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Saving Power in a Tower

ideas 42

Changing organizational culture to reduce electricity consumption in a large office building

Conventional wisdom tells us that strategies that have successfully reduced household energy consumption are unlikely to be as effective in settings like office buildings, where end-users do not pay for the energy they consume. However, we show that behavioral interventions incorporating elements of feedback, social competition, and the assignment of responsibility can in fact achieve meaningful and enduring reductions in electricity use even in commercial settings.

Summary

Behavioral interventions using feedback and social norms have proven successful means of achieving cost-effective reductions in energy consumption in the residential sector. Since *Opower* first pioneered home energy reports benchmarking household electricity consumption to community averages, researchers have demonstrated the power of such strategies to promote more sustainable consumption of resources ranging from electricity to water, in countries ranging from India to the United States.

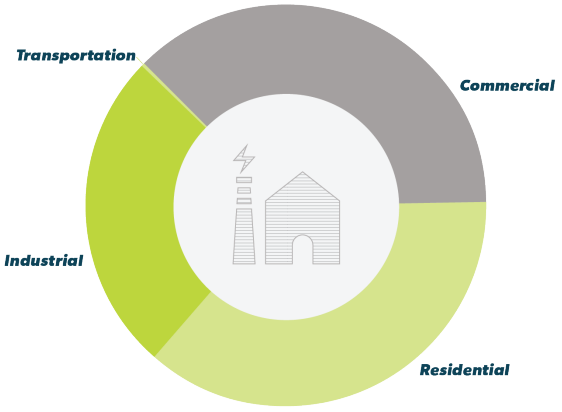
Yet the residential sector accounts for only a portion of the overall energy we consume. The commercial sector is another major consumer of electricity worldwide, responsible for as much as 40 percent of electricity consumption in developed markets like the United States. Within the commercial sector, office buildings constitute a major end-user of electricity, including in South Africa, the setting of this study. Finding effective solutions to reduce energy consumption in such commercial settings is thus a critical component of a transition to a more sustainable pattern of energy use. However, office buildings present several unique barriers to energy conservation. First, unlike residential consumers, occupants of office buildings typically have no direct incentive to conserve energy because they do not pay for the energy they use. Moreover, while the average household has four members, office floors can have as many as 200 individual users of electricity, making coordination much more challenging.

In light of these obstacles, conventional wisdom holds that energy conservation strategies – even ones that

Highlights

- Our intervention led to a drop in electricity consumption of up to 14 percent
- The size of this decline stabilized after five months, suggesting sustainable changes in energy use
- At these levels, implementing such an intervention can pay for itself through energy savings in under three years

U.S. Electricity Consumption by Sector (2017)



have proven effective among households – are unlikely to be as effective in places like office buildings. Intrigued by the challenge of finding ways to use behavioral science to reduce energy consumption in non-residential settings, ideas42 partnered with the government of the Western Cape, South Africa to test a set of behavioral interventions aimed at reducing electricity use among government employees at a large provincial government office building in Cape Town.

Workplace barriers to energy conservation

Before designing our intervention, we identified six major bottlenecks impeding more efficient use of energy among our target population through interviews, focus groups, and site visits.

1. **Diffusion of responsibility** – Employees are often unsure whose responsibility it is to turn appliances and lights off at the end of the day.
2. **Moral licensing** – Government employees consider public service, rather than reducing personal energy consumption, as their contribution to the environment.
3. **Unit confusion** – Employees typically do not know how small individual behaviors translate into and affect energy efficiency.
4. **Limited attention** – Employees sometimes simply forget to turn off devices.
5. **Identity** – While at work, employees who might identify as environmentally-conscientious in other spheres of life fail to translate their energy efficient behaviors to the office.
6. **Social norms** – Employees do not know how much energy their colleagues use and therefore have no reference point for how energy efficient they are.

