Table 1: Document History Summary

Revision Month	File version	Summary of Changes
22/02/2019	v0.1	Draft ToC circulated to the entire consortium and comments have been discussed during the 6th plenary meeting in Athens.
12/04/2019	v0.2	Final ToC version and task delegations' plan has been agreed among all partners.
24/05/2019	v0.5	ICCS and INTELEN provide the 1st round of contributions regarding the Business Model Canvas and the Value Proposition Canvases.
14/06/2019	v0.7	ICCS and INTELEN provide the 2nd round of contributions regarding the quantifiable economic figures towards SOCIALENERGY value propositions' commercialization. NRG and SU-NIS provide their contributions regarding their dissemination and exploitation activities.
21/06/2019	v0.8	INTELEN compiles the pre-final version for internal review integrating inputs and comments for enhancements from all partners.
26/06/2019	v0.9	ICCS and NRG reviewed the deliverable and provided comments for enhancements to INTELEN.
02/07/2019	Final	INTELEN addressed the final amendments and forwarded to the Coordinator for submission in ECAS portal.

Executive Summary

SOCIALENERGY is a European innovation (I) project (https://socialenergy-project.eu/) aiming to facilitate the easy, rich and deep communication among the energy sector stakeholders and residential energy consumers that will allow them to: i) discover each other and their needs, ii) educate themselves towards a better understanding of the difficulties and the challenges that each one faces and iii) finally, interact and trade with each other especially in the form of innovative demand response energy programs and other innovative digital user engagement services. SOCIALENERGY is a multi-disciplinary S/W platform operated by an electric utility company or energy service provider (ESP) in the retail electricity market to accurately inform and effectively educate end users on energy efficiency in a user-friendly way. The concept of online social networks is exploited through the development of the Green Social Response Network (GSRN) concept, combined with behavioral economics models (such as peer pressure). These lead to the creation, dynamic adaptation and management of virtual energy communities (VECs) that aim to trigger very effectively behavioral changes towards energy efficiency. The self-evolving SOCIALENERGY game integrates several mathematical models and algorithms towards energy efficiency and education of users. An innovative hybrid demand response (DR) strategy is developed, which combines incentive-based and price-based DR through the use of advanced user engagement technologies and exploitation of financial incentives. Finally, a competence based educational (CBE) framework is introduced aiming to create the best 'individual learning plan' (ILP) for each individual SOCIALENERGY user and subsequently guide him/her through the whole online learning and user engagement process.

The main business goal of SOCIALENERGY S/W platform is to offer the required S/W infrastructure substrate for an electric utility/retailer/ESP to adopt any combination of state-of the-art behavior change programs according to its targeted business needs. As a result, electric utility companies will be able to easily adopt technology-driven innovations to create new revenue streams and be sustainably competitive in the liberalized electricity markets' context.

The SOCIALENERGY architecture is *"modular by design"* in order for all its software subsystems (i.e. GSRN deployed by INTELEN, GAME deployed by NRG, RAT deployed by ICCS and LCMS deployed by SU-NIS) to be potentially exploitable as stand-alone commercial products in the future. The technical APIs for the interaction between the various subsystems have been appropriately designed in a way that any possible combinations of SOCIALENERGY subsystems to be commercially exploitable in the future (e.g. GSRN with RAT as one single product, GAME with RAT as another one, GSRN-GAME as another one, GSRN-RAT-LCMS as another one, etc.). This strategic decision at the design phase provides the flexibility to the consortium to decide how to prioritize its dissemination, communication and further exploitation activities towards commercialization. Of course, all the pre-mentioned SOCIALENERGY subsystems have already been integrated in one single S/W platform in the context of WP5 work (cf. D5.3, which includes an end user manual for the platform's 'beta' version, which was released in March 2019). This way, the SOCIALENERGY product and associated services are expected to be competitive enough in order to enter the liberalized ICT/energy market and be sustainable as a product from a business perspective.

This report elaborates on the findings of:

- D6.2 (released in M15), which was the intermediate version of business modelling work.
- D3.2 and D4.3 (both released in M24), which included the final version of SOCIALENERGY's real and virtual world functionalities respectively.
- D5.3 (released in M27), which included the final version of S/W integration and validation activities (i.e. 'beta' version of SOCIALENERGY S/W platform as a whole).

In section 1, an overview of the SOCIALENERGY's business plan and summary of the consortium-level decisions made so far is provided. In particular, we describe the motivation behind SOCIALENERGY's business modelling, how the technical objectives and the S/W architecture components are mapped with business goals and finally, we summarize the technical achievements so far and the next steps that need to take place towards commercialization.

In section 2, we provide a very detailed business plan including the cost structure and revenue stream projections for the SOCIALENERGY S/W platform exploitation as a whole. Furthermore, we analyse the four (4) short-listed value propositions that we believe that are closer to commercialization phase according to several feedback information and consultation received by business experts and communication activities with the targeted customer segment (i.e. electric utility companies and electricity retailers). For each one of these 4 value propositions (or else business cases), quantified economic figures are provided (i.e. cost structure and revenue stream projections) together with comments and discussions about the "pros and cons" of each business case.

Sections 3 and 4 provide a detailed list of SOCIALENERGY's dissemination, communication and exploitation activities and respective achievements that took place during the entire project's lifetime. All these activities are classified in several categories and short summary of each activity is provided.

Finally, section 5 summarizes all SOCIALENERGY Research and Innovation (R&I) insights and describes a roadmap towards beyond H2020 objectives. The final outcome of this process concludes to a short list of recommendations proposed by SOCIALENERGY consortium to the European Commission based on the R&I findings and lessons learned within the SOCIALENERGY project's lifetime.

1. Overview of SOCIALENERGY's business plan and summary of the decisions made so far

1.1. Motivation behind the SOCIALENERGY's business modeling

In Figure 1, the general idea of the proposed "Green Social Response Network" (GSRN) concept that SOCIALENERGY S/W platform introduces, is illustrated. There are three main gamification steps: 1) gamify the user engagement in Demand Response (DR) and energy efficiency programs, 2) gamify the process (e.g. Virtual Energy Community - VEC management, Energy Program - EP selection, etc.), and 3) gamify the results and feed them back to step (1). As depicted in the following figure, there is a perpetual information and knowledge flow among the 3 gamification steps in a way that all types of users (i.e., individual energy consumers, VEC leaders, electric utilities, ESCOs) are continuously educated towards understanding their role in the smart grid market/ecosystem and the needs/interests of all other related market stakeholders in a liberalized electricity market context. The proposed GSRN is called *"Green"*, because it facilitates and enables the use of clean energy and good practices on energy efficiency focusing on the residential sector. It is also called *"Social"*, because its users are able to participate in Virtual Energy Communities (VECs) and communicate with other peers who have the same interests, or even communicate with other commercial stakeholders to better understand their needs/interests. Finally, GSRN is called *"Response Network"*, because it enables/facilitates efficient DR procedures to take place and motivates the individual energy consumers to change their behaviour in terms of the way they consume energy in their everyday lives. The result of this process will ultimately lead to environment-friendly use of energy resources, the efficient operation of liberalized electricity markets and the realization of new businesses and revenue streams from both new and existing smart grid market stakeholders.

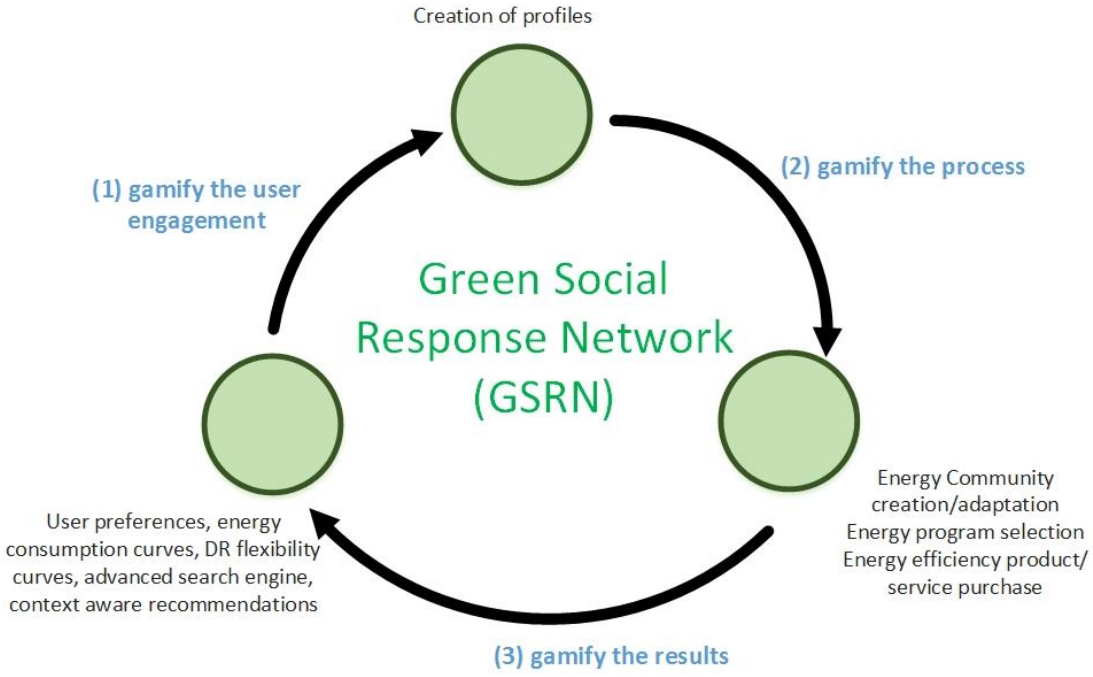

Figure 1: Green Social Response Network (GSRN) concept

According to several recent surveys undertaken by independent world-known consultancy companies and policy makers (see more details in [1]), the high-level business strategy objectives of a progressive utility (or else Energy Service Provider - ESP) are summarized in Table 2 and each one of them is directly mapped to one of the five main SOCIALENERGY subsystems. In the next sub-section, all SOCIALENERGY subsystems are described together with their main functionalities and innovation points.

Table 2: Mapping of ESP's Business Objectives with SOCIALENERGY Subsystems [1]

ESP's Business Objectives	Expected outcome	SOCIALENERGY subsystem
Build and strengthen a strong core of digital trust with clientele	Maximize customer satisfaction, minimize churn rate, cope with high competition in the market.	Core GSRN platform
Move from services to experiences via a cohesive personalization strategy	Customers are better and more efficiently engaged, because they deeply comprehend the services that are being offered by the ESP.	GAME, LCMS
Personalize at scale via the use of advanced research algorithms; adopt a hybrid strategy (i.e. blend of automated & manual processes)	Adopt automated processes (sophisticated algorithms) to quickly scale up personalized services. Adopt manual processes to get feedback from the customer, involve him/her in the process and ultimately upgrade automated processes.	RAT
Exploit the deep insight into energy use consumption to engage customers on cross-sell options that fit their needs	New revenue streams via collaborations with stakeholders from sectors other than/not directly related with energy.	Virtual Marketplace/ EIDaaS
Use rapid prototyping (i.e. modular and customizable S/W platform)	Cope with various various, diverse, volatile and dynamically changing needs of the liberalized energy market and customer segmentation.	APIs among all subsystems (modularity-by-design approach)

1.2. Summary of SOCIALENERGY system architecture design and technical objectives

SOCIALENERGY is a holistic S/W infrastructure to be used by today's progressive electric utilities (or else Energy Service Providers - ESPs) towards the realization of their first steps in the digitization era of retail electricity markets. The main objective of SOCIALENERGY is to develop, validate and demonstrate a gaming and social network platform for educating energy consumers and virtual energy communities towards evolving EU energy markets' operation. In SOCIALENERGY's virtual world, users are seamlessly educated via advanced gaming techniques in good practices and decision making related with energy efficiency. Subsequently, users are able to interact in SOCIALENERGY's "real-world" platform, which will facilitate the easy, rich and deep communication among involved stakeholders from individual energy consumers and virtual energy communities, to utilities, policy makers, and even other indirect stakeholders (such as electric appliance retailers and building renovators) that will allow them to: i) discover each other, ii) educate themselves in order understand the

difficulties and challenges that each one faces and iii) finally interact and trade among.

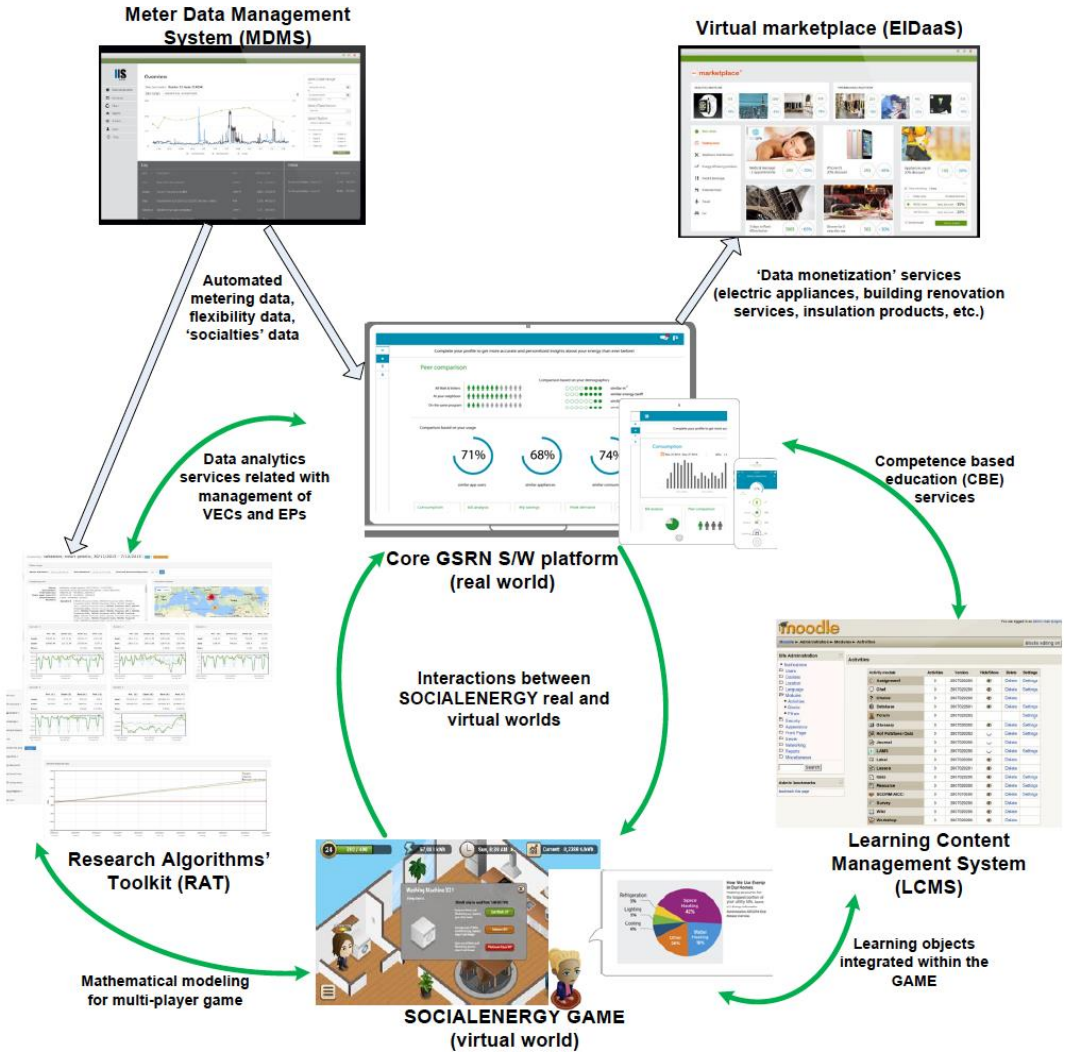

Figure 2: SOCIALENERGY S/W platform architecture [2]

Conclusively, a holistic S/W infrastructure together with a multi-disciplinary business model is required in order to cope with all the afore-mentioned challenges. Therefore, we propose the SOCIALENERGY S/W platform, which consists of several systems and S/W modules from various disciplines, including the ICT, energy efficiency, behavioral economics, socio-economic sciences, online social networks, competence-based education, serious games and gamification sectors. The major contribution points of the proposed SOCIALENERGY framework can be summarized as follows:

- A **multi-disciplinary S/W platform is proposed in order to accurately inform and effectively educate end users on energy efficiency in a user-friendly way**.
- An **innovative hybrid demand response (DR) strategy** is developed (towards EPs that offer effective Demand Side Management), which combines incentive-based and price-based DR through the use of advanced user engagement technologies and exploitation of financial incentives.
- The concept of **online social networks is exploited through the development of the Green Social Response Network (GSRN) concept, combined with behavioral economics models (such as peer pressure)**. These lead to the creation, dynamic adaptation and

management of virtual energy communities (VECs) that trigger very effectively behavioral changes towards energy efficiency.

- The **self-evolving SOCIALENERGY game** integrates all the aforementioned mathematical models and algorithms towards energy efficiency. This allows the emulation of a real residential home capable to: i) educate empirically end users in a very effective way and ii) offer a "virtual" pilot for experimentation purposes in order to accelerate development of effective energy efficiency services.
- A **competence based educational (CBE) framework** is introduced aiming to create the best 'individual learning plan' (ILP) for each individual SOCIALENERGY user and subsequently guide him/her through the whole online learning and user engagement process.

Based on state-of-the-art, there is a plethora of behaviour change programs implemented by progressive electric utilities, which can be classified in three major categories: 1) *information-based*, 2) *social interaction-based*, and 3) *education-based* (see more details in [1] and [2]).

Nowadays, an electric utility company may select to adopt one or more behavior change programs, but it does so in an ad-hoc manner. The SOCIALENERGY vision is to offer the required S/W infrastructure substrate for an electric utility company (or else Energy Service Provider - ESP) to adopt any combination of state-of-the-art behaviour change programs according to its targeted business needs.

1.3. SOCIALENERGY business objectives

The SOCIALENERGY architecture is "modular-by-design" in order for all subsystems to be potentially exploitable as stand-alone commercial products in the future. The technical Application Programming Interfaces (APIs) for the interaction between the various subsystems have been appropriately designed in a way that any possible combinations of SOCIALENERGY subsystems to be commercially exploitable in the future (e.g. GSRN with RAT as one single product, GAME with RAT as another one, GSRN-GAME as another one, GSRN-RAT-LCMS as another one, etc.).

This strategic decision at the design phase provides the flexibility to the consortium to decide how to prioritize its dissemination, communication and further exploitation activities towards commercialization. Of course, the ultimate objective of the consortium was to fully integrate all 4 subsystems into one single SOCIALENERGY S/W platform in the context of WP5 work. This was successfully achieved in early April 2019, when a stable 'beta' version of the integrated platform has been released to end users for experimentation and pilot testing. This way, the SOCIALENERGY product and associated services are expected to be competitive enough in order to enter the liberalized ICT/energy market and be sustainable as a product from a business perspective.

SOCIALENERGY consortium has early recognized the need for the S/W platform under development to be not only a "technology platform", but truly embraces the idea that technology platform and platform-based business models are equally important and should therefore be developed in parallel and in close collaboration. With respect to the

SOCIALENERGY's business modeling work, SOCIALENERGY S/W platform has been designed in a way that it:

1. Follows a platform-based, multi-sided and customer-centric business modeling approach.
2. Enables network effects and is able to absorb exponential digital growth mechanisms.
3. Fosters open ecosystems with focus on application programming interfaces (APIs) enabling open, combinatorial and incremental innovation.
4. Reflects the most recent as well as the expected for the future trends in both technological and societal developments - e.g., the ones related to digitalization, gamification, advanced data analytics, competence-based education, customer preferences, etc.

As of business objective #1 above, by the term ***"platform-based"***, we mean a web-based software infrastructure, which can be accessed via the Internet and be available in any type of device (i.e. desktop, mobile device, etc.). This platform can offer multiple web-based services to its users. By the term ***"multi-sided"***, we mean that this kind of software infrastructure/platform can be accessed by multiple types of users. In particular, SOCIALENERGY can support five (5) types of users, namely: i) individual energy consumers or else end users, who are able to view and edit their own profile, ii) EC leader users, who are able to view the profiles of all the member of a certain Virtual Energy Community (VEC), iii) electric utility user, who is able to manage the whole business portfolio of the company and have thus access to all end users' data, iv) ESCO user, who is a user that works in a company other than the electric utility and collaborates in a B2B fashion with the electric utility for cross-selling purposes, and v) other external users (e.g. EC, policy makers, researchers, etc.), who are willing to download SOCIALENERGY platform, install it in their computer and perform ad-hoc experimentations with real-life data from SOCIALENERGY platform. Finally, by the term ***"customer-centric business modeling"***, we mean that the customer segment that we target is very specific from the early stages of the project and this is the progressive electric utility companies (or else the emerging Energy Service Providers - ESPs). This is very important in order to targetedly design all S/W development and functionalities according to the business needs of our customer.

