EXECUTIVE SUMMARY

Designing A Circular Economy Board Game to Engage the Banksia Community in Climate Resilience Efforts

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Serious games provide an opportunity to teach real world concepts by engaging players in interactive fun, using the game's design to teach complex, and potentially transformative, subjects related to climate change. Climate change is affecting billions of people worldwide through increases in extreme weather events and effects on agricultural production, which are estimated to cause over 150,000 deaths annually. In Australia, the average temperature rise has been greater than the world average at over 1.4°C (Museum, 2022). In 2019, Australia experienced both its driest year on record and its hottest year on record. Heatwaves in Australia are already so severe that roads can melt and turn vegetation black (Museum, 2022). Furthermore, impoverished people suffer the most at the hands of climate change, even though they produce the least amount of harmful emissions. One of the most disadvantaged areas in Australia is Broadmeadows, a suburb of about 12,000 people located in the northern region of Melbourne. There are many social issues prevalent in the area, including high rates of unemployment, of about 15.9% as of 2016, and high crime levels. Being a socio-economically disadvantaged community, residents of Broadmeadows have been some of the main victims of the increasing temperatures over the summer. It is common for temperatures inside homes to reach 104℉, and most residents live in public housing without air conditioning.

Banksia Gardens Community Services (BGCS) is a neighborhood house, registered charity, and community service organization in Broadmeadows. BGCS has been working with businesses, community groups, schools, and the local council to deliver programs that assist disadvantaged community members. BGCS believes there is a strong correlation between social and environmental justice and, in 2009, adopted environmental sustainability and climate resilience as one of their organizational principles. BGCS recently received a grant that includes two proposed climate relief community initiatives: a Heat Haven and a Food Forest. The Heat Haven will provide a community space where residents will get refuge from heat waves. The plans for the Heat Haven, shown below in Figure 1, include large deciduous trees with overlapping canopies to provide shaded areas for residents and staff to cool down, along with some umbrellas and a pergola for further shade. The Food Forest, also shown in Figure 1, is a long-term vision which will sustainably develop adjacent land, provide residents with a place to cool down, and support BGCS's food program through fruit trees, which provides food for the most vulnerable of the community.

Figure 1: BGCS's proposed Heat Haven (left) and Food Forest (right).

To help BGCS engage and educate the community in these climate resilience initiatives, and in circular economy thinking more broadly, our team designed a board game that highlights the principles of circular economies while highlighting the unique features of the BGCS grounds and community initiatives. The game teaches the principles of the circular economy, which include: recycling and reusing whenever possible to "close the loop" of the local economy, because resources are reused instead of passing straight through the economy; using resources in generative ways that amplify positive outcomes; and cooperating and collaborating, because achieving climate resilience requires an economy in which social and environmental goals are achieved for all.

The Game Design Process

To start the game design process, the team looked at examples of other serious and entertainment games to understand how games are able to transform their subject matter into a work of entertainment and education successfully. Playing games, both among the team and with members of the community, allowed the team to identify lessons for our game design and, in particular, to identify what constraints were needed. While gaming, the team used a rubric for each game to note fun, mechanics, difficulty, artwork, cooperation, relevancy to BGCS, competition style, playing time, and age range. Through this, the team determined that the game should remain simple, engaging, educational, collaborative, fast-paced, and include the particular features of BGCS's climate resilience plans.

When creating the board, the team wanted to highlight features of BGCS and the concept of a circular economy. To do this, the team took inspiration from the board game *Settlers of Catan* and utilized hexagonal Tiles in our prototype, as shown in Figure 2. The hexagons in our game represent BGCS locations and initiatives, allowing for players to build these features and expand the area as they play. The board was created in the formation of Rings to further the connection with a circular economy, with the idea that players had to start from the middle and expand sustainably across the board space.

The team designed the game to contain as many relevant BGCS features as possible for players to both relate to and learn about, enriching their playing experience. To determine these important features, the team spent time with community members and leaders. They participated

in events such as a Community Planting Day, familiarizing them with the community garden, shipping containers that are used as innovation hubs and social spaces, and the social housing, all important BGCS features that represent the community. The team also discussed key circular economy goals at BGCS with Dr. Edgar Caballero Aspe, which helped them identify the relevant features, such as the composter, Food Forest, and Heat Haven. These features were chosen to highlight the sustainability programs at BGCS and to create interesting gameplay mechanics such as those relating to the reuse of resources and expansion.

