



D1.5 – Handbook of best practices in gamification

WP1 – State-of-the-Art

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EXECUTIVE SUMMARY

This document looks at the state of the art gamification techniques that enable, motivate and trigger people to participate and act. We start by addressing the various definitions and the meaning of the term of gamification. We then touch upon the general goals and aims of gamification to enhance non-game applications. In the third and fourth part of the report we look at the most frequently used game mechanics and elements to give an overview of the available options and trends, as well as list general advice for good practices collected through the various academic papers and practical guidelines. These first four sections aim at introducing the concept of gamification, its use and limitations and its application in the field.

In the fifth and sixth section, we narrow in on specific good practices and describe six cases where gamification is working to improve an application. The cases are analysed in a matrix of gamification in order to identify what elements are being used, how they work and what makes these gamified applications effective in reaching their goals.

Finally, we narrow in even further; addressing the PARENT project specifically with lessons learned from the analysis and provide recommendations for gamification for the PARENT Virtual Energy Adviser (VEA).

This deliverable feeds directly into task 4.4 where specific gamification mechanisms elements will be selected and adapted for the implementation in WP5.

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1 Introduction to the concept of Gamification

Games are a part of our culture. We learn and use games from an early age and play in the various environments, for training and learning, entertainment and for social development. Over the last decade, the digital game medium in entertainment and as popular culture has grown exponentially with 1.2 billion people paying games globally in 2013 and over 700 million people gaming online.¹

1.1 Definition and scope

Gamification, often defined as applying game elements to non-game situations or environments, has been emerging in almost every field; especially in education, information studies, human–computer interaction, technology adoption, project management, sustainability, health and community building (social engagement). It is also widely used inside corporations for employee training or performance improvement and for customer relations (customer satisfaction, branding and loyalty) in companies.²

Although the term gamification is relatively new, it is not a new concept, having roots in marketing endeavours, such as loyalty cards and rewards memberships such as frequent flyer programmes, military simulations, educational structures (e.g., scholastic levels, grades, and degrees), and workplace productivity.³

Other definitions of gamification include: *“The selective incorporation of game elements into an interactive system without a fully-fledged game as the end product”* and *“the use of game design elements in non-game contexts.”*⁴ Another view from service marketing definition is: *“a process of enhancing a service with affordances for gameful experiences in order to support user’s overall value creation”*⁵

¹ Spilgames. 2013. State of Online Gaming Report. Hilversum

² Seaborn, Katie & Fels, Deborah. 2015. Gamification in theory and action: A survey. *Human-Computer Studies* 74 (2015) 14–31 & Zichermann, Gabe & Cunningham, Christopher. 2011. *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. O'Reilly Media, Inc.

³ Seaborn & Fels 2015, Zichermann & Cunningham 2011 & Kumar, Janaki & Herger Mario. *Gamification at Work: Designing Engaging Business Software*. The Interaction Design Foundation

⁴ Deterding, S. et. Al. 2011 Gamification: Toward a Definition. *Gamification: Toward a Definition CHI 2011*, May 7–12, 2011, Vancouver, BC, Canada.

⁵ Huotari K., & Hamari, J. 2012. Defining Gamification - A Service Marketing Perspective. *Proceedings of the 16th International Academic MindTrek Conference*, Tampere, Finland, October 3-5.

Zichermann and Linder define gamification, in the field of marketing and customer loyalty as a tool for supplementing branding initiatives through the application of game elements and mechanics.⁶

Huotari and Hamari (2012) define the term “gamification” as a process of supporting service with the use of gameful experience for backing up consumer’s value creation.

In general, gamification describes those features of an interactive system that aim to motivate and engage end-users through the use of game elements and mechanics. Some gamification mechanics can also be used without necessarily being an obvious gamification and without making an application looking like a game. For example, LinkedIn incorporates several gamified elements, such as the progress indicator on how much information you have filled in. It has a clear mission encouraging the user to fill in that extra information about herself. Other elements include the visualization of community (showing how many people you are connected to, or how many people have viewed your profile). These classic uses of game mechanics encourage the user to expand your network and bring more value to LinkedIn.⁷ Thus, gamification does not provide a core service in itself; rather it enhances other services or intentions.

Seaborn and Fels (2015) conducted an overview study of 31 academic papers analysing gamification and its effectiveness. In the process, they looked at a number of interrelated concepts and game terms including the notion of funware and funology from industry, ludic qualities inspired by video games and other playful scenarios, serious games or applied games designed for a primary purpose other than pure entertainment (often through simulations), productivity games, surveillance entertainment, behavioural games, game layers, alternate reality games, games with a purpose, and pervasive or augmented reality games.⁸ This array of terminology for the various types of games of gamified influences make it challenging to set a fixed definition of the term gamification. Nonetheless, there is a consensus in literature that the term can be used for describing a set of game mechanics when applied to the various goals, especially for encouraging users to participate, learn, engage and change behaviours.

⁶ Zichermann, Gabe & Linder, Joselin. 2010. *Game-Based Marketing: Inspire Customer Loyalty Through Rewards, Challenges, and Contests*. Wiley.

⁷ Kumar & Herger

⁸ Seaborn & Fels, 2015. & Zichermann & Cunningham, 2011.

2 Aims of gamification: motivations, values and behaviour change

2.1 Aims and Behaviour

Gamification is applied to make tasks more interesting, playful, fun and easy, thereby triggering behaviour change and engagement. It can also be used to remind people to do something (e.g., Nike+ running sending reminders for exercise programme through a person's smart phone), simplify and visualise (e.g., eco driving leaf where flowers grow on your dashboard when driving well), make something more social and participatory by removing the sense of feeling alone in doing a task and being a part of a community. Finally, gamification can be helpful in allowing for data collection for monitoring and for comparing. Both for an individual user: the quantified self⁹ and for a company to get data and overview of performance.

*“While effectiveness, efficiency, and satisfaction are worthy goals, gaming and gamification extends and adds increased **engagement** to these goals. In the context of a game, players voluntarily seek challenges to enhance their playing experience. They seek empowerment over efficiency, delight and fun over mere satisfaction. These factors increase their level of engagement in the game.”¹⁰*

Gamification does not magically make a boring task fun, or make a poorly developed application intriguing or popular. Rather, through the various tools, that aim to motivate and engage people, users learn to use an application and get further involved in the entire programme being gamified. In order to motivate and engage it is important to look at users' values and characteristics. Naturally, people are different, and some are more motivated by, for instance, competition and winning, whereas others are drawn rather to elements that encourage social interactions or build people's reputation.

Several experts have categorised people into groups such as Richard Bartle who pointed out that people respond to different triggers and have different reasons for

⁹ “‘Quantified Selves’ track many day to day tasks with the aim to improve the parts of their lives, they are unhappy with. The point of Quantified Self systems is to help the users reach their own goals. People use sophisticated technology to gather information about themselves.” Bildl, Stefan. 2014. Gamification of the Quantified Self. In Lindemann et al. Fun, Secure, Embedded. Advances in Embedded Interactive Systems Technical Report – Summer 2014. Volume 2, Issue 3. P. 5-10.

¹⁰ Kumar & Herger.

playing as well as in-game behaviour. In Hearts, Clubs, Diamonds, Spades: Players who suit MUDs, he outlined the four types of players: Socialisers, Achievers, Explorers and Killers.¹¹ These categories have since been further broadened including: The Competitor, The Explorer, The Collector, The Achiever, The Joker, The Director, The Storyteller, The Performer, and The Craftsman.¹² In short, these characteristic types that are being grouped refer to people's motivations for playing. For example, where some respond to winning and competition, others are more attracted to collaborating with others or co-creating, and others want to solve problems, find information and learn. So even within clearly defined target groups of users, there will be a different level of engagement depending on the structure and the mechanics of the gamification. Taking into account the different types of players and selecting which mechanics to use is therefore key to reaching the various groups.

2.2 Motivation and Values

Looking beyond what type of players exist, motivation theory. Zichermann examines motivation, breaking it down into intrinsic motivation and extrinsic motivation.¹³ Intrinsic value is a value within itself, and following an intrinsic motivation is doing something because it aligns with a person's inner values, pursued in and for itself. Extrinsic value is an instrumental value- something that is a means to an end. Something has extrinsic value if it brings about beneficial consequences. Extrinsic motivation includes incentives or external rewards. The table below, table 2-1 shows an example of what could be considered intrinsic and extrinsic motivations.

Table 2-1 Examples of Intrinsic and Extrinsic Motivations

Intrinsic motivations (Value within itself)	Extrinsic motivation (instrument of value – means to an end)
Feels good	Financial rewards
Right thing to do	Improved reputation /status
Aligns with one's values	New friends made

¹¹ Dixon, Dan. 2011. Player Types and Gamification. CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

¹² Inbar, Ohad, Tractinsky, Noam, Tsimhoni, Omer & Seder, Thomas. 2011. Driving the Scoreboard: Motivating Eco-Driving Through In-Car Gaming. CHI 2011, May 7–12, 2011, Vancouver, BC, Canada

¹³ Zichermann, G., 2011. Intrinsic and Extrinsic Motivation in Gamification. Gamification.co

E.g., values for environment/sustainability, for planet, for equality, for animal wellbeing, for poverty alleviation, for democracy, for health, for community, for quality of life, for charity, for social cohesion, etc.	Non financial rewards – e.g., in-game rewards
Sense of belonging /being a part of something bigger than oneself	Achievement/winning/accomplishment
Fun/pleasure	Time saving
Gives meaning/satisfaction	Learning

When designing gamified features to an application or an instrument, taking into account both intrinsic and extrinsic values and motivations is important. When relying only on extrinsic motivation, there is a risk of losing long-term engagement. While extrinsic motivation is great for attracting users, for triggering participation and creating a fun atmosphere that will engage users, intrinsic motivation will make users engaged for longer term and have a better ability to change behaviour.

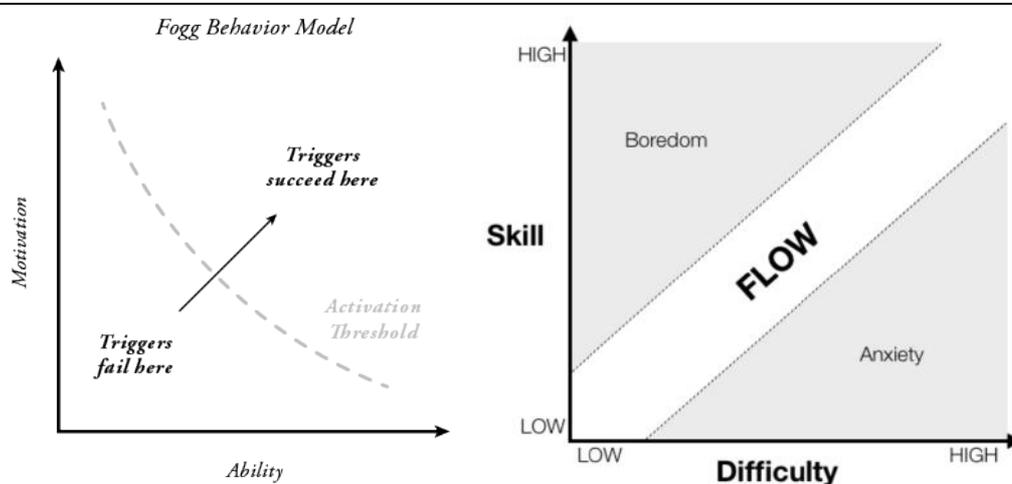
Another element to look at in regards to motivation is the level of difficulty, the evolution of a gaming element over time and the activation threshold. For a person to start playing they must feel that they have the ability to play the game. Otherwise a person may feel anxious and give up. A game that is too easy will quickly become boring. In order to get the first buy-in of the game and to maintain interest a game needs to consider the user's ability/skill, and its development over time. This has been described by Fogg and Szentmihalyi (figure 2-1).

Figure 2-1. Fogg's behaviour model¹⁴ and Csik Szentmihalyi psychology of optimal experience¹⁵

¹⁴ "The Fogg Behavior Model shows that **three elements must converge at the same moment** for a behavior to occur: **Motivation, Ability, and Trigger**"

<http://www.behaviormodel.org/>

¹⁵ Csikszentmihalyi, M. (1990). Flow: the psychology of optimal experience. New York: Harper Perennial



3 Game elements & game mechanics

In his book on game mechanics in the field of business, Hugos (2012) stresses four traits of games in operating models. Although the model is defined for business and company operation, these traits have been adapted and incorporated into the field of gamification in a broader sense:

- **Goals:** Setting clear definitions on what the game is about and why those goals are important and attainable.
- **Rules:** Explaining what is fair and what is not, and placing limitations on how the players can accomplish the goals.
- **Feedback systems:** Keeping players informed about their progress towards reaching their goals.
- **Voluntary participation:** players understand and accept the goals, rules and feedback systems.¹⁶

In the collection of Seaborn and Fels (2015), where they conducted an overview study of 31 papers on gamification, they identified the following motivational game elements in addition to setting the ground rules of Hugos' game traits: "feedback and reinforcement; pattern recognition; collecting; organizing; surprise; unexpected delight; gifting; flirtation; recognition for achievement; leading others; fame; getting

¹⁶ Hugos, Michael. 2012. Enterprise Games, Using Game Mechanics to Build a Better Business. O'Reilly Media, Inc.

attention; being the hero; gaining status; nurturing and growing.”¹⁷ Kumar and Herger add to this list: “connecting; self expression; reciprocity (linked with gifting) and blissful productivity (right level of difficulty/challenge).”¹⁸ Poornikoo (2014), contributes to the list of motivational elements by including: Conditions of flow (explanations); Control (Person believes their actions have direct impact); concentration/Focus (linked with blissful productivity); Reduced self-consciousness or doubt (due to focus on game and enablement); and altered sense of time. Fuller (2010) identified ten reasons on why people engage in online co-creation activities, which are related to gamification. They include playful tasks, community support, friends making, curiosity, self efficiency, looking for information, developing skills, compensation monetary reward, recognition, and personal need displeasure.¹⁹

3.1 Game Mechanics

“When used appropriately, game mechanics can leverage a natural motivational driver in the player.”²⁰

Looking at the instruments commonly used in gamification, points, leader boards and badges come up frequently. However, there are more instruments being used. The following list is a compilation of the most often cited game mechanics based on the various literature from the reference list. There is an overlap how the different authors define game elements, values, motivational elements, game mechanics and monitoring. This table (Table 3-1) aims to provide a simplified overview.

Table 3-1 Commonly used game mechanics in gamification

Game Mechanics	Explanation	Why
Achievements /Badges /trophies	Given once succeeding a task, a goal, a level or a challenge. Symbols that indicate mastery of skills and accomplishment. Virtual rewards that can be shared online as a symbol of success.	Status, Achievement, progress monitoring, accomplishment, positive reinforcement
Points	Granular units of measurement. A way	Feedback, collecting,

¹⁷ Seaborn & Fels 2015.

¹⁸ Kumar & Mario.

¹⁹ Fuller, Johann. 2010. Refining Virtual Co-Creation from a Consumer Perspective. California Management Review; Winter 2010, Vol. 52 Issue 2, p98. California: Management.

