Fall 2018 BCT Lecture Series

UMASS Amherst Procurement Strategies

Competitive Energy Services

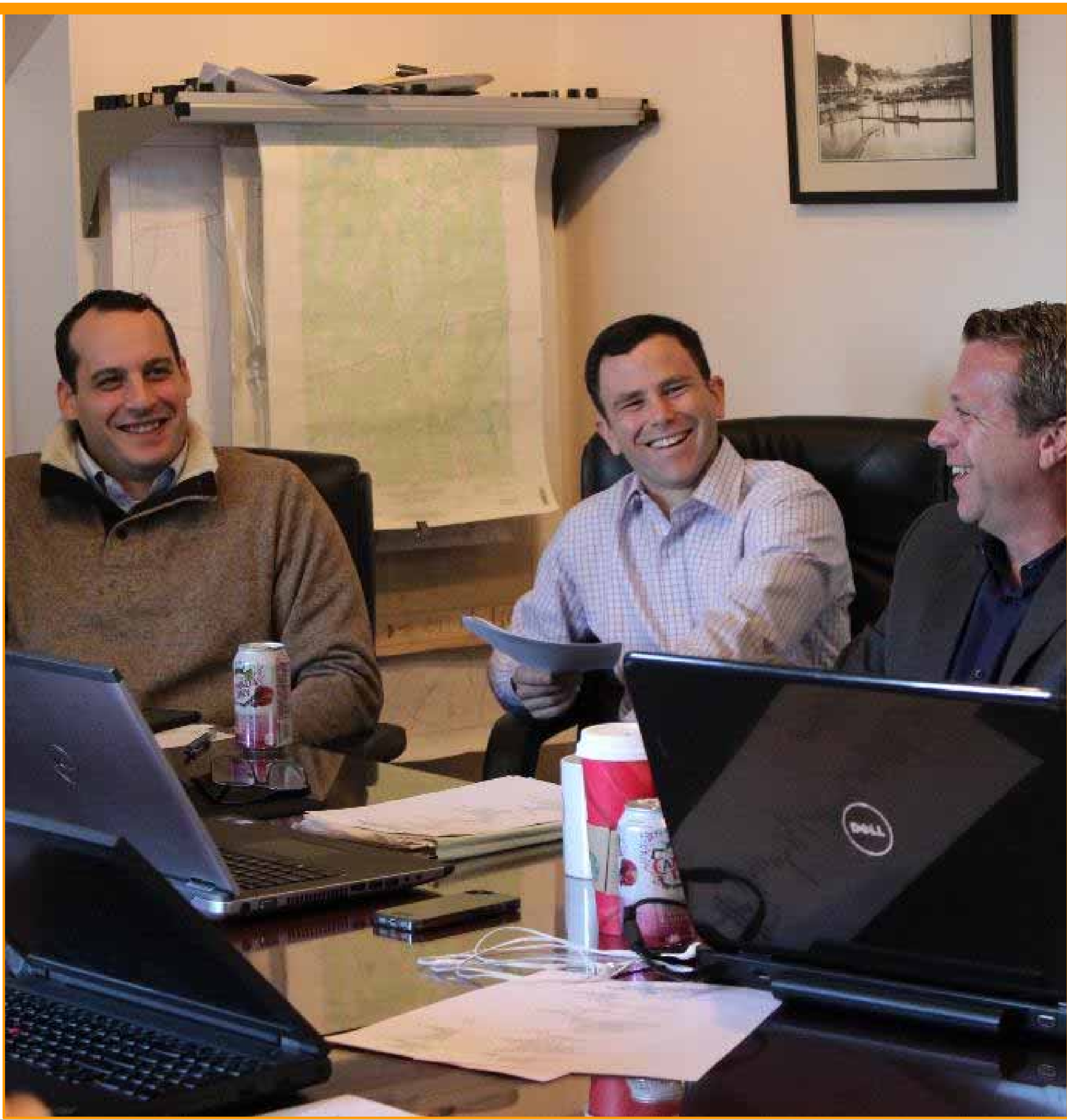
October 29, 2018

Agenda

- Energy Markets
  - Retail Energy Cost Components
- UMass System Metrics
- Behind the Meter DG
- Offsite Renewable Energy Strategies

CES A TEAM OF EXPERTS

- Independent Energy Services Firm
- Based in Portland, ME and Topsfield, MA
- Over 800 clients
- $2 billion in energy spend
- Clients across the US and Canada
- 100% supplier neutral/ product neutral
  - Over 50 suppliers throughout North America
- Transparent fees
- Customized energy solutions
  - Procurement, Full Services, and Consulting



CES SUITE OF SERVICES

Competitive Energy SERVICES

PROCUREMENT

- Market Monitoring
- RFP Management
- Bid & Financial Analysis
- Product Choice Analysis
- Contract Negotiation

FULL SERVICE

- Energy Budget Management
- Alternative Fuel Analysis
- Tariff Evaluation
- Tariff Negotiation
- Utility Bill Analysis & Audit
- Utility Data Management
- Demand Response Analysis
- Grant Assistance

CONSULTING

- Greenhouse Gas Services
- Energy Master Planning
- Renewable Energy
  - Wind
  - Solar thermal & PV
  - Hydro & Biomass
- Cogeneration
- Fuel Conversion
- LNG/CNG systems

CES THE RESULT OF BEST PRACTICES

HIGHER EDUCATION

Amherst College
Bates College
Bowdoin College
Brandeis University
Colby College
Colgate University
Dartmouth College
Dean College
Hampshire College
Maine Community College System
Maine Maritime Academy
Northern Essex Community College
Ohio University
Springfield Technical Community College
University of Connecticut
University of Maine System (all campuses)
University of Massachusetts System (all campuses)
University of Rhode Island
University of Vermont
Wellesley College
Wheaton College
Williams College

STATE & MUNICIPAL

City of Boston
City of Lebanon, NH
City of Manchester, NH
City of Montpelier, VT
City of Portland, ME
City of Providence, RI
City of Sommerville, MA
City of South Portland, ME
Province of New Brunswick
Town of Dracut, MA
Town of Glastonbury, CT
Town of Millbury, MA
Certified vendor with the MA DOER

TECHNOLOGY & RESEARCH

Adobe Systems
Axcelis Technologies
DeLorme/Garmin
Incom
The Jackson Laboratory
Netscout Systems
Photonis
Woods Hole Oceanographic Institution

COMMERCIAL

Big Y Foods
Boston North Technology Park
Coca-Cola Bottling Company of Northern NE
Dole & Bailey
Ethan Allen
Hannaford Bros./Delhaize (all locations)
L.L. Bean (all locations)
New Balance Athletic Shoe
Olympia Sports
Southbridge Savings Bank
Sullivan Tire Company
Sure Winner Foods
Unum
Woodard & Curran
YMCAs of Maine

HEALTHCARE

Covenant Health Systems
Eastern Maine Healthcare System
Harrington Memorial Hospital
Heywood Hospital
MaineHealth (all facilities)
Overlook Health Center

ISO-NE IS CHANGING

Competitive Energy SERVICES

COST ANATOMY | 2 Components

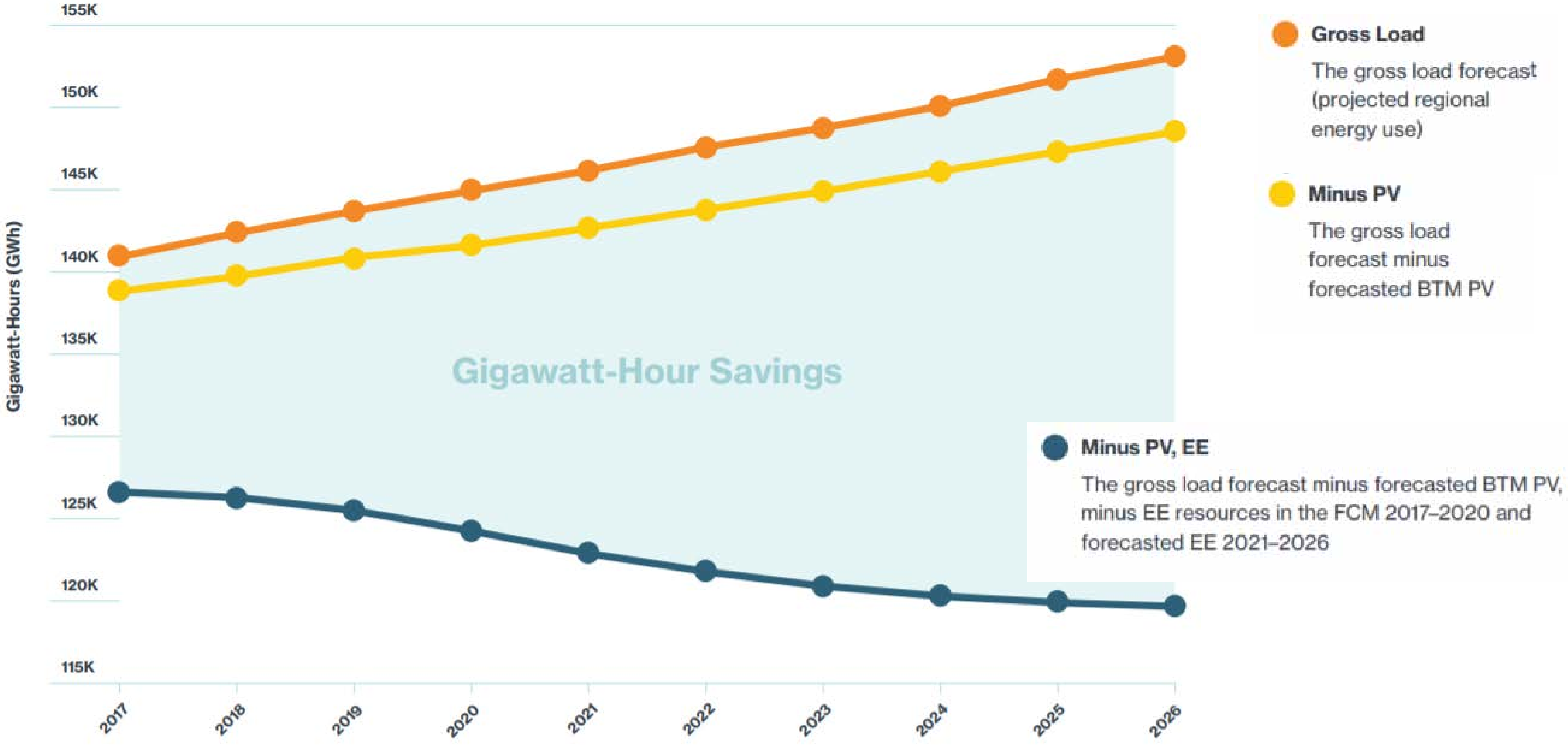
SUPPLY

The SUPPLY is the source of the energy. SUPPLY is the commodity, what is bought, sold and traded. The supplier generates the power and transmits it to the power grid. This also includes ISO-NE costs for the forward capacity market along with the ancillary services.

TRANSMISSION & DELIVERY

The Utility, or Local Distribution Company (LDC), takes the power off the grid and transports it to the consumer. These TRANSMISSION & DELIVERY (T&D) charges make up the other half of your bill.

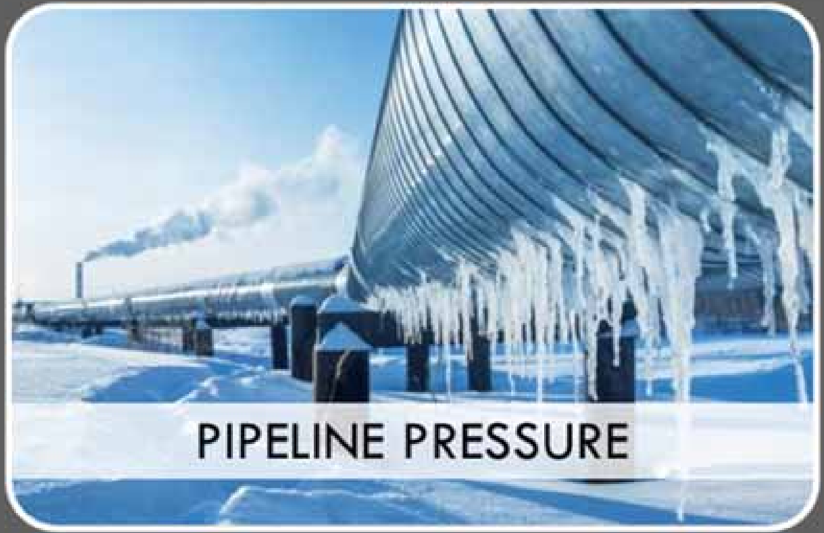
ISONE | Projected Annual Energy Use w & w/out EE & PV

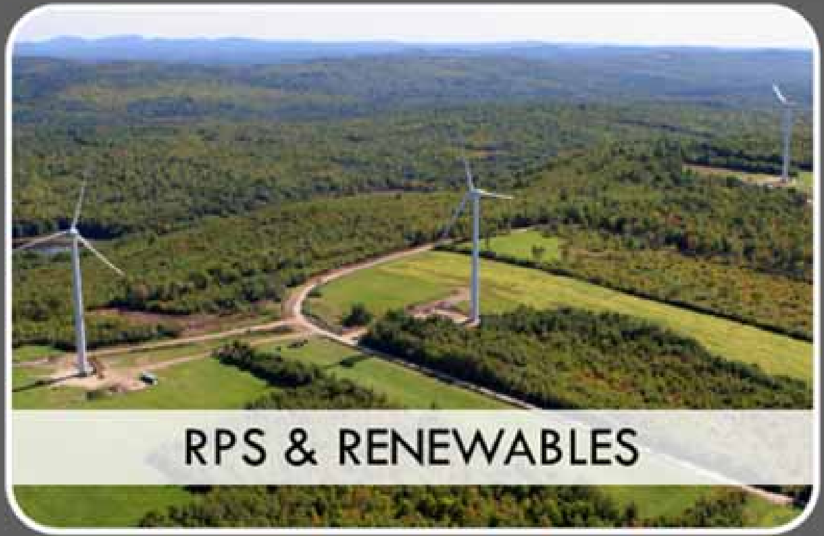


With energy, the future is always uncertain…

To know what to do, we first need to understand the **4 key factors** impacting costs.

Key Energy Cost Components in ISO-NE





FACTOR #1

POWER PLANT RETIREMENT AND **CAPACITY COSTS**

Competitive Energy SERVICES

You pay capacity charges on your electric bill to **fund power plant upgrades and new plant construction**, so that there is always enough energy to meet local demand.

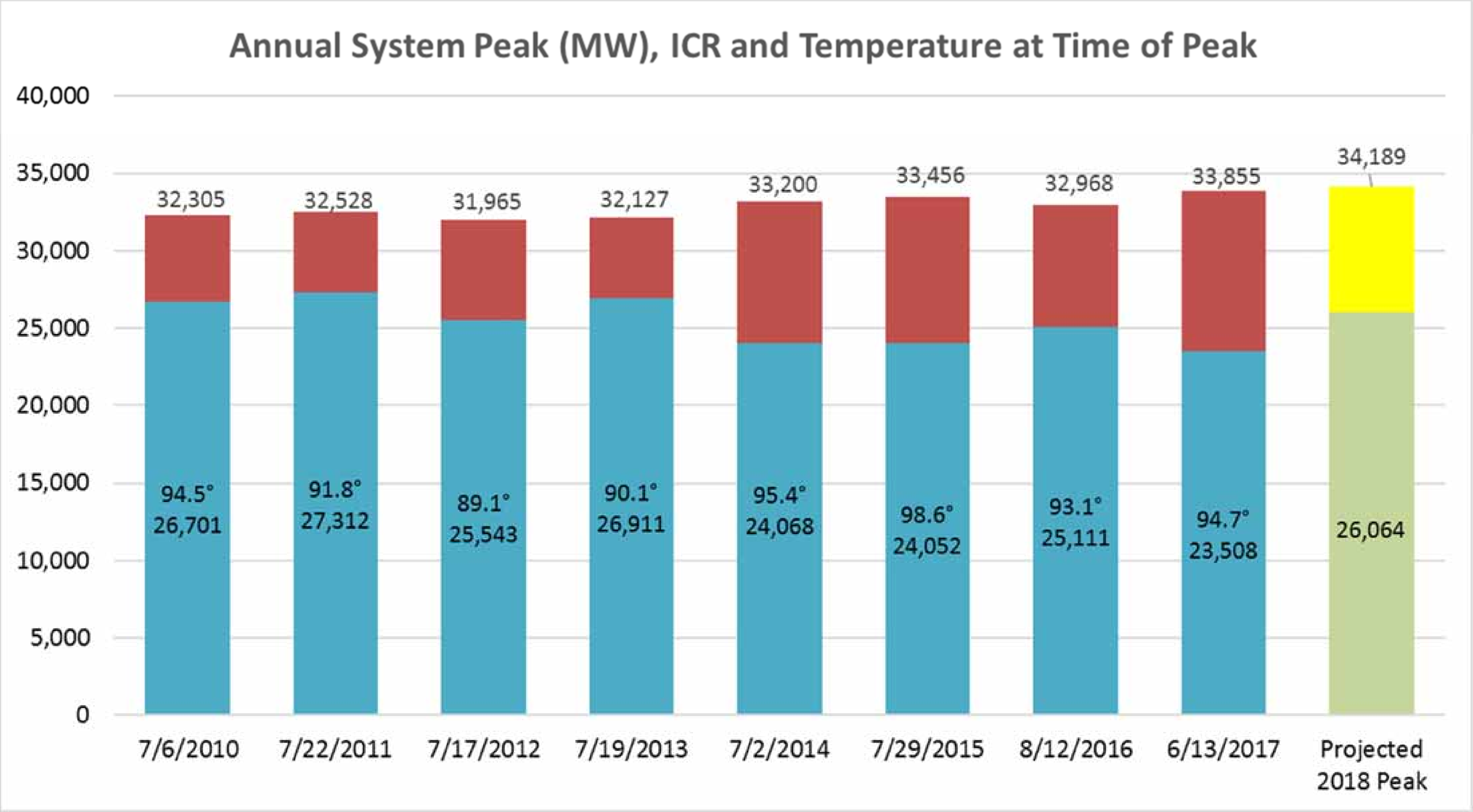
THE PROBLEM IS…

New England power plants are OLD

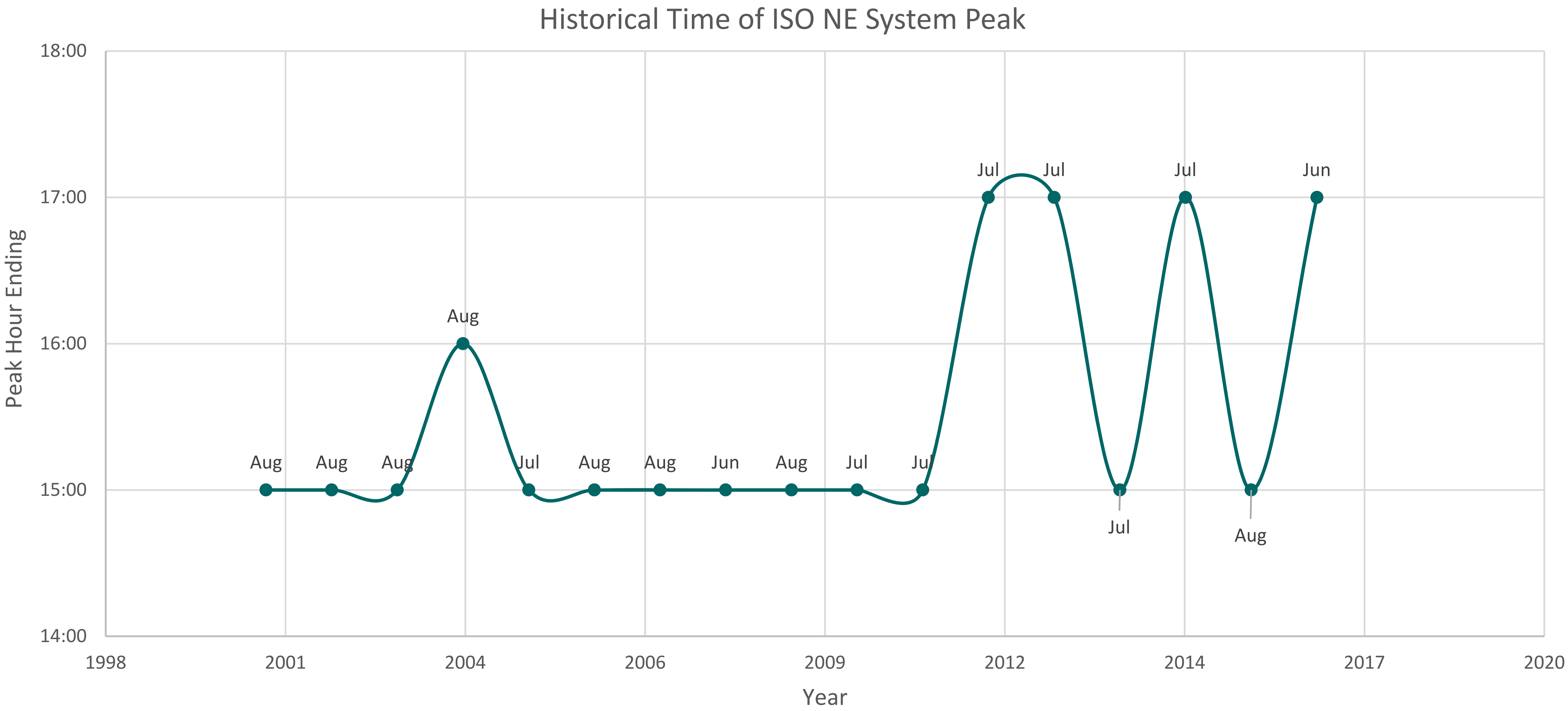
4200 MWs of generating power have retired or plan to retire in the next few years. Another **4,100 MW** are at risk for retirement.

