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# Application Design and Engagement Strategy of a Game with a Purpose for Climate Change Awareness

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**Abstract.** The *Climate Challenge* is an online application in the tradition of games with a purpose that combines practical steps to reduce carbon footprint with predictive tasks to estimate future climate-related conditions. As part of the *Collective Awareness Platform*, the application aims to increase environmental literacy and motivate users to adopt more sustainable lifestyles. It has been deployed in conjunction with the *Media Watch on Climate Change*, a publicly available knowledge aggregator and visual analytics system for exploring environmental content from multiple online sources. This paper presents the motivation and goals of the *Climate Challenge* from an interdisciplinary perspective, outlines the application design including the types of tasks built into the application, discusses incentive mechanisms, and analyses the pursued user engagement strategies.

## 1 Introduction

Mitigating the impact of climate change is among the most important and complex contemporary issues, requiring an interdisciplinary response including, but not limited to, technical innovations, economic plans, global political agreements, and societal engagement. Although the problem is widely recognized, changing attitudes and citizens' lifestyle choices has proven to be a societal challenge from educational, social and psychological perspectives (Marshall, 2014).

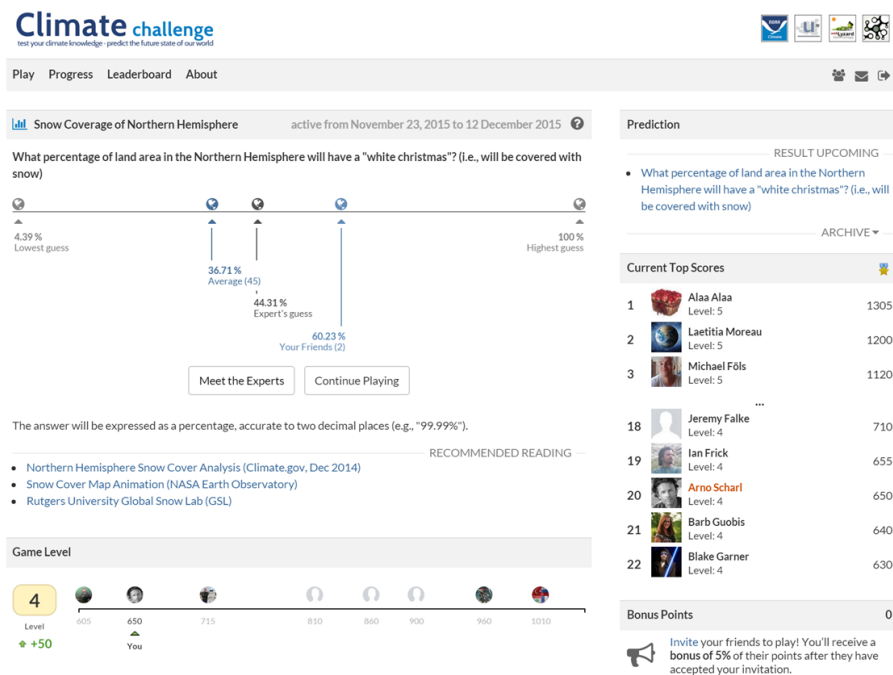
The *Climate Challenge* ([www.ecoresearch.net/climate-challenge](http://www.ecoresearch.net/climate-challenge)) is part of a collective awareness platform conceived to contribute to this societal challenge. Going beyond informing citizens and focusing on triggering environmental action and behavioural change, the *Climate Challenge* as a platform-independent social media application that engages citizens with a competition in the tradition of games with a purpose (Ahn and Dabbish, 2008; Rafelsberger and Scharl, 2009). It provides differ-

ent strategies to help people learn more about Earth’s climate, assess climate knowledge, and promote the adoption of sustainable lifestyle choices.

