A Smarter, Greener Grid: Using the Smart Grid for Climate Mitigation

Kevin B. Jones, PhD

Kbjones@vermontlaw.edu

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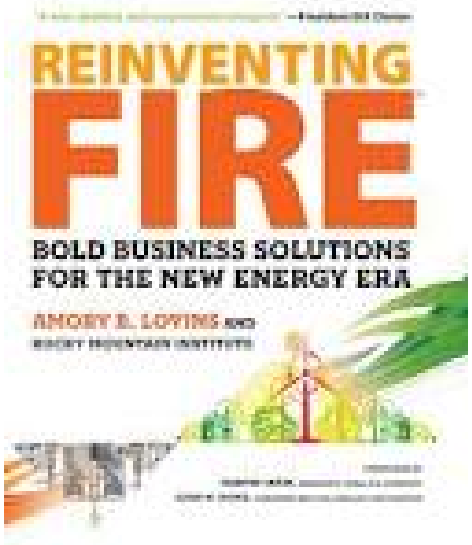
Electricity's Bright Future

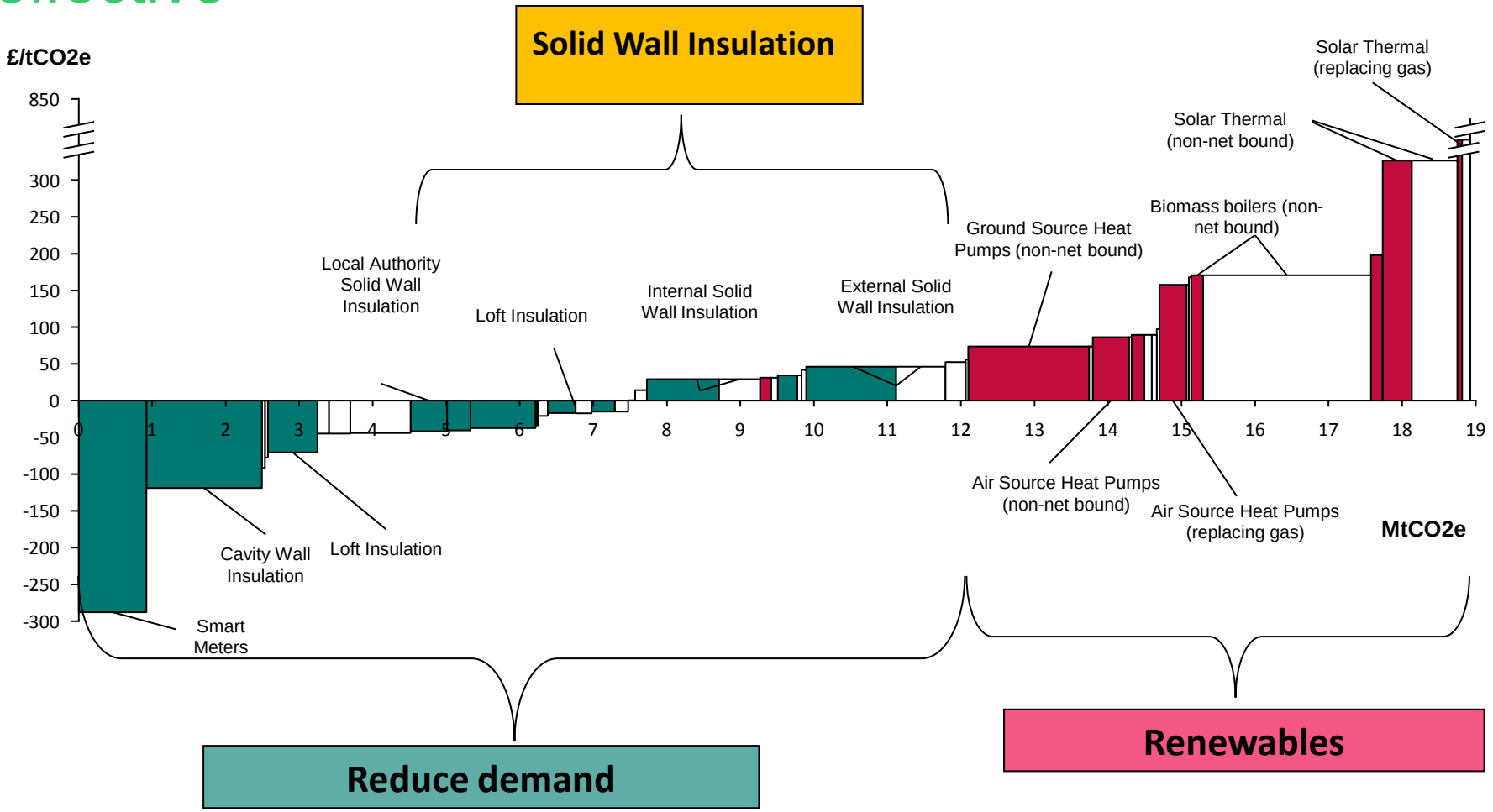
- *Today, electricity – along with the digital information and communication systems it enables and requires – provides the vital root system that sustains our economy.*



