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Innovation Action



CleAnweb Gamified Energy Disaggregation



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D5.8 2nd Year Dissemination report including communication material

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Abbreviations

ADDMA	Athens Development and Destination Management Agency
CORDIS	Community Research and Development Information Service
EASME	European Commission Executive Agency for SMEs
ESCos	Energy Service/Savings Companies
IEEE	Institute of Electrical and Electronics Engineers
KPI	Key Performance Indicators
MCIS	Mediterranean Conference on Information Systems

Executive Summary

The main objective of the ChArGED dissemination strategy is to describe the achieved and planned dissemination activities and tools to ensure that various target groups get aware of the activities of the project. More specifically, through these activities, ChArGED aims to create public awareness and generate interest to different communities (scientific, industrial, wider public, policy makers, etc.) as well as to inform and consult industrial players in the field across Europe about the ChArGED solutions for energy efficiency in public buildings, in general. Dissemination/ Communication activities help towards the identification of the benefits of the ChArGED outputs and the exploitation of these in order to maximise the impact of the project on all stakeholders.

To this end, the project has been communicated (during the first year of its life) through different online and offline channels; these activities are thoroughly presented in this document. This report presents the dissemination effort and material which have taken place during the entire second year of the project implementation.

1 Introduction

This report, part of WP5, summarises the dissemination activities, along with the communication material, that were performed during the first year of the ChArGED project. At the beginning of the project, the identity and the main communication channels with the stakeholders were built. The identity contributes into the recognition of the ChArGED project, and is mainly based on the graphical consistency of the material and the dissemination of project results. The following are the main topics of the ChArGED dissemination efforts during the second year:

- The ChArGED as a project in general,
- The ChArGED end-user deployment plans (results of WP4),
- The ChArGED architecture and initial design (results of WP3),
- The ChArGED planned system components and particularly the gamified app.
- The ChArGED baseline assessment methodology

A wealth of activities, online and offline, have taken place. These are described in more detail in the next chapters.

2 Communication material

2.1 Flyer and poster

A flyer has been re-designed, in order to present the recent results of the project as mentioned above. The flyer is also publicly available for download at the ChArGED website.



Figure 1 ChArGED flyer v1



Figure 2 ChArGED flyer v2

2.2 Presentation template

The project presentation was updated for complete project presentation, further contributing to the identity forming and making the project recognisable.

The project general presentation has been also updated to include project results related to the system components and validation methodologies.



Figure 3 Extracts of ChArGED baseline presentation

2.3 Document templates

Although document templates can be considered part of the quality management, since some deliverables are public, the consistent form of these documents contributes to the ChArGED graphic identity.

Dx.y-Deliverable-Title

|H2020-EE-11-2015|
Innovation Action

CleAnweb-Gamified-Energy-Disaggregation

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 696170

Dx.y-Deliverable-Title			
Report-Identifier:	Dx.y		
Work-package, Task:	WPx	Status--Version:	A.BB
Distribution-Security:	PU/CO	Deliverable-Type:	R-DEM-DEC-OTHER
Editor:	Name-Surname-(Organisation)		
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Reviewers:	Name-Surname-(Organisation)		
Quality-Reviewer:	Name-Surname-(Organisation)		
Keywords:			
Project-website:	www.??		

1 - Introduction

Introduction should be a brief Section to provide background, also from within the Project (i.e. could cite work from other WPs, or previous work of the same WP). It is advisable not to exceed 3 pages for this Section.

USE STYLES throughout the document. If you want to insert a header, please use the heading 1/2/3/4 style, do not simply adjust the font. The same applies for normal text and everything else.

Figure 1 illustrates the logo of the project. Please make sure that you always use cross-references when referencing figures, tables, other (sub) sections, etc. If you do not know how to insert cross-references, please contact the coordinator.

Figures must be centered, and always followed by a descriptive, numbered caption below (use right-click-/insert caption).

Figure 1-ChArGED-logo

Tables should be presented as follows:

Table 1: A sample table (vertical)

Column-1-title	Column-2-title
Cell-1	Cell-2

Table 2: A sample table (horizontal)

Row-1-title	Row-1
Row-2-title	Row-2

Figure 4 Extracts of ChArGED deliverable template

3 Online Activities

The project website, at <http://www.charged-project.eu/>, has been continuously updated with project results, and events. For the visitors' convenience almost all subpages of the website are accessible by the main page with respective quick links. Moreover, links to the social media accounts (LinkedIn and Twitter), "amplifying" the branding of the project, are available on the Main Page of the website.

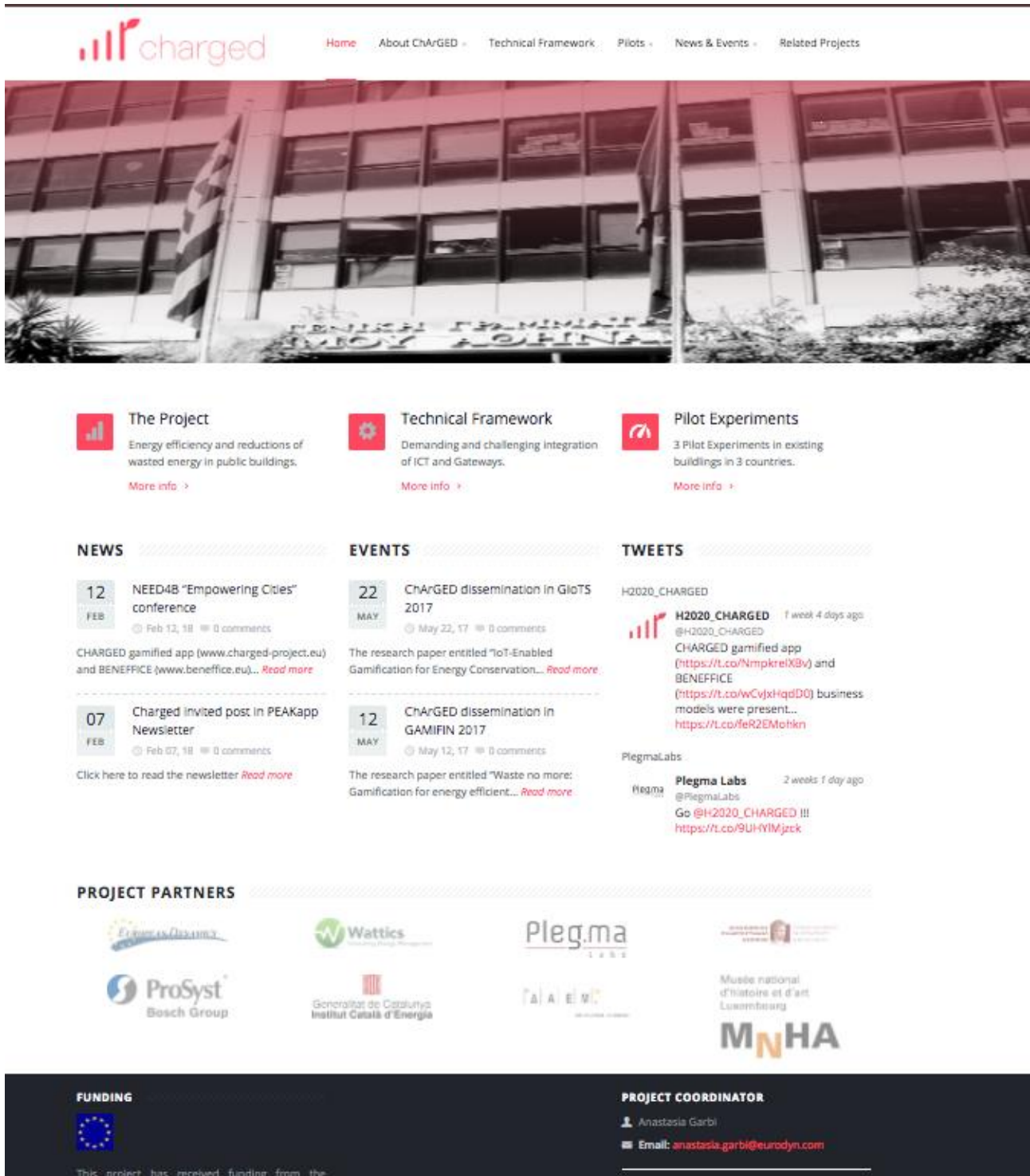


Figure 2 Screenshot of ChArGED website (main page)

The ChArGED website has proved highly effective in the dissemination of the project. The number of visitors shows increasing trends, while the monthly number of unique visitors are beyond the 2000 mark since June 2017. A constant increase at the number of visits appears in January 2017, after the dissemination of ChArGED in the European Utility week and the VIMSEN project workshop.



Figure 3 ChArGED website sitemap

The duration of the visits, which is one of the factors in calculating the audience engagement¹, is slowly declining following the increase in visitors. This is an expected behaviour, as normally more visitors means that the site is accessed by a wider audience which is not necessarily interested in all the technical details of the projects. Nevertheless, the overall average duration is at the 2 minutes mark, which is assessed as good performance based on industry standards.²

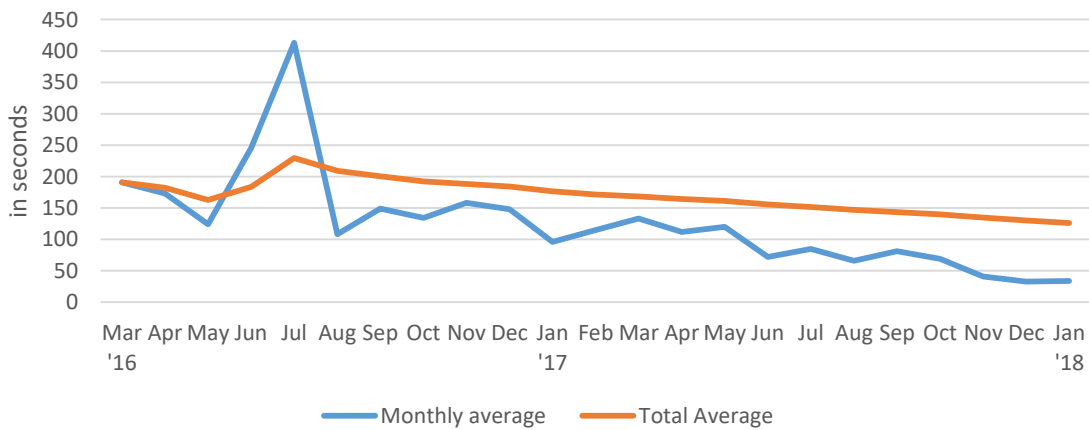


Figure 4 ChArGED website visit duration

¹ The other factors are: click depth, return frequency and long-term loyalty, Peterson E., Carrabis J., “Measuring the immeasurable: visitor engagement”, WebAnalyticsDemystified, 2008

² <https://www.spinutech.com/blog/digital-marketing/7-website-analytics-that-matter-most/#AvgSessionDuration>

Hits on the project web pages via search engines show increased interest, with more than 80 hits per month constantly after October 2016.

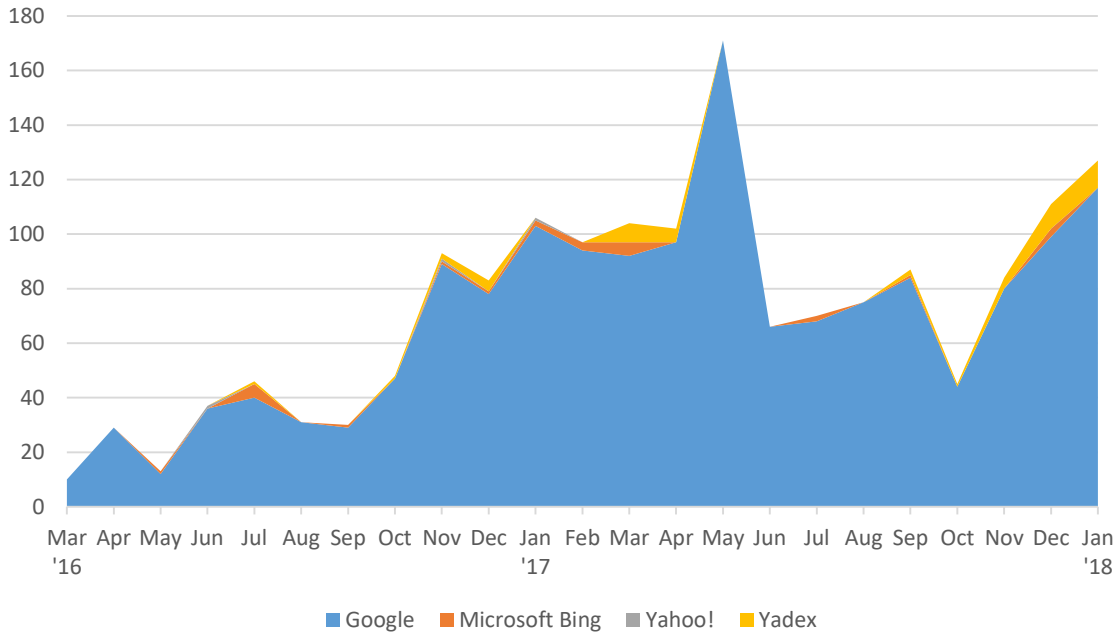


Figure 5 ChArGED website hits from search engines

Public deliverables are also available for download at the website. The total number of downloads after March 2017 is constantly above 100.