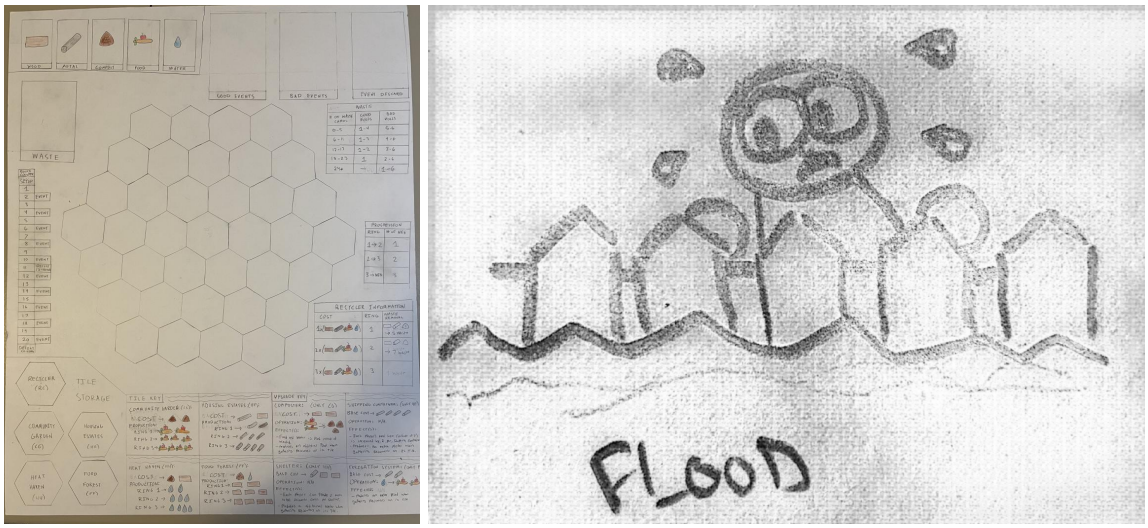

Figure 2: Picture of Prototype One (note hexagonal Tiles for the board).

The Circular Economy Game

Players cooperate to sustainably develop all the Rings of hexagonal Tiles around the BGCS Tile in the center of the board by crafting Tiles and Tile Upgrades on the game board, shown in Figure 3 below. If players unsustainably develop the land, Waste builds up and extreme weather or other bad Events occur more often, leading to a likelihood that the players will exceed the waste limit or run out of game plays and will collectively lose the game. If they sustainably develop the land, then beneficial Events, such as social programs that BGCS runs, will occur more often, increasing the odds that players will complete the Rings by the end of the Round limit. Importantly, the game is a cooperative game, in which all players collectively win or lose. The cooperative nature of the game is emphasized by adding mechanics such as trading and Tile Upgrades affecting all players, not just those who built them.

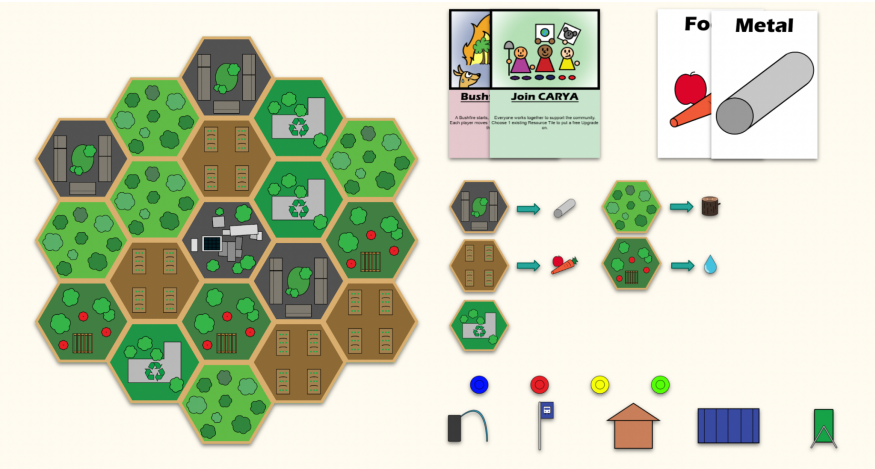

Figure 3: The final board game, along with its main components.

The game utilizes various Resources: Food, Water, Wood, Metal, and Compost. Resources play a critical role within the game, being utilized within player Actions such as Operating Upgrades, Crafting new Tiles, or trading between players. The use of Resources within the game also represents the circular economy. Players must manage Waste generated by the Social Housing and Events or else Waste quickly accumulates, making the game more difficult and increasing the risk of losing. By recycling and careful, sustainable development of the area, players are able to manage how many of their Resources are Wasted. The focus on collaboration was maintained throughout the prototyping and testing process; for example, the mechanic of Chain Trading was introduced to allow players to cooperatively trade more often, an example of which is shown in Figure 4.