1,600 MW of new generation has come online in the last few years, and **6,700 MW** of new resources have qualified for the next auction.

ELECTRICITY | Capacity Peak Day



CAPACITY | Historical Time of System Peak

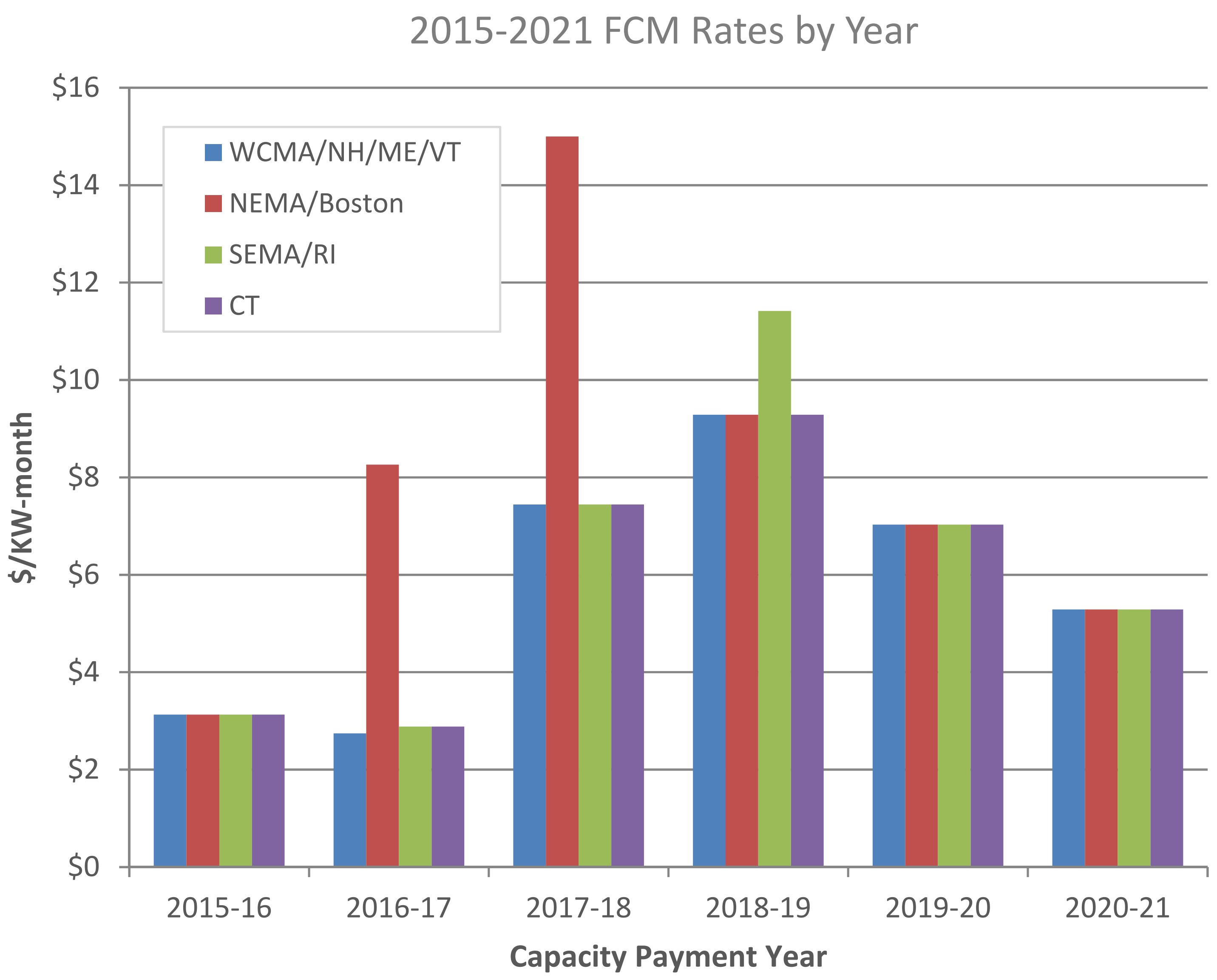


ELECTRICITY | Demand Management Process

- Capacity charges make up 30-70% of your energy bill
- ISO-New England holds FCM auctions to set payment rates
- End-users are charged the following on a monthly basis:

CAPACITY CHARGE =
PAYMENT SETTLEMENT RATE X
RESERVE MARGIN X CAPACITY TAG

- FCM costs doubled in the 2017 – 18 power year
- End users can reduce the impact of the rising payment rate through demand management during the annual peak hour event



FACTOR #2

PIPELINES

& THE IMPACT OF WINTER WEATHER

Competitive Energy SERVICES

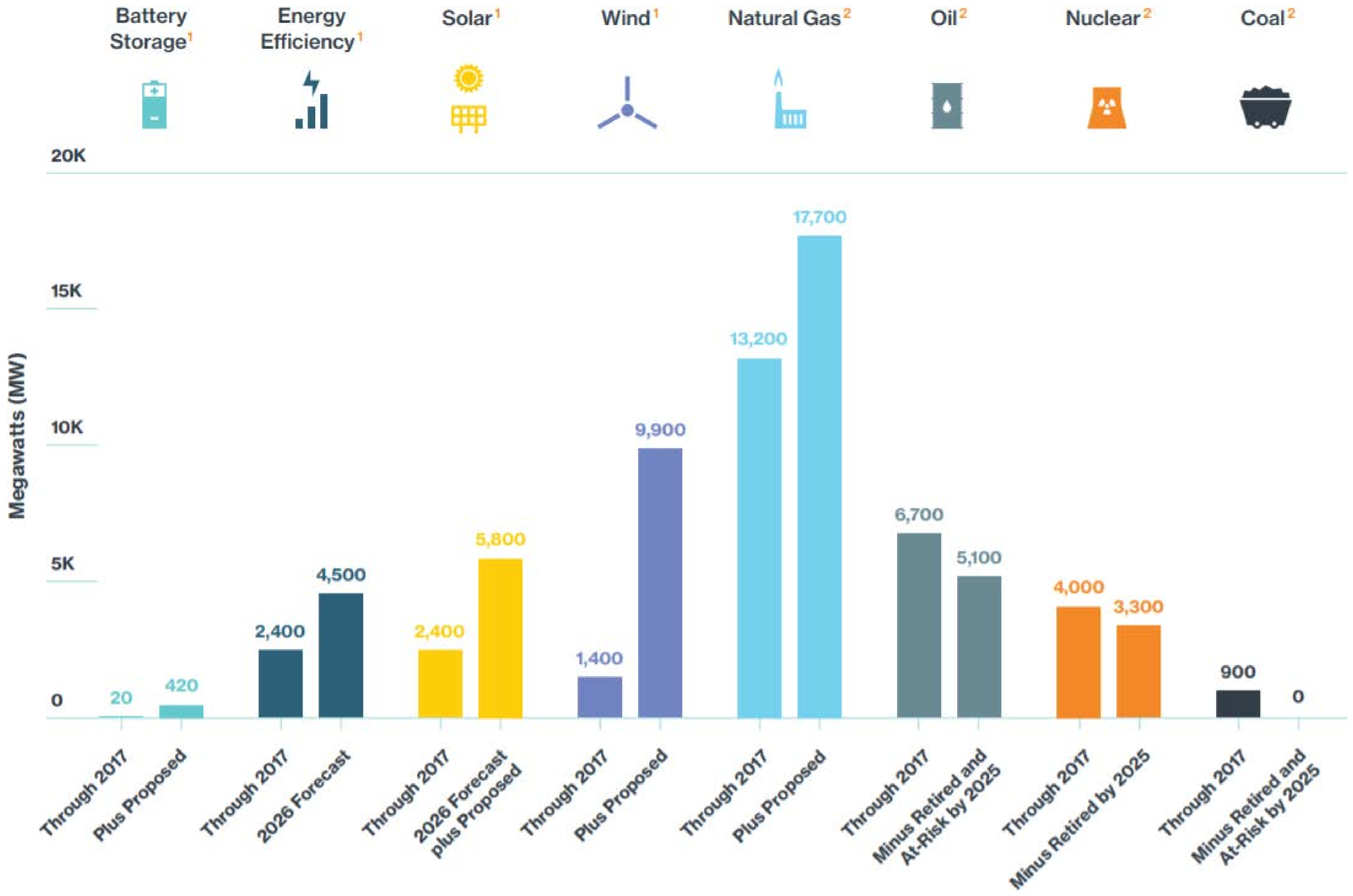
New England isn't just running short on generation facilities, it's also in need of greater pipeline capacity for natural gas.

PIPELINES | Where does NE electricity come from?

Annual Net Energy for Load

	2000	2017*
Natural Gas	13%	41%
Nuclear	27%	26%
Net Imports	14%	17%
Renewables	7%	9%
Hydro	6%	7%
Coal	16%	1%
Oil	19%	1%
Other**	N/A	<1%

PIPELINES | Even More Natural Gas on the Way



CURRENT PIPELINE CAPACITY IS **2 TO 3 BCF**

ON A COLD WINTER DAY…

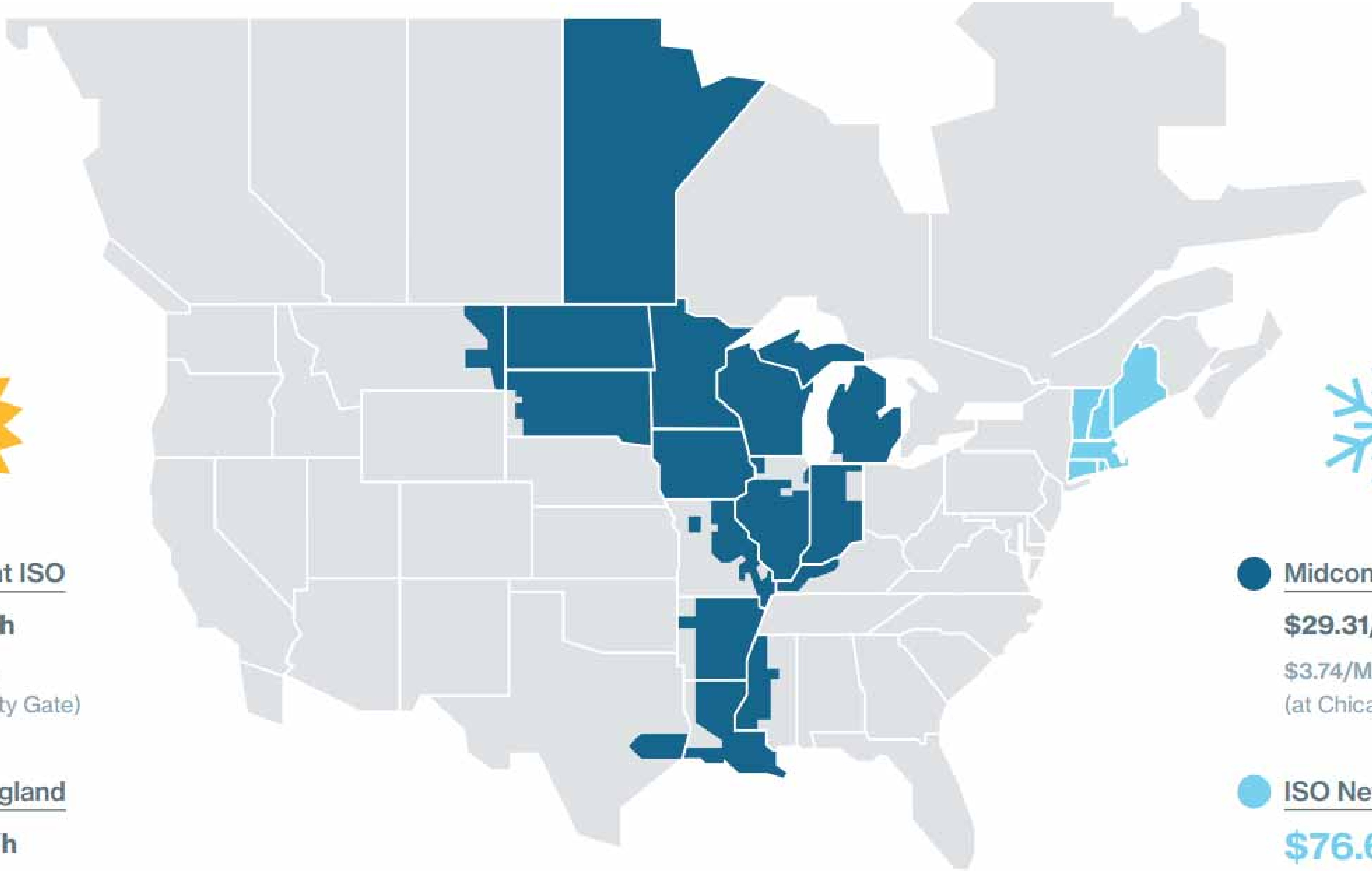
HEATING AND INDUSTRIAL PROCESS DEMANDS…………..4.5Bcf

ELECTRIC GENERATION DEMAND…………………+0.5 to 1.5 Bcf

TOTAL DEMAND FOR NATURAL GAS………………5.0 to 6.0 Bcf

SHORTFALL IS **2 TO 3 BCF**

PIPELINES | The Impact of Winter Weather



Midcontinent ISO

$28.78/MWh

$2.80/MMBtu
(at Chicago City Gate)

ISO New England

$26.86/MWh

$2/MMBtu
(at Algonquin City Gate)

Midcontinent ISO

$29.31/MWh

$3.74/MMBtu
(at Chicago City Gate)

ISO New England

$76.64/MWh

$10.70/MMBtu
(at Algonquin City Gate)

FACTOR #3
TRANSMISSION
TROUBLES

Competitive Energy SERVICES

In the past, transmission charges have always been relatively low, but extensive system upgrades are on the horizon.

TRANSMISSION | New Generation vs. Demand Centers

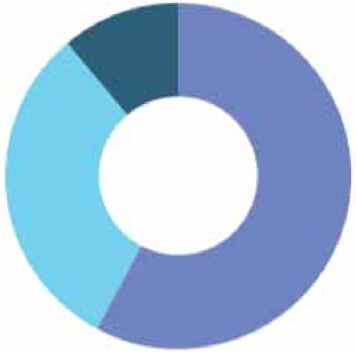
New generation is only worthwhile if you can deliver it to the places that need it the most.

Significant Wind Power Is on the Horizon

In 2017, the amount of new wind power seeking interconnection in New England surpassed proposed new natural-gas-fired generation for the first time. About 4,000 MW of that wind power would be offshore of Massachusetts, with most of the remaining 4,500 MW located in Maine. Because of the large distances from some of the proposed onshore wind power projects to the existing grid, major transmission system upgrades will be needed to deliver more of this power from this weaker part of the system to far-away consumers. Proposed offshore wind projects closer to New England load centers may require fewer upgrades to the existing grid, but building wind turbines offshore is typically more costly than placing them on land.

New Energy-Project Proposals in New England

All Proposed Generation: ≈14,800 MW



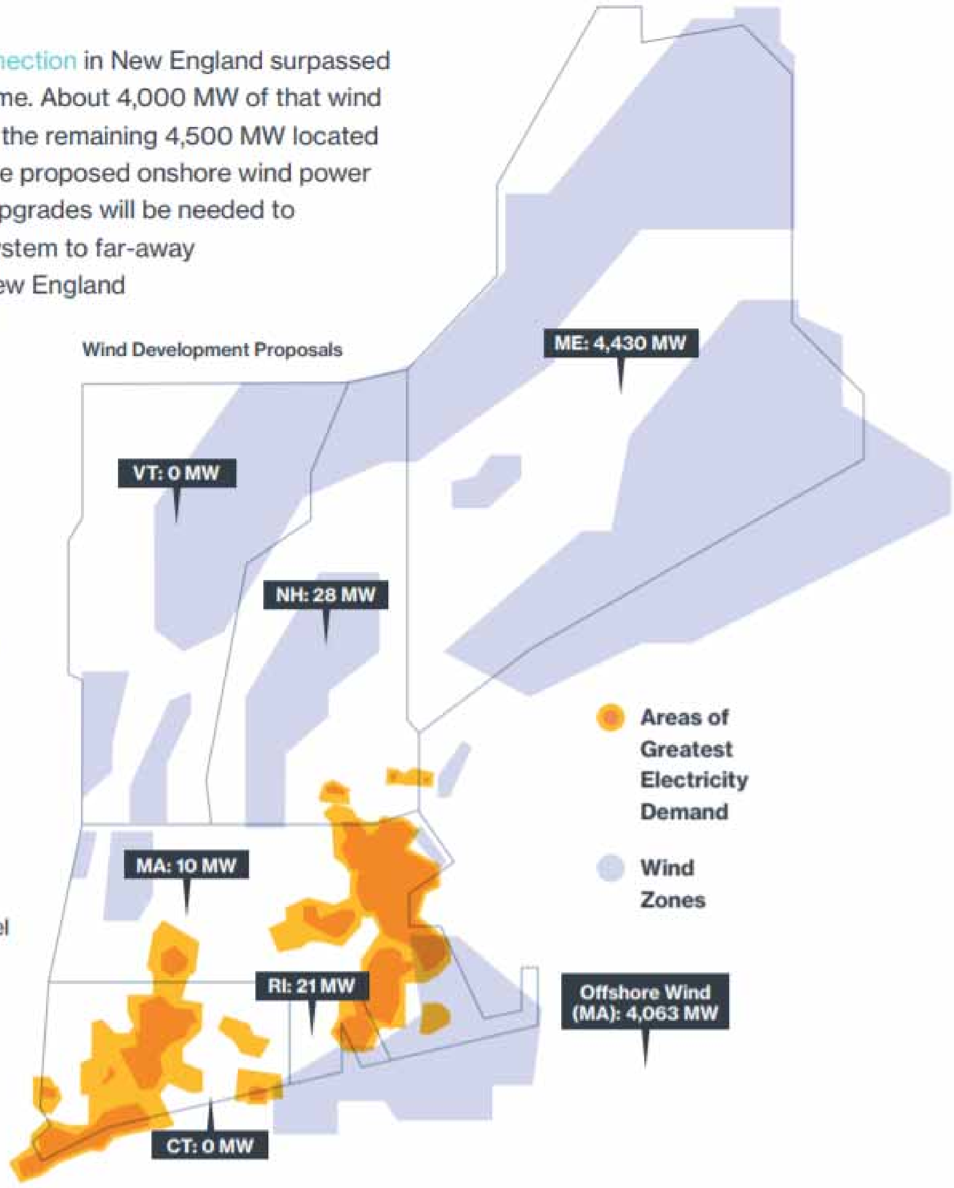
- Wind* 58%
- Natural Gas** 31%
- Other 11%

* Some wind projects include battery storage.

