
SMART *power*

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

Electric Utility Business and Regulatory Models of the Future

Presented to PJM at their Annual Membership Meeting

Hyatt Regency Chesapeake Bay, Cambridge MD
May 18, 2011

Peter Fox-Penner

The Brattle Group
1850 M Street, NW Suite 1200
Washington, DC 20036
www.brattle.com

SMART *power*

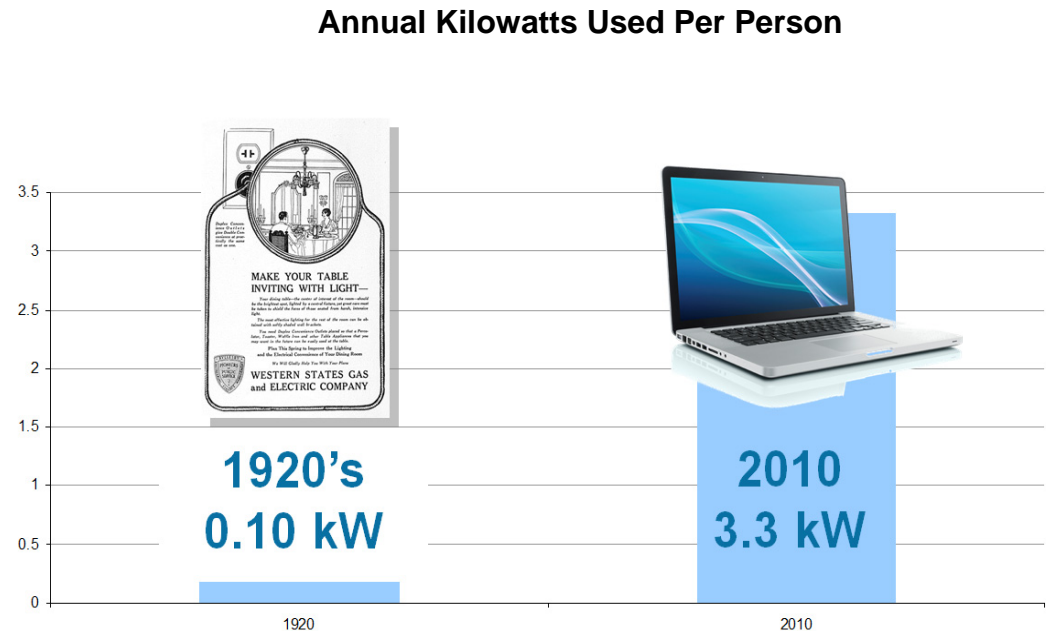


Solutions that inspire change.