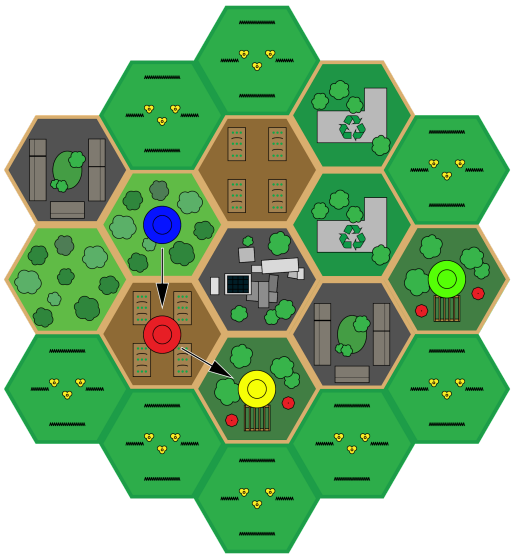

Figure 4: Flow of a blue player Chain Trading to a yellow player.

The Events mechanic globally affects all players, thereby giving them a common goal. Events occur every round and may be either good or bad, depending on the current level of

communal Waste, some examples of which are shown in Figure 5. This solidifies the idea that climate change is a collective challenge and must be tackled through coordinated actions, because if Waste gets out of hand, players experience more bad Events. Events were created to give players a sense of both urgency and community, because they happen every round and require immediate player attention, and also take the collaborative effort of all players to quell. Good Events are often in the form of BGCS programs/initiatives or positive weather such as rain, while Bad Events are typically in the form of negative climate change impacts related to weather (droughts or heat waves) or bad behavior exhibited at BGCS, such as vandalism.

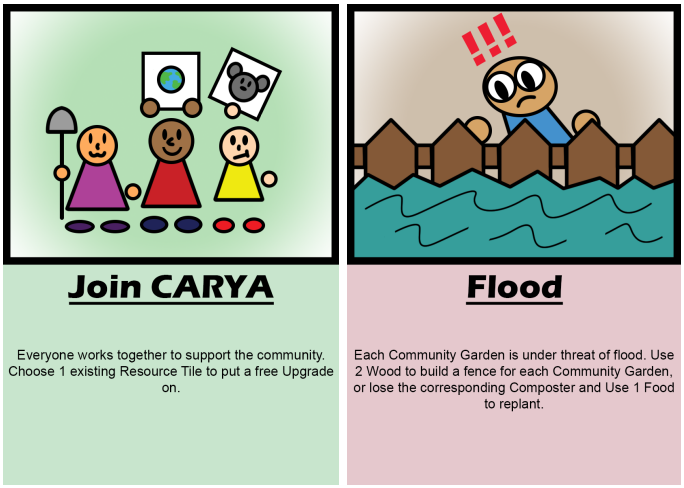

Figure 5: Two Event cards showing a good Event and a bad Event.

Playtesting was commenced to confirm not only the playability of the game at any given prototype stage, but to ensure the game did not violate any set design criteria. The first set of playtesting sessions was done within the team to test if the game fit the constraints set. The second set of playtesting sessions was done among the WPI IQP student cohort and the WPI advisors, testing intuitiveness and the winnability of the game. The final stage of testing was done to further test the intuitiveness and educational ability of the game, with individuals from the external groups Circular Economy Victoria, Hume City Council, and RMIT University, as shown in Figure 6.

Figure 6: The final testing of the prototype with an external group.

Conclusion and Next Steps

The game, by following the design constraints set and by teaching circular economy and climate change concepts, was positively received by the sponsors and community. Suggestions created by the community included utilizing the game as a team-building tool for sustainability oriented non-profit organizations, or promoting competition between groups by seeing who finishes the game the fastest. Through the interest and enthusiasm generated by BGCS partners, such as Circular Economy Victoria, there are new opportunities for WPI project teams or other partners that are interested in game design to improve and produce the game. They could focus on further testing and refining of game mechanics or introducing new features.

A major potential expansion opportunity for the game would be to digitize it. The game dynamics could be easily replicated in an online game and, in fact, digitization could simplify many of the mechanics as presented to the player. For example, instead of counting the number of cards in the waste pile, rolling a die, and determining whether to draw a good event or bad event based on the amount of waste, the computer could automatically calculate which type of event to display immediately. Specific information could also be shown to the player when the player requires it, instead of overwhelmingly displaying a lot of information at all times — for example, it could only show crafting costs when players are attempting to craft. Digitization would increase the accessibility of the game, exposing more people to the principles of circular economies through fun gameplay. As Banksia Gardens Community Services continues to develop new community programs, these programs could be implemented in the board game. Additionally, the game could be adapted to represent other regions and ecosystems in Australia or globally, though we believe the current game design based on the Banksia Gardens community would have universal appeal and relevance.