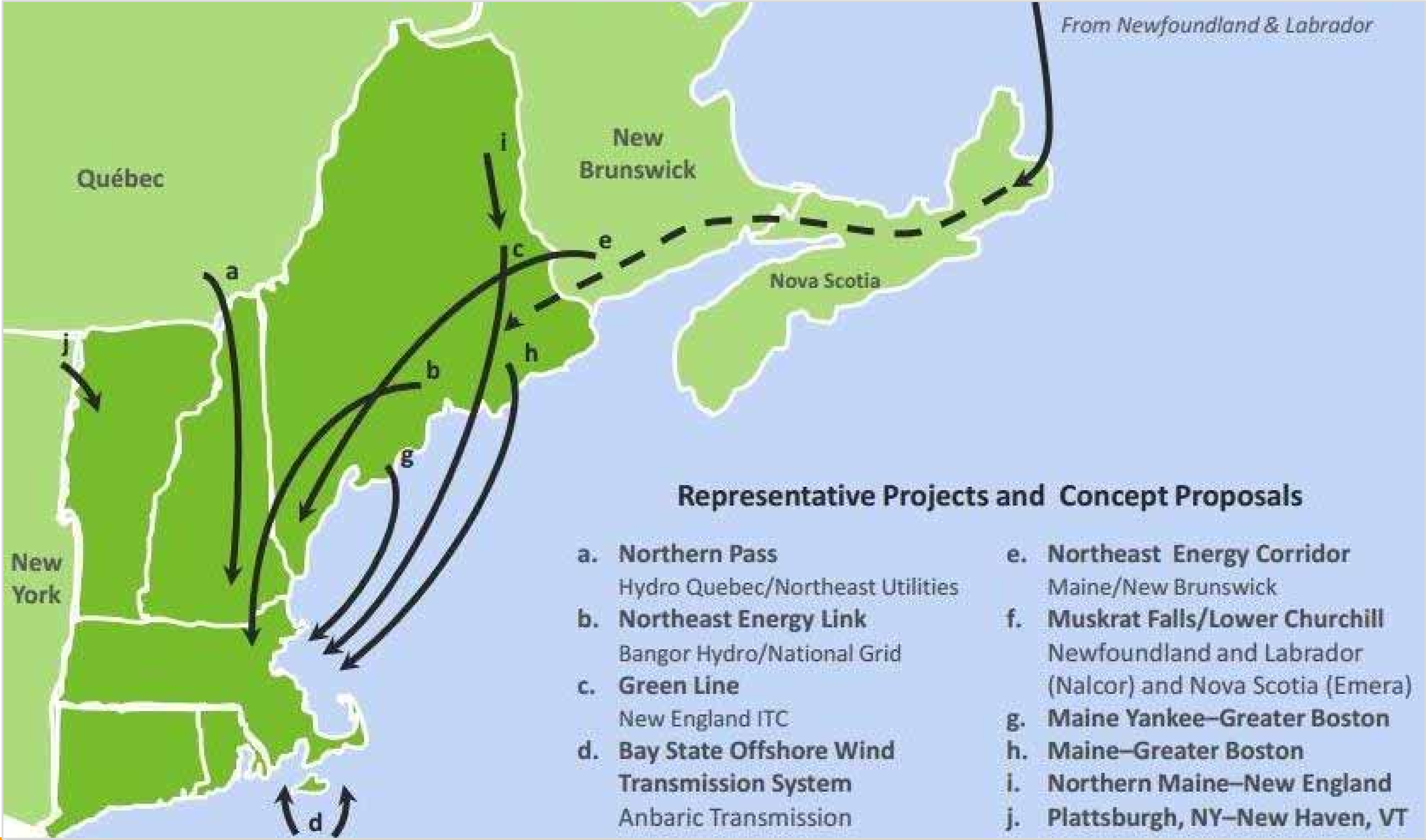
** Some natural gas projects include dual-fuel units (typically oil).

Source: ISO New England, *ISO Generator Interconnection Queue* (January 29, 2018)

Wind Development Proposals



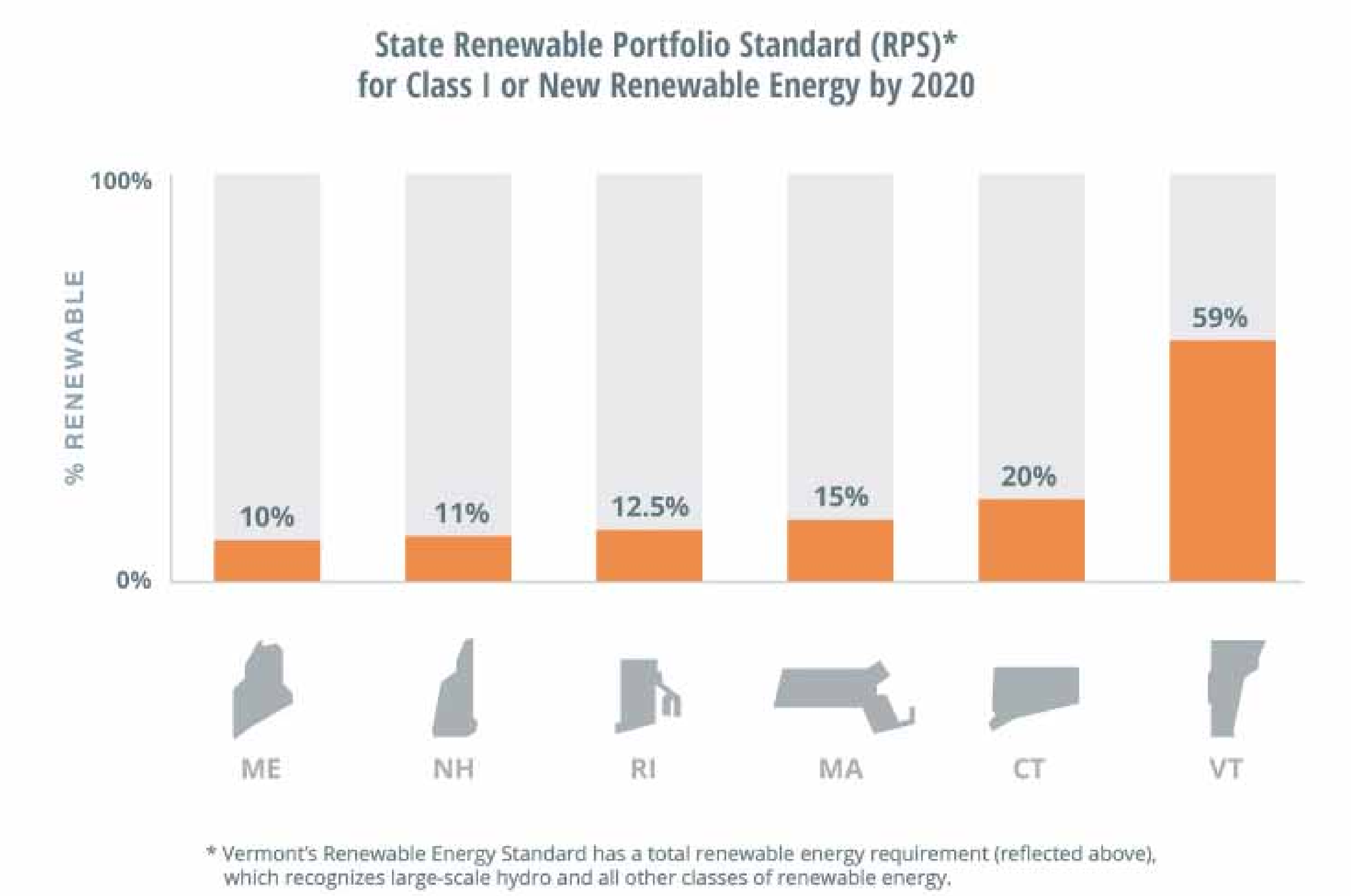
TRANSMISSION | Transmission Upgrades



FACTOR #4
A NEW FOCUS ON RENEWABLES

Competitive Energy SERVICES

You pay a renewable energy charge to support sustainable generation in your state. As goals to reduce fossil fuel reliance increase, so does this charge.



http://www.iso-ne.com/about/key-stats/resource-mix

RENEWABLE PORTFOLIO STANDARD

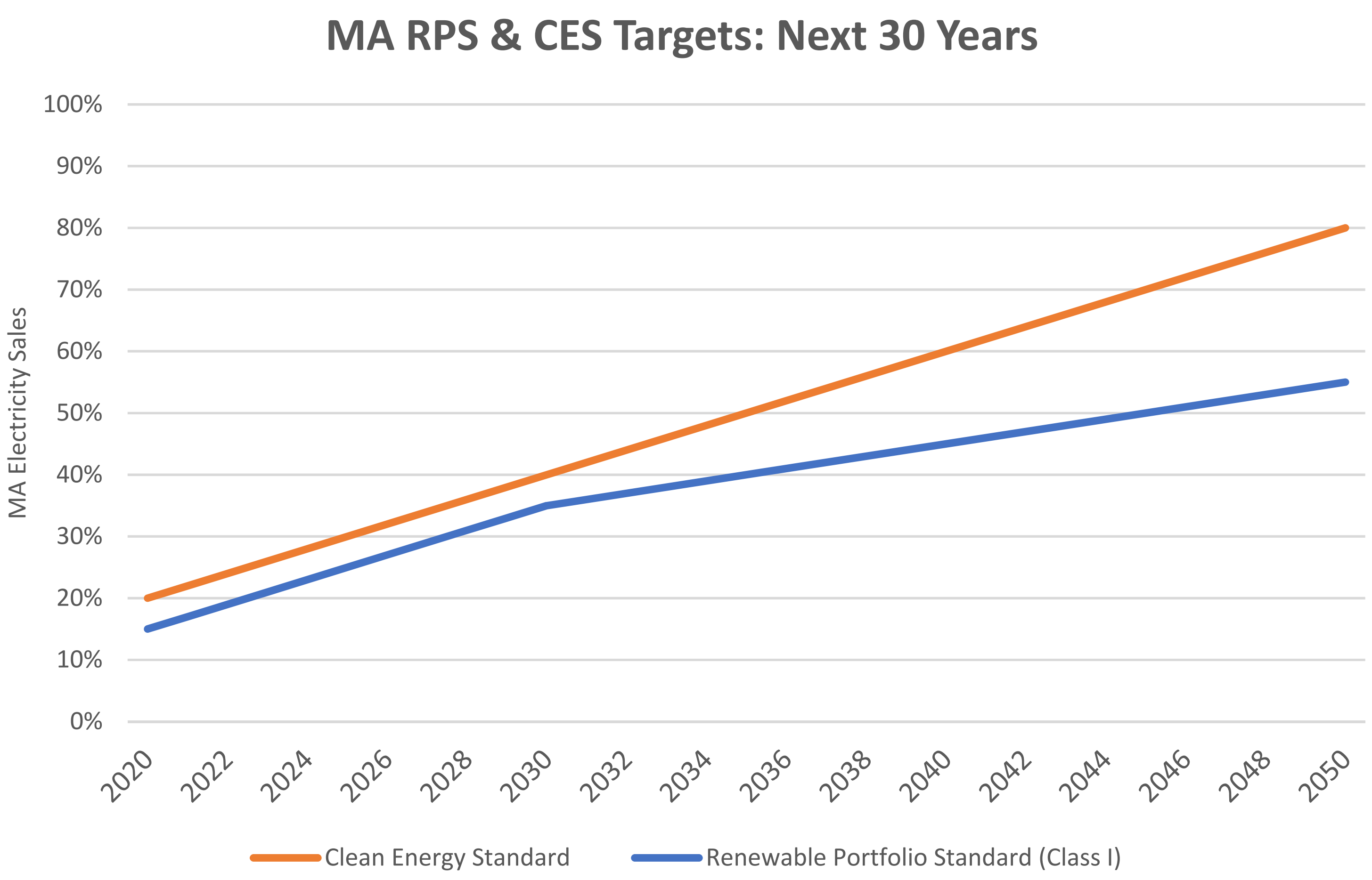
A Minimum Quantity of Renewable Energy Set by State Law That Applies To All Consumers

MASSACHUSETTS CLEAN ENERGY MANDATES

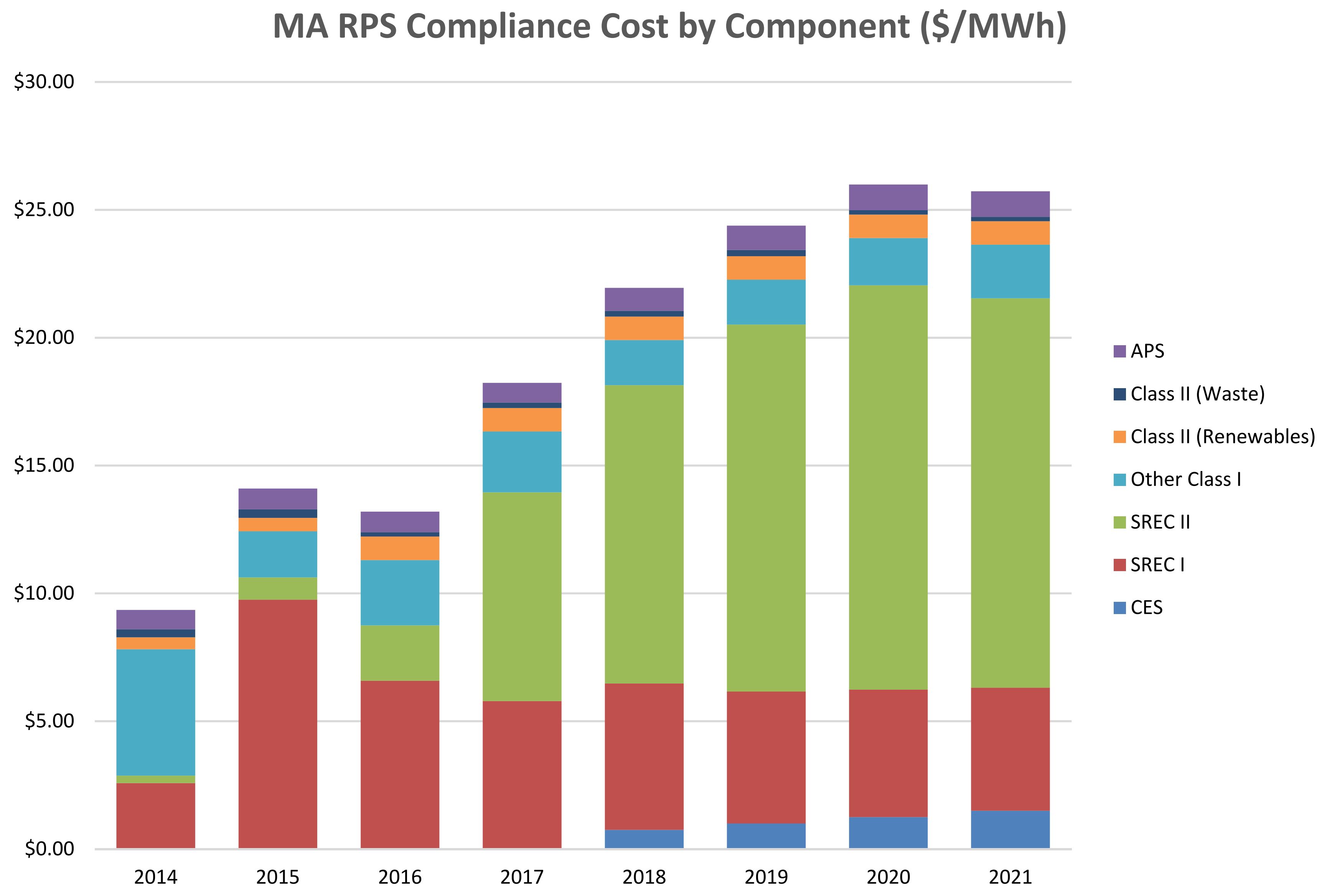
20% of Massachusetts' annual greenhouse gas emissions are tied to electricity generation.

Massachusetts has mandated electricity sales from clean energy sources increase to **80% by 2050** from 16% today.

To date, costs to support clean energy expansion have been borne through electric **supply** charges.



RENEWABLE PORTFOLIO STANDARD COSTS



Since the 2008 Global Warming Solutions Act, Massachusetts ratepayers have seen increasing RPS costs in supply charges.

Over the next three years, CES projects roughly **25% of electric supply** costs for Massachusetts C&I electric customers, ~**2.5 cents per kWh**, will be associated with RPS obligations

IMPACT OF RENEWABLE ENERGY POLICIES

Break-Even REC Price	$/MWh
Biomass	$36.00
Solar PV (New)	$64.00
Solar PV (Existing)	$73.00
Wind On-Shore (New)	$34.00
Wind On-Shore (Existing)	$8.00
Wind Off-Shore (Fixed Base)	$104.00

(Assumes no federal/state tax subsidies)

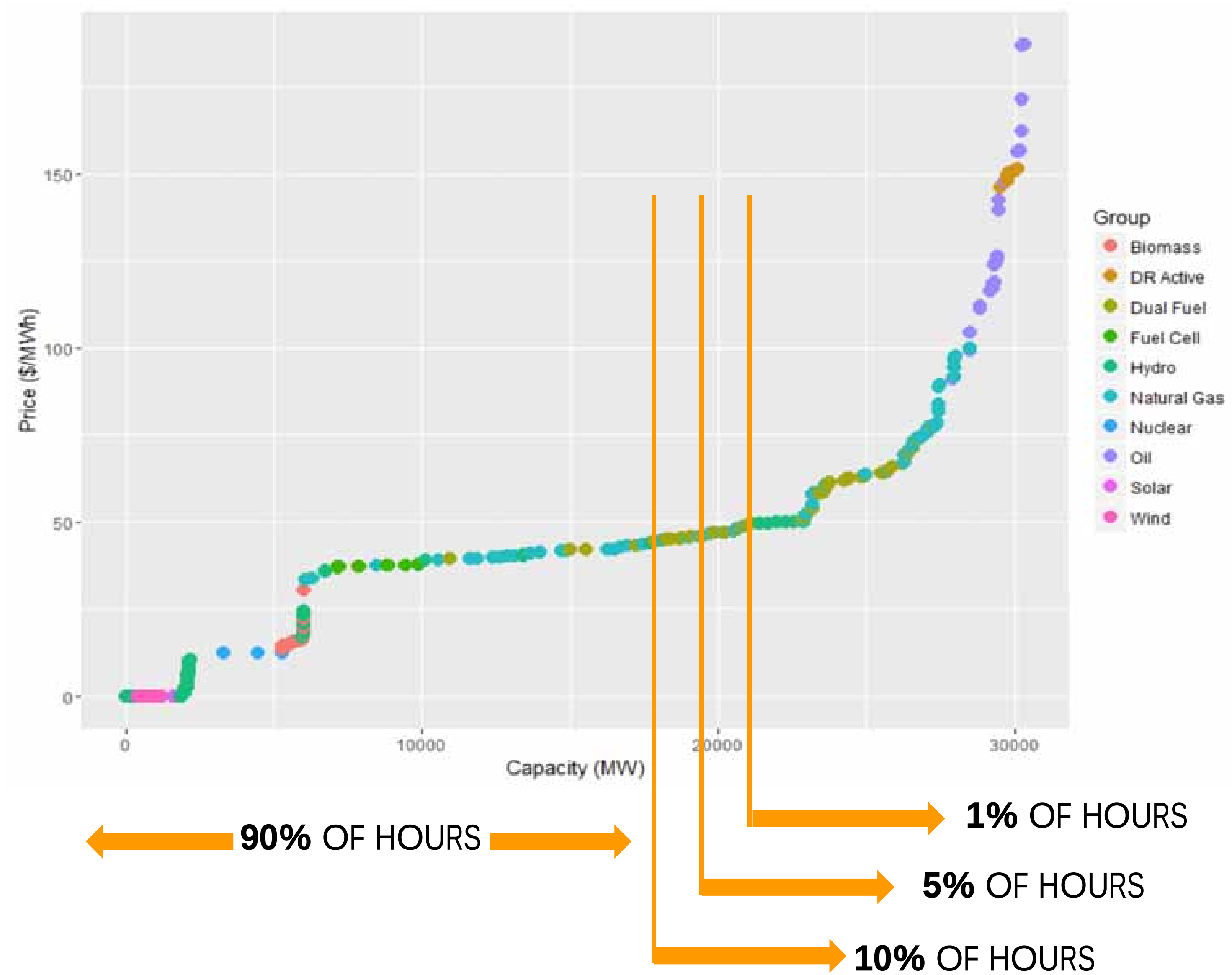
This table shows the estimated price per REC necessary to support expansion of each renewable generation option.

London Economics International, LLC, NESCOE Study, Phase 1, Winter 2017

If New England state environmental targets are to be reached, there needs to be a major expansion of renewable generation in region.

This can only happen if the development of renewable generation is financially viable.

