

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

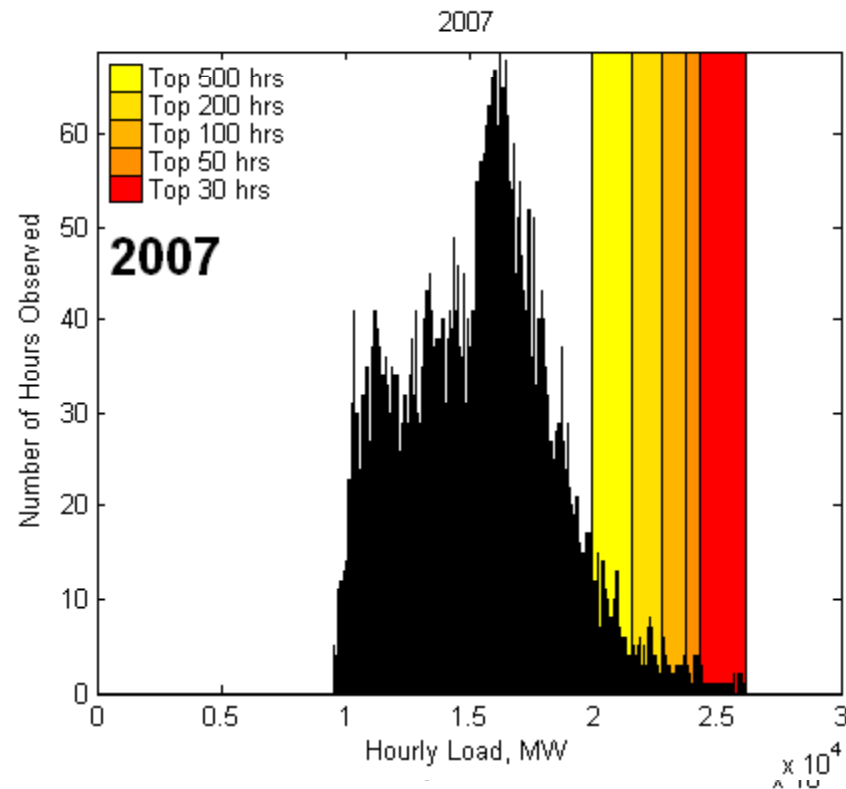
Cost-Effective Solutions

- 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

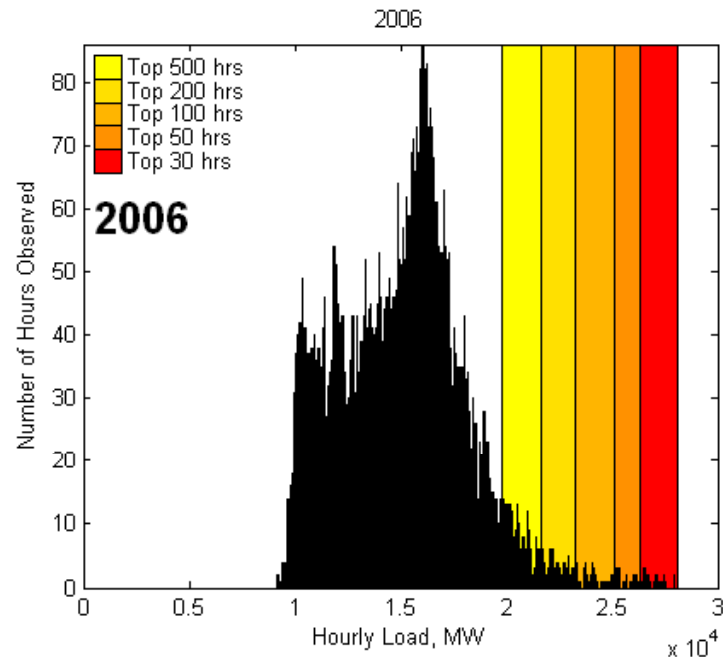
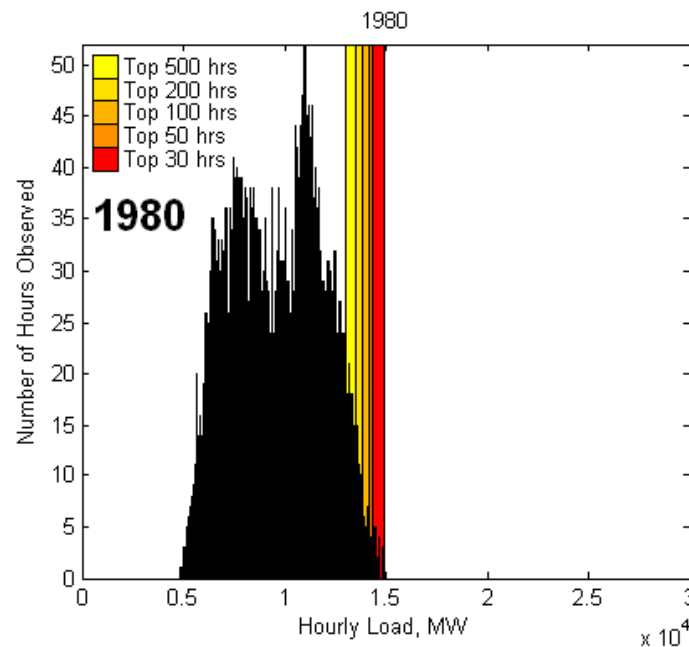
Peak Load Problem is Getting Worse in ISO-NE



