Insights on Home Energy
Reports from Smart Meter
Data Analytics
A National Summit on Smart Grid and Climate Change
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Data “explosion” in energy

- Smart meters, thermostats, appliances, cars
- Linked to other time and location-specific information (temperature, census, satellite)
- Provide vast, constantly growing streams of rich data that can be used in novel ways
What is a HER program?

Welcome to your first home energy report. This report is part of a free program to help you save money and energy.

How you’re doing:

Great

Good

We estimate that you could save $150 each year.
Explosion in the use of HER Programs
Outstanding Issues with HER Programs

• What time of day are the saving generally occurring in?

• What types of actions generate the savings?

• How soon after delivery of HERs do the savings begin?

• Are those savings maintained between delivery of HERs?

• Are the savings from HERs persistent over time?
• HER program implemented as a “randomized controlled trial”

• Hourly electricity data from Pacific Gas & Electric’s (PG&E) AMI system

• Two datasets from different rollouts (“waves”)

<table>
<thead>
<tr>
<th>Wave</th>
<th># Treat</th>
<th># Control</th>
<th>Launch Date</th>
<th>Hourly interval data available</th>
<th>PG&amp;E baseline territory</th>
<th>Quartile of energy use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave One</td>
<td>400,000</td>
<td>100,000</td>
<td>Feb 2012</td>
<td>Aug 1, 2012- Oct 31, 2012</td>
<td>P, Q, R, S, T, V, W, X, Y</td>
<td>Top 3 quartiles</td>
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<tr>
<td>Gamma Wave</td>
<td>72,300</td>
<td>72,300</td>
<td>Nov 2011</td>
<td>Nov 4, 2011- Aug 1, 2012</td>
<td>R, S, T, W, X</td>
<td>All quartiles</td>
</tr>
</tbody>
</table>
Absent Smart Meter data, savings from HER presumed constant over all hours

**Historical Hourly Savings Profile**

- Estimated Savings, kWh
- Hourly Savings Profile
- Historical
Hour-by-hour savings estimates now possible with Smart Meters

Peak period

Estimated Savings (kWh)
Hour-by-hour savings estimates now available with Smart Meters

Off-Peak period

Estimated Savings (kWh)

Normalized

Proportional

Hour
Hour-by-hour savings estimates now available with Smart Meters

Larger savings on highest peak demand days

Smaller savings on lowest peak demand days

Estimated Savings (kWh)

Hour

10 Highest Peak Days
10 Lowest Peak Days
All Days
Estimates of actions generating savings now available with Smart Meters

- In PG&E’s service territory, the highest demand levels occurs on days that are very hot whereas the lowest demand days are usually much cooler.

- AC use is correlated with high temperatures and can be relatively easily discerned from an analysis of a load profile.
Estimates of actions generating savings now available with Smart Meters
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Savings on the hottest days driven by HHs predicted to use AC

Best guess – change AC settings
Interval smart meter data can be used to assess:

- How quickly after the initial delivery of the HER residential customers change their electricity consumption behavior?
- If savings continue between HER deliveries?
- If savings decay between HER deliveries?
- If savings are consistent across all days between HER deliveries?
- If savings change upon receipt of subsequent HERs?
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Day after mailing

Mailing 1
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Day after mailing

Mailing 1

Quick ramp up
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Mailing 1

Mailing 2

Day after mailing
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Day after mailing

Mailing 1

Mailing 2

Mailing 3
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Day after mailing

Mailing 1
Mailing 2
Mailing 3
Mailing 4
Timing of when savings occur after HERs delivered now possible with Smart Meter

Savings continue between mailings (there are statistically significant savings every day)
Timing of when savings occur after HERs delivered now possible with Smart Meter

Estimated savings, % of average daily kWh

Day after mailing

However the level of savings appears to vary somewhat
• Knowing hour-by-hour savings allows for more accurate cost-effectiveness estimates
• Knowing actions that might be undertaken by HH receiving HERs when savings are most needed should contribute to more effective targeted program marketing
• Knowing how quickly savings are achieved after HERS delivered and the degree to which those savings are maintained between deliveries should contribute to more effective DSM portfolio planning and HER program design
Quantified and verified savings from HER programs with Smart Meter Data could be used to more accurately adjust CO$_2$ emission rate when demonstrating compliance with a rate-based CO$_2$ emission limit.

To maximize impact on CO$_2$ emission rates, HER programs can be targeted to coincide geographically and temporally with locations and times of poorest air quality.