

A Consumer Perspective on Smart Grid Issues

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A presentation to the
Illinois Smart Grid Initiative

Chicago, Illinois

August 5, 2008

Is there such a thing as a SMART GRID?

- No single definition
- Watch out for “necessary” elements proposed by vendors.
- Some fairly consistent elements across U.S.:
 - Interval meters
 - Two-way communications (meter to MDMS)
 - Meter Data Management System(s)
 - Together, these are the “Advanced Metering Infrastructure
- NOT necessarily HAN, PCT, other customer-side devices
- Additional features, depending on state/utility

Is this a Smart Grid?

An electrical grid that includes digital technologies such that it allows utilities:

- (a) to identify the flow of electricity along the grid with great precision to identify outages and voltages out of allowed ranges, and to transmit signals to transformers, capacitors, circuit-breakers and other distribution equipment, so as to initiate diagnostic or corrective actions,
- (b) to record the usage of a customer using time intervals of demand in the range of 5 minutes to one hour, to communicate usage information virtually continuously to a meter data management system (from which it can be distributed to authorized users of the information), and
- (c) to send and customers to receive information at the meter concerning system and area conditions and prices, and to signal customer premises equipment that can be programmed to respond to such information by adjusting usage levels.

Insist on the Business Case

- Do the costs exceed the benefits?
 - First, system-wide?
 - Then, by customer class and for certain vulnerable customers?
 - If not, can reallocation hold all vulnerable customers harmless?
- How certain are the cost estimates?
- How certain are the benefit estimates?
- Who is going to take what risks?

What I'll cover

- What is a “Smart Grid”??
- What should utilities show to get consumer support?
- How have residential customers responded to time-varying pricing?
- Recommendations

Cost and Benefit Categories

■ Costs -

- NEW METERS, new communications system(s), new MDMS, new back-office procedures and software, etc.

■ Benefits –

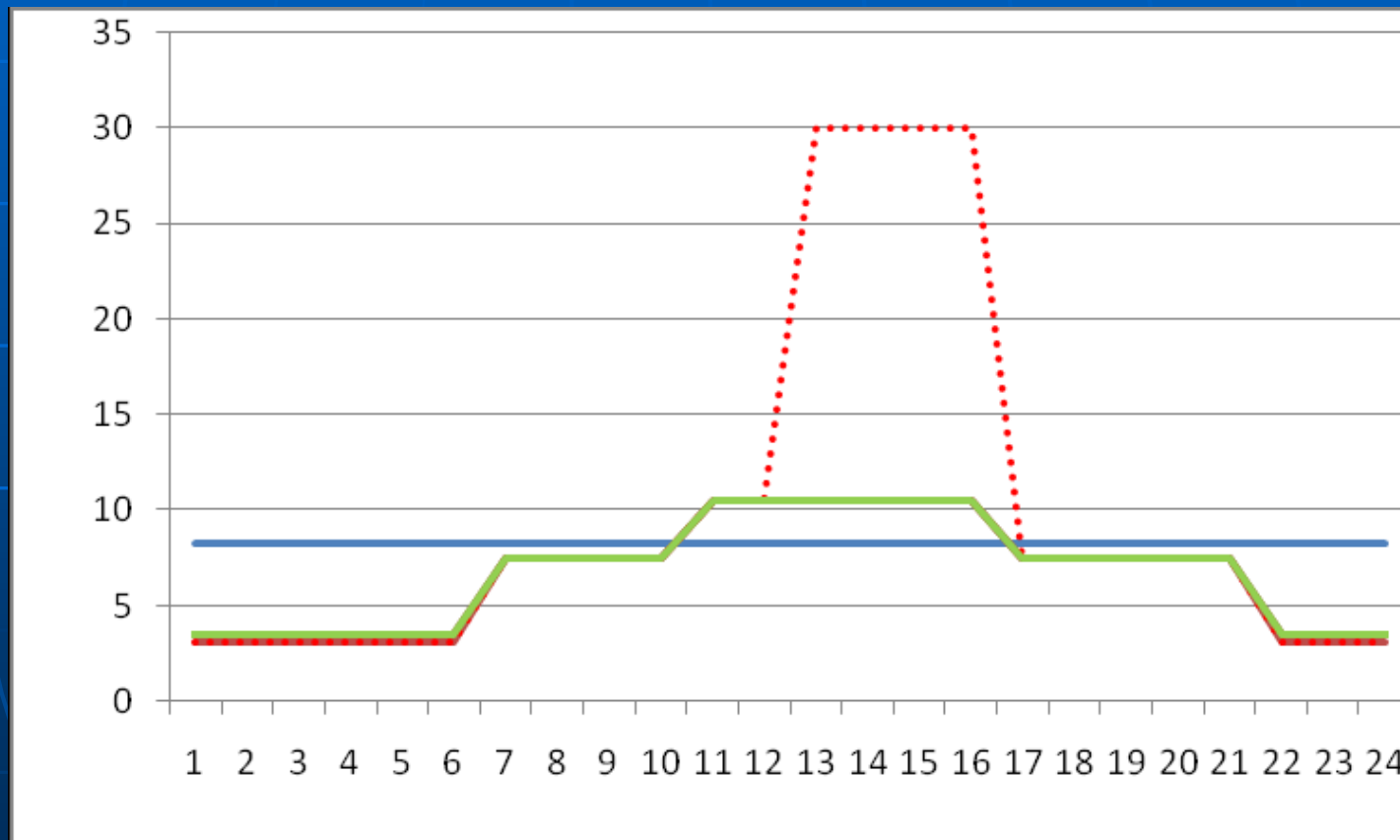
- Operational
 - Automatic meter reading (labor cost savings = 50% to 80%)
 - Quicker outage response/better communications
 - Other
- Peak load reductions (from dynamic pricing)?
- Expanded use of T&D network?

