EnerGAware
Energy Game for Awareness of energy efficiency in social housing communities

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D2.3 – Game Requirements

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Executive summary

This report represents Deliverable 2.3 Game requirements developed in the course of WP2 Specification of user, building and game requirements of the EnerGAware project. This deliverable is one of three complimentary reports produced in WP2 that define the requirements for the design of the EnerGAware serious game. For user and building requirements refer to Deliverables D2.1 User requirements and D2.2 Building requirements.

Deliverable 2.3 presents the game requirements of the EnerGAware serious game derived from a review of the energy-related serious games available in the market, the analysis of the data collected by means of the large-scale, city-wide Social Housing Survey, undertaken in Plymouth (UK) during 2015 (see D2.1), and the conclusions of the Gameplay scenarios focus groups undertaken in Plymouth with a group of DCH social housing tenants. This report also includes the analysis of existing IT devices (tablets) available in the market and the selection of the most suitable tablet for the deployment of the EnerGAware serious game.

The results of the Social Housing Survey, as well as the focus groups conclusions, validate that a significant part of the social tenants have a good IT-literacy, Internet and social networks habits, and experience in playing video games. Therefore, the results suggest that the online serious game approach adopted for the EnerGAware serious game should not be a barrier for the targeted audience.

Both the focus group and the Social Housing Survey results suggested that the EnerGAware serious game should be a management game (home management, family management, resources management) focused on a virtual house customization game mechanic. .

Regarding the graphical aspect and the setting of the EnerGAware serious game, the results of the Social Housing Survey suggest that this is not a major criterion of game choice for the targeted players. However, the focus groups concluded that a pseudo-realistic game setting would be better than a fantasy world (or sci-fi, or cartoon) and better than a fully-realistic simulation.

A tactile tablet was identified as the most suitable IT device (both technically and cost-effectively) for the deployment of the EnerGAware serious game.

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Glossary and abbreviations

n/a

1. Introduction

This report represents Deliverable 2.3 – Game requirements developed in the course of Work Package 2 – Specification of user, building and game requirements of the EnerGAware project.

The Work Package (WP) 2 tasks (T2.1-2.4) have provided a comprehensive identification and analysis of the specific user, building and game requirements that are necessary to design the EnerGAware serious game. The WP2 tasks focused on understanding, together with the social tenants, what they want and what their priorities and ideas are in relation to a serious game that could help them save energy at home (T2.4 Game requirements). WP2 also aimed to obtain a deeper understanding about social tenants' motivations, behaviour and perceptions regarding their energy use at home (T2.2 User requirements). Furthermore, a detailed analysis of the technical characteristics (building envelope, building services and controls and renewable energy generation) of the social housing stock was undertaken (T2.3 Building requirements).

Deliverable D2.3 – Game requirements is the third of three complimentary reports produced in WP2 that define the requirements for the design of the EnerGAware serious game. For user and building requirements refer to Deliverables D2.1 – User requirements and D2.2 – Building requirements.

The main goal of Deliverable 2.3 is to have a better understanding of the gaming experiences and preferences of the social housing tenants in order to identify the most suitable serious game category and experience the EnerGAware serious game should offer to the users. This deliverable also aims to define the EnerGAware serious game user profile, the preferred game concept and finally, the most suitable IT device where the serious game could be deployed.

The data used to define the game requirements outlined in this report were obtained from a review of the energy-related games existing in market, data collected by means of the large-scale, city-wide Social Housing Survey, undertaken in Plymouth (UK) during 2015 (see D2.1), and the conclusions of the Gameplay scenarios focus groups undertaken in Plymouth on the 22nd and 23rd May 2015 with a group of DCH social housing tenants. The selection of the IT device most suitable for the deployment of the EnerGAware serious game was based on a review of the existing devices in the market and their technical characteristics.

The outcomes of WP2 will directly influence the design of the serious game in WP3.

This document is structured in four parts.

— Energy-related serious games review:

It provides a review of the existing serious games focused on energy aspects and their different game features.

— Social Housing Tenant survey results:

It presents an analysis of the data collected by means of the Social tenant survey related to game experiences, internet experience, social media practices and IT devices ownership.

— Gameplay scenarios focus groups results:

It describes the conclusions of the Gameplay scenario focus groups in relation to the concepts and gameplay features of the EnerGAware serious game.

— IT device selection:

It presents a hardware study of the existing tablets in the market where the EnerGAware serious game could be deployed and a recommendation of the most suitable and cost-effective IT device that meets the project requirements from the game development constraints point of view.

2.Energy-related serious games review

2.1 Introduction to energy-related serious games

Serious games aim to change human behaviour through education and training. Serious Games are a simulation environment, based on social interaction and scenario experimentation, designed to highlight, although virtually, potential realistic outcomes.

Serious gaming is generally considered to be a powerful means to educate people. Using such games to influence energy consumers – i.e. social tenants to become more environmentally friendly and conserve more energy at home– presents researchers and designers with both a promising research field and a potentially engaging and influential behavioural transformation tool for achieving energy demand reduction in the residential sector.

Traditional education programmes have difficulties to adapt to the information processing styles, communication and social routines of people in the new digital age: 'digital natives'. Typically, digital natives prefer visual information over textual, are cross-media oriented, play games (from casual games to MMORPGs - massively multiplayer online role-playing games) and are highly active on social network sites (Bennet et al., 2008). This is why methods and tools to encourage energy efficiency at home need to be updated, in order to achieve effective knowledge transfer, and stimulate occupants' behaviour change.

Serious games constitute a suitable learning tool, due to their engaging character (Annetta, 2008; Ratan & Ritterfeld, 2009). Defined as "a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, 2005), they go beyond 'game based learning' (Prensky, 2007) or 'elearning games' in that they also have the ambition to incorporate fun and enjoyment in the gaming experience while the learning elements are less overtly positioned in the game. An effective serious game should take into account intrinsic motivational ingredients like challenge, curiosity, fantasy, and control (Rieber, 1996).

A number of elearning games and serious games addressing energy efficiency, sustainability and renewable energy have been developed and deployed in recent years. Some of these games have been publicly-funded (e.g. funded by the European Commission or national governments; e.g. EnerCities is co-funded by the European Commission Intelligent Energy Europe Programme), while others are industry-driven (e.g. companies active in the energy sector such as Chevron). Examples include EnerCities (available in 6 languages), ElectroCity (English language), EfficienCity (English language), EnergyVille (English language), EcoVille (13 languages), Clim'Way (French and

English language), Simurenov (French language), Energetika (German language), Lachez prise (French language), Les enjeux de l'énergie (French language), Powerwise (Arab and English languages), BBC Climate Challenge (English language), Eco-Agents (24 languages), CEO2 Climate Game (English language), 2020 Energy (10 languages), EON/Sweden's largest energy saving experiment (Swedish and English languages), or even SimCity Societies (more than 20 languages).

All these online games have the aim to increase awareness of the social, economic and technological challenges related to energy efficiency, sustainability, climate change or renewable energy. Not all games, however, have been able to appeal to digital natives and to trigger them to stay online, game, absorb and learn. It seems that many elearning and serious games dealing with energy related issues have put fun and enjoyment less central in the game concept. Ideally, such games should first be games for enjoyment containing explicit or even implicit specific content instead of specific content looking for or transformed into game formats.

The following section describes a selection of the most relevant games to the forthcoming EnerGAware serious game, and the lessons to improve the EnerGAware Serious Game.

2.2 Description of energy-related serious games

2.2.1 Clim'way

The game is a Sim-city like game where the player manages a city and can interact with buildings, facilities, fields, power plants, etc. The educational aim of the game is to make people more aware of the consequences of climate change and greenhouse gas emissions, and provide them with a better understanding of suitable development.

The game contains a virtual environment consisting of a map with four main areas: the mountain, the countryside, the city and the seashore. The player can click on elements on the map to open a dialog box that display information about it. Each menu has several items in it and lead to other sub menu with written information and a video (See Figure 1). Based on this information, the player can decide what kind of research or upgrade wants to do to the city to reduce the greenhouse gas emissions.

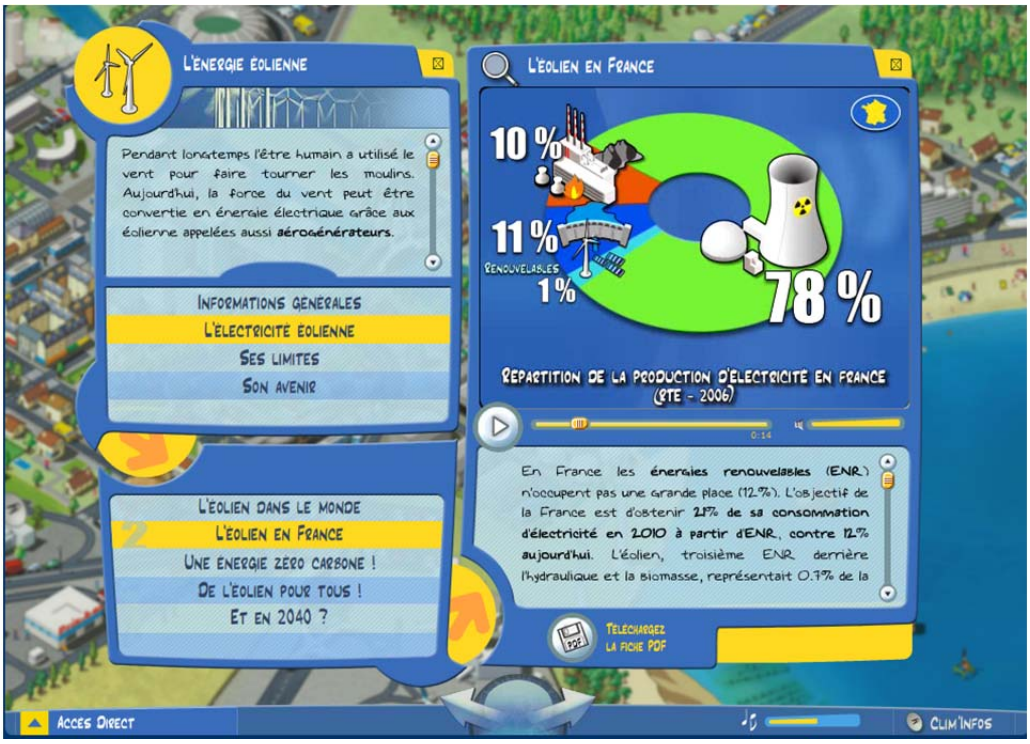

Figure 1. Clim' way.

The goal of the game it to manage the city during 50 rounds (50 years) and make the right decisions to enhance the ecological value of the city. Each decision the player decides to make costs points (game currency) and translates into a change in the game, like reducing greenhouse gas emissions. At the end of the 50 rounds the objectives can be fulfilled or not.

There is no social media feature in this game.

2.2.2 Simurenov

This game (in French) allows the player to simulate the refurbishment (energy upgrade) of a house. The player has 10 minutes and a limited amount of money to upgrade the virtual house by buying more energy efficient technologies (e.g. windows with a better thermal insulating value). The ultimate aim is to reduce the energy consumption and the greenhouse gas emissions of the virtual house. Every time an action is undertaken by the player, an animation is played to give more information to the player about the improvements made to the house and the energy efficiency technology selected. At the end of the game, the virtual house has achieved an improved energy performance and the score is saved.

There is no social media feature in this game.

Figure 2. Simurenov.

2.2.3 Energetika

This game (in German) allows the player to manage the energy production and consumption of a country.

The player is asked to manage the energy levels of the country during 40 years with the final goal to achieve the maximum score in 3 different categories: "Ecology", "economy" and "social". The player can make some big decisions like trying to influence the population with a campaign or change the price of electricity. The player can also build new sources of energy or disable / remove them.

There is no social media feature in this game.

Figure 3. Energetika.

2.2.4 2020 Energy

This game (in French) challenges the player with several missions with the final aim to conciliate ecology, economy and social aspects.

Each level presents an animation and story about the aims and context of the mission. Within this context, the player is offered several choices that might help to improve or not the three aspects (ecology, economy and social) previously mentioned. At the end a score is given and a review of the different missions is done with in depth explanation.

The game story is summarised as follows: "We are in 2020, the world has consumed and wasted the energy. Despite a massive awareness, it's too late. The player may have the power to change this state with a time travel to the 2012 year. Now, something may be done: you have to make the good choices to change the future."

The social media features of this game allow the player, at the end of the game, to share the score and invite friends to "change the future" on Facebook and Twitter.

