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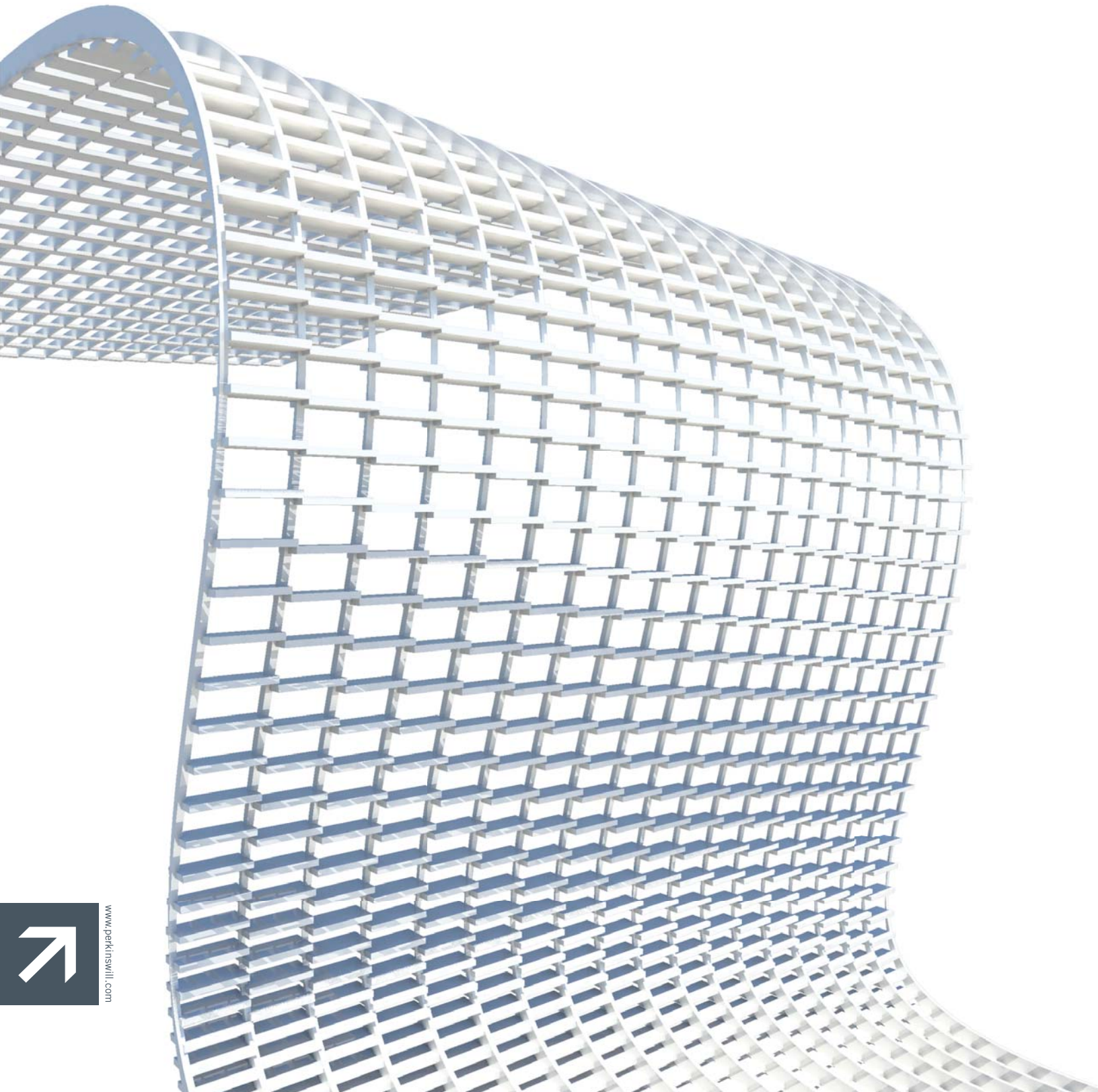

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01.
A STUDY OF OCCUPANT ENGAGEMENT:
Energy Reduction Using an Online Competition Dashboard

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ABSTRACT

It is well known that occupant behaviour is a factor that affects a building's energy performance. While a good deal of study and research has been done on residential energy use, less research has focused on the behaviour of commercial office occupants. This paper explores how occupant engagement, coupled with a web-based energy challenge, can help identify opportunities for energy consumption reduction in buildings and lead to changes in building operations.

In a two-week energy competition using energy management software from Pulse™, more than 600 employees in seven offices were engaged in energy-conserving behavior that was aimed at reducing office energy use by ten percent per office. The primary theory tested within the study was whether an energy competition (focused on an electric car race) would be more compelling than simply displaying real-time information to building occupants. There were thousands of visits to the Pulse™ competition webpage, with most visits occurring during the final week of competition. The competition resulted in some office locations achieving daily reductions of energy consumption of up to 40 percent. Overall, the competition saved more than two Megawatt hours of electricity. The study revealed that harnessing rivalries using an electric car race resulted in greater than anticipated energy savings. The observations and lessons learned may inform upgrades to existing buildings and also potentially inform energy systems design.

KEYWORDS: occupant engagement, actual energy performance, metering and monitoring, dashboard, community based social marketing, behaviour change

1.0 INTRODUCTION

The buildings architects and engineers design do not always perform as intended. The ASHRAE 90.1-2004 User's Guide points out that energy modeling is not meant to provide "an accurate prediction of actual energy consumption or costs for the building as it is actually built", but to provide a baseline for comparing design strategies or for the purposes of comparison under a green building rating system[1].The rationale for the proposed use of an energy model is largely based on the impossibility of predicting performance given the number of factors that can affect a simulation's outcome in the real world. One of the most poorly understood factors within these simulations are the behavior patterns of the building occupants. In a 2006 study by Lawrence Berkeley Labs and the USGBC, it was found that modeled energy consumption of 21 LEED buildings deviated significantly from actual performance. The actual energy consumption in one case was more than 400 percent better than the modeled design and in another was 55 percent worse[2]. While modeling error or a lack of information about building schedule or use are likely culprits for some of the deviation, there is no doubt that how the occupants or facility managers interacted with the building systems played a role.