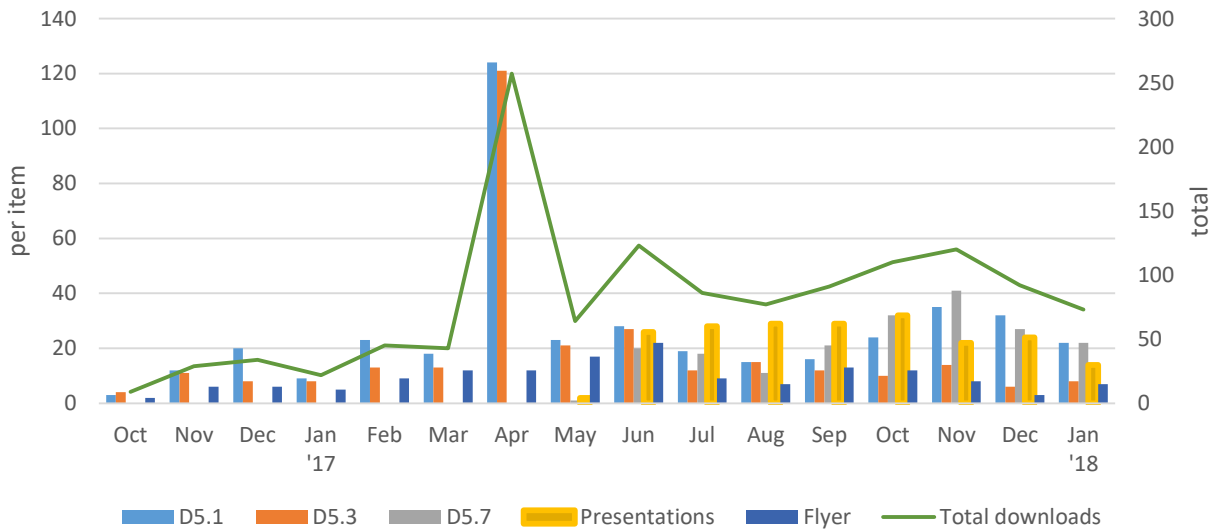


Figure 6 Public deliverables downloads

3.1 Social media

3.1.1 LinkedIn

During this period the project LinkedIn group was renamed to Energy Efficiency projects as this is now used by other projects and specifically the projects ENTROPY, BENEFFICE(common coordinator), PEAKapp. This has been created with the initiative of ChArGED proposed and welcomed by other projects. More project will be invited. Furthermore, while the group itself is a way to connect relevant interested persons and parties, and promote to them the project results and relevant discussions, the same news and results of the project have been also published as posts of partners and republished by others in order to reach larger audience. Indicatively while the group now includes x members, recent project news have been reported to have 1164 views .

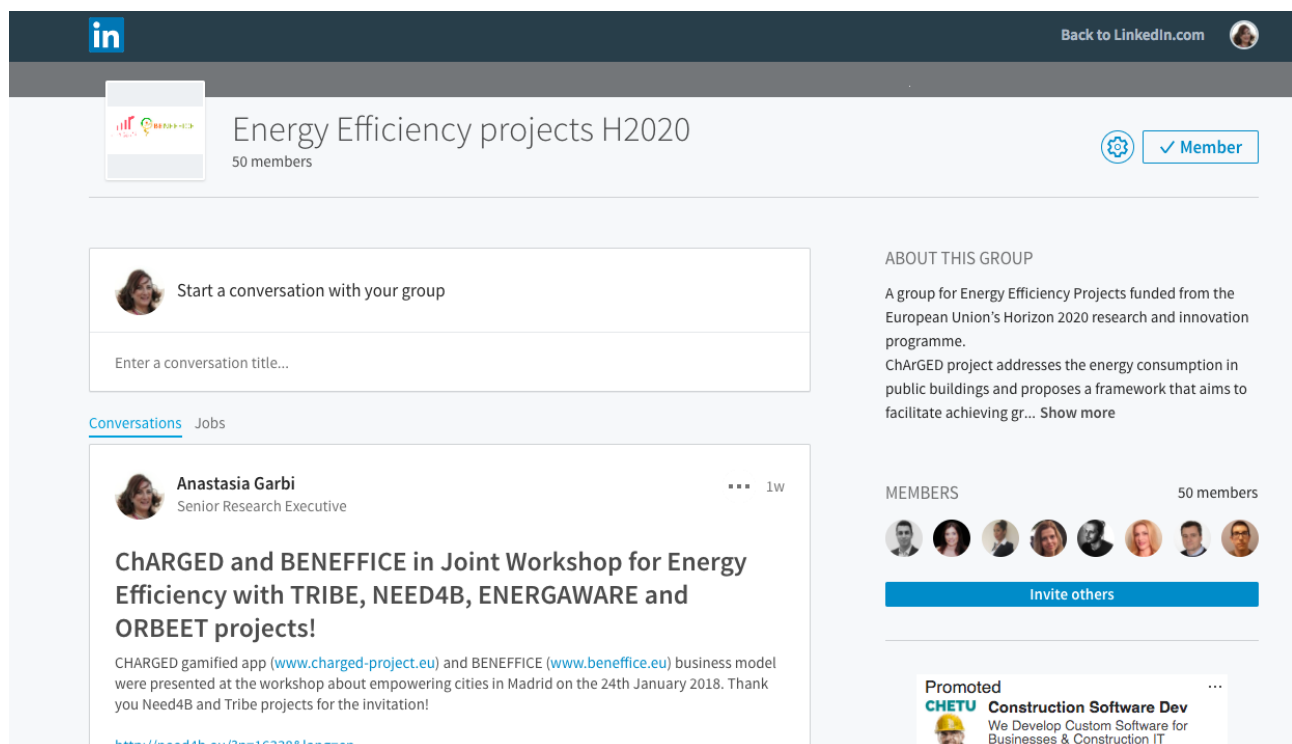


Figure 7 LinkedIn Energy Efficiency Projects H2020 group

Therefore in the second year the LinkedIn group has expanded from 30 LinkedIn members to 51, showing a big increase and real benefit of cooperating with other relevant projects. The aim is to engage with the different communities (academic, industrial, etc.) and enable them to actively participate in the professional conversations or even initiate their own, thus creating a focused audience.

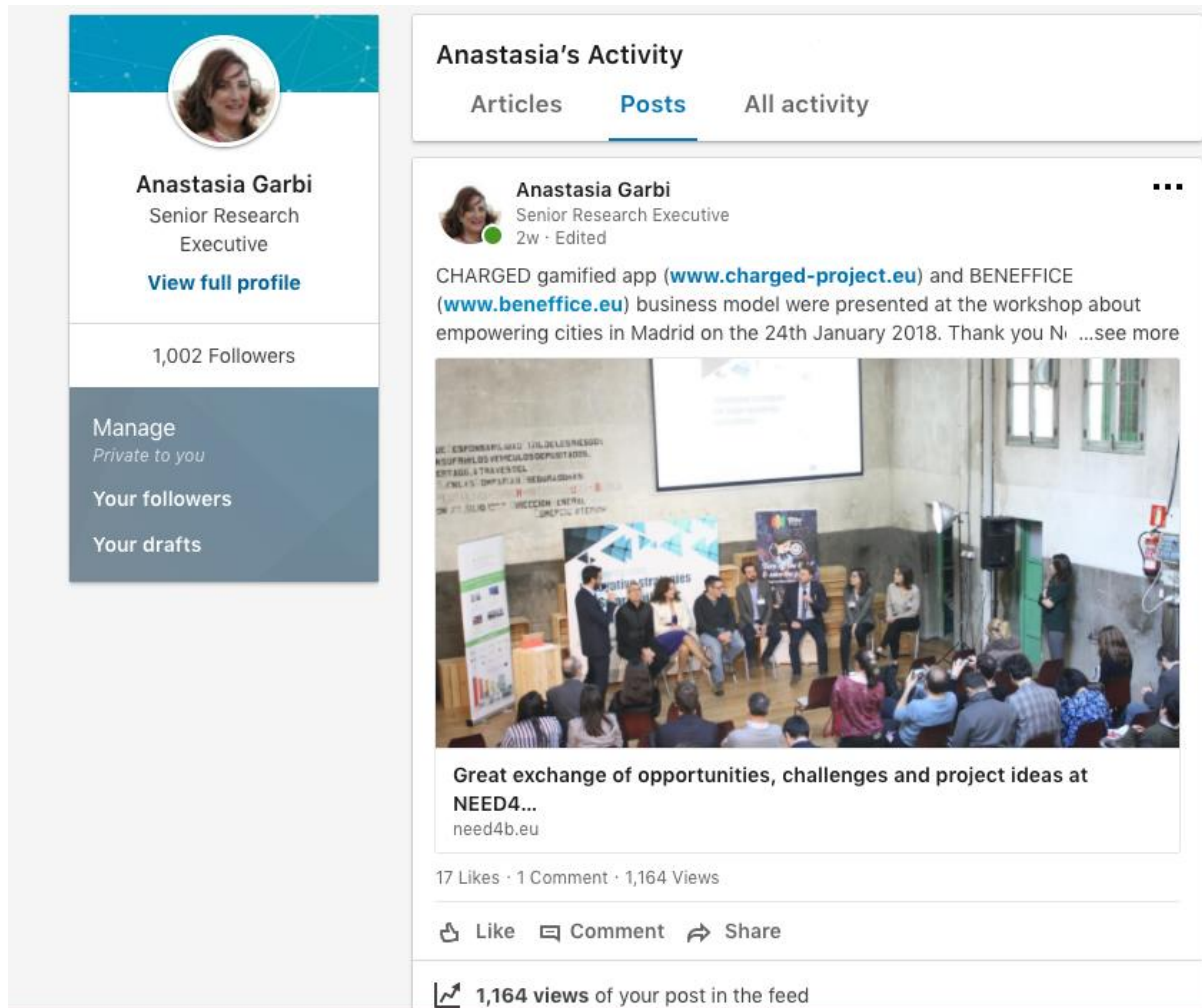


Figure 8: LinkedIn post in the open space

The statistics of the Group members industries are summarised in the following graph:

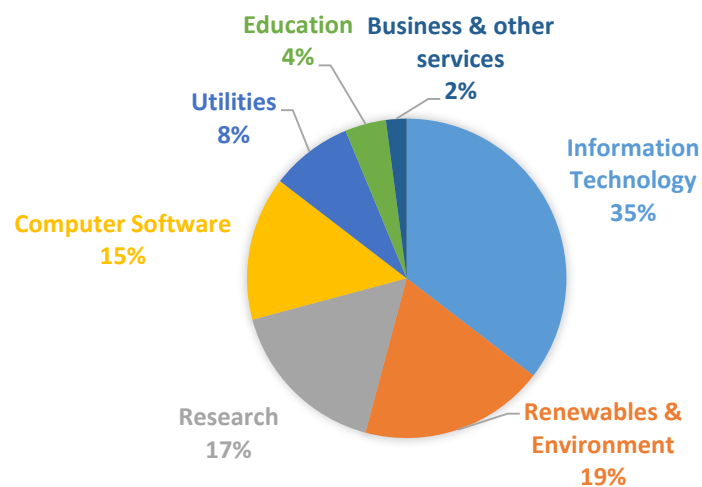


Figure 9: Industries of LinkedIn group members

3.1.2 Twitter

A twitter account has been also set up and updated with the latest news and events.



Figure 10 ChArGED twitter announcements

Up to the time of creating this document the twitter account had 45 followers and a total of 22 tweets.

28 day summary with change over previous period



Figure 11 Last 28 days summary of Twitter account

The ChArGED tweet impressions, as expected do not have a constant number since they are largely dependent on the number and nature of the tweets themselves. However, a constant trend for an average value of 300 tweet impressions per month can be observed.

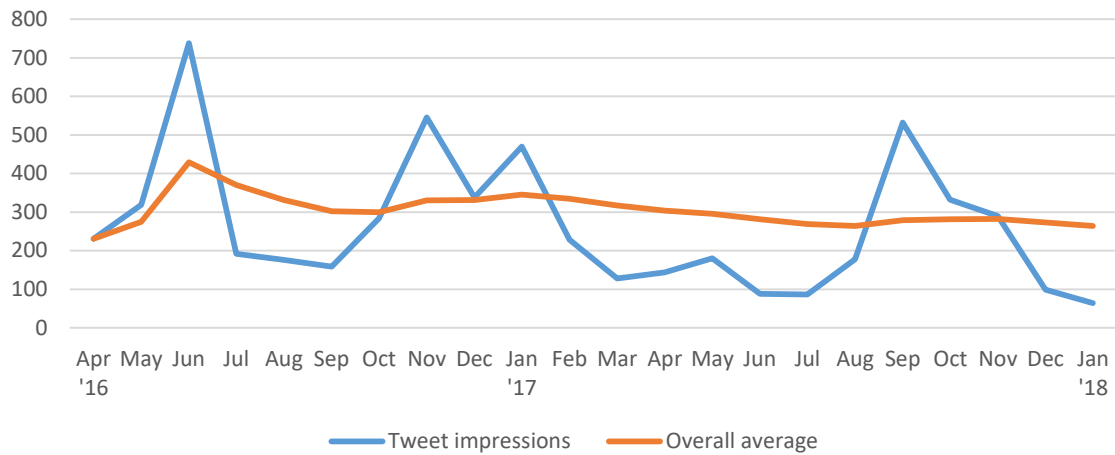


Figure 12 ChArGED tweet impressions

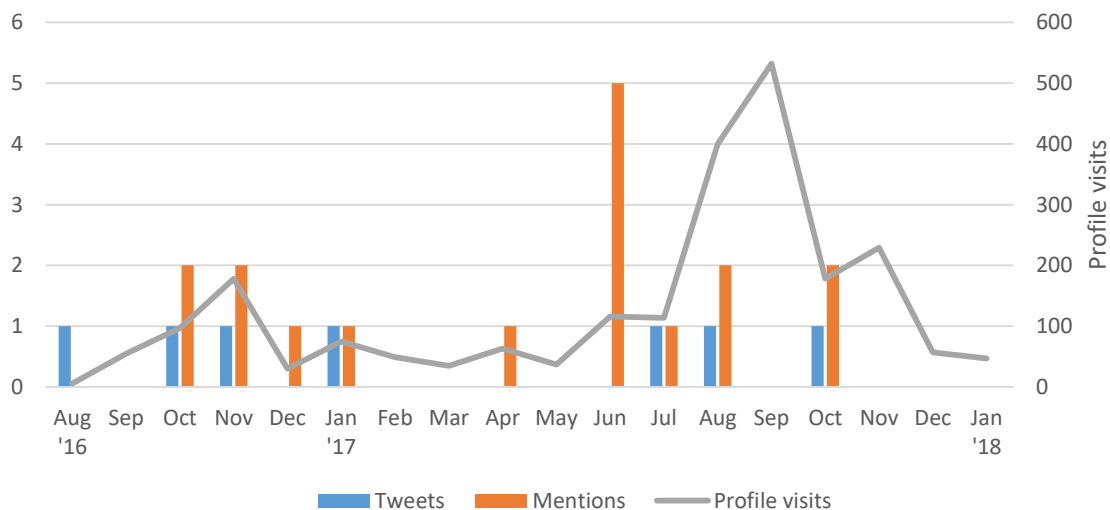


Figure 13 Twitter profile monthly statistics - Tweets, mentions and profile visits

3.2 EC and partner websites

The links to partners websites have been maintained.