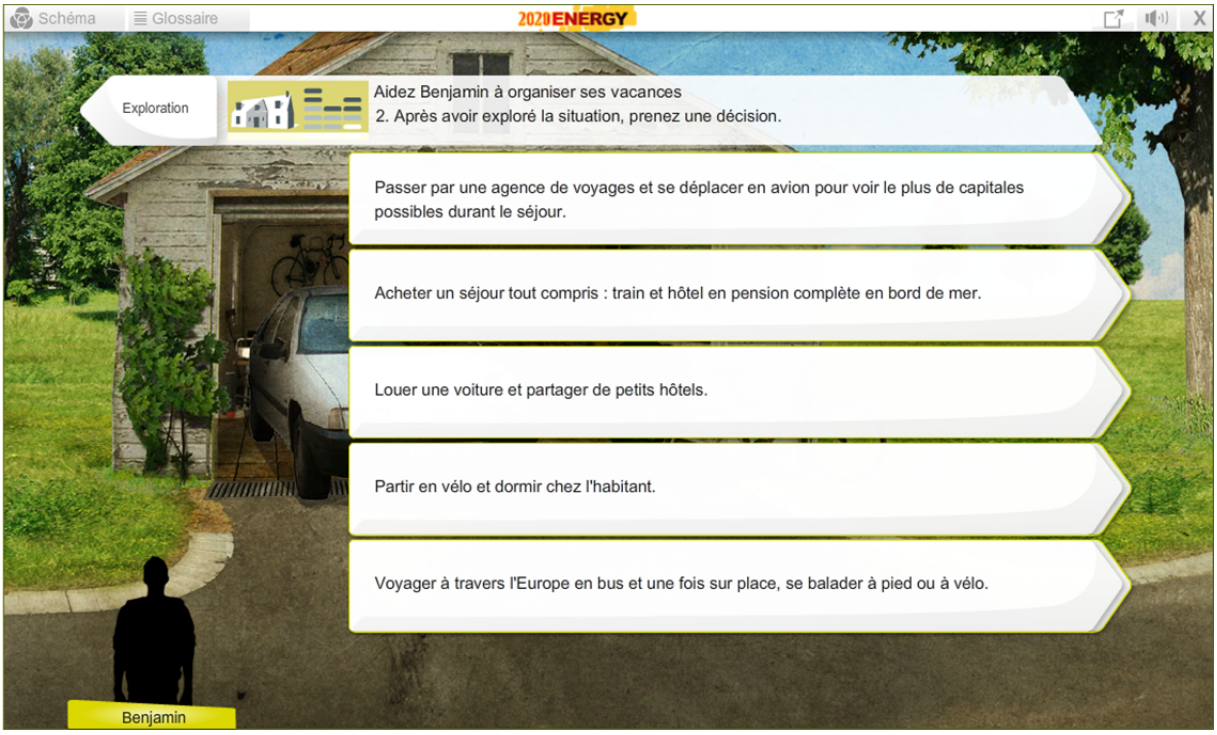

Figure 4. 2020 Energy.

2.2.5 Lâcher prise

In this basic "point and click" game, the player has 9 minutes to visit 7 rooms of a house to resolve different energy-related problems.

The main character of the game is inspector 00Watt. His mission is to find and stop the Terawattus Energivorus monster which uses a kind of mind control over the residents, which makes them waste a lot of energy.

During the visit, the player can search into the scene and look for hidden items to help him progress. Each energy-related problem is an illustrated puzzle and must be solved with the help of an object. The player can interact with objects in the scene and can eventually keep it for later purpose. Once the problems are solved, the player earns a new object that will allow him/her to defeat the high energy consuming robot which is the "final boss" of the game.

There is no social media feature in this game.

Figure 5. Lâcher Prise.

2.2.6 Les enjeux de l'énergie

This serious game (in French) for primary and secondary school students (age 7 to 10), explains how to supply a city with energy, to manage the production and consumption, to respond and anticipate the needs of the population. It also includes an awareness aspect about the chosen source of energy, the impact on the environment and how to take care of the consumer's needs during the winter, for example.

Several themes are presented: energy management, resources, transport and distribution, saving and responsible consumer, and impact on the environment.

The characters of this game consist of a team who challenges the player. Each member represents one aspect of the game: Nolan Prod, Distri Bulle, Conso Manolo and Green Cindy.

It is also a pedagogic tool for teachers and students who are registered. As a teacher, the user may create and share scenarios for the classroom activities. As a student, the player can reach the leaderboard high scores and challenge classmates.

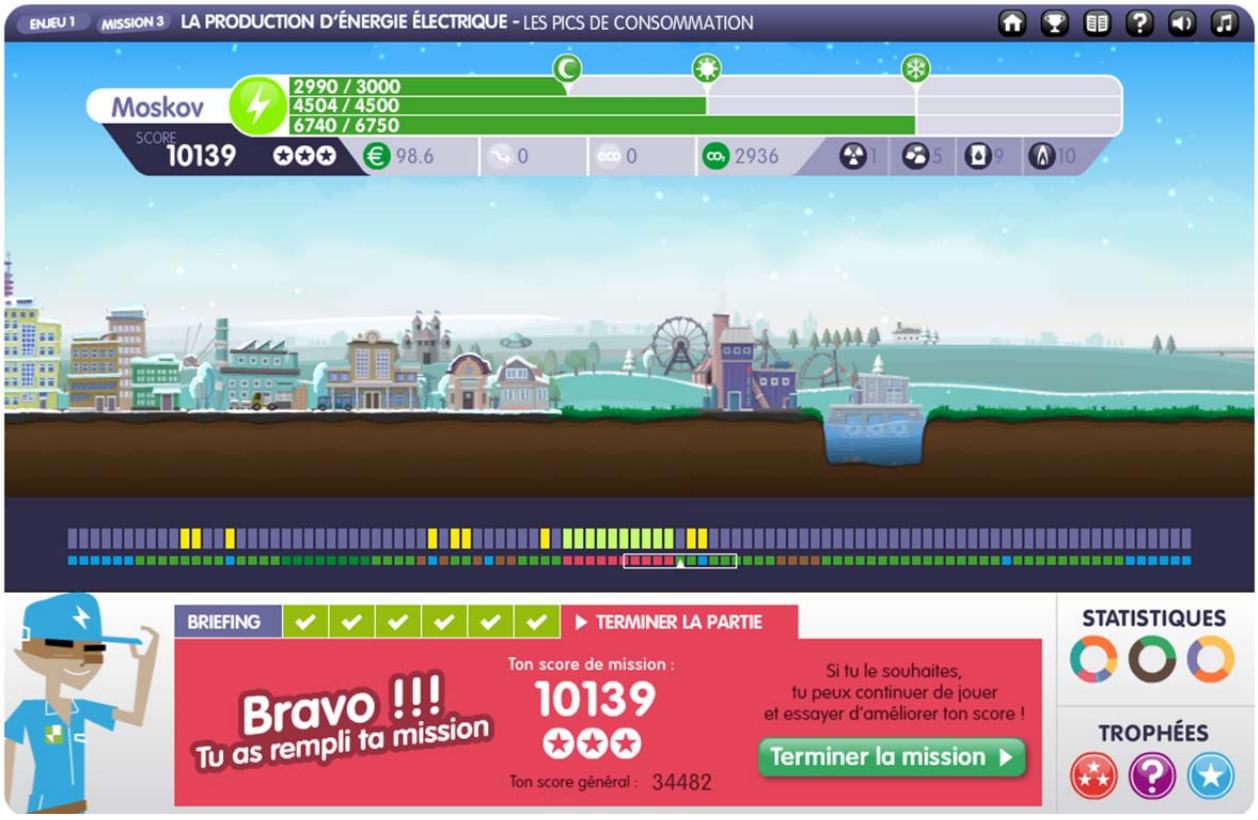

Figure 6. Les Enjeux de l'Energie.

2.2.7 Powerwise

This serious game is promoted by the Abu Dhabi authorities. It is a hidden objects / "point and click" game where the player has to find in few minutes all the objects that use energy in different rooms of a house.

When the player finds one of these objects that use energy, he/she is asked to select the most energy-efficient way to use that object in order to save energy. In the event of selecting the most energy-efficiency action, the game updates the number of power points, which represent the player's score. The game also provides advice to the user on replacing or installing some appliances in order to help reduce the global energy consumption.

The social media features of the game allow the player, at the end of the game, to share the score (best time and saved energy points) on Facebook to challenge his/her friends.

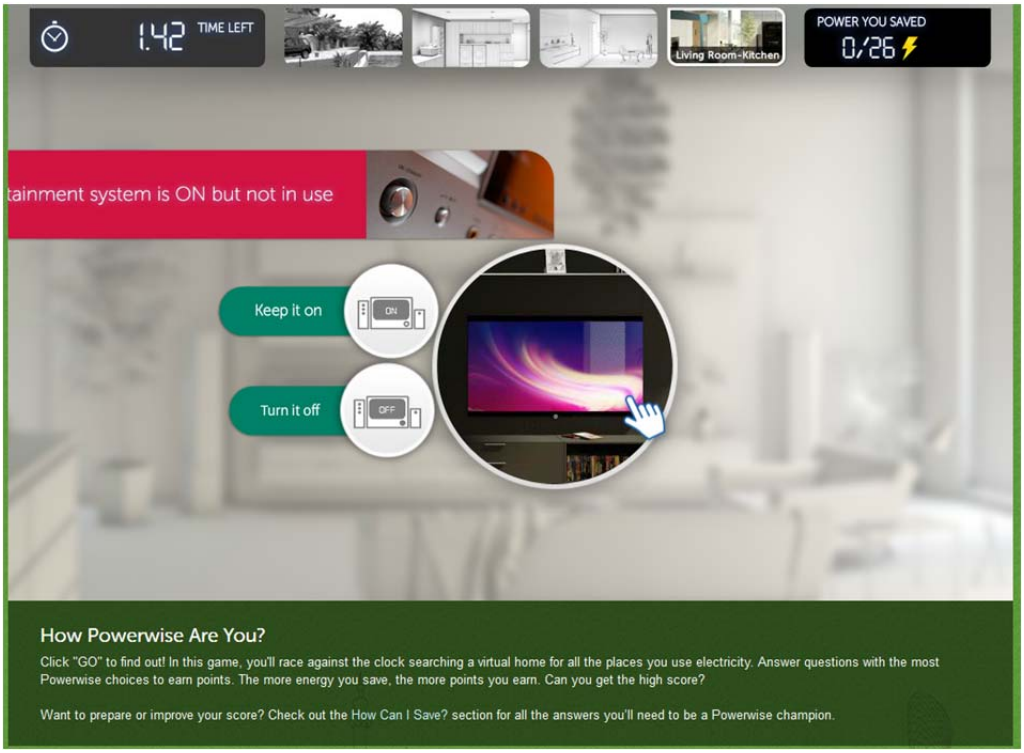

Figure 7. Powerwise.

2.2.8 Energy Animated Quizz

This is a graphic and animated quiz where the player can click on common items located in a virtual house. For each item, the game asks questions to the player related to the best action to undertake in order to reduce energy consumption. Each question correctly answer results in energy savings in the "Energy Usage Meter".

There is no social media feature in this game.

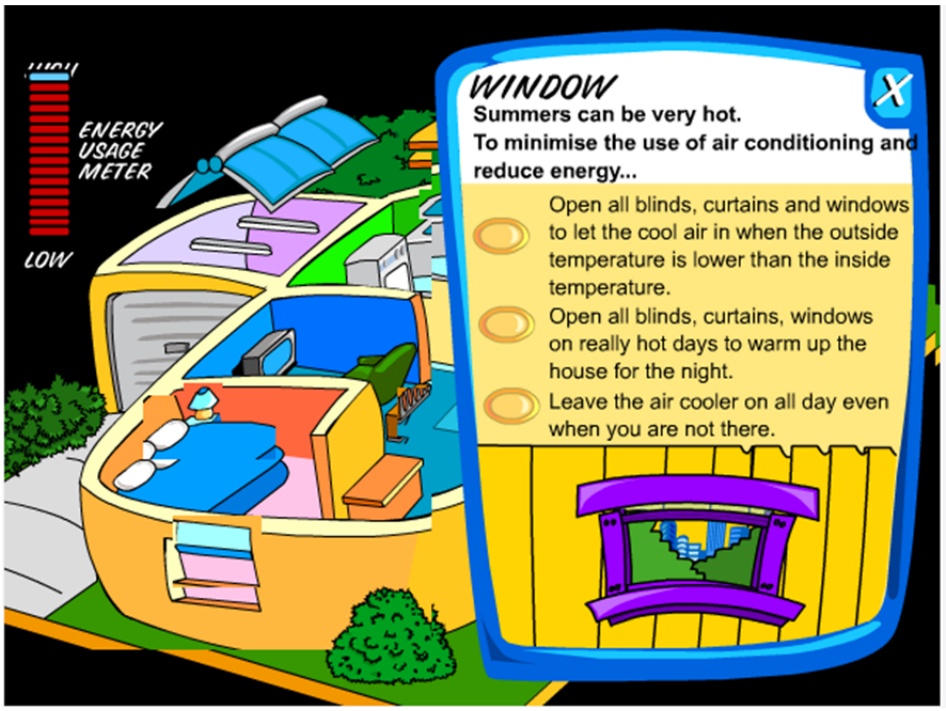

Figure 8. Energy Animated Quizz.