Regarding business objective #2, we assess that SOCIALENERGY ***"enables network effects"*** via: i) allowing VEC leaders and peers to communicate with each other like following the successful paradigm of online social networks, ii) encouraging community building actions, facilitating thus innovative B2B partnerships and respective cross-selling and up-selling value propositions. SOCIALENERGY platform is also able to ***"absorb exponential digital growth mechanisms"***, because its technical design is based on the latest advancements on web-based services' engineering, allowing thus the platform to scale up efficiently and accommodate thousands of users in the long term.

As of business objective #3, we assess that SOCIALENERGY platform "***enables open, combinatorial, and incremental innovation"*** meaning that: i) it is open, because its "alpha" version is publicly available in GitHub area and we also provide developer's and end user's manual, ii) it enables combinatorial innovation because each interested customer can select among several combinations of S/W components that best fit its targeted business needs, and, iii) it enables incremental innovation because all S/W modules can be easily extended

according to the future end users' and system's requirements, which are going to be set by the customer in the future.

Finally, regarding business objective #4, SOCIALENERGY platform follows up a well-designed mixture of emerging ***"technological and societal developments"***, which are considered to be in the converged ICT/energy business reality within the next decade. More specifically, the multi-disciplinary team of SOCIALENERGY project has taken into consideration novel research fields such as behavioral economics, socio-economic sciences, online social networks, competence-based education, serious games, gamification, etc., towards defining the digitization future of electric utilities.

SOCIALENERGY S/W platform initially aims at ***adopting a 'freemium'-based revenue model incorporating also features from 'marketplace', 'experience' and 'network' revenue models***. More details about SOCIALENERGY's business plan and value propositions including indicative quantitative figures are provided in section 2 of this report.

1.4. Summary of SOCIALENERGY integration, validation and pilot testing activities

In September 2018, the 'alpha' version of the integrated SOCIALENERGY S/W platform was released and made publicly available in the project's GitHub area[1]. Moreover, an explanatory and comprehensive user manual for the setup, configuration and basic experimentation of each main SOCIALENERGY subsystem is publicly available. In particular, any interested user (e.g. researcher, utility, market stakeholder, developer, etc.) is able to download the respective open-source S/W prototype and follow the step-by-step guidelines towards operating each subsystem in a stand-alone mode. Mock-up as well as indicative historical datasets are also provided in order for the (developer) user to be able to experiment himself/herself with the basic functionalities of each subsystem. A comprehensive user manual for the setup and configuration of the SOCIALENERGY system as a whole is also available. More specifically, once the developer user has installed and tested all subsystems, then s/he is able to setup the various web services (i.e. technical APIs) in order to start experimenting with the interactions among the 4 main subsystems. All this documentation has also been uploaded and is publicly available in project's GitHub area.

In April 2019, after making many enhancements to the 'alpha' version according to the feedback received from the end users, the 'beta' version of the integrated SOCIALENERGY S/W platform was released via the delivery of Deliverable 5.3. This document provides an explanatory and comprehensive end user manual for the initial registration and navigation of the end user throughout the main SOCIALENERGY subsystems. In particular, any interested end user is able to follow-up the step-by-step guidelines towards navigating through all SOCIALENERGY subsystems and thus better understand and become familiar with the platform's functionalities. Moreover, a summary of the S/W integration results is provided including indicative screenshots showcasing how the changes in one subsystem produce real-time changes in the central GSRN platform. For example, when an end user plays the GAME,

[1] https://socialenergy-project.eu/index.php/downloads/github-source-code

the GSRN is automatically and online updated with all game scores, credits, experience points, badges and activities, etc.

D5.3 was used as an end user manual in order to engage the real-life end users in the SOCIALENERGY's pilot tests, which took place during the last 3 months of the project's lifetime. More details about the pilot testing and project assessment results are provided in Deliverable 5.4. It should be noted that SOCIALENERGY's pilot testing work is an ongoing task and will continue even after the project's lifetime following up the consortium's communication and exploitation activities, which are described in sections 3 and 4 of this report.

2 SOCIALENERGY Business Model and value propositions towards commercialization

The figure below summarizes the business modelling work for SOCIALENERGY S/W platform as a whole. Figure 3 presents an updated version of the Business Model Canvas (BMC), whose initial version has been described in the previous D6.2 (M15). Please note that we focus on one customer segment that is progressive electric utility company (or else Energy Service Provider - ESP). We also consider four (4) distinct value propositions (or else business cases), which we extensively analyse in subsections 2.4.1 - 2.4.4.

2.1. Business Model Canvas for the progressive electric utility customer segment

In this subsection, we analyze each one of the 9 building blocks in a sententious manner, focusing on the targeted customer segment, which is the progressive electric utility companies or else Energy Service Providers (ESPs). These two terms are used interchangeably throughout the whole report.

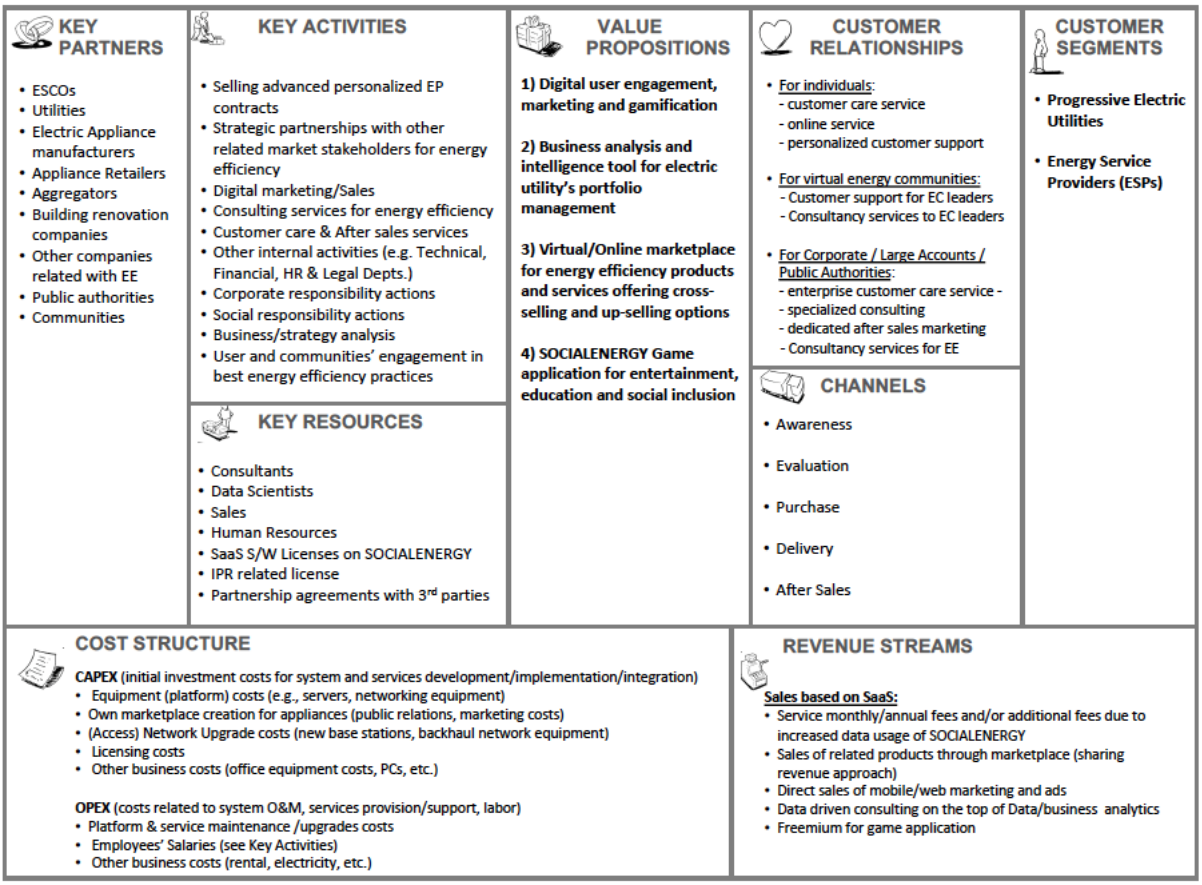

Figure 3: A high-level business model analysis of SOCIALENERGY (updated BMC version)

In section 3.2 of D6.2, all 9 building blocks of the SOCIALENERGY's BMC have been analyzed, so the interested reader may look for more details in D6.2. It should be noted that

the number of value propositions has been reduced to 4 (from a total 5 introduced in the previous BMC version), because the administrative tool for VEC management is now merged with value proposition #2 “Business analysis and intelligence tool for electric utility’s portfolio management”.

2.2. Cost structure for SOCIALENERGY’s business model

SOCIALENERGY project has created a fully exploitable SaaS (Software as A Service) platform that will be able to offer four (4) vertical product/services (either separately or in a combined bundle):

1) Data analytics Services
2) Games
3) GSRN Platform and Digital Engagement
4) Educational services

Each vertical service has a leading partner from the consortium and other partners as a backend support, if needed. Every service can be sold and offered individually or as a combined service together with other SOCIALENERGY’s S/W modules. It is up to the customer/client to select the desired bundle of products/services from the SOCIALENERGY S/W platform’s portfolio. This flexibility is important in the B2B SaaS enterprise market. In order to be able to discriminate the vertical offerings, 4 (four) separate Profit and Loss (P&L) calculations were executed by the consortium and the relevant partners, in order to estimate the cost structures and operational expenses for each vertical proposition:

2.2.1. Data Analytics Services (RAT S/W module)

The offering includes Data as a Service and the implementation of various algorithms on demand for the prospective clients. The client will upload or integrate their data sets (either online or offline) on the Data Analytics backend and the platform will be able to perform calculations and produce results, based on the GSRN Analytics Admin Panel.

The operating expenses (OPEX) and required human capital for one projected year are shown in the figure below. In order for ICCS to lead and offer Data Analytics services, a total OPEX of 168K Euros/Year (including travel and Cloud/H/W equipment and fees) and 36 Person Months will be required to serve an initial client volume of approximately 5-10 businesses (B2B).

in .000

	One Year Projection												
EXPENSES (Europe)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Payroll	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	9,0 €	108,0 €
Apartment	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Office	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Finance Cost	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Legal Services	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Travel Expenses	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	24,0 €
Marketing	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Hardware/Equipment	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	36,0 €
Total	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	**14,0 €**	168,0 €
HR Headcount													
Integration Developer													
Product Developer (Software)	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (UIX)													0,0 €
Sys Administrators													0,0 €
Energy Engineers/Consultants	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Data Scientists	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Account Mgt / PM													0,0 €
Content Manager (Marketing)													0,0 €
Financial Qtr													0,0 €
Salesmen													0,0 €
COO													0,0 €
Total	3	3	3	3	3	3	3	3	3	3	3	3	36,0 €

Figure 4: OPEX for data analytics services provided by RAT subsystem for one year

2.2.2. Gaming Services (SOCIALENERGY GAME)

The offering initially includes a desktop game (and then a mobile web app) to users and the latter are now able to play and engage. There will be a freemium model, where initially the game will be for free, but with some In-App purchases and marketing. At a later stage, more levels and stages can be unlocked by payment.

in .000

	Projected One Year												
EXPENSES (EUROPE)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Payroll	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	20,0 €	240,0 €
Apartment	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Office	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Finance Cost	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	0,3 €	3,6 €
Legal Services	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Travel Expenses	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Marketing	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	6,0 €	72,0 €
Hardware/Equipment	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	0,5 €	6,0 €
Total	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	**26,8 €**	321,6 €
HR Headcount													
Integration Developer													
Product Developer (Software)	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (UIX)	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Sys Administrators													0,0 €
Energy Engineers/Consultants													0,0 €
Data Scientists													0,0 €
Account Mgt / PM													0,0 €
Content Manager (Marketing)	2	2	2	2	2	2	2	2	2	2	2	2	24,0 €
Financial Qtr													0,0 €
Salesmen													0,0 €
COO													0,0 €
Total	4	4	4	4	4	4	4	4	4	4	4	4	48,0 €

Figure 5: OPEX for gaming services provided by the GAME for one year

The operating expenses and required human capital for one projected year are depicted in the figure above. In order for NUROGAMES to lead and offer Gaming services, a total OPEX of 321K Euros/Year (including travel and Cloud/HW equipment and fees) and 48 Person Months will be required to serve an initial client volume of approximately 1M end users.

2.2.3. GSRN Platform and Digital End User Engagement

This offering includes the frontend GSRN Platform with MDMS subsystem, loyalty, social network and virtual marketplace features for end user engagement to electric utilities. Utilities will pay under a licensing/SaaS subscription fee, based on their customer volumes. The operating expenses and required human capital for one projected year are shown below:

in .000

EXPENSES (EUROPE)	Projected One Year												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Payroll	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	15,0 €	180,0 €
Apartment	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Office	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	12,0 €
Finance Cost	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	1,0 €	12,0 €
Legal Services	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	0,8 €	9,6 €
Travel Expenses	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	2,0 €	24,0 €
Marketing	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	3,0 €	36,0 €
Hardware/Equipment	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Total	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	22,8 €	273,6 €
HR Headcount													
Integration Developer	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (Software)	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (UIX)													0,0 €
Sys Administrators	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Energy Engineers/Consultants													0,0 €
Data Scientists	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Account Mgt / PM	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Content Manager (Marketing)													0,0 €
Financial Qtr													0,0 €
Salesmen													0,0 €
COO													0,0 €
Total	5	5	5	5	5	5	5	5	5	5	5	5	60,0 €

Figure 6: OPEX for core GSRN services for one year

In order for INTELEN to lead and offer GSRN engagement services, a total OPEX of 273K Euros/Year (including travel and Cloud/HW equipment and fees) and 60 Person Months will be required to serve an initial client volume of approximately 0,5 - 1M end users.

2.2.4. Educational Services (LCMS)

This offering will include the provision of the LCMS S/W modules to end users and clients, under a B2B or B2C licensing approach. Users interested in taking the SOCIALENERGY LCMS courses will pay for them by using the SaaS platform. There could be some sort of subscription or one-off courses, according to the pricing policy and specific offers. The operating expenses and required human capital for one projected year is shown below. In order for SU-NIS to lead and offer Educational services, a total OPEX of 64K Euros/Year (including travel and Cloud/HW equipment and fees) and 36 Person Months is required to serve an initial client volume of approximately 100K end users.

in .000

EXPENSES (EUROPE)	Projected One Year												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Payroll	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	5,0 €	60,0 €
Apartment	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Office	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Finance Cost	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	0,2 €	2,4 €
Legal Services	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Travel Expenses	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	1,2 €
Marketing	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Hardware/Equipment	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	0,1 €	1,2 €
Total	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	64,8 €
HR Headcount													
Integration Developer	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (Software)	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Product Developer (UIX)													0,0 €
Sys Administrators	1	1	1	1	1	1	1	1	1	1	1	1	12,0 €
Energy Engineers/Consultants													0,0 €
Data Scientists													0,0 €
Account Mgt / PM													0,0 €
Content Manager (Marketing)													0,0 €
Financial Qtr													0,0 €
Salesmen													0,0 €
COO													0,0 €
Total	3	3	3	3	3	3	3	3	3	3	3	3	36,0 €

Figure 7: OPEX for LCMS services for one year

Conclusively, for the total four (4) vertical SOCIALENERGY modules, a specific cost structure is defined, under a specific Profit & Loss (P&L) calculation that can be also used for fund-raising or business formation and budgeting.

2.3. Revenue stream scenarios for SOCIALENERGY's business model

The revenue stream structure will follow the classical SaaS model, where revenues will come from licensing or subscription to the specific modules. The anticipated volumes are described below:

REVENUES (in thousans of EURO)	One Projected Year												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Vertical Markets													
Data Analytics (9,5K/month)	2,0 €	5,0 €	15,0 €	30,0 €	45,0 €	50,0 €	50,0 €	60,0 €	65,0 €	70,0 €	90,0 €	95,0 €	577,0 €
Games (1,7/user)	1,0 €	3,0 €	5,0 €	5,0 €	6,0 €	7,0 €	10,0 €	11,0 €	14,0 €	15,0 €	16,0 €	17,0 €	110,0 €
GSRN (20K/month)	0,0 €	0,0 €	20,0 €	20,0 €	40,0 €	40,0 €	60,0 €	60,0 €	80,0 €	80,0 €	80,0 €	100,0 €	580,0 €
Education LCMS	2,0 €	2,0 €	4,0 €	5,0 €	5,0 €	5,0 €	7,0 €	7,0 €	7,0 €	8,0 €	8,0 €	10,0 €	70,0 €
TOTAL (in thousans of EURO)	5,00 €	10,00 €	44,00 €	60,00 €	96,00 €	102,00 €	127,00 €	138,00 €	166,00 €	173,00 €	194,00 €	222,00 €	1.337,00 €

Figure 8: SOCIALENERGY revenue streams for one projected year

Based on the initial revenue projection calculation, for the four vertical offerings we have a SaaS price of:

- For data analytics 9,5K/month for a big corporation with more than 10,000 data sources (data volume to be analyzed).
- For gaming services, we estimate 1,7Euro/user for in-game adds and new level purchases.
- For GSRN, we estimate a 20K/month platform licensing for utilities of more than 100K consumers.
- For educational services, we estimate 14 Euros/year (1,1 Euro/month subscription) on average for one individual module to be taken.

Based on the above assumptions, we have the revenue projection graphs shown below, for the 4 vertical offerings:

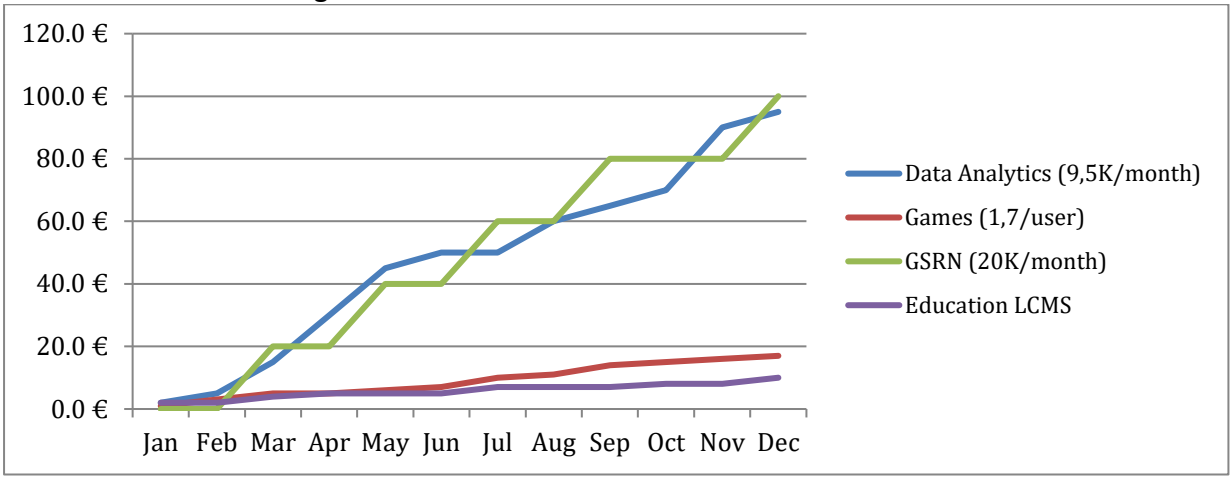

Figure 9: Revenue streams projection for the 4 vertical offerings (revenues in thousands of Euros)

2.4. Value propositions

As already explained, the focus of SOCIALENERGY project is on one single business model, which has been extensively analyzed in the previous section as well as in the previous D6.2 version of this deliverable. In this subsection, we introduce the Value Proposition Canvas (VPC) as a tool to analyze the four (4) short-listed value propositions:

1) Digital user engagement, marketing and gamification platform
2) Business analysis and intelligence tool for electric utility's portfolio management
3) Virtual/Online marketplace for energy efficiency products and services offering cross-selling and up-selling options
4) SOCIALENERGY Game application for entertainment, education and social inclusion

In subsections 2.2-2.3 above, we analyzed the cost structure and revenue streams for each one of the 4 main SOCIALENERGY subsystems. In the following subsections, we analyze the cost structure and revenue streams for each one of the 4 short-listed value propositions. In other words, we consider a specific workload percentage for each one of the 4 subsystems, which contribute in the realization of the 4 different value propositions (or else business cases).

