Smart Policies for a Smart Grid: Enabling a Consumer-Oriented Transactive Network

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Overview of remarks

- Technological change has yet to transform consumer value propositions in electricity as it has in other markets
- A smart grid is a transactive grid
- Examples
- In a transactive network equilibration occurs through decentralized coordination instead of imposed, hierarchical control
- Policies to enable a transactive grid emphasize the removal of entry barriers and other barriers to rivalrous retail competition

A smart grid is a transactive network

- Network of physical assets + human agents
- Price-responsive end-use devices enable autonomous consumer control: **empowerment**
- A smart grid is a *transactive* network, and if it's not transactive, it's not smart

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What does transactive mean?

- Network as a distributed market platform
- Connects producers and consumers
- Contracting and negotiation
- Mutual exchange of value (product, service) for value (payment)
- Reduces transaction costs that can stifle otherwise beneficial exchange

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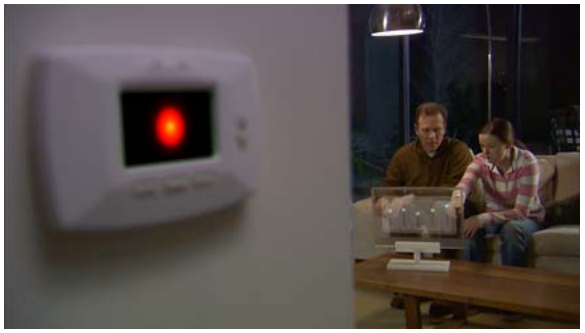
Imagine the potential …



- Example: Home consumer gateway portal
  - User-friendly information transmission
  - Bundling of services in the home
- Example: GridWise Olympic Peninsula demonstration project
  - Intelligent, price-responsive thermostats and water heaters enable autonomous response
  - Retail contract choice
  - Customer savings, high system reliability

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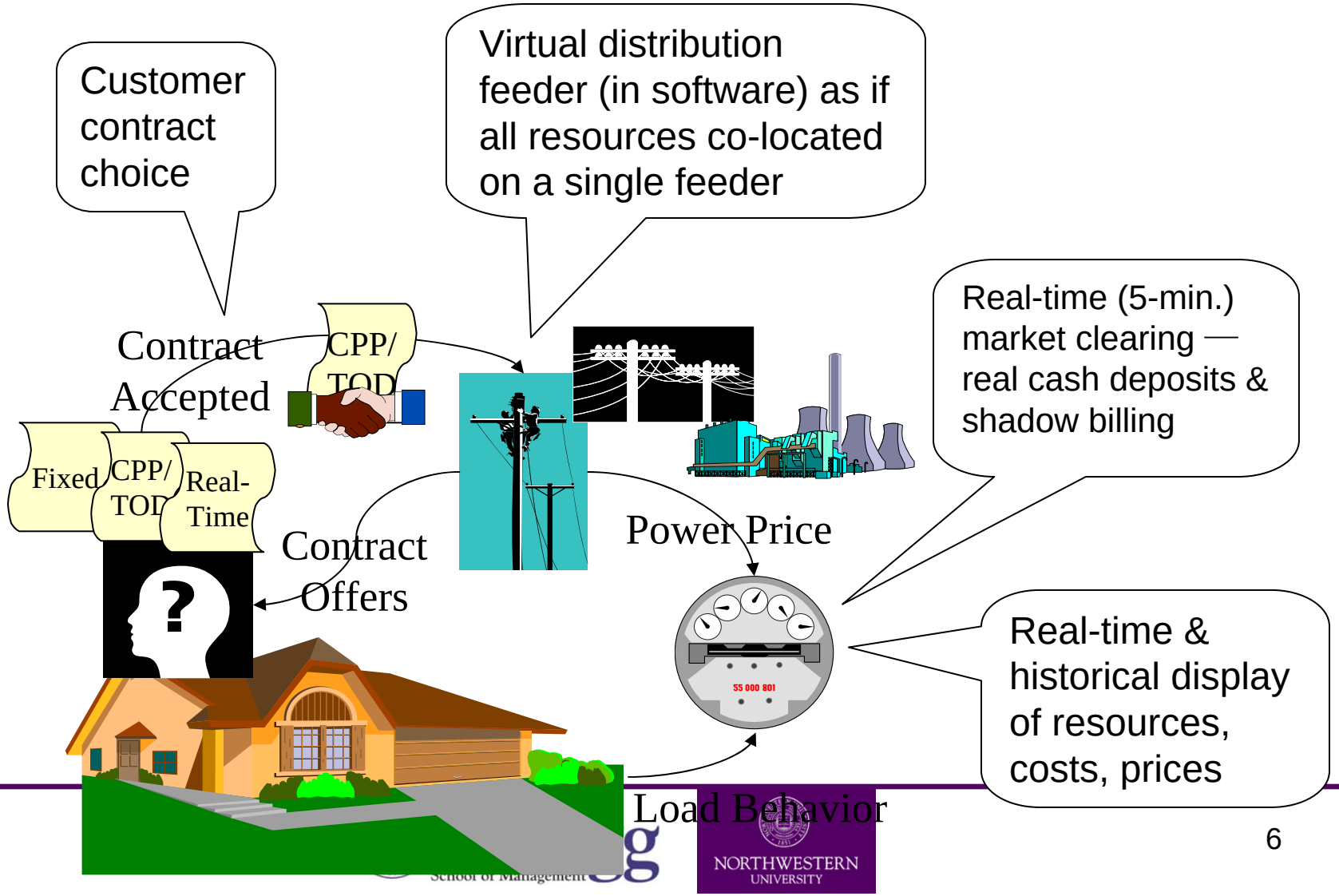
Testing Market-based Customer Incentives in a Transactive Network



Results

- RTP: Peak consumption reduced 15-17% relative to counterfactual (what peak would have been without dynamic pricing)
- TOU: Peak consumption reduction of 20% relative to the fixed price group
- Average customer saved 15%
- High reliability and system stability
- Note that this is the first implementation of a double auction RTP design

Transactiveness => beneficial complexity

- Fine-grained ability to respond to prices in 5-minute intervals changes the nature of the problem
- Distributed automation + RTP => complex adaptive system
- 5-minute price elasticity seen in submitted bids follows a power law distribution, not a normal distribution
- Implication: these results can scale to larger implementation, and indicate robustness and self-organization

Coordination and control

- The regulatory history of the electricity industry is one of *hierarchical control*
  - Both economic and physical
- Digital communication technological innovation of the past 30 years has enabled, and reduced the cost of, *decentralized coordination*

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Decentralized coordination can create the physical reliability historically associated with hierarchical physical control

Some policy implications

- A network is not transactive, and thus not a smart grid, without dynamic pricing for retail customers
- A smart grid enables, and indeed requires, looking beyond the regulated utility business model
  - Removing barriers to retail competition
  - Removing barriers to non-utility agents making technology investments
  - Institutional change => technology pull

Our current regulatory apparatus is premised on centralized control, and we cannot achieve the (consumer + producer surplus) benefits of decentralized coordination without institutional change

Competition policy in electric power

- "Perfect competition" is about an equilibrium outcome: a static place where P=MC
  - Rests on assumptions that basically assume away the process of competition
- But competition is inherently a dynamic process of ***rivalry*** among heterogeneous producers
- In electricity, as the natural monopoly disintegrates, applying this concept of competition suggests policies that focus on reducing entry barriers (except for wires, for now)

References

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Other references and contact information

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