

Delivering on Sustainability Commitments: A Portfolio Approach

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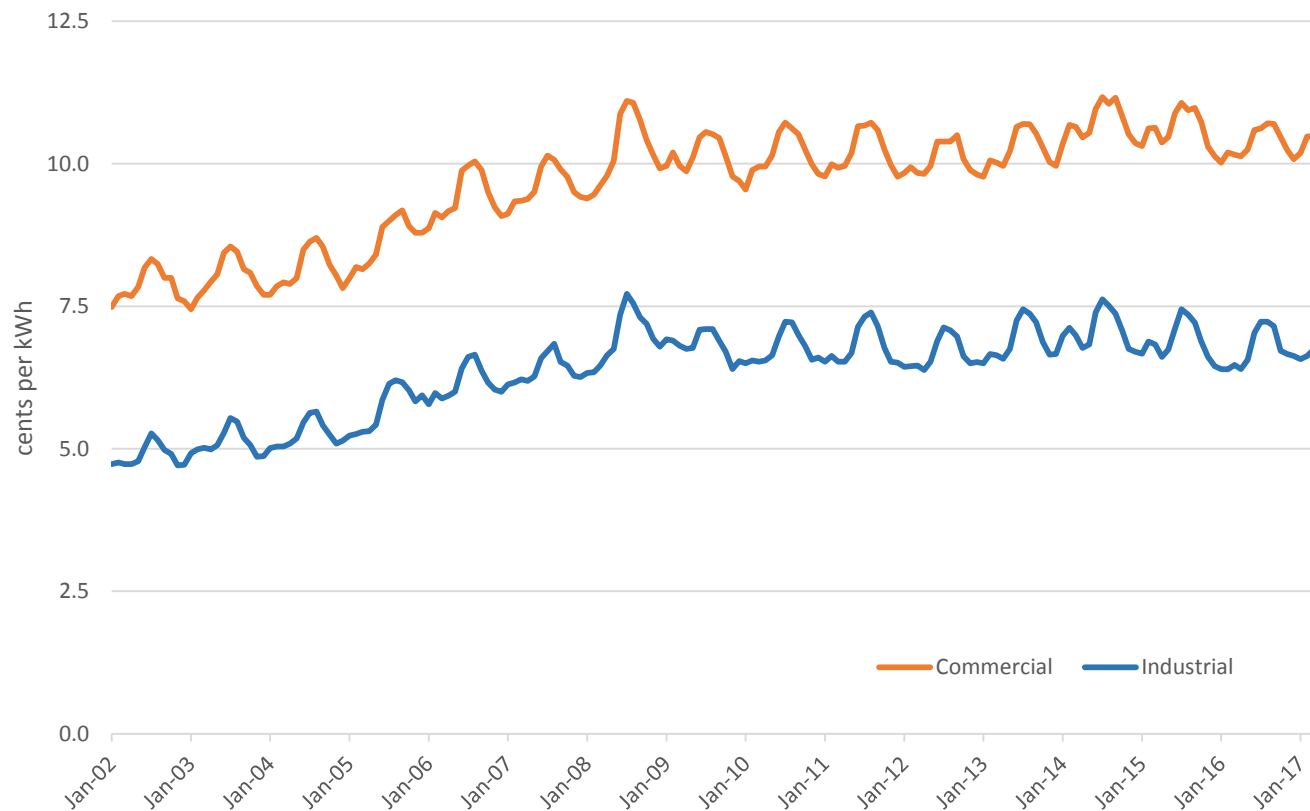


▼ *“University Leaders may commit to sustainability goals and leave it up to facility managers or operators to make it happen – while keeping operating costs as low as possible!”*



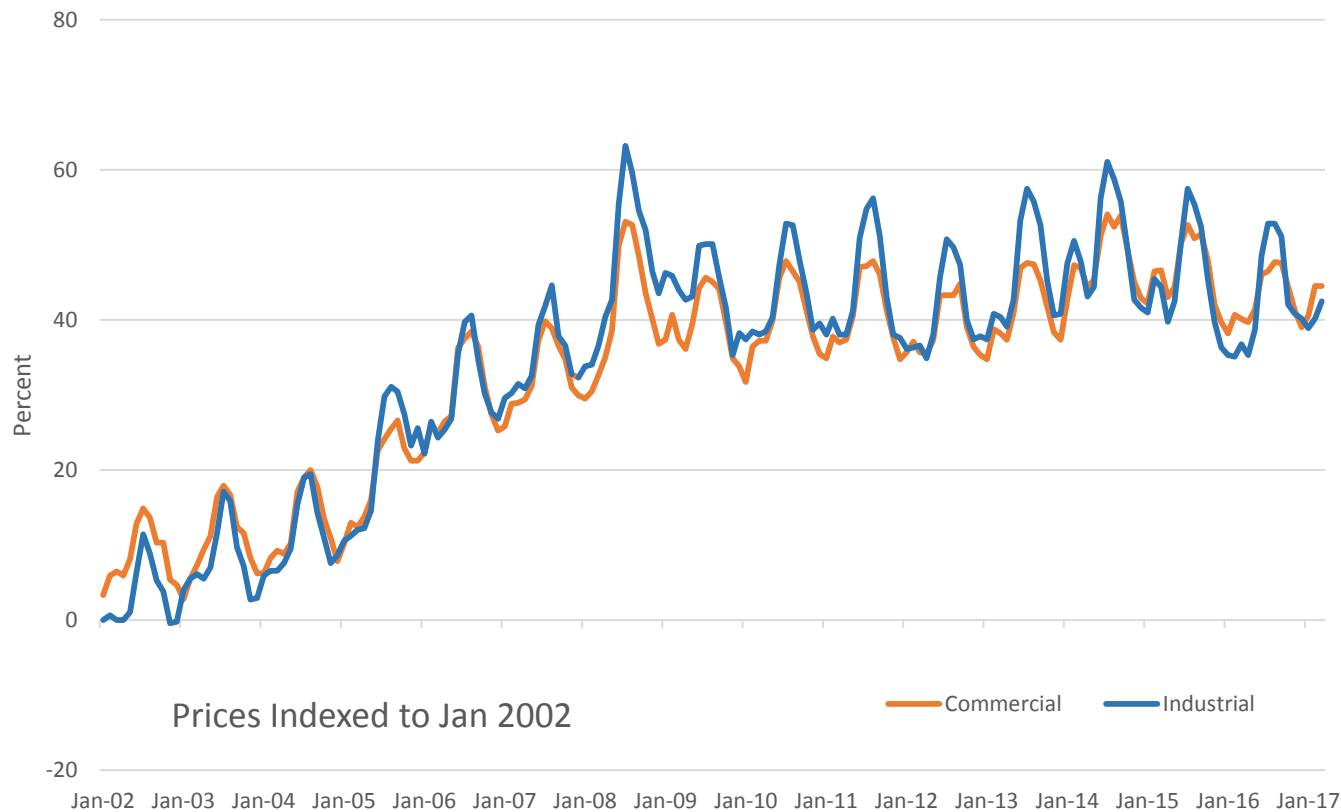
- ▼ **Power Generation Industry Trends and Transition**
- ▼ **Carbon and Energy Efficiency**
- ▼ **CHP and Managing Natural Gas Price Risk**
- ▼ **Sustainability and Renewable Energy Trends**