The Brattle Group

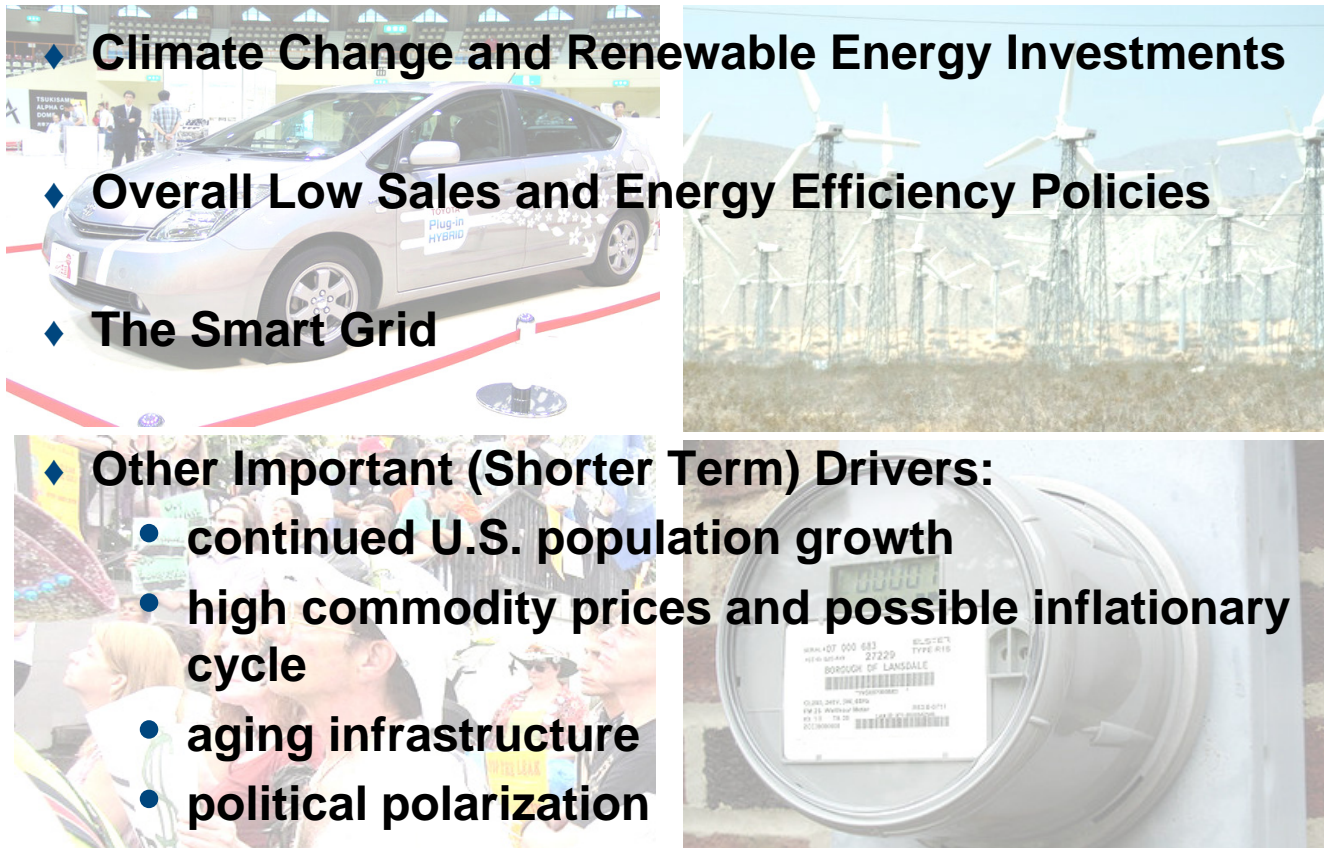
Electrification of America

- ◆ 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



Data Sources: EIA Annual Energy Review 2009; Digest of Education Statistics, The National Center for Educational Statistics, July 2009; Bureau of the Census U.S. Department of Commerce.
Image Sources: National Museum of American History and The Schenectady Museum Archives.

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



- ◆ **Climate Change and Renewable Energy Investments**
- ◆ **Overall Low Sales and Energy Efficiency Policies**
- ◆ **The Smart Grid**
- ◆ **Other Important (Shorter Term) Drivers:**
 - continued U.S. population growth
 - high commodity prices and possible inflationary cycle
 - aging infrastructure
 - political polarization

Photo Sources (From top left, clockwise): PHEV-MJTR. Edited with PS by Mariordo. Toyota Prius Plug-in Hybrid exhibited in Tokyo, 2008. 8 September 2008. Flickr; Wind Farm- Vincent McMorow-Purcell. Wind Farm, Palm Springs, California. August 21, 2004. FreeFoto.com; Smart Meter- Zuzu. Elster Type R15 electricity meter. 20 May 2008. Wikimedia Commons; Infrogmat of New Orleans. BP Oil Flood Protest, Jackson Square. Protest against the great oil spill disaster in the Gulf of Mexico. 30 May 2009. Infrogmat (talk) of New Orleans.

