A FRAMEWORK FOR DESIGNING SERIOUS GAMES

by

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Abstract

Integrating traditional learning content with the feeling of enjoyment that has made commercial video games wildly popular presents a significant design challenge. Serious video games, or games for learning, are most often studied from the viewpoint of disciplines such as psychology or education. There is a lack of applied research to guide serious game design, particularly the development process. Such frameworks are nonexistent or in their infancy.

This thesis extends game design theory and creates an applied design framework for serious game development. It focuses on gameplay - the connection between the interactive engagements happening on-screen and the methods by which those events are manifest. Two game design constructs are conceptualized, linked, and illustrated: player archetypes and gameplay themes.

The design framework is an applied tool to help serious game designers make video games that are both fun and educational, and that maximize audience appeal. The framework has broad design utility and is suited for use across a spectrum of serious game genres and content areas.

The framework is illustrated with examples based on a University of British Columbia serious game project that is the focus of a community-based participatory research project with the municipality of Delta, British Columbia. The game, Future Delta 2, represents a new way to engage hard-to-reach community groups like youth in building awareness and action around the local causes and impacts of climate change.
Preface

I am solely responsible for all parts of this thesis, including the research questions, hypotheses, research design, and methods. I conducted the research and wrote the manuscript.
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Special thanks are owed to my mother and grandfather, who have supported me unconditionally throughout my years of education.
Dedication

To my Grandfather and Grandmother
1 Introduction

1.1 Goals and aims

Video games emerged enigmatically onto the cultural scene in the 1980s. Some, like Pong and Ms PacMan, had a public presence in restaurants, bars and corner stores. Others, like Multi-User Dungeons (MUDS), an early internet text-based video game that allowed thousands of users all over the world to simultaneously connect and play online together in a single continuous virtual game world, were largely invisible to the general public. By the turn of the twenty first century, educators and researchers were increasingly interested in the allure that video games hold for children and young adults. The military had long grasped the significance of game technology for creating simulators for training and educating their personnel. Now the serious games movement, across fields as diverse as education, climate change, and health, began to see beyond video games’ reputation for engaging young people in violent and deviant behavior to their potential for influencing society in positive ways.

Clark Abt coined the term “serious game” in the 1970s. He imagined serious games as a combination of "the experimental and emotional freedom of active play" and "the seriousness of thought and problems that require it". Abt maintained that serious games have an “explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement”. In the early 2000s, as video games surpassed motion pictures in the race for American entertainment dollars, academics and educators glimpsed their potential to educate and effect social and behavioral change. More recently, funders have become interested in the development of serious games. The European Union recently awarded serious game developer Sara De Freitas approximately 5 million pounds. Similarly, the Robert Wood Johnson Foundation has provided generous support for the “Games for Health” initiative. The availability of financial support for serious games research has generated interest across a broad range of disciplines in the investigation of video games as cultural forms, quite separately from their role as manifestations of technological change. Currently there is a robust research agenda around player and public motivation, engagement, social interactivity and learning. However, much less is known about the applied design of video games - knowledge that is necessary for the development of games that present and help solve intractable social problems.

This thesis develops a framework for serious game design and uses a serious climate change game to illustrate the underlying design principles. Future Delta 2 is a serious game developed through a community-based participatory research project with the School District of Delta,
British Columbia. Its purpose is to engage public attitudes and behaviors around the causes and consequences of climate change.

The study addresses a gap in our knowledge concerning the effectiveness of place-based, scientifically-grounded educational games about climate change, that are designed with community input. Little is known about how to effectively convey information about climate change to various types of stakeholders. It is necessary to find new ways to engage hard-to-reach community groups like youth in building awareness and securing support and action on climate change targets at the local level. Securing buy-in and building response capacity among younger generations and other key community groups is vital to meeting community and Provincial greenhouse gas reduction targets.

_Future Delta 2_ is a unique and novel approach to informing public attitudes about climate change. In contrast to video games like _SimCity_, which involve geographically diverse groups of players and generic environments (streets, neighborhoods and cities), _Future Delta 2_ is the first place-based game that is so strongly grounded in a real community, in which the affected community participates in the game objectives and plays the game. Another strength is that the game is based on scientific data and modeling of both adaptation and mitigation options. Potential scenarios involve, for example, flood hazard mapping, community retrofit and alternative energy scenarios, and adaptation costs and benefits, using detailed 3D data for accurate and realistic visualization.

Climate change is one of the most far-reaching environmental problems affecting society. Despite decades of debate and heightened societal awareness, a sizeable gap remains between global climate change science and local community engagement in its implications and available options for mitigation and adaptation. 

Traditional means of disseminating scientific information are insufficient to overcome indifference and a perceived lack of relevance at the local and individual levels. Many scientists insist that time is running short. Therefore, there is an urgent need to offer complex information about climate change science in a way that reaches the hearts and minds of the public and motivates change in behaviors.

One promising avenue is to reach out to children, youth, and young adults. A poll of teachers and learners in the UK found that while 72% of teachers never play computer games in their leisure time, 85% of the children polled play computer games quite regularly. In 2003, a report undertaken for Pew Internet and American Life polled US college students and found that 70% had played video, computer or online games at least once, while 65% were regular or occasional players. In the same survey 20% of respondents saw games as a social activity and a way to make friends, while 60% used games to fill time when friends were not available. Most adolescent today are “digital natives” a demographic group whose members “require multiple streams of information, prefer inductive reasoning, want frequent and quick interactions with content and have exceptional visual literacy skills.” De Freitas (2006) points out that these demands are well supported by game-based learning approaches. Moreover, video game technology has the potential not only to deliver knowledge and shape the attitudes
of youth, but through spillover effects, such as the role of social media in the “Arab Spring” of 2011, to also influence parents, policymakers, elected officials and society.

On the face of it, many aspects of video gaming are pedagogically appealing. At its best, gameplay is about “problem solving, applying ingenuity, anticipating the programmers’ challenges, and their humor, in a tough cycle of ‘observe, question, hypothesize, test’ that any science teacher would be ecstatic to see evidenced”¹². Also, crucial peer support networks are available where players can experience encouragement, camaraderie and competition on a global level. According to de Frietas³, serious games can “encompass the immersive and engaging characteristics of games” along with the “educational and training effectiveness of simulations to foster the development of learning applications that can support different sectors of learning” including “learners, tutors, training organizations, educational institutions and policy makers.”

**Figure 1 Serious game development**

However, integrating learning objectives with the feeling of enjoyment that has made commercial video games wildly popular is a significant and persistent design challenge. According to de Freitas³, the design of games in learning contexts is the hardest problem to crack. Killi observes that applied design frameworks are nonexistent or in their infancy¹³.

**SERIOUS GAME DESIGN FRAMEWORK**

* A tool that guides the implementation of serious design principles onto the screen.

There are five main components of serious video game design. The first is the specification of the overall learning objectives of the game. The second is the development of the narrative or storyline. The third is the design of the game world. The fourth, gameplay design, is the focus of this thesis. It involves both player archetypes and gameplay themes. The fifth component includes monitoring player activity and gathering data on player outcomes to evaluate whether the learning objectives and goals of the game (or project) are being met.
In particular, there is a dearth of both conceptual and applied research on gameplay design.

**GAMEPLAY**

At the most basic level, gameplay can be thought of as the interaction or interface between the player and other players, non-player characters, and objects in the world.

Historically, theorists and philosophers have found “games” and “play” almost impossible to define. Wittgenstein despaired of finding a suitable way to define play. Currently few, if any studies have managed to adequately analyze the processes of play. However, the professional design disciplines are well positioned to help remedy the problem.

This focus of this thesis is two gameplay design constructs: player archetypes and gameplay themes.

**PLAYER ARCHETYPES**

This concept refers to the range of drivers that motivate video game players.

To be effective, serious games must appeal to diverse populations. There is a need for a deep understanding of how to design games that appeal to broad or targeted audiences. This thesis reviews the small body of extant literature on player archetypes and then presents a new typology.
This thesis presents a typology of gameplay themes, a design project that has not previously been undertaken. Further, the design framework developed in this thesis links the two typologies: player archetypes and gameplay themes.

**GAMEPLAY THEMES**

This concept refers to the different types of player interactions.

**THESIS GOALS**

The goal is to help designers translate design principles into practice by:

- Providing a conceptual grounding in two major design constructs – player archetypes and gameplay.
- Proposing a rubric that links the two constructs to help serious game designers understand audience appeal.
- Helping designers infuse the fun of entertainment games into serious games by familiarizing them with entertainment gameplay themes.
- Providing a game design framework in which educational objectives can be integrated.
Figure 3  Thesis aims

- Review the serious game design literature.
- Develop a revised typology of player archetypes.
- Develop a typology of gameplay themes.
- Develop a gameplay design framework that includes a proposed rubric for linking player archetypes and gameplay themes.
- Integrate the learning objectives, story, gameworld, and preliminary evaluation strategy into the serious gameplay design framework. Illustrate the framework in the context of a climate change video game for students.

The serious design framework presented in this thesis is based in part on my experience in three related but very different areas. The first is my knowledge of the academic literature on serious game theory and my academic work with the Future Delta 2 climate change game development team. Second, I draw on seven years of experience in commercial video game development as a level designer. The game franchises I worked on include Sarge’s Heroes, Asheron’s Call, Turok, Splinter Cell and Max Payne; these genres range from first person shooter, to massive multiplayer online role-playing, stealth, and action/adventure. Third, my design perspective is experiential - shaped by growing up in the first generation of avid video gamers. My understanding is that the potential of serious games lies in their design as scientific themed virtual experiences - not as digital chalk boards. Playing in video game worlds is, de facto, a process of learning. I view the design of serious games as an endeavor of the imagination involving a series of organic player interactions and interpretations that have the potential to influence individual and societal attitudes, beliefs, and behaviors.

In sum, this thesis extends theory and creates an applied archetype-gameplay design framework for serious game development. The illustrations are loosely drawn from my
experiences with a University of British Columbia serious game project that is the focus of a community-based participatory research project with the municipality of Delta, British Columbia. Its purpose is to engage public attitudes and behaviors around the causes and consequences of climate change. The game represents a new way to engage hard-to-reach community groups, like youth, in two sustainability goals at the local level: building awareness and encouraging support and action on local climate change initiatives. Securing buy-in and building response capacity among younger generations and other key community groups is vital to meeting community and Provincial greenhouse gas reduction targets and developing resilience. The thesis focuses on two gameplay design constructs, player archetypes and gameplay themes, and the links between the two. The design framework presented is a tool to help serious game designers make video games that are engaging and educational, and that maximize audience appeal. The framework has broad design utility and is suited for use across a wide spectrum of serious game genres and content areas.

1.2 Methodology

The first section of this thesis identifies key issues in the serious game literature as well as relevant commercial game literature. It draws on a meta-review of video game design theory as well as key peer-reviewed articles and relevant websites. The analysis has been organized into four conceptually meaningful categories: introduction to player archetypes; the visualization of data; games as a pedagogical strategy; and video game-based learning. The literature was sourced from keyword searches of electronic databases, key journals in the field, and a general search of the internet. Selected criteria used to identify relevant literature include those proposed in significant meta-reviews and empirical studies on the use of games, as well as general relevance to game-based learning. Recommendations from experts in the field were also used to identify important articles, texts and examples from practice. Analyses of commercial off-the-shelf games as well as digitally distributed content were also used.

The second section of the thesis constructs a new serious game design framework. It is both conceptual and applied. First, it extends current theory about player archetypes and creates a revised typology of archetypes. Then it draws from commercial game design to create a typology of gameplay themes. Next, it offers a rubric that links the archetypes and gameplay typologies and provides an integrated applied design framework for serious games. The framework is illustrated to provide serious game design guidance. Illustrations are based on a climate change project.
The final section of the thesis assesses the key messages that emerge. It also discusses future research, highlighting the challenges of embedding substantive scientific information into serious games, evaluation strategies, and serious collaborations.

A glossary of terms is embedded in the thesis. The references cited are found at the end.

The thesis includes an appendix of technical interest to serious game developers, a level design document. It represents the author’s design work on an alpha version of the University of British Columbia climate change serious game *Future Delta 2*. 
2 Literature review: the role of games in learning

2.1 Introduction to player archetypes

The design of commercial virtual game worlds remained largely atheoretical for almost two decades. Analyses of video games were mainly conducted by shareware developers and commercial game studios. They concentrated on the technological and economic dimensions of game development. Then in 1996, Richard Bartle, a research scientist from Essex University in the U.K., published an article entitled “Hearts, Diamonds, Spades: Players who Suit MUDs." His study evolved out of a spirited debate with senior members of a prominent Multi-User Dungeon (MUD) development team, lasting several months. Bartle was led to create a paradigm shift by pondering, “What do people want out of a MUD?” He posited that:

“Whatever it is that causes a player to come back to a virtual world time and time again, there must be things happening that, on the whole, they find enjoyable or personally rewarding. This is what they call fun. There might not be a lot of it, or there may be a good deal of it, but it has to be there. Players enter a virtual world to have fun; other people could have different ideas about whether it’s fun, but to that player it’s fun. It’s relative to individuals.”

Bartle shifted the paradigm from the application of other theories to the design of virtual worlds, to the development of theories of virtual worlds themselves. He began the attempt to understand what motivates people to play in virtual worlds. Bartle tried to classify what players actually do in virtual worlds and thereby construct a theory about what constitutes “fun” for particular individuals. He hypothesized that player’s fall into four categories.

- **Achievers**. These people put the game-like aspect of the virtual world to the fore. They like doing things that achieve defined goals, thereby advancing their character through the world’s built-in ranking system.

- **Socializers**. Their greatest reward is interacting with other people through the medium of the virtual world. Some do it as themselves; others role-play behind a mask.

- **Explorers**. The ultimate delight for explorers is increasing their knowledge about the way virtual worlds work. Their joy is discovery. They seek out the new.

- **Killers**. These people want to dominate others through a range of actions from attacking other players or otherwise making life difficult for them, to more subtle types of psychological warfare that can exist in any social interaction.
Bartle then went on to construct two axes, putting these four player motivations each in their own quadrant. The X axis represents an aspect of player preference that spans people-focused to work-focused activities. The Y axis represents another aspect of preference from “interaction” to “unilateral action” (see the figure above). This foundational work provided a launch pad from which Bartle and other researchers could question his initial conceptualization.

Other lines of questioning emerged. Was Bartle’s representation a productive way to think about player archetypes, or was placing them on two axes too restrictive? If Bartle’s framework ascribes a restrictiveness and rigidity to player motivations, then it may fail to realistically account for composite behaviors as well as the evolutionary and stochastic (fickle) nature of player behavior.

Nick Yee took up this idea in his article “Unmasking the Avatar”. Yee states that “Bartle postulates two axes and four resulting player types..., but unfortunately, it is not clear that reality divides up neatly, simply just because we postulate that it does.” Yee argues that “In fact, Bartle's sub-division of the existing types into 8 types merely exposes the weakness of this paradigm of categorizing players. There is no reason why people would fall naturally into 4, 8 or even 16 buckets, and there is no reason why someone should be excluded from the Achiever bucket just because they fall into the Socializer bucket”.

Instead Yee posited that “a player could score high or low on some set of primary motivations, and their score on any one motivation doesn't constrain their other scores in any way.” This seemed to be a step forward. Yee’s methodology was also different: “Instead of starting with an a priori framework” such as Bartle did, Yee conducted several surveys aimed at developing an empirical model of player motivations. Yee’s methodology had three goals: 1) to ensure that components of each motivation are related; 2) to ensure that different motivations are different; and 3) to provide a way to assess these motivations. His survey was intended to test the appeal of the following five game design elements across a range of demographics 1) a
good combat system; 2) a good crafting system; 3) varied and interesting landscape; 4) varied and interesting quests; and 5) highly customizable character creation. Yee applied factor analysis to his survey data. The results yielded 3 main factors: achievement, social and immersion. Additionally, Yee identified 10 sub factors: advancement, mechanics, competition, socializing, relationship, teamwork, discovery, role-play, customization, and escapism.

2.2 The visualization of data

The visual display of information plays a central role in how we describe and explain the world we inhabit. In the context of social issues such as climate change, researchers seek to communicate to various stakeholders the knowledge required for the assessment of causes and consequences over time. Thus the design task at the core of serious game development is exposing players to substantive content and contextual information as well as facilitating a virtual experience that will shape their attitudes and behaviors. The information may be complex and therefore challenging to convey effectively.

