Economics of Electric Real-time Metering

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Electric Metering/Pricing Alternatives

• **Category 1: Residential and small commercial users**
  
  – Metering typically tracks total consumption measured in Kwh over the billing period (e.g., 27-32 days)
  – Pricing based primarily on specified rate per Kwh consumed

\[
\text{Cost} = \text{Kwh} \times \$/\text{Kwh}
\]
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Electric Metering/Pricing Alternatives (cont)

- **Category 2:** Large commercial and industrial users
  - Metering tracks total consumption *and* demand data on a real time basis
  - Pricing based primarily on
    - Consumption at a specified rate per Kwh consumed
    - Demand charges \((KW_{\text{max}})\)
Electric Metering/Pricing Alternatives (cont)

- In addition to consumption and demand, other pricing factors may include
  - Energy surcharges
  - Power adjustment factors
  - Charges for transformer and line losses
  - Size of power line feed
  - Noncompliance penalties for failing to meet emergency curtailment requirements

- State public utility commissions regulate pricing formulas and approve rate structures for $/Kwh, rules for determining peak periods, combined Kwh and $KW_{max}$ pricing rate schedules, etc.
Establishing Demand and Associated Charges

- Demand charges typically vary by season (summer/winter) and time of day – e.g., for summer season
  - *On peak* (e.g., M-F, 1200-1800)
  - *Partial peak* (e.g., M-F, 0800-1200 & 1800-2200)
  - *Off peak* (e.g., M-F, 2200-0800, S/S/H anytime)
  - Add-on all season charge

- Demand typically established by calculating moving average of the highest demand ($KW_{\text{max}}$) during a specified time interval (1-60 minutes) over the billing period
Establishing Demand and Associated Charges

- Demand charges are cumulative during billing period – e.g., for summer season
  - Summer *on peak* demand charge ($KW_{max}$)
  - Summer *partial peak* demand charge ($KW_{max}$)
  - Summer *off peak* demand charge ($KW_{max}$)
  - Add-on all season charge ($KW_{max}$)

- Example for Category 2 user during summer billing cycle

Cost = $K_{\text{wh}} \times \$/K_{\text{wh}}$ (consumption)
+ $KW_{\text{max}} \times \$/A/KW$ (peak demand for on peak period)
+ $KW_{\text{max}} \times \$/B/KW$ (peak demand for partial peak period)
+ $KW_{\text{max}} \times \$/C/KW$ (peak demand for off peak period)
+ $KW_{\text{max}} \times \$/D/KW$ (add-on demand factor)
Why pursue electric real-time metering?
Section 543 of National Energy Conservation Policy Act (42 U.S.C. 8253) to be amended as

- All federal buildings shall, for the purposes efficient use of energy and reduction in the cost of electricity used in such building, be metered or sub-metered.
- Each agency shall use, the maximum extent applicable, advance meters or advance metering devices that provide data at least daily and that measure at least hourly consumption of electricity at the federal buildings.
- Deadline: 1 October 2010
Potential Management Benefits

- Provides accurate data on electricity use and cost on real time basis
- Allows facility managers to make informed decisions on electricity use patterns
- Helps avoid energy use during peak period when electricity is more expensive
- Helps avoid high power demand charges
- Helps avoid demand curtailment penalties
Examples of how real-time electric metering might be used at a facility......
## Pacific Gas and Electric E-20 Rate Schedule (excerpt)

<table>
<thead>
<tr>
<th>Season</th>
<th>Time of Use Period</th>
<th>$/KW</th>
<th>$/Kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer On Peak (5/1-10/30)</td>
<td>12:00 – 18:00, M-F, ex holidays</td>
<td>$13.35</td>
<td>$0.18407</td>
</tr>
<tr>
<td>Summer Partial Peak (5/1-10/30)</td>
<td>08:30-12:00 &amp; 18:00-21:30, M-F, ex holidays</td>
<td>$3.70</td>
<td>$0.09814</td>
</tr>
<tr>
<td>Summer Off Peak (5/1-10/30)</td>
<td>21:30-08:30, M-F, Sat Sun, &amp; holidays</td>
<td>-</td>
<td>$0.09069</td>
</tr>
<tr>
<td>Winter Partial Peak (11/1-4/30)</td>
<td>08:30-21:30, M-F, ex holidays</td>
<td>$3.65</td>
<td>$0.10391</td>
</tr>
<tr>
<td>Winter Off Peak (11/1-4/30)</td>
<td>21:30-08:30, M-F &amp; All weekends and holidays</td>
<td>-</td>
<td>$0.09048</td>
</tr>
<tr>
<td>All seasons</td>
<td>Maximum demand</td>
<td>$2.55</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Demand interval is 30 minutes per billing cycle