The effects of behaviour are so powerful that the consumption in identical households – even those designed to be low-energy dwellings – can differ by a factor of two or more depending on the behaviour of the occupants[3]. Unlike filling a car with gas (a person knows how much he or she pays before they start driving), a building's energy bill comes after the energy has been consumed. Energy utilities around North America have begun to work with different visualization techniques to encourage energy reduction, but the gap between energy-consuming behaviour and the energy bill remains. The addition of real-time metering to solve this critical infor-

Table 1: Participating offices.

Office	Employees	Gross Area	Heating/Cooling Supply	ASHRAE Climate Zone[4]
Charlotte	30	1,449 m² (15,600 ft²)	VAV	3A
Chicago	272	6,039 m² (65,000 ft²)	Fan coil	5A
Miami	50	715 m² (7,700 ft²)	VAV	1A
Raliegh	28	771 m² (8,300 ft²)	VAV	4A
San Francisco	100	1,858 m² (20,000 ft²)	VAV	3C
Seattle	30	1,115 m² (12,000 ft²)	Electric/Passive	4C
Vancouver	93	1,951 m² (21,000 ft²)	Electric/Passive	5C

mation gap often yields only a minor effect on energy use, which is a topic covered in greater detail in section 3 of this paper.

While the study and engagement of the residential market has been substantial for the last four decades, the commercial sector is more poorly understood. Building operators and policy analysts have begun to take actions to engage occupants who do not see financial returns on the energy that is saved by their thrifty behaviour. Behaviour that reduces energy use is a harder sell when the financial benefits are not paid back directly to the occupants. Instead, the nature of competition between individual colleagues or different offices can be a more powerful driver than financial gain. Utilities have also begun to explore this effect within billing data.

As part of a campaign to conserve energy and test how far occupants could be engaged without direct financial reward, Pulse™ worked with Perkins+Will to create and administer an energy savings competition involving seven offices across North America.

A web-based energy visualization tool (here after referred to as a "dashboard") was developed for employees to track and monitor real-time energy usage. Results of a survey conducted showed a positive response to the competition, but revealed some needed changes to the communication around setting baselines and measuring relative performance.

2.0 EDUCATIONAL EFFECTS ON OCCUPANT BEHAVIOUR

Research has been conducted in the field of occupant engagement heavily since the energy crisis of the 1970s. Many government organizations in the United States started using large scale education initiatives to reduce home energy use. To study the effects of education alone, psychology staff from the University of Virginia looked at the impact that intensive workshops had on residential energy conservation. Participants were exposed to three hours of education in a variety of formats. All of the material had been designed to impress upon participants the possibility of reducing home energy use significantly through simple behaviour changes. The participants' attitudes and beliefs were tested before and after the workshops. While attendees indicated a greater awareness of energy issues and more appreciation for the many things that could be done to reduce utility costs and save resources, this awareness by more than 40 workshop participants only translated into the lowering of thermostats on hot water heaters (after three hours worth of information). Two participants did place insulation around their hot water heaters, but they had done so before the workshops even began[5].

With the knowledge of how to save energy and the awareness that it will save money, most people will continue to behave in ways that consume large amounts of resources. A significant number of barriers stand in the way of more sustainable behaviour, such as inconvenience and indifference, which means that information campaigns alone will rarely change behaviour, since they only address one of the many barriers to behaviour change[6]. The lack of building specific resource reduction associated with typical behaviour becomes even greater when the person occupying the space is not paying the bills. Many employers and designers have, therefore, turned to automated or "smart" building sys-

tems to attempt to overcome these variations in behaviour. For example, it is difficult to find an airport anywhere in the world today where the faucet is not spring loaded for 5 to 10 seconds of water or motion activated.

The ability to automate a system is limited and building occupants can outwit the smartest building systems and technologies. In the study of a hotel kitchen, it was found that even though kitchen staff were given microwave ovens and other warming devices, many still ran hot water over food for extended periods of time to thaw it. It was estimated that educating the staff and having the kitchen manager be responsible for the water bill of the kitchen (rather than bundled with the overall hotel bill), could save an estimated 2,500 gallons per day (or $7,000 annually) for the hotel studied[7].

3.0 METERING AND CONTEXTUAL VISUALS

A study conducted in Holland revealed that providing households with real-time information about energy conservation did not reduce energy use[8]. A similar Swiss study of 64 pilot projects using only energy meters was conducted to better understand the efficiency gains generated by smart metering and monthly billing showed a poor saving potential. After eliminating studies that had methodological weaknesses and low explanatory power, the study showed energy savings of just 1 to 2 percent. With direct feedback to the building occupants, additional savings in the order of 1 to 2 percent were realized[9].

Greater success is likely achieved with metering where community based social marketing (CBSM) takes place or where energy billing can be tied to simple visual cues.

CBSM is the principle that initiatives are more effective when they are carried out at a community level. The approach as written by McKenzie-Mohr and Smith is to "identify barriers and benefits to a sustainable behaviour, designing a strategy that uses behaviour change tools, piloting the strategy with a small segment of a community, … evaluating the impact of the program once it has been implemented across a community.[6]"

Energy information systems (EIS) software is an effective tool in most CBSM campaigns. In a recent study, CBSM was used in conjunction with EIS software to show a 12 percent electrical savings on three floors of an office building located in Victoria, British Columbia. On one floor there were occupant switches, on another there was daylight dimming and automation and on the other there were no lighting measures. The report suggested that employee behaviour changes can deliver reduction in energy consumption over and above technological measures such as installing photo sensors or light switches with dimmable ballasts. This was demonstrated by the greatest savings being achieved by the floor that had only manual occupant switches[10].