2.4.1. Value Proposition #1: Digital user engagement, marketing and gamification platform

In this business case, we focus on the SOCIALENERGY services that the individual energy consumer is experiencing. The electric utility company wants to offer an online S/W platform to its users, through which the latter will be able to monitor their energy consumption, receive useful tips about ways to minimize their electricity bill, purchase beneficial energy programs based on their needs, etc. Furthermore, the end user is able to play the GAME and be educated in energy efficiency issues through LCMS. With this platform, utility aims at engaging its end users, apply efficient online marketing policies and offer advanced personalized energy services to the end users. Moreover, end users are incentivized to become Energy Community (EC) leaders and thus be able to manage their own social groups

and in return receive more offers and benefits from the SOCIALENERGY platform. In a nutshell, this value proposition disposes the following features:

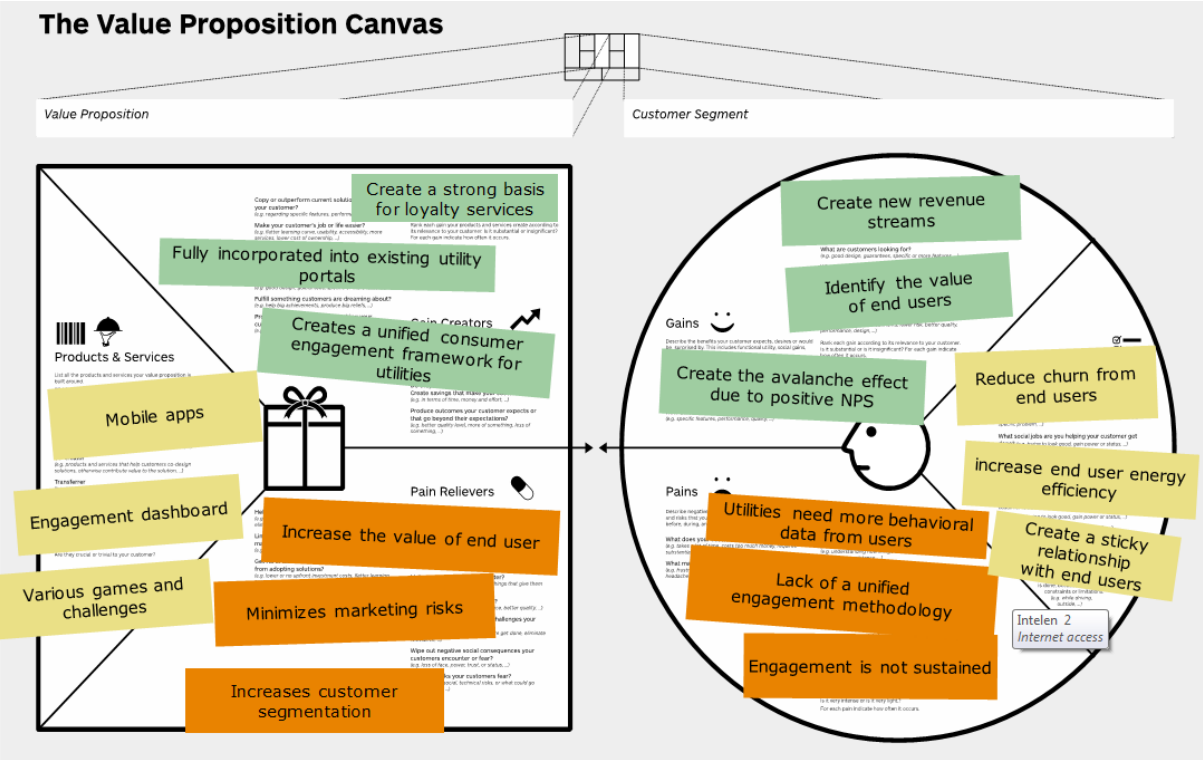

Figure 10: VPC for value proposition no. 1 [3]

- Focus on the simple end user and EC leader user interface (not the admin and ESCO user).
- Focus on GSRN-GAME-LCMS subsystems and not on RAT & virtual marketplace. The electric utility just wants to offer this product to all its clients and is not so interested on the admin user interfaces and interaction with other market stakeholders (i.e. virtual marketplace).
- The energy consumer (end user) can continuously monitor his/her ECCs. The EC leader can also view the profiles of all his/her group members, who belong in the same VEC.
- The end user is digitally engaged in the ESP's operations and can thus understand how s/he can lower his/her electricity bills. This is achieved through the gameplay and taking LCMS courses. In case that the end user is a member of a Virtual Energy Community (VEC), s/he can also get instructions by the VEC leader through the GSRN's online chat system.
- The user can purchase Energy Programs via the platform and see all the billing information (integration with an online payment system).
- The end user can get advice about energy efficiency via recommendations. EC leader may also recommend/provide some hints to its group members in order to be more effectively engaged in SOCIALENERGY system's operation.
- A gamified experience is offered to the end user. S/he can have fun through gameplay and at the same time be educated on best energy efficiency practices. Highly engaged

end users may become EC leaders and thus manage their own social groups within the SOCIALENERGY platform.

- The end user enjoys a personalized behavioral education program through LCMS (i.e. more advanced users take more advanced courses). EC leaders can customize the LCMS features in order to provide more educational content to their group members and also help them understand the various energy efficiency related concepts.
- The electric utility company can apply its digital marketing and advertising via the platform. Cost structure is based on the providing personalized services to the end user and the EC leader. Revenue stream structure is based on keeping the end user happy and gradually engage him/her by adopting a Freemium based policy (i.e. gradually unlocking various GSRN features).

Cost structure projections for value proposition #1

In this first value proposition, the combined cost structure includes variable costs from all the engaged partners, in order to support the value proposition #1 services to the market. The combined P&L structure can be seen below, by engaging the various partners but in different cost percentages (i.e. INTELEN that manages the core GSRN platform will have more OPEX than other partners in this specific value proposition). In other value propositions, this percentage will change and adapt according to the business case under consideration.

in .000		P&L Projected One Year (Value Proposition #1)												
EXPENSES		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P&L (%)														
0,8	Intelen	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	13,6 €	163,2 €
0,5	ICCS	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	84,0 €
0,5	SU-NIS	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	2,7 €	32,4 €
0,2	NURO	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	5,4 €	64,3 €
Total	Total	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	28,7 €	343,9 €

Figure 11: SOCIALENERGY combined P&L for one year for value proposition #1

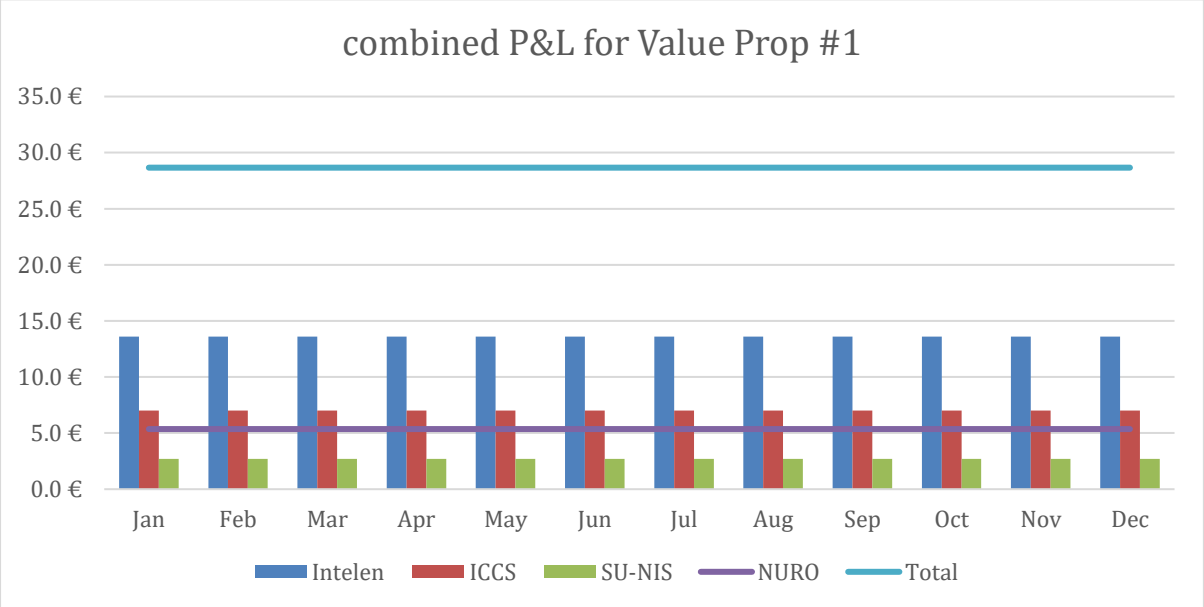

Figure 12: SOCIALENERGY combined P&L for one year for value prop #1, with a total of 28,7K euros/month

Revenue streams projections for value proposition #1

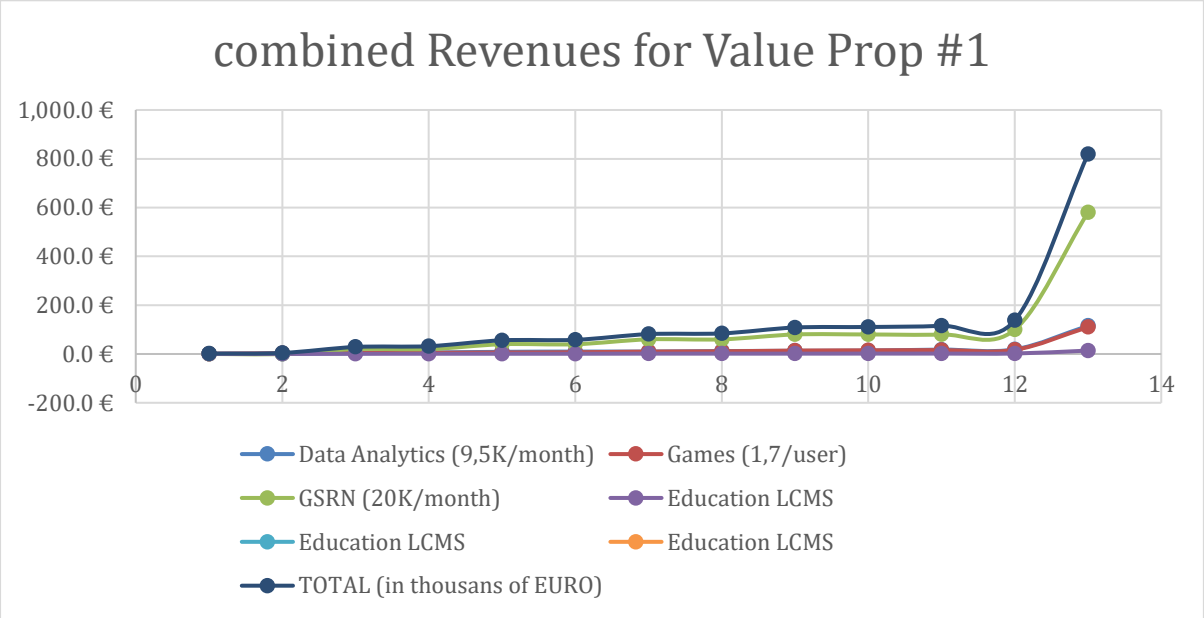

Figure 13: Revenue stream projection for value proposition #1

Respectively, the Revenue Streams for the Value proposition #1 will have the majority of the principal revenue, which is the selling of the GSRN platform for customer engagement, with the use of games and gamification products (cf. NRG). The pricing methodology includes also a combo product pricing towards the final customer, which also includes the support prices of all modules from all partners: i.e. the customer buys the GSRN platform to receive services, but in this price scheme behind the scenes, the cost for RAT, GAME and LCMS is also weighted and included.

The combined weighted revenue projection for one year for Value Prop #1 (based on the general projection table shown in Figure 9), can be shown below in the Graph:

Break-even point in April (revenues in April 32K vs. 28,7 expenses)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Data Analytics (9,5K/month)	0,4 €	1,0 €	3,0 €	6,0 €	9,0 €	10,0 €	10,0 €	12,0 €	13,0 €	14,0 €	18,0 €	19,0 €	115,4 €
Games (1,7/user)	1,0 €	3,0 €	5,0 €	5,0 €	6,0 €	7,0 €	10,0 €	11,0 €	14,0 €	15,0 €	16,0 €	17,0 €	110,0 €
GSRN (20K/month)	0,0 €	0,0 €	20,0 €	20,0 €	40,0 €	40,0 €	60,0 €	60,0 €	80,0 €	80,0 €	80,0 €	100,0 €	580,0 €
Education LCMS	0,4 €	0,4 €	0,8 €	1,0 €	1,0 €	1,0 €	1,4 €	1,4 €	1,4 €	1,6 €	1,6 €	2,0 €	14,0 €
TOTAL (in thousans of EURO)	1,80 €	4,40 €	28,80 €	32,00 €	56,00 €	58,00 €	81,40 €	84,40 €	108,40 €	110,60 €	115,60 €	138,00 €	819,40 €

Lessons learned and respective R&I insights related with value proposition #1

Table 3: Summary of lessons learned and R&I insights for value proposition #1

Lesson learned	R&I insight
The end user seems to be more engaged when s/he gets personalized messages from SOCIALENERGY system	Work more on Machine Learning and Artificial Intelligence (ML/AI) research algorithms and techniques to provide even more interesting notifications/reports/recommendations to end users

The end user/EC leader seems to be more engaged when s/he understands how the SOCIALENERGY point system works and which are the benefits of his/her participation	Work more on gamification techniques and interaction with the end users (use of GSRN data to further understand each end user's behavior within SOCIALENERGY system).
The end user seems to be more engaged when an instruction/suggestion comes from a peer or an EC leader rather from the system administrator. S/he is also much more interested in the actions of peers, who have similar end user profiles.	Work more on Online Social Networks (OSN) theory (VEC creation and dynamic adaptation algorithms including more feature data).
There is no "one-size-fits-all" context for end user's and EC leader's engagement in SOCIALENERGY system	More work on social/behavioral/digital education sciences research in order to understand in more depth which are the weights of the various incentivization factors for each individual end user.

2.4.2. Value Proposition #2: Business analysis and intelligence tool for electric utility's portfolio management

As shown in the figure below, progressive electric utilities handle large volumes of data, which are often complex in structure and are produced in real-time. These data sources can be categorized as: i) energy related, ii) behavioral, iii) based on online social network, and iv) other data sources. The 1st step is to gather, store and easily retrieve these datasets using a well-designed database. Then, data analytics tools are needed in order to unveil the potential added value out of these structured datasets. The 3rd step is to combine data analytics results with specific Key Performance Indicators (KPIs) in order to quantify research algorithms' results and assess their business impact. The final step is to automate the business analytics process and connect it with the real-time business operation.

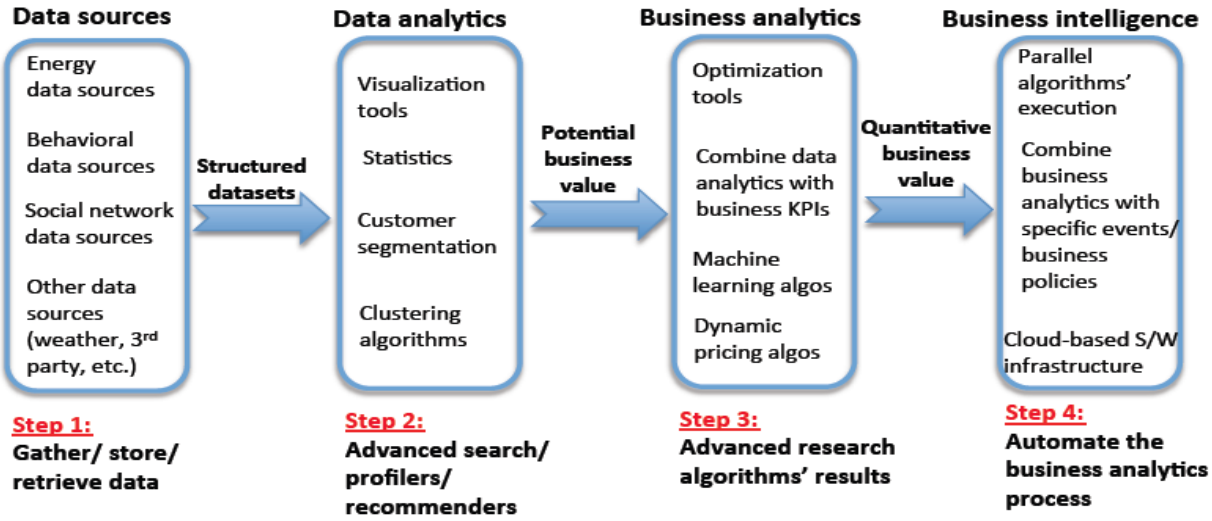

Figure 14: The 4 main steps of business intelligence process for progressive electric utilities

In this business case, we focus on the SOCIALENERGY services that the electric utility (or else administrative user) is experiencing. Via the use of the Research Algorithms and Business Intelligence Tool (RABIT), the SOCIALENERGY admin user can:

- Automatically create innovative energy programs (or else pricing schemes) and run exhaustive "what-if" scenarios to precisely quantify important KPIs for utility's

business, such as energy cost reduction, users' welfare, business profits, aggregated energy consumption reduction, etc.

- Create and dynamically adapt Virtual Energy Communities (VECs) based on multiple parameters, such as energy data related analytics, behavior data related analytics, social network data analytics, etc.
- Experience advanced search, profiling and recommendation services facilitating thus the establishment of efficient communication channels with the end users and VECs for advanced quality of service (QoS), digital marketing, and e-commerce purposes.

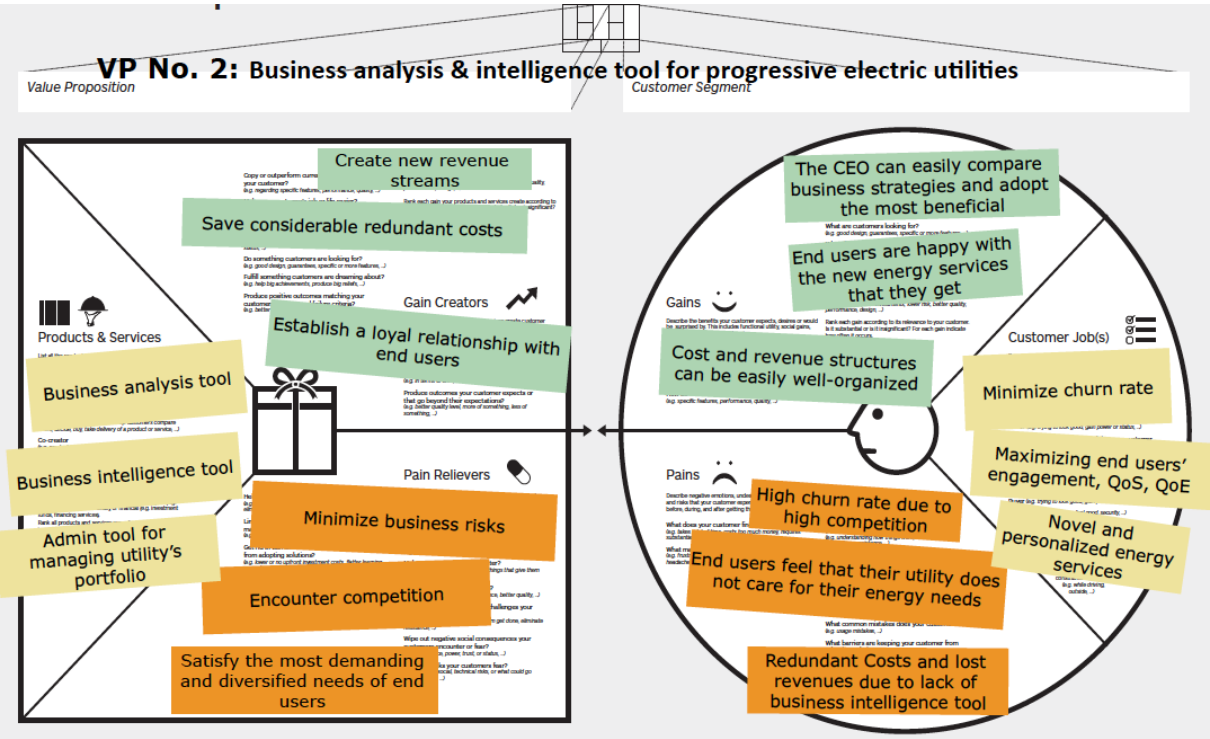

Figure 15: VPC for value proposition no. 2 [3]

Cost structure projections for value proposition #2

In this second vertical value proposition, the combined cost structure includes variable costs from all the engaged partners, in order to support the value proposition #2 services to the market. The combined cost P&L structure can be seen below, by engaging the various partners, but in different cost percentages (i.e., ICCS that manages the core RAT platform will have more OPEX than other partners, in this specific Value proposition. In other value props, this percentage will change and adapt.

in .000		P&L Projected One Year (Value Proposition #2)												
EXPENSES		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
weighted P&L (%)														
0,4	Intelen	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	6,8 €	81,6 €
1	ICCS	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	14,0 €	168,0 €
0,3	SU-NIS	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	19,4 €
0,4	NURO	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	10,7 €	128,6 €
Total	Total	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	33,1 €	397,7 €

