Gamified Energy Efficiency Programs

Frederick Grossberg, Mariel Wolfson,
Susan Mazur-Stommen, Kate Farley, and Steven Nadel
February 2015
Report Number B1501

529 14th Street NW, Suite 600, Washington, DC 20045
Phone: (202) 507-4000 • Twitter: @ACEEEDC
Facebook.com/myACEEE • www.aceee.org

Contents

About the Authors

Frederick Grossberg is ACEEE's editor. He was formerly a marketing consultant for Panasonic and researched social marketing theory for Manifest Communications and the Academy for Educational Development. He has a PhD in English from Harvard and a BA in English from the University of Toronto.

Mariel Wolfson is a freelance writer focusing on energy and environment, and a teaching fellow in environmental science and public policy at Harvard. She is working with Harvard's Joint Center for Housing Studies on a study of healthy-housing concerns among American households. Mariel recently completed a PhD in the history of science at Harvard, with a dissertation on energy-efficient housing in the United States during the 1970s and 1980s. She has an MA in the history of science from Harvard and a BA in history from Columbia University.

Susan Mazur-Stommen is the principal and founder of Indicia Consulting. She directed the Behavior and Human Dimensions Program at ACEEE from 2011 to 2014. In that role she co-chaired the BECC conference and conducted qualitative research on behavior change and energy usage. Susan has a PhD and an MA in cultural anthropology from the University of California, Riverside, and a BA in cultural anthropology from San Jose State University.

Kate Farley is pursuing a master's degree at the Yale School of Forestry and Environmental Studies. She formerly was a research assistant in the ACEEE Behavior and Human Dimensions program. She has a BA in environmental science and public policy from Harvard.

Steven Nadel is ACEEE's executive director and has been conducting research on energy efficiency topics for more than 30 years. He is the author or coauthor of more than 200 papers and reports covering energy efficiency technologies, programs, and policies.

Acknowledgments

This report was made possible through the generous support of our project sponsors: Consolidated Edison, Cool Choices, Energy Trust of Oregon, the New York State Energy Research and Development Authority (NYSERDA), Pacific Gas & Electric Company, and Southern California Edison. The authors gratefully acknowledge external and internal reviewers who supported the study. External expert reviewers included Kathy Kuntz (Cool Choices), Marsha Walton (NYSERDA), Nick Lange (Vermont Energy Investment Corporation), and Lauren Mason (WeSpire). External review and support does not imply affiliation or endorsement. Thanks to Naomi Baum for eagle-eyed internal review. We are also grateful to Beth Karlin, director of the Transformational Media Lab at the University of California, Irvine, for sharing her dataset, and to three wise interviewees: Raj Shukla of Cool Choices, Nicholas Lange of Vermontivate, and Ian Bogost, professor of games at Georgia Institute of Technology. Finally, we would like to thank Roxanna Usher for copy editing, Eric Schwass for help with the figures, and Patrick Kiker for his assistance in launching the report into the world.

Executive Summary

In late 2013 ACEEE published its *Field Guide to Utility-Run Behavior Programs*, a survey and analysis of over 300 programs in utilities across the country (Mazur-Stommen and Farley 2013). One of the 11 broad categories the researchers discussed was games. The current study zooms in on that single category, describing and analyzing 22 game-based solutions that either are or could be part of an energy efficiency program.

Turning something into a game—using the features of games to accomplish a real-world objective—is called *gamification*. Over the past five years or so, businesses, nonprofits, and governments have gamified a wide array of activities. So far the evidence suggests that games definitely can encourage positive behavior change. Most notably for this report, a number of games have been developed that motivate consumers to save energy.

We should be careful to distinguish gamified solutions from rewards programs on the one hand and videogames on the other. Rewards programs like frequent flyer miles engage people by promising them a tangible reward in exchange for some action. In gamified solutions, only some players may win such a reward, and the prospect of a prize is not their only reason for playing. In some ways gamified programs are more like videogames, which offer players entertainment, fun, and challenges. But whereas the only point of a videogame is to entertain its players, gamified activities are meant to motivate players to perform real-world actions.

We collected information on 53 games for this study, all of them meant to influence behavior around energy efficiency and sustainability. Of these 53, we present case studies of 22 games that could be or actually are part of a utility energy efficiency program. They include:

- Games in which players undertake and are rewarded for a range of energy savings activities
- Energy savings challenges in which players compete, either individually or on teams, to save the most energy during a particular time period
- Games that employ real-time granular data on players' energy use as feedback for their actions
- Games that make extensive use of virtual worlds

We used a detailed analytical framework in the 22 case studies and in the following discussion. This framework can also help guide developers through the process of game design, implementation, and evaluation. Its elements are as follows:

Provenance. Who are the developer, implementer, partners? Is this a pilot or a full deployment? What are the implementation dates?

Business objectives and desired outcomes. Why has the utility or other implementer deployed the game? What does the game achieve from a business perspective?

Target audience and their goals. Who is meant to play the game, and what personal goals can the game help them achieve (e.g., a lower energy bill)?

Target behaviors and metrics for success. Exactly what real-world actions does the developer want the players to take? What are the desired quantified results?

Play space. Does the game take place solely in the real world, solely in a virtual world, or in some combination of the two? Is it smartphone enabled?

Progress path, levels. What is the players' progression from initial achievements to greater challenges and mastery?

Triggers. What reminders and calls to action prompt players to continue on their journey?

Player engagement model. Do players interact only with the game, or also with other players? If the latter, do they play in teams?

Data-based feedback. What quantified data do players receive about their progress, and at what intervals?

Achievements and rewards. What actual and virtual rewards and recognition do players receive, and for what achievements?

Social dimension. Does the game use social norms (not wanting to be out of step with one's neighbors) to motivate player behavior? Does it use social media to amplify achievements or for other purposes?

Intrinsic versus extrinsic motivation. Does the game motivate players to change their behavior for intrinsic as well as extrinsic reasons?

Results. What results—energy savings, other quantifiable results, and changes in players' behavior—have been documented?

Nine of the games we analyzed documented specific energy savings in a format that could potentially be compared to other games and programs. Available evidence indicates that gamified energy efficiency programs can achieve energy savings of 3–6% among a sizable number of participants. Savings of more than 10% can be achieved in narrowly targeted programs.

Introduction

Games are one of the most powerful and widespread ways that human beings interact, communicate, and have fun. Many people play them, and many are captivated by them. According to the Entertainment Software Association, 51% of American households own at least one game console. Surprisingly, 48% of gamers are female. There are actually more female gamers over 18 (36% of the total number of players) than male gamers under 18 (17% of players) (ESA 2014). Games can reach millions if not billions of people. *Angry Birds*, which is free to play, is the number-one downloaded app of all time, with over 2 billion downloads and hundreds of millions of active players (Edge 2014). *Grand Theft Auto V*, the best-selling game of 2013, sold over 30 million copies worldwide across all game platforms (Thier 2014).

Human brains are wired to enjoy the challenges, positive feedback, and social bonding that games provide. The advent of digital technology has simply amplified the hold that games have always had on us. Many younger people are so immersed in games that game mechanics—adventures, avatars, points, badges, virtual currency, and so on—are almost more compelling to them than ordinary life. It is no wonder that educators, marketers, and enterprise solutions developers are turning to games to help them achieve their objectives. These disparate professionals are all in the business of motivating people to do something, and, as we shall see, games are one of the most effective motivational tools they can deploy.

Clearly, however, none of these professionals is interested in using games for the sole purpose of entertaining their target audience. Rather, they want to use them to accomplish an objective such as helping students master algebra, selling more hamburgers, promoting physical fitness, or increasing energy efficiency. Turning something into a game—using the features of games to accomplish a real-world objective—is called *gamification*. Gamification imports the elements that normally operate in game worlds into real-world contexts like classrooms, offices, hospitals, and homes. Gamified solutions transform everyday activities into game-like experiences.

Over the past five years or so, businesses, nonprofits, and governments have gamified an array of activities. Many of these task areas are employee facing and are intended to improve worker performance. Gamified solutions have been developed for almost every enterprise element including strategic planning, product development, marketing, sales, HR, training, customer relations, accounts payable, travel reporting, call center management, cybersecurity, and computer programming. A second type of gamified solutions consists of customer-facing games that enhance experiences ranging from buying a burger to attending a conference. Games help teenagers learn physics, adults learn languages, and researchers fight HIV/AIDS. Gamification is especially powerful in motivating behavior change. Games help people become more fit, lose weight, stop smoking, report pain when being treated in the hospital, work safely, improve their credit, plan their retirement, give to charity, and fight world hunger. Most notably for this report, a number of games have been developed that motivate consumers to live sustainably, recycle, and save energy.

So far, the evidence suggests that games actually are able to encourage positive behavior change. Several studies of individual game mechanics have demonstrated that they significantly influence behavior. Anderson et al. (2013) developed a model of how badges influence behavior that accurately predicted user actions on the question-and-answer website, Stack Overflow.

They found that badges are a powerful motivational tool and that users are willing to put in a significant amount of work to attain them. Another study found that introducing points and a meaningful framework to the simple task of annotating images motivated participants to create a greater number of higher quality annotations (Mekler et al. 2013). A third study, a recent review of 24 research papers on gamification, found that "According to a majority of the reviewed studies, gamification does produce positive effects and benefits" (Hamari, Koivisto, and Sarsa 2014).

Gamified solutions are a recent phenomenon. The clumsy word *gamification* first became widely adopted in 2010; in 2011 it was on the U.S. shortlist for the Oxford dictionaries' word of the year.[1] At the end of that year, Gartner predicted that 70% of Global 2000 companies would have at least one gamified application by 2014, 25% of all business processes would be gamified by 2015, and gamification would become a $2.8 billion business by 2016 (Gartner 2011a; 2011b). Gartner tempered this exuberance a year later, cautioning in 2012 that "gamification is currently being driven by novelty and hype" and that poor design would doom 80% of currently gamified applications to fail to meet business objectives (Gartner 2012). Nevertheless, in January 2014, IDC Energy Insights estimated that by the end of the year, utilities would spend $13.5 million on gamification worldwide, rising to $65 million in 2016. By then, 60% of "progressive" energy retailers would be using at least one gamified solution (IDC 2014).

Gamified energy efficiency solutions can be as simple as a competition between neighborhoods to save the most energy, or they can be as complex as a social-media-enabled smartphone app linking real-time energy-use data to the fate of imaginary creatures in a virtual world. What they have in common is the appeal of all games as compared to everyday life:

- *Clear goals and rule of play*, whereas in the real world goals can be murky and rules selectively applied
- *A compelling storyline* ("Underdog wins!") compared to the miscellaneous, disconnected activities of everyday life
- *Short-term challenging but achievable tasks*, whereas real-world challenges are often long-term and insurmountable
- *Quick feedback* compared to the real world's slow feedback cycles (think annual performance reviews) (Gartner 2011a)

Although gamified solutions share these characteristics with all games, including videogames like *Angry Birds*, we should be careful to distinguish such solutions from rewards programs on the one hand and videogames on the other. Rewards programs (e.g., frequent flyer miles) engage people by promising them a tangible reward in exchange for some action. Customers are motivated to engage because they will be compensated. Videogames are at the opposite pole. People play them to have fun and be entertained and challenged; simple enjoyment is their payback.

[1] http://blog.oup.com/2011/11/squeezed-middle/.

Although gamified solutions share some of the same mechanics as videogames (e.g., challenges, feedback, and points), they are fundamentally different. Whereas a videogame is designed to entertain its players, gamified activities are meant to motivate and help the players to perform real-world actions. When videogame players capture an alien spacecraft, that victory is not in service of anything else except (probably) more of the same as the game continues. In an energy efficiency game, players may have adventures and rack up the highest scores, but those achievements are not ends in themselves but a means of encouraging them to save energy. Figure 1 illustrates the distinctions between gamification, videogames, and reward programs.

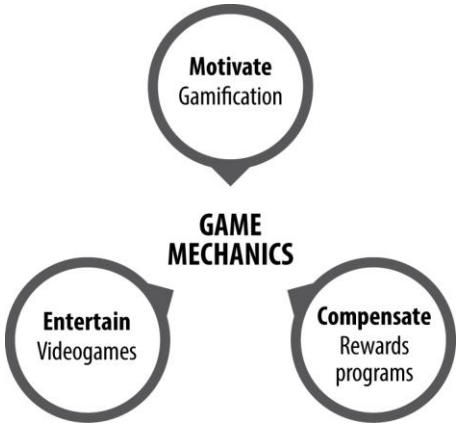

Figure 1. Gamification, videogames, and rewards programs. *Source:* Burke 2014.

Another way of putting this is to say that whereas fun is the whole point of videogames, it is simply another way of achieving the whole point of gamification, which is to motivate and encourage people to do something. Gamified solutions use fun to keep players engaged. As Volkswagen's videos on Fun Theory make clear, fun is one of the most powerful tools we can use to motivate positive behavior change. Figure 2 gives a small taste of one of the Fun Theory projects, but you should visit the site and watch the videos to get the full idea.[2]

Figure 2. Piano staircase. *Source:* Greenely.com.

[2] http://www.thefuntheory.com/.

In short, gamification encourages people to do something by making it fun.

Methodology

In late 2013 ACEEE published its *Field Guide to Utility-Run Behavior Programs*, a survey and analysis of over 300 programs in utilities across the country (Mazur-Stommen and Farley 2013). One of the 11 broad categories the researchers discussed was games. The current study zooms in on that single category, describing and analyzing 22 game-based solutions that either are or could be part of an energy efficiency program. It is aimed at developers who want to know more about including games in their offerings. Whether they have never tried a game but are considering one, have used games before but would like to learn more, or even just want to see what is going on in the industry, this report can help them with future decision making.

We collected information on 53 games for this study, all of them meant to influence behavior around energy efficiency and sustainability. The earliest game we found in this space dates from 2007, with the majority arriving on the scene after 2010. We conducted most of our research online, where we found a rich store of information provided by utilities, third-party game developers, analysts, and others. In addition we accessed the archives of the Behavior, Energy & Climate Conference (BECC), which has presentations on games and their results dating to 2007. Beth Karlin, director of the Transformational Media Lab at the University of California, Irvine, also shared her dataset. Where current contact information was available, we sent data requests to game publishers and administrators.

We conducted telephone interviews with Raj Shukla of Cool Choices, Nicholas Lange of Vermontivate, and Ian Bogost, professor of games at Georgia Institute of Technology and author of the book, *Persuasive Games: The Expressive Power of Videogames*. We spoke with Raj and Nick about their roles as game designers and implementers, going into the history behind their games' creation, and how they came to decide that a game made sense for achieving their goals of energy saving. Our conversation with Ian Bogost focused on larger questions about the nature of games, why game mechanics work, and what games do that media cannot.

The majority of the 53 games we collected incorporate an energy efficiency component, sometimes as the primary focus of the game, and sometimes as one among a suite of topics. We found that some types of games were closer to the center of this inquiry than others. Figure 3 shows our target area and the rings surrounding it. In order to circumscribe what could be an endless expanding topic, we limited our discussion in this report to the bullseye and the innermost ring. Appendix B contains thumbnail descriptions of the other games we considered.

Figure 3. Relevant games for this report

Working our way toward the center of our topic, we found a number of interesting gamified solutions in areas such as recycling and alternative energy. These included GB Recycle, Trash Tycoon, and SunPower. These games might provide some ideas that energy efficiency program developers could apply to their own solutions. Next (but still outside our focus area) were a large number of games that have at least a peripheral energy efficiency component. These included simulations like SimCity Edu, educational solutions like Ludwig, and children's games like Eco Ego, Energy Elf, and Unplugged (in French, Lachez Prise).[3] Although these games may lead their players to actually save energy, they do so only indirectly, since real-world actions are not part of the game.

Moving to the innermost ring, we encounter a number of games that do encompass energy savings in their play space and so are included in this study but that (as far as we can tell) have not yet been incorporated into customer-facing utility energy efficiency programs. Some of them are sponsored by utility-funded organizations (e.g., Vermontivate and Carbon4Square), but many are not; the WeSpire games, for example, are commercially developed and marketed to particular non-utility clients. It is not until we reach the bullseye that we find gamified energy efficiency solutions that utilities have actually deployed to customers, either alone or in collaboration with third-party providers.

In the next section we describe and analyze 22 gamified solutions from the bullseye and the innermost ring. We have chosen these games from among many others to illustrate the range of

[3] Other simulations and educational games with an energy savings component include Climate Defense, EnerCities, ElectroCity, Energy City, Energyville, Eskom Energy Planner, Power Matrix, and Power Planets. See Appendix B.

possible game types and to feature what seemed to us to be the most innovative, substantial, and successful solutions. They include:

- Games in which players undertake and are rewarded for a range of energy savings activities
- Energy savings challenges in which players compete, either individually or on teams, to save the most energy during a particular time period
- Games that employ real-time granular data on players' energy use as feedback for their actions
- Games that make extensive use of virtual worlds

We used a number of questions to guide our discussion of the games, not as an organizational template for every case study (which would get monotonous), but as a background analytical framework. We use this same framework more overtly in the Discussion and Recommendations section that follows the case studies. We should note that for many of the games we lacked the data to answer a number of the questions, sometimes because we were not privy to the developers' decisions, and sometimes (especially in the case of achieved energy savings) because insufficient data existed.

Here is the framework:

Provenance. Who are the developer, implementer, partners? Is this a pilot or a full deployment? What are the implementation dates?

Business objectives and desired outcomes. Why has the utility or other implementer deployed the game? What does the game achieve from a business perspective?

Target audience and their goals. Who is meant to play the game, and what personal goals can the game help them achieve (e.g., a lower energy bill)?

Target behaviors and metrics for success. Exactly what real-world actions does the developer want the players to take? What are the desired quantified results?

Play space. Does the game take place solely in the real world, solely in a virtual world, or in some combination of the two? Is it smartphone enabled?

Progress path, levels. What is the players' progression from initial achievements to greater challenges and mastery?

Triggers. What reminders and calls to action prompt players to continue on their journey?

Player engagement model. Do players interact only with the game, or also with other players? If the latter, do they play in teams?

Data-based feedback. What quantified data do players receive about their progress, and at what intervals?

Achievements and rewards. What actual and virtual rewards and recognition do players receive, and for what achievements?

Social dimension. Does the game use social norms (not wanting to be out of step with our neighbors) to motivate player behavior? Does it use social media to amplify achievements or for other purposes?

Intrinsic versus extrinsic motivation. Does the game motivate players to change their behavior for intrinsic as well as extrinsic reasons?

Results. What results—energy savings, other quantifiable results, and changes in players' behavior—have been documented?

Table 1 summarizes the characteristics of the 22 games featured in the case studies.

Table 1. Features of games in case studies

Game	Individual players	Teams	Residential	Multifamily	Workplace	Commercial	Community-based	School involvement	Utility involvement	Import utility data	Compare to neighbors	Educational focus	Live events	Tangible rewards	Virtual rewards only	Virtual world	Use social media	Facebook integration	Smartphone enabled	Customizable
Cool Choices	•	•			•									•						•
WeSpire	•	•			•									•			•		•	•
Ecoinomy	•	•			•									•						•
Vermontivate	•	•	•				•	•	•			•	•	•						
Power Agent		•	•						•	•		•			•				•	
JouleBug	•		•							•					•		•	•	•	•
Rock the Bulb	•		•				•		•				•	•						
Reduce the Use	•		•				•		•		•			•						
SMECO Savings	•	•	•				•		•					•			•	•		
Kansas Take Charge	•	•	•				•	•	•				•	•						
Energy Smackdown	•	•	•				•		•				•	•						
Chicago Neighborhood	•	•	•	•			•			•	•		•	•						
Carbon4Square	•	•			•	•	•					•			•					
Kukui Cup	•	•					•					•	•	•			•			
Beat the Peak	•	•	•				•	•	•					•					•	
Biggest Energy Saver	•		•				•		•					•			•			
San Diego Energy	•	•	•				•	•	•	•				•			•			
Opower	•		•						•	•	•				•		•	•	•	•
Leafully	•		•						•	•		•			•		•	•	•	
Dropoly	•	•	•	•			•	•				•		•						•
Energy Chickens	•				•										•	•				
Power House	•		•						•	•	•	•			•	•	•	•		

Exemplary Energy Efficiency Games

COOL CHOICES

Cool Choices is a Wisconsin nonprofit that creates sustainability-focused games for use in workplaces and schools. Cool Choices launched its first game, iChoose, as a pilot project on April 22 (Earth Day), 2011. iChoose was developed for Miron Construction, one of Wisconsin's largest construction companies, and produced in collaboration with Filament Games, a professional game development firm (Cool Choices 2014a). According to a Cool Choices designer, this and other Cool Choices games were meant to be easy and undemanding so that players would associate saving energy with ease and fun rather than with complicated calculations (Raj Shukla, director of programs, Cool Choices, pers. comm., April 30, 2014).