Project information is also available at the EC Community Research and Development Information Service (CORDIS).



The screenshot shows the CORDIS (Community Research and Development Information Service) website. At the top, there are navigation links: "About CORDIS", "Contact", "Advanced Search", "Legal Notice", and "English (en)". The main header features the European Commission logo and the text "CORDIS Community Research and Development Information Service". Below the header, a breadcrumb trail reads: "European Commission > CORDIS > Projects & Results Service > CleAnweb Gamified Energy Disaggregation".

The main content area includes a search bar with a "Search" button and a "Sign in" link. A navigation menu contains "NEWS & EVENTS", "PROJECTS & RESULTS" (which is underlined), "RESEARCH*EU MAGAZINES", and "PARTNERS". Below the menu, there are icons for "Download" (PDF, DOC, PPT), "Print", "Booklet", and "My booklet (0)".

The project details for "ChArGED" are displayed, including the "HORIZON 2020" logo, "Project ID: 696170", and "Funded under: H2020-EU.3.3.1. - Reducing energy consumption and carbon footprint by smart and sustainable use". The project title is "CleAnweb Gamified Energy Disaggregation", with a duration of "From 2016-03-01 to 2019-02-28, ongoing project".

The "Project details" section is organized into two columns:

<p>Total cost: EUR 2 220 312,50</p> <p>EU contribution: EUR 2 220 312,50</p> <p>Coordinated in: Belgium</p>	<p>Topic(s): EE-11-2015 - New ICT-based solutions for energy efficiency</p> <p>Call for proposal: H2020-EE-2015-2-RIA See other projects for this call</p> <p>Funding scheme: RIA - Research and Innovation action</p>
--	---

Figure 14 CORDIS project web page

3.3 Application to the Common Dissemination Booster

The project has taken part to the application to the Common Dissemination Booster which has been coordinated by the project PEAKapp. 9 other projects have cooperated for this including BENEFFICE, CHARGED, encompass, ENTROPY, ORBEET, ENERGAWARE, GREENPLAY, GAIA, TOGETHER. Unfortunately this application has not been successful and has been rejected by EC.

3.4 ChArGED Newsletter

1ST CHARGED NEWSLETTER, OCTOBER 2017

structured interviews) and online surveys to better understand the situation regarding the individual factors that influence energy consumption for the employees in the pilot sites, their current energy-consumption habits and their in-game preferences, with additional questions on gameplay preferences, work engagement and burnout. In terms of individual

conserving energy and resources is important to them and their own problem.

- Show sensitivity to social norms, claiming that saving energy is a collective effort (doing it alone does not have an impact).
- Are willing to help their organization and to change their daily routine to conserve energy.

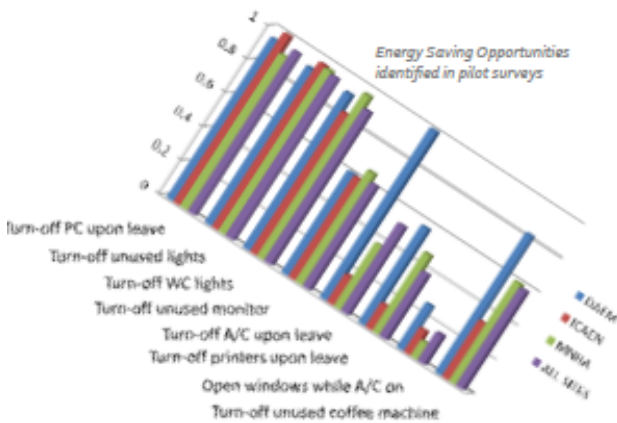
Consider their personal comfort at work of crucial importance.

Thus, in general, employees are positively positioned towards pro-energy conserving behavioral changes, as long as their personal comfort is not significantly affected. The main targeted behaviors that waste energy at the three pilot sites are:

- Printers are mostly left on after working hours.
- Some employees open windows whilst the A/C is on.

In terms of in-game preferences, we found that most of the employees consider that only team efforts would be effective towards energy conservation at work. Also, we found that a social competition would be of interest for the majority of employees, as long as individual performance is not exposed. Finally, the majority of employees are motivated by some sort of reward (monetary or not) for energy conservation. Based on the above, we developed game scenarios, and related challenges which will be the core game mechanics of the developed mobile App.

Our approach in high-level: energy-consumption events are translated into in-game scores or trigger tips to the users.



behavioral factors, we found that the majority of employees at all sites:

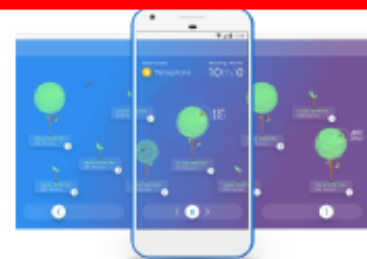
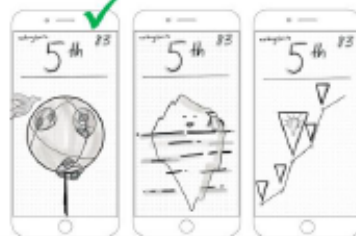
- Exhibit positive environmental awareness and environmental worldviews.
- Exhibit activated environmental personal norms, acknowledging that

- Monitors are mostly left on stand-by when employees leave office, even after switching-off their PCs.
- A/Cs are left on even when no employees are present at their respective spaces (in one building A/Cs turn-off manually, while in the other two they are centrally controlled).

Mobile App Frontend design

For the purpose of finalizing the ChArGED gamification concepts design, an anonymized questionnaire was prepared by AUEB, TPL, ED and was circulated to pilot site users and other partner employees to quickly validate the prevailing design concepts. The questionnaire included 3 Different Concepts ("Tree", "Fitness", "Iceberg"), 2 Visuals per Concept (Emotional & Informative) and included a presentation of 3 the concepts and questions on attitudes and intentions towards participating in the ChArGED gamified app, to assess the engagement potential of each concept. Based on the assessment of the questionnaire replies, the "Tree" concept was considered as the overall favorite, followed by the "Iceberg" concept and having last in preferences the "Graph" Concept. The core ChArGED gamification concept revolves around a virtual living

of a Tree, that represents the effects of the energy consumption behaviour of the cumulative users in terms of each (and groups) individual effect on all the energy consuming devices in their vicinity of operation. Some initial visualizations of the ChArGED game have been developed, more to come soon.



1ST CHARGED NEWSLETTER, OCTOBER 2017

Pilot Site Preparations

So far we have examined in detail the characteristics of each site, to explore the exact usage patterns and installations, in order to specify what the game play conditions will be and what the monitoring and game setup requirements are. We have reviewed the topology of each pilot site, to highlight the way each floor plan is divided among teams and areas, and to put each electrical appliance, electrical circuit and controller on the map. Furthermore, we have identified the ways in which the various building spaces are used, in order to specify what aspects should be monitored to capture the usage patterns during the game execution. Additionally, the project has organized the energy consumption data collection for all pilot sites with the targeted use of IoT smartplugs and Accuenergy smartmeters. Finally, for the pilot execution, DAEM has installed a photovoltaic microgeneration system of peak power of 4,88 kWp, on the roof of the building, consisting of 25 solar panels, generators, a DC electrical panel and a KACO Powador TL3 inverter.



Internal Workshops

On 23, 24 November 2016 the research group of Athens University of Economics and Business, that participates in the project, hosted a ChArGED Workshop on Gamification that was attended by external expert application designers and



representatives from Plegma Labs, European Dynamics and the peak lab. The

workshop included discussions about existing solutions on Gamification in Energy Efficiency and brainstorming sessions for building new concepts that will lead to important gamification design conclusions for ChArGED.

Additionally, on 17-19 January 2017 the ChArGED technical partners met in ACEin, Athens, Greece for a developers technical workshop.



Dissemination Highlights

✓ In the context of "Gamification, a driver for sustainable behavior change in cities?" webinar hosted by the Green Digital



SBC webinar on Gamification Part1 - CHARGED



1ST CHARGED NEWSLETTER, OCTOBER 2017

on Wednesday 7 June 2017, ChArGED presented its overall goal and gamification process to motivate energy wastage and energy friendly employee behaviour through state of art gamification processes. During the webinar, ChArGED presented its Gamification approach and the potential of introducing gamification in Public buildings.

✓ The research paper entitled "IoT-Enabled Gamification for Energy Conservation in Public Buildings" (T.Papaioannou et al.), was presented at the 2017 Global Internet of Things Summit (GloTS) in June 6-9 2017, in Geneva, Switzerland. The paper is now also available in IEEE Xplore at



<http://ieeexplore.ieee.org/document/8018269/>

✓ The ChArGED project and the gamification research was presented in the GamiFIN 2017 Conference held in Pori, Finland on May 9th-10th 2017. The



paper entitled "Waste No More: Gamification for Energy Efficient Behaviour at the Workplace" examines the potential to engage the employees through

state of art gamification mechanics and dynamics, utilizing information from the everyday interactions of employees with energy consuming devices. The paper alongside with the remaining Gamification papers can be found in the GamiFIN 2017 proceedings website (<http://ceur-ws.org/Vol-1857/>) and are available as free open-access.

Publications list

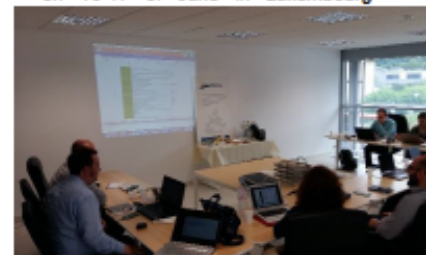
1. D.Kotsopoulos, C.Bardaki, S.Lounis, T.Papaioannou, K.Pramatari, "Designing an IoT-enabled Gamification application for Energy Conservation at the Workplace: Exploring Personal and Contextual characteristics", 30th Bled eConference, Bled, Slovenia, June 18-21, 2017.
2. T.Papaioannou, V. Hatzi, I. Koutsopoulos, "Optimal Design of Serious Games for Consumer Engagement in the Smart Grid", 12th IEEE Power and Energy Society PowerTech Conference, PowerTech, Manchester, UK, June 18-22 2017
3. T.Papaioannou, D.Kotsopoulos, C.Bardaki, S.Lounis, N.Dimitriou, G.Boultadakis, A.Garbi, A.Schoofs, "IoT-Enabled Gamification for Energy Conservation in Public Buildings", Global Internet of Things Summit (GloTS) in June 6-9 2017, in Geneva, Switzerland
4. S.Lounis, D.Kotsopoulos, C.Bardaki, T.Papaioannou, K.Pramatari, "Waste no more: Gamification for energy efficient behaviour at the workplace", GamiFin conference 2017, in Pori, Finland on 8-9 May 2017.
5. T.Papaioannou, V. Hatzi, I. Koutsopoulos, "Optimal Design of Serious Games for Consumer Engagement in the Smart Grid", IEEE Transactions on Smart Grid, vol.PP, no.99, May 2017, doi: 10.1109/TSG.2016.2582298.
6. D Kotsopoulos, C Bardaki, K Pramatar, "Gamification, Geolocation

and Sensors for Employee Motivation Towards Energy Conservation at the Workplace", 10th Mediterranean Conference on Information Systems (MCIS 2016), Paphos, Cyprus, 4-6 September 2016.

Plenary Meetings

So far 3 plenary meetings have been organized:

✓ on 16-17 of June in Luxembourg



✓ on 25-26 of October in Brussels



✓ and on 3-4 July 2017 in Dublin



FUNDING



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3.5 ChArGED invited post in PEAKApp newsletter

PEAKApp has invited CHARGED for a post on their newsletter.

PEAKApp - Personal Energy Administration Kiosk application: an ICT-ecosystem for Energy Savings through Behavioural Change, Flexible Tariffs and Fun

[Facebook](#)
[Twitter](#)
[LinkedIn](#)
[Website](#)

Introduction

18 months of PEAKApp

PEAKApp - Personal Energy Administration Kiosk application: an ICT-ecosystem for Energy Savings through Behavioural Change, Flexible Tariffs and Fun - is a 3-year project co-funded by European Union's Horizon 2020 research and innovation program. 10 partners coming from Austria, the Netherlands, Turkey, Denmark, Germany, Spain and Estonia are joining forces to develop an unprecedented ICT ecosystem to reduce energy consumption of European households. The system is technically developed and is currently being tested for consumer validation. Analysis of these tests are planned to be finalised in 2019.

"Innovative and state-of-the-art." European Commission in the Review Report, 30 November 2017

[Read the full article on website](#)

PEAKApp 'How to' VIDEO

PEAKApp is here! This video is a "How to" made by partner GreenPocket GmbH from Germany to guide existing customers of EnergieAG from Upper Austria (also partner in PEAKApp) on how to use the smart phone app. It is also an excellent demonstration of PEAKApp results.

More than 1000 households recruited as test users in 2017

The recruiting campaign aimed at residential clients of ENAMO to test the app demo version finished in September 2017.

[Keep Reading](#)

News from the Energy Efficiency H2020 world

Winter Challenge in START2ACT project: apply for the energy saving competition to save energy on heating at the workplace.

[Apply here](#)

OrbEEt was presented at the 6th European Congress on the Use, Management and Conservation of Buildings of Historical Value visited by more than 200 participants.

[Read more](#)

Within ChArGED project the first version of the integrated gamified app is ready. In the next days the app will be demonstrated to collect the first feedback.