²⁰ Kumar & Herger.

	for counting success or progress (e.g., whether numbers or calories or CO2 saved etc.)	encouragement, achievement, self monitoring
Leader boards	Tracking, ranking and displaying different actions. Can be for all players, for a sub group (friends), or for teams. Can be highest scores ,for most frequent users, biggest improvement etc. Leader boards bring in the social aspect of points and badges	Competition, comparison, recognition, social connection
Rewards and Bonuses	Monetary or non monetary prize for reaching a certain goal or target	Incentives, winning, accomplishment
Incentives	In addition to rewards and prizes there may be other types of incentives. Such as receiving a credit in game, or local currency that can be used locally	Motivation, winning, benefits, reputation, fun and engaging (for a short while)
Challenges/quests	The game can set a challenge, the user can set his own challenge, or be challenged by a fellow player. A journey of obstacles a player must overcome	Motivation to act, organizing player effort
Constraints & time restraints/pressure	Deadlines, time limit, limited amount of tries, count downs	Achievement, status
Appointments	Player must return at certain time for a task, or mix with real life events, location specific	constraints such as deadlines, when combined with urgent optimism, motivate people to action
Status/Rank	Status or rank of player that can go up or down (linked with leader boards). Reaching higher levels can give player more challenges and harder tasks	Longevity, continuity, competition, status, leadership
Levels	Unlocking levels based on progress, improved skills, and accumulation of points	Maintain interest, sense of accomplishment
Competition	A task with winners and losers	Competition
Progression and Tracking	Visualisation of progress. Success is granularly displayed through the process of completing tasks, such as a progress bar, geographic map of area	Visualization, learning, self monitoring, competition, curiosity

	covered, percentage of tasks completed, improvement over time, successes etc.	
Instant Feedback	Anytime an action is done, the player receives feedback	Learning and self monitoring, motivation, sense of control and impact
Information provision	Feedback to user, step by step information on next steps- tips – help text, educational input, basic knowledge etc.	Learning, growing, retain motivation
Transparency	Player's ability to capture performance data and user information	Learning, control, trust
Comparing	Graphically comparing either own performance over time, comparison with others in similar conditions or comparing with the whole group over time	Quantified self, information and learning, competition (internal/external)
Reminders	Push notifications to remind user to do an action (e.g., conduct exercise, check meters, turn on game to solve a puzzle, etc.)	Learning, maintaining motivation
Lottery	Winning something by chance, selected out of a group	Fun, surprise, motivation, feeling lucky
Mini games	Distractions from task with fun, e.g., solving a puzzle or a quiz before going to the next level	Entertainment, fun, surprise
Journey	getting people on-board, giving proper introduction- and once on-board, giving feedback on progress, and future goals	Blissful productivity, maintained interest
Goal Setting	User sets his or her own goals and targets step by step. Adds engagement	Feeling in control, meaning, sense of achievement,
Discovery/ Exploration	New information new game elements, a surprise.	Learning, surprise, enhanced motivation, fun
Free ride/ gifting	Progressing or receiving something without having to do anything due to a fellow player giving a gift (or the system)	Connection, winning, surprise, fun
Loss Aversion	Linked with constraints - player having	Debatable, sense of

	to do something to avoid losing something. E.g., having to log on every day/week to not lose points	urgency, duty, and pressure
Training	Providing education, text or videos, improving understanding of a subject, helping player improve in a field	Self improvement, learning, growing,
Tools	Time management tools/saving tools/self monitoring. Manual data input to organise information	Self- monitoring and improving, efficiency and effectiveness, better organized user,
Marketplaces/ exchanges	A place where players can trade badges, skills, etc. to progress in game and collaborate	Connection, collaboration, friends, being a part of something bigger, using intelligence to maximize through trading with other players
Relationships	Adding friends to profile- or as support in support groups (motivating each other to do something good or avoid something bad)	Connecting, peer pressure
Roles/Narrative	A story where the player/character goes through a journey, may have roles that can be complimentary to roles of other players allowing for collaboration and sharing of resources.	Engagement, fun, belonging, ownership, loyalty – can be too much required from user
Avatars (customizable)	Customizing a character, sometimes with specific skills or characteristics. Rewards can be new options for avatar (tools, outfits, look, upgrade)	Ownership, self expression, loyalty
Personalised information	User name/photo/pitch, description	Belonging, connecting, having control, self expression
Social sharing/ reputation	Sharing a players results and progress steps through social media, or through gamified platform amongst fellow players	Building reputation and status, sharing accomplishments and pride, connecting with others, social support
Invite friends	A way to increase number of players, rewards for adding players,	Popularity, connection, more people more fun higher potential impact

Communicating with other players	Ability to text, or signal other players compare, challenge or ask for advise – discussion board or chat	Social support, positive reinforcement, making friends, pairing
Gifts/ helping other players /Sharing goals	Giving other players something	Belonging, reciprocity, connecting, reinforcement
Community collaboration	Group scoring, group set to solve a problem or gather certain level, scoring collectively	Social, connection, feeling of belonging, peer pressure, virality
Cooperation	Players compete together against system, shared outcomes (together we have saved xx CO2), collective results, shared resources, shared skills (when many are online at same time, task becomes easier or worth more points)	Connection, feeling of belonging, loyalty, peer pressure, deeper involvement

The table above is not exhaustive, but it does cover most gamified mechanics used today in gamified systems. Creativity, combinations of mechanics and exploration could lead to a development of a whole new set of gamified mechanics and enhance results. Being selective clear and targeted , and taking into account Hugos' traits of games and motivational theory will contribute to a better development of gamification.

4 General considerations when creating a gamified application

With the continued advancement and growth of the field of gamification, along with the larger phenomenon of social networks and virtual spaces, there is a shift in gaming from competition to collaboration. Online, people are sharing resources, co-creating, collaborating and co-developing. There is a cultural shift towards online freedom from copyright and sharing mentality. In gaming, the massively multiplayer online role-playing game such as World of Warcraft, Eve online and Battlestar Galactica all have strong elements of collaboration, shared problem solving and online connecting of players.²¹ This is something that the gamification area could

²¹ Zagal, J, Rick, J and Hsi, I. 2006. Collaborative games: Lessons learned from board games. Simulation & gaming, Vol. 37 No. 1, March 2006 24-40. & McGonigal, Jane. 2010. Gaming can make a better world. Ted 2010.

learn further from. This would mean shift not only from competition to collaboration, but also from solely individual scores and achievements to additional collective scores (already used e.g., in Fiat Eco drive application) and from fixed user roles to user adaptive roles, where each user can adapt the system to his or her desires. Throughout the literature scanned, several other suggestions and advise have been proposed when developing a game. These include:^{22, 23, 24, 25}

Clear objectives of the game: This applies to the developers of the game. It is important to have a clear view of what the gamified element should do and how it should contribute to the platform already established. Objectives could be to increase uptake, or participation, to influence behaviour, to collect data on users, to reduce energy consumption or a variety of other objectives. Only when this is very clear, can the gamified element be designed to address exactly the objectives. It will help in deciding what type of behaviour should be rewarded etc.

Understand the target group: The level of technological knowledge, level of online participation, and some behavioural aspect should be understood about the user in order to cater directly to their needs.

Technical definitions: Making the point system, reward system and the rules clearly defined for the backend to work and test these to see how they work. How are points given and why? How does each gamified mechanism work? The same goes for goals, levels, prizes, rewards, ranks etc.

Knowledge: Using the platform to share knowledge, e.g., information on energy consumption, tips, quizzes, providing opportunities for further learning

Clear marketing strategy: A gamified platform will only work as long as it has users. Thus, having a concrete plan on how to promote a platform and reach users, how to multiply them over time and maintain the system is essential.

User friendliness and design: It is important that a gamified platform looks attractive and intuitive to use. It should fit to the needs of the user target group already defined, and have possibly an option to create an avatar, collect locally relevant

²² S3C toolkit. Choosing and combining monetary and nonmonetary incentives. Smart Consumer, Smart Customer, Smart Citizen.

²³ S3C toolkit. Guideline: gamification - making energy fun. Smart Consumer, Smart Customer, Smart Citizen.

²⁴ Seaborn & Fels. 2015.

²⁵ Kumar & Herger.

information and have an easy access to help or FAQ area. Also having easily understandable measurement units and progress display

Collaborate: Integrate platform with other relevant platforms. Get partners who are relevant, beneficial and fit with the goals of the platform to be gamified. Combine with other programmes.

Combine: Internal and external goals for players, personal progress with collective progress, private and social elements to attract a larger user base.

Make use of emotions and narratives: In order to enhance the sense of ownership. Allow users to feel like they are a part of something bigger, that addresses their intrinsic values, use emotional personalized triggers like avatars or visualization of progress. By creating a story, users are more likely to get emotionally invested in the platform.

Don't overburden participants: Less can be more, and users will perhaps not want to be required to log in many times a day or even every day.

Data management, monitoring and measures: Deciding on what should be measured and communicated is a key element to define in advance. The whole process needs to be managed and the more data collected requires more analytics, storage and processing. The motivation needs to be monitored, and mechanics need to be measured continuously.

There are several options for what can be measured and monitored, or as Kumar and Herger list exemplifies:²⁶

²⁶ Kumar & Herger.

Engagement:

- Average number of actions
- Median number of actions
- Number of users performing actions
- Number of times users return
- Progression of users through the experience
- Customer satisfaction results

Time:

- Retention
- Frequency
- Decrease of response time
- Timeliness

ROI:

- Number of active users
- Productivity increase
- Cost reductions
- Sales increase

Metrics

- Number of registered users
- Number of active users
- Number of top contributors (above a certain point threshold per period)
- Average response times to forum questions
- Other metrics like the Net Promoter Score, which is a measure of the satisfaction of members in the community.

Start simple: Test along the way in connection with the users and allow for improvements over time. This will also keep the users interested if changes and evolution happens in steps. Create intermediate targets and communicate those. Plan perhaps for a few releases ahead, introduce new features periodically to sustain novelty and interest. Expectations for development, as well as those of the users, need to be managed.

Respect privacy and data security: Gamification can be used as analytical strategy to generate a large amount of data about the user group. Which can be used to improve the system and user experiences. It can help also for creating sub groups and make specifically targeted measures. To avoid problems further down the line and increase user acceptability, transparency on data usage, honesty and ethical treatment of the data should be ensured.

5 Examples of gamification in practice

In the following two chapters we move from the more general and abstract analysis of gamification to the more concrete and specific. In order to look at what gamification means to existing applications, how they are developed and implemented in real life and how they have an impact, we have chosen six different gamified applications that have a good reputation, high success rates and large user groups.

The six cases were thus selected based on reputation (from online sources and literature review), relevance to the PARENT project (overlaps in some aims, as well as scope for innovative new applications from non related fields), availability of information, and broad field of application. For the last one, we chose to look specifically at different fields to get a broad overview.

The first case addresses eco driving. The relevance to PARENT is clear in the sense that this application focuses on saving fuel and vehicle lifetime through better information provision along with gamification elements that bring together users, challenge them and allow for rewards.

The second case Nike+ is probably the largest application of the six, which makes it a different scope from the PARENT VEA. However, it also used metrics and information to help its users make better decisions, and targets internal motivations for health.

The third case addresses electricity directly through a demand dispatch system, In the EU funded project MIRABEL. There, gamification mechanisms are applied in a demand dispatch system in order to achieve a more efficient energy management and to utilize a higher amount of renewable energy.

The fourth case study looks at a game called Energy battle. This case is very related to the PARENT project aims, as the main goal of the application is to reduce household electricity consumption through information provision, feedback on behaviour and rewards.

The fifth case iWOPI looks at combining intrinsic motivation for supporting good causes, crowd funding and fitness in one application. It displays that through creative means, different partners can be brought together to reach a their diverse

goals (funding for projects, improved company CSR profile and individual health and fitness).

Finally, the last case, Recyclebank looks at how to enhance pro-environmental behaviour with direct financial rewards. The Recyclebank focus is on making recycling more attractive by providing discounts at shops. As such, the instrument may not be innovative, but the additional features of adding both an online educational aspect and local activity aspect through sponsoring local schools enriches the app and makes it an interesting case.

All six cases have their unique features while sharing a mix of intrinsic and extrinsic values for motivation, feedback mechanisms, rewards and social engagement features. The following session gives a description of these cases while chapter 6 analyses the specific features with the aims to use these cases to provide learning and recommendations for the PARENT project virtual platform.

5.1 Eco driving and Gamification for the Auto Industry

Gamification in the auto industry focuses mainly on three main behavioural aspects. Firstly, gamified apps and initiatives are used for marketing and customer loyalty: encouraging people to buy and use their brand. Secondly, to encourage driving safety: reducing speeding and distracted behaviours, and thirdly for eco driving: using less fuel and better treatment of vehicle.²⁷

For this analysis, we will look at eco-driving mechanisms and look at how the industry uses gamification to encourage drivers to drive more environmentally responsibly. Currently, several car producers offer in-vehicle applications for various purposes of improve driving and improved use of a car. These include: Fiat EcoDrive,²⁸ Nissan Leaf,²⁹



²⁷ Diewald et al. 2013. Gamification-supported Exploration and Practicing for Automotive User Interfaces and Vehicle Functions. Munich. P.3. & Rodríguez et al. 2014. In-car Ambient Displays for Safety Driving Gamification. Oxaca. P. 26

²⁸ eco:Drive 2016.

²⁹ Badgeville. Gamification Wiki. Gamification of Environment 2016.

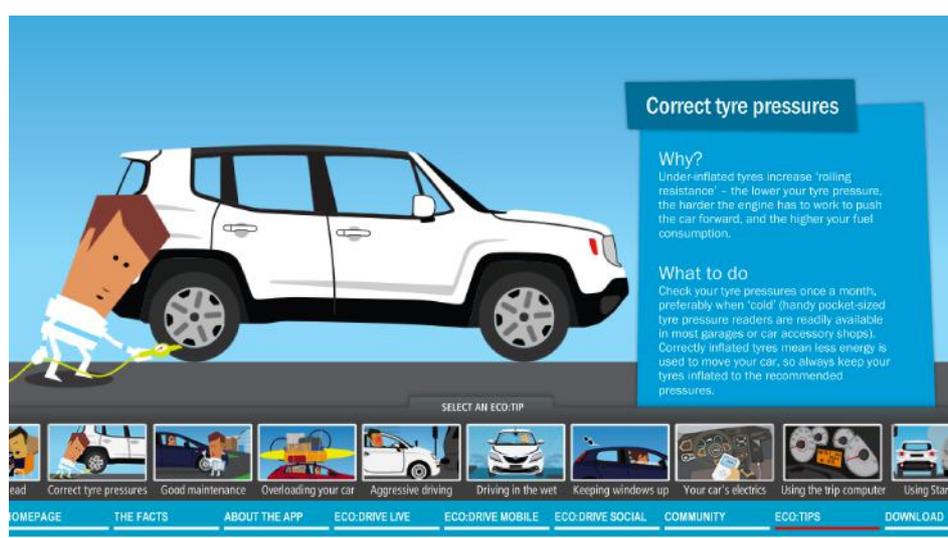
Ford Smart Gauge³⁰ and Renault eco driving.³¹ Additionally, smart phone apps that can be connected to your vehicle such as the Swedish STR EcoDriving Lite³², Energy Saving Trust's FuelGood App³³ and Garmin Mechanic with ecoRoute HD³⁴ are widespread on the market. These are either free, provided by public authorities as the first two, or for a small cost that the driver should be able to recover through fuel savings as the last example indicates.

5.1.1 Goals

The gamified applications have their own nuances, ways to assess driving and gamified aspects, but they share the common goal of sensitising the driver to become more aware of his or her driving, to reduce fuel usage and to lower their ecological footprint. Thus the main goal is to modify driver behaviour.

