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

H2020 ICT-731767

Pilot setup and small-scale experimentation plan

Deliverable D5.1

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Glossary of Acronyms

Acronym	Definition
API	Application Programming Interface
BMS	Building Management System
CAPEX	Capital Expenditure
CBE	Competence Based Education
CBSM	Community Based Social Marketing
DR	Demand Response
DSM	Demand Side Management
DSO	Distribution System Operator
EC	Energy Community
ECC	Energy Consumption Curve
EC-RTP	Energy Community Real Time Pricing
EE	Energy Efficiency
EIDaaS	Energy Information distribution as a Service
EMS	Energy Management System
EnPI	Energy Performance Indicator
EP	Energy Program
ESCO	Energy Services Company
ESP	Energy Services Provider
GDPR	General Data Protection Regulation
GSMaaS	Gamified Social Marketing as a Service
GSRN	Green Social Response Network
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
M&V	Measurement & Verification
NPC	Non Player Character
OPEX	Operational Expenditure
OSN	Online Social Network
P-RTP	Personalized Real Time Pricing
P2P	Peer-to-Peer
QoS	Quality of Service
QoE	Quality of Experience
RAT	Research Algorithms Toolkit
S/W	Software
SaaS	Software as a Service
ToU	Time of Use
VEC	Virtual Energy Community

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Document History

This deliverable includes the outputs of Task 5.1 activities. It includes a thorough description of the pilot tests and a specific experimentation and validation plan.

Table 1: Document History Summary

Revision Month	File version	Summary of Changes
04/05/2018	v0.1	Draft ToC version circulated to the entire consortium by INTELEN.
10/05/2018	v0.2	ICCS enhanced the draft ToC version and all partners agreed on the final ToC version.
13/06/2018	v0.5	First round of contributions from all partners. INTELEN contributed in sections 1 and 2, while all other partners provided the S/W validation plans for each subsystem (see section 3).
22/06/2018	v0.8	INTELEN provided its 2nd round of contributions and a pre-final version for internal review.
26/06/2018	v0.9	ICCS made the internal review and provided comments for deliverable's quality enhancement to INTELEN.
29/06/2018	Final	INTELEN addressed internal review comments and provided a final version. Coordinator submitted the final version in ECAS portal.

Executive Summary

This report summarizes the SOCIALENERGY project's work undertaken in the context of Task 5.1 activities. A clear roll-out plan is described in section 1 and will be executed in the context of task 5.3 from M19 until the end of the project's lifetime. A Greek utility company (i.e. Protergia S.A.[1]) has already been selected as external pilot partner. Initial discussions with a couple of other EU utilities have already taken place and the consortium anticipates for final responses within the next months. The roll out plan has been divided into 4 basic sub-periods as follows:

- Phase 1: Initial Planning
- Phase 2: Integration, Preparation and Testing
- Phase 3: Operational Phase
- Phase 4: Phased roll-out

Regarding the small-scale experimentation plan, this is thoroughly described in section 2 of this report. The Key Performance Indicators (KPIs) that are considered in the SOCIALENERGY's experiments are categorized in two main categories, namely: a) Energy Performance Indicators (EnPIs), and b) behavioural/user engagement indicators. Some indicative EnPIs that will be used are the following: i) Building Electricity Consumption reduction (kWh), Building Electricity Consumption reduction (%), iii) Building Total Consumption per square meter (kWh/m^2), iv) Building Total Consumption per square meter (kWh/m^2), v) Building Electricity Consumption per usage hours (kWh/usage hour), etc. There will be also used some novel "behavioral" KPIs such as: i) participation KPIs, ii) awareness KPIs, iii) effectiveness KPIs, iv) engagement KPIs, v) knowledge KPIs, etc.

Finally, regarding the S/W validation plans, in section 3 of this report, extensive validation checks have been reported for each one of the SOCIALENERGY subsystems. The first version of S/W validation results show that the system works as expected taking into consideration the use of mock and historical datasets (see more details in D5.2 delivered in M18). The next step for the consortium is to start integrating real-life and real-time datasets from real users from M19 onwards.

[1] https://www.protergia.gr/en

1. Roll-out Plan

The roll out plan will be divided into 4 sub-periods:

1) Initial Planning
2) Integration, Preparation and Testing
3) Operational Phase
4) Phased roll-out

All periods will be sequential for each utility pilot partner and will be run in parallel for many utilities.

On every use case scenario execution and pilot testing scenarios, data and respective analytics will be gathered for assessment and reporting.

GDRP compliance will be taken into account regarding the personal data of end users.

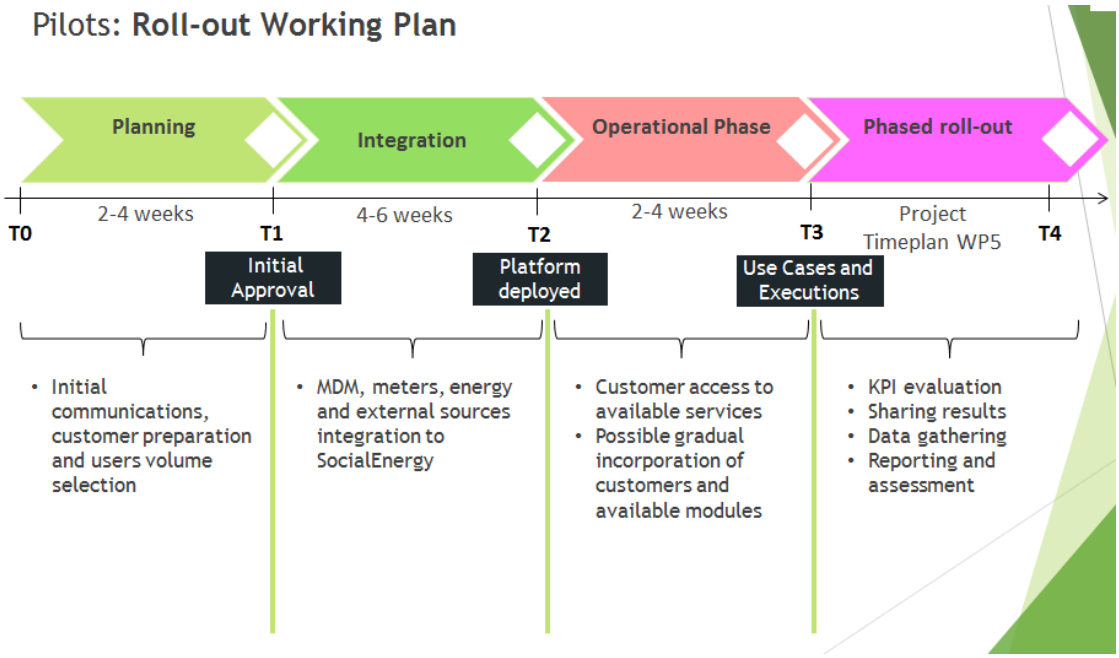

Figure 1: The SOCIALENERGY project's roll-out working plan (4 phases)