2.3 Conclusions of the energy-related serious game review

2.3.1 Game content and energy theme treatment

The review suggests that serious games adopt different ways to communicate energy-related information and increase people's awareness.

The majority of games provide the player with a large amount of information to process (e.g. Clim'way, 2020 Energy, and Energetika). They assess the player's understanding by asking questions and analysing the response or by requesting the player to make decisions and asses the appropriateness of the action taken.

The review also reveals that most of the games providing the player with very limited, and sometimes unclear, feedback on the implications of the actions taken in the game that explain the changes in the performance (e.g. Energetika, Simurenov). For example, information that explains why the player's choice is wrong and why the right answer/action was another, or how the player could improve the performance in the game based on his/her previous actions.

Regarding the content, the majority of games reviewed provide too much information which might be difficult for the player to comprehend. At the same time, this information is sometimes presented in the form of unclear messages.

The review also showed that these games do not commonly offer much ingame or external rewards to the player. They are meant to be played once, or a few times only, and do not tend to motivate the player to play more than once.

2.3.2 Art

Regarding the graphical style and art directions, the review revealed that the three most common styles are:

- Cartoon: Clim' way, Lâcher prise, Les Enjeux de l'Energie, Animated Quizz
- Pseudo-realistic: 2020 Energy, Energetika
- Realistic or photographs: Simurenov, Powerise

2.3.3 Link to social media platforms

While most of the serious games offer a solo pedagogic experience, some serious games have a social media link:

- The usual social link of these games is to share a score to challenge friends (usually on Facebook and/or Twitter) as ***2020 Energy*** and ***PowerWise.***

- Some request the users to register to allow a little community to share contents and scores: for example ***Les enjeux de l'énergie***.

2.3.4 Recommendations for the design of the EnerGAware serious game

The review of current energy-related serious games has provided a good view of the existing solutions currently in the market and free-to-access by a general audience. The analysis of the features and content of the games, plus the personal experience whilst playing them (by the project partner and game developer FRE), has provided useful information for the creative process of designing the EnerGAware serious game.

Didactical content:

This study has made evident that the energy topic (including energy consumption, energy efficiency, energy management, etc.) is a challenging story/concept to be addressed by a serious game. There is a general tendency to give a significant amount of information (sometimes very technical) and data to the player in order to increase awareness and knowledge in energy-related concepts and behaviours. However, the complexity of the information provided can be a barrier for the player's learning process at the same time that it reduces the player's motivation and interest in the game.

Therefore, when designing the didactical content and format of the EnerGAware serious game, it is important to find the right balance of quantity and complexity of the information provided, at the same time it remains attractive, accurate and scientifically exact and complete.

Graphical aspect:

Regarding the art style, the studied games chose either a cartoon or a realistic style, which seem to be obvious choices to tell a story about energy: Cartoon to try to simplify the topic, and maybe attract children; and realistic, for a credible and "simulation" approach. However, the full-realistic style is not well suited for low budget games development, since the standard, especially in realistic

styles, is high and so is the audience expectation. The cartoon style, on the other hand, could narrow the targeted audience to the younger game players and people already used to play games.

For the EnerGAware serious game, the most suitable choice would be a "pseudo-realistic" graphical style, so players can relate to the graphics and characters. However, the game should not be perceived as a simulation software, providing enough differences from the real environment to avoid deceptive expectations of a real-life-simulation.

Social media features:

Despite the majority of the energy-related games reviewed do not provide social media features, it is envisaged that some social features could be added to the EnerGAware serious game. These include:

- "Like" the serious game home page.
- Share unlocked achievements to show the player's game progress.
- Share a useful or pedagogic tip to disseminate good advices and increase the awareness.
- Share a score to challenge friends.
- Share a screenshot to motivate friends.
- Comment on a friend's screenshot.
- Send and receive a daily bonus (money game, special decorative item, etc.) to keep players engaged.

Universe / background story:

Most of the games about energy take place in a realistic environment but not in the real world. That allows adding some fantasy to items, actions or characters to bring some fun to highlight some behaviours or bad habits, to offer a setting that should not be possible in the real life.

EnerGAware game design seeks to offer a fun experience in a realistic place, allowing the players to identify references of their everyday context, but presented in a different, attractive and engaging setting. For instance, the game environment could use some of the Plymouth (the pilot city in the UK) architecture traits and landmarks without making explicit to the player that the game is based in the real city of Plymouth.

Characters:

There is no type of character common to the different energy-related games reviewed. However, it has been identified the role of the "mission managers" as a common character amongst energy-related games. The "mission manager" gives useful advice, warn the players about "dangers" or mistakes, improve the awareness about the dedicated subject, correct the answers with pro and cons, give feedback, congratulate, etc.

There are also some characters used as references to illustrate good or bad situations. The player, as spectator, is not directly impacted by the events but may see the effects of others' decisions.

In the EnerGAware serious game, characters could be used as references, mentors or as actors to execute the player's orders. Characters could compose families, and these could have the form of different archetypal families. For example, there could be:

- The Crazy family with unusual habits, wasting a lot of energy (electric radiator in the garden, open unreasonably windows and doors in winter, washing and drying one piece of clothes at a time, etc.).
- The Green family with ecologic motivations and way of life, always trying to use alternative solutions to achieve lower energy consumption.

Multiplayer interaction:

None of the reviewed energy-related games allow multiplayer interaction.

For the EnerGAware serious game, some limited actions could be considered. However, it is important to bear in mind some of the limitations of multiplayer interaction, which include:

- A player could ruin all the game of another player.
- Multiplayer mode needs to synchronise continuously the different games.
- More complicated to settle, deploy and tune.

The EnerGAware serious game could consider the use of social media features to allow real-time multiplayer interaction. However, the effort and budget needed to develop a suitable multiplayer interactions might be too significant compared to the expected benefits.

3.Social Housing Tenant Survey results

The Social Housing Tenant Survey is a large-scale, city-wide survey, undertaken in Plymouth, UK, during 2015, which was administered to all the social houses managed by project partner DCH in the city. It gathered information related to socio-economic characteristics; energy consumption motivations, behaviour and perceptions; and game experiences and IT literacy of the social housing community. This section presents the results of those questions related to the game experiences and IT literacy. In particular, it focuses on:

- Internet access, frequency and duration of connection, and IT devices used to connect online.
- Game play experience, and IT devices used to play games.
- Game play habits, frequency, game play contextual situation, and games commonly played.
- Use of social media platforms.
- Level of confidence using IT devices.

3.1 Use of internet

3.1.1 Internet access

Deliverable 2.2 (Section 2.5) shows that around two thirds (66%) of the social housing tenants have access to the Internet at home. Out of the homes with Internet access, 85.7% have wireless broadband, 27.1% Mobile 3G and 19.5% Mobile 4G. The total percentage of Internet connection types is greater than 100% because some of the households have multiple types of Internet connection in the same home. Please see Figures 45 and 46 in Deliverable 2.2.

3.1.2 Internet use

Figure 9 shows that the majority of respondents (57%) stated that they or another member of their household, use internet at least once a day. 45% reported to use the internet more than once in the same day. Only 21% of the respondents indicated that never use the internet, and 3% less than once a month.

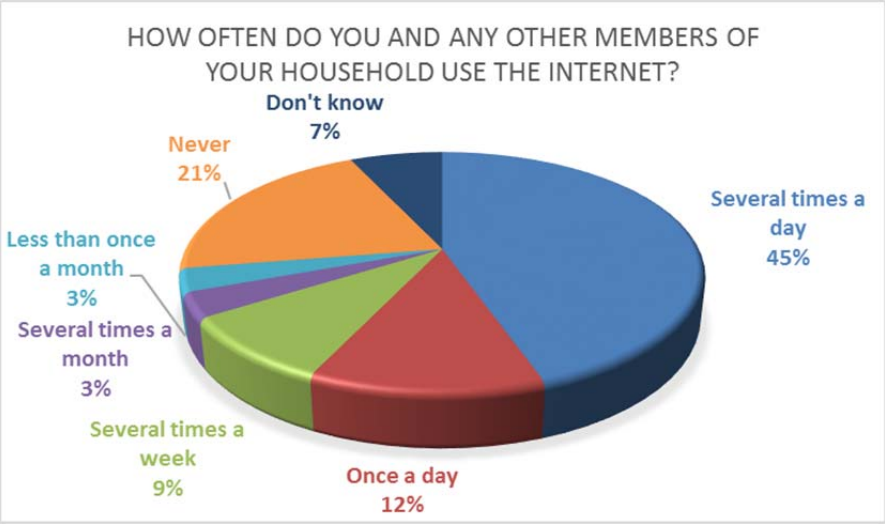

Figure 9. Internet use.

Figure 10 shows that the majority of social tenants responding the survey and with access to the Internet spend either 10 minutes (26%) or 60 minutes (27%) in a single session. Results suggest that 70% of the respondents spend one hour or less on the Internet in a single session.

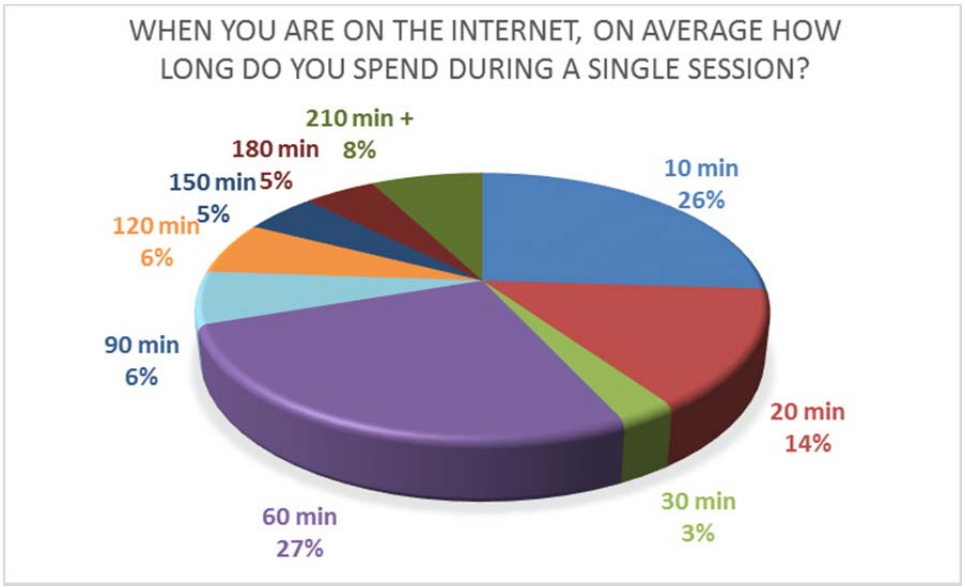

Figure 10. Internet session duration.

As shown in Figure 11, the majority of respondents (51%) responded that they spend between 10 minutes and 150 minutes each day on the internet.

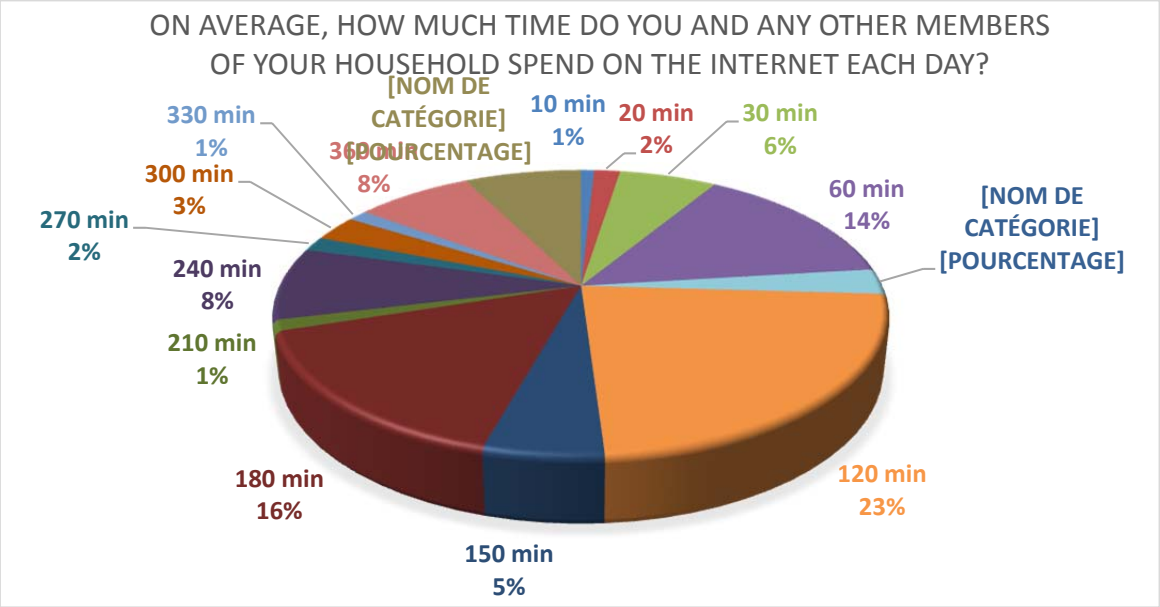

Figure 11. Internet use each day.

