



Large Scale Energy Reductions Through Sensors, Feedback, and Information Technology

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The Opportunity

How can we most effectively use Smart Metering to reduce energy use?

Conservation



Efficiency



Demand Response



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The Potential of Smart Meters

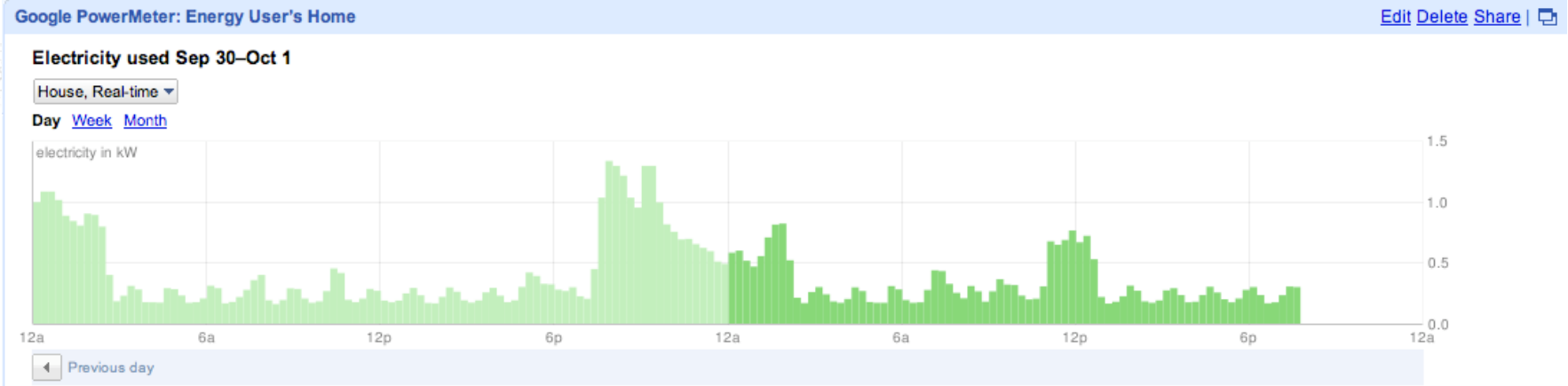
Smart Metering can:

- Give **information** to consumers about their own energy use
- Create a **platform** that allows delivery of behavioral programs
- Allow utilities to **engage** directly with consumers





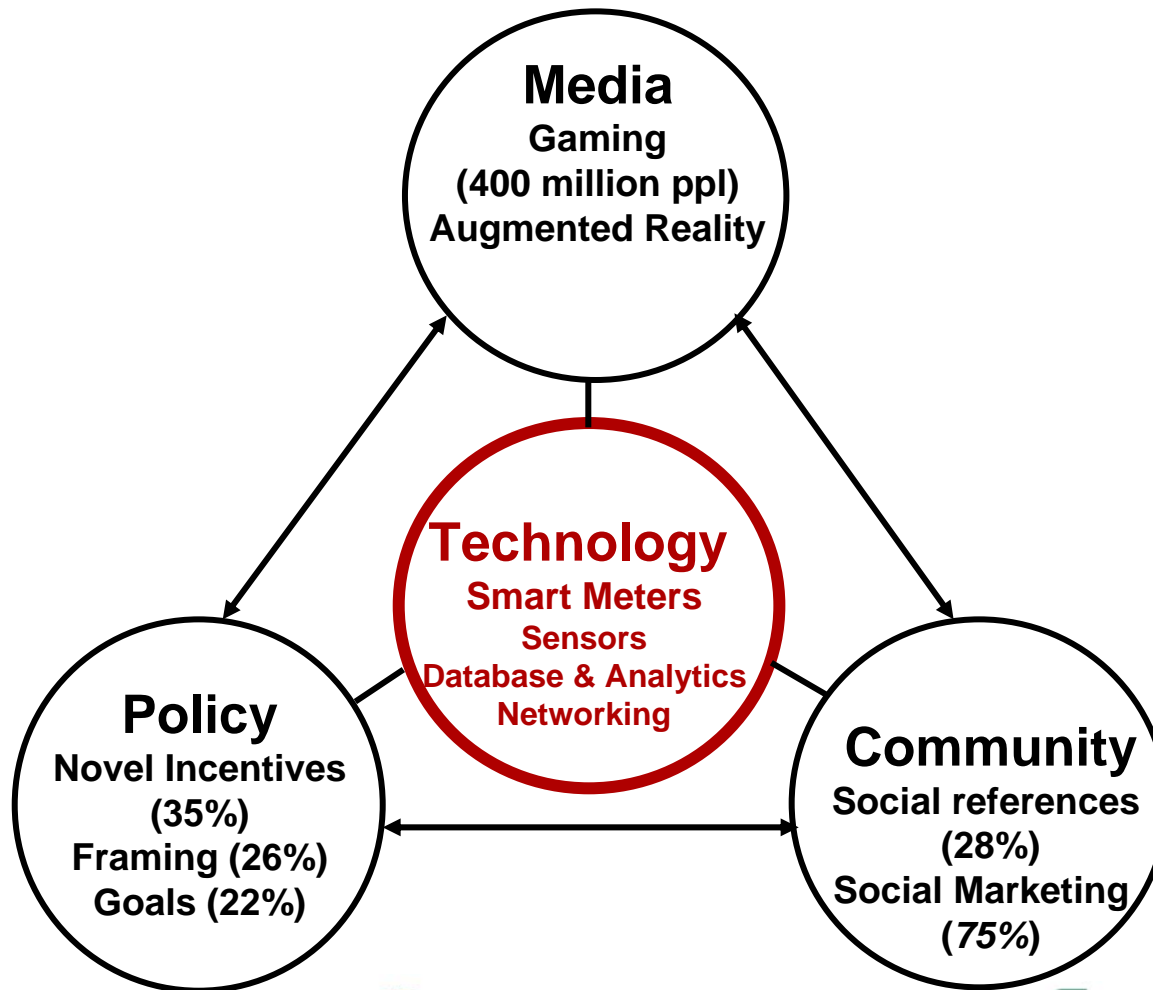
Smart Meters allow consumers to see their energy use