The reason for the gamified elements and in vehicle continued measuring of performance is to maintain interest and participation. Research shows that even when drivers are given training in eco driving, the improvement of changed behaviour deteriorates over time as drivers return to previous bad habits³⁵. The goal of these apps is therefore not only to educate drivers and create awareness of their way of driving, but also to maintain the practice over time. Drivers have been shown to respond favourably to in vehicle devices.³⁶

Figure 5-1 Fiat EcoDrive advice and hints for better performance



³⁰ Smart Design. Setting the bar high in a crowded market. 2016.

³¹ Renault. Eco Driving. Simple Principles before and during your trip. 2016.

³² The Swedish National Association of Driving Schools, STR. 2016.

³³ Energy Savings Trust UK. fuelGood App. 2016.

³⁴ Garmin. Garmin Mechanic with ecoRoute™ HD. Overview. 2016.

³⁵ Coroba Magana & Munoz-Organero. 2015. Using a gamification tool to save fuel. IEEE Intelligent Transport System 7 (2) P 2.

³⁶ Inbar et al. 2011. P. 2.

5.1.2 Expected practical outcomes

Again, the various tools have slightly different expected outcomes, the main focus of measurable impact being reduced fuel consumption. According to Magnana and Munoz-Organero “Adopting an efficient driving style, drivers can save up to 24% of fuel.”³⁷ However, the Fiat EcoDriver users reduced an average of 6% their fuel consumption and the top performers reached a 16% reduction.³⁸ Renault advertises an up to 10% reduction of fuel consumption.³⁹

5.1.3 Measurements and feedback

For most of these eco driving applications, there are general ways of driving that are considered to be more ecological, and these can be measured and added to the feedback mechanisms

- Speed – keeping a steady average speed
- Accelerating and breaking down slowly – smooth driving
- Shifting gears up properly
- Heater and air conditioner use
- Fuel consumption data

Some measurements are quite sophisticated and take into account location (urban/highway), weather conditions, traffic, etc.



Figure 5-2 Fiat EcoDrive star ranking for gear shifting



³⁷ Inbar et al. 2011. P. 2

³⁸ eco:Drive. 2010. Eco-driving uncovered. The benefits and challenges of eco-driving, based on the first study using real journey data. Fiat.

³⁹ Renault. Eco Driving. Simple Principles before and during your trip. 2016.

5.1.4 Gamification aspects

The level of gamification varies quite a bit. So does the richness/detail of information provided. The main tools are information, rewards and competition. From a small visual hint through growing and shrinking leaves depending on your performance (Nissan Leaf Eco Indicator & Ford's Smart gauge) or colour changes from red to green (Kia's eco driving), to real time feedback, tips and advise. Drivers get direct hints if they are breaking too fast or if they do a good steady acceleration they receive extra points. Pointes given range from stars, leaves, and even coins that then can be used in game for changing an avatar for instance. Most applications add a social element where drivers can compare with other drivers, via scoreboards, badges and social media sharing. There is also a possibility to set challenges for other drivers and compete directly (Fiat eco drive).

The gamification aspects address both intrinsic and extrinsic motivations. Persuasive gaming that provides useful information, changing attitude and encouraging reflection can boost intrinsic motivation.⁴⁰

On one hand a driver is inspired to improve his or her own performance and receives direct feedback. A driver that can compare similar or repeated trips can view his or her personal improvement over time and feel satisfied. The drive also can see directly an environmental impact in lower greenhouse gas emissions and can see a real financial saving. The social aspect allows for competition and comparison and allows drivers to build a reputation within their network of users. The tool also educates drivers through coaching, tips and feedback and drivers' ability to review their own performance. For hybrid or electric cars, drivers are able to optimise the range of their vehicles.

Figure 5-3 Fiat EcoDrive Social elements



⁴⁰ Ecker et al. 2011. EcoChallenge: A race for efficiency. Stockholm P. 91

5.1.5 Limitations

There are several limitations of an in-vehicle eco driving app, and some of these can be addressed through more detailed data collection for how location, weather and traffic affect efficiency possibilities. Other can be addressed through the visualisation design and the look. Simplifying complex data in a meaningful way is a key element in success of an eco driving application. In order for the social aspects to have an impact, a relatively large number of users need to participate. This gives a strong case to using car brand specific tools, since eventually all owners of the same car brand become players/competitors.

These are some of the limitations listed in literature:

- Driver distraction. The system needs to carefully select which features are the most important to display. It is key not to overcrowd drivers with visual stimuli while they drive.
- Limited gaming during driving. Gaming should not require actions from the driver during his or her drive apart from changes in e.g., speed or speed of breaking.
- Uncontrollable aspects that impact fuel efficiency, e.g., weather conditions, traffic, etc. can contribute to lack of accuracy.
- Different types of vehicles have different range for improvement. Older cars may have more room for improvement as newer may have inbuilt fuel saving features and in general may be more fuel efficient
- Relatively low economic impact of low level fuel saving.
- Resistance to follow - some people do not like being told what to do. If the design is in giving advise in obtrusive or patronising way, there may be higher resistance to adopt the system

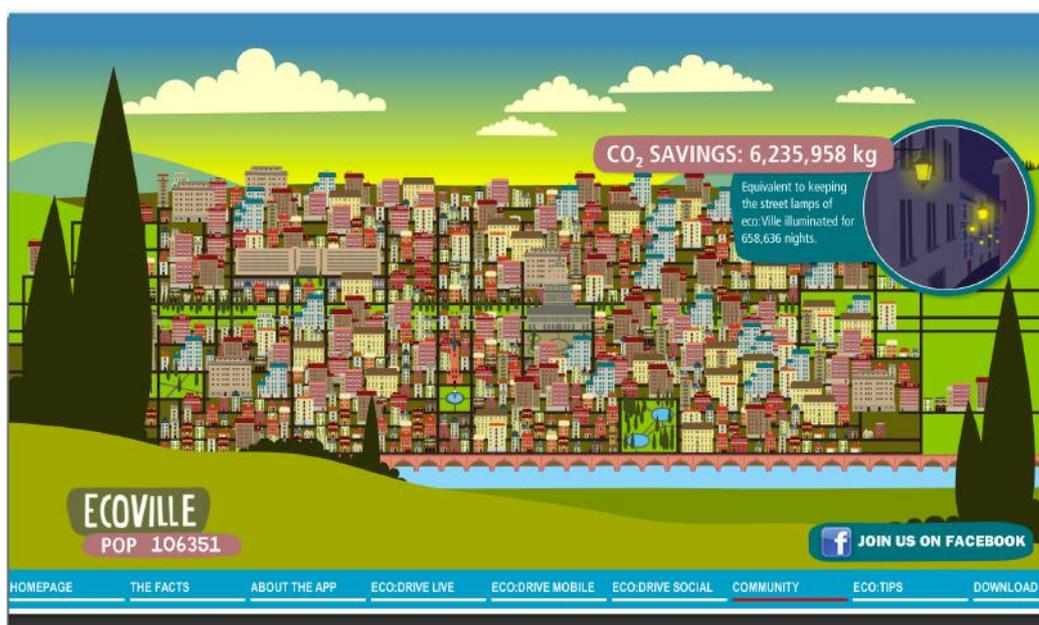
5.1.6 Further analysis: Fiat Eco drive⁴¹

For the matrix analysis, the Fiat Eco drive will be analysed. It has the broadest range of gamified features and Fiat conducted a study that provides useful results.

The Fiat Eco drive is an eco driving application that launched in Beta in 2008. **EcoDrive** is a free software co- developed by Microsoft and Fiat Automobiles Eco Drive live is built into the vehicle display. In 2008, the app worked only via usb stick that collected data that was then analysed afterwards. Currently the EcoDrive works with a smart phone connection and is installed in all Fiat cars.

⁴¹ eco:Drive. 2016

Figure 5-4 Fiat EcoDrive Social aspect- Ecoville



The EcoDrive features:

- It analyses trips based on acceleration, deceleration, gear changes or speed, and recommends changes.
 - Score ranges 1-5 stars for each of them, collected into an eco-index
 - Display shows red, orange, yellow or green for each 4 measures
 - It provides a real time feedback on the car dashboard or on the smart phone
 - It also memorises the results of your last efforts
- It grades a driver's driving technique on a 100-point scale, giving them their own eco:Index
- The application includes personalised tutorial and tips for improved driving. For example, it plays back a driver's least efficient trip and gives specific tips on how to better their performance
- The eco:Calculator calculates data for a group of trips, such as the total distance travelled, average fuel consumption, total CO₂ emitted and average eco:Index
- Driver can set his or her own eco:Index as a target and choose that start and the end point for the challenge

-
- The Fiat ecoDrive app also offers a solution for businesses owning a fleet of Fiat cars, to create an overview of the cars' usage and create internal ranking of drivers etc.

Eco:Drive Social

The EcoDrive application also offers a social part where a driver can log onto a platform, find friends and share with them their accomplishments. Drivers can also challenge each other, there is a leaderboard and badges. The social platform is called eco:Ville – where the online community represents every FIAT® 500 owner around the world using eco:Drive. On the platform, drivers can view the total CO2 reductions made by the whole community. The application is further analysed in section 6.2

5.2 Fitness and gamification

In fitness gamification apps, users employ gamification elements like scoreboards, competition between friends, awards and achievements to help them stay motivated to reach their personal health and fitness goals.⁴² Additionally, a large part of the motivation is to allow users to track their progress, to set their own targets and social sharing.

Fitness applications are extremely popular and abundantly available to users, often for free or partially free.⁴³ This market is rapidly growing and expected to continue to grow by over 30% in the next four years.⁴⁴ While many of these focus on running or cycling (Couch to 5K,⁴⁵ Zombies, Run!,⁴⁶ Strava Running and Cycling,⁴⁷ Endomondo,⁴⁸ Nike+ running⁴⁹), fitness apps can range from Pilates (Blogilates⁵⁰), yoga (Daily Yoga,⁵¹ Yoga Wake Up⁵²), weight lifting (StrongLifts 5x5⁵³) and to mixed

⁴² Wyie, J. 2014. Fitness Gamification: Concepts, Characteristics, and Applications. Elon University.

⁴³ Lister, Cameron et. Al. 2014. Just a Fad? Gamification in Health and Fitness Apps. JMIR Serious Games 2014 Vol2 (2) p1-2

⁴⁴ "Technavio's analysts forecast the global fitness app market to grow at a CAGR of 31.35% during the period 2016-2020" PR Newswire. Global fitness app. Market. Mar.01 2016.

⁴⁵ Couch to 5k. 2016.

⁴⁶ Zombies, run. 2016.

⁴⁷ Strava. The social network for athletes. 2016

⁴⁸ Endomondo. The personal trainer in your pocket. 2016.

⁴⁹ Nikeplus. Your best begins here. 2016.

⁵⁰ Blogilates. 2016.

⁵¹ Daily Yoga. Fitness on the go. 2016.

fitness programme, general exercises and tracking (S Health,⁵⁴ Sworkit, Fitnet, Nike+ Training Club, fitbit⁵⁵). Most of these applications are for free with optional in app purchases unlocking further material (video, levels, tracking systems).

5.2.1 Goals

The main goal is to improve fitness and wellbeing of user. For the above mentioned fitness applications on mobile devices or wristbands, the gamification goals are to get users motivated, trigger them to get started, to reward them for good behaviour and in some ways use social sharing to reward and nudge users to continue.

Using gadgets to track their own performance data supports users understand their own behaviour and habits and can give them self-insight and increase their self-control.⁵⁶ The users of these apps are already interested in improving their fitness, so in once sense there already exists some motivation and desire to use these apps and to improve level of fitness. This makes the role of the gamification less about convincing users to engage, but more about motivation to get started and to continue improving. Nonetheless there is a great variation between users. Many are active athletes that want to measure their progress, whereas some are beginners that may be joining to combat health issues or people who suffer from obesity and use these apps to monitor progress for health reasons. Therefore the app needs to offer flexibility, individual goal setting based on the user's level, and customised coaching.



5.2.2 Expected practical outcomes

The aims of these apps are to encourage fitter and healthier lifestyles as well as improved wellbeing through regular exercise and active engagement with the application. Thus, lasting behaviour change. For the makers, since many of these apps are free, are publicity of a brand and brand loyalty. Nike uses its applications to reach a large customer group and can directly market its products and services to its users. It also collects an enormous amount of user data given freely by users that can help the company for further branding or marketing. The Nike+ community is

⁵² Yoga Wake Up. 2016.

⁵³ Stronglifts. The simplest workout to get stronger. 2016.

⁵⁴ S health. Take the leap to better health and better you. 2016

⁵⁵ Fitbit. Take the next Big Step. 2016.

⁵⁶ Bildl, Stefan. 2014. Gamification of the Quantified Self. In Fun, Secure, Embedded: Advances in Embedded Interactive Systems. Technical Report Vol 2(3). EISLab Universitat Passau. P.5-9

approaching 30 million users in 190 countries.⁵⁷ For others, in application purchases to unlock videos (e.g., first video per trainer for free, second for 99 cents⁵⁸) or further material is the expectations of makers. The certified trainers often behind these apps such as the Yoga and Pilates applications provide a sample of their classes and those act as publicity for signing up for physical classes or other through other paid channels.

5.2.3 Measurements and feedback

Users benefit from direct feedback to their exercise programmes. They can monitor progress and receive reminders to exercise more.

Elements measured include (but vary from application to application)

- Distance
- Route (using GPS)
- Time spent exercising
- Videos or training programmes followed
- Sometimes manual input of food, sleep, exercise that is recalculated to the application unit
- Amount of steps taken
- Amount of time in resting position (sleeping pattern for wearable fitness bracelets)
- Calculation of calories burned/Nike fuel used/points scored. Based on application conversion from exercise data to system used.
- Manual data input to add information on workouts, eating or sleeping.

5.2.4 Gamification Aspects

- Tracking/analytics of various elements for progress helps users quantify their workouts and increases their awareness of their performance
 - o Speed, distance, conversion of the amount of exercise in units/Nike fuel/scores
 - o Frequency of activities
 - o Other factors e.g., eating, sleeping, and resting...



⁵⁷ Nike+ Fuel lab. 2016.

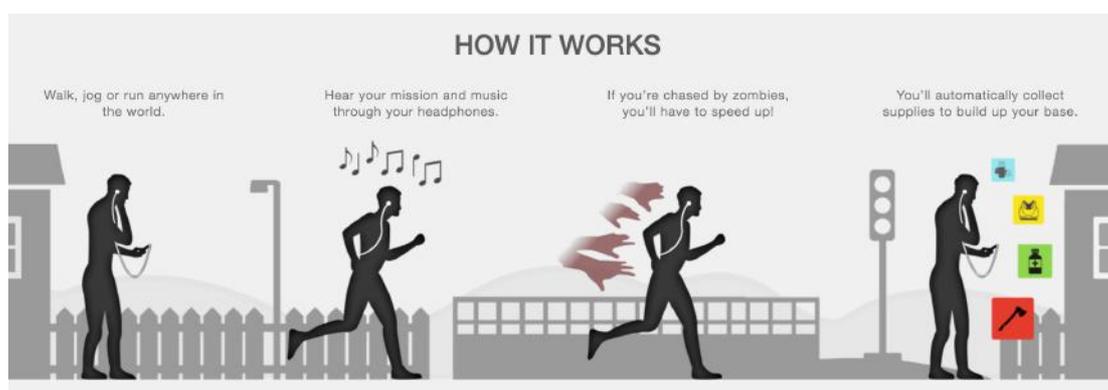
⁵⁸ Yoga Wake Up. Teachers Guide. 2016.