3.1.3 IT devices used to access internet

Figure 12 shows that the majority of the respondents or another member of their household access the internet by means of a laptop, a tablet or a smartphone, being the laptop the most common device. These results suggest that the most common devices to connect online are wireless (computers, tablets, smartphones...). This is a particular interesting finding when considering the design of an online serious game.

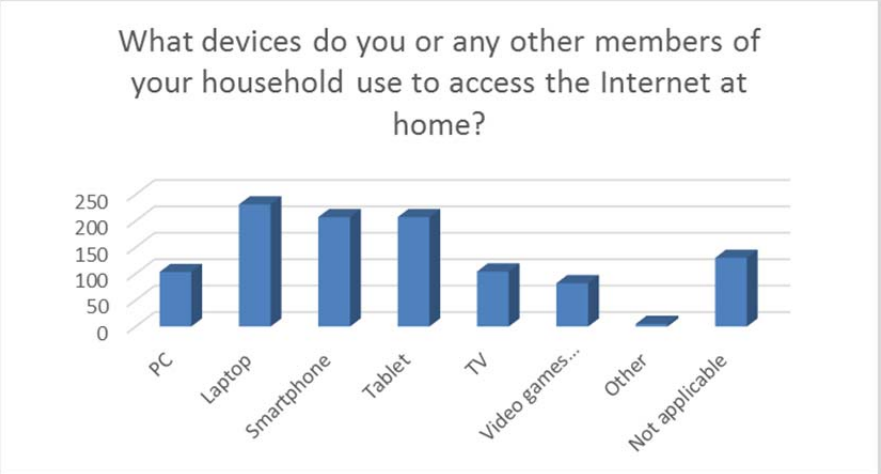

Figure 12. IT devices used to access Internet.

The survey also asked respondents to report on the ownership of smartphones and tablets and the specific brand owned. Information regarding the brand of the smartphone helped to identify the proportion of Android and iOS users, but it was considered more appropriate to ask for the brand instead of the operating system, which could be more difficult to identify for some respondents.

With regards to smartphone ownership, Figure 13 shows that 69% of the respondents owned at least one smartphone at the time of responding the questionnaire. From those respondents owning a smartphone, the majority (26%) own a Samsung smartphone, which operates on an Android operating system. The second most common device (20.5%) is an Apple smartphone, which operates on an iOS operating system (See Figure 14).

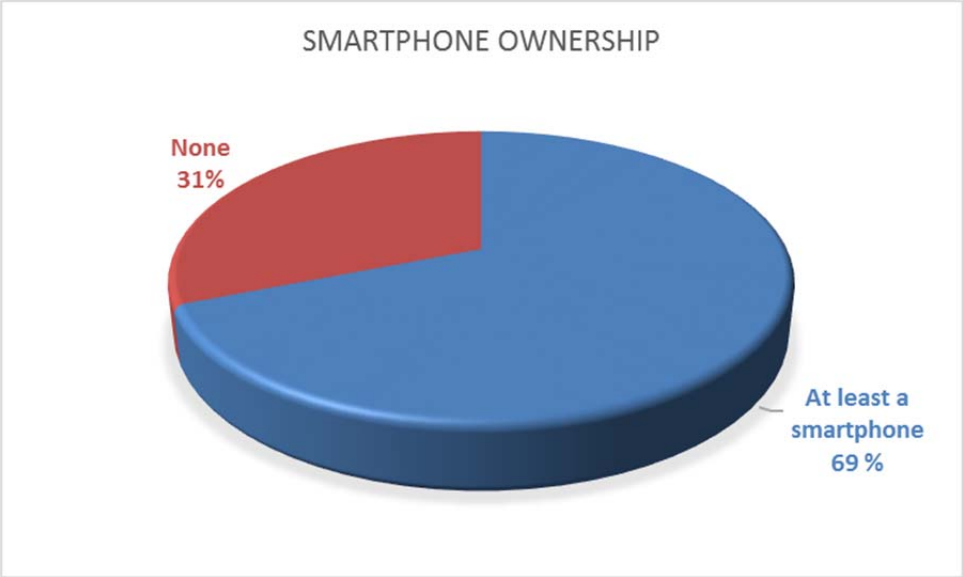

Figure 13. Smartphone Ownership.

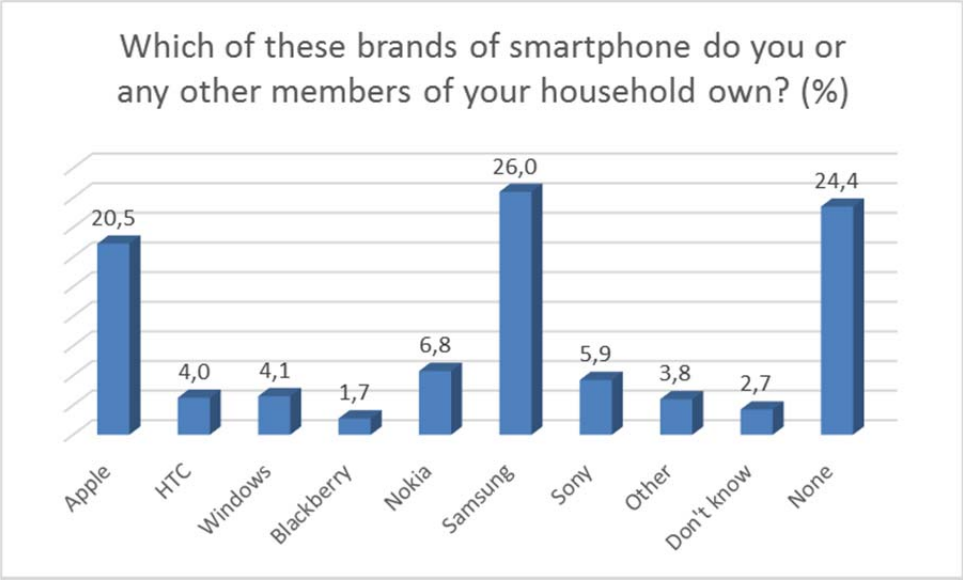

Figure 14. Smartphone brands.

With regards to tablets ownership, Figure 15 shows that 52% of the respondents owned at least one tablet at the time of responding the questionnaire. From those respondents owning a tablet, the majority (18%) own an Apple tablet, which operates on an iOS operating system. The second most common tablet (13.8%) is a Samsung tablet, which operates on an Android operating system (See Figure 16). The rest of the brands owned by the respondents (Microsoft, Amazon and Sony tablets), apart from Google, are also operated by an iOS system, making iOS tablets the most common tablets according to the survey.

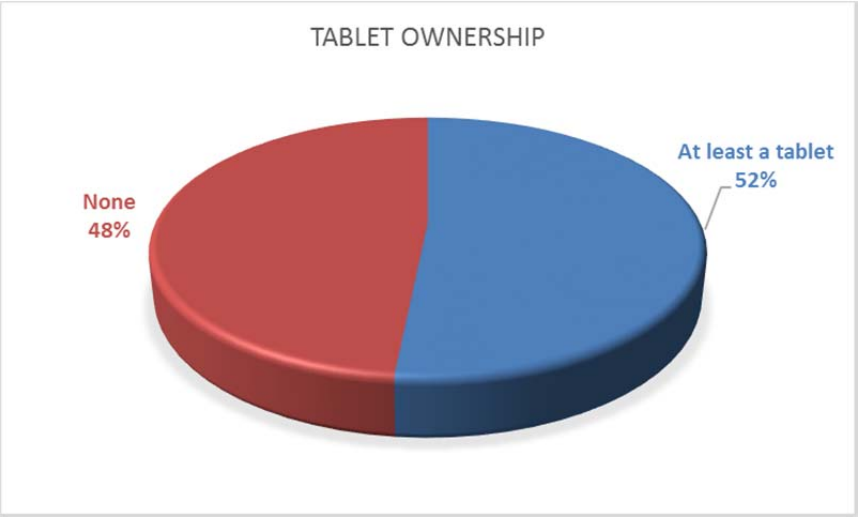

Figure 15. Tablet ownership.

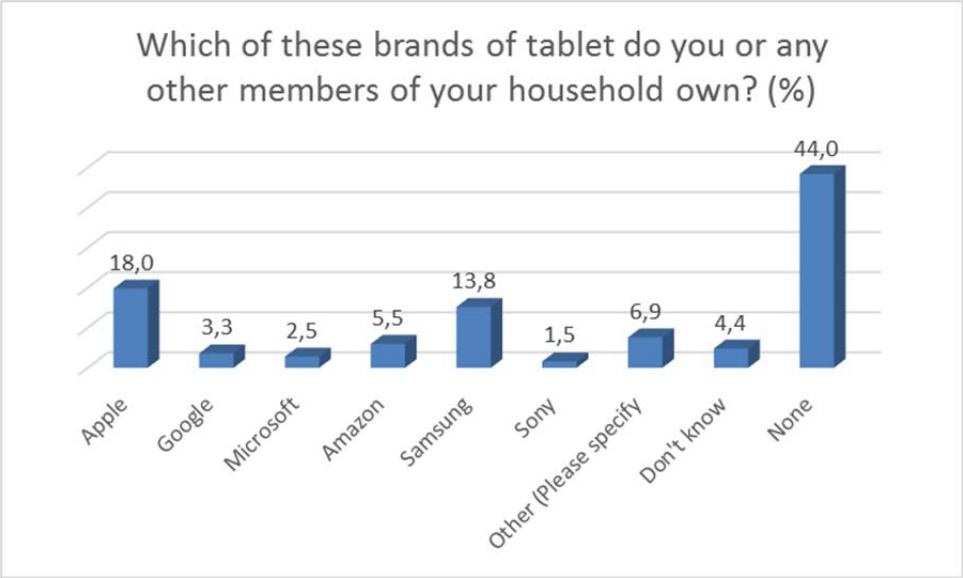

Figure 16. Tablet brands.

3.2 Game play experience and habits

3.2.1 Game play experience

Figure 17 shows that nearly half (44%) of the respondents or other members of their household usually play games in devices such as computers, smartphones, tablets, videogame consoles, etc. From those respondents that reported that they play games, the majority indicated that they play games using a tablet (28%), a smartphone (24.6%) or a videogame console (24.3%) (See Figure 18).

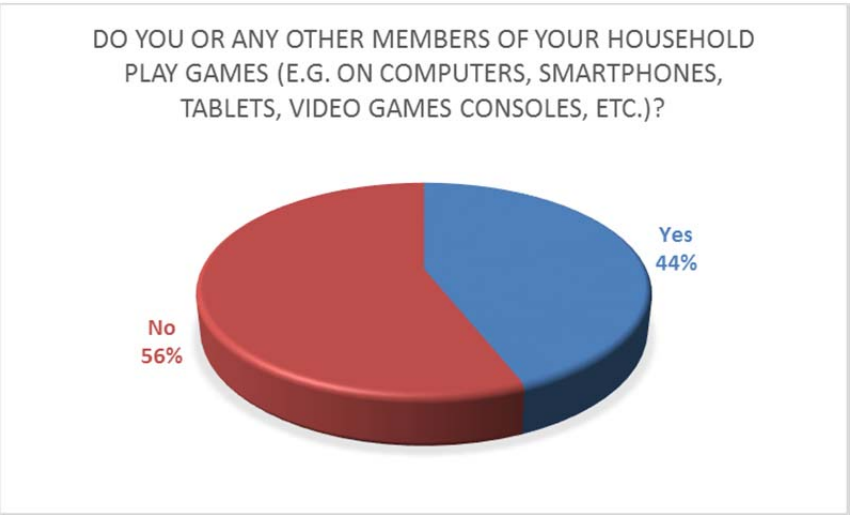

Figure 17. Game play experience.

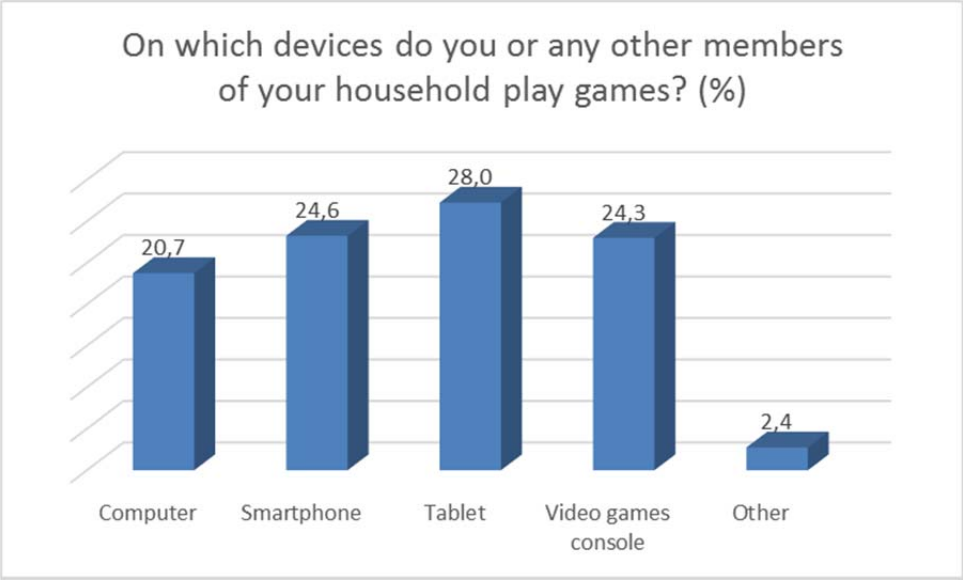

Figure 18. IT device used to play games.