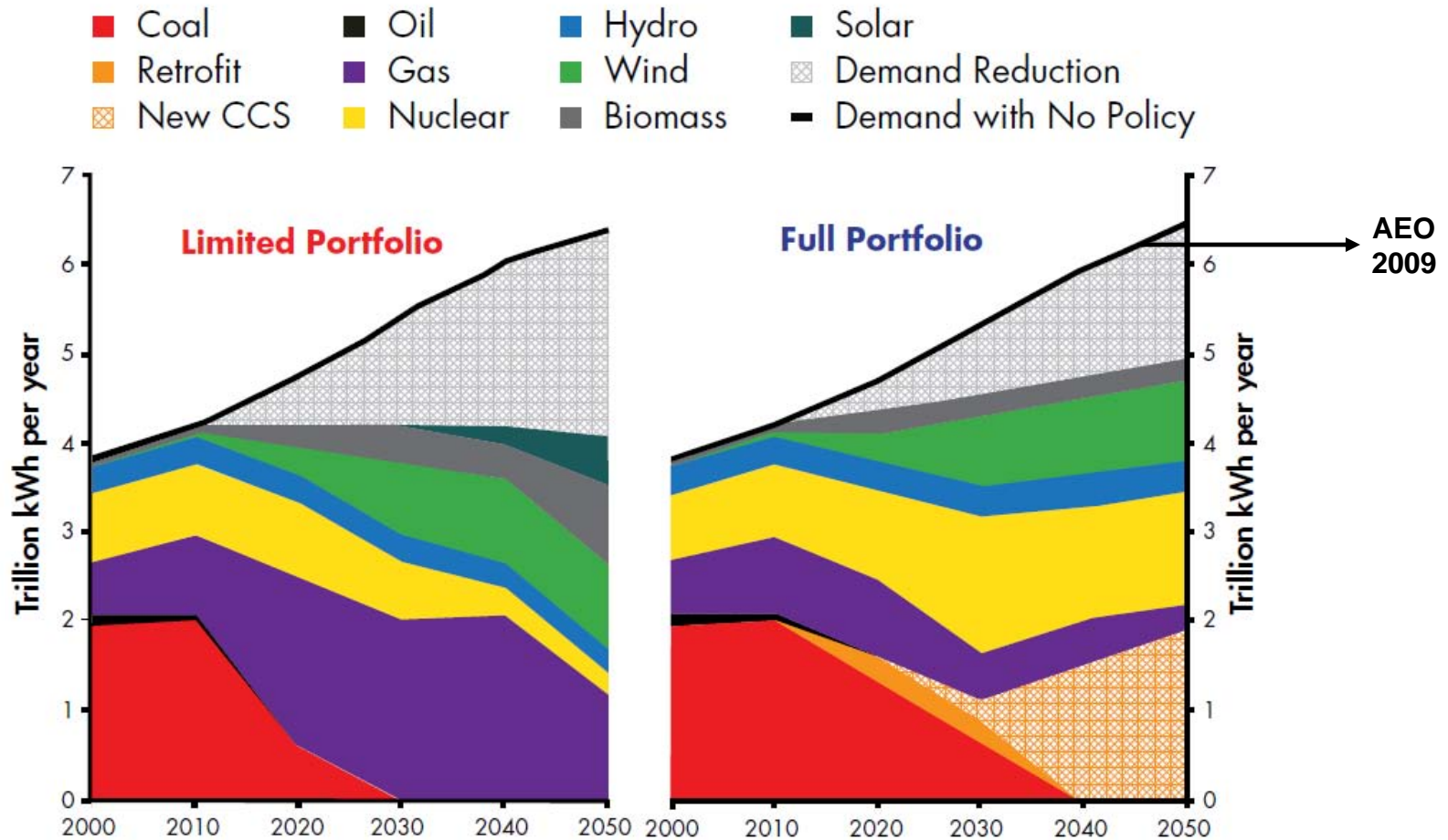
Enormous U.S. Investment Needs

- ◆ 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 - \$1 trillion
- ◆ Replace aging distribution system with smart grid - \$600 billion



Image Source: Electricity Transmission. Невідомий. 10 April 2009. Wikimedia Commons.

