

Challenges to The Utility Business Model

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Power Generation is Changing

- Concerns about climate change
 - Reduce the use of fossil fuels
- New technologies
 - Distributed generation
 - Intermittent power supplies

Four Challenges

- Decoupling
- Intermittency
- Behind-the-meter solar
- Large scale storage
 - No base load
 - No peakers

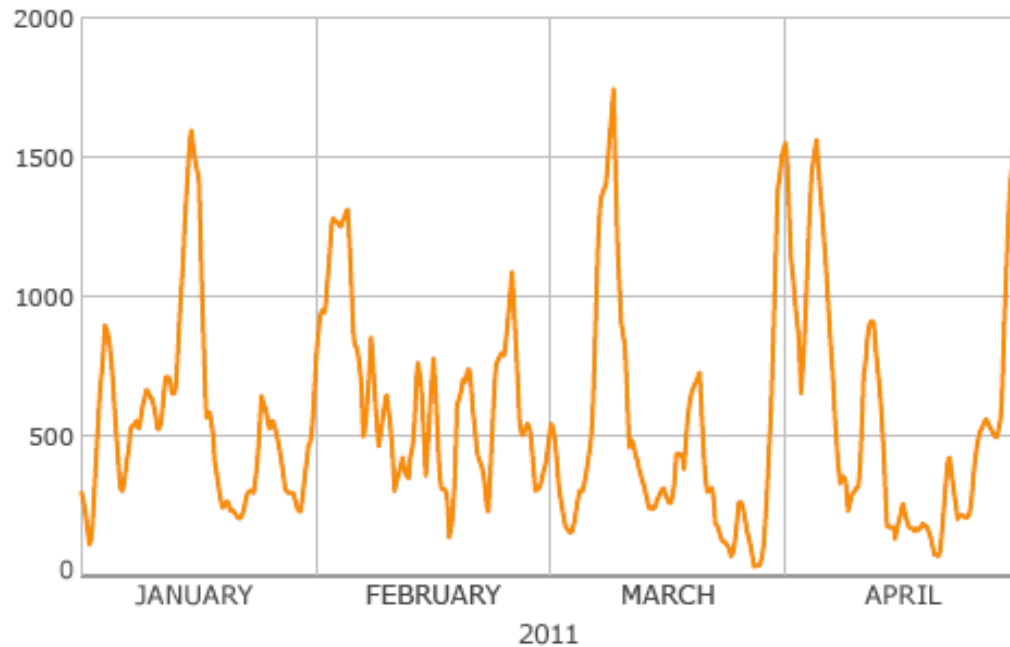
Decoupling

- Utility incentives are to sell more power, use more fuel
- But must cut back fossil fuel use
- Find revenue model for which success does not depend on selling more power
- Typically a target rate of return, with prices adjusted ex post to achieve this

Intermittent Renewables

Output from UK wind turbines, January-April, 2011

One day moving average, Megawatts



Source: National Grid

Backup

- Currently gas in the US
- Hydro in Northern Europe
- Up to 30% seems easily managed
- As fossil fuels phased out gas must be replaced by storage

Storage

- California currently requiring utilities to invest in storage
- At costs of \$200-400 kWh, 50mWh costs \$10m-\$20m

Behind-the-Meter Solar

- Commercial and residential users with solar pose two problems
 - They want to sell excess power to the grid
 - They want access to the grid but may pay very little towards its costs under present pricing regimes

Net Metering

- Allows sales of excess power at retail prices
- Clearly not economically justified
- Need to move to offering locational marginal prices

Pricing Grid Connectivity

- Grid access provides insurance or an option value
- Behind-the-meter users may contribute little to the costs of the grid
- Need to find a way of pricing and charging for grid connection

Large-Scale Storage

- Electric power is one of few commodities that can't be stored
- Has to be produced exactly when it is needed by users
- Leads to great complexity in the transmission and distribution systems



