

2017 Integrated Resource Plan: *PSEG Long Island Analysis Summary*

April 10, 2017

Draft



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Objectives, Approach, and Industry Trends

- Objectives, Approach, and Industry Trends
- Existing Generation
- Clean Energy Standard and Offshore Wind
- Steam Plant Modernization
- Independent Brattle Group Assessment
- Key Assumptions

Objectives

- An Integrated Resource Plan (IRP) is a long-term study of the electric system that reflects a comprehensive consideration of assumptions, alternatives and uncertainty as of a date.
- This IRP examined the potential transmission and generation needs for long term system reliability under a range of scenarios and in the context of economic and policy considerations, including:
 - Meeting the newly enacted 50x30 Clean Energy Standard (CES), and
 - NYS Reliability Council and NYISO reliability planning criteria.
- The IRP was intended to identify resource needs, not to select specific transmission or generation proposals.

Approach: Methodology and Analytics

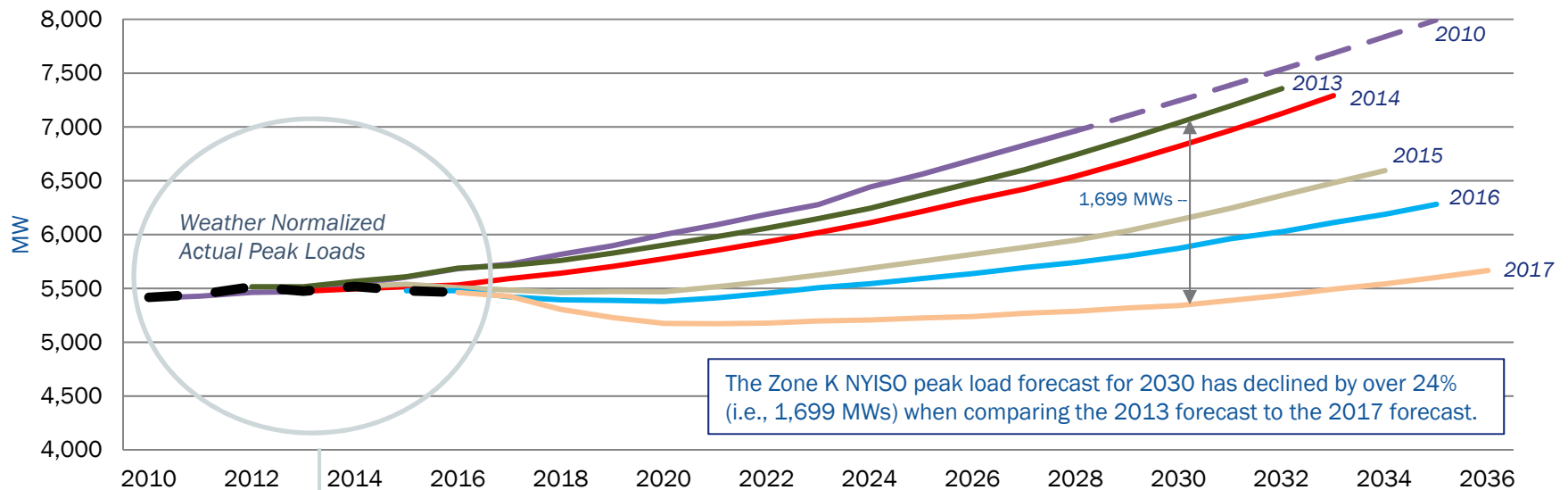
IRP reflects a disciplined, structured, and collaborative approach to examining alternative resource options

- Summary developed based on LIPA's confirmation of compliance with CES regulation.
- A 20-year study (2016-2035) with a 10-year actionable period (2016–2025).
- Over 50 scenarios and sensitivities analyzed.
- Resource needs assessment: when, how much, and under what conditions.
- Identification of resource solutions: conventional technologies, renewables, repowerings.
- Development of key assumptions.
- Use of sophisticated models.
- Identification of case sets, including various off-shore wind and electric vehicle (EV) penetration scenarios developed as a result of collaborative efforts with NYSERDA, the DPS, and LIPA.
- Sensitivity analyses around case sets, including those developed in collaboration with NYSERDA/DPS/LIPA.
- Analyze results along a variety of parameters (e.g., emissions, renewables, costs, retail rates).

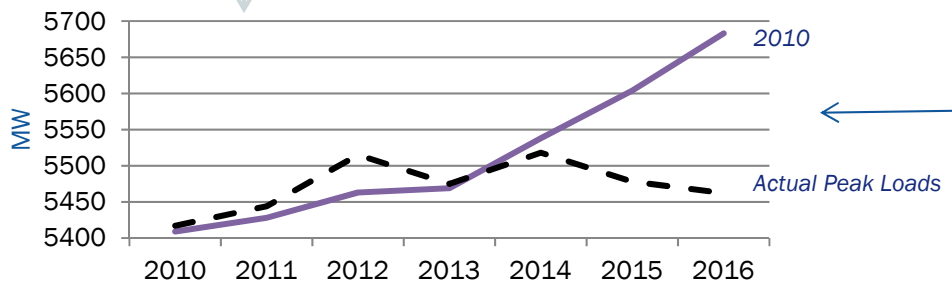
Industry Trend: Rapid Decline in Peak Load Forecast

Recent peak load forecasts show dramatic reductions from earlier forecasts driven by increases in energy efficiency, net metering, feed-in-tariffs, the decoupling of economic growth and energy use, and lower econometric growth projections.

