
SMART *power*

Climate Change, the Smart Grid,
and the Future of Electric Utilities

The Sustainable Utility Future

Presented to:

**The 2nd Annual Gridposium,
hosted by the National Information Solutions Cooperative (NISC)
and the National Rural Telecommunications Cooperative (NRTC)**

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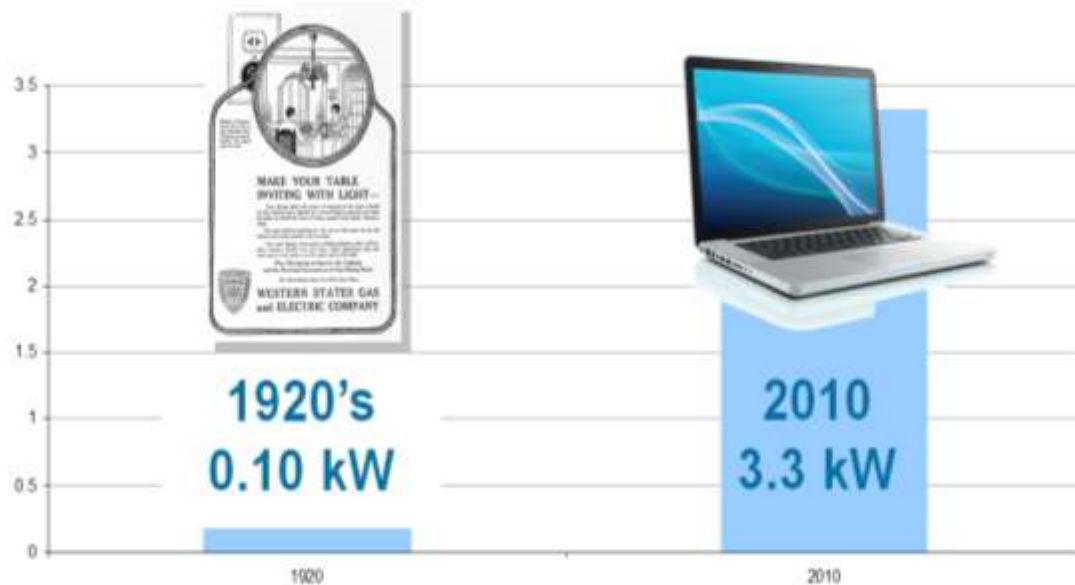
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Electrification of America

- ◆ 100% productivity increases
- ◆ 99% reliable power in nearly every dwelling from largest grid on earth
- ◆ 4% or less of disposable income
- ◆ Financial stability since the 1930s
- ◆ Per-Capita Use up 300% 1920-2010

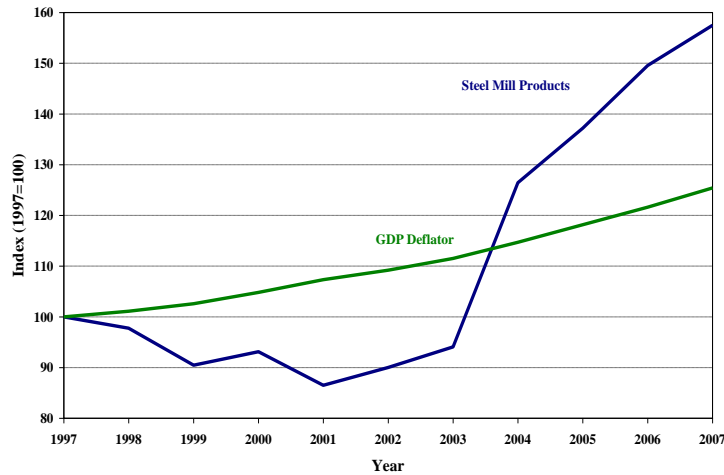


But Today, Electricity Utilities Are Getting Hit By the Biggest Changes in Their History

