

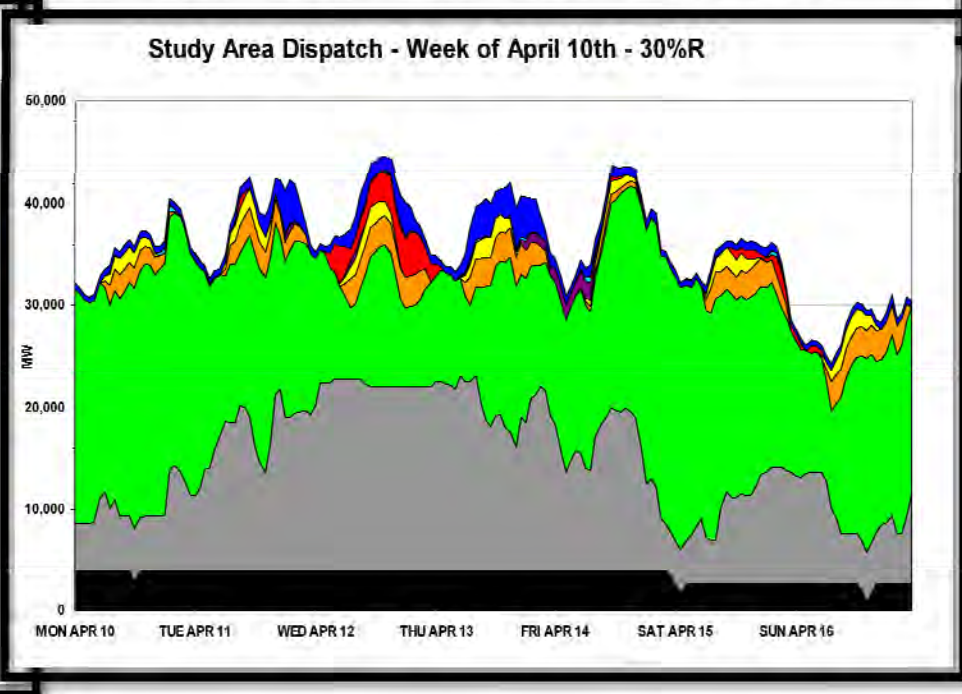
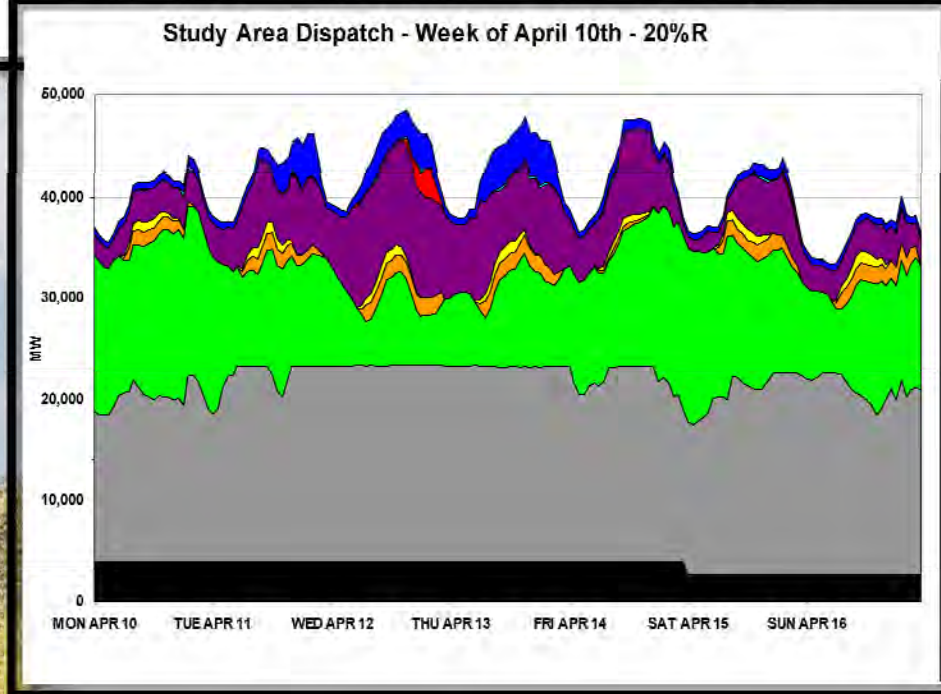