ISO-NE MARKET SUPPLY CURVE



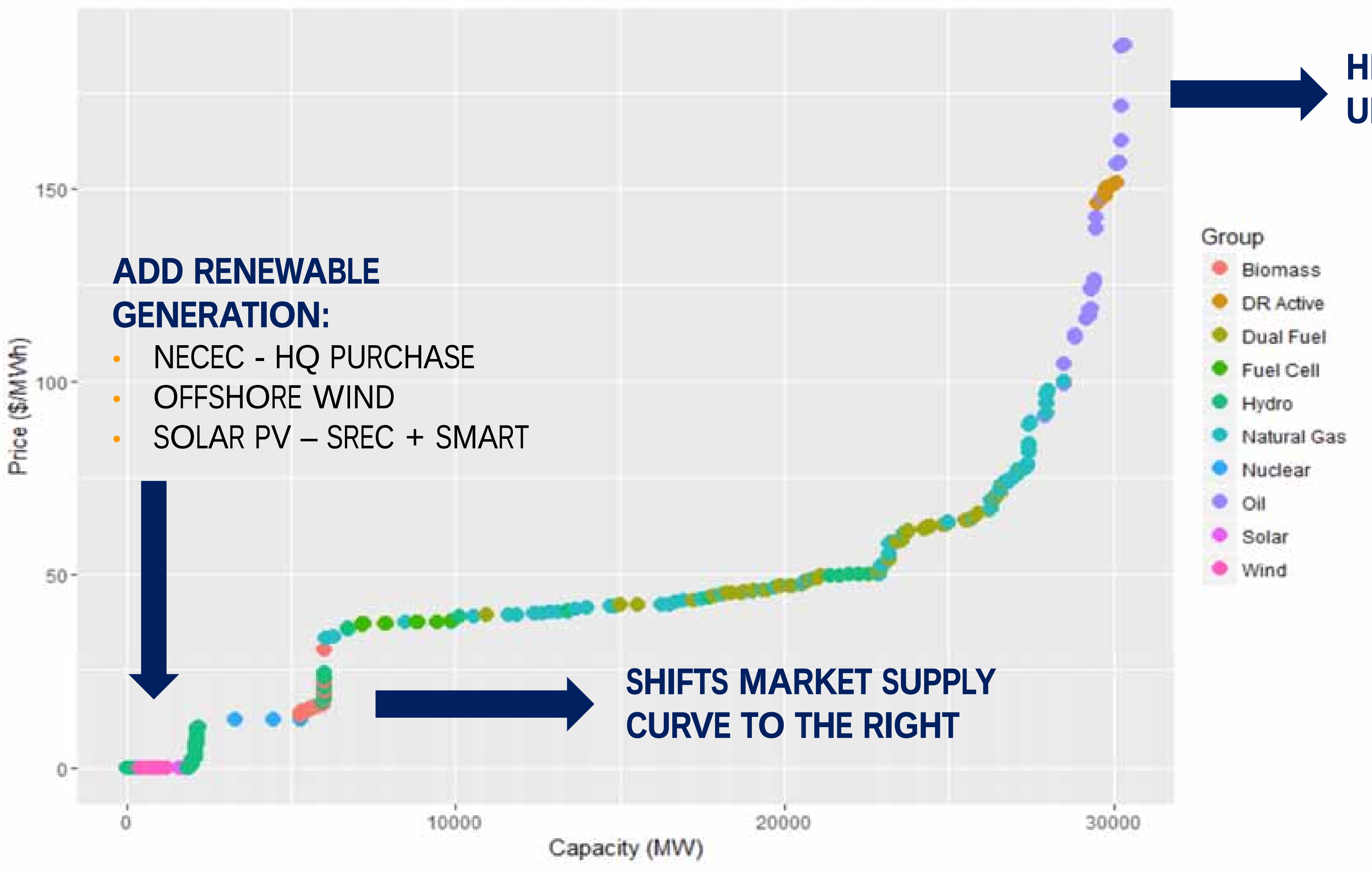
London Economics International, LLC, NESCOE Study, Phase 1, Winter 2017

Many of the generators operating in the New England energy market run only a few hours each year – **less than 1% of the 8760 hours.**

At these low capacity factors, they are not able to earn enough money in the energy market to remain in business.

They must get revenues from the capacity market.

IMPACT OF RENEWABLE ENERGY POLICIES

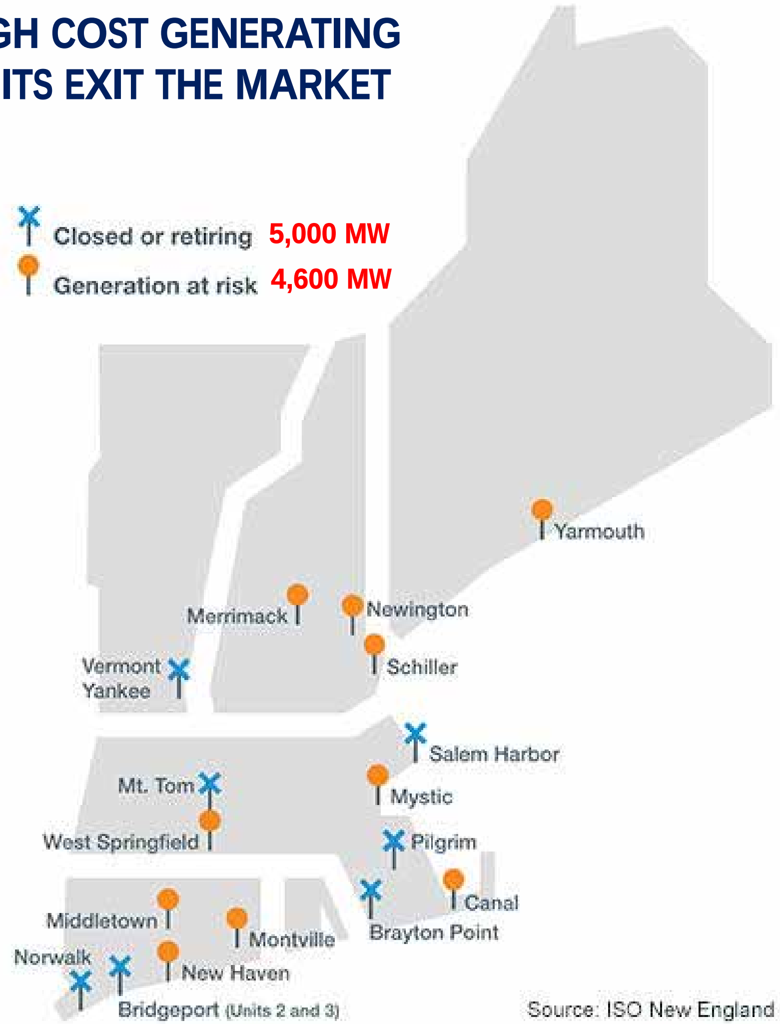


ADD RENEWABLE GENERATION:

- NECEC - HQ PURCHASE
- OFFSHORE WIND
- SOLAR PV – SREC + SMART

SHIFTS MARKET SUPPLY CURVE TO THE RIGHT

HIGH COST GENERATING UNITS EXIT THE MARKET



Source: ISO New England

IMPACT OF RENEWABLE ENERGY POLICIES

- Reduces Operating Hours of High Cost Plants – Increases financial pressure on these plants leading to retirements.
- Reduces Clearing Prices in the Market – Increases financial pressure on plants that run many hours.
- Forces Non-Renewable Generating Plants to identify/create new sources of revenues to remain financially viable.
- Forces Renewable Generating Plants to rely on sources of revenues outside of energy markets – e.g., tax credits, RECs, State/Utility above market Power Purchase Agreements (PPAs)

CES incorporates these considerations into our procurement strategies, consulting services, and long-term electricity price forecasts for New England

UMA ENERGY COST ANATOMY

Supply & Utility Breakdown

Competitive Energy SERVICES

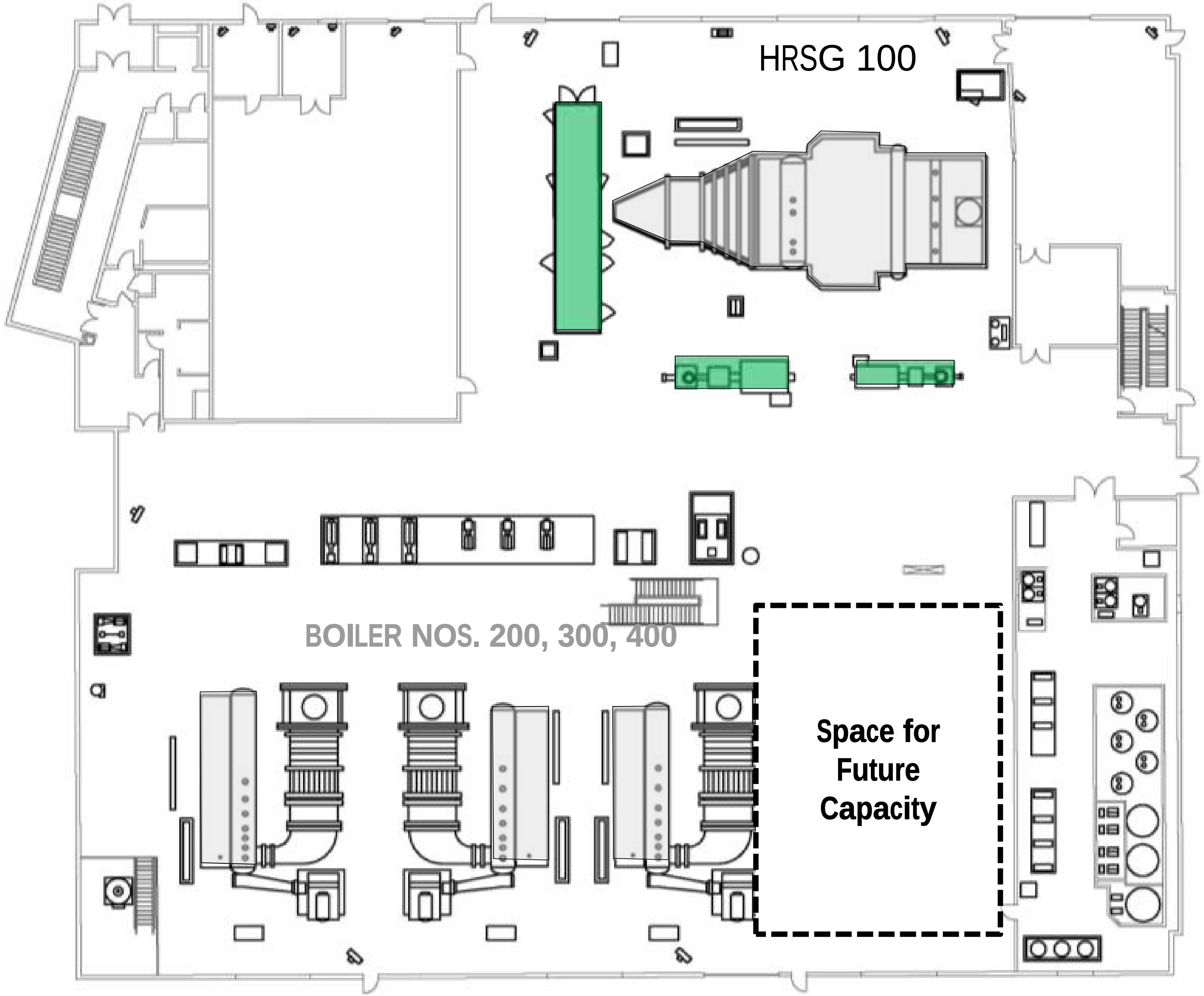
OVERVIEW | Steam Generation System

BOILER CAPACITY

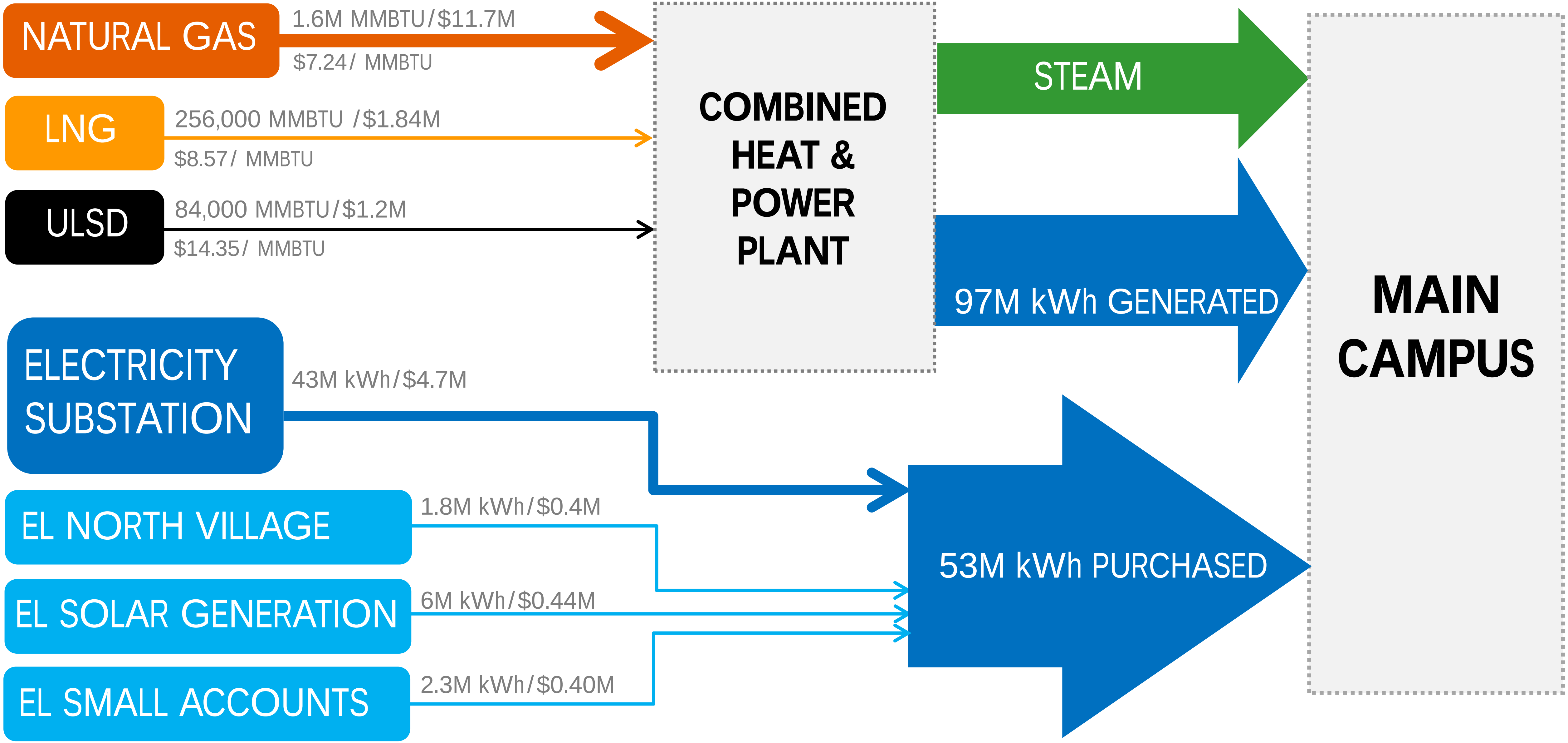
HRSG/ Boiler No.	Boiler Capacity (pph)	Firm Capacity (pph)	Second Fuel
100	100,000	100,000	---
200	125,000	---	Diesel
300	125,000	125,000	Diesel
400	125,000	125,000	Diesel
Total	475,000	350,000	---

TURBINE SUMMARY

Turbine No.	Turbine Type	Capacity (kW)
G-1	Comb. Turb.	10,000
STG-1	Steam Gen.	2,000
STG-2	Steam Gen.	4,000
Total	---	16,000



OVERVIEW | Main Campus FY17 Energy Forecast



SUPPLY

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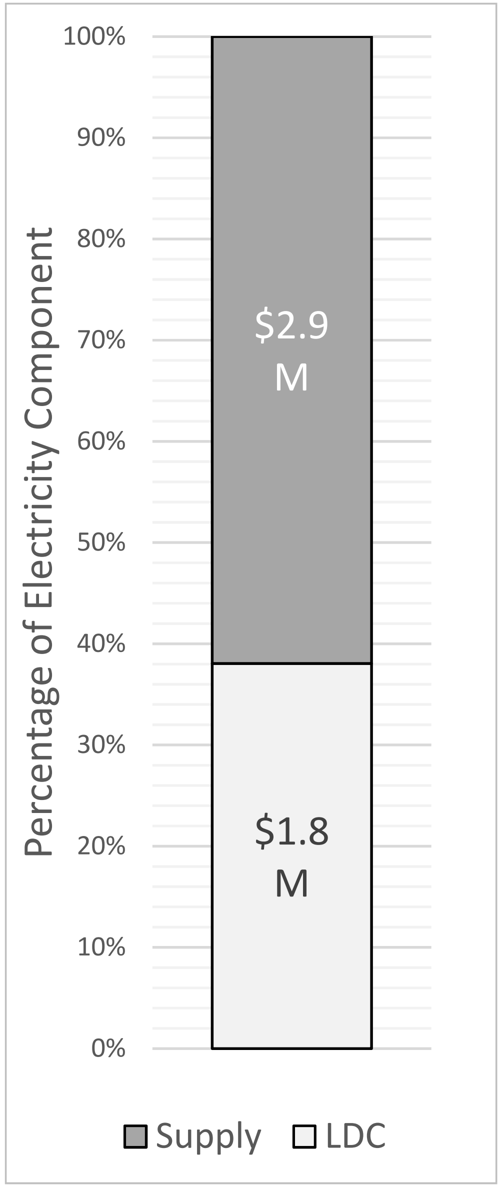
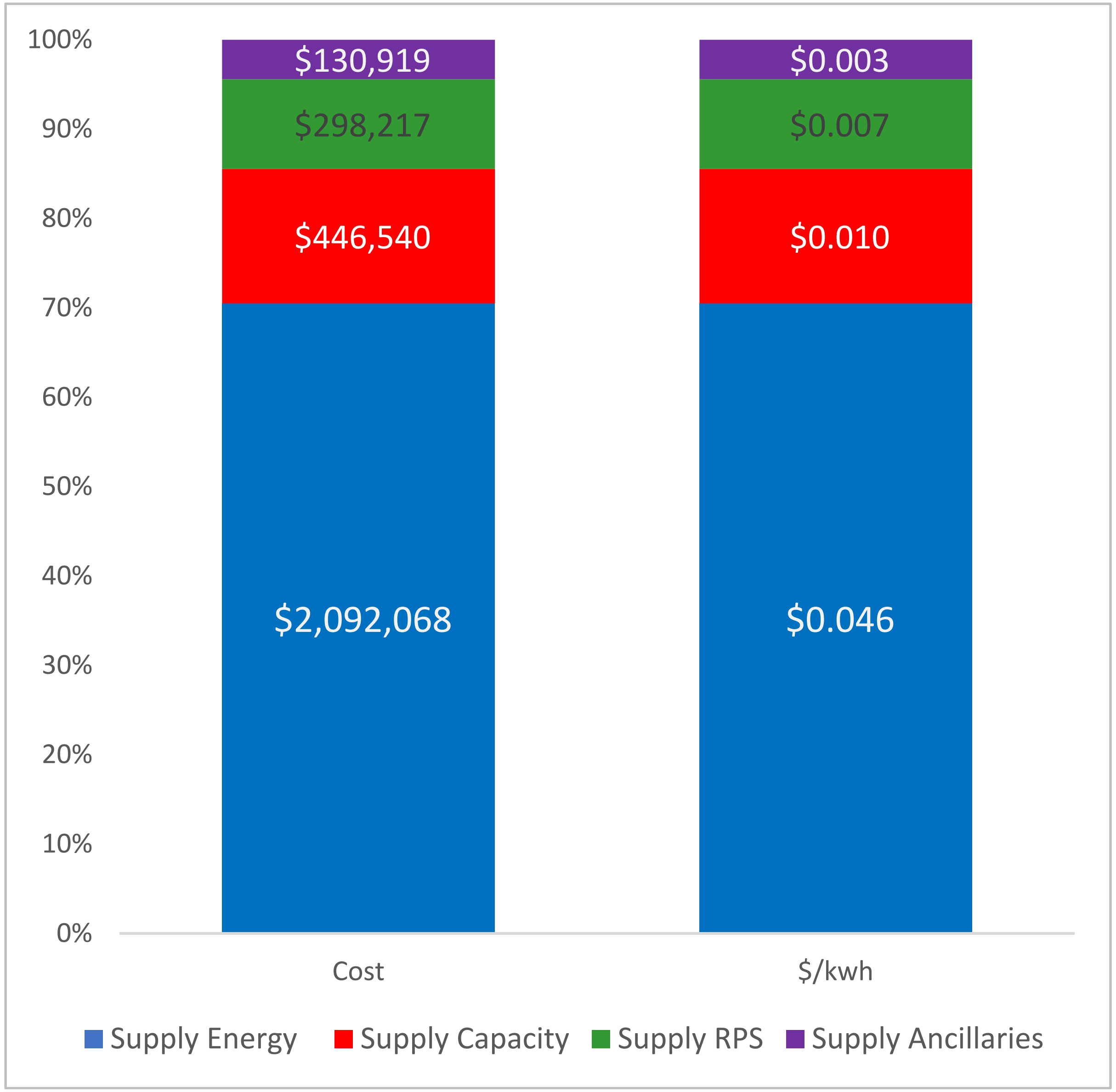
TRANSMISSION & DELIVERY

The Utility, or Local Distribution Company (LDC), takes the power off the grid and transports it to the consumer. These TRANSMISSION & DELIVERY (T&D) charges make up the other half of your bill.

