

Deliverable D4.2

PTwist reward and incentive monitoring



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Abstract

This document describes the rewarding and incentivizing methodologies and approaches and how they are integrated with the gamification tools of the PTwist platform.

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1. Introduction

PTwist main objective has always been to create a platform focused and designed along the user (user-centric approach) whilst also taking into consideration the requirements from the pilots and the defined overall project's goals. While eliciting the requirements from the different stakeholders, PTwist determined that it was pivotal to create an engaging and rewarding experience to users. It is important from the users' point of view, to have a platform that is entertaining while also offering motivation by utilizing multiple rewarding mechanisms.

As a result, PTwist was designed with a gamification approach, to fulfil these requirements. Gamification provides several advantages: it creates meaningful experience to users, users are motivated to explore and use more the platform, it rewards users for their activities, it facilitates the learning curve, among others. Thus, PTwist created several gamification approaches, most notably the Plastic Heroes game, the in-game trophy system and the PlasticToken.

One of the most interesting area of the gamification approach and PTwist, is that through the creation of a rewarding mechanism (the PlasticToken) which acts as an internal currency, it also promotes the concept of a plastic waste circular economy. In other words, through a gamified mechanism, PTwist is also tackling a sustainability challenge.

The Plastic Heroes game, the rewarding elements based on the Plastic Token and trophies, and their role in the rewarding and incentive monitoring developed in PTwist are further explained in this document. It is not part of this deliverable to explain the economic mechanism of PTwist, which will be detailed in depth in the upcoming deliverables of WP6.

2. PTwist Gamification strategy

2.1. Definition and usage of gamification

2.1.1. Definition

Gamification is the application of game-design elements and game principles in non-game context to add value. Concretely this means that gamification is implemented to enhance the function of something by making it more engaging and easier to use.

Typical elements are often descriptions, points, prizes, high scores and tasks that require interactive, play-like solutions which are then connected with the subject of gamification.

Traditional areas for gamification are the entertainment and advertising industry. Nowadays, fitness, shopping, work and learning environments often use gamified concepts.

While Gamification raises engagement, it is possible that it might lead to a habituation towards games and therefore might lower the engagement in non-gamified areas (Bendel, 2012). This fact also needs to be considered in the project.

When it comes to the topic of gamification, there are two distinctions, first order gamification (Invasive) and second order gamification (pervasive):

- 1) Invasive Gamification: This has been driven by a popularization of analogue as well as digital games since the 1960s as well as the intrusion of games into fields reserved originally for other forms of media and practices.
- 2) Pervasive Gamification: This is the deliberate and purposeful inclusion of gameplay elements (generally digital game elements and mechanics) into non-game related fields and disciplines for increasing engagement.

A related topic is Serious Games, which are games designed for a purpose other than just entertainment as they use fun and competition as an additional incentive to learn. Different designers and academics use different terms when talking about serious games, such as “persuasive games”, “games for change”, “applied games” and so on. According the book **Games, Game Design and Games Studies**, the two most important aspects for the transfer of knowledge in digital games are:

- 1) The exploration of the fields of study, mechanics, story, aesthetics, technology and transmedia in the context of serious games.
- 2) Placing serious games in the history of digital games as well as the history of culture and media.

Mechanics: Mechanics are the ways and methods that the player interacts with the game. Mechanics together provide a game’s core gameplay loop. In the context of serious games, designers should consider in what ways do the game’s mechanics limit, prefigure, or counteract the message that the game wants to send, and should consider designing mechanics and gameplay loop which can properly and effectively send the message.

Story: Story and narrative focuses on the series of events that unfold within the game world and on the double structure of spatiality and simultaneity of actions spaces. In the context of serious games, designers should consider how the game's story and narrative effectively be used for learning, especially when compared to other forms of textual or visual media.

Aesthetics: In serious games, unlike in commercial games which can base their aesthetics in fiction and non-reality, the aesthetics generally have a connection with reality since the players are learning real-world processes, knowledge, or skills. Therefore, it is important for serious games to clearly distinguish between reality and fiction in order for the players to learn the right thing.

Technology: Since the process of learning depends upon the reduction of the extrinsic load, the advancement of technology and interaction design directly affects the efficiency and success of learning. Provided a certain realism of action is retained, the main obstacle in the way is that to what extent the reduction in the complexity of the real-world processes and methods affect the transfer of knowledge.

Transmediality: Serious games are more embedded in social and cultural processes than entertainment games, since the players learn real world knowledge and not just get entertained. Therefore, designers of serious games require research and understanding of how to combine theoretical and practical knowledge with game design principles.

Plastic Heroes (*Ch.2.4*) is an example of a Serious Game. A formal distinction between Serious Games and Gamification on the one hand, is that serious games are fully designed games that is designed for the purpose of teaching, training, raising awareness, or advertisement. These games intend to deliver their knowledge in a playful and engaging way. Gamification, on the other hand, is the appropriation of digital game elements into non-game related areas in order to increase engagement and provide motivation.

2.1.2. New technologies and gamification

Through smart phones, gamification has reached new dimensions and can be found in any part of life today. In the context of this project, gamification will be applied to teach about environmental pollution, recycling and other related topics.

Therefore, gamification will be used for the following reasons:

- **A higher User Engagement and Motivation:** the intrinsic motivation to learn about the environment should already be there when downloading the application. An additional extrinsic motivation in form of a gamified fun application can support this process.
- **Higher Memory Recall:** it is easier to learn things within the protected environment of a game, and while users receive less information, more of the information they get is remembered later (Growth Engineering, 2019). The reason for this is that the part of the brain responsible for memory recall is the same part that gets stimulated during play.
- **An Emotional Connection:** gamification forges an emotional connection from the player. It makes the content, in this case environment, more relevant to the player by tying it to the game (Growth Engineering, 2019). Dopamine and Serotonin released while playing games creates positive associations between the game and the desired learning effect.