In the early 1990s, Edward Tufte began publishing a seminal body of work on excellence in the visualization of data. He explained with unprecedented elegance the problem of reducing the “magnificent four-dimensional reality of time and three-space” to a static, flat medium – paper at that time. Tufte produced a series of influential books between 1990 and 2006 that traces the history of visual explanation and illustrates the design principles behind envisioning information in ways that allow the viewer to “escape from flatland”19. The principles Tufte developed are as relevant to digital data and pixels as they are to conventional (non-digital) data and paper.

Tufte’s general principles of excellence in information visualization highlight the importance of presenting not only interesting data, but also well-designed data. He points out that such data is nearly always multivariate, which requires communicating complex ideas with clarity, precision, and efficiency. Tufte stresses the need to convey the most knowledge, in the shortest time, with the least ink in the smallest space. He underscores the significance of telling the truth about the data, and he provides guidelines for visualization integrity. These include standard practices such as the physical areas on the graphic should be directly proportional to the number represented; data and important events should be labeled and explained; data variation, not design variation, should be demonstrated and explained; the number of visual dimensions should not exceed the number of data dimensions; and data should not be displayed out of context. Thus Tufte’s work theorized and illustrated what he calls “beautiful evidence.”

Approaches to visualizing data and facilitating virtual experience will also be influenced by the norms of the content area. For example, the climate change communication literature suggests a rubric for envisioning information. To engage the public more deeply in acknowledging and
preparing for climate change, visualizations of climate change data should be as locally salient and concrete as possible. Closely related to this goal is the need to lower cultural barriers to action by creating scenarios that are culturally sensitive and relevant. Climate change visualizations should also employ experiential learning and use vivid visual media to increase engagement. Visual stimuli can trigger innate and instant reflexes and feelings, which can be persistent even in the face of new information. Imagery that triggers affective responses has been shown to influence decision-making. According to Nicholson-Cole and Sheppard, if such factors are taken into account then realistic landscape visualization holds great promise for conveying strong messages quickly, condensing complex information, engaging constituencies in issues of environmental change, and motivating personal action.

2.3 Games as a pedagogical strategy

In addition to the visualization of information, there is another issue at the heart of serious game design: play. The idea of play as a learning mechanism has a long history. There is a large body of literature on conventional game-based learning as a pedagogical strategy. These studies have shaped the way academic researchers approach serious video game design. Their key points are outlined below.

Educational theorist Gagne constructed a typology of events or processes whose activation, he posited, is necessary for effective game-based learning. These events include: 1) gaining the attention of the player; 2) informing the player of the learning objectives; 3) stimulating the player’s recall of prior learning; 4) presenting the player with stimulus material; 5) providing the player with guidance; 6) eliciting player learning achievement; 7) providing the player with feedback; 8) assessing the player’s performance; and 9) enhancing the retention and transfer of learned information. Subsequently Van Eck argued that serious games should embody all phases of Gagne’s “Nine Events of Instruction”.

Communication and education scholar Deborah Lieberman described the pedagogical benefits of games. They 1) provide the player with an active experience; 2) encourage the player to learn by doing; 3) are a social medium providing the player with human-to-human like interactions and emotional responses; 4) are participatory by providing the player with customized, rapid feedback; 5) are engaging; 6) promote behavioral learning that can encourage desired behaviors in real life; 7) offer consequences that are not abstract or hypothetical but are represented in the game; and 8) provide positive behavioral experiences for the user. Lieberman argues that all these benefits translate to the design of serious games.

Dodlinger draws from constructionist theory to inform serious game development. Seymour Papert defined constructionism as “a view of learning as a reconstruction rather than as a transmission of knowledge.” Constructionist theory proposes that “learning becomes active and self-directed through the construction of artifacts”. Dodlinger points out that this approach
involves two game-related activities: the construction of knowledge through experience; and the creation of personally relevant products.

Mihaly Csikszentmihalyi’s theory of flow has been widely influential. It has guided serious game researchers such as Jane Mcgonigal and Kristian Kiill. Flow is a positive emotional state defined as the happiness we experience when we are fully engaged in something - when we are marshalling our resources and receiving feedback that we are making progress toward a goal. Both Kiill and Mcgonigal suggest that Csikszentmihalyi’s theory of flow has much to offer in the context of the design of participatory systems, particularly given the role of positive psychology in game design.

### 2.4 Video game-based learning

Studies on conventional game-based learning provided a launch pad for a burgeoning literature on serious video games as educational tools. Not surprisingly, this research is generated primarily by two disciplines: education and psychology. The following section is a synopsis of the main themes from the literature.

#### 2.4.1 Skill building

Initial reactions to the effects of entertainment video games on youngsters often were motivated by the assumption that these games were at best addictive time-wasters and probably much worse. For example, in seeking to determine the extent of their adverse effects, researchers commonly asked such questions as: to what extent does exposure to violent game play negatively affect the social behavior of players? By contrast, researchers de Aguilera and Mendiz posited that entertainment video games actually have positive skill-building effects on children. They maintain that “arguments in favor of the cognitive importance of video games are based on a number of studies indicating that many video games are conducive to the development of specific skills: attention, spatial concentration, problem-solving, decision-making, collaborative work, creativity, deduction and hypothesis testing, complex concepts and abstract thinking, visual and spatial processing.”

#### 2.4.2 Flow

Mihaly Csikszentmihalyi’s concept of flow plays a central role in the serious game literature. De Freitas and colleagues note that video game spaces are often highly immersive and thus conducive to the flow phenomenon. Immersive learning refers to the delivery of knowledge through activities and experiences rather than the transfer of knowledge from tutor to learner. In the context of video games, the immersive learning experience takes place through the player’s avatar, which embodies the learner in the virtual space.
Dodlinger’s\textsuperscript{26} observations on mastery are also connected to Csikszentmihalyí’s flow theory. Much attention has been directed to the use of serious games in recent years partially because of their perceived capacity to captivate player attention and hold it for long periods of time. Players maintain intense focus as they master game complexities. Castranova\textsuperscript{33} provides guidelines for translating Csikszentmihalyí’s concept of flow into design requirements for games. He posits that “some of the critical elements for inducing flow are immediate feedback, a clear sense of objectives and failure states, and a challenge level that is not too easy or too hard.”

2.4.3 Problem solving

Research also suggests that video games enhance critical thinking and problem solving skills. According to Eck\textsuperscript{34}, problem solving may be the most powerful pedagogical benefit of commercial games in general and of game-based learning and serious games specifically. Eck proposes that problem solving in video games is far more complex than it may appear. Game-based problem solving offers a wide range of challenges. Problems differ, for example, in structure, requirements for prior knowledge, ability to embed other sub-problems, and cognitive structure. Just as game genres, such as first-person shooter, adventure, role-playing games (RPGs), and massively multiplayer online games (MMOs), encourage different game-play experiences, so also different types of problem solving opportunities can exist within these experiences. It is essential to understand the full complexity of different problem types in order to construct effective theory and practice in serious game-based problem solving.

Jim Gee\textsuperscript{35} argues that all games are situational, complex problem-solving opportunities in which players are immersed in a culture and way of thinking. Other researchers make the same point. Kiili\textsuperscript{13}, for example, contends that “a game itself is a big problem that is composed of smaller causally linked problems.” He maintains that games are undoubtedly more than just problems to be solved, but it is difficult to conceive of a game that does not incorporate problems to be solved. Thus problems can be seen as the raw materials for producing games, which can themselves be thought of as problem-solving domains.

In other research on game-based problem solving, Dickey\textsuperscript{36} finds that 3-D learning environments not only provide a narrative context for situating and contextualizing learning, they also enable spatial relationships rather than linear ones. Dickey concludes that spatial and narrative contexts offer learners “a cognitive framework for problem-solving because the narrative storyline in games provides an environment in which players can identify and construct causal patterns which integrate what is known (backstory, environment, rules, etc.) with that which is conjectural yet plausible within the context of the story.”

2.4.4 Behavioral psychology

A significant literature on serious video game-based learning has emerged from the discipline of psychology. An important contribution from Nick Yee\textsuperscript{37}, which I return to in the next section of this thesis, tries to tease apart player motivations. Yee asserts that although player motivations
vary widely, they fall into three major categories: 1) achievement, which includes advancement, progress, accumulation, competition, and challenge; 2) social, which includes socializing, relationships, support, teamwork, and collaboration; and 3) immersion, which includes discovery, exploration, role-playing, story, fantasy, customization, and escapism.

Psychological studies also investigate the emotional goals of players. For example, Nicole Lazzaro\textsuperscript{38} constructs a four-part typology of game-based fun. Hard fun is personal triumph over adversity in the moment. It involves issues like winning, goals, challenges, obstacles, strategies, power ups, and levels. By contrast, easy fun relates to curiosity, which involves exploration, imagination, interpretation, investigation, creativity, and figuring things out. Further, people fun refers to amusement. It involves cooperation, competition, communication, performance, spectacle, characters, and personalization. Finally, serious fun is relaxation. These activities include meditation, working out, learning, repetition, rhythm, completion, and collection.

In the relatively new field of positive psychology, serious game developer Jane McGonigal\textsuperscript{39} observes a growing sense among scientists that contributing to large-scale group projects is a fundamental part of happiness. Aided by advances in technology, video games provide such opportunities for players. In the science of happiness, one of the seminal findings is that the desire to join communities and be a part of endeavors much larger than ourselves appears to be a natural human instinct.

2.4.5 Interactivity and collaboration

Interactivity is another key dimension of video game design. Dodlinger\textsuperscript{26} observes that interaction between the player(s) and the game environment is an element embedded in the narrative context and game objectives. Effective games weave objects and characters into a game environment that provides feedback for successful game play\textsuperscript{40}. The degree of user control over the game environment is related to the level of interactivity. Swartout and van Lent\textsuperscript{41} deemed that the best games are “highly interactive, deliberately generating tension between the degree of control the story imposes and the player’s freedom of interaction”. They reason that in games with complete freedom of interaction, the playing experience can be boring and unchallenging. On the other hand, when the plotline imposes too much control, the player becomes a passive observer rather than an active participant. By providing a balance between these extremes, effective game design gives players “the perception they have free will, even though at any time their options are actually quite limited.” Gee \textsuperscript{42} called this concept the “Regime of Competence Principle”, which aims to challenge the player at the edge of his or her abilities.

In an overview of the design process and elements of multiplayer games, Zagal, Nussbaum, and Rosas\textsuperscript{43} examined the role of interactivity as a critical element in effective games, proposing that game designers should consider the extent to which the game rules, props, and tools affect stimulated and natural social interaction. Such interactions might depend on cooperation, competition, or a combination of both. They might also require synchronicity or coordination, types of interactions which are determined by player composition in the game.
Similarly, Dickey\textsuperscript{44} argues that contextual elements such as a first person symbolic perspective and 3-D representations of space increase learners’ sense of presence and consequently their interaction and collaboration. De Freitas\textsuperscript{3} proposes that multiplayer online games are one of the most powerful forms of modern gaming because they provide a community context in which situations and conflicts in different settings and conditions can be relived. Further, tools such as discussion forums, bulletin boards, and concept mapping software may be used to support multiplayer online games by mediating social interaction and encouraging discussion.

2.5 Summary

Two notable issues emerge from the review of the serious game literature. First, while lacking in some key areas, the serious game research is diverse and multidisciplinary. It is generated by media studies, education science, psychology and other interested fields. Many sectors of academia – policy studies, health, environmental studies, planning, architecture and landscape architecture, to name a few - are becoming aware of the potential role of video games, and video game technology, to translate the implications of their research across the public spectrum.

Nonetheless, while this plethora of viewpoints brings a richness and momentum to the study of serious game development, a review of the literature also reveals unevenness and gaps. Specifically, there is a critical lack of research on player archetypes in the context of serious games. The player archetype studies referenced in this literature review (Bartle and Yee) are based on commercial video games. There is also a dearth of studies that bridge academic disciplinary boundaries. Further, research on serious game design has not been embraced by the professional design disciplines.

A second and related issue is that serious game research, as evident in this review, remains primarily at the conceptual level. While this is not unexpected given the effort, complexity and cost (at least in terms of labor) of production, the result is a lack of game design studies that offer applied implementation and evaluation strategies. Development and production research that describes best practices in operationalizing the concepts identified in the literature is needed. For example, Winn\textsuperscript{45} talks about the important of balance and pacing in video games stating that there are distinct areas of the game that require balance, including conversation and gameplay. However, applied design guidance is needed to help serious game developers successfully translate and implement this concept into their products.
3 From visualizations to video games

The Collaborative for Advanced Landscape Planning (CALP) at the University of British Columbia applies visioning methodologies to the communication of climate change science (CALP)\textsuperscript{46}. CALP’s goals are to increase public engagement; provide a platform for discussing and evaluating adaptation and mitigation options; support decision-making on tough climate change choices; and help build support for local climate change policies. Landscape visualization involves representing actual places and on-the-ground conditions in three dimensional (3D) perspective views, often with fairly high realism\textsuperscript{47}. Geographic Information Systems (GIS) methods for landscape visualization have long been applied to depict alternative future scenarios for visioning, acquiring public input, and facilitating decision-making in fields such as coastal zone management, rural land use planning, and forestry\textsuperscript{48,49}. Now video game technologies offer new interactive instruments for envisioning landscape data and disseminating climate change information.

Video game design is difficult because the world is complex, dynamic, and multidimensional. Winn\textsuperscript{50} observes that serious game design is a creative, sometimes chaotic process. The design must reflect the rich visual world of interactive experience and measurement over time using mere pixels on a computer screen. Tufte\textsuperscript{51} observed that the effective visualization of data draws the audience into assessments of change, dynamics, cause and effect, and mechanisms, all of which are at the heart of thinking and explanation.

But there is a fundamental difference between Tufte’s visualizations and video game design: Tufte’s medium is static and deterministic whereas the game designer’s medium is dynamic and stochastic. This is not to say that static visualizations do not convey dynamism and change. For example, Caravaggio’s “The Conversion on the Road to Damascus” (below) is clearly about movement. Saul is thrown off his horse and blinded, out of control. With the trappings of power and dignity taken away, Saul becomes lower than the animals. This inversion of order (the man under the horse’s belly) makes the horse, which is the focal point of the painting, nervous. With great sensitivity, the groom leads the horse out of the picture\textsuperscript{52}. Thus, in the hands of a master, oil and canvas forcefully convey the conversion experience.
Caravaggio’s painting offers two key design principles for serious games. First, distilling grand themes and learning opportunities into mundane moments that resound deeply with the audience is vital to reimagining serious game content. Second, a game world, like a painting, is inherently an edited or simplified representation of a real world scenario.

Grasping these concepts will help the designer focus and stage the learning objectives. What would a continuous and interactive experience of “The Conversation on the Road to Damascus” be like? To the extent possible, Saul, the horse, and the groom would have agency, and the audience/player experience, rather than being deterministic, would be stochastic. The player can potentially enact all the moments leading up to and following the Caravaggio moment. The design challenge lies in giving each mundane moment meaning and making the transitions between them seamless.
Films are a dynamic medium that engage the audience using narrative and emotion. But while freed from the constraints of a static medium, they do not offer the audience agency. By contrast, a well-designed video game can provide the player with a probabilistic interactive experience. No one player is likely to catch all the moments and all the meanings, so there must be enough meaningful moments embedded in each iteration of player experience to maximize exposure and response to learning outcomes.

Thus, the complexity of serious game design can increase exponentially and quickly. To manage this complexity, it is crucial to have a strong, simple (not simplistic) core concept, and to iteratively validate gameplay themes as well as learning outcomes with players.

**Figure 7  Serious game design process**

*Gameplay* involves the ways in which two dynamics develop on the screen: the interactions between the player and other human, non-player characters, and objects in the world; and the interactions between the player and the user interface. The next section of this thesis draws from commercial video game development as well as academic studies to construct a design framework that operationalizes gameplay in serious video games.
4 Gameplay design

Gameplay design is intricate and requires agility. As the figure below shows, it is characterized by feedback loops with other design components - learning objectives, game story or narrative, 3D world, and evaluation - that permit the designer to iteratively assess and adjust the design as game development evolves. In the framework developed here, “GAMEPLAY” is the central design component; the other elements feed into it. But serious game developers can prioritize their own expertise and understanding (usually learning objectives, story, or 3D world), making that component central to the process. The rationale behind designating gameplay as the central focus is to help ensure the product is “fun” and has authentic video game style and appeal.

**Figure 8 Design components**

![Diagram of design components]

4.1 The mechanics of gameplay

While Bartle and Yee’s models laid the initial groundwork for conceptualizing player archetypes and the corresponding variation in players’ experiences of fun, they offer very little applied information to help a game designer give on-screen life to their conceptual models. Understanding that “a good combat and crafting system” and “varied and interesting quests” are important components of gameplay and fun in video games does not address the question of how to design and implement “a good combat and crafting system” or “varied and interesting quests” in a product.
Moreover, Bartle and Yee developed their models based on the commercial video game industry. It is not known how well these models function in serious game design.