-
- Achievements can be tracked, levels, reputation, amount of badges, or goals completed
 - Metaphorical visualisation:⁵⁹ allowing users to see the impact of their work e.g.,
 - On geographical maps
 - As an animation/avatars (e.g., garden that grows the more the user moves, or fish tank with happy fish when exercised, and other users' fish are also visible).⁶⁰ Visual stimulation that may motivate user to continue exercising to allow his animated characters to survive/thrive
 - Real-time running or walking to chase away enemies or run away from them (wolves, zombies or other animated characters), running to collect supplies or points (also called exergames)
 - Information/Education: tips, training, coaching videos and personalised guidance based on goals set, feedback on progress
 - Goals: Users setting their own targets and goals, or alternatively, the gamification model setting goals based on data provided by user- becoming smarter over time the more data is input into the system
 - Nudges: reminders to move or follow exercise plan
 - Social incentives: online sharing of workouts via social media (Facebook or on app interface) in real time allowing friends to encourage you during or after you reach a new goal, badges and achievements. Users can add photos, quotes, tracking results or maps of their workout route
 - Community: web platforms, real life meet-ups between users, exclusive sports events, peer to peer encouragement, sending (motivational) messages to other friends who use the same application, forming teams to compete, or collaborate through mutual goals (shared accountability/rewards), to compare with friends and strangers, and 'being watched' (peer pressure)
 - Marketing of products: selling products, branding, belonging to a team through products and gadgets (for makers)
 - Connecting with music: connecting the application with a spotify account or iTunes allows users to select playlists for their workouts. In some cases playlists can be selected by the application

⁵⁹ Chen, Yu & Pu, Pearl. 2014. Healthy Together: Exploring Social Incentives for Mobile Fitness Applications. Swiss Federal Institute of Technology: Lausanne. P. 2-3.

⁶⁰ Lin. James et. Al. 2006. **Fish'n'Steps: encouraging physical activity with an interactive computer game.** UbiComp '06 Proceedings of the 8th international conference on Ubiquitous Computing. Springer-Verlag Berlin, Heidelberg p. 261-278

Figure 5-5 Zombie Run



<https://zombiesrungame.com/>

5.2.5 Limitations

These application and gamified programmes to stimulate users to exercise are quite nuanced and the variation of focus and applications available means that there should be an application out there fitting to any type of user. However, the applications are tools that help motivate and make more fun exercising. If an individual user is not interested, the applications will have no impact. So these will only reach users that are already motivated and want to exercise.

Another aspect to consider is the accuracy of energy/burning per session, although this does not seem to deter users, since the measurement methods remain constant so comparison is possible. Other concerns may include:

- Users hesitation to share their workouts on social media as not to over share or appropriateness
- Competition, sharing and even collaborating with strangers through an application might not suit all user groups.⁶¹ This is why some applications such as Nike+ allows users to choose their level of interactiveness with other Nike+ users, allowing those less inclined towards the social and community building aspects to nonetheless benefit from the other elements of the applications.
- Using only the individual tracking and motivation part of an application, a user may forget to pay attention to the app or lose interest over time, fall back into old habits or be 'too busy to take time for the workouts'. Whereas the social element, collaborative activities and the community aspects may

⁶¹ Ahtinen, A et. Al. 2009. Designing social features for mobile and ubiquitous wellness applications. MUM 2009 - Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia. Cambridge. ACM Press

help maintain motivation and avoid the 'novelty wear off effect'. Thus, a clever combination of the various gamification elements is needed to find a balance of personal motivation and group dynamics.⁶²

- In competition mode, it is important to pair together people with similar abilities. Competing with someone at a much higher or much lower level can be demotivating. With enough users of an application and good data collection, this can be solved.

"Through gamification, Quantified Self systems are not only useful, but also become enjoyable to use" "Quantified Self applications let users reflect on their own life" (Bildl)

5.2.6 Further analysis: Nike + Running / Nike+ Training Club

For the matrix analysis, the Nike+ applications will be analysed.

The Nike+ applications are downloaded for free onto smart phone or a partner device (e.g., iPod or iWatch). It connects with iTunes or Spotify and plays music to motivate running and improve performance. Nike+ running focuses on running and the Nike+ Training club acts more as a personal trainer providing a workout plan and coaching videos.

The Nike+ community apps have evolved quite a bit as when launched in 2006, Nike+ was a product tracking runners' performance using a wireless equipment to connect Nike running shoes with a sensor and an iPod music player.⁶³ Currently a gamified version no longer requires special sensors, but works with smart phones, Nike fuel wristband and apple products.⁶⁴



⁶² Chen & Pu. 2014. P. 7

⁶³ Poornikoo, Mehdi. 2014 Gamification: A Platform for transitioning from Goods-dominant logic to Service –dominant logic: Case of Nike+ Fuelband. Master Thesis Norwegian School of economics. Bergen

⁶⁴ "When you finish a run on the Nike+ Running App, your run information will automatically sync to your Nike+ account if you are connected to a wireless data network. The devices that require syncing data to your Nike+ account via Nike+ Connect include the Nike+ FuelBand SE, first generation FuelBand, Nike+ SportWatch GPS, Nike+ SportBand, Nike+ Basketball and Nike+ Training Sport Sensors, and Nike + iPod Running Sensors." Nikeplus. App and Device support. 2016.

The user adds some personal information (height weight and gender for starters), and decides on level of connectedness (if he/she wanted to join the online community and thereby participate in more of the gamified elements). The user can also choose a training programme through the application coach programme.

While running, the application tracks time, distance and pace, and provides feedback and collects personal records. It is possible to connect to music (iTunes or Spotify), take photographs during run and follow progress on map (using GPS of smart phone or other device used). Hence, the key primary features are to track one's individual workouts and compare results with previous runs for personal improvement.

When a user connects with the online community and starts sharing, more options for gamification open up, including

- a leader board ranking the users monthly distance versus their Nike+ Running friends
- Challenges where personalised goals can be set and friends can be invited to see who reaches the goal first (competition)⁶⁵
- Sharing a run on Facebook and receive feedback
- Smart playlist tuned to the speed of the running
- Options to receive encouragement from friends during run
- Badges for important milestones⁶⁶

The Nike+ Training Club has a similar setup, and links with Nike+ Running and the Nike Fuelband. It acts as a personal trainer, providing over 100 video workout programmes free of cost with guidance. The user sets a plan with the help of the application that can be adapted and revised based on the user's needs. The Nike+ Training club allows for user to manually add activities he or she has done in addition to the workout videos provided. As with the Nike+ running users can share their workouts with friends. Additionally, the Nike+ community organises real life events, training meet-ups with other users, exclusive running events etc. The community forum allows space for athletes to connect over shared goals. Users can post comments, likes, shares and flags and interact with other users, which can be a motivational factor.

⁶⁵ McDannald, Jim. 2016. Tech Trends: A deeper dive into the Nike+ running app. Competitor.com.

⁶⁶ Nikeplus Running App club. Your perfect running Partner. 2016.

5.3 Gamification in Demand Dispatch Systems

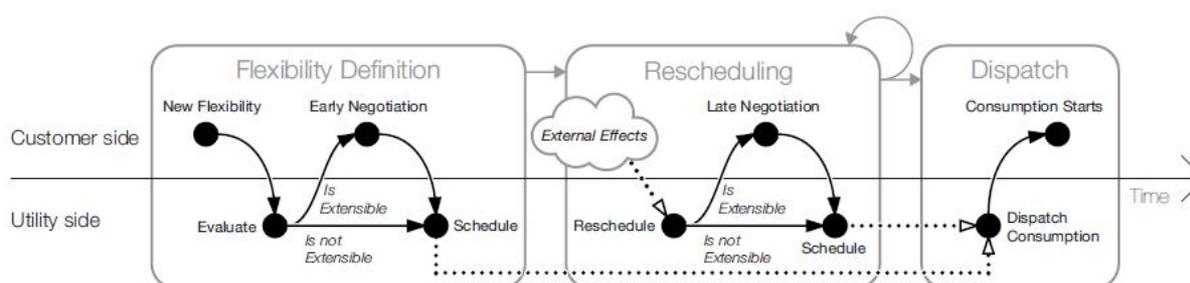
Active involvement of end-consumers in modern demand response systems is essential for optimizing the grid's efficiency and improving the utilization of Renewable Energy Sources (RES). For instance, in demand dispatch systems,⁶⁷ consumers can define their demand flexibilities and submit them to the utility side, which in turn maintains an execution schedule, under consideration of the most beneficial exertion of the demand flexibilities.

In order to achieve an active participation of end-consumers in demand dispatch systems, motivation techniques from the uprising research area of gamification are needed. Gamification utilizes the design patterns and dynamics of games to enrich user experience and to engage users in otherwise pragmatic products.⁶⁸

5.3.1 Aims

In the EU funded project MIRABEL,⁶⁹ gamification mechanisms have been applied in a demand dispatch system in order to achieve a more efficient energy management and to utilize a higher amount of RES. To allow the user to convey his/her consumption flexibilities to the electricity provider, communication links between the two are established through a mobile user interface. With this application users may define their flexibilities and manage already submitted ones. Furthermore, the interface allows the Balance Responsible Parties (BRP) to negotiate flexibilities with the consumer (see Figure 5-6). This becomes important when slight extensions of the flexible period are assumed to allow a far better grid optimization with the shiftable demand.

Figure 5-6 the life cycle of demand flexibility in the system



⁶⁷ Brooks, Alec, et al. 2010. Demand dispatch. IEEE Power and Energy Magazine 8.3 (2010): 20-29

⁶⁸ Seaborn and Fels. 2015.

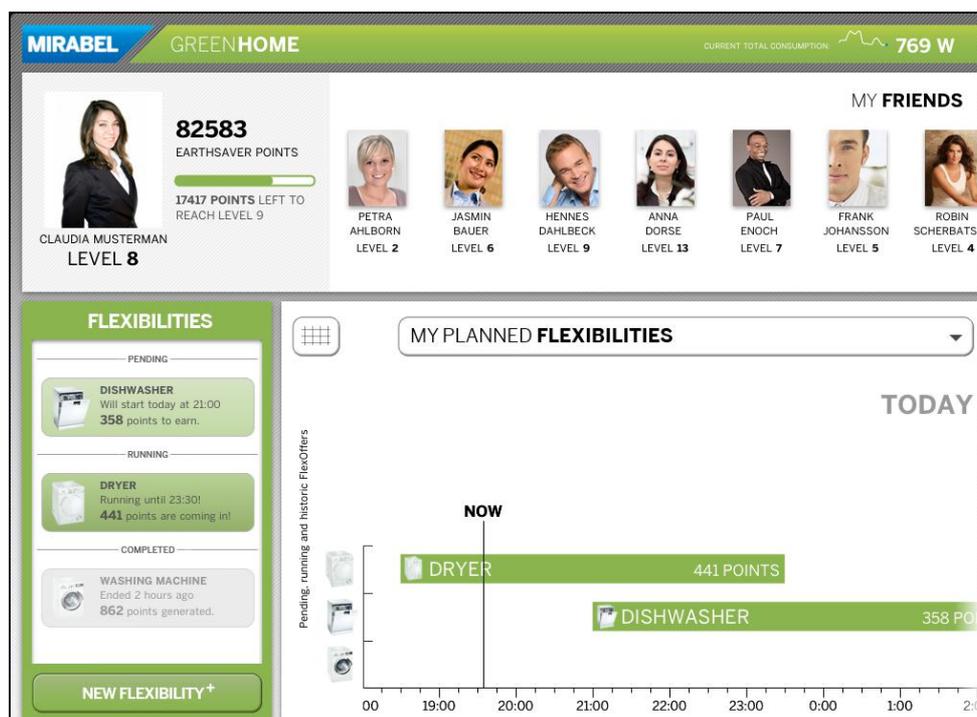
⁶⁹ Micro-Request-Based Aggregation, Forecasting and Scheduling of Energy Demand, Supply and Distribution (MRABEL), EU FP7 Project. <http://www.mirabel-project.eu/>.

5.3.2 Gamification elements:

The gamification techniques used to engage end-consumers in this project are characterized as follows:

- *Satisfying work*: The user experience of an interactive system greatly influences the motivation of its users. To take a positive effect on the user's engagement, especially on long-term, the system is designed to not only be perceived as useful or easy to use, but also enjoyable and exciting. This is achieved through an attractive user interface with stimulating visuals and exciting interaction concepts, as well as a high degree of usability. To obtain a single view on all major functions of the system, the main screen (see Figure 5-7) is split in three parts: *The game area* where the user's score, level and leaderboards are displayed, *the flexibility area* which presents the currently pending, running and historic demand flexibilities, and *the monitoring area* where charts on the historic consumption, a plan on the pending flexibilities or the predicted amount of renewable energy in the mix are displayed.
- *Experience of success*: To provide feedback, the system reward users' actions according to their effort and impact. This is established by a *scoring system*, rewarding submitted consumption flexibilities with so called EarthSaver Points (ESP). For each submitted flexibility, the consumer is rewarded a specific amount of ESP, dependent on its attributes and impact. This amount is determined by three major factors: i) *the direct impact* the dispatchable demand takes on the grid's balancing, ii) *the potential impact* the flexibility bears to cope with unforeseen effects (i.e., flexibilities with a higher length in time has a higher impact), and iii) *the energy efficiency* of the actual consumption (e.g., running the washing machine on 'eco-modes'). A *score function* is defined which takes the three factors into account.
- *Social connection*: To bring social aspects into the system and create a normative social influence on the user, consumers are able to compare their performance to the performance of: i) the average user, ii) their friends or neighbours, and/or iii) other people with a similar household size. The levels of selected friends can also be shown in the main screen (see Figure 5-7).
- *Meaning*: The essential background of a demand dispatch system is to optimize energy supply and demand for a better integration of renewables and less CO₂ emissions. These pro-environmental aspects are inherent throughout the product to create a meaning for one's participation in such a program, making the user part of a broad initiative towards ecologically aware behaviour.

Figure 5-7 Main screen of the user interface



As a coarse feedback on the user's overall performance, a *level* is assigned (see Figure 5-7), dependent on the ESP earned so far. When levelling up, certain external rewards can be given, such as low-cost items that are nonetheless valuable for the customer. To prevent motivation crowding, these rewards are held relatively small at first and increase in value when a level up occurs less often for the user. Additionally, each level is connected to a certain title that virtually describes the user's engagement in the system so far; such as "Consumption newbie", "Eco Hero", "Green Mastermind", among others. With each level, the amount of points to reach the next stage increases, so levelling up becomes harder in progressed stages.

5.3.3 Results

In a first user study, the system was evaluated regarding its usability and user experience. In Gnauk et al.,⁷⁰ the authors mention that the user interfaced was

⁷⁰ Gnauk, Benjamin, Lars Dannecker, and Martin Hahmann. 2012. Leveraging gamification in demand dispatch systems. Proceedings of the 2012 Joint EDBT/ICDT Workshops. ACM.

found appealing and easy to use by test participants and bears the potential of engaging the user in participation.

5.3.4 Limitations

- Though several electric appliances can be integrated with the demand dispatch system, their demand flexibility can be submitted only when they are included in the communication network.
- The system might essentially create some privacy risks of consumers' personal data and signals being transmitted. This data might reveal information about the occupancy patterns in households and their daily energy consumption behaviour and appliances usage. In view of this, some customers might be unwilling to communicate their data in real time.
- The effect of the gamification techniques used on changing the consumers' energy consumption behaviour on the long-term is not mentioned. *The energy efficiency* of the actual consumption is one of the parameters in the scoring function and it would be interesting to see how the role of this parameter on behaviour changes.

