



**Global Energy Partners, LLC**

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# Smart Grid Pricing Experiment

**Craig Williamson**

**Global Energy Partners, LLC**

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## Two Case Studies

- Case Study #1 – Midwestern Utility, started Smart Grid project, designed pricing/technology pilot study, received ARRA funding
- Case Study #2 – Xcel Energy's Smart Grid City project, includes pricing pilot study and in-home smart device study, no ARRA funding



## Case Study #1

- Background
- Guiding principles
- Rate & technology options
- Demographic segments
- Experimental design
- Status
- Analysis plans



## Background

- Smart Grid implementation in mid-sized city with
  - ◆ More educated population
  - ◆ High penetration of broadband internet
  - ◆ Environmentally conscious

In other words, a university town

Goal: Defer two new peaking generators scheduled for 2015 and 2016 (165 MW each)

- ◆ Need 20% participation and 1.3 kW load reduction per participant

## Guiding Principles

- DR results will be obtained through customer empowerment.
- Utility will not directly control customer equipment or appliances.
- Customers will choose their balance of cost versus comfort.
- Pricing will reflect true market prices.
- Future customer participation will be voluntary, so participation in pilot will also be voluntary.
- Enabling technology will be provided to customer at no cost.



## Guiding Principles (continued)

- Customers will be encouraged to remain on the program for the entire length of the study and incentives may be required.
- A control group will be used to minimize the impact of weather, economic conditions, fuel prices, and other non-controllable variables.
- The number of customers participating must be large enough to provide statistically significant results which can be applied to utility's entire customer base.
- The sample will include all demographic groups from the utility customer population.



## Two Rate Options

- Critical Peak Pricing (CPP)
  - ◆ Two period TOU (on and off peak) with critical period called with at least two-hour notice
  - ◆ On peak period is summer (6/1-9/30) weekdays from 2:00 pm to 7:00 pm
  - ◆ Off-peak price 4.5¢/kWh
  - ◆ On-peak price 23¢/kWh
  - ◆ Critical peak price 46¢/kWh



## Two Rate Options

- Variable Peak Pricing (VPP)
  - ◆ Off-peak price is 4.5¢/kWh
  - ◆ On-peak price set day-ahead to one of three pre-set price levels:
    - ❖ Low – 4.5¢/kWh (same as off-peak)
    - ❖ Standard – 11.3¢/kWh
    - ❖ High. – 23¢/kWh
  - ◆ With two-hour notice, on-peak price can be set at critical price level - 46¢/kWh



# Four Technology Options

- Web portal
  - ◆ Online access to customer's own usage along with price information
- In-home display (IHD)
  - ◆ Showing current and cumulative customer usage
- Programmable communicating thermostat (PCT)
  - ◆ Customer can preprogram settings based on price levels
  - ◆ Utility does not control directly
- Combination of all three



## Research Goals

- Main goal is to estimate load reduction resulting from each rate/technology combination.
  - ◆ See which, if any make the 1.3 kW target
- Demographic segmentation is secondary to main goal of finding rate technology impacts
  - ◆ Three segments in each of two dimensions
    - ❖ Age and income
  - ◆ Use to adjust results to reflect broader utility population
  - ◆ Useful for future marketing efforts



# Sample Design

## Residential – design for 2,000, recruit 2,400

Technology	Standard Residential	R-VPP	R-TOU CPP
Web Portal		200	200
IHD		200	200
PCT		200	200
Web portal, IHD, & PCT		200	200
Control	400		

## Commercial – design for 660, recruit 792

Technology	Standard Commercial	C-VPP	C-TOU CPP
Web Portal		66	66
IHD		66	66
PCT		66	66
Web portal, IHD, & PCT		66	66
Control	132		

\* Increased sample sizes by 20% for attrition

## Residential Randomization

- Because the goal was to estimate the impacts for each rate/technology combination *if that were the only option offered*, we needed to randomize assignment to each combination
  - ◆ Customers did not get to choose – they were only offered one option, and could “take it or leave it”
- All customers in the pilot were pre-assigned to a randomly selected cell (treatment or control)
- When they signed up online or by phone, they first had to answer a household survey, then were either:
  - ◆ Offered a rate/technology option
  - ◆ Told they could not participate (maybe next year)