The application motivates participants through a gamification strategy, in which individuals are immersed in a context that favours play and healthy rivalry within a growing online community. Measuring the distribution of opinions among citizens in a monthly prediction task as shown in **Fig. 1**, for example, represents a first step in harnessing the wisdom of the crowd in ways that benefit society – e.g. decision making in the face of a high degree of uncertainty.

The competition-based approach is intended to overcome the perceived lack of personal efficacy among individuals. As part of DecarboNet ([www.decarbonet.eu](http://www.decarbonet.eu)), the *Climate Challenge* has been continuously updated with new content for 18 months. It engages a diverse population and measures not only changes in energy conservation habits, but also capturing the evolution of environmental knowledge and attitudes, which are at the foundation of sustainable changes in behaviour.

Advantages of using social networking platforms to engage citizens include a large number of potential participants, intrinsic motivation in an environmental context, and effective mechanisms to detect and combat attempts of cheating or manipulating results. Viral mechanisms will trigger behavioural change, track the pursuit of common goals and induce competitive behaviour. Using real-time updates whenever possible, the strategy to engage Climate Challenge participants and sustain the competition among them includes regular content updates and the unlocking of new task types.



**Fig. 1.** User Interface of the Climate Challenge (Prediction Task; December 2015)

## 2 Motivation and Goals

The DecarboNet project develops a *Collective Awareness Platform* to empower citizens, help translate awareness into behavioural change, and provide visual analytics tools to understand processes that underlie this behavioural change. The platform engages environmental stakeholders with a focus on carbon footprint reductions.

*Climate Challenge* is designed to appeal to citizens of various backgrounds, leveraging their interest in the domain as a motivational factor together with the application's entertainment value. Users learn about changes in the Earth climate system, and how to adopt more sustainable lifestyles.

To harness the player's intrinsic motivation, to keep them interested in the game and to encourage them to invite their friends, a variety of tasks is being offered - avoiding repetition and resulting in a richer dataset to analyse. Built-in notification systems and real-time progress statistics help engage users and leverage the wisdom of the crowds for scientific purposes. A differentiating feature of *Climate Challenge* compared to other knowledge acquisition games is its pronounced educational goal, a feature resembling virtual citizen science projects.

## 3 Earth Hour 2016 Competition

In collaboration with the organizers of the WWF Earth Hour, the world's largest grassroots movement for the environment that took place 19 March 2016, a special edition of the Climate Challenge was announced. Individuals interested in the Earth Hour were invited to join the online competition and win one of the monthly prizes.

Earth Hour 2016 represented an ideal opportunity to engage users with an interest climate change, as it came at a moment when the world stood at a climate crossroads – emerging from a year that was marked by a universal climate deal, but at the same time learning that 2015 had been the hottest year on record.

The provided content consisted of a set of multiple choice questions about the history and impact of Earth Hour, polarity assessments of keywords related to the event, and a prediction question asking users to guess at how many people would use their "social power" for Earth Hour 2016 (including all Facebook users who either changed their profile picture or allowed the Earth Hour application to post on their behalf).

The *Media Watch on Climate Change* (Scharl et al., 2016; Scharl et al., 2013) is a content aggregator on climate change and related environmental issues, publicly available at [www.ecoresearch.net/climate](http://www.ecoresearch.net/climate). It not only provided the keywords for the polarity assessment task mentioned above, but also was used by the *Earth Hour* team to monitor the online coverage before, during and after the event. The screenshot in **Fig. 2** exemplifies the system's analytic capabilities by showing a query on "earth hour" resulting in a total of 106,000 documents from a wide range of online sources – including news media, social media platforms, as well as the Web sites of environmental organizations and Fortune 1000 companies.