1.1. Initial planning phase

The initial phase is the one where all important information is gathered from the electric utility company. It can last 2-4 weeks depending on the meetings and access to information. Questionnaires and user inputs are designed and executed. The process is sententiously described below:

Phase	Description	Input & Output
Initial Planning	Duration: 2-4 weeks (typically) Involved parties: Utility and SOCIALENERGY consortium Description of work: SOCIALENERGY and Utility shall arrange planning meetings to discuss business / marketing and technical requirements. The objective is to agree on the main features deployed, the major milestones of the project and a description of the resources, work and processes followed. The meetings schedule shall be agreed upon by both parties and can be split into functional teams. Also, initial questionnaires and user selection (clustering) will be performed, based on contextual data, demographics, behavioural data, age, digital literacy and social KPIs. Initial invitations will be sent.	Input: 1. Project deployment guide 2. Technical integration with AMR 3. Preparation checklist / feedback form. Output: 1. Agreed project plan which shall include: (deployed features, phased rollout plan, communication plan, resource assignments, support structure, marketing, Integration & Preparation plans) 2. Initial user clusters to be invited

1.2. Integration, preparation and testing phase

The 2nd phase is the AMR integration and smart meter connection with GSRN MDM system. In other words, Phase 2 has to do with real data integration to GSRN.

Integration & Preparation/ Testing	Duration: 1 month (typically) Involved parties: Utility and SOCIALENERGY consortium (technical and marketing teams) Description of work: Integration Technical teams from both sides shall aim to complete the Integration tasks as agreed (MDM - Meters). Typically, protocol and methods of data exchange and data formats should be specified [file exchange, DB queries, APIs, etc. CRM data, past invoices and billing information, tariffs, energy data from meters, etc.]	Input: 1. Any other support documentation or data that may be needed. Output: 1. Technical Integration completed 2. MDM connection with AMR Checkpoint: Approval of the work is required by both parties in order to progress to the next phase and validation of real time energy data on SOCIALENERGY MDM (for selected users invited and accepted)

1.3. Operational phase

The 3rd phase is the operational phase for the user on-boarding and the final preparation and testing of the core GSRN platform. Users should be able to login to GSRN and start engaging with the various SOCIALENERGY platform's functionalities.

Operational phase	Deployment: At a commonly agreed upon date / period Involved parties: Utility and SOCIALENERGY consortium Description of work: At the agreed date(s) the platform is made available online to selected initial users via web. All new users will need to go through a registration process to gain access to SOCIALENERGY. During this phase the support structure is also operational. The Customer shall be able to promote the DiG platform both in terms of marketing, content management and digital marketing aspects.	Input: 1. SOCIALENERGY Use Case scenarios Output: 1. Platform operational 2. Analytics reports provides as agreed 3. Consultancy or managed services provided for users 4. All users connected (on-boarding)

1.4. Phased roll-out

The 4th phase is final roll out, where users start engaging with the platform subsystems and RAT middleware starts gathering data, user interactions and applies analytics.

Phased rollout	Full rollout and user case study execution: For the initial deployment, the modules that are deployed are: • My Energy • My Game • My marketplace/e-Commerce • My Courses • Notifications • Social Groups • Energy reporting (for Admins)	Output: SOCIALENERGY pilot testing by executing all Use Cases and Game. Data and respective analytics will be obtained.

2 Small-scale experimentation plan

The Key Performance Indicators (KPIs) considered in the SOCIALENERGY's pilots for the small-scale experimentation plan, are categorized in two main categories, namely: a) Energy Performance Indicators (EnPIs), and b) behavioural/user engagement indicators.

Our methodology for evaluating the engagement across the consumer segments is summarized as follows: Behaviours related to energy savings can be divided into two categories: *efficiency* and *curtailment behaviours*. Efficiency behaviours are typically performed by replacing obsolete appliances with new ones that are more energy efficient, or by investing in more energy efficient methods and technologies (e.g. insulation and/or building renovation). Curtailment refers to reducing energy consumption, e.g. by turning off lights or appliances, when nobody uses them or by lowering thermostat settings.

Throughout the years, history shows that usability is not enough for user engagement and behavioral change. Norman [1] points out the basic levels of processing, adding on Nielsen's Usability theory [2], the emotional design concept. Norman also tested the existence of correlation between design and usability, concluding that attractive things make people feel good and in turn makes them think more creatively and examine multiple alternatives. Behavioral economics takes those concepts, and uses them as it seeks to find how users make their decisions and thus how to influence their choices. The methodologies and techniques that emerged from the aforementioned fields have also been applied to Fogg's captology model [3].

Captology is a way of thinking about target behaviors using technology. Fogg presents the FBM framework, in which he points out the three elements to converge for a behavior to occur: Motivation, Ability, and Trigger. **SOCIALENERGY's approach for the platform on behavioral training takes these components into account in order to boost user's participation and eventually achieve the greater goal.**

The overall network of relationships between a set of related constructs is called a nomological network. We use this approach to present how Fogg's framework components work together.

