The Smart Grid enables energy efficiency and demand response

• Rising fuel prices and capacity costs, shrinking reserve margins and greenhouse gas emissions are setting the policy maker’s agenda today

• Utilities and state commissions are placing a renewed emphasis on the demand side of the equation to deal with these issues

• Both energy efficiency and demand response can play a vital role in meeting future customer energy needs while controlling rising bills and making sure the lights stay on

• The Smart Grid opens new vistas when it comes to dealing with tomorrow’s customers who will be born into the digital age
In the new century, we need a multi-faceted approach for reaching the customer

- **Information** about energy costs as they are incurred and ideas on how to manage those costs
- **Codes and standards** for new appliances, buildings and industrial processes
- **Enabling technologies** that control costs in real-time conditions such as two-way communicating thermostats
- **Rebates and financing** for accelerating the adoption of smart end-use technologies
- **Smart rate design** such as inclining block rates and dynamic pricing rates
The smart grid will help customers make smart energy buying decisions

- Providing real-time feedback to customers on their energy consumption should help them better manage their energy behavior.

- New empirical evidence from a number of pilots shows that in-home displays and similar devices that are enabled by the smart grid can lower energy use by up to 6 percent.

- This has been observed to happen even with existing rate designs.

- Of course, greater impacts will be observed if the rate designs are changed as well.
What will be the likely impact of inclining block rate designs?
Four illustrative inclining block rate designs
Representative customer billing distribution

The graph shows the distribution of customer billing sizes, measured in kWh/month, and the corresponding percentage of the customer population for each size category. The x-axis represents customer size in kWh/month, ranging from 100 to 2,000 kWh/month. The y-axis represents the percent of customer population, ranging from 0% to 16%. The distribution peaks at around 1,100 kWh/month, with significant percentages also occurring at sizes of 800 to 900 kWh/month and 1,200 to 1,300 kWh/month.
Energy use could decline by up to 5.9 percent and customer bills by up to 9.1 percent.

### Avg Percent Change in Usage

<table>
<thead>
<tr>
<th>Price Elasticity</th>
<th>Avg Percent Change in Usage</th>
<th>Rate A</th>
<th>Rate B</th>
<th>Rate C</th>
<th>Rate D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Run</td>
<td>Mean</td>
<td>-5.9%</td>
<td>-2.2%</td>
<td>-1.0%</td>
<td>-0.5%</td>
</tr>
<tr>
<td></td>
<td>Std Dev</td>
<td>2.0%</td>
<td>0.8%</td>
<td>0.3%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Long Run</td>
<td>Mean</td>
<td>-18.4%</td>
<td>-6.7%</td>
<td>-3.1%</td>
<td>-0.7%</td>
</tr>
<tr>
<td></td>
<td>Std Dev</td>
<td>6.5%</td>
<td>2.4%</td>
<td>1.1%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

### Avg Percent Change in Class Revenue

<table>
<thead>
<tr>
<th>Price Elasticity</th>
<th>Avg Percent Change in Class Revenue</th>
<th>Rate A</th>
<th>Rate B</th>
<th>Rate C</th>
<th>Rate D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Run</td>
<td>Mean</td>
<td>-9.1%</td>
<td>-3.1%</td>
<td>-1.0%</td>
<td>-1.4%</td>
</tr>
<tr>
<td></td>
<td>Std Dev</td>
<td>3.1%</td>
<td>1.1%</td>
<td>0.4%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Long Run</td>
<td>Mean</td>
<td>-28.4%</td>
<td>-9.4%</td>
<td>-3.3%</td>
<td>-2.6%</td>
</tr>
<tr>
<td></td>
<td>Std Dev</td>
<td>9.9%</td>
<td>3.4%</td>
<td>1.1%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>
Price response mitigates the impact on high use customers by shifting the breakeven point.
What will be the likely impact of dynamic pricing rate designs?
An illustrative dynamic pricing rate design

Price Duration Curve

Cost-Based CPP/TOU Rate

Current Rate

Number of Hours in Summer Period

Rate ($/kWh)
Customers respond to dynamic pricing

- PTR
- CPP
- CPP with Technology
Enabling technologies magnify demand response

Role of Technology on Pilot Program Impacts

Note: PSE&G load impacts on CPP days are not provided in the reviewed study. The load impacts are calculated using the reported kWh reductions and an estimate of consumption during peak on CPP days.
Customer response in the mass market varies by segment.
Crediting customers for the hedging premium broadens the appeal of dynamic pricing

Distribution of Bill Impacts
High CPP Rate

- Revenue Neutral
- 3% Premium, No Demand Response
- 3% Premium, With Demand Response

Customers with Flatter Consumption

Customers with Peakier Consumption

Percentile of Customer Base
The way forward is to offer customers a menu of pricing options.
The smart grid enables smart energy buying decisions

- Providing real-time feedback to customers can lower energy use by a few percentage points.
- Inclining block rates can reduce energy consumption by up to 6 percent in the short run and may additionally lower peak demand.
- Dynamic pricing rates can reduce demand by 13 to 27 percent during critical peak periods.
- Taken together, these measures can make a substantial contribution to meeting Indiana’s future energy needs at a reasonable cost.
The digital library


- The Brattle Group, “Quantifying the benefits of dynamic pricing,” Edison Electric Institute, January 2008 (Downloadable from www.eei.org/ami)