<table>
<thead>
<tr>
<th>Demand Charge Category</th>
<th>(a) Peak Demand (KW&lt;sub&gt;max&lt;/sub&gt;)</th>
<th>(b) Peak Demand Rate ($/KW)</th>
<th>(c) Total Usage (Kwh)</th>
<th>(d) Usage Rate ($/Kwh)</th>
<th>(e) Cost (a<em>b)+(c</em>d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Peak (12:00-18:00)</td>
<td>887</td>
<td>$13.35</td>
<td>106,188</td>
<td>$0.18407</td>
<td>$31,387</td>
</tr>
<tr>
<td>Partial Peak (08:30-12:00 &amp; 18:00-21:30)</td>
<td>900</td>
<td>$3.70</td>
<td>120,419</td>
<td>$0.09814</td>
<td>$15,148</td>
</tr>
<tr>
<td>Off Peak (21:30-08:30)</td>
<td>870</td>
<td>0</td>
<td>362,541</td>
<td>$0.09069</td>
<td>$32,879</td>
</tr>
<tr>
<td>Maximum Demand</td>
<td>900</td>
<td>$2.55</td>
<td>NA</td>
<td>NA</td>
<td>$2,295</td>
</tr>
<tr>
<td>Total Charges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$81,709</td>
</tr>
</tbody>
</table>
### PGE E-20 Rate Schedule – Cost Savings Differentials

<table>
<thead>
<tr>
<th>Shifting From</th>
<th>To</th>
<th>Savings $/KW</th>
<th>Savings $/Kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer On Peak (max)</td>
<td>Summer Partial Peak (max)</td>
<td>$ 9.65</td>
<td>$0.08693</td>
</tr>
<tr>
<td>Summer On Peak (max)</td>
<td>Summer Partial Peak</td>
<td>$13.10</td>
<td>$0.00745</td>
</tr>
<tr>
<td>Summer On Peak</td>
<td>Summer Off Peak</td>
<td>$13.35</td>
<td>$0.09438</td>
</tr>
<tr>
<td>Winter Partial Peak</td>
<td>Winter Off Peak</td>
<td>$ 3.65</td>
<td>$0.01343</td>
</tr>
</tbody>
</table>
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Fresno Facility – Demand (KW) History
(15-min. interval averages 6/21/02 – 7/24/02)
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Stockton Facility – Demand (KW) History
(15-min. interval averages 6/20/02 – 7/20/02)

Shifting this “on peak” demand to “partial peak” saves $934 (70kw X $13.35) in demand charges in one summer month.
## Demand Profile Analyses - Inventory Major Components

<table>
<thead>
<tr>
<th>Energy Systems</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>Lamps, Ballasts</td>
</tr>
<tr>
<td>Heating</td>
<td>Electric heaters, heat pumps</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>Chillers, pump motors</td>
</tr>
<tr>
<td>Ventilation</td>
<td>Fan motors</td>
</tr>
<tr>
<td>Industrial process</td>
<td>Motors, special equipment</td>
</tr>
<tr>
<td>Plug Ins</td>
<td>PC, vending, kitchen appliances, etc</td>
</tr>
</tbody>
</table>
Common Demand Shedding/Shifting Techniques

- Turn off portions of lights
- Pre-cool building before on-peak period
- Shift work schedule or equipment use hours
- Fuel substitution – gas absorption chiller
- Use of adjustable speed drives
- Install thermal storage capabilities
There are clearly advantages to knowing how much electricity your facility is using from hour to hour.

so how can you establish a real-time metering capability?
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Gaining Access to Facility Real-time Meters

- Utility companies often install telemeters that record and transmit real time consumption data; may also be manual read.

- Utilities own the meters, but may allow customers to tap into data through some form of sharing arrangement.

- Utilities may convert conventional meters at larger facilities to real-time meters at either no, partial, or full cost to customer.
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Costs Associated with Real-time Metering

- Metering equipment installation: $500 - $3,000 per meter
- Communication line: initial installation cost and monthly fee (e.g., phone lines, wireless, intranet, Ethernet, etc.)
- User interface: initial hardware/software development cost, incremental cost of upgrade or ESCO contract fee, staff training
Conclusion

- Potential cost savings will depend on many variables
  - Rate schedule (penalty clause, competitive purchase)
  - Demand profile based on energy systems and operational characteristics
  - Capability to shift demand
- Real time metering is first step
- Training and retrofit projects are needed to establish demand management capability
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