[Read more](#)

Upcoming events

[InnoGRID2020+](#) is THE event on innovation in European electricity networks and takes place in Brussels, 15-16 May 2018. Mark the dates in your agenda!

4 Offline activities

4.1 Publications

4.1.1 Press articles

DAEM has proceeded to a press release in 11 July 2017 focusing on the implementation of CharGED project, its main objectives and the Application that is developed. The press released has been indexed in the following links:

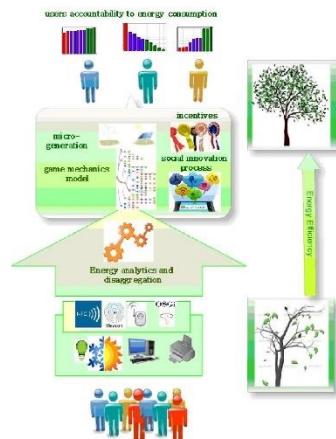
1. **Netweek:** <http://www.netweek.gr/default.asp?pid=9&la=1&arId=3555>
2. **SEPE:** <http://www.sepe.gr/gr/InformationTechnology/it-article/9408360/i-daem-ylopoiei-pilotiki-efarmogi-gia-to-eyrwpaiiko-ergo-charged/>

Η ΔΑΕΜ υλοποιεί πιλοτική εφαρμογή για το ευρωπαϊκό έργο

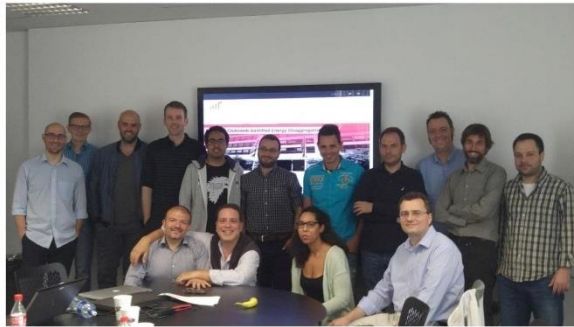


ChArGED: CleAnweb Gamified Energy Disaggregation

Η ΔΑΕΜ υλοποιεί πιλοτική εφαρμογή για το ευρωπαϊκό έργο ChArGED, το οποίο έχει ως στόχο να συμβάλει στη μείωση της κατανάλωσης ενέργειας στα δημόσια κτίρια με τη χρήση νέων τεχνολογιών και ενός ειδικά σχεδιασμένου ενεργειακού "παιχνιδιού" με τη μορφή εφαρμογής για κινητές συσκευές (mobile app). Το ενεργειακό πλαίσιο που προτείνει το ChArGED ενισχύει σημαντικά την ενεργειακή απόδοση των κτιρίων με την αξιοποίηση Internet of Things (IoT) εφαρμογών και συσκευών χαμηλού κόστους (NFC ή iBeacons).



Το ενεργειακό "παιχνίδι" που θα διεξαχθεί στις εγκαταστάσεις της ΔΑΕΜ στοχεύει στην σταδιακή υιοθέτηση μιας πιο "πράσινης" συμπεριφοράς από τους εργαζομένους όταν βρίσκονται στους χώρους της εταιρείας. Η κατανόηση από πλευράς χρηστών των περιβαλλοντικών επιπτώσεων στις καθημερινές τους πράξεις στον εργασιακό χώρο (π.χ. άσκοπη χρήση φωτισμού, κλιματιστικών, μεγάλη ποσότητα εκτυπώσεων κ.α.) θα συμβάλει στην μείωση της ενεργειακής σπατάλης με τελικό σκοπό την καλύτερη ενεργειακή απόδοση του κτιρίου.



Στα πλαίσια της υλοποίησης του **ChArGED** πραγματοποιήθηκε συνάντηση εργασίας στις 3 & 4 Ιουλίου, με τη συμμετοχή όλων των εταιρών στο Δουβλίνο. Κατά τη διάρκεια των διήμερων εργασιών συζητήθηκαν εκτενώς θέματα που αφορούν την εγκατάσταση του κατάλληλου εξοπλισμού (smartplugs, sensors κ.α.) που θα πραγματοποιεί τις ενεργειακές μετρήσεις στα κτίρια αλλά και στον σχεδιασμό της εφαρμογής μέσω της οποίας θα διεξαχθεί το ενεργειακό "παιχνίδι". Στην πιλοτική εφαρμογή του **ChArGED** πέραν της **ΔΑΕΜ** συμμετέχει το Ινστιτούτο Ενέργειας ICAEN της Βαρκελώνης και το Εθνικό Μουσείο Ιστορίας και Τέχνης ΜΝΗΑ του Λουξεμβούργου.

Περισσότερες πληροφορίες για το **ChArGED** μπορείτε να βρείτε στο επίσημο website: <http://www.charged-project.eu/>

Additionally, a second press release was published in 6 September 2017 presenting the solar panel installation in DAEM premises. The article underlined that the installed infrastructure combined with the proposed framework of CharGED facilitates the reduction of energy consumption in public buildings. The press release has been indexed in the following online media:

1. <http://www.businessnews.gr/article/84303/daem-egkatestise-fotovoltaiko-systima>
2. <https://energypress.gr/news/i-daem-egkatestise-fotovoltaiko-sto-plaisio-ylopoiisis-toy-eyropaikoy-ergoy-charged>
3. <http://www.netweek.gr/default.asp?pid=9&la=1&cID=1&arId=35789>
4. <https://www.b2green.gr/el/post/49653/egkatestise-fotovoltaiko-systima-i-daem>
5. <http://www.energyinvest.gr/ananeosimes-piges-energeias/eidiseis-ananeosimon-pigon-energeias/iliaki-energeia/fotovoltaika/ybridika-fotovoltaika/6735-daem-egkatestise-fwtoboltaiko-systima>
6. <http://www.palo.gr/perivallon-nea/daem-egkatestise-fwtovoltaiko-systima/16494657/>

06/09/2017

ΔΕΛΤΙΟ ΤΥΠΟΥ

Η ΔΑΕΜ εγκατέστησε φωτοβολταϊκό σύστημα στο πλαίσιο υλοποίησης του ευρωπαϊκού έργου ChArGED αξιοποιώντας την ηλιακή ενέργεια των κτιριακών της εγκαταστάσεων

Η ΔΑΕΜ εγκατέστησε φωτοβολταϊκό σύστημα μέγιστης ισχύος 4,88 Kwp στις κτιριακές της υποδομές στο πλαίσιο της πιλοτικής εφαρμογής που υλοποιεί για το ευρωπαϊκό έργο ChArGED, μειώνοντας σημαντικά την κατανάλωση ηλεκτρικής ενέργειας στα γραφεία της. Συνολικά τοποθετήθηκαν 25 φωτοβολταϊκά πάνελ στην ταράτσα επί του κτιρίου της οδού Λιοσίων 22 (με κλίση 30° ως προς τον ορίζοντα και με νότιο προσανατολισμό), βάσει της τεχνικής μελέτης που εκπονήθηκε προκειμένου να επιτευχθεί η μέγιστη αξιοποίηση της ηλιακής ενέργειας που δέχεται το κτίριο.



Η μετατροπή της ηλιακής ενέργειας μέσω του φωτοβολταϊκού συστήματος σε ηλεκτρική, τροφοδοτεί σημαντικές ενεργειακές ανάγκες των γραφείων της ΔΑΕΜ όπως είναι ο φωτισμός, ο κλιματισμός και η χρήση ηλεκτρονικών & ηλεκτρικών συσκευών. Ταυτόχρονα αντλούνται πληροφορίες σχετικά με την παραγωγή του ηλεκτρικού ρεύματος από την συνδεδεμένη κάρτα δικτύου του αντιστροφέα.





CITY OF ATHENS - IT COMPANY

Τα δεδομένα που θα συλλεχθούν από τη χρήση του φωτοβολταϊκού συστήματος μέσω της πιλοτικής εφαρμογής του ευρωπαϊκού έργου **ChArGED**, θα δώσουν σημαντικές πληροφορίες για το πως η αξιοποίηση των ανανεώσιμων πηγών μπορεί να επεκταθεί και σε άλλα δημόσια κτίρια. Καθώς για την Ελλάδα, υπάρχει κοινοτική οδηγία, η οποία ορίζει ότι μέχρι το 2020 η καταναλισκόμενη ενέργεια από ανανεώσιμες πηγές ενέργειας θα πρέπει να είναι μίνιμουμ το 20% της συνολικής ετήσιας.

Το **ChArGED** προτείνει ένα συνολικό πλαίσιο που στοχεύει στην καλύτερη ενεργειακή απόδοση των κτιρίων με την αξιοποίηση των Internet of Things (IoT) εφαρμογών και των συσκευών χαμηλού κόστους (NFC ή iBeacons). Για το σκοπό αυτό πέραν του φωτοβολταϊκού συστήματος στους χώρους εργασίας της **ΔΑΕΜ** έχει εγκατασταθεί και ο ανάλογος τεχνολογικός εξοπλισμός, όπως αισθητήρες, “έξυπνες” πρίζες (smart plugs) κ.α., που θα επιτρέψει να γίνουν οι απαραίτητες ενεργειακές μετρήσεις.



Οι μετρήσεις αυτές θα συμβάλλουν στην εύρυθμη διεξαγωγή ενός “ενεργειακού παιχνιδιού” που θα διεξαχθεί στις εγκαταστάσεις της **ΔΑΕΜ** με στόχο την σταδιακή υιοθέτηση μιας πιο “πράσινης” συμπεριφοράς από τους εργαζομένους όταν βρίσκονται στους χώρους της εταιρείας. Οι εργαζόμενοι μέσω του “παιχνιδιού” με τη μορφή εφαρμογής (mobile app) για κινητές συσκευές (smartphones) θα κατανοήσουν τις περιβαλλοντικές επιπτώσεις των καθημερινών τους συνθηκών π.χ. άσκοπη χρήση φωτισμού, κλιματιστικών, μεγάλη ποσότητα εκτυπώσεων κ.α. Τελικός σκοπός είναι η μείωση της ενεργειακής σπατάλης και η αύξηση της ενεργειακής απόδοσης του κτιρίου.

Περισσότερες πληροφορίες για το ευρωπαϊκό έργο ChArGED:

<http://www.daem.gr/euprogrammes/trexonta/charged/>
<http://www.charged-project.eu/>

ΔΑΕΜ Α.Ε.

**Ανώνυμη Αναπτυξιακή Εταιρεία Μηχανογράφησης
& Επιχειρησιακών Μονάδων ΟΤΑ του Δήμου Αθηναίων**

Λισσίων 22, 104 38, Αθήνα

<http://www.daem.gr/>

FBpage:/daemitcompany

4.1.2 Scientific Publications

The following articles have been presented in conferences or published in scientific journals (this section presents all the publications during the entire project so far). All of the project publications are introduced the open repository of Research Gate.

<p>Thanasis Papaioannou added 3 research items Oct 17</p> <div style="border: 1px solid #ccc; padding: 5px; margin-bottom: 10px;"> <p>Waste No More: Gamification for Energy Efficient Behaviour at the Workplace</p> <p>Conference Paper May 2017</p> <p>Stavros Lounis · Dimosthenis Kotsopoulos · Cleopatra Bardaki · [...] · Katerina Pramataris</p> <p>Energy wastage in public buildings amounts to an important and not fully addressed cost. The present study is focused on introducing gamification at the workplace, with the overall goal ...</p> <p>View Follow 46 Reads</p> </div> <div style="border: 1px solid #ccc; padding: 5px;"> <p>Designing an IoT-enabled Gamification Application for Energy Conservation at the Workplace: Exploring Personal and Contextual Characteristics</p> <p>Conference Paper Jun 2017</p> <p>Dimosthenis Kotsopoulos · Cleopatra Bardaki · Stavros Lounis · [...] · Katerina Pramataris</p> <p>This paper focuses on determining the important factors that must be considered when designing and developing a gamification application that educates employees in workplaces, towards a more sustainable energy ...</p> <p>View Follow 35 Reads</p> </div>	<p>Nikos Dimitriou added an update Sep 7</p> <p>2017 Global Internet of Things Summit (GloTS) paper in IEEE Xplore</p> <p>The paper presented in 2017 Global Internet of Things Summit (GloTS) is now also available in IEEE Xplore at http://ieeexplore.ieee.org/document/8016269/</p> <p>Comment 16 Reads</p> <hr/> <p>Thanasis Papaioannou added an update Jul 22</p> <p>New paper that analyzes behavioral factors that affect energy consumption of employees in public buildings and their relations based on survey data.</p> <p>Comment Recommend 21 Reads</p> <div style="border: 1px solid #ccc; padding: 5px; margin-top: 10px;"> <p>AN EXPLORATION OF PARAMETERS AFFECTING EMPLOYEE ENERGY CONSERVATION BEHAVIOUR AT THE WORKPLACE, TOWARDS IOT-ENABLED BEHAVIOURAL INTERVENTIONS</p> <p>Conference Paper</p> <p>Jan 2017 · 11th Mediterranean Conference on Information Systems (MCIS)</p> </div>
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1. First Paper

Publication Title: IEEE Transactions on Smart Grid , vol.PP, no.99, doi: 10.1109/TSG.2016.2582298
URL:<http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7494677&isnumber=5446437>

Article Title: "Optimal Design of Serious Games for Consumer Engagement in the Smart Grid".

Authors: T. Papaioannou; V. Hatzi; I. Koutsopoulos

Optimal Design of Serious Games for Consumer Engagement in the Smart Grid

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Abstract—Serious games are a promising approach for demand-side management that aims to higher user engagement and active participation. In this paper, we introduce the problem of optimal serious-game design for achieving specific energy-consumption reduction goals. We consider a serious game, where a serious-game designer entity presents publicly to all consumers a list of top- K consumers and a list of bottom- M consumers according to their respective energy-consumption reduction at peak hours. The driving forces of this serious game are the user discomfort due to demand load reduction, the user desire for social approval and the user sensitivity to social ostracism. We formulate the problems of the serious-game designer as an operational-cost minimization one for the utility company and that of each consumer as a utility-maximization one. The serious-game-design problem is to decide on K , M and on the feedback provided to the consumers, while the consumer-side problem amounts to selecting the behavioral change to energy consumption that maximizes the expected user utility. By a series of simulations, we show how the choices of K , M affect the energy consumption reduction for different types of consumers.

