



Residential Electricity Use Feedback: Looking Back and Moving Forward

Tuesday, March 31, 2009

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Today's Presentation

- Definitions and context
- Feedback delivery mechanisms
- Past research:
 - Results and gaps
- Ongoing research:
 - Addressing the gaps, preliminary results
- Going forward

Feedback Defined

- What is feedback:
 - “A process whereby the results of action serve continually to modify further action.”
-- Webster’s Pocket Dictionary, 1997



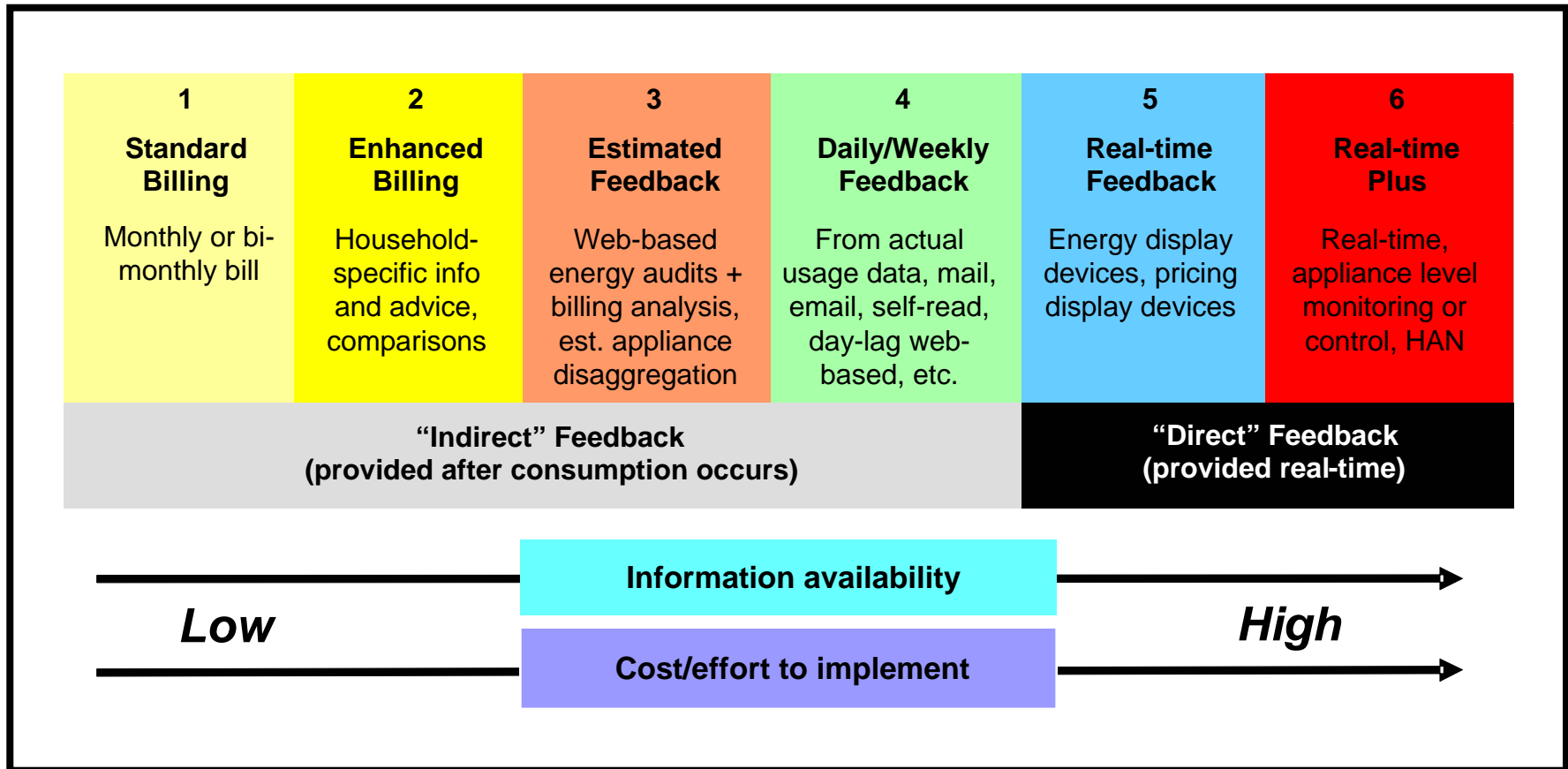
- Household-specific electricity consumption information

Context



- Why consider feedback, why now?
 - Pressing issues support the need for conservation and efficiency
 - Climate change
 - New power generation requirements
 - Transmission constraints
 - New technologies allow for ease of provision
 - Conservation results
- So why isn't everyone doing it?
 - EPRI wants to help understand and resolve utility/regulator/customer concerns