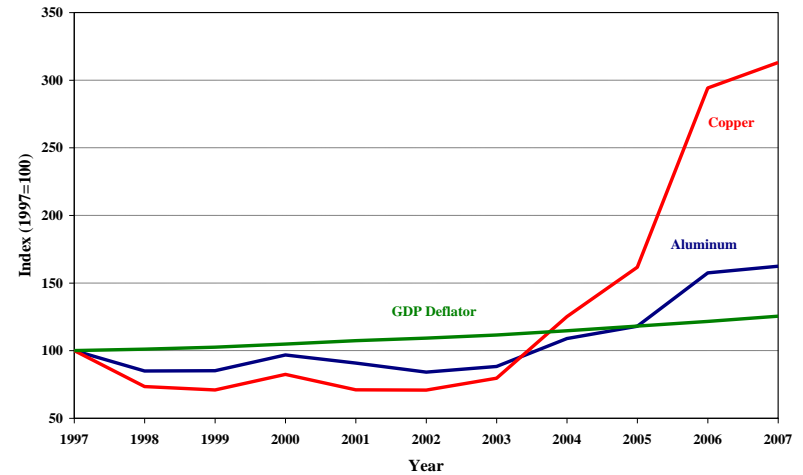


Commodity Prices Were Rising Before the Crash

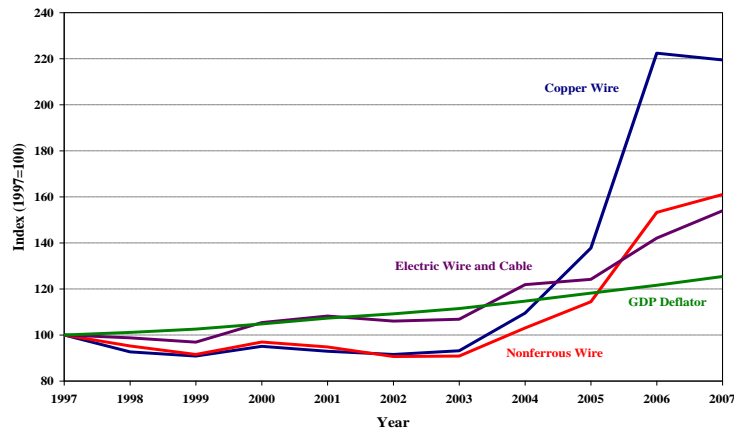
Steel Mill Products Price Index



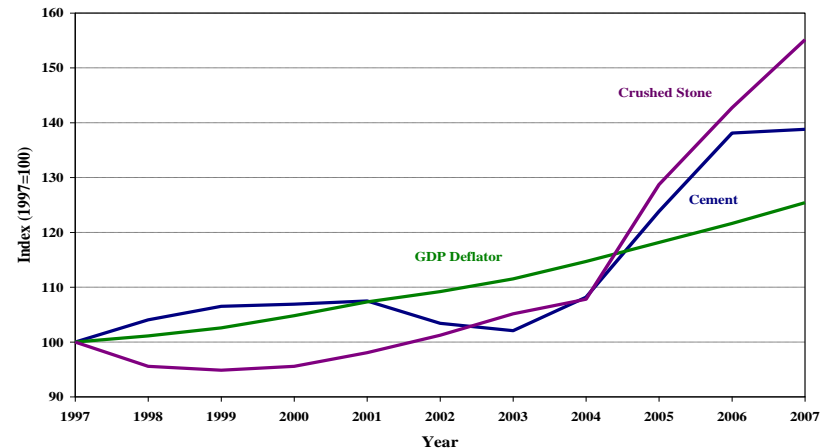
Aluminum and Copper Price Indexes



Electric Wire and Cable Price Index

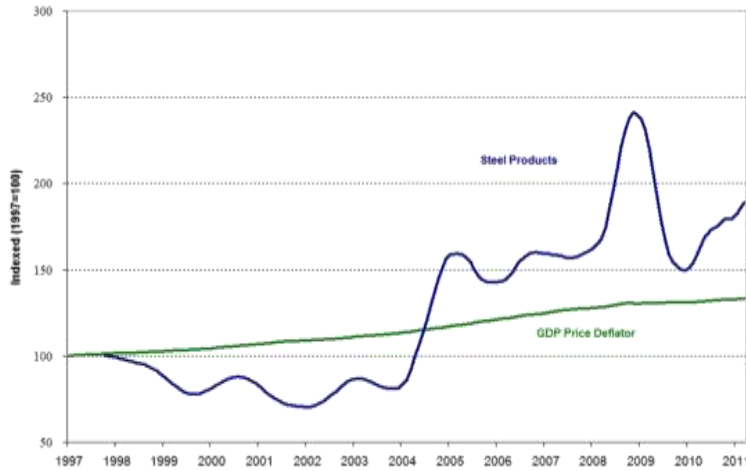


Cement and Crushed Stone Price Indexes