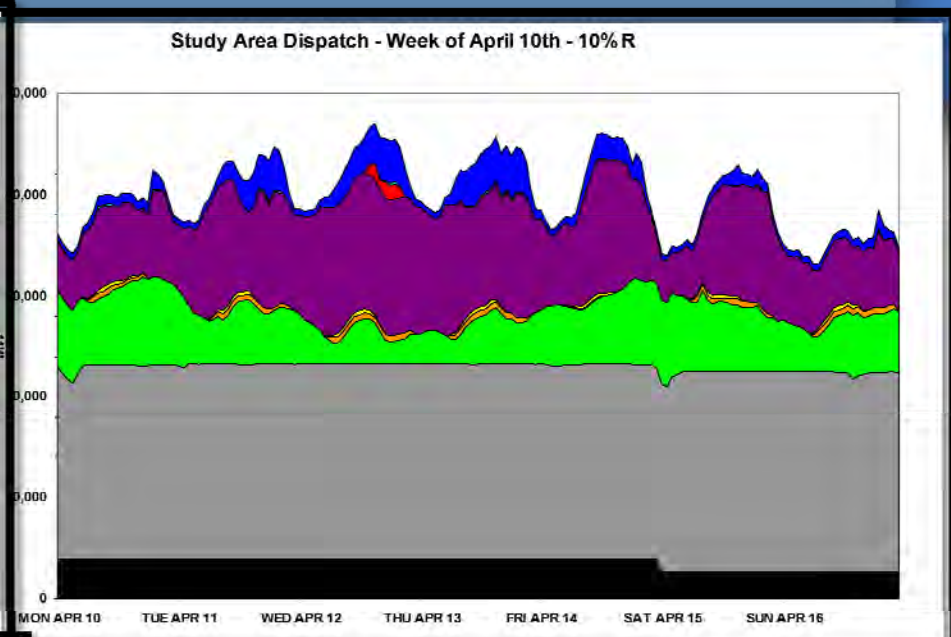
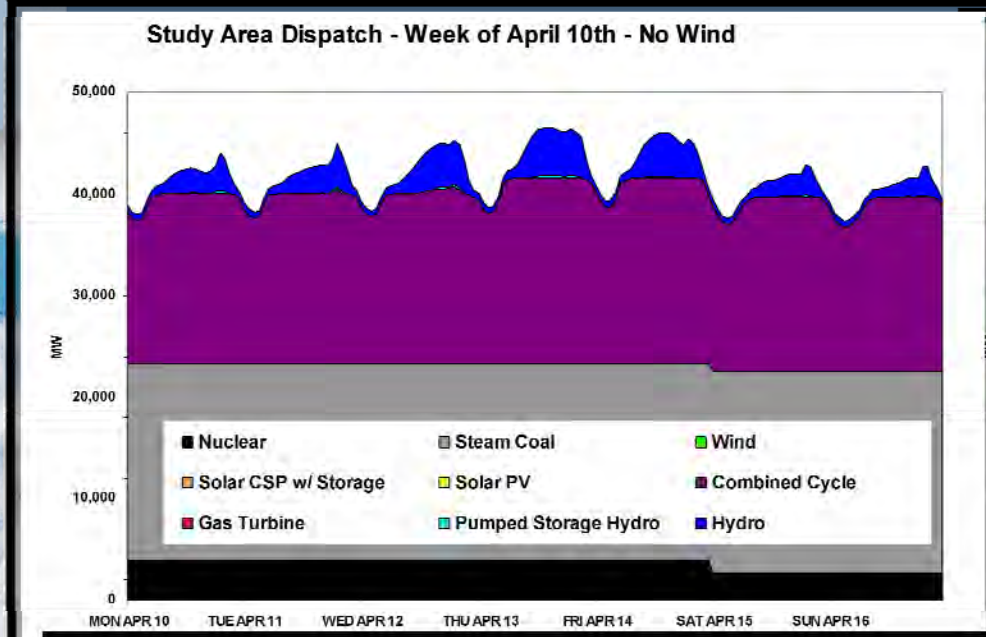