Running for six months, iChoose involved 220 Miron employees out of a total of 330. Players received a new deck of action cards every month, with each card featuring a specific sustainability-focused action. Each month had a theme: household energy (electricity and natural gas), transportation, water, waste, and indoor environmental quality. Energy was the theme for May and October (McClure 2013).

Each month's set of actions was divided into four categories based on the type of action: step, leap, focus, and create. Steps were one-time (but repeatable) actions such as "Turn off the lights," for 5 points. Leaps were habitual actions such as optimizing car tire pressure, for 25 points. Focus actions such as "Explore how your home uses electricity" (also for 25 points) encouraged investigation, learning, and discovery. The Create category asked the players to innovate and develop a repeatable new practice such as devising a new way to share seldom-used items (e.g., camping equipment), for 50 points. In general, iChoose gave more points for actions that were more difficult (requiring more time and/or resources) or that yielded greater emissions reductions. Air sealing and insulating one's home were worth 150 points. (McClure 2013; K. Kuntz, executive director, Cool Choices, pers. comm., December 30, 2014). Figure 4 shows cards from all four categories.

Figure 4. Cool Choices cards. *Source:* Cool Choices 2014c.

There were 58 predetermined actions, one per card, but players were also encouraged to expand beyond the 58 by creating their own activities, by educating themselves about sustainability issues, and by documenting their actions through photos, stories, or videos. Documenting an action earned bonus points ranging from 20 for a photo to 250 for a video (McClure 2013).

Cool Choices maintained a website where players could log their actions to receive points, follow a leaderboard, and see updates from their coworkers. The website also offered links to fact sheets and other educational resources about sustainability.

iChoose offered both individual and team competitions, with employees divided into six teams. Monthly cash prizes ($100, $75, and $50) were awarded to the top three finishers, and raffles awarded $25 to any two people who had completed actions that week. At the end of the game, Miron gave the four winning teams grants that they could donate to charities to support sustainability-focused initiatives of their choice (McClure 2013).

The Energy Center of Wisconsin (ECW) conducted an independent impact evaluation of iChoose. Participants claimed 3,500 unique sustainability actions during the game, about half of which were new and half were repeated but still received points. Based on post-game interviews about actions taken, ECW estimated annualized electricity savings per active player of 700–900 kWh. A billing analysis of these participants found average electricity use reductions of 400 kWh per active player (95% confidence interval of 100–800 kWh). Participants used an average of about 10,000 kWh annually, and thus the 400 kWh saved represent about 4% of annual consumption. There were also some natural gas savings, but these were estimated to be less than 1% of pre-game natural gas usage. According to ECW, "indications are that one-year persistence is fairly high" (Bensch 2013).

Since its pilot program with Miron Construction, Cool Choices has implemented 10 additional workplace games across manufacturers, law firms, public agencies, meat processors, and a university department. It has also built a customizable web-based game platform with administrative tools for local partners and has adjusted game lengths, team composition, and prize strategies. Using the Cool Choices platform, all players within a workplace community can see the actions reported by others. Players may also respond to queries or submit photos that appear automatically in the game's social stream (Cool Choices 2014b; K. Kuntz, pers. comm., December 30, 2014).

Over 4,000 individuals have played Cool Choices games to date, with one game having 959 players. The law firm had a 70% participation rate; the manufacturers, 25–50%; and the public agencies, 10–40%. In late 2014, Duke Energy began offering selected commercial customers access to Cool Choices games as part of Duke's energy efficiency programming (K. Kuntz, pers. comm., December 30, 2014).

Game costs are based on level of customization and the target population size. Energy savings vary by region. Based on the ECW evaluation and other data, Cool Choices estimates that players in its Midwest games save an average of 390 kWh of electricity, 10 therms of natural gas, 20 gallons of gasoline, and 645 gallons of water (K. Kuntz, Cool Choices, pers comm., October 6, 2014).

WESPIRE

Formerly known as Practically Green, WeSpire rebranded and rebuilt its platform in 2013 to extend beyond environmental issues and include "health, citizenship, responsibility, and other positive impacts that businesses—and people—can have" (WeSpire 2014a). Working with

enterprises to improve employee engagement, WeSpire develops customized programs that address a client's specific business goals. While these goals may focus on energy conservation, they could just as easily focus on another sustainability issue or on health or citizenship, depending on the client's priorities.

WeSpire has worked with clients such as eBay, MGM Resorts, Sony Pictures, and McDonald's (WeSpire 2014b). It also has developed consumer-facing games for the NBCUniversal Green Is Universal program and for a partnership with EnerNOC, a provider of energy intelligence software for enterprises (L. Mason, marketing coordinator, WeSpire, pers. comm., January 2, 2015).

Although the WeSpire platform is customized to suit the client's goals for its employees, it relies on a standard strategy and set of game mechanics: points, achievements, teams, leaderboards, and levels (Taylor 2014). For example, if a company wanted to encourage its employees to reduce gasoline consumption, players might receive a list of actions with associated points:

- Calculate your mpg: 5 points
- Take public transportation to work: 5 points
- Get a subway pass: 10 points
- Sign up for a ride-sharing program: 25 points

Actions are both one-time-only and repeatable. Since the goal is to turn positive actions into habits, players can earn points multiple times for the repeatable actions (e.g., take public transportation), but only up to a certain number of repetitions. Once an action has become habitual, that action is closed. As players complete additional actions, they move up in levels, which range from 1 (lowest) to 10 (highest). To advance through the upper levels requires more points than to advance through the lower ones; e.g., it is harder to go from level 8 to 9 or 9 to 10 than to go from 1 to 2.

Players can also divide into teams based on criteria appropriate for the company (interest, department, and so on) and watch their point totals grow together. Leaderboards track the top performers. While WeSpire does not (yet) link to a preexisting social media platform like Facebook, it has a social feature of its own, where players can report on their actions with text or photos and track other players in real time (figure 5).

Figure 5. WeSpire social feature. *Source:* WeSpire 2014d.

For the employer commissioning the game, WeSpire aims to supply abundant analytics using two main tools: a dashboard and a return-on-investment (ROI) calculator. The dashboard tracks and measures players' actions over time, while the ROI calculator quantifies the impact of these changes in terms relevant to the client. For an energy challenge, these would be energy/fuel saved, emissions prevented, water conserved, waste prevented, and trees left standing.

WeSpire bases its ROI calculations on "reliable, third-party academic, government, and nongovernmental sources" (WeSpire 2014c). It can also factor in life-cycle data when appropriate (e.g., reducing meat consumption will also save energy and water from reduced livestock feed).

WeSpire offers both web-based and mobile applications that can be customized to meet a client's needs. It could likely incorporate extrinsic rewards (e.g., gift cards) into the game at the client's request.

According to the company's estimates, WeSpire's platform runs hundreds of engagement projects across 30 customers, and since July 2013, these customers have collectively saved over

$1 million (about $250 per participating employee) while reducing their environmental impact in the following ways:

- Over 4,000,000 pounds of CO_2 avoided
- 3,200,000 kWh saved
- 165,000 gallons of fuel saved
- Over 215,000 pounds of waste diverted
- 3,600,000 gallons of water use avoided (L. Mason, marketing coordinator, WeSpire, pers. comm., September 14 and October 6, 2014)

ECOINOMY

Based in the United Kingdom, Ecoinomy is another workplace-focused program designed to encourage sustainable behaviors among employees. Ecoinomy frames incentivized actions such as double-sided printing in terms of both sustainability and financial savings for the employer. The game aims to create a "virtuous circle of rewards" by rewarding employee behaviors with donations to good causes of their choice (Grbac 2014). Ecoinomy's social media platform is called "the eco.system." When employees complete qualifying actions (e.g., printing in black-and-white instead of color), they log them on this platform and earn virtual currency called e.coins. Employees can also form teams, called guilds, based on a desire to donate their e.coins to the same charitable cause. A leaderboard reports the rankings of the guilds (Fortune 2011).

VERMONTIVATE

Vermontivate is a team-based game that runs for six weeks, during which the players compete to accrue as many points as possible for completing a variety of sustainability-focused actions. The game was originally created by Kathryn Blume, an environmental activist and artist, and Nick Lange, an energy efficiency consultant with the Vermont Energy Investment Corporation (VEIC), which sponsored the 2012 pilot game (VEIC 2014). Audubon and Toyota funded initial technical development (Vermontivate 2014a). The game has also received financial support from numerous local foundations and grantors (Vermontivate 2014b).

Vermontivate is played in teams formed by Vermont towns or schools. People living outside Vermont can join a town team; for example, a resident of Massachusetts with friends or relatives in Vermont could still help them accrue points and win. In 2012, the game attracted 225 participants from 31 towns (VEIC 2014).

A new set of challenges is announced to all Vermontivate players every week. Each week has a different theme: team-building, food, energy, transportation, capital, and future action. Invoking Vermont's agricultural heritage, five fun and whimsical animal game masters announce the weekly challenges (figure 6).

Figure 6. Vermontivate game masters. *Source:* Vermontivate 2014c.

Weekly challenges are ranked as easy, medium, hard, or wildcard (an action created by the player to suit his/her circumstances). An easy challenge might be using reusable grocery bags or turning out the lights, while a hard challenge might be completing a whole-home insulation.

Vermontivate has a fairly complicated scoring system: players can receive anywhere from 1 point for just signing up to 500 points for being selected player of the week. Team scores are calculated by adding up a team's total points and dividing by its number of players. Vermontivate also has a more detailed algorithm intended to calculate the relative "quality" of team performance (Vermontivate 2014d).

Vermontivate is not only about bottom-line energy savings but also about raising awareness and encouraging reflection about environmental problems. The game aims to encourage as much sustainability-focused activity as possible, and the organizers are eager to reward creativity (Vermontivate 2014e). The scoring system seems deliberately flexible in order to encourage and reward such creativity. While the game rewards quantifiable changes such as reducing electricity consumption or vehicle miles traveled, it is equally supportive of actions that are creative, educational, or awareness raising. Thus, in addition to earning points for actions like using reusable grocery bags or combining car trips to save gas, players can also earn them for writing a song related to the environment or assessing whether or not to start a home garden (Vieira 2013).

Additionally, besides earning points for completing challenges, players can also earn them for submitting a Moment of Play, a post to the Vermontivate website of writings, photographs, or films about their actions (50 points each). Points are also awarded for posting sustainability events to the community calendar, or posting a report on an event one has attended.

Extrinsic rewards in Vermontivate are relatively minor, which reinforces the impression that the game is largely about building community, creativity, and environmental awareness. The winning town receives an ice cream party from Ben and Jerry's, and the winning school receives a six-foot teddy bear from the VT Teddy Bear company. There is also a mid-game prize of a free energy audit offered by the Energy Co-Op of Vermont (Vermontivate Blog 2014). Potential winners of the audit are nominated for being good team players, and then one is chosen at random.

Vermontivate has been played three times since its initial launch in May of 2012. After the 2013 game, 75% of players said they wanted to play again, and just 5% said they would not.

According to VEIC, 94–95% of players reported average to above-average understanding of and engagement with climate change and sustainability after playing Vermontivate, compared to 78% prior to playing. In addition, 85–87% of players strongly agreed that Vermontivate helped them feel like they could make a positive change in their life and community.

In the 2014 game, 711 players from all 14 counties in the state (59 towns, and 8 schools) completed 4,673 challenges. The schools division was particularly active in 2014, with many teachers incorporating Vermontivate into their science curriculum and using it to teach reading comprehension and writing. (VEIC 2014; N. Lange, VEIC, pers. comm., December 31, 2014).

Related Game: Earth Hour

Another community-based movement that has expanded to achieve global reach and recognition is Earth Hour, which began in Sydney, Australia in 2007 and spread worldwide by 2008. FortisBC, a utility in British Columbia, has encouraged its customers to participate in this "global awareness campaign" for several consecutive years (FortisBC 2009). The "hour in the dark" occurs on an evening in late March, during which FortisBC encourages its customers not only to turn out the lights, but to

> take it even further and unplug unnecessary appliances, TVs, computers and cell phone chargers . . . . Instead enjoy the time with family or friends over a game or candle-lit dinner. Go for a walk and enjoy the stars. Put a glow stick on your dog's leash and take him along. . . . (FortisBC 2009)

One city in British Columbia, Castlegar, turned Earth Hour into a competition to see which neighborhood could boast the most residents with their lights off. FortisBC committed to monitoring their energy savings (FortisBC 2009).

POWER AGENT

Power Agent was a Swedish pilot project implemented in the spring of 2008 with funding from the Swedish Energy Agency. Two teams, each comprised of a family with teenagers, competed for 10 days to achieve the greatest relative reduction in electricity consumption. Each team lived in a different small Swedish city. An automatic meter reading system collected real-time data on household electricity use.

The game was played on mobile phones. Each day, a boss called Mr. Q announced a mission to all players (called power agents) via their phones. The mission lasted several hours, usually from 5 p.m. to 10 p.m. (hours of generally heavy electricity use). Each mission had a theme: lamps, kitchen, entertainment equipment, heating, washing and cleaning, and showering and bathing. Players had to cooperate with family members to reduce their electricity use; they received clues through their phones such as "Unplug wall sockets to prevent the DVD or the stereo from using electricity when not in use." At the end of the game, all players received a summary from Mr. Q on their phones, which included not only their 10-day performance record, but also the potential energy and financial savings if they continued the same behaviors over an entire year (Gustafsson and Katzeff 2009).

JOULEBUG

JouleBug, by Cleanbit Systems, is an application designed to promote sustainability-oriented actions and behavior changes. The app aims to make it easy, fun, and gamelike to save energy, water, and other resources. The user, playfully called a JouleBug, downloads a free app to a smartphone, tablet, or computer, and sets up a profile. The profile asks for basic data about the user's home (square footage, age, type of heating, and so on) to improve the accuracy of energy and financial savings calculations. JouleBug can connect to and import data from some utility accounts. The app and website both have a professional and appealing aesthetic, and are clearly designed for a generation of young users accustomed to sleek and attractive app designs and graphics.

After downloading the app and filling in as much or as little of the profile information as you can or want to (one can always return later), you are ready to play JouleBug. The basic process is simple: JouleBug offers at least 94 separate achievements, or actions that contribute to some aspect of sustainability across multiple categories (see Appendix A). Users can sort achievements by name, location (home, office, transportation), cost (free to most expensive), benefit (water, energy, land, oil), or frequency (daily, weekly, monthly, special). This allows them to identify those achievements most relevant to their lifestyle or interests.

As shown in figure 7, achievement descriptions are whimsical, bordering on silly.

Figure 7. JouleBug achievement prompt. *Source:* JouleBug 2015a.

When you complete an action such as replacing a burnt-out incandescent light bulb with a CFL, you "buzz" that action by clicking on a little icon that represents it. These icons are called pins, and, for some users, may recall Girl Scout or Boy Scout achievement badges. To earn these pins, you have to buzz them a requisite number of times. For example, every time you use your reusable mug or grocery bag, you buzz the associated pin. Occasionally, for a major action (such as caulking all the leaks in your house), you earn the pin with only one buzz. Although they have no real-world value, the pins are fun and aesthetically appealing (figure 8), tempting players to collect more and more of them by completing more and more sustainability actions.

Figure 8. JouleBug pins. *Source:* JouleBug 2015b.

Buzzes also earn points that are correlated with "the impact the action has on your wallet and the environment" (iTunes Preview 2015). The more you repeat an achievement (using your reusable mug every day, putting on a sweater instead of turning up the thermostat), the closer you get to earning a virtual trophy for your trophy case. The more trophies you earn, the higher you climb up the JouleBug leaderboard, potentially outdoing your friends, neighbors, coworkers, and so on. Your profile tracks your points, history, trophies, and savings.

JouleBug quantifies the yearly results of each achievement pin in terms of relevant savings: usually in terms of kWh, kilograms of CO_2, or dollars. Sometimes the savings are materials-based: pounds of paper saved by opting out of credit card offers or catalogs, gallons or bathtubs-full of water saved by shorter showers. Sometimes the savings are (humorously) intangible: 15 headaches and 250 stressful days saved by sharing the road with bikes and pedestrians. One of JouleBug's stated objectives is to get people thinking about sustainability. Educating users about the real-world impacts of seemingly small actions is certainly a step in this direction.

Although an individuals or households can use JouleBug to track their own sustainable behaviors in isolation, the earning system of pins, badges, and trophies is clearly designed to encourage friendly competition. This is where the social aspect of JouleBug comes into play. JouleBug is set up so that the buzzing of a pin can automatically be shared through Facebook or Twitter ("for social media bragging rights"), although you do not have to use any social media platform (JouleBug 2015c). To engage the competitive aspect of the game, JouleBug users can join an existing challenge as an individual or member of a team, or can create their own challenge in their neighborhood or community. The social media connection also enables users to follow their friends, and hopefully be inspired and motivated by their achievements.

JouleBug offers both free and fee-based products for groups or organizations. Individual accounts are free, as are small-group Nests, which facilitate a small-scale competition. Although JouleBug does not offer tangible prizes, challenge organizers can choose to do so, for example, by inviting players to exchange pins for gift cards. Community accounts also include an analytics report with data on how the group performed: most frequent achievements, user count, buzz count, time-of-day usage statistics, and so on, all of which can help the organizers to measure the impact of the challenge.

JouleBug can also host larger-group, fee-based contests, called (in increasing order of size) Swarms, Hives, and Colonies. The last of these is a customized, branded app with localized content rather than the standard JouleBug interface.[4] Fee-based products can highlight the achievement categories and priorities most important to the client organization (e.g., water, waste, or transportation). Notifications can be used as triggers to remind members of important events like peak energy-demand periods.

Related Game: Lockheed Martin Carbon Footprint Reduction

We note that Lockheed Martin is developing a solution called the Carbon Footprint Reduction Game that, like JouleBug gives players in-game rewards for completing such tasks as installing efficient light bulbs and programmable thermostats (Lockheed Martin 2014).

ROCK THE BULB

Rock the Bulb, by Washington State's Puget Sound Energy (PSE), was a multi-event campaign that ran from July through October of 2009 (Puget Sound Energy 2009). During the four months of the campaign, PSE held 16 weekend events featuring a free light bulb exchange and energy education. These events were held at local hardware stores where PSE's residential electric customers could exchange up to 10 incandescent bulbs for CFLs. PSE also used Rock the Bulb as a data-collection opportunity. Customers receiving CFLs were required to give PSE employees their address and utility account number; this allowed PSE to track the impact of the CFLs on the household's energy savings.

The second major part of the campaign was a contest called Be an Energy Rock Star, in which PSE customers competed to reduce their household energy use during the month of October. The winning family received a $7,500 Lowe's gift card for reducing its consumption by 94%, beating the runner-up by 8%. The winners' actions were probably too austere for long-term sustainability: they included unplugging all but the most essential appliances, using solar flashlights inside their darkened home, and cooking outside. Still, these draconian measures captured media attention (Bellevue Reporter 2009).

Ultimately, PSE beat its CFL-distribution goal by 25%. The utility distributed 511,543 bulbs to 25,000 households and gave away $45,000 in total prizes (BusinessWire 2009). Rock the Bulb also won the Silver Anvil Award from the Public Relations Society of America and helped PSE win the title of ENERGY STAR® Partner of the Year (ENERGY STAR 2014).

Related Game: Palo Alto Ugliest Lighting

Light bulbs were also the focus of an "Ugliest Lighting" contest run by the City of Palo Alto, California in February and March of 2012. Contestants submitted photos of their worst incandescent or halogen lights, whose ugliness was judged according to five criteria: number of lights in the photo, inaccessible locations, outdated styles, wattage amount, and hours of daily use. The winner received $400 to be used toward certified LEDs (Palo Alto 2015). A primary

[4] JouleBug has developed customized apps for the city of Houston, the city of Austin, the University of Texas, and Texas A&M University.

goal of this contest was to raise awareness of Palo Alto's rebates for various energy-efficient home upgrades, including not only LED lights but also ENERGY STAR appliances, solar water heating systems, and solar panels (Selverston 2012).