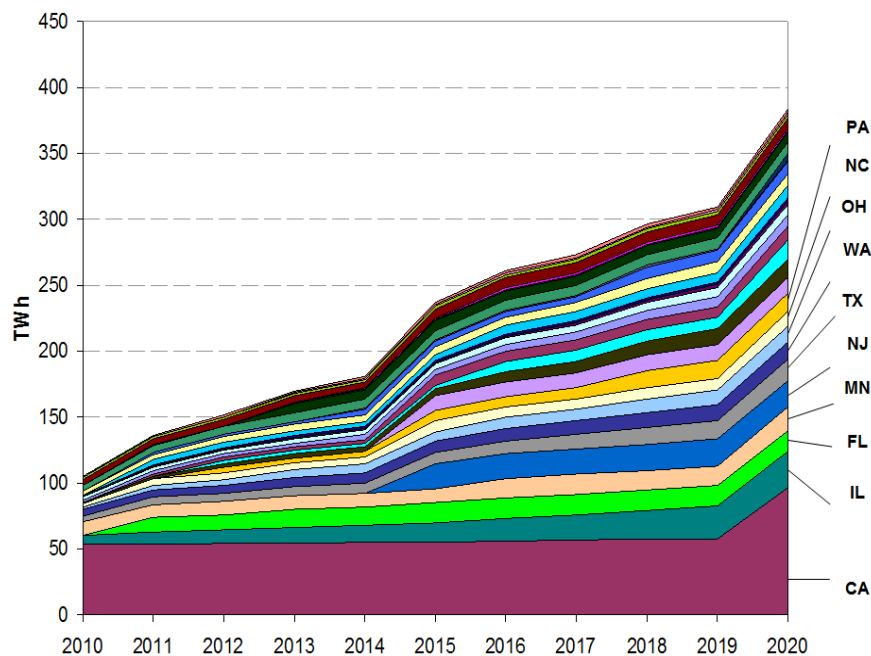
Our Sources of Power Will Change Dramatically



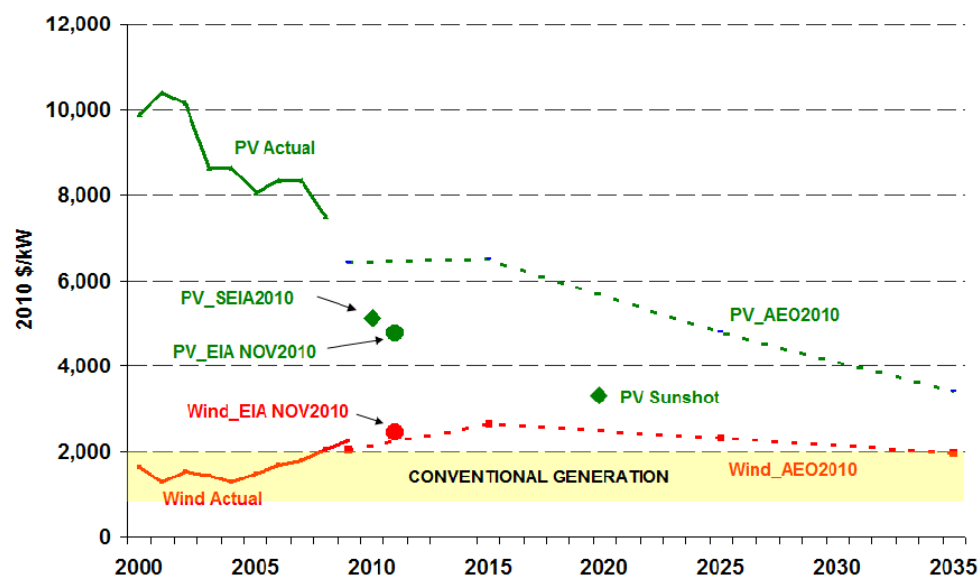
Data Source: "Prism/MERGE Analyses 2009 Update," Electric Power Research Institute (EPRI), 2009.
 Notes: The EPRI Limited Portfolio Scenario assumes no CCS for coal or new nuclear development.