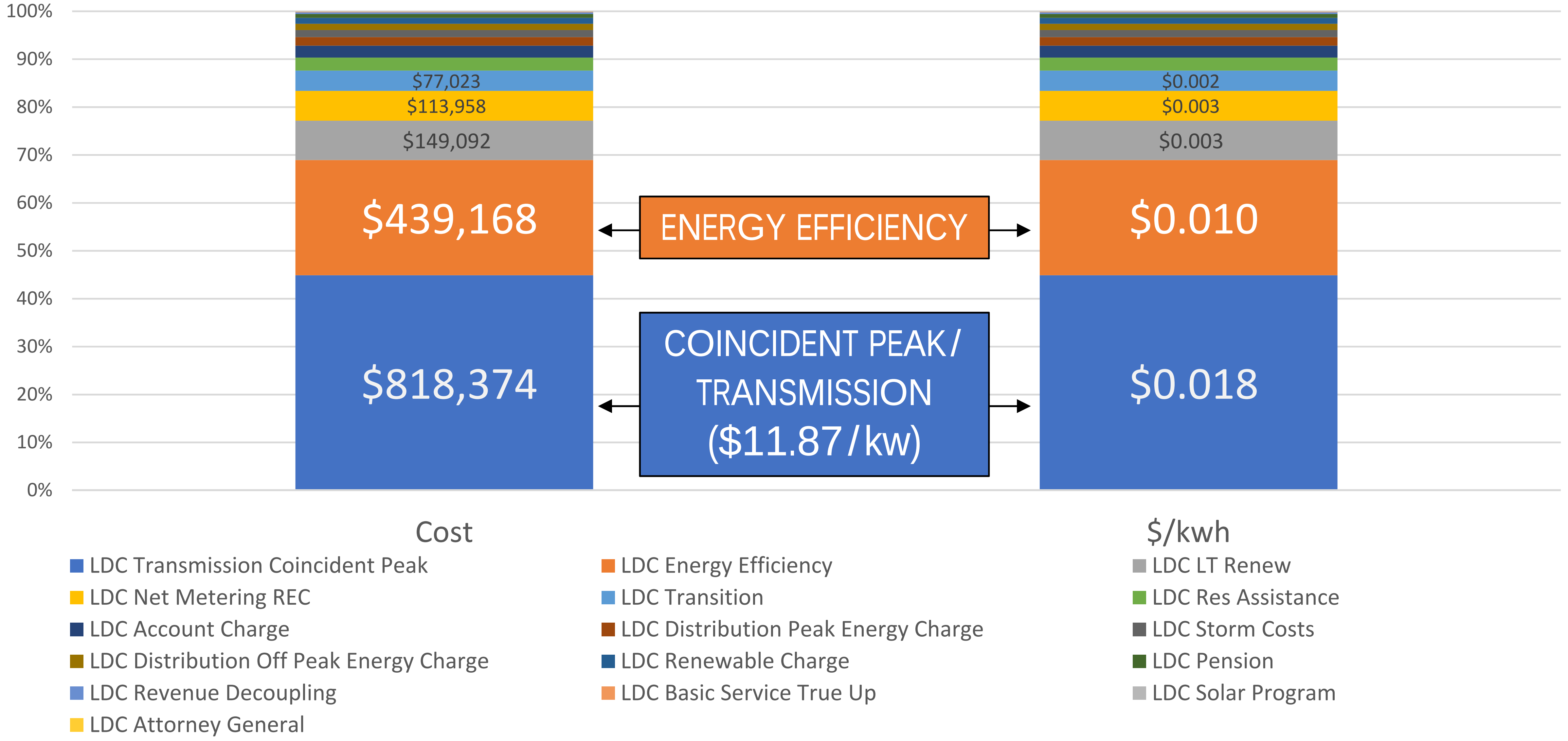
COST ANATOMY | What Makes Up Your Supply Price?



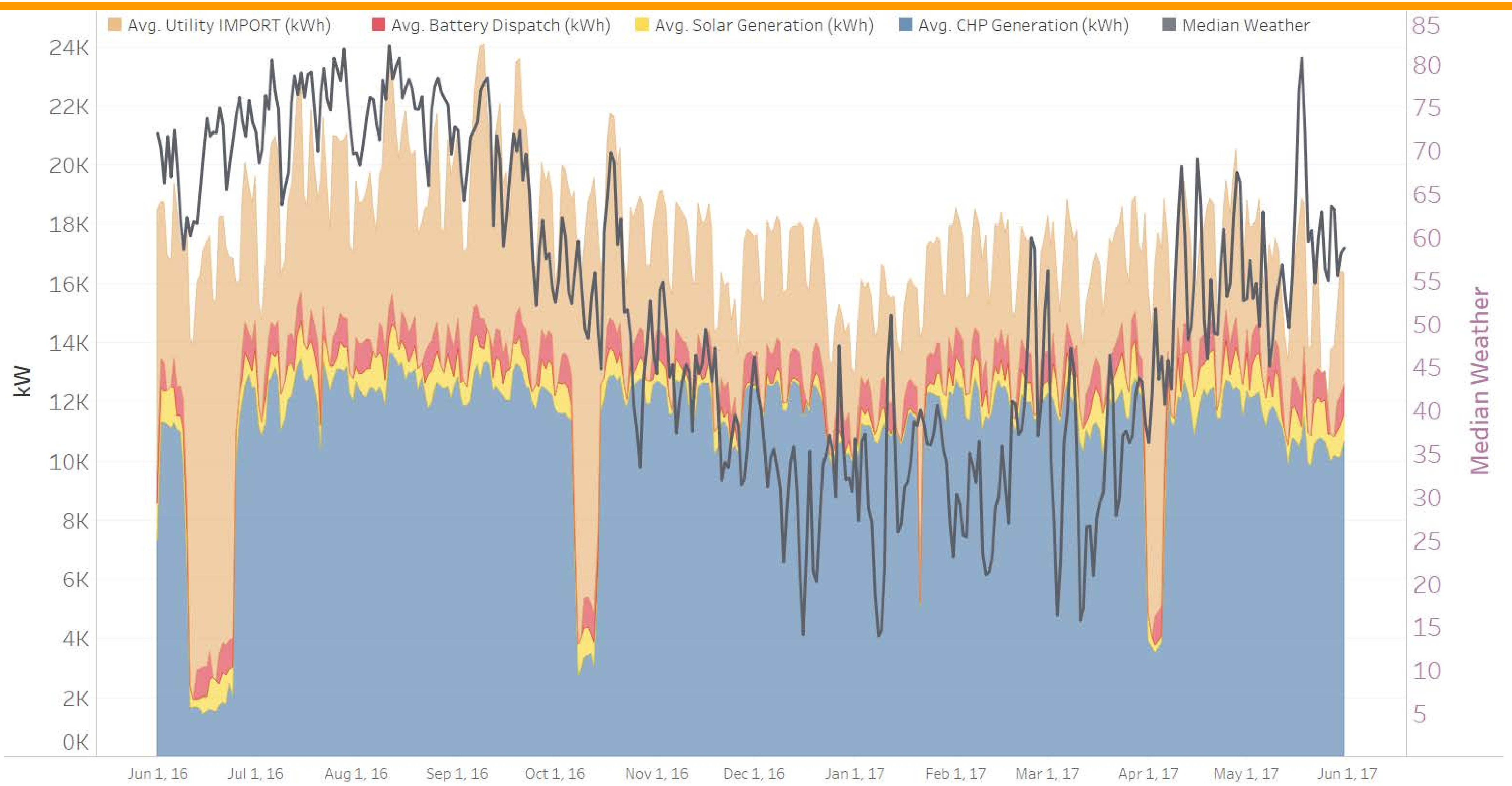


- **ANCILLARIES:** Administrative charges billed to load-serving entities by the NEISO to operate grid safely and reliably
- **RENEWABLE PORTFOLIO STANDARDS (RPS):** Mandates set by individual states for load-serving entities to purchase a certain amount of renewable energy; determined by state regulated compliance percentages and the financial market for renewable energy certificates (RECs).
- **CAPACITY**: Determined by NEISO scaling factors, price auctions and customer's capacity tag. Designed to ensure grid reliability and ensure enough generation available to the region.
- **ENERGY:** The cost of procuring the actual electrons transmitted through the T&D lines.

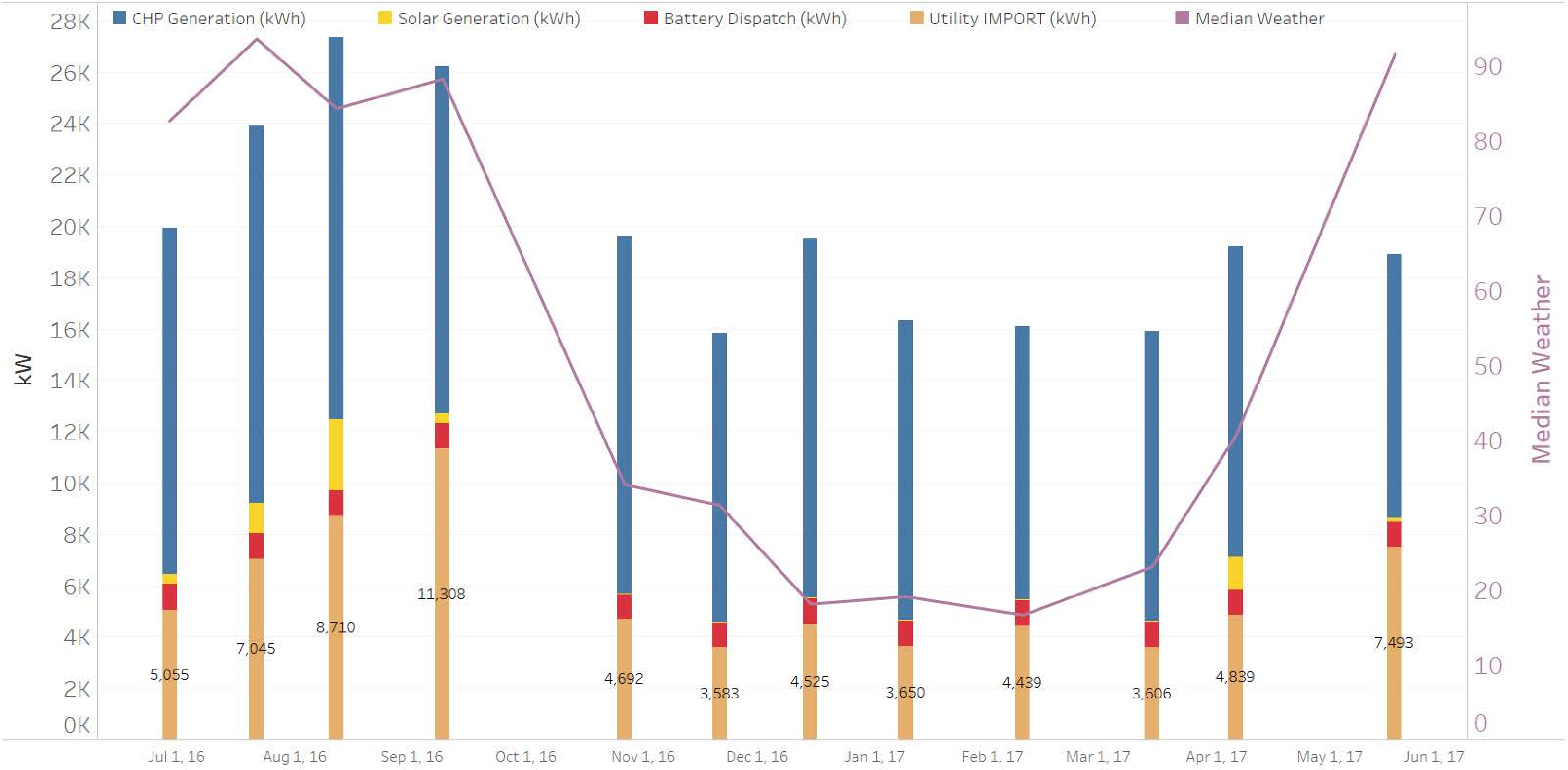
COST ANATOMY | What Makes Up Your LDC Price?



COST ANATOMY | **UMA FY17 Energy Profile**



COST ANATOMY | LDC Coincident Peak



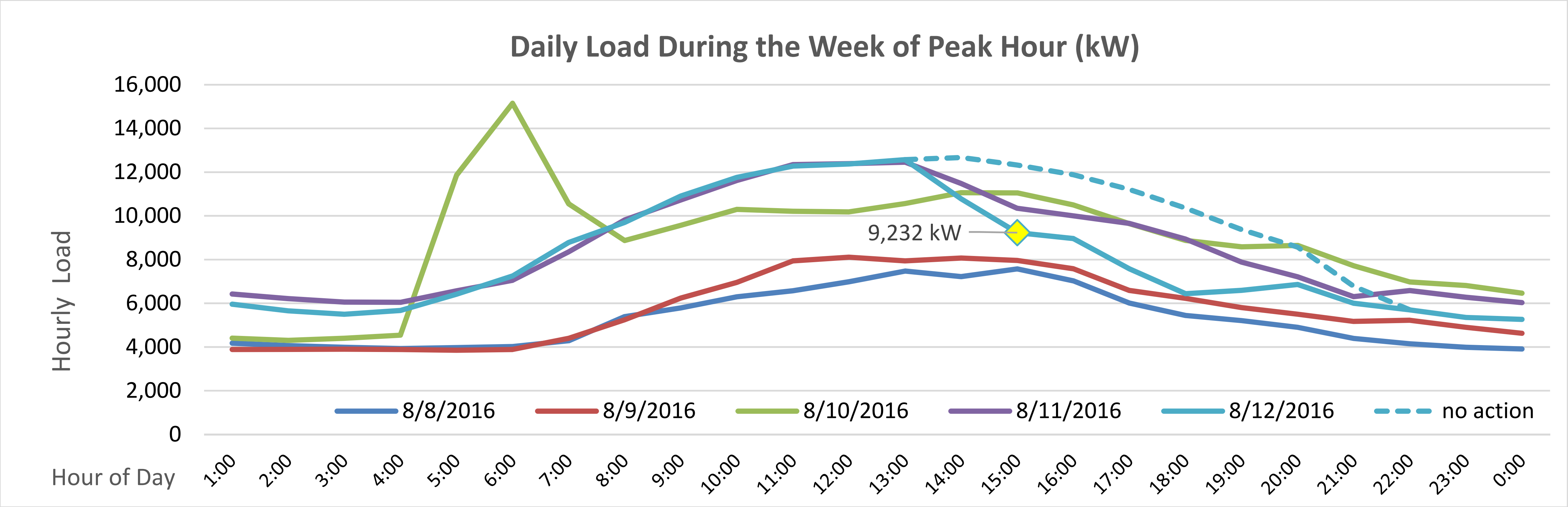
COST ANATOMY | LDC Coincident Peak- Cost Mitigation

DATE	DAY OF WEEK	HE	UMA TOTAL LOAD (KW)	UMA WMECO IMPORT (KW)	UMA SOLAR GENERATION (KW)	UMA CHP GENERATION (KW)	UMA BATTERY DISPATCH (KW)
6/29/2016	Wednesday	17	18,542	5,055	370	13,487	1,000
7/22/2016	Friday	17	21,749	7,045	1,144	14,704	1,000
8/12/2016	Friday	15	23,587	8,710	2,759	14,877	1,000
9/9/2016	Friday	16	24,847	11,308	368	13,539	1,000
10/27/2016	Thursday	18	18,627	4,692	-	13,936	1,000
11/21/2016	Monday	19	14,850	3,583	-	11,267	1,000
12/15/2016	Thursday	18	18,490	4,525	-	13,965	1,000
1/9/2017	Monday	18	15,326	3,650	-	11,676	1,000
2/9/2017	Thursday	19	15,101	4,439	-	10,662	1,000
3/15/2017	Wednesday	19	14,902	3,606	-	11,295	1,000
4/6/2017	Thursday	17	16,939	4,839	1,273	12,099	1,000
5/18/2017	Thursday	18	17,787	7,493	127	10,294	1,000

SCENARIO	NO COGEN	STATUS QUO	SOLAR REDUCTION	CHP REDUCTION	BATTERY REDUCTION
TOTAL (KW)	220,746	68,945	6,041	151,802	12,000
$/KW	$11.87	$11.87	$11.87	$11.87	$11.87
TOTAL COST ($)	$2,620,260	$818,374	$71,701	$1,801,886	$142,440
$/kWh	$0.0582	$0.0182	$0.0016	$0.0400	$0.0032

COST ANATOMY | Supply FCM Cost Mitigation

Applicable Time Range	Settlement Rate ($/kW/month)	Reserve Margin	Effective Rate ($/kW/month)	UMASS AMHERST Peak (kW)	Estimated Annual Capacity Cost	Monthly Capacity Costs	Potential Savings per 1 MW Reduction
6/1/2016 - 5/31/2017	$2.74	47%	$4.03	9,232	$446,540	$37,212	$48,369
6/1/2017 - 5/31/2018	$7.44	53%	$11.38	4,621	$631,221	$52,602	$136,598
6/1/2018 - 5/31/2019	$9.29	51%	$14.03	6,732	$1,133,230	$94,436	$168,335
6/1/2019 - 5/31/2020	$7.03	51%	$10.62	5,732	$730,163	$60,847	$127,384
6/1/2020 - 5/31/2021	$5.29	48%	$7.83	5,732	$538,524	$44,877	$93,950
6/1/2021- 5/31/2022	$4.63	49%	$6.90	5,732	$474,520	$39,543	$82,784



ACES | UMass Amherst Project Overview

- 1.33MW/4MWh lithium ion battery system to be owned and operated by UMass Amherst
- Battery will be operated to reduce peak electricity delivery and supply charges, help optimize operation of onsite solar PV and cogen, and bolster campus resiliency
- Comprehensive research initiative will be conducted by the UMass Clean Energy Extension to maximize lessons learned for the Commonwealth
- Project includes educational contribution by Borrego and educational collaboration with UMass Amherst students

PROJECT TEAM

University of Massachusetts Amherst, UMass Clean Energy Extension, Borrego Solar Systems, Competitive Energy Services