REDUCE THE USE IN DISTRICT 39

Reduce the Use in District 39 was a pilot energy-saving competition for 161 households in 6 Brooklyn neighborhoods that ran from August 2010 to August 2011. The game launched after a pre-pilot competition involving 40 households that showed a 6% average reduction in energy use. NYSERDA initiated the program; ConEdison and New York City Councilmember Brad Lander joined as partners (Bard and Kessler 2011). ConEdison was responsible for reporting monthly usage, participant outreach, and prizes. NYSERDA performed data analysis, contributed to the updates and newsletters, and was the overall manager of the competition. The councilman's role is described below.

Households competed in two categories: smallest energy footprint and greatest reduction as compared to the preceding year. Rather than major changes like retrofits, new insulation, or appliance replacements, participants were encouraged to use simple tricks and smart practices to lower their energy consumption. These included actions such as turning off lights and appliances when not in use, reducing the use of ovens, using programmable thermostats, and closing windows and shades on hot summer days (Hussain 2014).

Participants received monthly updates that reported per-capita kWh usage based on the household's monthly ConEdison bill. The updates also contained seasonally appropriate energy-saving tips. The competition shared further information via a Facebook group (Bard and Kessler 2011).

The monthly update gave the household's ranking in relation to the other competitors in the two contest categories. Reduce the Use added a fun new dimension to this strategy by including Councilman Lander's ranking on every household's monthly report. For example, during one month Lander was 67th in the smallest footprint competition and 148th in the biggest reduction category.

A newsletter also accompanied each month's update, in which Lander wrote "Brad's Blog," updating his constituents on his own energy-saving improvements and challenges. For example, he reported on efforts to reduce vampire plug loads in his home, and on the addition of his daughter's energy-hungry fish tank. The newsletter also gave useful information on topics like appliance recycling and home energy tax credits.

Contest winners achieved impressive results: the winner in the biggest reduction category reduced their kWh/person usage 49% from the previous year. The winner of the smallest footprint category used a yearly average of 213.8 kWh/person. Overall, participating households reduced energy use by 4% (Bard and Kessler 2011). The program did not track the persistence of savings beyond the pilot period.

Related Game: Gainesville Green

The idea of ranking participants' energy use is also central to another solution we looked at, called Gainesville Green. Its premise is simple: search for your home on a map of Gainesville, Florida and learn how your energy consumption compares to that of your neighbors and others in the city. A house colored green is doing well: it has small energy bills relative to others; yellow houses are average, and red houses have high bills and high consumption. Houses are ranked according to their raw consumption of electricity, gas, and water. They are also ranked according to their carbon emissions, which are calculated according to an algorithm using EPA conversion data. Because houses vary so much in size, there is also an option to normalize your ranking based on energy usage per 1,000 square feet of space (Gainesville Green 2015a; 2015b).

SMECO ENERGY SAVINGS CHALLENGES

SMECO, the Southern Maryland Electric Cooperative, has hosted two recent electricity-savings competitions, each lasting three months and designed to encourage reduced electrical energy use as compared to the same time period in the previous year. First, the SMECO Energy Savings Challenge ran from April to June of 2013. It challenged participants to reduce energy use by at least 3% compared to the same three months in 2012. Second, the SMECO Hometown Spirit Energy Savings Challenge ran from November 2013 through January 2014. This winter challenge included both individual and team competitions: the individual goal was to reduce electricity usage as much as possible as compared to the same months during the previous winter. For teams, the goal was to achieve the greatest per-person and cumulative electricity savings during the three-month contest period. This was calculated by dividing total team savings by the number of team members (SMECO 2014).

The platform for the springtime challenge was Facebook, while the platform for the winter challenge was Opower's Facebook app (see below) branded with SMECO's logo. For both challenges, use of a Facebook account was required in order to participate (SMECO 2013; 2014). For the winter challenge, Opower calculated energy use reduction and SMECO identified the winners (SMECO 2013). SMECO used email, Facebook posts and ads, digital banners, the SMECO web page, and promotional flyers to promote both challenges (Zandt 2014).

The social normalization potential of these games seems to have been underused. Although the SMECO website has a home energy reports link where customers can see their usage patterns and compare their usage to similar homes (based on proximity, size, type of heating), households could not compare themselves to other contestants until the end of the spring challenge. During the winter challenge, players could only compare themselves to members of their own team.

The springtime challenge offered various prizes. First place won a $1,000 Sears gift certificate for the purchase of any ENERGY STAR certified Kenmore appliance, two second-place winners received energy efficiency kits valued at $200, and eight third-place winners won energy efficiency kits valued at $45. Kits contained weather stripping, CFLs, faucet aerators, and more. For the winter challenge, individuals (one from each team) with the greatest percentage reduction in electric use received a $200 Visa gift card. (Compare this to the energy-focused prizes awarded in the spring challenge.)

Organizers report that 201 customers participated in the springtime challenge, and 76 (or almost 38%) achieved the 3% reduction goal. The top 11 achievers saved 27% compared to their previous-year baseline, and the first-prize winner reduced his use by 54% (SMECO 2013). Only 22 customers participated in the winter (Hometown Spirit) challenge, but the top 4 saved more than 30% compared to their previous year baseline. Organizers hypothesized that launching the challenge during the holiday season—in contrast to the springtime launch of the first SMECO challenge—might have compromised participation (Zandt 2014).

Participants in the springtime challenge saved a total of 50,098 kWh excluding customers who used more energy compared to their 2012–2013 baseline, and 29,233 kWh including those customers. The winter challenge savings amounted to 16,864 kWh excluding customers who used more energy compared to their 2012–2013 baseline, and 2,056 kWh including those customers (Zandt 2014). We found no data on the persistence of savings beyond the challenge periods.

KANSAS TAKE CHARGE CHALLENGE

The Kansas Take Charge Challenge was initiated by the Climate and Energy Project, a Midwest nonprofit working to reduce greenhouse-gas emissions through the use of energy efficiency and renewables. Six towns competed to outperform each other in energy savings from April 2009 through March 2010. A second challenge involving 16 Kansas towns took place in 2011. The same model was subsequently used in a competition called the Mokan Challenge that involved four cities in Missouri and Kansas.

The six original participating towns included communities of different types: urban and rural, large and small, and geographically diverse. The Climate and Energy Project recruited local leaders to serve as organizers and representatives of the competition, drawing on churches, schools, low-income neighborhoods, Chambers of Commerce, the agricultural sector, and so on. An estimated 10,000 people participated in the challenge, more than 10% of the eligible population in the six towns (Fuller et al. 2010).

The Kansas Take Charge Challenge involved two competitions, one based on actual kWh savings during the year of the contest (2009–2010), and the other based on predicted long-term savings stemming from measures like upgrading appliances and completing home energy improvements. In the first competition, since the competing towns were so different, they were compared not with each other but with geographically and demographically similar towns that were not participating in the challenge and therefore making no conscious effort to improve their energy efficiency (Fuller et al. 2010).

A major component of the long-term savings competition was a lighting challenge. Players were encouraged to replace as many incandescent bulbs as possible with CFL bulbs, and to log these replacements on a website where they could track their progress in relation to other players and towns. The website presented real-time data and allowed players to see both individual results (player names and the number of bulbs they had replaced) and town rankings.

Since many residents of the participating towns did not own computers, word-of-mouth became just as important as the challenge's website. Local media—particularly radio and

television—helped promote the contest and raise awareness of its successes by showcasing personal stories of energy saved and homes audited (Fuller et al. 2010).

Other actions that were factored into each town's predicted long-term energy savings were the installation of programmable thermostats, enrollment in the Weatherization Assistance Program for eligible homeowners, and use of appliance and HVAC rebate programs sponsored by local utilities. Households were also encouraged to take advantage of home energy audit offers. The predicted long-term energy savings of these actions contributed to each player's individual score and to each town's overall score (Fuller et al. 2010).

In addition to these specific recommended actions, towns were encouraged to be creative and to devise their own energy-saving challenges. One school, for example, had its students compete in a Halloween "vampire hunt," during which they identified (and presumably modified) electricity-draining vampire loads in their homes. The winning classroom received a pizza party as a reward.

Although the winning communities also received prizes, Program Director Jackson believes they would have been just as competitive without extrinsic rewards (Fuller et al. 2010).

Relative to its control town, the winning town in the kWh competition reduced its energy consumption by 5.5% during the course of the year. The winning town in the second competition saved an estimated 3.7 million kWh per year from longer-term changes such as weatherization and appliance upgrades (about 2.5% of the town's total electricity use). Overall, the participating towns saved a combined 6 million kWh in one year, plus an additional predicted 7 million kWh spread over many years from long-term measures (Climate and Energy Project 2010). There were also 112 energy audits and 300 new households joining the Weatherization Assistance Program as a result of the contest (Fuller et al. 2010).

The challenge also resulted in unanticipated savings. For example, in one school district, the superintendent realized that two physically identical schools were using drastically different amounts of energy. After adjusting janitorial practices and thermostats in the less-efficient building, that school ended up saving $42,000 annually (Fuller et al. 2010). Such a discovery and change might not have occurred without the impetus of the competition.

Across the six towns, the program cost approximately $170,000 including about $75,000 of staff time, $75,000 in prizes and other direct expenses, and $20,000 in costs incurred by participating local utilities (Fuller et al. 2010).

ENERGY SMACKDOWN

Similar to the Kansas game, Energy Smackdown was a year-long pilot competition held in 2009 between three teams from the Boston-area neighborhoods of Arlington, Cambridge, and Medford. Approximately 100 households joined the teams, vying in both individual and team competitions. Saving electricity and heating fuel were two of the six areas in which players tried to reduce CO_2 emissions. Program staff estimate that, on average, participating households reduced annual electricity use by 14% and annual heating fuel consumption by 14%, although it

is unclear how these estimates were derived. The program cost about $200,000 (Fuller et al. 2010).

CHICAGO NEIGHBORHOOD ENERGY CHALLENGE

The Chicago Neighborhood Energy Challenge was a six-month pilot program launched in November 2013. It was developed by the Mayor's Innovation Delivery Team, an initiative funded by Bloomberg Philanthropies. It was also part of the Retrofit Chicago Residential Partnership, a program working to improve energy efficiency in both single- and multifamily housing, and the Sustainable Chicago 2015 initiative (City of Chicago 2014b). Several community organizations collaborated on implementing the challenge, including the Hispanic Housing Development Corporation and its subsidiary, Affordable Community Energy (ACE) (City of Chicago 2013).

Residents of seven multifamily buildings in two neighborhoods competed to achieve the greatest reductions in their use of electricity, gas, and water, with winners declared both monthly and at the conclusion of the six-month period. The buildings' combined 500 units housed approximately 750 residents, many of them low-income senior citizens, or disabled (City of Chicago 2013). Participation was completely voluntary, and it was estimated that approximately 600 residents chose to compete (City of Chicago 2014a).

The emphasis of the challenge was on behavioral modifications within existing home environments rather than technological fixes such as appliance replacement. As Wyllys Mann, ACE's director of operations, explained, "it's not about a new refrigerator . . . it's about using what's in your house, better" (Elliott 2013). Each month, residents received a new workbook guiding them through recommended energy-saving actions, ranging from reading their utility bills to vacuuming their refrigerator's cooling coils. Because of the workbooks, the program did not rely on online communication, a potential advantage for older and lower-income residents. The challenge also relied on word of mouth and local radio and television.

Being online did add a dimension to the challenge, however. Players were given a personal web page that automatically imported and posted their energy usage data (only they could see this). They could track their usage compared to preceding months as well as to the same month in the previous year (figure 9).

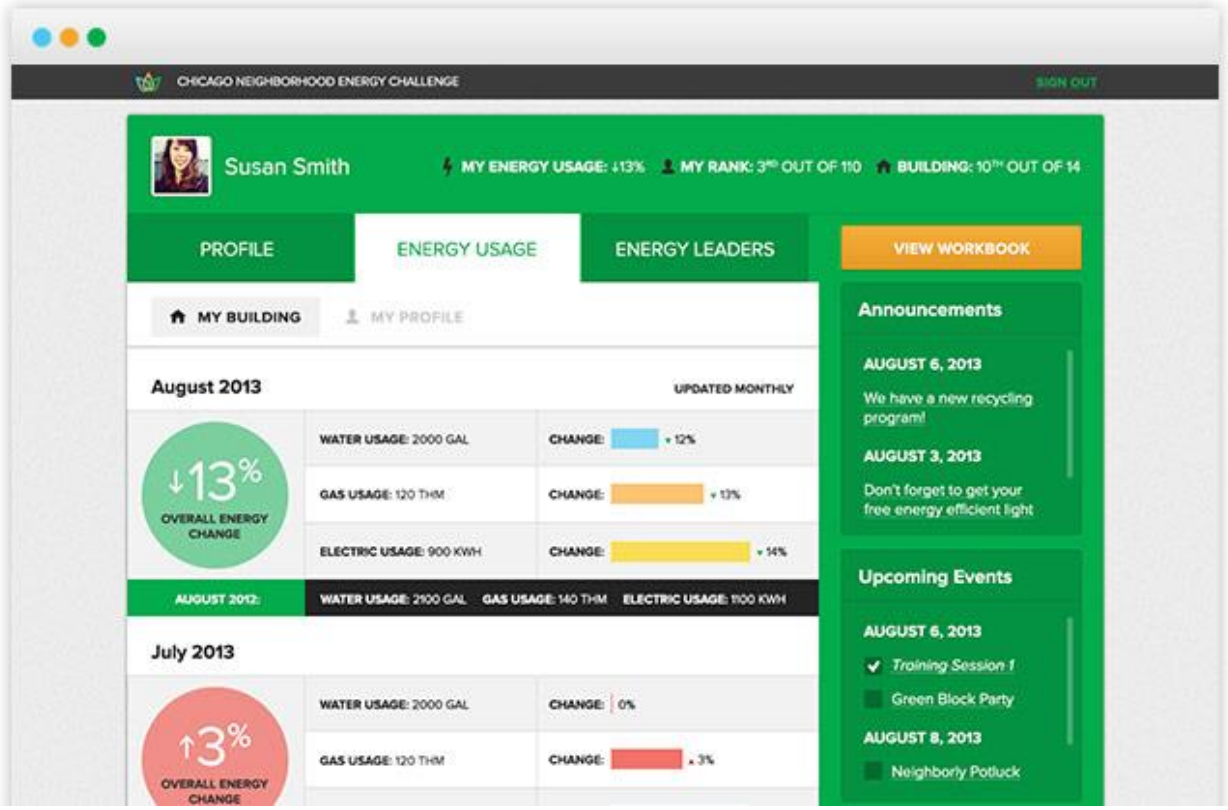

Figure 9. Chicago Neighborhood Energy Challenge personal web page. *Source:* Chicago Challenge 2014.

As shown in figure 10, participants could also compare themselves to other players and compare their building's performance to that of other buildings (Chicago Neighborhood Energy Challenge 2014).

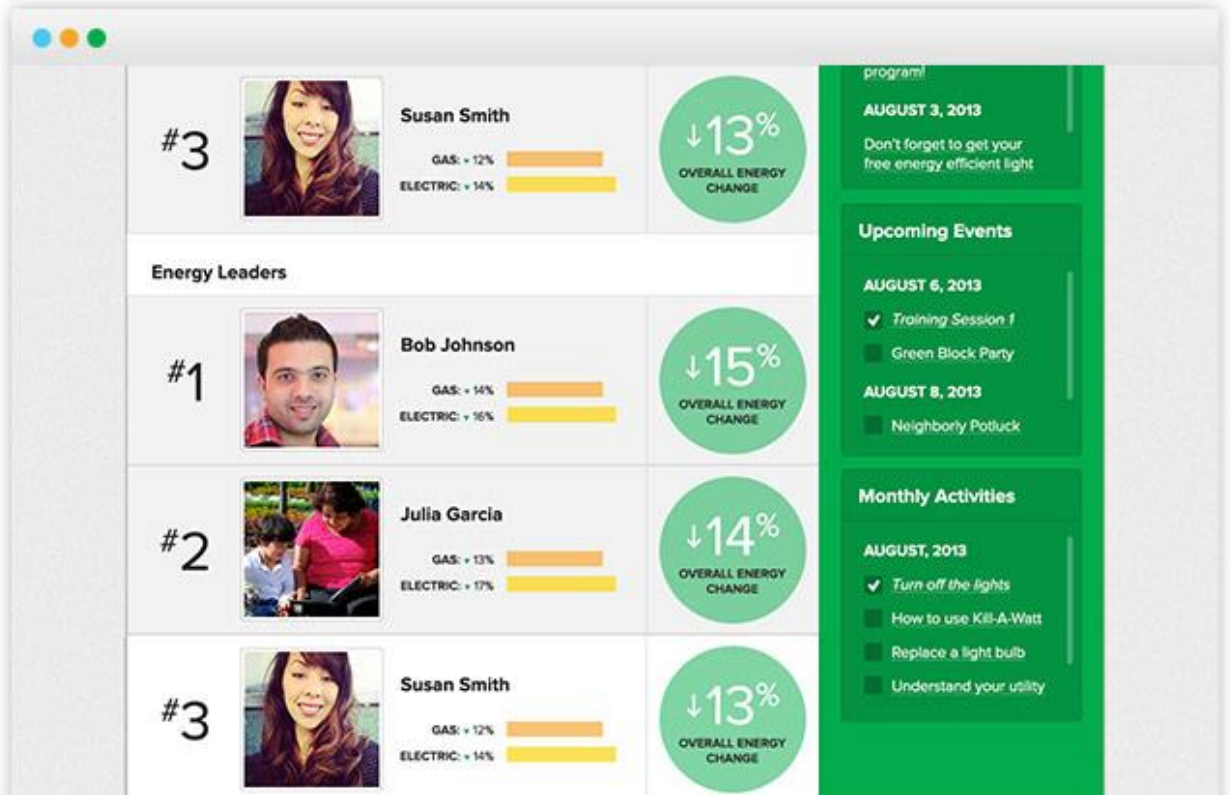

Figure 10. Chicago Neighborhood Energy Challenge comparison page. *Source:* Chicago Challenge 2014.

Like the Kansas Take Charge Challenge, the Chicago Neighborhood Energy Challenge effectively recruited and employed on-the-ground local community leaders who took responsibility for answering questions and driving the message home to their neighbors (Chicago Neighborhood Energy Challenge 2014). These building residents were able to connect directly with their neighbors, which likely contributed to the relatively high rate of participation. Over the course of the 6-month challenge, participants attended approximately 36 workshops, pizza parties, and other events designed to educate them about energy savings through simple behavior changes.

Overall, the challenge awarded more than $45,000 in prizes. Buildings with a higher rate of participation had a better chance of winning the $25,000 grand prize that they could re-invest in an energy-related project. The second- and third-place winners won $7,500 and $3,500 for their buildings; the top-saving individuals won $200 and $100 (City of Chicago 2014a). Monthly prizes included passes for bike sharing, local museums, and ice-skate rentals at Millennium Park (City of Chicago 2013).

Although the Chicago Neighborhood Energy Challenge's initial goal was a 5–10% reduction in electricity, gas, and water usage, the results were far better: the buildings achieved a 20% reduction across all three categories as well as a $54,000 savings in utility bills (average of $110 per family). This 20% reflects a 5% savings on electricity, 10% on gas, and 45% on water. The

winning building achieved 34% savings overall, second place saved 22%, and third place saved 19% (City of Chicago 2014a).

CARBON4SQUARE

Carbon4Square was a competition involving 85 commercial office buildings in the Portland area in 2010 and 2011. Any building over 20,000 square feet was eligible to participate. The contest had begun as the Office Energy Showdown in 2006 and became the Kilowatt Crackdown in 2012 (Building Performance Partnership 2014).

The Carbon4Square Building Efficiency Challenge officially began in October 2010. The challenge was sponsored by the Building Owners and Managers Association of Portland (BOMA) and was also supported by partnerships with the Northwest Energy Efficiency Alliance (NEEA), the Best Business Center, the City of Portland's Bureau of Planning and Sustainability, the EPA ENERGY STAR program, the City of Portland's Office of Transportation, and the Energy Trust of Oregon (Carbon4Square 2014a, 2014b).

The name Carbon4Square refers to the four main drivers of carbon emissions: "watts, water, waste, and wheels":

> Watts: emissions generated through the energy in building operations. Water: emissions generated through the energy used in pumping, treating, moving and disposing of water. Waste: emissions generated through the consumption of products and removing, hauling and treating of waste. Wheels: emissions generated in getting people, goods and services to and from buildings. (Carbon4Square 2014a)

The goal of the competition was to earn as many points as possible out of a maximum total of 100, based on reducing emissions across the four categories of watts, water, waste, and wheels. Participants tracked and recorded their emissions in these four categories during both years of the contest, and performance assessment was largely based on improvements from one year to the next. Buildings also had the option of participating only in the energy—watts—category.