Zone K NYISO Peak Load Forecasts



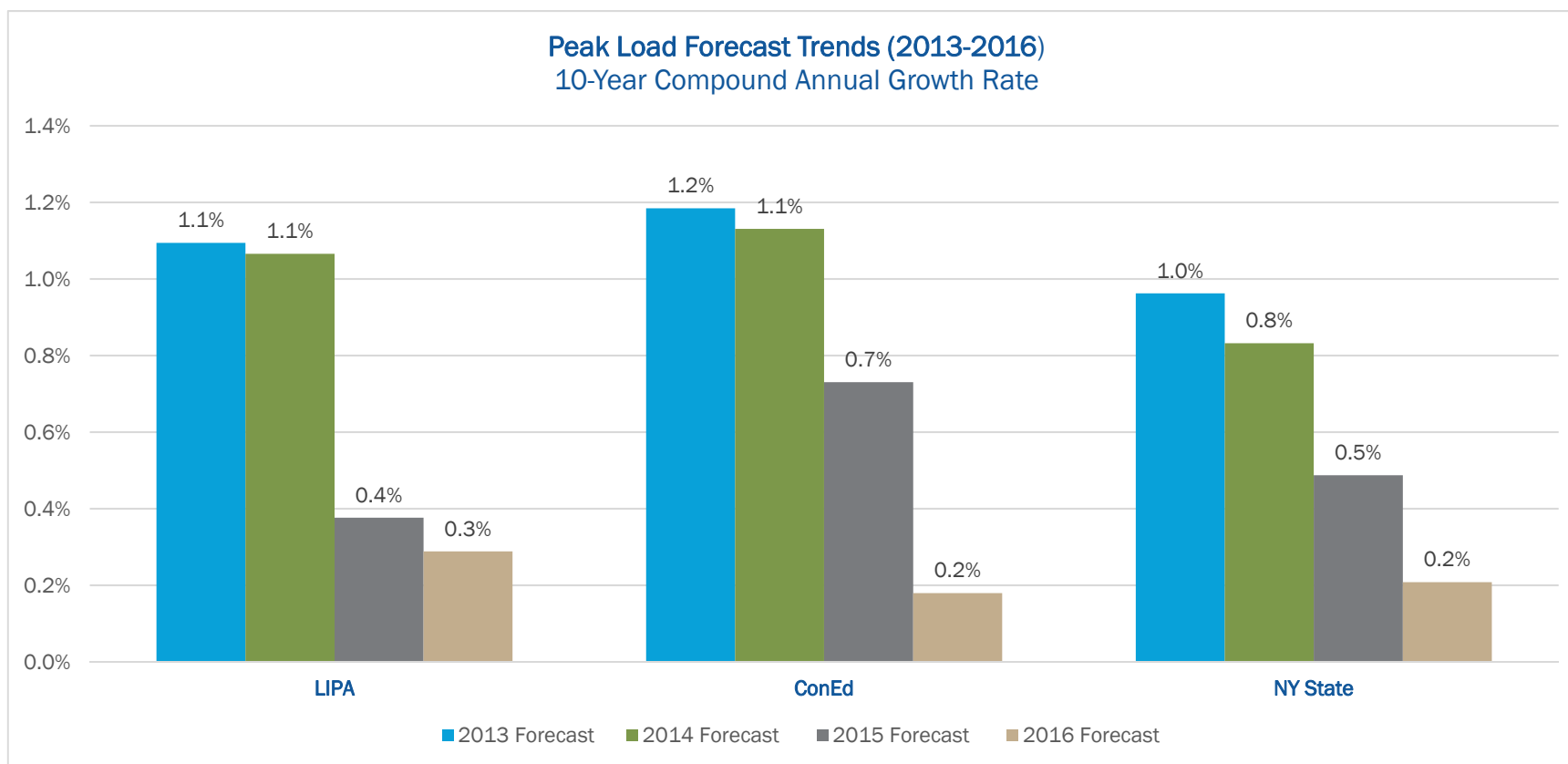
The Zone K NYISO peak load forecast for 2030 has declined by over 24% (i.e., 1,699 MWs) when comparing the 2013 forecast to the 2017 forecast.



The 2016 weather adjusted actual peak load is over 200 MW less than the 2010 forecast for 2016.

Industry Trend: Rapid Decline in Peak Load Forecast

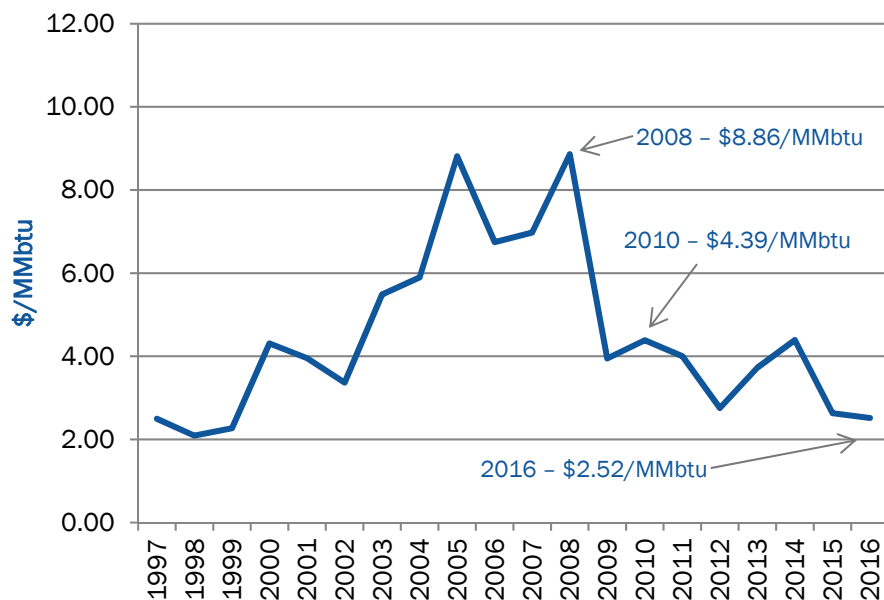
Long Island's recent peak load forecast reductions are consistent with state-wide and national trends and reflect the recognition of significant and continuing changes in the energy markets.



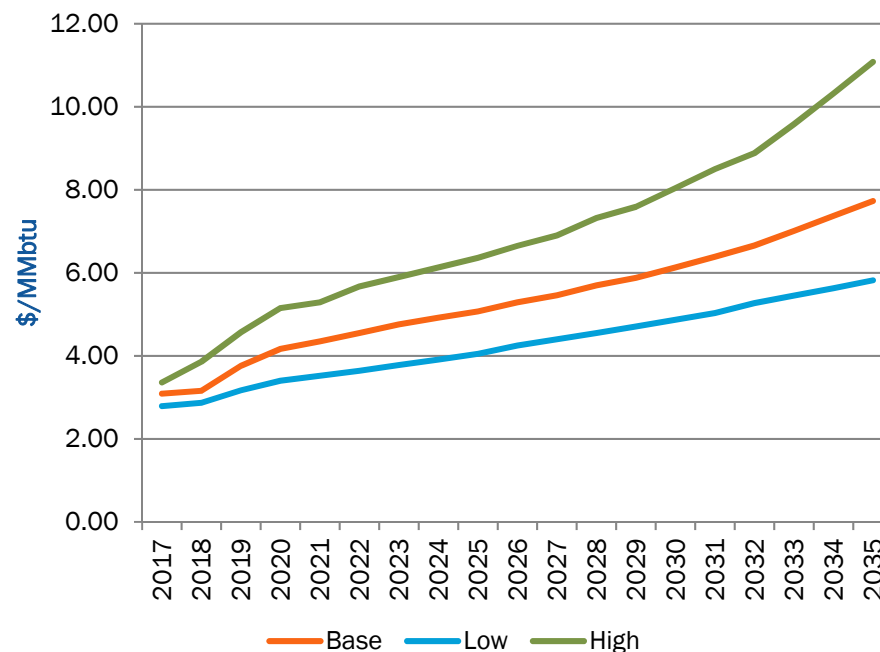
Industry Trend: Natural Gas and Power Prices Have Declined Sharply

- Natural Gas prices are back to late 1990s levels having decreased 72% since 2008 and 43% since 2010.
- Lower natural gas prices have also reduced the price to buy power in the regional electricity markets (in lieu of self generating).

Henry Hub - Historical Natural Gas Price



Henry Hub - Natural Gas Price Forecast



State Initiatives

State initiatives over the last three years are changing the State's energy markets. The exact timing, size and impact on Long Island's electric grid will become clearer over time.