Figure 16: SOCIALENERGY combined P&L for one year for value proposition #2

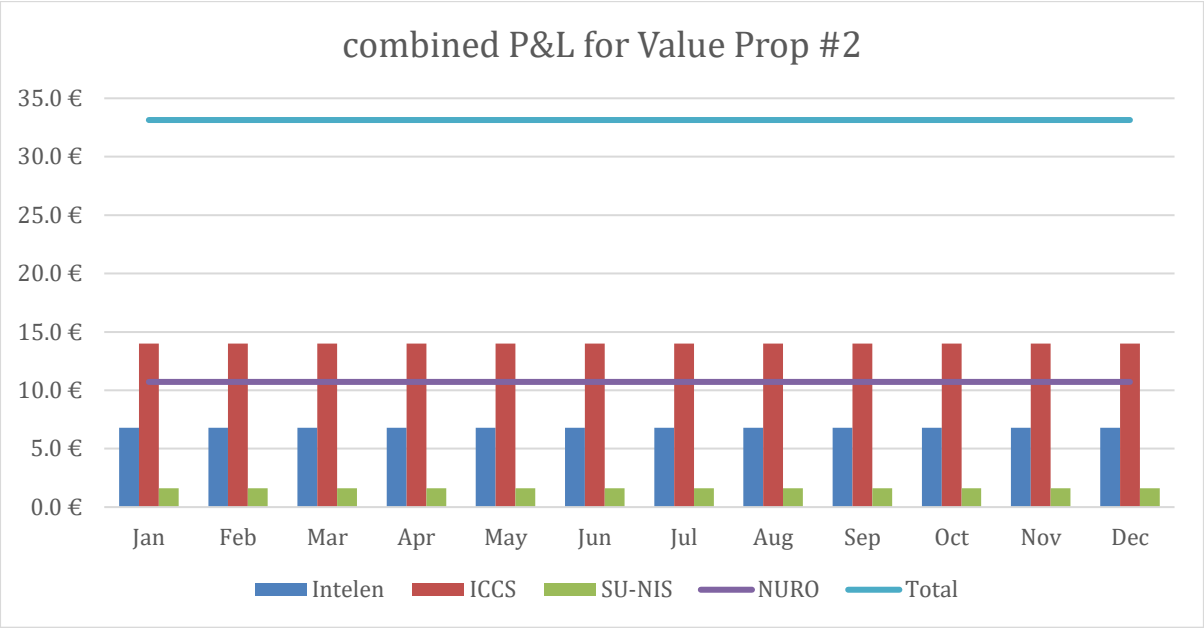

Figure 17: SOCIALENERGY combined P&L for one year for value proposition #2

Revenue streams projections for value proposition #2

Respectively, the Revenue Streams for the Value proposition #2, will have the majority of the principal revenue, which is the selling the Data Analytics and the RAT system, over the GSRN platform or in parallel. The pricing methodology includes also a combo product pricing towards the final customer, which also includes the support prices of all modules from all partners. The combined weighted revenue projection for one year for Value Prop #2 (based on the general projection table shown in Figure 9) is shown below:

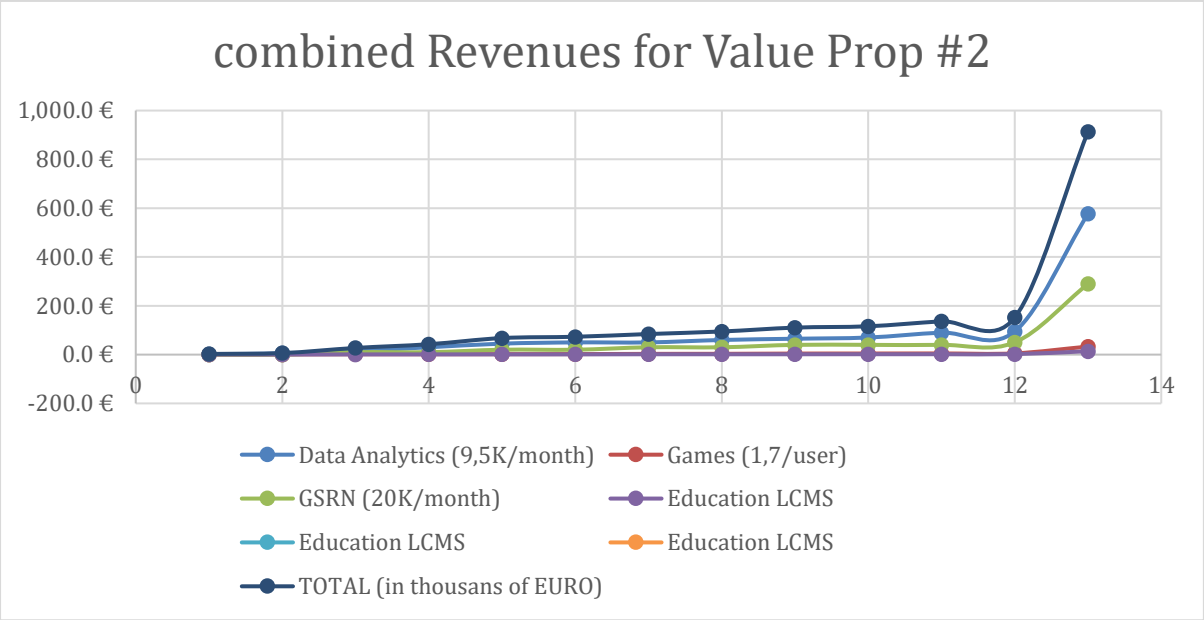

Figure 18: Revenue stream projection for value proposition #2

Break-even point in April (revenues in April 42,5K vs 33,1K expenses)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Data Analytics (9,5K/month)	2,0 €	5,0 €	15,0 €	30,0 €	45,0 €	50,0 €	50,0 €	60,0 €	65,0 €	70,0 €	90,0 €	95,0 €	577,0 €
Games (1,7/user)	0,3 €	0,9 €	1,5 €	1,5 €	1,8 €	2,1 €	3,0 €	3,3 €	4,2 €	4,5 €	4,8 €	5,1 €	33,0 €
GSRN (20K/month)	0,0 €	0,0 €	10,0 €	10,0 €	20,0 €	20,0 €	30,0 €	30,0 €	40,0 €	40,0 €	40,0 €	50,0 €	290,0 €
Education LCMS	0,4 €	0,4 €	0,8 €	1,0 €	1,0 €	1,0 €	1,4 €	1,4 €	1,4 €	1,6 €	1,6 €	2,0 €	14,0 €
TOTAL (in thousans of EURO)	2,70 €	6,30 €	27,30 €	42,50 €	67,80 €	73,10 €	84,40 €	94,70 €	110,60 €	116,10 €	136,40 €	152,10 €	914,00 €

Lessons learned and respective R&I insights related with value proposition #2

Table 4: Summary of lessons learned and R&I insights for value proposition #2

Lesson learned	R&I insight
Monetary gains for the utility/ESP seem to be not economically sustainable. There are no high profit margins in the retail electricity market.	Model more energy markets (e.g. emerging flexibility/balancing markets) and apply P-RTP/B-RTP/C-RTP models in these markets, too. ESPs can thus follow stacked revenue model approaches to maximize their profits.
The mathematical modeling for the Energy Programs should be more practical for the admin user and include competition with other retailers. Investment on RES/storage assets is also very important for electric utilities.	Advanced mathematical models (e.g. MPEC/EPEC, network-aware optimization, strategic bidding policies, etc.) and integration of storage/RES/DR flexibility models.
Cheating end users may try to take advantage of the SOCIALENERGY DR mechanism and point system affecting thus the success of the SOCIALENERGY business model as a whole.	More advanced mechanism design and incentive compatible techniques to allocate DR gains to all participating users in a more fair way maximizing the social welfare without degrading end user's welfare, too. More work on game-theoretic models.
An optimal combination between reporting and recommendation is needed for effective and long-term energy efficiency engagement. Need for more energy data per device level in order to provide even better data analytics services.	Advanced data analytics (ML/AI) techniques to avoid end user frustration and disturbance.
Measurement & Verification (M&V) is a rather complex procedure even if it is applied in virtual energy communities' level.	Further research is needed in behavioral M&V.

2.4.3. Value Proposition #3: Virtual/Online marketplace for energy efficiency products and services offering cross-selling and up-selling options

Regarding this value proposition about the virtual/online marketplace, the proposed business case aspects can be summarized as follows:

- The electric utility company wants to understand the needs and communicate better with other energy efficiency sector stakeholders such as electric appliance retailers/vendors, building renovation companies, construction companies, smart home automation/IoT vendors/retailers, etc.
- The focus is on cross-sales & e-commerce personalization services to realize new revenue streams via strategic collaborations between the electric utility and various other ESCOs and companies related with energy efficiency sector.

- The virtual marketplace can host products and services from electric appliance vendors/retailers, building renovation companies, etc., so that the user can have an end-to-end experience on the way to achieve his/her energy efficiency targets.
- Exploit the deep insight into energy use consumption to engage customers on cross-sell and up-sell options that fit their needs.
- Bridge the gap between energy consumers and multiple other market stakeholders related to the energy efficiency sector. 'Win-Win' market situations are realized as all involved actors can benefit from the participation in the virtual marketplace.
- The utility company can generally sell Energy Information Distribution as a Service (EIDaaS) to whom it may concern in the long-term future (cf. "data monetization" service).
- Mainly GSRN, but also LCMS and GAME are exploited from the ESCO's perspective.
- In the future, individual energy consumers could also ask for offers (e.g. for house renovation/upgrades) and the proposed SOCIALENERGY platform could be the mediator for this type of innovative services' provisioning.

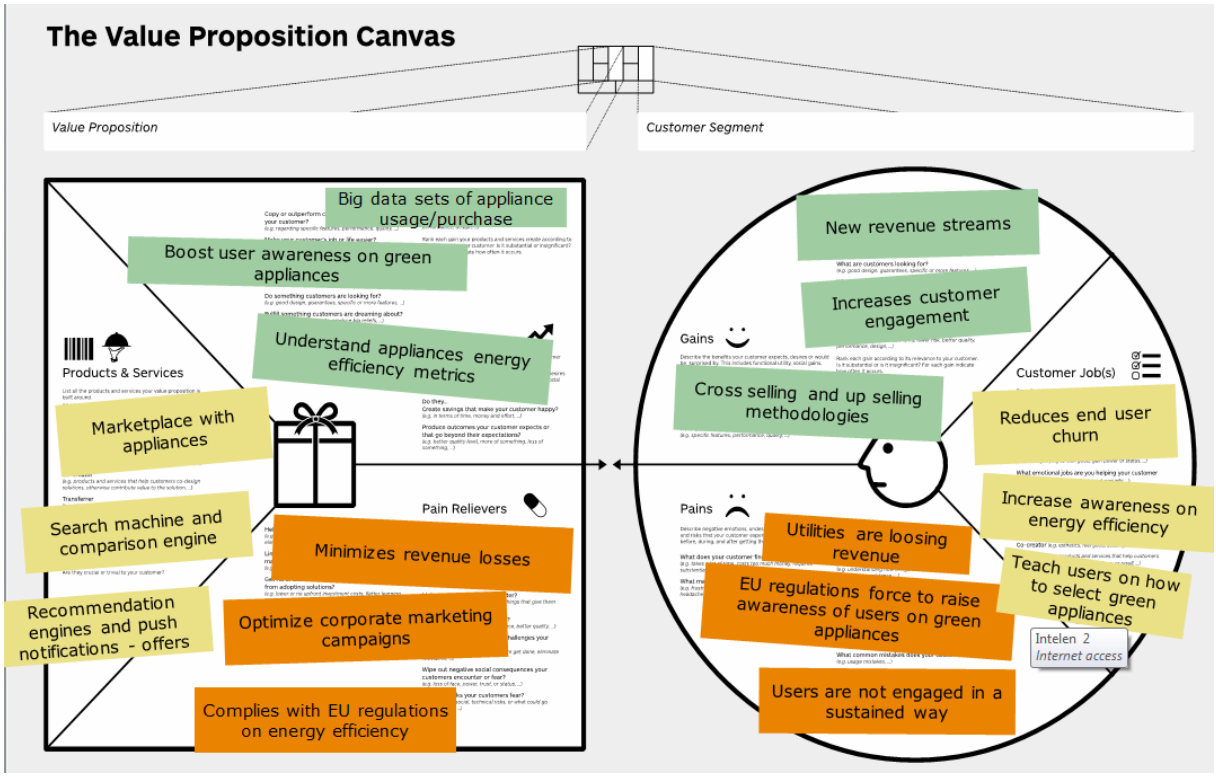

Figure 19: VPC for value proposition no. 3 [3]

Cost structure projections for value proposition #3

In this third vertical value proposition, the combined cost structure includes variable costs from all the engaged partners, in order to support the value proposition #3 services to the market. The combined cost P&L structure can be seen below, by engaging the various partners, but in different cost percentages (i.e. INTELEN and ICCS that manage the core GSRN with the marketplace platform that needs personalization and thus RAT, will have more OPEX than other partners, in this specific Value proposition. In other value propositions, this percentage will change and adapt.

in .000 EXPENSES		P&L Projected One Year (Value Proposition #3)												
weighted P&L (%)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
0,6	Intelen	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	10,2 €	122,4 €
0,5	ICCS	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	7,0 €	84,0 €
0	SU-NIS	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
0	NURO	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
Total	Total	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	17,2 €	206,4 €

Figure 20: SOCIALENERGY combined P&L for one year for value prop #3

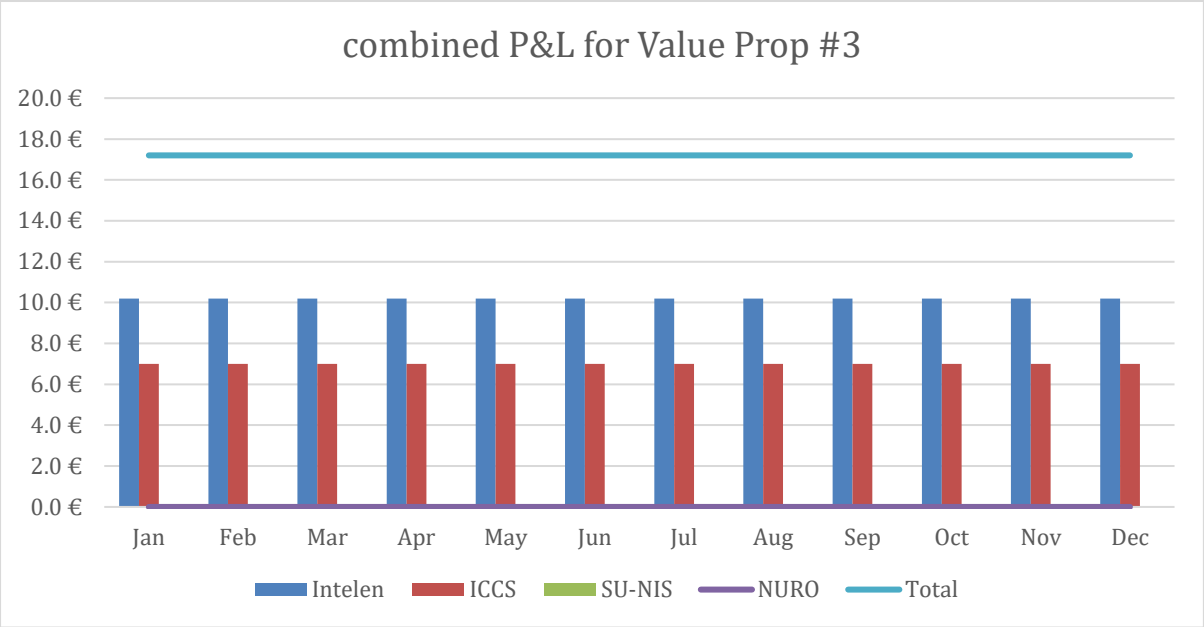

Figure 21: SOCIALENERGY combined P&L for one year for value proposition #3

Revenue streams projections for value proposition #3

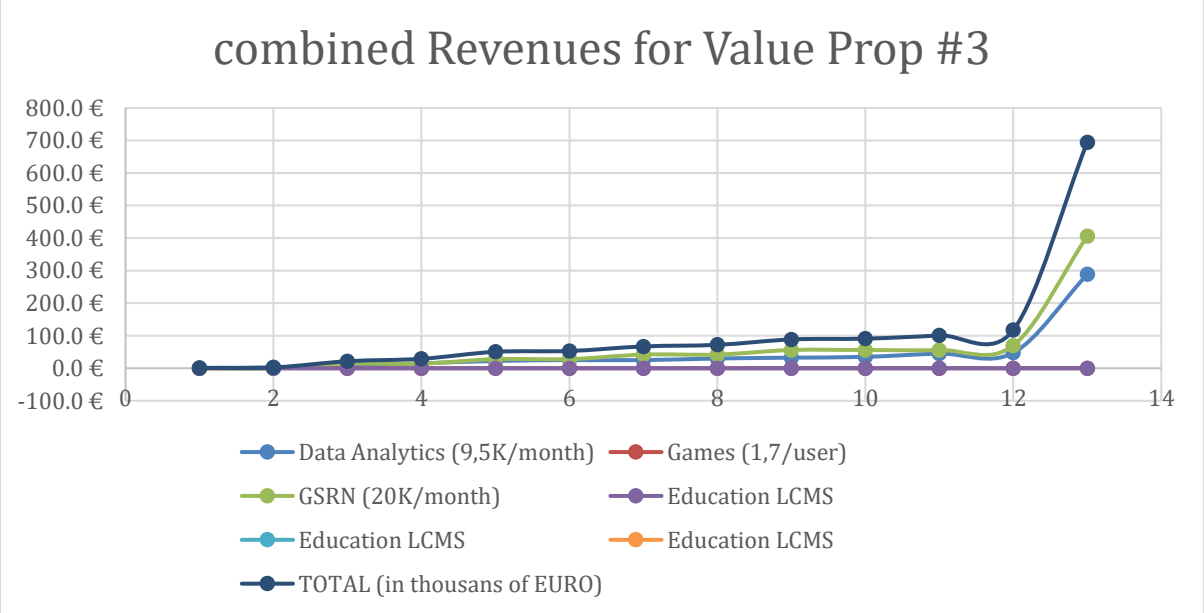

Figure 22: Revenue stream projection for value proposition #3

Respectively, the Revenue Streams for the Value proposition #3, will have the majority of the principal revenue, which is the selling the marketplace products and services through

GSRN and the RAT system. The pricing methodology includes also a combo product pricing towards the final customer, which also includes the support prices of all modules from all partners. The combined weighted revenue projection for one year for Value Prop #3 is shown in the figure above.

Break-even point in March (revenues in March 21,5K vs 17,2K expenses)
Faster break-even in Value prop #3 but less revenues in total for one year

REVENUES (in thousans of EURO)	One Projected Year Revenues for Value Prop #3												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Data Analytics (9,5K/month)	1,0 €	2,5 €	7,5 €	15,0 €	22,5 €	25,0 €	25,0 €	30,0 €	32,5 €	35,0 €	45,0 €	47,5 €	288,5 €
Games (1,7/user)	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
GSRN (20K/month)	0,0 €	0,0 €	14,0 €	14,0 €	28,0 €	28,0 €	42,0 €	42,0 €	56,0 €	56,0 €	56,0 €	70,0 €	406,0 €
Education LCMS	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €	0,0 €
TOTAL (in thousans of EURO)	1,00 €	2,50 €	21,50 €	29,00 €	50,50 €	53,00 €	67,00 €	72,00 €	88,50 €	91,00 €	101,00 €	117,50 €	694,50 €

Lessons learned and respective R&I insights related with value proposition #3

Table 5: Summary of lessons learned and R&I insights for value proposition #3

Lesson learned	R&I insight
GDPR-related issues hinder the further exploitation of energy/social/behavioral data by an electric utility company. EIDaaS is not so easy to be exploited given the current legislative/ regulatory context in many EU countries and elsewhere.	Need for open data platforms, data sharing economy and data market for trading data-related assets. Need to treat data and data analytics as a commodity to traded in an online marketplace.
Need for more data (e.g. per device energy data, house energy class, lifestyle data, etc.) in order to be able to design more interesting cross/up-selling services	ML/AI-based recommendation algorithms and brainstorming on new business models (e.g. B2B2X) in order to design more interesting cross/up-selling services
Electric utility companies are very skeptical about the optimal way to exploit their clients' data internally (in-house exploitation) or build on strategic B2B partnerships with other market stakeholders.	Need for a trusted Data Asset Marketplace (DAM) to lower privacy barriers associated with the development of innovative data-intensive applications that consume personal data.

2.4.4. Value Proposition #4: SOCIALENERGY Game application for entertainment, education and social inclusion

This value proposition is aimed towards the energy consumers (i.e. individual end users), or those who are going to interact with SOCIALENERGY game. In fact, the game application as a result of the SOCIALENERGY project can be approached to a number of customer segments regardless whether they are dedicated to a specific domain, genre or a platform. Thus, we recognize that the value proposition of the SOCIALENERGY Game can involve several gamer mentalities (based on the classification of Kallio et al.[2]) namely:

- Committed gamers – those who are deliberately using GSRN and the Game due to being socially attached to the problem. These players want to learn more about the

[2] Kallio, K.P., Mäyrä, F. & Kaipainen, K. (2011). At Least Nine Ways to Play: Approaching Gamer Mentalities. Games and Culture, 6(4).

market, play more often and tend to have longer sessions in comparison to an average user.

- Causal gamers – these are the players who engage in the gaming activities from time to time and not absorb all the attention or interest in the gaming environment. The sole purpose of the SOCIALENERGY game would be occasional entertainment only.
- Gaming companions or social gamers – types of players who prefer to play together with other individuals for the sake of competition, result comparison, or simply for sociable gaming. For this, certain gamification approaches were adopted and presented to the user in form of leader boards. Simple collaborative gaming is introduced with the use of NPCs, but conceptually the game is designed to support real multi-user interaction in virtual environment and can be introduced during the commercialization stage.