Carbon4Square buildings had to complete benchmarking during the first few months of the competition in order to establish a baseline for comparison after making improvements. Much of a building's score was tied to improvements in its EPA benchmark rating and ENERGY STAR rating. Participating buildings were assigned a 4Square Coach, a liaison to the program (and NEEA consultant) who helped them with benchmarking and data collection. Competitors could track their progress through an online status board, but this showed only whether they had completed basic contest requirements like benchmarking, and not actual building performance data.

To incentivize timely benchmarking, Carbon4Square offered scoping studies valued at $2,000–3,000 to the first 50 buildings to submit their benchmarking scores. Scoping studies included a building walk-through, interviews, and assessment of ways to improve performance. This highlights an important theme of Carbon4Square: whether or not a building was ultimately a contest winner, the program provided numerous opportunities for learning and performance

improvement, with the goal of changing operating procedures over the long term, not just during the one-year contest period.

Other examples of Carbon4Square's emphases on learning and long-term behavior change included online instructional resources, community resources, and a sustainability playbook. Online resources included a list of best practices. (See Appendix A.) Additionally the resources and support section of the website contained numerous links to information on benchmarking and on energy efficiency and transportation best practices.

Another notable learning opportunity was the Carbon4Square Playbook: "a quick, strategic sustainability plan for your building. The intent of the Playbook is to help you think through and prioritize your sustainability initiatives over the next 2-3 years" (Carbon4Square 2014e). Participants were to use a Playbook template and work with their 4Square coach to outline their goals according to the watts, water, waste, and wheels framework.

Data were collected through the end of December 2011 and submitted through March 2012 (Carbon4Square 2014c). A panel of jurors evaluated and ranked the contestants using their emissions scorecard and their ENERGY STAR ratings. The grand prize winner—KG Investment Management in 2011—was designated "The Carbon Samurai" and awarded a trophy of the same name (Building Performance Partnership 2014; Carbon4Square 2014d). There were several other award categories as well that did not include tangible prizes.

As the contest's website advertised, the rewards of participation also included the recognition and satisfaction of demonstrating a commitment to sustainability, personalized coaching, technical support for ENERGY STAR benchmarking and other audits, the development of a sustainability playbook for the future, access to educational opportunities, and inclusion in Portland's sustainability community.

THE KUKUI CUP

The 2011 Kukui Cup was an energy-saving competition for undergraduate students living in dormitories at the University of Hawaii at Manoa. Planning for the Kukui Cup began in 2010 among a group of researchers at the university led by Philip Johnson. He and his team were aware of over 150 previous collegiate energy competitions, and they designed the Kukui Cup as a pilot program for students and as a research project to assess the efficacy of collegiate energy competitions generally (Johnson et al. 2013). The Kukui Cup has been played at the University of Hawaii every year since 2011 and has now expanded to Hawaii Pacific University (Hawaii Pacific University 2012).

The inaugural Kukui Cup took place in the fall of 2011 and lasted three weeks, from October 26 through November 7 (Brewer 2013). The researchers developed two open-source software infrastructures for the game: Watt Depot, which they used to collect, store, analyze, and visualize electricity data, and Makahiki, a platform (including a website) for the competition that could eventually be customized for other organizations' energy challenges. Figure 11 shows a personalized Makahiki home page.

Figure 11. Kukui Cup individual player home page. *Source:* Johnson et al. 2013.

The competition involved 4 dormitories of 13 floors each, all built in the 1970s. Each building housed 270 students, for a total of 1,080 potential participants in the competition (Brewer 2013). Ultimately, about 400 students competed (Johnson et al. 2013).

Teams of students, divided by dormitory floors, competed in two ways: first, to consume the lowest absolute amount of electricity as a floor (the Go Low competition), and second, to accumulate the most points based on their completion of a variety of sustainability-focused activities (the Get Nutz competition). Only individuals could earn points, but they could pool their points with those of their teammates.

The competition had three rounds, each lasting one week. Players could compete in one, two, or all three rounds. Each round was a standalone competition, so that it was not a disadvantage to compete, for example, only in Round Two. However, there was also an overall competition that rewarded players who participated throughout the three weeks.

Prizes were awarded to the winners of each round, both to the dorm floor that saved the most energy and to the individual who scored the most points. Raffles also served as incentives in each round: players earned one raffle ticket for every 25 points and could choose which raffles to enter based on potential prizes and their chances of winning as calculated by Makahiki.

In the energy-saving competition, teams of students competed to reduce their kWh of electricity use to the lowest level. The team with the lowest absolute electrical consumption in each round won. (All the teams had head starts: given Hawaii's temperate climate, the buildings did not have central heating or air conditioning.) Usage was measured at approximately 15-second intervals using Shark 200S meters from Electro Industries/Gauge Technologies (Brewer 2013). These meters had online connectivity, allowing both researchers and students to see the data in real time (figure 12).

Figure 12. Kukui Cup energy usage feedback. *Source:* Brewer 2013.

The points-based competition was designed to influence student behavior and to improve energy and environmental literacy (a priority of the Cup's designers). Students earned points by completing as many actions as possible from a list presented on the Makahiki website. The website recorded students' actions and gave them instant feedback in the form of points.

There were three types of actions: activities, defined as "one-time, verifiable actions," commitments, defined as ongoing, non-verifiable behaviors, and events, for which attendance was required at a particular place and time (figure 13). There were 62 possible activities, 21 commitments, and 24 events (Brewer 2013, 60). (Some are listed in Appendix A.) Events included a workshop on environmental careers where students could learn about various energy and environment majors. This was one example of the Kukui Cup's emphasis on improving energy literacy (Johnson et al. 2013).

Figure 13. Kukui Cup activities, commitments, and events. *Source:* Brewer 2013.

Activities earned between 5 and 50 points depending on their level of difficulty. For example, one could earn 5 points for liking the Kukui Cup on Facebook or tweeting about it. One could earn 10 points for watching a video about solar energy or replacing an incandescent light bulb with a CFL bulb. A more challenging activity, estimating the total daily energy consumption of one's room, earned 35 points. One had to complete easier tasks before advancing upward to harder ones.

Ultimately, despite the competition's many successes, the experience of Philip Johnson and his team with the inaugural Kukui Cup led them to question the design and assumptions of most

collegiate energy competitions. They concluded that differing dorm configurations and team sizes could prejudice fair rankings, baseline values might be grossly inaccurate, savings might be inflated, teams that were already energy conscious before the competition were at a disadvantage, and sustained behavior change was almost never measured and might not even occur (Johnson et al. 2013).

Related Games: Other Campus Challenges

As Johnson and his team noted, many other campuses besides the University of Hawaii run energy challenges. One example is the Power Down Challenge at the University of Pennsylvania. Students compete in three separate contests to achieve the greatest reduction in energy use: in dormitories, in non-residential university buildings, and among fraternities and sororities (Penn 2014b). In each category, the winning building receives a $750 prize, and any building with a 10% reduction receives $250 (Penn 2014a).

Campus challenges are also held at the national level. For example, Campus Conservation Nationals (CCN) is a competition sponsored by the U.S. Green Building Council, Lucid, the National Wildlife Federation, and the Alliance to Save Energy (CCN 2015a). Colleges and universities throughout North America are invited to compete for the highest percentage reduction in electricity and/or water use. Schools sign up in the fall and then choose a three-week period during the spring in which to hold their competition.

CCN involves two models: individual and group. In the individual model, buildings on the same campus compete against each other. In the group model, schools compete against peer institutions in their region (CCN 2015b). CCN offers a wealth of information and support to students who want to participate in the competition, including a behavior change guide (CCN 2015b).

One other variation on the campus challenge model deserves mentioning: the Michigan State University Green League. Unlike most campuses challenges, this one targets university employees, not students. Teams of players complete sustainability challenges in the workplace to earn points. Challenges include recycling toner cartridges and posting educational signs in the office. At the end of the season, which may last about a month, the highest scoring team wins $1,000, second place wins $750, and third place, $500 (MSU 2015a; 2015b; 2015c).

BEAT THE PEAK

Beginning in 2013, Minnesota Valley Electric Cooperative (MVEC) customers signed up to be notified by email, text, or phone one day ahead of peak-demand summer days. There were approximately 11 Beat the Peak event days that summer, with each event lasting 4 to 5 hours, generally between 4:30 and 9:30 p.m. Customers who were most successful in reducing their usage were eligible to win cash prizes at the end of the summer (over $25,000 was awarded). The event was repeated in the cooler summer of 2014 when over 1,700 MVEC customers participated during 3 peak events. Participants formed 29 teams, including 11 representing elementary schools. MVEC is planning another Beat the Peak Energy Challenge for the summer of 2015.

Beat the Peak features both individual and team competitions, with monetary rewards increasing in size according to the number of team members. There are three team-size categories: 5-10 players, 11-25 players, and over 25 players (MVEC 2014b). Team energy savings (as a percentage of reduced kWh) are calculated by combining the savings of all members.

Before the launch of the first Beat the Peak challenge, MVEC put up a webpage to explain the program and illustrate to customers the many reasons they should participate. The page features four fictional characters who represent the benefits of joining the competition and who clearly reflect MVEC's segmented target audience. Ellie is a busy mother of four who forms a team with her church to win the $7,500 prize, which the church would use to buy a new sound system. Chuck is an ultracompetitive bowler who forms a team with more than 50 people—reaching them through Facebook and Twitter—because "the thought of someone else winning the cash was more than he could stand." Robert is a frugal energy enthusiast who already checks his household's energy use each day online; he plays as an individual mainly for educational reasons. Finally Ed and Deb are a retired couple not interested in winning money but wanting to do their part (MVEC 2014a). The Beat the Peak website also features a page listing the "Top 10 Ways to Beat the Peak" (see Appendix A).

The prize-winning teams in the summer of 2014 represented a neighborhood of families in need, a local club, and a local elementary school. Customers saved approximately 13 megawatt hours over 3 peak events of 4 hours each (MVEC 2014c).

Related Game: DRIVE

Another gamified solution aimed at reducing peak energy use has been developed by Ikehu, a startup based in Hawaii named after the Hawaiian word for energy. The company's Demand Response IncentiVE (DRIVE) platform encourages utility customers to shift their power consumption to off-peak times. Players participate by downloading a mobile app to their smartphones and registering with their utility. During a peak-demand event, the utility sends a text message inviting customers to shift their power consumption in exchange for points that are redeemable for airline miles (Ikehu 2015).

BIGGEST ENERGY SAVER

The Biggest Energy Saver contest was a small-scale pilot competition that took place from September through November of 2011 in San Diego. About 200 households competed against each other to achieve the greatest reduction in energy use. The contest was developed by Grid 21, a nonprofit working with electricity customers to make better use of smart meter data (SDG&E 2014).

Each home's energy use during the three months of the contest was compared to the same three-month period of the preceding year. Recommended energy-saving actions included weatherization of doors and windows, air sealing, adjusting thermostats, and changing to more efficient light bulbs (Perez 2011). The players monitored their energy consumption in real time using devices that were integrated with a social media platform, so that results were instantly broadcast to all players. The data devices were developed by Tendril Networks and distributed to players by San Diego Gas and Electric (SDG&E), while the social media application was developed by Simple Energy.

Throughout the competition, raffles awarded players with gift cards and iPads. The grand-prize-winning couple won a laptop by reducing their energy use by an impressive 46% for a family of three. The average savings of players who used Simple Energy's gamified platform along with the Tendril automated control device was about 20%. By comparison, those who used only the Tendril devices saved 9% (SDG&E 2014).

SAN DIEGO ENERGY CHALLENGE

During the summer of 2012, SDG&E launched another contest, the San Diego Energy Challenge, in collaboration with Simple Energy**.** This challenge was funded by a DOE grant designed to encourage better use of smart grid data (DOE 2012). It involved 42,000 households in saving energy and responding to peak events.

As in the Biggest Energy Saver contest, players in this challenge had their daily energy use compared to days during the previous year with similar weather. They earned points for each day (called a Saver Day) when they used comparatively less energy. Anyone who earned a Saver Day was eligible to win a gift card from that day's raffle and to enter monthly drawings for iPads. Players also earned points by recruiting friends to join the competition.

Some participants played on behalf of local middle schools. Students in these schools were also encouraged to participate; the winning school recruited 69% of its population. Schools ultimately won $26,500 in prizes (SDG&E 2013).

Using their SDG&E account website, players could see a graph of their hourly, daily, and monthly energy use and check how their friends (and local schools) were doing on various leaderboards (Reguly 2013).

Simple Energy has subsequently developed a personalized dashboard for use in similar energy challenges. Players can see where they stand on a leaderboard and how their consumption compares to others in their community. The dashboard can also show an appealing, colorful picture of a house with tags attached to major appliances and systems (water heater, HVAC) indicating how much they are costing the user per month (Simple Energy 2014c).

For the San Diego Energy Challenge, SDG&E estimated 6% overall energy savings during the summer and 2% during the winter. On-peak demand reduction was 2.2% (Reguly 2013).

OPOWER SOCIAL ENERGY APP

The Opower social energy application is a web-based tool available for smartphones, developed in partnership with Facebook and the Natural Resources Defense Council (NRDC). According to Marcy Scott Lynn, who leads sustainability programs at Facebook, "The app is intended to make saving energy social and create a conversation about the merits of energy efficiency that doesn't currently happen" (Alliance 2012). Opower, NRDC, and Facebook launched their social energy app on April 3, 2012.

The user can log into Opower directly through a Facebook link on Opower's website, or avoid Facebook and work with Opower only. The non-Facebook option takes you through a simple interface that asks basic questions about your energy bills and usage. The Facebook option is

much more streamlined and user friendly. It walks you through four steps: signing in, creating a home profile, connecting to your utility, and inviting five or more friends to compete.

With its Facebook integration, the Opower app is geared toward a younger audience that is fully comfortable with social media and the sharing of personal information online. It may deter some users who care about energy efficiency but who are not ready to broadcast their usage data to their social networks—even though one can decline Opower's invitation to "post to Facebook for you."

The app works most effectively when your utility has a contract with Opower, as usage data can then be imported directly from your account. If your utility does not participate, then you must go through the more tedious task of entering data directly from your utility bills, which clearly requires more time and motivation.

One of Opower's main features is to compare your home against similar homes. This can be done without connecting to Facebook. You are asked for basic details about your home, beginning with the cost of last month's electricity bill. After saving this data, the app compares your energy efficiency to comparable homes across the United States (figure 14).

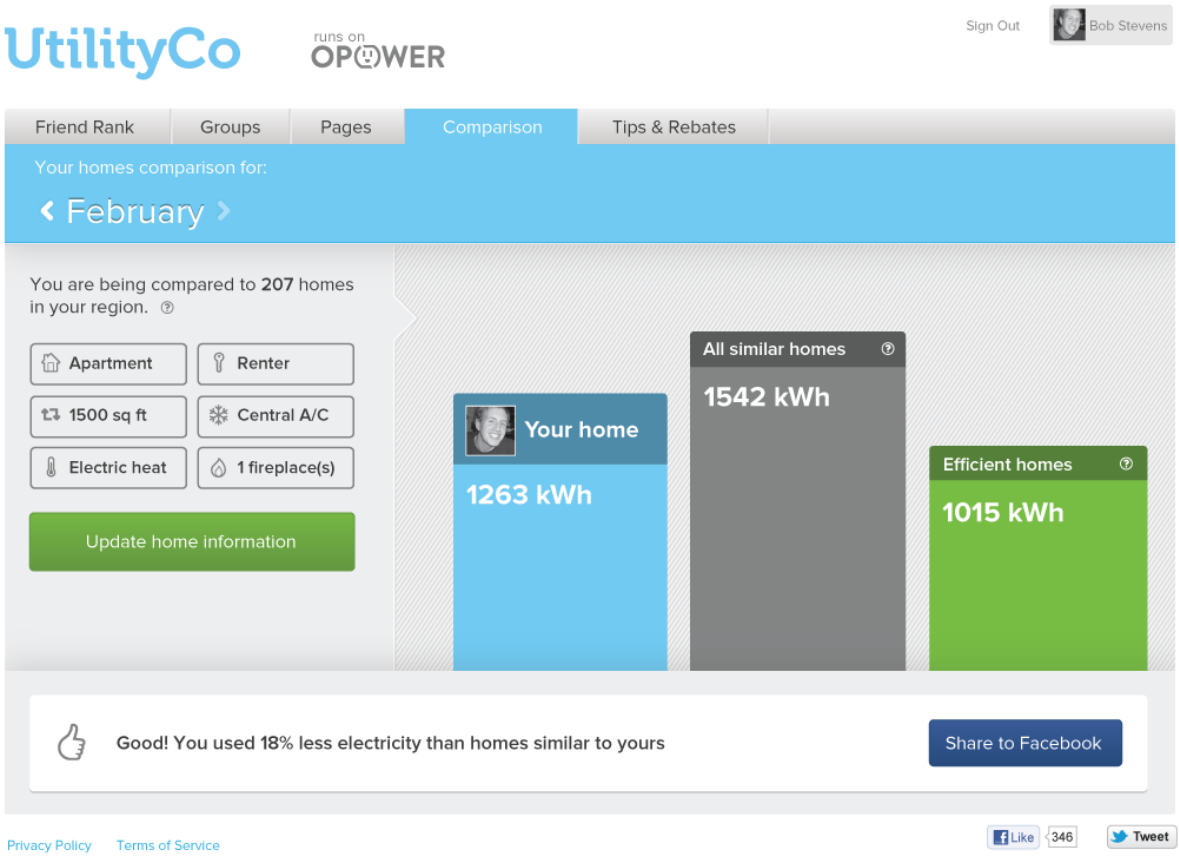

Figure 14. Opower energy use comparison. *Source:* Opower 2014.

One potential source of inaccuracy here is that renters may be less likely than owners to know about their home's heating systems, and not all renters pay for heat and/or electricity. The Opower app might not sufficiently accommodate these nuances.

Once logged in through Facebook, Opower asks, "Feeling competitive?" and offers a button that you can click to invite friends. A Groups tab lets you form a group of friends, coworkers, or neighbors, with the goal of promoting friendly competition. Once the group members sign up and include their data, Opower produces monthly reports ranking each person or household according to their energy usage.

A Ways To Save tab offers tips under the categories of appliances, cooling, heating, lighting, water heating, and other. Clicking on each tip leads to further information: an explanation of why the action is beneficial, estimated financial costs and benefits, and the amount of time before the change will pay for itself. The explanations are fairly informative and detailed.

However, in contrast to games like JouleBug or Cool Choices, these actions are merely recommendations; they are not linked to points, pins, badges, or other virtual or real rewards. On the other hand, if you were using Opower to compete in a group, you could presumably post or brag on Facebook about making energy-saving changes.

LEAFULLY

How many trees does it take to offset the carbon produced by the electricity you used last month? This question is the foundation of Leafully, an app that tracks a customer's energy usage over time and shows its environmental impact in terms of trees. In 2012, Leafully won the U.S. Department of Energy's (DOE) Apps for Energy contest, which aimed to stimulate innovative use of Green Button data.[5]

To begin playing Leafully, you download the free app to your smartphone, tablet, or computer. The app has a simple, green-hued interface designed to reinforce the underlying tree concept. As with the Opower app, you are encouraged, though not required, to log in through Facebook. The Facebook connection makes the app more social, as it allows you to see what energy-saving actions your friends are taking and to report your own achievements.

After setting up a Leafully account, which is quick and easy, you are invited to select your utility from the list of 17 current partners. (The utilities are distributed across the country although emphasis is on the West Coast.) This enables the automatic import of daily and monthly usage data, which is critical to the Leafully experience. If your utility is not listed, you can upload a file of Green Button data; however, it is unlikely that most users are familiar with Green Button and could easily access their data files. This means that you would have to be highly motivated and persistent to use Leafully with nonparticipating utilities, if this is indeed possible.

[5] Green Button is an industry-led effort that provides consumers with real-time online access to their electricity usage data.

Leafully has a strong educational component, emphasizing environmental impact and climate change to a greater extent than many other games in our survey. Whereas energy use is generally presented to consumers in abstract units of kWh, Leafully represents it in terms of something everyone can understand: trees. Its calculations are based on EPA's measurement of the amount of carbon a tree sequesters "from seedling to 10 years of age" (Leafully 2014).