Index Terms—gamification, social enforcement, power demand, utility theory, optimization, energy conservation

I. INTRODUCTION

THE reduction of carbon footprint is the holy grail of our times and is to be realized primarily through prudent energy consumption. Different techniques have been proposed, spanning the entire chain of energy generation, transmission, distribution and consumption in the context of realizing a smart energy grid towards reaching the goal above. However, the weakest link in the chain above remains the end-consumer. No matter how sophisticated these techniques become for the rest of the chain, it is the end-consumer that determines to a large extent the mode of energy consumption in the end.

Demand-side management (DSM), which includes demand response (DR), is an active research area that aims to reduce or smoothen energy consumption. Pricing-based and incentive-based DR schemes have been proposed; e.g., by having different prices per unit of energy presented to consumers for different times of the day (i.e., TOU pricing), rational consumers are forced to shift part of their demand-load from peak-times to off-peak times. Incentives may be provided to the consumer in the form of monetary or non-monetary rewards. For example, in the Critical Peak Rebate incentive scheme, participants are paid for the amounts of power by which

¹Part of this work was published in IEEE SmartGridComm 2014 [1].

they reduce consumption below their predicted consumption levels during critical peak hours. In the presence of a DR scheme, consumers optimize some form of utility functions that factor the monetary gains from load shifting/reduction and the inconvenience cost induced by the shift.

The main shortcomings of pricing-based incentives are the strong financial-rationality assumption about consumers and that they are often met with negativity by consumers. Also, more often than not, consumers are not bill-payers (e.g., they are employees in an office building or younger/elderly household members), while their energy literacy level (i.e., awareness and capability to act on energy savings) varies. In reality, consumers are humans and their decision-making process is often influenced by multiple factors, such as sentiments or interest about the social norm, as opposed to strict financial motives. The interface with which the incentive scheme is addressed to the end-consumer is also a decisive factor, in the sense that it should serve the purpose of making the interaction sense (and be) worthwhile and joyful.

Serious games design is a new area that aims at addressing precisely the issues of educating and maximizing user engagement in various contexts [2]. A serious game is a game that is designed for a purpose that goes beyond that of offering pure entertainment. There have been some initial attempts to use serious games for demand-side management [3], [4], [5], [6] with great success in realistic case studies [7]. To the best of our knowledge, building a foundational theory on modeling and understanding serious games with the purpose of extracting guidelines for serious games design in this context has not hitherto been explored.

In this paper, we introduce the problem of *optimal serious-games design for the purpose of enforcing prudent energy consumption*. We define a simple serious-game scenario that does not employ direct monetary incentives for the consumers and a generic game-theoretic mathematical framework for the optimization of the parameters of the serious-game. We assume that a serious-game designer entity (e.g., the energy supplier, a private entity or an energy-efficiency minded administrative authority) aims to design a serious game for smoothening the energy-consumption behavior of consumers. The serious-game designer runs daily contests on energy consumption reduction on behalf of the players during the peak hours.

We consider a simple class of serious games, where the serious-game designer publicly announces a list of top- K

[15], albeit with no modeling or analysis on the serious-game design, as opposed to our work. In [5], a serious game for smart grids is organized as a virtual world with many user roles and actions, involving direct actions and training for sharing a Medium/Low Voltage transformer among prosumers. A serious game for energy conservation among students is described in [6]. The serious-game website and associated game mechanics are provided by the Makahiki system [16]. Similarly to our setting, no monetary rewards are included in the game; incentives are introduced through competition among consumers for points for energy conservation actions and for participation to online educational and real-world activities. According to [6], energy feedback systems should be actionable, include training and be time-persistent to have long-term effect into energy consumption behavior. Our serious-game model is time-persistent.

Also, the game “Energy Battle” [14], similarly to [6], aimed at encouraging occupants of student-households to save energy by means of competition. In [17], Johnson *et al.* review multiple energy competitions among university students and identify several pitfalls in their design. Specifically, the use of total energy consumption or (relative) energy-consumption reduction for winner determination is deemed as not adequate when static baseline calculation methods are employed and may be unfair for already “green” consumers.

An online game for improving home energy behavior, named Power House, is proposed in [4]. Its objective is to track activities and assist each member of a virtual family to save energy, while real-world energy behaviors produce particular in-game advantages and disadvantages. An online serious game (“EnerCities”) is presented in [3] to increase the environmental and energy-related awareness of secondary school students, and to influence their energy-related behaviors. Also, a virtual pet game designed for energy use reduction in a commercial office setting is presented in [15], where device-specific energy consumption is reflected in the fitness of virtual pets. There are also a number of studies on gamification in general [18], [19], which verify that specific serious-game design elements, such as leaderboards, points and levels, positively influence user participation, engagement and behavioral change.

In a different class of work, a number of game-theoretic dynamic-pricing schemes that involve interaction between the utility company and the consumers for energy-consumption smoothening have been proposed [13], [20]. However, [21] shows that dynamic pricing mechanisms can lead to peak-shifting when consumers rationally respond to price signals, unless specific strategies of bounded rationality are employed. In our paper, consumers take decisions based on social influence, as opposed to financial incentives.

Finally, prospect theory is employed in [22] for studying the problem of customer-owned energy storage management in the smart grid in a less rational manner, as opposed to the von Neumann-Morgenstern utility theorem employed here. In [22], a human player subjectively observes and makes her charging/discharging decisions based on the potential value of the benefit from selling energy and of the penalty from power regulation rather than the final outcome.

VI. CONCLUSION

This paper makes a first attempt to develop a theory from first principles on the design of a simple class of serious games for energy efficiency. The game designer optimally selects the game parameters, so as the utility-maximizing choices of consumers to minimize the operational cost of the utility company for energy production. The sole game parameters utilized are the sizes of the upper list (i.e., winners) and of the lower list (i.e., losers) of consumers according to their energy-consumption reduction. Simulation experiments show that even such simple serious games can provide adequate incentives to the consumers, so that the utility company achieves specific demand-side management objectives. Our serious game model can be deployed in practical settings and is privacy-friendly, as only normalized energy-consumption increase/decrease needs to be shared by the users with the game designer. As a future work, we will consider additional design choices of serious games for demand-side management and more comprehensive user decision-making models based on behavioral sciences.

ACKNOWLEDGMENT

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Figure 15 Extracts from the IEEE Transactions on Smart Grid paper

2. Second Paper

Publication Title: The 10th Mediterranean Conference on Information Systems (MCIS 2016), Paphos, Cyprus, 4-6 September 2016.

URL: <http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1039&context=mcis2016>

Article Title: “Gamification, Geolocation and Sensors for Employee Motivation Towards Energy Conservation at the Workplace”.

Authors: Kotsopoulos, Dimosthenis; Bardaki, Cleopatra; and Pramataris, Katerina, "" (2016).

2016

Gamification, Geolocation and Sensors for Employee Motivation Towards Energy Conservation at the Workplace

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Tenth Mediterranean Conference on Information Systems (MCIS), Paphos, Cyprus, September 2016
8

Figure 16 Extracts from the MCIS 2016 paper

3. Third Paper

Publication Title: GamiFin. conference 2017, in Pori, Finland on 8-9 May 2017.

Article Title: "Waste no more: Gamification for energy efficient behaviour at the workplace"

Authors: Lounis, D.Kotsopoulos, C.Bardaki, T.Papaioannou, K.Pramatarí.



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Figure 17 Extracts from the GamiFIN 2016 paper

4. Fourth Paper

Publication Title: Proceedings of 30th Bled e-Conference: Digital Transformation – From Connecting Things To Transforming Our Lives, Bled, Slovenia, 2017.

Article Title: "Designing an IoT-enabled Gamification Application for Energy Conservation at the Workplace: Exploring Personal and Contextual Characteristics"

Authors: Dimosthenis Kotsopoulos, Cleopatra Bardaki, Stavros Lounis, Thanasis Papaioannou, Katerina Pramatarí

30TH BLED ECONFERENCE: DIGITAL TRANSFORMATION – FROM CONNECTING THINGS TO TRANSFORMING OUR LIVES (JUNE 18 – 21, 2017, BLED, SLOVENIA)
A. Pucihar, M. Kljajic Boztar, C. Kittl, P. Ravestejina, R. Clarke & R. Bons



Designing an IoT-enabled Gamification Application for Energy Conservation at the Workplace: Exploring Personal and Contextual Characteristics

DIMOSTHENIS KOTSPOULOS, CLEOPATRA BARDAKI, STAVROS LOUNIS, THANASIS PAPAIOANNOU & KATERINA PRAMATARI

Abstract This paper focuses on determining the important factors that must be considered when designing and developing a gamification application that educates employees in workplaces, towards a more sustainable energy consumption behaviour. We have conducted on-site surveys, as well as unstructured interviews with employees from three different workplaces where we will deploy the app. We present our key findings and propose specific insight and guidelines for experiments aiming towards energy conservation at the workplace through behavioural change. We conclude that the individual contextual characteristics of workplaces lead to the availability of different energy conservation behaviours that can be acted upon by the employees. At the same time, the employees' preferences for the gamified app include, among others, a collaborative game scenario – that features both intrinsic as well as extrinsic rewards based on the individual participant profile. This research is conducted in the course of a H2020 EU funded project, through which an IoT-enabled energy monitoring platform for workplaces will be developed, with the ultimate goal to change the employees' energy consumption behaviour through a gamification application.

Keywords: • Energy Conservation • Gamification • Workplace • Employee Behaviour •

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Figure 18 Extracts from the 30th Bled paper

5. Fifth Paper

In the context of Global IOT Summit Geneva Jun 2017, ENTROPY EE H2020 project, coordinated with several projects the organisation of the workshop. The workshop co-chairs were Antonio Skarmeta and Anastasios Zafeiropoulos ENTROPY consortium, George Bouladakakis CHARGED consortium, Sébastien Poulain GreenPlay consortium, Piero Fraternali enCompass consortium, Miquel Casals EnerGAware consortium, Johannes Reichl PEAKapp consortium, Giorgos Mylonas GAIA consortium, Javier Royo OrbEEt project.

This workshop looks to be a forum of discussion between different stakeholders, researchers, industries etc, in order to present the most recent advances in the area of ICT and IoT based Energy Efficiency

solutions. It will also promote the collaboration and mutual exchange of experiences between researchers. The presence of researchers from EU funded projects will be promoted although open to all kind of contributions.

The technical topics of interest included:

- Data management and knowledge extraction
- Novel network infrastructures
- Smart metering infrastructures
- Wide area management and monitoring systems
- Networking protocols for low-power devices
- Methodologies for studying and analyzing smart buildings' performance
- Pilot applications and experiences in both public and private buildings
- IoT-based gamification for behavioral change towards energy efficiency
- IoT for Energy-related issues in Education

Publication Title: Global IoT Summit 2017 (Workshop on Energy Efficient Solutions Based on IoT – EESIoT 2017), Geneva, Switzerland, June 2017.

Article Title: "IoT-Enabled Gamification for Energy Conservation in Public Buildings"

Authors: Thanasis G. Papaioannou, Dimos Kotsopoulos, Cleopatra Bardaki, Stavros Lounis, Nikos Dimitriou, George Bouladakis, Anastasia Garbi, Anthony Schoofs

IoT-Enabled Gamification for Energy Conservation in Public Buildings

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Abstract— Buildings consume more than 40% of EU energy and produce 36% of total EU CO₂ emissions. Public buildings are a particularly challenging category of buildings to address for energy conservation due to lack of occupant motives and lack of individual accountability among others. In this paper, we describe a gamification approach to change energy-conservation behaviors and reduce energy waste in public buildings based on team competition and non-monetary rewards. The game scores of employees depend on their individual energy-conservation behaviors. Energy-conservation disengagement at the device and at the individual levels is enabled through the combination of multi-channel smart meters, NFC tags, BLE beacons and the user smartphones.

Index Terms— demand side management, serious games, energy disaggregation, NFC, BLE

1. INTRODUCTION

Buildings consume more than 40% of Europe's energy use [1] and are responsible for 36% of EU CO₂ emissions, for this reason improving the energy performance of e.g. public buildings is a key action in the fight against climate change and improvement of energy security. The EU has been supporting the improvement of the energy performance of buildings for many years with a range of legislative and financing mechanisms and instruments. However, research [2, 3] has shown that there are important individual-level barriers that hamper further energy conservation, especially for (public) office buildings, mostly related to a) lack of problem awareness, b) lack of knowledge on how to conserve energy, c) lack of opportunity (time and interest), d) lack of financial incentives, e) lack of personal norms or values for energy conservation, and f) lack of personal accountability on energy use (partly due to limited introduction of smart metering devices in light of privacy concerns). This lack of personal accountability on energy use in public buildings allows occupants to go unreported, while individual motives are usually absent. Gamification approaches can be considered as an engaging means of intervention that aims to stimulate certain desired

behavior by tapping into intrinsic motivation [4]. According to [4], intrinsic motivation (spontaneous energizing force based on activity or situation) is powerful in persuading people to perform certain actions. Malone and Lepper [5] defined seven types of intrinsic motivation as: fantasy, curiosity, control, challenge, competition, cooperation and recognition. Moreover, feedback information about energy consumption has proved to be an effective means to enable people to change their energy consumption behavior, as it alleviates the lack of knowledge on energy conservation. There have been numerous interventions using feedback to stimulate energy saving [6].

This paper describes the IoT-enabled gamified approach of ChAeUED project to alter consumption behaviors and conserve energy in public buildings. ChAeUED addresses the energy consumption in public buildings and proposes a framework that aims to facilitate achieving greater energy efficiency and reduction of wasted energy in public buildings. The framework leverages IoT-enabled, low-cost devices (NFC or Bluetooth Beacons) to improve energy disaggregation mechanisms that provide energy use and (consequently) savings at the device, area and on-user level. These savings are targeted by a gamified application that feeds personalized real-time recommendations to each individual end user on a consumption over-driven basis. The design of the game is based on human incentives factors and will help users to understand the environmental implications of their actions and adopt a more green, active and responsible behavior. The blend of social interaction and competitions with its personalized character are expected to eventually contribute to the user engagement and commitment to generate savings in the long term leading to tackle energy efficiency targets in public buildings while emphasizing on cost effectiveness. The approach of ChAeUED will be validated in three pilot sites, and specifically, in public office buildings in Greece and Spain, and in a public museum in Luxembourg.