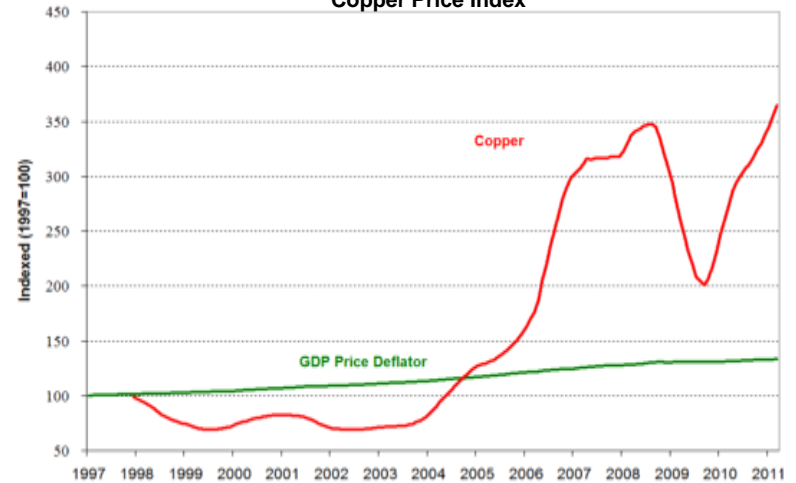


And They're Back

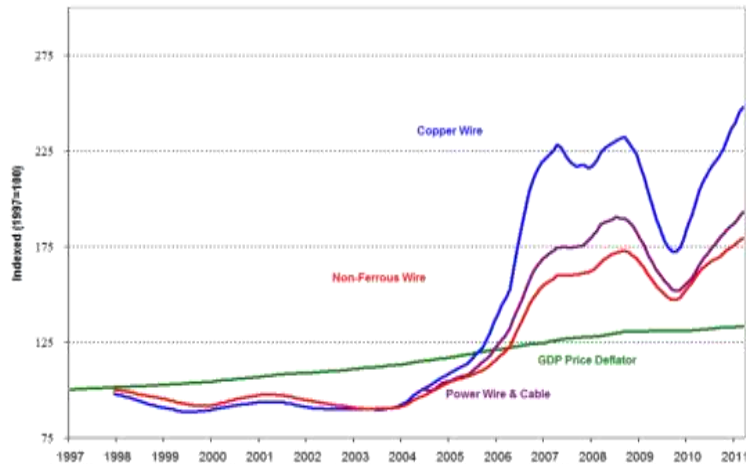
Steel Mill Products Price Index



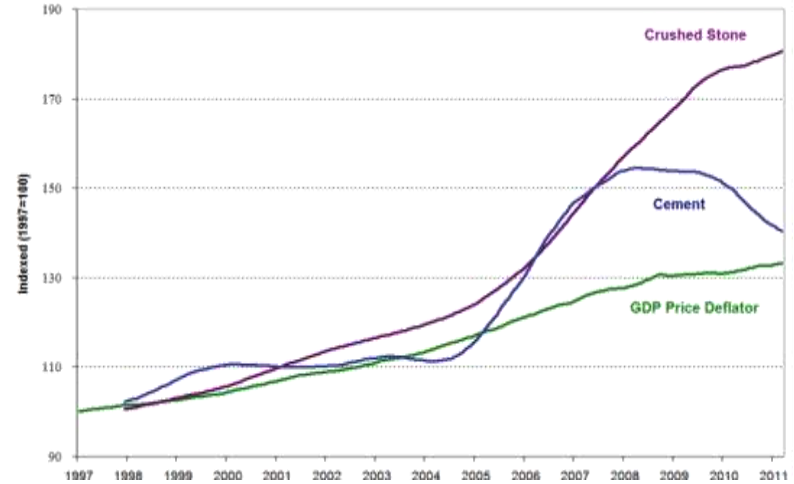
Copper Price Index



Electric Wire and Cable Price Index



Cement and Crushed Stone Price Indexes

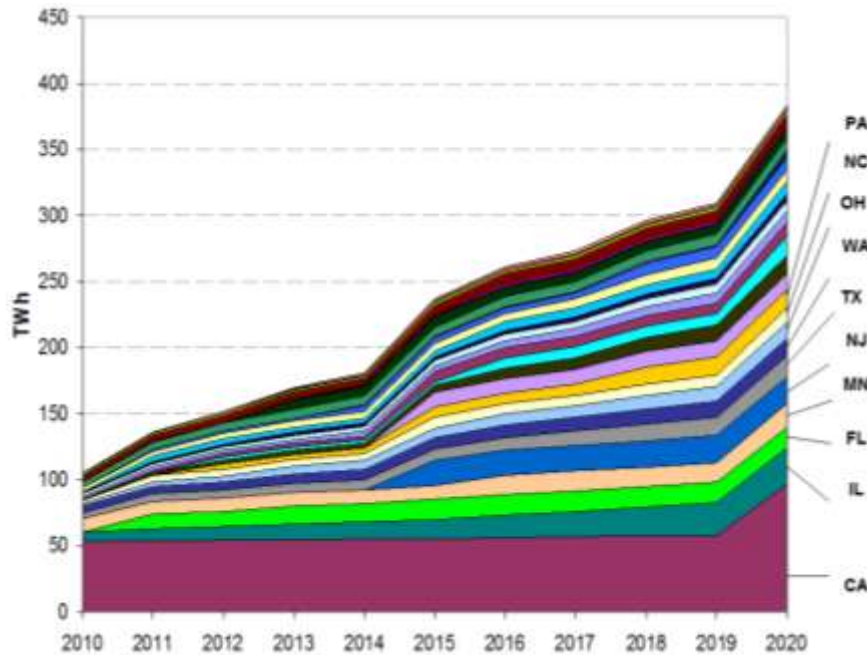


Enormous Investment Needs

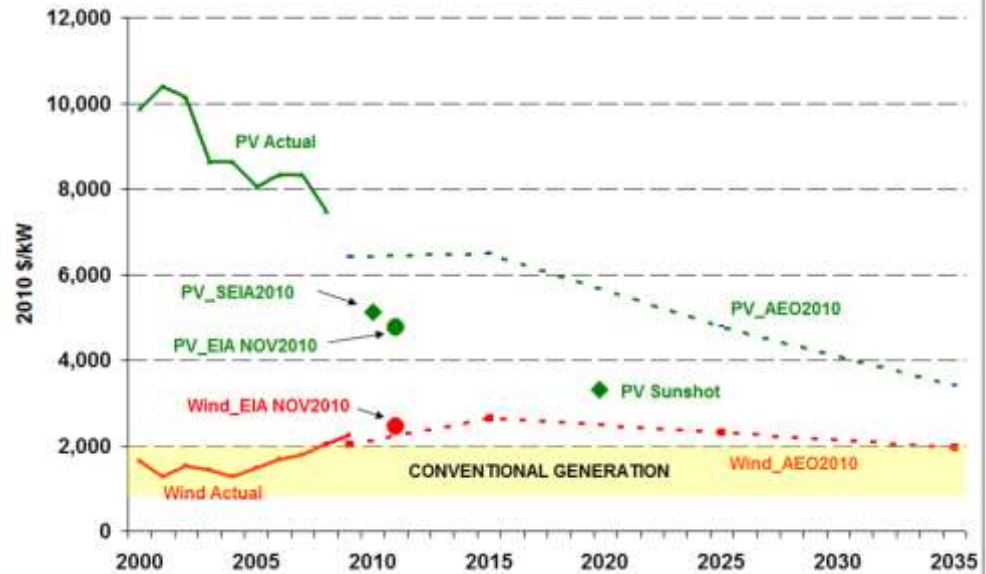
- ◆ 350 TWh new green energy from state RPS by 2030- \$120 billion
- ◆ New transmission to integrate renewables and maintain reliability- \$ 250 billion
- ◆ Decarbonize existing generators – roughly \$1 trillion
- ◆ Replace aging distribution system with smart grid - \$600 billion

Renewables and RPS Trends

Expected Demand in the U.S., 2010-2030 (TWh)