The home screen (figure 15 below) displays data in six main categories: My Footprint, Alerts, Usage for the current month, Trends, Peak Energy, and Sleeping Energy. These are quantified with little green tree symbols when appropriate: a footprint of 32 means that last month it would have taken 32 trees to offset your emissions from electricity generation. The Trends screen shows you that your usage is down 5% compared to last month and 6% compared to last year. Peak Energy shows your electricity consumption during hours of peak demand, and is represented as five trees. Sleeping Energy is likely to be an eye-opening category for some users: it represents the electricity consumed in the household 24/7 (such as by a refrigerator). In this example it would take 19 trees to offset sleeping energy for just one month.

Figure 15. Leafully home screen. *Source:* iTunes Preview 2014.

Another screen (figure 16) shows daily usage as a line graph for the entire month: the vertical axis represents trees while the horizontal indicates the date.

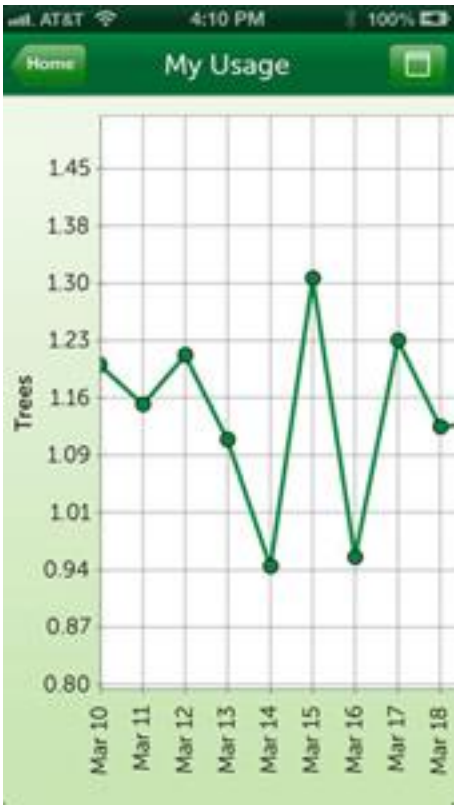

Figure 16. Leafully daily usage screen.
Source: iTunes Preview 2014.

The currency of trees is also used in the app's alerts (figure 17). For example, an alert for Irregular Usage reads: "You used 3.4 trees last Monday. You typically use 2.0 trees on a Monday." Alerts can also be summaries: "You used 35 trees last month. You used 1.8 less trees than the previous month" (iTunes Preview 2014).

Figure 17. Leafully alerts screen.
Source: iTunes Preview 2014.

Leafully also has a calculator feature that enables you to calculate the energy savings and environmental impact of changes to your home and transportation. For example, you can calculate the trees saved by driving a hybrid or carpooling. A Ways to Save section gives energy-saving tips, particularly for reducing sleeping energy consumption. There is also a section where you can set goals and make pledges (e.g., reducing energy consumption by 10 trees next month).

Another Leafully innovation is that it can help you buy renewable energy certificates (RECs) to offset your use of traditional energy sources. This reinforces the strong environmental theme of the app. Leafully buys bulk RECs on the open market on behalf of customers, which is more economical than if customers were to purchase RECs on their own.

According to Treehugger.com, Leafully's creators intended to use the app as a gamification vehicle, but they did not have the time to complete it by the contest deadline (Treacy 2012).

Related Game: Oreoco

Another game that we surveyed, called Oreoco, is somewhat similar to Leafully. Developed in partnership with the CoolClimate research group at the University of California, Berkeley, Oroeco uses life-cycle assessment data to calculate the carbon value of players' daily choices: purchases, food, transportation, and home energy use. Players can then make changes in response to personalized tips that the game provides. Oroeco invites players to offset the impact of their less benign actions by helping to buy green cookstoves that "save forests and lives in Africa" (Oreoco 2015).

Related Solution: Efficiency Leaves

The Ford Fusion has a feature that, like Leafully, translates the abstract concept of energy efficiency into concrete environmental imagery. As figure 18 shows, the car's dashboard displays "Efficiency Leaves," verdant vines and leaves that grow and flourish as driving efficiency increases.

Figure 18. Ford Fusion Efficiency Leaves. *Source:* Ford 2015.

DROPOLY

Dropoly has an interesting business model that combines education, engagement, and fundraising in a way that distinguishes it from the other games in this report. Its gamified solution is based on its virtual home energy audit tool, which works on any Internet-connected device. The Dropoly tool asks you for your zip code and other details about your home, as well as for data from previous electric bills. From these it creates a virtual home that reflects your heating and cooling systems, appliances, and so on. It then uses an algorithm (claimed to be 99% accurate) to make recommendations about your personal savings opportunities. Particularly useful is that it works for both single-family homes and apartments, making it relevant to renters or condominium dwellers (Dropoly 2014a; Renew Missouri 2013).

Dropoly's gamified solution is called Learn and Earn with Dropoly. In this program, schools raise money by competing against each other to learn about energy and climate change and to make energy conserving changes at home. According to its website, Dropoly is currently recruiting its first round of participating schools. Students are given access to the Dropoly app when their school joins the program. They use Dropoly's interactive lessons to learn about climate change and how their energy behaviors will affect it. They earn points by recruiting supporters (friends, family, and neighbors) who are then encouraged to use the app themselves. As they win points, the students (individually or in teams) move up a leaderboard, which is updated in real time. Program sponsors agree to reward winning schools in exchange for partial branding of the app: Dropoly messages include sponsors' logos, which, through the network of supporters the student recruits, will then reach more people (Dropoly 2014b).

ENERGY CHICKENS

Energy Chickens is a virtual pet game that motivates office workers to conserve the energy used by typical office appliances. It was designed by a team of researchers at Pennsylvania State University and tested with 57 workers in a midsize office for 6 months in 2012–2013 (Orland et al. 2014).

At the start of the study, researchers attached up to five wireless Plugwise sensors to devices like monitors, computers, and desk lamps in each participant's office. They measured each player's plug loads for the next five weeks to establish a baseline, namely the peak average daily kWh usage for workdays and non-workdays respectively

Beginning in this pregame period, a poster campaign encouraged workers to conserve energy. Two different posters (changed each week) were placed in high-use areas around the office. They featured reminders to "Turn it off" and "Unplug it."

Then the game began. Players signed a pledge to reduce their energy consumption by 15%, and each received a set of "Turn It Off" stickers to put on their devices. Then a virtual farm populated by up to five animated chickens appeared on each player's desktop. Each chicken on their farm corresponded to one of their appliances. As players unplugged, turned off, and reduced the use of their appliances, their chickens flourished and laid eggs. Conversely, if their energy use increased, their chickens declined and looked sickly.

Chicken health was graded on a five-point scale (-2, -1, 0, +1, +2), with baseline or neutral health being "0." Figure 19 shows the levels.

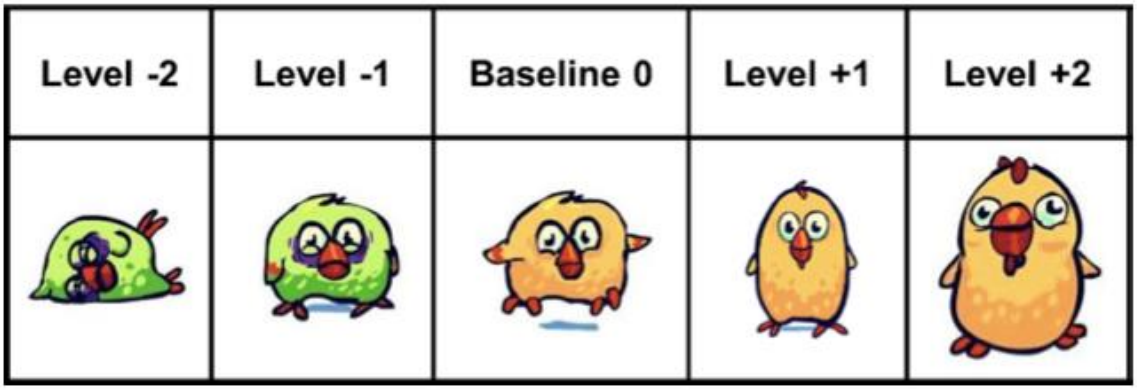

Figure 19. Levels of Energy Chickens' health. *Source:* Orland et al. 2014.

Chickens at levels 0, 1, and 2 laid eggs. These eggs were currency that players could use in a virtual general store selling items for the farm ranging in price from 5 to 200 eggs. Cheaper items included small hats, flowers, and fence posts. Costlier items included fancier hats, fruit bushes, and gnomes.

Besides the health of their chickens, players also received quantified feedback on their energy usage. A button labeled Graph on the user interface brought up a line chart showing their energy use over time. Although players were not competing with each other, they could also see how the whole office was doing by clicking on a button labeled Mountain View on the user interface. This presented them with an overview of the chickens on all players' farms.

Players' rewards for their energy-saving achievements were limited to virtual eggs and merchandise. At the same time every player received $100 for completing pregame, postgame, and daily surveys regarding their well being and productivity. In addition, everyone (including 16 nonplayers) was entered into a raffle to win a $100 gift card.

The results of the test were impressive. The researchers found a 13% overall reduction in plug-load energy consumption while the game was being played. Especially striking was a 23% reduction in plug loads on non-workdays. In addition, 69% of participants said that they had become more energy conscious. Once the game ended, the researchers monitored players' energy use for another eight weeks to assess the lasting behavioral impact. Although they found that postgame energy use returned to the baseline, this may have been due at least in part to the IT department's insistence that computers no longer be turned off at night and on weekends so as not to interfere with online security and backup management (Orland et al. 2014).

POWER HOUSE

Power House is a prototype game developed by researchers from Stanford University's Department of Communications led by Byron Reeves, and produced in collaboration with Kuma Reality Games and Seriosity, Inc. Development of the game was supported by the DOE

Advanced Research Projects Agency–Energy (ARPA-E) (Scarborough 2012). Trials of the game were conducted in 2011 with Pacific Gas & Electric customers (Reeves, Cummings, and Anderson 2011).

Power House uses the virtual world of a typical family home to educate players about household energy consumption. Figure 20 shows this virtual home.

Figure 20. The virtual home of Power House. *Source:* Reeves et al. 2015.

Power House involves a set of games that can be played in the virtual house. In the game that is documented in the literature, a player begins by following one family member around the house, helping them with their daily household tasks by clicking on appliances to turn them on and off as needed. Tasks include making dinner, doing laundry, exercising, watching television, using computers to go online, and so on. As each appliance is turned on and off, the game shows the amount of energy it uses (accounting for factors such as time of day, age and efficiency of appliance, and so on) and the cost of that energy. The game also keeps a running tally of the total household energy use and its cost.

Next another family member enters the house and the player must keep track of both people, turning appliances on to facilitate tasks and turning them off when not in use to save energy.

Eventually up to four family members may be in the house at the same time. The game becomes more and more difficult as the player tries to help everyone while monitoring the home's growing energy demands (Reeves, Cummings and Anderson 2011; Reeves et al. 2015).

As the player progresses, "play is interrupted and players are offered an opportunity to learn more about energy and to challenge other players to save energy" (Reeves, Cummings, and Anderson 2011). They can also earn badges by answering questions about energy use. At the end of a session, a screen declares, "Day 1 complete! You completed one day in the life of the family!" and shows players their total energy consumption and associated score (Scarborough 2012). The lower their energy consumption while still meeting the family's needs, the higher their score.

Power House also encourages players to transfer the energy savvy they have gained in their virtual house to their real-world energy use. Using real-time data from participating utilities, each player's dashboard displays a graph of their real-world energy use over the past 24 hours and compares it to past data. Players get credits (called Upgrade Bucks) for reducing their usage from day to day, and they can exchange the credits for virtual items like energy-saving upgrades to their virtual house, or for real-world rewards like gift cards. Of course the virtual upgrades help them achieve higher scores the next time they play the game with their virtual family's appliances.

Players can also invite their Facebook friends to compete in a real-world energy-saving challenge. They can see their own and their friends' real houses represented in a virtual neighborhood, and they can even use a real photo of themselves as an icon that hovers above their own virtual house.

A dashboard enables players to check competition results, view a leaderboard of individual and team rankings, and see their total credits. The dashboard also offers access to a chat forum where players can ask each other questions and report on what they have learned about saving energy (Reeves, Cummings, and Anderson 2011; Reeves et al. 2015). Finally, players can also click on a Launch Marketplace tab to learn about and purchase carbon offsets (Scarborough 2012).

A recent study (Reeves et al. 2015) reports on two results in terms of energy savings. In a laboratory setting, subjects who had played Power House for 30 minutes turned off an average of 2.55 appliances on leaving the room, as compared to subjects who had played an entertainment game, who turned off 0.55 appliances. In the second study, smart meter data for the 30-day period following Power House play showed an approximately 2% decrease in electricity usage compared to the 30-day period before play.

Discussion and Recommendations

Our main objective in describing these games is to help energy efficiency program developers decide whether they want to deploy a gamified solution, and, if so, to help them design and implement it. As Kevin Werbach and Dan Hunter write, gamifying a process like saving energy involves more than drizzling it with challenges, points, and badges "like caramel syrup on a sundae." Rather:

> Gamification requires a great deal of thought about the entire design of the system, including understanding the nature of your users, thinking about what you'd like them to do and how best to make them do it, considering the best technology platform to do that, and examining the specific game elements you're going to employ to get them to do things—among many other considerations. (Werbach and Hunter 2012, 124)

All the games we described in the preceding section presumably went through a more or less elaborate development process, and in many cases we can deduce the decisions the developers made from the final shape of the game. In this section we will use those decisions to illustrate the design, development, and deployment process that every successful gamified solution must undergo. That way many of the features of our 22 games can become lessons learned for your own future gamified programs.

BUSINESS OBJECTIVES AND DESIRED OUTCOMES

Gamification has to make business sense, so the first question to ask is, Exactly why do we want to gamify? What are the bottom-line benefits to the business? Since this question is likely to come up from senior management, it is a good place to start. The obvious answer will be to increase energy savings, a result that has clear bottom-line benefits for energy efficiency programs. However, many of the games we surveyed clearly have additional business objectives and outcomes. Some, like Beat the Peak, explicitly aim at peak reduction. Many of the others aim to engage and empower their players in order to add customer value, improve customer sentiment, and increase program enrollments (Shaw 2012). Most efficiency programs touch a small set of people who are motivated by information; using games extends their reach to everyone else. "Changing the utility-customer relationship," Davide Savanije writes, "is crucial for utilities as electricity starts to emerge from behind the meter" (Savenije 2014).

Besides utilities, businesses that are considering adopting a gamified solution offered by a provider like Cool Choices or WeSpire need to ask the same probing question: Why? The answers might range from employee engagement to environmental impact to lower energy bills.

TARGET AUDIENCES AND THEIR GOALS

The more clearly defined the audience, the more successful the program. Our 22 games illustrate a range of targets, from single- to multifamily, from residential to commercial, and from college students to office workers. Sometimes the target demographics are more subtle, as with Cool Choices, which was developed in Wisconsin and involves some actions unsuited to carless urban apartment dwellers. Whether conscious or not, the choice of audience determines almost every other feature of the game. For example, it would make no sense to reward the installation of energy-efficient appliances in a game targeted to multifamily tenants. If the typical bill-paying household decision maker is a woman in her 30s, then it is likely that a casual game for the smartphone delivered via an app will see more activity than will something requiring a greater time commitment and learning curve.

The point of a gamified solution is to motivate someone to do something. If your game is to be successful, you should spend as much time as possible getting to know your intended audience:

what motivates them, what their goals are, what might make them want to save energy in the first place. Leafully, for example, emphasizes the environmental benefit of user actions by correlating energy savings with the health and survival of trees. This is one among several possible motivations for saving energy that you can tap into.

There are multiple ways to frame energy games—from saving money to addressing climate change—and different frames will appeal to different customers. Once you know your target audience, you will be in a good position to design a game that reinforces their personal motivations and makes energy saving more interesting, more fun, and more compelling—for them in particular.

TARGET BEHAVIORS AND METRICS FOR SUCCESS

Wherever possible in our survey, we dug down to try to generate a list of the exact behaviors (e.g., buy a motion sensor for your outside lights) that a game includes in its play space and that it rewards with points or other virtual currency. Appendix A lists the target behaviors of Cool Choices, JouleBug, Carbon4Square, the Kukui Cup, and Beat the Peak. Even games that are not based on rewarding players for numerous specific actions promote an implicit set of behaviors; for example, Energy Chickens wants its players to do various things to reduce plug loads. Game developers should specify these behaviors before developing, commissioning, or adopting their solution and should quantify them if possible (not just reduce energy use, but reduce it by 15%).

Developers should also *prioritize* the target behaviors. Which behaviors are most critical to the mission of the game, and therefore which should be most highly rewarded? Cool Choices, for example, gives 5 points to activities like watching less TV, but 50 points to devising a new way to share items with others. These distinctions reflect the game's commitment to innovation and to community-level collaboration to reduce emissions.

Target behaviors need not be specific actions; they can include general outcomes like thinking, knowing, and caring more about energy use. Vermontivate, for example, places special value on long-term attitudinal transformation. "It changes the way people think," according to Kathryn Blume (Delaney 2013).

Finally, developers should decide whether they are aiming at short-term or persistent behavior change. Games that encourage extreme behavior (e.g. stop showering to win a dorm competition) may not lead to the adoption of long-term habits. One strategy that may potentially facilitate long-term change is social networking. When a game showcases our behavior in front of peers, we may be less likely to abandon that behavior once the game is over, lest we be seen as a flip-flopper (K. Kuntz, pers. comm., December 30, 2014).

ANALYTICS AND BENEFITS REALIZATION

One other thing to consider from the outset is a system to track and analyze the key performance indicators for the gamified solution in order to measure its success in attaining the business objectives. Of course one of these indicators will be the amount of energy saved, but others might include the number of players, their demographics, their performance in the game, the number and type of actions they take, and their understanding of and attitude toward energy efficiency. Developers must determine a baseline for all of these variables and devise

systems and processes for collecting before-and-after data. This is made simpler by some third-party providers, e.g., WeSpire and Simple Energy, that offer analytics packages for their clients.

Once these systems are in place—whether your own or packaged—you will be in a position to see how the game is doing throughout its pilot and final deployment, and you will be able to calculate its return on investment in relation to your business objectives. According to Doug Palmer and his colleagues at Deloitte,

> It's not enough to just capture data; you need to be prepared for meaningful analysis of the results. Return on investment assumptions should be thought of beyond simple project dollars spent. Develop formulas to measure the long-term value of more engaged or loyal customers or employees. (Palmer et al. 2012, 67)

Finally, one frustration we encountered in this study was the paucity of data on project results. As the gamification of saving energy matures, everyone's future projects will benefit from solid data and lessons learned about the cost-effective results of this strategy. In any case, developers should consider gamified solutions in conjunction with other behavioral approaches that have a longer and more intensive history of evaluation, measurement, and validation.

CUSTOM VERSUS LESS COSTLY SOLUTIONS

Once the business objectives, audience, and target behaviors are defined, it is time to decide whether to use a software-as-service option, adapt an existing game, go with a packaged solution, or develop the game from scratch. As far as we know, none of the 22 games we surveyed uses the first option, which offers generic gamification platforms that support game mechanics, management tools, social media integration, and analytics. Offered by companies like Bunchball, Badgeville, and BigDoor, these engines can be customized within limits and may include extensive technical support. Developers may find them sufficient for backstopping a real-world game like an energy challenge.

Six of the games we looked at—Cool Choices, WeSpire, Ecoinomy, JouleBug, Opower, and Dropoly—are highly developed packages that can be customized to an individual client's specifications. This approach has clear advantages in terms of cost, reliability, and quality. At the same time, the basic game premise, look, and mechanics of these solutions are fixed, and they may not offer as much of a competitive advantage as a successful custom solution.

Most of the other games we discuss are custom solutions that came about in a variety of ways. For example, the two games we studied that create the most robust, vivid, and potentially fun virtual worlds—Energy Chickens and Power House—were developed as pilot research projects to evaluate how gamified solutions affect office and residential behaviors, respectively.

Other solutions include the numerous energy-saving challenges like Reduce the Use in District 39, the SMECO Energy Savings Challenge, the Kansas Take Charge Challenge, the Chicago Neighborhood Energy Challenge, Beat the Peak, and the San Diego Energy Challenge. Although these challenges vary in their particular structures, durations, and goals, they are all rooted in particular communities and many have made effective use of public-private partnerships.

A variation on the energy challenge model is Rock the Bulb and its Be an Energy Rockstar contest. Rock the Bulb had a very clear focus: replace incandescent with CFL bulbs, and it accomplished its goals through a series of weekend events that largely relied on customers showing up and interacting with Puget Sound Energy (in contrast to logging their actions online).