Average U.S. Retail Electricity Price



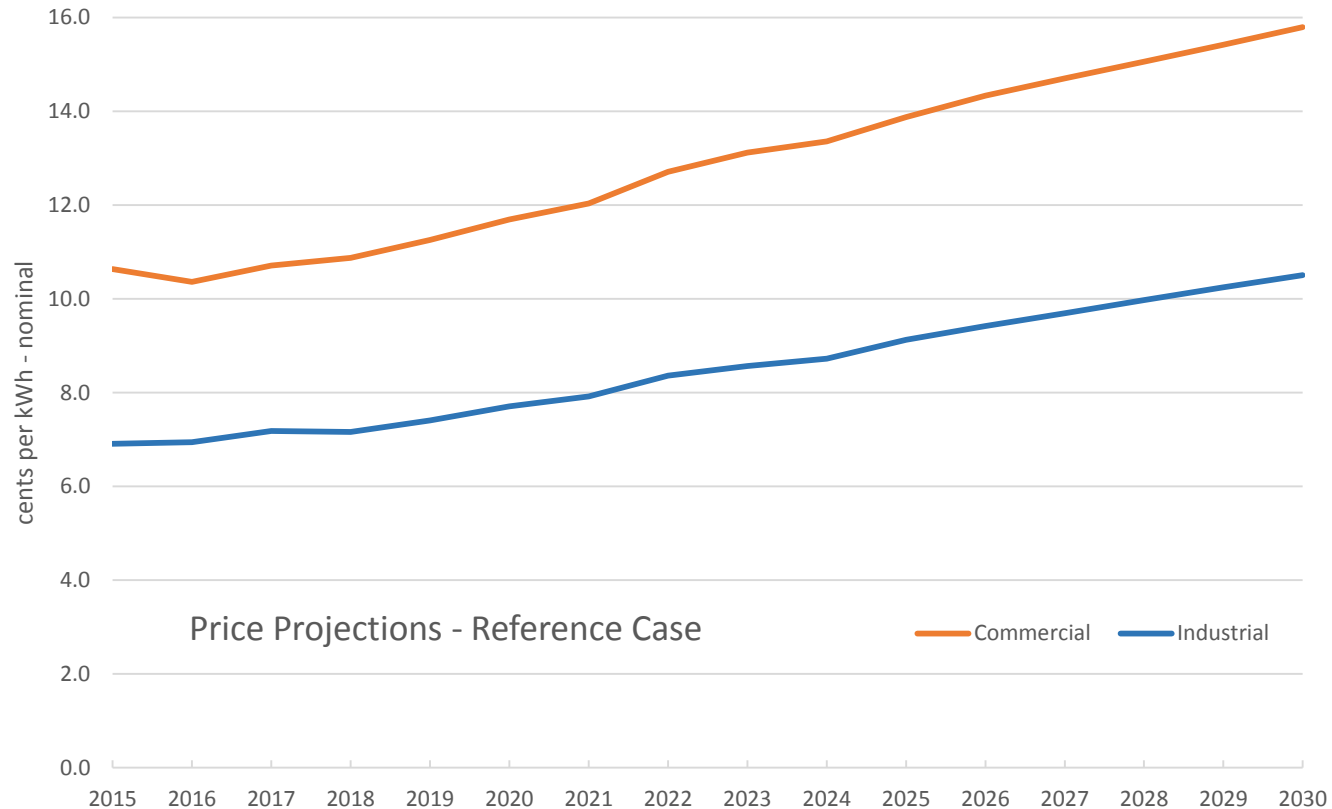
Source: US Energy Information Administration

Average U.S. Retail Electricity Price



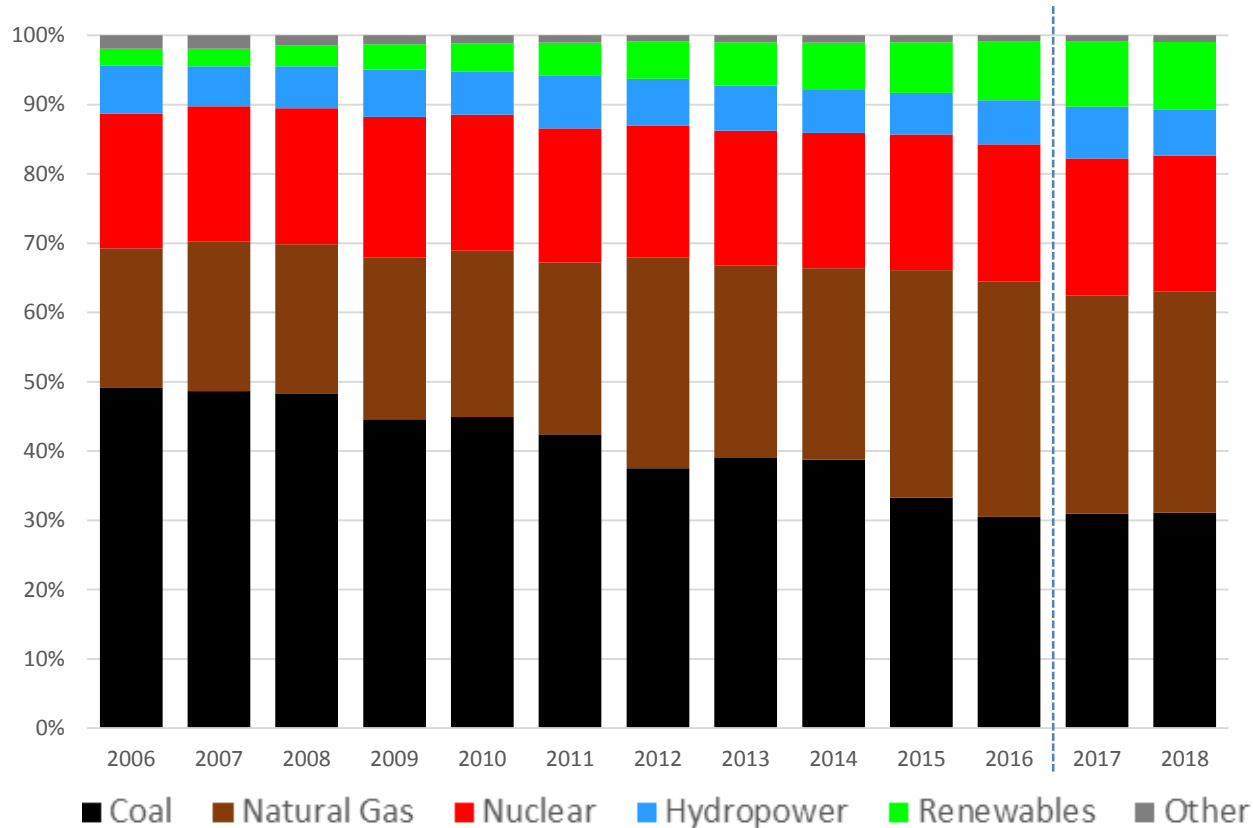
Source: US Energy Information Administration