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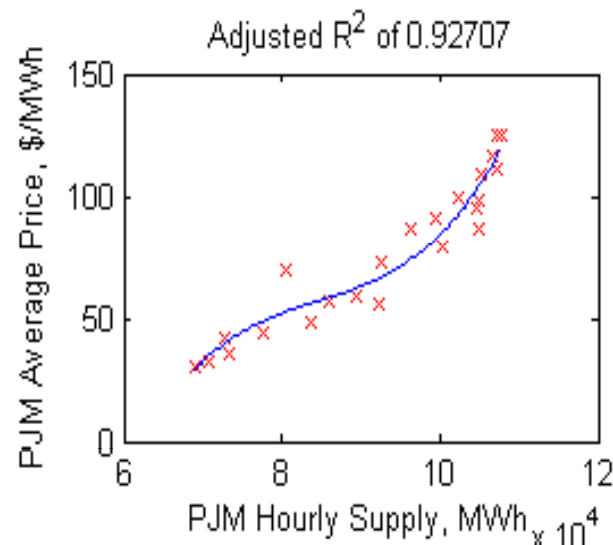
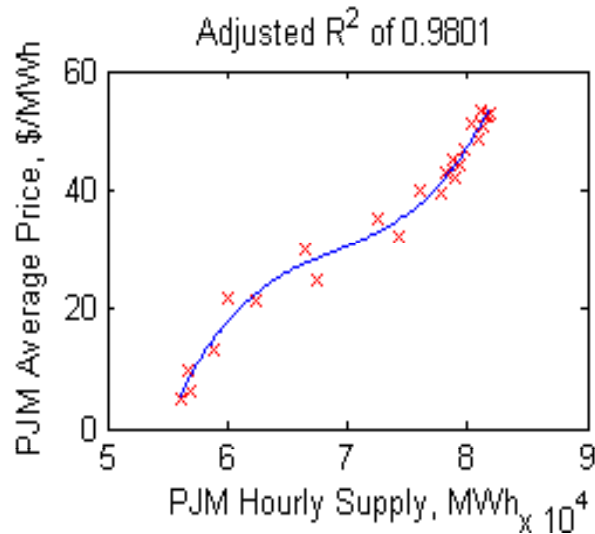
Peak Load in ISO-NE Change Between 1980 and 2006



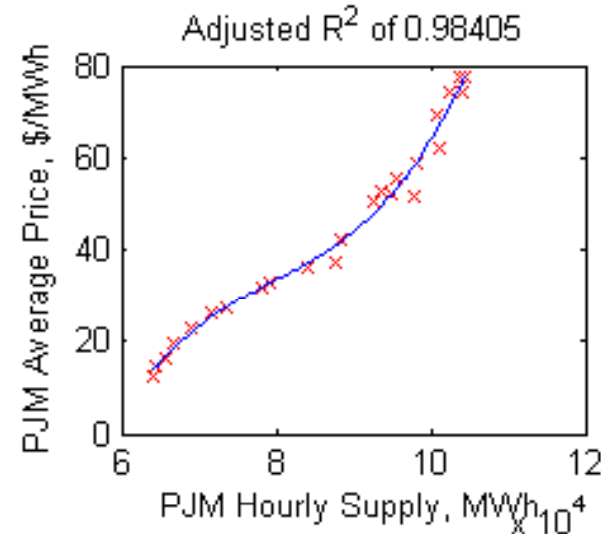
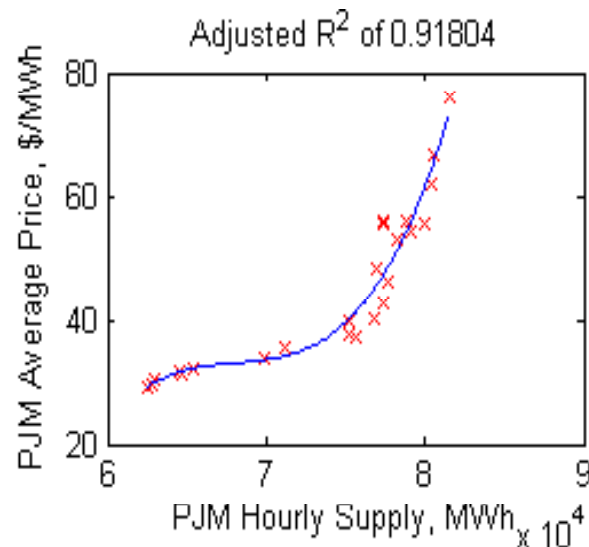
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Daily Supply Curves