GRANT FUNDING AMOUNT

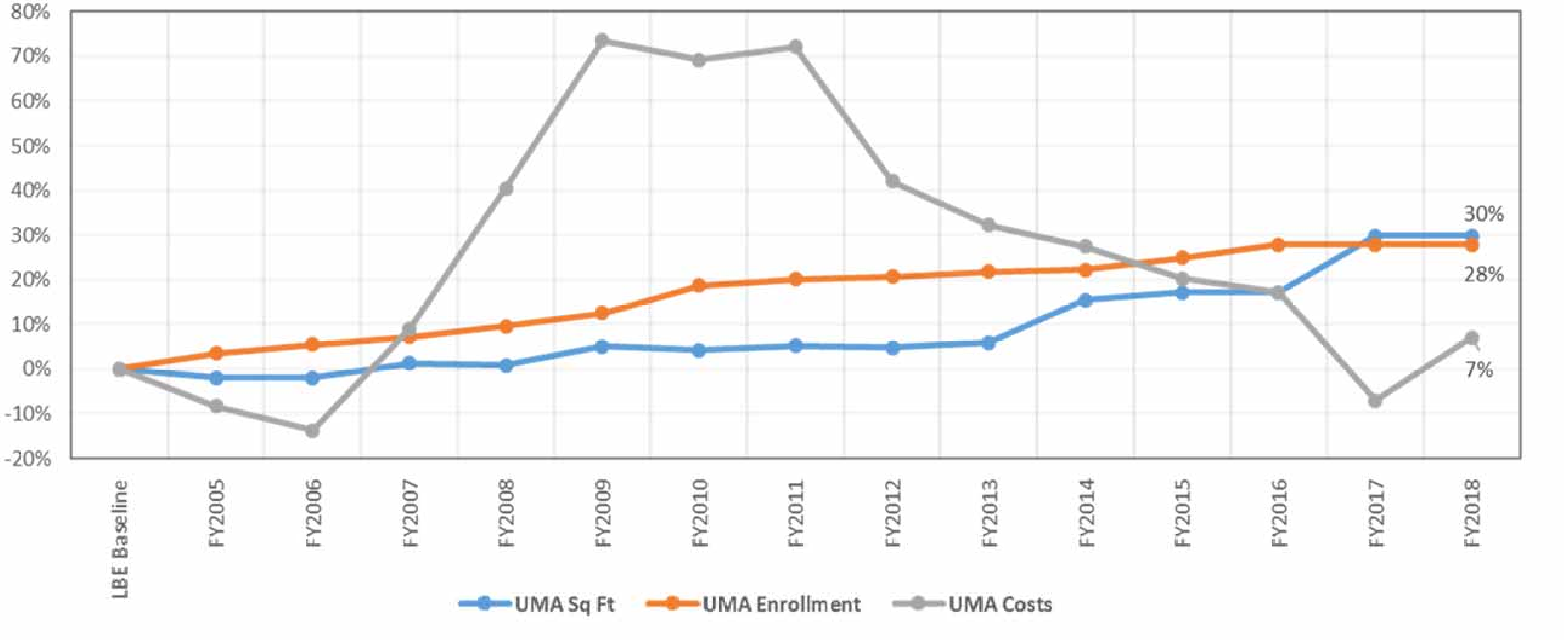
$1.14 million, approximately 50% of project cost

MAIN CAMPUS ENERGY FLOWS

Key Metrics

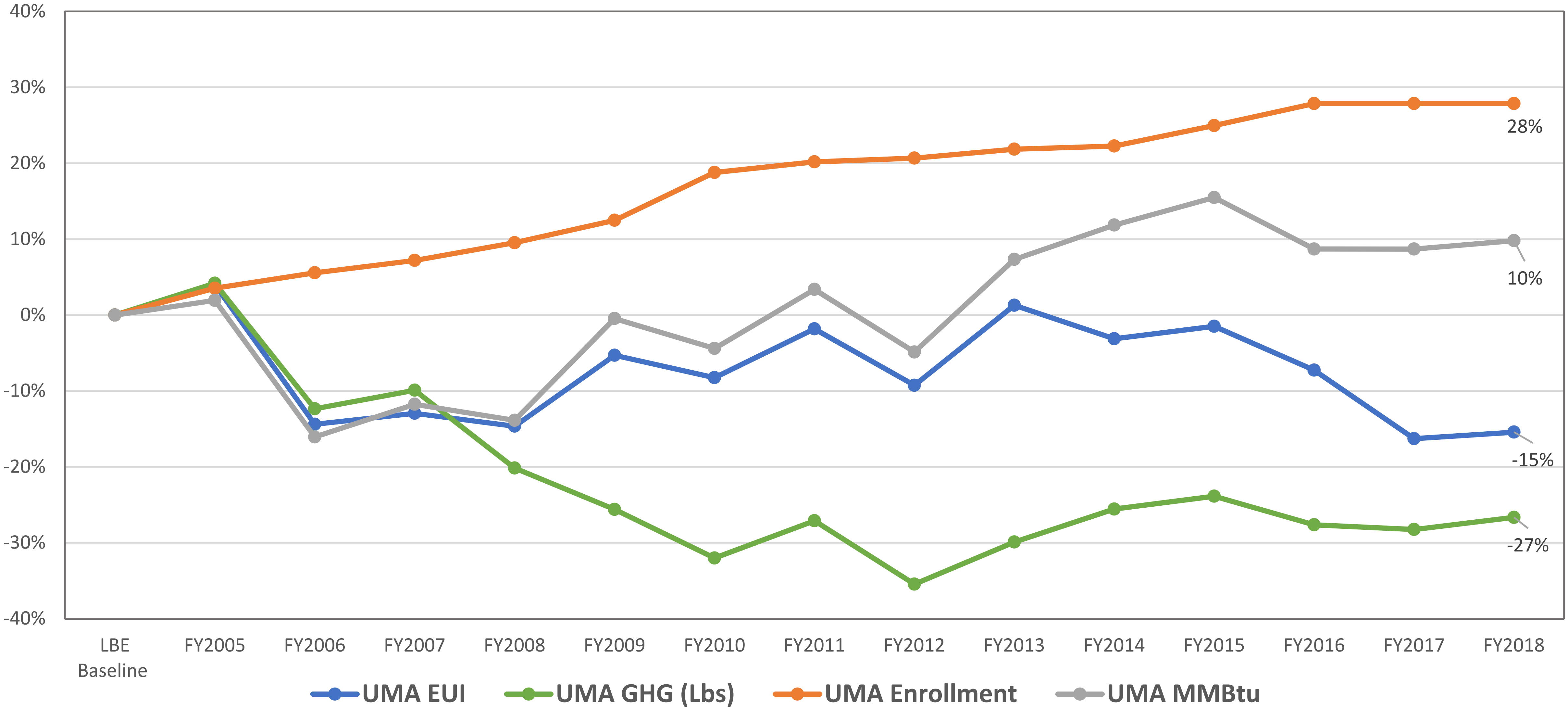
Competitive Energy SERVICES

METRICS | **Despite Growth, Costs not Increasing at Same Rate**

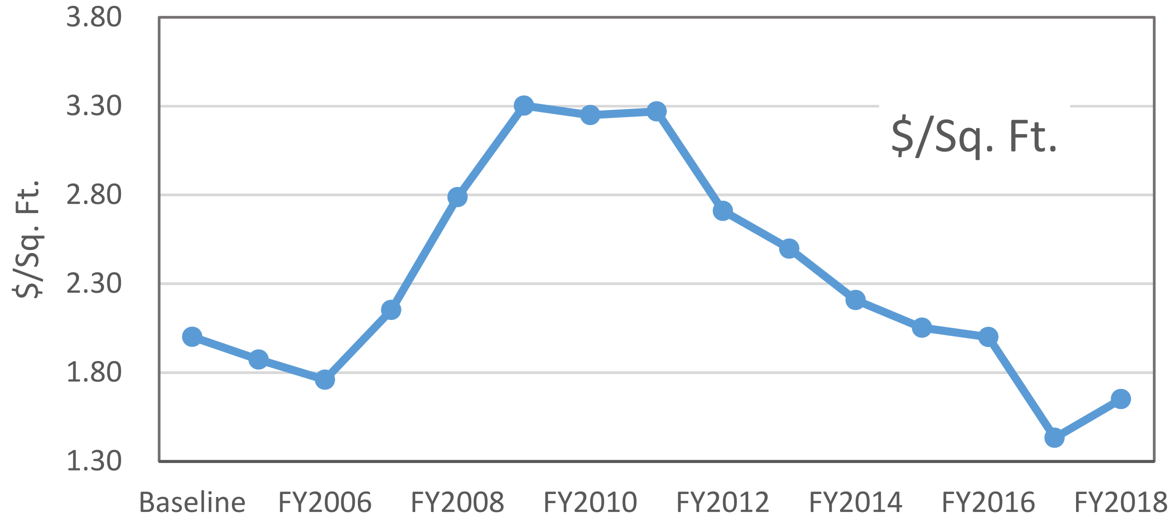


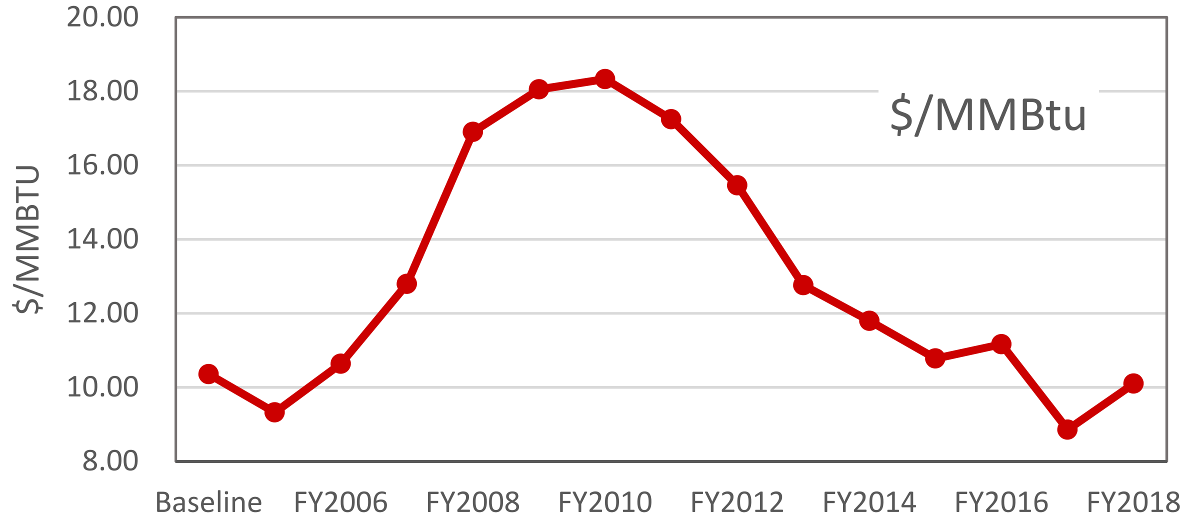
*KPI's indicate expected year end totals, based on CES collected data through April. Unavailable data points hold 2017 LBE reported values constant.

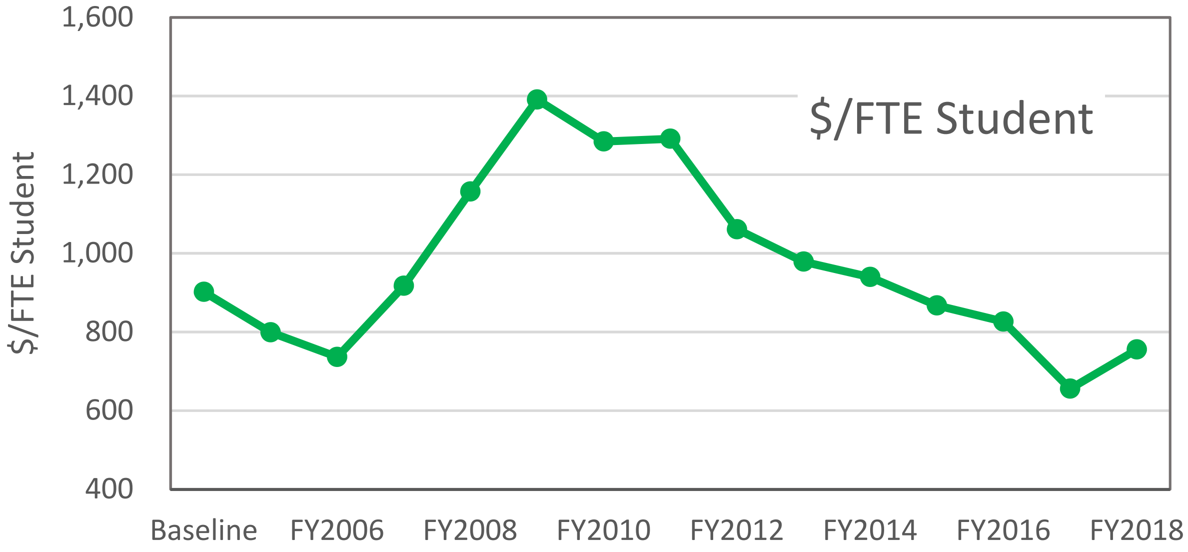
METRICS | Despite Growth, Carbon & EUI are decreasing

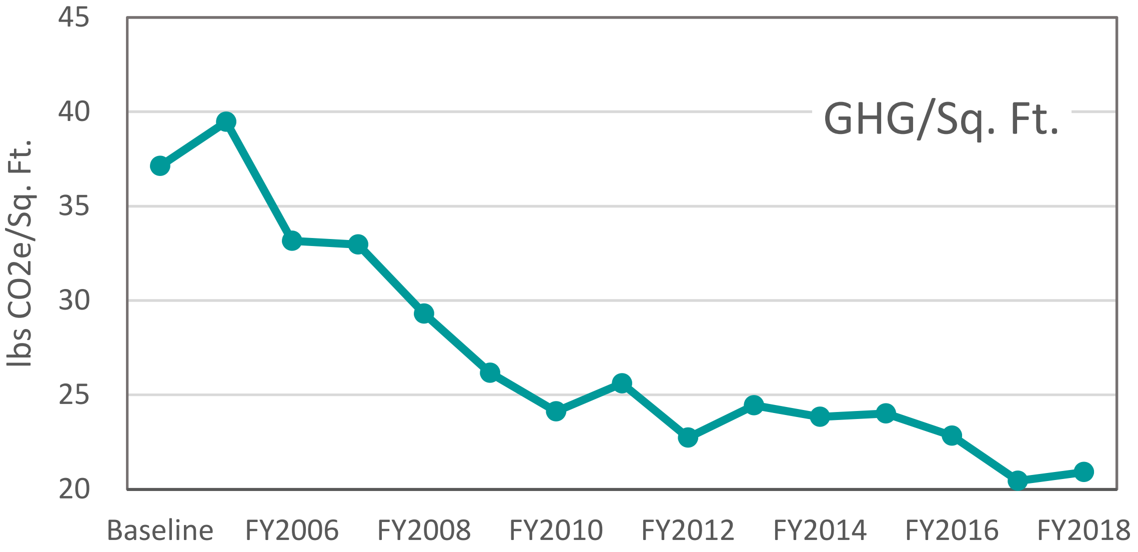


METRICS | UMass Amherst KPIs









Those with the ability to control peak consumption will be best suited to control costs.