Research conducted to explore the effects of competing within a neighbourhood has proven popular with utilities. U.S. based software company, O-Power, compares households' energy consumption by adding a social element to conservation. The company works with local utility companies, which use its software to add persuasive information to customer bills. Instead of just listing each household's own energy use, it adds information for households on the same street showing how the consumer measures up in comparison to all of the household's neighbours as well as the most efficient households on the street. A home with low energy use is encouraged with smiley faces beside their usage (as seen in Figure 1)[11].

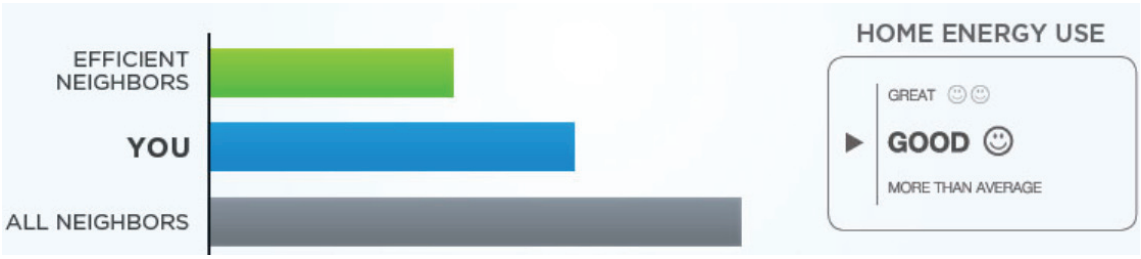

Figure 1: O-Power billing graphic[11].

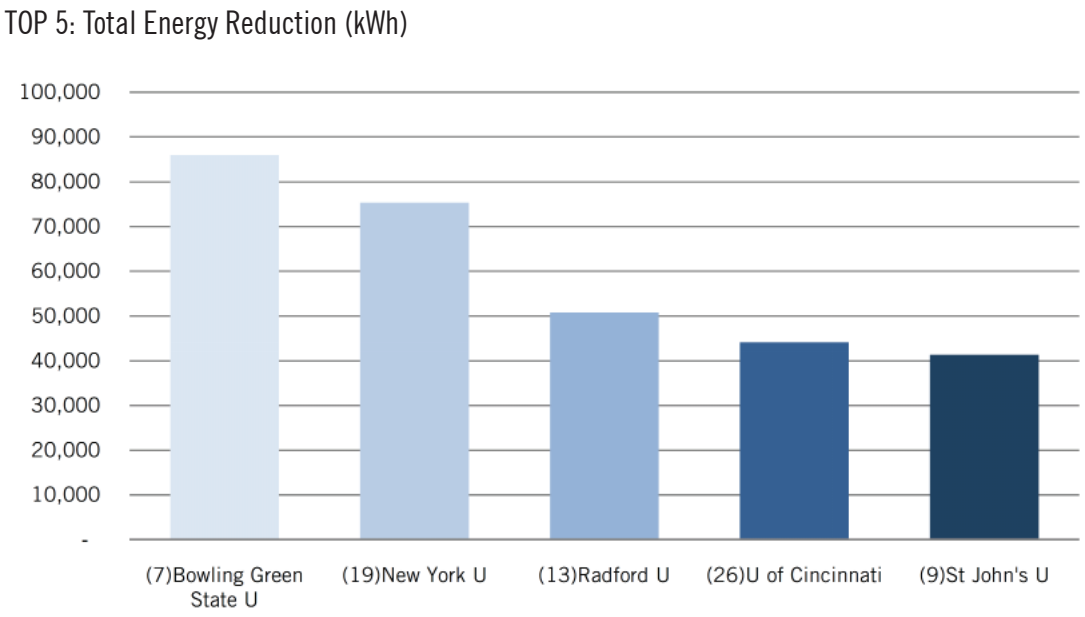

Figure 2: Campus Conservation Nationals energy reduction (kWh).

The graph above shows the kWh savings of the top five campuses. The value in brackets ( ) represents the number of residential buildings participating in the competition.

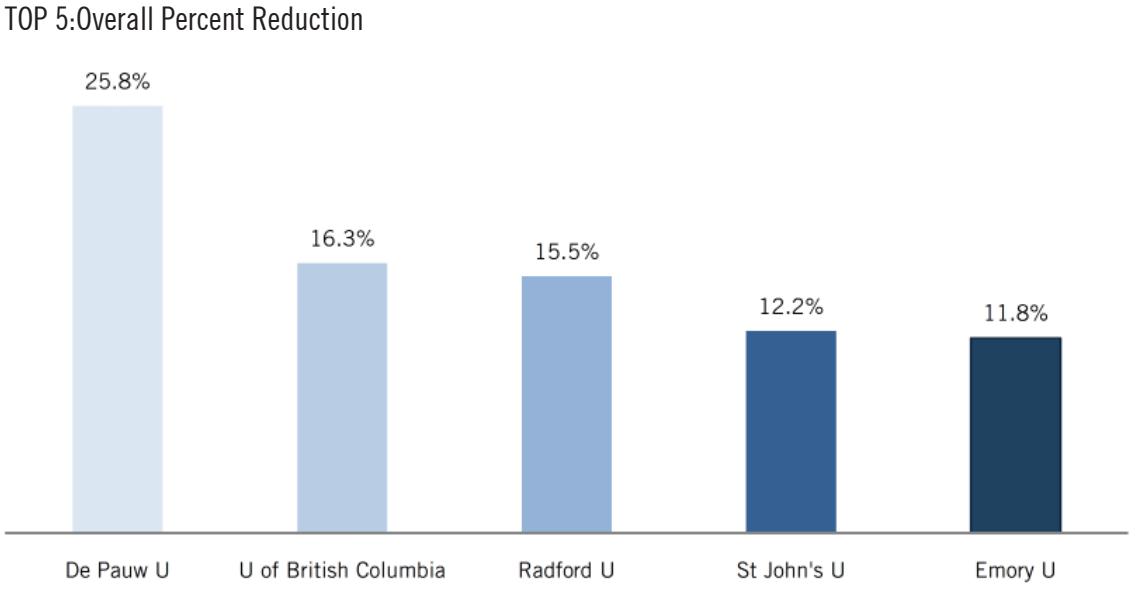

Figure 3: Campus Conservation Nationals energy reduction (percentage reduction).