EIA 2017 Annual Energy Outlook



Source: US Energy Information Administration

U.S. Electric Generation

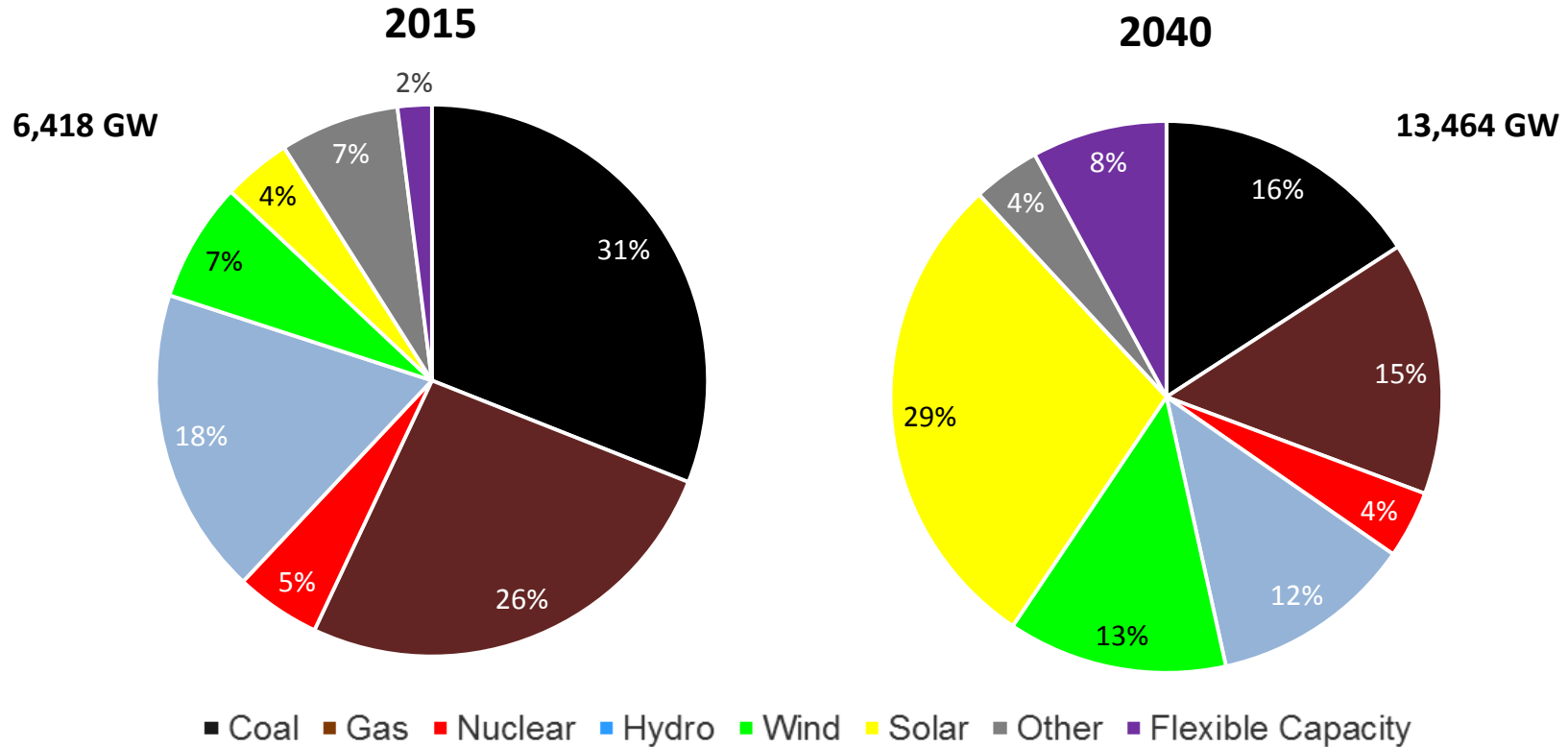


Source: US Energy Information Administration



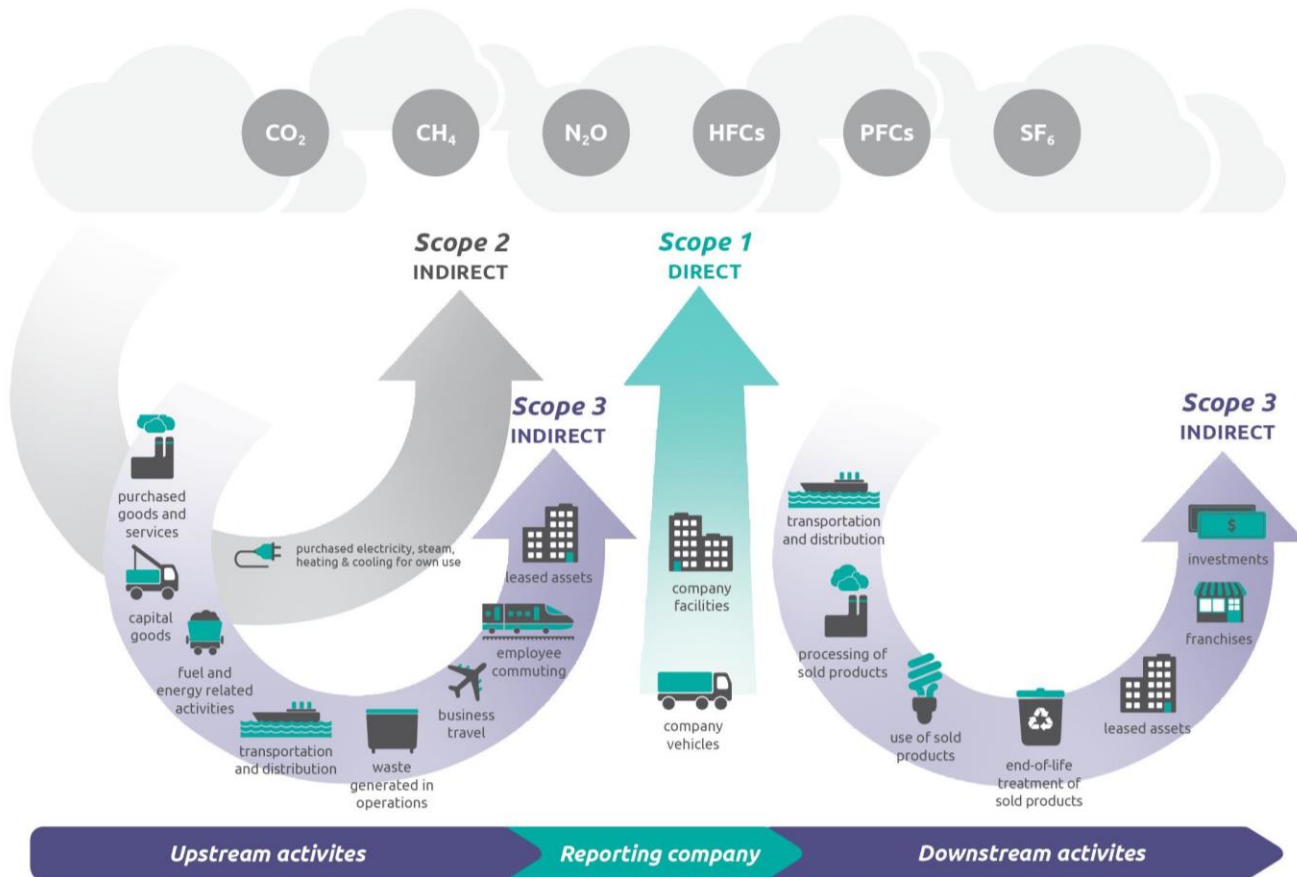
- Low gas prices have suppressed U.S. production levels
 - Running through the DUCs
- Natural gas exports are increasing
 - Increasing exports to Mexico (3-4 Bcf per day)
 - International LNG exports (2-3 Bcf per day)
- Gas storage on track to be lowest since 2014
 - 2016 injection rate yields low-end of 5-year average in storage
- Natural gas generation moving from seasonal to base-load