What I won't cover

- AMI Bill impacts – Data are sketchy at best
- Costs of implementing dynamic pricing
 - All targeted-peak price methods require interval meters
 - Don't require Advanced Metering Infrastructure (AMI)
 - Cost/Benefit of AMI is a separate question
- System savings achieved by reducing peak demands
 - And hence BCR of pricing options
- Alternative approaches to reducing peaks
 - TOU rates, EE/DSM, standards, DLC – may be better 1st choice?
- These are important questions,
 - on which a lot has been written. See reading list handout.

Chart of CPP/TOU/Flat Rate Prices on a Critical Peak Day

Cents/kWh



Hours

“Just say no”

- Opponents say: benefits don't justify costs:
 - “Most residential cannot save”
 - Cannot shift load to off-peak hours
 - Cost of metering will eat up savings
 - Big problem for low-use and low-income customers
 - These customers will suffer
 - “Those residential who can save, won't”
 - Have enough money to pay the peak prices
 - Will just buy through, so no system benefit
 - Effects will not persist, but costs will

Let's look at the facts

- Three recent pilots with controls/evaluations
 - California Special Pricing Pilot
 - Energy Smarttm Pricing Plan – Chicago
 - Ontario Energy Board Smart Price Pilot

California Results, overall – Customers without Smart Thermostats

Source: Herter, et al

- Ave. CPP-F response in 5-hr CPP: -0.1 kW
 - 9% - cool temps
 - 4% - moderate temps
 - 13% - hot
 - **23% - REALLY hot**
- BUT
 - In one mild temp band, ave. 8% *INCREASE*
 - *No* significant response in other hours

CA SPP:

CPP-F Average % Reduction in Peak Usage by Usage Level and End-Use

<u>Usage & End-uses</u>	<u>Year 1*</u>	<u>Year 2**</u>
■ High Use	-17.2%	-14.7%
■ Low Use	-9.8%	-12.2%
■ Single-family house	-13.5%	-14.0%
■ Multi-family building	-9.8%	-11.8%
■ Central A/C	-12.8%	-17.4%

* Source: CRA, *SPP Evaluation, Summer 2003*, Table 5-9

** Source: CRA, *SPP Final Report*, Table 4-19

California results overall – Customers with PCTs (CPP-V)

Source: Herter, et al.