The graph above shows the percentage reduction (another metric to show a winner) of the top five campuses. It is unclear what specific measures were implemented to achieve these savings but the competition website suggests that they were largely behaviour-driven.

These powerful visuals have begun to be a major element in behavioural campaigns around energy reduction, as they both contextualize energy consumption and encourage competition.

4.0 COMBINING METERING, VISUALS CUES AND COMPETITION

Another U.S. based software firm, Lucid Design Group out of California, has created an energy competition dashboard that has proven to be very effective in campuses across North America. The Campus Conservation Nationals 2010 engaged more than 40 college and university campus residential houses. Some of the results from this competition can be seen on the page 10[12].

While a research paper on this competition has yet to be published, the three week competition hosted on November 1 to November 19, 2010, shows that the power of peer pressure and campus rivalries can work to save more energy than metering and displaying the information alone.

5.0 CHOOSING A COMPELLING COMPETITION VISUAL

While a simple arrow or line is often sufficient to convey when one team is ahead of another, the creation of a more compelling visual was desired for the energy competitions used by Perkins+Will. An electric car race was chosen as the competition metric for success. The car race was chosen since it was expected that employees would react more strongly to a race rather than a simple comparison graphic (i.e. bar charts). The more energy an office saved, the more energy (measured in kWh) that propelled the electric car forward. After the metric was chosen, Pulse™ began work on how to best make the visual compelling and accurate. A great deal of work was done by Pulse™ to ensure that the metric could be scaled to an office of any size (as a larger office had the potential to save more energy). Rather than create complex algorithms to address the issue, a simple system was put in place so that larger offices were given more cars to move forward rather than one (which did not appear in the visual to avoid confusion.) While it was explained via email and through the Pulse™ dashboard that the competition baseline was being set for each office to eliminate any perceived advantages, survey results showed that many employees did not understand this subtlety.

The hope was that a competition based on an electric car race would be more compelling than a simple competition based around a quantity of savings. A map was later added by Pulse™ to help further enforce the idea that the energy saved could move a vehicle a set distance. An email was sent to the Vancouver office during the initial competition that read “Help propel our electric car to Seattle so we can drive there, knock on their door and say ‘You lose!’” The close working relationship and rivalry between the Seattle and Vancouver offices would prove to be a significant factor in the amount of energy the two offices saved. The survey results confirmed that the electric car race was seen by the survey participants as the most compelling piece of the competition visuals[i].

A live feed comment box that anyone could see online was added to the competition dashboard by Pulse™. The idea behind the live feed was that employees could write about the energy reduction strategy they would be implementing and others could indicate whether they were doing the same action (through a “did this” button). The goal was that this type of social media interface would encourage participants to take on the positive behaviours of their peers. While many employees used the tool in this manner, many also used it as a way to goad other offices and further challenge office participants. One exchange gives some insight into the competitive nature of the West Coast offices and the level of hyperbole used within the live feed comment box.

- Seattle: “Seattle turned off all lights in the studio space. We are considering unscrewing the emergency lighting if needed.”
- San Francisco: “We have all shut down computers and are all drawing by hand.”
- Vancouver: “We’ve started using beeswax candles for both light and heat. We’re considering replacing printers with a Gutenberg printing press.”

In these types of exchanges the “did this” button took on the role of the comment portions of social media sites with each response bringing more energy and creativity to the competition. While it is unclear if the live feed did anything to improve energy performance, it did serve to bring people back to the competition dashboard to see how an office was performing.

[i] Other competition visuals are discussed further in section 10.

6.0 SETTING THE APPROPRIATE COMPETITION BASELINE

In the inaugural test to explore how much energy could be saved through behavior and simple operating strategies alone, the Vancouver office challenged the Seattle office between September 20 and September 24, 2010. These two locations were the perfect testing ground as both offices:

- Had almost identical Energy Use Intensities (EUI) of around 100-110 kWh/m²/yr (31.7-34.9 BTU/ft²/yr.
- Were in the same general climate (4C).
- Were passive heritage buildings with no cooling.
- Were 100 percent electrically powered with the entire office space reflected in the dashboard.

The EIS used a baseline point to create a standard for each location's energy consumption. The baseline point is a critical benchmark against which the success of future energy and environmental strategies can be measured. It functions as a meaningful line of comparison by predicting what the power values would have been if the savings measures had not been adopted. For the Pulse™ software used, a baseline point is essentially a streamlined typical curve point with a forced end date. The end date means that only readings during the baseline period are being used to build the predictive model. The typical curve represents how a building typically performs under similar conditions. It is based on historical behaviour and correlates with weather conditions, time of day, day of week, month, season and other available variables such as occupancy rate. A typical curve predicts the readings of a point based on a number of variables, some of which are definable and some of which are automatically determined by the system. If a typical curve point is added to a chart, it will show how the building would normally perform during the time frame selected[13].

After completing the necessary baseline point analysis, a target of a six percent energy reduction was set. It was calculated that a six percent reduction would be equal to a car travelling a distance of 70 miles in five days of consistent savings. By the end of day four the competition ended, as both offices had surpassed this target with Vancouver going 177 miles (136.9 kWh) and Seattle finishing with 87 miles (22.48 kWh). It also became apparent on day four that something had changed in the Seattle office as the previous days savings of 7.82 kWh could not be duplicated. A short call to the Seattle office revealed that the likely culprit was a seasonal setting on the thermostat that implemented a fall heating mode when heating was unnecessary. With the building system overriding the occupants, it was not possible to continue the competition until the system could be overridden. The result of the beta testing phase enabled Pulse™ to fine-tune the energy savings baselines for the buildings participating in the firmwide contest. It also became apparent that an un-automated building had the greatest potential for occupant-led energy savings (see below for competition #1 summary)[14].

