# BUILDING ENERGY SYSTEMS



**1**  *A member of Fraunhofer CSE's Building Energy Systems group tests the performance of a thermostat in a residence.*

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**About Fraunhofer CSE**

Fraunhofer CSE is an applied research and development laboratory dedicated to building tomorrow's energy future today. Our staff's expertise in solar photovoltaics, smart energy-efficient buildings, and grid technologies provides a platform for deeply integrating distributed energy resources through collaborative R&D with private companies, government entities, and academic institutions.

**Building Energy Systems at CSE**

Fraunhofer CSE's Building Energy Systems Group performs applied R&D to provide insights into energy performance of building systems and develop new energy-saving technologies and practices. Our interdisciplinary team has expertise in the following areas of research:

- Field-Testing and Evaluation
- Algorithm Development
- Behavioral Analysis
- Technology Assessment
- Energy Consumption Characterization

**Project Teams**

We create project teams tailored to the specific needs of each project to effectively and efficiently deliver for our clients. We

- Test, demonstrate, and evaluate the performance of emerging building technologies in the field
- Develop building performance assessment and control algorithms
- Evaluate the impact of people and behaviors on energy consumption
- Characterize building energy consumption to inform policy decisions
- Assess building technologies to identify high-impact opportunities
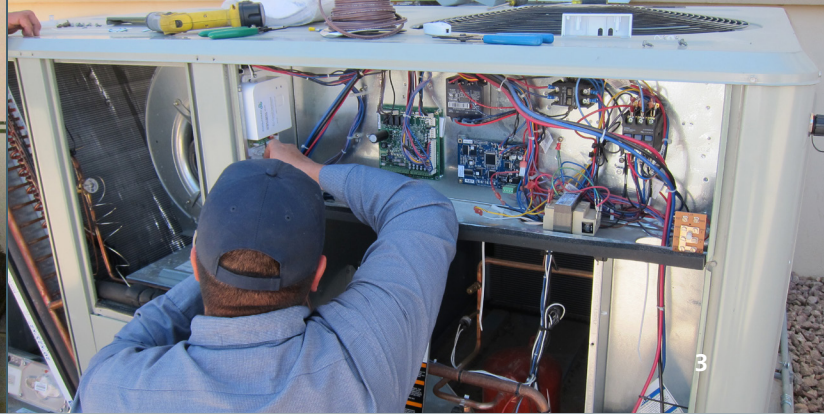
### Field-Testing and Evaluation

- Design rigorous field experiments to deliver maximum value and insight
- Recruit and manage buildings for pilots, including large samples of households
- Deploy comprehensive, reliable data acquisition solutions
- Perform behavioral analysis to assess how people use building technologies
- Evaluate the impact on energy consumption, peak demand, and indoor environmental quality
- Analyze large data sets field tests to rigorously evaluate field experiments
- Apply building energy models to extend field-test results to other contexts

### Algorithm Development

- Apply machine-learning algorithms to emerging data sources, such as communicating thermostats and electric and gas interval data, to develop new insights into building performance and energy-saving opportunities
- Develop Non-intrusive load monitoring (NILM) algorithms to disaggregate electricity consumption by different devices
- Apply optimization techniques to optimize building performance

### Behavioral Analysis

- Design and execute field experiments to rigorously evaluate real-world behaviors
- Analyze field data to assess peoples' behaviors and their impact on energy consumption
- Conduct focus groups and user experience studies to assess the adoption and inform the development of emerging sustainable energy technologies
- Design strategies to increase the adoption of sustainable energy technologies
- Design and analyze surveys to understand peoples' motivations and attitudes about potential products

### Technology Assessment

- Quantify the energy savings potentials and demand impacts of new and emerging technologies using whole-building energy modeling
- Evaluate the current and future cost effectiveness in different applications
- Evaluate commercialization barriers at different stages of the building development, deployment, and operations processes
- Identify the most promising applications and markets for emerging technology platforms
- Prioritize research, development, and demonstration activities

### Energy Consumption Characterization

- Apply a combination of primary (field testing, surveys) and secondary research to model and quantify the per-device, state, and national energy consumption by different devices and end uses
  - Model device usage patterns and power draw by mode
- Conduct scenario analyses to project the future energy consumption of different devices and end uses
- Identify emerging energy-saving opportunities

**2** *Behavioral testing analyzes peoples' motivations and provides actionable insights into how people interact with building technologies.*

**3** *The Building Energy Systems Group conducts field testing to evaluate the performance of building systems including HVAC.*