Feedback Mechanisms



Feedback Body of Research - Past

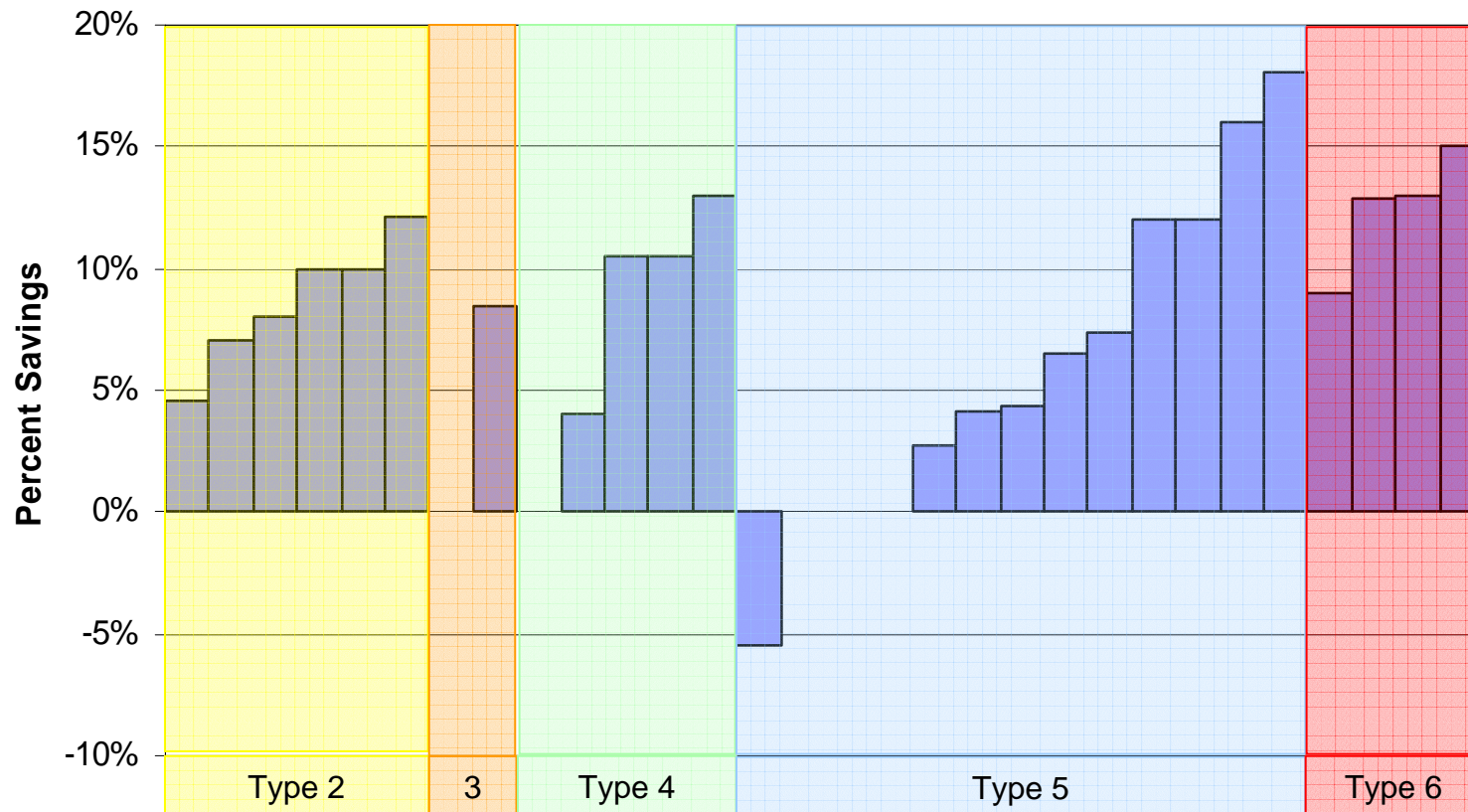


- Several critical summary analyses:
 - Darby 2001, 2006
 - Fischer, 2007
 - Abrahamse, *et al.*, 2005
- Average conservation effects:
 - Direct feedback: 5-15% range
 - Indirect feedback: up to 10%
- From EPRI, 2009 report:
 - 31 past studies: wide range, from -5.5% to 18%