Thus, the current lack of tools or roadmaps that translate theory into practice is an obstacle to serious game design and development. Generating practical gameplay design guidance will help to address this gap.

**GAMEPLAY**
At the most basic level, gameplay can be thought of as the interaction between the player and other players, non-player characters, objects in the world, or the interface.

Gameplay themes refer to the various on-screen events facilitated by the player’s interaction with the user interface via the input controller(s). The joystick, game pad, keyboard, and mouse are all examples of input controllers. Serious video game design requires an understanding of the connections between the player control mechanisms, the interface, and the 2D/3D world. Each impacts the arc of player experience. Gameplay is the expression of the interactions between these three components.

**GAMEPLAY THEMES**
This concept refers to types of player interactions with the user interface via the input controllers.

There is little academic literature about gameplay themes. Therefore, I draw primarily on my knowledge and experience, as well as key informants in commercial entertainment video game design, to develop a typology of serious gameplay themes.

**VIDEO GAME GENRES**
Genres are categorizations of video games based on gameplay mechanics rather than visual or narrative differences.

There are a wide range of video game genres including action, flight and driving simulations, sports, puzzle, stealth, first-person shooter (FPS), multiplayer online battle arena (MOBA), real-time strategy (RTS) and role-playing games (RPG). The conceptualization of genres is relatively fluid. The rise of mass market video games has led to a compression of more and more genres into a single product. Currently it is not uncommon to find diverse genres in the same game. If developers can get the formula just right, they can expand their player base and market share.

In this thesis, the principles of gameplay are illustrated using the 1st and 3rd person action-adventure and RPG genre. 1st and 3rd person refers to the player’s spatial relation to her game.
self or avatar, which is explained in more detail below. Action-adventure and RPG games tend to focus on exploration of the virtual world, quests to find and gather selected items, and puzzle solving. This genre most closely mimics human perspective, locomotion, and experience. Therefore it is relatively easy to understand and suggests itself as having the richest potential for experiential learning in serious video game design. However, the principles of gameplay developed here are applicable across genres.

AVATAR
The player’s game self – the biopsychosocial representation of the player’s character in the game world.

Inherent in the human psyche is the desire to be unique, to differentiate one’s representation from others. The player’s avatar represents him and embodies his agency in the game. This includes everything from initial character creation, to clothing, pets, and modes of transportation. In all these areas, players want choice - and technology is delivering it. Twenty-five years ago, most games did not allow any avatar customization (not even sex - male or female). Currently some entertainment games offer more than 25 different variables related to eyebrow customization alone. These parameters might include eyebrow arc, shape, length, width, color, and more. Some gamers spend dozens of hours making and refining their avatars.

PLAYER CONTROLLER
The key technical piece in the interactive connection between the real human player, the player’s game self (avatar), and the way the player interacts with the game world.

The player controller determines how the player interacts with other objects as well as the user interface. My design centered approach to the player controller is based on four features:

- Camera position relative to the avatar
- Locomotion of the player controller
- Avatar or 3D model
- Scale

The way the game designer combines these controller design features shapes the player’s experience. It determines: the characteristics of the player’s new self (avatar); the player’s spatial relation to that new self, i.e. whether the player actually inhabits that self (1st person) or, by contrast, looks down on that self (3rd person); and the way the player moves through the world.
4.1.1 Camera position

This refers to how the camera is positioned relative to the player avatar. 1st person perspective means that the camera is located directly inside the avatar’s head at the eyes, and therefore the player sees the world from a human perspective. 3rd person perspective indicates that the camera position is some distance over the shoulder from the avatar. The latter perspective implies a different type of player agency over the avatar. This distance changes the way the player see the world – not through the eyes of the avatar but rather like an omniscient being who “sees all”. There are other novel camera positions such as “fixed” and “on a rail” – each impacts the way the player sees and interacts with the world. The gameplay themes described later in this thesis are applicable to these camera positions as well.

4.1.2 Locomotion

There are three key components of player controller locomotion: speed; acceleration; and turning speed. Other components of player locomotion are also important, especially in considering the design of the world. For example, whether or not the player has the ability to jump not only influences the mode of travel the designer wants to simulate, but it also influences the construction of the physical space.

4.1.3 3D Model

An explicit model refers to a 3 dimensional screen representation through which the player’s agency is enacted. Examples of explicit models include avatars such as human figures, vehicles like airplanes, and even abstractions like aliens or blobs. If the camera is inside the player’s head (1st person perspective), the player will typically only see the player’s hands and what he is holding (in the case of lethal games, the gun, heaving back and forth as he runs) – along with all the action in front of him. In other cases, especially in the absence of a strong modeling and animation team (or the budget to purchase models and custom animations a la carte), the model is implicit and therefore not represented physically on the screen. It is only implied and therefore not visible.

4.1.4 Scale

In video game design, scale refers to the idea of creating the illusion of the correct size relationships between the camera position, the character model (if there is one), and the objects in the game. The concept of scale is as relevant to video game design as it is to architecture, landscape architecture, engineering, and other fields. In serious games, scale relates to another, even more important dimension – learning objectives. Designers who aim to imbed learning outcomes in a serious game must first ask themselves at what scale, or across what scales, are the specified learning outcomes likely to reside. For example, as a designer of a serious climate change game project in the landscape architecture department, I approached the design of the game knowing that many learning concepts related to revealing carbon emissions in the landscape exist not only at the individual or parcel scale, but also at the
neighborhood and regional scales. While global outcomes are also relevant to the topic, the focus of this particular game is on local conditions. A 1\textsuperscript{st} person controller and perspective might not be the best mechanism by which to convey regional-level learning outcomes. The point is that many critical design elements and learning outcomes are tied to scale and therefore the role of scale is vital.

Specifying the appropriate scale in planning, implementing, and evaluating the game design is challenging. Consider the following scenarios.

4.1.4.1 Human or individual level scale

Scale will often dictate the type of player controller used. For example, if the game world and gameplay take place in the 1\textsuperscript{st} person, a player controller with human locomotion may be appropriate, meaning a speed of roughly 4 kilometers per hour and relatively slow turning capacity, and a human 3D model (or no model). This scenario is illustrated in the figure below. The image shows a 1\textsuperscript{st} person controller, with no avatar, at a cement factory.

Figure 9 1\textsuperscript{st} person controller without an avatar at a cement factory

4.1.4.2 Neighborhood or regional level Scale

By contrast, if the game world is on a larger scale, i.e. city, regional or global, then a flight-style player controller with airplane locomotion may be effective, meaning a speed of approximately 300 kilometers per hour and relatively fast turning, and an airplane 3D model. \textit{SimCity} is a commercial game that popularized the neighborhood or regional scale, although it does not use
a plane as the player controller. The figure below shows a scenario with an airplane flight controller at the city scale.

**Figure 10** 3rd person controller with airplane model at the city level

It is possible, but not traditional, to combine multiple controllers, such as walking and flight, to create a dream sequence or super hero feeling (e.g. Spiderman). However, developing a hybrid controller that “feels right” and makes sense contextually can be technically and creatively challenging.

### 4.2 A revised typology of player archetypes

Video games must first be fun and engaging if players are going to interact with the product in a meaningful way and learn from it. This imperative makes the design of a video game with general appeal a complex task. Each user expects to get something out of the experience, and that expectation can change in both the short and long terms. Moreover, significant variation in players’ expectations across demographic, cultural, social and economic groups presents further challenges. Designing for this elasticity in player preferences is extremely difficult, even for well-resourced commercial studios.

**PLAYER ARCHETYPES**

Despite elasticity in player preferences, theorists have categorized these preferences and developed typologies of player archetypes.
Initial as well as ongoing attempts to classify types of entertainment gamers are invariably linked to psychological theories of motivation. The “Bartle Test of Gamer Psychology”, a series of questions and a scoring algorithm developed by Erwin Andreasen and Brandon Downey\textsuperscript{53} classifies players based on their gaming preferences. It has reportedly been downloaded nearly a million times. Andrzej Marczewski\textsuperscript{54} offers a classification of users similar to Bartle’s mode. It designates eight user types: half are intrinsically motivated and half are extrinsically motivated. While Yee claims that his typology is empirically based, Ville Kikku\textsuperscript{55} shows that Yee’s model maps reasonably well onto psychologically-based categories of motivation posited by self-determination theory. Kikku defends weaknesses in this mapping by arguing that Yee’s sample and thus his factor analysis suffers from selection bias, meaning not all groups, based on demographic and other characteristics, have the same probability of being represented. The goal of this thesis is not to defend or challenge the links between psychological theories and player archetypes but simply to highlight the dominant approach to the categorization of entertainment video gamers.

By contrast, the typology of player archetypes developed in this thesis is grounded in applied design. This alternative approach acknowledges Bartle and Yee, and builds on their work to the extent that the psychological paradigm is ubiquitous to the way contemporary culture understands human behavior. Several of the archetypes proposed in the current typology resonate with the factors that Yee identified, e.g. explorer, lore-enthusiast and socializer (Sinkewicz) have similar traits to discovery, role-play and socializing (Yee), respectively. However, the current typology evolves from a design-centric approach to create actionable tools for game designers. Although Bartle and Marczewski claim to have similar aims (Yee much less so), a limitation of their design value is that their typologies have not so far been linked to gameplay. Further, while extant typologies are rooted in commercial game design, this thesis illustrates the current player archetype typology in the context of serious game design.

Nonetheless, this thesis also draws heavily from commercial game design. Player archetypes are important in commercial game development. However, unlike academic models, which have thus far remained at the conceptual level, commercial player typologies are applied-practice oriented. Their purpose is to give clear, actionable guidance to level designers, not only based on what is known about the target audience but also taking into account knowledge about game mechanics and the limits of technology within a particular game genre.

The typology of player archetypes below is based on the way commercial level designers think about player types although, as mentioned, the links with motivational theory are evident. It is constructed to give the designer a sense of the characteristics associated with each player type and, with this in mind, ultimately facilitate the practical design task of engaging with gameplay themes to translate narrative and action from the creative regions of the designer’s brain onto the screen.
Table 1 Typology of player archetypes

<table>
<thead>
<tr>
<th>Archetype</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actionist</td>
<td>Hand-eye movements, multi-tasking action</td>
</tr>
<tr>
<td>Completionist</td>
<td>Leaves no stone unturned, compulsive</td>
</tr>
<tr>
<td>Socializer</td>
<td>Relational, likes interaction</td>
</tr>
<tr>
<td>Lore Enthusiast</td>
<td>Role play, enjoys fantasy</td>
</tr>
<tr>
<td>Explorer</td>
<td>Trailblazer, curious, world discovery</td>
</tr>
<tr>
<td>Stealther</td>
<td>Cerebral, rational, formulaic, assess &amp; respond</td>
</tr>
<tr>
<td>Tradeskiller</td>
<td>Pragmatic, physical, economical</td>
</tr>
<tr>
<td>Learner</td>
<td>Real world knowledge acquisition</td>
</tr>
</tbody>
</table>

4.2.1 Actionist

Actionist players typically prefer a cacophony of on-screen movement and button pressing. Their skills primarily involve hand-eye coordination, timing, and the ability to account for many simultaneous processes. For example, the real time strategy (RTS) genre, which is well suited to the action player, can feature simultaneous control over hundreds of individual agents acting at multiple levels across a wide and varied landscape. These agents are involved in a variety of tasks including scouting and exploration, resource gathering, base building, and in-game technological development. A desirable tension results from the vast range of available options. The player must balance production and resources while selecting from a subset of options that produces an optimal balance between offensive and defensive actions across all game mechanics. The ability to accomplish these tasks is measured in individual keystrokes and mouse clicks, called actions per minute (APM). Players who are new to the genre might start with an APM of less than 40, while the best professional players consistently register over 400 APMs during a 45- to 90-minute match. At the professional level, the intensity of focus and training required to successfully make and expedite a sequence of more than 36,000 split second decisions to win a match is on par with the skills required to compete in other professional sports. The official record is 818 APM, held by Park Sung-Joon.

4.2.2 Completionist

This player likes to engage completely with some or all aspects of the game, with “no rock left unturned”. To satisfy the completionist, there must be continuity and flow to the narrative, character development, game world, game mechanics and overall arc of player experience. Completionists do not appreciate dead or loose ends. Of note is an extremely successful video gaming trend known as “Achievement Points” (AP). Developed over the last 10 to 15 years and
popularized by Xbox, AP targets the completionist archetype. A brilliant under-the-hood strategy by XBox requires developers to expose a game’s entire underlying design framework and assign points to every possible task that can be accomplished in the game. Players consult their “Achievement Points” index to see what they have accomplished and what is still left to be done. The player’s AP index is updated and displayed online on Xbox live, a virtual venue where gamers gather to share and compare their progress and experiences. This clever mechanic not only makes the possibilities in the game transparent, it also compels players to stick with a product longer in order to attain all its APs. A worldwide meta-game grew out of the AP craze in which players compete for the highest number of APs across as many games as possible. Perhaps the completion phenomenon is best embodied in one of the most globally successful children’s entertainment media franchises of the last 20 years, Nintendo’s Pokemon, whose slogan entices players to keep playing because they “Gotta catch ‘em all”.

4.2.3 Socializer

This player’s preferences are linked to personal relations with other virtual human players or computer non player characters (NPCs) in the game world. In an interview with gamesbrief.com, legendary game designer John Romaro observed that a game oriented to social players has, “a very gentle learning curve, easy-to-understand user interface, and lives on a social network, taking advantage of [player] friendships in meaningful ways within the game.”

Given the current ubiquitous nature of online social networks, it is crucial that serious game designers learn to manage and package elements and mechanics associated with social games. It is important to understand that social gaming does not stand on its own, but is nested within a hierarchy of both real and digital social circles that extend well beyond the game. According to entertainment video game websites RockYou and Interpret, social gamers spend an average of 13 hours a week on social networks and 9.5 hours a week on social games. Overall, they make an average of 20 new friends through social gaming and they play social games with slightly smaller groups of real-life friends. Thus, the contagion effect inherent in digital social circles suggests that the successful engagement of each player with a serious game has the potential to create ripples across the social network.

4.2.4 Lore Enthusiast

This archetype enjoys getting caught up in the lore and fantasy of playing a part (often the protagonist) in a story and world that differs from her own. Storytelling, fundamental to human relationships, is an exchange between teller and listener, latent with meaning. The narrative archetype is well known to novelists, and film and television script writers. While stories themselves are ubiquitous, their telling changes with the available technology. New media produce new narrative methods and structures. Bio Shock and Star Wars: The Old Republic are classic entertainment video game titles that appeal to the narrative archetype. Interestingly, game designers have begun to discuss more novel forms of narrative. Currently there is a debate around the viability of emergent narrative, which involves “storymaking”, wherein the player goes beyond the role of protagonist to partially author his or her own story. The designer’s job is not to tell, but rather to facilitate the player’s telling of his own stories within
the game’s mechanical framework. While emergent narrative is not something that might appeal to every player, and the design challenges are considerable, it is an avenue worth exploring. Terrence Lee of HitBox Team and others argue that merging character development with personal development is the key to truly immersive storytelling.

4.2.5 Explorer

These players are trailblazers. They are always on the lookout for new discoveries as a means to satisfy their acute sense of curiosity. In the game world, discovery archetypes often seek to map the entire game space, cataloguing people, places, items, knowledge and lore as they go. Their sense of achievement comes from knowing more facts (often obscure ones) and finding secret shortcuts and mnemonics. They love to demonstrate their knowledge to others. These players get satisfaction from identifying where the pitfalls lurk and demystifying areas that may confuse others. They wish to delineate paths for others to follow. Explorer archetypes often value knowledge for knowledge’s sake. Yet they can be like those kids who do all of the work for a project and then forget to turn it in. They have already extracted from the project what they consider valuable – and this does not include the grade.

4.2.6 Stealthier

These players are attracted to games that create palpable tensions of the sort that are unmatched in other games: the push, the pull, the contemplative pause... and then the rush of action. Two key design dialectics - light and shadow, and sound and silence – often play primary roles in creating and sustaining the tensions that hold the attention of the stealthier archetype. This player enjoys analysis, pattern recognition, and strategic planning based on clandestine and surreptitious activities. The preferences of analyst archetypes are particularly relevant for serious games because many of the gameplay themes do not involve lethality. In contrast to shooter titles that mostly boil down to running through a variety of settings mowing down hundreds of henchmen and the occasional lieutenant or super villain, games that appeal to stealthier archetypes can be significantly less emotional and more cerebral. Two of the greatest gaming franchises in entertainment video game history, Metal Gear and Splinter Cell, are geared toward the stealthier archetype.