Smart Grid and System Integration

Matt Futch, Governor's Energy Office



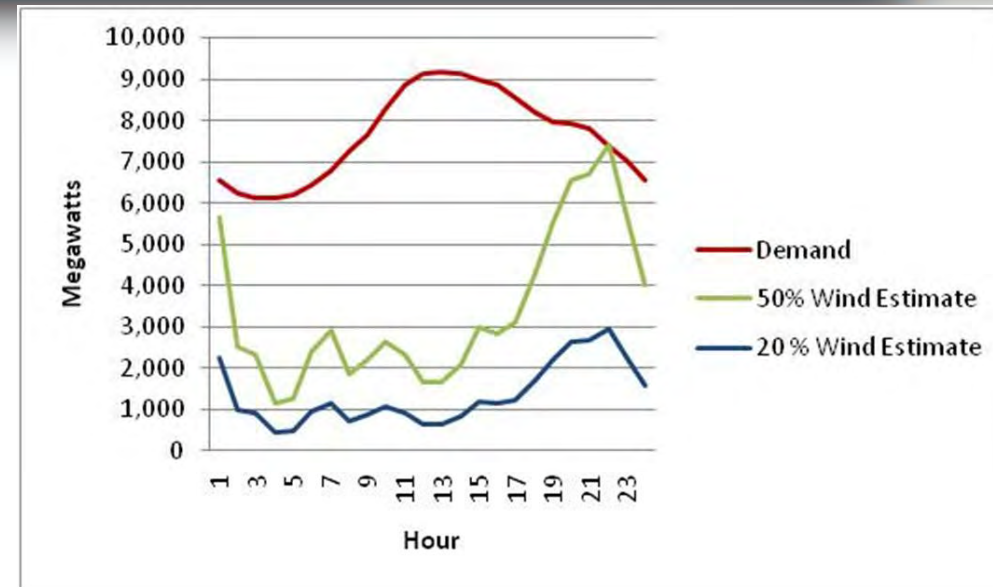
High RE Penetration Impacts on Operation



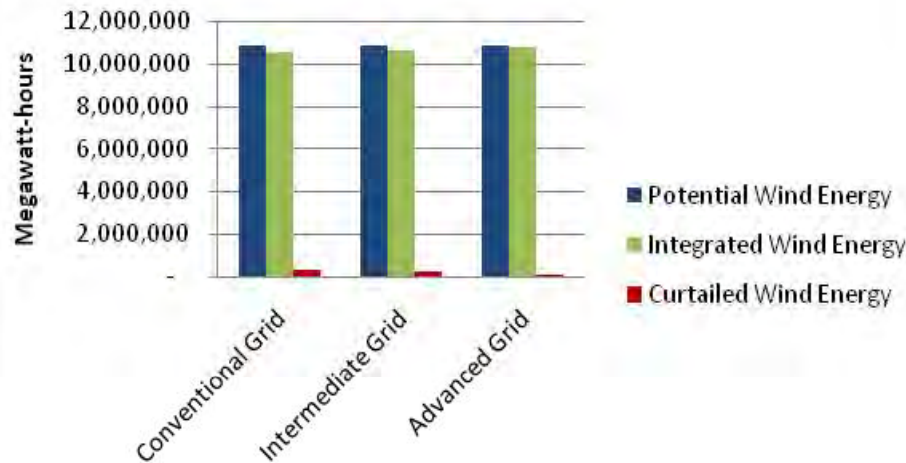
Source: Western Wind and Solar Integration Study, NREL