A Range of Results



Average Conservation Effects



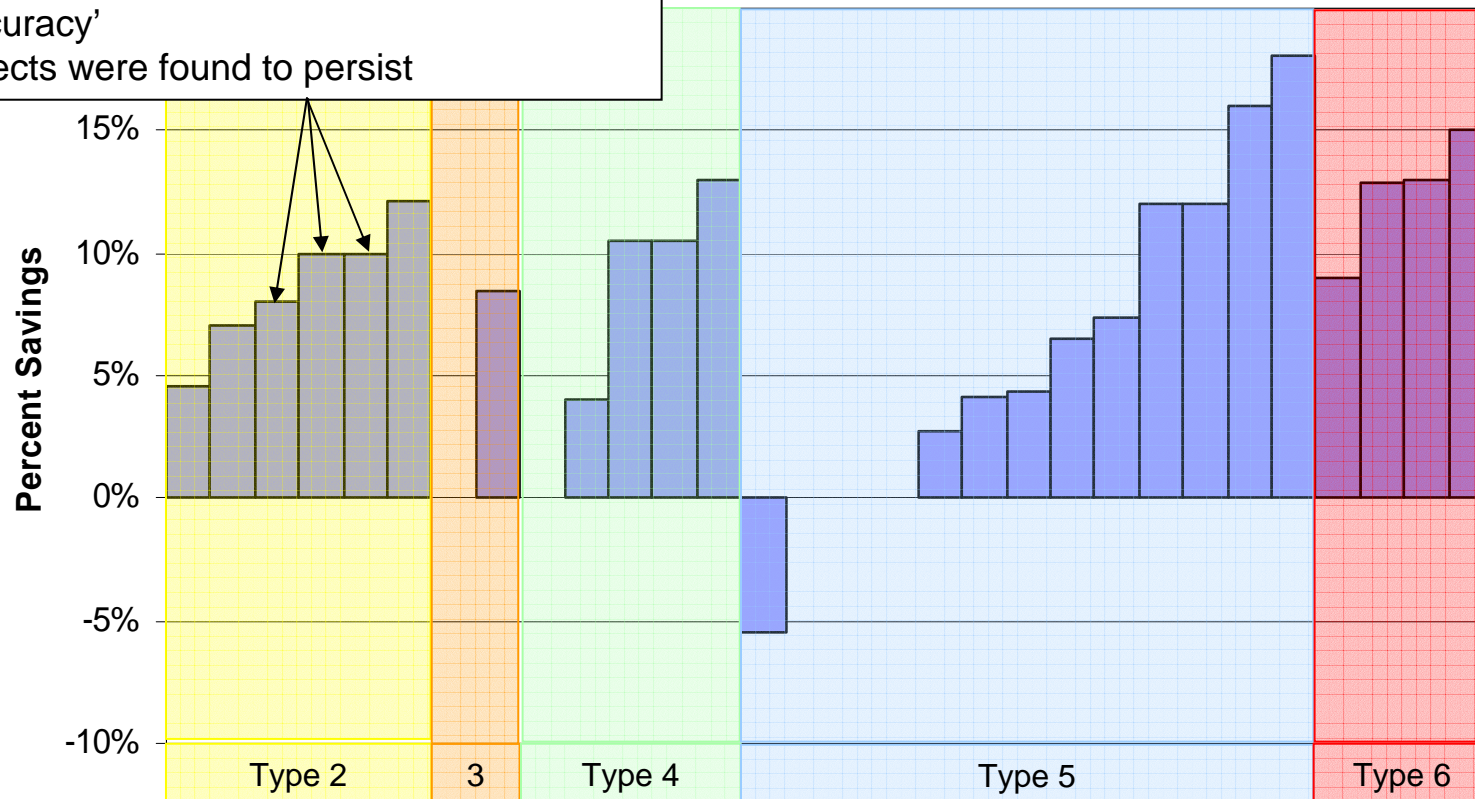
A Range of Results



Scandinavian studies (early 80s to late 90s)

- Enhanced billing
- N = 611-2,000
- t = up to 3 years
- 8-10% savings
- Main factor was increased frequency and accuracy'
- Effects were found to persist