State initiatives include the following:

January 2017: Governor Cuomo announces commitment to 2,400 MW offshore by 2030

October 2016: Clean Energy Standard: Phase 1 Implementation Order

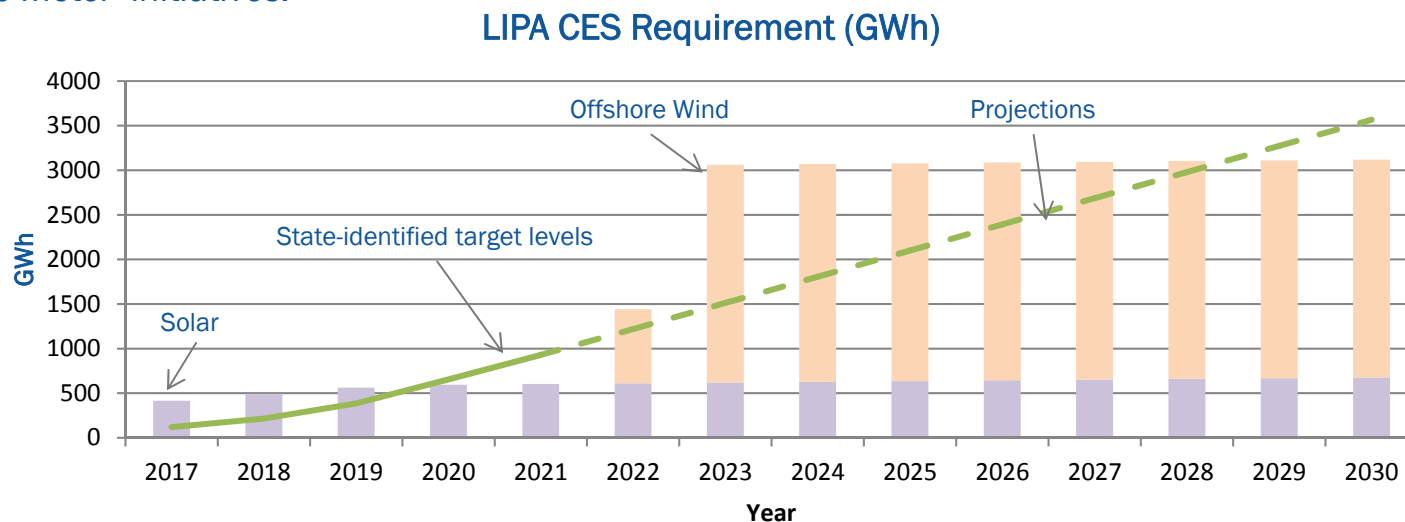
August 2016: Clean Energy Standard 50x30 Order

May 2016: REV - A Ratemaking and Utility Revenue Model Policy Framework Order

February 2015: Reforming the Energy Vision (REV) Order

State Initiatives: 50% by 2030 Clean Energy Standard

State's 50x30 CES will require that LIPA acquire 800 MW (nameplate capacity) of new renewable generation; load is expected to be reduced by ~950 MW by 2030 through energy efficiency, rooftop solar, and other 'behind the meter' initiatives.

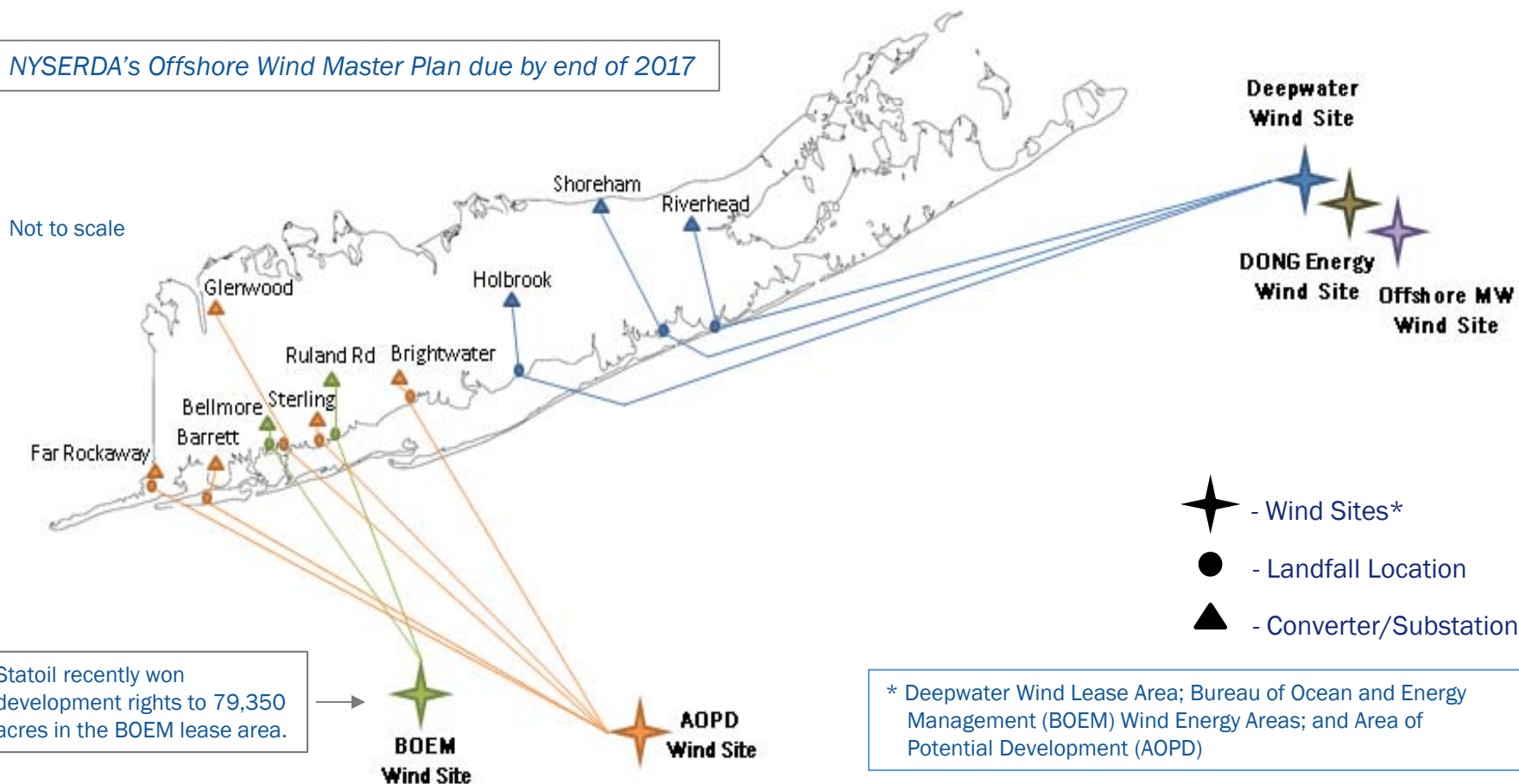


- LIPA's CES requirement is 12.3% of the statewide requirement of 29,000 GWh by 2030
- The IRP assumed that LIPA would meet its requirements by:
 - Acquisition of 400 MW of renewable resources by 2022.
 - Additional 400 MWs of utility scale renewables to comply with CES by 2030.
 - Small deficits in 2021 and 2029/30 are assumed to be met with banked credits.
- Energy Efficiency, rooftop solar, and other behind the meter renewables are expected to reduce LIPA's load by approximately 950 MW by 2030 (~2,200 GWh).

State Initiatives: 2,400MW Offshore Wind by 2030

Governor's 2,400 MW offshore wind goal by 2030 will likely increase renewable generation interconnected to Long Island to meet the 50x30 Clean Energy Standard, changing needs for Long Island's electric grid.