The remainder of this paper is organized as follows: In Section II, we overview related applications and projects. In

individual employees. However, when the employee prints from a USB device or photocopies some pages, the user gets associated to the printer by sending her/his smartphone over the NFC tag of the printer. An energy-consumption event is registered for the user and the associated energy consumption is metered. The user swipes again her/his smartphone for disconnecting herself/himself from the device. If overall printing behavior of an individual amounts to a positive behavioral change, as compared to her/his baseline, then positive game points are registered for the user, which are proportional to the fraction of the energy saved, and vice versa. Team score and leaderboards are updated in real time based on the updated individual score.

B. Having a Meeting

The employee may occasionally use a meeting room. There, she/he will employ a number of appliances, e.g., projector, large LCD screen, videoconferencing equipment, lights, HVAC, etc. Then, the gamified application of ChAeUED should provide her/him with a tip to turn-off all unused devices when she/he leaves, e.g., "please, do not forget to turn-off the lights after your meeting". BLE beacons are employed to discover when a particular employee is in the meeting room. Energy consumption for the devices in the meeting room is associated to all users participating in the meeting. For devices that are left on after the meeting, i.e., energy wasting, all employees that participated in the meeting are held responsible. Energy wasting is associated to negative points in the game. Also, desirable/undesirable user behavioral changes are detected and each employee is assigned positive/negative points.

VIII. CONCLUSION

This paper described the IoT-enabled gamification approach that is followed in ChAeUED project for behavioral changes towards saving energy in public buildings. Energy-disaggregation at the device and the user level is performed by employing a multi-channel plug-level meter, NFC tags, BLE beacons and the user smartphones. The employees in public buildings are motivated by means of pre-primers based on team competition and by means of direct (non-monetary) rewards. The game score reflect individual energy consumption and desirable/undesirable energy-consumption behavioral changes based on prior consumption baselines. Our approach will be experimentally validated through pilot studies.

ACKNOWLEDGMENT

This work has been supported by the activities of EU project ChAeUED (funded from the European Union's Horizon 2020 research and innovation program under grant agreement No 666570). The authors thank all consortium members of ChAeUED for their valuable comments on this work.

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Figure 19 Extracts from the Global IoT Summit 2017

6. Sixth Paper

Publication Title: 2018 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops)

Article Title: ChArGED: Implementing a framework for improving energy efficiency in public buildings through IoT-enabled energy disaggregation and serious games

Author(s): Dr. Nikos Dimitriou, Mr. Anastasia Garbi, Mr. Kostas Vasilakis, Mr. Manolis Nikiforakis, Mr. Sarantis Kotsilitis, Mr. Anthony Schoofs, Mr. Amr Taha, Mr. Fabian Pursche, Mr. Nikolay Deliyiski, Mr. Dimosthenis Kotsopoulos, Dr. Thanasis G. Papaioannou and Dr. Cleopatra Bardaki (PERCOMM 2018) Athens, 19-24 March 2018.

ChArGED: Implementing a framework for improving energy efficiency in public buildings through IoT-enabled energy disaggregation and serious games

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Abstract— This paper reports on the approach for the design and development of the H2020 ChArGED project framework. ChArGED addresses energy wastage and proposes a framework that aims to facilitate achieving greater energy efficiency in public buildings. The framework leverages IoT-enabled low-cost devices, to improve energy disaggregation mechanisms that provide energy use and -consequently- wastage information at

Ur-Watts, Energy Tracker, Watts Plus, etc., mainly focus on increasing energy-consumption awareness, assuming that the users are already interested in their energy consumption and motivated to reduce it. In a public building, employees are primarily busy with their job activities and moreover they do not pay the energy bill. Therefore, their engagement to such a game app cannot be taken for granted and thus a carefully-

Figure 20 Extracts from the PERCOM 2018 paper

7. Seventh Paper

8.

Publication Title: IEEE SmartGridComm 2017, Dresden, Germany.

Authors: Thanasis G. Papaioannou and George D. Stamoulis

Article Title: “Teaming and Competition for Demand-Side Management in Office Buildings”

Teaming and Competition for Demand-Side Management in Office Buildings

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Abstract—Energy conservation at public-office buildings can be tricky, due to the absence of direct incentives, e.g., regarding the electricity bill, and the potentially higher aversion of employees to comfort loss. Few serious games have been developed for motivating occupants to save energy based on peer pressure and/or prizes. However, the design of these games has mostly been based on a game-theoretic approach, while behavioral traits of employees were either considered on average only (rather than per individual player) or not considered at all. In this paper, we analytically study the design of an effective serious game in a work environment involving team competition and prizes. We introduce an innovative model of the energy-consumption decisions of an employee that includes several factors, namely sensitivity to comfort loss, desire for conformance to the social norm, desire for teaming and appreciation of monetary rewards. We formulate the problem of maximizing the effectiveness of the serious game with respect to the team size and the amount of rewards based on numerical evaluation with synthetic and real datasets, we show the significant impact of these game parameters to the effectiveness of the serious game as an incentive mechanism for energy conservation in this context.

I. INTRODUCTION

According to the European Environment Agency (2017), a significant fraction of electricity is consumed by the services sector (29%), of which a key part comprises office buildings. Although the energy-consumption reduction in buildings is a complex issue and should also be addressed by means of energy-efficient refurbishing and retrofitting of the buildings, the consumption behavior of the people in these buildings is considered a key factor and it should be properly addressed as well, in order to accomplish energy-consumption reduction and smoothing, because “buildings don’t use energy, people do” [1]. Demand-side management (DSM) refers to the adjustment of the demand side of electricity supply, so that it minimizes supply (generation) costs. DSM includes energy efficiency and demand-response (DR) solutions. The latter attempt the modification of electricity demand as a response to some special signals to the customers. While price-based DR programs directly involve economic incentives for user participation through the electricity prices used for charging, most incentive-based DR programs (e.g., Critical Peak Rebate, Direct Load Control) also indirectly involve economic incentives through monetary rewards, discounts or penalties.

Few attempts have been made for DR in office buildings mostly based on automated control of HVAC using sensory data [2], [3]. This is because, more often than not, providing economic incentives for DSM in office buildings may not be practical, while various other behavioral traits of consumers may

be equally or more important for their decision-making process than cost-saving [4]. Such behavioral traits for users at a work environment include attitude towards energy conservation, problem awareness, knowledge, habits, desire for conformance to social norms, needs, inclination towards teamwork, mobilization by means of rewards, etc. Serious games and gamification are a means for engaging and motivating people towards specific goals, i.e., learning, training, persuasion, change behavior, etc., as in-game playing strategy. The employment of serious games for DSM is a recent approach followed by few prior works [5]–[7] that statically employed different game genres, e.g., life simulation, sports. In [8], which is co-authored by one of the present authors, the first attempt to mathematically model the problem of optimal design of a serious game for individual players was made. However, to the best of our knowledge, a team-competition setting with team ranking based on aggregate scores has never been analyzed in the past.

In this paper, we investigate the potential effectiveness for energy-consumption reduction of a team-competition game among employees in an office context. We introduce an innovative model for the energy-consumption decisions of an employee, which includes four key behavioral traits of employees, namely their sensitivity to personal-comfort disruption, their desire for conformance to social norms, their desire for teaming and their appreciation of monetary rewards. We mathematically model the user problem regarding her game strategy for energy-consumption reduction. Moreover, we analytically study the problem of the game designer regarding team formation and rewarding scheme, in order to maximize the potential effectiveness of the game. Based on numerical analysis with synthetic and real data from three pilot sites of the EU project CHARGED (<http://www.charged-project.eu>), we establish that the team size and the rewarding scheme should be appropriately chosen for different communities of office employees, in order to maximize the net achievable energy savings, i.e., the value of saved energy minus the cost of incentives.

The remainder of this paper is organized as follows: In Section II, we define our game model. In Section III, we define the problem of the individual player of the game for selecting her performance. In Section IV, we define the problem of the game designer for optimally selecting the parameters of the game. In Section V, we numerically evaluate our work for synthetic and real datasets. In Section VI, we review the related work and, finally in Section VII, we present some concluding remarks and directions for future work.

behavior. Similarly, Johanson *et al.* [7] reviewed multiple energy competitions among university students and identified several pitfalls in their design. Specifically, the use of absolute or relative energy-consumption reduction for winner determination was deemed as not adequate when static baseline calculation methods are employed and may be unfair for already green consumers. Anticipating these in our approach, dynamic baseline calculation will be employed along the game and p_i^t can be considered to represent not the total nominal energy consumption of employee i , but her nominal consumption due to misbehavior. Overall, none of these competition game-settings were analytically studied in terms of effectiveness, as opposed to our work. Also, a virtual pet game for energy use reduction in a commercial office setting was introduced in [5]; device-specific energy consumption was reflected in the fitness of virtual pets.

Multiple serious games were also proposed for energy conservation in residential settings [8], [12]–[14]. Geelen *et al.* [12] performed a pilot study on motivating occupants of student-households to save energy by means of team competition with a prize, similarly to our game setting. They found that this game setting achieved 24% savings on average, however, not long-lasting ones. A serious game for sharing a Medium/Low Voltage transformer among prosumers was organized as a virtual world with many user roles and actions in [13], albeit without exploiting any means of social pressure. Another game, called Power House, for improving residential energy behaviour was proposed in [14]. Incentive mechanisms included score boards with links to real-world social networks and virtual currency awards. The first approach to mathematically model and optimally choose the design parameters of a serious game was made by Papaioannou *et al.* [8]. Only social pressure was considered there as a means of incentive in a simple game, where consumers were competing to each other for their relative energy-consumption reduction at a peak-time slot, and then top- K and bottom- M consumers were announced as winners and losers respectively.

There are also a number of studies on gamification in general [15], which verify that specific serious-game design elements, such as leaderboards, points and levels, positively influence user participation, engagement and behavioural change without compromising the users intrinsic motivation. Also, Wang *et al.* studied efficient team creation for team competition games in [11] to maximize game enjoyment. They aimed to create teams of comparative strength, as we also do in our approach based on sampling. However, in [11], they also consider playing style of players apart from their individual performance for team formation. They found that enjoyment is positively correlated to the team presence of players with global-liberal playing style, i.e., those that assist others. We leave the consideration of this aspect for team formation as a future work. Moreover, team competition was game-theoretically studied in [16], however, in a very different setting than ours: winner determination was based on a one-to-one matchmaking among ordered team players according to their reported strength.

VII. CONCLUSION

In this paper, we analytically studied the potential effectiveness of a serious game involving team competition and prizes

for energy conservation in public-office buildings. We considered four behavioral traits that guide the energy-consumption behavior of employees in our analysis: (i) sensitivity to personal discomfort, (ii) desire for conformance to the social norm, (iii) enjoyment from teaming, and (iv) desire for prizes. We analytically modeled the problem of the player for choosing her in-game performance, so as to maximize her net benefit and the problem of the game designer for optimally selecting the number of teams and the amount of rewards, so as to maximize the achievable net energy savings of the game. Based on numerical evaluation with synthetic and real data, we proved that the number of teams and the amount of rewards play significant role on the effectiveness of this game setting for energy conservation and they should be carefully chosen based on our optimization approach. However, the level of the validity of our model remains to be assessed by running our serious game in the pilot sites of CHARGED. As a future work, we will perform a sensitivity analysis on the impact of the various behavioral aspects on the model. Also, we intend to investigate appropriate team formation, apart from team size, optimal reward allocation and a more detailed user-utility model at the device level.

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Figure 21 Extracts from the IEEE SmartGridComm 2017

9. Eighth Paper

Publication Title: IEEE International Energy Conference, Towards self-healing, resilient and green, electric power and energy systems. ENERGYCON18 .

Authors: Dimitriou N.

Article Title: “ChArGED: Improving energy efficiency in public buildings through IoT-enabled energy disaggregation and serious games”.

ChArGED: Improving energy efficiency in public buildings through IoT-enabled energy disaggregation and serious games

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Abstract— ChArGED addresses energy consumption in public buildings and proposes a framework that aims to facilitate achieving greater energy efficiency and reductions of wasted energy in public buildings. The framework leverages IoT enabled, low-cost devices to improve energy disaggregation mechanisms that provide energy use and -consequently- wastages at the device, area and end user level. These wastages are targeted by a gamified application that feeds personalized real time recommendations to each individual end user. The ChArGED solution is being developed with iterative end-users' engagement during analysis, design and development in public buildings located in 3 different countries: Luxembourg, Austria

end system, to determine variations over the energy context within the building. The Analytics Back-end component is responsible for delivering insights that will enable the ChArGED application to deliver custom and targeted feedback and incentives to the end-users. Finally, the Gamification group is responsible for processing field data and insights created from such data and make decisions as to the evolution of the game for each user, i.e. what the next step is towards more energy savings. That group also delivers the mobile app the end-users interact with which acts as an interface between the user and the charged system updating the user with the current

Figure 22: Extracts from the ENERGCN2018 paper

10. Ninth Paper

Publication Title: 11th Mediteranean Conference on Information Systems (MCIS), Genova – Italy, MCIS 2017 Proceedings. 27.

Authors: Kotsopoulos, Dimosthenis; Thanasis, Papaioannou G.; Stamoulis, George D.; and Pramadari, Katerina

Article Title: "An Exploration Of Parameters Affecting Employee Energy Conversation Behaviour At The Workplace, Towards IOT-Enabled Behavioural Interventions"

<http://aisel.aisnet.org/mcis2017/27>

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An Exploration Of Parameters Affecting Employee Energy Conversation Behaviour At The Workplace, Towards IOT-Enabled Behavioural Interventions

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Kotsopoulos et al. /Parameters Affecting Employees' Energy Conversation

Acknowledgment: This research study is partially funded by the project ChARGED (ChARMed Gamified Energy Diagnosis), that receives funding from the EU Horizon 2020 research and innovation programme, under grant agreement No 696170.