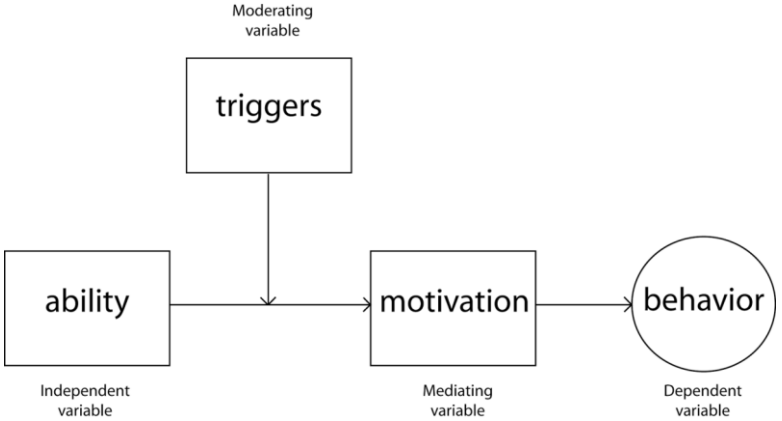

Figure 2*:* Ref: Bhattacherjee, Anol. "Social science research: principles, methods, and practices." (2012)

As GSRN and SOCIALENERGY platform will be the main principle of 'captology' and utilize the 'game' concept, by default it allows a higher level of motivation being achieved.

In order to assess users' involvement with the content, techniques first for planning and afterwards for evaluating the whole training process, should be used. The model in the following figure (based on the Kirkpatrick's Four Level Evaluation Model) could be also seen as a trouble-shooting heuristic:

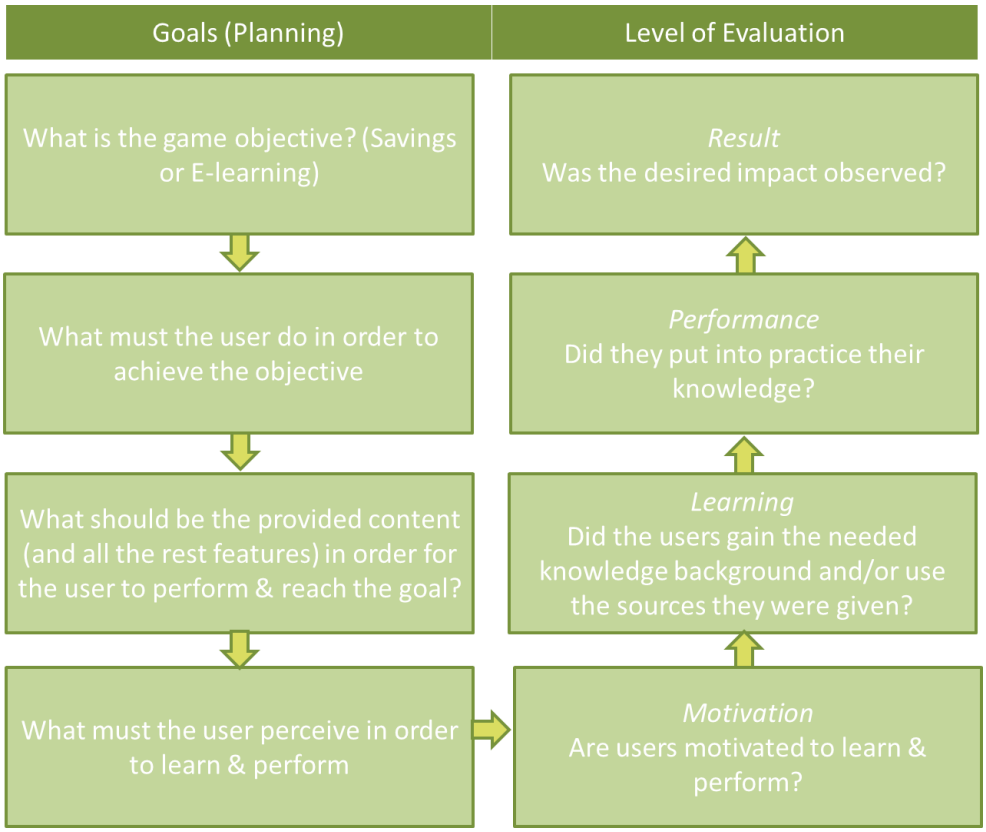

Figure 3: Evaluation Model for deriving SOCIALENRGY's behavioral KPIs

First and foremost, we have to understand the different levels of the training process and only then, we will be able to stipulate the metrics that better correspond to each level or SOCIALENERGY's behavioral educational process.

Motivation

(i.e. What do they need to perceive in order to learn and perform? Do they see a need for the desired performance?)

When a learner goes through a learning process (i.e. LCMS), such as a gamification-based training course, the learner has to make a decision as to whether s/he will pay attention to it. If the goal or task is judged as important and do-able, then the learner is normally motivated to engage in it. However, if the task is presented as low-relevance or there is a low probability of success, then a negative effect is generated and motivation for task engagement is low. Moreover, the less relevant the learning package is to a learner, the more effort has to be put into the design and presentation of the learning package. That is, if it is not relevant to the learner, then the learning package has to hook the learner through

slick design, humor, games, etc. This is not to say that design, humor, or games are unimportant; however, their use in a learning package should be to promote or aid the learning process rather than just make it fun. And if a learning package is built of sound purpose and design, then it should support the learners in bridging a *performance gap*. Hence, they should be motivated to learn—if not, something dreadfully went wrong during the planning and design processes! If you find yourself having to hook the learners through slick design, then you probably need to re-evaluate the purpose of your learning processes.

Learning

(What did they learn? i.e. the extent to which the learners gain knowledge and skills)

This is the extent to which learners improve their knowledge background as a result of participating in a learning process. The learning evaluation normally requires some type of post-testing to ascertain what skills were learned during the process and what skills they already had (pre-testing).

Measuring the learning that takes place is important in order to validate the learning objectives. Evaluating the learning that has taken place typically focuses on such questions as:

- What knowledge was acquired?
- Which knowledge fields were enhanced more?
- What attitudes were encouraged?

Learner assessments are created to allow a judgment to be made about the learner's capability for performance. There are two parts to this process: the gathering of information or evidence (testing the learner) and the judging of the information (what does the data represent?). This assessment should not be confused with *evaluation*. Assessment is about the progress and achievements of the individual learners, while evaluation is about the learning program as a whole.

Performance

(i.e. What do individuals have to perform in order to create the desired impact?)

This evaluation involves testing the learner's capabilities to put into practice what knowledge was acquired. These evaluations can be performed formally (testing) or informally (observation). It determines if the correct performance is now occurring by answering the question, "Do people indicate through their actions what they have learnt?". It is important to measure such performance, because the primary purpose of learning is to improve results by having its people gain new knowledge and then actually applying them on their daily routine. Since performance measurements must take place when they are acting, the measurement will typically involve instruments that can grasp such information.