Global Installed Electric Capacity



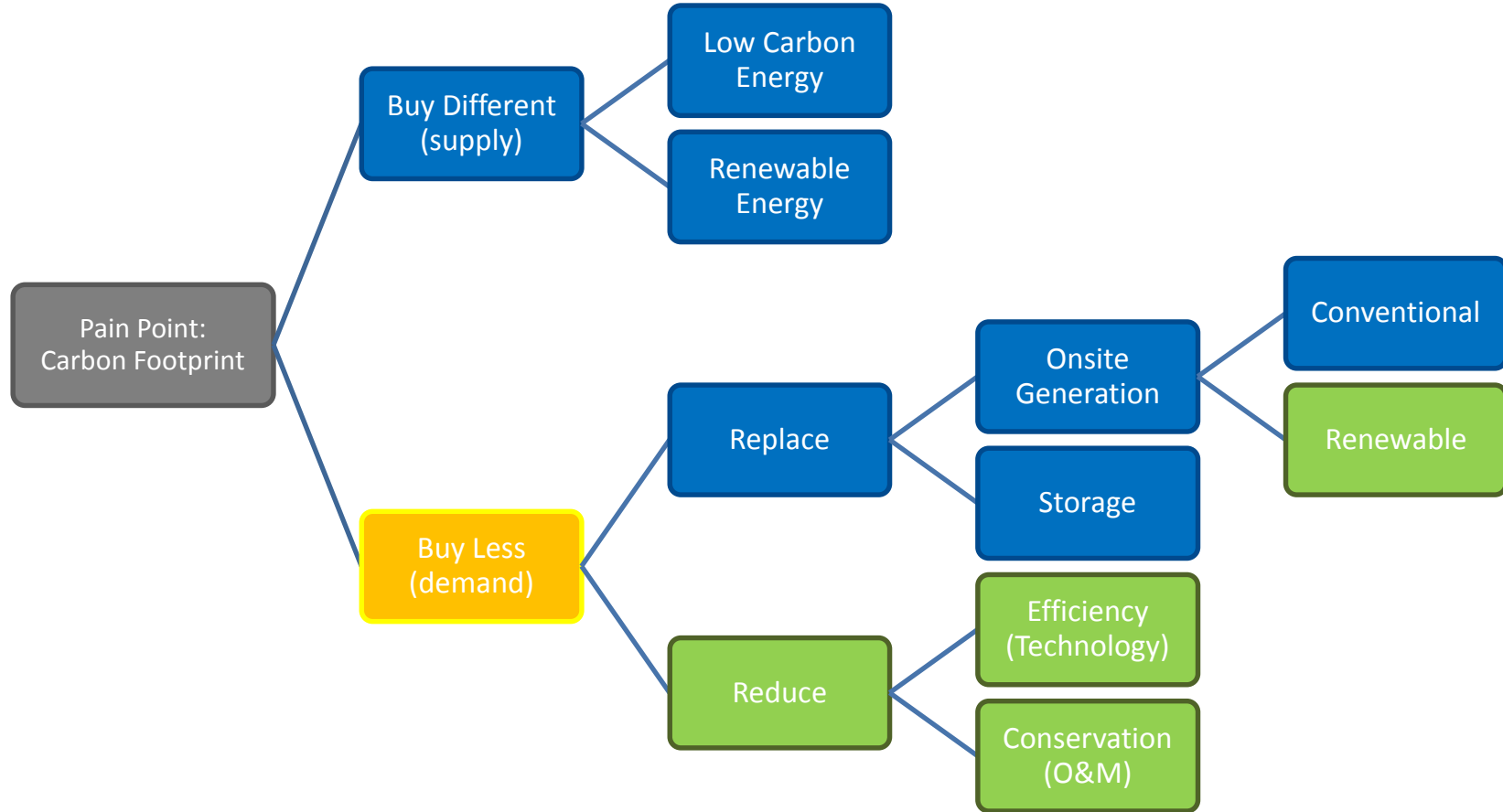
Source: Bloomberg New Energy Finance

Carbon/GHG Protocol Emission Scopes

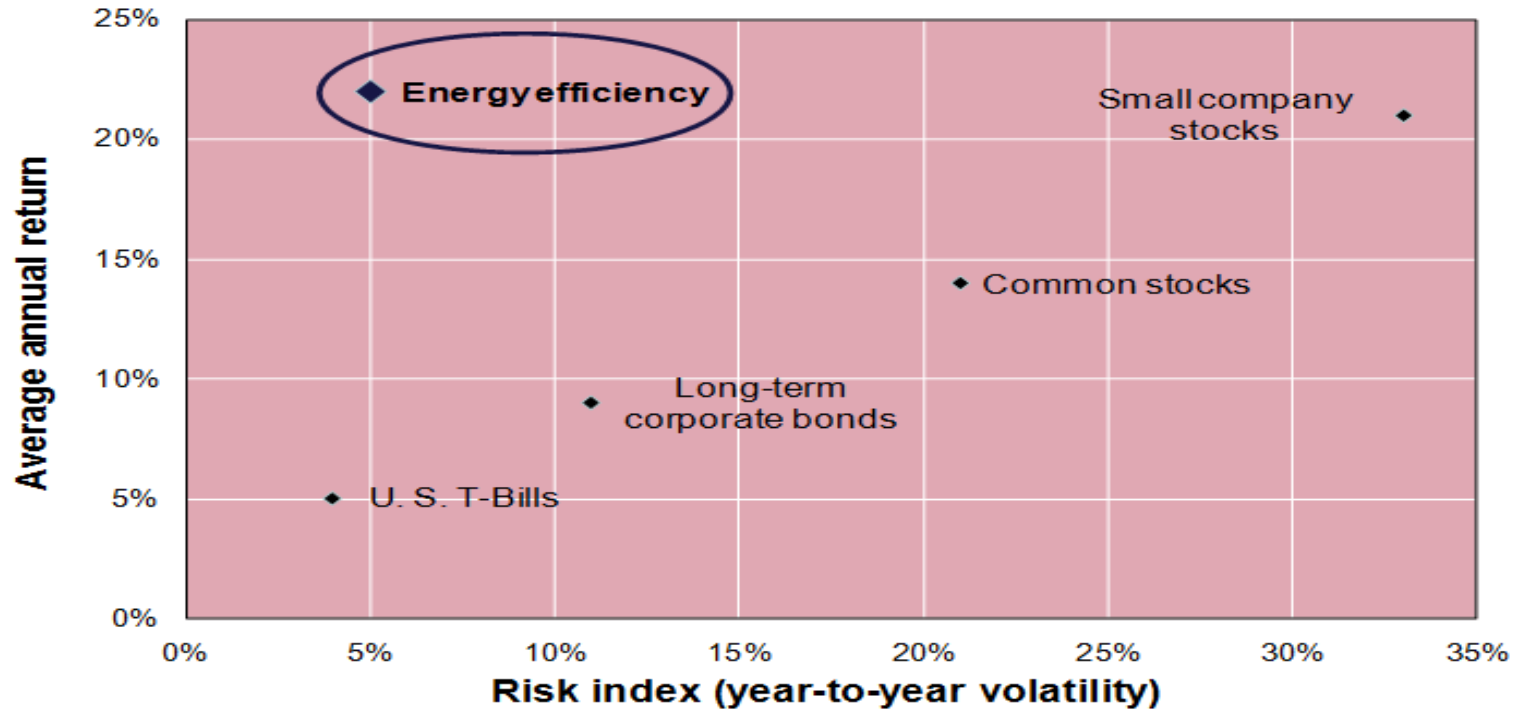


GREENHOUSE
GAS PROTOCOL

Carbon Reduction Strategies

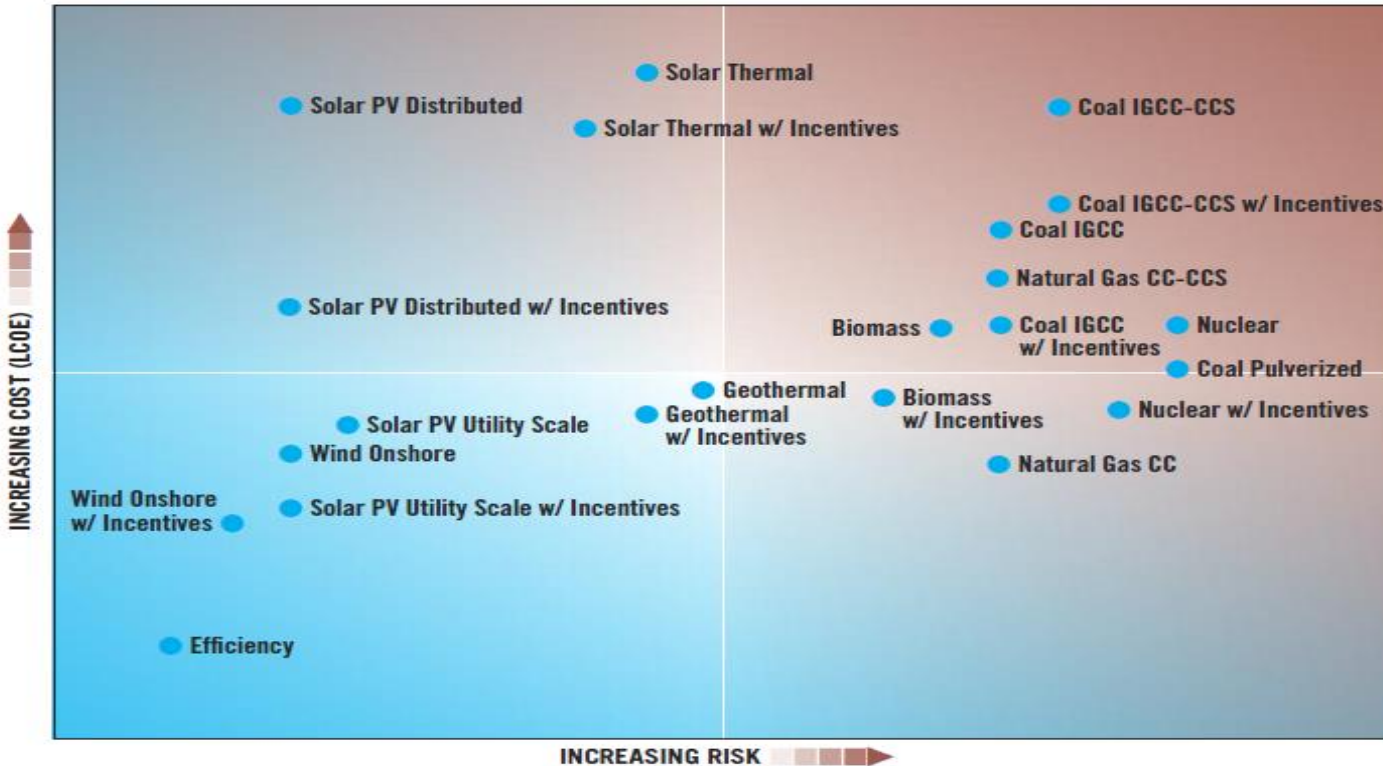


Energy Efficiency – Low Risk, High Reward



Source: ACEEE

Energy Efficiency vs. Electric Supply Options



Source: "Ceres Report: Practicing Risk-Aware Electricity Regulation, 2014 Update"



