A Smarter Distribution System

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A Century of Achievement

• National Academy of Engineering named the US electricity system as the greatest 20th Century engineering achievement

• Stellar engineers keep price falling while adding to reliability & power quality – until the 1970s

• Increasing costs & blackouts led to ad hoc legislative fixes that created problems – deregulation & standard market design
Simple, Elegant, Proposals – of Questionable Desirability

Pure technology solutions:
• FACTS – Redo the transmission grid
• Transmission highway – copper plate USA
• Ambitious renewable portfolio standards
Good Engineering is Good Technology and Good Business
What are the Goals?

• Electricity that is inexpensive (externalities internalized)
• Sustainable (30-50 year time horizon)
• Eliminate distortions due to unwarranted subsidies & bad pricing
Cost-Effective Solutions

• Efficiency – implementing current technology, we could save money & not increase generation capacity through 2030 – but formidable barriers
• Life style changes (California tiered pricing)
• Dynamic pricing: Customers face hourly cost of generation (locational marginal prices)
The Problems with Flat Rates

• Electricity is sold at 10¢ when generation cost -7.5 ¢ to 300 ¢

• Demand getting peakier – expensive capacity used less than 100 hr/yr

• Price should include a capacity charge – use during peak demand hours – not any time of use
Peak Load Problem is Getting Worse in ISO-NE

Kathleen Spees
Peak Load in ISO-NE Change Between 1980 and 2006

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Daily Supply Curves

- Price and load have strong relationship on any given day
- 3rd degree polynomials
- Adjusted R² stats:
  - Mean 0.913
  - Median 0.943
  - Range 0.403-0.996

Kathleen Spees
Examples of our recent work

The value of peak shaving (Spees & Lave)

Kathleen Spees
Dynamic Pricing

• Time of Use: Lousy approximation on various days & various times – but easy to understand
• Critical Peak Pricing/Rebate: Focused only on extreme hours – money left on table
• Real Time Pricing: Gets incentives right, but hard to understand & react to
• Or DLC: Unnecessary customer discomfort
Customer Understanding

- Few people know why the lights go on, where electricity comes from, and why their bill changes
- TOU & CPP/CPR easier to understand, but implementation difficulties
- RTP hard to understand & likely to bring forth bitter complaints (Bakersfield)
- Without customer understanding, implementing RTP will be bruising
AMI as Religion

• Will a customer using 50 kWh/month ever save the cost of AMI?
• Spees: need 2.5 kW at peak & elasticity of about -.1 to get payback (40% of PA residential customers)
• Giving everyone AMI raises costs
• Don’t spend a dollar to save a penny
• Some customers want, & will pay for, flat rate prices – no hassle!
Making RTP Work

- People need to understand & trust provider
- Some customers will lose – need to explain & placate
- Need easy access to current price
- React to day ahead price plus CPP
- Need automated device to carry out customer instructions in response to price
Implementation Barriers

- Public Utility Commissions
- Consumer advocates
- Informing customers & getting their trust
- Adaptive implementation: experiment with a small group, adapt design, get viable design before rolling out to all customers.
- Rollout AMI & dynamic pricing as it makes sense – when meters need to be replaced
- Cost-effective implementation