5.4 The Energy Battle

Generating the power necessary to run our future cities is one of the major concerns for scientists, societies and policy makers alike. Strategies are already being implemented to develop solutions for the efficient usage of energy at different levels. Involving citizens in the efficient planning and usage of energy is key.⁷¹ To achieve energy savings, more attention is being paid in the recent years to user behaviour in relation to product design, since it has a determining effect on energy consumption. Most people have a positive attitude towards saving energy. Positive attitudes to the behaviour however do not provide a clear prediction that the behaviour will actually be performed.⁷² Feedback information about energy consumption supports the development of knowledge and has proved to be an effective means to promote people energy-conscious behaviour. In order to be successful, feedback has to be given frequently, over a long period of time and

⁷¹ Verbong, Geert PJ, Sjouke Beemsterboer, and Frans Sengers. 2013. Smart grids or smart users? Involving users in developing a low carbon electricity economy. *Energy Policy*, 52 (2013): 117-125

⁷² Ölander, F. and Thøgersen, J. 1995. Understanding of consumer behaviour as a prerequisite for environmental protection. *Journal of Consumer Policy*, Vol. 18, No. 4, pp.345–385.

should enable users to see the consequences of their activities. Besides, feedback information should be presented in such a way that it motivates action. In a similar way, tips will only be effective when they help users to fulfil a goal. While feedback only gives information about the results of (energy saving) activities, tips provide knowledge about how to save energy.⁷³

The Energy Battle⁷⁴ is a game aims at encouraging households to save energy. The game was developed by Shifft, a communication consultancy in cooperation with students of the Faculty of Industrial Design Engineering, Delft University of Technology. It was initially tested with student households and focused on electricity consumption. The main goal is to explore which role the game and its elements play in facilitating energy saving behaviour.

The Energy Battle targets energy consumption in several ways:

- Providing general information about energy consumption of a household's electric devices.
- Making energy consumption visible via feedback.
- Rewarding energy savings during the game.

The participating households have to be provided with an energy meter and an access to an online platform. The energy meter provides a direct feedback on power consumption and stores the consumption data over time, which after uploading is displayed via the dashboard (see Figure 5-7). The players in Energy Battle are instructed to upload the data themselves. The online platform consisted of:

- A dashboard displaying electricity consumption over time; per day and per hour (Figure 5-8).
- Tips about electricity saving.
- Ranking of all the households.
- A game with building blocks (Figure 5-9).

⁷³ Geelen, D., Keyson, D., Boess, S. and Brezet, H. 2012. Exploring the use of a game to stimulate energy saving in households', *J. Design Research*, Vol. 10, Nos. 1/2, pp.102–120

⁷⁴ Geelen, Keyson, Boess, and Brezet. 2012.

Figure 5-8 Dashboard, electricity consumption over time



Figure 5-9 The Online building blocks game



By saving energy the households gain credits that can be used to buy building blocks. The more a household would save, the bigger and nicer a construction they would be able to build. The main goal of the game is to save as much energy as possible. A secondary goal is to build a nice construction with the building blocks. There are two prizes for households announced after a predefined period (e.g., four

weeks in the pilot initiated in student households), one for the household that saves most energy compared to the baseline measurement (i.e., the highest prize), and one for the household with the most creative construction in the online game would (e.g., dining vouchers). This creativity prize aims to stimulate playing the building blocks game on the online platform.⁷⁵

In the pilot in student households, the Energy Battle was executed in three phases:

1. Baseline measurement of two weeks. Two weeks before the start of the competition the energy meters were installed in the households to start measuring energy consumption. The inhabitants could not use the meter yet.
2. Competition during four weeks. At the start the participants received information about how to use the energy meter and how to log on to the website. During the competition the households received e-mails to further stimulate participation. After four weeks the two winners were announced.
3. Follow-up measurement. In the month after the competition, the energy meter remained in the household for follow-up measurement to monitor the levels of energy consumption after the competition.

Twenty households (teams) in the City of Rotterdam, the Netherlands participated in the game. The households consisted of two to five persons and were located in three different buildings of a housing association. An online questionnaire held by the organizers directly after the pilot. In addition, complementary interviews were held, since the questionnaire did not provide a deep insight about motivation and ability, nor long-term effects.⁷⁶ The research questions which were considered for the Energy Battle and the answers of respondents were as follows:

1. What are the motivating factors for participating in the Energy Battle?

Both the prizes and the energy savings were important reasons for participation. In the complementary interviews another reason was mentioned: "curiosity for learning about energy consumption in the home". Another team was only interested in winning. This team was among the households that saved the most electricity.

2. How much saving would be achieved during the Energy Battle?

The average amount of savings in electricity use of all participating households was 24%, with the highest being 45%. Figure 5-10 shows the amount of saving per household. Figure 5-11 shows the amount of electricity

⁷⁵ Geelen, Keyson, Boess and Brezet. 2012.

⁷⁶ Geelen, Keyson, Boess and Brezet. 2012.

consumption per person per day for each household before (baseline) and during the Energy Battle.

Figure 5-10 Amount of savings (%), relative to baseline measurement

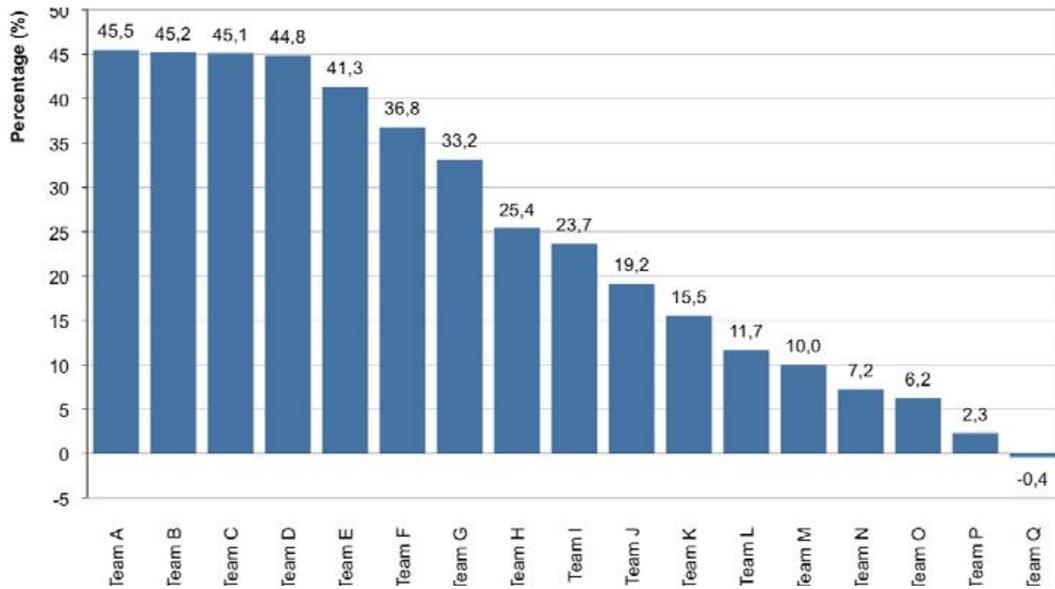
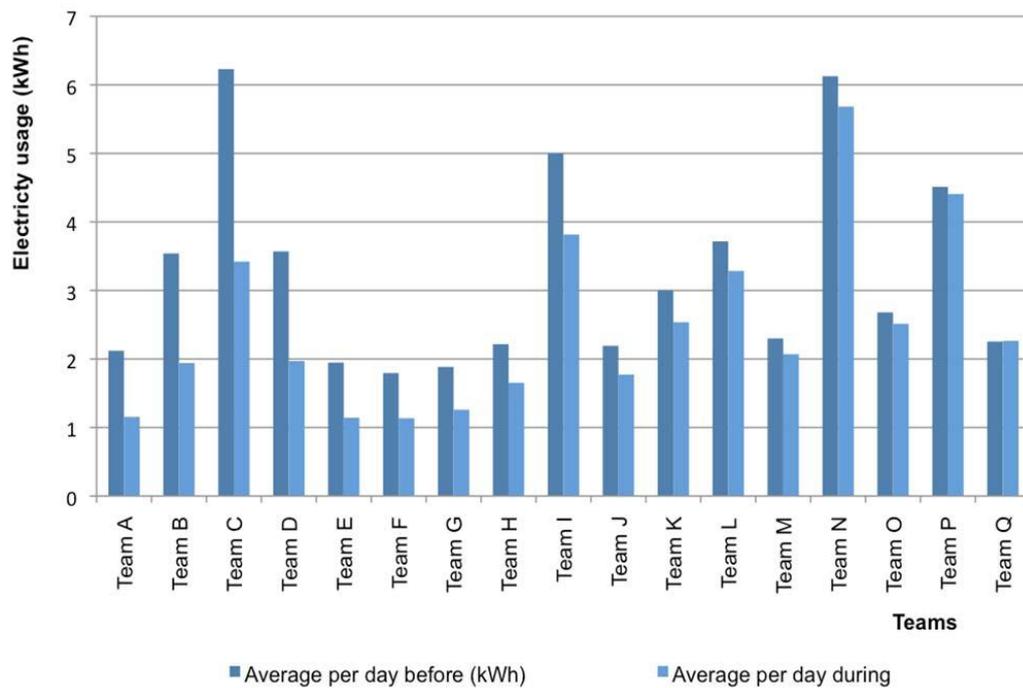


Figure 5-11 Energy Consumption per person/day before and during the Energy battle



a. What activities for saving behaviour would be developed by the teams?

Table 5-1 lists the activities the households had done to save energy and the amount of energy saving achieved. The social activities that lead to energy saving is especially interesting. Respondents reported to eat together thus cooking in one batch instead of each housemate separately. They also reported that they avoided being at home to avoid using electricity.

Table 5-1 Energy saving measures

	Missing*	<0%	0%– 15%	15%– 30%	30%– 46%	Total
Lights (turning off/saving bulbs)	1	1	2	3	7	14
Cooking/kettle	1	0	1	0	4	6
Media (less PC or less TV)	1	0	1	3	2	7
Social activities	0	0	0	0	2	2
No standby/unplug	0	0	0	0	4	4
Turn off refrigerator	0	0	1	0	1	2
Personal care	0	0	0	0	1	1
Total respondents	1	1	2	3	8	15

*Measurement data was not available for this team

3. What role would the specific game elements serve in the motivating and in enabling increased energy saving behaviour?

The main Energy Battle game elements are: direct feedback, feedback over time, tips, prizes, ranking, game with building blocks and teamwork.⁷⁷

- *Energy meter - direct feedback:* As mentioned before, the energy meter provides a direct feedback on the power consumed by electric devices and appliances. The respondents reported that the direct feedback of the meter provided insight and motivated to use less electricity.
- *Dashboard - feedback over time:* The respondents on the one hand said it has been very useful. On the other hand, there were teams that

⁷⁷ Geelen, Keyson, Boess and Brezet. 2012.

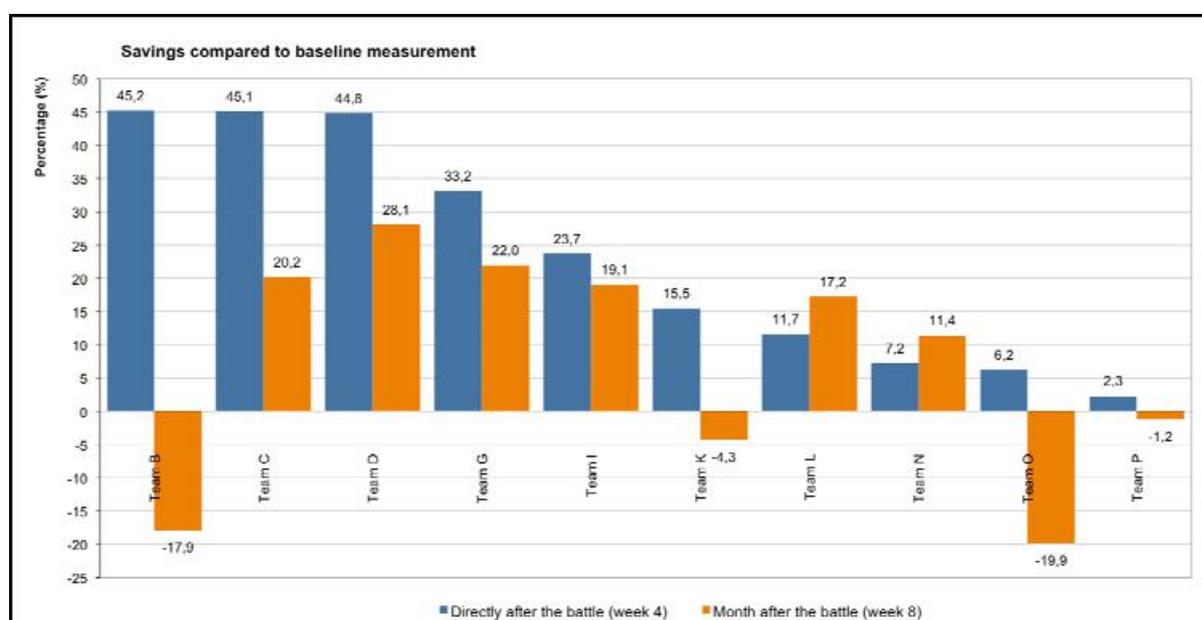
had problems with uploading the information and as a result could not use the information.

- Tips: The responses to the questionnaire suggest that the tips contributed to higher energy savings, because the respondents stated that the tips were useful for saving energy were from households that saved more than 30%.
- Prizes: Some households reported that winning the prize was the main reason to keep on going; others were mainly interested in gaining more insight in energy consumption and saving energy.
- Ranking: According to the responses to the questionnaire, teams who were not able to win anymore because of their place in the ranking lost motivation to save energy. There were also households that did not pay a lot of attention to the ranking since they were only interested how their own household could save energy.
- Game with building blocks: The questionnaire results indicated that the building blocks game was challenging and motivating to save energy. However, the interviews didn't confirm the findings of the questionnaire: The building blocks game was *"not really important. We wanted the other prize, but we won on this element"* (said respondent 2 whose team won the originality prize for nicest construction). Respondent 1 stated: *"...especially in the beginning, we had very little points so we could not really build something. So it was not a motivator"*.
- Teamwork: The questionnaire did not address teamwork as a factor that influences the energy saving activities in the Energy Battle. The team of respondent 2, which finished second in the ranking, had agreed to eat together and not to use more than one computer at a time. Housemates thus had to coordinate computer use. The also stimulated each other to turn off the lights. Teamwork could also include agreements about not being at home. According to respondent 2, and to her annoyance, the members of the winning team were hardly at home. In other teams, agreements were not made explicitly. The team would simply start and discuss their individual findings with each other (respondent 1 and 3). Discussion with the other team members was considered useful: *"The best about the Energy Battle was that we were consciously talking about it. Although we did not work on it together so much"*. (due to different working hours) (respondent 3).

4. If people change their behaviour, would it be sustained following the completion of the game?

Directly after the Energy Battle, the energy meter remained in the households for a month. Figure 5-12 shows the relative energy savings after one month. Unfortunately, these data could not be retrieved for all the teams. Two teams continued to lower their electricity consumption (team L and N). In four of the ten monitored households, electricity consumption rose, but still remained below the level of before Energy Battle. Two households (team K and P) have a difference in electricity consumption level before and after the game of less than 5%. Finally, two teams (B and O) use more electricity than before the Energy Battle.⁷⁸

Figure 5-12 Energy saving directly after and 1 month after Energy Battle compared to baseline (%)



5.4.1 Limits

The Energy Battle main limitations and some directions for future work:

The last questions describe the main challenge of the Energy Battle game. It is essential to know to what extent behaviour changes would be maintained after completion of the Energy Battle. Further research is required to understand long-term implications for an Energy Battle game. It would also be interesting to explore the possibility of playing the game can continuously on the long term, providing a periodic prizes at every pre-defined periodic period.