SOLAR | Value of a Solar kWh

SOLAR PV KWH VALUE

OFFSET SUPPLY PURCHASE

- Hourly profile – on peak vs. off-peak
- Seasonality

OFFSET UTILITY DELIVERY CHARGES

- Tariff Structure - $/kWh, $/kW

REDUCE CAPACITY CHARGES

- Demand reduction during the annual hour of the New England system peak

RENEWABLE BENEFITS

- Offset carbon associated with grid purchase
- Claims depend on REC ownership

EXCESS GENERATION

- Compensation depends on net metering availability

RE TECHNOLOGY TRENDS

Cost, Efficiency & Capacity Factors

Competitive Energy SERVICES

 Learning Rate- Ford Model T

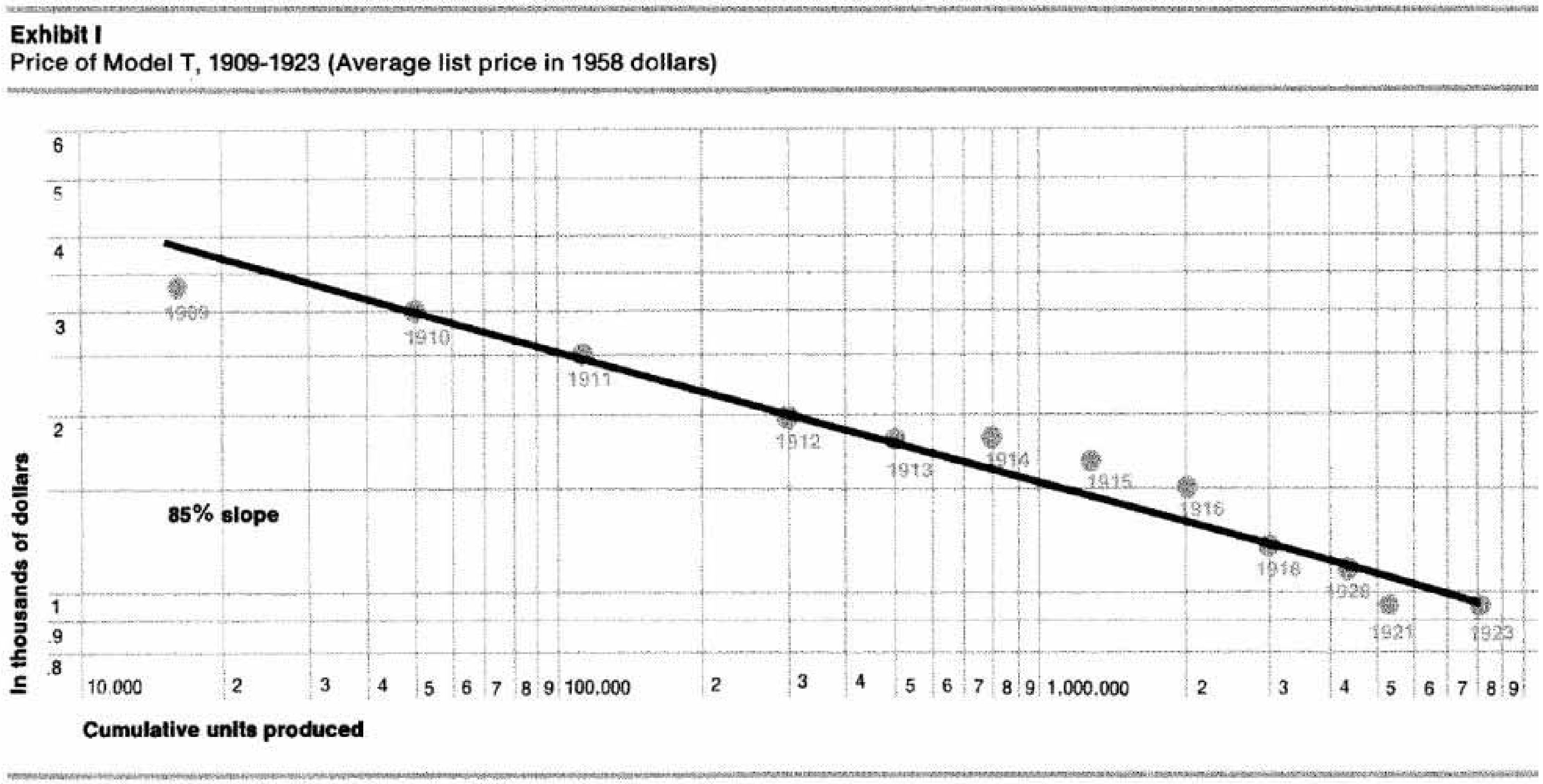
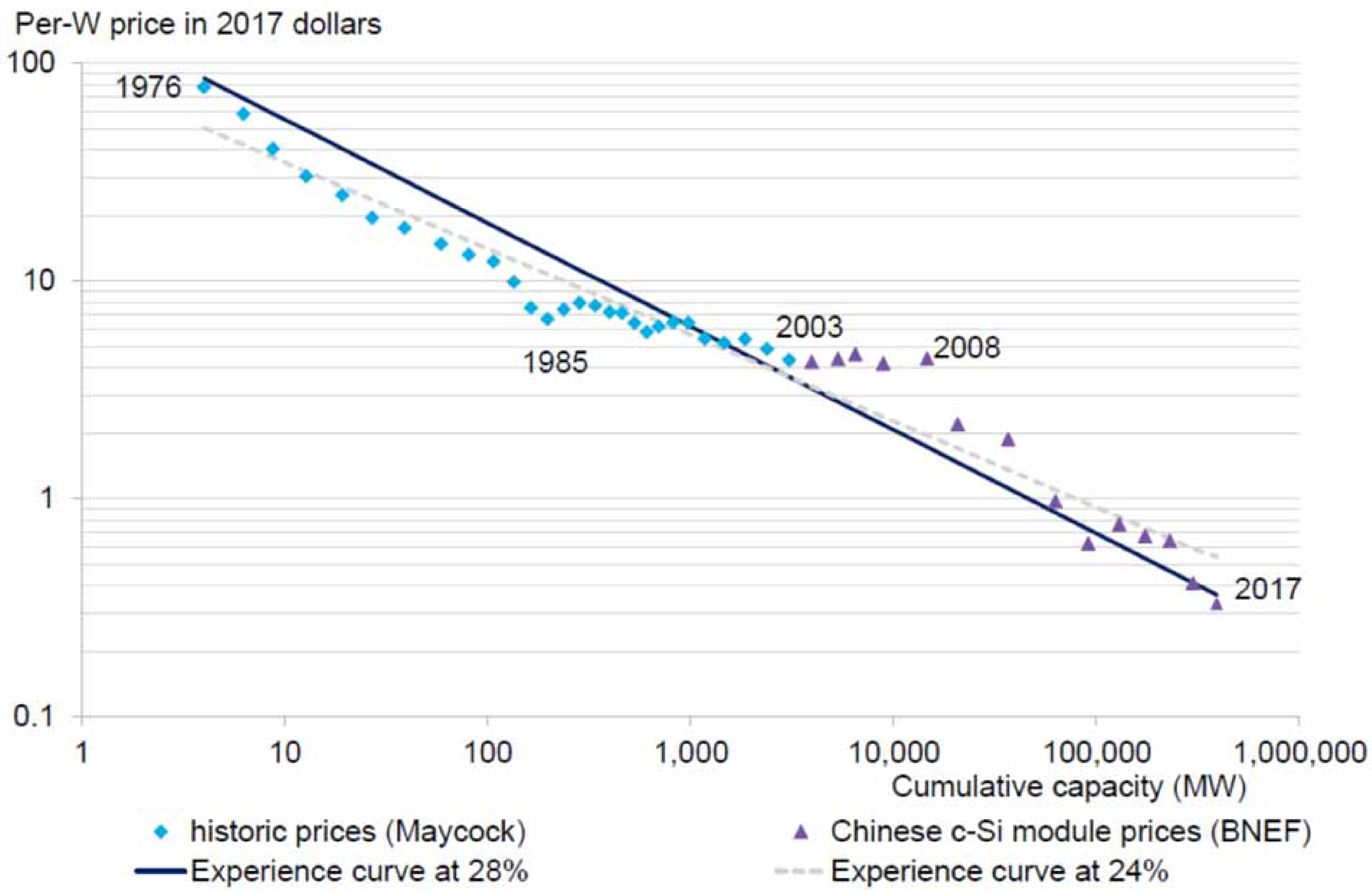
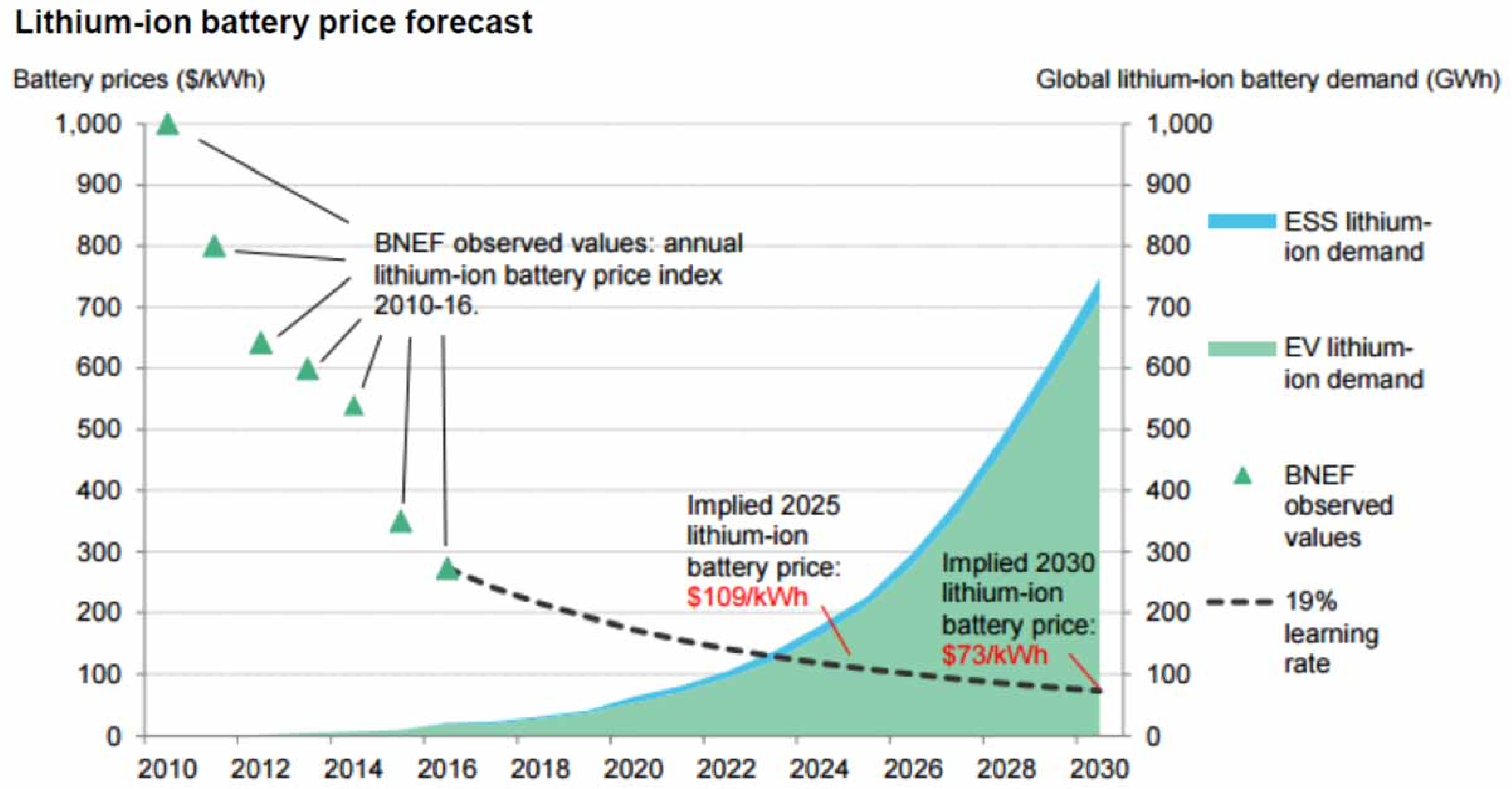


Figure 1. The price of the Ford Model T from 1909-1923[2].

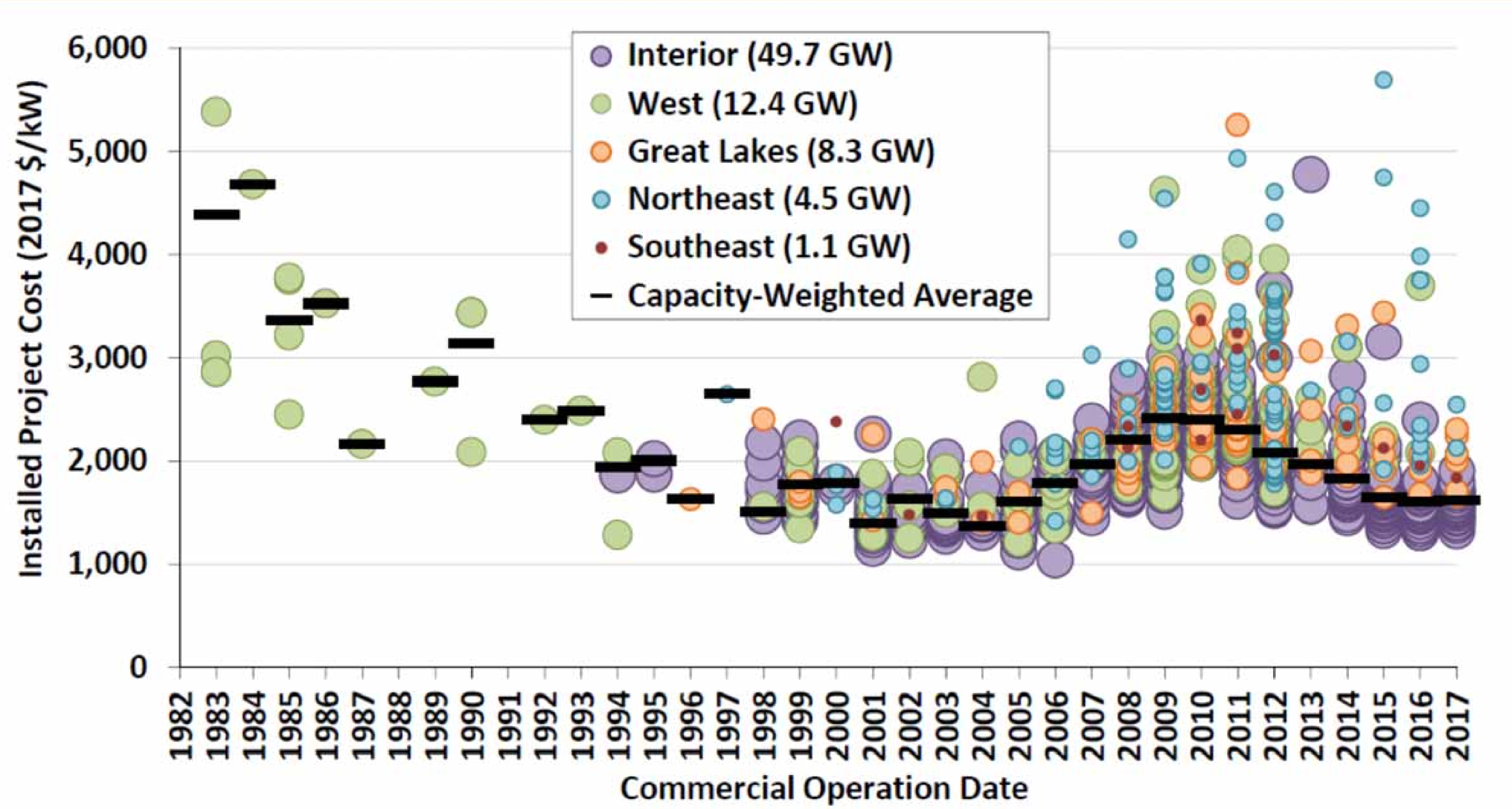
RE TRENDS | **Learning Rate for Crystalline Silicon PV**



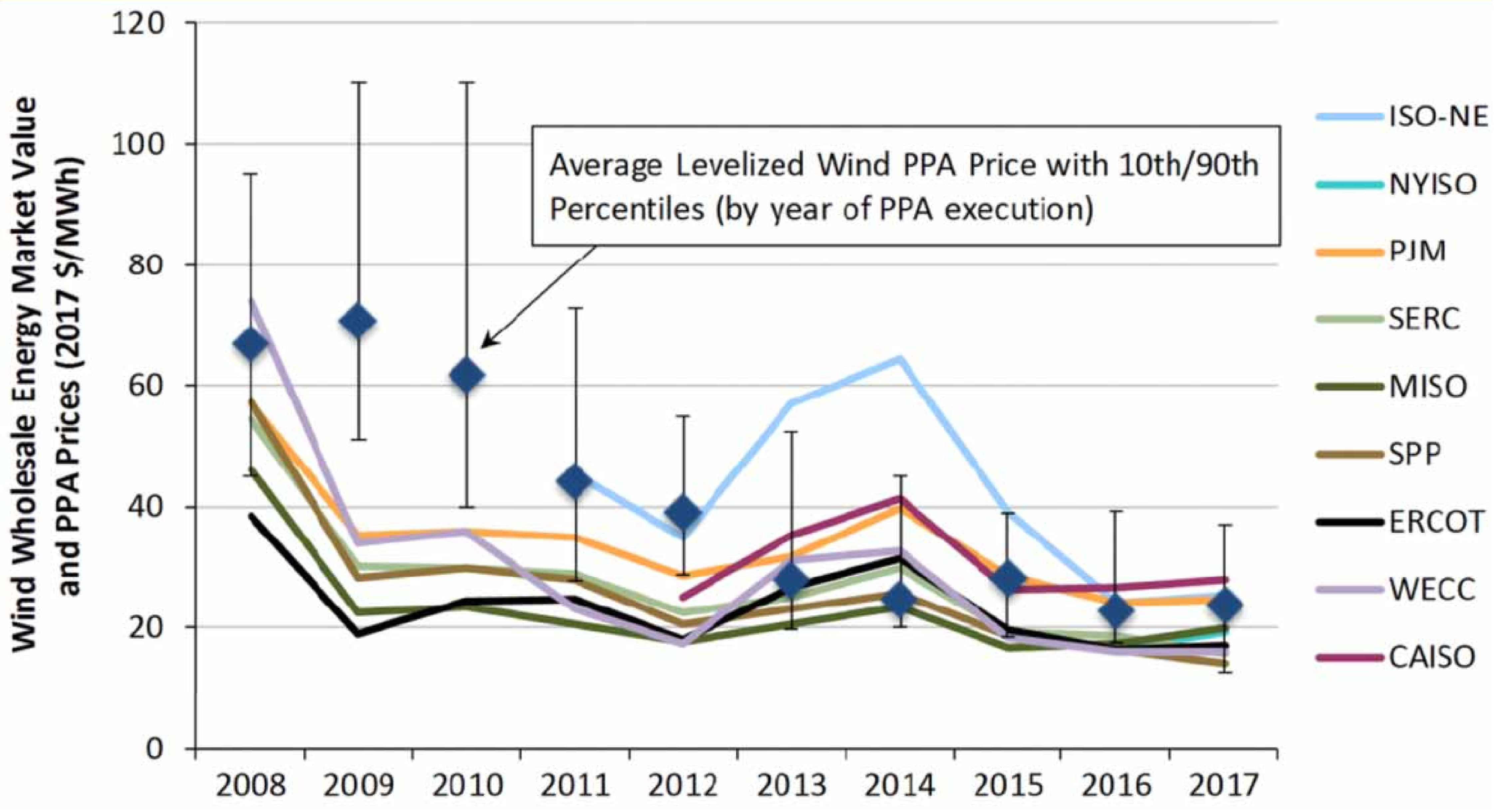
RE TRENDS | Learning Rate of **Battery Storage**



RE TRENDS | **Wind Installed Costs**



RE TRENDS | **Wholesale Market Value of Wind**

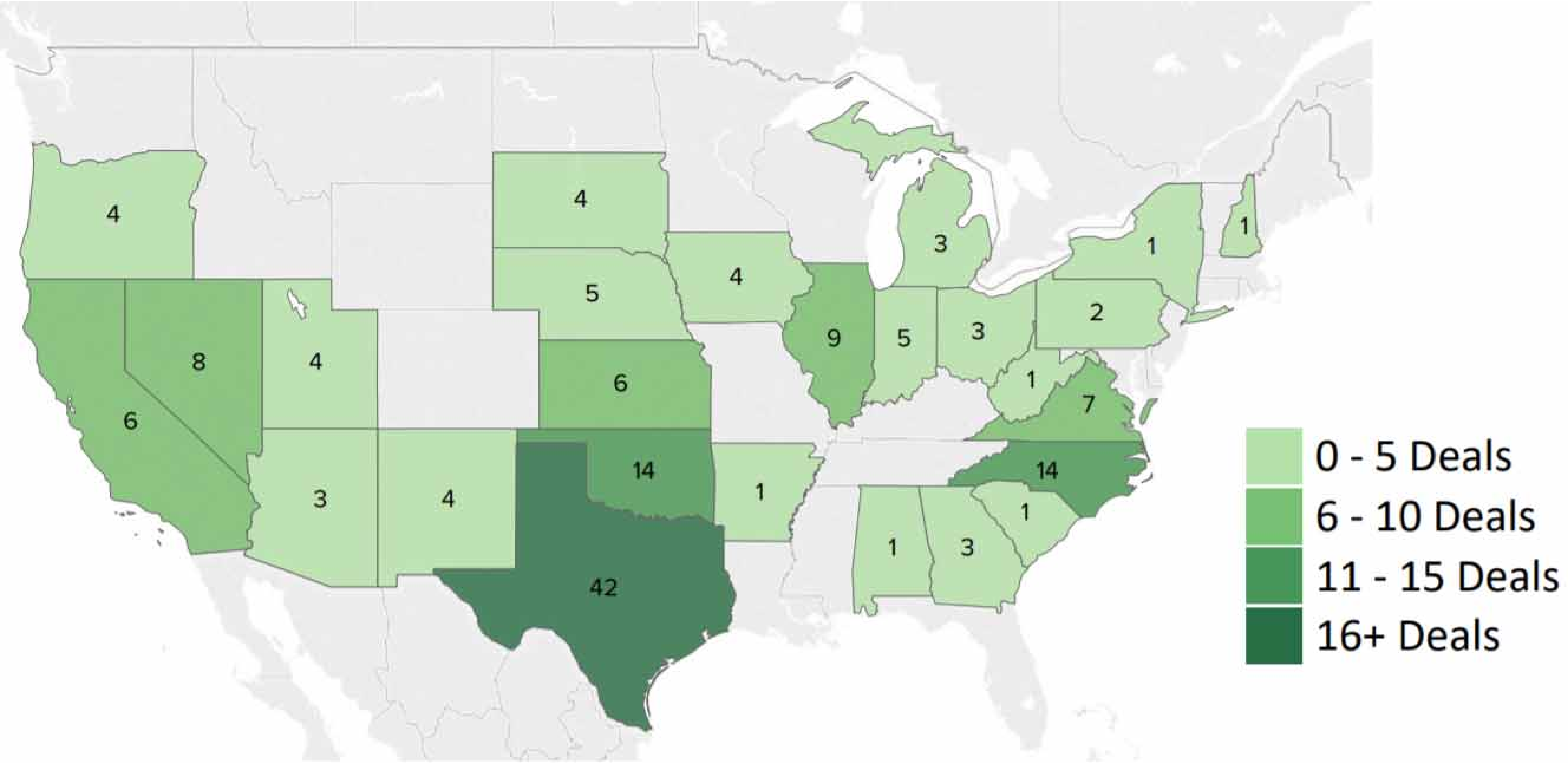


FINANCIAL CFD

Leveraging Offsite Opportunities

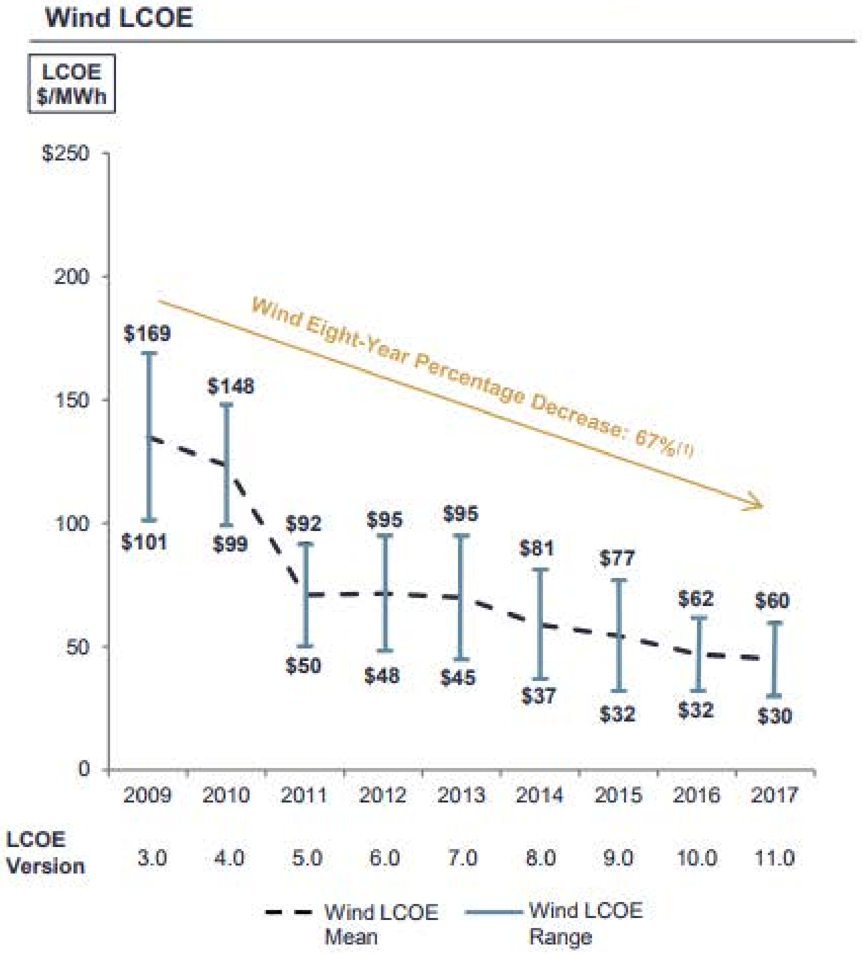
Competitive Energy SERVICES

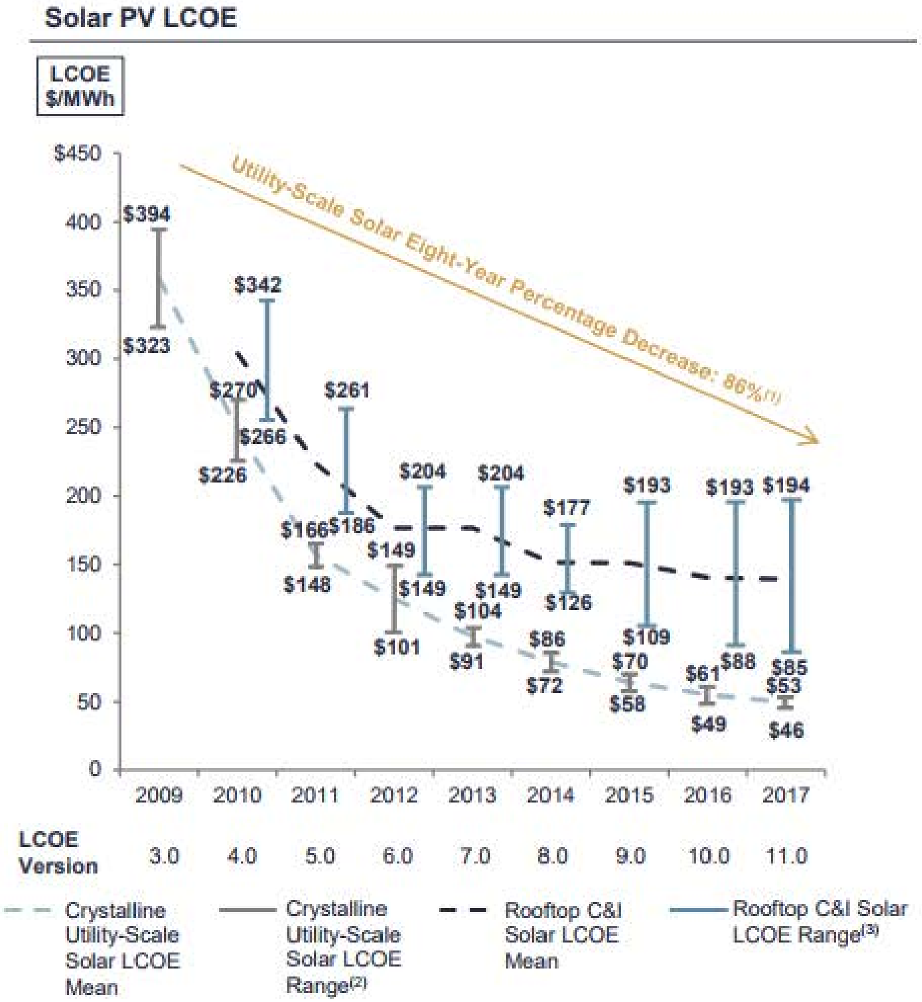
WIND & SOLAR | 2008-2018 Deals by State



Unsubsidized Levelized Cost of Energy—Wind & Solar PV (Historical)

