

MARKET-DRIVEN, COMMON GROUND ACTION ON CLIMATE CHANGE

ACEEE INTELLIGENT EFFICIENCY CONFERENCE
DECEMBER 5, 2016

CONVENTIONAL DATA CENTER OUTDATED, MASSIVE, COSTLY, INEFFICIENT, NOISY, HIGH HEADCOUNT



NAUTILUS DATA CENTER INNOVATIVE, COMPACT, AFFORDABLE, EFFICIENT, QUIET, LOW HEADCOUNT



CURRENT UNITED STATES POLICY

Over 100 Federal and State Mandates

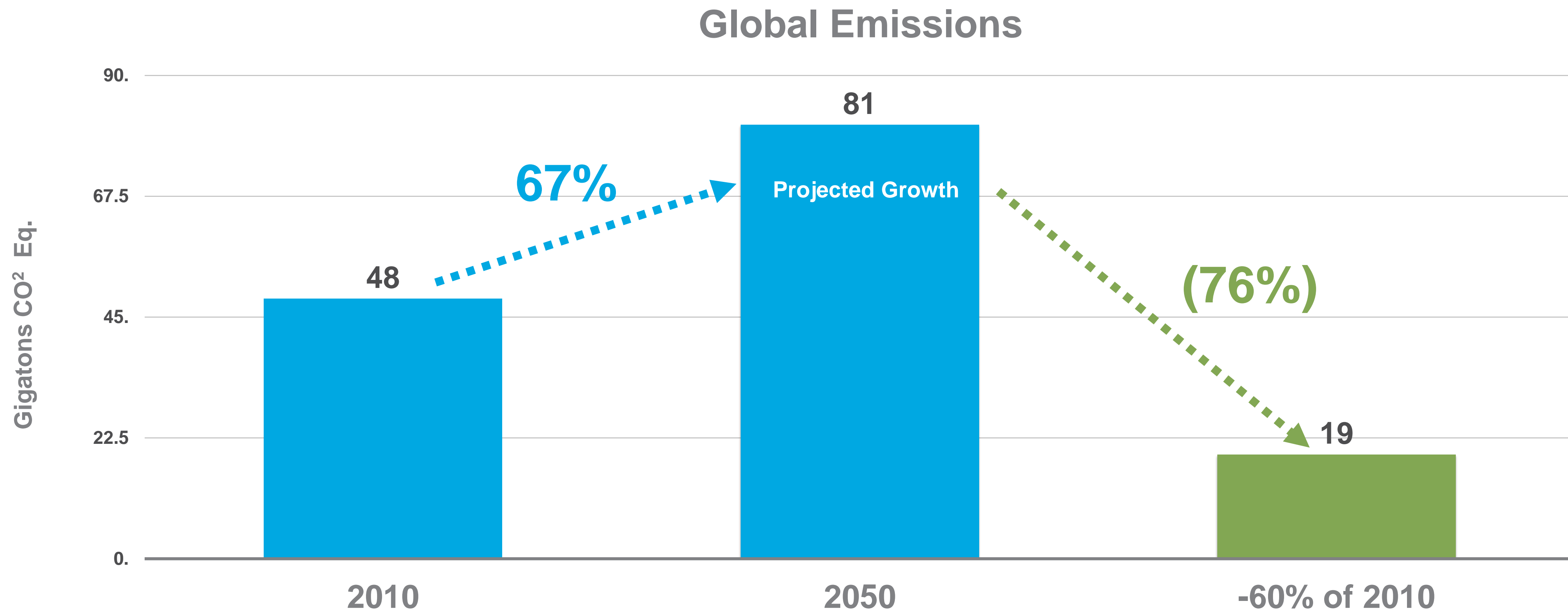
- Renewable Power* (37 States)
- Greenhouse Gases* (10 States)
- Power Plant Air Pollution*
- Vehicle Fuel Efficiency*
- Renewable Fuel*
- Lighting Efficiency*
- Appliance Efficiency
- Ozone Depleting Substances
- Building Efficiency Codes (50 States)
- Clean Power Plan[*]

* USES MARKET-BASED SYSTEM

Over \$150B Incentives

- Tax Credits (on and off again)
- Clean Energy Payments
- None
- Tax Credits, Subsidies
- Tax Credit (Expired), Subsidies
- Tax Credits, Subsidies, Rebates
- Subsidies, Rebates
- None
- Tax Credits, Subsidies
- Clean Energy Incentives

NEED 60 GIGATONS OF REDUCTIONS TO REDUCE GLOBAL GHG EMISSIONS 60% BY 2050



Note: 2050 forecast from OECD Environmental Outlook to 2050 (OECD, 2012).