4.2.7 Tradeskiller

This player is a pragmatic constructivist, which refers to a theory of learning that views knowledge as constructed by players’ interactions with their environments rather than something simply waiting to be discovered. There are typically three aspects to building and crafting mechanisms in video games: gathering resources from out in the world; assembling those resources to form a new object, often with a physical representation in the world such as an architectural structure or a garment or piece of armor; and finally using or selling the new object. The game Minecraft by Mojang is a global sensation with dozens of spinoffs that cater primarily to the builder archetype. Minecraft is a game about gathering resources and breaking and placing blocks. At first, players simply built structures to protect against nocturnal monsters.
but, as the game evolved, players collaborated to produce wonderful, imaginative creations. The success of *Minecraft*, currently reporting $14 million total sales on all platforms\(^6\), especially among pre-teens, supports the evidence that the tradeskiller archetype exists in significant numbers and is global.

### 4.2.8 Learner

The learner archetype prioritizes the acquisition of real world knowledge. This archetype is not necessarily new to commercial or education games, but needs to be updated to address both the changing culture and the growing popularity of the serious games movement. The learner archetype also needs to be reconsidered in light of the rapid growth in technology, which has provided the resources to build increasingly complex digital interactive systems that display progressively more information. This development offers the potential for serious game designers to address the preferences of the learner archetype in innovative ways. Tom Clancy, renowned for the importance he gives to real world research in his novels, is also the creative force behind the popular video game franchise *Splinter Cell*. Critics say Clancy’s research lends authenticity to his work, which in turn enhances the reader’s/player’s immersion. This may partially explain why Clancy is one of the most successful writers of his generation. Similarly, many commercial game development studios deploy a small research and development team to locations likely to be included in the game. They take photographs, conduct interviews with local people, record videos, and assemble literature for the development team to reference throughout the project. Not only does such research add authenticity to the game, it also provides game designers with substantive contextual content to infuse into the story and gameplay. This real-world knowledge can increase the appeal of the game to the learner archetype.

### 4.3 A typology of gameplay themes

Any entertainment gameplay theme relating to killing or injuring, such as shooting, is likely inappropriate for serious games. However, this ‘lethal’ style of gameplay can be repurposed with some creativity. For example, a point-and-shoot theme with crosshairs, usually reserved for guns, could also apply to a camera. The same essential gameplay actions and skills are required of the player, but the non-lethal gameplay strategy is not linked to the negativity and violence that is often associated with commercial gameplay. However, it can be difficult to recreate with a camera the same sense of urgency that motives a player to shoot hundreds of enemies. Therefore it is important to understand and make use of the entire palette of nonviolent gameplay options.

**NON-LETHAL GAMEPLAY THEMES**

Mechanisms that motivate the action on the screen and engage the player in ways that do not evoke violence or negativity.
This section develops a typology of some of the primary non-lethal gameplay design strategies found in commercial 1st and 3rd person role playing and action/adventure video games. The gameplay typology serves several purposes:

- It provides baseline knowledge for stakeholders who do not play video games. This information will enable such persons to understand the mechanics of gameplay design and how those mechanics fit into the larger meta-narrative and educational objectives.

- For designers of serious video games, it functions as a skeleton on which to drape the narrative and content (educational and otherwise) to produce a baseline video game experience for the player.

- It helps designers target particular audiences and keep the game fresh and engaging. It is important to appeal to diverse audiences without diluting the quality of the gameplay.

The typology is not intended to be comprehensive; it is, however, sufficient to launch the design of a serious (or commercial) game. In developing gameplay theme nomenclature, priority was given to terminology that is already in use in commercial entertainment game design. In two cases, this results in similar labels across archetype and theme categories: stealthier and stealth, and tradeskiller and tradeskills. Although potentially confusing, the decision was made in favor of consistency with commercial game development terminology.

### Table 2 Typology of gameplay themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Typology of Gameplay Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery</td>
<td>Scout an unknown region to gain information or items essential to the narrative</td>
</tr>
<tr>
<td>Mini Game</td>
<td>Short and simple sub game with modified simple interface and controller scheme</td>
</tr>
<tr>
<td>On-a-Rail</td>
<td>Locomotion is locked, player focuses on a non-movement task</td>
</tr>
<tr>
<td>Gather/Fetch</td>
<td>Identify and collect objects, data or information in a localized area</td>
</tr>
<tr>
<td>Tradeskills</td>
<td>Construct specialized objects or parts of the game world from resources</td>
</tr>
<tr>
<td>Stealth</td>
<td>Analytical, calculating, move and act in a covert fashion</td>
</tr>
<tr>
<td>Defend/escort</td>
<td>Defend a weaker entity, repel a threat, on the move or stationary</td>
</tr>
</tbody>
</table>

Note. Non-lethal, 1st and 3rd person role playing and action/adventure video games

#### 4.3.1 Discovery

If there is a law of videogame dynamics, it is this: “There is a player. There is a world. The player must discover the world.” The discovery gameplay theme is nearly ubiquitous across all 1st and 3rd person game genres, either explicitly or implicitly. It is described first, not only because discovery or exploration is inevitable, but also because it lends itself to providing opportunities to subtly imbed learning objectives. In a 1st or 3rd person adventure title, the player must move throughout the built 3D world. He may not cover all the available territory, depending on the
path he or the designer has chosen, but technically he must migrate from an initial starting point in an environment through to the end point in order to complete the level. Every step along this trajectory is an opportunity for the designer to lure the player into exploring novel situations from which he can learn, by eliciting both emotion and cognition. Thus, these design principles, found in both architecture and landscape architecture, concerning the multiple ways in which a player moves through and interacts with built and natural space are also relevant to the design of virtual, interactive spaces.

From entertainment to serious gameplay - In the fantasy game Seek out the Wolfmaster in Howling Den to learn more about Skyward, Sword of Ages, the player is told to scout an unknown area to discover information that is essential to a progression in the objectives or narrative. Discovery tasks are often be broken down into many sub tasks, even if they are not noted as such. This means that the player must depart from his current location, find the Howling Den, and then find the Wolfmaster inside the Den. Is it on the map? Does the player already have the map? Does the player have to ask other players or non-player characters for directions? Will challenges along the way require the player to collaborate with others? Will the Wolfmaster require something in return for the information? Or before giving up the information? Discovery gameplay may embody some or all these elements. There is no limit to how this theme can unfold and become elongated in combination with other gameplay types such as Gather/Fetch (described below). Discovery gameplay in the commercial context can be repurposed for serious games within a non- or quasi-fantasy context. For example, the exploration could become “Seek out the Lead Engineer at GreenTek to get the plans for the wind turbine”. Attention must be given to the label. While the actual discovery gameplay may be identical to its fantasy counterpart, the description must pull its weight in presenting a compelling objective.

4.3.2 Mini-game

Many simple games sold as apps for smartphones can be considered mini-games. This gameplay theme entices the player into a small sub game, nested inside the main game. The mini game generally has a modified interface and control scheme that is characteristically very simple yet engaging. It usually contains not more than 2 or 4 movement directions and often only a few buttons (or “swipes" for touch surfaces) of action.

From entertainment to serious gameplay - There are several key reasons to include mini-game gameplay in a serious gameplay framework. First, mini-games provide easy ways to get groups of students engaged and having fun. The video game Mario Party illustrates the effective use of mini-games by showing how much fun it is to play mini games in small groups of people. This is a crucial tool for serious game designers, who must take advantage of group-level gameplay dynamics in order for the game to be successfully integrated into classrooms. Second, mini-games allow serious game designers to break from their baseline interface and mechanics. The result is a new range of opportunities to embed learning outcomes in the game, especially those that may be difficult to imbed elsewhere. The trade-off is that each new control scheme
and design mechanic, however simple, requires development time. So each gameplay mechanic should be leveraged by deploying it in as many places as possible without it getting stale.

4.3.3 On-a-rail

“On-a-rail” gameplay refers to the rail of a train or roller coaster. The player’s locomotion is locked or limited (on a rail). This phenomenon gives the player the opportunity to put her full attention onto other control themes, besides movement. In commercial games, this usually involves shooting. Because the player’s movement is locked, targets are only in the field of view for a limited period. This adds a time dimension to the gameplay. For example, imagine passing through a shooting gallery while riding a small train. This rail moment can provide the player with a cinematic experience outside the bounds of the normal game and the chance to concentrate on developing an area, cinematic moment, or educational message – or all three. The usual gameplay animations might allow for shooting, running, walking, and sneaking. However, if the designer wants to show the player taking off his belt, jumping out a window and shattering the glass, hooking his belt over a wire, sliding down the wire while taking out enemies on another building’s roof and windows, then dropping into a garbage bin at the bottom of the alley, these actions can be captured in a unique cinematic moment. While such unique experiences can be impactful, rail moments are also labor intensive to develop and can generally only be used in only one situation in the game. Therefore, they must be incorporated into the design scheme judiciously.

From entertainment to serious gameplay - The typical commercial shooter rail gameplay scene described above could be transformed into “Photograph 10 birds, their food, and their habitat as you ride the electric train through the bird sanctuary.” There is an element of tension in effective gameplay moments. For example, tension could be generated by the amount of time that birds, their food, and their habitats are exposed to the player’s field of view, thus allowing only a narrow window of opportunity for the player to acquire the required photographs. A bird that is easily photographed could remain sitting on a branch for the entire 35 seconds it is in the train’s field of view. This gives the player a full 35 seconds to take that picture. By contrast, a rare spotted bird could swoop down for only 3 seconds at a specific moment in the train ride, out of the field of view the designer expects the player to be looking. If the player is paying attention, gets lucky, or has played the level before, she might capture a picture of the bird. However, it is unlikely that the player will be successful on the first pass. So another benefit of the rail gameplay theme is that it can add replayability. In particular, certain player archetypes, such as completionist, will play the level repeatedly in order to complete all of the most challenging photographs.

4.3.4 Gather/fetch

This type of gameplay is extremely common and relatively basic, but it can emerge under many different guises and in various ways to increase the game’s appeal to a variety of players. Helpful illustrations of this gameplay type are found in popular massive multiplayer online role-playing games (MMORPG), such as World of Warcraft. It is the first gameplay theme every
player encounters upon starting the game. After character creation, the game begins with the player standing directly in front of a NPC who asks the player, for example, to “Gather 10 bat wings” or “Fetch 15 wolf pets” and then return these items to him. In such cases, the fetching generally involves slaughtering as many animals as possible, usually in the general vicinity, until the player gathers the assigned quantity of items. These items are obtained at a variable rate from each source, for example, ranging from 5% to 100% from any given bat or wolf. For the designer, there is a balance to be struck between monotony, which is of course to be avoided, and keeping the player busy but not overwhelmed with directions and objectives. Gather/Fetch gameplay works particularly well if the base game mechanics are already fun. This style of quest is relatively easy to create, and draws out the game’s total playable minutes/hours. In contrast to other gameplay themes, Gather/Fetch quests are usually localized, i.e. they are geographically restricted.

*From entertainment to serious gameplay* - In a commercial game, a player may be confronted with the following task. “Chef Makkara has asked you to venture out into Fadebloom Forest to gather 10 speckled glowshrooms for tonight’s feast”. This quest could be repurposed for serious games as “Chief Engineer Scott has asked you to go to 10 wind turbines at the wind farm and download their weekly data dumps to your handheld gadget. Return to Chief Engineer Scott with all 10 data points downloaded onto the device, as well as any other important information you discover along the way”.

### 4.3.5 Tradeskills

Humans derive satisfaction from gathering and building things. Video game design has recognized the gratification these activities produce and reproduced it in gameplay. As video games move more and more into the mainstream, gameplay themes like tradeskills have rapidly gained popularity. Examples range from titles like *Farmville* where the player builds and manages a farm to *Minecraft* where the player builds an entire world. This type of gameplay is less reliant on hand-eye coordination, fast twitch button pressing, and quick movements to accomplish its goals. Instead, more strategic skills are required. The low difficulty coupled with high satisfaction gives this gameplay theme a low barrier to entry and makes it generally accessible to all types of players. The odds of tradeskills being a successful component of the overall gameplay design strategy are relatively high.

*From entertainment to serious gameplay* - In a commercial game, a player may be required to “Combine 3 owl feathers, 1 toad eye, pixy dust, and a drop of water from Moonriver Falls into the cauldron to create the antidote”. For serious games, this assignment could be reconfigured as “Gather the parts required to build your own solar panel from various places in your neighborhood”. This objective alone could launch an entire series of sub-objectives where the player must acquire each item using different skills, tactics or negotiation strategies with other characters. In video game design, tradeskills gameplay is often split into three distinct phases: gathering, building, and using (or selling). The gathering phase could be envisioned as a fetch quest as outlined above. The building phase could be designed as a mini game with a modified simple interface where the items gathered in the fetch quest (in the example above, 3 owl
feathers, 1 toad eye, pixy dust, and a drop of water) are combined to create a new item (in this case, the antidote). Then there is likely to be a use phase, meaning that this item could be used to further a main or side narrative. It may be traded or sold to other players, as is the case in many commercial online MMORPGs.

### 4.3.6 Stealth

Stealth, originally a niche gameplay theme found only in a few major brands, is now more widely used across genres as its popularity increases. Stealth is the act of moving or acting in a covert manner to progress through a level. The primary function of stealth gameplay is to hide (usually behind objects or in the shadows if light/dark gameplay mechanics are present) and avoid contact with nearby enemies or detection devices (e.g. cameras, lasers). Usually the overall challenge is similar to a puzzle, with multiple actors, variables, pathways, and potential solutions. The most effective use of stealth, which caters mainly to the Stealther archetype, is to design the gameplay so that the player is offered multiple solutions to each challenge. Some common stealth actions include avoiding guard patrols, gaining entry to secure areas, disguising the character, vertical and horizontal movement and hiding schemes, sneaking and crawling, using high-tech gadgets, and blending into environments and crowds. Muhammad Alkaisy suggests that game designers ensure that the characters the player faces in stealth gameplay be balanced and aware of their environment in order to present an effective challenge to the player. Usually in this gameplay theme, when one of the enemies is alerted by the player, then the difficulty level increases, triggering the appearance of more foes.

*From entertainment to serious gameplay* - An entertainment game might give the following quest to a player: “Without arousing suspicious, log into Sgt. Gurgenidze’s computer to steal the access codes to the police precinct weapons locker.” The implication is that the player is not allowed to log onto Gurgenidze’s computer and that when she does, she will have only a minute or two to find the specified information and leave the room. Is Gurgenidze at his computer now but will soon get up to get a drink or use the restroom? Is that when the player acts? Is anyone else watching? Do cameras or other security devices pose threats? Is more information or a password needed to log onto Gurgenidze’s computer? Where is the password? Is the door to his office locked? Where is the key? Stealth gameplay is all about presenting the player with a series of challenges and then windows of opportunity in which parts or all of a challenge can be completed. This type of gameplay can easily become suitable for serious gameplay by changing the narrative and objective from stealing to something less offensive, such as measuring carbon emission levels. The tension and gameplay dynamics are still mostly there even when the story is repurposed.

### 4.3.7 Defend/escort

Here again video game design taps into two activities that leave humans with feelings of satisfaction: defending a weaker entity; and demonstrating power by repelling an attack. This gameplay theme typically charges players with defending an area, object, or player against a wave or waves of attackers. When the defense takes place on the move, it is often referred to
as an “Escort” mission. The area to be defended or route to be traveled is inundated with enemies or dangerous situations that must be defeated, solved or avoided in order to progress in the game.

*From entertainment to serious gameplay* - A player in a commercial game could be required to “Defend the caravan from attackers as it moves from the Lockjaw Oasis to the City of Mythos”. The gameplay could be repurposed for serious games as follows: “Free 10 trapped survivors and lead them safely to higher ground as a tsunami batters your coastal village”. Again the larger objective can be broken down into a series of sub-objectives in which, for example, each set of survivors is located in a different geographic area of the game world and must be freed from their various unique predicaments. Each sub-objective represents the opportunity to embed a different set of learning objectives while still maintaining a recognizable commercial gameplay format.

