

## Waste What? — A game to communicate about local circular economy practices

Johannes Roland Scholz<sup>(a)</sup>, Isabel Ordonez<sup>(b)</sup>, Vera Susanne Rotter<sup>(a)</sup>

a) Department of Environmental Technology, Chair of Circular Economy and Recycling Technology, Technische Universität Berlin, Strasse des 17. Juni 135, 10623 Berlin, Germany

b) ELISAVA, Barcelona School of Design and Engineering, La Rambla, 30, 32, 08002, Barcelona, Spain

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### Abstract:

Waste What? is a card game, intended to communicate about linear economy while highlighting sustainable alternatives of local circular economy (CE) practices offered by grassroots initiatives. The objective of this article is to present the applied co-creative game development process and to show identified CE enablers included in the game. Based on the results, lessons learned and recommendations for future projects are formulated. The project that developed Waste What? used a co-creative development process with four phases: 1. Field Trips: That collected perspectives, insights, and impressions from local CE-Stakeholders. 2. Prototyping: Developed the game concept based on observations. 3. Testing & Design: Prototypes are developed into the final game by including the perspectives of stakeholders in testing sessions. 4. Dissemination and Documentation: The game was documented and published with an open-source license and disseminated at events. With an individual design of 110 cards, a game board, chips, and a manual, Waste What? communicates an experience of involvement in local CE- practices. In the game, players from two teams take the perspective of CE-initiatives. They are active in the re-use of items of the categories: Textiles, Electronics, Food, Furniture, Construction Materials and Bicycles. Players have several options, including selling, donating, storing, combining or incinerating items. The game communicates observed CE-enablers connected to people, items, and infrastructure. The study concludes that CE-games can communicate principles and people are interested in the approach. However, it is recommended to tailor games to specific target groups and plan extensive dissemination efforts to maximize its impact.

### Introduction:

*Waste What?* is a card game resulting from the science-communication project “Trash Games - Playing with the Circular Economy Transition at the HdM”, financed by the Berlin University Alliance in 2021-2022 (Rotter et al., 2024). The objective of this project was to develop an open-source game which opens the field of circular economy to new target groups. It is intended to display a realistic picture of the current waste management system as part of the linear economy, while highlighting sustainable alternatives of local circular economy (CE) practices offered by grassroots CE - initiatives. This was done with the intention to increase recognition of such CE-initiatives, and to motivate players to reflect on their waste generation habits and hopefully nudge them into CE-practices. CE-initiatives are small and medium-sized civil based companies, or associations that engage in CE- practices known as the R-strategies: Re-use, Re-fuse,

Re-purpose, Re-furbish and Re-cycle (Scholz, Vosse, et al., 2023). Initiatives engage specifically with waste prevention by preparing wasted or used items for reuse and making them available for the public by purchase or donation.

The implementation of R-strategies is part of the European Circular Economy Action plan (EUROPEAN COMMISSION, 2020). In the EU, an increasing number of CE-initiatives are visible, but they still face similar challenges and lack recognition from the public and local authorities (Partnership on Circular Economy, 2019; Rexfelt & Ordoñez, 2017; Scholz, Ordonez, et al., 2023). Part of this movement is the “Haus der Materialisierung” (HdM), a civic platform that groups several CE-initiatives from Berlin (Grundlach, 2024), and is an associated partner in the Trash Games project. It is part of the Haus der Statistik, a flagship project for community-oriented neighborhood development in Berlin (HdS, 2023).

The project successfully developed the game *Waste What? using co-creation methodology*. Games and gamification are increasingly used to represent circular challenges and opportunities (Selvefors et al., 2023; Whalen et al., 2018). Games have been classified into serious games and entertainment games by (Susi et al., 2007). Serious games are effective instruction methods, by increasing the learner's engagement, encourage experimentation, and train critical thinking and problem-solving skills (Manshoven & Gillabel, 2021). Serious games set their focus on problem-solving experiences with elements of learning and a realistic simulation, including realistic communication between stakeholders. For entertainment games, the focus is set on experiencing a specific dynamic, which is hopefully also fun. To enjoy the game, simplified simulation processes are required, and a perfect (often simplified) communication between stakeholders is used (Susi et al., 2007).

The Trash Games project decided to aim at the development of an entertainment game with educational and scientific communication purposes. The team targeted a self-explaining and enjoyable gaming experience, which motivates players to interact with the content, without the requirement of a guided session. The idea: it needs to be fun to be able to disseminate well. The project applied a co-creative game development approach, involving perspectives of the CE-initiatives and waste management professionals from Berlin. The development was documented, and the resulting game was presented as part of the exhibition at the PLATE2023 conference (Niinimäki & Cura, 2023).