Overnight Cost Trends for Wind and Solar PV



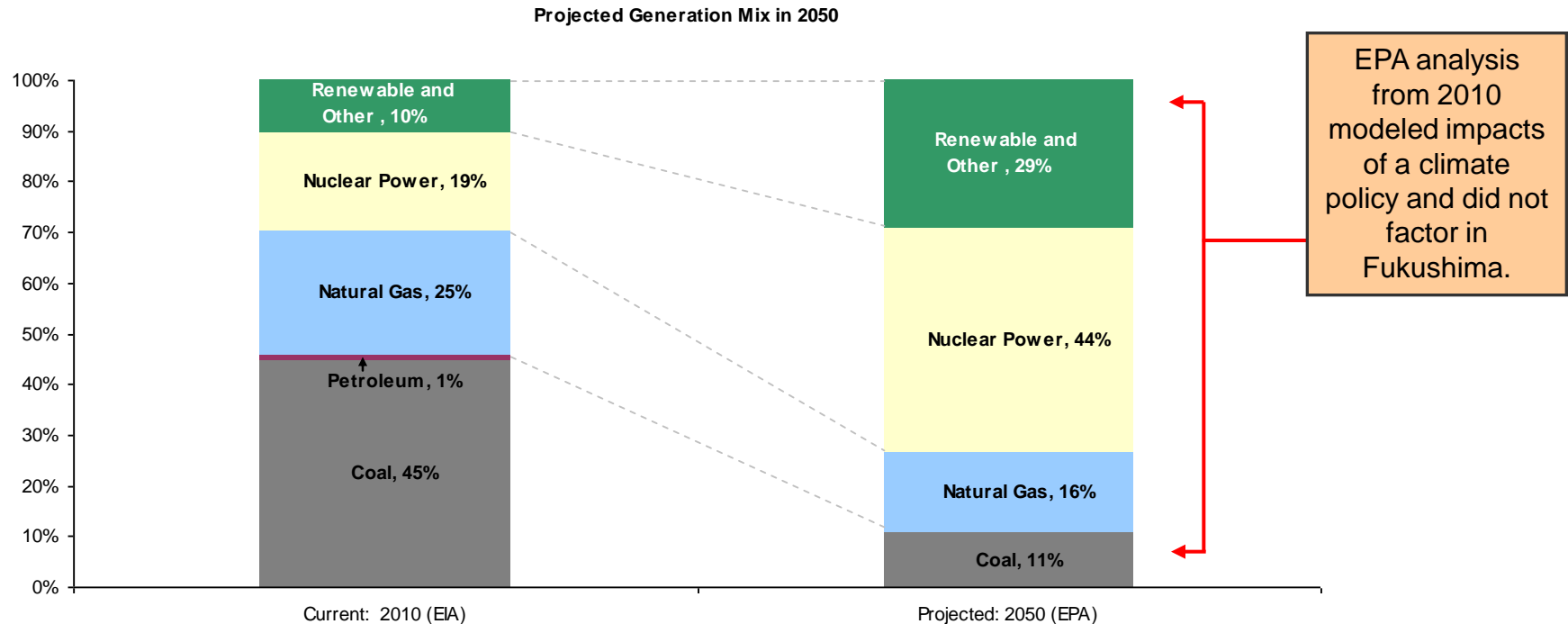
Sources and Notes:

- [1] Expected Demand From RPS from Johannes Pfeifenberger and Peter Fox-Penner, "Transmission Industry Overview: High-Level Drivers," October 26, 2009.
Note: All 50 states are shown in this chart, although only the ten largest are labeled individually.

PV and Wind Price Sources:

- [2] EERE Wind Technologies Report, 2009, page 41.
- [3] LBNL, "Tracking the Sun II: The Installed Cost of Photovoltaics in the U.S. from 1998-2008", 2009, page 10.
- [4] EIA, "Updated Estimates of Power Plant Capital and Operating Costs", November 2010.
- [5] AEO'00-AEO'10 Assumptions.
- [6] "U.S. Solar Industry Sizzles in 2010; Global Growth Hotter," *The Energy Daily*, March 11, 2011.

Changing Generation Fuel Mix – EPA Projection



A Few Years Ago:

- ◆ Chance of a nuclear revival
- ◆ Solar projected to be expensive
- ◆ Shale resources assumed to stay expensive
- ◆ Climate legislation forces shut downs

Now:

- ◆ Nuclear not likely to expand
- ◆ Fossil fuels still present
- ◆ Solar will be cheaper than thought
- ◆ Gas will expand

Sources: 2010 generation mix from AEO'11; Projection from "EPA Analysis of the American Power Act in the 111th Congress," June 14, 2010.

Power Sales, Energy Efficiency, and Demand Response

- ◆ In the U.S. power use has dropped approximately 5% over the last two years, primarily due to the recession
- ◆ Recovery in sales growth in near terms will depend on:
 - Economic growth
 - Gas and power prices
 - State energy efficiency policies
- ◆ Twenty-six states have enacted energy savings goals, or Energy Efficiency Resource Standards (EERS), through legislation and several states have pending EERS
- ◆ Peak Load (not sales) is getting reduced by Demand Response (DR) and “Dynamic Pricing”
- ◆ Demand Response could lower peak load by 40,000 – 140,000 MW by 2019 - - eliminating all new peaker construction
- ◆ Total industry sales growth projected to be well under 1%/yr through 2050

Downstream Market Developments

- ◆ Smart meter penetration across the U.S. reached 8.7% in 2010 with an estimated 12,830,723 meters deployed
- ◆ Demand response potential 38,000 to 138,000 MW by 2019!
- ◆ Dynamic pricing moving slowly but long-term inevitable, financial benefits could exceed \$65 billion by 2030
- ◆ Utility-side Smart Grid investments (e.g., voltage management) evolving steadily
- ◆ The ISO/RTO council estimates 1 million PHEVs will be on the road within 10 years, adding 3,700 MW of electric load
- ◆ Telcos, Googles, and other disintermediators are seeking utility markets

Sources and Notes:

- [1] "2010 Assessment of Demand Response and Advanced Metering," FERC, February 2011.
- [2] Ahmad Faruqui, "The Case for Dynamic Pricing," *The Brattle Group, Inc.* for Smart Grid Latin America, August 23, 2010.
- [3] Chris Holly, "EV Growth Will Challenge Grid Mangers- Report," *The Energy Daily*, March 31, 2010.