⁷⁸ Geelen, Keyson, Boess and Brezet. 2012.

Another challenge in the Energy Battle game is that it requires that households should upload their energy consumption data to the online platform to be included in the ranking of the competition. This task is quite challenging. The results showed that some households did not upload their data; either because they were not able to upload it or they had lost interest in participating.

In addition, the responses to the questionnaire provided an insight into the trade-off between energy saving activities and users' comfort. Most respondents indicated that they had done more to save energy than they found acceptable for comfortable living. This issue should be given a serious consideration in the any virtual energy advisor that implements gamification mechanisms.

5.5 iWOPI Crowd funding for non-profit

iWOPI⁷⁹ is social community where members can donate the kilometres covered doing sports or simply walking to a charitable cause, choosing among the causes available in the community.

Causes are created by non-profit organizations and are supported usually by a company that is sponsoring the cause. This model helps both the non-profit organization and the sponsor company to increase the visibility of a cause, and to promote the corporate social responsibility (CSR) activities of a company. Indeed, the power of the community is the viral phenomenon of the cause and the individual contribution through social networks, such as Facebook and/or Twitter. The online community engagement contributes to reach more people and to get an organic promotion for the causes and the brands.

5.5.1 Goals

iWOPI's solution aims to obtain financing for a proposed project by a non-profit organization, with the support of a community.

- Community members can support a charitable cause without spending their own money, just by generating "noise" to attract the interest of sponsor companies. When the number of members willing to donate kilometres to a cause is considerable, sponsors are more likely to support that cause, and convert kilometres into money.

⁷⁹ iWopi. Donate your miles, change the world. 2016.

-
- The non-profit organizations increase their visibility as the number of people supporting their causes increase thanks to social networks and iWOPI's platform. This fact increases the chances and facilitates obtaining a sponsor.
 - Companies use iWOPI as a vehicle to develop actions of Corporate Social Responsibility, Human Resources, Communication and Marketing.

5.5.2 Measurement and feedback

Indicators:

User Engagement:

- Number of active users
- Donated Kilometres combined (12,558,945 km so far)

Non-profit and sponsor interest:

- Number of current and total causes (86 causes launched since the beginning of the project)
- Ratio new causes/month
- Funding achieved

Feedback

The app informs users in the community of their own individual contribution to a cause, it also includes a ranking of the users that have contributed the more, in kilometres.

5.5.3 Gamification aspects

iWOPI's gamification solution consists of providing objectives that foster the motivation of doing sports and displaying the users' contribution in ranking. The ranking mechanism boosts the peer pressure as the user is encouraged to be among the members that donate the most. This factor raises the engagement to the application.

5.5.4 Limitations

The number of users' metric has a key importance in this project. The solution is communication, marketing channel and also a way to achieve visibility for the sponsors. The causes are interesting to them only if they mobilize a large number of users. Small causes can have difficulties to find financing. This model will only work if a critical amount of users is reached.

5.6 Recyclebank

Recyclebank⁸⁰ is a program that seeks to encourage citizens to recycle and to enhance their education on greening behaviour by offering them tangible rewards. Points can be earned by recycling, by being more energy efficient, by filling out quizzes, by playing “green” games, and by interacting with educational articles on environmental protection. The obtained points can then be used to score coupons or gift certificates.⁸¹

Gamification is applied in the field of sustainability to motivate pro-environmental actions, behaviour and habits. Gamification techniques try to increase the motivation by providing performance feedback (i.e. energy saved or kg. of garbage recycled) or by using rewards.

- Performance feedback or eco-feedback is based on the hypothesis that most people lack understanding about how their everyday behaviours affect the environment. Therefore, feedback or information about the consequences of their behaviours may bridge this gap. However, eco-feedback is not only about solving an information gap problem, but also a motivational one.⁸²
- Rewards are used in gamification to increase the mobile-app engagement. The explicit incentives categories adopted in environmental gamification are both tangible and intangible.
 - Tangible rewards: points that can be converted to discount to buy products or in donations to social causes are the key motivator of Recyclebank.
 - Intangible rewards are based on satisfying users’ self-realization need: this kind of need is satisfied by motivating the user with badges and profile status when goals are reached.

5.6.1 Goals

Recyclebank’s solution aims to increase waste recycling by motivating individuals to implement and maintain green behaviours and habits. Positive recycling actions are rewarded with tangible incentives such as product discounts and special offers in some local or national shops like Wal-Mart and Best Buy.

⁸⁰ Recyclebank. Recycling will save you money. Yes, seriously. 2016.

⁸¹ Freebiefindingmom.com. 2016

⁸² Froehlich, 2015.

Recyclebank's mission is "to motivate individuals and communities to realize a world in which nothing is wasted—changing how people view their role in creating a sustainable future."⁸³

The way that Recyclebank attempts to influence behaviour change is through education on ecological issues. People receive points not only for using a recycling container, but also for attending short recycling lessons online, and by participating in games and quizzes. Information creates a change towards green-attitudes, the activator of stable green habits, while tangible rewards are calls to action and facilitators to achieve an easy and quick behavioural change.

5.6.2 Expected practical outcomes

The impact of Recyclebank is measured by the metrics of recycling rate and number of points allocated.

The UK Department for Environment report: Local Authority Waste Management Statistics for England, revealed in 2011-2012 statistics showing that recycling performance in England has increased by 1.5 %, from 41.5 % to 43 %.⁸⁴

Recyclebank communities, on the other hand, continue to exceed the current trend. This is the case of the Royal Borough of Windsor & Maidenhead, which had an increase of 12.5% over last year. As well as, the Halton Borough Council, which has also outperformed by five times that national average increasing by 14%.⁸⁵

Points can be donated to schools to fund student projects across the country. Since 2007, Recyclebank's Green Schools program has granted close to \$350,000 to more than 100 schools.⁸⁶

5.6.3 Measures and feedbacks

- Kg of waste recycled
- Points earned at recycling
- Points earned by following lessons
- Live Green: a collection of articles about environment and recycling

5.6.4 Gamification aspects

The social motivation to increase the community's recycling ratio is the intangible incentive provided by the solution.

⁸³ Kanani, 2011.

⁸⁴ UK Department for Environment, 2012.

⁸⁵ Recyclebank, U.K. Recyclebank Communities Increase Recycling Levels Three Times Faster than National Average, 2012.

⁸⁶ Recyclebank, Member Donation Period for Recyclebank Green Schools Program Enters Final Two Weeks, 2012.

Points are given to the user depending on their interaction with the solution:

- Green actions: The user receives points for taking part to a large number of interactive features like quizzes, lesson or slideshows.
- Recycling actions: users that are part of a community where the Recyclebank is operated, get points for recycling. Containers measure the weight of the waste recycled, so that, the user can be rewarded with points in relation to the amount of waste recycled.
- Using points: Points can be exchanged to get discounts in Recyclebank online store, local and national stores or companies wanting to promote their social responsibility (i.e. Walt Disney)

5.6.5 Limitations

- A clear limitation is that providing a tangible award implies a good commercial structure to identify a significant volume of businesses disposed to promote themselves in exchange for discounts.
- Specific recycling actions are limited to pilot communities; the project is not scalable as it needs the installation of a considerable distribution of special containers.
- Earning points with lessons and slide show may increase users' knowledge, but this does not translate necessarily to habit changes or greener behaviours. An important effort should be done in changing attitudes that are more predictive of a behavioural change.

6 Evaluation Matrix of Gamification

6.1 Structure and development of the matrix

In order to further evaluate, analyse and compare the six case studies, we developed a descriptive matrix that includes the key issues of gamification for the apps. The fields were selected based on literature review, and the previous sections of this report where key gamification mechanisms and good practices have been identified. Based on the goals of the PARENT project, its goals and current format, we further selected fields particularly relevant to address.

The matrix fields are divided into five major categories:

1. Game characteristics
2. Game aims and goals
3. Game mechanics
4. Game measurements
5. Game challenges and limitations

The first category; characteristics, aims to explain the gamification elements, why it was developed (to address what issues) and how it works. The second looks at motivations (intrinsic and extrinsic), the target group the game addresses and the desired outcome. The third category; game mechanics looks at the more technical aspects of which gamification elements are used and how. It asks whether the design takes into account factors deemed important in previous sections, such as competition/collaboration, time frame, user centeredness and technical feasibility. The game measurements category describes how results are measured and how success defined and monitored. Finally, the fifth category looks at limitations and challenges that have been reported for each case study.

By breaking down each case study and looking more in depth at how it was developed, for what purpose, and which mechanics are applied, we get a better look at the individual features. Based on the case study description and furthermore the matrix breakdown, we are able extract and to develop recommendations for the PARENT project Virtual platform. We will take the features that have proven to work and see how they can be adapted to the parent VEA.

6.2 Fiat EcoDrive

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used? (information, challenges, incentives, motivations, fear, physical real live actions required/virtual)
ecoDrive - Fiat eco driving application	An eco driving application that launched in Beta in 2008. Then using a usb stick to collect data. At this time all data could only be accessed after the drive. A social element was added. Then a connection with a smart phone for direct feedback. The Fiat ecoDrive app also offers a solution for businesses owning a fleet of Fiat cars, to create an overview of the cars' usage and create internal ranking of drivers etc.	Fiat is considered a general eco friendly brand. By adding an eco driving gamification in their vehicles they improve their reputation and provide their customers with a tool that can help them save fuel- and thus reduce their CO2 impact. Motivated through personal improvement and a community ranking	Data is analysed and based on that, drivers are given a score. This score is the main gamification feature. There are also personal tips relating to the type of roads a driver uses (urban/rural/highways). Users can set their own goals. Then there is the social part, where fiat drivers link with a community and share their scores for ranking through a leader board. Users can challenge other users for reach their own score. Online reward system is also implemented
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	aims of game/ desired outcome	Motivation tools (intrinsic, extrinsic, competitive, collaborative, incentives, punishments, community)
Fuel efficiency and customer loyalty - changing driver behaviour	Fiat car drivers. Ecologically aware - people interested in eco driving and fuel efficiency	16% fuel reduction, strong Fiat community	Mix of tools (see game design): main focus on intrinsic- personal improvement, learning, being better for the environment and the car owned. Social element as incentive, leader board to enhance competitiveness and badges to earn reputation. The community consist of over 100.000 users

Core Values targeted /benefits for users		Incentives used	Benefit or added value for user?
Ecological behaviour, treating your car better, money saving from enhanced fuel efficiency. Focus on win-win situations,		leaderboard, badges- certifying good deeds, social reputation, virtual recognition. Internal motivation	money saving, a good feeling
Game mechanics (how does the gamification work)			
General	Game design/ game mechanics : key actions & control mechanisms used to gamify	Gaming elements: individual or collective	goal of gamification elements
Data is collected based on 4 different factors and efficiency is calculated as well as fuel savings. Users see their results in percentage and how well they perform with the goal to improve. 1. Early gear changes 2. Smooth Acceleration 3. Efficient Deceleration 4. Steady average speed	1. Track your progress: marks driving technique from 1-100% - 2. tutorials to improve eco driving skills - 3. Set your own targets or challenges - 4. compare your trips- possibility to view trips over time (time, distance and cost of each trip - CO2 emission and fuel consumption) - 5. Community aspects- join community to see overall achievements - 6. Badges based on your progress 7. share your results via social media - 8. earn credits - 9. create a profile - share activities, connect with others	All 3. main focus is on individual improvement and performance. Secondly to compete and reach high on leader board. Finally on community page- the eco village, there is a display of total CO2 saved by all users and the number of "inhabitants"	customer satisfaction with Fiat, improved sense of community with brand, fuel efficiency and emission reduction

Does it allow for sub grouping within game	Is it competitive? Collaborative?	Does it encourage player to support each other	Time frame of game
<p>Yes, there is the Fiat Fleet option - a corporate version to improve fuel efficiency of company fleets. Fleet manager can view company's fleet up to date info online- use, km, fuel consumption and co2.</p> <p>For individual users, they have their profile and can connect with friends- earn badges and compare within their group</p>	<p>All- see previous</p>	<p>Not particularly- It encourages players to challenge each other to improve performance</p>	<p>long term. For vehicle lifetime</p>
Technical feasibility (effort vs. Impact, how hard is it to make)		Is it user centred?	
<p>Relatively complex data collection, but algorithm's already established. Has been in development over years with beta version in use in 2008.</p>	<p>Users can set their own targets and goals. Users can not make amendments or change parameters</p>		
Game measurements (how do you measure effectiveness of gaming elements)			
How is effectiveness measured?	How does it Monitor player motivation?	How does it plan for longevity? (
<p>Improved Eco driving performance (1. Early gear changes, 2. Smooth Acceleration, 3. Efficient Deceleration, 4. Steady average speed). CO2 reduction- fuel consumption, learning curve of users to improve driving (most improvements in first 10 days), number of users in community, activities of community</p>	<p>driving behaviour, badges collected, activity in community,</p>	<p>In 2008 the Eco Driving started as a usb application and now uses smart phones to provide real time feedback. The application is adapting to new technological possibilities. To maintain user interest is not clear apart from gamified features mentioned above</p>	

Feedback mechanisms	Feedback content:	Feedback timing: direct or over time
Direct feedback to driving (e.g. Direct scoring for how fast you accelerate or stop), Facebook page is not up to date, neither is website.	tips and tutorials available for users to learn and improve	direct with smart phone
Challenges and limitations		
General	Main limitation of gamification	main challenges to participation, engagement continuation, motivation...
Lack of evolution of application may be a challenge. However if drivers feel the benefit of ecodriving, learning has taken place and turned into a habit, no further incentives may be needed for this long term behaviour change	the game credits can not be used for anything in real life. Need to connect with other users to maintain interest in community aspects. Does not evolve with users, accuracy of data?	Need to be fiat driver, once driving has improved (after around 10 days), additional benefits are small, apart from maintaining a good score

6.3 Nike+ Running

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used?
Nike + Community (Including Nike+ Running & Nike+ Training Club)	Nike+ Running and Nike+ Training Club are fitness applications using mainly smart phones and an online community. Main focus is on tracking performance, getting fit and staying in shape with help of information on progress, coaching training and social elements.	Nike has a large market share in the sport and fitness market. By providing this free service to users (over 30 million), the company can collect data on its customer group, create branding and loyalty. Also, with more athletic people, there is a larger market for selling products and services.	<ol style="list-style-type: none"> 1. Tracking of individual performance, increasing user awareness and interest in improving 2. Possibility to share progress with others and receive encouragement 3. gamification of competition, setting goals in groups, getting badges, staying motivated 4. Learning, through coaching, training videos and guidance users become better at their sport
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	Aims of game/ desired outcome	Motivation tools
To improve health and fitness. To teach and encourage users to get fit and stay fit/improve. Company goal is customer loyalty, branding, expanding customer base	Runners, athletes, people who want to work out. Since the levels are broad, exercises range in difficulty as well as challenges, anyone who has any interest in working out, but need a bit of structure, or wants for monitor themselves is a target user. Especially relevant for the quantified self group that wants to gather information about themselves	Improved health and fitness, improved awareness on health and fitness, regular workouts. (customer loyalty)	<ol style="list-style-type: none"> 1. Intrinsic: feel good of exercising, getting fitter & stronger, learning, self monitoring, online reputation, community participation (sense of belonging to a group) - 2. Extrinsic: social sharing of results, positive feedback, rewards in leader board & badges,