3.2.2 Videogames experience

The survey specifically asked the respondents about their experience playing videogames. Figure 19 shows that the majority of respondents (66%) do not own a videogame console. Figure 20 indicates that the most common videoconsole devices owned by the social housing tenants are Microsoft Xbox360, Nintendo Wii and Sony Playstation 3.

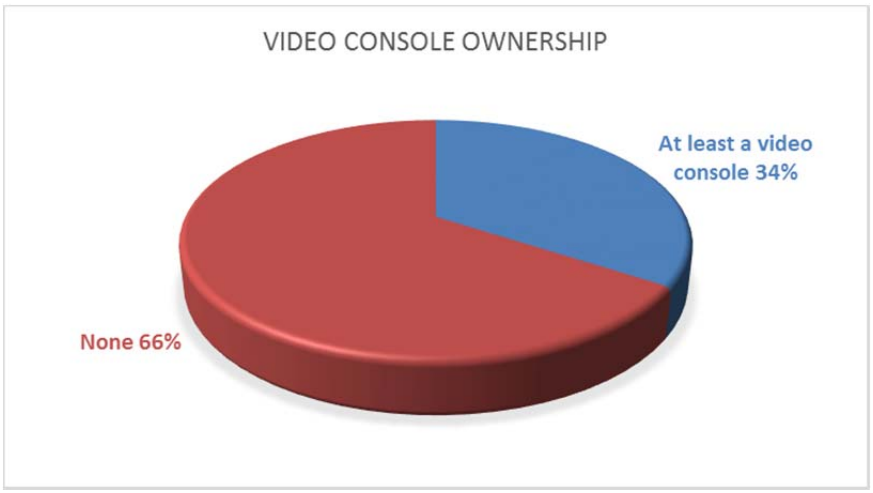

Figure 19. Videogame console ownership.

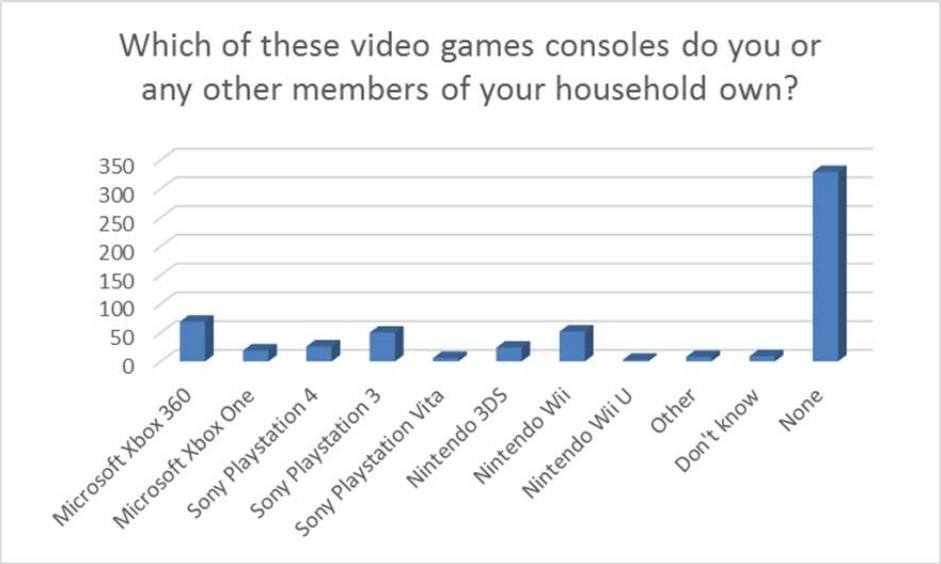

Figure 20. Videogame console brand.

3.2.3 Game play habits

From the group of respondents that reported that they or other members of their household play games, nearly half of them (49%) play games at least once a day, 33% of them admitting playing games several times in the same day. Only 17% of the respondents play games less than once a week.

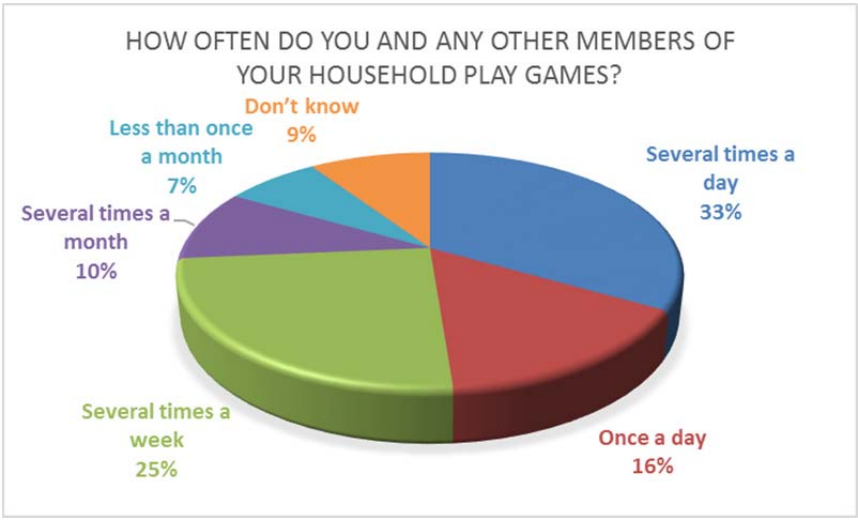

Figure 21. Game play habits: Frequency.

Figure 22 indicates the main part of the group use to play from 30 minutes (18%) to 120 minutes (20%).

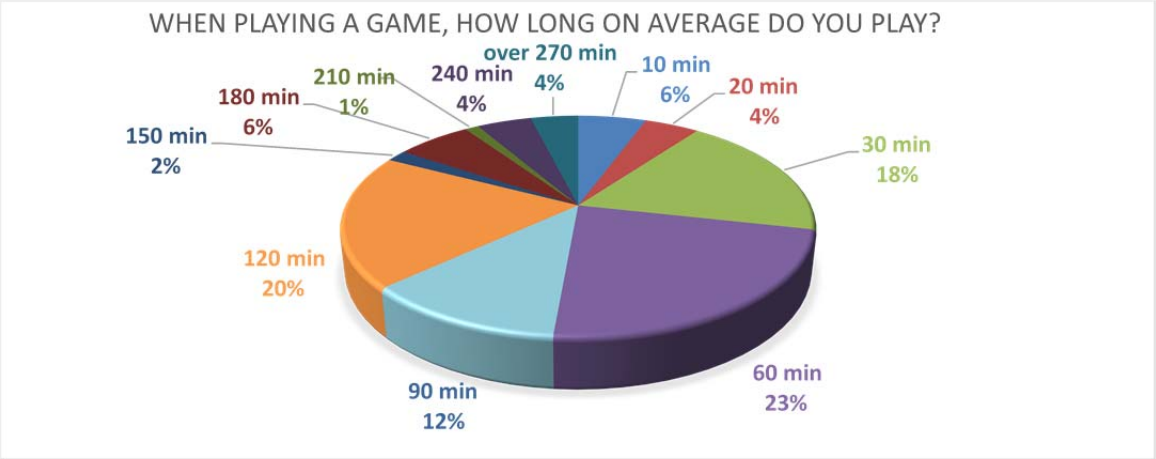

Figure 22. Game play habits: Duration in a single session.

Figure 23 shows that nearly a fifth (21%) of the respondents or other members of their household usually play games during 2 hours (120 min).

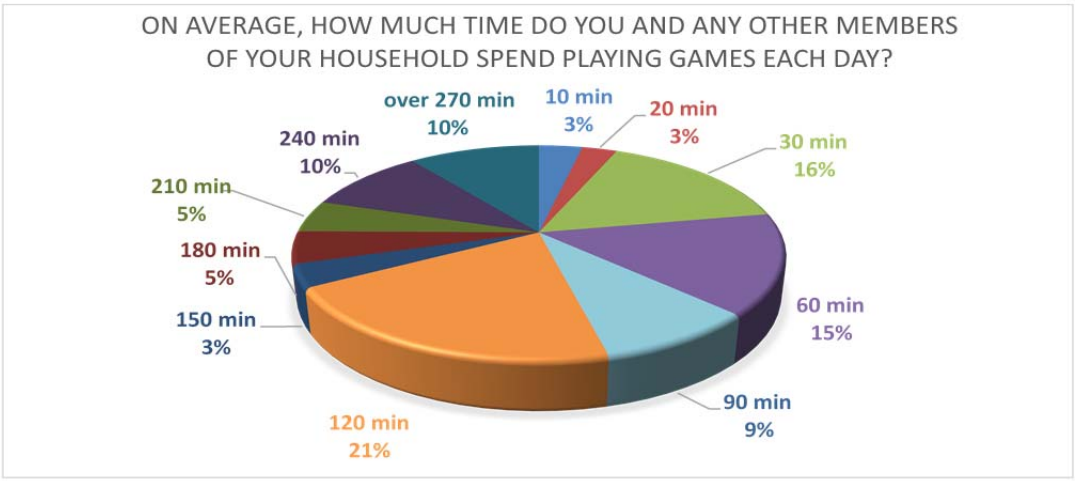

Figure 23. Game play habits: Duration per day.

The survey also asked respondents about the most common location where they play games. Figure 20 shows that the majority of respondents (54.4 %) play games at home. The following most common locations are during long journeys by car, train, etc. (14.4 %) and at friends' and family's homes (12.9 %).

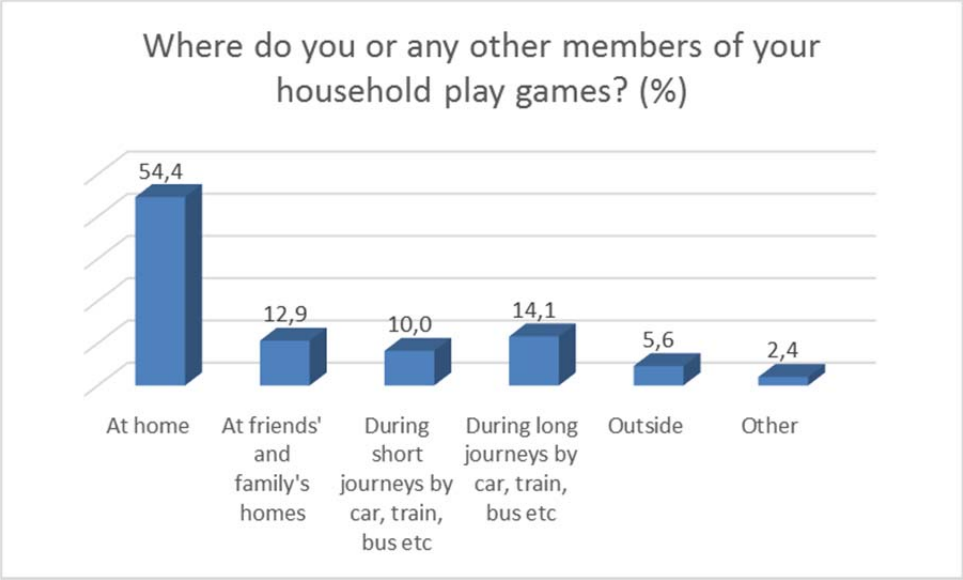

Figure 24. Game play habits: Location.

The survey also reported that only 27% of the respondents or other members of their household usually play games with other people (family, friends or online), i.e. in a social or multiplayer environment, 13% of them playing every day and 14% several times a week. 46% of the respondents indicated that they or other members of their family do not play social or multiplayer games.