Smart Grid Backlash

◆ Reactions:

- CA: Santa Cruz passed a moratorium on PG&E's Smart Meters until more information could be collected
- TX: A class action suit was filed against Oncor for fraud following smart meter deployment
- MD: State regulators initially denied BG&E's request to recover smart meters costs, even with a DOE grant to offset roughly half the cost
- British Columbia: BC Hydro's Smart Meter pilot resulted in higher bills for 84% of customers, sparking widespread opposition

◆ Issues:

- Data access: the utility industry is asking "who owns the data?"
- Privacy concerns: consumer groups urging protection of personalized data
- Higher prices: uninformed consumers fear higher prices
- Cost Recovery: utilities must prove to regulators their investments are prudent

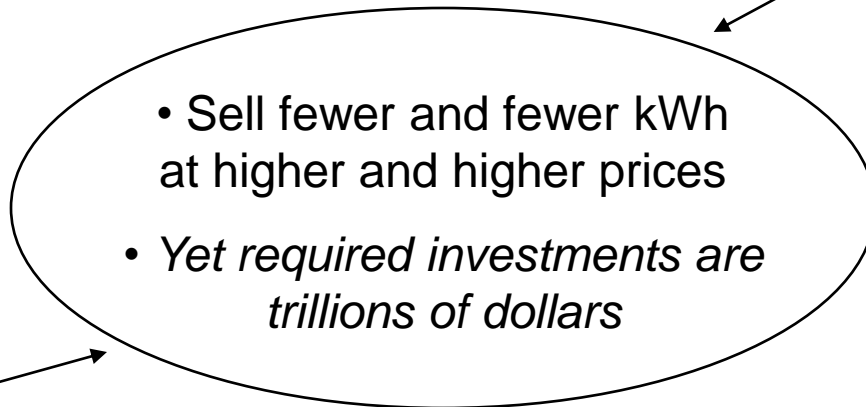
The Old Business Model is Under Attack

Need for transmission and Smart Grid investments

Potential rate case backlash

Carbon limits and RPS

Population growth -- new hookups



Demand response and customer-sited generation lowers sales

High construction and fuel costs



Two Future Business Models

The **Smart Integrator** operates an incentive-regulated or publicly owned Smart Grid offering independent power and other services at market prices.

- ◆ The SI combines upstream supply, local supply and storage, and operates the grid to ensure reliability
- ◆ Similar to internet backbone company

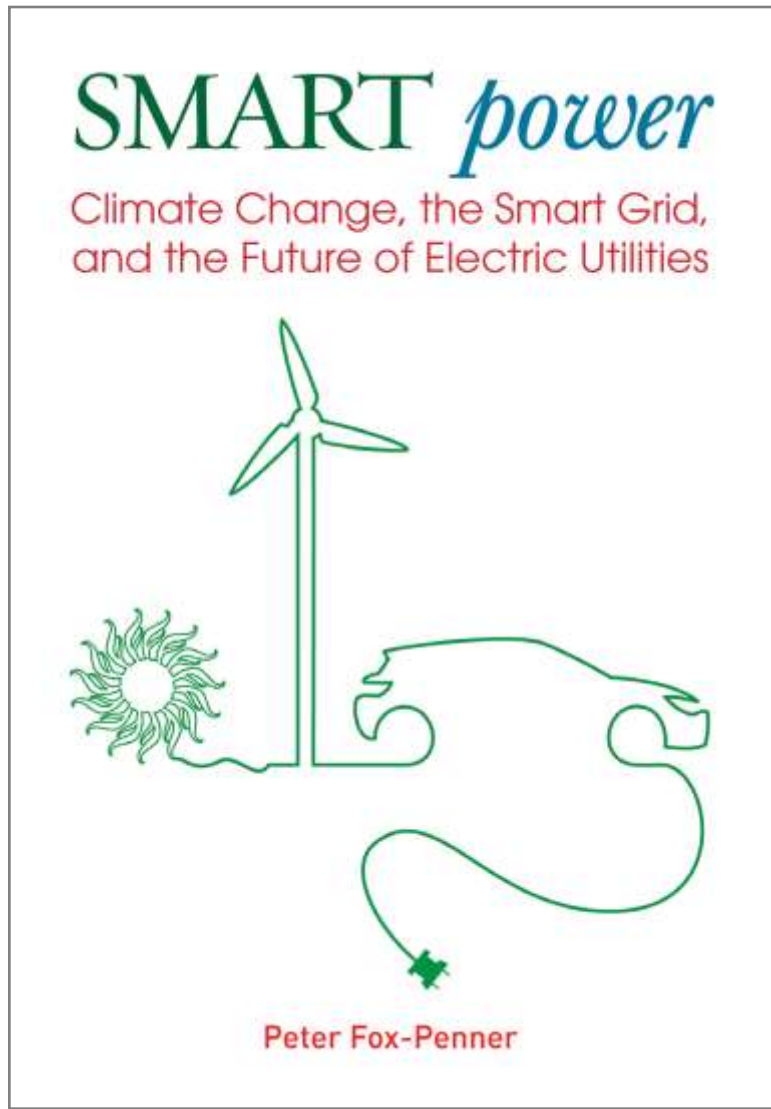
The **Energy Services Utility** changes the utility from a pipes-and-wires business to a customer-service-centric model.