NYSERDA's Offshore Wind Master Plan due by end of 2017

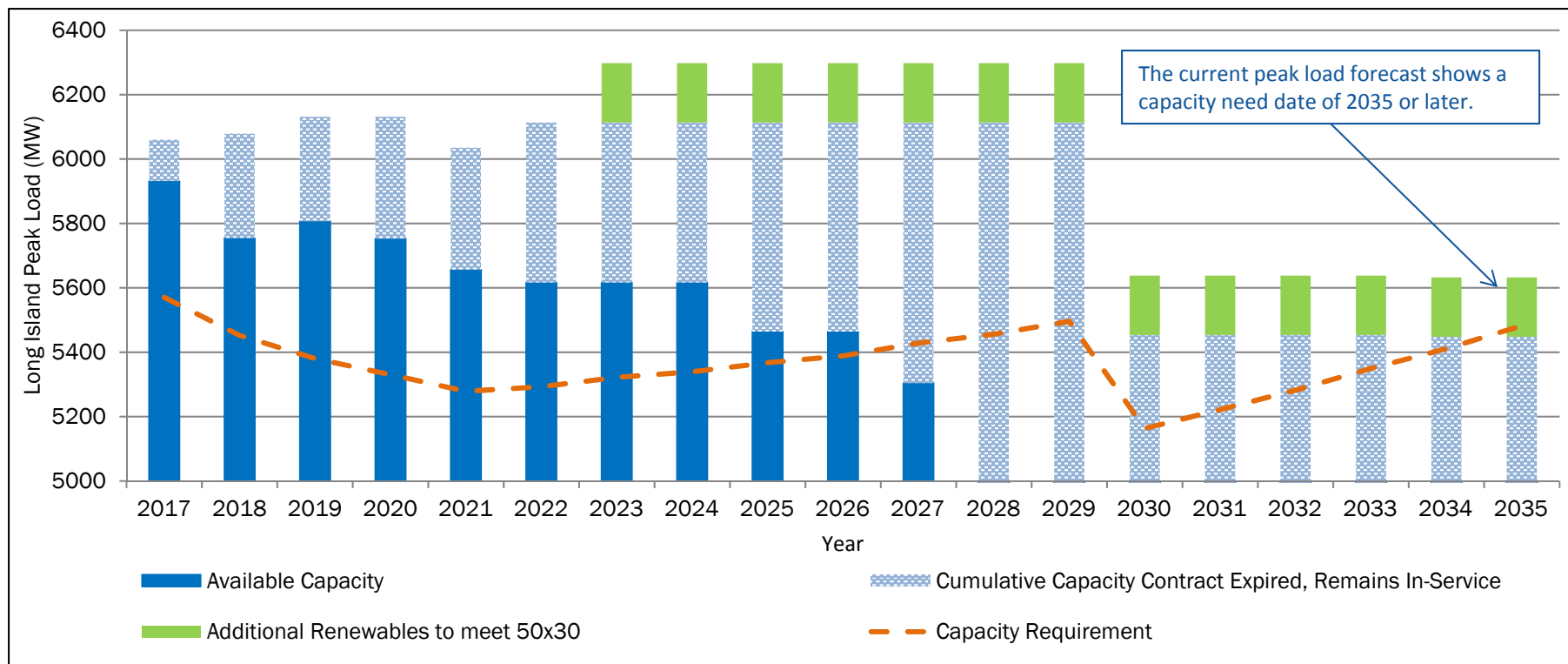


Existing Generation

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Existing Generation: Provides Planning Flexibility and Redundancy

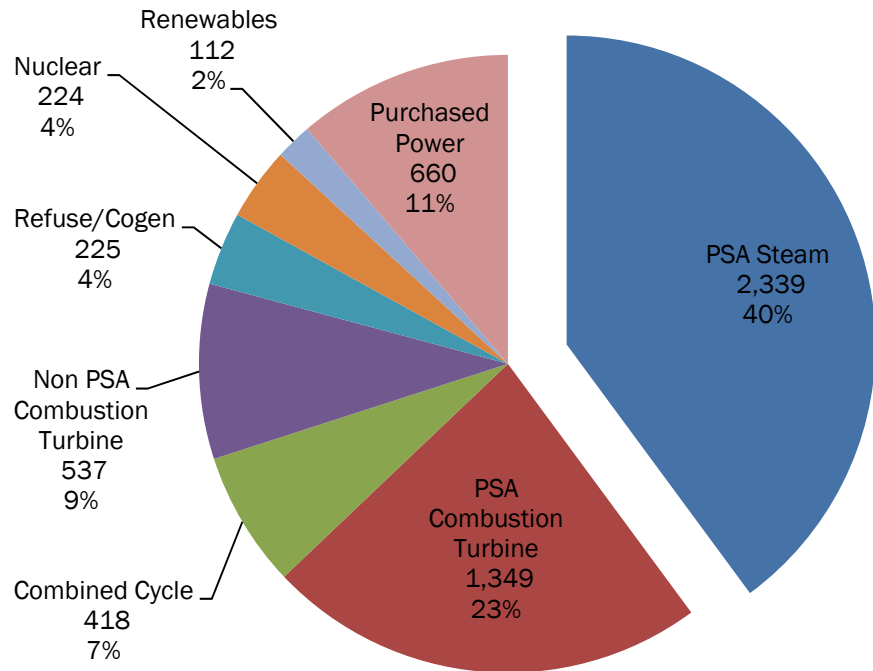
Ninety nine percent (99%) of LIPA's capacity contracts are up for renewal by 2030 providing substantial planning flexibility to reposition generation in response to changing conditions; excess supply over the peak load forecast provides redundancy.



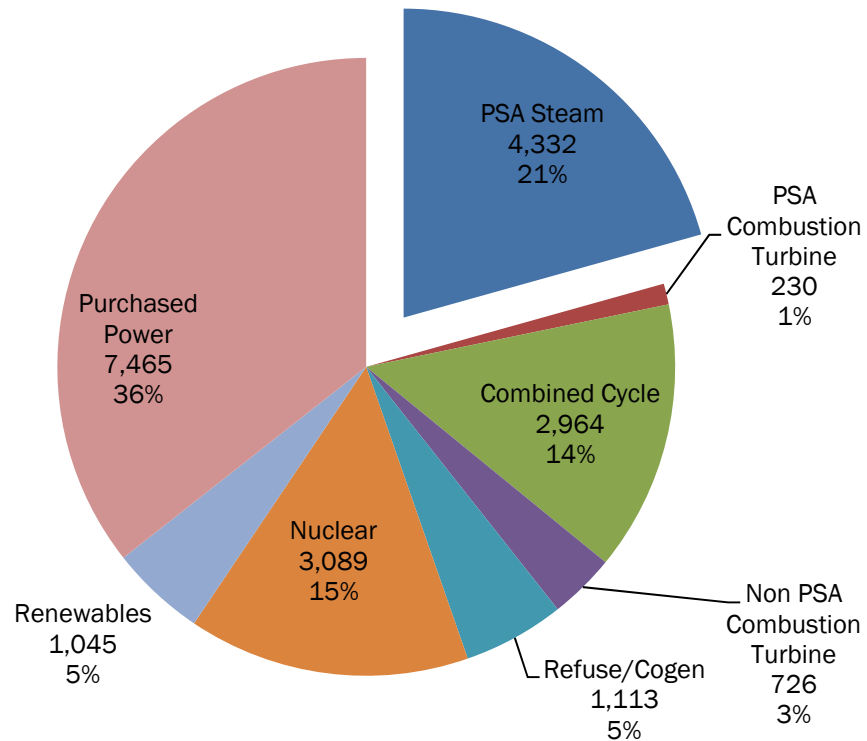
Existing Generation: Resource Mix

The PSA steam units represent 40% of LIPA's generation capacity while generating only 21% of energy requirements. NYISO determines which units are run to optimize and reduce cost.