Core Values targeted /benefits for users	Incentives used	Benefit or added value for user?	
health, being a part of a team, becoming more aware of your own physical health	leader board, badges, positive feedback, social sharing incentives, reaching goals	increased health, fitness and reputation through sharing with friends	
Game mechanics (how does the gamification work)			
General	Game design/ game mechanics key actions & control mechanisms used to gamify	Gaming elements: individual or collective	Goal of gamification elements
Data collection for Nike+ Running includes distance, speed and pace. For Nike+ training club, it is based on how many videos are completed in how much time (to provide recommendations for next steps. Annual data is also collected on age/height/weight(level of fitness and users can add manually workouts not caught by apps	<ol style="list-style-type: none"> 1. Data sharing. Users see their performance directly and can see over time their personal improvements 2. Training and guidance. The applications set up training programmes, either creating a running plan (Nike+ running), or through the coaches who set up a workout plan (Nike+ training club). 3. Goals and targets - users set their own goals and reach them, either individually or through social gaming 4. sharing progress with friends on social media and through apps- receiving encouragement, 5. Leader boards, goal set and friends compete who reaches those goals first, setting up of teams 	Both, mostly individual, compete against themselves, or compete against friends. Being a part of the Nike+ club does bring in a sense of community with some real life events and internal encouragement between users, and organising collective running programmes or plans allows for some collective feelings	Regular visits over long time, higher performance, improved fitness, increased awareness and better exercising

Does it allow for sub grouping within game?	Is it competitive? Collaborative?	Does it encourage player to support each other	Time frame of game
yes, a group of friends can set a goal and compete, or alternatively plan a run and conduct at same time. Not specifically made for teams but some teamwork is possible	Mostly individual, with feedback from community. The social sharing allows for some collaborative feedbacks and encouragement.	yes, through the social incentives and sharing	long term, it aims to encourage healthy fit lifestyle that includes regular exercising
Technical feasibility		Is it user centred?	
The large user group allows for a lot of different levels and programmes as well as data collection. Managing such a highly used application and community must require high effort.		Yes users are encouraged to set own goals, and provide personal data to allow application to calculate and recommend programmes	
Game measurements (how do you measure effectiveness of gaming elements)			
How is effectiveness measured?	How does it Monitor player motivation?	How does it plan for longevity?	
As one of the most popular fitness application the Nike+ community continuously grows.. number of users, total km's run total number of videos viewed, number of users online at a time, return rate, increased sales of Nike products through app?	distance run, time spent on app, levels reached, overall engagement with application and social aspects. E.g. Number of runs/workouts shared on social media	The Nike+ community has already evolved much since 2006 when running was the only feature. Now there is also Nike+ Training club, Nike+ Skateboarding, Nike+ Fuel band and the evolution reaches also to offline events. Intensity and levels are available. There is constant possibilities for improvement in running and fitness	

Feedback mechanisms	Feedback content	Feedback timing
peer- to peer feedback. Online community, support email	In app coaching videos and training, advise, direct feedback on performance how far how much Nike fuel burned, how fast. Nudges and reminders to go work out. Voice highlighting milestones as you pass them in real-time. Direct option for sharing results online. High level of feedback	direct
Challenges and limitations		
General	Main limitation of gamification	main challenges to participation, engagement continuation, motivation...
Generally these applications meet their targets and can be considered successful	not a high level of collaborative tasks or efforts. Individualist focus. Incentives remain online, not useable offline. Risk of users coming off as smug when posting too frequently on social media their achievements	Users need to be self motivated to exercise

6.4 Demand Dispatch Systems

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used?
Gamification in a <i>demand dispatch</i> system.	Consumers can define and submit their demand flexibilities, and the execution of their requests can be scheduled within the given flexibilities. The final goal is to optimize the grid's efficiency and improve the utilization of Renewable Energy Sources (RES).	To achieve an active participation and engagement of consumers in the demand dispatch system.	Attractive user interface with stimulating visuals and exciting interaction concepts, as well as a high degree of usability.
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	aims of game/ desired outcome	Motivation tools
To achieve an active participation of consumers in the demand dispatch system.	Electricity consumers in the residential sector.	To enrich user experience and engage and many consumers as possible in the demand dispatch system. The ultimate goal of the electricity provider is to optimize the grid's efficiency and improve the utilization of RES.	<ul style="list-style-type: none"> • A scoring function (intrinsic). • A level for the user's overall performance (intrinsic). • Rewards depending on the user's level (extrinsic). • A title to describe the user's engagement in the system (intrinsic). • Competition through social connection.

Core Values targeted /benefits for users	Incentives used	Benefit or added value for user?	
Pro-environment meaning due to the impact of demand dispatch in improving the penetration of renewable energy sources and reducing CO2 emissions.	Levels, titles, scores and external rewards depending on users' level can be given, such as low-cost items.	1. Making the user part of a broad initiative towards ecologically aware behaviour. 2. Tracking of its own energy consumption performance. 3. Rewards.	
Game mechanics (how does the gamification work)			
General	Game design/ game mechanics: key actions & control mechanisms used to gamify	Gaming elements: individual or collective	goal of gamification elements
The interactions between consumers and the electricity provider are done through a communication link and a mobile user interface. In this application, consumers define their flexibilities, manage already submitted ones, receive feedback, check titles and scores, follow other consumers, among others.	<ul style="list-style-type: none"> • A scoring function determined by three factors: i) the direct impact the dispatchable demand takes on the grid's balancing, ii) the potential impact the flexibility bears to cope with unforeseen effects, and iii) the energy efficiency of the actual consumption. • A level for the user's overall performance. • Rewards depending on the user's level. • A title to describe the user's engagement in the system. 	<p>Individual: A competition between households to get a higher a higher level, title, a reward.</p> <p>Collective: The higher the number of the engaged households, the higher the final benefits that can be achieved (optimizing the grid's efficiency and improving the utilization of RES).</p>	Frequent visit, information collection, enhance knowledge, improve understanding.

Does it allow for sub grouping within game?	Is it competitive? Collaborative?	Does it encourage user to support other	Time frame of game
Yes, a group of households can set a goal and compete.	Competitive through the social connection and comparison of own performance with other consumers.	No.	The game is played every time a consumer wants to submit its demands flexibilities. The interaction and feedback of the system appears on different level: an estimation of the score, an immediate feedback, and an overall aggregated score of the user.
Technical feasibility		Is it user centred?	
Applied using a mobile user interface and communication links between the user and the electricity provider.		Yes, consumers decide to participate and submit their flexibilities, to change them, or to extend them.	
Game measurements (how do you measure effectiveness of gaming elements)			
How is effectiveness measured?	How does it Monitor player motivation?	How does it plan for longevity?	
- Engagement level (represented by the number of participating consumers), number of appliances connected per household, titles achieved, and scores collected.	Through a data management system, a two-ways communication link, and an interactive mobile user interface.	The pilot was applied in student households, and seen as a means to provide input towards a next version of Energy Battle aimed at families with children, while also including electricity, gas and water consumption.	

Feedback mechanisms	Feedback content	Feedback timing
scores, advise,	<ul style="list-style-type: none"> • An estimation of the score the anticipated flexibility would earn. • If the performance could have been better (i.e. extension possibilities exist), it is indicated immediately in the early negotiation and the possibility to 'try again' is provided by the given extension options. • An immediate feedback of the score gained. 	Direct.
Challenges and limitations		
Main limitation of gamification		main challenges to participation, engagement continuation, motivation...
<ul style="list-style-type: none"> • Though several electric appliances can be integrated with the demand dispatch system, their demand flexibility can be submitted only when they are included in the communication network. • The system might essentially create some privacy risks of consumers' personal data and signals being transmitted. This data might reveal information about the occupancy patterns in households and their daily energy consumption behaviour and appliances usage. In view of this, some customers might be unwilling to communicate their data in real time. • The effect of the gamification techniques used on changing the consumers' energy consumption behaviour on the long-term is not mentioned. 		<ul style="list-style-type: none"> • Motivating consumers to continuously submit their flexibilities without annoying them. • Engaging as many consumers as possible. • Dealing with negotiations with users to extend/change their submitted flexibility.

6.5 Energy Battle

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used?
The Energy Battle	The Energy Battle is developed by Shiftt, a communication consultancy in cooperation with students of the Faculty of Industrial Design Engineering, Delft University of Technology. The game is initially tested with student households and focused on electricity consumption.	The goal of the game is to explore which role the game and its elements play in facilitating energy saving behaviour.	information displayed in a smart meter, online dashboard displaying electricity consumption, an online building blocks game.
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	Aims of game/ desired outcome	Motivation tools
The Energy Battle game aims at encouraging households to save energy.	Electricity consumers in the residential sector (could also target gas and water consumers).	<ul style="list-style-type: none"> • Increase energy saving. • Change consumers energy consumption behaviour. 	Both: Intrinsic: Participation in energy saving, ranking, knowledge. Extrinsic: Direct feedback, feedback over time, tips, prizes, game with building blocks and teamwork.

Core values targeted /benefits for users	Incentives used	Benefit or added value for user?	
Pro-environment meaning due to the impact of energy saving.	Ranking and prizes.	<ul style="list-style-type: none"> • Prizes. • Tracking of its own energy consumption performance. • Being a part of a broad initiative towards energy saving. 	
Game mechanics (how does the gamification work)			
General	Game design/ game mechanics: key actions & control mechanisms used to gamify	Gaming elements: individual or collective	Goal of gamification elements
<p>The participating households are provided with an energy meter and access to an online platform. The energy meter provides a direct feedback on power consumption and stores data on the consumption over time, which after uploading is displayed via the dashboard. The online platform consisted of:</p> <ul style="list-style-type: none"> • ‘dashboard’ displaying electricity consumption over time; per day and per hour. • Tips about electricity saving. • Ranking of all the teams. • A game with building blocks. 	<ul style="list-style-type: none"> • Providing general information about energy consumption of household devices. • Making energy consumption visible via feedback. • Rewarding energy savings during the game. • A game with building blocks: By saving energy the households can gain credits that could be used to buy building blocks. The more a team would save, the bigger and nicer a construction they were able to build. • The main goal of the game is to save as much energy as possible. A secondary goal is to build a nice construction with the building blocks. The team that saves most energy compared to the baseline measurement would win a prize. The team with the most creative construction in the online game would also win a second prize. 	<p>Cooperation between household members and a <i>competition</i> with other households to save energy.</p>	<p>Information collection, improved understanding, enhancing knowledge, higher performance, energy consumption behaviour change.</p>

Does it allow for sub grouping within game?	Is it competitive? Collaborative?	Does it encourage user to support other	Time frame of game
Yes, a group of households can set a goal and compete.	Cooperation between household members and a <i>competition</i> with other households to save energy.	Only inside the household itself via "teamwork".	The game is played as long as the smart meter is connected, the data is uploaded, and the households are willing to participate and save energy. In the pilot, the game has been played for four weeks, but it could be played always and the prizes could be given periodically.
Technical feasibility		Is it user centred?	
Smart meters + ability of households to upload their measurement data to an online platform in order to be included in the ranking of the competition.		Yes, consumers decide the way of energy saving (social activities, appliances turn-off, cooking, media, lights) and to provide the measurement data.	
Game measurements (how do you measure effectiveness of gaming elements)			
How is effectiveness measured?	How does it Monitor player motivation?		How does it plan for longevity?
Engagement of households, frequency of consumption measurement data upload, savings achieved.	Via a 'dashboard' displaying electricity consumption over time; per day and per hour. Via monitoring the construction they households are able to build in the building block game.		The system has been achieved as a part of a EU funded FP7 project.
Feedback mechanisms		Feedback timing	
The energy meter provides a direct feedback on power consumption. The dashboard provides feedback about electricity consumption over time. The tips that helps households to discover how to save energy.		Both direct and over time.	

Challenges and limitations	
Main limitation of gamification	main challenges to participation, engagement continuation, motivation...
<ul style="list-style-type: none"> • The main challenge is to know to what extent behaviour changes would be maintained after completion of the Energy Battle. Further research is required to understand long-term implications for an Energy Battle game. • In addition, the responses to the questionnaire provided an insight into the trade-off between energy saving activities and users' comfort. Most respondents indicated that they had done more to save energy than they found acceptable for comfortable living. 	<ul style="list-style-type: none"> • Engaging as many households as possible. • Helping and motivating households to continuously uploading their stored data on the consumption over time.

6.6 IWOPi

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used?
IWopi (www.iwopi.org)	IWopi is social community where members can donate the kilometres covered doing sports or simply walking to a charitable cause, choosing among the causes available in the community. Causes are created by non-profit organizations and are supported usually by a sponsor company.	Increase the participation of community members in order to generate a critical number of active audience of social responsibility marketing campaigns	<ul style="list-style-type: none"> - Physical real life actions are required (running, walking, biking, swimming). - Contribute to charity causes may increase the motivation to perform real life actions - The rankings provide high level motivation in the Maslow's hierarchy of needs (Self esteem needs) and peer pressure
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	Aims of game	Motivation tools
<ul style="list-style-type: none"> • Community members can support a charitable cause. When the number of members willing to donate kilometres to a cause is significant, sponsors are more likely to support that cause, and to convert kms to money. • The non profit organizations have a visibility increase as the number of people supporting their causes can grow • Companies use iWOPI as a vehicle to HR Resources, Communication and Marketing. 	<ul style="list-style-type: none"> • Users: sports people • Sponsor: Large companies with CSR department • Non-profit companies 	To obtain financing for a project proposed by a non-profit organization, with the support of a community.	<ul style="list-style-type: none"> Intrinsic: supporting a charity while increasing personal health Extrinsic: social sharing of performance, company CSR records. Community/ charity (collaborative) Consumption goals (collaborative) Rankings (competitive)

PARENT is an initiative of [JPI Urban Europe](#)

Core Values targeted /benefits for users	Incentives used	Benefit or added value for user?	
Health and solidarity	Notification to the users, when a cause is achieved.	Contributing to cause in his own community (or neighbourhood). Viralize the cause to users' friends	
Game mechanics (how does the gamification work)			
General	Game design/ game mechanics: key actions & control mechanisms used to gamify	Gaming elements: individual or collective	Goal of gamification elements
Community members choose a cause among those available in the app. He/she can donate kilometres by using the app when they are running, walking or cycling, while the mobile GPS system of the smartphone or the watch measure the km. The accumulated kilometres of all the members of the community taking part to the cause are added and when a goal number of km is reached the sponsor gives funds for that cause. Cause status and description can be shared in the social media to spread the impact of the user actions and achievements.	<ul style="list-style-type: none"> • individual contribution in km to the cause • community overall contribution to the cause • contribution ranking 	Individual: Score Collective: Score and ranking	Engagement and use of the social network to viralize the communication and to increase the users' number.
Does it allow for sub grouping within game?	Is it competitive? Collaborative?	Encouraging user to support other	Time frame of game
Team that includes the employees of a company can be created. Iwopi has been used by companies to promote healthy behaviours and social responsibility among the employees.	Collaborative (donate or contribute to a cause) and competitive (ranking)	No.	It can be used every time a community member walks or do other sports

Technical feasibility		Is it user centred?	
Technically it is not a difficult app to develop, the challenge is to engage users and get new users		Goals (the causes) can set by a company or a non-profit organization. The user can choose among a large range of options	
Game measurements (how do you measure effectiveness of gaming elements)			
How is effectiveness measured?		How does it Monitor player motivation?	How does it plan for longevity?
Users Engagement: • Number of active users • Donated Kilometres (12.558.945 km so far) Non-profit and sponsor interest: • Number of current and total causes (86 causes launched since the beginning of the project) • Ratio new causes/month • Funding achieved		GPS System	There is a continuous rotation of new causes and new sponsors
Feedback content		Feedback timing	
The app informs users on the community and his own contribution to a cause, including ranking of the users that have contributed with more kms.		Direct on application for kms donated, and once a cause is supported	
Challenges and limitations			
Main limitation of gamification		Main challenges to participation, engagement continuation	
The number of users' metrics has a key importance in this project. Causes are interesting for users only if they mobilize a large amount of users. Small causes can have difficulties to find financing. This model should work only if a critical amount of users is reached		<ul style="list-style-type: none"> • Marketing and communication in the social networks increase awareness and reinforce the participation of the community member • To have a continuous rotation of sponsors and new causes 	