In recent years, gamification has seen a rapid growth in adoption in various non-game related fields and disciplines, as well as a growth in research and development in the topic. It has grown from being a novel idea into a thriving field. The common practices of gamification helped several organizations to avoid certain

pitfalls and have increased employee moral and engagement. In understanding gamification, several game elements (leaderboards, levels, badges, etc.) have been selected, appropriated to fit the context, and used to see if it increases engagement.

In this process, six major contextual types of rewards in gamification have been identified. These include:

- 1) **Fixed Action Rewards:** This is when the player successfully completes a task and gets the exact same reward they expected to get from competing said task.
- 2) **Sudden Rewards:** This is the type of reward that is given out as a surprise to the users during gameplay
- 3) **Random Rewards:** This type of reward is similar to Fixed Action Rewards. The difference lies in the fact that the user does not know what reward they will receive. It is only revealed once the player is being rewarded
- 4) **Rolling Rewards & Rolling Penalty:** Rolling Rewards and Penalty go from one player to another with the intention that a winner occurs solely by chance.
- 5) **Social Treasure:** This type of rewards can only be given to a player by another player.
- 6) **Reward Pacing:** This type of reward is given out a piece at a time instead of all at once

2.1.3. Goal: Gamification for learning and sustaining user engagement

Currently, there are a lot of issues with waste management in the European Union, with only 30% of plastic waste being recycled (European Parliament, 2018). This is especially critical concerning the fact that most plastic which recycled downgrades in its quality is. Even though the European Union has a working waste disposal system, a significant part of its trash lands in oceans disturbs local ecosystems and, currently, is the predominant marine litter type in the Eastern Mediterranean Sea (Kordella, Geraga, Papatheodorou, E., & Mitropoulou, 2013).

The goal of this project is to use gamification, and to an extend serious gaming, to increase user engagement among people learning about recycling. In PTwist, the buying and selling process of the PlasticTokens (See Ch.2.2.) is the main technology used to enhance engagement. The in-game currency in Plastic Heroes can be converted to PlasticTokens and therefore gives each user an incentive to play the game.

The main goal of gamification in this project is to create extrinsic reinforcements like “playing the game to save the environment”, which works well as the target group is already interested in environmental issues. This reinforcement, over time, will lead to the more intrinsic motive to not just play the game to support the environment, but also because it is *fun*, to raise one self’s skill level in the game and to, eventually, finish it.

2.2. Monetization scheme in PTwist game and platform (internal economy)

2.2.1. Definition of the PlasticToken

Blockchain is a new and state-of-the-art technology that has been developed mainly for cryptocurrency like Bitcoin, Ethereum and so on. The technology involves having a list of records named blocks and are linked to each other using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp of the transactions, and the transaction data. PTwist will make use of this cutting-edge technology for PlasticTokens (the cryptocurrency used by PTwist) and the PWallet to maintain immutable plastic reuse transactions records in a decentralized ledger capable of supporting plastic reusable materials, products

bargaining and transactions. The PlasticTokens can be purchased on the platform and the Pwallet can store the cryptocurrency for individual and/or community use.

A big advantage of using blockchain instead of other technologies is in its resistance to hacking and malicious modifications. This is due to, as discussed above, the usage of timestamps and hash pointers that link the last block to the previous one. By design, any modification made in one block compels the regeneration of the following blocks in the chain, which is an extremely hard and exhaustive process to complete. This would ensure that any activity performed on the blockchain will be legit and honest.

PTwist intends to be a global platform where anyone can participate and join the PTwist community.

Moreover, there are other ways to obtain PlasticTokens, in order to keep the economy going, plastic is being recycled, and so that people have other avenues to earn PlasticTokens. Some of these include:

- 1) **Responsible Choices:** Although retailers might not sell plastic-free products, the platform encourages retailers to do so by integrating a subvention system for the retailers, who disclose the plastic impact of each of their products, will get certain subsidies on their products.
- 2) **Rewarding:** As an incentive of gamification, the players will be rewarded PlasticTokens for completing certain tasks and achievements.
- 3) **Event Participation:** Another way of earning PlasticTokens is through participation in various events that will take place, in accordance with the PTwist Consortium. Various events will be organized regarding plastic and reusing/reducing/recycling plastic waste. Winners of these events will receive certain amount of PlasticTokens (based on the event/competition).

2.2.2. Circular economy and the PlasticToken

Circular economy is an economic system aimed at minimising waste and maximising the use of resources. Whether a circular economy is more sustainable is still to be discussed, especially on a social level. However, on an environmental level it can be argued that the minimization of resource use is always an improvement in terms of sustainability compared to a linear economic model. Additionally, with the current climate change and plastic waste issues, such circular economies have increasingly started being adopted by various organizations and also some nations.

Blockchain technology is a booming area of technology. PTwist responds to this call of action for an ambitious redesign with a longer-term view of the plastics value at a stake and intensive collaboration among various players, with the help of its foundation in blockchain. The platform aims to establish a circular economy between the consumers and retailers, sustained by supply-and-demand. The consumers obtain the plastic waste through various sources. These sources include plastic bottles, plastic bottle caps, containers, straws, etc. The consumers then can then find various avenues and PTwist partners to sell the plastic waste to, which after confirming the quality of the plastic, the users will receive newly generated PlasticTokens, which they can use to convert to real currency and to purchase items from the marketplace.

The retailers can then then reuse this plastic waste to create various different objects and items, which they can then sell on the PTwist platform, on the marketplace. The items can have a fixed price, or can have a bidding structure, where the users can bid for the item.

2.2.3. Usage of PlasticToken

A merchant-like service will be integrated to the blockchain payment scheme through the Plastic Inventions e-shop module. This module is connected to the Tier 1 gamification module, which reach the peer-to-peer blockchain layer by passing through the processing middleware layer. Once the transactional information is in the P2P blockchain layer, the e-payment processing is done and the information is recorded in the blockchain, which becomes available for the payment scheme users.