Renewables and RPS Trends

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



Overnight Cost Trends for Wind and Solar PV



Sources and Notes:

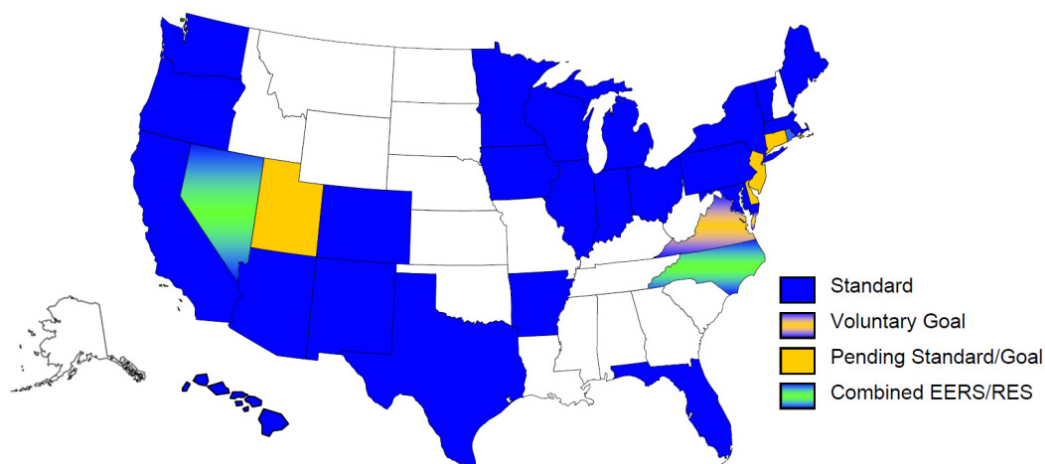
- [1] Expected Demand From RPS from Johannes Pfeifenberger and Peter Fox-Penner, "Transmission Industry Overview: High-Level Drivers," October 26, 2009.
Note: All 50 states are shown in this chart, although only the ten largest are labeled individually.

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.

Power Sales and Energy Efficiency

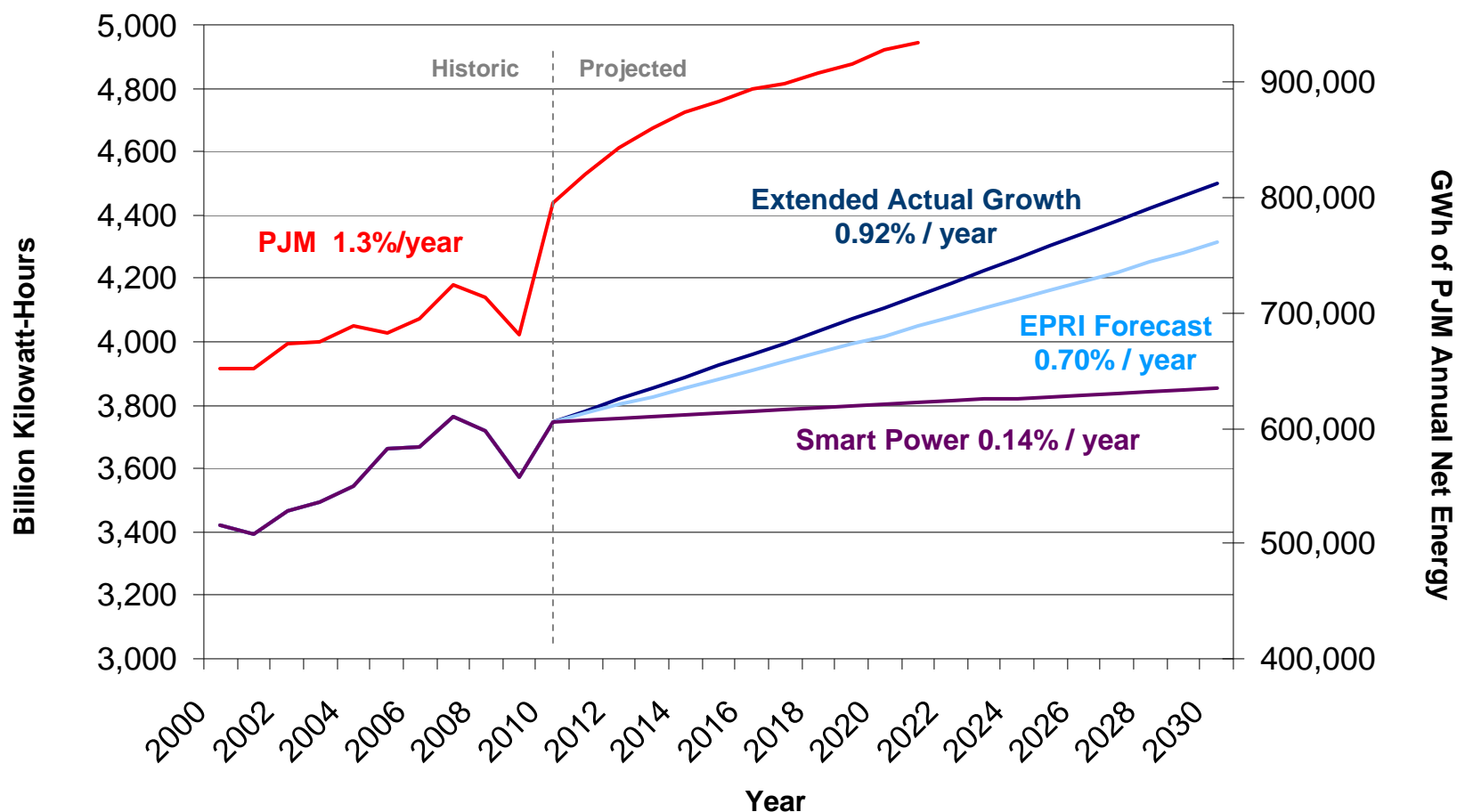
Energy Efficiency Resource Standards by State
(as of December 2010)