Smart Grid: Modeling Wind Integration

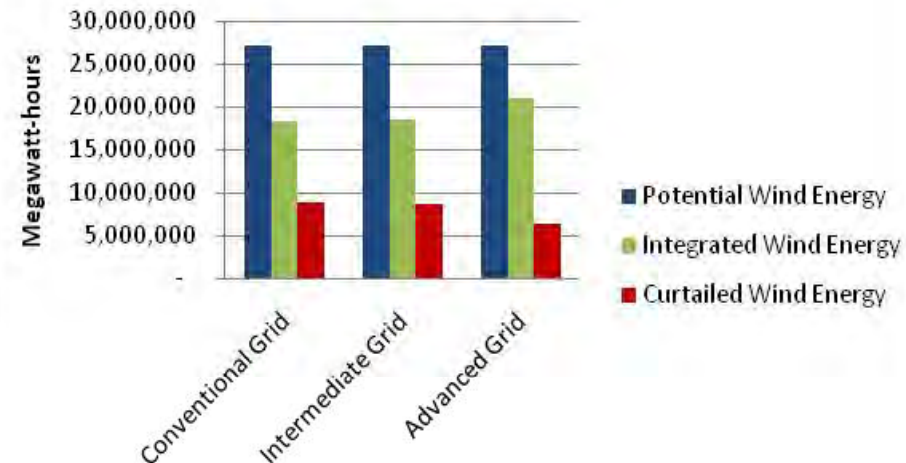
- Smart grid supports wind integration by aligning demand with renewable generation.