Results

(i.e. What are the tangible results of the learning process in terms of reduced cost, improved quality, increased production, efficiency, etc.?)

"Results" measure the effectiveness of the initiative. Although it is normally more difficult and time-consuming to perform than the other three levels, it provides information that is of increasingly significant value as it proves the worth of a learning and performance process. However, using the *Goals/Planning/Evaluation* model should ease the process, as we will now have a clear picture of what we are trying to achieve. That is, when we plan for something, then we more readily understand how to evaluate it.

Motivation, Learning, and *Performance* are largely soft measurements; however, decision-makers who approve such learning processes prefer results. In general, we could claim that the value of information becomes greater as we go from motivation to results.

The SOCIALENERGY platform incorporates 4 subsystems in terms of user interaction: GSRN, LCMS, GAME and Social/Marketplace. Each subsystem creates data and interactions that RAT middleware will analyze and based on the captology theory and the descriptions above, specific KPIs will be used to measure the behavioral experimentation output and savings from the behavioral DR programs.

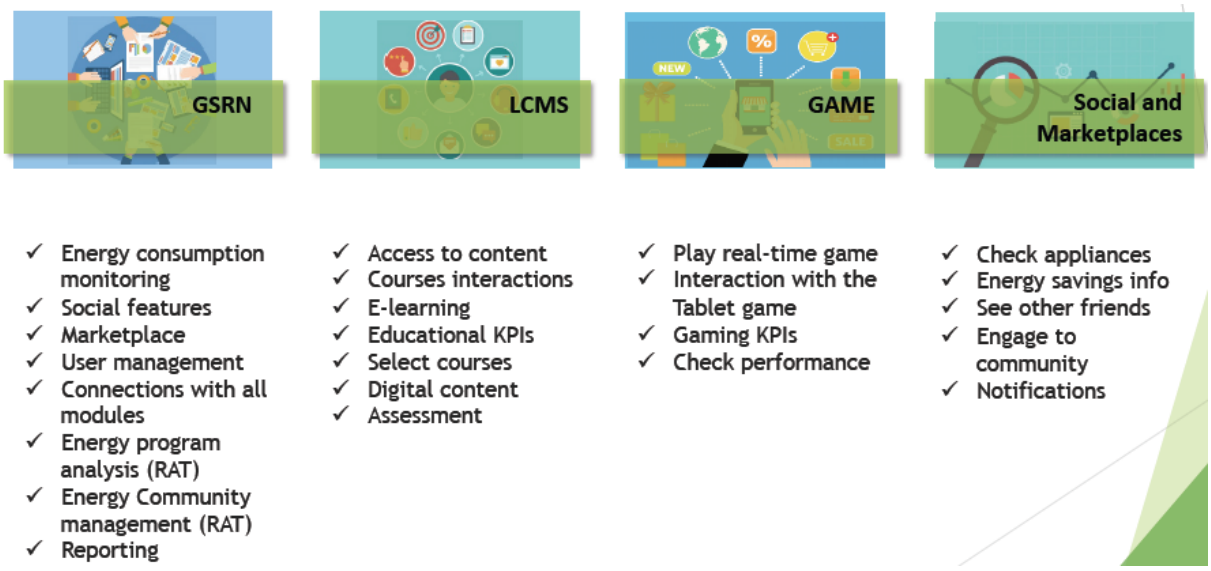

Figure 4: Phased roll-out procedures and steps

In terms of the Energy KPIs (EnPIs), data will be gathered from the MDM and the GSRN 'My profile' dashboard, based on the Behavioral DR and Energy programs executed.

The extracted metrics from the digital interactions

Even the use of a single KPI could serve our needs for measuring user's interaction with the platform itself. By measuring users' three basic metrics:

"*Engagement*" (KPI). "*Knowledge*" (KPI), "*Effectiveness*" (KPI) with the GSRN platform, important conclusions can be drawn. To achieve so, the digital platform interactions listed below, will be considered:

- Login - the user logs in to the web (logins)
- Content read/selected interactions and clicks
- Questionnaire taken – the user completes a survey/questionnaire (content)
- Level/Grade Achieved – the points accumulated from the actions (Points)
- Content View - the user views particular content (click history, views)
- Game results – Game performance and Game KPIs
- LCMS interactions – courses taken and grades
- Marketplace interactions – discounts and appliances selection
- Various logs

These digital interactions will be stored in the main database for RAT analysis:

Update calculation Period: calculate/re-evaluate engagement metrics every day and some aggregated KPIs will be computed every week.

Based on the interactions metrics and the behavioural KPI calculation, we will have a very clear and solid view and analysis of all users' behavioural profiles. One of the basic objectives (knowledge, engagement and effectiveness) will be under a continuous recursive calculation, in order to feed the recommender. The recommender will also tune and personalize more the content, per groups, per user groups, per individual profiles, per user selections, and per user persona. This will be initially tuned by the questionnaire input and general demographics.

The three Behavioural KPIs will be defined as the **Table** below shows:

Table 2: The 3 basic behavioural KPIs used for SOCIALENERGY's experimentations

Behavioral Metric	
Engagement	Measures the interaction of the player with the platform and the content (Game, LCMS, Tips)
Knowledge	Measures the knowledge level of the users, acquired from his interaction with the content (LCMS)
Effectiveness	Measures the effectiveness and speed of user interaction with the content (GSRN, RAT)

Regarding the Energy KPIs

Target variable is energy consumption (in kWh), while some important the features that will be used are:

- Previous day consumption
- Previous week (or 3 weeks back) consumption for the same day/hour
- Weekday index

Since not all individuals will have the same potentials for savings due to different demographics, different comfort level, different environmental awareness level etc., not all individuals should be treated the same.