Source: EERS data and graphic from the American Council for an Energy-Efficient Economy (ACEEE), December 2010.

- ◆ 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

A Future of Declining Sales Growth



Data Sources: PJM Load Forecast Report, January 2011.

Energy Information Administration. "Table 8.1 Electricity Overview, 1949-2008," The Annual Energy Review, 2009.

Energy Information Administration. "Table 8. Electricity Supply, Disposition, Prices, and Emissions," The Annual Energy Outlook, 2011.

"Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.," The Electric Power Research Institute, January 2008.

Peter S. Fox-Penner, "Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities," Island Press, 2010.

What is the Smart Grid?

Transmission Level (“Upstream”)

- Digital
- Advanced Communications
- Sensors & Automation
- Predictive & Self-Healing
- Digital
- Advanced Communications
- Sensors & Automation
- Predictive & Self-Healing

Distribution Level Smart Grid (“Downstream”) will change customer relationships

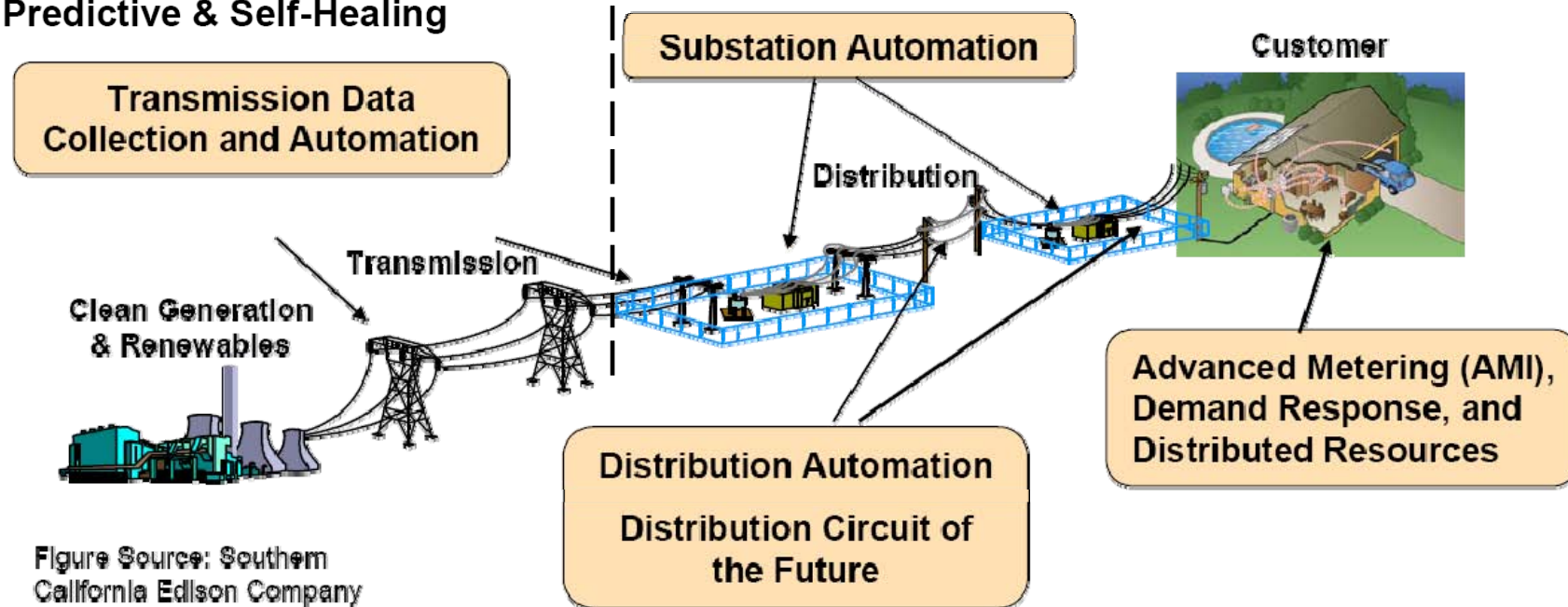


Figure Source: Southern California Edison Company