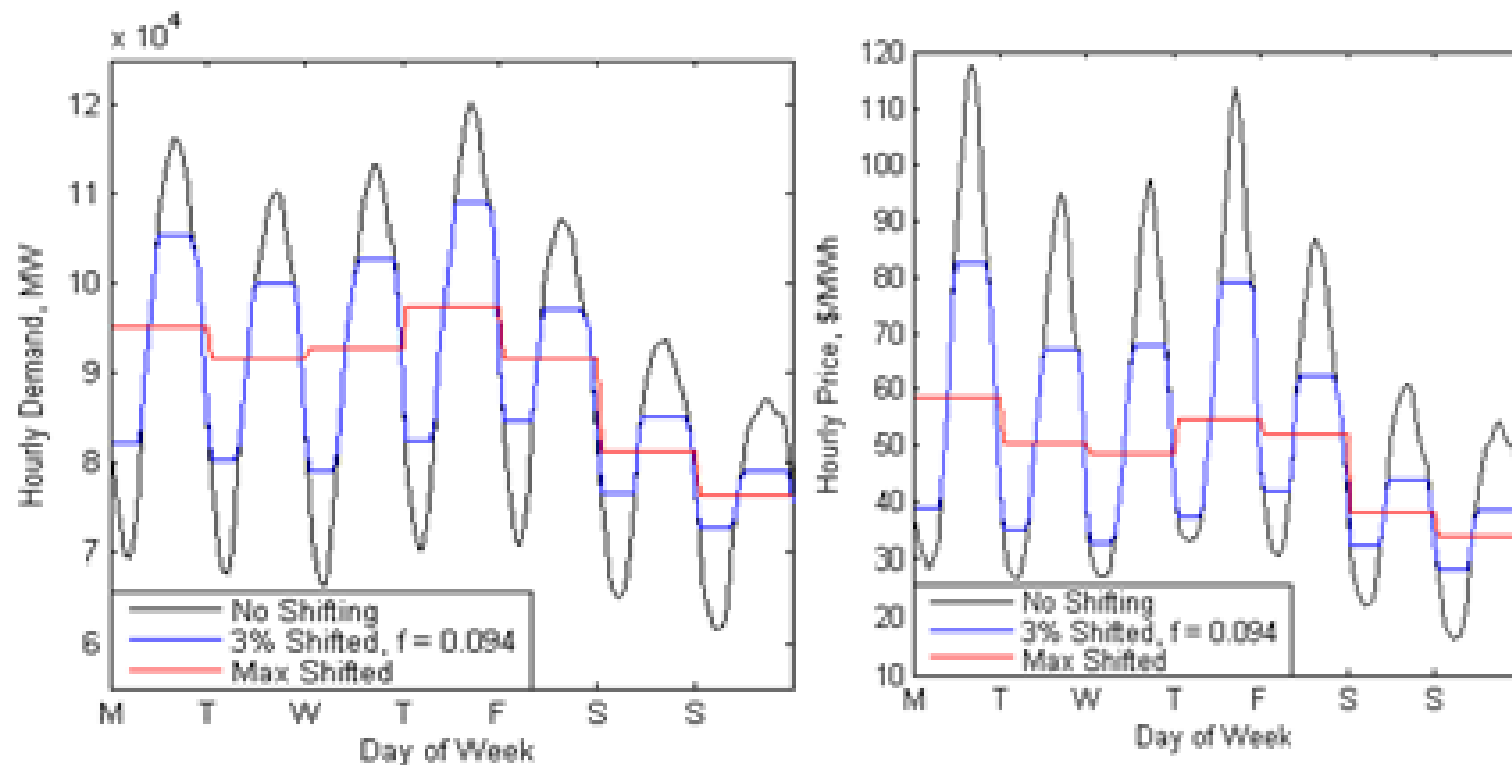
- Price and load have strong relationship on any given day
- 3rd degree polynomials
- Adjusted R^2 stats:
 - Mean 0.913
 - Median 0.943
 - Range 0.403-0.996



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Examples of our recent work

The value of peak shaving (Spees & Lave)



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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