- **Ave. PCT response to 5-hr. CPP***
 - 8% down – lowest temps
 - 1% down – mild temps
 - 6% - 7% down – moderate temps
 - 25% down – high temps

- **Ave PCT response to 2-hr. CPP:**
 - 13% - 15% down for most temps
 - 41% down for high temps

- ***Smart Thermostats produced big responses***

**Herter, et al. Other ISOs calculate -0.55 kW*

CA SPP

Demand Response by usage: Per Herter

- **Low use households,**
 - Regardless of income level, no statistically significant response to CPP
- **High use households**
 - Regardless of income level, **statistically significant response**
 - On average, 0.208 kW during CPP

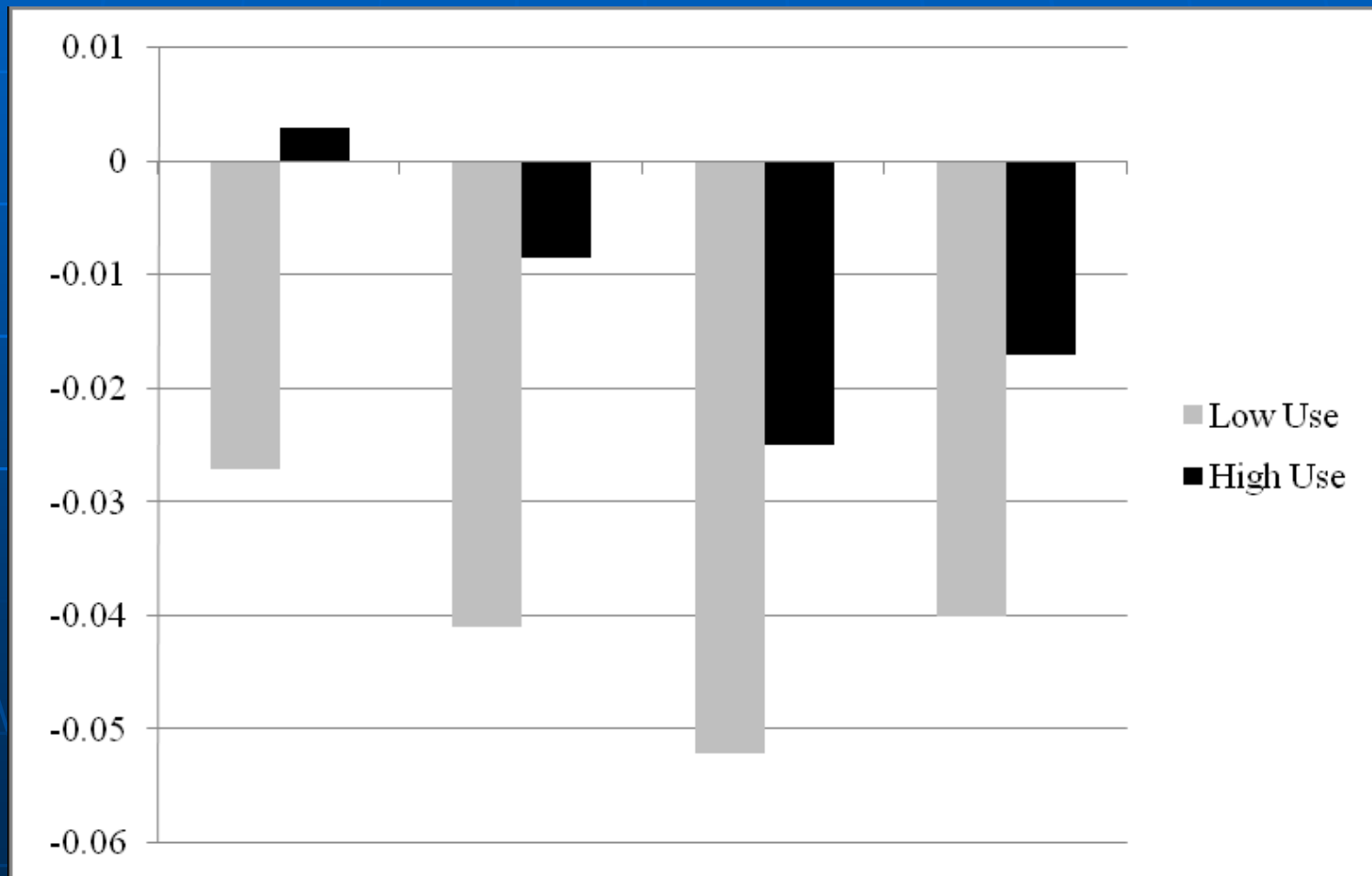
Low Income CA SPP load response

Source: M.Cubed and Charles River Associates,
Statewide Pricing Pilot Track B: Evaluation of Community-Based Enhancement Treatment.