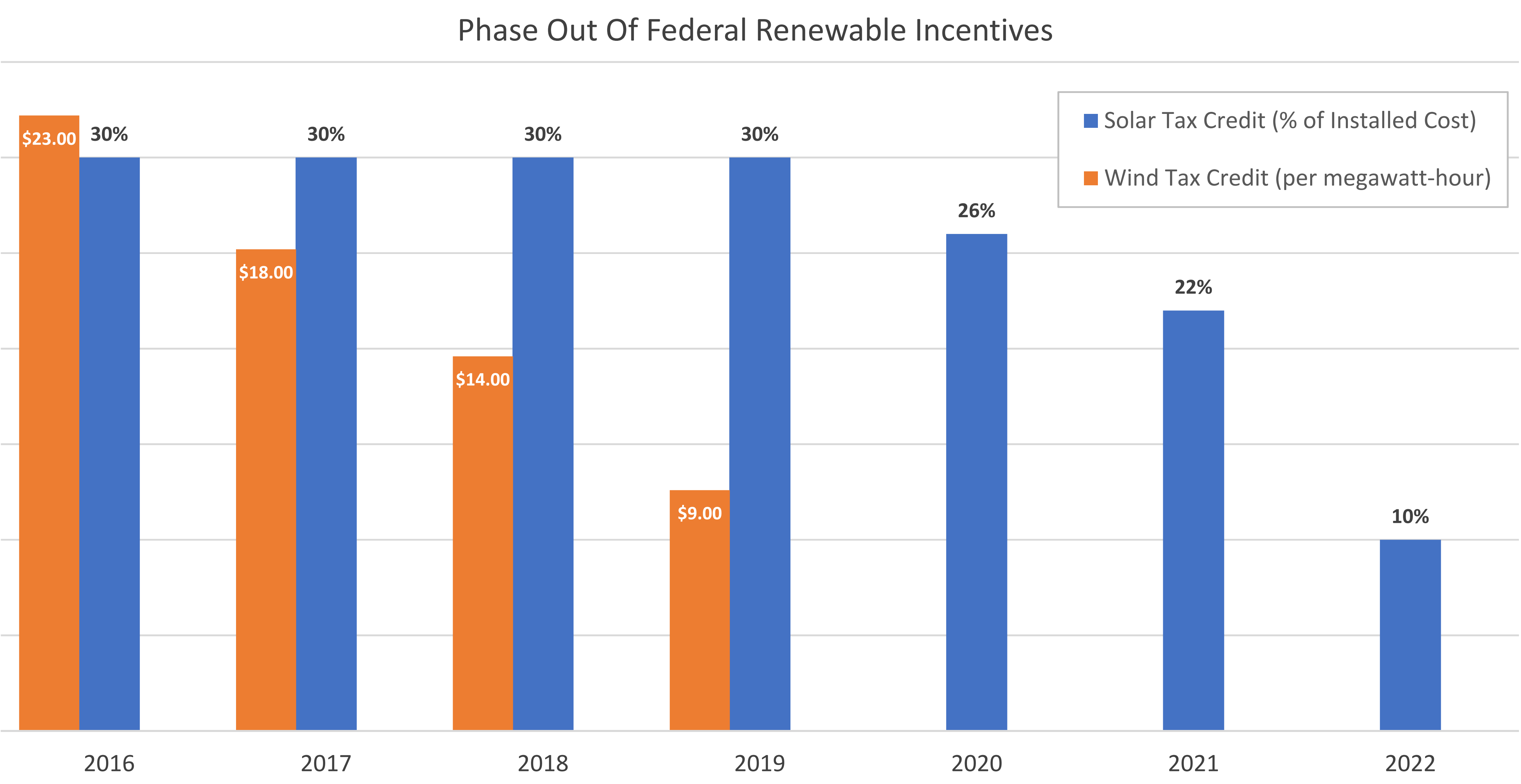
Over the last eight years, wind and solar PV have become increasingly cost-competitive with conventional generation technologies, on an unsubsidized basis, in light of material declines in the pricing of system components (e.g., panels, inverters, racking, turbines, etc.), and dramatic improvements in efficiency, among other factors





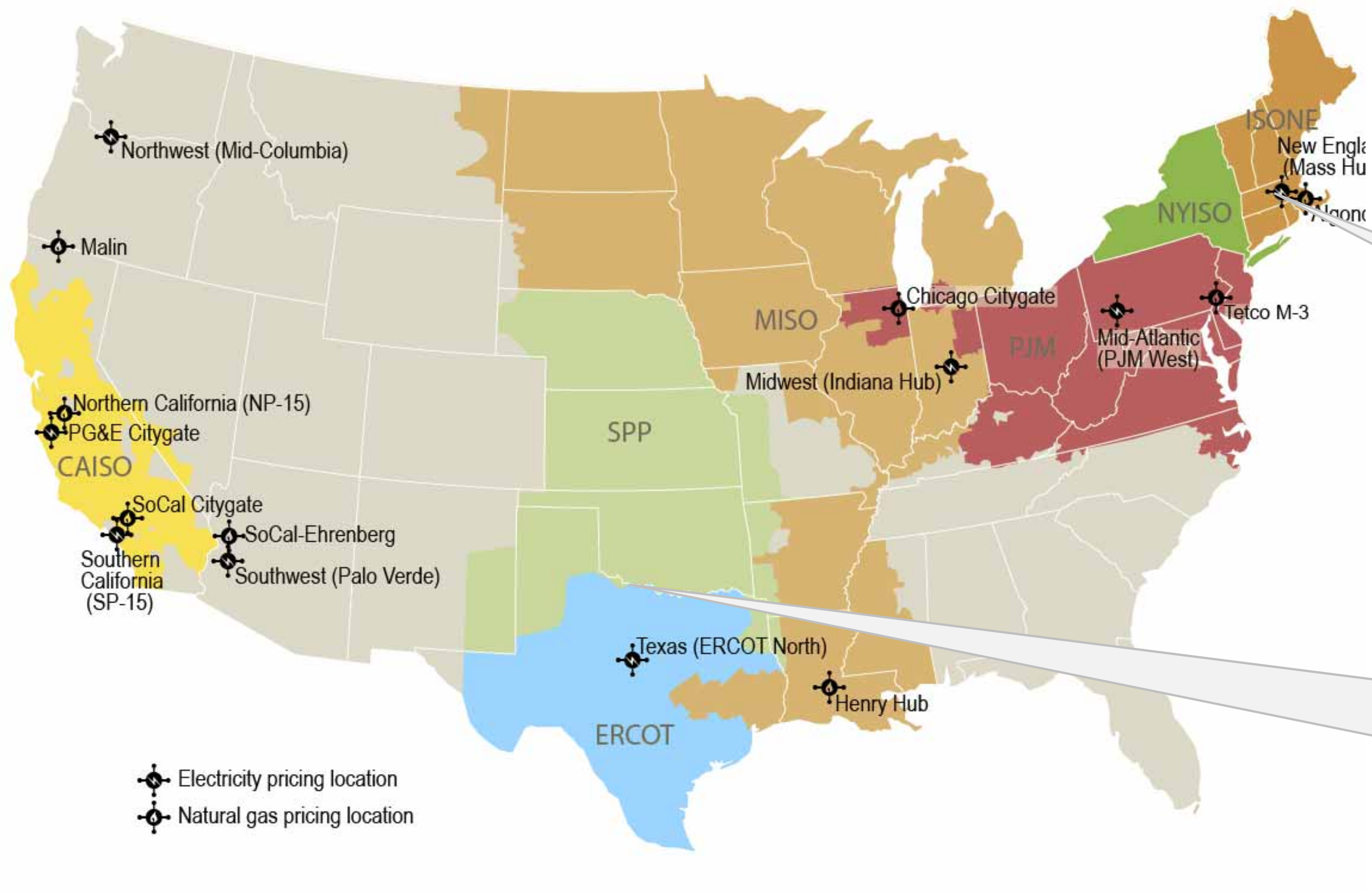
Lazard Freres

WIND & SOLAR | **Federal Incentive Phase Out**



FINANCIAL CFD | **Project Geography**

Selected price hub locations for wholesale electricity and natural gas reported by Intercontinental Exchange



Note: Colored areas denote Regional Transmission Organizations (RTO)/Independent System Operators (ISO)
Source: U.S. Energy Information Administration based on Ventyx Energy Velocity Suite

EVALUATION CRITERIA

- Economics
  - Price & Net Cost
- Message
  - Additionality
  - Carbon impact
- Proximity
  - Visibility
  - Market access

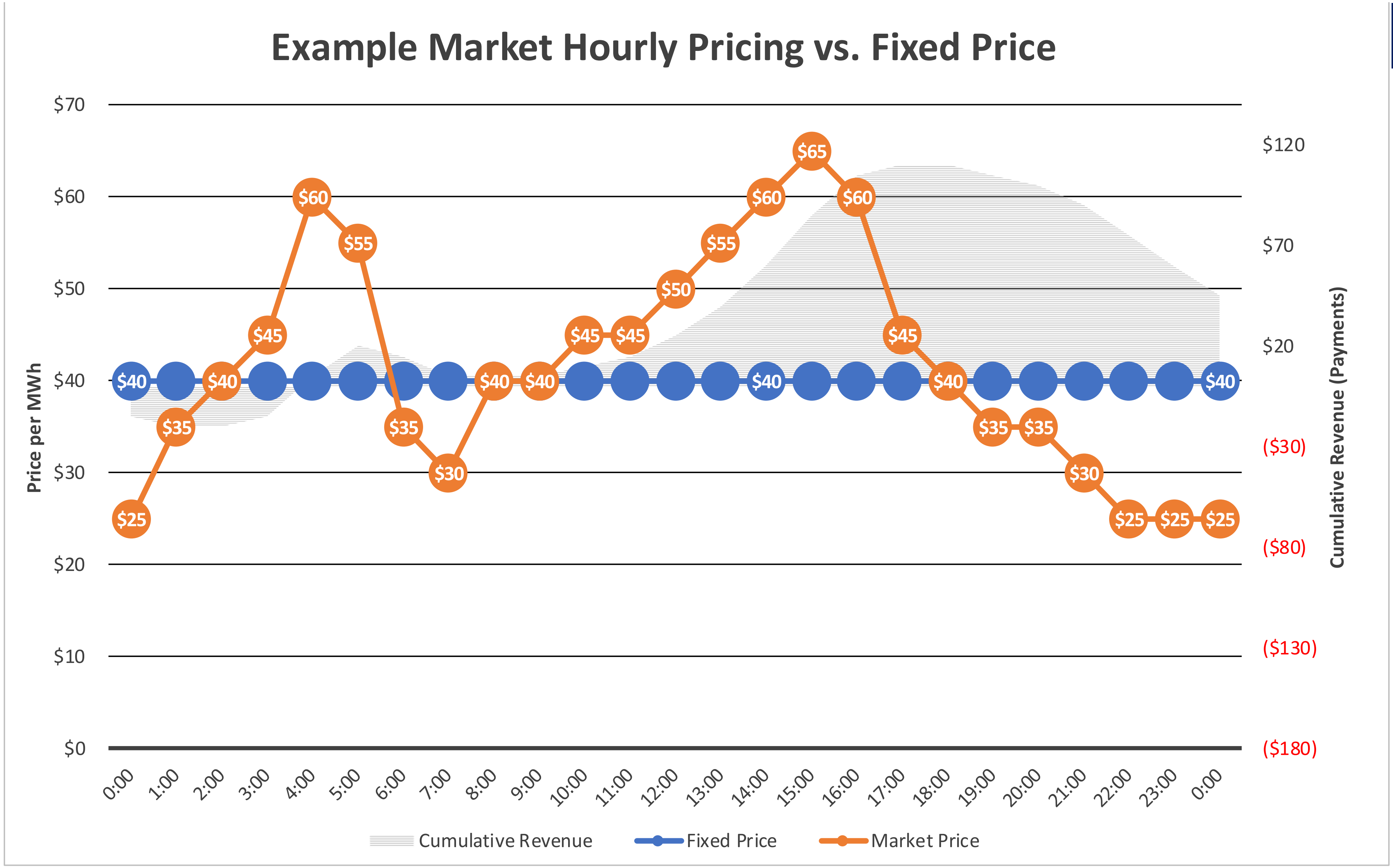
NEW ENGLAND WIND & SOLAR

- Pro: Nearby
- Pro: ISO-NE market access
- Con: Price premium

MIDWEST WIND

- Pro: Lower project prices
- Pro: Higher carbon impact
- Con: Far away
- Scale of competing offtakers

FINANCIAL CFD | **Settlement Example - Daily**



HOUR	NET BENEFIT (PAYMENT)
0:00	$15
1:00	$5
2:00	$0
3:00	($5)
4:00	($20)
5:00	($15)
6:00	$5
7:00	$10
8:00	$0
9:00	$0
10:00	($5)
11:00	($5)
12:00	($10)
13:00	($15)
14:00	($20)
15:00	($25)
16:00	($20)
17:00	($5)
18:00	$0
19:00	$5
20:00	$5
21:00	$10
22:00	$15
23:00	$15

FINANCIAL CFD | **Process Overview**

Competitive Energy Services

FLOATING LMP PAYMENT

1

PHYSICAL ENERGY

REC OWNERSHIP

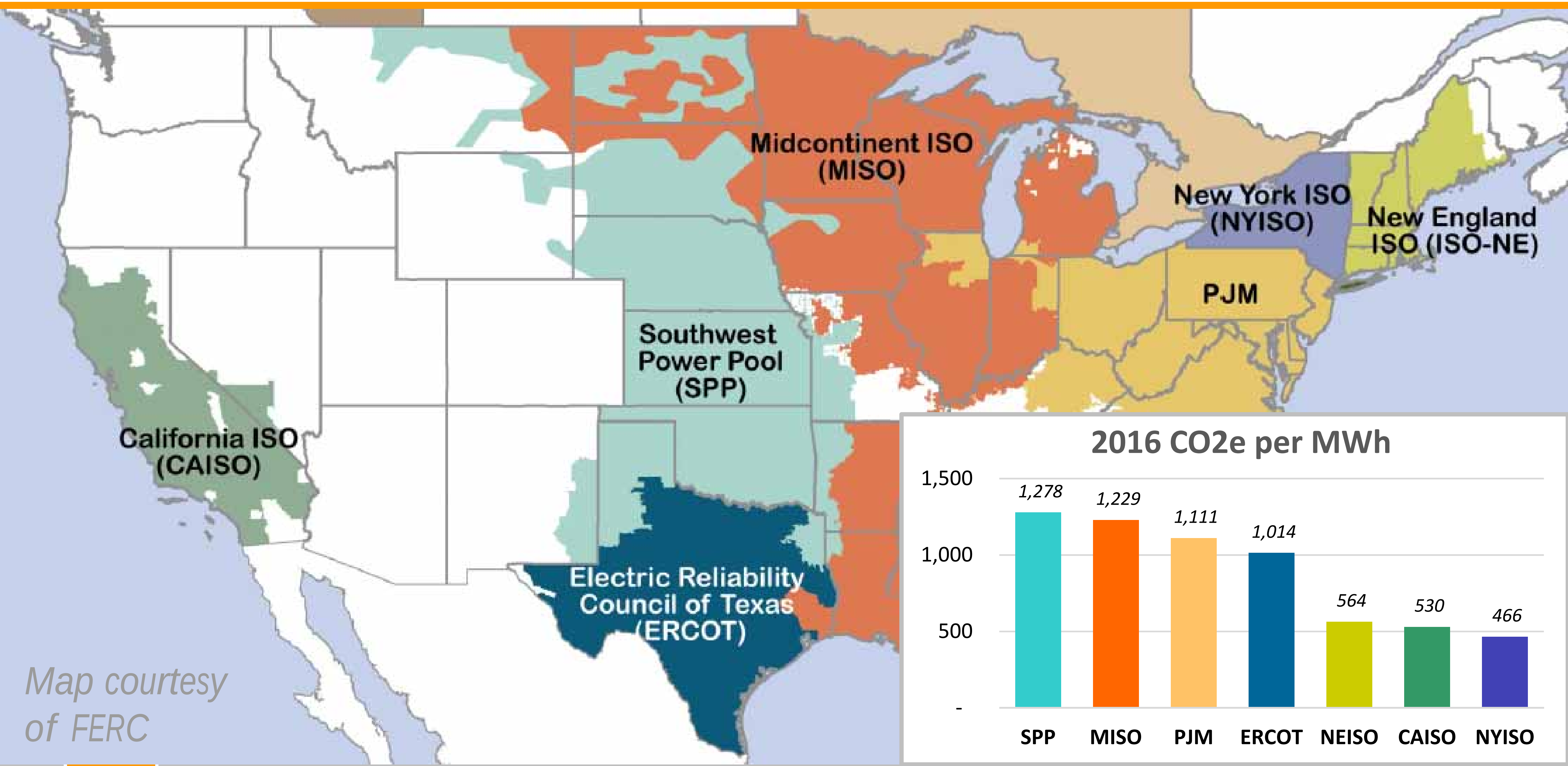
2

SETTLEMENT: FIXED PRICE – LMP PRICE

END USER

1. WHOLESALE ENERGY SALE: Offtaker signs a long-term contract with the project owner at a specified price. Once operational, the facility delivers energy to the grid and the owner receives the locational marginal price (“LMP”) at the project’s interconnection point.
2. HOURLY SETTLEMENT: Each hour, the difference between the fixed contract price and the LMP price is multiplied by the generation delivered to the grid. At the end of each month, Offtaker either pays the project owner or receives a payment from the project owner.
3. REC OWNERSHIP: The project owner deposits the RECs generated by the facility to a GIS account Offtaker owns. Offtaker either retires or sells the RECs.

FINANCIAL CFD | **Regional Carbon Impact**



Map courtesy of FERC