The greater kWh savings difference from the competition race results are due to the size of the Vancouver office (2,107 m²/22,670 ft²) compared to the Seattle office (1,115 m²/12,000 ft²). Vancouver was given 1.5 cars in order for the race to remain competitive as a relative energy reduction competition. As the fifth day of competition saw almost no savings in the Vancouver office, another tactic was devised to attempt to create competition without another office participating.

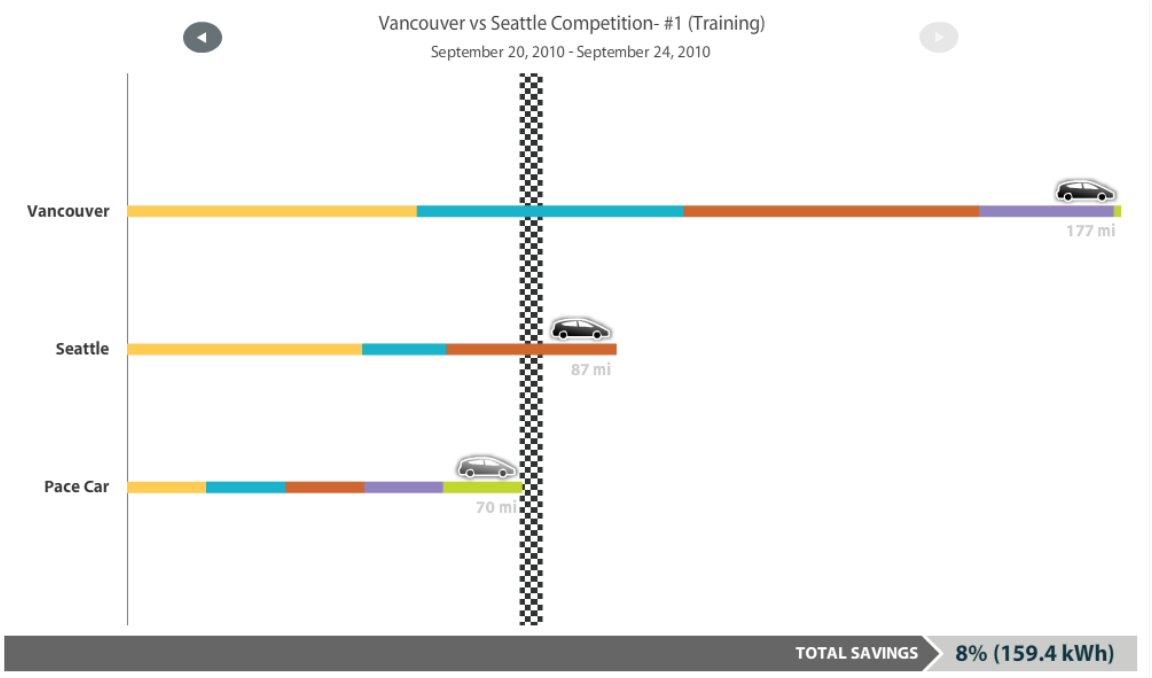

Figure 4: Competition #1 online screen capture showing mileage and percentage reduction[14].

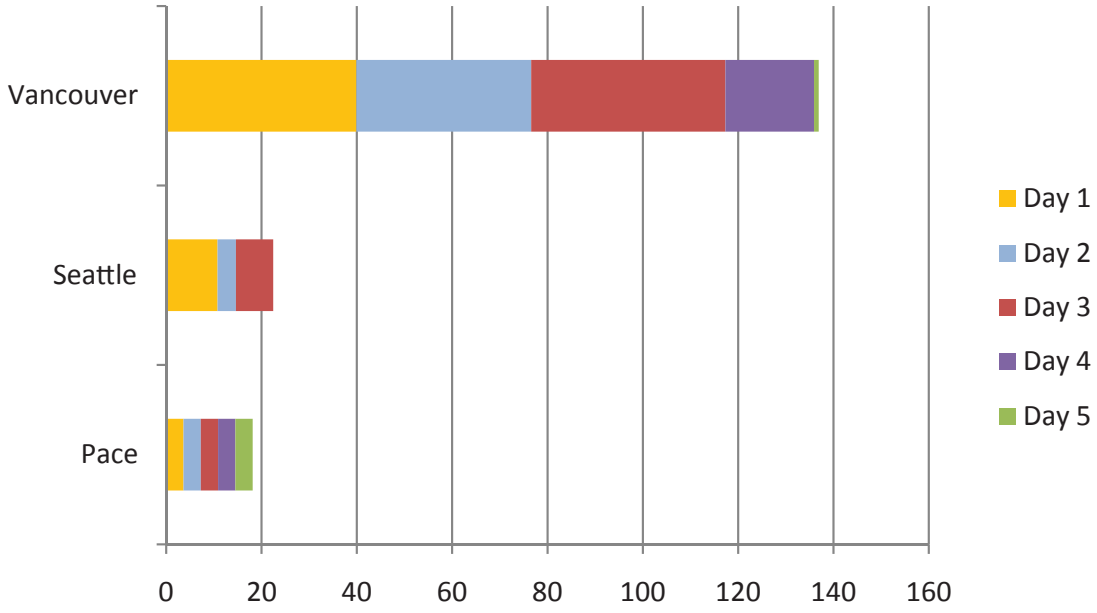

Figure 5: Competition #1 summary of daily kWh savings[14].

Figure 6: Competition #2 online screen capture showing mileage and percentage reduction[15].