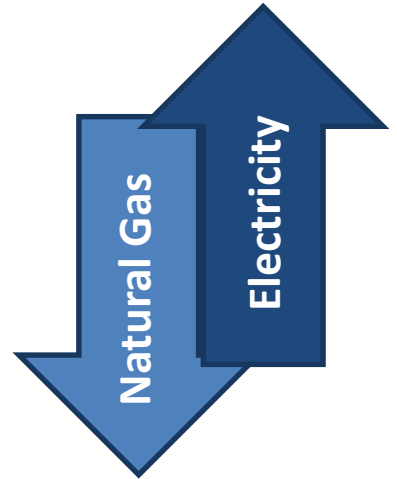
▼ CHP Benefits

- Reduce overall energy costs
- Reduce carbon emissions
- Improve overall efficiency
- Enhances electric reliability
- Opportunity to control long-term electricity costs with gas hedging

Drivers for a CHP Application



- ▼ High electricity costs ($> \$0.08$ /kWh)
- ▼ Low delivered natural gas prices ($< \$6$ /MMBTU)
- ▼ Thermal load year round, 24/7 operation
- ▼ Grid or power supply issues
- ▼ Environmental compliance issues
- ▼ Aging equipment or boiler issues
- ▼ Plant efficiency projects are diminishing
- ▼ Utility or government incentives for CHP



Onsite Generation: Combined Heat & Power

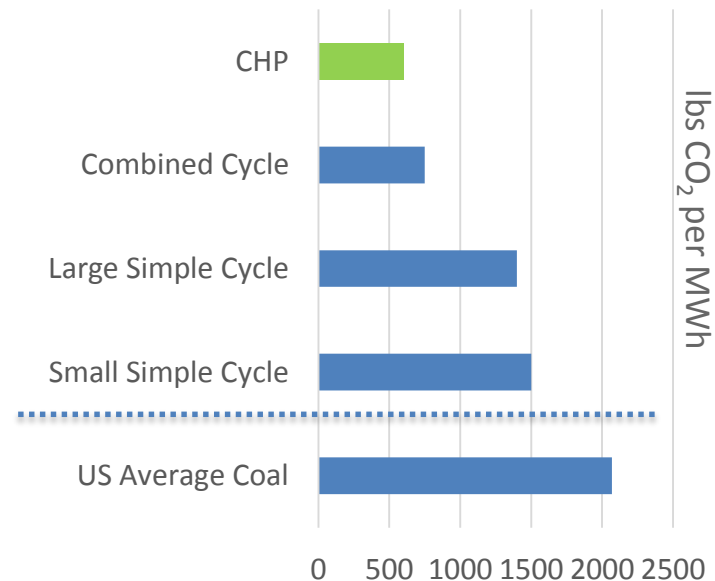


Natural Gas is the Least Carbon Intense Fossil Fuel

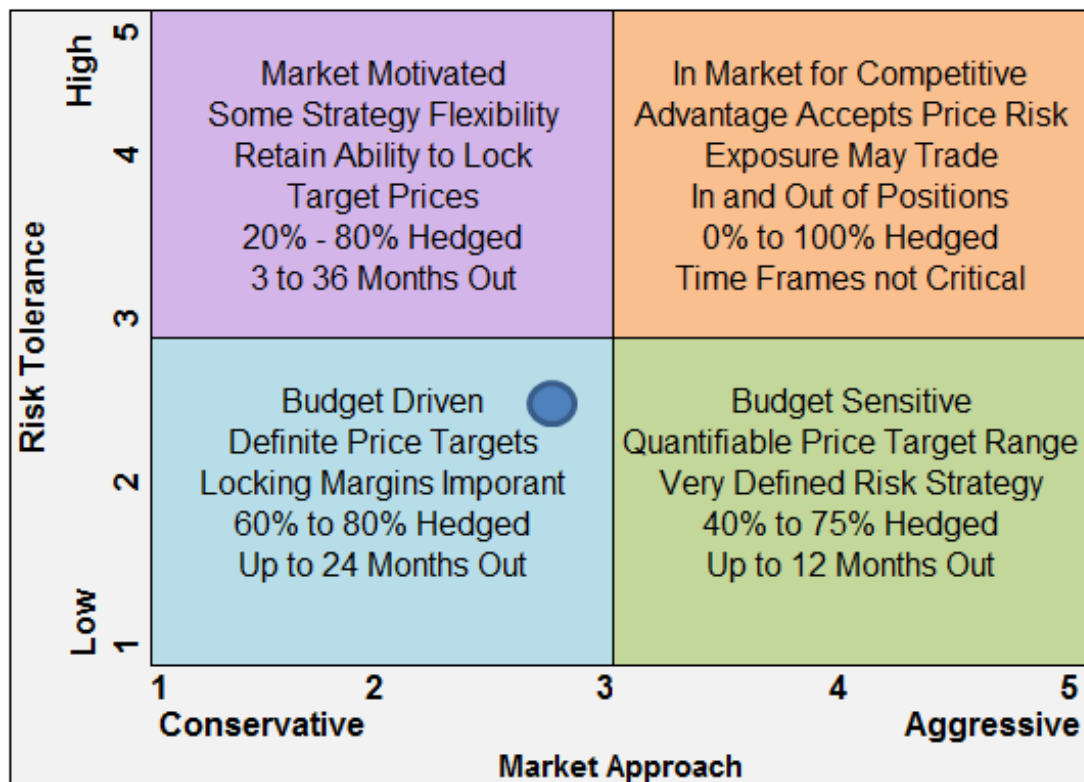
Fuel	lbs CO ₂ per MMBTU	lbs of CO ₂ per MWh
Coal		
Bituminous	206	2,070
Subbituminous	214	2,160
Lignite	215	2,170
Natural Gas	117	1,220
Distillate oil (No. 2)	161	1,640
Residual oil (No. 6)	174	1,760