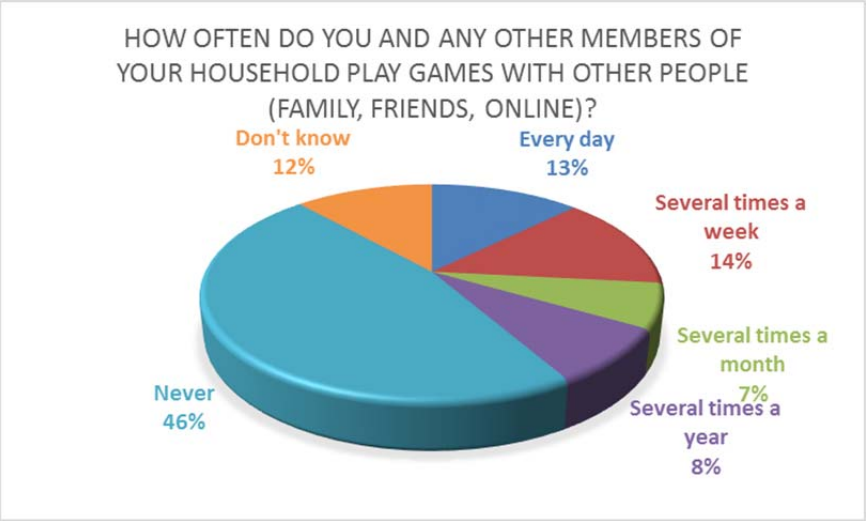

Figure 25. Game play habits: Multiplayer format.

Figure 26 shows that 41.7% of the residents use the social network to play games whereas 51.7% of them do not. From the group that reported playing games in social networks, the majority (30.7%) reported playing games in Facebook mobile and Google Play Games (19.7%) (See Figure 27).

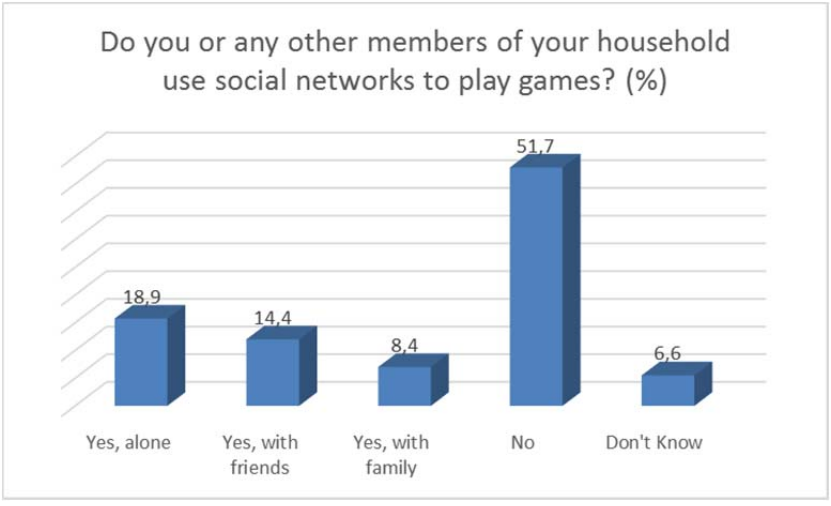

Figure 26. Game play habits: Social networks and games.

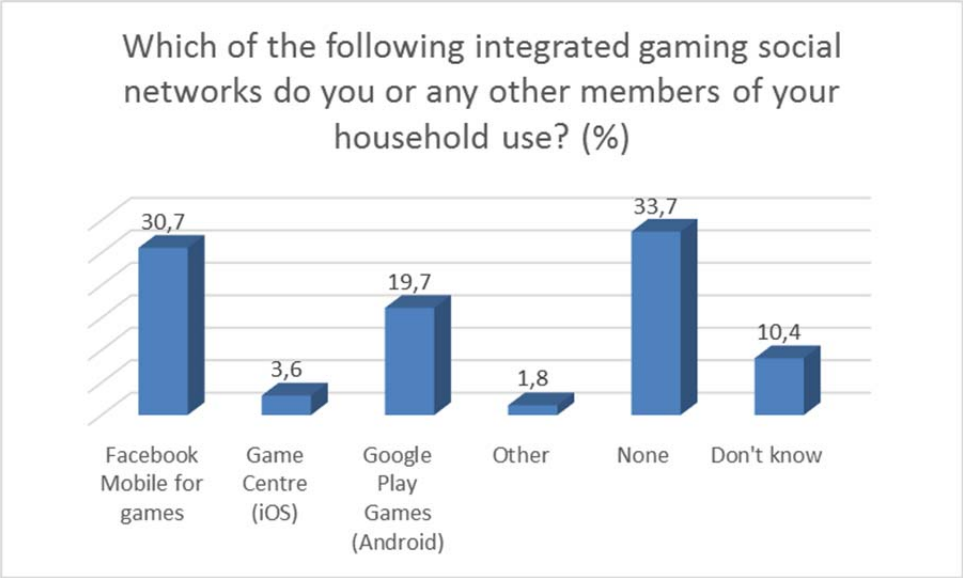

Figure 27. Game play habits: Integrated gaming social networks.

The social housing tenants were specifically asked about their previous experience with serious games. The results in Figure 28 reveal that only 21% of the respondents or other members of their household had played a serious game before. 61% reported that they had never played a serious game.

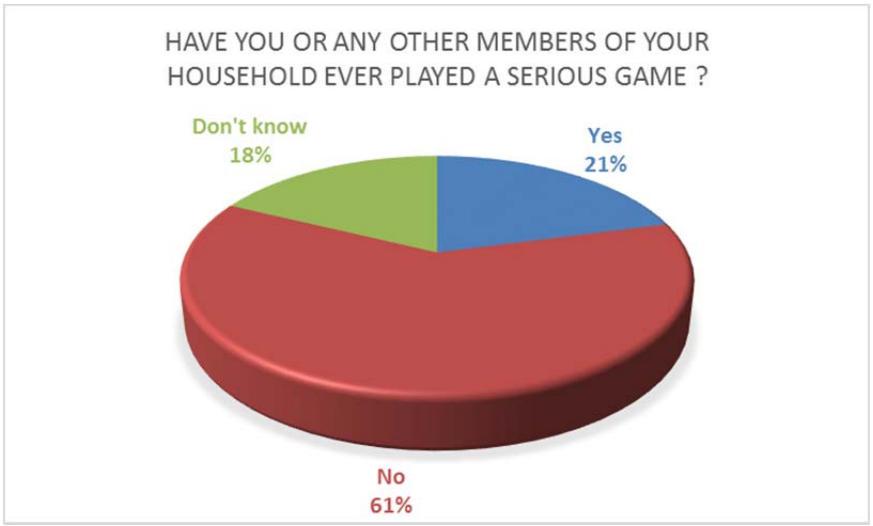

Figure 28. Game play habits: Serious games experience.

Figure 29 shows the main favourite games among several types of games.

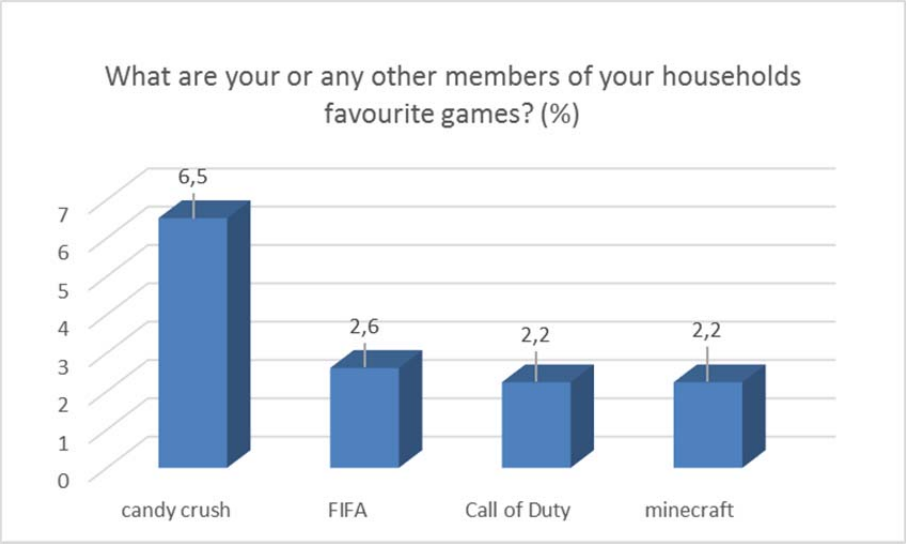

Figure 29. Game play habits: The main favourite games.

Figure 30 shows that from those games in Figure 29, which are considered to be casual and addictive games, "Candy Crush" is clearly a leader in term of users (48%).

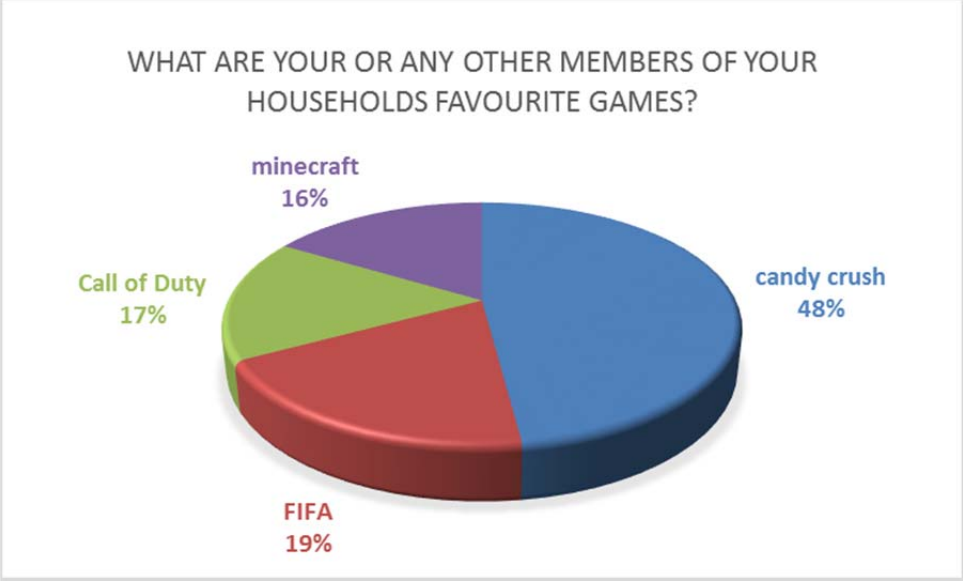

Figure 30. Game play habits: The main favourite games.

Figure 31 and Figure 32 identify the last games that have been played by the social housing tenants at the time of responding the survey.

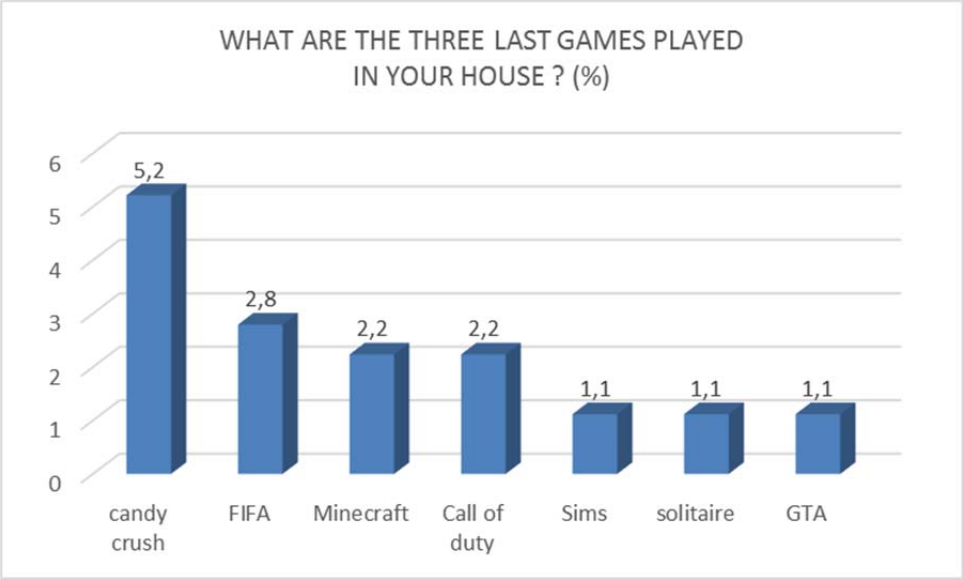

Figure 31. Game play habits: The 3 last games played in your house.

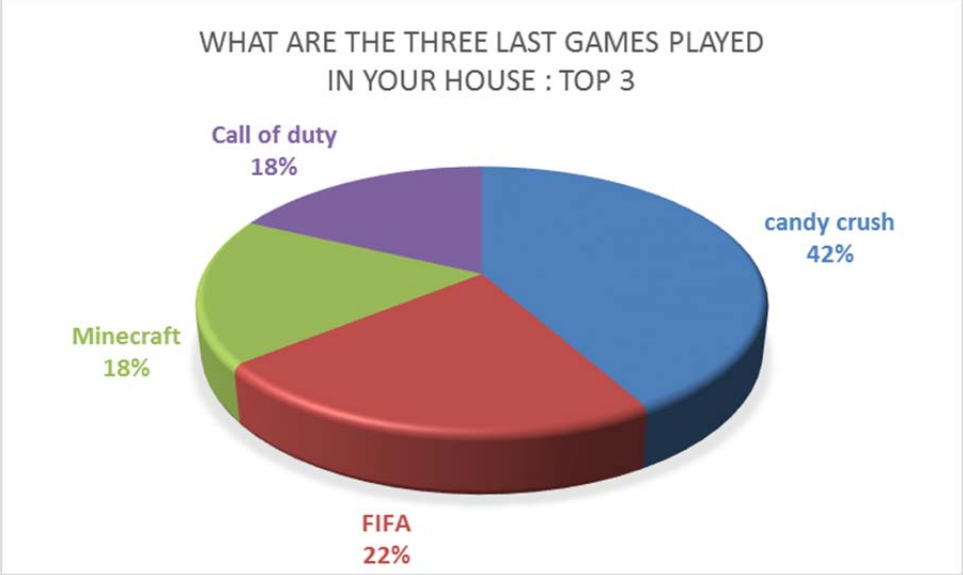

Figure 32. Game play habits: The 3 last games played in your house.