- *It's clean, efficient, precise, flexible …*

- *Yet as crucial and as ubiquitous as it has already become, electricity is poised for a profound leap in importance as* ***the key enable****r of the transitions in transportation, buildings, and industry…*

The Energy we don't use can be the most cost effective



Source: UK Department of Climate and Energy

San Diego Gas & Electric:
The Smart Grid's Leading Edge

Institute for Energy and the Environment
Vermont Law School

Salt River Project:
Delivering Leadership on Smarter Technology & Rates

Institute for Energy and the Environment
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ComEd's Smart Grid Innovation Corridor:
Piloting the Regulatory Environment in Illinois

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SMUD's SmartSacramento:
A Clean Technology Pioneer

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The Customers' Smart Grid:
Pecan Street Inc.'s Energy Internet Demonstration Project

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CVPS SmartPower:
A Smart Grid Collaboration in Vermont

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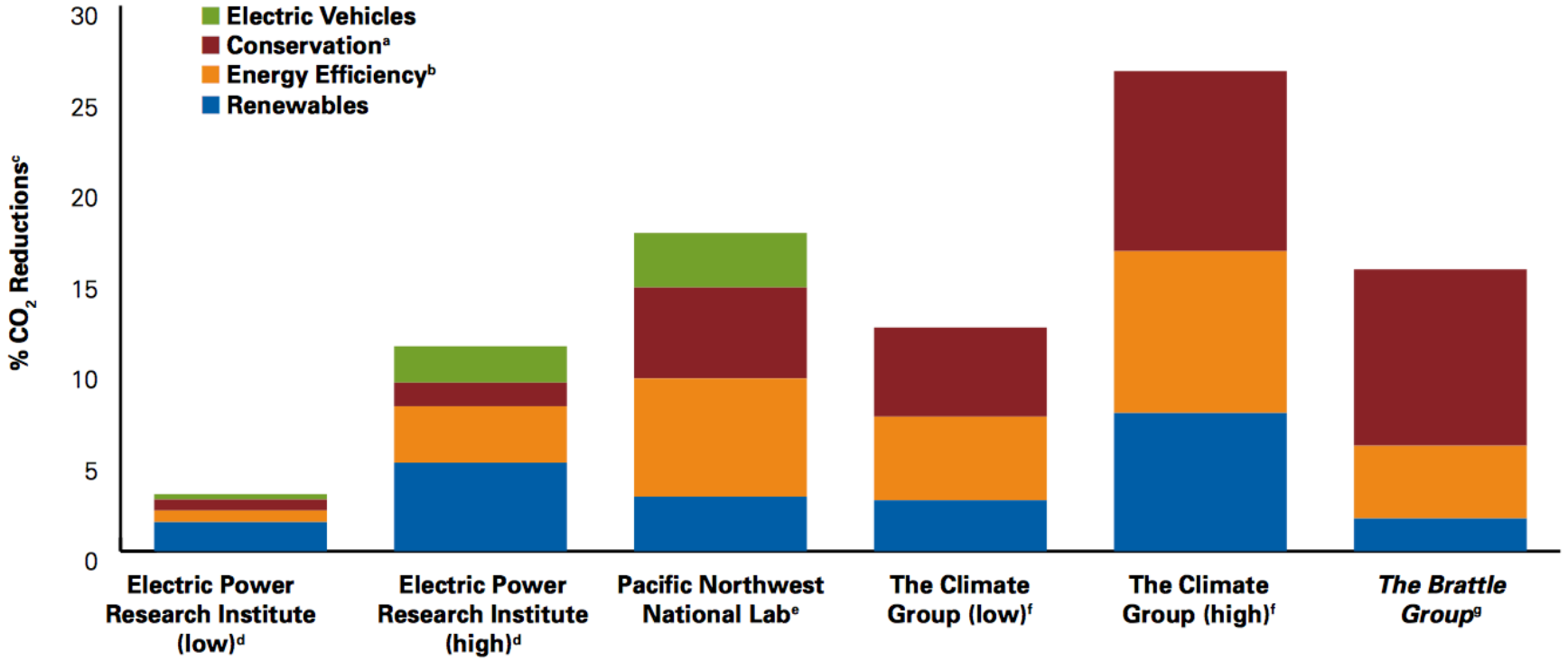
The Five Pathways to Climate Mitigation

1. Supercharging Energy Efficiency
2. Democratizing Demand Response
3. Maximizing Electric Vehicle Integration
4. Ubiquitous Distributed Technologies
5. Conserving with Distribution Optimization