Designing an energy conservation strategy

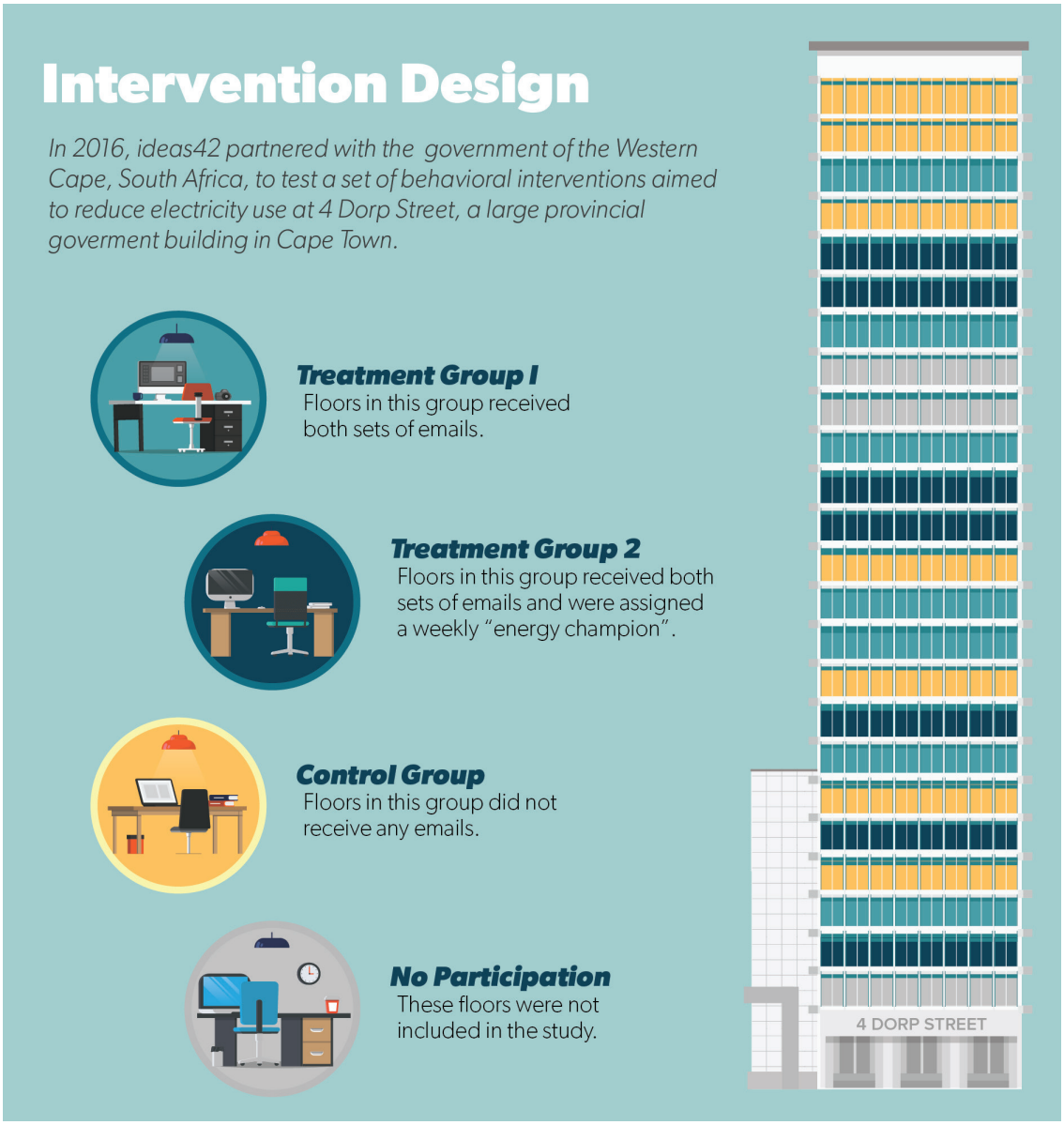
We subsequently designed intervention components to respond to and mitigate the observed bottlenecks by using an automated email system to test the effect of different isolated messages that incorporate the following intervention components:

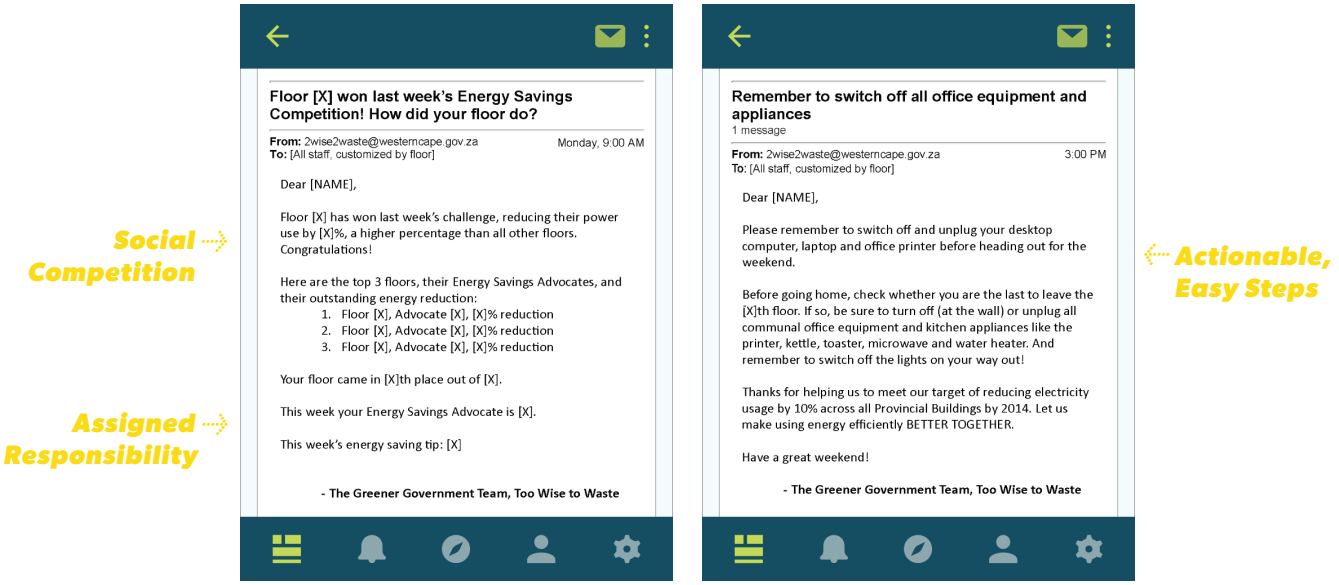
1. **Providing information about specific actions** – Giving easy-to-understand information regarding energy use that employees can easily translate into action and also place specific behaviors into a context that is familiar to them.
2. **Social competition** – A program that compares energy use on one floor with that on other floors to foster a sense of competition and provide regular feedback.
3. **Assigning responsibility** – One employee is randomly selected on a weekly basis as the "energy champion", or the person with overall responsibility for energy consumption, for the entire floor. This employee is subsequently given specific tasks throughout the week (e.g., "turn off lights at the end of the day", "turn off the water heater", "unplug the printer").

Evaluating our interventions

After installing smart meters in the office building, we randomly assigned floors into one of three groups to test our leading design ideas through a randomized controlled trial that ran from June through October 2016.

- **Treatment group I:** Floors in this group received bimonthly emails that include **information on actionable steps** to reduce energy consumption and weekly **inter-floor competition** results.
- **Treatment group II:** Floors received the same monthly general **information** emails and weekly **inter-floor competition** results as in Treatment 1, as well as the **assignment of one weekly "energy champion"** on each floor.
- **Control group:** Floors did not receive any emails.