The gamification tools and methods exploited in PTwist will include virtual rewards, real rewards and in-app communication chats, which the players can access on the platform to view their rewards and PlasticTokens progress. PTwist will impact the blockchain's adoption by a cross-discipline approach which will monetize a seemingly ordinary thing (plastic) for twisting it to an asset which re-enters and drives the circular economy.

PTwist progresses as in EU plastic circular economy mobilizing action which will uptake disruptive technologies and generate both social and commercial change. This is due to the experimentation of monetizing of plastics and incentivizing approach along with new social empowerment mechanisms, which will advance user motivation and engagement.

2.3. Game design elements

2.3.1. Rewarding tokens

Tokens are rewarded for ecologically impactful actions and are saved in the PlasticWallet. Additionally, a leaderboard will be developed to motivate the users to improve their performance.

In order to make the rewards in the new payment scheme effective, the gamification component is integrated into the blockchain through special operations designed to instruct the network that a new reward has been earned and hence must be transferred to the user. This provides a reliable and secure transfer of rewards and a comprehensive integration of the blockchain with the gamification to enhance PTwist's engagement.

Furthermore, having a global leaderboard will be developed to enable the players to see where they rank with other players around the world and encourage them to improve their performance. The PlasticTokens which will be used during the pilots will provide data for leaderboards and engage players to be more active and efficient in the platform. Based on other user cases and piloting requirements, gamification technologies and experiences will be reached during the implementation of the project.

2.3.2. Badges and points (trophies)

Rewarding players can be a powerful tool to upkeep long term motivation and give the player a red thread through the game (Hamari, 2017). If a game contains any kind of "badges" or trophies, users are much more likely to post, carry out transactions or comment. Their activity in the games is also significantly higher (Hamari, 2017). Therefore, it is crucial to root this mechanic in the game.

2.3.3. Interactivity

Developed gamification methodologies are applied in this game to encourage behavioural change of users towards plastic reuse and create a self-awareness regarding the environmental footprint of their actions.

This game will have left the “gamification” spectrum and is a full serious game. It is completely interactive and, while having a narrative, ties it in into the interaction and focuses more on ludic elements.

As with any game, digital or analogue, User Experience is an important aspect, which can determine how effective and engaging the gamification methods are. Gamification is especially hard, since designers have to find a perfect balance between fun and the tone of the subject matter. To address this, designers should consider “Player-Centred Design”. Knowing and identifying the users is vital to get gamification right. The gamification elements should suit the user’s personality and motivations. Therefore, when implementing things like scoring, leaderboards, points, badges, etc., designers should ensure that the mechanics enhance the user’s experience.

A good way to do this, and is used by several companies, is creating personas. Personas are fictional characters with various different personality types (age, gender, ethnicity, occupation, likes/dislikes, hobbies, etc.) in order to test whether or not they would use or like the product. Good gamification would engage the most types of users and increase moral and productivity.

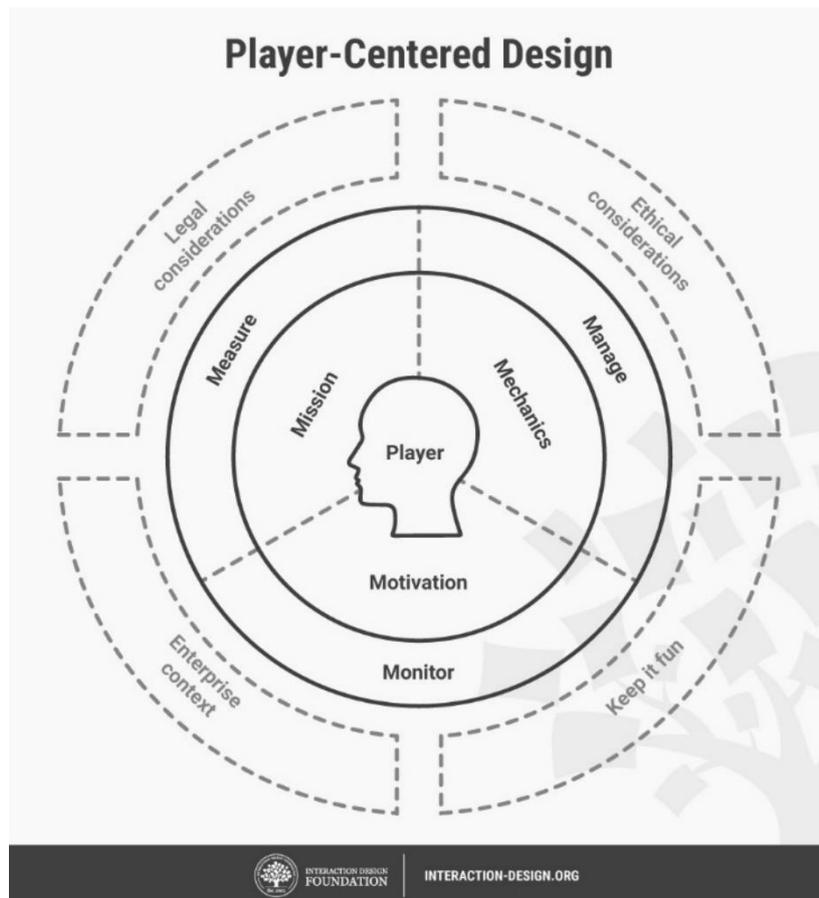


Figure 1: <https://www.interaction-design.org/literature/topics/gamification>

2.4. Plastic Heroes Game

Plastic Heroes is a game where players can interactively learn about plastic waste, different types of plastic and, of course, recycling.

The player controls an individualized 3D avatar who is a member of the “Plastic Heroes”. His goal is to protect the environment and teach about the topic, or, more specifically, about different aspects towards plastic reuse practices. Controlling the hero is done via tapping the screen to either move him or tap the screen on an interactive area to interact.

2.4.1. In-Game Avatar

The player can create their own custom in-game avatars in Plastic Heroes. The purpose of this is to make the experience more personal and engaging for the players. The players can select from various parameters such as gender, hairstyle, hair colour, skin colour and so on, as illustrated in **Figure 2**.