The objective of this article is to present the co-creative game development process and to show insights about the identified CE enablers included in the game. Based on the results, lessons learned and recommendations for future projects are formulated.

## **Methodology: Developing *Waste What?***

The project consortium consisted of two different disciplines: The chair of Circular Economy and Recycling Technologies of the Technische Universität Berlin (TU) and the Institute for Urban Anthropology from the Humboldt Universität Berlin (HU). In this interdisciplinary cooperation, the TU group delivered knowledge about waste management, CE-practices and CE-initiatives. The HU group provided their expertise in game

development, game dynamics and science communication. The co-creation process of the game was two-fold, on one hand, the interdisciplinary collaboration between the recycling technologies and urban anthropology departments, and on the other hand, the transdisciplinary involvement of different CE-initiatives and waste management actors through field trips and game testing sessions. The game development process was structured into four phases:

### **Phase 1: Field Trips**

Five field trips were organized to create a common knowledge base for the project team and to involve local stakeholders and their perspectives on the existing CE and waste management structure. The locations visited were: the local waste incineration plant, a second hand mall, run by the public waste management company, several re-use marketplaces, a non-profit textile sorting company and the HdM. In all places, guided tours and unstructured interviews with the management were conducted. From the observations key CE-enablers were identified.

### **Phase 2: Prototyping**

Based on the observations and impressions from phase 1, several initial prototypes were developed. One prototype was selected and developed into the first playable version.

### **Phase 3: Design & Testing**

The playable version of the game was used for several game tests. For the testing sessions, the stakeholders visited during the field trips were invited to reflect on the game and how their operations were represented in it. Two structured game test sessions were organized and used as key input sessions for the game iteration. One was with CE-initiatives at the HdM, and the other with waste management professionals at TU-Berlin, assuring that all organizations could share their opinion about how material reuse, recycling, and incineration were represented in the game. A constant exchange between testing and design led to the resulting game.

### **Phase 4: Dissemination and Documentation**

The final design was professionally printed with 50 copies made in German and 50 in English, distributed among the project partners for their use and further dissemination. An open-source, downloadable version was published on the project webpage, with DIY printing instructions. The game development process was documented through a video, also available on the project-webpage (Rotter et al., 2024). Several presentations and game sessions of

*Waste What?* were organized at fairs, conferences or other events. Reactions, observations and feedback from players were summarized to formulate the lessons learned.

### Results: *Waste What?*

In *Waste What?* players take the role of a CE-initiative, drafting three skills from the areas of Textiles, Bicycles, Construction Material, Food, Furniture, Electronics and the Creative Community. Two players or teams are confronted with the residues of the linear economy, which should create the feeling of an unstoppable wave of waste. Players must collaborate to find sustainable solutions for the items that are drawn each round. They must sell, donate, repurpose, store, recycle or incinerate the items they draw. Since capacities and skills are limited, the challenge is to deal with a limitation of possible actions. Some actions will generate income (i.e., selling for reuse, incineration), while others will cost money (i.e., recycling of problematic waste, storage). To win, players should reach the end of round six being able to pay rent for their storage, while not having emitted the maximum of three CO<sub>2</sub> markers from waste incineration. The game is affected by event cards that players draw starting in the second round. The events are inspired based on experiences from the practitioners involved in the co-creation sessions. By randomization, a replayable experience is created. Figure 1 contains a picture of the *Waste What?* game set-up. Figure 2 and table 1 explain the gameboard, certain cards and game mechanics.



**Figure 1.** A picture of *Waste What?* during a game session. Visible are the board, skills, waste cards, events, and the storage cards. *Waste What?* is designed to visualize the residues of the linear economy and encourages

engaging with local CE-practices with a special focus on repair, reuse and repurpose. The key CE-enablers included in the game are:

- People and CE-initiatives
- Discarded items and their properties
- Infrastructure and storage space

Based on these CE-enablers, the following messages are part of the game mechanics:

**CE-practices need affordable infrastructure and space:** A crucial requirement for CE-practices is to be able to store, treat and offer items. It bridges the time between waste generation and re-use.

**Complexity of CE-practices:** Different types of items require different levels of expertise, infrastructure, and tools. CE-initiatives increase their expertise through their operations.

**Synergies of skills:** The application of CE-practices on complex items requires a combination of skills (i.e. E-Bikes require skills in bicycles and electronics).