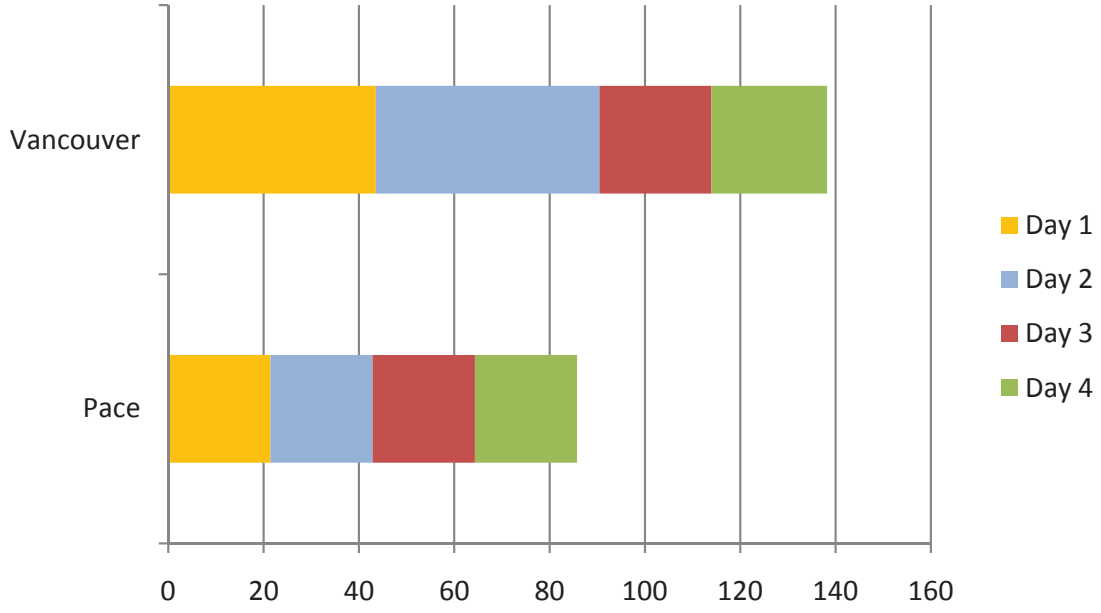

Figure 7: Competition #2 summary of daily kWh savings[15].

The following week a "workstation challenge" was undertaken in the Vancouver office. The office would compete against a pace car while two electrical usage monitors ("kill-a-watt") would be placed on two selected workstations. Without telling anyone which workstations were being monitored, the test was to see whether the Vancouver office could save more than the previous week's 136.9 kWh. Without knowing whether they were competing against their colleagues the entire office managed to save 138.2 kWh in only four days, suggesting the energy reduction would have been greater than when the Vancouver office was competing against the Seattle office. The difference after the competition in the two metered workstations was less than 5 percent (even though one desk was near the atrium's natural light and the other was near the stairwell with limited natural light). The desks were chosen as both employees shared the same working hours and were known to have good conservation habits. This suggests that competition amongst the employees (not knowing if they were chosen) drove the reductions in the absence of a visible competitor (see below for competition #2 summary)[15].

Based on the success of the pilot projects, Perkins+Will then took seven offices from across North America to further test the competition on a wider scale.

7.0 PERKINS+WILL ENERGY CUP

The Energy Cup elimination rounds were launched in October, 2010. Chicago, Miami, Raleigh, Seattle, Charlotte, San Francisco and Vancouver competed in one round, three-pool championships. The winners of each pool faced off in a week-long final. The chart below shows the competition brackets.

During the two week competition, more than 600 employees engaged in energy conserving behavior with thousands of visits to the Pulse™ competition dashboard. As a result, some Perkins+Will office locations (namely Seattle and Vancouver) achieved daily reductions of energy consumption of up to 40 percent[16]. These savings were a result of the drastic operational and behavioural actions taken by these offices (as detailed in section 8 and 9).

The final included Vancouver, Seattle and Miami. While only two teams were set to compete in the final in the original proposal, it was decided that both Seattle and Vancouver would advance to the Energy Cup. Since the teams had developed such a positive rivalry and no clear winner could be agreed upon, it was determined by Pulse that continued competition between the two offices would likely lead to greater reductions in the final week of competition.

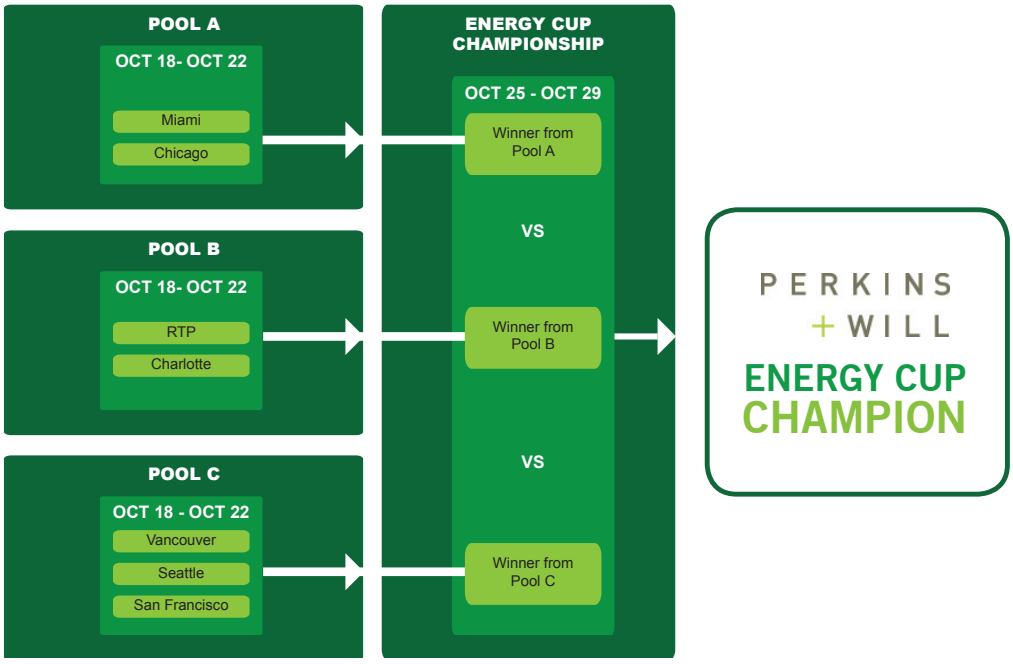

Figure 8: Perkins+Will Energy Cup competition schedule.