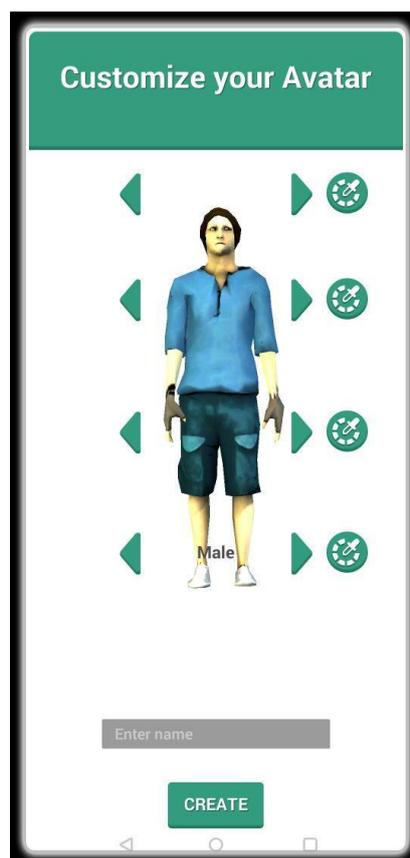


Figure 2: Screenshot of the avatar customization page

2.4.2. Outdoor Missions

Missions are usually carried out on the beach, in forests, parks or other environmentally impactful areas. The player must collect as much plastic as possible in a given time frame and gets special rewards for exceptional success. The area is full of various plastic waste with different types of plastic. When the user comes close to an object, they can pick it up. When they pick up garbage, an image of what the user has pick up will be displayed (straws, plastic cutlery, bottles, etc) as well as the type of plastic said object is made of (PVC, HDPE, PP, etc). The players are required to memorize the object as well as the type of plastic it is made of. Throughout the level are different enemies moving around. If the player comes in contact with an enemy, they are stunned and cannot move for some time. The players are required to avoid enemies. Finally, there are various power-ups in the level which can help the players collect more plastic waste. These include magnet (which causes nearby plastic waste to gravitate towards the player) and speed boost (making the player move faster for a certain about of time).

At the end of outdoor missions, the player will confront the people who cause the pollution. He can then teach them by telling them real facts, which the player has to choose from in a multiple-choice sheet. Those quizzes can be trained in the Hero Base as well.

2.4.3. Hero Base

The player has a “Hero Base” that he returns to after each mission and where he can recycle trash. He can use the recycled plastics to print new, more valuable objects via a 3D printer or craft new objects manually and then later sell them for PlasticTokens or use them as decoration on the base.

The player then returns to the Hero Base, where he can choose between different activities:

- Choose another outdoor mission or replay any unlocked ones
- Recycle trash by looking at items and identifying which type of plastic it is.
- 3D print objects with recycled plastics
- Craft objects with recycled plastics
- Decorate and upgrade the Hero Base and the avatar with objects.
- Sell the objects to earn PlasticTokens
- Look at his laptop to learn more about plastic waste (This is linked to external sources)

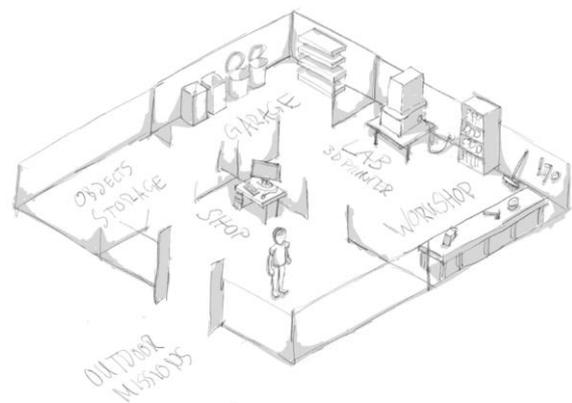


Figure 3: Wireframe of the Hero Base in the game

2.4.4. Identifying Sorting Plastic Waste

Within the hero base, the player can sort out the plastic waste they have collected in the outdoor mission. This starts a mini-game, wherein the player must correctly put the waste in their respective garbage can. If the player correctly identifies the object and its plastic type, the player can use it as raw material. If the player is wrong, the plastic item is lost.



Figure 4: Mini game for sorting plastic

2.4.5. 3D Printing

The player can also access the 3D printer, also present in the hero base. When the user correctly sorts plastic waste, they will get raw material. The player can then use this raw material for printing 3D objects. The game offers several various objects they can print, all of which require a certain number of a particular type of plastic. If the player has the required amount and the blueprint, they can print out the object. After that, the player can sell these objects to earn in-game currency.

2.4.6. Quiz and Knowledge Base

The knowledge centre is where the player can gather information about plastic use and plastic waste to better understand the concept. The player can also take quizzes. Questions to the quiz can be added to the database using the Nuro Question Tool.

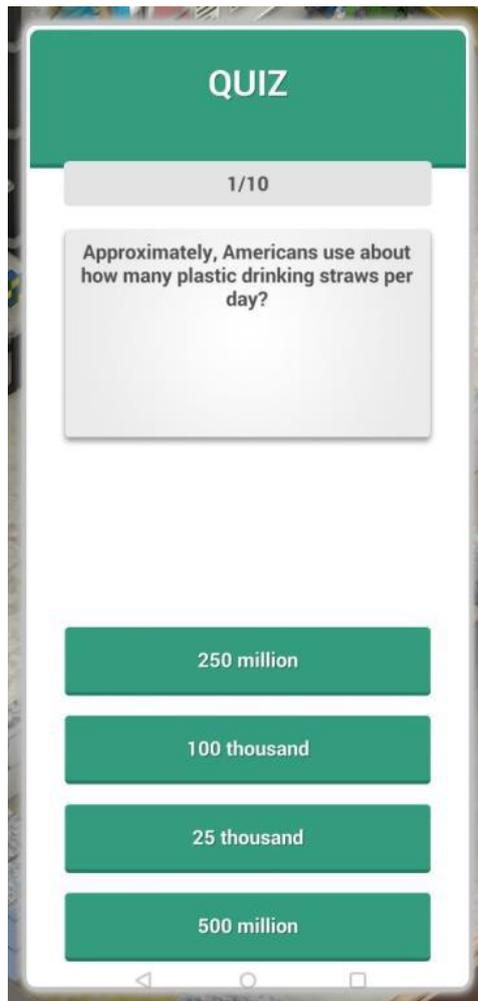


Figure 5: Screenshot of the quiz mini game

Through all those actions, the player can gain experience points. On a Level Up, he can then receive blueprints for different objects, unlock new outdoor areas and more PlasticTokens. PlasticTokens may also be used to unlock those parts of the game.