20% Wind Generation

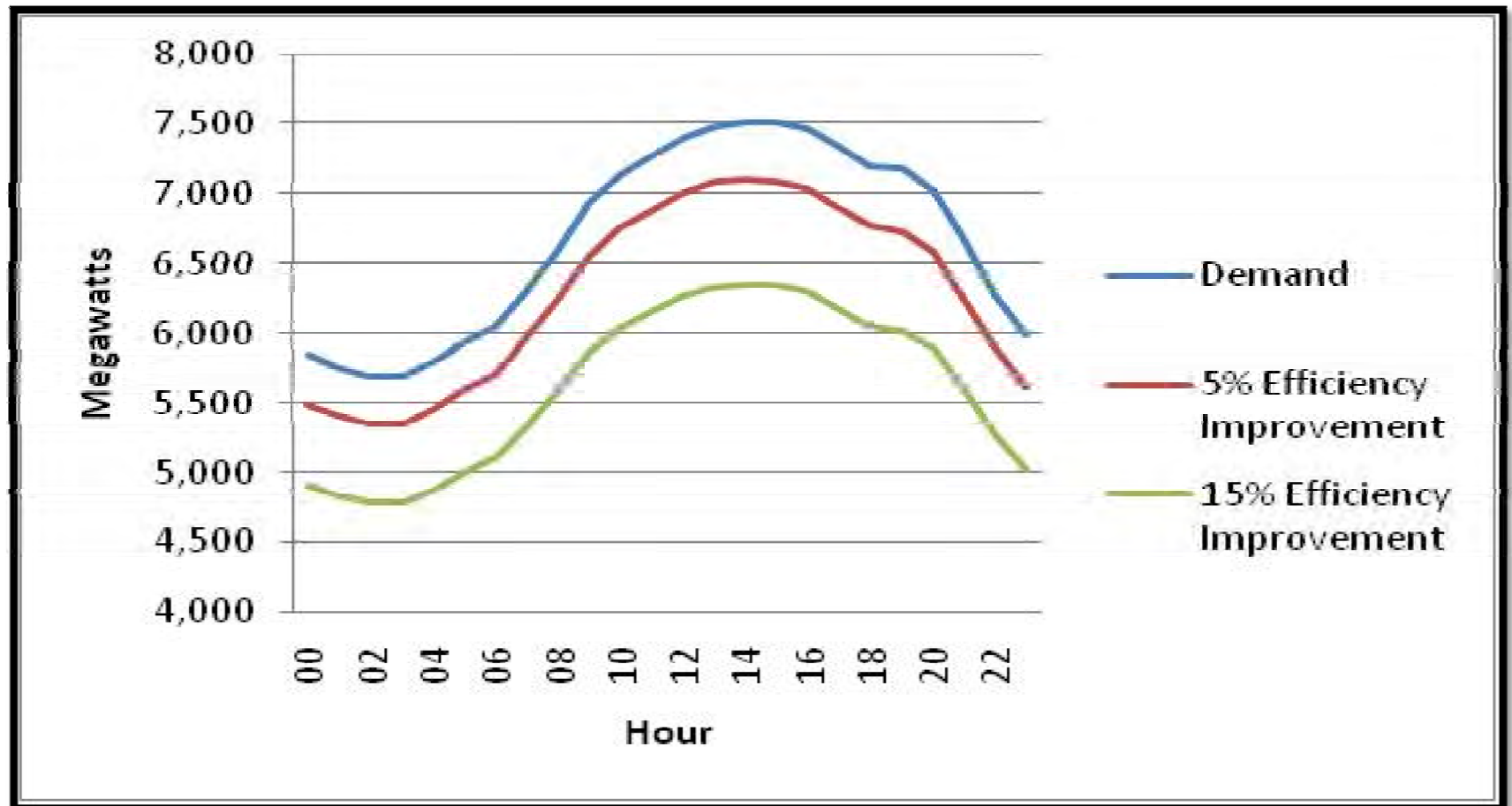


50% Wind Generation



Smart Grid: System Efficiency

- The following actions enabled by Smart Grid increase efficiency of the system, reduce peak and smooth integration of new resources:
Load Balancing / Line loss savings / Distribution/substation loss reduction



Smart Grid - Dynamic Pricing

*“One of those salient opportunities for change that is enabled by the Smart Grid is the pricing of electricity. By and large, existing rate designs hide the temporal variation in the cost of electricity and thereby promote overconsumption of electricity during peak times and under-consumption during off-peak times.” **

Dynamic pricing rate designs can remedy this problem and enhance economic efficiency. For that reason, they are receiving increased attention by state commissions throughout the country. California has made a major commitment to it, by approving the deploying of advanced metering infrastructure (AMI) and by establishing critical-peak pricing (CPP) rates as the default tariff for all non-residential customer classes with AMI.² Other smart rate designs, such as real-time pricing, may be provided as options.

System Critical Peak / TOU

System Wide CPP/TOU Rate

- The CPP/TOU rate layers a Critical Peak Price rate on top of a TOU
- Customers pay a critical rate during peak hours on the few days of the summer when wholesale prices are the highest.
- During other peak days, the CPP/TOU rate operates like a TOU rate.
- During peak hours customers will pay a peak rate that is higher than the existing all-in rate. During all other hours, customers have an off-peak rate that is lower than the existing rate.
- The CPP/TOU rate is designed to convey the true cost of power generation to electricity customers and to provide them with a price signal that more accurately reflects variation in energy costs over the course of the day.

