Opportunities and Challenges for Energy Data and Climate Change

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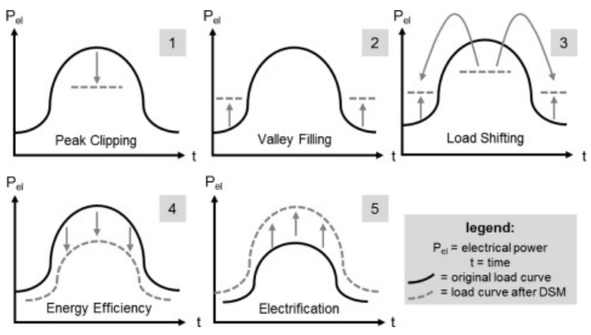
Overview of Demand Response and Demand Side Management Programs

What is Demand Response and Demand Side Management

Change in consumer electricity usage by reducing or shifting demand; incentivized using time-varying pricing structures or financial rebates and credits[1]

Eg: Nest Thermostats

- Consumers allow utilities to control thermostat during times of peak demand in exchange for a bill credit
- Utility can adjust thermostat temperature to reduce demand on the grid



Demand Side Management (DSM) load shaping opportunities[2]

Benefits of Demand Side Management and Demand Response[1]

- Lowers the need for investments in peak load power plants and grid infrastructure
- Helps balance fluctuating feed-in of renewable energy sources
- Increases the security of supply
- Reduces transmission congestion

Reduces electricity system costs and greenhouse gas emissions

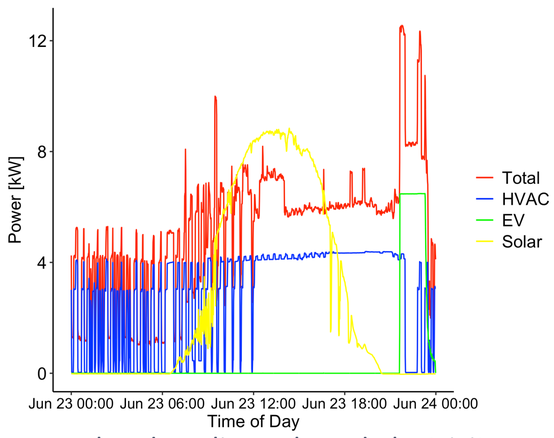
Since 2011, Nest thermostats have saved

41,243,542,022

KWh of energy*

Role of Energy Data in Research of Demand Response Programs

High resolution temporal data on electricity usage in individual households and for individual appliances (smart meter data) is needed for research on the effectiveness and application of demand response programs.

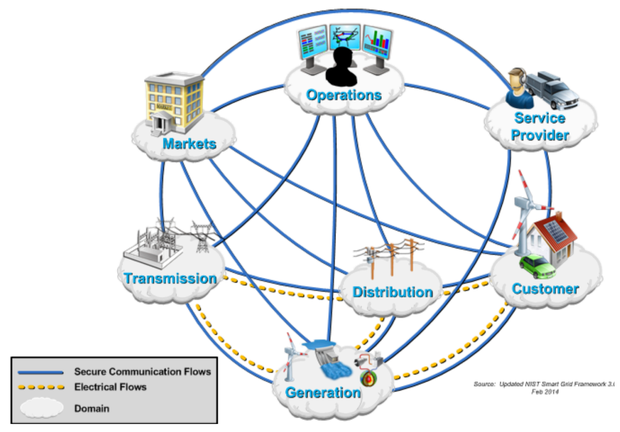


Temporal and appliance based electricity usage for a single home in Austin, TX[3]

Demand response programs have been shown to reduce peak load but do not necessarily reduce total electricity consumption[3]. Studies on these programs would not be possible without temporal energy consumption data.

Role of Energy Data in Implementation of Demand Side Management Programs

1) Record near real-time data on electricity usage in individual homes
2) Transmit this data using a variety of communication technologies between appliance, consumer, and utility
3) Receive communications and data from the smart grid, such as real-time pricing or remote commands



Conceptual model of the electrical and communication flows for a smart grid[4]

Data Privacy and Security Concerns and Limitations

Privacy Concerns

Smart meters and monitors on individual appliances can reveal the activities of people inside the homes

- Work schedules
- Traveling
- How many people live in the household

Security Concerns

Digital transmission of smart meter data and the communication networks that connect home devices to the grid and generation infrastructure are potential targets for misuse of data

- Cyber security and grid stability concerns
- Open potential link for hacking into grid or transmission infrastructure through home devices

Cyberattacks Make Smart Grids Look Pretty Dumb

Bloomberg Opinion

An outage in South America is a reminder that connected devices can become easy entry points for hackers.

By David Fickling
June 17, 2019, 3:26 AM CDT

Smart Grid Security: Are We Up for the Challenge?

T&DWorld

The electric industry must do more to deter, detect, and defeat cyberthreats as connectivity increases.

David Shadle | Sep 05, 2019

Conclusions

- Demand side management and demand response programs have significant potential to help reduce emissions from the electricity generation sector
- Proper analysis of the effectiveness of the various proposed DR and DSM frameworks requires high resolution temporal electricity usage data
- Implementation of such programs requires recording and transmitting near real-time electricity usage and other data
- Security and privacy concerns for this data must be considered and handled appropriately during research, development, and implementation of DR and DSM programs
- Organizations like RDA can play an important role in this process

Select References

1) Clark Gellings, Kelly Parmenter. Demand Side Management. Frank Kreith, D. Yogi Goswami. *Handbook of Energy Efficiency and Renewable Energy.* 2007.
2) Lukas Kreuder, Catalina Spataru. *Assessing demand response with heat pumps for efficient grid operation in smart grids*. Sustainable Cities and Societies. December 2015.
3) Arkasama Bandyopadhyay, Benjamin D. Leibowicz, Emily A. Beagle, and Michael E. Webber. *As One Falls, Another Rises? Residential Peak Load Reduction Through Electricity Rate Structures.* 2019. In Review
4) David Wollman. *The Architectural Framework; What's New in the Evolving Smart Grid*. National Institutes of Standards Presentation. May 2, 2014

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