- 5-15% savings
- Appliance specific information → higher savings?
- Make the information *simple* and *interesting*



Smart Meters create a platform that enables behavioral programs



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Smart Meters allow utilities to engage with consumers



1. Utilities gain information about the way that consumers use energy (targeted programs).
2. Real time evaluation of programs
3. Direct control



The Stanford Team

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Principle Investigators

Byron Reeves, H-STAR Institute and Department of Communications • Carrie Armel, Precourt Institute
Tom Robinson, Prediatrics • Banny Banerjee, Mechanical Engineering • Jim Sweeney, Management Sciences
and Engineering.

Faculty and Lead Researchers

Andrew Ng, Computer Science • Gregory Walton, Psychology • Balaji Prabhakar, Electrical Engineering •
Martin Fischer, Civil and Environmental Engineering • Philip Levis, Computer Science • Nicole
Ardoin, School of Education • Abby King, Health Research and Policy • Hamid Aghajan, Electrical
Engineering • Scott Klemmer, Computer Science • Samuel McClure, Psychology • John Weyant,
Management Sciences and Engineering • Chrystos Kozyrakis, Computer Science • Monica McDermott,
Sociology • Jeff Shrager, Symbolic Systems

Postdoc

Annika Todd, PEEC

Students

Sebastian Houde • Marilyn Cornelius • Anant Sudarshan • Zico Kolter



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Project Number	Project Category	Project Name	Deliverables	Investigators	Stanford Departments
1	Software Platform	Computer Infrastructure for Prototyping and Evaluation	Database + analytics for experimentation (at Stanford + in a scalable organization, e.g., Google)	Levis, Klemmer, and Russell	Computer Science and H-STAR Institute
2	Intervention (Foundational)	Intervention Foundational Work	Policies on data privacy, catalog of energy behaviors, energy behavior products, and data presentation	McDermott, Banerjee, and Armel	Sociology, Mechanical Engineering (Design) and Precourt Institute
3	Intervention (Technology)	Smart Automation	Software that helps customize HAN automation	Aghajan and Ng	Electrical Engineering
4	Intervention (Media)	Multiplayer Game	Online game utilizing team competition available for public use	Reeves and Armel	Communication and Precourt Institute
5	Intervention (Media)	Mobile Interactions	Novel mobile applications	Banerjee and King	Mechanical Engineering (Design) and School of Medicine
6	Intervention (Policy)	Smart Monetary Incentives	Utility program that stretches the motivational value of monetary incentives	Prabhakar and Todd	Electrical Engineering and Economics

7	Intervention (Policy)	Nudges to Purchase Energy Efficient Appliances	Information and framing tools for guiding the purchase of energy efficient appliances and electronics	McClure and Todd	Psychology
8	Intervention (Policy)	Goals and Collective Action	Web application that helps consumers monitor goals and compare energy use	Walton	Psychology
9	Intervention (Community)	School & Community Programs	Curricula that increase engagement with sensor data and diffuse sensor use to families	Robinson and Ardoin	School of Medicine and School of Education
10	Data Modeling	Energy Consumption Forecasts	Models that forecast building energy consumption to guide utility interventions	Fischer	Civil & Environmental Engineering
11	Data Modeling	Behaviorally Informed Prescriptive Economic Models	Behaviorally informed economic models to guide policy	Sweeney and Weyant	Management Sciences and Engineering
12	Energy Sensor Network	Open Extensible Communication Network	Development of an extensible HAN protocol to enable innovation	Levis and Kozyrakis	Electrical Engineering