- ◆ The ESU might own and generate power or buy generation to bundle with energy service technology
- ◆ All other roles are the same as the Smart Integrator

Conclusion

- ◆ The industry is caught between flattening sales and enormous investment needs – long-term cycle of per-unit rate increases
- ◆ Integrating forward into distributed generation and end use services pulls in the positive – growth parts of the value chain
- ◆ Smart Grid technologies enable this new business model
- ◆ Cooperatives have a distinct advantage in this transition
 - Strong customer franchise
 - Positive reputation
 - Potentially lower capital costs
 - Economies of scale are changing

Thank You





The Smart Grid: Recent Developments and Observations

Cybersecurity and the Smart Grid

In a survey of major critical electricity infrastructure enterprises:

- ◆ 85% worldwide experience network infiltration in 2010
- ◆ 80% experienced weekly DOS attacks
- ◆ 66% found malware designed for sabotage on system monthly
- ◆ 25% have been victims of cyber-extortion (much outside of the U.S.), including blackouts in Brazil
- ◆ U.S. enforcement of cybersecurity comparatively weak; 20% audit rate (vs. 90% in China)
- ◆ A major cybersecurity event will set the Smart Grid back by a decade or two

Source: "In the Dark - Crucial Industries Confront Cyberattacks," The Center for Strategic and International Studies (CSIS) and McAfee, 2011.

IEE and Brattle: Smart Grid Benefits Study

The Smart Grid study quantified “net benefits” for a range of utility types. To illustrate range of benefits, the analysis included 4 “prototype” utilities – South, Central, East, and West – with real world load shapes and 1 million customers each.

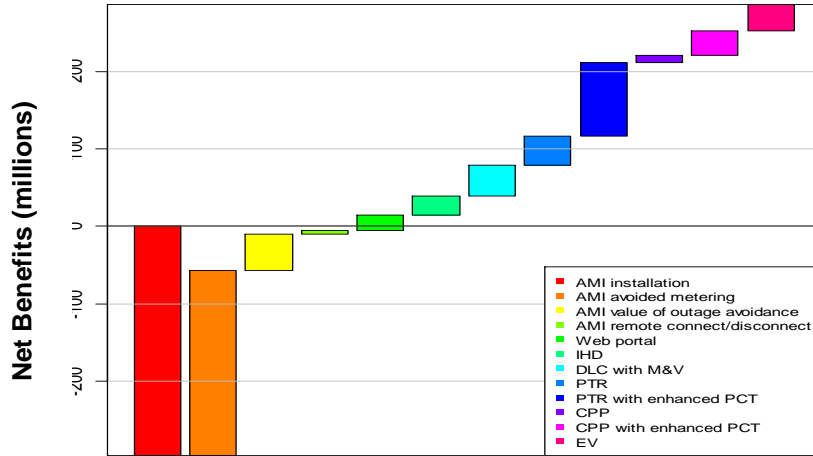
Smart meter benefit flows to customers:

- ◆ Access to information on energy use; updated daily
- ◆ Direct load control, where shifted load is now measurable and verifiable
- ◆ System wide availability of a peak time rebate (customers stay on current rate but receive incentive to shift load during certain hours on very high priced days)
- ◆ Ability to opt into a critical peak pricing program
- ◆ Ability to charge electric vehicle with a time varying rate