### 4.4 Linking player archetypes and gameplay themes

Each gameplay theme may be creatively used across archetypes. Innovative scenarios that combine player archetypes and gameplay themes are limited only by the designer’s imagination and available resources. The latter involves a realistic assessment of the design and production team’s person hours and specific skills and talents (e.g. programmers, artists, designers and animators), as well as the technical limitations of the specified game engine or editors. Given that most game development environments are constrained in some ways, an understanding of what type of player is likely to be attracted to each gameplay theme is useful as some archetype-theme linkages are more easily achieved. The table below is provided to help designers use scarce resources efficiently to achieve the learning objectives for the intended audience.

For a serious video game to be an effective teaching tool and brought to scale, it often must be robust enough to appeal to various sub groups of students, for example, across sex, cultural backgrounds, and some variation in age groups. Further, the game must appeal to students who may play commercial video games for more than five hours per day as well as those who have played very little or not at all. A serious game that maximizes diversity in gameplay themes across multiple player archetypes is more likely to appeal to a wider audience. However, this means the design team must create diverse scenarios that maximize interactions between player archetypes and gameplay themes. On the other hand, a serious game may target selected players with narrowly defined characteristics. In either case, depending on how the audience is envisioned, the table below is a tool that points the designer to a range of archetype-gameplay theme matches with which her intended players are likely to engage. The suggested interactions are based on evidence of such linkages in successful entertainment games as well as the author’s experience in executing these combinations in designing entertainment games.
The proposed rubric (Table 3) for linking player archetypes and gameplay themes will be evaluated in future research. The evaluation design is discussed in section 6.2 Evaluation.

<table>
<thead>
<tr>
<th>Suggested Gameplay Theme and Player Archetype Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gameplay Themes</strong></td>
</tr>
<tr>
<td>Discovery</td>
</tr>
<tr>
<td>Gather/Fetch</td>
</tr>
<tr>
<td>Tradeskills</td>
</tr>
<tr>
<td>Defend/Escort</td>
</tr>
<tr>
<td>Stealth</td>
</tr>
<tr>
<td>Mini-Game</td>
</tr>
<tr>
<td>On-a-Rail</td>
</tr>
</tbody>
</table>

The columns show that some archetypes are more suited to a wide range of gameplay themes. This is best demonstrated by the learner archetype in the right hand column. The learner archetype offers the designer a wealth of opportunities to imbed curricular content throughout the game. The table also functions as a checklist when the scope of gameplay themes for a particular archetype is limited. For example, the designer must be more intentional with player archetypes such as the Completionist and Stealther.

Similarly, the rows show that some gameplay themes have more potential across player archetypes. The discovery gameplay theme is the best example. There is always an element of discovery throughout a game as the player interacts with the game world. From 2D user interfaces to 3D worlds, video games are essentially endless voyages of exploration. By contrast, gameplay themes such as tradeskills are best incorporated into the design in a focused manner to appeal to a discrete subset of player archetypes.

Armed with baseline knowledge of how each gameplay theme functions, the designer can tailor these themes to the player audience and link them to the narrative, 3D world, and objects inside the world. Selected examples of the interactions shown in the table above are described in section 5.6 An Original Typology of Gameplay Themes. Additionally, the next section of the thesis illustrates a range of player archetype-gameplay theme interactions based on the climate change game.
5 A SERIOUS DESIGN FRAMEWORK

The design framework presented in this section is a tool that provides the designer with a guide to the links and interfaces between five design components.

Figure 11 Design framework components

Each of the five components of the design framework and their links to each are described next, in the context of climate change.

For illustrative purposes, the principles of gameplay design are developed and explained in the context of a single level (or act/scene/mission) in a serious climate change game for high school students. The single level is treated as the entire game.
5.1 Goals and learning objectives

The goal is to design a fun and engaging video game that educates high school students about local climate change problems and solutions. The specific learning objectives of an individual level (or act/scene/mission) in the game are described below:

LEARNING OBJECTIVES
1. To familiarize students with the concept of greenwashed industries.
2. To provide students with experience evaluating the effect of environmental legislation on the planning and implementation of energy sector decisions.
3. To give students an understanding of embodied energy and variation in carbon emission levels of objects in an industrial scene.
4. To give students the ability to “green” the industrial scene by swapping low carbon objects for high carbon objects.

The game’s four learning objectives are summarized as follows.

Figure 12 Design framework: goals and learning objectives

<table>
<thead>
<tr>
<th>DESIGN FRAMEWORK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GOAL:</strong> DESIGN AN ENGAGING SERIOUS VIDEO GAME THAT EDUCATES STUDENTS ABOUT CLIMATE CHANGE PROBLEMS AND SOLUTIONS</td>
</tr>
<tr>
<td><strong>LEARNING OBJECTIVES</strong></td>
</tr>
<tr>
<td>1. UNDERSTAND ‘GREENWASHED’ INDUSTRIES</td>
</tr>
<tr>
<td>2. EVALUATE THE EFFECT OF CLIMATE CHANGE LEGISLATION ON ENERGY PRODUCTION DECISIONS</td>
</tr>
<tr>
<td>3. UNDERSTAND VARIATION IN CARBON EMISSION LEVELS</td>
</tr>
<tr>
<td>4. UNDERSTAND OPTIONS FOR GREENING THE ENVIRONMENT</td>
</tr>
</tbody>
</table>

5.2 The story

You are a student in a course entitled *Business and the Environment 100*. Your assignment is a capstone project, described below, that offers the opportunity to demonstrate your understanding of the effect of environmental legislation on business decisions in the energy sector.

An overview of the level narrative is as follows:
New legislation has been passed targeting the reduction of carbon emissions by 33% by 2020.

Tilbury Corp is the industrial site of your investigation. Tilbury is in the business of fuel production and distribution. Given the new legislation, Tilbury must make decisions about whether to increase investments in the production of coal or biofuels.

Tilbury is recognized as one of the “greenest” corporations in the world and its CEO was recently awarded the “business person of the decade”. This recognition enables Tilbury to obtain government grants and tax breaks for its environmental approach to supplying energy.

Your tour of Tilbury’s plant and office will give you the opportunity to measure carbon emission levels of various objects in the plant as well as components in the energy production process.

You will also gather information from plant employees about operations and business decisions and how they are made.

Your investigation will not only inform plans to improve the health of the community, it is also a step towards addressing the global climate change “problem” and saving the world from climate-related disasters.

Throughout the mission, you uncover information that reveals the complexities of planning, implementing, and evaluating industrial climate change solutions in industry at the site and regional scale. Your new knowledge will a) give you better insight into greenwashed industries, and b) prepare you to explain climate change challenges and solutions to the public and elected officials - in a world that isn’t as black and white as you may think...

The above story line can be fleshed out with increasing detail and diagrammed in the blue section of the design framework as follows:
Figure 13  Design framework: story

Carbon Emission Policy 33% by 2020

Invest in coal or

Biofuel production

- Sell biofuel
- Build RR

Biofuel for RR

- Transport for:
  - Sequestration
  - Local food to markets
  - Barrier islands bldg materials
  - Flood gates, biodiesel
  - Floating homes
  - Solar components
  - Green building materials

Build RR

- Green building
- Managed retreat
- Densification
- Local food production
- Biofuel biomass

Sea level fall

Kickstart low carbon economy

Coal production

- Sell coal to China
- Buy flood supplies

Build bird sanctuary

- Sea level rise
- Sell flood supplies

Build dikes

Build RR

- Transport solid waste to WTE plant
5.3 The game world

The 3D game world and objects in it are developed in conjunction with the other design components. To help manage the gameplay, story, learning, and technical limitations of the game engine, each game world (or level) is divided into several distinct areas (ten in the case below). Each area delivers a unique style of gameplay and educational or narrative moment. Together the areas are woven into the larger story arc of the level. The spatial layout of the industrial plant in the climate change game is shown below.
Figure 14  Design framework: game world

Game World

1. SHIPPING CONTAINER YARD
2. PARKING LOT CARS
3. TRAIN MAINTENANCE BLDG
4. TRAIN/CRANE LOADING AREA
5. INTERIOR PROCESSING WAREHOUSE
6. TRUCK LOADING AREA
7. INTERIOR STORAGE WAREHOUSE
8. DOCKS/HEIGHTLINER
9. OUTDOOR PROCESSING AREA
10. OFFICES
5.4 Evaluating learning objectives

Student learning objectives are explicitly monitored in three ways in the game (purple panel in the design framework, Figure 15). Additional dimensions of the evaluation strategy are discussed in section 6 of the thesis. The first in-game indicator, percentage of learning objectives completed, is shown in the top purple panel below. This indicator gives the player real time feedback on her performance. The second set of indicators, located in the middle of the purple panel, is comprised of three circles that measure the size and direction (positive or negative) of the social, financial and environmental impacts resulting from player decisions and actions. The third set of indicators in the bottom purple panel shows the carbon emission level of each object the player encounters. This evaluation log is available to the player during the game. An added evaluation feature allows the student to upload a two-minute video clip of his policy advocacy speech arguing for or against the climate change legislation.
Figure 15  Design framework: player evaluation

PERCENTAGE COMPLETE

SOCIAL IMPACT

ECONOMIC IMPACT

ENVIRONMENT IMPACT

CARBON EMISSION LEVELS

VIDEO CLIP: 2-MIN POLICY ADVOCACY SPEECH
## 5.5 The integrated framework

The table below offers examples of the integration of four of the design functions - gameplay, story, learning objectives, and evaluation strategy - in the context of the serious climate change game.

**Table 4 Player archetype and gameplay theme interactions**

<table>
<thead>
<tr>
<th>PLAYER ARCHETYPE AND GAMEPLAY THEME INTERACTIONS IN A CLIMATE CHANGE GAME</th>
<th>GAMEPLAY</th>
<th>STORY</th>
<th>LEARNING</th>
<th>EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAYER ARCHETYPE</td>
<td>GAMEPLAY THEME</td>
<td>TASK</td>
<td>OBJECTIVES</td>
<td>TOOL</td>
</tr>
<tr>
<td>explorer actionist learner</td>
<td>discovery</td>
<td>use drones to examine the physical layout</td>
<td>greenwashed industry</td>
<td>percentage complete</td>
</tr>
<tr>
<td>tradeskiller completionist learner</td>
<td>mini game</td>
<td>build railroad</td>
<td>environmental, economic &amp; social impacts</td>
<td>impacts</td>
</tr>
<tr>
<td>completionist learner</td>
<td>on-a-rail</td>
<td>ride train, photograph products</td>
<td>greenwashed industry</td>
<td>percentage complete</td>
</tr>
<tr>
<td>completionist learner</td>
<td>gather/fetch</td>
<td>measure carbon emission levels</td>
<td>carbon emission</td>
<td>carbon emission levels</td>
</tr>
<tr>
<td>tradeskiller learner</td>
<td>tradeskills</td>
<td>build dikes</td>
<td>sea level rise</td>
<td>impacts</td>
</tr>
<tr>
<td>stealthier socializer learner</td>
<td>stealth</td>
<td>network to find loopholes in environmental regulations</td>
<td>environmental legislation</td>
<td>percentage complete, impacts</td>
</tr>
<tr>
<td>actionist lore enthusiast learner</td>
<td>defend/escort</td>
<td>protect birds during sanctuary construction</td>
<td>environmental impacts, political feasibility</td>
<td>percentage complete, impacts</td>
</tr>
</tbody>
</table>
The table shows, for example, that the task of gathering intelligence about the game world can be operationalized using the discovery gameplay theme. This theme allows the player to access information that will move the story forward. It can be tailored to the Explorer archetype by designing the game world to include regions that are ordinarily inaccessible to the public, such as the interior of a coal mine or nuclear power plant. It can be made appealing to the Actionist archetype by introducing a player-controlled drone that the player uses to discover (or uncover) more areas of the game world. To attract the Learner archetype, the drone can reveal introductory to advanced levels of climate change science as it covers the territory.

The full design framework below illustrates how each design component is woven into the serious design. The learner archetype does not appear in the illustrations: it is assumed to be relevant to all archetype-theme scenarios. The framework is a design tool that can be validated and improved with live user testing.
GOAL: DESIGN AN ENGAGING SERIOUS VIDEO GAME THAT EDUCATES STUDENTS ABOUT CLIMATE CHANGE PROBLEMS AND SOLUTIONS

LEARNING OBJECTIVES

1. UNDERSTAND 'GREENWASHED' INDUSTRIES
2. EVALUATE THE EFFECT OF CLIMATE CHANGE LEGISLATION ON ENERGY PRODUCTION DECISIONS
3. UNDERSTAND VARIATION IN CARBON EMISSION LEVELS
4. UNDERSTAND OPTIONS FOR GREENING THE ENVIRONMENT

Carbon Emission Policy 33% by 2020

Invest in coal or biofuel production

Coal production

Sell coal to China

Sea level rise

Sell flood supplies

Build RR

Biofuel for Tilbury transport

Build bird sanctuary

Sell flood supplies

Build RR

Transport solid waste to WTE plant

Biofuel for RR transport

Photograph products while riding the train

 DEFINITION, ASSEMBLE, COMPONENTS

TradeSkiller

Completeist

Mini Game

Player Archetype

Gameplay Element

ACTIONIST

Lore Enthusiast

Defend/escort

Stealth

Social Impact

Economic Impact

Environmental Impact

Per centage Complete

Carbon Emission Levels

Video Clip: 2-Min policy advocacy speech

Player Archetype

Gameplay Element

Explorer

Actionist

Exploration

Use drones to investigate the office and plant

Game World

1. Densification
2. Managed retreat
3. Local food production
4. Biofuel biomass
5. Sea level fall
6. Kickstart low carbon economy
7. Managed retreat
8. Local food
9. Managed retreat
10. Low carbon economy

Use drones to investigate the office and plant
5.6 *Future Delta 2*: Supplemental technical information

The appendix contains design-related documentation and illustrations of the author’s design work on an alpha version of the University of British Columbia climate change serious game *Future Delta 2*. It further illustrates the design principles and framework developed in the thesis. This supplemental information will be of particular interest to readers who are actively involved in designing serious games.
In 1971, Avedon and Sutton-Smith wrote that because “game design is an emerging discipline, we often borrow from other areas of knowledge — from mathematics and cognitive science; from semiotics and cultural studies. We may not borrow in the most orthodox manner, but we do so in the service of helping to establish a field of game design proper”\textsuperscript{65}. Similarly, the literature review in this thesis shows that while serious video games are studied from the viewpoint of psychology, biology, education and more, translational research on the design of serious games, in particular gameplay, is lacking. Fortunately, the professional design disciplines are well positioned to provide remedies that inform the challenge of infusing the magic found in the best entertainment games into serious games.

This study develops and illustrates a design framework that offers serious game developers applied knowledge of how to get ideas from the imagination onto the screen. It makes three primary contributions to gameplay design. First, it builds on existing models of player archetypes to provide novel insights into player audiences. It develops a new eight-category player typology based on assumptions and knowledge of gamers drawn from commercial entertainment game development. Second, this study develops a typology of gameplay themes. The construction of a model of gameplay themes has not previously been undertaken by serious game researchers. Thus, this part of the thesis addresses a deficit that left serious designers without systematic guidance about how to conceptualize and execute player action on the screen. Third, this thesis provides a design framework that overlays player archetypes and gameplay themes. Further, the integrated design framework illustrates how the five main game design components – learning objectives, story, 3D world, gameplay and evaluation – are executed in the context of a serious climate change game.

Designing a good entertainment game is challenging, but designing a good serious game is even more difficult. Rather than solely focusing on the entertainment dimension of the game, the serious game designer must also optimize the player’s probability of learning specific content and skills. Although the player archetype-gameplay theme design function is the focus of this study, it does not have to carry the load alone. The literature review in this thesis shows there are many other design aspects that can be integrated into the design framework. Researchers have suggested that factors such as fun\textsuperscript{66}, flow experience\textsuperscript{13,28}, engagement\textsuperscript{29}, feedback\textsuperscript{26}, goals\textsuperscript{13,26,67}, problem solving\textsuperscript{13,26,68,69}, game balance and pacing\textsuperscript{68-70}, interesting choices\textsuperscript{15}, risks and rewards\textsuperscript{26}, and fantasy narrative\textsuperscript{67,71} among others contribute to the success of a serious video game. Although these design criteria have been identified, very few attempts to build these features into a functional product with rigorous evaluation strategies embedded into the design process and final products have proven successful\textsuperscript{13}. The development in this study of a framework for conceptualizing and linking player archetypes and gameplay themes is a step in this direction. It also points to areas for future research.
6.1 Learning outcomes

A fertile area for research is the development of applied strategies for integrating learning outcomes into the design framework and final product. Though challenging, opportunities to embed substantive knowledge into gameplay and story are plentiful and diverse. For example, the designer can choose varying degrees of realism in the game world, the grandest story arc or simply a brief chance encounter, and variation in the landscape in terms of flora and fauna to offer such opportunities. The potential to integrate learning outcomes lies in each side quest; conversation tree; and dimension of the built and natural environments, such as building structures, the sky, water, and what is in the water. Educational outcomes can also be incorporated into the way the character gets to work, the food he eats, and his challenges and successes. Learning outcomes can be presented indirectly as well as directly. Generally, successful strategies avoid designs where, for example, players simply walk their avatars into a traditional classroom setting, listen to a 3D non-player character deliver a lecture, and after exiting the lecture then engage in status quo commercial video gameplay.