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.

Over Time The Smart Grid Will Change Everything

- ◆ Integrate distributed generation and storage
- ◆ Improve grid reliability
- ◆ Improve the benefits of PHEVs
- ◆ Raise large new cyber security and privacy issues
- ◆ Above all: Change the business model and regulation



Photo Source: EVB Energy Ltd. Smart meter used by EVB Energie AG. 12 August 2008. Wikimedia Commons.

Adding it All Up...

- ◆ ...The industry must change or die
- ◆ Trillions of dollars of investments needed
- ◆ Costs increasing faster than sales
- ◆ Threats from customer and community generation
- ◆ Smart-grid enabled rivals trying to steal the customer
- ◆ Two evolutionary business models and paths

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

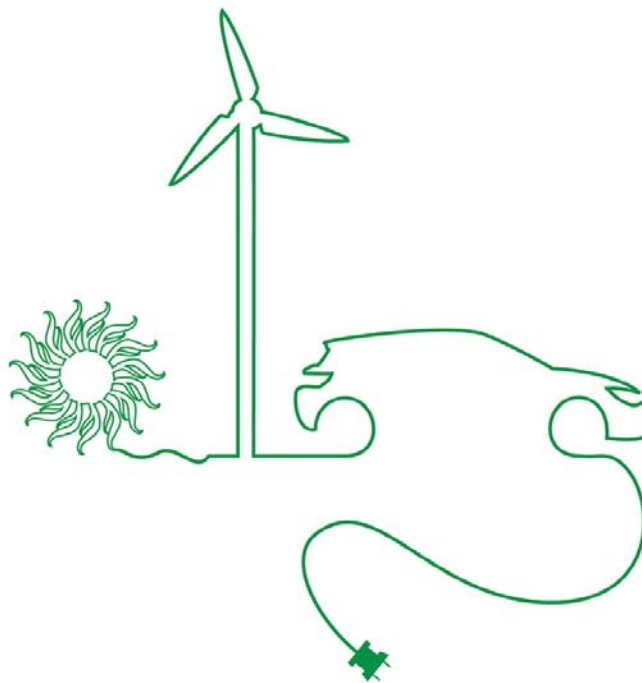
Conclusion

- ◆ **No federal law, but a nationwide movement to reform regulation**
- ◆ **Policy-maker and regulator dialogues and public discussion**
- ◆ **Energy regulator education and resources**
- ◆ **Invest in the Smart Grid in stages, with customer buy-in**
- ◆ **Pass and fund strong energy efficiency and climate policies**