Thus, a specific methodology will be used as depicted in figure 5 below:

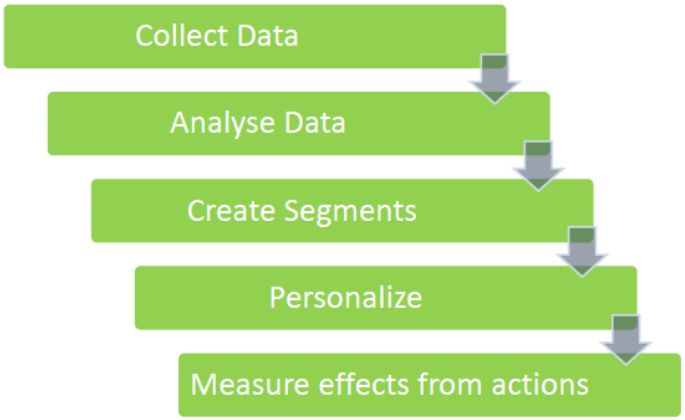

Figure 5: Behavioral M&V method/steps to follow in order to calculate actual savings from behavioral change

In the above figure, personalization is defined in terms of provided content, whether a user should be exposed to a particular functionality (e.g. is s/he ready to be exposed?), the way and means of communication, the provided incentives, etc.

An example of savings calculation (Figure 6) based on a baseline model (green line) can be shown below in four energy profiles, where clearly from a daily measured profile (blue bars), there is an amount of saved energy, compared to a baseline consumption (green line) normalized by weather and external parameters, in a specific timeslot where a behavioural DR event took place.

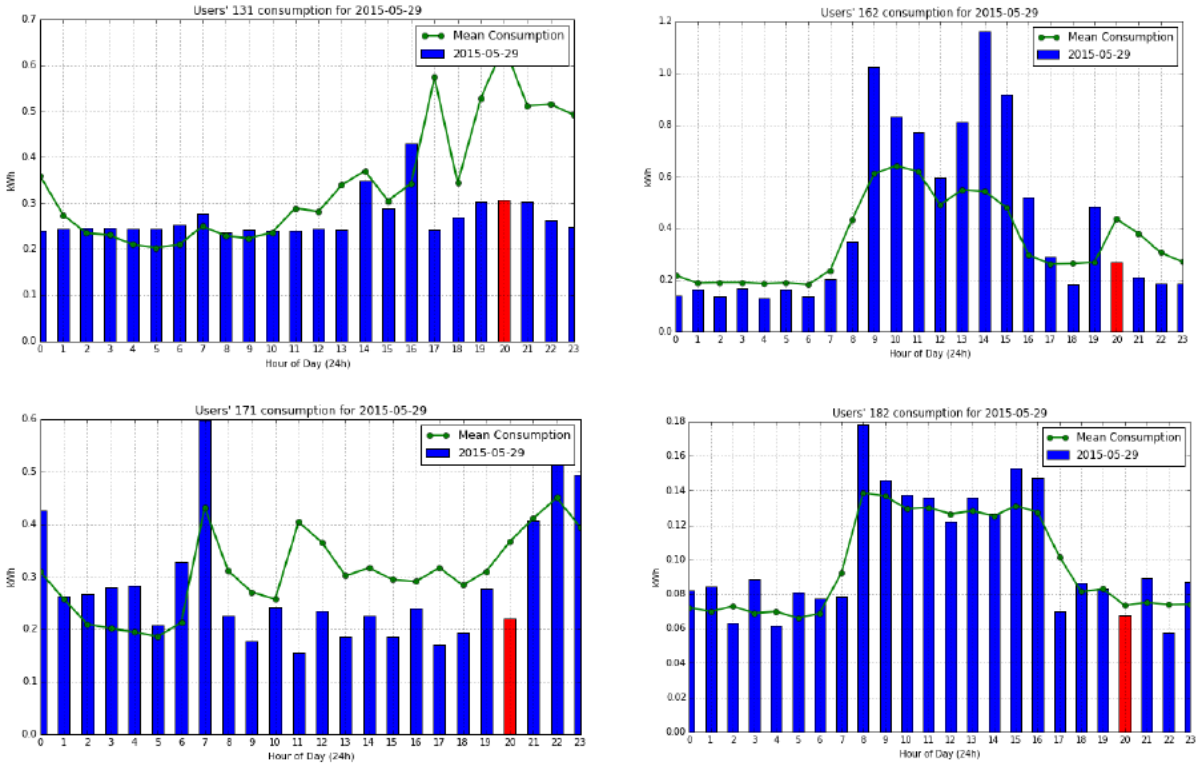

Figure 6: Actual savings (blue) VS energy baseline (green) in energy profiles (indicative example)

RELEVANT BIBLIOGRAPHY regarding BEHAVIORAL M&V that will be used, based on the EU EEA framework

- Annex 3, Art. 5 of Ordinance No 7 of 2004 on Energy Efficiency of Buildings effective from 15.07.2015;
- DNV-GL. (2014). 2013 Impact Evaluation. Seattle;
- EEA. (2013). Achieving Energy Efficiency through Behavioral Change: What does it Take. EEA . Luxembourg: Publications Office of the European Union.;
- Hunt Allcott, T. R. (2013). The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation;
- KEMA. (2014). Review of PG&E Home Energy Reports Initiative Evaluation;
- Schare, S. (2014). Program Year 2 (2012-2013) EM&V Report for the Residential Energy Efficiency Benchmarking Program. Navigant Research.

Example for reporting the Energy Savings calculation in SOCIALENERGY per Utility pilot

User	Average consumption	Savings coeff.	Final energy savings	Total final energy savings	Total final energy savings	Primary energy savings	Total primary energy savings	Equivalent CO2 savings
N	**P**	**R**	**$FES_{kWh,el}$**	**$FES_{tot,kWh}$**	**$FES_{tot,toe}$**	**PES**	**PES_{tot}**	**CO_2**
[Number]	[kWh]	%	[kWh/year/consumer]	[kWh/year]	[toe/year]	[toe/year/consumer]	[toe/year]	[tCO_2/year]
200,000	2300	2%	46	9,200,000	791.1	0.01187	2,373.17	7,534.800