One understudied approach to the integration of learning outcomes in serious games involves fantasy. We know from literature, films and theater that many people are deeply engaged by fantasy. Learning should be fun and for many individuals fantasy is fun. This suggests the utility of developing capacity on the design team to incorporate learning objectives into fantasy scenarios.

Another approach that needs study involves the concept of personal choice, which extends well beyond character customization. Games like *Star Wars: The Old Republic* offer player choice in several key areas, such as conversation trees and even major story decisions. For example, the player has (or appears to have) freewill and can decide either to kill the master and turn to evil or to spare the master’s life and decide in favor of good. These player choices impact, or give the illusion of impacting, the course of the game and thus lend urgency and weight to each decision the player makes. The result is increased player engagement and likelihood of achieving the learning goals.

The design of the 3D world itself and the objects in it is another area where personal choice plays a role. Given the vast range of player preferences for particular aesthetics, it cannot be claimed that one design is better or worse for engagement, or more or less conducive to learning than another. Nonetheless, the quality of the aesthetic style matters. Much like an architect or landscape architect, if the video game designer is able to offer high quality choices and let the player partially shape the world the she inhabits and explores, then the player is more likely to become engaged, maintain engagement, and therefore attain the educational objectives of the game.

It is essential to narrow the gulf between video game designers and educational content specialists - namely researchers, scientists and educators, many of whom are not gamers.
Ideally, the two groups will work together to integrate substantive knowledge into engaging video games.

6.2 Evaluation

Extensions of this thesis include an empirical evaluation strategy that assesses the proposed rubric linking player archetypes and gameplay themes. The evaluation design includes first building user profiles based on the new typology of player archetypes presented in this study. The relevant data will be self-reported by video gamers. Data will also be gathered internally through software that monitors each player and the gameplay themes with which they engage. Statistical models will be used to analyze the likelihood that individual archetypes are related to specific gameplay themes. Triangulating methods of capturing player data is key. A multidimensional approach will integrate traditional methods, such as paper and electronic surveys that are linked to administrative data, with innovative technologies that involve big data. Massive amounts of player information can be gathered and analyzed via game logs, biofeedback data, video recordings of players’ faces, and screen capture tools. Analyzing these data will provide new information on the design process, e.g. intent versus reception, and ultimately facilitate the development of more effective, engaging and educational games.

Research on assessing learning outcomes in serious games and evaluating them against design intentions and strategies is in its infancy. Mitgutsch\textsuperscript{71} notes that the lack of assessment tools to analyze serious games and insufficient knowledge on their impact on players are recurring critiques. In particular, problems around how to assess the quality of the game’s formal conceptual design in relation to its purpose remain poorly articulated and unresolved. According to Mitgutsch, in the majority of cases the designers’ good intentions justify incoherence and insufficiencies in their design. While some studies have ventured into the assessment of the quality of serious game content, there is little assessment of their intention-based design.

In the few cases where visualizations have been evaluated for their validity or effectiveness,\textsuperscript{5,72} Lange suggest that higher realism may lead to more emotional and more valid responses, and interactivity may improve cognition. Stock and colleagues\textsuperscript{73} developed a landscape-planning tool with a game-engine called SIEVE (Spatial Information and Visualisation Environment) that allows users to explore scenarios in a real-time 3D environment. Similar results have been obtained in the field of interaction design, where engaging experiences embed narratives as a dramatic structure for interpretation\textsuperscript{74,75}. Where users have an active role, they tend to explore things that are both attractive and unknown or mysterious. The experience provides connections to other individuals in collaborative activities, creating shared perceptions of being part of a social structure. A focus on the experiential aspects of interactive technology has fostered such movements as Emotional Design\textsuperscript{78}, Critical Design\textsuperscript{79}, and Experience Design\textsuperscript{77}. 
McGonigal proposes that game designers, virtual world builders, social media developers, and other “funware” creators have the potential to offer essential design strategies for otherwise “serious” initiatives. While their goals vary from scientific to civic, social to promotional, all of these projects share a common operating model. They are seeking to create robust, large-scale communities capable of collectively producing valuable data, ideas, and content. That output will be shared, applied, leveraged or monetized, but only if the community becomes large and active enough to produce something new and different. The value of the project’s output is dependent on the quantity and quality of participation from many people. Commercial game development can offer guidance here. It uses simple metrics like “game-play hours” to measure the quantity and quality of a game product or user experience. Some commercial products attract millions of users for thousands of hours over the course of the players’ relationships with the product.

Rigorous baseline studies are needed to quantify how much and in which ways games and simulations are currently being used most effectively to support learning. There is a requirement for guidelines, case studies and exemplars to inform and improve the quality and delivery of games-based learning across sectors and to support better future planning and resource allocation.

6.3 Serious collaboration

Promising developments in the serious games movement include the opportunity for collaborations between academic, commercial and government sectors seeking to develop proprietary learning games. However, bridging the gap between the commercial game development community and these other sectors remains a significant challenge. Common vocabularies and shared expectations are essential to support the collaborative development of game-based learning. This endeavor will be as much art as science. It will take a broad-based, trans-disciplinary and trans-sectoral approach that includes commercial developers that can incorporate intellectual property that is already robustly developed. These collaborations will facilitate the refinement of design frameworks to ensure that serious games achieve their full potential.
References

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Appendix A: Level design document

FUTURE DELTA 2.0
ACT 2

LEVEL DESIGN DOCUMENT

Carbon Visualization:
Face to face with the Silent Enemy
LOCATION: TILBURY PLANT
Year: 2025

Last Updated: 11/12/2014
Authors: Nick Sinkewicz, David Flanders, Alicia Lavalle, Dr. Stephen Sheppard
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NARRATIVE SUMMARY

Backstory

You are a 3rd year university student who has become involved in a student organization the "Carbon Inquisitors", a group of motivated students determined in taking on the carbon based economy in a big way. Some in the group are quite sceptical about industry greenwashing their images, others feel that government policy is lacking and a low-carbon economy is a pipe dream. One thing you all agree on is that everyone needs to be taking climate change more seriously and it is time to make a splash and do something important.

Lately the group has had an interest in investigative journalism. Someone suggest that the real problem is corruption and the focus should be revealing corruption. Ekta’s father works as a contractor for one of the Tilbury companies that has been winning awards for sustainable innovation and there are rumours that they might have their biggest “green contract” yet, but no one seems to have more information. Your mother works at the company as a lead scientist, and, based on things you’ve heard her say, you know there has been some tension between factions at the plant and she is quite sure that staff is not getting the whole story. Some want the contract, some are dubious, and a lot of people are indifferent.

This could be your big opportunity to discover something big so you decide to do some sneaking around - you don’t want to get your mother or Ekta’s father in trouble, and you certainly don’t want anyone to lose their jobs, but you need to know a little more about what is really going on.

Pre-Act: Intro Trailer

You get an update from your GUI, Carbon Viz is now working. You get a chance to test it out in your house in North Delta where you see some objects glowing and giving you data on their annual carbon emissions in tonnes/yr. The know you have a pretty important secret weapon with Carbon Vision, this could be perfect for your organizations idea to get more info on the good the bad and the dirty going on in Tilbury Industry. If you could just get a chance to look around maybe you could show your organization, your father and the media what’s really going on, maybe people would stop turning a blind eye to this stuff. You call up 2025 Ekta, leader of the Carbon Inquisitors and say – I’m going in! Cover me I’ve gotta go tonight something my mother said at the dinner table makes me think that something big is going on right now, the board has a meeting tomorrow and she is pretty sure they are going to be making a critical decision, but she wasn’t sure about what. You think it might be about that big “green contract” and you aren’t so sure it’s really all that green.

You go on an intelligence quest at night, in the fog, in the rain, to the Tilbury plant to gather information and to catalogue carbon. Throughout the mission, you uncover information that both verify and force you to question your cynicism. Be prepared to use all the tools you have and look for clues where you may least expect them. You might find that the world isn’t as black and white as you thought...
**Part 1: The corruption?**

Though you go in looking for corruptions you find that the truth is even more complicated. There is a bit of a scandal going on with coal and not everyone in the company likes what is going on but technically it is legal. Coal is being exported overseas, coal that can’t be used in Canada due to health and environmental regulations, but there is still a demand for it as long as coal is cheaper than other fuels. It sure seems unethical to you and your friends but what you were looking for was something new to tell the media. Your friends back in headquarters look it up and tell you unfortunately, it’s not illegal. So you keep searching.

**PART 2: The Solutions?**

You discover there has been some interesting pilot project going on inside the company. The stockyards are full of interesting things, by-products of other Delta Industries and you learn how many of them can be used as alternative fuels or tools for reducing carbon emissions. This has been successful on the one hand, the company has been a leader in helping reduce how much waste ends up in Delta’s landfills.

The problem is there are some people in the company that know that coal is still more lucrative to export. They worry that the board has been letting profit margins slip with these “pilot projects”. They are worried about jobs. They know the CEO and the board have been really trying to push these new products but as far as they are concerned this system works great. Sure it is high-carbon but it’s not like the coal is being burned in Delta. They feel that it will not hurt them if people far away want this coal, let them have it. Now you have a new problem on your hands, perhaps even more complex to deal with than the corruption you thought you would find, misinformation and apathetic attitudes. What can be done?
## LEARNING

### Learning by Themes:

<table>
<thead>
<tr>
<th>Theme</th>
<th>ADAPT</th>
<th>ADAPT + MITIGATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[Player has to solve this in order to move on]</strong></td>
<td><strong>[Player must spend more time in Act and deal more with CO2 sources/sinks]</strong></td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>Adapt to vulnerabilities using existing energy mix</td>
<td>Find waste energy from industrial sectors and put them to use to adapt to vulnerabilities</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Discover the potential benefits of agricultural waste products – information that can be used in later acts</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Adapt to storm surges and freshet by making sure that an emergency preparedness plan is in place</td>
<td>Protect Bog and discover in map at end of act co-benefits of carbon sequestration and “sponge”- like capacity to buffer area from spikiness in storms and freshet</td>
</tr>
<tr>
<td>Transportation</td>
<td>-- Protect Port and shipping</td>
<td>--Personal Transportation Options (i.e. Carpooling)</td>
</tr>
<tr>
<td></td>
<td>-- Make new transport infrastructure (rail and bike paths) with multiple landscape functions in mind (i.e. topography to protect from flooding)</td>
<td>--Reducing embodied energy in transport of goods</td>
</tr>
<tr>
<td></td>
<td>-- Makes new infrastructure to protect landscape function (i.e. Burns Bog)</td>
<td></td>
</tr>
<tr>
<td>Jobs/Training</td>
<td>Emergency preparedness – make sure training and procedures are in place.</td>
<td>--Personal Transportation Options (i.e. Carpooling)</td>
</tr>
<tr>
<td>Economy</td>
<td></td>
<td>--Develop new jobs in the green sector</td>
</tr>
</tbody>
</table>
## Learning by Category of Solution

<table>
<thead>
<tr>
<th>Category</th>
<th>ADAPT</th>
<th>ADAPT + MITIGATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Player has to solve this in order to move on]</td>
<td>[Player must spend more time in Act and deal more with CO2 sources/sinks]</td>
</tr>
<tr>
<td>Technical = Dykes</td>
<td>Deal with the fact that the Dykes are insufficient - patching and pumping</td>
<td>Create a situation where dykes can act as integrated green infrastructure</td>
</tr>
<tr>
<td></td>
<td>-- Stop Gap Measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-- Carbon Score goes up</td>
<td></td>
</tr>
<tr>
<td>Technical = Energy</td>
<td>Use same energy mix for protecting industry from floods</td>
<td>Seeing how much energy is used burning fossil fuels for production, focus friend’s attention on the pilot projects you learned about on the way</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a) Biomass in the form of woodchips for energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Municipal solid waste as energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Recycled heat waste as energy</td>
</tr>
<tr>
<td>Policy</td>
<td>Emergency preparedness planning.</td>
<td>Change policy’s hindering carbon reduction innovation or investment by industry</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Abandon Industrial Sector on waterfront</td>
<td>Fortify Industrial sector with transportation solutions that offer local jobs</td>
</tr>
</tbody>
</table>
**Learning by Tools:**

**Carbon Vision:**
- Helps you see how much each object in the landscape is emitting or sequestering carbon.
- Allows you to inventory the data on carbon emissions or sequestration.
- Allows you to see into the secret world of fuel sources and understand differences between fossil fuels and renewable fuels.
- Allows you to see waste heat/energy.

**Example:** Use Carbon vision to help you discover which containers have coal and which have BC biomass and waste-to-energy fuels in the shipping yard. Swap the coal shipments back to the lower-carbon fuels that are supposed to be shipped.
  - MITIGATE
  - Gain regional carbon points

**Influence Points:**
Collected/Used when talking to NPC’s.
Example: One of the guards is your friend Carl from Act 1: Convince him that the stockpiled sandbags are something they will need right away to protect their own industry from the river breaching it’s banks and to remind the staff of their emergency preparedness plan.
  - Learn how to use influence points to change behaviour

**Inventory:**
Inventory of Items collected through both CIMA tagging, and CViz can be used to swap out high carbon emitting assets for lower carbon solutions.

Optional: Newspaper articles collected can be used at critical moments.

**Carbon Vision Objects, colour and emissions**

<table>
<thead>
<tr>
<th>Item (Grouped into categories)</th>
<th>Colour (high or low carbon, including embodied carbon)</th>
<th>Emissions (tonnes C/yr for CViz text box)</th>
<th>Particle effect</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NONE = 0</td>
<td>V. LOW = 0-100</td>
<td>OUT (emitter)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>V. LOW = 0-100</td>
<td>LOW = 100 – 1500</td>
<td>IN (sequester)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOW = 100 – 1500</td>
<td>MED = 1500 – 5000</td>
<td></td>
<td>OFF (neither)</td>
</tr>
<tr>
<td></td>
<td>MED = 1500 – 5000</td>
<td>HIGH = 5000 – 10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGH = 5000 – 10,000</td>
<td>V. HIGH = 10,000+</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Industrial</strong> (not swappable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Color</td>
<td>Quantity</td>
<td>Status</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>----------------</td>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Municipal solid waste</td>
<td>Red</td>
<td>244,480,000 tonnes</td>
<td>OUT</td>
<td>382 kg CO2e per tonne MSW x 640,000 tonnes per yr to Vancouver Landfill. (<a href="http://pentz.com/NoIncinerator/greenhouse%20Emissions.pdf">http://pentz.com/NoIncinerator/greenhouse%20Emissions.pdf</a>)</td>
</tr>
<tr>
<td>Freightliner</td>
<td>Red</td>
<td>40,000,000</td>
<td>OUT</td>
<td><a href="http://www.martrans.org/docs/publ/REFEREED%20JOURNALS/WMUJMA%20EMISSIONS%202009.pdf">http://www.martrans.org/docs/publ/REFEREED%20JOURNALS/WMUJMA%20EMISSIONS%202009.pdf</a></td>
</tr>
<tr>
<td>Industrial stack</td>
<td>Red</td>
<td>359,179.21</td>
<td>OUT</td>
<td>2 concrete plants supply 13% of Metro Vancouver’s 5,525,834 CO2 tonnes-yr. (5,525,834/2)*.13</td>
</tr>
</tbody>
</table>

