

THE PROBLEM

There is typically a gap between the way things are *supposed* to work, and the way they *actually* work in the real world. We can see this gap all around us, including in the way all the cool apps on my new smartphone works (NOT!). If California and the planet are going to meet goals for reduction in greenhouse gas emissions, such gaps cannot be tolerated. Many of these problems are caused by either a mismatch of technology and human factors of the end users or providers, or by institutional or organizational structures that get in the way of simple solutions.

We need to look with open eyes and consider realistically whether or not efficiency solutions (such as technologies, policies and programs, behaviors and best practices) are really meeting our objectives: are they providing “realized” savings? Research must focus directly on those gaps and on what is keeping us from systems that perform optimally when operated in the real world.

THE SOLUTION

These types of problems are neither intractable nor insoluble, and in most cases, their solutions are not rocket science either. However, the hard part is recognizing the gap and identifying practical, appropriate solutions that don't have realization gaps of their own! These solutions will take many forms:

- *Technical*: Appropriate user interface designs can help users to determine the best strategy for themselves, to be implemented and automated by advanced controls. However, nuanced behavioral and outside-the-box thinking is necessary to design interfaces that respond accurately to the real needs and desires of the user.
- *Policy*: It would be tough to dramatically simplify building codes without reducing the potential savings for individual buildings. However, if it can remove a barrier to code compliance, the resulting savings will vastly outweigh the incremental savings potential left on the table.
- *Behavioral*: By studying psychological, social, and cultural factors that drive behavior, (of both end-users and trade allies), interventions can be used to encourage or facilitate the adoption and effective utilization of efficient technologies.
- *Rethinking our Assumptions*: Other solutions will require rethinking some of our assumptions about how we use energy: for example, we tend to take for granted that even “early-adopters” will not be willing to tolerate the slightest inconvenience, discomfort, sacrifice of amenity, or high costs. Perhaps it is time to revisit these assumptions, maybe even to resurrect the “C” word—conservation! We will have to slay some sacred cows and pursue technologies that allow for and even facilitate these expanded operating modes. The potential for performance, using these new assumptions, is game-changing!

Engineering research into the optimization of existing technologies and the development of new super-efficient technologies is always essential. But no matter how well the technology performs on the computer and in the lab, technologies that are not well suited to the habits, needs, capabilities, interests, motivations, and understanding of their users will not perform as effectively in the field as they did on the drawing board.

Applying rigorous social science research methods and theories is essential to understanding these factors and anticipating the necessary solutions. This is particularly true now, as we are undoubtedly entering an era of rapid change in priorities, concerns, limitations, acceptance of different policy solutions, and willingness to participate. Really understanding the way people and groups make decisions and adopt and adapt their technologies is necessary to make sure that the technologies will adapt to the changing paradigms.

PROPOSAL: ESTABLISHING THE CALIFORNIA REALIZED ENERGY SOLUTIONS COLLABORATIVE

A research collaborative should be established, focused on this gap between expected energy and *realized energy*, to respond to these needs and seek these innovations.

The California Realized Energy Solutions Collaborative (CRESC) will be an informal and "virtual" collaborative research group that brings attention across the state into focus on the topic of realized energy solutions.

- *CRESC will...* align the efforts of world-class interdisciplinary researchers in various existing departments and research centers across California universities to conduct world-class research and industry engagement that results in commercially available solutions that work in the real world. It will create the critical-mass and context necessary to attract the attention of potential clients and partners and share the principles of realized energy solutions.
- *CRESC will...* provide context for distinct projects to tell a comprehensive "story" about the real-world that will help to inform and drive policies, programs, market innovations, and research roadmaps. All research funding will continue to go directly to the research centers and individual researchers.
- *CRESC will...* facilitate engagement between industry stakeholders, policymakers, and the research community, to help ensure that findings are practical and feasible, and ensure that solutions are making their way into products and policies.
- *CRESC will...* develop and maintain a vibrant and informative website that will facilitate dialog on the problems and solutions and serve as a clearinghouse for related research plans and results, active project descriptions, one-pagers, report archives, and links to project web-pages. These will be presented in ways that highlight their synergies. CRESC will provide a one-stop-shop for clients, industry, and policy partners looking to create real-world solutions.
- *CRESC will...* create value through outreach activities that provide the context for the individual projects, highlight the synergies between the individual projects, and make all aspects of the work accessible to sponsors, partners, and the public. These activities will include sponsoring events (such as an annual symposium), publishing an annual report, and providing speakers, lecturers, and reviewers.
- *CRESC will...* serve as a matrix organization that can bring together diverse resources drawn from multiple centers to provide the best capabilities for any particular project. In doing so, it can also help to maintain high standards for scholarship, research methodology, and real-world applicability.
- *CRESC will...* support many different programs and policies in California, such as the Electric Research Investment Plan, the California Long Term Energy Efficiency Strategic Plan, building and appliance energy efficiency standards, the Existing Buildings Energy Efficiency Action Plan, and the Clean Energy and Pollution Reduction Act.

CRESC can be provided with a modest budget since it serves primarily coordinating and outreach functions. It can be developed incrementally, beginning with an initial effort to develop and scope the concept, bring a set of researchers together, and create a simple website.

Approximately \$50,000 will be required for Year One activities.

THE ROOFTOP AIR-CONDITIONER “ECONOMIZER” IS A GREAT EXAMPLE OF THE GAP

Economizers are contraptions designed to save significant amounts of energy by using fresh outside air to cool buildings on cool days, rather than recirculating warm air. Unfortunately, studies confirm that economizers have almost a **two in three chance of not working!** It is important to note that when an economizer “goes bad,” it doesn’t just miss the opportunity to achieve savings. It can actually *increase* the air conditioning load dramatically by letting in hot air that has to be cooled down before it can cool the occupants.

There are many reasons for this. Oftentimes, economizers get neglected, broken, disabled to fix another air-conditioning problem, not configured or installed correctly or maybe even never connected, from day one. Because so many owners are reluctant to invest in fixing something that they can't see, many service contractors don't even bring this opportunity to the owner's attention.

So, there’s that gap: many building codes require installation of economizers on new and renovated buildings. The writers of the code claim full credit for a significant energy and peak demand savings that isn’t really there. To claim additional savings from going out and fixing those economizers (or prevent them from going bad in the first place), then, would be a case of “double-dipping,” barring the use of public or ratepayer funds.

We have fooled ourselves into thinking that we’ve saved energy, meanwhile we are actually *preventing* restorative work from taking place. The savings are not realized.

Of course, there are many other examples, such as:

- The failure of code compliance (in some areas, 90% of installations fail to comply!);
- Programmable thermostats that are so difficult to program they are routinely left on override; and
- The difficulty in selling commissioning services (“*You didn’t tell me I was going to have to pay extra to get a building that works!*”).



*Notice the device that is supposed to be opening and closing the dampers has been **jammed** into the dampers, negating savings and creating huge energy waste in both the summer and the winter!*

This effort is led by Dr. Kristin Heinemeier, Sole Proprietor of Realized Energy (realized-energy.com), and former Principal Engineer at the University of California’s Energy Efficiency Center. Identifying ways to realize efficiency in the real world has been her life’s work, with a 30-year portfolio of positions in academia, private industry, non-profit agencies, local government and community-based organizations. She has contributed to the advancement of the fields of measurement and verification of savings, building commissioning for new and existing buildings, the role of HVAC contractors and technicians in achieving realized savings, and using behavioral understanding to develop more effective technologies, processes, and best practices. She has a PhD in Building Science, a PE license, and is an ASHRAE Fellow.

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