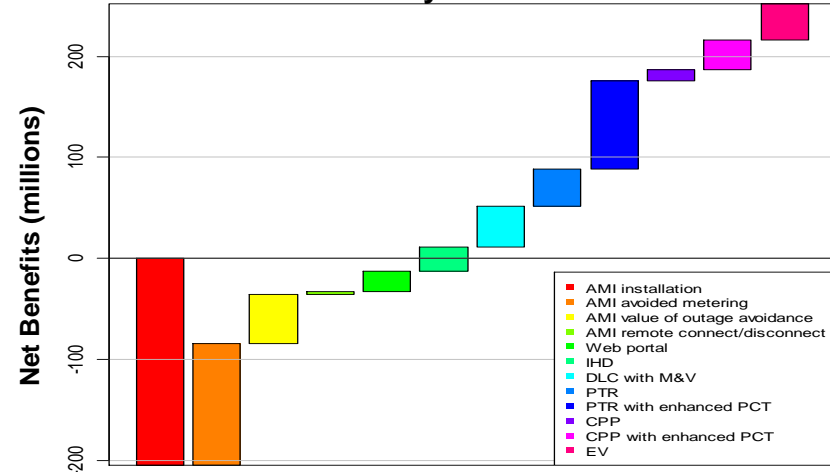
Source: Ahmad Faruqui and Lisa Wood, “IEE Releases: The Benefits of Smart Meters,” The Institute for Electric Efficiency, presented at NARUC’s Winter Meetings, February 16, 2011. Note: Results are preliminary.

Utility Specific Benefit-Cost Ratios

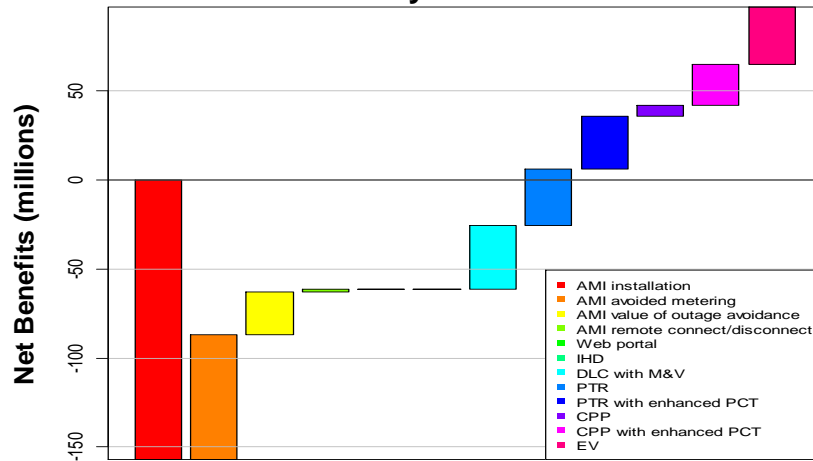
Utility South: 1.8



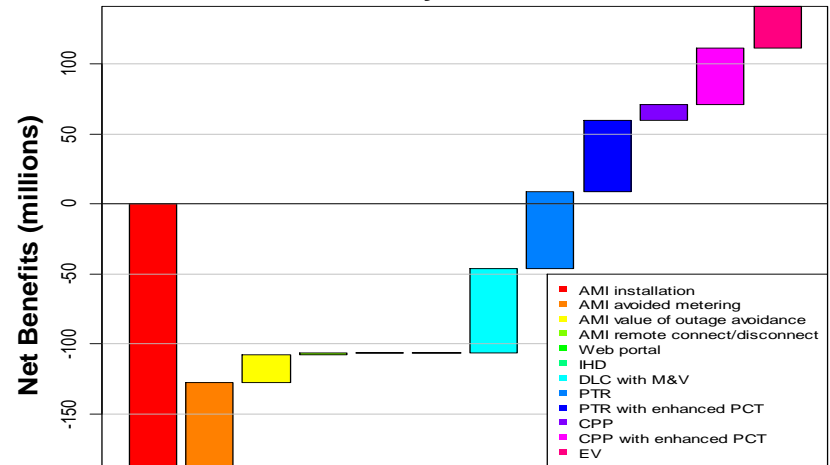
Utility Central: 1.9



Utility East: 1.4



Utility West: 1.5



Source: Ahmad Faruqi and Lisa Wood, "IEE Releases: The Benefits of Smart Meters," The Institute for Electric Efficiency, presented at NARUC's Winter Meetings, February 16, 2011. Note: Results are preliminary.

About *The Brattle Group* and The Author

The Brattle Group (www.brattle.com) provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governments around the world.

We combine in-depth industry experience and rigorous analyses to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.



Dr. Peter Fox-Penner, principal and chairman emeritus of *The Brattle Group*, specializes in economic, regulatory, and strategic issues in network industries. He is a frequent speaker on energy topics and the author of *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities*. (www.smartpowerbook.com)

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