In contrast with the previous 3 value propositions/business cases, a reverse approach in the business process is followed. Initially, the end users play the GAME and then, after their engagement in the GAME, they start purchasing all other SOCIALENERGY products and services. Nevertheless, the focus now lies on the Gameplay and how to engage the end users of an electric utility company/ESP or any other household into simulation. Inter-relation of gameplay with GSRN-LCMS services is provided in order to incentivize users to purchase more advanced versions of the GAME and enjoy the best SOCIALENERGY platform's services at the minimum cost. The utility company can also use the GAME as part of its corporate and social responsibility actions towards educating the society on energy efficiency issues and for social inclusion purposes in cooperation with a public authority, educational institute, etc.

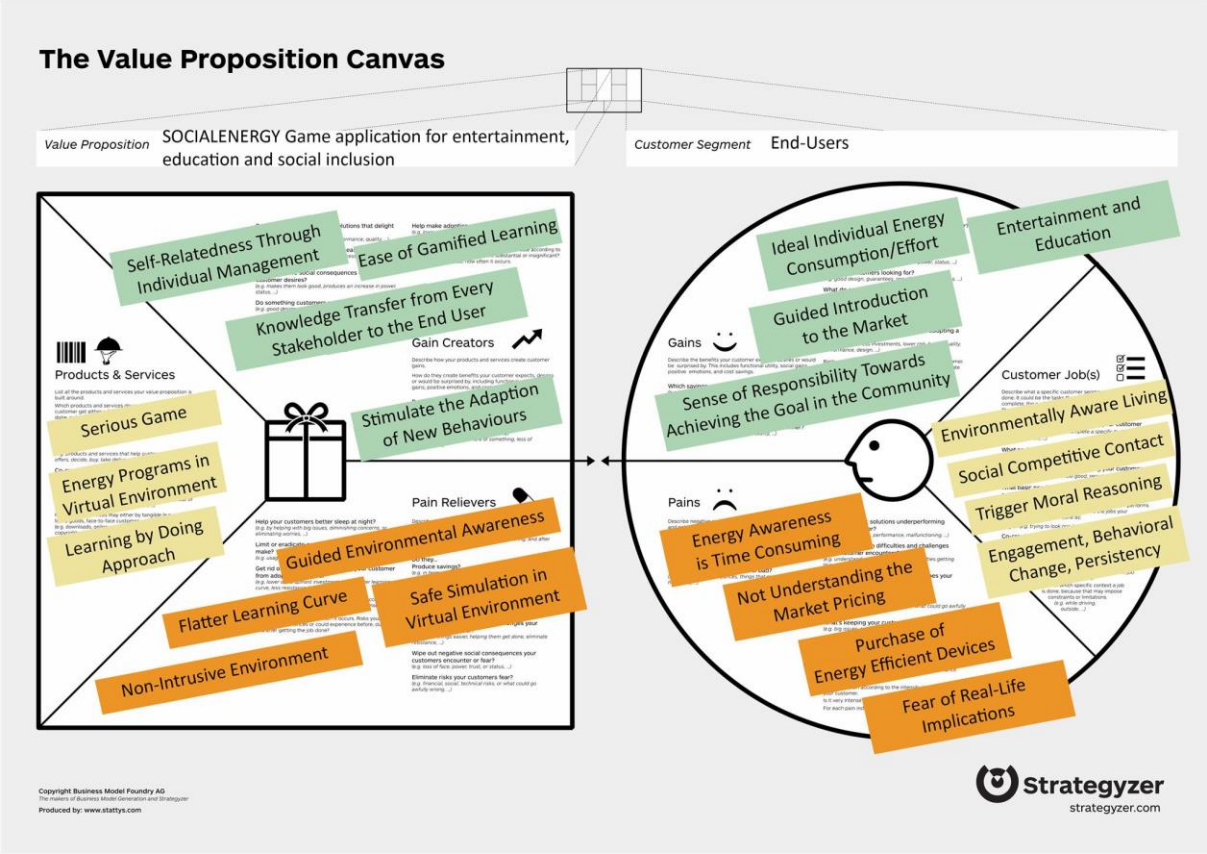

Figure 23: VPC for value proposition no. 4 [3]

Cost structure projections for value proposition #4

In this fourth vertical value proposition, the combined cost structure includes variable costs from all the engaged partners, in order to support the value proposition #4 services to the market. The combined cost P&L structure can be seen below, by engaging the various partners but in different cost percentages (i.e., Nurogames that manage the core Game with all extensions will have more OPEX than other partners, in this specific Value proposition. In other value props, this percentage will change and adapt.

in .000			P&L Projected One Year (Value Proposition #4)												
weighted P&L (%)	EXPENSES		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
0,2		Intelen	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	3,4 €	40,8 €
0,2		ICCS	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	2,8 €	33,6 €
0,3		SU-NIS	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	1,6 €	19,4 €
1		NURO	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	26,8 €	321,6 €
Total	Total		34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	34,6 €	415,4 €

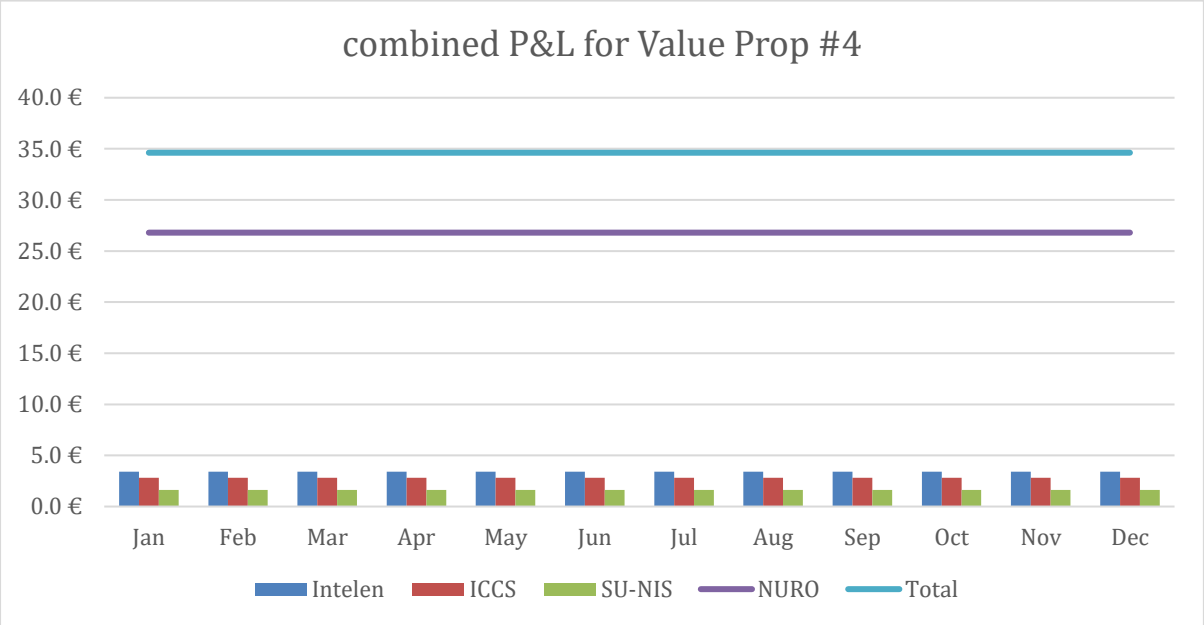

Figure 24: SOCIALENERGY combined P&L for one year for value proposition #4

Revenue streams projections for value proposition #4

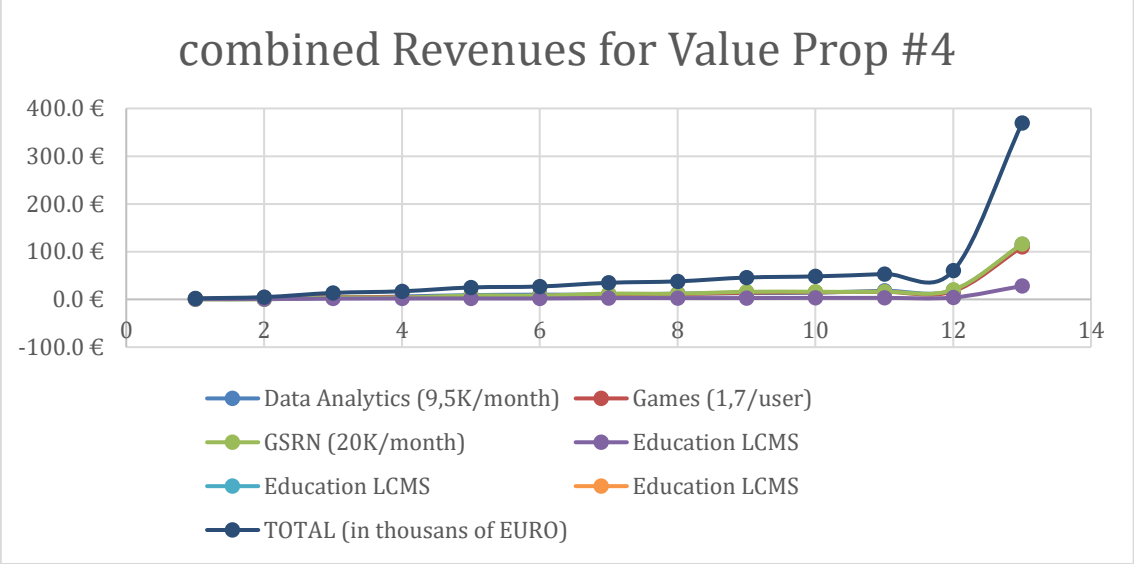

Figure 25: Revenue stream projection for value proposition #4

Respectively, the Revenue Streams for the Value proposition #4, will have the majority of the principal revenue, which is the selling the Game and relevant services. The pricing methodology includes also a combo product pricing towards the final customer, which also includes the support prices of all modules from all partners. The combined weighted revenue projection for one year for Value Prop #4 is shown in the figure above.

<u>Break-even point in July</u> (revenues in July 34,8K vs 34,8K expenses)

REVENUES (in thousans of EURO)	One Projected Year Revenues for Value Prop #4												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Data Analytics (9,5K/month)	0,4 €	1,0 €	3,0 €	6,0 €	9,0 €	10,0 €	10,0 €	12,0 €	13,0 €	14,0 €	18,0 €	19,0 €	115,4 €
Games (1,7/user)	1,0 €	3,0 €	5,0 €	5,0 €	6,0 €	7,0 €	10,0 €	11,0 €	14,0 €	15,0 €	16,0 €	17,0 €	110,0 €
GSRN (20K/month)	0,0 €	0,0 €	4,0 €	4,0 €	8,0 €	8,0 €	12,0 €	12,0 €	16,0 €	16,0 €	16,0 €	20,0 €	116,0 €
Education LCMS	0,8 €	0,8 €	1,6 €	2,0 €	2,0 €	2,0 €	2,8 €	2,8 €	2,8 €	3,2 €	3,2 €	4,0 €	28,0 €
TOTAL (in thousans of EURO)	2,20 €	4,80 €	13,60 €	17,00 €	25,00 €	27,00 €	34,80 €	37,80 €	45,80 €	48,20 €	53,20 €	60,00 €	369,40 €

<u>Lessons learned and respective R&I insights related with value proposition #4</u>

Table 6: Summary of lessons learned and R&I insights for value proposition #4

Lesson learned	R&I insight
Need to enhance the gaming experience in order to offer a really innovative product in the gaming market	Use of interactive technologies such as Virtual Reality (VR) and Augmented Reality (AR) in order to create a cyber-physical environment in which the end users will not only play the GAME but their actions within the GAME will be transferred in the real-life environment
End users would like to play a multi-player version of the game	Non-technical factors that affect the user engagement in the gameplay should be studied in more depth.
End users would like to be able to interact more with the SOCIALENERGY's virtual world (GAME)	Make the learning/gaming process more personalized, interact more with LCMS and make the game player co-creator of the gameplay.
Utility (admin) users would like to be able to customize the operation of the SOCIALENERGY GAME point system including the dynamic pricing models.	More work is needed on mathematical models and research algorithms in order to make the gameplay more sophisticated and be able to provide many different gameplay versions (e.g. in the form of challenges) to the end users.

3. Report on the Dissemination & Communication Activities

SOCIALENERGY dissemination and communication activities are presented in seven (7) main categories, namely:

- Academia-oriented publications and events
- Presentations and participation at major international events
- Industry-oriented communication activities of SOCIALENERGY products to interested stakeholders
- Open access SOCIALENERGY reports, data and software
- Training activities and academic dissemination
- Cooperation and mutual dissemination activities with other related EU projects
- Other general public dissemination actions

3.1. Academia-oriented publications and events

Regarding academia-oriented publications and events, there are three main sub-categories, namely: a) international journal papers, b) international conference papers, and c) organization of SOCIALENERGY Special Sessions at international conferences. More details per dissemination item are provided below:

3.1.1. International journal papers

J1 – N. Doulamis, A. Doulamis and E. Varvarigos, "Virtual Associations of Prosumers for Smart Energy Networks under a Renewable Split Market", IEEE Transactions for Smart Grid, vol. PP, no. 99, pp. 1-1, 2017, DOI: 10.1109/TSG.2017.2703399, http://ieeexplore.ieee.org/document/7924428/.

This paper introduces the concept of dynamic clusters of energy prosumers created through information and communication technologies (ICTs) and are called Virtual Associations (VAs). VAs support the prosumers' active participation in the market, the dynamic formation of the clusters to maximize prosumers' profit and participation, and the fair competition among the VAs and among the prosumers. A fair sharing scheme is proposed that favors the most competitive VAs and prosumers, without excluding less competitive ones from the market. Different algorithms to form VAs are examined based on a min-max optimization strategy and fair sharing. Fair sharing provides: a) incentives to the VAs to increase their competitiveness, b) increased prosumers' participation and c) dynamic interaction with the market. Experimental results obtained on realistic traces reveal the advantages of the proposed energy community creation algorithms.

J2 – G. Tsaousoglou, P. Makris, E. Varvarigos, "Electricity Market Policies for Penalizing Volatility and Scheduling Strategies: the Value of Aggregation, Flexibility, and Correlation", Elsevier Sustainable Energy, Grids and Networks (SEGAN) Journal, vol. 12, pp. 57-68, December 2017, https://doi.org/10.1016/j.segan.2017.09.004

This paper presents a method of quantifying the value of energy prosumer's flexibility and provide insights for a future policy of effectively compensating prosumers for their

flexibility. The possibility of cooperation among energy prosumers in a certain geographical area is also studied, showing that it can lead to more intelligent and profitable operation of the system as a whole. Finally, the value of energy prosumption profiles' correlation is studied, too. As a general conclusion, we show that the cooperation among prosumers (i.e. clusters of prosumers or else virtual energy communities' formation) lead to less energy costs compared to the case when each prosumer acts individually. The results of this research have been integrated in SOCIALENERGY RAT subsystem.

J3 – K. Pancheva, A. Antonova, K. Stefanov, A. Georgiev, P. Mihnev, T. Malcheva, "Supporting European Energy Consumers through Gamification and Competence-based Learning", Serdica Journal of Computing, Vol. 11, Nr. 3-4, pp.225-248, January 2018. ISSN 1314-7897 – Online; ISSN 1312-6555 – Print, http://serdica-comp.math.bas.bg/index.php/serdicajcomputing/article/view/313

The European energy market liberalization strategy aims to assign a new role to consumers and end-users' communities so that they can become active participants on the energy market. In this paper, we present the project SOCIALENERGY, EU-funded under the H2020 program. This project aims to promote the EU energy market transformation policy and to deliver supporting instruments. By developing innovative ICT-based tools, the project consortium will empower the EU energy consumers to become more energy efficient and competent. Apart from presenting the advanced features of SOCIALENERGY multi-modular platform, we will highlight the importance of the novel competence-based education (CBE) framework to support educational activities and to promote creation of social communities in the energy efficiency domain.

J4 – K. Steriotis, G. Tsaousoglou, N. Efthymiopoulos, P. Makris, E. Varvarigos, "Real Time Pricing in Environments with Shared Energy Storage Systems", Springer Energy Efficiency Journal, August 2018, https://doi.org/10.1007/s12053-018-9723-8

This paper presents the business case in which an Energy Service Provider (ESP) owns a shared Energy Storage System (ESS) that could be exploited from its end users taking advantage of the fact that a shared ESS is more efficient than the operation of many individual ESSs (i.e. personal ESS case). Thus, we propose a shared ESS aware Real Time Pricing (RTP) model that achieves a very attractive trade-off in terms of the ESP's and end user's interests. We also compare our system with its predecessors (traditional RTP without storage and RTP with storage but without shared ESS) and we witness its superiority. The proposed scheme achieves much higher behavioral efficiency without sacrificing at all users' welfare and ESP's profit dynamics.

J5 – G. Tsaousoglou, N. Efthymiopoulos, P. Makris, E. Varvarigos, "Personalized Real Time Pricing for Efficient and Fair Demand Response in Energy Cooperatives and Highly Competitive Flexibility Markets", Springer Journal of Modern Power Systems and Clean Energy, October 2018, https://link.springer.com/article/10.1007%2Fs40565-018-0426-0.

This paper contributes to the well-known challenge of active user participation in demand side management (DSM). We propose a Personalized – Real Time Pricing (P-RTP) mechanism design framework that fairly allocates the system's cost reduction only to the users that provoke it. Our mechanism achieves significant reduction of the system's cost without sacrificing at all the welfare of electricity consumers. Fair allocation of monetary

benefits among all participating users is also ensured, which is very important in highly competitive flexibility market environments as well as in cooperative communities (e.g. EU RESCOOPs). This paper's algorithm has been integrated in the SOCIALENERGY RAT subsystem under the "Energy Programs" tab. Thus, the administrative user is able to run exhaustive "what-if" scenarios in order to recommend beneficial energy programs to flexible energy consumers (i.e. end users who are willing to change their energy consumption behavior and get appropriately reimbursed).

J6 – P. Makris, N. Efthymiopoulos, V. Nikolopoulos, A. Pomazanskyi, B. Irmscher, K. Stefanov, K. Pancheva, E. Varvarigos, "Digitization era for progressive electric utilities: A novel business model through an inter-disciplinary S/W platform and open research challenges", IEEE Access Journal, vol. 6, pp. 22452-22463, April 2018, 10.1109/ACCESS.2018.2828323.

This position paper describes the SOCIALENERGY S/W platform (as a whole) and the respective business model and value propositions. It also provides important research and innovation insights and challenges to be addressed towards the proposed Green Social Response Network (GSRN) concept and the exploitation of SOCIALENERGY system as part of more complex systems for the 2030 smart grid era and beyond. This paper has also been used as a brochure for SOCIALENERGY's communication activities with interested industrial stakeholders (see more in section 3.3 below).

J7 – I. Mamounakis, N. Efthymiopoulos, P. Makris, D. J. Vergados, G. Tsaousoglou, E. Varvarigos, "A novel community pricing scheme for managing virtual energy communities and promoting behavioral change towards energy efficiency", Elsevier Electric Power Systems Research (EPSR), vol. 167, pp. 130-137, February 2019, https://doi.org/10.1016/j.epsr.2018.10.028

In this paper, we propose a Community Real Time Pricing (C-RTP) scheme together with an Energy Community Formation Algorithm (ECFA), where users are clustered in virtual energy communities (VECs) according to: i) their level of flexibility in modifying their energy consumption, and ii) their relationships in Online Social Networks (OSNs). We show that C-RTP with ECFA can achieve considerable reduction in system's energy cost, while simultaneously resulting in a greater aggregated users' welfare (AUW) than with the state-of-the-art real time pricing. C-RTP also adopts a much fairer pricing policy as each user is rewarded exactly according to her individual contribution in reducing system costs, thus promoting further the desired behavioral change. This paper's algorithm has been integrated in the SOCIALENERGY RAT subsystem under the "Energy Programs" tab. Thus, the administrative user is able to run exhaustive "what-if" scenarios in order to recommend beneficial energy programs to flexible energy consumers (i.e. end users who are willing to change their energy consumption behavior and get appropriately reimbursed).

J8 – K. Steriotis, G. Tsaousoglou, N. Efthymiopoulos, P. Makris, E. Varvarigos, "A Novel Behavioral Real Time Pricing Scheme for the Active Energy Consumers' Participation in Emerging Flexibility Markets", Elsevier Sustainable Energy, Grids and Networks (SEGAN) Journal, vol. 16, pp. 14-27, Dec 2018, https://www.sciencedirect.com/science/article/pii/S2352467718300201.

As we argue in this paper, the energy pricing schemes proposed so far (e.g. Real Time Pricing) do not provide strong enough financial incentives to consumers to modify their energy consumption habits, and are therefore unfair and unable to effectively trigger

behavioral changes. Based on this observation, we develop a Behavioral Real Time Pricing (B-RTP) scheme, which offers an easily adjustable level of financial incentives to participating users by fairly rewarding the ones that make desirable behavioral changes in the way they consume electricity. Performance evaluation results demonstrate that the proposed B-RTP scheme affects the behavior of the consumers much more efficiently than RTP, outperforming the latter in all widely adopted metrics. B-RTP is able to reduce energy cost from 6% to 30% compared with RTP by slightly increasing in the same time end users' welfare from 1% to 3%. B-RTP algorithm elaborates on the P-RTP algorithm described in J4 above, by not only modeling curtailable loads but also shiftable ones.