- **Model for calculation**
- Parameters used:
  - KWh_{saved} – saved KWh energy for the entire program
  - N – number of participants in the program
  - C_{avg} – average consumption of energy for a household
  - R - percentage of savings determined by the statistical model (see: base regression model for management of behavior)
  - FES_{toe} - Final energy saved in tons of oil equivalent
  - k_{el}: coefficient of transformation from final energy (kWh) into final energy (toe) (0,086*10^-3 toe/kWh or other based on the local National formula)
  - k_{pr} – coefficient for transformation from final energy (toe) into primary energy (toe) (3 toe/toe)
  - k_{CO2} – emission factor for transformation of a unit of final energy into equivalent CO_2 savings (819 tCO_2/toe or other based on the local National formula)
  - BS – White certificates if any
  - PES_{tot} – Total primary energy saved

- tCO_2 – Tons of reduced emissions

- Energy savings:
  - $KWh_{saved} = N * C_{avg} * R$
- Final energy savings in tons of oil equivalent
  - $FES_{toe} = KWh_{saved} * k_{el}$
- Primary energy savings in tons of oil equivalent:
  - $PES_{tot} = FES_{toe} * k_{pr}$
- White certificates:
  - $BS = PES_{tot}$
- Equivalent CO_2 savings
  - $tCO_2 = FES_{toe} * k_{CO2}/1,000/1,000$

The outputs of the algorithmic approach will be visualized and specific reports will be generated. The results of the analytics features and functions are very important in order to personalize the whole experience and to calculate accurately the impact of the behavioural shifting of the GSRN and SOCIALENERGY impact. Thus, special reports will be generated, that will indicate on overlapping infographics, the behavioural and energy KPIs, including also some other KPIs exported by the algorithms (i.e. RAT). A draft sample of the report is shown below with dummy data:

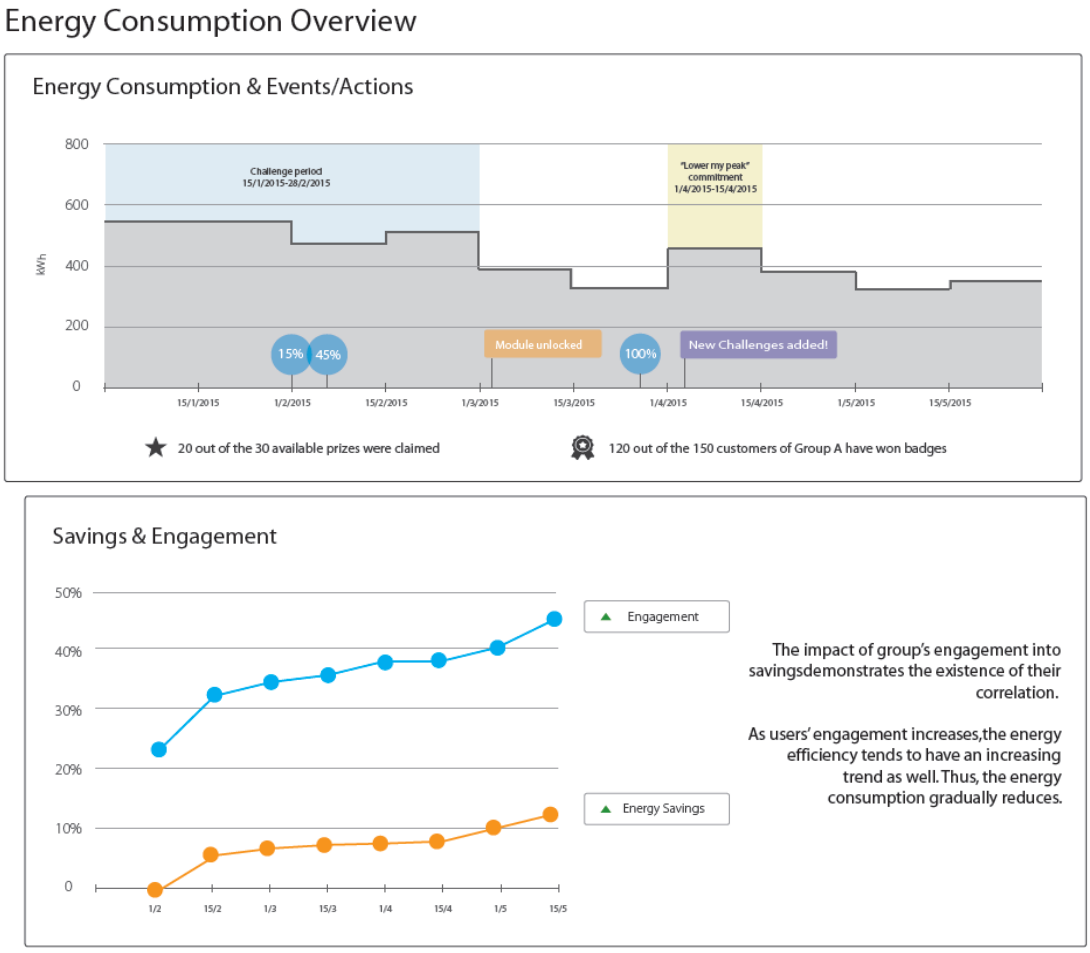

Figure 7: Draft example of the project's assessment results to be delivered at the end of the project's lifetime

3 Validation plan

This section provides a summary of the S/W validation plans per SOCIALENERGY subsystem. The first version of S/W validation activities have been reported in D5.2 (M18), while the final version will be delivered in M27 via D5.3.

3.1. Validation plan for GSRN core S/W platfrom

Table 3: Summary of GSRN testing and validation activities

ID	Validation check	Expected outcome	Real outcome
GSRN01	User registration, login, create account to LCMS.	An Admin should be able to create a new user account in GSRN, under the hood: GSRN creates a new user account to LCMS.	Just as expected
GSRN02	User logins with GSRN credentials, to RAT – LCMS using oauth2.	A user with an active GSRN account should be able to login to the RAT – LCMS - GSRN using GSRN credentials.	Just as expected
GSRN03	User account management.	A registered user should be able to update his credentials, edit his own account, etc.	Just as expected
GSRN04	A Registered user should be able to complete the questionnaire.	The first time a user logins, questionnaire must pop-up, after successful completion, questionnaire will be hidden.	Just as expected
GSRN05	Results from questionnaire must be posted to LCMS.	LCMS is using results from questionnaire to create – initialize learning plan of user.	Just as expected
GSRN06	Real-time data visualization of analytics.	Real-time data should be displayed in the 'My Energy Profile', data is coming from MDMS database.	Just as expected
GSRN07	Real-time data visualization of LCMS PROFILE.	Real-time data should be displayed in the 'LCMS PROFILE', data is coming from LCMS service saved to MDMS database.	Just as expected
GSRN08	Real-time data visualization of GAME PROFILE.	Real-time data should be displayed in the 'GAME PROFILE', data is coming from MDMS database, posted from GAME app.	Just as expected
GSRN09	Real-time data visualization of Notification.	Real-time data should be displayed in the 'GAME PROFILE', data is coming from MDMS database, posted from RAT.	Just as expected
GSRN10	Create a new product – support CRUD	An admin must be able to create a new product in the marketplace, view,	Just as expected