- On average, Track B load response = 2.6%
- But a small # of participants pushed up the average response
- Statewide lower income participants
 - <\$40K - reduced by 10.9%*
 - CARE – reduced by 2.9%*
- *Bill savings* for lowest-income/high-use groups =
 - **ZERO, ZIP, NADA, NEGATIVE.....**
 - **Even before adding incremental metering costs**

CA SPP Mean Annual % Change in Bills by Usage and Income (*Without AMI Costs*)

Source – Herter, Figure 5

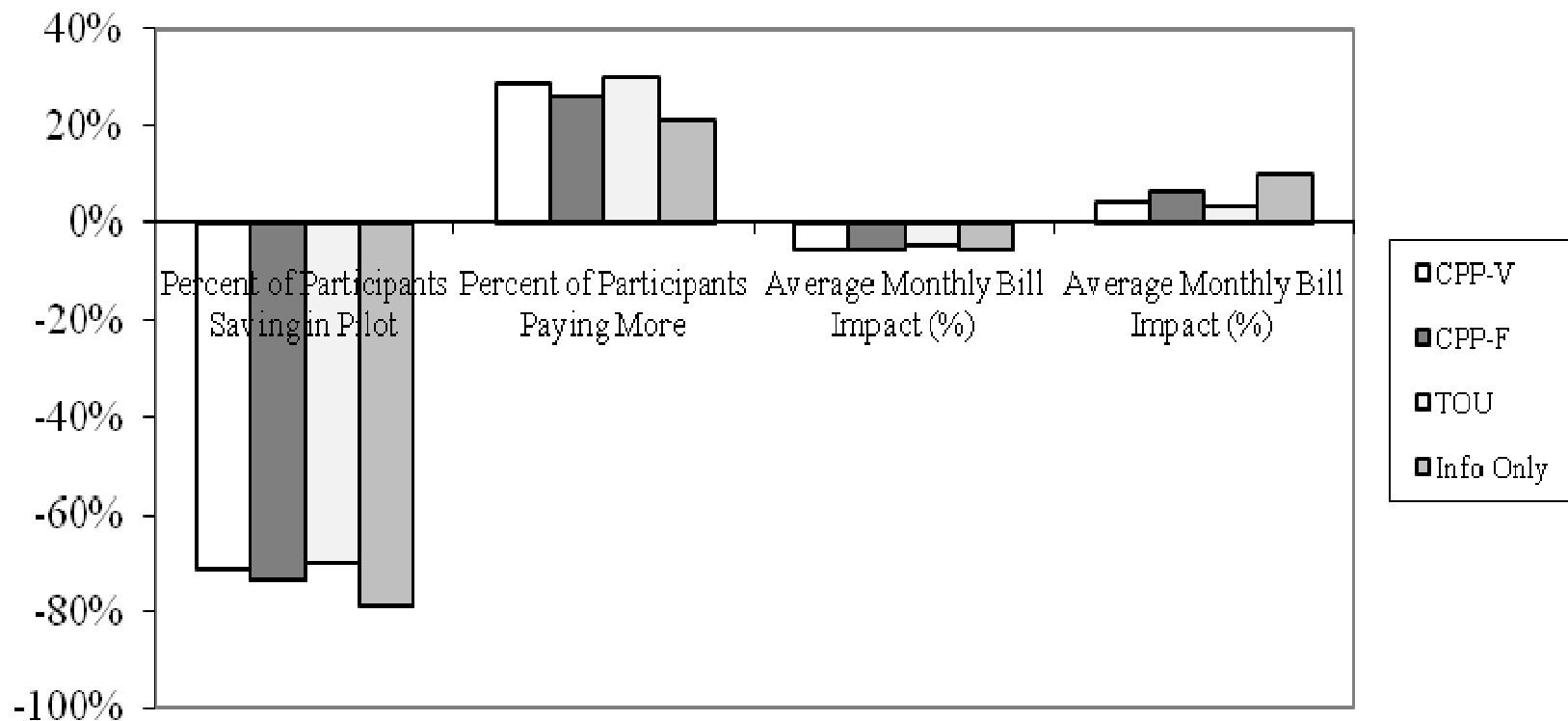


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CA SPP

Incomplete estimate of bill impacts

Average Bill Impacts, CA SPP Residential
[Does not include incremental meter costs]