Smart Grid - Dynamic Pricing

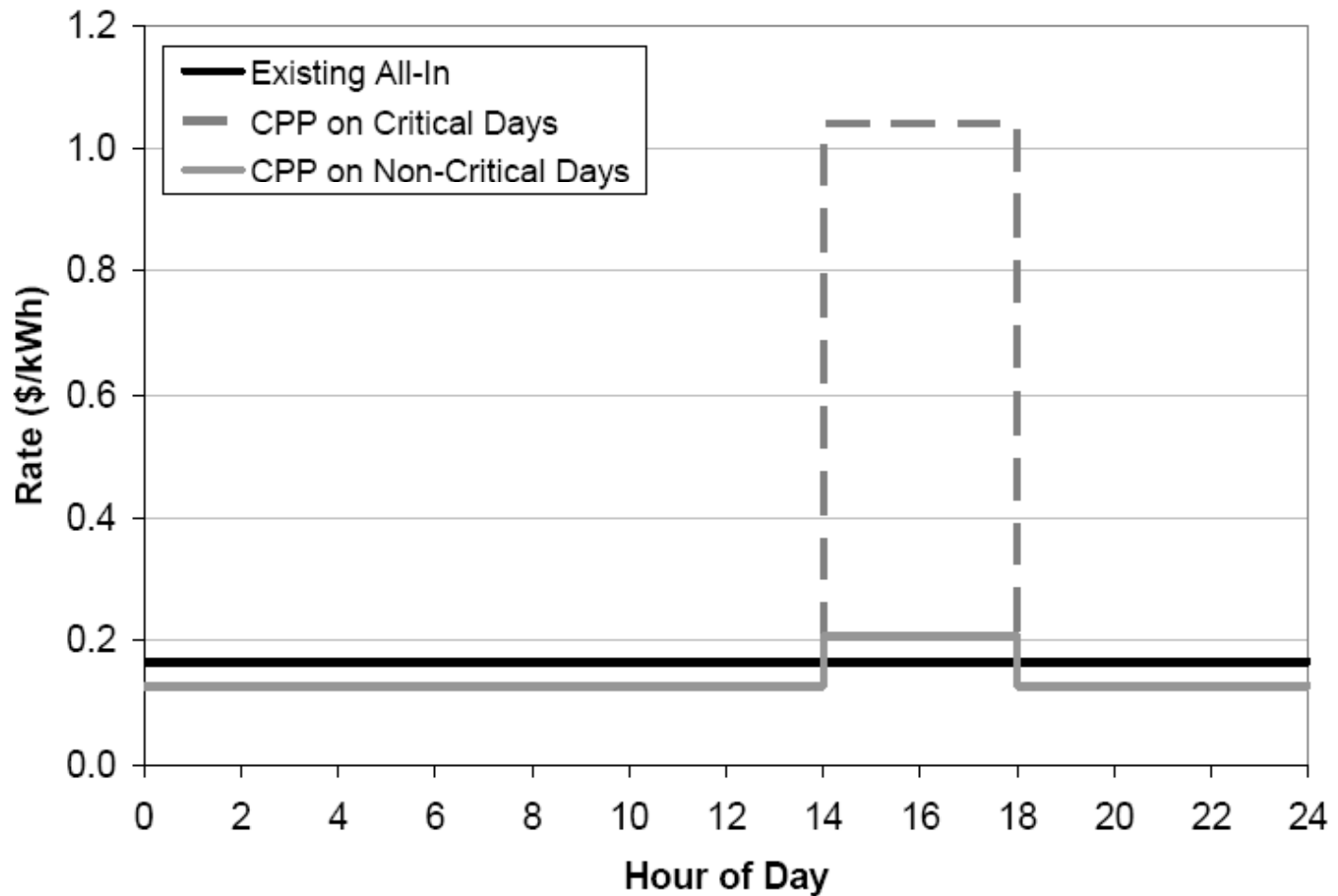