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The 11th Mediterranean Conference on Information Systems (MCIS), Genoa, Italy, 2017

14

Figure 23 Extracts from the MCIS 2017 paper

11. Tenth Journal Paper

Publication Title: MDPI, Sensors 2018. <http://www.mdpi.com/1424-8220/18/2/537>

Authors: Thanasis G. Papaioannou , Nikos Dimitriou , Kostas Vasilakis , Anthony Schoofs, Manolis Nikiforakis , Fabian Pursche, Nikolay Deliyiski, Amr Taha, Dimosthenis Kotsopoulos, Cleopatra Bardaki, Sarantis Kotsilitis and Anastasia Garbi

Article Title: " An IoT-based gamified approach for reducing occupants' energy wastage in public buildings"

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


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Sensors 2018, 18(2), 537; doi:10.3390/s18020537

Open Access Article

An IoT-Based Gamified Approach for Reducing Occupants' Energy Wastage in Public Buildings

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


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Abstract

Conserving energy amenable to the activities of occupants in public buildings is a particularly challenging objective that includes associating energy consumption to particular individuals and providing them with

Figure 24 Extracts from the MCIS 2017 paper

4.2 Events

4.2.1 Participation in conferences, seminars and workshops

ChArGED was disseminated via the participation of consortium partners to various events. Again the events are kept and the new ones in the Year 2 have been added, for consistency and for giving a good overview of the project activities and achievements.

• Dissemination event #1: Workshop for EE 2014 & 2015 Coordinators

Date: 23-24 May 2016

Audience/Activity

EASME POs, EE2015/2015 project coordinators

Short description

The European Commission Executive Agency for SMEs (EASME) organised a very creative workshop for EE 2014 & 2015 Coordinators on the 23rd-24th of May 2016, in Brussels. Project coordinators had the chance to meet, present their projects, interact with the POs and get the insight of the "ICT for Energy Efficiency" initiative, acquire a clear view of the other projects' content and create synergies.



Figure 25 Extracts from the presentation given at the EASME workshop

• **Dissemination event #2: Internet of Things Conference 2016, Athens-Greece**

Date: 19 September 2016

Audience/Activity

Business Community, IoT researchers

Short description

The conference focused on the predictions and trend of the IoT ecosystem, the regulatory framework that will determine the function and the platforms upon which business applications will be based. A lot of case studies were presented to show the practical issues concerning the IoT ecosystem, which will eventually influence business plans and future investments. AUEB participated in the conference and presented ChArGED project to the audience (presentation title: IoT applications in Retail and Energy-efficient Workplace).

Webpage: <http://iotconference.boussiasconferences.gr/default.asp?pid=1&la=2>



Figure 26 Extracts from the presentation given at the Internet of Things Conference 2016 workshop

• **Dissemination event #3: Stakeholder Engagement Event 2016-Icarus project (Integrated Climate Forcing and Air Pollution Reduction in Urban Systems)**

Date: 03 November 2016

Audience/Activity

PAs (Greek), Local Authorities/Municipalities & Regions, Academia/Researchers, Business, NGOs, Institutes

Short description

The ICARUS Stakeholder Engagement Event was organized by the Athens Development and Destination Management Agency (A.D.D.M.A.) and the Environmental Engineering Laboratory (EnvE-Lab) of the Aristotle University of Thessaloniki (A.U.Th.) on 3 November 2016 in Athens. At the event distinguished experts presented their insights and discussed policy framework measures that together with the ICARUS innovative technological tools can contribute to air pollution reduction and mitigation of climate change and lead towards the development of Resilient Cities. DAEM participated promoting CharGED.

Webpage

<http://icarus2020.eu/icarus-stakeholder-engagement-event/>

<https://www.facebook.com/daemitcompany/posts/1160117017376652>



Figure 27 Photos from the ICARUS workshop

- **Dissemination event #4: European Utility Week 2016**

Date: 15-17 November 2016

Audience/Activity

Utilities, hardware manufacturers, investors, ESCos

Short description

European Utility Week is the premier business, innovation and information platform connecting the smart utility community, with experts from utilities, network operators, vendors, consultants, startups and system integrators covering the entire smart energy value chain.

Wattics had a stand at the trade event and took the opportunity to promote CHARGED together with its own solutions for the duration of the event.

Webpage: <http://www.european-utility-week.com>



Figure 28 Photo from the WATTICS booth and the ChArGED screen at the European Utility Week

- **Dissemination event #5: Urban Policies Workshop**

Date: 18-19 December 2016

Audience/Activity

PAs (Greek), Local Authorities/Municipalities & Regions, Academia/Researchers, Business, NGOs, Institutes

Short description

The Urban Policies Workshop Event was organized by CoE Civic School of Political Studies in Greece - Symbiosis and the Athens Municipality Resilience and Sustainability Office on 18 and 19 December 2016 in Athens. This Lab used a political and institutional perspective to explore cities as governance systems. Participants engaged in analysing urban politics and governance from political and institutional perspectives. The objectives included the exchange of best practices relating to the local authorities' communication with their citizens through information and data sharing. DAEM participated promoting CharGED.

Webpage

<https://resilientathens.wordpress.com>



Figure 29 Photos from the Urban Policies workshop

- **Dissemination event #6: VIMSEN workshop**

Date: 13 January 2017

Audience/Activity

EE project partners, related stakeholders, academics, entrepreneurs, researchers.

Short description

ChArGED participated (via European Dynamics) in the VIMSEN «Virtual Microgrids for Smart Energy Networks» technical workshop that was organized on 13 January 2017 in Athens, Greece with a presentation entitled "H2020 ChArGED project: Cleanweb gamified energy disaggregation"

Webpage: <http://www.ict-vimsen.eu/index.php/news>

INVITATION
FOR THE INDUSTRIAL WORKSHOP OF THE VIMSEN PROJECT:
«Virtual-Microgrids for Smart Energy Networks»

Friday, 13 January 2017
 OTE Academy, Room Σ123, Building of Schools, Ground Floor (Pelika & Sparti 1, 15122, Maroussi)

We invite you to participate to the VIMSEN project «Virtual-Microgrids for Smart Energy Networks» workshop.

This Workshop will be held on Friday, 13 January 2017 at 9:30 AM, at OTE Academy, Room Σ123, Building of Schools, Ground Floor (Pelika & Sparti 1, 15122, Maroussi).

Participants will have the opportunity to see specific functionalities of the VIMSEN platform as well as follow speeches, presentations and demonstrations of pilot programs of other ongoing EU-FP7/H2020 research and innovation projects.

The VIMSEN Project (<http://ict-vimsen.eu/>), is a 7th Framework co-funded Program of the European Commission (FP7-ICT-2013).

The main objective of the workshop is to inform all stakeholders of the results of the VIMSEN project as well as communicate and disseminate the results of many more EU R&I projects.

12:50-13:10	H2020-INPUT-Project: "In-Network-Programmability for next-generation personal-cloud-service-support" Dr. George Lyberopoulos, Head of Research & Development Dept., Fixed & Mobile-COSMOTÉ S.A.
13:10-14:15	Lunch
14:15-15:55	Topic 3: Innovative software platforms in the energy sector using ICT
14:15-14:35	Advanced customer profiling and recommendation services to emerging utilities and ESCOs: The VIMSEN commercial solution Dr. Vasilis Nikolopoulos, CEO, INTELEN Ltd.
14:35-14:55	H2020-SOCIALENERGY project: "A Gaming and Social Networking Platform for Evolving Energy Markets' Operation and Educating Virtual Energy Communities" Dr. Nikolaos Fotopoulos, Senior Researcher, Institute of Communications and Computer Systems (ICCS)
14:55-15:15	H2020-CHARGED-Project: Cleanweb-gamified energy disaggregation Dr. Nikos Dimitriou, Senior R&D consultant, European Dynamics S.A.
15:15-15:35	FP7-OS4ES-project: The FP7-OS4ES-project and Hypertech IoT solutions Dr. Antonios Satsoukoulou, Senior Project Manager, Hypertech S.A.
15:35-15:55	ENTROPY--An innovative IT ecosystem for improving energy efficiency through consumers' engagement and behavioural changes Ms. Eleni Fotopoulou, Senior Software Engineer, UBITECH
15:55 -- end of day	Networking session among all participants

VIMSEN
 Virtual Microgrids for Smart Energy Networks

Prof. Manos Vazvargios
 VIMSEN project coordinator
 Tel: +30-210-7724731
 Email: manos@eid.upatras.gr

Dr. Prodrimos Makris

Figure 30 Extracts from the VIMSEN workshop agenda

charged
 EU project ChArGED: Cleanweb Gamified Energy Disaggregation

Dr. Nikos Dimitriou
 European Dynamics (coordinator)
www.charged-project.eu

VIMSEN project industrial workshop
 Athens, January 13, 2017

Charged disaggregation & feedback loop

ChArGED multi-level energy disaggregation
 made possible with additional data provided by smartphones, NFC and other sensors

NFC Beacons are placed on appliances and are paired with user's smartphone

Profiling energy consumption required for some appliances

ChArGED mobile gamified app

Aim: associate consumption to users (identify energy consumption behavior)...

Disaggregated energy consumption per appliance and user

OSGI Sensor Gateway forwarding sensor data to ChArGED

main electricity circuit

NFC Beacons track, trace, generating consumption patterns with appliances and user behaviour

Building control energy monitor

... and motivate users to adjust their behavior

Figure 31 Extracts from the presentation given at the VIMSEN workshop

- Dissemination event #7: Mobile World Congress 2017, Barcelona, Spain

Date: 26 February 2017 – 2 March 2017

Audience/Activity

SMEs, StartUps, Enterprises Academia/Researchers, Business, NGOs, Institutes

Short description

ChArGED participated in the Mobile World Congress 2017 via DAEM as a member of HAMAC (Hellenic Association of Mobile Application Companies) participating in the booth of greek companies. CharGED project was disseminated through flyers as well as one-to-one discussions/presentations.

Social media :

<https://www.facebook.com/daemitcompany/photos/a.383341638387531.92980.345291462192549/1285299831525036/?type=3&theater>

- **Dissemination event #8: CEBIT 2017, Hannover, Germany**

Date: 21 - 24 March 2017

Audience/Activity

SMEs, StartUps, Enterprises Academia/Researchers, Business, NGOs, Institutes

Short description

ChArGED participated in CEBIT 2017 via DAEM hosting a booth and presenting ICT solutions for the public sector as well as its current R&D projects. CharGED project was disseminated through flyers as well as one-to-one discussions/presentations.

Webpage:

<http://www.cebit2017.de/exhibitor/daem/L460500?source=akl>

Social media :

<https://www.facebook.com/daemitcompany/photos/a.383341638387531.92980.345291462192549/1298534096868276/?type=3&theater>

- **Dissemination event #9: City Challenge Crowd Hackathon #smartcity, Hellenic Kosmos Culture Center, Athens, Greece**

Date: 12 - 14 May 2017

Audience/Activity

PA s (Greek), SMEs, StartUps, Local Authorities/Municipalities & Regions, Academia / Researchers, Business, NGOs, Institutes

Short description

ChArGED participated in City Challenge Crowd Hackathon via DAEM presenting ICT solutions for the public sector, as well as its current R&D projects. DAEM hosted a booth and was also part of the invited speakers' agenda. CharGED project was disseminated through flyers, one-to-one discussions and DAEM presentation.

Social media : <https://www.facebook.com/daemitcompany/videos/1354668694588149/>

- **Dissemination event #10: Gamification, a driver for sustainable behavior change in cities?"**

Date: 7 June 2017

Audience/Activity

Presentations from the ChArGED, EMPOWER and hackAir project. The audience in the day of the webinar were 67 individuals from different organizations interested in energy efficiency from the academy, government and business across Europe.

Description

A webinar hosted by the Green Digital Charter, <http://www.greendigitalcharter.eu>. ChArGED presented its overall goal and gamification process to motivate energy wastage and energy friendly employee behaviour through state of art gamification processes. During the webinar, ChArGED presented its Gamification approach and the potential of introducing gamification in Public buildings.



Figure 32 VIMSEN Paper

- **Dissemination event #11: IEEE Global Internet of Things Summit (GIoTS)**

Date: 6-9 June 2017

Audience/Activity

A scientific IEEE global conference involving also a good degree of industry. Around 50 participants were following this workshop.

Short description

The research paper entitled "IoT-Enabled Gamification for Energy Conservation in Public Buildings" (T.Papaioannou et.al.), was presented at the 2017 Global Internet of Things Summit (GIoTS) in June 6-9 2017, in Geneva, Switzerland. The paper is now also available in IEEE Xplore at <http://ieeexplore.ieee.org/document/8016269/>. ED (George Boultadakis) participated at the event and presented this paper.

This workshop in the event GIOTS was organised by EE project Entropy.

- **Dissemination event #12: IEEE PowerTech Manchester**

Date: 18-22 June 2017

Audience/Activity

One of the flagship conferences of the IEEE PES and IEEE SmartGrid communities with 689 registered participants from academia and the industry.

Short description

The research paper entitled “Optimal Design of Serious Games for Consumer Engagement in the Smart Grid” (T. G. Papaioannou et al.) was presented at the 2017 IEEE PowerTech in June 6-9 2017, in Manchester, U.K. AUEB (T. G. Papaioannou) participated at the event and presented this paper.



- **Dissemination event #13: GamiFIN 2017 Conference**

Date: 9-10 May 2017, Pori, Finland

Audience/Activity

The scientific community of the gamification field. In the session of the ChArGED related publication approximately 35 people participated.

Short description

The paper entitled "Waste No More: Gamification for Energy Efficient Behaviour at the Workplace" examines the potential to engage the employees through state of art gamification mechanics and dynamics, utilizing information from the everyday interactions of employees with energy consuming devices. The paper alongside with the remaining gamification papers can be found in the GamiFIN 2017 proceedings website (<http://ceur-ws.org/Vol-1857/>) and are available as free open-access.