2016 Generation Capacity by Resource (MW)



2016 Energy by Resource (GWh)

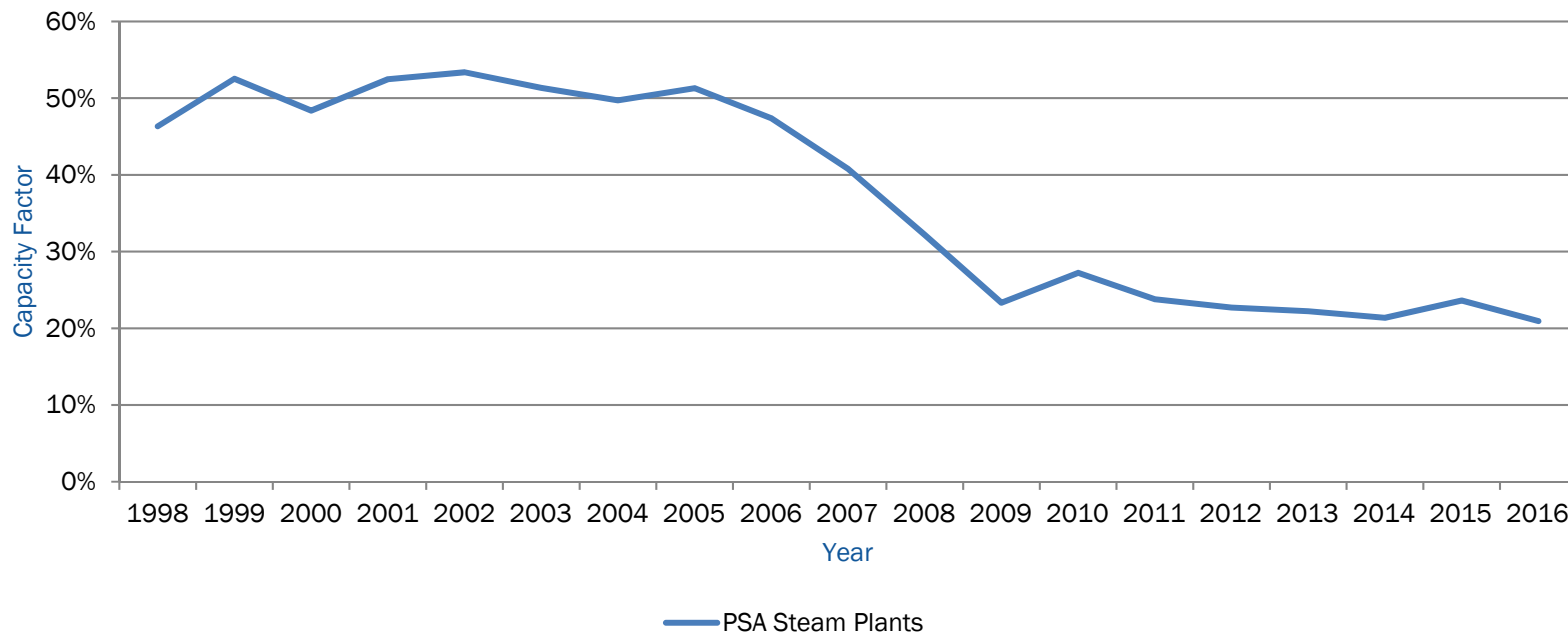


Note: PSA – Power Supply Agreement with National Grid

Existing Generation: Steam Units Run Time Has Declined Significantly

The PSA steam units represent 40% of LIPA's capacity but the plants' usage has declined precipitously since the late 1990s with the addition of more efficient on-island generation and new transmission cables that better connect Long Island with regional power markets.

PSA Steam: Average Historical Capacity Factors
(energy produced / maximum output)



Existing Generation: Steam Units Operate Reliably

The PSA steam units operate reliably with equivalent availability (summer) averaging well above 90%, in line with modern LIPA-contracted combined cycle facilities.

Steam Plants - 2016	
Plant	Equivalent Availability: Summer (%)
Barrett Steam Units	92
Northport Steam Units	94
Port Jefferson Steam Units	98
New Combined Cycle Plant Contractual Guarantee (typical)	95 - 97

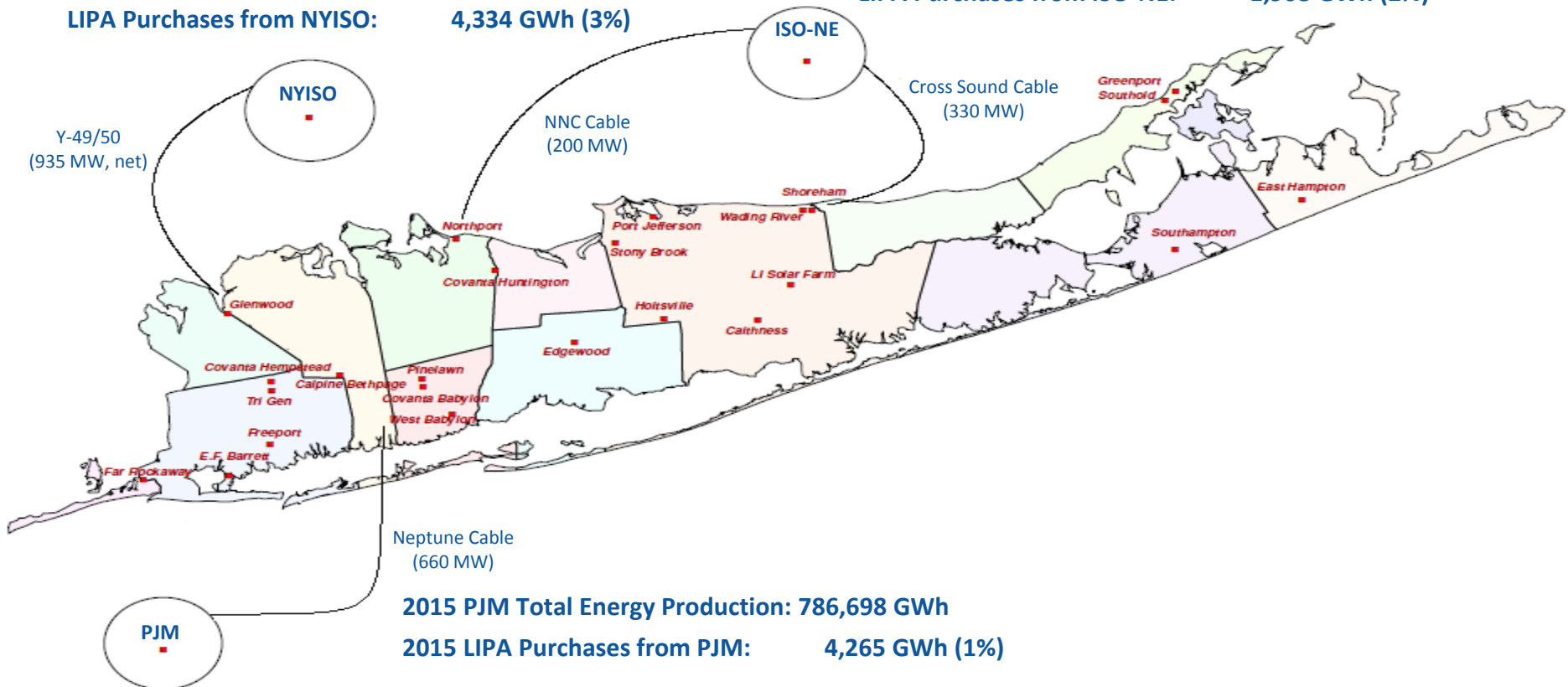
An independent condition assessment by RCM Technologies concluded that with reasonable capital O&M expenditures the steam units should operate reliably through the study period.