Comparison of Potential Smart Grid CO2 Reductions



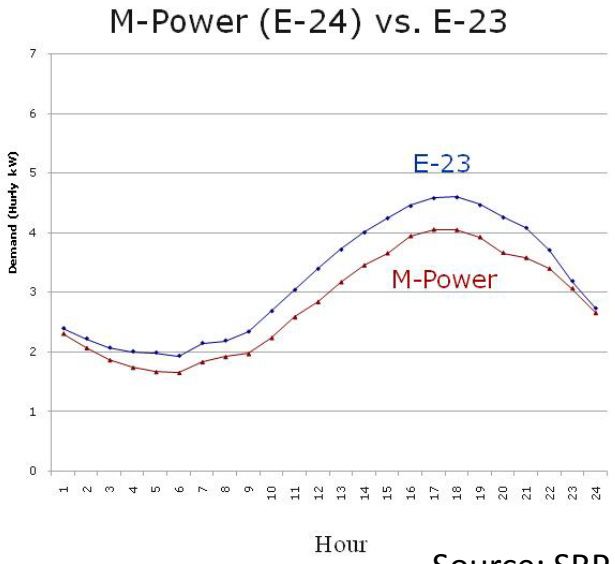
a In home display direct feedback and consumption impacts of load shifting.
b Reduced line losses, conservation voltage reduction, advanced voltage control, measurement and verification of efficiency programs, and accelerated efficiency deployment.
c Reductions in power sector emissions measured relative to DOE/EIA 2030 Refernce Case except ICT study where reductions are based on 2020 Reference Case.
d Electric Power Research Institute (EPRI), *The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled be a Smart Grid,* 2008, 1016905.
e Pacific Northwest National Lab (PNNL), *The Smart Grid: An Estimation of the Energy and CO_2 Benefits*, PNNL-19112, 2010, Richland, WA.
f The Climate Group, *Smart2020 Enabling the Low Carbon Economy in the Information Age,* 2008.
g Ryan Hledik, *The Brattle Group*, "How Green is the Smart Grid?" *The Electricity Journal* 22(3) 2009:29-41.

Source: NRDC 2012

Supercharging Energy Efficiency

A Smart Grid provides:

1. The customer with more detailed and timely consumption information and enhanced opportunities for controlling end-use.
2. The utility with much more detailed load information for improved measurement and verification.



Source: SRP

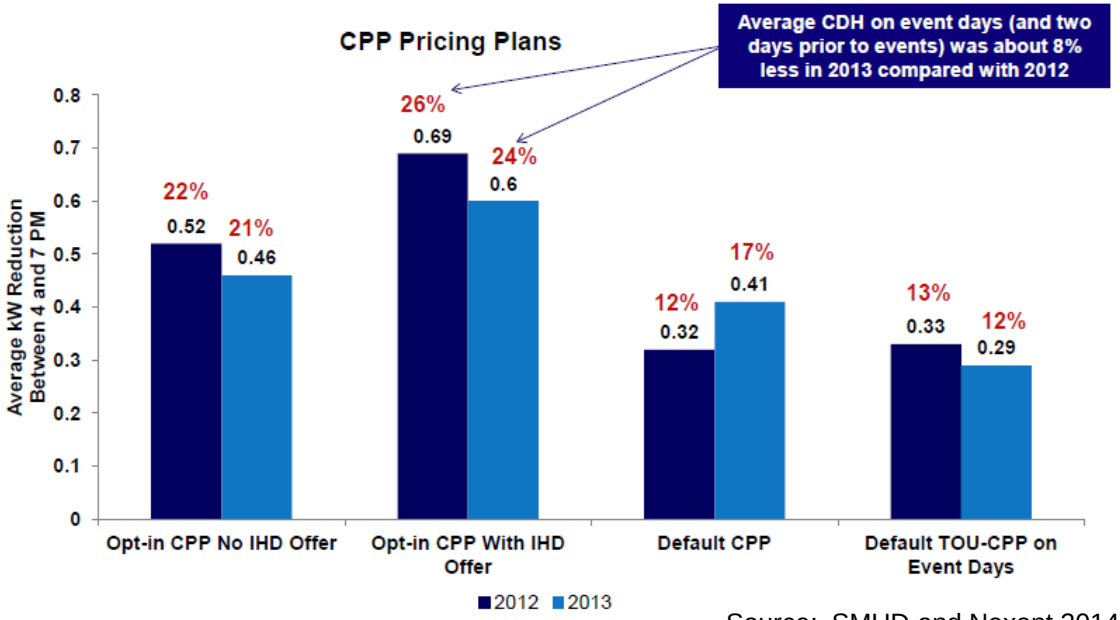
Democratizing Demand Response

Traditional Demand Response

- Primary utility control
- Open to limited end-uses
- Limited customer options
- Incentives for participation