- **Dissemination event #14: IEEE SmartGridComm, Dresden, Germany**

Date: October 23-26, 2017

Audience/Activity

The flagship conference of the IEEE ComSoc and IEEE SmartGrid communities with hundreds participants from academia and the industry.

Short description

The research paper entitled “Teaming and Competition for Demand-Side Management in Office Buildings” (T. G. Papaioannou et al.) was presented at the 2017 IEEE SmartGridComm in October 23-26 2017, in Dresden, Germany. AUEB (T. G. Papaioannou) participated at the event and presented this paper.

- **Dissemination event #15: Athens Innovation Festival 2017**

Date: 21 November 2017

Audience/Activity

Public Authorities (Greek), Local Authorities/Municipalities & Regions, Investors, Academia/Researchers, Business, other projects. More than 100 people participated at the event.

Short description

The project was presented by Dr. Cleopatra Bardaki from ELTRUN E-Business Research Center in the context of a specialized workshop held at the Athens Innovation Festival 2017.

The Athens Innovation Festival 2017 was a three-day festival of innovation held in Athens, Greece in 20th -22nd November 2017. In the context of the workshop, a number of innovative solutions were presented to a large audience, focusing on EU-funded research activities. Additionally, the workshop participants had the opportunity to interact with the presenter/ project partner and learn more regarding the ChArGED solutions and its potential benefits.

Workshop Agenda

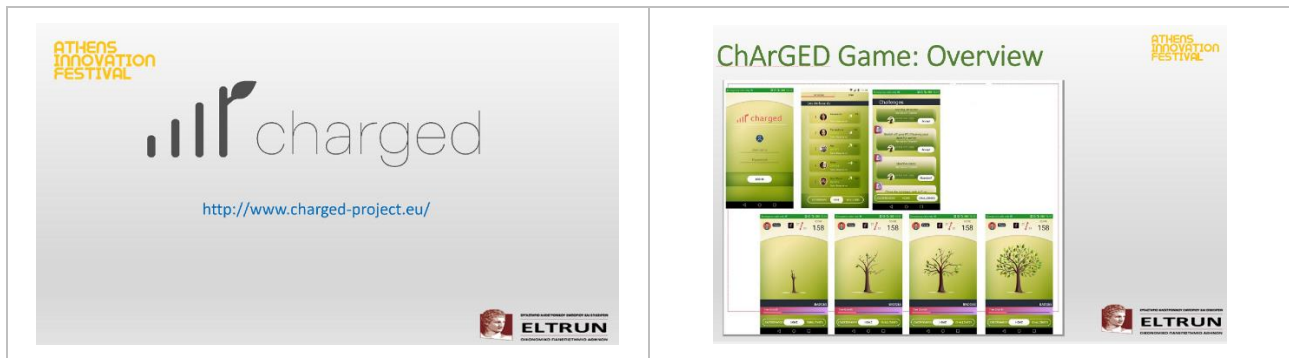
ΤΡΙΤΗ	21.11.2017
WORKSHOP // IOT & BUSINESS ANALYTICS – e-commerce ΕΡΓΑΣΤΗΡΙΟ ΗΛΕΚΤΡΟΝΙΚΟΥ ΕΜΠΟΡΙΟΥ ΚΑΙ ΕΠΙΧΕΙΡΕΙΝ - ELTRUN, ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ	
Approaching Consumer Centricity in the new ecommerce and IoT era	
Δρ. Κατερίνα ΦΡΑΪΔΑΚΗ e-Commerce Coordinator ELTRUN	
Δρ. Κλεοπάτρα ΜΠΑΡΔΑΚΗ senior researcher ELTRUN	
Δρ. Ελένη ΖΑΜΠΟΥ senior researcher ELTRUN	
Δώρα ΤΡΑΧΑΝΑ Υπ. Διδάκτορας ELTRUN	
Μαρίanna ΣΚΙΑΔΑ Υπ. Διδάκτορας ELTRUN	
Αναστασία ΓΡΗΒΑ Υπ. Διδάκτορας ELTRUN	
Βασίλης Σταυρου Υπ. Διδάκτορας ELTRUN	
ΣΥΝΤΟΝΙΣΤΗΣ: Γιώργος ΔΟΥΚΙΔΗΣ, Καθηγητής Οικονομικό Πανεπιστήμιο Αθηνών, Διευθυντής ELTRUN	
ΠΕΡΙΓΡΑΦΗ Παρουσίαση αποτελεσμάτων ευρωπαϊκών έργων τα οποία έχουν διεξαχθεί και διεξάγονται από το ΟΠΕΚ και έχουν ως κύριο αντικείμενο το IoT, το gamification και το business analytics.	
Αίθουσα 14 14:00 - 16:00	

ΔΙΟΡΓΑΝΩΣΗ

ΣΥΝΕΡΓΑΣΙΑ

ΧΟΡΗΓΟΙ ΕΠΙΚΟΙΝΩΝΙΑΣ

Extracts of CHARGED presentation



• **Dissemination event #16: EMEX the Energy Management Exhibition**

Date: 22-23 November 2017

Audience/Activity

ESCos, energy managers, manufacturers, public bodies

Short description

EMEX is the energy management show that connects all energy users with leading experts, policy makers, suppliers and technical solutions. The event includes a conference programme that helps attendees control energy costs, gain industry insights, source innovations, share knowledge and stay up to date with the latest and upcoming legislative changes and how these are affecting businesses.

Wattics had a stand at the trade event and took the opportunity to promote CHARGED together with its own solutions for the duration of the event.

EMEX establishes and builds partnerships between business, third party intermediaries, training suppliers, government and public bodies to accelerate the adoption and the implementation of energy efficiency measures in order to reduce energy use and carbon emissions.

Webpage: <https://emexlondon.com/>

Media and videos



Interview with Scott Armstrong, Head of Energy & Sustainability & ESOS Lead Assessor, Bourne Leisure

40 views



Wattics Ltd
Published on Dec 1, 2017

SUBSCRIBE 56

In an interview with Wattics, Scott discusses Bourne Leisure's Sustainability CAPEX programme as well as the importance of investing in a team fit to not only meet existing objectives but also introduce innovation in sustainable practices.

<https://www.youtube.com/watch?v=TPw7522pE2U&list=PLNPiGLbDyTzfbdvYVOIQQtMrCwGT4CSw>

- **Dissemination event #17: Empowering cities. Innovative strategies for smart buildings and citizens**

Date: 24 January 2018

Audience/Activity

PAs (Greek), Local Authorities/Municipalities & Regions, Academia/Researchers, Business, other projects. More than 100 people participated at the event.

Short description

The event was organized by the research center CIRCE, under the umbrella of two of the European projects that the center coordinates: NEED4B and TRIBE. The co-organizers of the event are the Cataluña Technical University, through the EnerGAware project, and the company Solintel, through the OrbEEt project at the impact hub in Madrid. This was an opportunity for many projects to be presented and raise important issues that were used as seeds for fruitful roundtable discussions towards the upcoming calls for proposals in energy related topics. ED (Anastasia Garbi) participated promoting Cha

Agenda

Empowering cities Innovative strategies for Smart buildings and citizens

24th January / Impact Hub Madrid (C/ Gobernador, 26)

09:15H Registration REGISTER HERE!

09:30H Welcome and Introduction - *CIRCE*
Towards the 9th FP. Spanish position in the field of buildings - *CDTI*

09:45H Innovative approaches and solutions for low energy buildings

- An integrated methodology for design, construction and operation of buildings - *RINA*
- Cost – effective solutions for very low energy buildings - *CIRCE*
- ICT Monitoring and Management. Tools for Smart-Buildings - *ACCIONA*
- Challenges in circular economy in the building sector - *GBCE*
- Transferring Knowledge of Integrated Disciplines to Society - *OZU*
- Q&A

10:55H Coffee Break

11:15H ICT-based solutions for energy efficiency in buildings

- The Behavioural Change Framework: Gamification & Targeted Feedback - *Coventry University*
- Tools to enhance energy efficiency habits in public buildings - *CIRCE*
- Impact of serious games on the energy efficiency of social housing communities - *UPC*
- A game to promote energy efficiency actions - *Euroquality*
- An IoT Platform for Energy Efficiency based on Data Analytics and Behavioural Change - *University of Murcia*
- A Smartphone App for Energy Savings Through Behavioural Change, Flexible Tariffs and Fun - *Energie Institut*
- A gamified system for Energy Efficiency in the public sector buildings - *EURODYN*
- Q&A

12:45H Cocktail

13:15H Towards the future. Challenges and new initiatives in H2020 - *CIRCE*
Upcoming EU calls opportunities - *CDTI*

PARALLEL ROUNDTABLES

Roundtable 1. Socio-economic actions towards a sustainable energy use

- LC-SC3-EC-1. The role of consumers in changing the market with informed decision or collective actions
- LC-SC3-EC-2. Mitigating household energy poverty
- LC-SC3-CC-5. Research, innovation and educational capacities for energy transition
- LC-SC3-EE-14. Socio-economic research conceptualising and modelling energy efficiency and energy demand

Roundtable 2. Solutions and services for building renovation

- LC-SC3-EE-1. Decarbonization of EU building stock. Innovative approaches and affordable solutions changing the market for buildings renovation
- LC-SC3-EE-2. Integrated home renovation services
- LC-SC3-EE-13. Enabling next-generation of smart energy services valorising energy efficiency and flexibility at demand-side as energy resource

Extracts of CHARGED presentation



Figure 33 Photos from the Empowering cities workshop

4.2.2 ChArGED, Organisation of conferences, seminars and workshops

- **Event: ChArGED WP3 workshop on Gamification Design**

Date: 23 – 24 November 2016

Audience/Activity

WP3 partners, invited external innovators/experts.

Short description

A ChArGED WP3 workshop on Gamification Design was hosted by AUEB in the Athens Center for Entrepreneurship and Innovation (ACEIn) in Greece. During this workshop external innovators (in the areas of gamification and mobile app design) were invited to assist the WP3 partners in the concept of the ChArGED game and mobile app design/development. The workshop included a presentation of the main ChArGED concepts to the invited experts, as well as brainwriting 6-3-5 method sessions in order to gather ideas for developing candidate scenarios, epicss, acceptance criteria and userstories that would be used as inputs for the generic ChArGED game and mobile App design.

Webpage: <http://www.charged-project.eu/?q=content/charged-workshop-gamification-23-24-november-2016>

ChArGED Gamification Design Workshop

23 – 24 November 2016, 10:00 – 17:00

[Athens Center for Entrepreneurship and Innovation](#)

Greece, Athens, [Kefallinias 46, 2nd Floor](#)

Wednesday 23rd November 2016				
Time	Module	Presented By / Facilitated By	Attended By	Module Outcome
09:00 - 09:15	Welcome / Registrations	AUEB	Partners and Invited	
09:15 - 09:45	Workshop Agenda Presentation	AUEB	Partners and Invited	Presentation of Agenda and Brainwriting 6-3-5 Familiarization
09:45 - 10:45	Gamification in Energy Efficiency SoA	AUEB	Partners and Invited	Familiarization with Project Scope, Current trends of Gamification in Energy Efficiency, Indicative output of User feedback
10:45 - 11:00	Coffee Break			
11:00 - 11:30	New Concepts Design: Brainwriting 6-3-5 Method	AUEB	Partners and Invited	Different top level game concepts
11:30-12:00	New Acceptance Criteria Design: Brainwriting 6-3-5 Method	AUEB	Partners and Invited	Different in-game structures of actions / reaction
12:00 - 14:00	NCD : Elaboration on previous module	AUEB and PEAK	Partners and Invited	First rough version of EPICs + AC
14:00 - 14:30	Lunch (And/or Voting dependent on Philippe's schedule)			
14:30 - 17:00	Outline of NCD + Voting	AUEB	Partners	Updated version of EPICs

Figure 34 Extract from the Gamification workshop agenda

















Figure 35 Photos from the Gamification workshop

5 Impact evaluation

Key Performance Indicators for the impact evaluation are documented in D1.1 – Project management plan. It is worth to mention the high rate of success of the dissemination and communication activities, with most of the targets to have been overachieved.

Table 1: Targets and actual impact of the dissemination and communication activities

	KPI	Target (M36)	Target (M24)	Achieved
WP5 – Project Impact	5-1-1 Visibility of the public ChArGED website	Approximately 1500 visitors	1000 (average per month)	1538 (average per month)  
	5-1-2 Number of written and electronic publications (in academic and technical media)	≥ 5	2	10  
	5-1-3 Number of written and electronic publications (in industrial, business and public media)	≥ 5	2	8 
	5-1-4 Number of website / newsletter articles via partner's channel	≥ 5	2	2  
	5-1-5 Number of presentations (in symposiums, meetings, congresses)	≥ 6	4	15  
	5-1-6 Number of Project workshops	≥ 1	1	1 
	5-1-7 Number of followers on Twitter	≥ 50	35	45
	5-1-8-Number of followers on LinkedIn	≥ 50	35	51
	5-1-9 Number of publications on LinkedIn	≥ 15	10	25
	5-1-10 Number of Communication videos	≥ 1	0	0
5-2 Innovation creation and exploitation activities	5-2-1 Number of third party organisations contacted for technology licensing	≥ 3	0	3
	5-2-2 Participation to industry leading trade fair events	≥ 3	2	3
	5-2-3 Number of partners integrating part of the Project' technology within own product range	≥ 2	0	0
5-3 Business Modelling and Socio-economic Sustainability	5-3-1 Number of new business models (BMs) for offering gamified solutions for energy efficiency are defined and evaluated	≥ 3	0	3
	5-3-2 Expected socio-economic evaluation of the project solution based on the data from the pilot studies	Positive	N/A	N/A
 Achieved		 Target for M36		
 Significant overachievement		 Not Achieved		

6 Conclusions

The project has overall conducted various dissemination activities for the second year. Most of the relevant KPIs for the period have been achieved and some of them significantly overachieved. The project will continue to intensify these activities during the next year, especially since more results will be available that can be demonstrated.