CHP is the Most Efficient Use of Natural Gas

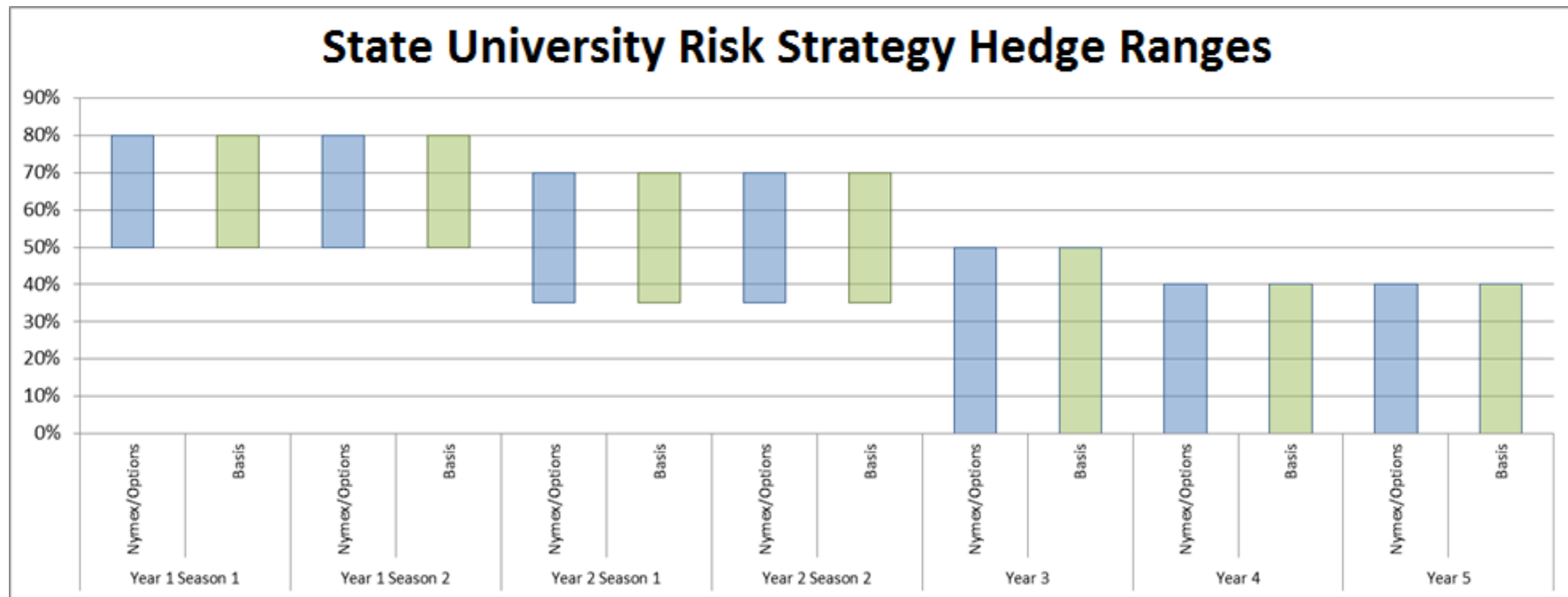
Natural Gas Turbines:



Energy Risk Management Survey Results



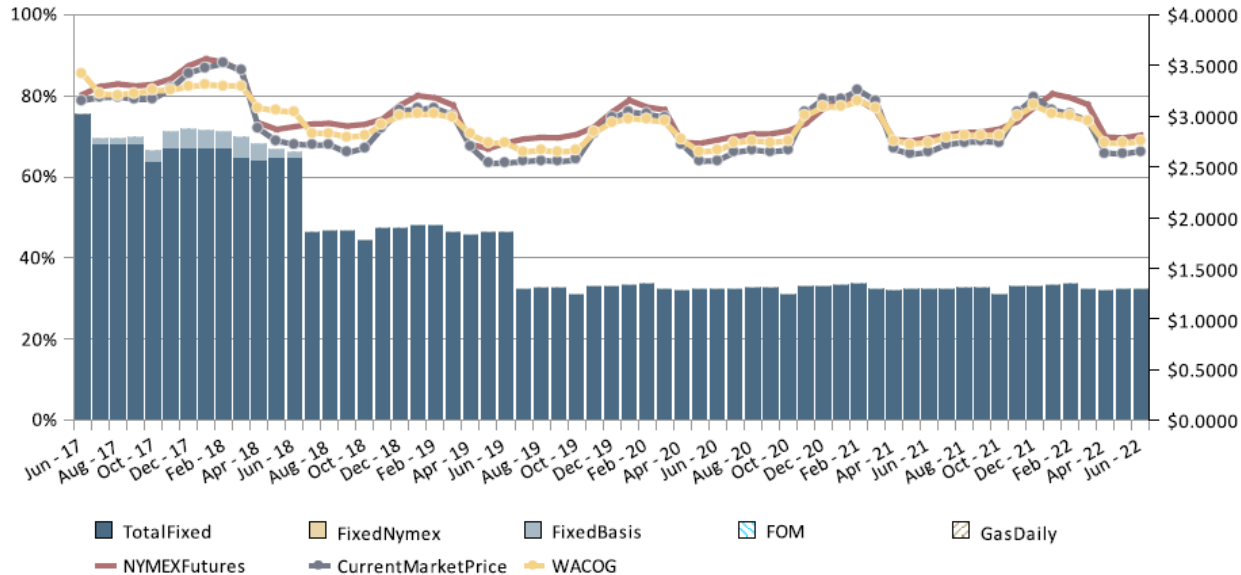
Strategy Hedge Ranges



Position Report



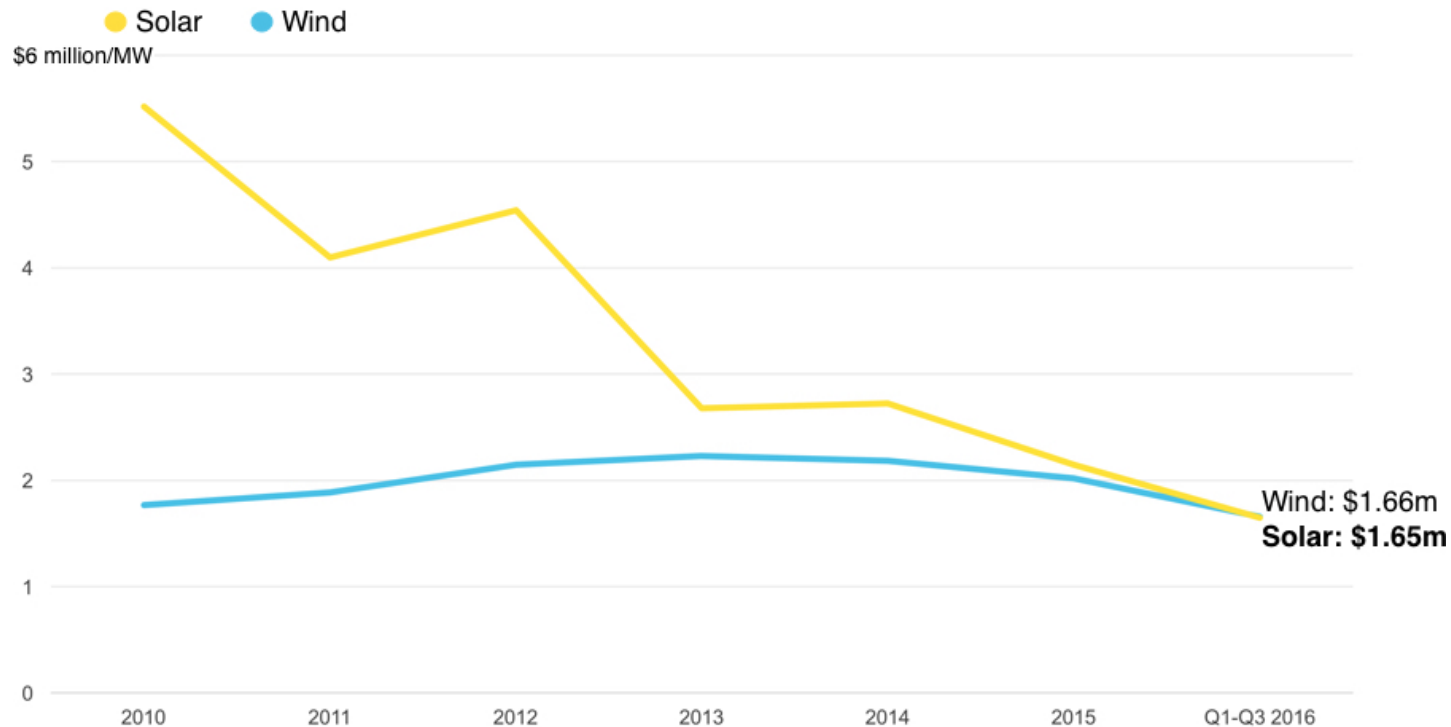
State University Position Report



- **40% of U.S. electric needs -- 1,118 gigawatts**



Solar Prices Fall Below Wind



▼ Increasing Solar Panel Efficiency

- Efficiency increased from 15% to 22% over the past five years
- Research solar cells achieve efficiencies of 46%

▼ Prices Projected to Continue to Fall

- The International Renewable Energy Agency estimates that LCOE will fall another 59% over the next decade