Sample weekly inter-floor competition results email (left) and general information email (right).

Key findings

Comparing the changes in energy use throughout the study period across the different treatment groups suggests that the interventions led to large decreases in electricity consumption relative to the control. Specifically, we found that:

- **Floors in treatment group II**, which received general energy conservation tips, inter-floor competition results, and the assignment of an "energy champion," **reduced electricity consumption by 14 percent** (significant at the 5 percent level).
- **Floors in treatment group I**, which received only general conservation information and inter-floor competition results, **reduced electricity consumption by 9 percent** (significant at the 10 percent level).

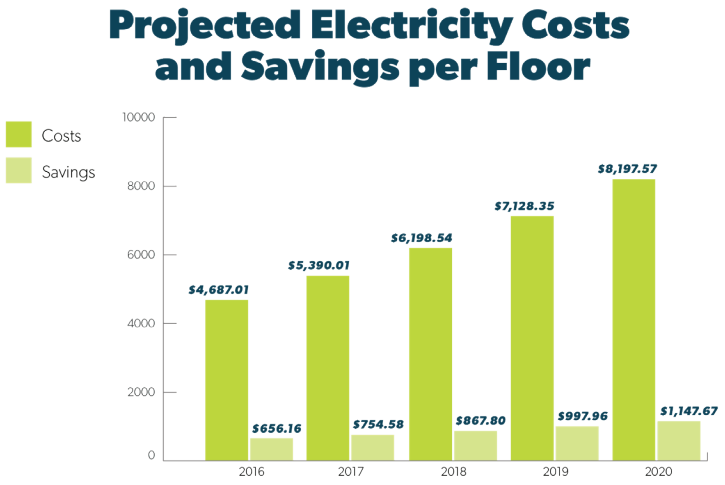
In raw numbers, this means floors in treatment group II consumed about 0.7 fewer kilowatts of electricity per hour relative to floors in the control group on average, while floors in treatment group II consumed 0.4 fewer kilowatts per hour.

An examination of electricity consumption at different times of day offers some insight into how and when the intervention affected energy use. Rather than uniform reductions in energy use over a 24-hour period, our results indicate that much of the impact we observed came from reduced energy use during non-working hours, after most employees had left the office. On floors in treatment group II, for example, electricity usage was significantly lower after working hours compared to other floors, suggesting that empowering energy champions to either turn off appliances at the end of the workday, or nudge their colleagues to do so, is an effective way to cut office energy use.

Encouragingly, the results we observed appear to endure over time, suggesting that our interventions led to sustainable changes in energy use behaviors among targeted employees. After examining the evolution of changes in energy use month by month to estimate the size of any attenuation, we saw that although there was a higher level of energy reduction during the first few months after the intervention was rolled out, by five months out the effects of the intervention on energy use appear to fully stabilize at the levels reported above, with any attenuation having faded out completely.

Conclusions

Behavioral interventions appear to be cost-effective ways to reduce energy use even in non-residential settings where individuals have no pecuniary incentive to cut energy use. Assuming the 14 percent reduction observed for floors on treatment group II are sustained over time, our estimates suggest that energy cost savings would more than recoup the cost of installing the smart meters within two-and-a-half years. Accounting for additional fixed costs such as consulting fees, the full expenses of this intervention would be covered in fewer than five years.



While this study offers encouraging evidence supporting the robustness of behavioral energy conservation strategies across a variety of settings, our research also emphasizes the importance of the particular context in which a behavioral intervention is to be deployed. In follow-up surveys conducted after the conclusion of the experiment, we discovered that while some treatment floors worked as a team to reduce energy consumption, other floors were lukewarm towards the regular reminder emails. The net effect of such behaviors resulted in an ultimate decline in electricity use for treatment floors, but this variation in how occupants on different floors responded to our nudges underscores the importance of taking into account differences in behavior when considering the scale-up of any behavioral intervention.