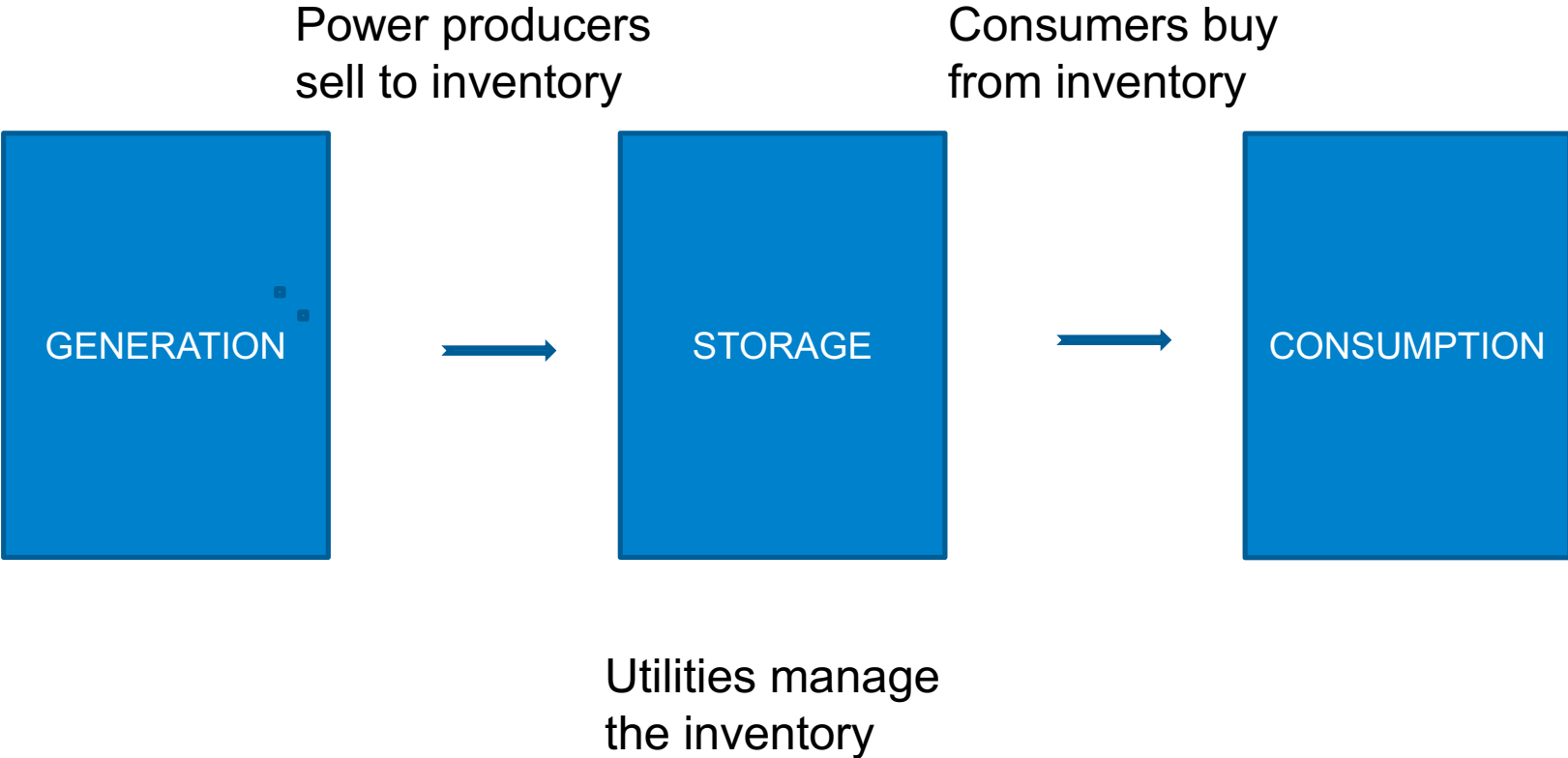
GENERATION

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CONSUMPTION

The Future

- Inexpensive grid storage will change this model
- Power will be produced when convenient (when the sun shines/ wind blows)
- Stored as inventory
- Sold from inventory when needed
- Breaks the production = consumption equation



Implications

- No need for base load power
- No need for “peakers”
- More efficient use of generating capacity
 - 20% of US generating capacity used < 100 hours/year
 - Capacity factor on gas turbines was 16% in 2015

Low Spot Prices

- Zero-marginal-cost renewables can bid prices down to gain market share
- Forces thermal plants to operate at a loss
 - Happening with nukes in New York State
 - Most US utilities don't own thermal plants
 - But German utilities do – EON and RWE

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Summary

- Renewable energy, intermittent and distributed
- Storage
- Movement from fossil fuels
- All lead to radical change in utility model

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