There will additionally be a leaderboard system implemented on the PlasticTwist Web Platform where users can compare their statistics.

3. Rewarding element based on token (game mechanic)

3.1. Goal of earning PlasticTokens

The usage of the blockchain technology for creating a utility token (or the internal cash of PTwist) called PlasticTokens, is related to two objectives of the project: reintroduction of value to plastic waste and another mechanism of gamification.

On one hand, plastic waste is usually perceived as worthless and useless by a considerable percentage of the public. In addition, the European Union (*A European Strategy for Plastic in a Circular Economy*, 2018) has reported that less than 30% of plastics are recycled in Europe, that between 150,000 and 500,000 tonnes of plastics are thrown to the ocean each year and that only 6% of the plastic demand in Europe comes from recycled plastics. This situation shows that there is a necessity to reintroduce plastic waste into the supply chain, by transforming it into an asset. In PTwist, this is done by monetizing plastic waste with our own internal currency, PlasticToken.

On the other hand, PlasticToken was created also as a form of gamification. By rewarding users for their actions and activities, PTwist promotes the usage of the platforms whilst also improving the engagement with users. In other words, it keeps the experience fun!

3.1.1. Circular economy and Reintroduction of value to plastic waste

As already explained in sections above, circular economy is the economic system idea that by design seeks to minimize waste to the maximum and utilize resources to the maximum. It tries to transform a challenge into opportunities for innovation and new ideas.

The concept of circular economy challenges the adopted linear economy and seeks to address several sustainability challenges. It also unlocks various benefits of the community apart from sustainability, such as “new business opportunities, creates local low and high-skilled jobs, social integration, clean products and others” (European Commission, Internal Market, Industry, Entrepreneurship and SMEs). It involves all the actors in the market chain, from consumers, producers and retailers.

One of the current problems of the linear economy and waste is plastic waste. The “escape” of the plastics value from the economic system is critical. To illustrate, according to the European Union, in the European union “95% of the value of plastic packaging material, i.e. between EUR 70 and 105 billion annually, is lost to the economy after a very short first-use cycle” (European Commission, *A European Strategy for Plastic in a Circular Economy*, 2018).

In consequence, The European Union has defined that plastic waste is one of the key priorities to tackle (European Commission, n.d.). The objectives defined by the EU doesn't only include the recycling aspects, but also demands for the reduction of plastic waste, re-usage, develop a market for recycle plastics, better standards, collection standards, among others. In other words, create a circular economy for plastic waste, by reintroducing value to previously “unwanted and worthless” waste.

It is precisely this situation that PTwist seeks to tackle, change the mindset from plastic waste to plastic asset, that can be capitalized and monetized. One of the ways that PTwist monetizes plastic waste, is by creating a token (which is like a cryptocurrency). Using the high-end technology of blockchain, PTwist creates a utility token (the PlasticTwist) to reintroduce value to plastic waste. For example, users can sell their plastic waste on the Marketplace for PlasticTokens, instead of throwing it to the trash. Another form is by leaving plastic waste on defined areas, where the users will be able to earn PlasticTokens.

Because of this system, users are incentivized to see plastic waste no longer as a trash but as an asset, that can be traded for PlasticTokens or for other elements. Users are then rewarded with the internal currency when they do actions that have a positive impact in the environment.

3.1.2. Gamification

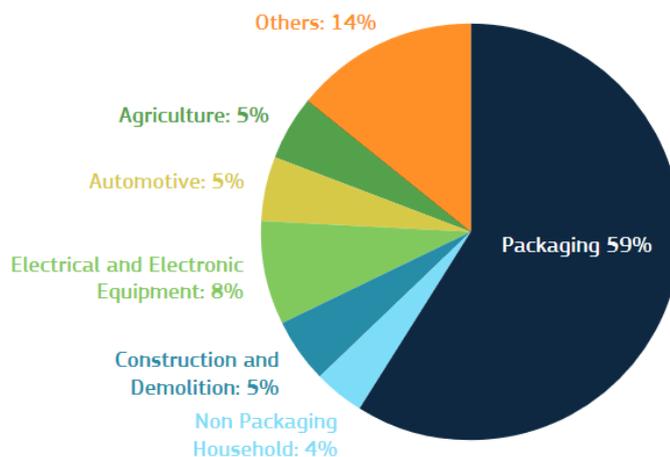
As mentioned in Ch.2.1, Gamification leads to a more productive learning environment, drastically enhances memory recall, makes learning more engaging and keeps the player emotionally committed towards a topic. In this chapter, a more in-depth analysis will be conducted.

A higher memory recall is proven by multiple studies (Growth Engineering, 2019), (Ninaus, Pereira, & al., 2015). While it is not possible to raise the maximum working memory capacity of an individual, gamification facilitates a person's performance closer to their maximum capacity. This is possible because the Hippocampus, the part of the brain that triggers both short- and long-term memory recall is also highly stimulated during play.

Those studies have also shown that, additionally to this, users' abilities and willingness to train is higher if gamification is implemented. This drastically improves motivation and user engagement through extrinsic motivations. Over time, the extrinsic motivation "I want to get the token" can convert to an intrinsic motivation fuelled by e.g. fun, engagement or the willingness to learn about plastic waste, which is ultimately the goal of this app. An emotional connection and positive associations to the game and its content support this.