The most popular is "Candy Crush", a "Three in a row" casual game, usually played on Facebook and mobile devices (smartphones and tablets).

The three others most popular games are:

- "FIFA", a 3D football game with a part of management and simulation.
- "Call of duty", a "First Person Shooter" game with some customization (weapons, equipment, perks...).
- "Minecraft" a crafting / building / sandbox game.

"FIFA" and "Call of duty" are usually played on PC or consoles and need some practice to master the difficulty.

"Minecraft" is a sandbox where the player may craft and build tons of things (from water to cathedral) played on computers, mobile, tablets and consoles.

3.3 Use of social media and IT literacy

3.3.1 Social media experience

Figure 33 shows that the majority of respondents or another member of their household (71.6%) have an account in a social network platform. The most popular social network amongst the respondents is Facebook (35.8%). 26.4% of the respondents do not use social network platforms.

The majority of the respondents (62%) with an account in a social network reported that they or another member of their household use the account at least once a day, 46% of them logging into the account several times in the same day (See Figure 34).

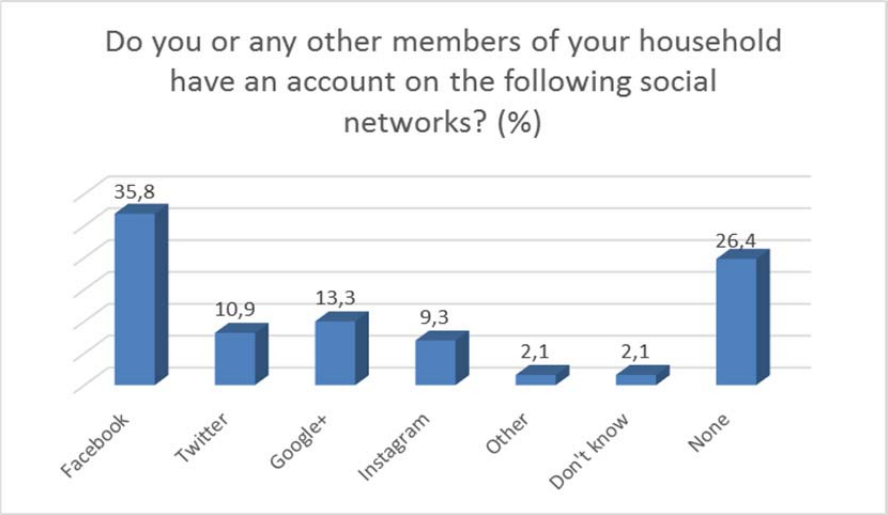

Figure 33. Social networks accounts.

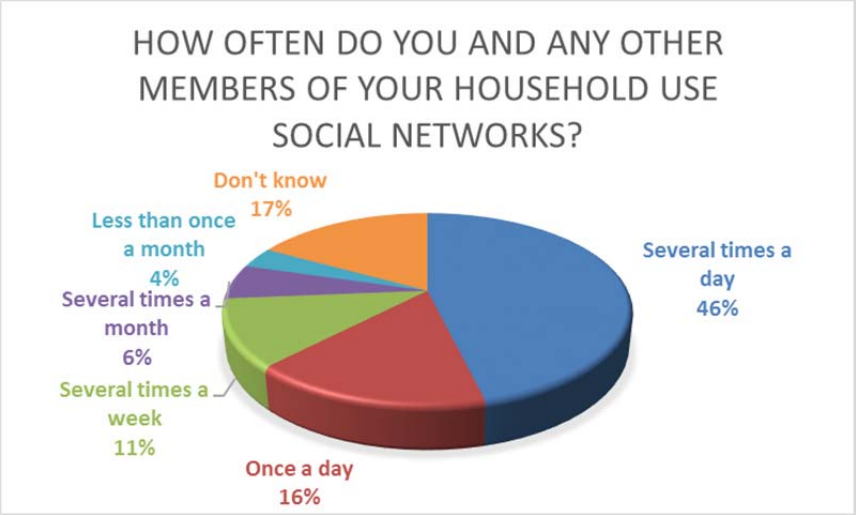

Figure 34. Social networks frequency of use.

Figure 35 shows that nearly a quarter (23%) of respondents or another member of their household spend 60 minutes on social networks each day.

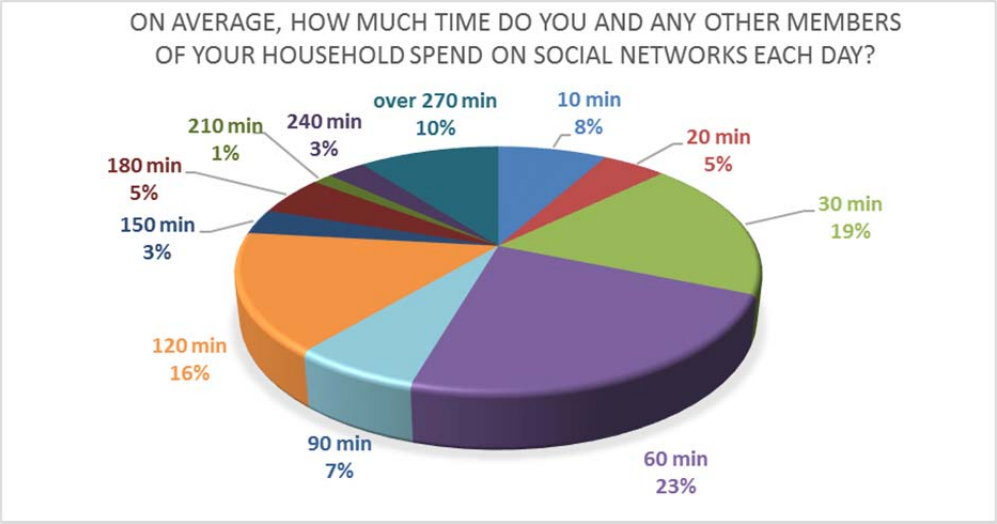

Figure 35. Social networks frequency of use.

3.3.2 IT literacy

The survey also collected information about the level of attitudes towards IT of the social tenants. Respondents were asked about their level of confidence when using a computer and the internet.

Figure 36 shows that 54% of the respondents strongly agree and tend to agree that they feel confident using a computer. Only 14% strongly disagree and tend to disagree, stating that they do not feel confident using a computer. 12% of the respondents neither agree nor disagree.

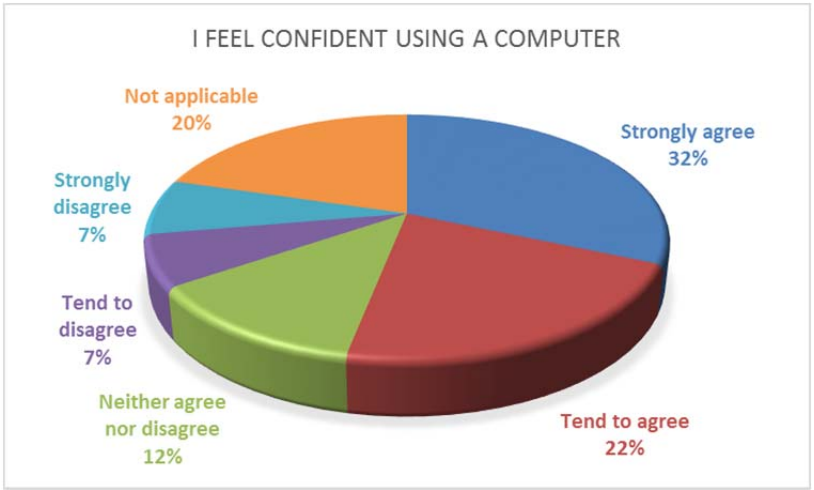

Figure 36. IT literacy: Use of computer.

Figure 37 shows that 54% of the respondents strongly agree and tend to agree that they feel confident using the internet. Only 13% strongly disagree and tend to disagree, stating that they do not feel confident using the internet. 12% of the respondents neither agree nor disagree.

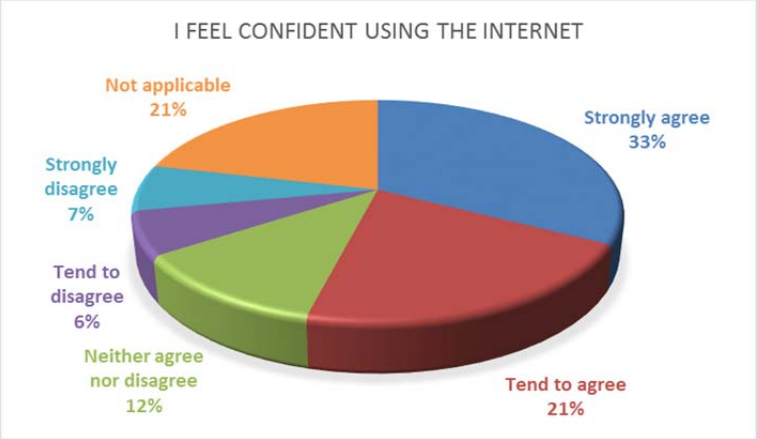

Figure 37. IT literacy: Use of the internet.

3.4 Recommendations for the design of the EnerGAware serious game

The data collected by means of the Social Housing Survey has provided useful information for the design of the EnerGAware serious game.

Game experiences & features:

This study has made evident that the tenants are mostly casual gamers who appreciate a friendly user interface and easy game mechanics. A 3D game is highly recommended since most of the favourite and last played games are 3D games (FIFA, Call of Duty, Minecraft). Management and customization are some of the appreciated features. The art style was found not to be a relevant criteria since tenants admitted playing games with cartoonish and very colourful graphics (i.e. "Candy Crush"), games with very realistic graphics (i.e. "FIFA", "Call of Duty") and games with minimalist graphics (i.e. "Minecraft").

Internet and social networks:

Taking into account that a large part of the social tenants use internet and social networks, the EnerGAware serious game should be an online game. Expected social features of the EnerGAware game include getting feedback, sending notifications, e-mails and tips, collecting data about the

players actions to better understand how they use the game and to use the social networks to share with people experiences, advices, tips, screenshots, achievements, etc.

IT device:

Results of the social housing survey suggest that the EnerGAware serious game should be designed to be deployed in a tactile device. Since a significant group of social tenants are used to smartphones or tablets, it is believed that the deployment of the game in a tablet should not become a barrier for the social tenants to engage with it.

4. Gameplay scenarios focus groups results

4.1 Living Lab methodology

The EnerGAware project is guided by the Living Lab methodology which engages with the social tenants from the very beginning of the project. A Living Lab is a user driven open innovation environment, where the social tenants can participate and have an active part in the process of research, development and innovation (Bilgram et al. 2008). The Living Lab methodology consists of the co-creation and evaluation of a product (i.e. the Serious Game) in a real-life environment over a determined period of time, integrating concurrent research and innovation processes within a public-private-people partnership (Pallot et al. 2010).

By using a Living Lab, the researchers can obtain a deeper understanding about how people interact with serious games, sharing ideas, influencing solutions, finding constraints or new features, leading to the development of a better product, more adequate to user needs and expectations, thus increasing success in user acceptation. Through the co-creation of the EnerGAware serious game with the social tenants, the game should also have the greatest probability for impact in energy reduction, increasing energy awareness and occupant behaviour transformation.

In the context of the EnerGAware serious game design, the Living Lab is based on the social housing community (the pilot). In early stages of the game design, the Living Lab consist of a series of focus groups aimed at, firstly, collecting the social tenants' ideas and inputs in relation to the initial game concepts, and later, testing early game prototype ideas and developments. Afterwards, the Living Lab becomes the pilots for the deployment and testing of the EnerGAware serious game integrated with the energy metering system. Essentially, the Living Lab will be the location where ideas, innovation and solutions are created by the social tenants of the pilot and the EnerGAware team.

This section presents the findings of the first set of focus groups called "Gameplay scenarios focus groups", aimed at providing the game developers with general ideas and guidelines, and help them to prioritise those aspects of playability that seem to be most relevant for social tenants.