HOW BIG IS ONE GIGATON OF CO2?

| Today's Technology | Actions that Provide 1 Gigaton per Year of Mitigation ¹ |
|---------------------------------------|--|
| Coal Power Plants with CCS | Build 507 500-MW coal-fired power plants with CCS (assumes 90% capture, 25% parasitic energy loss & 70% capacity factor) to replace 380 500-MW coal-fired plants ² w/o CCS (70% capacity factor). 0 TODAY. 10+% OF CURRENT PLANTS |
| Geologic Sequestration | 1,000 sequestration sites like Norway's Sleipner project (1.0 MtCO ₂ /year). 300X CURRENT |
| Nuclear | 128 1-GW plants (90% capacity factor) to replace 329 500-MW coal plants (70% capacity factor). 33% CURRENT |
| NGCC | Install 608 500-MW NGCC plants meeting EPA's 1,000 lbs per megawatt hour New Source Performance Standard (70% capacity factor) to replace 608 500-MW coal plants ² (70% capacity factor). 10+% CURRENT |
| Efficiency | Deploy 290 million new cars at 40 miles per gallon (mpg) instead of new cars at 20 mpg. ALL THE CARS IN US, EU, OR CHINA |
| Wind Energy | Install 165,000 2-MW turbines w/30% capacity factor to replace 329 coal power plants w/70% capacity factor. 2-3X CURRENT |
| Concentrated Solar Power | Install 1,100 300-MW CSP plants w/35% capacity factor to replace 329 coal power plants w/70% capacity factor. 300X CURRENT |
| Landfill Gas Electricity | Install 7,700 "typical" landfill gas electricity projects (typical size being 3-MW projects at non-regulated landfills) that collect landfill methane emissions and use them as fuel for electric generation |
| Solar Photovoltaics | Install 2.8 million acres of 2-axis concentrated solar photovoltaics (generation-weighted average land use of 2.8 acres/GWh/year) to replace 329 coal-fired power plants ² (operating at 70% CF). MORE THAN 100x CURRENT |
| CO ₂ Storage in New Forest | Convert 100 million acres of barren area to new forest, (assumes Douglas Fir) 2.5X SIZE OF WASHINGTON STATE |

¹ capacity factor was about 60%.

³ The average size of a new wind turbine installed in 2014 was ≈ 2.0 MW.

SCALABLE, MARKET-DRIVEN, COMMON GROUND POLICY ACTIONS TO START: LEGISLATE A NUMBER—HOW FAR, HOW FAST, HOW COSTLY

MAKE ELECTRICITY MARKETS COMPETITIVE

- Unleash Investment in Innovation
- Constitutional Lawsuit or Federal/State Legislation

SIMPLIFY POWER GENERATION MANDATES

- Tech Neutral, Performance-Based, Cost Cap, Pre-Emption
- Natural Gas, Clean Coal, Nuclear, Hydro, Other Renewables

SIMPLIFY TRANSPORTATION MANDATES

- Tech Neutral Using Feebate for Vehicles
- Tech Neutral for All Fuels (National Security, Density, Emissions)

RESTORE AND EXPAND NUCLEAR ENERGY

- Existing, Gen3 Plus, Gen 4, and Small Modular Reactors
- Infrastructure, Finance Reform, Federal Policy

DEPLOY ANALYTICS FOR POWER, VEHICLES, FOOD

- About 25% Power System Efficiency Gain; 8% in Grid Alone
- Federal Policy, PUC Policy—Data as New Utility Asset

TRADE ENERGY SUBSIDIES FOR MUCH MORE R&D

- Portion to Public and Private R&D; Portion to Pay Down Debt
- Tax Reform, Federal and State Budgets

TAX POLICY: REPATRIATION, CORPORATE, EXPENSING, MUST INFLUENCE CHINA AND INDIA AND AVOID CARBON LEAKAGE