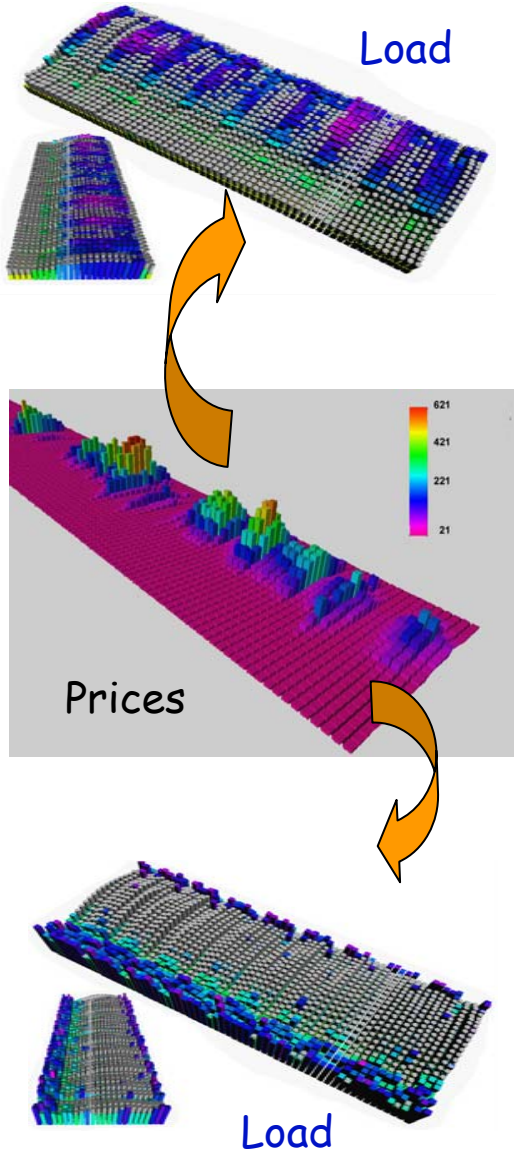

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Changing Consumer Behavior: Do Incentives & Price Signals Work?

Presented to:

Colorado's New Energy Economy: The Path Forward

Denver, CO, October 30, 2007

Presented by:

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Outline

1. Will consumers respond to price signals and incentives?
2. How can response be characterized?
3. Evidence that consumers do respond
4. Implications for improving the performance of the electricity sector

1. Will consumers be responsive to dynamic pricing?

No

- Electricity is too insignificant a cost to be bothered with
- Electricity is too essential, and there are no substitutes
- Electricity is not consumed directly (indirect demand)
- Conservation trumps price response in terms of benefits
- Insufficient inducement/incentive to respond
- It's too hard to respond
- Paying consumers to curtail is more effective

Yes

- Electricity expenditures are equal to those of telephone service, more than cable and internet
- Indirect demand is true of communication services
- Price repose may result in a different level of service
- Reflects utiltiy and regulatory preferences, not necessarily those of customers
- Pilots in CA, IL, Canada found response with no enabling technology
- Prices do a better job of rationing

2. Price elasticity

Customer's Ability to change

Incentive to Change

Observed Change in electricity usage

Price Elasticity = $\frac{dP}{P^R} \times \frac{dQ}{Q^R}$

Price Elasticity - % change in usage induced by a 1% change in price
0 </= Price Elasticity </= over 5.0 (absolute value)
Elasticity =1 yields changes in proportion to load

Own-Price Elasticity

adjustment of overall expenditures in response to change in the price of electricity *(goods/output swapping).*

Negative values

Substitution Elasticity

adjustment of overall expenditures in response to change in the price of electricity *(temporal/input swapping).*

Positive values

3. Estimates of Price Elasticity

Short-run- technology/devices fixed

	Mean	High
Residential	.08	.38
Commercial	.05	.20
Industrial	.15	.30

- Several trials show convergent results
- Higher values associated with controls

- Based on very meager evidence
- Higher values associated with DG, internal champion

- Largest variance in individual values
- Large % non-responders
- Some incorrigibles