Energy Smart™ Pricing Pilot

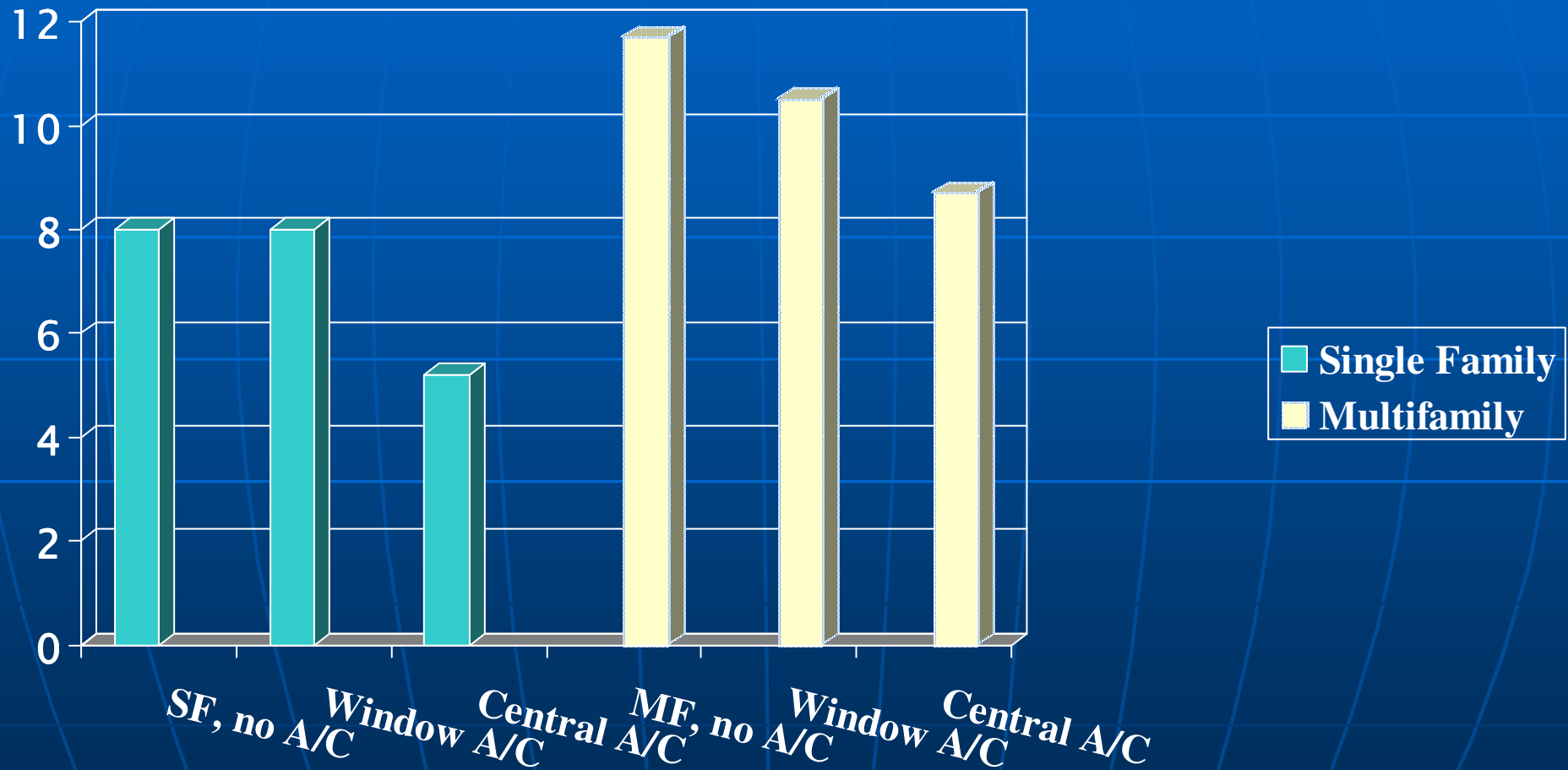
- Chicago, Illinois area, 2003-2006
 - Community Energy Cooperative + ComEd
- Residential customers
 - Coop members invited; by 3rd year, 1400 joined
 - Control group – random assignment – flat rate
- Hourly price tariff
 - Advance notice of next day prices/especially "high price" days
 - Interval meters installed
 - Hourly pricing, day-ahead
- Relatively low-tech, by design
 - Programmable thermostats offered
 - 57 participants fitted with DLC on A/C from yr 2
 - Phone, email, fax notice of upcoming critical peak