To translate an extrinsic motivation into an internal motivation, the players' motivations need to be analysed and exploited. A player who is interested in getting rewarded will be more motivated to gain tokens, while players that e.g. like exploration, conflict or narrative need to be motivated through other means (Belludi, 2015).

EU PLASTIC WASTE GENERATION IN 2015



Source: Eunomia (2017)

Figure 6: sources of plastic waste in the EU. Source Eunomia (2017)

3.2. PlasticTokens and interaction with the internal economy

PTwist economy revolves around buying and recycling plastic, via the alt-currency PlasticToken. Hence, PlasticToken are at the core of the project as they allow the exchange of recycled products with a currency that is not linked to euro in any part. Yet, as the tokens must be issued so that they circulate, it is fundamental to devise a policy about token issuance, carefully balanced so that the market will not collapse from a misguided idea.

Hence, before applying any policy, it is essential to look at the mechanisms in which tokens can be issued in our system. A clear knowledge of the mechanisms, as well as their impact, the size of their target and their financial impact will thus help the consortium to devise an economical model in phase with the market.

Three ways of issuing tokens have been identified:

- **Automatic issuing**, where coins are minted by a user via a smart contract in the chaincode. This action is the easiest one, as it does not require any human validation at any point of the process, but for the same reason it must be carefully used, as one mistake can be instantaneously used by an attacker.
- **Authorized issuing**, where coins are minted by a user, after getting an authorization by a PTwist partner. This operation implies that, for instance, a partner issues a list of people who will get rewarded (because, for instance, they participated in an event). Once the list is issued, the rewards are automatically minted in the beneficiaries' wallet.
- **Manual issuing**, where users become eligible to a reward, after completing certain tasks. Once they have met the criterion, they must come to the PTwist committee and ask for their reward. Upon inspection of the claim, the committee will then decide to give the reward or not.

One can observe that these ways range from the less human costly to the costliest, but also from the most susceptible from an attack to the least susceptible. This inverse correlation between the human cost and the risk of an attack: as there are fewer humans verifying the validity of the transactions, there will be more incentive to attack this particular scheme.

Then, we also use the following KPIs:

- Size of the target audience: a reward is more interesting if it will be claimed by many users than just a few.
- Size of the reward: users will be more interested in big rewards. However, rewards cannot all be high, as we need to prioritize the rewards, as not all actions have the same impacts.

For each reward mechanism, we identify what are the values related to these KPIs – so we can have a clear decision model.

3.3. How to earn PlasticTokens

When a new user joins PTwist, they do not earn any PlasticToken, by design: offering some amount of coins to any new user would create an obvious vulnerability, where an attacker spawns thousands of new accounts and transfers the money to their primary account). Because the PTwist economy is aimed to be decorrelated

from the Euro market, there is no official broking between Euros and PlasticTokens. This means that a new user willing to collect tokens must either contact a non-official broker, who will convert their euros to PlasticTokens for a fee, or more simply follow the path intended for earning PlasticTokens: by participating in reward-inducing schemes. Note however that while PTwist cannot prohibit non-official brokers (as it can be done by anyone without difficulties), the emphasis is put on the reward schemes. Thus, an honest PTwist user will only be able to get PlasticTokens through the reward mechanisms (or by selling their recycled assets on the marketplace). They are not able to obtain tokens in another way, nor can they sell their own tokens for euros.

In this section, we present the envisioned rewards.

3.3.1. Depositing plastic to a partner

Rewarding method: authorized

Target size: average

Reward size: average to high

Reusing plastic, and thus reducing waste is the core value of PTwist's project. Thus, users are encouraged to bring their plastic waste to the partners who accept it. The plastic can then be revalued for other purposes, such as being shredded, melted then molded into a new object, or anything else.

3.3.2. Games and quizzes

Rewarding method: automatic

Target size: large

Reward size: small

Gamification apps are already a method developed by the consortium to engage users into the PTwist ecosystem, but additional incentive can be given through rewards. For instance, without rewards, the gamification will only reach a public of people interested in games. If we add rewards, new users will also use the games, as they will be interested in the rewards. The more people play the gamification and answer the quizzes, the more they will be exposed to the related educational content. Thus, economic rewards in the gamification will increase the retention rate of the users, as they will have an additional incentive.

Every time a user completes a quiz, the server computes the user's score, and send a request to the blockchain. Immediately, based on the score, the user's account is credited with a small amount of PlasticTokens. These tokens are generated on the spot, thus creating an inflation that will allow the currency to grow along with its user base. However, in order to avoid fraud (where for instance a user generates thousands of accounts and thus thousands of tokens), there will be a limited cap on each game, so that the inflation stays under control by the PTwist committee. Similarly, for games, rewards can be attributed for completing certain specific tasks that give the user a badge, as well as some amount of PlasticTokens.

Note that both of these rewards are fully automatic: the user only needs to give their public key to the game at their first use, and then will be automatically credited by the appropriate number of coins each time they earn a reward.

3.3.3. Events

Rewarding method: authorized

Target size: small

Reward size: average to high

An event is a real-life gathering aiming to reduce plastic waste, either by educating people, or by action (collecting plastic waste on a beach, for instance). For ensuring more interest by the users, a gamification method has been implemented, in the form of rewards for the attendees.

It is desirable that the events, organized by the PTwist pilots, gather as many people as possible. It is also desirable that people who take part into these events get some awareness about PlasticTokens. Hence, participating to pilot-led events can be rewarded by PlasticTokens. Doing so will motivate people who are already in the PTwist ecosystem to participate for earning tokens, and will advertise the PTwist ecosystem to people who did not hear about it beforehand but who are nonetheless interested in the topic of plastic reduce.

Tokens thus distributed would be created on the spot, as they are for the quiz rewards. Similarly, to the quiz rewards, unlimited rewards are banned, as they would lead to a collapse of the economic model. Hence, the PTwist consortium defines some periods, and assigns budget to each pilot for the current period. During said period, each pilot is free to organize their events as they please, and to distribute the rewards to the participants as they please.