Observation Effects

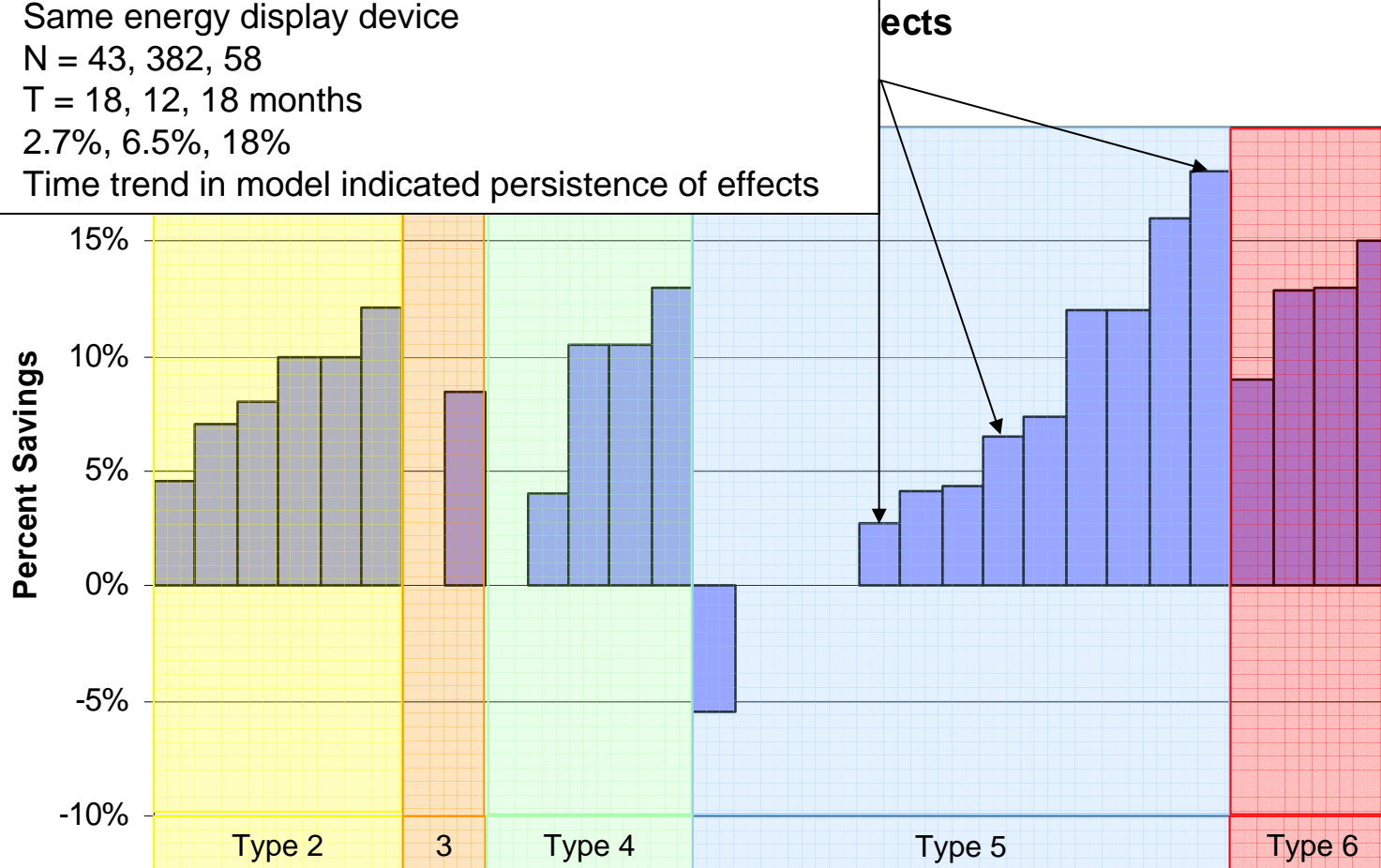


A Range of Results



British Columbia, Ontario, Newfoundland (2005, 2007)

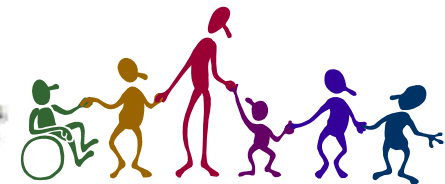
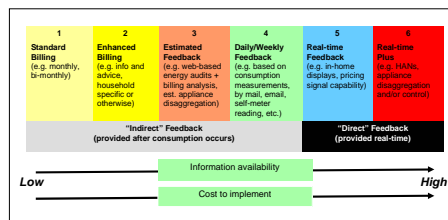
- Same energy display device
- N = 43, 382, 58
- T = 18, 12, 18 months
- 2.7%, 6.5%, 18%
- Time trend in model indicated persistence of effects