**Sharing is caring:** CE-initiatives are widely engaged in charity and social services. Affordable items are offered or donated, and activities invite social and practical participation.

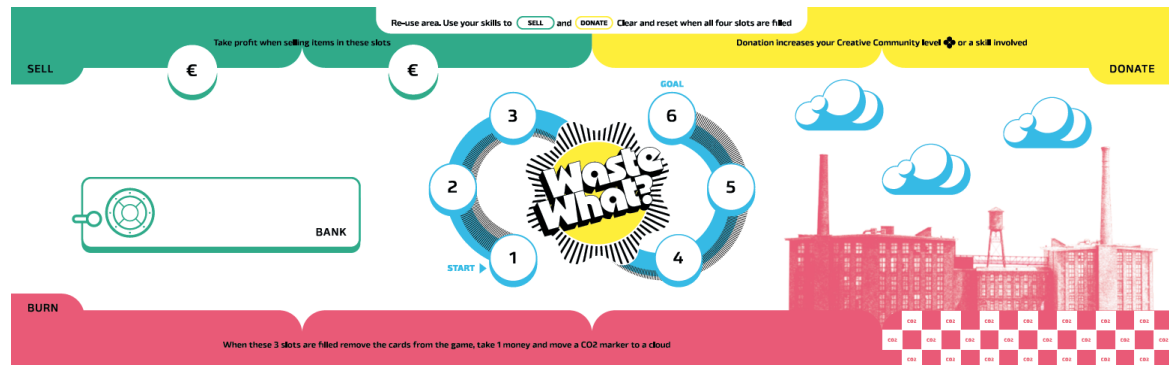
**Creative community:** Civil actors with their creativity can invent use cases for wasted items, outside regular perspectives.

**Zero Waste – not yet an option:** Many items resulting from the linear economy are waste and not suitable for reuse or recycling due to mixed waste, low quality or toxicity.

**Waste incineration as a necessary infrastructure:** Reuse and recycling are often not possible or not feasible. Waste incineration uses the calorific value of items to generate heat and electricity. At the same time, CO<sub>2</sub> and residues are generated.

**Events can change everything:** CE-initiatives are heavily influenced by positive or negative events. For these small companies in a challenging economic situation, the influence of events can be even more impactful.

The Trash Games project focused on the development and production of the game. The whole process took a little over a year. Just a marginal use and communication phase was included in the original time plan. The team presented the game on different occasions, but with limited follow-up on the actual effects of scientific communication. No concrete exploitation plan for the game was considered in the project timeline. The project team has evaluated the possibilities of doing a second edition of the game, including additional translations, and a print-on-demand option.



**Figure 2.** The game board (which is at the same time part of the game box) is used to manage the winning conditions, the bank, and the treatment options for waste cards. Winning conditions are to complete six rounds without emitting the three available CO<sub>2</sub> clouds. Treatment options for items are: 1. SELL items for money (Green), 2. DONATE items for an increased Creative Community (Yellow) and 3. BURN three items to emit one CO<sub>2</sub> marker, but also receive money due to the generation of heat and energy (red).

Description:	Example of a card:	Description:	Example of a card:
<p><b>The Skill cards:</b> The Skill cards are used to explain the specialization in one particular item category. Selected skills are: Textiles, Electronics, Construction Material, Bicycles, Food, and Furniture. During play, by reusing items, the skills are increased in their level, allowing the players to gradually process more items, and more complicated items. The teams can combine their skills to treat high-level items.</p>		<p><b>The Waste cards:</b> In total, 72 waste cards describe items from 6 different waste categories. Each waste card is combined with a complexity level from 1 to 5. To be able to successfully treat the item, the player needs the required skill at the required level or higher. Some Waste cards come with additional conditions or restrictions (i.e., the need for an extra furniture skill to treat it).</p>	
<p><b>Storage card:</b> The storage card organizes the cash, storage capacity and rent of each team. One losing condition is if one team is unable to pay rent. Basic rent is 1 cash. With each additional storage space, the rent increases. Players can share their storage capacity to be able to handle waste flows if desired, since it is a collaborative game.</p>		<p><b>Just Waste cards:</b> Not all materials can be reused, recycled or stored. This is represented by the Just Waste cards. Players are forced to incinerate this mixed waste. The difficulty level of the game can be regulated by increasing the number of Just Waste cards available in the Waste cards deck, ranging from 9 to 18 cards in the deck.</p>	

**Table 1.** Displayed are four different types of cards, representative of different game mechanics and dynamics implemented in the game. Displayed are Skill cards, Waste cards, Storage cards and Just Waste cards. In total, 110 cards are part of the game.