For a pilot, the easiest way of distributing the rewards would be using a semi-automatized method: the day of the event, the pilot will scan the QR code of the participants' public key. From this list, they can for instance use a script that will automatically assign a reward to every participant.

3.3.4. Days Streak

Rewarding method: authorized

Target size: large

Reward size: small

Another method for keeping the users interested in the gamification app is by giving rewards for continuous implication inside the games. For instance, if the user plays the quizzes everyday for a week, they can be rewarded with a badge, or simply with tokens. Keeping the user on the platform will help consolidating the awareness of said user, as regular sensibilization is much more efficient than punctual sensibilization.

3.3.5. Participating in the crowdfunding event

Rewarding method: manual or authorized (can be done with an external script)

Target size: large

Reward size: average to high

As PTwist goes live, a crowdfunding event will be held, to gather economic support for the future of the platform, and for spreading awareness about the project (see the upcoming Deliverable D3.4 for more details). In this crowdfunding, users will receive PlasticTokens as a gratification for backing the project. The

size of the reward will depend on the amount that has been pledged; big backers will receive bigger number of tokens.

Since we aim at largely promoting this crowdfunding event, rewards for the crowdfunding will be higher than usual, so that the early adopters will be advantaged. This simple additional reward will incentivize users to adopt the PlasticToken early, instead of waiting for the currency to grow, thus boosting the initial growth (and hopefully the future growth) of the project.

Finally, the KPIs given in the previous section are a good help for summarizing the properties of each reward, and allow for a quick comparison of their efficiency when viewed in a table display, which we present in **Figure 7**.

REWARD	EXPECTED TARGET SIZE	SIZE OF THE REWARD	REWARD MECHANISM
DAYS STREAK	Large	Small to average	Authorized
GAMIFICATION	Large	Small	Automatic
BRINGING PLASTIC	Average	Average to high	Authorized
CROWDFUNDING	Large	Average to high	Manual
EVENT PARTICIPATION	Small	Average to high	Authorized
...

Figure 7: Summary of the rewarding KPIs

3.4. A practical example

Note: the amount of the rewards given here are fictional, but the order of magnitude between the different rewards is intended.

Alice hears about PlasticTwist by a friend, Bob. Curious, she checks the website, and is interested by the topic of plastic reducing. She downloads the Plastic Wallet, but it’s empty! Bob transfers her 25 tokens as a welcome gift, and advises her to own her own tokens via the gamification app. Alice downloads the app, and starts playing. After a few moments, she gets all correct answers to a quiz. Immediately, she earns a badge and receives 2 tokens on her wallet. Thrilled, she decides to get more, and by the end of the day, she has passed level 10 of the game, earning her 5 tokens.

Later, she sees on social media that one PTwist partner is organizing an event. She decides to attend with Bob, because she is interested in meeting people sharing the same ideals. Upon arrival, the organizer asks for her wallet address. She complies and is credited 50 tokens on her wallet. During the event, the organizer talks about their next nature excursion, a trashtag day, where volunteers pick up the trash littering in the nature. They also mention that every participant shall receive 100 tokens as a thank you gift. Then, they continue and award the “evangelist of the year” award to the user who most talked about PTwist on social media, cumulating 100,000 views and 200 retweets. The user is awarded 1,000 PlasticTokens.

Finally, before going back home, Alice buys a souvenir from the event: a bookmark made of recycled plastic, with a funny face printed on it, for 30 tokens. Before she goes to bed, she registers for the trashtag event.

3.5. Plastic Wallet integration (PTwist game and marketplace)

As noted in Section **Error! Reference source not found.**, some rewards can be fully automatic, but others must be validated by some authority. And in both cases, the rewards must be limited, so that no hyperinflation can come from these rewards. For instance, the European Central Bank (ECB) seeks to reach about 2% inflation per year, but never more (Bank, 2019). As such, there will be limited amounts available for each reward. For instance, for events, each pilot will be assigned a budget that they can spend in rewards for their users. Once the budget is spent, the pilot will not be able to issue new minted tokens to the users anymore. If they still want to attribute rewards, they must do so with their own funds, by transferring already existing tokens from their account to the user's.

Similarly, the gamification app will not deliver unlimited amount of tokens: that would be an obvious default in the system, as any user would be able to create thousands of accounts, and thus collecting the game rewards via an automated script, which would pretend to be the player. As a consequence, for each game-related reward, only a fixed number of tokens can be issued each year. If all tokens have been minted, then the next user completing the badge will not get the reward. This is in fact the game mechanism behind limited rewarding systems: in many games, only the first few who complete the challenge are issued a substantive reward, while the later players get the badge proving they did complete the task, but not in the first group. This system is an incentive for players to get involved into the games, and to look for opportunities to get better, so their probability of winning early, and thus earning the reward, is higher. As such, far from being a limitation, putting a cap on PTwist rewards will instead make gamers strive for improvement.

3.6. Description of the token transfer

As described in section **Error! Reference source not found.**, three methods for giving the rewards to the user have been identified. For each of these methods, the token transfer will be different.

3.6.1. Transfer for an automatic reward

This reward is triggered when a smart contract is activated on the blockchain. For instance, let us assume that there exists a smart contract in charge of gathering funds for an NGO: if a user wants to donate, their just activate the smart contract, with an amount of their choice, and said amount will be transferred to the NGO account. Assume furthermore that the PTwist consortium has decided to encourage this NGO, so that for each donation, the NGO will also receive the same amount of newly minted tokens (up to a certain amount).

This can be trivially coded in a smart contract, in which the additional reward for the NGO is hard-coded in the smart contract. Note that only members of the consortium should be able to write such contracts, but this restriction is natively taken in charge by the underlying blockchain Hyperledger Fabric: the chaincode is issued by the consortium, and as such they have a total control of the smart contracts

3.6.2. Transfer from an authorized reward

In this situation, the reward is given if and only if it has been approved by a member of the PTwist ecosystem. For the gamification, most rewards will be of this kind, with the approving member being NURO: as the user

completes a challenge giving him a right for a reward, NURO is immediately notified via the gamification app. Then, the rewards are triggered by NURO using a specific smart contract deployed on the blockchain. The smart contract can only be triggered by one PTwist member, each member having their own smart contract.