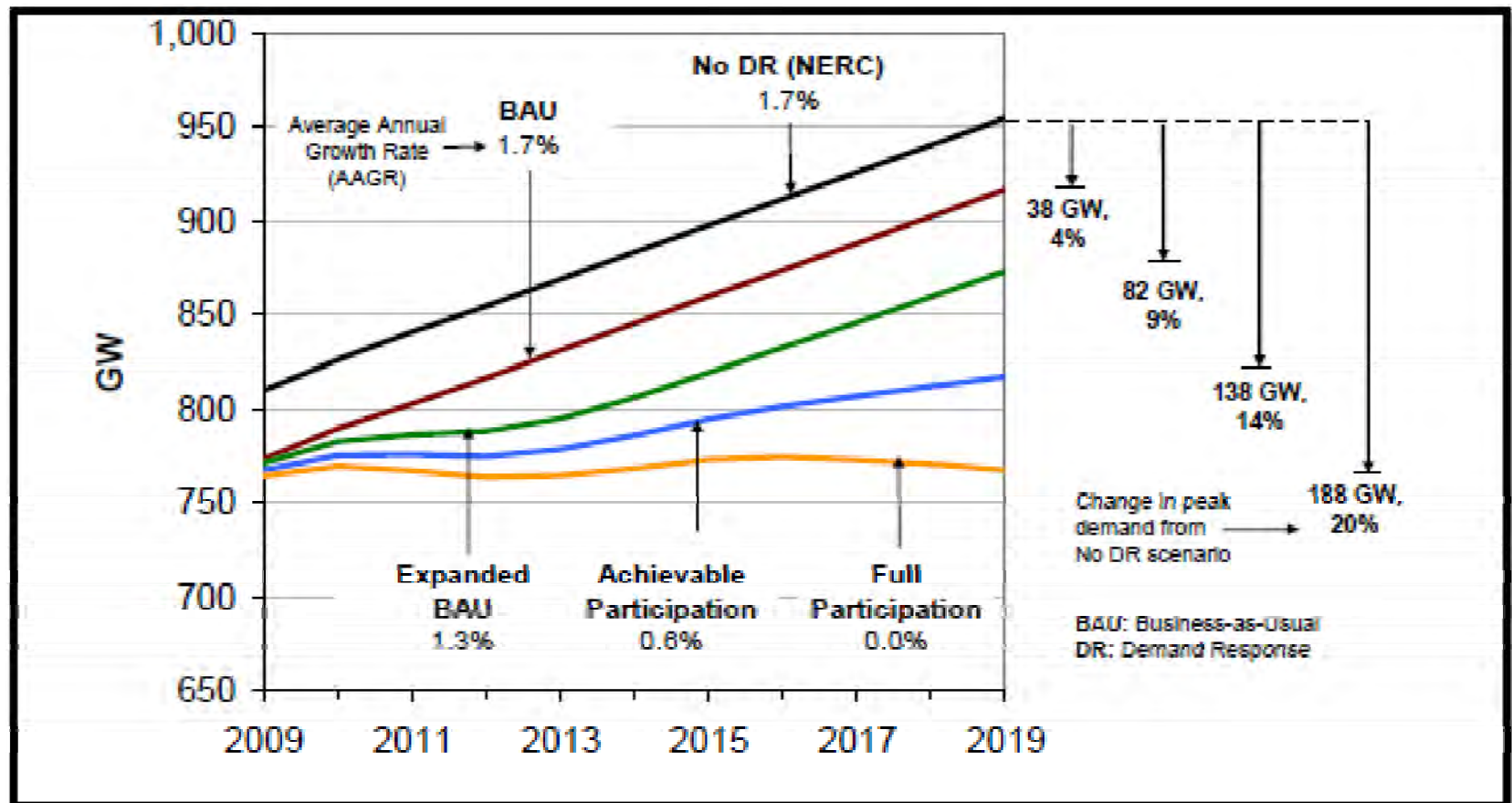