J9 – I. Mamounakis, N. Efthymiopoulos, D. J. Vergados, G. Tsaousoglou, P. Makris, E. Varvarigos, "A pricing scheme for electric utility's participation in day-ahead and real-time flexibility energy markets", Springer Journal of Modern Power Systems and Clean Energy, May 2019, in press, DOI: 10.1007/s40565-019-0537-2.

Energy Service Providers (ESPs) have to offer to their end users (consumers) competitive (low cost) energy services. In this context, novel pricing schemes must act, among others, as automated demand side management (DSM) techniques able to trigger the desired behavioral changes according to the flexibility market prices in the energy consumption curves (ECCs) of the consumers. Energy pricing schemes proposed so far, e.g. real time pricing, interact in an efficient way with wholesale market, but they do not provide strong enough financial incentives to consumers to modify their energy consumption habits towards energy cost curtailment and thus they do not interact efficiently with emerging flexibility markets. Based on this observation, we developed a flexibility real time pricing (FRTP) scheme, which offers a dynamically adjustable level of financial incentives to participating users by fairly rewarding the ones that make desirable behavioral changes in their ECCs. Performance evaluation results demonstrate that the proposed FRTP is able to offer a 15%-30% more attractive trade-off between the stacked profits of ESPs (sum of the profits from retail and market) and the satisfaction of the consumers.

J10 – G. Tsaousoglou, K. Steriotis, N. Efthymiopoulos, P. Makris, E. Varvarigos, "Incentive Compatibility, Scalability and Privacy in real time Demand Response", under review in IEEE Transactions on Smart Grid, March 2019, https://arxiv.org/abs/1902.09251.

From a game-theoretic perspective, the basic key performance indicators (KPIs) for Demand Response (DR) mechanisms are: efficiency in terms of social welfare, practical applicability, and incentive guarantees, in the sense of making it a dominant strategy for each end user to act truthfully according to his/her preferences, leaving no room for cheating. In this paper, we propose a DR architecture, including a mechanism based on Ausubel's clinching auction and a communication protocol, such that both efficiency and truthful user participation are provably guaranteed. Practicality/easiness of participation is enhanced via simple queries, while user privacy issues are addressed via a distributed implementation. Simulation results confirm the desired properties, while also showing that the truthfulness property becomes even more important in markets, where participants are not particularly flexible.

J11 – G. Tsaousoglou, K. Steriotis, K. Smpoukis, N. Efthymiopoulos, E. Varvarigos, "Near-optimal demand side management for retail electricity markets with strategic users and coupling constraints", accepted (with minor changes) in Elsevier Sustainable Energy, Grids and Networks (SEGAN) Journal, June 2019.

The main objective of DSM is to achieve an aggregated energy consumption pattern that is efficient in terms of energy cost reduction, welfare maximization and/or satisfaction of network constraints. This is generally envisaged by encouraging electricity use at low-peak times. In this paper, we consider a system with strategic, price-anticipating energy consumers with private preferences that choose their electricity consumption patterns so as to maximize their own benefit. In this context, we take on the problem of coordinating the consumers' consumption behavior without sacrificing their welfare (i.e. Quality of Experience). In order to tackle this problem, we draw on concepts of indirect mechanism design and propose a DSM architecture that is able to fulfill specific system-wide constraints (e.g. energy cost reduction) and simultaneously achieve welfare that is very close to optimal. The proposed billing rule preserves both the budget-balance and the individual rationality properties. According to our evaluation, the proposed DSM architecture achieves a close to optimal allocation (1%-3% gap), compared to an "optimal" system that would use central optimization of user loads without user consensus or protection of their privacy.

J12 – D. J. Vergados, P. Makris, I. Mamounakis, G. Tsaousoglou, K. Steriotis, N. Efthymiopoulos, E. Varvarigos, "RABIT: A Business Analytics and Intelligence Tool for the Digital Transformation of Energy Retailers", under review in Elsevier SoftwareX Journal, June 2019.

This paper describes the S/W tool developed by ICCS team within the SOCIALENERGY project. RABIT is a Research Algorithms and Business Intelligence software Tool targeting companies, which provide advanced energy services to end users in the retail electricity market. RABIT has been developed within the context of the EC-funded H2020 SOCIALENERGY project as part of the SOCIALENERGY S/W platform. RABIT collects various types of data sources from end users such as energy, behavioural and social network related ones. Then, data analytics tools are used in order to unveil the potential added value out of these structured datasets. The next step is to combine data analytics results with specific Key Performance Indicators (KPIs) in order to quantify research algorithms' results and assess their business impact. Finally, the business analytics process is automated and can be connected with the real-time business operation according to the high-level objectives of the company. This paper has also been used as a brochure for SOCIALENERGY's communication activities with interested industrial stakeholders (see more in section 3.3 below).

J13 – K. Steriotis, K. Smpoukis, N. Efthymiopoulos, G. Tsaousoglou, P. Makris, E. Varvarigos, "Strategic and Network-Aware Bidding Policy for Electric Utilities through the Optimal Orchestration of a Virtual and Heterogeneous Flexibility Assets' Portfolio", under review in Elsevier Electric Power Systems Research (EPSR) Journal, May 2019.

High renewable energy penetration and exploitation of heterogeneous flexibility assets require an effective interaction between efficient energy markets and electricity grid management systems. In this business environment, modern Energy Service Providers (ESPs) need to: i) adopt imperfect market context - aware bidding strategies to maximize their profits, ii) respect the underlying network constraints, and iii) make decisions about the optimal mix of their heterogeneous flexibility (HetFlex) assets as well as their optimal sizing,

siting and operation. We propose a model that factorizes all the above and an algorithm that, optimally and in an integrated way, schedules Energy Storage Systems (ESSs) and Demand Side Management (DSM) systems in order to maximize a price maker ESP's profits. We model this problem as a Stackelberg game, expressed as a Mathematical Problem with Equilibrium Constraints (MPEC), which is finally transformed into a tractable mixed integer linear program (MILP). We show that: i) ESP's profits can be considerably increased, by on average 20% compared to the price taker solution, ii) the impact of HetFlex assets' siting and sizing can be accurately quantified, iii) even if the ESP accounts for a small portion of market's supply or demand capacity (i.e., low market power), significant profit benefits can be obtained, and iv) the network-aware feature leads not only to higher profits, but also to the avoidance of vital distribution network constraints' violation.

3.1.2 International conference papers

C1 - I. Mamounakis, D. J. Vergados, P. Makris, E. Varvarigos, N. Doulamis, "*A method for clustering RES prosumers towards creating target aggregated prosumption profiles based on recursive predictions*", 12th IEEE PES PowerTech Conference, Manchester, UK, 18-22 June 2017, DOI: 10.1109/PTC.2017.7981174, http://ieeexplore.ieee.org/document/7981174/

Dr. Prodromos Makris has presented this paper in 12th IEEE PES PowerTech Conference at Manchester (UK), which took place on 18-22 June 2017. The paper focuses on the problem of finding the set of prosumers, whose aggregate prosumption profile can best fit a given target pattern requested by a smart grid market actor. A linear autoregressive forecasting algorithm and a genetic clustering algorithm are proposed, which can easily adapt to the requirements set by the various SOCIALENERGY use cases. Numerical results show that the SOCIALENERGY S/W platform (i.e. Research Algorithms' Toolkit – RAT developed by ICCS team) can produce clusters (or else virtual energy communities) in real time improving the average deviation from the target pattern by up to 50%.

C2 – I. Mamounakis, D. J. Vergados, P. Makris, E. Varvarigos, "*Communication costs versus smart grid system performance for energy prosumers' participation in liberalized electricity markets: A trade-off analysis*", 32nd International Union of Radio Science General Assembly & Scientific Symposium (URSI GASS 2017), Special Session on "Communications for the Smart Grid" (invited paper), Montreal, Canada, 19-26 August 2017. 10.23919/URSIGASS.2017.8104964, http://ieeexplore.ieee.org/document/8104964/

This invited research paper was presented in the 32nd URSI GASS conference in Montreal, Canada on 21st August 2017. In this paper, we studied the trade-off problem between data communication cost and smart grid system performance for energy prosumers' participation in liberalized electricity markets. This work was an extended version of the work undertaken by ICCS team in the context of FP7-GA-619547 VIMSEN project. Within SOCIALENERGY context, this work studied the trade-off for the communication among the S/W agents (i.e. between each consumer and the SOCIALENERGY platform) regarding the dynamic pricing towards realizing the various proposed DR energy programs in an efficient way.

C3 – P. Makris, N. Efthymiopoulos, D. J. Vergados, E. Varvarigos, V. Nikolopoulos, J. Papagiannis, A. Pomazanskyi, B. Irmscher, K. Stefanov, K. Pancheva, A. Georgiev, "SOCIALENERGY: A Gaming and Social Network Platform for Evolving Energy Markets' Operation and Educating Virtual Energy Communities", IEEE ENERGYCON 2018, Limassol, Cyprus, 3-7 June 2018, https://ieeexplore.ieee.org/document/8398797.

Dr. Prodromos Makris presented this position paper in IEEE ENERGYCON 2018 under the Special Session on "Digitization era for the smart energy grid: Innovative S/W platforms, services, applications and business models", which was organized by ICCS. It is a position paper that describes the work progress in SOCIALENERGY project so far and disseminated its results to a targeted academic audience of the conference. Fruitful technical discussions have taken place in this Special Session, which ended up in new H2020 proposals' submission. One of these project proposals (i.e. FLEXGRID-GA-863876) has been recently accepted for EC funding and will start in October 2019 (see more details in section 3.7 below).

C4 – K. Steriotis, G. Tsaousoglou, N. Efthymiopoulos, P. Makris, E. Varvarigos, "*Development of Real Time Energy Pricing Schemes that Incentivize Behavioral Changes*", IEEE ENERGYCON 2018, Limassol, Cyprus, 3-7 June 2018, https://ieeexplore.ieee.org/document/8398840.

Mr. Konstantinos Steriotis presented this paper in IEEE ENERGYCON 2018 and it is a a Behavioral Real Time Pricing (B-RTP) scheme, which offers an adjustable level of financial incentives to participating users, rewarding desirable behavioral changes (in the form of their Energy Consumption Curve). Our evaluation results compare RTP and B-RTP, showing that our proposed B-RTP affects the behavior of the participating users much more efficiently than RTP, outperforming the latter in all widely adopted metrics. This paper is part of the technical work undertaken in the context of 'J7' journal paper described above.

C5 – I. Mamounakis, N. Efthymiopoulos, G. Tsaousoglou, D. J. Vergados, P. Makris, E. Varvarigos, "*A Novel Pricing Scheme for Virtual Energy Communities Towards Energy Efficiency*", IEEE ENERGYCON 2018, Limassol, Cyprus, 3-7 June 2018, https://ieeexplore.ieee.org/document/8398843.

Dr. Dimitrios Vergados presented this paper as part of the Special Session organized by ICCS and INTELEN in the context of IEEE ENERGYCON 2018 conference. It is actually a shorter version of the previously mentioned journal paper 'J6'. ICCS demonstrated various functionalities from SOCIALENERGY S/W platform such as the Energy Community and dynamic adaptation, the context-aware recommendation service and other data analytics services offered by the RAT subsystem.

C6 – P. Makris, D. J. Vergados, I. Mamounakis, G. Tsaousoglou, K. Steriotis, N. Efthymiopoulos, E. Varvarigos, "A Novel Research Algorithms and Business Intelligence Tool for Progressive Utility's Portfolio Management in Retail Electricity Markets", accepted in IEEE ISGT Europe 2019, Bucharest, Romania, 29 September - 2 October 2019, http://sites.ieee.org/isgt-europe-2019/.

This paper will be presented by Dr. Prodromos Makris in the prestigious IEEE ISGT Europe 2019 conference. Progressive electric utilities are gradually digitizing their business in order to be able to efficiently manage their customer portfolio and cope with the increasing competition in the retail market. Thus, advanced S/W tools and platforms are needed, like the Research Algorithms and Business Intelligence Tool (RABIT) proposed in this paper. RABIT

provides advanced data analytics services (i.e. advanced search, profilers, recommenders) targeted to the utility's administrative users (e.g. business analysts). In addition, it disposes: i) dynamic and behavioural pricing models linked with various innovative energy programs, and ii) algorithms for the creation and dynamic adaptation of virtual energy communities. RABIT can also automatically analyze exhaustive business/strategy 'what-if' scenarios by running parameterized system-level simulations. Performance evaluation results show that a utility company can exploit RABIT in order to: i) reduce costs for purchasing energy from wholesale market, ii) enhance its end users' welfare, iii) increase its business profits, and iv) increase its portfolio's energy efficiency. This paper is also being used as a brochure for SOCIALENERGY's communication activities with interested industrial stakeholders (see more in sections 3.3 and 3.7 below).

C7 – G. Tsaousoglou, K. Steriotis, E. Varvarigos, "A stochastic approximation method for price-based assignment of Electric Vehicles to Charging Stations", under review in 2nd International Conference on Smart Energy Systems and Technologies (SEST), Porto, Portugal, 9-11 September 2019, https://web.fe.up.pt/~sest2019/index.html.

This paper considers a setting where a number of users want to drive their Electric Vehicles (EVs) to a certain geographical area, park them in a Charging Station (CS), and receive them fully charged upon departure. Each CS faces a number of constraints related to the power that it can provide. In order to serve its EVs, each CS solves an optimization problem to derive the charging schedule, so that no constraints are violated and the energy needs of the parked EVs are met. The motivating problem is that centrally located CSs become congested and users that arrive later can no longer be served. In order to tackle this problem, we propose a method for the stochastic estimation of Charging Stations' shadow prices based on a dual decomposition method applied to offline simulations. Prices are determined so as to serve as many EVs as possible and minimize the social cost, while satisfying their constraints and energy needs. The algorithm's performance was evaluated under a number of possible online scenarios and compared to a benchmark solution in terms of competitive ratio and number of EVs served.

3.1.3. Organization of scientific SOCIALENERGY special sessions and/or workshops at international conferences

SS1 - Special Session on "Digitization era for the smart energy grid: Innovative S/W platforms, services, applications and business models", organized by SOCIALENERGY project, chaired by E. Varvarigos (SOCIALENERGY Coordinator) and V. Nikolopoulos (INTELEN CEO), IEEE ENERGYCON 2017, 3-7 June 2018, Limassol, Cyprus. http://www.energycon2018.org/

ICCS coordination team together with INTELEN organized an academic special session in the context of the 5th IEEE International Energy Conference and was be held between 3-7 June 2018. It is organized by the IEEE Cyprus Section, the IEEE PES Cyprus Chapter, and the KIOS Research and Innovation Center of Excellence of the University of Cyprus, in partnership with IEEE Region 8. ENERGYCON covers a broad range of electric power and energy systems topics and is open to contributions that are related to the theme "Towards Self-healing, Resilient and Green Electric Power and Energy Systems". The special session/track organized by SOCIALENERGY project discussed new emerging research and commercial trends regarding the "softwarization" of the smart grid as well as gaming/gamification and educational

approaches with respect to energy efficiency.

3.2. Presentations and Participation in major international events

P1 – ICCS presentation of SOCIALENERGY project in FP7 VIMSEN project industrial workshop, Athens, 13 January 2017, http://ict-vimsen.eu/images/Open_Data/workshop_presentations.pdf (see slides 260-281).

Dr. Nikolaos Efthymiopoulos presented the SOCIALENERGY project in an industry-oriented audience in Athens. Potential collaborations with other related projects have been discussed and respective foreground knowledge has been exchanged.

P2 – ICCS presentation of SOCIALENERGY project in a business day event called PANORAMA, Athens, 17 March 2017, http://www.pan-orama.org/efthymiopoulos-nikolaos/

Dr. Nikolaos Efthymiopoulos (ICCS) together with Dr. Vassilis Nikolopoulos (INTELEN) have participated in this business day event in Athens disseminating SOCIALENERGY's ideas and receiving valuable feedback from the participants.

P3 – INTELEN presentation in Energy and Commodities Conference, 12-13 May 2017, http://www.energycommodities.gr/default.asp?la=2.

INTELEN was a speaker. Presentation of INTELEN's engagement platform and connection with SOCIALENERGY project (gamified energy efficiency).

P4 – NUROGAMES participation and communication activities in Brussels Sustainable Energy Week, 19-25 June 2017, http://www.eusew.eu/

NRG engaged in a number of B2B meetings with relevant stakeholders of the energy market that further triggered one-on-one follow up calls discussing further collaboration on the project level and after the project end.

P5 – SU-NIS participation at major national event, on 26 June 2017, SOCIALENERGY project presentation by SU-NIS during the meeting of Bulgarian scientists with Director – General for Research and Innovation in EC: Robert-Jan Smits.

SU-NIS presented in front of Bulgarian scientists community and Director – General for Research and Innovation in EC Robert-Jan Smits project SOCIALENERGY together with its main objectives and activities.

P6 – NUROGAMES participation in Gamescom 2017, Cologne, 21-25 August 2017, http://www.gamescom-cologne.com/gamescom/index-9.php

Exploring the potential of SOCIALENERGY Game as a standalone product, NRG has engaged with a number of publishers to make them aware of the game under development. Further demonstrations are agreed upon final product readiness.

P7 – INTELEN participation in Ashoka, Energy Poverty Conference 2017, Athens, 22 September 2017, Schneider Electric Foundation, http://tacklefuelpoverty.com,

http://www.cnn.gr/oikonomia/epixeiriseis/story/98556/h-ashoka-greece-sti-maxi-gia-tin-katapolemisi-tis-energeiakis-ftoxeias.

INTELEN presented SOCIALENERGY project towards offering solutions to the energy poverty problem from a socio-economic perspective.

P8 – INTELEN participation in European Utility Week, Amsterdam, 3-5 October 2017**,** http://www.european-utility-week.com/.

INTELEN was an exhibitor and presented SOCIALENERGY project. Presentation of the SOCIALENERGY Project and exhibition of SOCIALENERGY impact at INTELEN's stand.

P9 – ICCS participation in a stakeholder meeting about Digital Education organized by the European Commission, Luxembourg, 10-11 December 2018, https://ec.europa.eu/digital-single-market/en/news/digital-education-stakeholders-meeting

In this stakeholder meeting, representatives from a cluster of ongoing H2020 projects in the Digital Education sector presented the progress of their projects. All projects presented their underlying rationale, focus, status quo and reflected on achievements, challenges and future vision. A brief summary of achievements, challenges, lessons learnt and future visions can be found in https://ec.europa.eu/digital-single-market/en/news/digital-education-stakeholders-meeting. Dr. Prodromos Makris had very fruitful discussions with several project representatives contributing also in the brainstorming sessions during the second day. The minutes of this meeting and more technical details of the discussed topics are provided in the web link above.

P10 – SU-NIS presentation during 6th international Exhibition & Conference for South-East Europe "Smart Cities" (https://viaexpo.com/en/pages/smart-cities), which took place in the InterExpo Centre on 27-29 March 2018, Sofia Bulgaria.

The event was dedicated to energy efficiency and digital solutions for citizens and integrated services like intelligent energy, water, waste and resource management. Special attention has been paid to issues related to digital transformation as a key prerequisite for the sustainable business development in the South East Europe. The project Social Energy was presented on a special track. During the discussion, companies' representatives and conference participants discussed different cooperation opportunities for more efficient, ecological and cost-effective solutions for every industry, municipality or home.

P11 – Presentation named "LCMS in SOCIALENERGY project" was presented by Katina Pancheva and Pencho Mihnev at the "Springtime Scientific Conference" of the Faculty of Mathematics and Informatics (FMI), Sofia University on March 31, 2018 (https://intranet.fmi.uni-sofia.bg/index.php/s/kKy1QpxHUom8t1g)

P12 – NUROGAMES participation in Gamescom 2018, Cologne, August 2018, https://www.gamescom.global/.

In August 2018, NRG had presented publicly the Gameplay of the SOCIALENERGY Game during the biggest event Gamescom 2018 taking place every year in Cologne, Germany. During the event, NRG had a dedicated booth within the Indie Area where public visitors could see the trailer and the play the demo of the game. Additionally, gameplay of SOCIALENERGY and the

scope of the project were presented in the Business Area of the event, specifically at the Medien Digital Land NRW stand area. In addition, the prototype has gone through the USK certification for public presentations.

P13 – Presentation of SOCIALENERGY's DEMO videos during the "European Researchers' Night" events, which took place on 28th September 2018 in Sofia, Plovdiv, Varna, Russe, Stara Zagora, Veliko Tarnovo, Shumen, Burgas, Harmanli, Haskovo and Sozopol.

The event in Sofia was organized at the Rectorate of Sofia University "St. Kliment Ohridski" (SU-NIS), where the visitors had the chance to participate in hands-on experiments, discussions, workshops, round tables, quizzes and games, as well as to visit exhibitions and the EU Corner stand. At the main hall of the venue, the EU Corner stand was installed where information about projects and activities funded by EU programs were presented by members of projects' implementation teams. Leaflets, brochure, flyers and gadgets produced within those projects were available to the interested visitors. A media screen was installed at the hall and short movies and videos produced under EU projects were projected during the whole duration of the night, including the SOCIALENERGY DEMO videos.