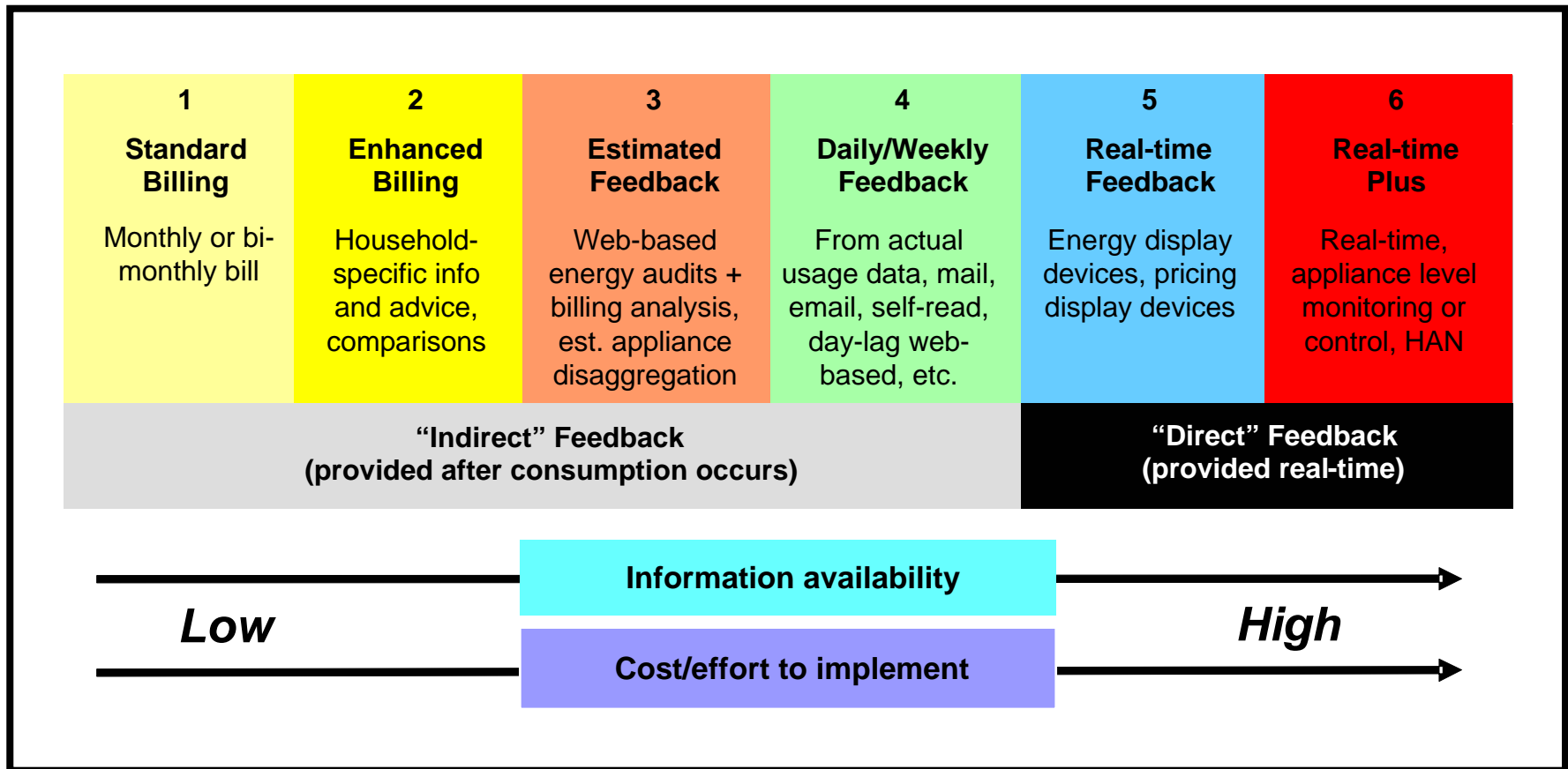
Feedback Body of Research - Past



- Research gaps:
 - Feedback delivery mechanism/type
 - Participation levels
 - Persistence
 - Pricing interactions
 - Demographic distributions



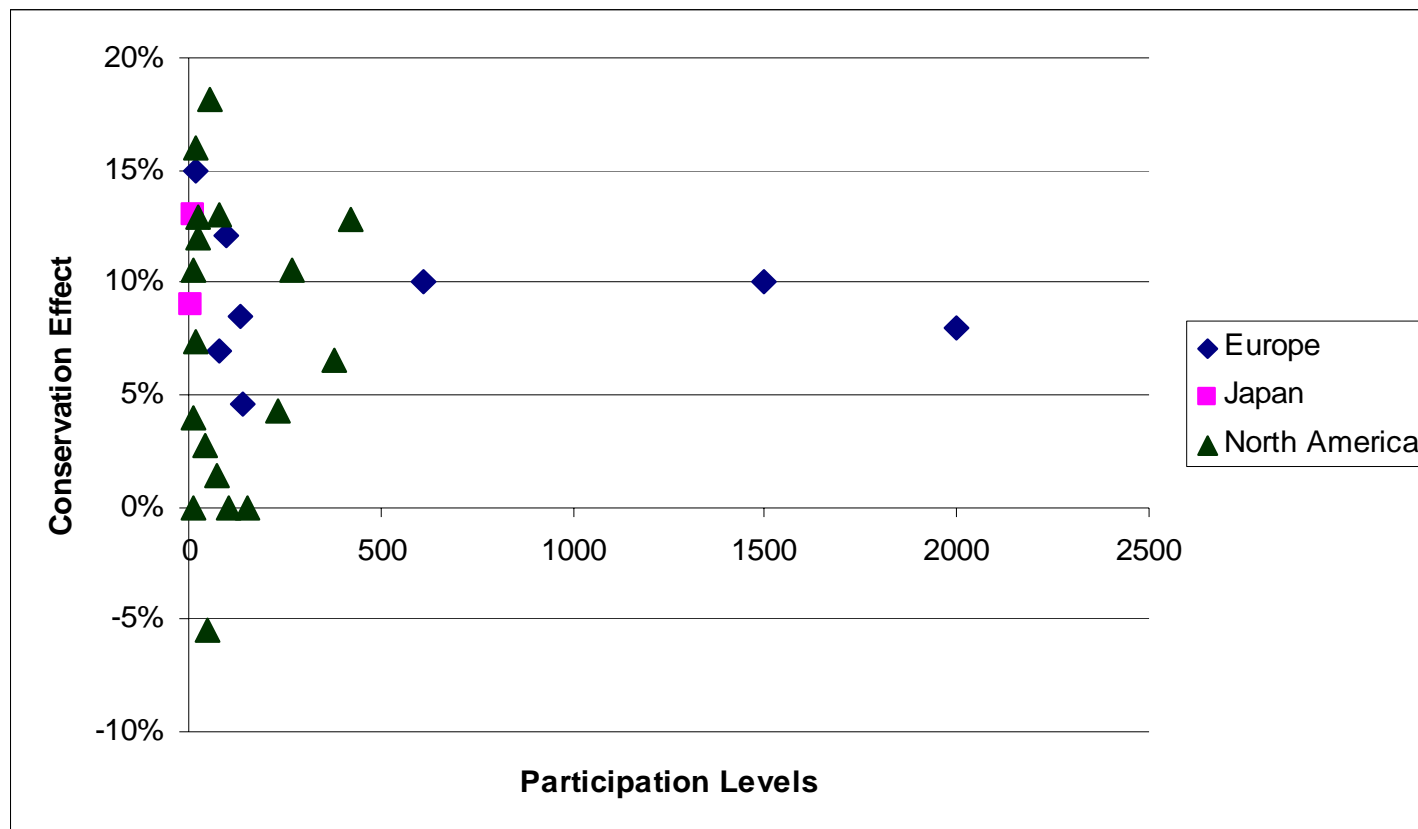
Area 1: Feedback Delivery Mechanism/Type