Transmission: Cables to Regional Electric Grids

LIPA's annual purchases of approximately 10,500 GWh of energy across five transmission cables to the New York, New England, and PJM power markets provides diverse and robust supply, redundancy, lower cost, and represents a tiny fraction of generation in those markets.

NYISO Total Energy Production: 142,346 GWh
LIPA Purchases from NYISO: 4,334 GWh (3%)

ISO-NE Total Energy Production: 107,916 GWh
LIPA Purchases from ISO-NE: 1,908 GWh (2%)



2015 PJM Total Energy Production: 786,698 GWh
2015 LIPA Purchases from PJM: 4,265 GWh (1%)

Clean Energy Standard and Offshore Wind (CES/OSW)

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CES/OSW: Meeting the 50 x 30 Clean Energy Standard

LIPA has a number of options to meet Governor Cuomo's 50 x 30 Clean Energy Standard; it will require the equivalent of 700–800 MWs (nameplate) of new renewable generation.

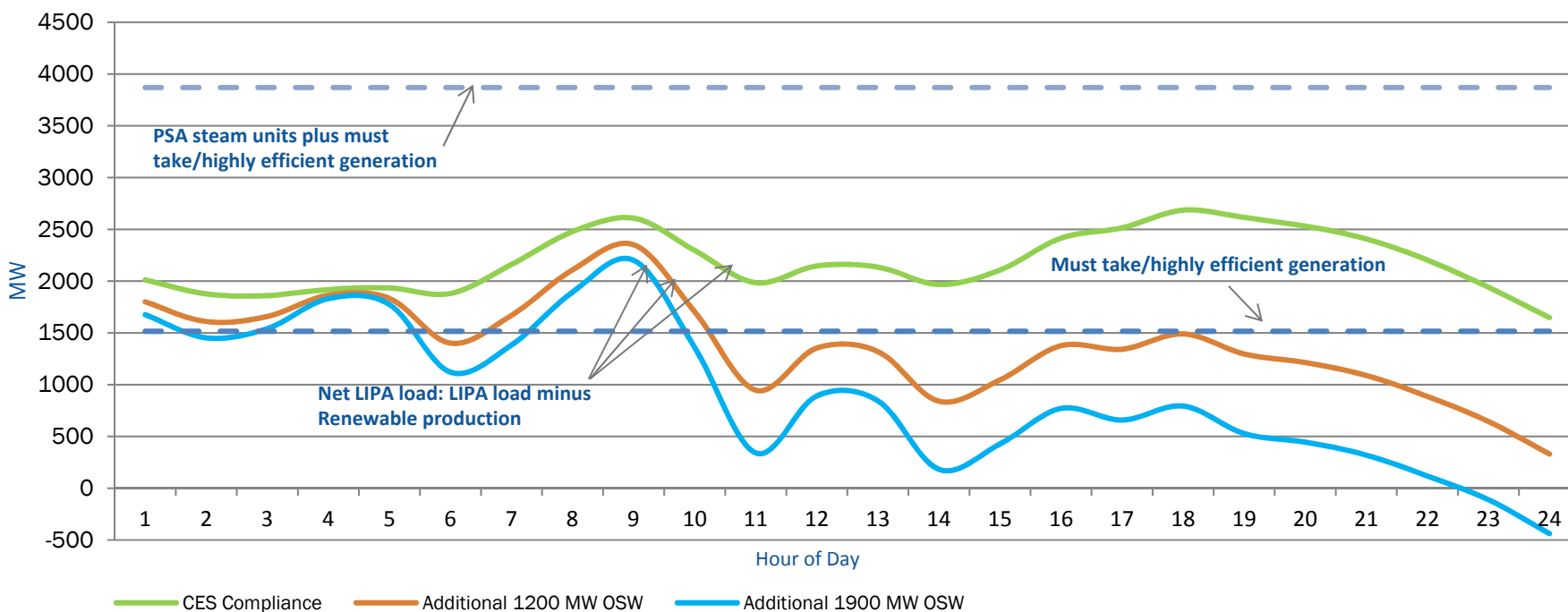
Approach	Benefits	Challenges
Self Supply By Entering Into Power Purchase Agreements	<ul style="list-style-type: none"> Resources are directly connected to the Long Island grid Existing 400 MW initiative ensures 50x30 compliance through 2023 	<ul style="list-style-type: none"> Limited on-island sites for solar and other resources Limits scale benefits as projects are sized to meet only Long Island needs
Utilize Statewide CES Initiatives	<ul style="list-style-type: none"> Wide-ranging options (hydro, terrestrial wind, solar) in combination with other utilities through NYSERDA Reduced cost from scale economies of larger offshore wind buildouts 	<ul style="list-style-type: none"> Impact on Long Island generation depends on points of interconnection

- LIPA executed a contract for a 90 MW offshore wind project – a gateway project to develop Long Island's offshore wind resource.
- Governor Cuomo's commitment to 2,400 MW of Offshore Wind by 2030 potentially provides the economies of scale associated with larger projects in partnership with the State's other utilities.
- NYSERDA to issue its Offshore Wind Master Plan in late 2017.

CES/OSW: Renewable Resources Significantly Alter Generation Needs

The injection of offshore wind and other renewable resources into LIPA's system significantly reduces reliance on the steam units and increases the need for peaking units, batteries, demand response and other more flexible resources.