Two other variations are the Kukui Cup and Carbon4Square. Energy-saving competitions are becoming popular at universities around the country, and college communities can provide a laboratory in which to study energy behavior.[6] Carbon4Square was also a community-based competition, but for commercial buildings. Although commercial and residential customers have different requirements, Carbon4Square used some of the same public-private partnerships, strategies, and incentives that have contributed to the success of residential energy challenges.

We also examined five game models that benefit local schools: Vermontivate, Kansas, Beat the Peak, San Diego, and Dropoly, with Dropoly being the most school-focused of the five. This is an interesting model that extends the game's reach beyond just the utility and the residential customer. The tie to the school may help participants feel that their individual actions are part of a larger cause.

However originated, funded, and positioned, custom development is not for the faint-hearted. For one thing, the design team's expertise needs to be prodigious:

> Design teams need to be able to address the overall organizational goals, measurement and analytics needs, design of incentives, and information technology considerations. Your effort could benefit from a multidisciplinary team that includes business-line strategists and managers, along with social scientists, marketers, game designers, programmers and those with data analytics expertise. (Palmer et al 2012, 67)

Another consideration is that upfront custom development costs are steep compared to those of packaged solutions. Eventually, however, no matter what the solution, ongoing and hidden costs may surprise the developer. Once they are built, all games need to be promoted and marketed to prospective players, and they must be managed and policed once they are deployed. Not only that, but they must change and evolve constantly in order to maintain player interest.

GAME ELEMENTS

As we have seen, gamified energy efficiency solutions come in many shapes and sizes. Whether you are developing a custom game or evaluating third-party offerings, the following discussion of game elements and mechanics may help you analyze your alternatives.

---

[6] In some respects, however, the energy behavior of students living in dorms may be atypical, since they are rarely financially accountable for their usage.

Play Space

Whereas videogames take place almost solely in virtual worlds, all gamified solutions must have a real-world component. This is what distinguishes them from simulations and from children's games such as Eco Ego (Appendix B). Although all the games we surveyed have a virtual component, the online dimension of most of them is limited to keeping score, team building, sharing information, triggers (see below), and social networking. Cool Choices has a more elaborate digital interface, with virtual cards taking the place of the real cards used in earlier iterations. JouleBug also has such a slick interface that the game seems to take place as much online as in the real world where players perform their actions. With Energy Chickens and Power House, we move to the virtual end of the spectrum. Although these games still reflect players' real-world actions, their virtual worlds are fully functional play spaces in themselves.

Progress Paths, Levels, and Triggers

Effective games break down big challenges into manageable steps, taking players on a journey through various stages to a final goal (Werbach and Hunter 2012, 41). The challenges must be difficult enough to maintain the player's interest, but not so insurmountable that they lead to frustration. The player progresses from one level of difficulty to the next, with the earliest levels being easy introductions to the world of the game ("onboarding"), and the later stages becoming increasingly demanding. These progressive challenges constitute a series of engagement loops in which the player takes an action, gets immediate feedback on the results, and, if successful, "levels up" to the next adventure and degree of difficulty. In addition to feedback, the game may also send triggers to the player, calls to action that remind them of specific things they should do at certain points. Opower and Beat the Peak, for example, text or email customers during peak demand periods.

Only some of the games we surveyed have this structure. A number of them are time-limited contests with only one main challenge: to save as much energy as possible. This approach is fine to engage customers in the short term, but the real power of games lies in their ability to engross players over a long period, giving them time to build new habits and permanently change their behavior. The more sophisticated games we surveyed, including Cool Choices, JouleBug, Vermontivate, and Kukui, do feature challenges of varying difficulty, the mastery of which wins increasing recognition and rewards. Energy Chickens has only one fundamental challenge, but the increasingly fertile chickens and ever-more opulent farm mark a clear upward path. Finally, Power House presents increasing levels of challenge in both its virtual and real-world play spaces.

Player Engagement Model

Unlike some videogames in which players only interact with the game, each of the solutions we surveyed involves some interaction among players. In some cases (JouleBug, for example), this player-to-player interaction seems secondary to the main business of racking up personal achievements. In others, especially the energy challenges, the friendly rivalry is central. Competition can be either between individuals or between teams. Some of the games we surveyed were played solely between competing individuals (e.g., Energy Chickens). Others, like San Diego and Reduce the Use in District 39, pitted household against household. (With these games we are moving into the area of team competition, as family members presumably

collaborate to save energy.) Some games, like Cool Choices, WeSpire, Vermontivate, and JouleBug, support both individual and team competition. Others, like Kansas, Chicago, and Kukui, are solely team based.

Being a member of a team combines competition and collaboration to engage a player on multiple levels. According to Bunchball:

> Teams provide an opportunity to connect and bond with others "like" you, (even if the only similarity is that you're on the same team), and work together as a cohesive unit to accomplish goals and compete with other teams. At the same time, the . . . pressure of not wanting to let down your peers, or be seen as the weakest link, can amplify behavior and drive dramatic increases in individual and team performance. (Bunchball 2012, 5)

Besides the sense of larger purpose conferred by team membership, energy challenges may also build on community spirit to motivate players. In Dropoly, for example, teams may compete on behalf of their child's school. Finally, all energy efficiency games have an additional larger purpose: the health of the environment. "What could be more dramatic than competing to save the planet?" asks Donald Kelley, the originator of Energy Smackdown (Fuller et al. 2010).

Feedback Via Data

As we have seen, real-time feedback keeps players engaged and energized on their journey toward mastery. All the games we surveyed have some system of scoring players' achievements and keeping players apprised of their progress and standing. Your points add up to mark your accomplishments. In the Kansas Take Charge Challenge, for example, players logged the number of light bulbs they replaced on a website that kept both running totals for individual players and rankings of the competing towns. WeSpire's dashboard tracks players' actions over time, and its ROI calculator quantifies their impacts. JouleBug also quantifies the yearly result of each achievement in terms of kWh and kilograms of CO_2. Leafully and Energy Chickens show players a line chart tracing their energy use over time.

Access to real-time energy use data has fueled the development of gamified energy efficiency solutions, not to mention companies like Opower and Simple Energy. Green Button and related technologies make it easy to provide consumers with real-time feedback on their energy use, and given that feedback is so central to games, gamified energy use solutions are the natural result. Seven of the 22 games we surveyed make use of or even are built around real-time utility-provided energy usage data: Power Agent, JouleBug, Chicago, San Diego, Opower, Leafully, and Power House.

Achievements and Rewards

Data are not the only kind of feedback in gamified solutions; even more important are the various rewards and recognition accorded to players' achievements as the game progresses. Games use this positive feedback to fuel players' motivation and keep them engaged. According to Brian Burke, rewards can take four forms: things, fun, self-esteem, and social capital (Burke 2014, 116–121).

Many games offer tangible rewards, but the rewarded actions and the size of the awards vary greatly. Several of the major energy challenges gave large cash prizes to players who dramatically reduced their energy use. Vermontivate rewards winning communities for many different kinds of actions (including raising awareness) with Ben and Jerry's ice cream. Cool Choices' rewards are often random, to anyone who plays in a particular week, and are usually small items like a water bottle (K. Kuntz, pers. comm., December 30, 2014).

As for less tangible rewards, fun is clearly an important element of several of the games we surveyed, including Vermontivate with its animal game masters, Joule Bug with its slick graphics, Kukui with its parties and scavenger hunts, and Energy Chickens with its drop-dead cute chicks. Self-esteem is another less tangible reward. In a good game, players become more and more proud of their accomplishments as they move up the levels and get positive feedback and recognition. Players also accumulate social capital within the game from fellow players and teammates, and also via social networks like Facebook, Twitter, and LinkedIn in games like Opower's.

Points, badges, and leaderboards are the currency of self-esteem and social capital in gamified solutions. Every game in our survey uses a more or less complex system of points as its basic currency. Points are clear, immediate rewards for players' actions and often the chief motivator for those actions. Points let players know they are succeeding, measure their achievements against fellow players, show others what they have achieved, and mark their progress on the way to their goal. As we have seen, they also prioritize the value of particular actions, indicating choices the developers made early on when they were defining their objectives and outcomes. So, for example, electricity-savings actions earn up to 60 points in Carbon4Square, whereas waste disposal only earns up to 10.

Some of the games also use badges to indicate plateaus of accomplishment. Badges may mark a particular level of points, or they may signify some special achievement. They provide clear mileposts for players to strive towards, and they symbolize their attainment. JouleBug's pins are good examples: resembling Boy or Girl Scout badges, they mark the path to the even more impressive trophies available for one's virtual trophy case. Energy Chickens' badges are both the healthy chickens and the virtual paraphernalia that players can acquire in exchange for their eggs.

Finally, leaderboards (online rankings of players and teams) give context to players' achievements in ways that points and badges cannot (Werbach and Hunter 2012, 76). Players want to know how they are doing in relation to others, and ultimately they want to do better than them. Thus leaderboards can be a powerful motivator. On the other hand, however, they can also demotivate players who see themselves falling too far behind. The Kansas Take Charge Challenge and Cool Choices take a creative approach to this dilemma by posting both team and individual accomplishments on their leaderboards. Less successful individuals could be heartened by their team's standing, and a losing team could take pride in the personal accomplishments of its members.

SOCIAL DIMENSION

Social standing is just as important to people as their individual accomplishments, perhaps even more so. Gamified energy efficiency solutions take advantage of this fact of human nature in a number of ways. As we pointed out, being a member of the team brings out the best in players who double their efforts in the service of something larger than themselves. The game context also gives them permission to coach each other on sustainable behaviors without seeming officious. Social norming is another strategy that some games use to fuel players' motivation. Opower, for example, gives feedback to its users that shows them not only their own energy use but also that of their neighbors. Since no one likes to feel that they are deviating from accepted group behavior, players naturally will try to keep up with their neighbors' energy savings.

Another powerful tool is social networking. By amplifying the accomplishments of energy game players, social networks also amplify their motivation. They allow players to enlist support from others, build team spirit, and proudly show their achievements. Five of the games we surveyed—JouleBug, SMECO, Opower, Leafully, and Power House—make Facebook an intrinsic part of their play space, and others seem to be developing that potential. Power House players can use the game's dashboard to invite their Facebook friends to compete in a challenge. The Opower game may seem to take place entirely within Facebook, where players invite their friends to join the game, compare their energy use to similar homes and those of friends, enter competitions, and share energy savings tips. Finally, it should be said that players of any of the games we studied could take the initiative to create their own Facebook group for strategizing and sharing.

INTRINSIC VERSUS EXTRINSIC MOTIVATION

A gamified solution's success depends on its ability to encourage people to perform mundane tasks that might otherwise be tedious. Elements like well-structured challenges, levels of achievement, triggers, team building, feedback, rewards, and recognition all draw on what behavioral science has learned about the best ways to motivate us. Effective games define a clear objective that is congruent with the players' own goals, break down the path to achieving it into manageable challenges, and encourage players as they progress through levels of mastery. The fact is that this is the dynamic of any behavior change regimen, from stopping smoking to saving for retirement—set goals, take baby steps, reward yourself for progress, enlist support from friends, move up to greater challenges, and repeat until a new habit is formed (Burke 2014, 53, 37).

Having surveyed 22 games and the features of successful games in general, we are now in a position to step back and consider a final key feature of gamified energy efficiency solutions, that is, intrinsic versus extrinsic motivation. The distinction is a simple one: if you pay children to do their homework, they are externally motivated, whereas if you can make the homework more stimulating, they may be intrinsically motivated to do it. Reward programs like frequent flyer miles are clearly based on extrinsic motivation; they encourage people to fly (and make

other purchases) by compensating them for it.[7] None of the games in our case studies gives tangible rewards to everyone who participates; instead, the games give players other reasons for saving energy. These range from the prospect of winning a cash prize to less tangible paybacks like fun, self-esteem, and social capital. These latter drivers help make the act of saving energy more intrinsically satisfying, whereas cash prizes are more of an extrinsic motivator. Can behavioral science tell us which approach is most effective?

The seminal researchers here are the educator Alfie Kohn, the psychologist Edward Deci and his colleagues, and later, Daniel Pink (Kohn 1993; Deci et al. 1999; Pink 2009). Deci et al. analyzed 128 studies that examined the effects of external rewards on internal motivation. They found that the former undermined the latter. In one of their own studies, they found that students given financial rewards to do puzzles were less likely than a control group to continue working on the puzzles once the cash rewards ended. In a way this makes sense: giving someone a tangible reward for doing something may make them feel that that is the only reason for doing it. This feeling may preclude them from finding the activity rewarding in itself, that is, intrinsically rewarding. In any case, intrinsic motivation is a more dependable and long-term motivator. If we enjoy something—if we have chosen to do it, we are good at it, and we can do it with others—then we naturally keep on doing it.

This insight goes to the heart of successful gamification. If we want people to save energy and to go on doing so after the game has ended, we need to stoke the fires of their intrinsic motivation, not simply give them things in exchange for their cooperation. Even points, badges, and competition are ultimately just a means to the end of making energy efficiency rewarding in itself. We do not want people to save energy in order to get an extrinsic reward, however intangible, but to save energy because they have come to see it as intrinsically satisfying, meaningful, or enjoyable.

RESULTS: ENERGY SAVINGS

A prime objective of energy efficiency games is to reduce energy use. While this is not the only useful outcome of these games, it may be helpful to summarize what we know about the energy savings they induce. In the sections above we pointed out energy savings where data were available; here we summarize the findings across the games we surveyed.

In our research we found nine games that were able to document specific energy savings in a format that could potentially be compared to other games and programs. Some of these estimates are by independent program evaluators, some by program staff. The nine are:

- Cool Choices
- Reduce the Use in District 39
- SMECO Energy Savings Challenge

[7] Classic energy efficiency program design is also built on extrinsic motivation: people are rewarded for energy efficient behavior through cash incentives or rebates.

- Kansas Take Charge Challenge
- Energy Smackdown
- Chicago Neighborhood Energy Challenge
- San Diego Energy Challenges
- Energy Chickens
- Power House

We summarize the savings estimates from each of these programs in table 2. Percentage savings are sometimes relative to preprogram use among participants and sometimes relative to a control group. There are wide variations on how baselines are determined, which can have a significant impact on the savings estimate (see Johnson et al. 2013).

Table 2. Energy savings from gamified solutions

Program	Number of participants	Energy savings (%)	Units/type	Notes
Cool Choices (Miron Construction)	220 employees	~4% <1%	kWh electricity Therms natural gas	
Reduce the Use in District 39	161 households	4%	kWh electricity	Participants chose to participate
Biggest Energy Saver	200 households	~11%		
San Diego Energy Challenge	42,400 accounts	6% 2% 2.2%	kWh during summer kWh during winter kWh peak demand	
Kansas Take Charge Challenge	6 towns	5.5%	kWh electricity	This is just for the winning town.
Energy Smackdown	3 towns, ~100 households per town	14% 17%	kWh electricity Heating fuel	Participating households were recruited by their town's team.
Chicago Neighborhood Energy Challenge	~500 apartments	5% 10% 45%	kWh electricity Therms natural gas Gallons water	
SMECO Energy Savings Challenge	201 customers	>3% *	kWh electricity	
Energy Chickens	61 workers	13%	kWh for plug loads	
Power House	51 adults	~2%	kWh electricity	

* Figure for average is not provided, but 38% of participants saved at least 3% including the top 11 who saved 27%.

Clearly, limited data from nine projects are not enough to draw any definitive conclusions; much more evaluation is needed, including evaluations of first-year savings and savings persistence. Still, from the nine studies that were conducted, energy savings in the range of 3–6% appear feasible among a sizable number of participants. For example, studies found 4%

median savings among the roughly half of employees who participated in the Cool Choices Miron Construction game, 5% savings in the Chicago Neighborhood Energy Challenge, and 6% savings in the San Diego Energy Challenge. When programs are more tightly targeted, such as the most active participants in Biggest Energy Saver and specially recruited participants in Energy Smackdown, savings of more than 10% can be achieved. So far, persistence of savings has not been examined in any systematic fashion.

Conclusion

Gamified solutions have a wide range, from community-based games that encourage saving energy as one activity among many, to utility-sponsored energy challenges that reward customers for reducing their energy use as dramatically as possible. Games are available for the residential, commercial, workplace, and campus sectors. They may take place almost entirely in the real world, or they may involve elaborate virtual play spaces. They may be one-off solutions or packages customized by a third-party provider. It might be worth referring back to table 1 on page 7 to review the numerous distinguishing characteristics of the 22 games in our case studies.

Our research found that careful planning is essential to a successful game. Since developing or adapting a game can be costly, your solution must make business sense. Games not only can increase energy savings, but they can also add customer value, improve the utility-customer relationship, and increase program enrollments. Carefully defining the target audience(s) will help you achieve these objectives. Since the goal of the game is to motivate its players to do something, the more clearly you understand who these players are, the more successful you will be in changing their behavior. A third key to success is to define and prioritize exactly what you want your players to do (replace light bulbs? reduce peak use?). Just as important, how will you track and analyze these performance indicators? In conducting research for this study, we were frustrated by the paucity of data on game results, particularly on the persistence of energy savings. If data collection is built in from the beginning, program developers will be able to make stronger business cases for existing and future gamified solutions.

Built on a foundation of careful planning and design, games can successfully deploy a variety of elements to encourage players to reduce their energy use. In an effective game, players progress through a number of challenges along a clear path to a final goal. They receive positive feedback as they meet each challenge and work their way up to the next level of difficulty. Useful information and prompts help them on their way. Real-time energy use data provide particularly powerful feedback. In some games, players compete as individuals; in others, as members of a team. Being on a team makes players feel that they are working for a larger purpose, one that may potentially widen out to include the welfare of their community and, ultimately, the planet.

Players' progress may be marked by the virtual currency of points and badges; these stand for the self-esteem and social capital they are accruing. Simple fun and enjoyment are other drivers of—and rewards for—player achievement, especially in games with well-designed virtual play spaces. The most effective games use social norms and social networking to compare, amplify, and reward players' efforts. All these elements work together to increase players' intrinsic motivation to save energy, not just for a cash reward, but as an end in itself. A well-designed

game can bring us to the point where we enjoy the effort of saving energy and persist in doing so after the game is over.

Maybe the best way to think about gamified energy efficiency solutions is to see them as training wheels, a way to introduce people to the intrinsic satisfaction of gliding along on their own two wheels after the game's apparatus is removed. The fact is that saving energy is highly rewarding in itself, and the greatest achievement a game could aim for is to bring out the multiple satisfactions that are there in the first place.

References

Alliance (Alliance to Save Energy). 2012. "Check Out the Social Energy App By Facebook, NRDC, Opower." March 20. http://www.ase.org/resources/check-out-social-energy-app-facebook-nrdc-opower.

Anderson, A., D. Huttenlocher, J. Kleinberg, and J. Leskovec. 2013. "Steering User Behavior with Badges." *Proceedings of the 22nd International Conference on the World Wide Web*. May 13–17. Rio de Janeiro. http://dl.acm.org/citation.cfm?id=2488398.

Bard, C., and S. Kessler. 2011. "NYSERDA's Competition Based Pilot for Residential Customers." Presentation at the 2011 Behavior, Energy, and Climate Change Conference. November 30. http://web.stanford.edu/group/peec/cgi-bin/docs/events/2011/becc/presentations/1%20NYSERDAs%20competition.pdf.

Bellevue Reporter. 2009. "Bellevue Family Wins Big with Energy-Saving Competition." December 16. http://www.bellevuereporter.com/news/79462667.html.

Bensch, I. 2013. *Identifying the Impacts of Cool Choices' Game at Miron Construction*. Madison: Energy Center of Wisconsin. http://ecw.org/publications/identifying-impacts-cool-choices-game-miron-construction-energy-savings-player-actions.

Brewer, R. 2013. *Fostering Sustained Energy Behavior Change and Increasing Energy Literacy in a Student Housing Energy Challenge*. PhD dissertation. University of Hawaii.

Building Performance Partnership. 2014. "Kilowatt Crackdown: Past Contests." Accessed November 14. http://www.kilowatt-crackdown.com/portland/history.

Bunchball. 2012. "Enterprise Gamification: The Gen Y Factor." White paper. http://www.gamification.co/wp-content/uploads/getting-started/White%20Paper_Enterprise%20Gamification_The_Gen_Y_Factor_2012.pdf.

Burke, B. 2014. *Gamify: How Gamification Motivates People To Do Extraordinary Things*. Brookline, MA: Bibliomotion.