ID	Validation check	Expected outcome	Real outcome
	functionalities.	update or delete if s/he wants.	
GSRN11	User must be able to add products to his basket or to checkout.	A user should be able to see all the products, to sort them, add them to his basket or even to checkout.	Just as expected
GSRN12	An Admin investigates all transactions of marketplace.	An admin should be able to edit/update/delete all transactions of marketplace.	Just as expected
GSRN13	User must be able to create communities.	A user can request permission to create group, after success, s/he can search and invite members to his/her group.	Just as expected
GSRN14	An Admin must have CRUD functionalities over communities.	An admin user should be able to edit/update/delete all transactions of communities.	Just as expected
GSRN15	User adds widget to his dashboard.	A user can add/delete/rearrange widgets to his/her dashboard page.	Just as expected
GSRN16	Widget of dashboard showing updates.	Widget of dashboard showing, receiving new records.	Just as expected
GSRN17	MDM-GSRN service.	MDM broadcast data (consumptions – consumers – geolocation) to GSRN.	Just as expected
GSRN18	GSRN-RAT service.	GSRN broadcast data to RAT - user behavioral data from MDM.	Just as expected
GSRN19	GSRN-GAME service.	GSRN authenticate user, saves game actions of user.	Just as expected
GSRN20	GSRN-LCMS service.	GSRN pulls LCMS user actions, saves them to MDMS.	Just as expected
GSRN21	GSRN-Marketplace service.	GSRN broadcast marketplace data. (behavior data – product related data)	Just as expected

3.2. Validation plan for RAT subsystem

Table 4: Summary of RAT testing and validation activities

ID	Validation check	Expected outcome	Real outcome
RAT01	User registration and login	A user should be able to create a user account in RAT and login	Just as expected
RAT02	User login with GSRN credentials	A user with an active GSRN account should be able to login to the RAT using GSRN credentials	Just as expected
RAT03	User account management	A registered user should be able to update his credentials, edit/delete his own account, etc.	Just as expected
RAT04	Register a new energy	An administrative user should be able to	Just as expected

ID	Validation check	Expected outcome	Real outcome
	consumer and synchronize energy data exchange with MDMS	register a new consumer in the RAT database and synchronize with central MDMS database	
RAT05	View list of consumers/ consumer details, edit/delete consumer details	A user should be able to view the list consumers together with their details and manage them according to his/her user rights	Just as expected
RAT06	Historical data visualization	Historical data should be displayed in the 'Consumer', 'Community' and 'Clustering' views in various time granularities and for any given timeframe in the past	Just as expected for energy data, behavioral data visualization service is ready for real-life pilots
RAT07	Real-time data visualization	Real-time data should be displayed in the 'Consumer', 'Community' and 'Clustering' views. The graphs should be updated dynamically as new data arrives	Just as expected, need input from more real smart meters (GSRN) to use in real-life pilots
RAT08	Community creation	An admin user should be able to create "communities" (i.e. groups of consumers). A consumer may belong to several communities, as long as they are in different 'clusterings'.	Just as expected
RAT09	View list of communities and details	A user should be able to details about each community such as community members, aggregated consumption, the 'clustering' it belongs to etc.	Just as expected
RAT10	Manage a community	An admin user should be able to edit/update/delete a community, for example to change its name, description, member consumers, etc	Just as expected
RAT11	Create a new 'clustering'	An admin should be able to create a new clustering (i.e. group of communities), based on several input parameters	Just as expected
RAT12	View list of 'clusterings' and details	A user should be able to see a list with all the 'clusterings' in the system and details about each 'clustering'	Just as expected
RAT13	Manage a 'clustering'	An admin user should be able to edit/update/delete clustering details, such as its name, description, and participating communities	Just as expected
RAT14	Algorithmic clustering creation – Consumer type	A user can create a clustering automatically based on the consumer type, location, energy program, etc.	Just as expected, need for more input from GSRN real-life pilots
RAT15	Algorithmic clustering creation – Consumption patterns	A user can create a clustering automatically based on the consumers' consumption patterns	Algorithmic results and visualization just as expected
RAT16	Algorithmic clustering	A user can create a clustering	Just as expected, need

ID	Validation check	Expected outcome	Real outcome
	creation – Flexibility patterns	automatically based on the consumers' flexibility patters (i.e. similar levels of flexibility over time)	input from GSRN (real-life pilots w.r.t. DR events)
RAT17	Algorithmic clustering creation – Behavioral data from GSRN activities	A user can create a clustering automatically based on the consumers' GSRN participation (e.g. similar levels of participation)	Just as expected for mock-up data, need input from GSRN during real-life pilots
RAT18	Algorithmic clustering creation – LCMS participation	A user can create a clustering automatically based on the consumers' LCMS participation (i.e. similar levels of participation/ learning achievements/level)	Just as expected for mock-up data, need input from GSRN during real-life pilots
RAT19	Algorithmic clustering creation – GAME participation	A user can create a clustering automatically based on the consumers' GAME participation (i.e. similar levels of gameplay achievements/engagement, etc.)	Just as expected for mock-up data, need input from GSRN during real-life pilots
RAT20	Reporting/ Recommendation service creation	An admin user should be able to create a new recommendation/ reporting service by using the output of the clustering algorithms	Just as expected for manual mode, need to integrate with clustering module for automatic mode
RAT21	View list of recommendations	A user should be able to see/preview the list of all recommendations that have been created and their status	Just as expected
RAT22	Manage recommendations	An admin user should be able to edit/delete/update a recommenda-tion (before it is sent) and then successfully send to the end users	Just as expected, need for more personalized messages in the future
RAT23	Create energy program evaluation scenario	A user should be able to create an energy program evaluation scenario, and assign various parameters to the scenario	Just as expected for historical data, advanced version with real-time datasets
RAT24	Create energy program evaluation scenario through API	A GSRN user can create an energy program scenario through the GSRN platform using a REST API	Just as expected
RAT25	View list of energy program evaluation scenarios	A user should be able to view the list of the energy program evaluation scenarios that have been created and compare the results	Just as expected
RAT26	Manage energy program evaluation scenario	A user should be able to edit/update/delete an evaluation scenario that s/he has created	Just as expected
RAT27	View and compare various energy programs	A user should be able to visualize the results of the evaluation scenario (various KPIs), compare various energy	Just as expected