The implementation is as follows: each partner is attributed a limited number of tokens they can issue each year. The funds do not exist before they are given as a reward to users, but are stocked in a smart contract. During the event, the partner determines the amount of the reward each user will receive and informs the smart contract of that amount. When a new user comes to the event, they simply present their public key to the partner, who will scan it and send it to the smart contract. Upon reception of the user's public key, sent by the partner, the smart contract will automatically issue the tokens to the user on their wallet. In the case of the gamification app, the user will simply indicate their public key once, and will then receive the awards as they play with the app.

3.6.3. Transfer from a manual reward

Similarly as for authorized rewards, the consortium (and/or pilots) will dispose of a smart contract with a limited amount of tokens-to-be. Once a user completes the tasks required for the manual reward (see Section 3.2), they will inform the consortium of the fact, via the channel of their choice (mail, social media, etc.). Upon reception of the claim, the consortium will inspect the claim and the provided proofs, to see if the user is indeed eligible to a reward. If such is the case, then the reward mechanism will be exactly the same as for an authorized reward.

Note that for both authorized reward and manual reward, there is no risk of leakage where an attacker finds a way to steal the tokens, as the tokens do not exist before they are awarded. Furthermore, the rewards are activated by a transaction made by the partner, and as such, signed by their private key. Hence, an attacker cannot maliciously use these smart contracts.

4. Rewarding element based on trophies-points (game mechanism)

4.1. The PTwist award trophy system

Plastic Heroes offers a variety of badges and achievements that are rewarded to the players for completing certain tasks. Some of the badges are relatively easy to get, while some take more time and effort. The badges that the player gets in Plastic Heroes will be displayed on that player's online platform account, where others can see them as well. Badges and rewards aim to give the players some form of motivation to play and complete tasks. Additionally, badges are one of the most visible elements of gamification. When designing badges for any game, there are four principles:

- 1) Balance delight with aspirational, predictable achievements
- 2) Design for visual appeal
- 3) Leverage scarcity principles
- 4) Integrate tightly with a larger system

There are a few rewards for good gameplay in Plastic Heroes. Good gameplay is defined by saving the in-game environment as good as possible. The rewards are:

- 1) **Outdoor Mission Badge:** This badge is awarded to the player for completing beach mission for the first time.
- 2) **Quiz Completion Badge:** This badge is rewarded when the player completes a quiz with all correct answers.
- 3) **Plastic Collection Badge (Total):** This badge is rewarded to the player when they collect a certain number of badges in the game.
- 4) **Plastic Collection Badge HDPE:** This badge is rewarded when the player collects a certain number of HDPE plastic
- 5) **Plastic Collection Badge LDPE:** This badge is rewarded when the player collects a certain number of LDPE plastic
- 6) **Plastic Collection Badge PS:** This badge is rewarded when the player collects a certain number of PS plastic
- 7) **Plastic Collection Badge PVC:** This badge is rewarded when the player collects a certain number of PVC plastic
- 8) **Plastic Collection Badge PP:** This badge is rewarded when the player collects a certain number of PP plastic
- 9) **Plastic Collection Badge PETE:** This badge is rewarded when the player collects a certain number of PETE plastic
- 10) **Plastic Collection Badge Other:** This badge is rewarded when the player collects a certain number of HDPE plastic
- 11) **Plastic Sorting Badge:** This badge is rewarded to the player when they sort a certain number of badges correctly.
- 12) **3D Printing Badge (Total):** This badge is rewarded to the player when they 3D print a specific number of objects.

- 13) 3D Printing Badge (Specific):** This badge is rewarded to the player when they 3D print a certain number of a specific object.
- 14) Number of Steps Badge:** This badge is rewarded to the player when they have travelled a certain number of steps.
- 15) Power-Up Badge:** This badge is rewarded to the player when they collect a certain number of power-ups in the game.
- 16) Selling Items Badges:** This badge is rewarded to the player when they sell a certain number of items on the game marketplace.
- 17) Level Badge:** This badge is rewarded to the player when they reach a specific level in the game (For example, level 5, level 10, and so on).

It is, however, important to note that the player should, by himself, already have an intrinsic motivation to play the game. This motive should either be fun or the wish to learn something about the environment. Therefore, the game should appeal to both target groups.

4.2. Exchanging trophies & game points to PlasticTokens

In our nomenclature, the trophies-points reward system is an authorized reward: as soon as the gamer completes the action for a badge, a request is sent by NURO to the blockchain API, with their credentials, in which they allow a reward to be given to the gamer. Then, everything is processed as defined in Section **Error! Reference source not found.**

For each reward, a specific amount of PlasticToken is defined beforehand: the harder to obtain a badge, the greater the reward of PlasticTokens to the user.

5. Conclusions

In this document, we exposed the gamification techniques used in PTwist to attract the user into the ecosystem, and most importantly, to educate the user about the topic of plastic waste. The concept of rewards, especially monetization rewards, will keep the user interested into the topic as they will look for new ways of obtaining tokens, thus playing along the rules and reducing their plastic impact on the world.

Similarly, the rewards will help improving the retention rate, and along with the retention rate, the awareness of the users, as they play the educational quizzes and games. Hence, we achieve the objective of the serious games: through the means of fun and entertainment, a user is educated about a specific topic (here, plastic waste and plastic reuse).

Even though the gamification app plays an important role in this incentivization system, other mechanisms have been put in motion so that real-life actions also have results. Hence, once the user is used to getting rewards from the game, they will naturally move to the real-life rewards, as they are more rewarding. We can observe that the created gamification system, with its various levels of “difficulty”, will exhort the users to keep making progress in the game and in real life, thus reducing their plastic impact without them necessarily realizing it.

Finally, the modular nature of the monetization system of the PTwist ecosystem allows us to include any additional rewarding mechanism that will be deemed appropriate in the future.