## Discussion & lessons learned:

The discussion of the study is structured into the methodology of games as a tool for science communication, and the presented approach to experiencing local CE-practice enablers.

### Methodology — Games as a successful tool for science communication

The development and application of games for scientific communication has turned out to be an ambitious objective.

The co-creative game development process led to a result that both CE-initiatives and waste management professionals agreed on. During the co-creation process, these stakeholders helped to create an abstract description of the system based on their experiences of real current practices. Their description of reuse, recycling and waste incineration processes, helped to shape how the game portrays waste management and CE-practices. What types of items come in the waste cards, and what events affect the players during the game, were all inspired directly from the experience of the stakeholders. Besides the stakeholders informing the game, the testing of early versions made them reflect on their role in the local CE, and to place themselves in a broader dynamic that they had not necessarily considered. The research team hopes that by participating in the early game tests, the stakeholders learned from how other stakeholders understand and relate to the items flowing through the city.

The intention to communicate the mechanics of complex systems with an entertaining game seems to be partly contradictory. To create a self-explaining and entertaining game with educational elements, it was required to create an enjoyable gaming experience, which is still able to communicate knowledge about a system. Game dynamics and fun vs. complexity of the system described should be balanced to allow an enjoyable, but still educational gaming experience. The challenge was selection, amount, balancing and explanation of the content. Especially in a complex system, where many processes, stakeholders, and connections exist, the trend to overload was evident during the first game prototypes. The simplification of the system and its dynamics is a difficult process, specifically deciding which elements should be cut out. If there is a mismatch and the rules or the contents are too complex or too trivial, the audience quickly loses motivation, and the objective of communication is not fulfilled.

It was noticeable that in *Waste What?* the number of topics and the complexity was relatively high, needing more than 30 minutes to explain the rules for the first time. Before the communication of the game content starts, people focus on the game mechanics. Due to this, less complexity is sometimes more communication. Defining a concrete target group for the game might help in clarifying the right balance between complexity of the system represented and enjoyment of the game.

### Experience - Enabler for local CE -practices

*Waste what?* urges players to cooperatively plan and discuss how to survive the current wave of waste items. This requires creative thinking, understanding of waste cards and their properties while considering their own skills, capacities and the financial situation. Like this, the experience gets close to the actual waste management and the CE-practices of local CE-initiatives. The game uses several simplifications to display connections between stakeholders, items, and infrastructure. I.e. The positive side effects of waste incineration were appreciated by the local waste incineration plant.

The game lacks the ability to explain the difference between the game and reality to the player. In the current version, it is partly not obvious which messages are included and why certain game mechanics were implemented. E.g. It is printed on the game board that waste incineration provides money and emits CO<sub>2</sub>, but it is not explained why this is the case. It was discussed in the project team to make an additional booklet, to provide the required information to fully understand the connections implied in the game. However, due to time and resource limitations, this never happened.

### Conclusions and recommendations:

Tools and games developed in academia with educational purposes can contain important knowledge and perspectives combined with game mechanics and an individual design. However, to achieve widespread educational impact and demonstrate their effectiveness, these projects require more than just the game itself. An appealing design, well-written instructions, a qualitative or quantitative evaluation, a dissemination plan and a distribution plan. These aspects often involve activities similar to those undertaken by a startup and are out of the scope of a project in academia.

The dissemination of *Waste What?* led to a list of around 100 people interested in receiving a copy of the game. However, no further development or systematic use of the game has been made, since none of the project team members has had allocated time to implement this. No concrete exploitation plan has led to the game being “stopped” in its tracks, and no mainstream channels outside the peer group were approached. The *Waste What?* game has not been able to reach its full potential as a science communication tool. Based on the study described, the following recommendations for future projects in the field of CE game development are formulated:

#### **Co-creation of games and communication:**

Involving stakeholders and their perspectives in a game development process is a recommended way of ensuring the game displays processes from reality. At the same time, the result includes the perspectives of practitioners and communicates to them as well.

**Circular economy in games:** The field of CE contains many mechanisms closely connected to players and their daily life. This can help to create attention and to activate engagement and creative thinking with a reflection of processes. Too much complexity in a game can hinder this process because players need to focus on game mechanics instead of the content.

**Target group:** Precise definition of a target group, including the expected level of knowledge, can help to design a game with an adequate level of complexity.

**Dissemination plan:** In research projects, a realistic dissemination plan with capacity to communicate the results is fundamental to reach a larger audience. For this, also leaving your own peer group and communicating with the mainstream media might be helpful.

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