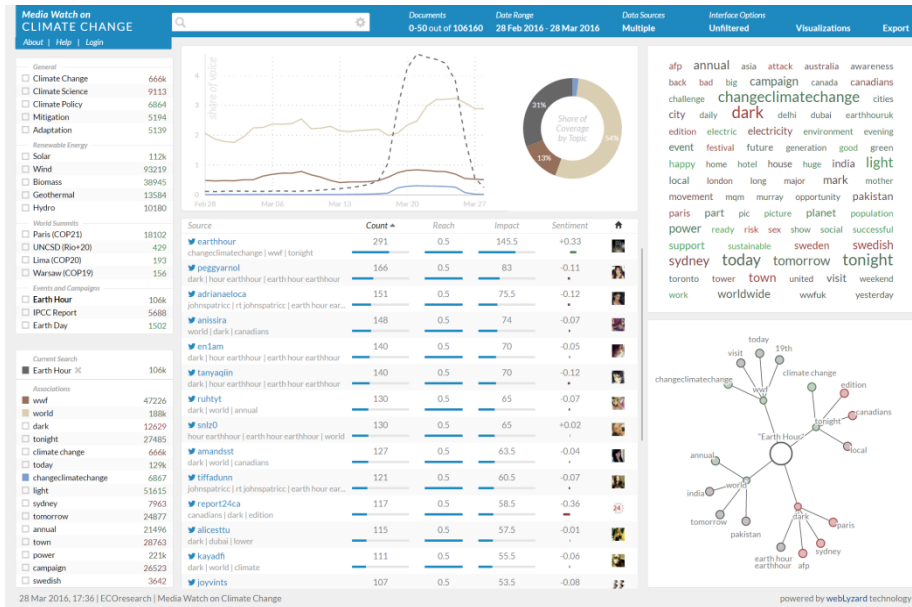


Fig. 2. Screenshot of the Media Watch on Climate Change (www.ecoresearch.net/climate)

## 4 Application Design and Task Types

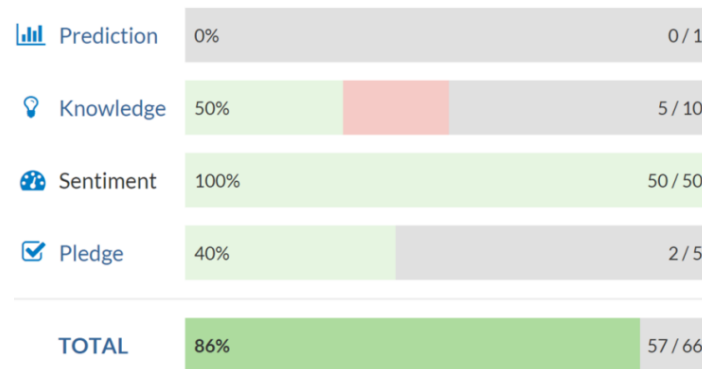
The *Climate Challenge* was launched in March 2015 and offers 12 monthly game rounds per year, where players accumulate points by solving various game tasks. Each round combines one prediction question about future climate conditions with a range of additional tasks to earn game points throughout the month. Currently, there are four general tasks built into the game:

- **Awareness** | Test your climate change knowledge
- **Prediction** | Correctly guess the future state of our planet, in terms of both global and regional indicators
- **Change** | Reduce your carbon footprint and adopt a more sustainable lifestyle
- **Sentiment** | Assess keywords in news media coverage about climate change

A flexible task management and prioritization system, together with the ability to directly link to specific task types, enables the system to personalise content. The bar chart visualization shown in Fig. 3 is available via the “Progress” menu, increasing transparency by presenting an overview of the game structure. It lets users track their progress by task type, and informs them about the total number of available questions.

Introducing new questions and game elements is central to the engagement strategy of the Climate Challenge (see Section 6) to motivate players and achieve a critical mass of interactions for analytic purposes. In addition to the generic task types described in the previous section, the Climate Challenge can also be used to address

specific domains or communities, and serve as a supporting mechanism for environmental campaigns – aiming to strengthen player identification with a particular cause, and to amplify dissemination activities via social networking platforms.