6.7 Recyclebank

Game Characteristics (what does it do?)			
Name of case	General	The concept of this gamification and why it is implemented	Interface design: what are the game elements used?
Recyclebank	Recyclebank solution aims to increase wastes' recycling by motivating individuals to implement and maintain green behaviours and habits. Positive recycling actions are rewarded with tangible incentives consisting in discounts and special offers in a list of local or national shops like Wal-Mart and Best Buy.	Boost a real life action (recycling) with tangible award is the easiest and quickest way to get short-term results. The problem is that without a change on the attitudes that behaviour may not be sustainable over time	<ul style="list-style-type: none"> • information • Quiz • Physical actions (recycling)
Game aims, goals, issues addressed (what does the game want to achieve, how does it go about it)			
General	Target group	Aims of game	Motivation tools
The game wants to boost short term recycling behaviours, as to a recycling action corresponds a tangible rewards. Long-term behaviours are incentivised by improving knowledge and positive attitudes using the online-lessons and quizzes	Any citizen capable to use an informatics support. Also schools are the a targeted group	To provide learning, change behaviour and increase recycling	Intrinsic: making the world better & less waste. Mostly extrinsic: Tangible incentives, economic discounts /savings
Core Values targeted /benefits for users	Incentives used	Benefit or added value for user?	
Environment protection, frugality	Exchange points for buying or getting discounts in products and services	Increased knowledge and positive attitude towards environment protection. Material (physical) rewards. Financing schools in the neighbourhood	

Game mechanics (how does the gamification work)			
General	Game design/ game mechanics	Gaming elements: individual or collective	Goal of gamification elements
Points are assigned if the user: <ul style="list-style-type: none"> • recycles in the appropriate container (only available in the cities where the project is running) • reads online lessons on recycling • successfully complete online quizzes The points accumulated can be exchanged to acquire products and services	Points and quizzes, tangible incentives	Individual: number of points Collectives: donate points to beneficial causes	To stimulate the recycling' increasing, to educate on recycling issues
Does it allow for sub grouping within game?	Is it competitive? Collaborative?	Does it encourage player to support each other	Time frame of game
No	Individual: the more an individual recycles, the more is rewarded. Collective: an individual can donate the points earned to a beneficial cause	No.	long term behaviour change
Technical feasibility		Is it user centred?	
It does not seem to present developing troubles. The barriers are to create a network of businesses disposed to sell discounted products or exchange products for points		There are no specific goals. Earn more points to get more tangible rewards	

Game measurements (how do you measure effectiveness of gaming elements)		
How is effectiveness measured?	How does it Monitor player motivation?	How does it plan for longevity?
<ul style="list-style-type: none"> • Kg of recycled waste • Points earned at recycling • Points earned by following lessons • Live Green: number of articles about environment and recycling read 	User engagement, participation in online activities, points collected. Grants given to schools	New shops or business offering new products or services. Continuous offers and new discounts. Targeting schools
Feedback mechanisms	Feedback timing	
Feedbacks are focused on encouraging the gaining of new points.	Direct when new offers or content arrive and when points are collected	
Challenges and limitations		
Main limitation of gamification	Main challenges to participation, engagement continuation, motivation...	
<ul style="list-style-type: none"> • A clear limitation is that providing a tangible award implies a good commercial structure to identify a significant volume of business disposed to promote themselves in exchange for discounts. • Specific recycling actions are limited to pilot communities, the project is not well scalable as needs the installation of a widespread distribution of special containers. • Earning points with lessons and slide show may increase users knowledge, but this do not translate necessarily to habit changes or green behaviours. An important effort should be spent in changing attitudes that are more predictive of a behavioural change. 	<ul style="list-style-type: none"> • Marketing and communication in social networks increase the awareness and reinforce the participation of the community members • To have a continuous rotation of products and services offered 	

7 Recommendations for PARENT- Conclusions

Chapters 2, 3 and 4 in this report give an overview of features that are being applied in gamification, addressing values and motivations, designs and elements in game design as well as general recommendations of what to consider when developing a gamified application. The six case studies in chapter 5 give a practical description of how gamification is implemented in real life in a successful way, and chapter 6 allows us to analyse these cases further with the matrix.

Therefore, it may be said that this whole report is a recommendation on how to apply gamification in abstract and in practical terms. In this final section we draw together these lessons learned and aim to create a summary list of key aspects that should be taken into consideration when developing the VEA for the PARENT project platform. This list along with the whole report should be taken into consideration when developing the PARENT gamification strategies (project Task 4.4) and when developing the platform itself.

For the PARENT project there are several specifics that need to be addressed. For instance the availability of technical data, the different type of data available in each of the four participating cities, as well as the different user groups in each city. Task 4.4 will focus on balancing the needs for having separate goals and tools in each city with the technical feasibility and resources available to create the VEA and its gamification elements. Below are the key recommendations that we suggest are further analysed and developed in task 4.4.

7.1 Game aims, goals motivation and values

Firstly, it is important to analyse why the application is created, what are its goals. Additionally to have a clear idea of what values and motivations the gamification targets. All six cases depend on a combination of intrinsic motivation (self realization, self esteem) and extrinsic motivation (savings and tangible prizes, peer pressure, social reputation, charity).

Intrinsic motivation can lead to long-term habit change. The VEA, like most of the cases analysed, does appeal to the intrinsic motivation for user (environmental benefit, personal improvement, learning, reputation among community of users, social participation, doing the right thing). This should be taken into account when combining with extrinsic motivational tools. Knowledge and attitudes change through information sharing (e.g. bite sized, easy to do solutions) and role models

can facilitate this process even if in the studied cases there is no evidence of measured long-term behaviour change.

Extrinsic motivation can serve as a trigger and accelerator to get people on board, and to adopt a new behaviour.

7.2 Game characteristics and mechanics

7.2.1 Visualising results

The fitness applications, eco driving apps and the demand dispatch apps all put a large emphasis into allowing users to get a good visualization of their status, results and progress. The figures need to be meaningful. KWH may be a logical measurement to show on the VEA, but it might be more easily understood in euros saved, or CO2 saved, or even points earned from savings. Also having progress measured in the way of a graph growing over time, or even a garden blooming with each new goal achieved can be motivational. General considerations when creating visual information:

- Clearly defined metrics – that are explained to the user
- Clear information on how progress is visualized over time
- Easy to understand figures and images
- Attractive looking
- Information designed to increase basic knowledge about the user's behaviour over time
- User friendly design, for various types of electronic devices

7.2.2 Learning Opportunities

The gamified application should contribute not only to entertaining and engaging the user, but also enable learning. Both in learning about themselves, how their behaviour evolves over time, and in learning about the subject. In the case of the VEA, learning how to use electricity more responsibly, and why. The cases analysed use different methods for knowledge sharing these include:

- Tips, hints, pop-ups with titbits of information
- Tutorials and videos
- Self- monitoring data
- Usage, performance data
- Information on events or workshops in the local area (or online links)
- Access to real life tutors/trainers

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- The most inspiring features of Recyclebank that can be adopted by the VEA, are on-line lessons, games and quizzes. Rewarding the readings of energy efficiency articles and content generation in the forum could increase the engagement and the learning motivation.

7.2.3 User centred and goal setting

The ability for a user to set his or her own goals is key when a target group is diverse. Some users may already have installed most electricity saving devices and will need to do relatively big measures to have an impact on their usage, or alternatively may focus on reaching more members on the VEA, whereas others may have a number of small simple measures that they can reach. It may also be overwhelming to start the VEA if too many goals and targets are present. Creating small attainable goals can help individuals begin new behaviours

This is important to also plan for longer-term participation that users can set their own higher and higher targets over time.

A user should also have some ability to personalise his or her account – thereby creating ownership and connection with that account. In some applications an avatar can be created. However, the technical burden should be kept at minimum.

7.2.4 Social sharing

All of the solutions analysed offer the possibility of share the results on social media. In addition to applying peer pressure (when one friend goes running, you feel like you should go running too, or since you went running 3 times last week, you need to show you are doing at least the same this week) & reputation (people admiring that you saved so much CO₂ by driving responsibly), it also brings people together. Instead of feeling alone in reducing energy consumption, you get that feeling that you are not alone making impact- you belong to a team of change makers and together there is a chance for real impact. Additionally, when users become enthusiastic about what they are doing, they want to share their results and receive feedback from their communities

A VEA target typology study is needed to determine if this feature is a priority. Perhaps it is less interesting to share a goal reached within VEA on Facebook or twitter, but it might be very relevant to share among other users of the VEA, locally or at the European level. Thus, adding a social sharing element to the online platform itself.

7.2.5 Teamwork - Peer organised competitions and collaborations

Peer pressure can increase the engagement to the application. As seen in Nike+, Eco:Drive, iWopi and Energy Battle, peer collaboration or competitions is an effective trigger to behaviour change and brings short terms results. This element is related to the social sharing, but yet a level higher. This ability to provide peer pressure and peer support via competitions and collaborative tasks has much potential. In many of the cases analysed, users are able to instigate and invite their peers, friends or defined groups (e.g. their company, or family) to a task or a challenge. These may be set up so that the best one wins, or in a way that the team wins, pulling collectively figures. If for instance together they manage to save a certain amount of electricity, or complete a certain amount of energy saving tasks, they can receive a collective reward (badge or real life reward)

7.2.6 Incentives

Linked with extrinsic motivation, the gamification elements should offer incentives for players to play and to continue playing. This is key in getting engagement of users. These can be online, or external incentives. The social sharing and reputation serves as an incentive to play, but there are more game mechanics available. In order to define which incentive scheme the VEA should apply, some testing needs to be done as well as technical feasibility taken into account

Common online incentive tools:

- Scoring functions and points, bonus scores for reaching targets
- Badges, leaderboards, trophies
- Levels and ranks
- Prices for updating an avatar or online layout/design
- Competition and comparison with other households, online rewards and titles

Recyclebank IWOPi and Energy Battle offer tangible rewards. In IWOPi money is collected for charities, and in the Recyclebank people receive discount on products. The efficacy of this kind of prize is unquestionable as leads to goals and behaviour changes very quickly. The problem is that the behaviour change may not be sustainable the tangible awards are removed

Further suggestions for external incentives based on cases:

- financial saving, possible point or credits that could in theory be used in real life
- 'eco points' could give lower insurance cost, electricity cost refunds, small tax incentives

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- VEA could produce a local currency or real incentives from local authorities to be used to purchase things from within community or local shops
 - The same model could be applied in the VEA, as in IWOPI: allowing the community members to contribute to a charity cause with the saved kWh.

7.2.7 Other aspects to keep in mind when designing the game mechanics:

- Clear objectives of the game
- Understanding the target group(s)
- Technical definitions (clear rules)
- User friendliness and design
- Time frame of game
- Technical feasibility
- Manual input vs. automatic
- Evaluation of system
- Installation of reminders, pushes and nudges to keep users on target

7.3 Game measurements and feedback

7.3.1 Measuring impact

The effect of the gamification techniques used on changing the consumers' energy consumption behaviour should be measured on the short and long terms. Usability and user experience should also be evaluated periodically. The project should have a concrete plan on how exactly to define and measure the VEA's performance, especially over time and allow this metric to be used for developing improvements tot the system

7.3.2 Defining metrics

There are several options available for defining metrics as listed in the general considerations (chapter 4). Since actual electricity savings might be challenging to accurately measure, user engagement, targets set, number of social shares, challenges solved etc. might provide for a better indicator of the user appreciation and effectiveness of the VEA. Depending on the technical feasibility, these will be further defined in task 4.4.

7.3.3 User feedback

Frequency of feedback should be designed carefully according to participants' preferences (urgent notifications, a daily report and tips, a weekly or monthly newsletter, etc.).

Direct feedback systems are observed in all the cases analysed. The users motivation increases if the feedback is tailored to the user. General tips are also available, but personalized feedbacks and rewards based on a user's actions or status reinforces the engagement

Similar to the demand dispatch system, real-time interaction with the VEA is expected to give a better engagement and a higher energy saving results. It is essential to consider in the gamification design how behaviour changes would be maintained after completion of project (long-term implications).

7.3.4 Further Technical specifications

The VEA should allow for an automatic upload of the energy consumption data, and solar PV production data in case of prosumers. One challenge of the Energy Battle game is that it required households to upload their energy consumption data to the online platform in order to be included in the ranking of the competition, which might be a barrier for user participation.

7.3.5 Privacy and Personal data

Privacy issues of personal data should be clearly communicated to participants and users of the VEA from the outset.

7.4 Game challenges and limitations

7.4.1 Data

In the residential field it is impossible to adopt an objective and a universally accepted method to calculate the energy savings. The difference between the consumption of a given month and the consumption of the same month of the previous year (the mainly applied criterion), presents some intrinsic problems related with data quality:

- Irregular dates range: is often incorrect to compare historical data derivate from invoices to the current month consumption due to the irregular range of the invoices dates. It is common that the billing dates do not correspond to natural months. Therefore, it is necessary to extrapolate the historical monthly consumption, obtaining estimated values.

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- Estimated consumption in invoices: In some cases, invoices do not represent the actual consumption, as they may contain estimated values.

The lack of quality in historical data makes the savings' estimations unreliable, and for this reason, rewarding the savings with tangible incentives may not be the right solution. However, a rewarding intangible system is applicable to VEA, giving users the opportunity to earn points and badges for achieving the savings' goals.

In addition to historical data issues, the quality of data collected can vary from pilot to pilot including:

- Availability of accessing homogenous data across 4 participating cities
- Accuracy of data collected
- Technical challenges of sub metering devices and internet connection
- Access to data
- Different target groups of participating cities (prosumers, active green conscious groups vs. low interest in environment groups, different age groups, different climates and housing)

7.4.2 Privacy

The system might essentially create some privacy risks of consumers' personal data and signals being transmitted. This data might reveal information about the occupancy patterns in households and their daily energy consumption behaviour. In view of this, some customers might be unwilling to communicate their data in real-time. This issue should be clear and discussed with the participants from the beginning. This issue can be addressed by maximising security options and transparent communication with users from the outset.

7.4.3 Loss of interest over time

As with the eco:Driving app, there may come a time when there is a lack of escalation - once a driver knows eco driving there is little scope for additional improvement. The same applies to the VEA: once the main electricity reductions have been achieved, the goal for the user is to continue low use/high performance. Maintaining interest in the VEA may become challenging. This is where community elements may prove most useful in keeping users active.

Additionally, the trade-off between energy saving activities and users' comfort should be carefully considered. Most respondents in the Energy Battle indicated that they had done more to save energy than they found acceptable for comfortable living, which might affect the long-term engagement.

7.4.4 Potentially low scope for improvement

The low impact of saving is a common problem seen in the cases. This decrease the longevity of the solutions if exclusively based on rewarding usage reduction. Depending on the user group, where some are already low electricity consumers, the actual savings resulting from participating in the VEA may be relatively low. Access to information on usage may be enough to keep users motivated, or receiving incentives for non- direct electricity saving actions, such as enlisting new members or participating in community challenges.

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