Area 2: Participation Levels



- Treatment group participation levels vary substantially
- Most were less than 200



Area 3: Persistence of Effects



- Some evidence of persistence
- Mainly involving enhanced billing (type 2) and display devices (type 5)
- Generalizability of the findings to the NA situation?
- Appropriate study length?



Area 4: Feedback and Pricing



- How do the two interact, if at all?
- Relatively new area

	Reference	Feedback Type	Sample Size	Duration (months)	Feedback Effect (Overall Conservation)	Feedback Effect (On-Peak Reduction)
		2				
CA SPP	Elliott, <i>et al.</i> , 2006	3	152	4	0%	0%
	Robinson 2007	4	106	3	0%	0%
	Hydro One 2008	5	411	5	4%	Incremental effect of 1.8% over TOU rates
CA SPP	Martinez and Geltz 2005	5	61	2	NA	0%
	Sexton, <i>et al.</i> , 1987	5	51	10	-5.5% (increase)	Incremental effect of 1.2% over TOU rates
		6				

Area 5: Demographic Effects



Trait	Evidence From Studies
Age	Greater effect with younger households?
Income	Variation in findings
Education	Greater effect with more highly educated households?
Electricity consumption	Greater effect with higher consumers?

- Some potential variations, but the links are tenuous



Feedback Body of Research - Ongoing



- Ongoing pilot activity
 - Mostly display devices (type 5)

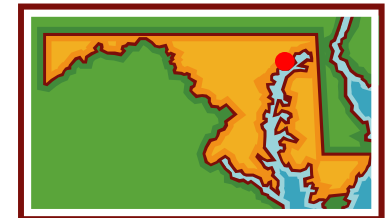
14 Ongoing Utility Pilots

Baltimore Gas & Electric	NV Energy
Dominion Virginia Power	OFGEM (UK)
Duke Energy	Omaha Public Power District
Energy Trust of Oregon	SaskPower
Focus on Energy Wisconsin	Sacramento Municipal Utility District (SMUD)
Hydro One	TXU
National Grid, NSTAR, W. Mass Electric	We Energies

Ongoing: Baltimore Gas & Electric



- Feedback type: 5
- Pricing display device assessment as part of dynamic pricing and enabling technology pilot
- N = 625 (subset of 1,300 home pilot)
- Duration: Feb '08 - Mar '09
- Results (preliminary, November 2008):
 - 6-7% peak reduction attributable to pricing display device
 - Continuing on this summer, using energy display device as well as pricing display device
 - Commercial



Ongoing: SMUD



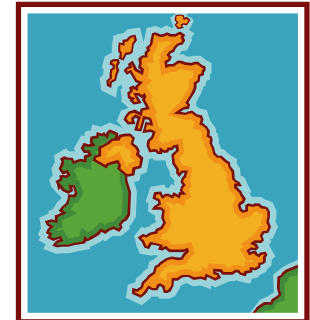
- Feedback types: 2, 5
- Monthly/quarterly energy reports (type 2); ongoing display device program (type 5)
- N = 35,000 (type 2); 10,000 (type 5, billing assessment will involve fewer)
- Duration: ~4 years (type 2); 1 year (type 5)
- Results (preliminary, November 2008):
 - Type 2: after ~ 6 months, a 2% savings compared to control
- We Energies: embarking on similar feedback assessments



Ongoing: Energy Demand Reduction Pilot (UK)



- Feedback types: 2, 5
- Wide range of information and feedback provision media being assessed
- N = tens of thousands
- Duration: at least two winters and two summers; completed by February 2009
- Results (preliminary, June 2008):
 - No statistical sig. effect for billing and display device trials
 - Various surveys: up to half of display device recipients not using device; half of these because the battery was not changed when required
 - One survey: a high % of people who installed their device changed their habits



Feedback Body of Research - Ongoing



- Feedback type: two large programs (OFGEM and SMUD) are comparing different types of feedback delivery mechanisms (type 2 and type 5)
- Participation levels: about half have sample sizes over 500
- Persistence: almost all studies are now at least one year in length to assess persistence
- Fewer pilots are looking at pricing and feedback interaction effects
- Fewer will be able to assess demographic variations of any potential feedback effects

Moving Forward - Collaborative Research



- Research gaps act as barriers to making decisions about what type of feedback and associated delivery systems are cost effective
- Requires research of scope and scale that is beyond the means of any one utility
- A collaborative organized effort:
 - avoid redundancy
 - focusing research on high-value issues
 - leverage pool of research talents
 - provide extensible results

Moving Forward - Feedback EM&V



- Behavior-dependent effect: problematic in including feedback in energy efficiency portfolios
- Standardized method to include feedback in EM&V?