Figure 1: Illustrative CPP/TOU Rate

Smart Grid – Load Balancing and Demand Response

As regulatory and fuel risk increase upward pressure on generation, demand response becomes increasingly important in system portfolio

U.S. Summer Peak Demand Forecast by Scenario

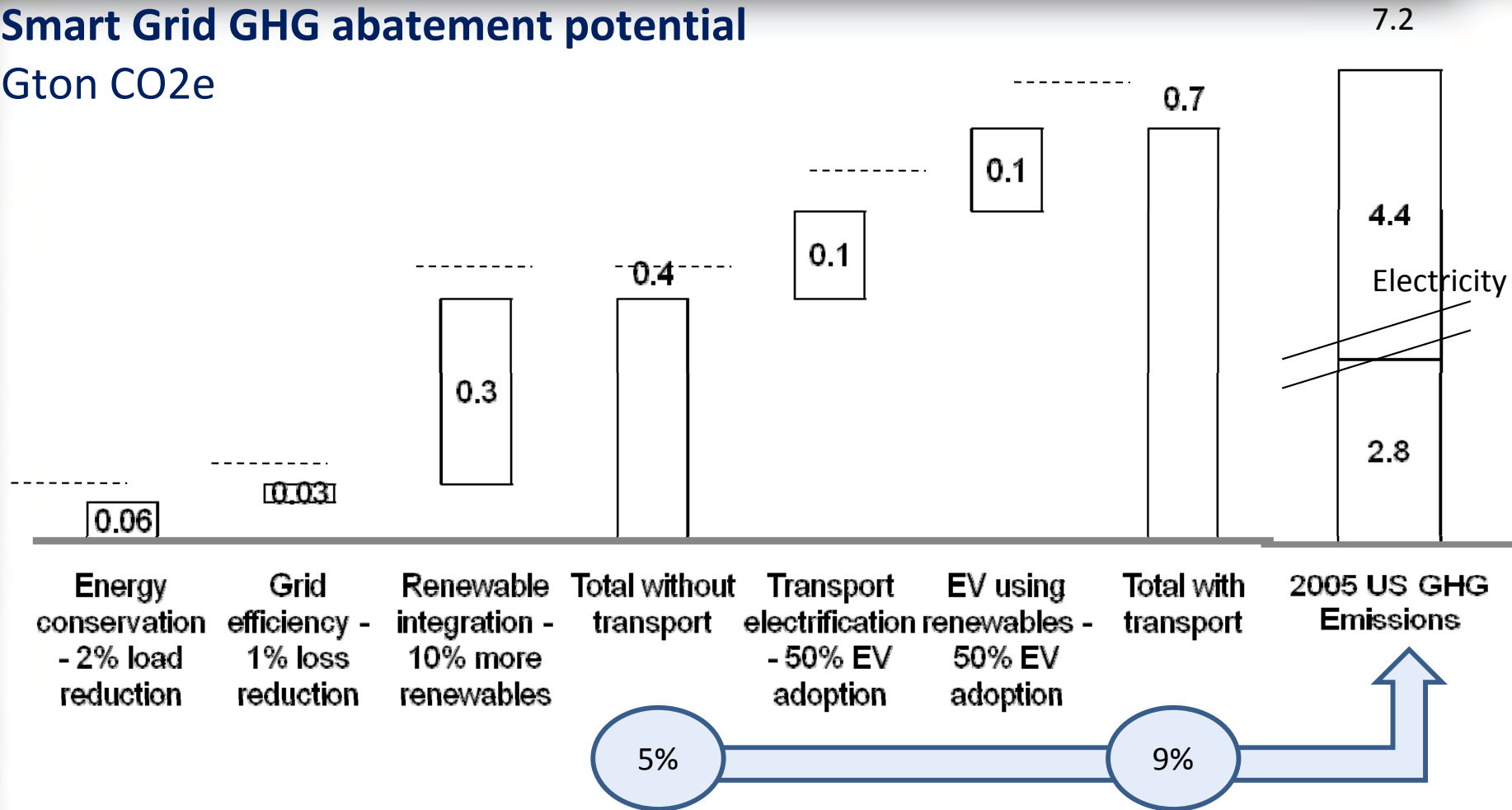


Source: 06-09 A National Assessment of Demand Response Potential

Smart Grid: Enable 5-9% GHG Emissions

Smart Grid GHG abatement potential

Gton CO₂e



One-quarter of Waxman-Markey GHG reductions can be realized through Smart Grid by 2030*

*Source: "Smart Grid and Climate Change", Michael Jung, Silver Springs Networks

The 21st Century Grid

A 21st Century Grid must substantially increase the use of existing production assets

Over 1,000 GW of production assets serve our national power needs, but many of these expensive assets are used only a few times each year.

A 21st Century Grid must readily accommodate new generation, transmission, distribution and consumer technologies

Growing environmental concerns will drive a diversity of cleaner sources of power.

A 21st Century Grid must actively identify and extract energy efficiency throughout the system

Maximizing energy efficiency from generation to load is critical in meeting our carbon reduction goals.

A 21st Century Grid must be operated in a highly efficient and highly automated manner.

As the grid rapidly increases in complexity, we must plan, design, build and operate a system that is much more automated; sensing changes, responding and adjusting in near real time—eventually becoming an adaptive self-healing system.

A 21st Century Grid must be able to highly differentiate the reliability requirements of consumers

We must plan, design, build and operate a grid that provides for variation in the quality of power while creating a grid that is absolute in providing for critical loads.