**Agriculture / buildings**

<table>
<thead>
<tr>
<th>Category</th>
<th>Color</th>
<th>Quantity</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food from California</td>
<td>Orange</td>
<td>0</td>
<td>IN</td>
</tr>
<tr>
<td>Construction materials from China</td>
<td>0</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>Coal from Wyoming</td>
<td>Red</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Limestone for cement</td>
<td>Orange</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Category</td>
<td>Color</td>
<td>Quantity</td>
<td>Status</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>Inorganic fertilizers</td>
<td>Orange</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Scrap tires to be used as fuel for industry</td>
<td>Red</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Parts for windmills</td>
<td>Yellow</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Organic fertilizer from compost</td>
<td>Green</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Woodchips from tree trimmings</td>
<td>Green</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td><strong>Lighting / electricity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional street light</td>
<td>Orange</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>LED streetlight</td>
<td>Yellow</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Solar panel street light</td>
<td>Yellow</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Stadium-style lights</td>
<td>Red</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Regular asphalt</td>
<td>Orange</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Permeable pavers</td>
<td>Green</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Sand bags</td>
<td>Yellow</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>Red</td>
<td>0</td>
<td>OFF</td>
</tr>
<tr>
<td>Plants / trees</td>
<td>Green</td>
<td>0</td>
<td>IN</td>
</tr>
<tr>
<td>Natural wetlands / rain garden</td>
<td>Green</td>
<td>0</td>
<td>IN</td>
</tr>
<tr>
<td>Category</td>
<td>Status</td>
<td>Color</td>
<td>Quantity</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Waste heat from pipes</td>
<td></td>
<td>Yellow</td>
<td>0</td>
</tr>
<tr>
<td>Green roof</td>
<td></td>
<td>Green</td>
<td>0</td>
</tr>
<tr>
<td><strong>Vehicles / power</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator - diesel</td>
<td></td>
<td>Red</td>
<td>161</td>
</tr>
<tr>
<td>Generator - Natural Gas</td>
<td></td>
<td>Orange</td>
<td>117</td>
</tr>
<tr>
<td>Generator - waste heat</td>
<td></td>
<td>Yellow</td>
<td>0</td>
</tr>
<tr>
<td>Cement truck</td>
<td></td>
<td>Red</td>
<td>7830</td>
</tr>
<tr>
<td>Pickup truck</td>
<td></td>
<td>Red</td>
<td>3132</td>
</tr>
<tr>
<td>Electric vehicle</td>
<td></td>
<td>Yellow</td>
<td>0</td>
</tr>
<tr>
<td>Delivery truck</td>
<td></td>
<td>Red</td>
<td>5220</td>
</tr>
<tr>
<td>Hybrid car</td>
<td></td>
<td>Yellow</td>
<td>1305</td>
</tr>
<tr>
<td>Family sedan</td>
<td></td>
<td>Orange</td>
<td>1958</td>
</tr>
</tbody>
</table>

**Terminology Defined in Act:**

Sequestration

Freshet
Rain Garden
Wetlands/Bog
Dykes
Emission Reduction Targets
Brownfield
Eco-Industrial Network
Waste-to-Energy
Waste heat
Infrastructure Vulnerabilities
Food Miles
Embodied Energy
AREAS

1. SHIPPING CRATES

Theme – Understanding Carbon Emission implications of common materials

GAMEPLAY DESCRIPTION

The mission starts on the other side of the factory perimeter fence finding a hole in the wall. Once over the fence the player must avoid the patrolling security guard as he scans a minimum of 5 crates. All of these crates have different materials within. Turning on Carbon Vision will allow player to collect data on the carbon emissions of the contents. After scanning 5 crates the player can get past the 2nd guard standing in the security hut.

Optional: [If already built keep this game play, if not then not part of Min. Viable Product]

The player can whistle from the darkness and lure the guard out of the hut to investigate. Or the player can wait for other NPC patrolling guard to circle back on his patrol to the hut and strike up a random conversation with the guard inside the hut.

This is the players’ first introduction to clickable interactions and NPC guard on patrol.
NPCS
1. NPC_guard_1 on patrol
2. NPC_guard_2 on guard

PRIMARY OBJECTIVES = In Quest Log
1. Scan 5 crate labels to find out what materials are in the crates and their carbon emissions.
2. Avoid patrolling guard.
3. Distract security guard in hut to get past him.
4. Pick up other interesting things to add to inventory that might help with your investigative journalism career.

OPTIONAL OBJECTIVES
1. Tag 10 crates using Carbon Vis.
   a. Gain additional knowledge points as well as materials for your inventory that might help you later
   b. Add this too your inventory
   c. Adds to knowledge points
2. Pick up newspaper sitting on the ground and read headline about IPCC 5th assessment report: reducing our carbon footprint immediately the only way to slow climate impacts.
   a. Add this too your inventory
   b. Adds to knowledge points
3. Flip over the newspaper and see local news reports job loss in Delta and an analyst giving a wide range of projections in the next 25 years. Variable that the dictate what will happen include rising costs of living including food, fuel, and infrastructure cost being required of commercial and residential taxpayers alike.
   a. Add this too your inventory
   b. Adds to knowledge points

EDUCATIONAL OBJECTS – CVIZ

Carbon Emitting objects
1. Food from California
2. Construction materials from China
3. Coal from Wyoming
4. Limestone for cement
5. Inorganic fertilizers
6. Scrap tires to be used as fuel for industry
7. Parts for windmills
8. Municipal solid waste
Carbon Sequestering objects

Note: at first you will only see these as green. Later you will see them as sequestering when "sequester viz" tool is unlocked. Only if player choses to come back here will they see this and gather knowledge points.  

9. Organic fertilizer from compost
10. Woodchips from tree trimmings

<table>
<thead>
<tr>
<th>EDUCATIONAL OBJECTS – CIMA</th>
<th>Cause</th>
<th>Impact</th>
<th>Mitigation</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Food from California *</td>
<td>High</td>
<td>High (Delta Vulnerable if relies</td>
<td>Low</td>
<td>None</td>
</tr>
<tr>
<td>(Make sure description includes the definition of food miles)</td>
<td>of food from elsewhere)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Construction materials from China *</td>
<td>High</td>
<td>High (Delta Vulnerable if relies of infrastructure material from elsewhere)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>3. Coal from Wyoming *</td>
<td>High</td>
<td>Medium</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4. Limestone for cement</td>
<td>High</td>
<td>all answers get points</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>5. Inorganic fertilizers</td>
<td>High</td>
<td>all answers get points</td>
<td>None</td>
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<td>all answers get points</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

* Define Embodied Energy in these Descriptions: All the energy required to produce goods or ‘embodied’ in the product itself during its’ whole life-cycle. Since this includes the energy required to transport a good things that are transported long distances using fossil fuels often embody more energy than things that do not travel as far
OTHER EDUCATIONAL OBJECTS:
Newspaper articles

CONVERSATIONS
1. Security guard 1 to security guard 2 – about the nasty weather. It seems so unpredictable these days. Unbearably hot for 2 weeks then nothing but rain. But would rather be out here than in another meeting. That last one about emergency preparedness – went on forever – who cares what a waste of time, what is there to be worried about, I fell asleep after 5 minutes.
2. Disgruntled comments about all of the investors from all over the world... who really owns this company anymore
3. Security guard 2 to security guard 1 – what’s with all the sand bags, and emergency supplies
4. Security guard 2 to security guard 1 – Why do we ship food from so far away when so much grows so much food right here in Delta (cite %)

SOUNDS:
1. WIND
2. RAIN
3. RUSTLING NEWSPAPER

FEATURES:
3. FOG
2. PARKING LOT – CARS

Theme – Personal Transportation Options and Water management

GAMEPLAY DESCRIPTION
Small transitional area to find CIMA objects and listen to NPC develop story. The player must avoid the train mechanic who comes out to smoke a cigarette as well as the camera above the door to the train maintenance building.

Optional: [If already built keep this game play, if not then not part of Min. Viable Product]
This is the player’s first introduction to security cameras.

NPCS
1. NPC_guard_1 on patrol. Guard is on cell phone

PRIMARY OBJECTIVES = In Quest Log
1. Avoid being seen by the mechanics
2. Listen to several conversations to find out about coal.
3. Avoid the security camera above the train maintenance building (only if already made).
CONVERSATIONS:
Guard on cell phone to “boss”:
“Yeah boss, the parking area is pretty full, even at night though nothing as crazy as during the day shift. Yeah I guess it is a bit better since we build new lots - Why? Oh carpooling – well most of us aren’t too into that, it takes a lot of effort to organize. Maybe if there was a program to help us organize or incentives or something. Yeah, I know congestion is bad around here 24/7. Yeah, we all know about the fleet of company vehicles that use alternative energy, I’ll tell everybody to try to use them more but to be honest I am not always sure how they work, I don’t like complicated new-fangled things.” Pause. “Yeah the pervious pavers are working well even in this rain, no puddles under the cars like before – I admit I like that... Hey, Why are we talking about this in the middle of the night?” Pause “Does this have something to do with the board meeting tomorrow?” Pause... “OK well, you’re the boss... Sure... Bye”

EDUCATIONAL OBJECTS – CVIZ
Carbon Emitting Objects
1. Conventional Street Light
2. LED Streetlight (hard to see without CViz)
3. Street Light with solar panel on top (hard to notice without CViz)
4. Regular asphalt

Carbon Sequestering objects
Note: at first you will only see these as green. Later you will see them as sequestering when “sequester viz” tool is unlocked. Only if player choses to come back here will they see this and gather knowledge points.
5. Permeable pavers in parking spots (Needs different texture)

EDUCATIONAL OBJECTS – CIMA
CARS and trucks of various sizes. These can be many of the same ones that were in N. Delta Act 1. Another opportunity for players to gather points if they did not do so before.
1. Pickup Truck
   - Cause: Medium
   - Impact: None
   - Mitigation: None
   - Adaptation: None

2. Family Sedan
   - Cause: Medium
   - Impact: None
   - Mitigation: None
   - Adaptation: None

3. Hybrid car
   - Cause: Low
   - Impact: None
   - Mitigation: Medium
   - Adaptation: None

4. Delivery Truck using Natural Gas:
   - Cause: Medium
   - Impact: None
   - Mitigation: Medium
   - Adaptation: None
5. Electric Vehicle with sign saying: This car powered by the sun, plugged into solar panel on streetlight
   - Cause: None
   - Impact: None
   - Mitigation: High
   - Adaptation: None

**SOUNDS Description**
1. RAIN
2. WHIRRING SECURITY CAM

**Feature Description**
1. LIGHTNING:
   a. Conventional Streetlight
   b. LED Streetlight
   c. Streetlight with Solar Panel
2. Asphalt
   a. Texture 1: Same surface as used in rest of Tilbury
   b. Texture 2: Porous paver
3. **TRAIN MAINTENANCE BLDG**

*Theme: Corruption or Ethics? Policy vs. Behaviour, decision making and carbon*

---

**GAMEPLAY DESCRIPTION**

Where the player can overhear conversations revealing why a lot of coal is coming from Alberta and the United States and why alternative fuels are being used, and why they are not.

**NPCS**

1. NPC_mechanic_1 = female
2. NPC_mechanic_2 = male

**PRIMARY OBJECTIVES = In Quest Log**

1. Scan contents of train cars, fuel containers, and generators
2. Use CViz to discover that some of the train cars contain coal when they say other things
3. Listen to conversations to find out about train contents without them seeing you
4. Distract workers by whistling or throwing a newspaper down so you can get past up onto the train.

**OPTIONAL OBJECTIVES**

1. Pick up some blueprints and reports on Dyke construction. Critical points
   i. How much Dykes would cost to protect Tilbury
   ii. How high they would need to be.
   - Read a few critical points and get knowledge points
2. MITIGATE: Use Swap tool to change out cars carrying coal that say biomass with the types of alternative fuels you inventoried in Area – Shipping Crates if you have enough knowledge points AND these alternative fuels in your inventory.
   - Add to your carbon reduction score
3. **MITIGATE**: Use Swap tool to change out fuels used for generators if you have enough knowledge points AND have the newspaper article about IPCC report and jobs to throw to mechanic that is worried about climate change and jobs in the future. Change fuel while he is reading.
   - Add to your carbon reduction score

**EDUCATIONAL OBJECTS – CVIZ**

1. **TRAIN CAR** – With **COAL**
2. **TRAIN CAR** – With “**Waste Fuels**”
3. **GENERATOR** – Using **DIESEL**
4. **GENERATOR** – Using **NATURAL GAS**
5. **GENERATOR** – Using **WASTE HEAT FROM SEWAGE**

**CONVERSATIONS**

Mechanic_1 to mechanic_2 and vice-versa:

“they keep telling me not to ask, but why is this so hush? Why do we always have to work on this after hours?”

“they don’t tell me much either but there’s **coal** dust all over those trains.”

“Coal? Are we still using coal around here, I thought we were supposed to be reducing our carbon emissions?”

“what?”

“yeah, BC has to reduce its emissions by a third by 2020... so seems to me coal is a bad idea, I worry about climate change and if my kids are going to be living in some kind of disaster prone world with freaky weather like this all the time.”

“Well we aren’t going to burn this stuff here, the shipments of coal are all going overseas. Something about Environmental Regulations in Canada say it is too dirty to burn here, causes air pollution or cancer or something like that”

“So we send it overseas to get burned there? What kind of sense does that make? That still means air pollution and cancer and it also still means climate change – don’t these guys get it, climate change is global!”

“Whatever, boss says its legal, no harm done”

“Even if it’s legal, I wonder is it really ethical? We burn it, they burn it, it is still fossil fuels being burnt and now we are shipping the dirtiest stuff that we don’t even want here in Canada. Who comes up with these ideas?”

“Not me man, I am just doing my job, what can one person do about it. I just lay low and do what I am told – get the job done. Keep my job you know.”

“I don’t know maybe you are right, but this kind of thing makes me very nervous, makes me wonder if I will even have a job to come back to day after next”
4. INTERIOR PROCESSING WAREHOUSE

Theme: Forecasting potential future scenarios

GAMEPLAY DESCRIPTION
This area is mostly transitional and serves to develop the next Act. The player must also avoid the 1 patrolling guard as well as the spotlight and security camera.

NPCS
1. NPC_guard on patrol
2. NPC_trucker_2

PRIMARY OBJECTIVES
2. Avoid patrolling guard, spotlight and security cameras while listening to a conversation.
CONVERSATION: Trucker_1 to Trucker_2 and vice-versa

“what’s with all this cement? I thought we were in the business of delivering plants and dredged sand for the company’s coastal habitat rehabilitation program.”

“Looks like some people have another plan. The other day when I was getting coffee in the office I saw some plans sitting on the table for a big concrete wall down in Boundary Bay. I was thinking of buying a house down there, beautiful ocean views, but not if there is going to be a fortress wall around it”

“Why would they need that down there?”

“Beats me... the drawing looked like some kind of big barrier, all around the houses to protect them from something. A big project... looked expensive”

EDUCATIONAL OBJECTS – CVIZ

Carbon Emitting Objects
1. SAND BAGS (Dredged Sand)
2. CEMENT (Definition Data box refers to embodied energy)

Carbon Sequestering objects
3. PLANTS
GAMEPLAY DESCRIPTION
The area is full of dock workers and is extremely well lit with stadium style lightning – so it is impossible for the player to sneak around. Instead he must go inside the hut and change into a dock workers uniform (there is no avatar so there is no visible change). From this point on the player has immunity and can walk around talking to other dock workers to gather information.

NPCS
1. NPC_dock_worker_1
2. NPC_dock_worker_2
3. NPC_dock_worker_3
4. NPC_dock_worker_4
5. NPC_dock_worker_5
6. Foreman
7. NPC_plant_manager
8. NPC_freightliner_captain

PRIMARY OBJECTIVES = In Quest Log
1) Change into dock worker’s uniform.
2) Gather information by talking to 4 workers on the docks

OPTIONAL OBJECTIVES
1) Gather information by talking to all of the workers at Dock
   • Adds to your Influence
## EDUCATIONAL OBJECTS – CVIZ

### Carbon Emitting objects
1. FREIGHTLINER
2. CEMENT (Definition Data box refers to embodied energy)

### Carbon Sequestering objects
3. NATURAL WETLANDS (Make sure definition data includes info about nearby Burns Bog)

## DIALOGUE

1) Foreman to player: These dykes, they don’t look good. Look at how close the water is to the edge and how the parking lots inside are already full of deep puddles, doesn’t seem like the place can handle and more water.

2) NPC_dock_worker_1 to player. Looks like there is a lot of cement being shipped. Did the plant get the new waste-to-energy bid? I heard that the CEO was really pushing for that but my friend is an economist, says with today’s policies the way they are that is a losing proposition.

3) NPC_dock_worker_2 to player. “I usually spend my time at the main docks down by Tsawwassen. It’s crazy how much stuff comes in from overseas. Food, building materials, even water! When look at the kind of stuff we can produce right here. Strange world we live in when we grow our own food, have all kinds of timber and fresh water here is in BC and what do we do buy stuff from halfway around the world.”

4) NPC_dock_worker_3 to player. “Doesn’t it seem kinda ironic that we just hauled off a shipment of drinking water from overseas when we are practically drowning in water here? Why do we need all this drinking water anyway? Does this have something to do with all that “emergency preparedness” they were droning on and on about lately in staff meetings?”