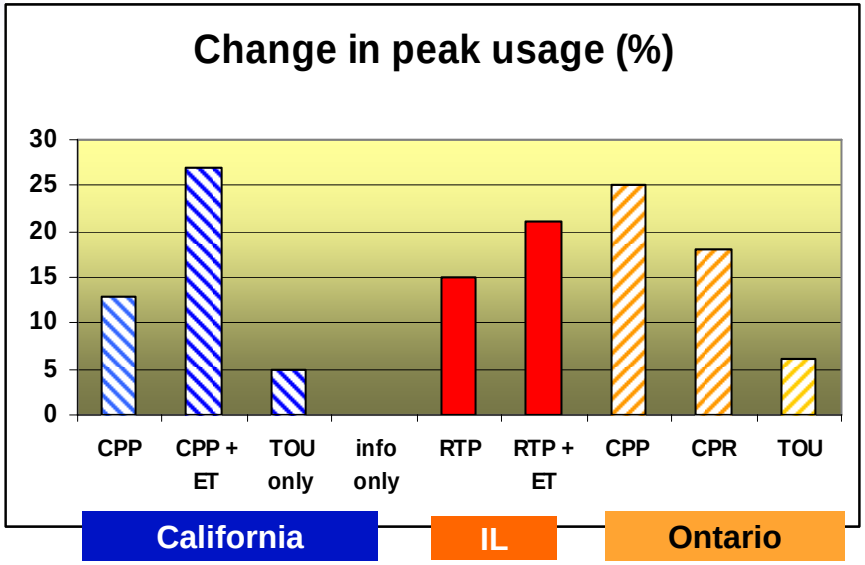
Practical Implications

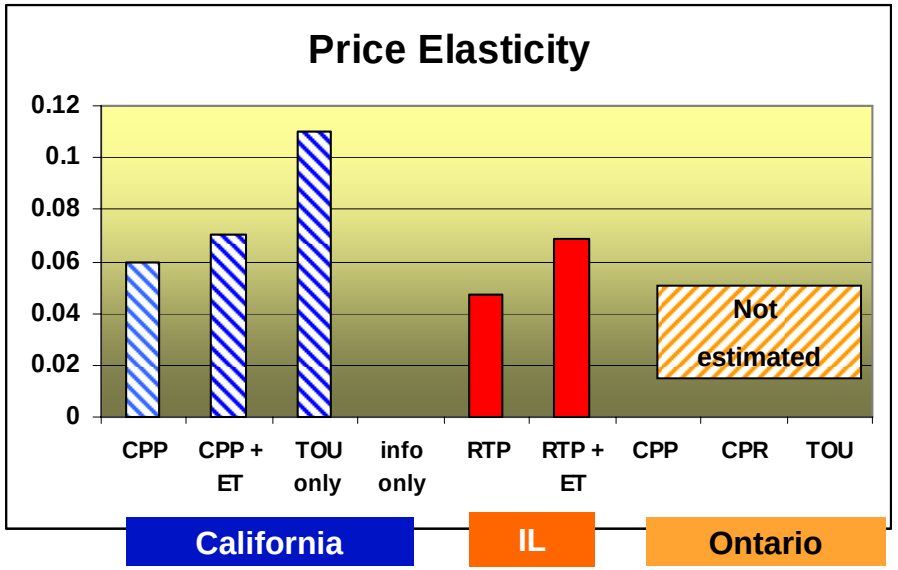
- 50% residential rate hike (IL, CT) would result in 4-17% reduction in usage in short run
- BUT total revenue would go up!
- Commercial and industrial customer would (on average) respond to a doubling of peak prices by reducing peak usage *ratio* by 10 -15%

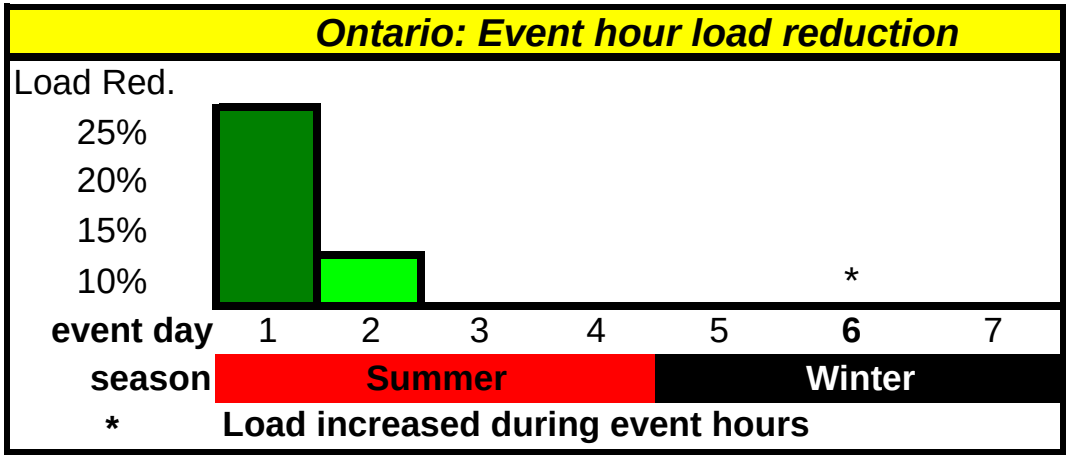
Long Run Price Elasticity

- Estimates range from .75 to > 1.2
- Based on sparse data
- Impact of growing miscellaneous usage ?