Thank You

SMART *power*

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



Peter Fox-Penner

SMART *power*

The Brattle Group

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)

Contact: Peter.Fox-Penner@brattle.com or +1.202.955.5050.

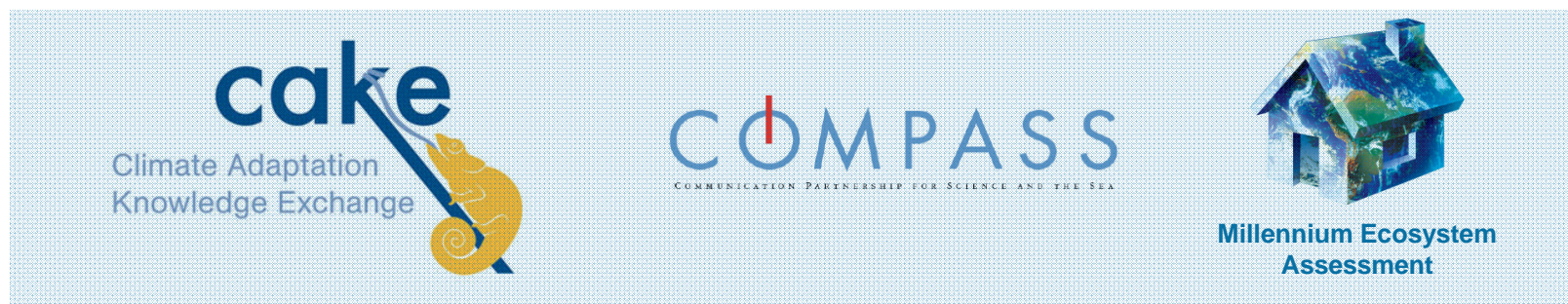
About Island Press



Island Press, a nonprofit organization, is the nation's leading publisher on environmental issues.

Their topics are both timely and wide-ranging, from biodiversity and land use to forestry, agriculture, marine science, climate change, and energy use.

Island Press believes in transforming science and evidence-based information into understanding and action. Island Press also develops programs that translate their work from print to practice.



Contact: programs@islandpress.org or visit www.islandpress.org

Acknowledgements

Please see *Smart Power* and www.smartpowerbook.com for extensive acknowledgements. For help with this presentation, special thanks to:

- ◆ Transmission Data: Lucas Bressan, Research Associate, *The Brattle Group*; the *North American Electric Reliability Council* and the *Edison Electric Institute*.
- ◆ Financial Health Data: Sin Han Lo, Research Analyst, *The Brattle Group*; Bente Villadsen, Principal, *The Brattle Group*; Michael Vilbert, Principal, *The Brattle Group*; Joe Wharton, Principal, *The Brattle Group*; Adam Winegar, Research Analyst, *The Brattle Group*.
- ◆ Energy Efficiency Data: Steve Nadel, Executive Director, The American Council for an Energy-Efficient Economy; Che McFarlin, Project Director, California Energy Commission; William Miller, Sentech.
- ◆ Design and Images: Heidi Bishop, Policy and Marketing Coordinator, *The Brattle Group*; Jenna Curto, Knowledge and Information Services Specialist, *The Brattle Group*; Marianne Gray, Executive Assistant, *The Brattle Group*; Chris Hunter, Director of Archives & Collections, Schenectady Museum; Hal Wallace, Associate Curator, Electricity Collections, National Museum of American History; Collin Young, Former *Smart Power* Intern, *The Brattle Group*.
- ◆ And Hannes Pfeifenberger and Laura Burns for overall support.