BusinessWire 2009. "Bellevue Family Wins $7,500 Gift Card to Culminate PSE's Rock the Bulb Energy Saving Campaign." December 15. http://www.businesswire.com/news/home/20091215006493/en/Bellevue-Family-Wins-7500-Gift-Card-Culminate#.VGkosNynPjJ.

Carbon4Square 2014a. "What is Carbon4Square?" Accessed November 14. http://carbon4square.com/about.

——. 2014b. "Partners." Accessed November 14. http://carbon4square.com/sponsors.

——. 2014c. "Calendar." Accessed November 14. http://carbon4square.com/calendar.

——. 2014d. "Samurai." Accessed November 14. http://carbon4square.com/samurai.

——. 2014e. "Carbon 4Square Playbook." Accessed November 14. http://carbon4square.com/sites/carbon4square.com/files/imageupload/Carbon4Square%20Playbook%20Overview.pdf.

CCN (Campus Conservation Nationals). 2015a. "CCN is the Biggest Energy and Water Reduction Competition in History." Accessed January 20. http://www.competetoreduce.org/overview-1/.

——. 2014b. "How It Works." Accessed January 20. http://www.competetoreduce.org/how-it-works/.

Chicago Challenge (Chicago Neighborhood Energy Challenge). 2014. "The Chicago Neighborhood Energy Challenge." Accessed November 23. http://chicagoneighborhoodenergychallenge.com.

City of Chicago. 2013. "Mayor Emanuel Announces Innovative Competition To Reduce Energy Usage in Humboldt Park and Logan Square Neighborhoods." Mayor's Press Office. November 1. http://www.cityofchicago.org/city/en/depts/mayor/press_room/press_releases/2013/october_2013/mayor_emanuel_announcesinnovativecompetitiontoreduceenergyusagei.html.

——. 2014a. "Mayor Emanuel Announces Results of Energy Efficiency Pilot Competition." Mayor's Press Office. July 17. http://www.cityofchicago.org/city/en/depts/mayor/press_room/press_releases/2014/jul/mayor-emanuel-announces-results-of-energy-efficiency-pilot-compe.html.

——. 2014b. "Retrofit Chicago Multi-Family Residential Partnership." Accessed November 23. http://www.cityofchicago.org/city/en/progs/env/retrofit_chicagoresidentialpartnership.html.

Climate and Energy Project. 2010. "Merriam, Quinter Win the Take Charge Challenge! Six Kansas Towns Save Over 6 Million Kilowatt Hours and More Than Half a Million Dollars." June 11. http://climateandenergy.org/news.1049483.merriam-quinter-win-the-take-charge-challenge-six-kansas-towns-save-over-6-million-kilowatt-hours-and-more-than-half-a-million-dollars.

Cool Choices 2014a. "Game Development." Accessed November 11. http://coolchoices.com/about/game-development/.

——. 2014b. "Game Partners." Accessed November 11. http://coolchoices.com/employee-engagement/game-partners/.

——. 2014c. "Play at My Site." Accessed November 11. http://coolchoices.com/about/contact-us/play-at-my-site/.

Deci, E., R. Koestner, and R. Ryan. 1999. "A Meta-Analytic Review of Experiments Examining the Effects of Extrinsic Rewards on Intrinsic Motivation." *Psychological Bulletin* 125 (6): 627–

668. http://home.ubalt.edu/tmitch/642/Articles%20syllabus/Deci%20Koestner%20Ryan%20meta.%20IM%20psy%20bull%2099.pdf.

Delaney, M. 2013 "How Gamification Helps Local Governments Engage Employees and Citizens." *StateTech*. September 30. http://www.statetechmagazine.com/article/2013/09/how-gamification-helps-local-governments-engage-employees-and-citizens.

DOE (U.S. Department of Energy). 2012. "DOE Announces Nearly $3.2 Million To Help Consumers Better Manage Their Energy Consumption." Office of Electricity and Energy Reliability. May 22. http://energy.gov/oe/articles/doe-announces-nearly-32-million-help-consumers-better-manage-their-energy-consumption.

Dropoly 2014a. "What We Do at Dropoly." Accessed December 6. https://dropoly.com/about/.

——. 2014b. "Marketing and Outreach." Accessed December 6. https://dropoly.com/marketing/.

Edge. 2014. "Two Billion Downloads? We're Just Getting Started, Says Angry Birds Creator Rovio." Blog. January 23. http://www.edge-online.com/features/two-billion-downloads-were-just-getting-started-says-angry-birds-creator-rovio/.

Elliott, A. 2013. "Chicago Neighborhood Energy Challenge Launches in Logan Square." *LoganSquarist.* November 11. http://logansquarist.com/2013/11/11/chicago-neighborhood-energy-launches/.

ENERGY STAR. 2014. "Puget Sound Energy: ENERGY STAR Partner of the Year" Accessed November 16. http://www.energystar.gov/index.cfm?fuseaction=pt_awards.showAwardDetails&esa_id=3834.

ESA (Entertainment Software Association). 2014. *Essential Facts About the Computer and Video Game Industry.* http://www.theesa.com/facts/pdfs/esa_ef_2013.pdf.

Ford. 2015. "Next Generation SmartGuage® with EcoGuide." Accessed January 26. http://www.ford.com/cars/fusion/features/#page=Feature5.

FortisBC. 2009. "FortisBC Urges Customers To Switch Off for Earth Hour 2009." March 20. http://www.fortisbc.com/MediaCentre/NewsReleases/2009/Pages/FortisBC-urges-customers-to-switch-off-for-Earth-Hour-2009.aspx.

Fortune, S. 2011. "Ecoinomy Shows Us How to Make the Most of Using Less." PSFK blog. March 30. http://www.psfk.com/2011/03/ecoinomy-shows-us-how-to-make-the-most-of-using-less.html.

Fuller, M., C. Kunkel, M. Zimring, I. Hoffman, K.L. Soroye, and C. Goldman. 2010. *Driving Demand for Home Energy Improvements.* "Take Charge Challenge." Lawrence Berkeley National Laboratory LBNL-3960E. September. http://drivingdemand.lbl.gov/reports/lbnl-3960e-charge.pdf

Gainesville Green. 2015a. "GainesvilleGreen.com Is a Website to Help Homeowners Conserve Energy Through Education and Competition." Accessed January 20. http://gainesville-green.com/overview.

——. 2015b. "Frequently Asked Questions." Accessed January 20. http://gainesville-green.com/faq.

Gartner (Gartner, Inc.). 2011a. "Gartner Says By 2015, More Than 50 Percent of Organizations That Manage Innovation Processes Will Gamify Those Processes." Press release. April 12. http://www.gartner.com/newsroom/id/1629214.

——. 2011b. "Gartner Predicts Over 70 Percent of Global 2000 Organisations Will Have at Least One Gamified Application by 2014." Press release. November 9. http://www.gartner.com/newsroom/id/1844115.

——. 2012. "Gartner Says by 2014, 80 Percent of Current Gamified Applications Will Fail To Meet Business Objectives Primarily Due To Poor Design." Press release. November 27. http://www.gartner.com/newsroom/id/2251015.

Grbac, D. "Ecoinomy." Accessed December 7. http://www.davidgrbac.com/ecoinomy.

Gustafsson, A., and C. Katzeff. 2009 "Evaluation of a Pervasive Game for Domestic Energy Engagement Among Teenagers." *ACM Computers in Entertainment* (7) 4. http://soda.swedish-ict.se/3858/1/Power_Agent_CIE.pdf.

Hamari, J., J. Koivisto, and H. Sarsa. 2014. "Does Gamification Work? A Literature Review of Empirical Studies on Gamification." *System Sciences (HICSS), 2014 47th Hawaii International Conference*. 3025-3034. Waikoloa, HI: IEEE.

Hawaii Pacific University. 2012. "HPU Takes On Energy Challenge with Kukui Cup." September 18. http://www.hpu.edu/HPUNews/2012/09/HPU_Kukui_Cup.html.

Hussain, Z. "3 Ways Using Competition Can Increase Energy Efficiency." GTech blog. September 10. https://gtechstrategies.org/compete-save-energy/.

IDC (IDC Energy Insights). 2014. "Utilities Will Spend $65 Million on Gamified Applications in 2016 To Engage Consumers, According To IDC Energy Insights." Press release. January 9. http://www.idc.com/getdoc.jsp?containerId=prUS24598214.

Ikehu. 2015. "D.R.I.V.E." Accessed January 19. http://ikehu.com.

iTunes Preview. 2014. "Leafully." Accessed December 6. https://itunes.apple.com/us/app/leafully/id634531160?mt=8.

——. 2015. "JouleBug." Accessed January 18. https://itunes.apple.com/us/app/joulebug/id391199306.

Johnson, P., Y. Xu, R. Brewer, G. Lee, M. Katchuck, and C. Moore. 2013. "Beyond kWh: Myths and Fixes for Energy Competition Game Design." Presentation to Energy 2013 conference, Lisbon. March. http://meaningfulplay.msu.edu/proceedings2012/mp2012_submission_72.pdf. https://csdl-techreports.googlecode.com/svn/trunk/techreports/2012/12-12/12-12.pdf.

JouleBug. 2015a. "Go Topless." Accessed January 16. http://joulebug.com/pin/go-topless/.

——. 2015b. "Explore Achievements." Accessed January 16. http://joulebug.com/achievement-explorer/.

——. 2015c. "FAQ." Accessed January 16, 2015. http://joulebug.com/faq.

Kohn, Alfie. 1993. *Punished by Rewards: The Trouble with Gold Stars, Incentive Plans, A's, Praise, and Other Bribes*. Boston: Houghton Mifflin.

Leafully. 2014. "Frequently Asked Questions." Accessed December 6. https://leafully.com/about/faq/.

Lockheed Martin. 2014. "Using Gamification To Reduce Energy Use." February 5. http://www.lockheedmartin.com/us/news/features/2014/gamification-energy-use.html.

Mazur-Stommen, S., and K. Farley. 2013. *ACEEE Field Guide to Utility-Run Behavior Programs*. Washington, DC: American Council for an Energy-Efficient Economy.

McClure, C. 2013. "Who Is Sustainable? A Case Study from Miron Construction and Cool Choices, Inc. http://coolchoices.com/employee-engagement/game-partners/miron-construction-company/.

Mekler, E., A. Tuch, F. Brühlmann, and K. Opwis. 2013. "Disassembling Gamification: The Effects of Points and Meaning on User Motivation and Performance." *CHI 2013 Extended Abstracts.* April 27–May 2. Paris. https://psycho.unibas.ch/uploads/x4epublication/46996/mekler_2013_gamification.pdf.

MSU (Michigan State University). 2015a. "About Environmental Stewards." Accessed January 21. http://league.bespartangreen.msu.edu/about/stewards.

——. 2015b. "Clubhouse: Join the Discussion on Facebook." Accessed January 21. http://league.bespartangreen.msu.edu/clubhouse.

——. 2015b. "Recycle: Under the Table Recycler." Accessed January 21. http://league.bespartangreen.msu.edu/?q=taxonomy/term/1.

MVEC (Minnesota Valley Electric Cooperative) 2014a. "Energy Challenge Examples." Accessed December 6. http://www.mvec.net/community/challenge/energy-challenge-examples/.

——. 2014b. "Energy Challenge Rules." Accessed December 6. http://www.mvec.net/community/challenge/beat-the-peak-rules-conditions/.

——. 2014c. "Despite Quiet Summer, Beat the Peak Saved Mega Kilowatt Hours." *Electric Eye* newsletter. November. http://www.mvec.net/wp-content/uploads/2011/10/2014_11_EE.pdf.

Opower. 2014. *Social Energy Application*. Data sheet. Accessed October 13. https://opower.com/uploads/files/US_DataSheet_Social.pdf.

Oroeco. 2015. "What Is Oroeco?" Accessed January 20. http://www.oroeco.com/about.

Orland, B., N. Ram, D. Lang, K. Houser, N. Kling, and M. Coccia. 2014. "Saving Energy in an Office Environment: A Serious Game Intervention." *Energy and Buildings* 74 (2014): 43-52.

Palmer, D., S. Lunceford, and A. Patton. 2012. "The Engagement Economy: How Gamification Is Reshaping Business." *Deloitte Review* 11: 53-59. http://www.deloitte.com/view/en_by/by/c7cee86d96498310VgnVCM1000001956f00aRCRD.htm.

Palo Alto (City of Palo Alto Utilities). 2015. "'Ugliest' Lighting Contest." Accessed January 25. https://cityofpaloalto.org/civicax/filebank/documents/28727.

Penn (University of Pennsylvania Penn Green Campus Partnership). 2015a. "Competition Archive." Accessed January 20. http://www.upenn.edu/sustainability/power-down-challenge/competition-archive.

——. 2015b. "Power Down Challenge." Accessed January 20. http://www.upenn.edu/sustainability/get-involved/power-down-challenge.

Perez, S. 2011. "Simple Energy and San Diego Gas & Electric Team Up To Encourage Conservation Through Gaming." *Techcrunch* (blog). September 2. http://techcrunch.com/2011/09/02/simple-energy-and-san-diego-gas-electric-team-up-to-encourage-conservation-through-gaming/.

Pink, D. 2009. *Drive: The Surprising Truth About What Motivates Us*. New York: Riverhead.

Puget Sound Energy. 2009. "PSE's Rock the Bulb Campaign To Give Away 400,000 Free CFL Bulbs to Residential Electric Customers from July through October." July 17. http://pse.com/aboutpse/PseNewsroom/NewsReleases/Pages/PSEs-Rock-the-Bulb-Campaign-to-Give-Away-400000.aspx

Reeves, B., J. Cummings, and D. Anderson. 2011. "Leveraging the Engagement of Games to Change Energy Behavior." Proceedings of the CHI 2011 Workshop, Gamification: Using Game Design Elements in Non-Game Contexts. May. http://gamification-research.org/wp-content/uploads/2011/04/23-Reeves.pdf.

Reeves, B., J. Cummings, J. Scarborough, and L. Yeykelis. 2015. "Increasing Energy Efficiency with Entertainment Media: An Experimental and Field Test of the Influence of a Social Game on Performance of Energy Behaviors." *Environment and Behavior* 47(1): 102-115. http://eab.sagepub.com/content/47/1/102.

Reguly, T. 2013. "The Role of Behavioral Approaches in Utility Customer Experience." Presentation at BECC Conference. http://beccconference.org/wp-content/uploads/2013/12/BECC-conference-Nov-2013-TReguly.pdf.

Renew Missouri. 2013. "Dropoly Creates Competition for Going Green." July 25. http://renewmo.wordpress.com/tag/dropoly/.

SDG&E (San Diego Gas & Electric). 2013. "Middle Schools Win with San Diego Energy Challenge." January 4. http://www.sdge.com/newsroom/press-releases/2013-01-14/middle-schools-win-san-diego-energy-challenge.

——. 2014. "SDG&E Celebrates San Diego's Biggest Energy Savers." Accessed October 22. http://www.sdge.com/biggestsaver.

Savenije, D. 2014. "How Simple Energy Gamified Energy Efficiency." Utility Dive. February 5. http://www.utilitydive.com/news/how-simple-energy-gamified-energy-efficiency/223567/.

Scarborough, J. 2012. "Can Games Change Energy Behavior and Reduce Consumption?" Presentation at BECC Conference. http://beccconference.org/wp-content/uploads/2012/11/1-James-Scarborough.pdf.

Selverston, A. 2012. "City Launches 'Ugliest Light Contest.'" Palo Alto Patch. February 2. http://patch.com/california/paloalto/city-launches-ugliest-light-contest.

Shaw, P. 2012. "Smart Energy Behavior: Using Game Dynamics to Engage Consumers." Presentation at Gsummit, San Francisco. June 20. http://www.slideshare.net/gzicherm/peter-shaw-gamification-to-drive-smart-energy-behaviors.

Simple Energy 2014a. "We Motivate People To Save Energy." Accessed November 24. http://simpleenergy.com.

——. 2014b. "Customer Journey." Accessed November 25. http://simpleenergy.com/customer-journey/.

——. 2014c. "Engagement Platform." Accessed November 25. http://simpleenergy.com/engagement-platform/.

——. 2014d. "Our Product." Accessed November 25. http://simpleenergy.com/product/.

SMECO. 2013. "SMECO Awards Prizes to Energy Challenge Winners." October 23. http://www.smeco.coop/news/13-10-23/SMECO_Awards_Prizes_to_Energy_Challenge_Winners.aspx.

——. 2014. "SMECO's Hometown Spirit Energy Savings Challenge: Official Rules." Accessed October 23. http://www.smeco.coop/Hometown%20Spirit%20Energy%20Challenge%20Official%20Rules_10.15.13.pdf.

Taylor, D. 2014. "5 Ways to Use Game Mechanics in Employee Engagement." WeSpire blog, September 26. http://blog.wespire.com/5-ways-to-use-game-mechanics-in-employee-engagement.

Thier, D. 2014. "'Grand Theft Auto 5' Has Sold Nearly $2 Billion." Tech Blog, *Forbes*. May 13. http://www.forbes.com/sites/davidthier/2014/05/13/grand-theft-auto-5-has-sold-nearly-2-billion-at-retail/.

Treacy, M. 2012. "Leafully Wins DOE's Apps for Energy Contest." TreeHugger. May 28. http://www.treehugger.com/clean-technology/leafully-wins-does-apps-energy-contest.html.

VEIC (Vermont Energy Investment Corporation). 2014. "Vermontivate! A Game-Based Approach to Addressing Climate Change." Accessed November 14. http://www.veic.org/our-results/success-stories/vermontivate-a-game-based-approach-to-addressing-climate-change.

Vermontivate. 2014a. "Behind the Curtain." Accessed November 14. http://vermontivate.com/about/behind-curtain.

——. 2014b. "Partners." Accessed November 14. http://vermontivate.com/partners.

——. 2014c. "Learn More About Vermontivate." Accessed November 14. http://vermontivate.com/about/learn-more-about-vermontivate.

——. 2014d. "Team Scoring System: May the Most Vermontivacious Teams Win!" Accessed November 14. http://vermontivate.com/sites/default/files/imce-uploads/vtvt_scoring.pdf.

——. 2014e. "Vermontivate 2014 Official Rules," Accessed November 14. http://vermontivate.com/about/rules.

Vieira, G. 2013. "Vermontivate Gamers Earn Points for the Planet." Seven Days. April 17. http://www.sevendaysvt.com/vermont/vermontivate-gamers-earn-points-for-the-planet/Content?oid=2243342.

Volkswagen. 2009. Thefuntheory.com. http://www.thefuntheory.com/.

Werbach, K., and D. Hunter. *For the Win: How Game Thinking Can Revolutionize Your Business*. Philadelphia: Wharton, 2012.

WeSpire. 2014a. "About." Accessed November 11. http://www.wespire.com/about.

——. 2014b. "Actions May Speak Louder Than Words. But Our Customers' Words Speak Volumes." Accessed November 11. http://www.wespire.com/customers.

——. 2014c. "Our Methodology." Accessed November 11. http://www.wespire.com/methodology.

——. 2014d. "How It Works." Accessed November 11. http://www.wespire.com/how-it-works.

Zandt, N. 2014. "New Approaches to Behavior Programs: Social Media and Gamification: Case Study: SMECO Facebook Competition Pilot." Presentation at the 2014 BECC Conference. April 1. http://www.aceee.org/files/pdf/conferences/mt/2014/E4-Zandt.pdf.

Appendix A: Particular Actions

COOL CHOICES

Adjust your thermostat from 68˚ to 60˚ during when no one is home or while the household is sleeping.
Set your central air conditioner temperature 3˚ F higher.
Adjust the water heater thermostat from 140˚ to 120˚.
Adjust your refrigerator temperature to 39˚ and your freezer temperature to 5˚.
Replace 85% of household incandescent bulbs with CFLs or LEDs.
Replace non-LED outdoor landscape lights with solar-powered outdoor landscape lights.
Replace an older appliance with an ENERGY STAR® model.
Purchase an LED TV instead of a plasma TV.
Turn off lights when leaving the room today.
Turn TV off if no one is watching it.
Watch 2 hours less TV today.
Calibrate your flat panel TV's picture.
Adjust the power management settings on your computer to recommended levels.
Turn the game console off if not in use.
Enable automatic power down of your video game console.
Remove and recycle your 2nd refrigerator or freezer.
Switch your furnace fan setting from continuous to auto.
Insulate the first 6 feet of hot and cold water pipes near the hot water heater.
Use cold wash/cold rinse laundry settings.
Line dry clothing.
Wash dishes with an ENERGY STAR® dishwasher rather than by hand.
Use the stairs instead of the elevator today.
Explore how your home uses electricity.
Hire a professional to do a home performance audit.
Air seal and insulate your home to recommended levels.