Typical Peak Winter Day: LIPA Load Net of Renewables

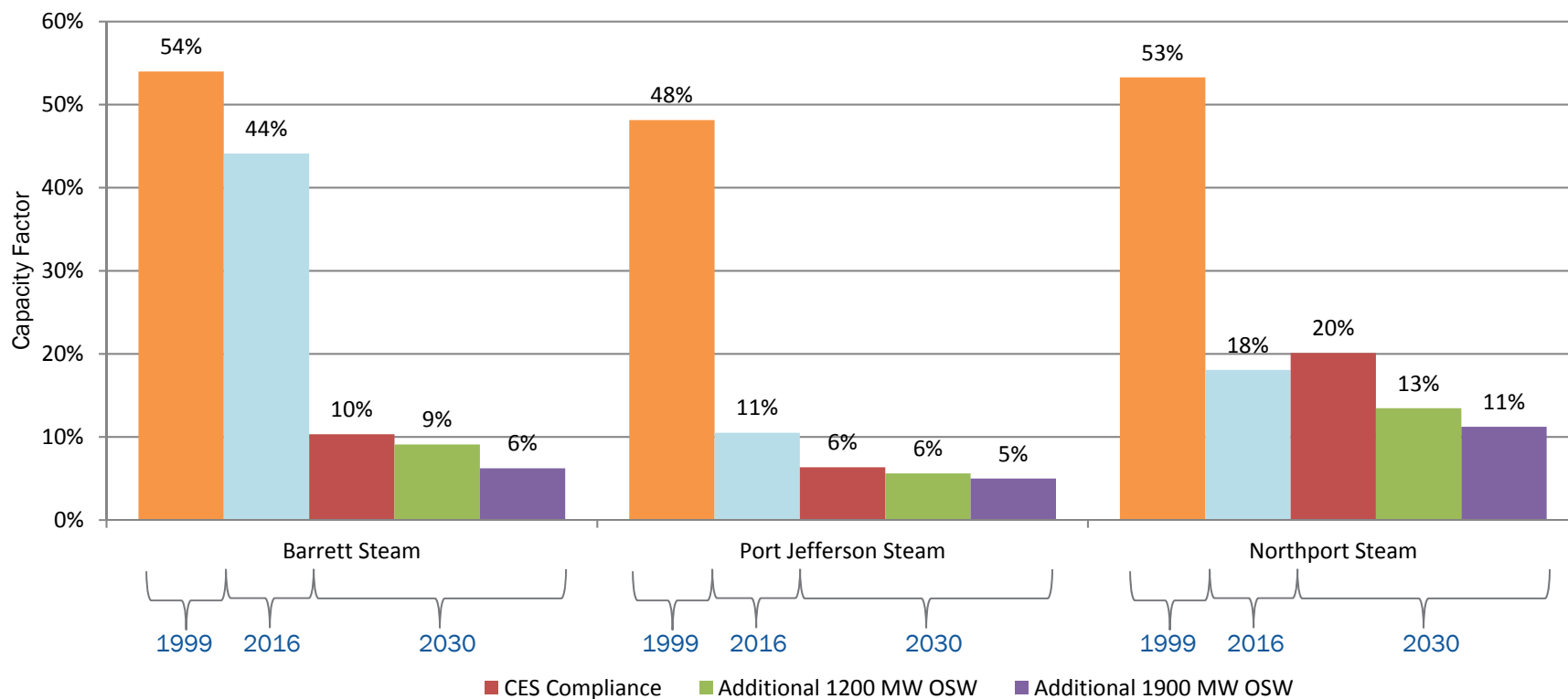


- The winter period is shown but the impact to the run time of the steam units is worse in the spring and fall periods.

Increasing Renewables Reduces Run Time of Steam Units

The injection of offshore wind and other renewable resources into LIPA's system as well as other system changes are projected to further reduce the capacity factors of the PSA steam units, dramatically for Barrett.

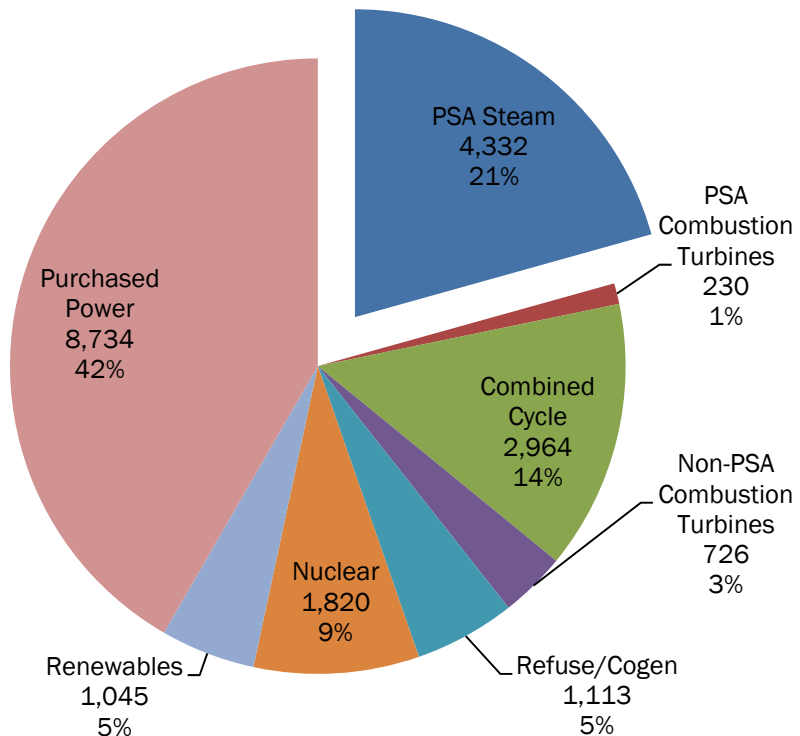
PSA Steam: Unit Capacity Factor Impacts: Historical vs 2030



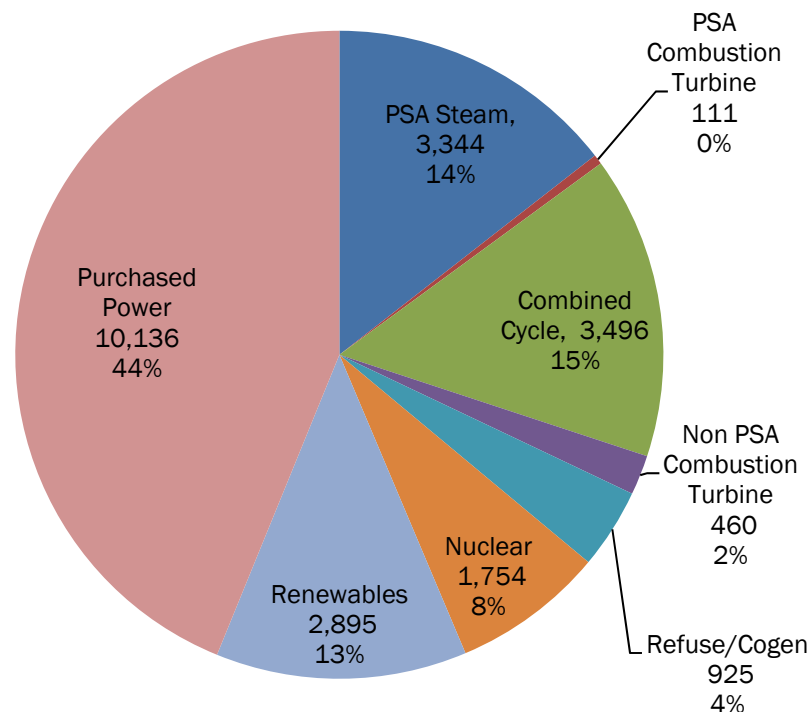
CES/OSW: Increasing Renewables Reduces Run Time of Steam Units

Achieving CES compliance by 2030 reduces generation from the steam units by 7 while renewable generation increases by over 7% as a percent of total energy requirements.

2016 Energy by Resource (GWh)



2030 Generation by Resource (GWh)



Note: Purchased power includes generation from Fitzpatrick contract that expires December 2017.