P14 – In August 2019, NUROGAMES again takes part in Gamescom 2019 event, whereas area spaces have already been reserved to showcase the latest developments and present the results to the industrial partners.

P15 – INTELEN presentation in Energy and Commodities Conference, 12 June 2019**,** http://www.energycommodities.gr/

INTELEN was a speaker. Presentation of INTELEN's engagement platform and connection with SOCIALENERGY project.

P16 – INTELEN presentation in Entrepreneurship Panorama**,** 23 March 2019 https://www.pan-orama.org/

INTELEN was a speaker, presenting the SOCIALENERGY platform and the extensions of Energy ICT in the electric utility markets.

3.3. Industry-oriented communication activities of SOCIALENERGY products to interested stakeholders

IC1 – INTELEN presentation to ENGIE Laborelec regarding energy analytics and SOCIALENERGY impact. ENGIE Laborelec lab, Brussels**,** http://www.engie.com/en/commitments/reasearch-innovation/research-laboratories/laborelec

INTELEN was a speaker at the workshop. Presentation to ENGIE Laborelec regarding energy analytics and SOCIALENERGY's potential impact.

IC2 – NRG direct engagement with the Senior Manager of Deloitte Limited Innovation and Entrepreneurship Centre, which launched an Accelerator, working closely with ESCOs and a number of other stakeholders of energy market. http://www.ariscy.com/

IC3 – INTELEN and ICCS presentation of SOCIALENERGY project to PROTERGIA S.A. https://www.protergia.gr/

PROTERGIA S.A (Mytilineos group) is one of the biggest private electric utilities in Greece with more than 160K users and customers. INTELEN and ICCS presented the SOCIALENERGY platform to Mytilineos-Protergia and they are very interested in taking part in the pilots (smart meters and consumers) and then buying the product to deploy it to their customer base (in compliance with their Digital Transformation strategy).

IC4 – INTELEN and ICCS presentation of SOCIALENERGY project to TERNA Energy (GEK Terna Group), http://www.terna-energy.com/ ICCS team presented SOCIALENERGY project and discussed several potential exploitation activities in collaboration with TERNA Energy. The meeting took place in TERNA's offices on 6/5/2019.

TERNA ENERGY is a vertically organized Renewable Energy Sources company undertaking the Development, Construction, Financing, and Operation of renewable energy projects (wind, hydro, solar, biomass, waste management). TERNA ENERGY operates, is constructing or has full licensing RES installations in Europe and America. The Company is targeting, in the longer-term horizon, to reach almost 2,000 MW of RES projects in operation in all countries where it has selected to extend its activities. TERNA ENERGY is also active in international initiatives to further promote the use of RES. The company is also a member of the European Renewable Energy Federation (EREF).

IC5 – ICCS presentation of SOCIALENERGY project and RABIT tool to NRG Electricity Provider in Greece, https://nrgprovider.com/en. ICCS team had a fruitful meeting with Mrs. Vanessa Larissi (Operations Manager, Energy Supply Division, NRG Trading House S.A.) on 31/5/2019.

In 2012, NRG enters the energy market. Today, NRG is among the top companies in the energy sector. By holding a strong Corporate Portfolio that comprises of both large business groups and small and medium-sized enterprises, and increasing steadily its market share in household consumption, NRG is rapidly rising. Our long-term plan is to further develop and expand the company's activities, with a view to actively participate in the constantly changing environment of the energy market. To this end, NRG enters the Natural Gas market, aiming at providing its customers a wider range of services. With the prestige and reliability of Motor Oil, NRG is today one of the leading companies in the fast growing energy market of Greece. ICCS team demonstrated the RABIT S/W tool as well as the SOCIALENERGY S/W platform to the NRG's operations manager. A short list of ideas for ICCS-NRG cooperation have been agreed.

IC6 – ICCS presentation of SOCIALENERGY project and RABIT tool to the Independent Power Transmission Operator (IPTO) of Greece, http://www.admie.gr/en. ICCS team discussed about the use of data analytics, research algorithms and flexibility services' provisioning

with IPTO's Director of Research, Technology and Development (Dr. George P. Papaioannou) and other members of his team on 24/5/2019.

The Independent Power Transmission Operator (IPTO or ADMIE) S.A. was established in compliance with Law 4001/2011 and European Union Directive 2009/72/EC regarding the adoption of common rules in the organization of EU electricity markets. According to Law 4001/2011 ADMIE undertakes the role of Transmission System Operator for the Hellenic Electricity Transmission System and as such performs the duties of System operation maintenance and development so as to ensure Greece's electricity supply in a safe, efficient and reliable manner. As of 20/6/2017, ADMIE follows the model of proprietary separated Administrator (Ownership Unbundling) and is fully harmonized with the Directive 2009/72/EC. The outcome of this meeting was to submit a new national project proposal in Greece on 4/6/2019 (together with Protergia S.A. as mentioned above). This proposal elaborates on SOCIALENERGY's research concepts in order to study the interaction between the operation of energy markets and transmission network operation.

IC7 – ICCS presentation of SOCIALENERGY project and RABIT tool to the Aegean Energy and Environment Agency (AEGEA), http://www.aegean-energy.gr/en/index.php. ICCS team discussed about social innovation actions in the energy sector and how could the use of SOCIALENERGY S/W platform help the EU's smart energy citizens in the future with Mr. Kostas Komninos and Mrs. Alkisti Florou on 7/6/2018.

The Aegean Energy and Environment Agency (AEGEA) was established in 2008 as a non-profit organization to support Greek islands and local authorities on sustainable development. The Agency's strategic target is to increase the islands' capacity on renewable energy, energy efficiency, wastes & water management, rational use of local resources, preservation of cultural heritage and landscape. Furthermore, AEGEA is acting as the technical and political advisor of islands in their participation in European projects and networks (Pact of Islands, Smart Islands Initiative etc.) AEGEA is also an active member of the European organization FEDARENE. The outcome of this meeting was to devise a digital social innovation platform facilitating EU energy communities' administration, holistic energy consultancy services' provisioning, e-commerce and bottom-up clean energy investments. A new H2020 project proposal has been prepared and has been submitted in September 2018. Both partners are now working on re-submitting an updated version of this project idea in another related call.

IC8 – Within Casual Connect Europe (http://europe.casualconnect.org/), that took place in October 23-26th 2018, SOCIALENERGY was presented to stakeholders in the gaming industry, more specifically to the investors and publishers seeking for serious gaming initiatives with more than 2000 participants.

IC9 – In January 2019, NRG submitted the SOCIALENERGY Game to the German Computer Game Awards (https://deutscher-computerspielpreis.de/) Committee within the categories as the Best Serious Game, Best Innovation 2019 thus raising the awareness of the project among the industry professionals.

IC10 – SOCIALENERGY project together with a demonstration of the GAME were presented on April 11th, 2019 in Brussels at the premises of the Deutsches Haus der Land- und Ernährungswirtschaft.

SOCIALENERGY Demo was presented by Andrew Pomazanskyi (Nurogames GmbH), also leading a discussion on energy use and its contribution to circular economy. NRG communicated ongoing SOCIALENERGY results to a number of stakeholders involved in circular economy ecosystem, which includes FNR (https://www.fnr.de/), iCons Foundation and BTG World.

3.4. Open Access SOCIALENERGY reports, data and software

Regarding the open access SOCIALENERGY reports, data and software, there are three main sub-categories, namely: a) public SOCIALENERGY reports and deliverables, b) open access datasets, and c) open access SOCIALENERGY software and user manuals.

Regarding (a), all SOCIALENERGY deliverables (together with all other dissemination material like scientific papers) are made public in the project's website (see the "Downloads" tab[3]), so as everyone may have access and download the respective material.

Regarding (b), each SOCIALENERGY subsystem provides open datasets to be used mainly for research purposes. For more details about the structure and contents of these datasets, please see the Data Management Plan – DMP in D6.1 (M6).

Finally, regarding (c), the consortium's strategy is to have a basic version of S/W prototypes fully accessible to anyone interested in understanding the basics about the whole system's operation and experiment with its innovative functionalities. In particular, a comprehensive user manual is now available for every subsystem and the system as a whole in order for everyone to be able to start experimenting with the platform's functionalities. This developer user's manual is provided in D5.2 (M18). Furthermore, the SOCIALENERGY end user's manual is provided in D5.3 (M27). This is done in order to further disseminate the project's results (i.e. SOCIALENERGY foreground knowledge). However, the final version of S/W prototypes (especially regarding the GSRN and GAME components) will be kept in "closed/restricted access" in order to boost the commercial exploitation activities of the two companies and protect the respective IPR.

3.5. Training activities and academic dissemination

TA1 – Spring Scientific Session of the Faculty of Mathematics and Informatics, Sofia University (SU-NIS), 25 March 2017.

SU-NIS team presented SOCIALENERGY subsystems and work progress related to LCMS. Discussed with lecturers, students and interested parties were the LCMS functionalities and SE competence framework.

[3] http://socialenergy-project.eu/index.php/downloads

TA2 – Prof. Manos Varvarigos presentations in the context of academic lectures at the Monash University, Department of Electrical and Computer Systems Engineering, 2017-2018.

During academic year 2017-2018, Prof. Manos Varvarigos included many SOCIALENERGY-related presentations and lectures in his academic program.

TA3 – ICCS team presentations in the context of academic lectures, National Technical University of Athens (NTUA), School of Electrical and Computer Engineering, 2017-2018.

During academic year 2017-2018, ICCS team made several SOCIALENERGY-related presentations and lectures in the NTUA's BSc and MSc program.

TA4 – ICCS team undertook one (1) training event in the premises of the National Technical University of Athens (hands-on experience workshop on the first release of SOCIALENERGY RAT toolkit, 10 BSc/MSc and PhD students attended), March 2018.

Once the first stable version of the RAT S/W toolkit has been released, ICCS team organized a training event for a total of approximately twenty BSc/MSc students, who had a hands-on experience with the RAT.

TA5 – The project "Social Energy" and its elements (the game and the e-learning platform) were presented by Albena Antonova within the short-term vocational course "Energy market development in Bulgaria – regulations, prices and energy trade" co-organized by the Centre for Training services at Sofia University and the journal "Utilities". The course took place on 8th, 9th and 10th of August 2018 in Sofia. There were involved 35 participants – energy company representatives, doctoral students and interested energy experts.

TA6 – ICCS team undertook another training event in the premises of the National Technical University of Athens (hands-on experience workshop on the first release of SOCIALENERGY RABIT toolkit, 18 BSc/MSc and PhD students attended), March 2019.

Once the second stable version of the RAT S/W toolkit has been released, ICCS team organized a training event for a total of approximately twenty BSc/MSc students, who had a hands-on experience with the RABIT.

TA7 – SU-NIS ream prepared academic course sections for automated competence-based e-learning by presenting the SOCIALENERGY e-Learning platform competence framework and courses will be included in the following BSc. And MSc. courses at FMI, Sofia University (SU-NIS):

1. BSc. Elective course "E-Learning" for students in 5 different CompSc. Specialities at: https://learn.fmi.uni-sofia.bg/enrol/index.php?id=5219 (Login as a guest, Pswd: elearn)
2. MSc. programme "E-Learning" compulsory course "E-Learning Design", led by prof. Krassen Stefanov and Pencho Mihnev (https://learn.fmi.uni-sofia.bg/enrol/index.php?id=4838)
3. "Software Systems for e-Learning" led by prof. K. Stefanov and P. Mihnev (https://learn.fmi.uni-sofia.bg/enrol/index.php?id=4839)
4. Course section for serious games by presenting the SOCIALENERGY game will be included at FMI, Sofia University in the BSc. Course "Design, development, and

evaluation of educational software" – an elective course for students in 5 different CompSc. Specialities at: https://learn.fmi.uni-sofia.bg/enrol/index.php?id=5222

5. Internal qualification training course for academic teachers of Sofia University on competence-based e-Learning, based on the SOCIALENERGY e-Learning platform is envisaged for the first semester of the academic 2019-20 year, led by prof. Krassen Stefanov, Atanas Georgiev, and Pencho Mihnev

Additional meetings and dissemination of the SOCIALENERGY project development and outcomes were held with the associate professor Atanas Georgiev from the Faculty of Economics and Business Administration, who is the director of the MSc. programme "Economics and Management in Energetics, Infrastructure and Utilities" at Sofia University (SU-NIS).

3.6. Cooperation and mutual dissemination activities with other related EU projects

RP1 – **H2020 RAGE project**: SOCIALENERGY closely followed up RAGE project activities as the latter is closely related to serious games development and is EU project flagship in this field. SOCIALENERGY exploits NRG and SU-NIS participation in RAGE for foreground knowledge dissemination and interaction between the two consortia. NRG followed the good practices and libraries for the efficient development of SOCIALENERGY GAME.

SOCIALENERGY established liaison activities with the H2020 RAGE project (http://rageproject.eu/) with bilateral communications on the impact creation of the both projects. SOCIALENERGY was invited to the RAGE Vienna networking session "RAGE: Boosting technology transfer to Serious Games & Gamification industry", held in Vienna on December 4th, 2018.

RP2 – **FP7 VIMSEN project**: SOCIALENERGY exploits ICCS background knowledge from VIMSEN project on research algorithms, which are used as input for the project. The VIMSEN DSS platform (TRL 5) is used for testing the various functionalities of SOCIALENERGY and as a good basis for the further development of RAT. Moreover, energy consumption datasets from real users are used in cooperation with VIMSEN consortium.

RP3 – **H2020 ENTROPY project**: SOCIALENERGY exploits INTELEN's foreground knowledge in gamification and user engagement. Our project is closely following-up [ENTROPY] results and the ways that pilot tests are set up including the appropriate key performance indicators that will be used for the real-life trials. INTELEN is also using related background knowledge and liaisons for the development of GSRN platform.

RP4 – **H2020 FLEXGRID**: FLEXGRID-GA-863876 is a new project proposal, which has been recently accepted for EC funding, will start on 1/10/2019 and will last for 36 months. FLEXGRID project proposes a holistic future smart grid architecture able to accommodate high RES penetration through the advancement, interaction and integration of: i) innovative models that are based on recent advances in game theory in order to quantify and highly improve the trade-off between the various future energy markets' requirements

(Real Time, Efficient, Strategy Proof, Competitive, Scalable, Fair and Privacy Protecting) and guarantee, theoretically and in practice, the "fairness" of the equilibrium points that energy markets reach, ii) grid system models that use optimization theory to achieve more efficient market clearing and Optimal Power Flow (OPF) algorithms to achieve scalability, in a way that must also be Low Overhead, Multi-period, Robust and Network Upgrade Planning Aware, and iii) innovative Business Models through the use of artificial intelligence, which can be exploited by modern Energy Service Providers (ESPs) and RES Producers (RESPs) to achieve economic and operational benefits through their efficient interaction with FLEXGRID's advanced markets and electricity grid models.
FLEXGRID will help: i) DSOs/TSOs manage safely and at low cost their electricity grid by interacting with ESPs and RESPs through novel flexibility market procedures, ii) modern ESPs become more competitive and sustainable, and iii) RESPs optimally compose and exploit their production in a risk-averse manner by making their RES generation dispatchable.

ICCS team is the coordinator of FLEXGRID project. It aims at exploiting background knowledge acquired from SOCIALENERGY and elaborate on algorithmic issues, mathematical models and dynamic pricing models. More specifically, in cooperation with University of Cyprus and the Electricity Authority of Cyprus (EAC), ICCS will pilot test P-RTP, B-RTP, C-RTP and other SOCIALENERGY programs in real-life conditions and with real users. Another pilot testing site will be in Germany (i.e. BADENOVA is an electric utility in Freiburg), where end users have also small-scale storage systems and can thus be more flexible in terms of shifting their electricity loads. Finally, ICCS team will be able to test the use of SOCIALENERGY's innovative energy programs in emerging flexibility markets partnering with NODES and Nord Pool AS from Norway, which is considered the most advanced market operator in the EU area.

RP5 – **WISENERGY project proposal**: ICCS and INTELEN teams have exploited background knowledge related with SOCIALENERGY to prepare a new project proposal in cooperation with another six prestigious EU partners. WISENERGY proposes a digital social innovation platform facilitating EU energy communities' administration, holistic energy consultancy services' provisioning, e-commerce and bottom-up clean energy investments. Three EU RES Cooperatives (RESCOOPs) are WISENERGY partners namely ECOPOWER from Belgium, SOMENERGIA from Spain and AEGEA from Greece. These 3 RESCOOPs are very much interested in SOCIALENERY's value propositions and the plan is re-submit this proposal within 2020.

RP6 – '**Researchers in Knowledge Triangle' (K-TRIO 3)** **https://rn.fmi.uni-sofia.bg/** is a two-year Horizon 2020 project funded under the Marie Sclodowska-Curie Actions and it is a part of the European initiative **"European Researchers' Night"**. The main project objectives are:

- Ensuring broad participation of researchers in the awareness campaign and the specific project activities;
- Facilitating the dialogue between researchers and the general public on the work of researchers, their achievements and contributions to the prosperity of economy and society;
- Bringing researchers closer to young people and providing kids and students opportunities to learn more on scientific achievements and researchers' career.

RP7 – **H2020 UtilitEE project**: The UtilitEE project (https://www.utilitee.eu/) is about executing Demand Response over behavioral analysis (behavioral DR) in order to reduce energy consumption in houses through behavioral change. Protergia SA is a full pilot partner in this project and due to the fact that Protergia is highly interested to the SOCIALENERGY pilot as well, the two projects are collaborating in a common pilot, using customers and Protergia pilot users from UtilitEE. The collaboration of the two projects will enable the use of smart metering equipment and real energy data for the realization of SOCIALENERGY pilot testing even after the end of the project's lifetime.

RP8 – **H2020 GOAL project**: SOCIALENERGY's architectural approach was presented to GOAL project (http://www.goal-h2020.eu/the-goal-project/) discussing on the impact of the intrinsic and extrinsic motivation, reward schemes and gamification principles that contribute to the behavioural change, learning and training. GOAL has exposed its API to the developers of the SOCIALENERGY Game to enable a conversion process of the in-game rewards to GOAL-Coin rewards that serve as a monetary reward for playing serious and applied games.

RP9 – **H2020 PTwist project**: NRG presented the gamification approaches used in the SOCIALENERGY Game to the PTwist consortium (https://ptwist.eu/), objective of which is to support multiple actors (citizens, communities, inventors, innovators, entrepreneurs, public institutions) in co-creating and sustaining new forms of plastic-as-an-asset practices, strengthening both societal and circular economy actions in-line with digital social innovation principles.

3.7. Other general public dissemination actions

All the above-mentioned dissemination material is periodically uploaded to the official SOCIALENERGY project's website: http://socialenergy-project.eu/index.php

Twitter and facebook accounts have been created. In the project's youtube channel (https://www.youtube.com/channel/UCiV4pEupQDoZ0vif3HXSemQ), the consortium partners have already released several DEMO versions showcasing the S/W implementation progress so far. These DEMO videos have been used in the communication activities during the meetings with several industrial stakeholders in order to better communicate and disseminate SOCIALENERGY's innovations and value propositions.

4. Report on the exploitation activities

4.1. SOCIALENERGY project's exploitation strategy

The SOCIALENERGY architecture is **"modular by design"** in order for all subsystems (i.e. GSRN deployed by INTELEN, GAME deployed by NRG, RAT deployed by ICCS and LCMS deployed by SU-NIS) to be potentially exploitable as standalone commercial products in the future. The technical APIs for the interaction between the various subsystems have been appropriately designed in a way that any possible combinations of SOCIALENERGY subsystems to be commercially exploitable in the future (e.g. GSRN with RAT as one single product, GAME with RAT as another one, GSRN-GAME as another one, GSRN-RAT-LCMS as another one, etc.). This strategic decision at the design phase provides the flexibility to the consortium to decide how to prioritize its dissemination, communication and further exploitation activities towards commercialization. Of course, the default choice and ultimate objective of the consortium was to fully integrate all 4 subsystems into one single SOCIALENERGY S/W platform. This way, the SOCIALENERGY product and associated services is expected to be competitive enough in order to enter the liberalized ICT/energy market and be sustainable as a product from a business perspective. **The "modular by design" approach provides flexibility to our system to be commercialized taking into consideration the diversified needs of all our potential customer segments.**

4.2. Overview of the business planning results so far

So far, a complete business plan has already been put in place in order for the SOCIALENERGY project to have a very accurate view of the costs and revenues, which are anticipated to be incurred by SOCIALENERGY commercialization after the end of project's lifetime. In D6.1 (M6), draft quantitative figures have been presented regarding the revenue streams and the market size as well as a SWOT analysis. In D6.2 (M15), a draft business model and description of the value propositions is provided. In section 2 of this report, we provide quantitative figures about the cost structure and revenue stream for each one of the four individual value propositions. All these business planning results are based on real business interactions and communication actions, which have taken place during the last 6 months between the SOCIALENERGY consortium partners and the potential customers of SOCIALENERGY products and services. More details about these communication activities are provided in subsection 3.3 above.