ESPP Results, percent reductions

- 2003 (cooler than normal)
 - On average, 20% reduction
 - Over half showed significant responses
 - Some showed no response
- 2004 (cooler than normal)
 - no statistically significant response
 - decreased load 8% on high price days
 - ***BUT A/C w/ DLC –***
 - reduced as much as 9% and 11%
- 2005 (Hot, hot, hot)
 - significant response on average –
 - **35.2 kW in peak month**

ESPP –

Price elasticities by housing type,
space conditioning devices



ESPP

Mixed Evidence of Income Effects

- Higher income, older households, Central A/C were:
 - *Less* likely to respond to high-price notifications
- Households with computers & those with more people at home during day were:
 - *More* price responsive
- Households in low-income neighborhoods
 - *Responded* like those in other neighborhoods
- Lower income households were:
 - More likely to have window A/C than central A/C, *but*
 - More likely to respond to high price notifications

Ontario Smart Pricing Pilot

- Ottawa, August 2006 - February 2007
- 3 Pricing Groups and a Control
 - CPR – 30 cent **rebate** for below-baseline CPP usage
- Up to \$75 incentive payment if reduce load during pilot
- Ontario rolling out interval meters to all
 - Those with such meters already, invited to join.

OSPP load responses by rate and time of use

	Summer Critical Peak Hours	Summer All Peak Hours	Non-peak Hours
TOU	No response*	2.5%	No response*
CPP	25.4%	11.9%**	No response*
CPR	17.5%	8.5%	No response*
<p>* Any response was not statistically significant</p> <p>** But note – during summer non-CPP peaks, CPP participants <i>increased</i> load 10.8%</p>			

OSPP Bill Impacts

Not counting incremental metering costs!

■ CPP

- 83% paid lower bills
 - Average savings = 4.2%
 - Greatest loss = 13.8%, Greatest savings = 7.6%

■ Overall

- 75% of participants saved \$, *but*
 - In August, TOU and CPP participants saw *higher* bills
 - In January, CPP participants saw *higher* bills

■ Low/moderate income – some had *higher* bills

- 5% saw bill *increases* over 10%
- Not counting meter costs

OSPP Demographics

- Participants disproportionately:
 - SFH
 - Newer housing
 - Central air
 - More education
 - Higher income
- May be hard to extrapolate to all vulnerable groups

4 key areas of CPP uncertainty

- Bill impacts
 - I really can't believe no one has studied this!!!
 - No single standard for equipment, so costs uncertain
- Self-selection bias
 - Payment for participation, volunteers, savvy consumers
- Participation rates
 - Not much evidence to support claimed 20%/80%
- Persistence of response
 - Was BIG problem in old TOU rates
 - Good reasons to hope Critical Peak approach does better
 - E.g. CP is less onerous, avoiding hedging premium = big savings, etc.
 - But at most 3-5 years of data

AMI: Who gets any benefits?

- If no AMR yet, Utility and all Customers get operational savings
 - Why exactly do utilities need pre-approval???
- If have to provide peak reducers 100% of the system savings for their reductions, only they can possibly benefit.
 - In this case, non-reducers will necessarily be harmed.
- Even if need not provide peak reducers 100% of system benefits, no sure winners
 - No study adequately looks at costs of AMI, allocation of AMI costs, and resulting impacts on allocation of net benefits or net costs.

Conclusions on Critical Peak Pricing

- Many residential customers can & do respond to CP pricing.
 - Benefits system greatly, by avoiding new capacity
 - Can be done without full AMI, where AMI not cost-effective
- But jury is still out on
 - Steady-state participation rates, persistence and especially
 - **Bill impacts**
- Programmable thermostats are the bee's knees, but costly still
- Low-use customers can benefit from CPP --- better load profile
 - Even if they don't reduce load
 - Many *did* reduce load in pilots
- **BUT** low-income/high-use customers are at risk
 - Need to identify, and direct our bill and DSM assistance here
- Alternatives could be more cost-effective in some cases
 - Direct load control produces dramatic results w/out AMI

Overall Recommendations

- Don't buy a pig in a poke.
- Beware an invitation to invest, from someone who does not want to take any risk.
- Don't substitute anecdote for fact.
 - *On either side!*
- Insist on a thorough business case.
- Weigh the risks of AMI against the risks of doing nothing.