**Fig. 3.** Progress bar to track task completion by task type

## 5 Application Development

The *Climate Challenge* has been developed using the *uComp Human Computation Engine* ([www.ucomp.eu](http://www.ucomp.eu)). It is based on HTML5 to address desktop and mobile users alike. A custom login framework is used to authenticate users, based on the OAuth2.0 protocol ([www.oauth.net](http://www.oauth.net)). To increase the flexibility of the system, a custom module supports logins through popular third-party social media platforms including Twitter, Google+ and Facebook. The module allows users to connect via these services and match their profiles to a unified user account that distinguishes users based on the provided e-mail address. The framework enforces the user to be authenticated in applications that are not written in PHP. The stored user profiles include selected attributes together with application-specific details such as the number of invitations and solved tasks in the *Climate Challenge*, or the access rights and ownership status of documents created with the context-sensitive document editor to support knowledge co-creation processes (Scharl et al., 2013).

Selected profile attributes (acquired with the explicit consent of the user) in conjunction with game statistics reflect engagement levels, shed light on the behavioural impact of certain tasks, and help create a richer and more personal experience for the user – e.g., by showing the scores of the user’s friends.

*Climate Challenge* uses a Model-View-Controller (MVC) design pattern to allow easy maintenance and extensibility. The different task types within the game are handled through a game class, which decides which type of task is given to the user, which specific task will be used, and it is also used to generate the basic HTML outline for the given task. For interactive game elements, JavaScript events trigger a communication with certain PHP hooks, which further process the request and are used to store answers and handle the navigation on the site.

## 6 User Engagement

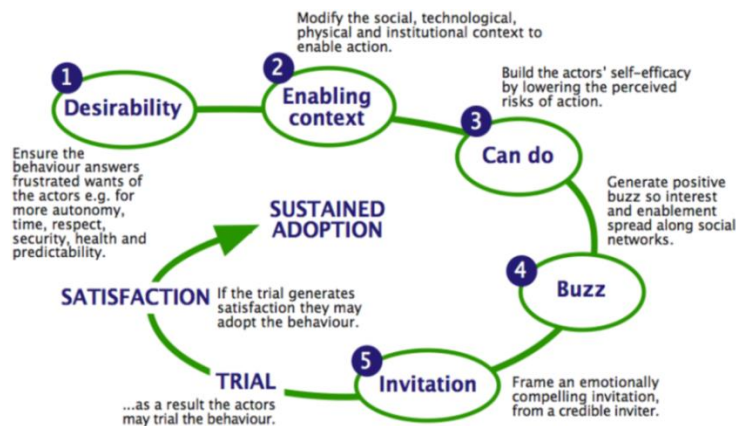
In the fast-growing market of casual Web and social media games, it is generally difficult for applications with a sustainability focus to become widely accepted. To attract a large number of players, we use a combination of general and task-specific promotional activities.

### 6.1 Incentive Mechanisms

To maintain and grow the community of players, built-in incentive mechanisms include a levelling system with the opportunity to unlock additional game features, the comparison of a player's performance vis-à-vis the network of online friends, detailed progress statistics for each of the tasks, and a leaderboard with aggregate monthly scores. Ongoing evaluation and targeted promotion per task type leverages the existing communities of the DecarboNet core and associate partners – e.g., social media activities around the presented carbon reduction strategies by employees of *WWF Switzerland* or monthly promotion of the prediction tasks by the *Climate Program Office* of the *National Oceanic and Atmospheric Administration* (NOAA).

### 6.2 Analysis of User Data

To evaluate the potential impact of the *Climate Challenge* on behaviour beyond the direct interaction within the game, we follow the *Five-Doors Theory of Behaviour Change* that integrates formal theories from psychology and social sciences to enable relationships between people and modify the technological and social contexts (Robinson, 2012; Robinson, 2015). **Fig. 4** outlines five factors that must be present in the actors' lives to trigger behavioural change, which have guided the development of the *Climate Challenge*.