4.2 Gameplay scenarios focus groups (May 2015, Plymouth)

On the 21st and 22nd of May 2015 the first series of focus groups for the design of the EnerGAware serious game took place in Plymouth (UK). The aim was to gather information of the social tenants' gameplay habits, expectations and preferences, as well as their feedback and input on the first EnerGAware serious game concepts presented as gameplay scenarios.

Participants were drawn from the DCH voice network at Plymouth, which is one of the DCH residents' associations. These associations consist of a group of residents in a certain area who meet to discuss various local issues, organise social events and campaign for improvements.

Three different focus groups were undertaken:

- 21st May (morning session), at Plymouth University. Group of 60 + years old social tenants.
- 21st May (evening session), at DCH Foyer. Group of 16 to 21 years old social tenants.
- 22nd May (afternoon session), at Plymouth University. Group of 30 to 50 years old social tenants.

The three focus groups had the same agenda, which consisted of the following sessions:

- Welcome presentation, overview of the EnerGAware project, objectives of the focus groups, ethics and consents.
- Gameplay scenarios focus group.
- Open discussion, Refreshments and Conclusion.

The focus groups started with a "welcome and thank you for partaking" message and a brief introduction to all the participants. This was followed by a general overview of the EnerGAware project, including the objectives and purpose of the gameplay scenarios focus group. Project partners involved in the focus groups made the participants aware of the ethical procedures under which the gameplay scenarios focus group took place. Participants were asked whether they agreed to the focus group being voice recorded. Participants were also made aware that by taking part in the focus group they consented to being involved under the ethical conditions outlined. In all focus groups, all participants remained in the focus group and accepted the ethical conditions.

The introduction was then followed by an open discussion about the gameplay habits of the participants, covering whether they played games or not, which games they played and why they chose to play these games. This discussion was complemented by a display of fourteen short video clips (30 seconds) of existing games with different genres; types; etc. These videos were used to start a conversation with the participants about whether and why they had played any of those games before, and whether they would be interested in playing those games that had not been played before. This discussion helped the game developers to gather information of the habits and preferences of the social tenants when choosing a game to play.

Later, the game developer partner explained why the gameplay scenarios focus groups are important in the pre-production phase of the EnerGAware serious game and the contribution that the social housing tenants were making to the game's development. The different characteristics of games were presented to the participants to see which ones the social housing tenants liked or preferred. For example: Local solo vs. Online Multiplayers; Competition vs. Cooperation; Long vs. Short game sessions; Action vs. Reflexion; 2D vs. 3D graphics; Game Universe – Science fiction/fantasy/modern world and Serious/Realistic/Cartoon/Fun. See Figure 38 to Figure 44.

Figure 38. Local Solo VS Online Multiplayers.

Street Fighter

A versus fighting game

Call of Duty

Team up with friends in gunfights.

Figure 39. Competition VS Cooperation.

Minecraft

A sandbox, just do what you want

Candy Crush

A free to play puzzle game

Figure 40. Long VS Short game sessions.

Tom Raider
Fast-paced adventure game

Criminal Case
Investigate to solve crimes

Figure 41. Action VS Reflexion.

Move on 2 plans, locked view

Move on 3 planes, free view

Figure 42. Graphics: 2D VS 3D.

Figure 43. Game universe Part 1.

Figure 44. Game universe Part 2.

Three initial concepts for the EnerGAware serious game were then presented to get the social housing tenants feedback on the ideas and which they preferred. Concept 1 – Home Sweet Home; Concept 2 – Beyond Space; and Concept 3 – Do it like Lemmings (See Figure 45). The social housing tenants commented on the ideas, providing feedback and possibilities for modification and development.

Figure 45. Initial concepts for the EnerGAware serious game.

Note: these images were only used to symbolise game concepts, they do not represent the actual design of the EnerGAware serious game

Concept 1 – Home Sweet Home consisted of a family and management game. It aimed at improving a house to be more efficient, and keep its inhabitants happy and in comfort.

Figure 46. Concept 1 mechanism.

The following mechanics were included in the concept:

- Earn money to upgrade the energy efficiency of the house.
- Teach the avatar good habits regarding energy consumption.
- Save energy in the real world.
- Team-up with others players in neighbourhood and take part in energy saving contests.

Concept 2 – Beyond Space consisted of a spaceship management and space exploration game, where the spaceship was an analogy to the house and saving energy was the only way to go further in deep space.

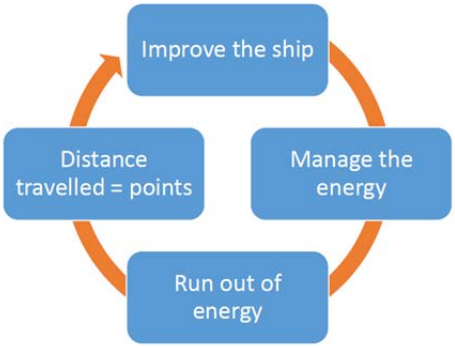

Figure 47. Concept 2 mechanics.

The following game mechanics were discussed:

- Each part of the vessel represents a part of a house (e.g. Cryogenic pods = fridge; Shell = wall).
- Try to travel as far as you can on each attempt.
- Discover planets and their inhabitants.
- Team-up with others players to cooperate.

Concept 3 – Do it like Lemmings consisted of a puzzle game where the player guides energy and tries to avoid waste. The player has to help little creatures, representing energy, to reach the exit of each level. Bad habits make lose creatures. There are different creatures, with different behaviours.

The following puzzle examples were discussed:

- A TV on stand-by mode makes you lose creatures → Turn it off with a specific creature.
- The heating is on and a window is open, which blows the creatures away → Close it with a specific "closer creature".

4.3 Recommendations for the EnerGAware serious game design

The overall conclusion of the Gameplay scenario focus groups was that the social housing tenants would prefer a "Sim's like" game. This type of game focuses the player's attention of managing a home: both the house and the characters.

Characters have constant needs (eat, sleep, wash, social interactions, etc.) and house equipment is needed to meet these needs. A variety of characters' behaviours and situations make the game attractive to players. The possibility of customizing the house also attracts the player as it promotes his creativity. As already discussed with the participants in the focus groups and taking into account that the EnerGAware project does not have enough budget to directly compete with "The Sims" franchise where every episode may cost several tens of millions dollars budget, considering industry standards), the EnerGAware serious game will be a simpler and more restrictive version of the Sims with several features missing. However, the possibility of customizing the house is considered to be important and thus, it will be kept. And of course the game would count some elements that are not present in the Sims: energy management, real-energy consumption link, and other elements to be designed to balance the game and make it fun and engaging, despite the fact that there would be less content and less features than in "The Sims".

Several other recommendations were gathered from the discussions with the participants. Those that were common to several participants are described below.

Fun

The characters in the game could turn into ice cubes or put jumpers on if they get too cold because the player does not heat the house at a sufficient comfort level. Snow and polar animals (penguin, polar bear) can also appear in the house in such a situation. If the internal temperature is too high, lava or heat wave animation could be used to display this situation.

The focus groups participants thought the game should be funny, not too serious.

Easy access

The focus groups participants suggested that the game should not take the player to the beginning if he/she fails/game over.

It was also suggested that a free demo version of the game should be available to help people decide whether they would like to install it or not. It implies that they may be willing to pay for a full version of the game.

It was also mentioned that the interface design is important.

Game Impactful

The focus groups participants suggested that:

- Consequences of the player's actions should be evident in the game.
- Health aspects related to energy consumption and comfort at home should be included in the game. For example, the characters might get respiratory diseases or hyperthermia if a suitable level of comfort is not achieved.
- The game should allow players to understand and learn how to compare energy deals from different providers.
- The game should allow players to understand and assess the impact of the energy-efficient and behaviour change actions. For example, the game could have an indicator that shows potential increase or decrease in energy consumption before an action is done.
- The game should include features to allow the player to tailor the construction of the virtual house as well as manage the life to the occupant.
- The game should help players to quantify the cost of their actions, for example the cost of running a bath.
- The impact of the energy-efficient and behaviour change actions on the energy consumption should be expressed in currency (money) and environmental related indicators.

Educational

The focus groups participants mentioned that some social tenants use games to play with children to educate them. This could be an aspect to consider for the design of the EnerGAware game, as it could be perceived as a tool to educate new generations on energy-related topics.

It was suggested that the game should allow players to learn how to balance energy use with occupant's comfort, as it could have a direct influence on life/health aspects.

Cooperative

The focus groups participants suggested that the game should allow friends to cooperate together or compete to save energy.

It was also suggested that the game could also allow players, by means of social media paltforms, to ask for lives to other online players as well as reward others online.

Short

The focus groups participants preferred short games sessions. The tenants played games to get short term satisfaction and make time go quicker.

A universe close to reality

All focus groups participants preferred to have the game situated in a modern world instead of science fiction world or fantasy world. They suggested that the game needs to be "quite realistic", meaning that it should take place on the Earth and involve human characters (not aliens or strange creatures).

5.IT device selection

To be able to effectively gather evidence of the impact of the game on people's awareness, the experimentation requires providing each tenant with the same tablet containing the game.

In order to select the most suitable tablet for the deployment of the EnerGAware serious game, several tablets were analysed. The analysis focused on those tablets satisfying the following preliminary requirements:

- Tablets must be currently available in the English market.
- The customer service must be easily reached.
- Contact points between vendors and tenants must be physical.

Finally, twenty-six tablets were analysed (see table 1) placing special attention to the technical characteristics (mainly graphical performance) and the purchase cost.

Table 1. Analysis of tablets.

Rank	Graphical performance	Price (£)
iPad Air 2	100%	399
NVIDIA® SHIELD™ TABLET	90%	240
Nexus 9	81%	299

Rank	Graphical performance	Price (£)
Xperia™ Z3 Tablet Compact	50%	269
ASUS MeMO Pad 7 (ME572C)	47%	179
iPad Air	41%	319
Samsung Galaxy Tab S 8.4	40%	249
Advent Vega Tegra Note 7	40%	130
iPad mini 3	35%	319
Asus Memo Pad 7 (ME176CX)	35%	120
Tesco Hudl 2	30%	99
Samsung Galaxy note 8	26%	299
Nexus 7	25%	199
LG G Pad 8.3	25%	199
Asus Fonepad 7 LTE	20%	199
Barnes & Noble Nook HD	15%	159
Asus Memo Pad 8	15%	170
Acer Iconia Tab 10	10%	179
iPad mini	8%	199
Tesco Hudl	8%	119
Archos 80 Titanium	8%	130
Kindle Fire HD 7 (3rd gen)	7%	119
Acer Iconia A1	7%	149
Amazon Kindle Fire HD 8.9-inch (2nd gen)	5%	230
iPad mini 2	----	239
GoClever Tab R974	----	179

After the analysis, the most cost-effective IT devices that meet the project requirements from the game development constraints point of view were found to be the ASUS MeMO Pad 7 (ME176CX) (£120) and the Tesco Hudl 2 (£99). In order to analyse if these tablets could run a 3D game meeting the expectation of a player in 2015, a technical test was undertaken in both tablets.

The test consisted in playing four games developed with the Unity 3D engine:

— Lara Croft: Relic run

This is a temple run type game where the player controls Lara Craft while she runs continuously across different environments. The player has to jump, slide, avoid danger

and shoot at monster to search relic. Thus, this is a fast pace game where the environment move very fast and are rich in details. In this game, humanoid animation, close camera and 3D collision are used.

— Vega conflict

Vega conflict is a game where the player manages a space station/base and a fleet of star ships. Player's base can be attacked and the player can attack other bases and fleets. This is a management game, which is relevant for EnerGAware comparison. The camera is from above the action and buildings and ships are really detailed. This game offers the possibility of having a lot of graphical elements at the same time on the screen.

— The Sims Freeplay

The Sims is a game where the player manages a family and their home. The player can tell them what to do, give them a job, change elements in the house. In this game, the player can also manage a mini-city with elements such as a garden or a fire station. The city can be improved by adding new houses and new citizens. Being similar with what is devised for the EnerGAware project, Sims Freeplay has humanoid animation and lots of graphical assets, including home visualisation and lighting.

— Hearthstone

Hearthstone is a card game in the universe of the famous "World of Warcraft". Having millions of players around the world, the main game mechanic is based on a fight with cards against other player or against the computer. The game is well-animated and seems to be highly demanding in terms of graphics.

Tests revealed that the Unity3D engine properly run in both the Tesco and Asus tablets. The graphical rendering was also found to be at a similar level in both tablets. ASUS MeMO Pad 7 (ME572C) was found to be able to run all the games without problems. Tesco Huld 2 also performed well with the aforementioned games, except in case of Hearthstone (the most demanding game), where some slowing and struggle time was experienced.

Taking into account the EnerGAware game will be developed with the Unity3D engine and that it is not expected to be to be highly demanding in terms of graphics, it can be concluded that the Tesco Hudl 2 is the most suitable tablet. Tesco Hudl 2 offers a good technical performance for the game and the lowest purchase cost.

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