Install low-flow showerhead.
Shorten your showers by 1 or 2 minutes.
Replace your toilet with one that uses 1.28 gal/flush or less.
Install a low-flow faucet aerator.
Turn off the water when you brush your teeth.
Only water your yard during early mornings or in the evening to reduce evaporation and interference from wind.
Explore household water usage.

Turn off your computer monitor at work when not in use.
Set work computers to sleep after 20 minutes.
Suggest a way to reduce energy costs at work.
Suggest a practice to save fuel for your organization.
Suggest a new way to save water at work.
Suggest a sustainable purchasing change at work.
Suggest a new way to recycle or reuse items at work.

Use public transit to get to work today.
Bike or walk instead of driving today.
Combine errand trips.
Carpool to work with one other person today.
Slow from 75 to 65 when driving on the highway.
Reduce idling by 5 minutes today.
Avoid "jack rabbit" driving—sudden stops and starts.
Use A/C when driving over 40 mph; turn off A/C and open windows when driving under 40 mph.
Maintain the correct tire pressure for your vehicle.
Remove excess weight from your vehicle.
Track your driving habits.

Recycle an item today.
Recycle old electronic equipment at local recyclers or stores.
Use reusable shopping bags at the store.
Compost food and/or yard waste.
Drink tap water instead of bottled water today.
Suggest a way to share (vs. own) needed but rarely used items with others.
Conduct a waste audit.

Prepare a meatless meal today.
Replace red meat with poultry, fish, or vegetables today.
Feed your household local food today.
Assess your dietary habits.

JOULEBUG

Instead of turning up your thermostat, put on a sweater.
Instead of "hiking the thermostat," dress for the cold.
Buy and use a programmable thermostat.
Adjust your winter thermostat: down 8 degrees when you go out, down 8-10 degrees at night.
Close your curtains to conserve heat (and weigh down the bottoms).
Open south-facing curtains during the day for solar heating.
In very cold climates: use clear plastic sheeting over your windows.
Reduce your need for AC by dressing for the heat.
Adjust your summer thermostat (turn up 8 degrees when you go out, turn up 4 degrees at night).
Close all blinds on hot days.
Use a room fan and turn up your AC 4 degrees.
Use your bathroom vent/fan for 20 minutes after a shower (reduces need for AC).
When it's hot, don't use your oven (use microwave or cook outside).
Caulk your windows and doors.
Caulk leaks in your house.
Seal ducts in your home.
When an incandescent bulb burns out, replace it with a CFL.

Use CFL bulbs, and recycle them appropriately.
Install LEDs.
Buy an ENERGY STAR dishwasher.
Buy an ENERGY STAR refrigerator.
Buy an ENERGY STAR washer.
Get an ENERGY STAR television.
Buy an ENERGY STAR DVD/Blu-Ray player.
Turn off the lights when you leave a room.
Buy a motion sensor for your outdoor lights.
Turn off your computer when not in use.
Get a timer, power strip, or unplug your home theater (another electricity vampire).
Stop electronic vampires!: get a timer for your DVR or cable box.
Only run a full dishwasher.
Let your dishwasher air dry.
Wash your clothes in cold water.
Wash only full loads of clothes.
Clean the lint trap in your dryer.
Dry your clothes outside instead of using the dryer.
Use the vent over your oven and in your laundry room.
Recycle old appliances and electronics like cell phones and CD players (Earth911.com).

Lower office thermostat 2 degrees during the day, 8 degrees at night.
Don't use a screensaver/turn off your monitor.
Get a smart/power strip for electronics.

Take public transportation.
Walk instead of driving.
Bike instead of driving.
Carpool.
Telecommute instead of taking a business trip.
Combine your errands into fewer driving trips to save gas.
Be a "feather foot:" don't accelerate your car, maintain your speed for better gas mileage.
Inflate your car's tires for optimal gas mileage.

CARBON4SQUARE

Aggressively manage HVAC supply temperatures.
Review building temperature set points (consider 74 or above during cooling season and 70 or lower during heating season).
Utilize advanced controls.
Calculate and understand cooling tower cycles of concentration.
Install variable frequency drives (VFDs) on pumps and fans.
Utilize free cooling whenever possible.
Keep conditioned air inside
Cut energy use in vacant spaces.

Discuss day cleaning and/or team cleaning with janitorial staff and tenants, to reduce need for nighttime cleaning and associated lighting.
Conduct nighttime walk-throughs.
Provide Saturday HVAC by request only.
Install CO sensors in parking garages; use to control ventilation fans.
Retrofit lights for maximum efficiency.
Use interior occupancy lighting sensors.
Use exterior photosensors and timers for parking garage and exterior lighting.

Install low-flow flush kits and aerators.
Install a VFD on primary water pump.
Experiment with water heater settings.
Adjust temperature sensors on hot water circulation pumps.
Reevaluate plants' moisture requirements.
Consider installing rain sensors.
Consider alternative water systems.

Incentivize carpooling.
Elicit tenant feedback about commuting alternatives (carpooling, need for more bike racks, etc.).
Start a tenant education campaign.
Track results.

Provide recycling.
Ensure convenient access to recycling.
Monitor use of recycling facilities.
Track results of recycling system.
Encourage tenants to print dual sided.

KUKUI CUP

Estimate your room's total daily energy consumption.
Watch video on how to audit your energy use.
Find out how much power your stuff uses.
Label power hogs in your room.
Examine your lounge's energy use.
Watch video about lighting.
Replace incandescent bulb with CFL.
Use sunlight instead of electric lighting.
Use task lighting instead of overhead lights.
Turn off the lights when leaving any room.
Turn off music when leaving room.
Turn off printer when not printing.
Turn off all appliances every night before going to sleep.
Turn off vampire loads using a power strip.
Configure computer to sleep after inactivity.
Limit TV use to 1 hour a day.

Wash laundry in cold water.
Use stairs instead of elevator.
Do something "unplugged" every day.

Measure shower water flow.
Measure sink water flow.
Turn off water when brushing teeth or shaving.
Turn off water when sudsing and scrubbing in shower.
Reduce shower time by 1 minute.
Wash only full loads of laundry.

Watch video about transportation energy use.
Walk to destinations less than one mile away.
Take public transportation.
Don't drive alone.

Recycle all beverage containers.
Bring reusable bags when shopping.

Watch video about power and energy.
Watch video on energy intuition.
Watch video about solar energy.
Watch video about climate change.

BEAT THE PEAK

Top 10 Ways to Beat the Peak

1. Sign up for one or more of MVEC's Energy Wise programs. Cooling programs—save 10% on all energy usage. Electric water heating and other heating programs—receive half-price rates or bill credits.
2. Increase your thermostat temperature by 4+ degrees on your air conditioning equipment.
3. Limit the use of electric appliances, like your stove, washer, dryer, dishwasher, and dehumidifier. If you need to use a larger appliance, limit usage to one electric appliance at a time. Or wait until the Beat the Peak event is over.
4. Delay using hot water (or shorten your shower), so the demand on your electric water heater is less.
5. Turn off or delay the use of pool pumps and lawn irrigation until after 10 p.m.
6. Turn off any unnecessary lights, appliances or electronics. Vampire loads such as gaming systems, computers, TVs, etc. can be placed on a power strip, making it easier to turn everything off with one flip of the switch. Wait to charge electronics until after 10 p.m.
7. Change your furnace filter for better air flow.
8. Keep your cooling system cleaned and tuned so it runs at optimal efficiency. MVEC offers an AC tune-up rebate!
9. Use shades or blinds and adjust as needed as the day progresses. Southern facing windows normally let in the most heat during summer months.
10. During the summer, direct the airflow down on your ceiling fan, allowing for cool air circulation.

Appendix B: Peripheral Games

ENERGY-RELATED SIMULATIONS AND EDUCATIONAL GAMES

2020 Energy gives the player the chance "to go back in time and to rewrite history" by making smart energy decisions. Players try to improve energy conservation, increase energy efficiency, and choose productive sources of renewable energy. They receive help from a team of advisors (economic, environmental, social) but ultimately must make all decisions themselves as they try to rewrite society's energy history. http://www.2020energy.eu/en/serious-game
http://www.2020energy.eu/en/about-project
https://itunes.apple.com/en/app/2020-energy/id577118438?mt=8

Climate Defense is a single-player game in which the player is in a race against time to mitigate global warming. As ominous dark clouds of CO_2 travel from earth's surface to the atmosphere, the player has three main options: growing trees, decreasing CO_2 emissions, or improving energy efficiency. Unfortunately, the game is not winnable since it is based on current real-world data. The player can play another version of the game where the data are modified to beat back climate change, but the title of this version—Let's Pretend—says it all.
http://www.gamesforchange.org/play/climate-defense/

ElectroCity is an online game designed to educate students about energy and sustainability in New Zealand. A player starts the game as mayor of a small city. The city begins as a pristine natural environment with few inhabitants and one small wind farm, but it grows and changes depending on the player's decisions, e.g., logging a forest, prospecting for gas or coal, upgrading the wind farm. Meters inform players about the status of their electricity supply, the health of their environment, the happiness of their population, and so on. Players must make numerous decisions that balance growth, environmental protection, economics, and quality of life.
http://www.electrocity.co.nz/About/
http://www.electrocity.co.nz/HowToPlay/default.aspx

EnerCities is an animated game aimed at young people of high-school and college age in which players try to build, expand, and sustain virtual cities while confronting the challenges of pollution, energy shortages, and the development of renewable energy.
http://www.enercities.eu/project/projectpage.html
http://www.gamesforchange.org/play/enercities/

Energy City is an online simulation game in which the player must provide power to a city for either 10 (standard) or 20 (expert) years. The challenge is to power the city while also monitoring the metrics of local air quality, global environmental health, and budget, and to prevent these metrics from bottoming out. Players try to create diverse energy portfolios from four categories: nonrenewable, renewable, inexhaustible, and conservation. They may also incorporate the views of stakeholders representing a range of demographics. If the city runs out of energy, the game is over. Players receive data and feedback about their performance after each turn and each complete game.
http://content3.jason.org/resource_content/content/digitallab/8250/misc_content/public/popup.html

Energyville is a game produced by Chevron in partnership with the Economist Intelligence Unit. It appears to be aimed at a high-school age population. Players are responsible for supplying energy to a city of 5.9 million people "while keeping them prosperous, secure and living in a clean environment." Potential power sources for the city include biomass, coal, geothermal, nuclear, petroleum, natural gas, conservation, and more. Players get an energy management score based on their use of these resources and their respective financial, security, and environmental impacts. There are limitations on how much of each source can be used, and a requirement that at least some petroleum be included for vehicles.
http://www.energyville.com/energyville/
http://teachinghistory.org/digital-classroom/tech-for-teachers/25173

Eskom Energy Planner puts a player in charge of a virtual city's energy portfolio. The goal is to use a combination of energy sources and to achieve a balance between efficient and environmentally friendly technologies. Players also have to locate their power plants strategically, taking into account impact on residents and physical requirements (e.g., a hydroelectric plant must be placed near a river).
http://www.formula-d.com/interactive_electricity_planner_game.html

Ludwig is a little research robot who crashes onto an abandoned planet Earth in the year 2098. He must rebuild himself and find new sources of energy in order to get back to his home planet. Unfortunately, humans long ago depleted the earth's resources, leaving Ludwig in a dire situation. As the player moves through the game, a knowledge base fills up with everything Ludwig learns about his new environment, producing a concept map of knowledge about renewable energy. The game is designed to teach physics concepts like combustion, water power, wind energy, and solar energy. http://store.steampowered.com/app/263120/

MySustHouse includes three games and several educational videos, as well as a guide for teachers wanting to integrate the project into their curricula. The three games—Environment, Building, and Town—challenge students to develop sustainable communities and houses. In each game, a simple Sustainability Meter swings from low to high depending on the player's decisions. To get players started, an introductory video explains the limitations and consequences of fossil fuels and highlights present and future effects of climate change. In the Building game, the player is given a lot on which he must build a house. An accompanying introductory video explains fundamental concepts such as the embodied energy of concrete, the advantages of local and renewable materials, and the health impact of toxic materials such as asbestos and lead. The player has a finite budget and can monitor his spending via an onscreen meter. The Town game requires the player to build not only houses, but also transportation infrastructure, schools, and energy sources. Players are introduced to the difficulties of energy decision making: for example, they can view a set of videos in which people debate the building of a nuclear power plant. The Environment game asks players to think about the impact of their choices: for example, living in a city reduces energy and transportation costs, but living in a rural environment may facilitate the use of renewable energy. A video explains the difference between brownfield and greenfield sites.
http://www.mysusthouse.org/_pdf/mysust_house_introduction.pdf
http://www.mysusthouse.org/game.html

Power Planets was a resource-management simulation game designed to coordinate with a Science Channel TV show called "Powering the Future." The game was embedded within Facebook and designed for multiple players. Each player began the game by managing his own miniature planet, which he had to supply with energy from diverse sources: coal, oil, natural gas, wind, solar, and more. Part of the game involved investing in research to develop these technologies; other parts of the game involved constructing buildings, generating income, and managing pollution. Players climbed the leaderboards by balancing "immediate payoffs, investments in future opportunities, and long term sustainability." Every few days a "planet handoff" occurred, in which every player received the planet previously managed by someone else, potentially encouraging players to think about the implications of their actions for future generations.
https://www.facebook.com/media/set/?set=a.449848721487.239719.173287921487&type=3

Ringorang is an energy trivia app mainly designed for smartphones. Questions are sent automatically to players' phones, popping up like text messages. (A promotional video shows men and women pausing to answer a quick question while drinking coffee, exercising, or at the office.) Multiple-choice questions are designed to be playable in less than a minute. Examples include "Penny Pynchon hates leaving her AC on all day while she's at work, but she can't stand coming home to a hot apartment. What should she do?" and "Set your water heater no higher than what temperature to save money without sacrificing comfort?" Players can click on a Clue button for help answering questions; to learn more about the issue, they can click on an Insight button. They earn points for answering questions correctly, and may ultimately win gift cards. A leaderboard gives players' rank compared to others. As players progress with the game, Vergence (the developer) collects data on their performance and knowledge retention, and uses this information to provide the sponsoring host with analytics about its customers.
https://itunes.apple.com/us/app/ringorang/id567781122?mt=8
http://play-learn-win.com

The goal of *Siemens Power Matrix* is to manage the energy of a city using a balanced mix of power plants, wind, solar, and hydropower. As in ElectroCity, the player's city begins as a rural district. With the addition of power plants, the population grows, industry arrives, and buildings are constructed. There are many power options to learn about and build: wind farms, solar, biomass, and more. Players can also trade surplus power with other players. They have a control center where they can see data and graphs of their energy portfolio, their scores in various categories (happiness, population, technology, production, consumption, trade, income), and their rank among other players.
http://www.powermatrixgame.com/en/index.html
http://www.powermatrixgame.com/en/features.html

SimCity EDU: Pollution Challenge! is designed for grades 6–8; it offers teachers lesson plans, analytics, and other tools to help them integrate the game into existing curricula. The premise of the game is that students are the mayors of their own cities and must balance environmental impact/sustainability, employment, and quality of life. The game offers four different missions at varying levels of difficulty.
http://www.glasslabgames.org/games/SC

http://vimeo.com/102270816

CHILDREN'S ENERGY GAMES

In *Eco Ego*, a small human-like figure goes about daily life while the player watches and is asked to make a series of choices with environmental implications. The player can choose to turn on or off appliances (e.g., TV, videogames), whether to drive or bike to the market, whether to use plastic or reusable grocery bags, what type of food to eat, and more. Two meters on the screen, "Ecology" and "Stress," rise and fall depending on the player's decisions. As the Ecology meter rises, bluebirds arrive and settle atop the house, which is built inside a tree. If the Ecology meter remains high, other healthy things happen: the treehouse sprouts more branches, flowers grow, penguins appear on an iceberg, and so on. At the end of the game, an underperforming player receives this message: "If you had chosen differently, we could now be living in a healthier environment."
http://www.dayfungames.com/play-online/eco_ego.html

In *Energy Elf*, a simple online, single-player game developed through the U.S. Department of Energy, children try to stop an "Energy Goblin" from "gobblin'" up all the energy in a cartoon home. The Goblin is an odd-looking blue creature with a long nose that (noisily) sucks energy from appliances, windows, light bulbs, and so on. As a timer ticks down, the player explores different rooms in the house and clicks on different objects (appliances, windows, lights, computers) looking for ways to save energy. For example, clicking on the home's refrigerator results in a gentle alert sound and a pop-up window explaining that ENERGY STAR certified refrigerators are the best choice. There are also explanations about power strips, curtains, light bulbs, computers, and more. At the end of the game, children are invited to play again and find more energy-saving options, and they are encouraged to "Help lead the way and talk to your parents about making your home more energy efficient!"
http://www1.eere.energy.gov/education/games/eere.html

FUNergy! Lolly vs. the Energy Monkeys is a simple online game in which Energy Monkeys are stealing too much energy from a home and the player must stop them by clicking on energy-wasting objects, e.g., a half-empty dishwasher, a running faucet, a refrigerator left open. With each click, an explanatory bubble appears and gives energy-saving tips. The game's loud noises are likely to annoy parents. There is an accompanying trivia game called "Watts the Answer" that asks basic energy questions (e.g., "True or False: A low energy lamp costs less to run than an ordinary light bulb").
http://www.cwndesign.co.uk/funergy/game/index.html

GreenSpace challenges players to reclaim a litter-laden colony and restore it to a lush, green mountain valley full of trees and solar-paneled houses. The game is embedded in Facebook and is similar in premise to Trash Tycoon (see below).
http://blog.games.com/2011/12/06/greenspace-facebook-game/
https://www.commonsensemedia.org/game-reviews/greenspace

Lights Out! is an online game with a simple premise: the player must race to replace traditional light bulbs with CFLs as quickly as possible, and then turn off all lights and devices in order to win. Using the arrow keys and spacebar on a standard keyboard, the player moves the character of CFL Charlie around a virtual house. Old lights glow yellow; the ones replaced with CFLs glow blue. A meter to the left of the house calculates the number of watts being burned as the player progresses.
http://www.kidsenergyzone.com/games/activitiesdetail63.cfm?activityid=8

Unplugged (Lachez Prise) was developed by the Science Center of Montreal. The player is given the identity of Inspector 00Watt and must combat the monster Terawattus Energivorus, who has possessed the residents of a haunted-looking house, causing them to waste "tons of energy." The player must free these people by hunting through the house (in five rooms and a backyard) for six energy-related objects that can be used to improve the home's energy efficiency. There is a time limit of nine minutes. A sinister yellow-green color scheme and haunting wind noises give the game an ominous atmosphere during the introduction. Once the game begins, the house erupts with various annoying noises, moving parts, characters, and animals (rats and cats).
http://www.lachezprise.qc.ca/en/index.html

OTHER SUSTAINABILITY GAMES

GB Recycle, or *Greenbean Recycle* incentivizes the recycling of glass, plastic, and aluminum containers through its "reverse vending machines" that reward recyclers with cash. Once you have registered, you identify yourself at the GB machine when you have something to recycle by typing in your phone number; as soon as you deposit your container, you see your results instantly online. Cash is directed into a PayPal account, a student cash account at a university, or to a charity of your choice. Players can form teams and also have the option of making the game social via Facebook. GB also offers challenges that increase potential rewards for recyclers. GB machines are currently on college campuses in the Northeast, but the company's founders want to expand to sports arenas, airports, and other large venues.
https://gbrecycle.com
https://gbrecycle.com/extra#challenges

The *SunPower Solar Discovery Game* was developed by a San Jose solar-panel company. Players earned points and badges by answering trivia questions about solar energy. Finding the correct answer might require a player to explore SunPower's website, thus increasing awareness of the company and its products. Players competed for an attractive grand prize: a $25,000 residential solar energy system. There were also raffles for large prizes (airfare to Hawaii) and small ones (museum tickets). http://www.greenbiz.com/news/2011/07/12/sunpower-turns-gamification-engage-customers

Trash Tycoon is an animated waste-management game embedded in Facebook, and therefore entirely virtual. The goal is to make a virtual city cleaner and greener by collecting and sorting trash to be recycled and upcycled. Players can use their collected materials to create new items that enhance the environmental health of the city, such as windmills, flowers, and recycling bins. Players can compete with other Tycoons via Facebook.
http://www.treehugger.com/culture/where-some-games-plunder-trash-tycoon-stands-apart.html