**Fig. 4.** Enabling factors according to the *Five Doors Theory of Behaviour Change*

The study includes the logged data of 645 users registered between 25 March 2015 and 16 December 2015, only considering players who provided answers to all task types (n=288). Players' actions were extracted as numerical features, which can be automatically processed by applying unsupervised pattern mining algorithms. Pledges and association with social media platforms were key elements to assess user participation, while tasks with specific targets were not considered for the analysis:

- **NP:** Number of pledges answered (at least five to be considered in the analysis).
- **%NPA:** Percentage of accepted pledges.
- **%NPR:** Percentage of rejected pledges.
- **%NPD:** Percentage of pledges that the user is already doing.
- **NPo/NL:** Number of points per visit.
- **SUP (Social User Profile):** Whether the user connected a social media account with the Climate Challenge; i.e. either Twitter, Facebook, or Google+.

Users were then clustered based on the proposed features that represent the Five-Doors' conditions. Results of the cluster analysis revealed that:

- 24 people (8.3% of the users) were in the “*Desirability*” stage – players with the lowest level of knowledge and also the second lowest level of pledge participation.
- “*Enabling Context*” has the majority of the users (n=111, 38.5%). They have adequate environmental knowledge (5.4 points per visit), and show the lowest participation in pledges (56%), but the highest will of participation (35%).
- 13.2% of the users are in the “*Can Do*” stage, characterised by the second highest participation level in pledges (64%), but relatively low number of points per visit.
- “*Buzz*” refers to 35.1% of the users with a relatively high participation in pledges (64%) and a good environmental knowledge (8.5 points per visit).
- The last stage “*Invitation*” contains only 4.9% of the users. They already do 70% of the pledges presented to them, achieve the highest number of points per visit (13), and access the Climate Challenge using their social media accounts.

Current users are mostly concentrated either on *Enabling Context* stage (38.5%), where awareness is transformed into behaviour change, or *Buzz* (35.1%). Both stages have a high number of points per visit, evidencing the potential of the game to raise awareness and build knowledge around climate change. Pursuing users' progress along the behaviour change process towards the *Invitation stage*, the Climate Challenge should strengthen practical information around changes in behaviour, and enhance the connection with social media, creating more incentives for people to share, cite and invite other people within their social network.

## 7 Summary and Outlook

*Climate Challenge* ([www.ecoresearch.net/climate-challenge](http://www.ecoresearch.net/climate-challenge)) is a social media application in the tradition of games with a purpose that provides an engaging way to help people learn about Earth's climate, assess the level of climate knowledge among



citizens, create collective awareness, and promote the adoption of sustainable lifestyle choices. In conjunction with data streams from the *Media Watch on Climate Change* ([www.ecoresearch.net/climate](http://www.ecoresearch.net/climate)), a news aggregation and visual analytics platform, the *Climate Challenge* provides a rich dataset for longitudinal engagement monitoring. This paper presents the motivation and goals that guided the development of the application, outlines the range of task types offered (generic as well as target-group specific), and groups the participating users in terms of engagement levels.

Future work will provide new content elements such as new task types that can only be solved in collaboration with other users, more complex energy consumption monitoring scenarios, or language-specific tasks to assess not only the sentiment of keywords associated with current events, but also other emotional categories.

In terms of dissemination and user engagement, a combination of general and task-specific activities will help to ensure an active user base, connecting and mobilizing different online communities around energy and climate issues.

## 8 Acknowledgement

The *Climate Challenge* has been launched as part of the DecarboNet project, which receives funding by the EU 7<sup>th</sup> Framework Program for Research, Technology Development & Demonstration under Grant Agreement No 610829 ([www.decarbonet.eu](http://www.decarbonet.eu)). It builds upon the crowdsourcing engine developed within the uComp project, which receives funding by EPSRC EP/K017896/1, FWF 1097-N23, and ANR-12-CHRI-0003-03, in the framework of CHIST-ERA ERA-NET ([www.ucomp.eu](http://www.ucomp.eu)).

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