POWER SECTOR TRANSFORMATION
THE U.S. OPPORTUNITY
CLEAN ENERGY NO LONGER ‘BOUTIQUE’

WIND COST & DEPLOYMENT

**LCOE - Lazard’s Levelized Cost of Energy Analysis 2008-2015, avg. of high/low figures
THE U.S. OPPORTUNITY
CLEAN ENERGY NO LONGER ‘BOUTIQUE’

SOLAR COST & DEPLOYMENT

Prices down more than 80% since 2009

Capacity increased 20X since 2009

*Capacity - GTM/SEIA Solar Market Insight Annual Report 2015
**LCOE - Lazard’s Levelized Cost of Energy Analysis 2008-2014, technology-weighted avg. of high/low ranges
THE U.S. OPPORTUNITY
STATE COMMITMENTS

CA: 50% by 2030
HI: 100% by 2045
VT: 75% by 2032
NY: 50% by 2030
THE U.S. OPPORTUNITY
RENEWABLES REPLACING FOSSIL FUELS

12,500 MW of renewables **ADDED**

13,700 MW of fossil fuels **RETIRED**
THE U.S. OPPORTUNITY
CO₂ DECOUPLING

**Figure 1**
Historical and projected U.S. energy-related carbon dioxide emissions under existing policy, and national GDP, 1990–2040
Carbon dioxide in millions of metric tons, GDP in billions of chained 2009 dollars

Source: Center for American Progress
THE GLOBAL OPPORTUNITY

Wind Power Global Capacity and Annual Additions, 2005–2015

- Annual additions
- Capacity

World Total: 433 Gigawatts

REN21 Renewables 2016 Global Status Report
THE GLOBAL OPPORTUNITY


Gigawatts

World Total
227 Gigawatts

Rest of World
Italy
United States
Japan
China
Germany

5.1 6.7 9 16 23 40 70 100 138 177

REN21 Renewables 2016 Global Status Report
THE GLOBAL OPPORTUNITY
COUNTRY/REGIONAL COMMITMENTS

EU
20% renewables by 2020

Denmark
100% renewables by 2050

Sweden
49% renewables by 2020 (already met)
OPPORTUNITY
NEW TECHNOLOGIES UNDERWAY
BUT... A CLEAN ENERGY FUTURE REQUIRES A FLEXIBLE GRID
How can the electric grid optimize for this?
A SUITE OF FLEXIBILITY OPTIONS

High Cost

Low Cost

Increasing Need for Grid Flexibility

Improved Operations
Demand Response
Grid Infrastructure
Fast Ramping Supply
Energy Storage

Optimize how resources are dispatched and shared across regions
IMPROVED OPERATIONS

Expand the EIM

Eight states
35 million customers
Savings of $70-200 million
DEMAND RESPONSE

TWO KINDS OF DEMAND RESPONSE

Dispatchable

Price-responsive
DEMAND RESPONSE

Shift demand based on supply and prices
Demand Response

Let supply and demand compete. Shift demand based on supply and prices.
DEMAND RESPONSE

GWs of latent DR opportunities across the economy
GRID INFRASTRUCTURE

TRANSMISSION

Regional optimization

Geographic diversity

Technological diversity
GRID INFRASTRUCTURE
REGIONAL OPTIMIZATION

Managing unpredictable variations

(Graph showing output normalized to mean over time with annotations for 15 and 215 turbines, with standard deviation and mean values provided.)
GRID INFRASTRUCTURE
GEOGRAPHIC AND TECHNOLOGICAL DIVERSITY

Managing *predictable* variations

FAST RAMPING SUPPLY
IMPROVE FOSSIL FLEXIBILITY

Use only existing gas capacity

Use only for power, not energy
FAST RAMPING SUPPLY

New natural gas WILL NOT get us to our emissions reduction goals
1.3 GW storage mandate drives deployment up, costs down
ENERGY STORAGE

Pumped hydro

Battery storage
Curtailment
The Most Expensive Option

Flexibility is key to reducing curtailment

Source: G. Brinkman, California Low-Carbon Grid Study, Presentation to RETI 2.0 Stakeholder Meeting, April 18, 2016.
CURTAILMENT
...OR LONG-TERM ELASTICITY?

Data Processing

Time of use rates

Desalination

Battery Electric Vehicles

Air Gases
HOW TO WIN

1. Reward utilities for providing energy services
2. Keep RPS going
3. (not) Net Metering
4. Demand and supply compete as equals
HOW TO WIN

Value fast on/off capabilities

Optimize the existing grid

Employ investment-grade policies

Reduce siting conflicts
America’s Power Plan is a platform for innovative thinking about how to manage the transformation happening in the electric power sector today.

We collect expert information for decision-makers and their staffs, highlighting specific solutions to today’s most pressing policy, regulatory, planning, and market design challenges.
THANK YOU