SOCIALENERGY consortium has a pretty clear business and exploitation plan for SOCIALENERGY system as a whole, which is realistic with current utilities' and ESCOs' business, gaming and converged ICT/energy markets. As a result, the estimated financial figures, which are presented in section 2 are based on real financial data according to existing client base of INTELEN and the company's experience with the targeted customer segment. However, this is only the starting point, as SOCIALENERGY aims to constitute the platform that will not only mediate the future energy market but also will harmonize demand and production in it through its very innovative and advanced features like the game, the support of sophisticated research algorithms for dynamic energy pricing and management of virtual energy communities, and the development of LCMS, which will guarantee the long-term user

engagement and continuous learning of good practices on energy efficiency. SOCIALENERGY consortium have already set up, submitted and will run new H2020 projects, which are pretty much related with SOCIALENERGY concepts or will use background knowledge from SOCIALENERGY to further develop more sophisticated algorithms, mathematical models and S/W tools. For more details about these projects, please see subsection 3.7 above.

The consortium has also agreed upon legal plans and licenses to make sure that the project's Intellectual Property (IP) is protected. There is also a strategy that incorporates the balance between presenting results that interest the targeted customer segment (i.e. electric utilities/ESPs) and protects the consortium's IPR. This strategy also addresses exactly how the licensing agreements to exploit the results among the consortium partners are distributed. Initial financial allocations have been agreed among all partners and are based on each S/W module's weight per business case (i.e. value proposition) being assumed. Detailed datasets with respect to all the envisioned business cases and value propositions are provided in subsections 2.4.1 – 2.4.4 of this report.

Note: It should be noted that the financial figures of the project's business plan (i.e. the cost structure and revenue streams) presented in section 2 refer to the period after the end of project's lifetime. The ultimate project's milestone was to bring SOCIALENERGY S/W platform at TRL 8 that is one step away from commercialization. At the end of the project's lifetime (i.e. June 2019), the consortium's objective was to have the final business plan and exploitation agreement in place as well as preliminary commercial agreements signed with real customers. Commercial activities of SOCIALENERGY will continue even after the project's lifetime following up the exploitation agreement signed among all the SOCIALENERGY beneficiaries (see the most important details of this exploitation agreement in the next suybsection).

4.3. SOCIALENERGY consortium agreement and exploitation agreement

Apart from the SOCIALENERGY consortium agreement, which was signed at the start of project's lifetime, an extra agreement has already put in place, which focuses on the exploitation and commercialization aspects of the project's innovation assets and foreground knowledge.

As already discussed, it is apparent that the flexibility choice of selecting any combination of SOCIALENERGY subsystems to match specific customer segment's needs provides enormous boost to the exploitation activities of all partners of SOCIALENERGY consortium. Therefore, the exploitation agreement signed by all partners provides an excellent basis for synchronizing the next commercialization steps of the consortium. Below, we provide some important notations taken from the confidential exploitation agreement document signed among all SOCIALENERGY partners.

First of all, there are some important terms that need to be defined. By the term *"SOCIALENERGY Assets"*, we mean the set of Methods, Reference Architectures, Software Platforms, Domain Knowledge and Components as well as their instantiations into a number of Industrial Trials experimentations. *"Product"* means any product or service, which could be commercialized on the basis of the SOCIALENERGY Assets. *"Commercial Business Opportunity"* means that one Party has the opportunity to sell SOCIALENERGY assets for a

final customer on the market, which is third party and is not any of the Party. *"Internal Use of Opportunity"* means that a Party (or a affiliated entity of the Party) is the final customer of the SOCIALENERGY solutions for its own Business activities. Both *"Commercial Business Opportunities"* and *"Internal Use Opportunities"* are generally referred as *"Business Opportunity"*.

In the context of the SOCIALENERGY Project, the Parties (i.e. partners) have produced Foreground in the form of a range of individual exploitable components. Some of components have been produced by one sole Party, while others have been produced based on the joint collaboration of several Parties. The purpose of the Exploitation Agreement is to establish the terms under which the Parties will exploit business or internal opportunities, which may derive from the SOCIALENERGY assets, once the EU financed Project will be finalized.

The Exploitation Agreement remains valid until the expiration of a period of twelve (12) months from the date on which the Grant Agreement is terminated (the "Final Date"), and shall be thereafter renewed for one (1) year period, each Party being entitled to terminate its participation, after the "Final Date", at any moment by sending to the other Parties a termination notice in this respect, which shall take effect at least sixty (60) days after the date of the termination notice. Notwithstanding anything to the contrary, in case of termination, the rights and obligations deriving from this Agreement will be maintained until finalization of all Business Opportunities carried out by one or more of its Parties in accordance with the conditions provided therein.

The Exploitation Coordination Committee (ECC) is responsible for: a) the definition of the strategy for the exploitation of any Product and foster business relationships and alliances with third parties, b) the adaptation of the terms of the Agreement to the necessities of the exploitation, c) review Business Opportunities presented by a Party, d) the follow-up of the issues regarding the Parties (participation, determination of defaulting parties, etc.).

Regarding each "business opportunity" that may come up in the future, a specific set of procedures and steps in the implementation phase have already been defined. Each party's rights and obligations and revenues' distribution/sharing policies are pre-determined, too. Of course, the exact work effort allocation and revenue sharing allocation among the beneficiaries will be agreed on an ad-hoc basis according to each customer's needs. It should be noted that nothing in this Exploitation Agreement limits the Party to exploit independently and out of this Agreement any of its own Intellectual property Rights related to the Products, which has been developed under the Project by it, or to exploit independently and out of this Agreement other solutions/products present in the market and in competition with SOCIALENERGY solutions. Upon the occurrence of a new *"Business Opportunity" (BO)*, the Proposing Party should present to the ECC a fully detailed dossier including a BO Value, with financial projections and assumptions (which for the avoidance of doubt shall be based on final price list proposed by the Parties, owners of the affected SOCIALENERGY assets for this particular BO), together with a description of the activities in which the involvement of the other Parties could be necessary (such as professional services or similar activities with financial conditions at which such involvement is expected by the Proposing Party). In case one or several Parties shall be involved in a Business Opportunity, they shall, together with the Proposing Party (and any third party, if need be), enter into specific arrangements to

implement the concerned Business Opportunity. The BO Value is the sum of affected SOCIALENERGY assets prices and sum of prices of all additional professional services or products included in the BO, (this latter price to be negotiated directly with the impacted Parties), included in BO value all the costs and after the deduction of the discounts based on CDL, but it refers the value before taxes.

The income distribution scheme to be determined for each Business Opportunity shall recognize for each participating Party: a) sales efforts, and therefore the related commission for such investments, b) the value of the IPRs made available by a participating Party for the concerned business opportunity, c) the costs / investments dedicated by one Party for: i) the evolution of any IPR; and ii) any additional knowledge needed, d) deployment and/or operation cost. It is specified that the values assigned to these items with respect to one Party in the Implementation Arrangements regarding one Business Opportunity, shall also, unless otherwise agreed by the participating Parties, be applicable for any further Business Opportunity for which such Party participates.

Residual issues like the ones related with liability and confidentiality issues and other general clauses are also defined in the confidential Exploitation Agreement.

4.4. GDPR-related issues and plan for further exploitation activities in the future

Various GDPR issues were faced during the utility pilot analysis, customer selection and onboarding phases, for the SOCIALENERGY pilots' realization.

Utilities (i.e., EDP in Portugal) were very interested to participate in SOCIALENERGY pilots, but there was some issues with every utility DPO (Data Protection Officer) and the Consent Forms that every end user has to sign (DPO procedures). This has put some serious delays in the pilot phases preparations and the availability of various European utilities to participate in the pilots.

A solution to the above delays was the collaboration of the SOCIALENERGY project with other projects (i.e. UtilitEE that has electric utility companies as partners) as a whole, so the onboarding phase could be accelerated and the data protection procedure is integrated in the "project collaboration agreement".

In general, GDRP introduces strict data protection procedures, end user information for consensus and substantial delays in every H2020 pilot site.

5. Summary of SOCIALENERGY R&I insights and roadmap towards beyond H2020 objectives

Conclusively, the consortium has now reached Milestone 8, meaning that the consortium has delivered the final business model and agreed on the management process of the SOCIALENERGY's innovation assets after the end of the project's lifetime. Milestone 9 has also been accomplished meaning that pilot testing results of SOCIALENERGY's small-scale experiments have been delivered providing thus interesting R&I insights for the future. In this section, we summarize the most important R&I insights from section 2 and describe the roadmap towards beyond H2020 objectives for the future. Finally, based on the consortium's experience throughout the whole project's lifetime, we provide concrete recommendations to the European Commission, which may be taken into account for future calls and collaborative R&I projects.

5.1. Advanced incentive technologies towards effective use of behavioral economics in the energy efficiency and demand response sector

Table 7: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #1

R&I insights	Recommendations to EC
Model the participation of an electric utility company in more energy markets (e.g. emerging flexibility/balancing markets) and apply P-RTP/B-RTP/C-RTP models in these markets, too. ESPs can thus follow stacked revenue model approaches to maximize their profits.	In SOCIALENERGY, we modelled the participation of an ESP in wholesale market and how it can incentivize its end users to adapt their energy consumption behavior in order for the latter to experience more beneficial tariffs and the ESP to minimize the cost of the energy purchased from wholesale market. This knowledge can also be used for ESP's participation in more complex electricity markets (generally called flexibility markets), which are currently emerging in several EU countries.
More work on social/behavioral/digital education sciences research in order to understand in more depth which are the weights of the various incentivization factors for each individual end user.	In SOCIALENERGY, we modeled the peer pressure mechanism as one of the main incentivization technologies that drive the end users' energy consumption behavior/ lifestyle. This knowledge can be used in conjunction with other incentive technologies in order to provide even better models for each social norm. Thus, more multi-disciplinary research is needed including social scientists, pedagogists and behavioral analysts.
Advanced mathematical models (e.g. MPEC/EPEC, network-aware optimization, strategic bidding policies, etc.) and integration of storage/RES/DR flexibility models.	In SOCIALENERGY, we assumed research problem formulations for modeling energy consumption and typical ESP's participation in wholesale and retail electricity markets. These models need to be considerably extended/ enhanced in order to include RES, storage and other types of available flexibility assets. Moreover, competition among various ESPs need to be modeled as well as interaction

	between the electricity markets and the operation of the electricity network. Progressive ESPs need to adopt strategic bidding policies in order to optimally place themselves in a liberalized electricity market context. This competition among ESPs should by all means respect the network constraints in order to ensure the security of energy supply.
More advanced mechanism design and incentive compatible techniques to allocate Demand Response gains to all participating users in a more fair way maximizing the social welfare without degrading end user's welfare, too. More work on game-theoretic models is needed.	New services for ESPs need to be developed relevant with optimal Distributed Flexibility Asset (DFA) aggregation and its automation through an online platform. The main research objectives are: - To develop models for the provision of services correlated with automated composition of DFA and for their optimal operation. - Intelligent algorithms for optimal DFAs' operation that serve the ESPs and DFA owners according to the traditional markets' (wholesale, flexibility, capacity, etc.) needs. - To develop mathematical models towards a meta-service able to optimally transform Flexibility assets (e.g. load shifts and curtailments) to Flexibility services. - To conduct an in-depth and high-quality research on the design of pricing mechanisms by indicatively combining in them KPIs such as: Optimality/efficiency, incentive guarantees/strategy proof, privacy protecting, convergence/scalability, Fairness, Externalities and constitute them competitive/sustainable. - To develop: i) optimal bidding processes, ii) allocation rules, iii) communication protocols and iv) peripheral components towards the next generation retail pricing schemes.

5.2. Transfer gaming technologies into the energy efficiency sector to educate and socially include end users in best practices on energy efficiency

Table 8: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #2

R&I insights	Recommendations to EC
Work more on gamification techniques and interaction with the end users (use of GSRN data to further understand each end user's behavior within SOCIALENERGY system).	In SOCIALENERGY, we found out that higher end user engagement is achieved when the end users understand the ultimate goal of the gamification activities. Based on SOCIALENERGY platform's data, the admin user will be able to further analyze the behavioral data from every end user and guide him/her through an optimal engagement process.
Use of interactive technologies such as Virtual Reality (VR) and Augmented Reality (AR) in order to create a cyber-physical environment in which the end users will not only play the GAME but their actions within the GAME will be	The SOCIALENERGY GAME is actually a simulation of real-life conditions within a future's smart home. The next step would be to further integrate the real and virtual worlds through the development of a cyber-physical environment. For example, an optimal gameplay could be transferred in the real smart home and via VR/AR technologies, the end

transferred in the real-life environment	user could be guided into performing the best combination of energy consumption actions in order to minimize his/her electricity bill and simultaneously contribute in reducing energy system's cost.
Make the learning/gaming process more personalized, interact more with LCMS and make the game player co-creator of the gameplay.	The gameplay design (as is) can be considerably enhanced by offering more interaction features to the player. For example, the player could design the stages for his/her own gameplay feeling thus that the gameplay is not boring and that s/he creates some features of it and possibly share this content with other group members.
More work is needed on mathematical models and research algorithms in order to make the gameplay more sophisticated and be able to provide many different gameplay versions (e.g. in the form of challenges) to the end users.	SOCIALENERGY GAME already includes several mathematical models for calculating and converting complex KPIs into realistic game points, which are much more understandable for the end player. Based on this background knowledge, more sophisticated mathematical models and research algorithms can be integrated into the gameplay in the future.
Work closer with teachers and digital technology educators to better understand key pedagogical aspects to enhance the related social inclusion and educational actions towards a more environmental-friendly society.	SOCIALENERGY GAME is designed in such a way that it can be played by anyone with little effort needed in order to understand the game's objectives and ways to proceed through the whole gameplay. However, this type of games can be easily adapted in order to explicitly serve educational and social inclusive purposes (e.g. in public schools). In this case, close collaboration with teachers, digital technology educators and pedagogists is needed in order to achieve the best possible results for the sake of a really successful behavior change towards a more environmental-friendly society.

5.3. Engage end users via advanced gamification techniques towards efficient management of virtual energy communities and interaction with commercial activities

Table 9: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #3

R&I insights	Recommendations to EC
Work more on Online Social Networks (OSN) theory (VEC creation and dynamic adaptation algorithms including more feature data).	In SOCIALENERGY, we found that an end user is much more engaged when an instruction comes from a friend or even a peer with a similar user profile. Therefore, more research is needed in order to exploit more complex OSN models, which can provide automated social network graphs and thus optimally allocate EC leader roles and optimal creation of VECs.
More work on social/behavioral/digital education sciences research in order to understand in more depth which are the weights of the various incentivization factors for each individual end user.	In SOCIALENERGY platform, we already have multiple types of heterogeneous datasets, which are somehow linked with each other. For example, we have energy-related datasets, behavioral datasets based on the use of the platform and social network datasets based on the social network actions inside the platform. This means that it is not straight-forward

	how to create and dynamically adapt VECs, because we often do not have explicit intuition about every possible combination of datasets. Thus, further research is needed in order to unveil the potential of heterogeneous data analytics, which are well hidden in complex software infrastructures.
Advanced data analytics (ML/AI) techniques to avoid end user frustration and disturbance.	In SOCIALENERGY, VEC creation and dynamic adaptation algorithms run periodically (e.g. every day and in smaller time granularities) and their output is used as input in context-aware reporting and recommendation mechanism. More research is needed to achieve the optimal trade-off between the end user engagement and the communication overhead. In other words, the end user may get frustrated if s/he gets too many messages or s/he may be dis-engaged if s/he is not well informed/guided in platform's processes through appropriate notification messages.

5.4. Data analytics and context-aware recommendation algorithms for bringing closer the energy sector stakeholders and end users

Table 10: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #4

R&I insights	Recommendations to EC
Work more on Machine Learning and Artificial Intelligence (ML/AI) research algorithms and techniques to provide even more interesting notifications/reports/recommendations to end users	In SOCIALENERGY, we basically consider smart meter data (at home level). However, given the fact that there are disaggregated energy data (e.g. per electric device) and other IoT/sensor data, more advanced data analytics services for end users can be developed. Moreover, Artificial Intelligence algorithms may be applied in order to comprehend more deeply the utility function of end users in order to proactively respond to end user's needs in the future (e.g. recommend more complex energy programs).
More work on social/behavioral/digital education sciences research in order to understand in more depth which are the weights of the various incentivization factors for each individual end user.	Furthermore, given the fact that end users give their consent about using demographical, building and other means of personal data, AI-based algorithms (e.g. neural network-based) can be used in order to map in much more detail the end user's behavior with the various incentivization factors. The goal is to find the optimal mix of these factors in order to provide the highest possible quality of service to end users. The results of this process may also be used by policy makers in order to better understand the behavior of EU citizens and subsequently be able to design better policies towards achieving higher level milestones (e.g. EU energy agenda for 2030/2050, EU single electricity market, etc.). Of course, in all these cases, thorough investigation of the "utility vs. privacy" problem should be undertaken.
ML/AI-based recommendation algorithms and brainstorming on new business models (e.g. B2B2X) in order	Electric utility companies should seek for new revenue streams taking advantage of their ongoing digital transformation with S/W platforms and digital

to design more interesting cross/up-selling services	products/services such as the ones offered by SOCIALENERGY. The EU regulation about liberalized energy markets' operation provides many opportunities for new business models and value propositions. For example, SOCIALENERGY's value proposition #3 could be easily extended to integrate more products and services that can be traded through the online marketplace. Thus, a utility company could realize more B2B and B2B2X partnerships and design even more interesting cross/up-selling services for its clientele (i.e. end users).

5.5. Small-scale experiments to validate the SOCIALENERGY concept, evolve its technologies and trigger its adoption by various energy market stakeholders

Table 11: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #5

R&I insights	Recommendations to EC
Further research is needed in behavioral M&V	Larger-scale pilot testing process should take place in upcoming EU projects to validate SOCIALENERGY results in large-scale deployments.
Virtual Energy Communities concept could be extended in physical communities of EU citizens through the adoption of social innovation activities like the EU RESCOOP movement	EU RESCOOP movement should be further supported via the exploitation of mature S/W platforms and tools like the ones deployed within SOCIALENERGY project. For example, SOCIALENERGY could be used as a S/W substrate for the development of a digital social innovation platform, which facilitates EU energy communities' administration, holistic energy consultancy services' provisioning, e-commerce and bottom-up clean energy investments.
Non-technical factors that affect the user engagement in the gameplay should be studied in more depth.	Closer collaboration between multi-disciplinary teams is needed and especially with expert digital technology educators and pedagogists, who can optimally design the real-life pilot process according to the diversified needs of the end users. For example, in K-12 public schools, pupils have certain requirements that should be taken into consideration in order for the learning process to be as efficient as possible.
Multi-player game development (cooperation vs. competition strategies in real-life pilots) and collaborative learning	SOCIALENERGY platform could be extended to serve for efficient bottom up and collaborative education of end users (energy prosumers), social innovators, public authorities, energy communities and energy companies. Through various gameplays, all users could easily understand their role in the community and deploy socially innovative actions towards achieving the community's goals.

5.6. Create a virtual marketplace and offer Energy Information Distribution as a Service (EIDaaS) to multiple stakeholders

Table 12: Summary of R&I insights and recommendations to EC related with SOCIALENERGY objective #6

R&I insights	Recommendations to EC
Need for open data platforms, data sharing economy and data market for trading data-related assets. Need to treat data and data analytics as a commodity to traded in an online marketplace.	Energy Information Distribution as a Service (EIDaaS) introduced within SOCIALENERGY project can be extended in a way that an Energy Data Asset Marketplace (EDAM) will be created, which will drive a data economy by linking sellers to buyers and ensuring that credit will be attributed to appropriate stakeholders no matter the complexity of the business process. In this EDAM, the data seller will manage and sell the data in the marketplace. The electric utility company's objective is to make profit. The cost of supplying specific data assets should be calculated together with the financial rewards given back to data owners. Thus, the company should put a price in each SaaS offering such that the monetary benefits from selling this service/product to the market will be higher than the marginal cost of production. From the data buyers' perspective, they will be able to use a user-friendly GUI to first discover and then buy the EDAM products that they are interested in. Data Buyers may be Energy Service Companies (ESCOs) such as electric appliance retailers and vendors, building renovation companies, etc., retail companies such as shopping malls, supermarkets, etc., building construction companies, insurance companies and several other cross-domain/vertical industry market stakeholders. From a business point of view, data buyers need to calculate the value of each EDAM product that they demand. In particular, the cost of purchasing an EDAM product should be lower than the revenue streams realized by selling advanced digital services to end users. Examples of these digital services may be based on novel applications, which can provide personalized and context-aware recommendations to end users about the most suitable electric appliances, energy programs, building renovation packages, energy efficiency guidelines to lower electricity bills, discount offers for retail products purchase, etc. This type of EDAM should: - maximize GDPR compliance through innovative policy & consent management strategies along with data fuzzification techniques - incorporate standardized practices for data management and privacy preservation - increase the trust and the involvement of the users in this type of emerging data sharing platforms - enhance the competitiveness of the energy market stakeholders and establish solid Return On Investment (ROI) trajectories for the end users.
Need for a trusted Data Asset Marketplace (DAM) to lower privacy barriers associated with the development of innovative data-intensive applications that consume personal data.	

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