Smart Grid Demand Response

- Emphasizes customer choice
- Available to all customers
- Many customer options
- AMI allows Dynamic Pricing



Source: SMUD and Nexant 2014

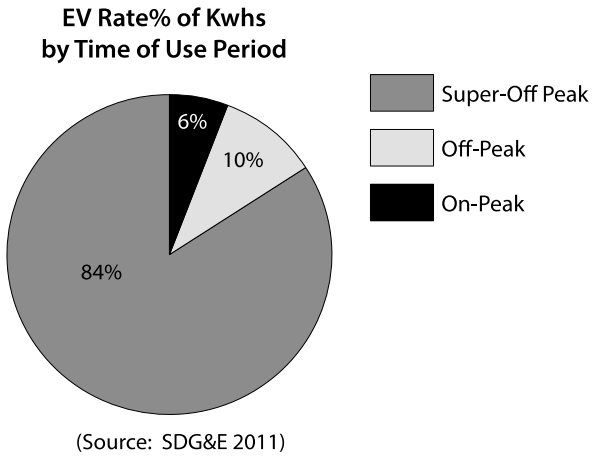
Electric Vehicles: Smart Charging

Even Assuming Today's Electric Mix (Kintner-Meyer et al 2007):

- **30% reduction in energy use per VMT**
- **27% reduction in carbon emissions**
- **52% reduction in oil imports**

With the Smart Grid

- **Smart meters, time of use rates, and increased renewable generation will promote further improvement**



(Source: SDG&E 2011)

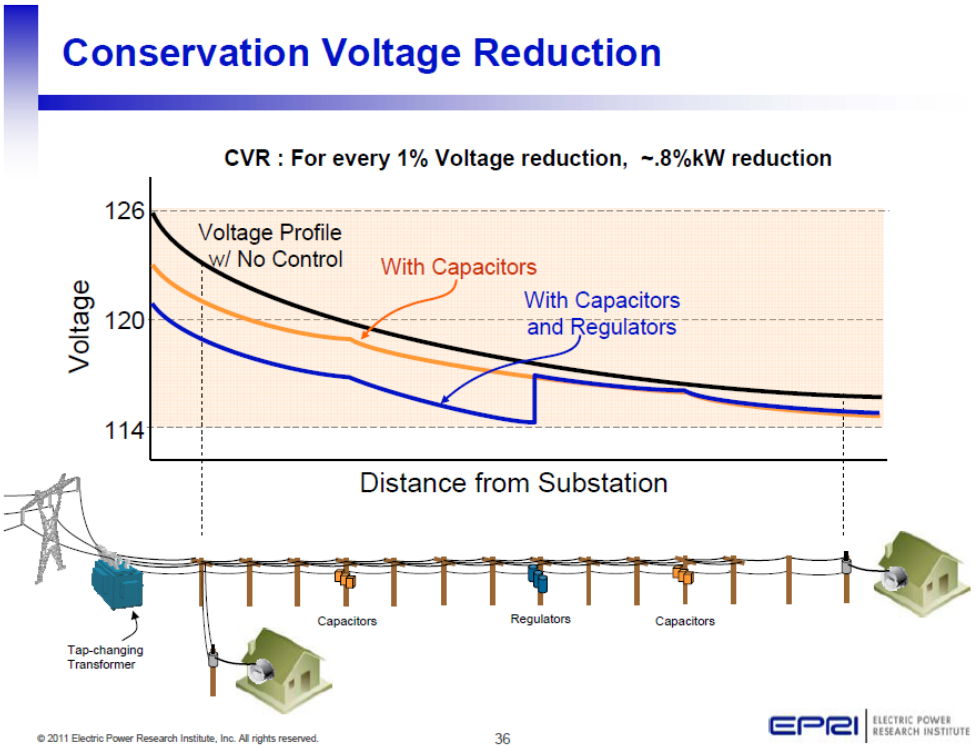
Ubiquitous Distributed Resources

Pose both challenges and solutions

- Challenges
  - Power Quality and Intermittency
  - Islanding
- Solutions
  - Smart Inverters
  - Demand Response
  - Storage

Conserving with Distribution Optimization

- End-use energy consumption drops when voltage is reduced
- A smart grid's measurement and communication capabilities provide an opportunity to optimize tradeoffs in service voltage and energy use by precisely controlling voltage within acceptable limits
- Better optimization of voltage can result in reduced energy consumption.



The Way Forward

A Smart Grid can deliver carbon savings through:

- Supercharging energy efficiency & democratizing demand response
- Integrating more clean distributed energy
- Reduced emissions from smart charging electric vehicles
- Minimizing losses by optimizing the distribution system