3. Residential Price Response Estimates







Conservation Effect

Evidence that dynamic pricing induces overall energy reduction

- **Ontario (CPP, TOU) - 6%**
- **Chicago (RTP) – 2%**
- **California - none**

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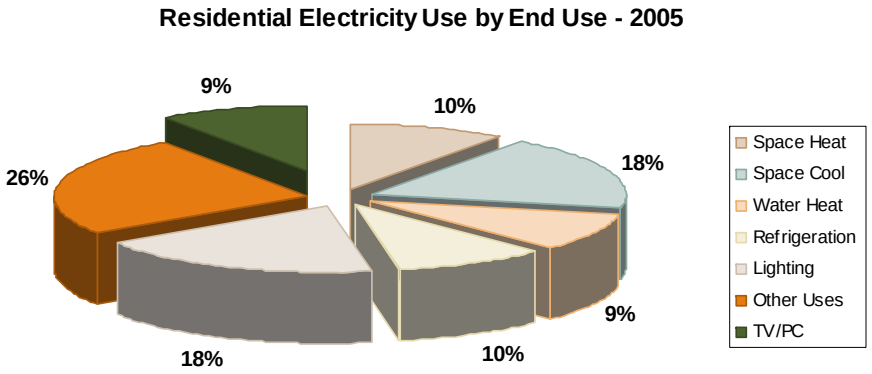
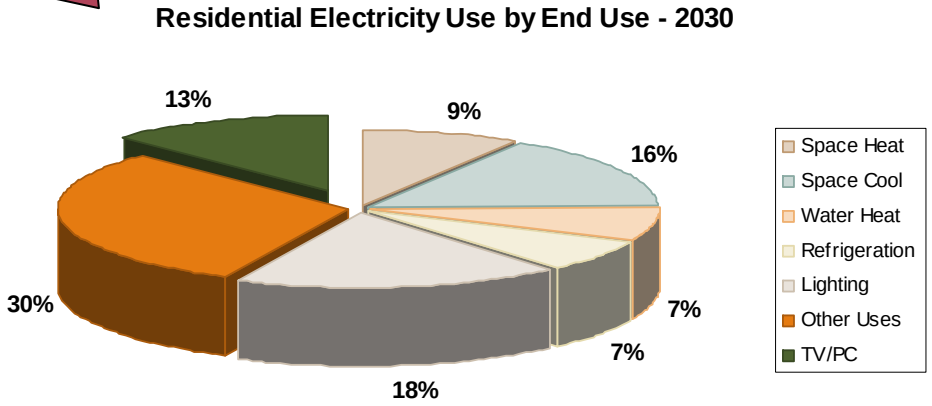
3. Expected Change (from 2005 to 2030) in the Intensity of Major *Residential* Electricity End Uses



"Miscellaneous" growing from 35% to 43% of Household electricity usage

This growth confounds efforts limit carbon emissions



Notes:

- Based on: ***DOE/EIA Annual Energy Outlook 2007, with Projectio 2030***, **Table A4, page 142**
- **Heating, cooling, and lightning intensity normalized based on p of building space**
- **Refrigeration and TV/PC/Set top/other uses normalized based on per household**

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3. Response to other inducements

- **Demand Response** - changes in usage undertaken to fulfill an obligation to do so or, in response to a situational buy-back offer
  - One tariff for normal conditions
  - A different price or penalty rate applied when the option is exercised
    - Traditional interruptible/curtailable tariffs
    - Critical Peak Pricing (FL, CA, a few others)
    - ISO/RTO capacity and emergency load-as-a-resource programs

Advantages of DR

- Limits exposure to high prices
- Up-front payment provides assurance
- May provide more certain response
- Can be integrated into standard rate
- High-profile response to public concerns

Disadvantages of DR

- No access to low prices
- How are the options priced?
- Ambiguities in measuring compliance
- Complexity and free-ridership issues
- Substitutes rationing for efficiency

4. Implications

- **Many factors influence a customer's ability to and inclination to respond to price changes**
  - **Inherent ability, available technology**
  - **Incentive level and for, which determines inclination**
  - **Personal and household circumstances**
- **Currently price response is low**
  - **Limits what can be accomplished at low prices**
  - **Favors administrative pricing (CPP) over dynamic cost pricing (RTP/TOU)**
- **Implementation conundrum**
  - **Opt-in/Opt-out – may result in low participation**
  - **Mandatory - exposes some customers to large, unhedgable risks**
- **Enabling technologies can provide a way to foster greater price response**
  - **Utilize existing controls in businesses**
  - **Automated and hands-free household controls**

4. EPRI Initiatives to Advance Price Responsiveness

- **Living Lab** – test price communication and control devices and systems
- **Intelligent Grid** - develop protocols to promote home automation networks that are integrated into electric system operations
- **Prices to Devices** – research and development to establish design and performance standards for readily controllable devices like lighting, appliances
- **Price Response Research** – synthesize research on price response and develop collaborative to increase understanding of how consumers value electricity

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Questions?

Comments and observations would be welcomed:

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