Table 2: Details of Perkins+Will Energy Cup reductions.

Office	Energy Reduction	GHG reduction	Local GHG of Utility
Chicago	19.56 kWh	723 g CO_2e	37 g CO_2e /kWh
Miami[i]	376.4 + 397.6 = 774 kWh	455,886 g CO_2e	589 g CO_2e /kWh
Charlotte	105.5 kWh	60,480 g CO_2e	576 g CO_2e /kWh
RTP[i]	146 + 38.78 = 185 kWh	106,560 g CO_2e	576 g CO_2e /kWh
San Francisco	170.5 kWh	43,350 g CO_2e	255 g CO_2e /kWh
Seattle[ii]	217.9 + 236.5 = 454 kWh	62,652 g CO_2e	138 g CO_2e /kWh
Vancouver[i]	249.4 + 363 = 612.4 kWh	22,658 g CO_2e	37 g CO_2e /kWh
TOTAL	2320.96 kWh	752 kg CO_2e	

[ii] These offices competed in the preliminary round and the final. Week one and week two are therefore shown.

Competition summary results from the two weeks include:

- Average energy reduction was 16 percent across the entire competition, with some offices saving over 40 percent on certain days.
- Reducing energy consumption in the offices saved a total of 750 kg (1653 lbs) of greenhouse gas emissions.
- The competition generated great interest in energy reduction within the firm as evidenced by 3000 website visits to the competitions dashboard (the firm has approximately 1500 employees).

The table above shows results during the two-week period. Offices that only competed for one week show only a single kWh energy reduction value, whereas the four other offices competed in both the preliminary round and the final. Miami's apparently large energy reduction is a result of a comparison with the only baseline available for the office at the time. The two weeks prior to the competition start saw a malfunction in the office HVAC system with non-stop cooling occurring 24 hours per day and employees bringing in electric baseboard heaters for warmth. As a result the office was able to save a considerable amount of energy from this baseline. It is worth noting that while Miami fixed this issue before the competition, the office also saw the highest persistent savings after the competition with no return to anything resembling the pre-competition baseline (the energy cup was handed from Seattle to Miami on April 26th 2011 for this reason). A clear explanation for the lack of savings in the Chicago office has yet to be properly defined. Energy data from this office shows the space performs in a consistent and predictable manner regardless of the time of year. Anecdotage evidence from emails and conversations with Chicago employees suggests the lack of savings may have resulted in a decrease in interest in the competition after the office came out to a very slow start (and Miami a very quick start) in the first week. This cannot, however, be confirmed as evidence for a lack of energy reduction during and after the competition as various other factors could be affecting the Chicago office's lack of energy reduction.

The final week of competition saw an overall savings of more than a Megawatt hour of energy with the two week competition saving more than two Megawatt hours. The combined area of the offices that achieved this level of savings was approximately 3,940 m² (42,400 ft²).

The Energy Cup saw no clear winner with the final decision being made to declare a tie between Vancouver and Seattle. While seen by some as an unpopular decision by the arbiter (Pulse™), no one was prepared for how close the final results would be. A lesson learned for future competitions was to be clearer about the actual end of the competition. An email was sent out confirming that "at noon PST the winner will be the office who has driven the furthest". The issue came when it was realized that due to a time delay of 12 minutes between when the information was collected and when it was displayed on the dashboard meant there was some confusion about when the competition was finished. Vancouver was the winner at 12:00 PST (by 1 mile) but Seattle had pulled ahead by 2 mile at 12:12 PST. As a result the Energy Cup was initially shared by these two west coast offices.

8.0 BEHAVIOURS OBSERVED DURING THE ENERGY COMPETITION

Notes were taken during the competition and behavior observed through field study in the Vancouver office. The successful behavioral patterns that were persistent after the competition in Vancouver included:

- Switching off boardroom lights and task lights
- Use of standby power for laptops and desktops and turning off monitors when away from desks (estimated to have the most effect on energy reduction)
- Turning off computers of employees not in for the day (automatic start up for software upgrades happen each morning at 6 am necessitating a shut off of computers without users).

Extreme behavioral patterns during the competition that were not persistent after the competition in Vancouver included:

- Lower than practical lighting levels (task lights and dimmed monitors only)
- No use of heating during a period that would have normally required heating
- No coffee after 10 am (machines turned off).

While observational notes were not taken in other offices, emails and phone conversations provided some information about the actions taken. Similar measures to those shown above were described in Seattle and San Francisco. The change to coffee drinking habits came as a live feed post from the Miami office with similar actions as those from the Pacific Northwest described. Phone conversations suggested that after a slow start on day one, the Chicago office had lost morale and office interest in competition had weaned such that very little savings were observed. Stronger interest in the Raleigh Technology Park (RTP) and Charlotte offices translated into solid reductions, but less extreme measures were taken in North Carolina.

9.0 OPERATIONAL CHANGES

Some rather drastic operational changes were made in the Vancouver, Seattle and San Francisco offices. These were largely a result of the behavioral actions not being seen as enough to win the competition. The desire to win the competition was stronger than anticipated, but the attention during the competition did lead to some creative operational changes.

Operational changes that are intended to become persistent in the Vancouver office include:

- Turning off under-used refrigerators and consolidating food and beverages.
- Naturally ventilating the server room when possible (open door also heats the office space).
- Turning down the set point of the water heater (very inefficient heater).
- Removal of lights in areas that do not require them (near atrium and ones that provide decorative lighting).