Moving Forward - Feedback EM&V



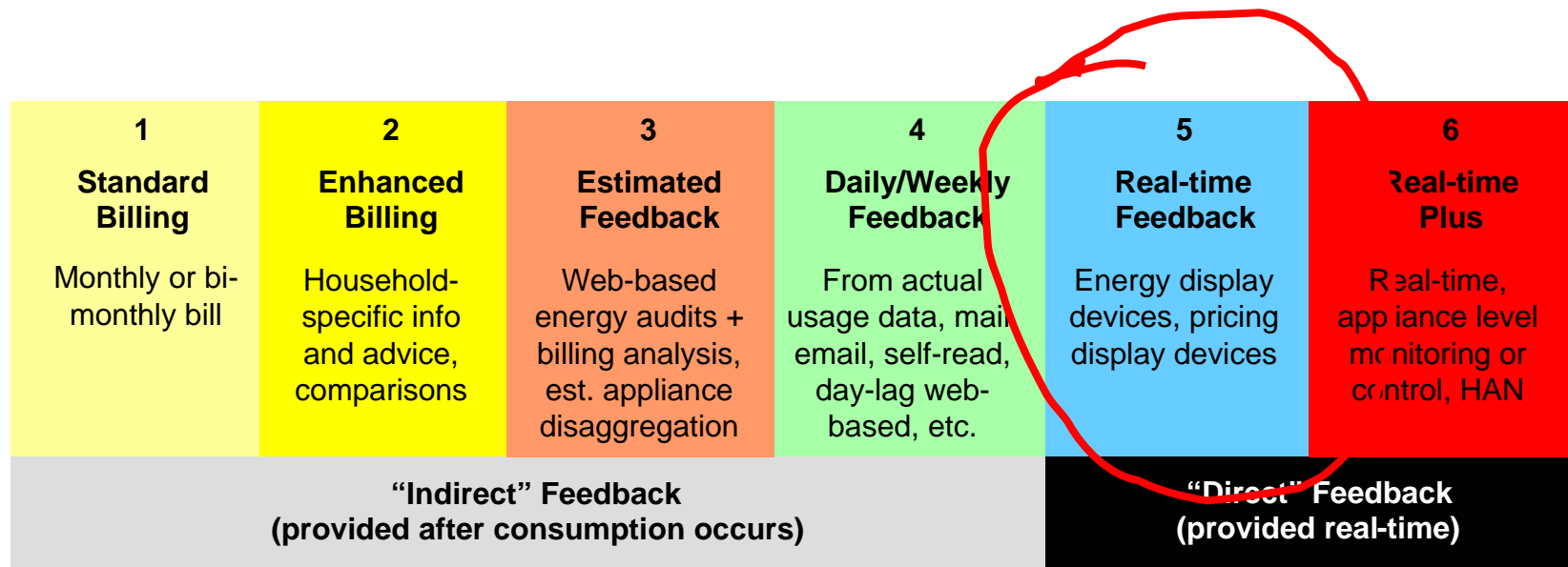
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1	2	3	4	5	6
Standard Billing	Enhanced Billing	Estimated Feedback	Daily/Weekly Feedback	Real-time Feedback	Real-time Plus
Monthly or bi-monthly bill	Household-specific info and advice, comparisons	Web-based energy audits + billing analysis, est. appliance disaggregation	From actual usage data, mail, email, self-read, day-lag web-based, etc.	Energy display devices, pricing display devices	Real-time, appliance level monitoring or control, HAN
“Indirect” Feedback (provided after consumption occurs)				“Direct” Feedback (provided real-time)	

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5

Real-time Feedback

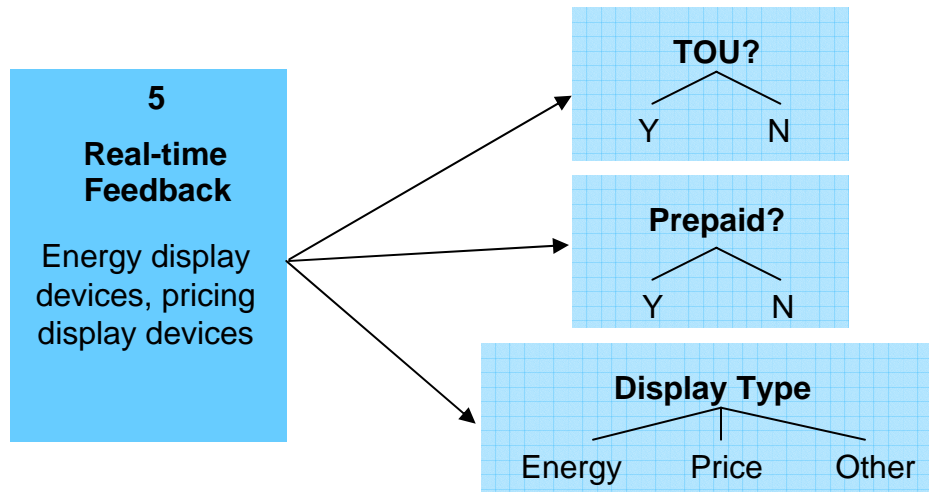
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Moving Forward - Feedback EM&V