ID	Validation check	Expected outcome	Real outcome
		programs in order to select the most beneficial one	

3.3. Validation plan for GAME

Table 5: Summary of GAME testing and validation activities

ID	Validation check	Expected outcome	Real outcome
GAME01	User login with GSRN credentials	A user with an active GSRN account should be able to login to the GAME using GSRN credentials.	Just as expected
GAME02	GSRN Competence Level	GSRN Competence is received and used to recommend Energy program	
GAME03	Avatar Customization	A user should be able to customize and play the customized avatar.	Just as expected
GAME04	Send Avatar Data	Data of the avatar is sent to GSRN to have a consistent avatar on all platforms	
GAME05	Energy programs	A user should choose energy program according to his current level.	Just as expected
GAME06	Info from LCMS	The user can get more information about the energy program from a link to LCMS.	Just as expected
GAME07	Task planner	The user plans his/her day by dragging and dropping his/her daily tasks into the plan at the hour s/he needs.	Just as expected
GAME08	Avatar control	The avatar can be moved by the user and interaction with objects is possible.	Just as expected
GAME09	Tutorial	The game provides the player with information needed to understand the game concept	Just as expected
GAME10	Jobs	Jobs can be made at the scheduled time or independent from schedule	Just as expected
GAME11	Activity	An activity is a step of a job trigger by interaction with an object. Activities have certain duration and unlock the next step of the job.	Just as expected
GAME12	Device options	Multiple device options are available and differ in energy consumption and convenience.	Just as expected
GAME13	Job Result	After a job is finished, a result window is displayed with user consumption, cost, convenience and reward.	Just as expected
GAME14	Rewarding	After a job is finished, the user is getting a reward.	Just as expected

ID	Validation check	Expected outcome	Real outcome
GAME15	Sending Job Info	Job information is sent to GSRN	Just as expected
GAME16	Fixed price program	In the fixed pricing energy program the prices are not changing.	Just as expected
GAME17	Result of the Day	The results of the day are presented to the user: Amount of Jobs finished, Consumption of the day, costs of the day compared with minimum costs, convenience of the day compared with maximum convenience, daily convenience score, daily cost score.	Just as expected
GAME18	Time of Use pricing program	In the time of use pricing program, the prices depend on the timestamp that the user performs an activity.	Just as expected
GAME19	Personalized real time pricing	The prices depend on the decisions made by user.	Just as expected
GAME20	Real Time Energy Community pricing	The price depends on the decisions of the user and the in-game NPCs.	Not yet implemented, will be implemented till M24
GAME21	Upgrades	The user can purchase upgrades for his/her electronic devices. The upgraded devices replace the former ones. The upgraded devices change the device options.	Just as expected
GAME22	Decorations	The user should be able to buy decoration items.	Just as expected

3.4. Validation plan for LCMS

Table 6: Summary of LCMS testing and validation activities

ID	Validation check	Expected outcome	Real outcome
LCMS01	User registration and login	A user should be able to create a user account in LCMS and login	Just as expected
LCMS02	User login with GSRN credentials	A user with an active GSRN account should be able to login to the LCMS using GSRN credentials	Just as expected
LCMS03	User profile management	Registered users should be able to change their own credentials (available only for locally registered users) and update account's settings	Just as expected
LCMS04	Create competency framework	An administrative user should be able to set up competency frameworks and add competencies to them.	Just as expected
LCMS05	Create learning plan on	A user authenticated with GSRN	Just as expected

ID	Validation check	Expected outcome	Real outcome
	behalf of GSRN	credentials should be automatically assigned with an individual learning plan, which includes all missing competences determined by the results from GSRN questionnaire	
LCMS06	Create learning plan	An administrative user should be able to create learning plan templates, add competencies to them and assign learning plans to a cohort of users or to individual selected users.	Just as expected
LCMS07	Create course	An admin user should be able to create course and add learning activities like text reading, take quizzes, forums etc.	Just as expected
LCMS08	Assign competencies to courses and course activities	An admin user should be able to add competencies to courses and course activities, and configure the rules for acquiring proficiency level.	Just as expected
LCMS09	Dashboard	Registered users should be able to view dashboard with their own learning plans, courses (in progress and passed) and the courses' progress.	Just as expected
LCMS10	Follow Learning Plan	According to the learning plan, the LCMS should provide appropriate educational materials to the user. Users should be able to view the degree to which learning plan is fulfilled.	Just as expected
LCMS11	Follow course	The user can view, download learning materials and perform different tasks such as uploading files, fill in quizzes, reply with a text in forums etc.	Just as expected
LCMS12	Obtain badge	When a registered user acquires a new competence, s/he is automatically awarded a badge.	Just as expected
LCMS13	RESTful Competency API	The RESTful Competency API should allow LCMS to communicate with the other subsystems learners' competencies and levels' of proficiency, courses' progress and grades, acquired badges.	Just as expected

4 Next steps

The plan is that the consortium will start the small-scale experimentations right after an 'alpha' version of the S/W platform is released in M19. Then, once a 'beta' version is available within the Q4 of 2018, the consortium will start gathering data from real users and derive all the above-mentioned energy and behavioural KPIs. Until the end of the project's lifetime, there will be at least a 6-month period, within which the KPIs will be evaluated in order to assess the final project's results in D5.4.

The next step for the consortium is to start integrating real-life and real-time datasets from real users. The goal for the consortium is to be able to test and validate the 2nd version of the integrated S/W platform in M27. The validation plans, which are included in this report will be followed for the live demonstrations that will take place during the 2nd review meeting (Athens, 18/9/2018).

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