Extreme operational changes made during the competition that are not likely to become persistent in the Vancouver office include:

- Turning off heat recovery ventilators.
- Turning off all refrigerators.
- Running laptops on batteries.

These operational changes were either implemented or suggested by Vancouver office employees.

Office upgrades recommended to the Vancouver office after the competition included:

- Add light switch to accounting office.
- Add a light switch for atrium perimeter lighting.
- New more efficient water heater.
- Make standby power setting after 20 minutes automatic on all computers.
- Motion sensors in kitchen, exit stairs and new sensors in boardrooms.
- LED upgrade throughout the office (after lighting is adjusted and wiring upgraded).
- Add a separate switch for the hall lighting and copy areas.
- Removal of all halogen lighting to be replaced with more energy efficient LED replacements.
- Set up protocol for naturally ventilating the servers.
- Set up a shut down protocol for un-used computer terminals.
- Removal of older fridges and consolidation of fridge goods to fewer fridges.
- Insulating loading dock elevator doors.

The Vancouver office has begun a number of these operational upgrades. As tenant fit ups are implemented further measures will be added. Other offices also reported changes to their operations as a result of the energy competition. The Charlotte office became aware that their HVAC system was running both day and night. With so many eyes on the competition dashboard, this operational issue was quickly fixed. Building operational issues in the Miami office were addressed the week before the competition began.

10.0 EMPLOYEE RESPONSE

A survey was conducted by Pulse™ the week following the competition. Respondents from all five offices participated in the survey with the highest number of respondents coming from the Vancouver (20 of 93 for 22 percent) and Chicago (28 of 272 for 10 percent) offices.

The survey revealed that most (75 percent) employees felt their office operated fairly efficiently, but that there was opportunity for improvement. That level of improvement was limited in some offices as the Seattle and Vancouver offices were passive with greater control by the occupants and the Chicago and Charlotte office had the least control over their systems. There was a direct correlation between the amount of energy saved during the competition (Vancouver and Seattle tied for first place) and the ability for an office to control base building systems and lighting (Chicago and Charlotte finished last).

More than half of the employees (63 percent) felt they had control over some aspects in their work area, but that most of the energy use was controlled centrally and thus there was little they could do aside from control their own spaces. This assumption was supported when greater than 90 percent of those surveyed felt they could control their computers and lighting, but little else. When asked about what level of effort they placed into the competition, 15 percent stated they were fanatical about their devotion to energy reduction, 43 percent were highly engaged and 36 percent were moderately engaged. When asked about how they felt about the competition, 85 percent said it was either a good or great experience. This was confirmed when 85 percent said they would be interested in participating in a future energy saving competitions, with some respondents suggesting the firm should challenge other consulting firms.

There was a great deal of other positive feedback within the survey about how the competition could be improved. A wide variety of opinions were put forward, but some consistent themes did appear such as “Secret competitions! Our offices go to crazy extremes, maybe say one week this month will be part of the contest but we won’t tell you which one!”; “A competition that we would be unaware of until the final results”; and “The competition should be a month or greater in length to really alter behaviour.” What is important about these survey results is not their statistical relevance (as the response rate was so low), but that of the respondents who felt the race results were unfair or confusing, all agreed the competition was useful and that future competitions should be held.

The competition proved to be a success in engaging occupants. The race visual of the car seems to have been the most effective competition tool to encourage employee energy reduction (73 percent) while the office demand curve showing office consumption was second at 44 percent. While the race visual proved to be the strongest element, the survey revealed a great deal of confusion regarding how the competition baseline was set. One respondent stated, “The parameters should be more clearly established before the week of the competition. Change the format to percentage energy saved and not base it on kWh saved as this unfairly gives advantage to larger offices.” This suggests that even though the competition visual showed both a percentage savings and kWh savings, the participants were not always aware of both metrics. While the information about handicapping of larger offices was emailed to all participants, this information proved to be something that many participants may not have understood. It is likely that future competitions will both prepare employees in advance of the competition on the parameters and simplify some of the race values. Regardless whether employees understood the metrics of the competition, the nature of competing alone seems to have been both popular and effective.

11.0 CONCLUSION

The primary theory tested within the study was inconclusive due to the low number of survey respondents and an inability to find a control group during the competition period. The competition based on an electric car race did, however, prove to be more compelling than simply making energy information available in real-time for the low number of respondents to the survey. The energy reduction results were much greater than the 10 percent expected before the competition began. Survey respondents agreed that the electric car was the most effective visual and without understanding the visual in all cases, the act of racing proved to be enough to encourage behaviour change within this group.

The contest generated a great deal of enthusiasm for energy conservation among company employees and was well-received overall. Running the energy savings competition yielded significant savings and fostered creative approaches to energy conservation. While some of the reductions have not been persistent, long-term savings are realized by engaging a building’s occupants and letting them see the impact of their collective actions. The contest also drove innovative operational

adjustments and uncovered opportunities to save energy that would not have been identified otherwise (such as the consolidation of refrigeration and elimination of un-needed refrigerators). Several offices saw persistent savings of up to 17 percent after the competition while others reverted back to their older patterns of use. The Energy Cup will likely be improved upon as it becomes an annual event that will help perpetuate the savings achieved during the inaugural event. Future competitions will also allow for better data collection and further analysis of behaviour patterns.

Given the extreme actions taken by some employees during the competition, it seems reasonable to question whether the employees had a positive reaction to the competition. The follow up survey, however, showed that 85 percent, most of the survey respondents, reported having a positive experience with the competition. A majority of those surveyed and questioned outside of the survey felt that future competitions should in fact be longer to better embed energy conservation behavior into day-to-day operations.

Given the success of the competition, the firm plans to add more offices to the energy management dashboard in 2011 and will likely monitor water reduction in future contests. In the years to come, Pulse™ and Perkins+Will will continue to implement studies and build robust tools for greater resource conservation.

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