▼ Climate & Renewable Energy Goals

- National commitments to Paris Climate Agreement
- Corporate renewable energy goals (e.g. RE100)

2015-16 Solar PPA Prices

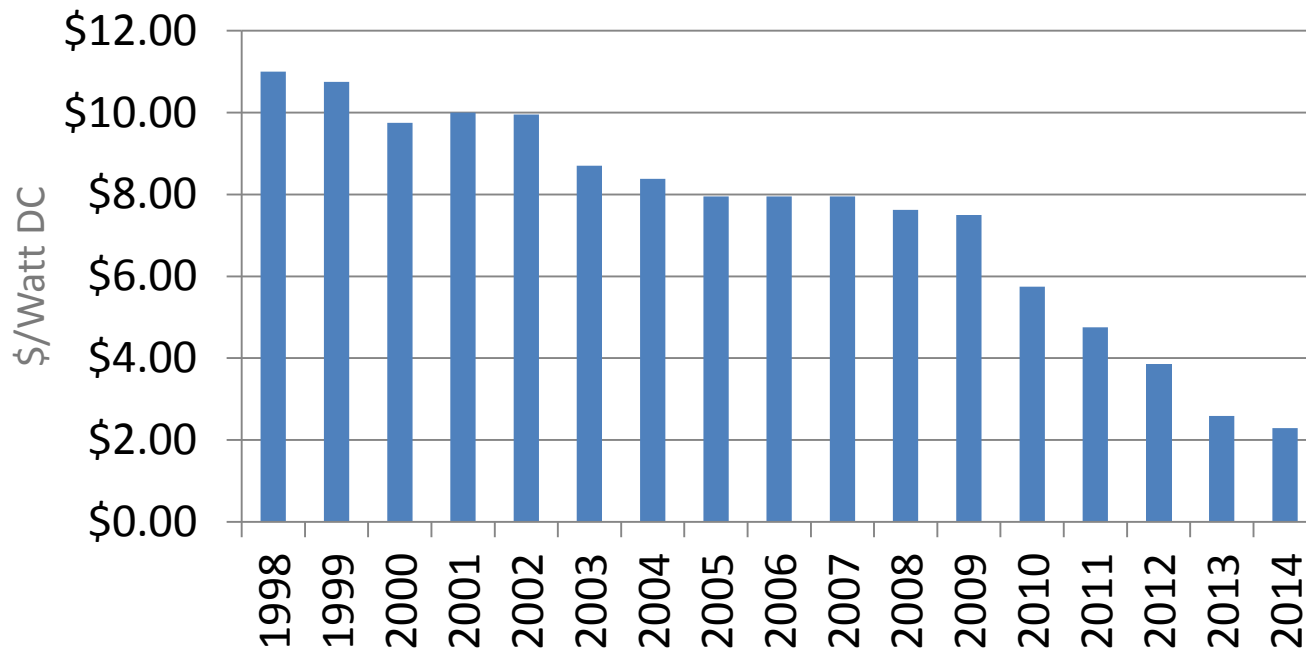


Project	PPA Term	Size	Price	Year
NV Energy	20	100 MW	3.87¢/kWh	2015
Dubai	25	800 MW	2.99¢/kWh	2016
Chile	20-25	120 MW	2.91¢/kWh	2016
Abu Dhabi	20-25	350 MW	2.42¢/kWh	2016

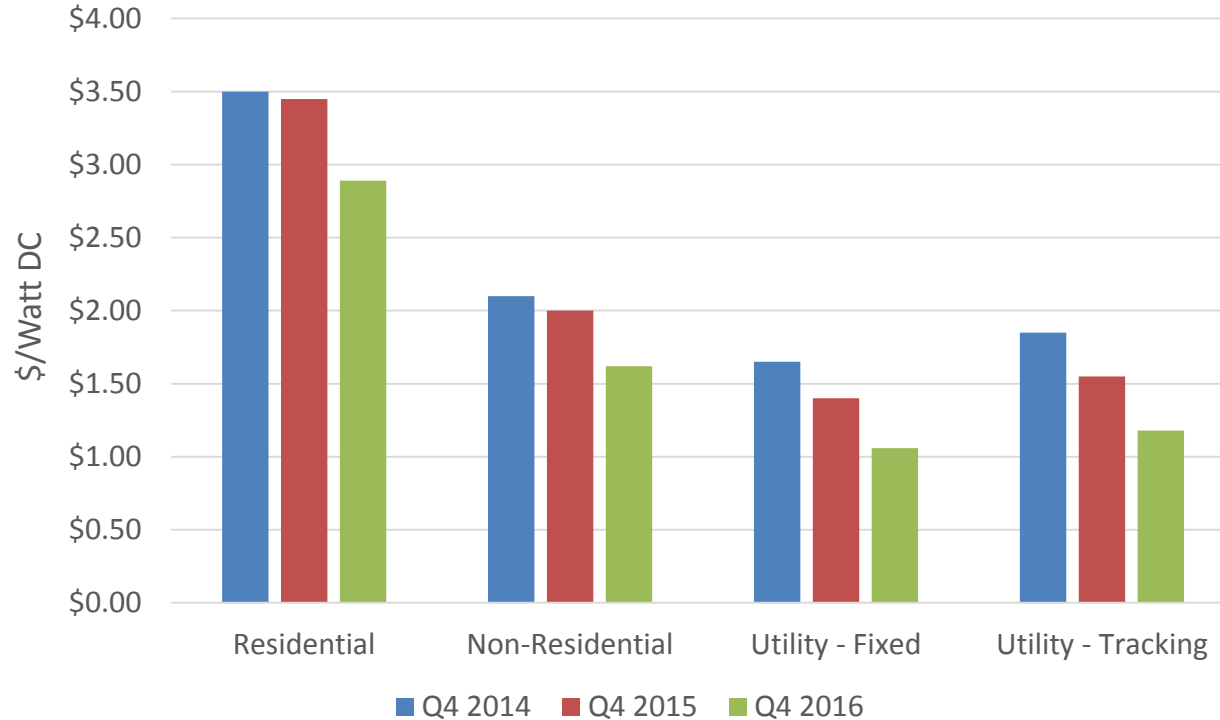
Falling U.S. Solar PV Prices



Average Installed Price of PV



Turnkey Installed Cost



U.S. Solar PV Incentives



Federal Investment Tax Credit

	2016	2017	2018	2019	2020	2021	2022
Level	30%	30%	30%	30%	26%	22%	10%

Modified Accelerated Cost-Recovery System (MACRS) + Bonus

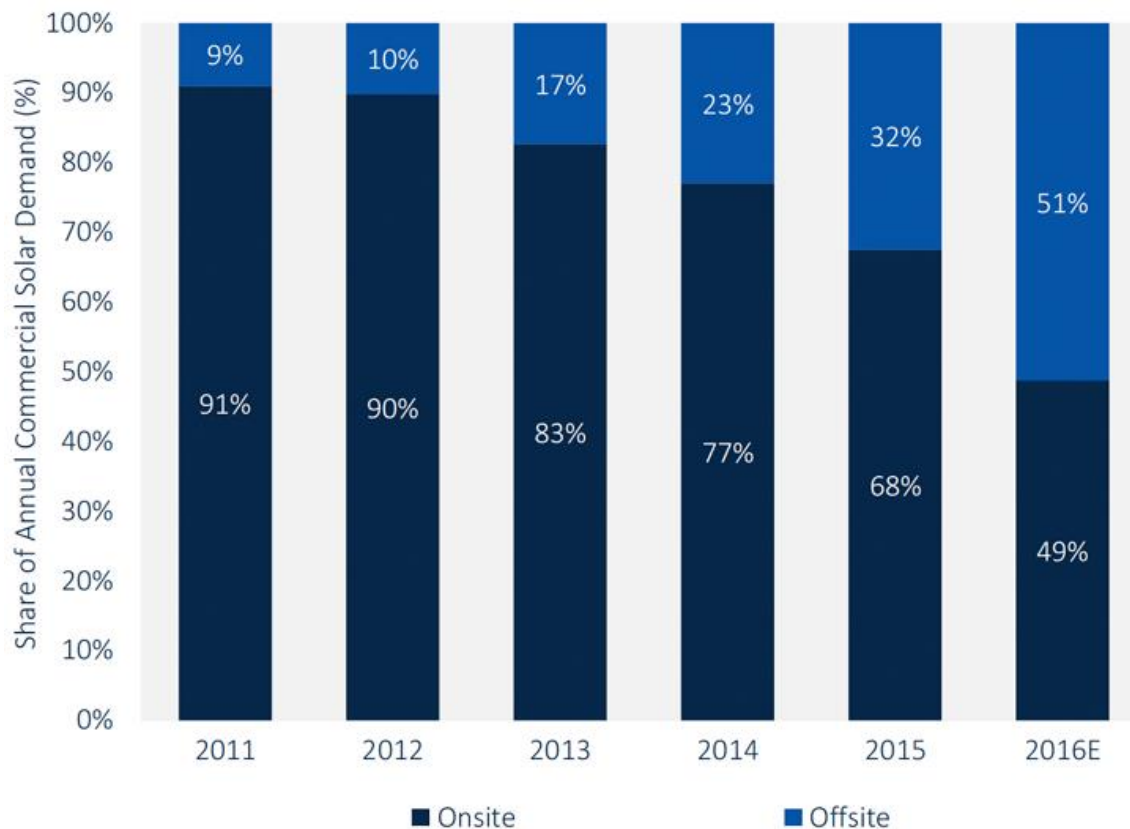
	2016	2017	2018	2019
Bonus	50%	50%	40%	30%