## Residential Randomization (continued)

- Customers were assigned proportionally (and randomly) across each demographic segment and size subgroup
- Control customers were assigned with slightly lower probability, to reflect that some participants would be disqualified for various reasons, but no control group customers would be disqualified
- We monitored recruiting, and where possible, we re-randomized some who had not yet signed up since cells filled up disproportionately



# Commercial

- Lower expectations on commercial
- Offering customers choice of rate/technology options until each cell fills up
- Control group will be made up of those who call in but either decline or are rejected; may need to be augmented with some matching
- Not optimal, but there were big concerns about ability to recruit even a smaller amount of small commercial customers – didn't want to unnecessarily turn away anyone



## Status

- Recruiting complete for summer 2010
- More recruits are young and higher income, which reflects population demographics
- Age demographics balanced, income not as much
- Closed some cells early, rerandomized some customers, also more heavily marketed some segments
- Residential: 2,070 Treatment, 597 Control
- Commercial: 453 Treatment, Control being picked
- No data to analyze yet . . .

## Analysis Plans

- Use regression analysis with period consumption as dependent variable, and participation, price level, weather, demographic, and household characteristics as independent variables
- No “before” data for initial analysis will be available – makes randomization more important
- Plan for second wave of recruiting, including 2010 control group, for 2011 participation – this group will have before and after data



# DOE Involvement

- Utility submitted plan for phase I with ARRA grant proposal
- Implementing that plan
- Working with DOE/industry consultants on plan for Phase II
  - ◆ Collaborative process
  - ◆ Positive feedback
- Ahead of almost everyone else by a year

## Case Study #2 – Xcel Energy

- Background
- Rates and technologies
- Status

## Background

- Smart Grid implementation in mid-sized city with
  - ◆ More educated population
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Déjà vu?

Boulder, Colorado is SmartGridCity



## Three Rate Options

- Time-of-Use (TOU) – “Shift and Save”
  - ◆ Two period TOU (on and off peak)
  - ◆ On peak period is weekdays from 2:00 pm to 8:00 pm
  - ◆ Off-peak price 8.7¢/kWh
  - ◆ Summer On-peak price 22.1¢/kWh
  - ◆ Winter On-peak price 10.8¢/kWh

Note: Rates from marketing materials, attempt to include actual charge customers will see



## Three Rate Options

- Critical Peak Pricing (CPP) – “Peak Plus Plan”
  - ◆ Two period TOU (on and off peak)
  - ◆ On peak period is weekdays from 2:00 pm to 8:00 pm
  - ◆ Off-peak price 8.7¢/kWh
  - ◆ Summer On-peak price 16.5¢/kWh
  - ◆ Winter On-peak price 9.8¢/kWh
  - ◆ Summer Critical peak price 56.8¢/kWh
  - ◆ Winter Critical peak price 38.6¢/kWh

Note: Rates from marketing materials, attempt to include actual charge customers will see



## Three Rate Options

- Peak-Time Rebate (PTR) – “Reduce-Your-Use Rebate”
  - ◆ Standard two-tier usage rate
    - ❖ First 500 kWh per month at 9.4¢/kWh
    - ❖ Usage over 500 kWh per month at 13.9¢/kWh
  - ◆ Summer rebate during events of 47¢/kWh reduced from baseline
  - ◆ Winter rebate during events of 29¢/kWh reduced from baseline

Note: Rates from marketing materials, attempt to include actual charge customers will see



## Sample Design

- Based on previous TOU pilot and goals of study
  - ◆ TOU – 1,055 customers, 185 with IHSD and 870 without
  - ◆ CPP – 414 customers, 144 with IHSD and 270 without
  - ◆ PTR – 531 customers, 185 with IHSD and 346 without
  - ◆ IHSD total, including pricing – 1,100 participants
  - ◆ Control Group – not randomized, 1,000 customers
  - ◆ Before and after data available

# Issues

- Regulatory delays
  - ◆ Regulatory filings, testimony, settlement discussions take time
  - ◆ Concerns over voluntary nature of pilot
- Start of Pricing Pilot moved from June 1 to October 1
- Delays with technology for IHSD
- IHSD start moved to late August
- As always, systems integration is a challenge
- Implementation of new tiered rates June 1
- Plans also laid out for Phase II for next summer

# Contact Information

**Craig Williamson**  
Global Energy Partners  
720-233-1500  
cwilliamson@gepllc.com  
[www.gepllc.com](http://www.gepllc.com)