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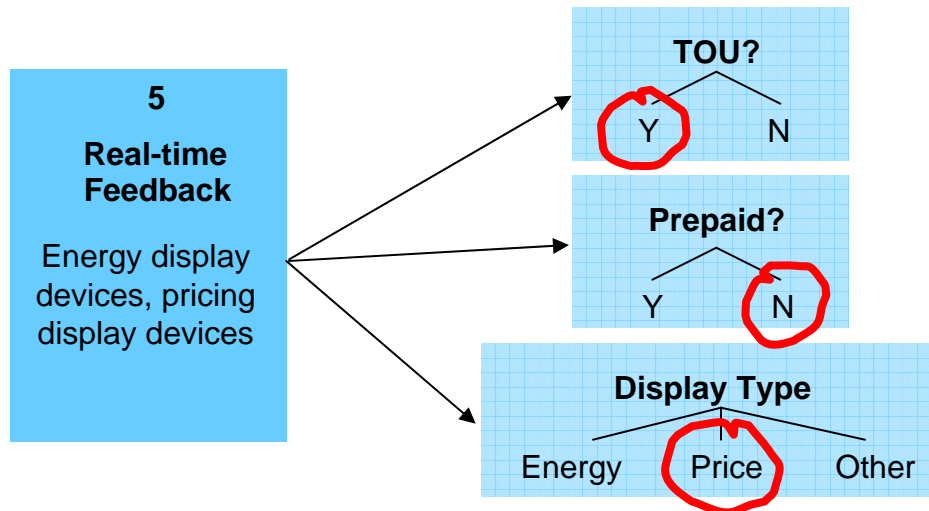


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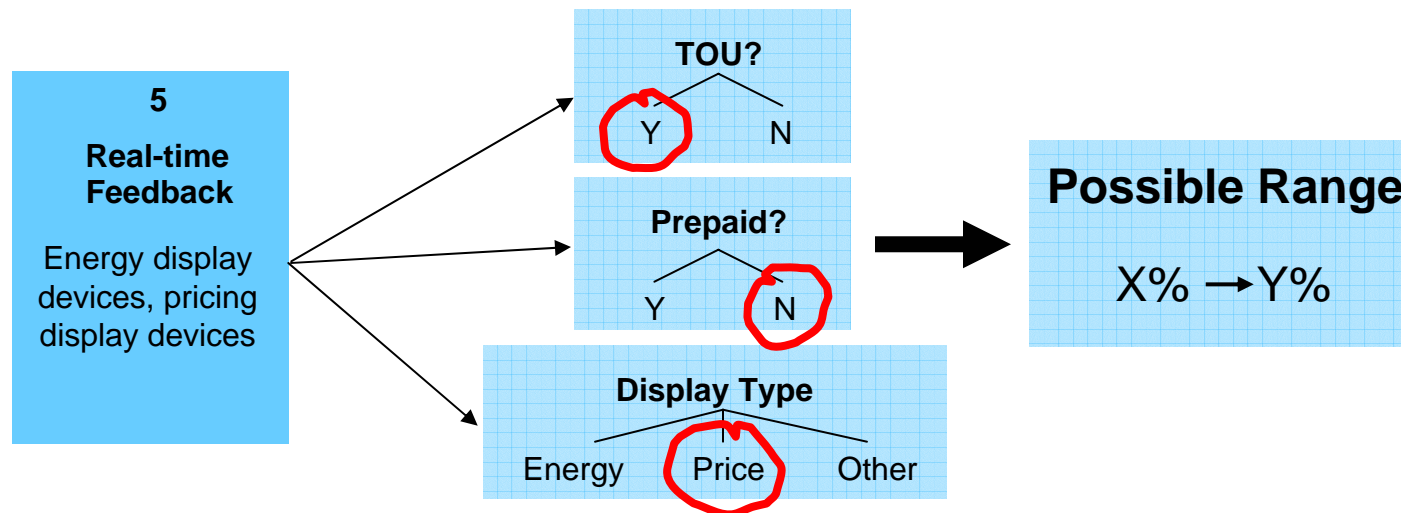


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Thank You



Together...Shaping the Future of Electricity

We welcome comments and suggestions:

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EPRI (2009). *Residential Electricity Use Feedback: A Research Synthesis and Economic Framework*. EPRI, Palo Alto, CA: 2009. 1016844.

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