Solar PV is a 5-year asset

State Incentives

- Sales tax exemption
- Property tax exemption
- Net metering

Virtual PPA (VPPA) Growth



Virtual Power Purchase Agreement





▼ Term

- Contracts run 20 – 25 years
- Newer products 10 – 15 years, some price premium

▼ Additionality

- Requires investing in projects under development

▼ Location

- WRI Scope 2 guidance says project should be on same grid

▼ Basis Risk

- Differential movement in power prices at utility and settlement point

▼ Negative Covariance

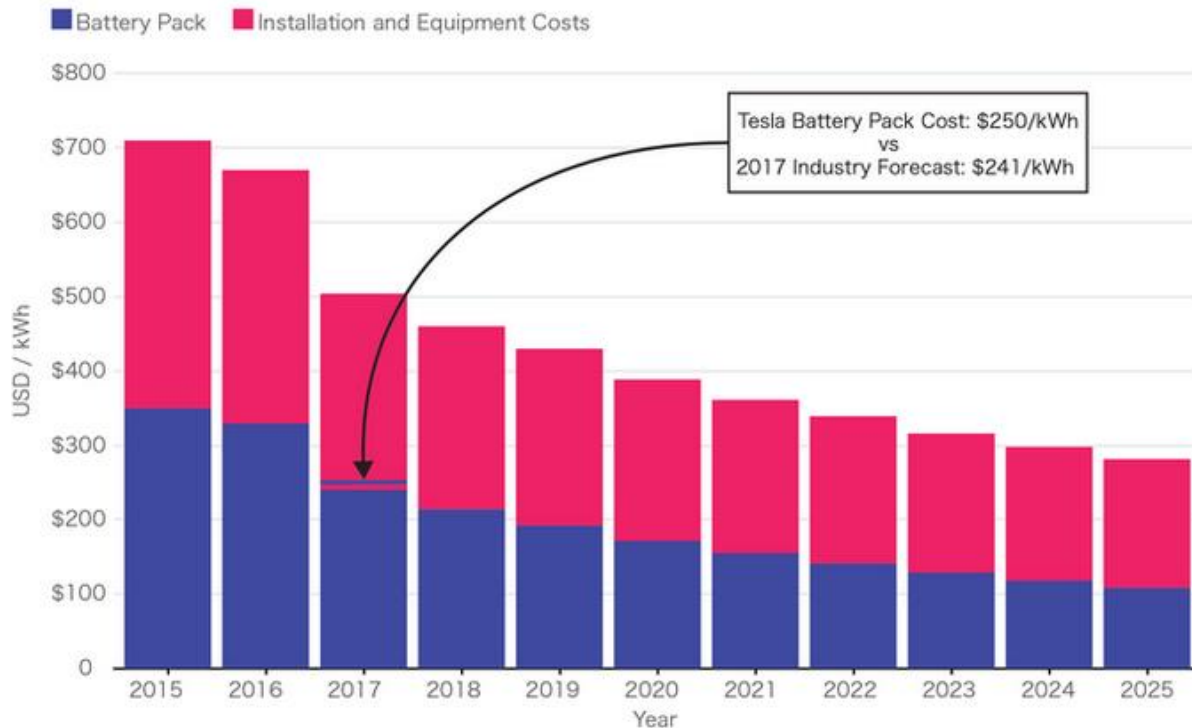
- growth in renewable energy may lead to falling power prices

Battery Storage



Tumbling Price of Battery Storage

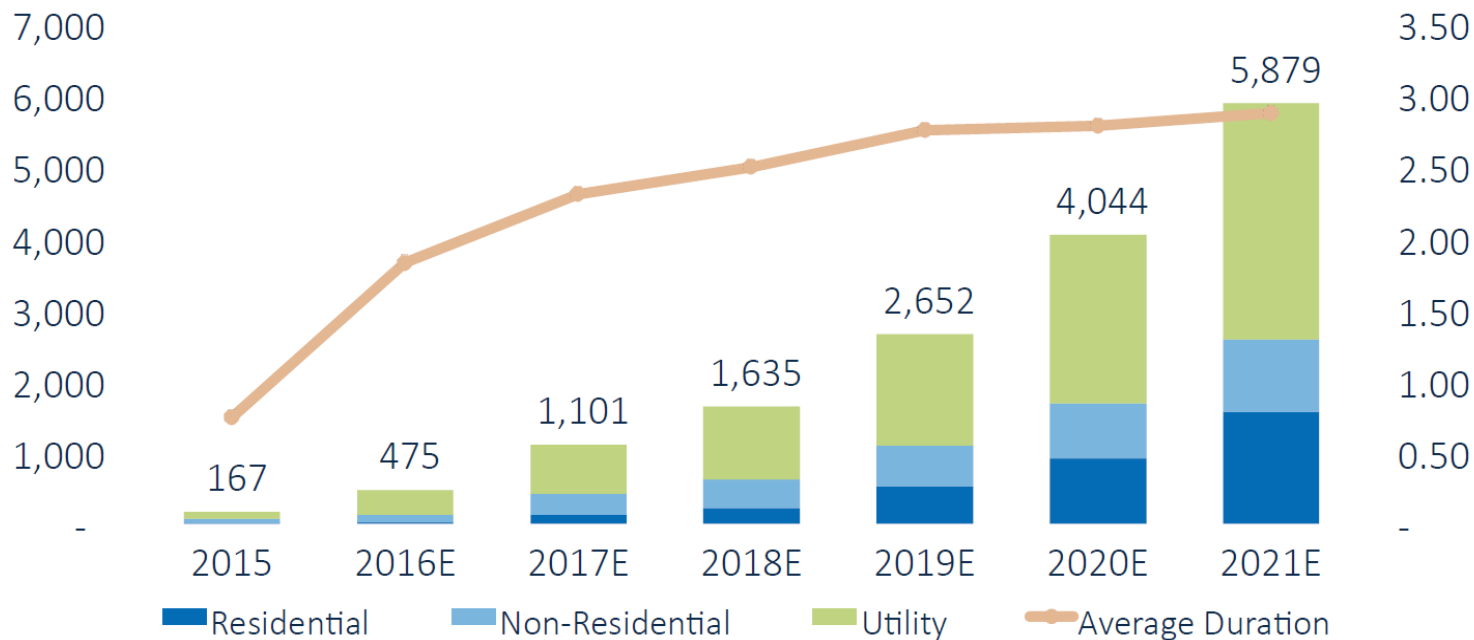
Tesla's Packs Are Cheap—But Not Exceptionally So



Where are we headed?



Energy storage deployments (MWh) in US, and average duration (hrs)



Questions? Thank you!



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