5) Plant Manager to Ship Captain: “If anyone says this load seems like more coal than we usually ship, remember it’s all legal and what are a few cargo containers more or less of this or that – we are shipping what our clients want, I say – staying in business is way more important than some grand ideas about reducing global emissions, the Fraser river here generated more economic activity than even the St. Lawrence River. BC and Canada just can’t afford these “big ideas” some people around here seem to have”

6) NPC_dock_worker_4 to dock worker 5: Working in this rain day and night, it’s miserable. I have lived in this area for 45 years and this is the wettest spring I can remember. Its crazy – and right after last year’s crazy drought and fires! What is going on? This can’t be natural.

7) NPC_dock_worker_5 to dock worker 4: You think this is unnatural! You should go down next to the water just over there – there is some kind of unholy stink like I’ve never smelled! Think that with all this rain the sewer system finally bust? I heard that was one of the things that might go wrong with these “freshet” floods. Ha – what a stupid name – I can tell you what I smelled there, that was the farthest thing from fresh ever to hit our river.
<table>
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<th>SOUNDS</th>
<th>DESC</th>
<th>TRIGGER</th>
<th>FILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HUMMING STADIUM LIGHTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>OCEAN WAVES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>OCEAN NOISES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>BACKGROUND NOISE GUYS WORKING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>CLANG OF CRANE PICKING UP AND DROPPING CRATES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FX</th>
<th>DESC</th>
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<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
<td>FOG</td>
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<tr>
<td>3.</td>
<td>STADIUM LIGHTS PIERCING FOG</td>
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<tr>
<td>4.</td>
<td>LIGHTNING</td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td>RAIN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. **TRUCK LOADING AREA**

*The mission morph for mitigation – make sure we are supporting carbon sequestration*

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**INTERMISSION = Cinematic Cut Scene**

Your future friend interrupts game play by talking to you about the big picture. She has finally gotten the past/future conversation tool of your gadget to work and she has come to tell you some things she know by being in the future.

1) She Re-iterates the difference between Adapt and Mitigate and points out that means to Adapt Delta to climate change are not always the best way to Mitigate and help the world avoid climate change all together. For Example

   “Ironically, what they are doing by stockpiling on sandbags and emergency supplies, drinking water, could be building up some local resilience. Why? Because it is helping locals in Delta Adapt to Climate Change impacts. But on the other hand there is still coal going through here, pretty dirty coal at that. Rather than making money off coal as some here seem to want to do, and at the same time concerning themselves with adapting to climate change, we would be much better off in the future if we had gotten people focused on mitigating climate change not just reacting to it all the time.”

   “I’m telling you again, if you want to save Delta AND save the world from Climate Change impacts, you have to address the problem at it source. Anthropogenic carbon is the cause. You need to make sure that while Delta is Adapting it is also doing so it ways that are Mitigating. Take a look at your carbon footprint *(see score)* and that of this
industry and the region. I am still here in 2100, and I can tell you a lot more still has to change! Please help!

2) She gives you some good news too. She has updated/fixed the carbon vision tool so that it now can give you more information of the things that are sequestering carbon. (Update of gadgets to Carbon Sequester Viz)

"Now that I am older and wiser I will tell you something that I realize, you and I had our hearts in the right place at this point in our life but we didn’t see the whole picture. I for one was real stubborn – and I thought industry was the source of all our problems. I didn’t see that there were some solutions to climate change going on right here in Delta – your looking at them all around you. Here, try using Carbon Sequestration Viz to help you see them? (turn on C Viz updated with Sequester Viz). For example this rain garden here, someone has put a lot of effort into making this small constructed wetland, and look, the plants growing it are absorbing carbon from the atmosphere – that’s an example of the carbon cycle working, we rely on plants, soils and peat bogs like Burns Bog to complete the carbon cycle. Conserving and restoring these ecosystem services is critical."

"I suggest you go back and do some inventory of carbon sequestration and reduction around here, it won’t be easy, but if you go back to places you have already been you might be surprised."

"BTW a tip in investigative journalism, it’s not all glamorous adventurous running around in the middle of the night stuff, in fact most of the time info you gather illegally can’t be used or gets you in a lot of trouble if you do use it. I am not saying what you are finding out here is not valuable, but careful how you go about it. You are good at what you do, you have a knack for gathering information and influencing people. Just remember that sometimes it a lot of the less glamorous stuff, like finding out what is already publicly available and putting together pieces of a complicated puzzle that may also pay off."

"Whatever you do, remember to mitigate and…. “ Crackle crackle fuzz – no more future audio

3) Player sit down on bench to and contemplate Future Ekta’s advise while looking at the rain garden with Carbon Viz. Cut Scene ends.

GAMEPLAY DESCRIPTION
Next to the player on the bench is a newspaper article about Burns Bog.

Sirens blare and a lot of people are running towards the docks. There is one guy that is left, slowly sweeping. You ask him what is going on. It is Carl, your friend from Act 1
PRIMARY OBJECTIVES = In Quest Log
1. Find Carl and convince him to help the emergency response. Tell Carl everything you know that might help him lead up the emergency response.
2. Find Carl’s missing key card for the offices

OPTIONAL OBJECTIVES
1. Pick up newspaper sitting on the ground and read headline about impending sea level rise- the only way to halt this is by reducing our GHGs immediately or establish major forested carbon sequestration areas.
   • Adds to your knowledge points
2. Read in the same newspaper about Burns Bog has recently been declared a UNESCO World Heritage site due to its ecological significance. ¹
   • Adds to your knowledge points
3. Decide if you will backtrack to find the carbon sequestration objects as Ekta recommended.
   • Adds to your knowledge points
   • Critical to meet threshold of points to have all options available to you to convince friends in the end
   • If you do you also have a chance to find Easter Egg.

NPCS
1. Dock Worker 1
2. Truck Driver 1
3. Security Guard 1
4. Carl (friend from Act 1) sweeping

CONVERSATION:
NPC’s say as they run by player on bench:
1. Dock Worker 1 to Player”
   “there is a breach in the dyke, the place is starting to flood, its’ complete chaos!”
2. Truck Driver 1 to player”
   “What are we supposed to do about this dyke, plug it with our fingers?”
3. Security Guard 1: Mumbling to himself while walking fast
   “Man I wish I were listening more during those emergency meetings about what our vulnerabilities were and what we were supposed to do about it – something about sandbags and pumps…. Do we have these things?”
4. Carl (friend and Custodial Worker): Carl to Player and vice-versa
   Carl: “Well hey there, I didn’t know you worked here now! Maybe I can confide in you something, I lost my key card for the offices I’m supposed to clean, do you think you can help me find it”

¹ See article on Burns Bog Conservation Website. This petition was first brought to House of Commons in 2009. Lets say that in 2025 it is passed. Use real info from Burns Bog website about Burns Bog sequestering abilities
Player: “Carl! Is that you? So good to see you here! But, why are you just standing here like nothing is happening, are you going to do something? Has this happened before?”
Carl: “Well the thing is every once in awhile this does happen, some of our property gets wet, used to be back in the day we had a lot of wetlands and Burns Bog over there, didn’t seem like a big deal, they sort of acted like a sponge, and nature just sort of took care of itself I figure... but this does seem different, everyone’s in a big panic huh?“
Player: “this time the I think the dyke isn’t really tall or strong enough and the river is really high. I was just over there on the waterfront and looks bad – Doesn’t anyone around here know what the emergency plan is?”
Carl: Oh, that was supposed to be me, in case of emergency they said I was supposed to lead a crew with sandbagging and direct the other guys to get the pumps going. Oh no, do we have this stuff? Where is it!? What am I supposed to do? They are going to ask me what things are what, what fuel to use... I don’t remember – do you know?

Information you can share with Carl if you know it.
1) Where the sandbags are
2) Where the fuels sources are. (Optional: Tell him to use natural gas, biofuels or even waste heat for the generators on the pumps, if you have these in your inventory)
3) The blueprints on the Dykes and the Cost (If you do so Carl will be influential in next Act on Boundary Bay decision making)

Carl: “Thanks this is a big help – how about you are you going over to the dykes”
Player: “I can’t I’m um sort of on my own mission to... um, help in a different way... I don’t suppose you know where you had the key card last do you?”
Carl: At my age – not a clue! I can barely remember what you just told me, I better get up there before I forget!

EDUCATIONAL OBJECTS – CVIZ
Carbon Sequestering objects
1. Rain Garden
2. Trees

EDUCATIONAL OBJECTS – Other
NEWSPAPER

SOUNDS DESC
1. LAPPING WATER
2. WIND IN THE TREES
3. DRIPPING FROM TREES
4. NEWSPAPER RUSTLING
8. JUMPING PUZZLE:
Fancy Footwork and free carbon

GAMEPLAY DESCRIPTION
There are no more NPC’s to avoid as everyone has gone to the docks. The front doors to the offices are closed and locked and the only way in is to figure out the jumping puzzle and climb up on a processing structure and then walk across a pipe to the offices rooftop. There player will find Carl’s missing key card to open office. Then the player descends the fire escape and enters into the offices via the green roof.

PRIMARY OBJECTIVES = In Quest Log
1. Find a way onto the offices rooftop and into the building.

EDUCATIONAL OBJECTS – CVIZ
Carbon Emitting Objects
1. Waste Heat from the pipes, (Data Definition includes info that water storage of heat from all this combustion could be reused to heat buildings)

Carbon Sequestering objects
1. Green Roof

CONVERSATION:
N/A
GAMEPLAY DESCRIPTION

Once inside the office building the player must pick up the keycard on the desk. Then, while avoiding cameras the player must make his way to the computer mainframe room and use the keycard to get inside. Once inside the player will find proposals for diking in Boundary Bay and some possible new rail lines, including one through Burns Bog.

The main point of this level needs to be to discover that the industry itself is facing major financial troubles. It is a locally owned business that employs 500 people in the area. However, since it has been investing in sustainable projects (i.e. green roofs, waste-to-energy,
constructed wetlands, solar energy). It has not had much help from the provincial or federal policies to support these investments. Now the company is near bankruptcy. What you discover is an audio dictation from the CEO to her secretary made the previous work day. She was dictating a memo to be delivered to the board the next day, there are currently 3 options:

a. We can fold now. If we decide to file for bankruptcy we can make sure our pension plans and personal stocks are protected. It will be a raw deal for all of our suppliers, especially the smaller locally run companies, we are their biggest client. These are our friends and neighbors and they might go down with us but ultimately I guess that’s just business and these are hard times for all of us…. Sigh

b. Sell the company to a foreign multinational. There has already been an offer from one of our clients. Actually the one that keeps asking us for more coal. I suspect if they buy our company, they plan to lay off most of Delta’s employees and perhaps move the operation overseas.

c. Join forces with an industry organization that is lobbying the government to give tax breaks to companies that can demonstrate they are increasing area’s resilience to climate change, reducing carbon emissions or sequestering carbon within Canada. This is a long shot.

d. It would really help if industry had more public support and the media and NGO’s cared more about how industries can be part of the solutions to these issues, but so far this isn’t getting much press. Anyone have any ideas? If I don’t get good feedback on this I will drop it by next week I guess we will only have the first two options.

“At the end of the dictation the secretary is heard saying: Ma’am this might be a little too candid for the memo – you are revealing a lot – are you sure that is how you want me to write the memo? The CEO agrees this is too much information, but she is tired, lets just try this again in the morning.”

While the player has been listening to the dictation the office building has started to flood because of the breaching dyke just outside. The player has a short amount of time to escape the building to meet his friend waiting in a boat ready for extraction.

**NPCS**

1. Voice of CEO
2. Voice of Secretary

**PRIMARY OBJECTIVES**

1. Avoid cameras, forcing you to see the dinghy.
2. Use keys found during jumping puzzle to open office door.
3. Escape out bathroom window where with your friend waiting in a dinghy
OPTIONAL OBJECTIVES
1. Make sure that project bid with blueprints for rail lines that go around Burns Bog (using higher dyke system) rather than blueprints that cut through the bog is on top. Cut out the newspaper article you found along the way about importance of Burns bog for sequestering Carbon and clip it to this bid along with Memo that says IMPORTANT.

DIALOGUE
See above

FILE: tbd

SOUNDS
DESC TRIGGER FILE
1. WATER FOUNTAIN

FX
DESC TRIGGER FILE
1. WATER FOUNTAIN
End of Act / EXIT:

You use your getaway boat to get to a safe place away from the surging waters (the guards are all busy now sandbagging the breached dyke and calling the RCMP to try to figure out what to do)

You come away from the Area with 2 major accomplishments – the big proposals you thought you were looking for all along and a copy of the digital recording that you have downloaded to your smartphone.

Panting you tell your friends in headquarters you got the document and an interesting recording. There is a Cheer. Then there is a groan from someone, the documents you uploaded on the proposals, this is all publically available stuff!

This initiates conversation to focus on the other things you learned/saw/did Focus of conversation with friends should be:

a) The recoding of CEO.

b) Newspaper articles (job forecast for Delta, IPCC saying mitigation is needed now),

c) The observations there is both some bad apples bent on staying in the coal business, as well as some innovations and good ideas. One of your Carbon Inquisitor friends is a sceptic about latter point. Use inventory to showcase projects you saw. If you meet a certain overall point threshold you convince people with this argument, if you don’t than the group decides industry in Delta is still the anthropomorphic carbon bad-guys and deserves to do bankrupt.

What you have to choose between:

1) Convince your friends to go to the media with the info that the company is going to sell to Multinational company.

2) Convince friends to use the organizational strength of the Carbon Inquisitors to join forces with the CEO

   a. Go to the media and get more attention for provincial/federal policy and programs that support the green infrastructure initiatives that you witnessed starting to take hold in this company

   b. Help the company identify the corrupt staff bending the rules on internal policies

3) Convince your friends that there are some good things going on at this company too. This is only possible if you have inventoried both carbon emission and carbon sequestration/reduction elements – if you have not, they will not be convinced.

   a. Help the company identify better staff, and hire some people from Carbon Inquisitors group instead.

   b. Convince the main sceptic in your group (who also volunteers at the Burn Bog conservation society) to bring up the issue at the next meeting that coal dirty coal is still nearby and they get media attention for potential health impacts to humans and the sensitive habitat sequestering carbon for them.
Outcomes of your decisions (What you see/learn happens in overview map).

1) If you go to media with the info that the company is going to sell to Multinational company it backfires and the stocks plummet and the other company does not want to buy them. They go Bankrupt anyway. Tilbury becomes a brownfield in Future Acts (you can see this in map view before Act 3. Delta loses all sorts of jobs. In the next scene Act where food prices soar this is a real problem as many people are without an income/living on fixed incomes of unemployment insurance/pensions.

**SUMMARY: ADAPT**

- Dykes Fixed temporarily but cost of pumping leads to less industry in 2035
- Adaptation Achieved through unorganized retreat of industrial area = less industry in 2035
- Job loss though more people have emergency responder skills
- More natural area potentially though fear of industrial contaminants
- Start next act in BOUNDARY BAY

2) If you go convince your friends to join forces with the company to clean out the bad apples and focus attention on government policy changes that would support industries trying to adapt to climate change or increase resilience of the area then you have a thriving Industrial sector in the next Act (it has expanded) with a reinforced dyke system.

**SUMMARY: ADAPT**

- Success in Adaptation
- Reinforced Dyke system with pumps using renewable energy
- Increased Resilience
- Start next act in BOUNDARY BAY

3) If you convince your friends to join forces with the company and additionally as apply for jobs to be the leaders in mitigation, as well as get other NGO's to be leaders in making fossil fuel rejection and sequestering priorities back into the limelight then you will see the Tilbury area gets more green infrastructure. A bike path along the expanded dyke from N. Delta to Tilbury to Ladner (all those former Carbon Inquisitor. activists as Tilbury employees get active in making low – carbon transport a priority to get to work.

**SUMMARY: ADAPT + MITIGATE**

- Reduce GHG's by 80% per the 2050 BC target
- New Dyke system also a bike path to Ladner and N. Delta
- Green Infrastructure includes wetlands, green roofs, reduced parking, trees in parking lots
4) If you did all mitigation options along the way during the act, in addition to 3 above

SUMMARY: ADAPT + MITIGATE

- More jobs in green industry
- There is no more regional coal exporting and instead there is a lot of alternative fuels being used in Delta and abroad
- Homes and businesses in Delta are using geothermal, solar, sewer heat recovery and other innovative ways of heating homes due to industry going from pilot programs to full scale production of tools
- The Industry shifts gear from being a coal user to getting it’s bid to be the regional solid waste to Waste-To-Energy plant, thus greatly reducing the regional carbon footprint.
- Start next act in LADNER