Steam Plant Modernization

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Steam Plant Modernization: Introduction

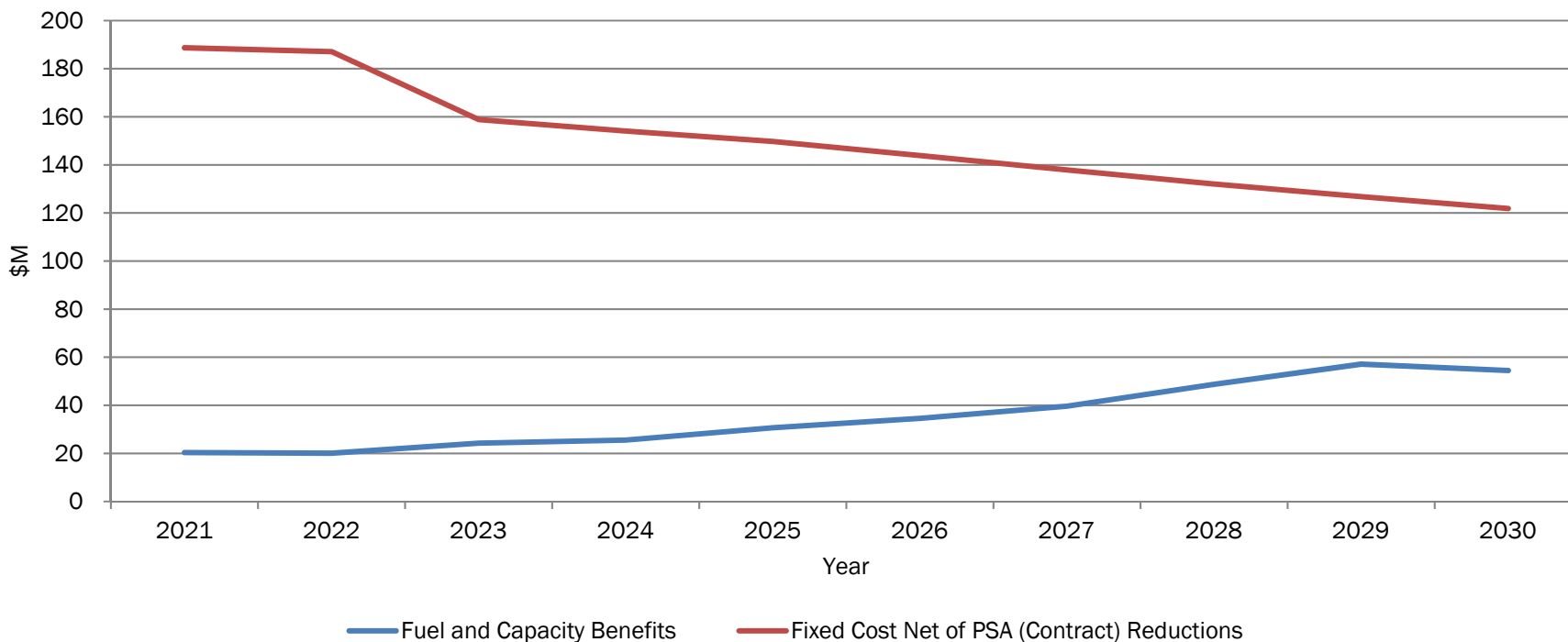
LIPA is considering three proposals to build large new “baseload” combined cycle plants. These proposals can be evaluated relative to how well they fit the system needs identified in the IRP.

- LIPA does not need to add generation to meet load growth through at least 2035.
- LIPA has received three proposals to build combined cycle plants to modernize the steam units:
 - Caithness II: a 706 MW project identified as part of a 2010 RFP.
 - Barrett repowering: a 637 MW project that would replace the Barrett steam units and most of the on-site combustion turbines; studied as part a State legislative requirement.
 - Port Jefferson repowering: a 397 MW project that would replace the Port Jefferson steam units; studied as part a State legislative requirement.
 - Northport repowering: to be studied as part of a State legislative requirement.
- The PSA expires in 2028, but LIPA has ramp down rights for all PSA generating units including Port Jefferson, Barrett and Northport.
- An IRP typically identifies needs and then leads to follow on studies and possibly procurements for resources that best meet the identified needs.

Steam Plant Modernization: Costs to Build Exceed Fuel Savings

Repowering the plants or building new combined cycle plants in another location do not pay for themselves with fuel savings.

Barrett Repowering

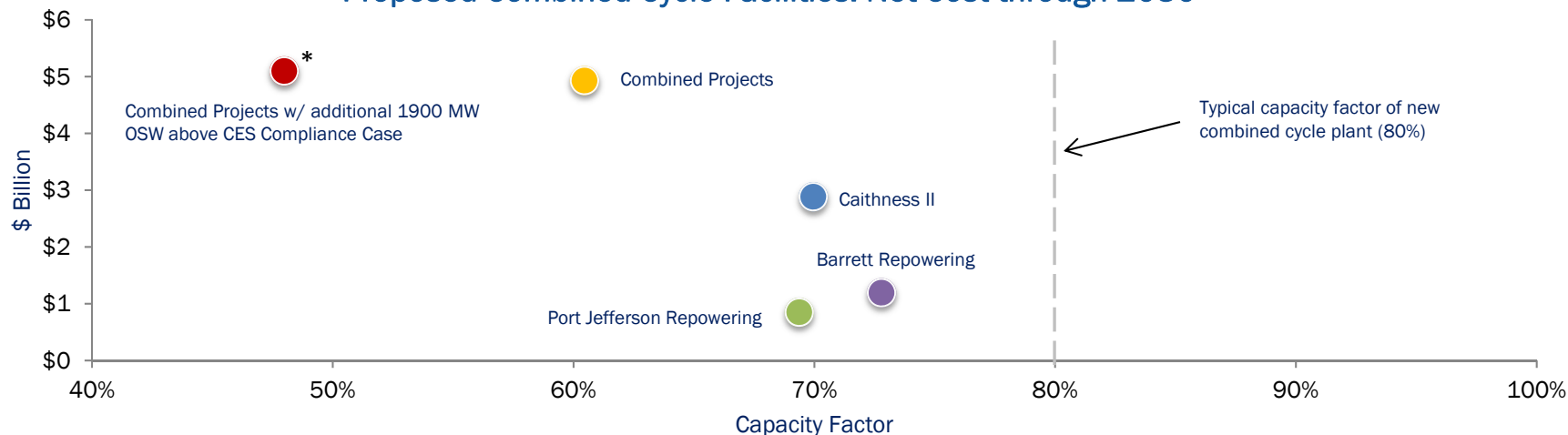


- Port Jefferson repowering and Caithness II are similar in shape.

Steam Plant Modernization: Net Cost Through 2030

Cost for steam plant modernization would exceed \$5 billion or \$2,210 for an average residential customer through 2030 and is not required for reliability purposes. Repowered plants or the addition of a new combined cycle capacity show a declining capacity factor and a considerable cost relative to CES compliance. A new combined cycle plant unencumbered by other competing combined cycle plants or renewables would be expected to have a capacity factor in excess of 80%.

Proposed Combined Cycle Facilities: Net Cost through 2030

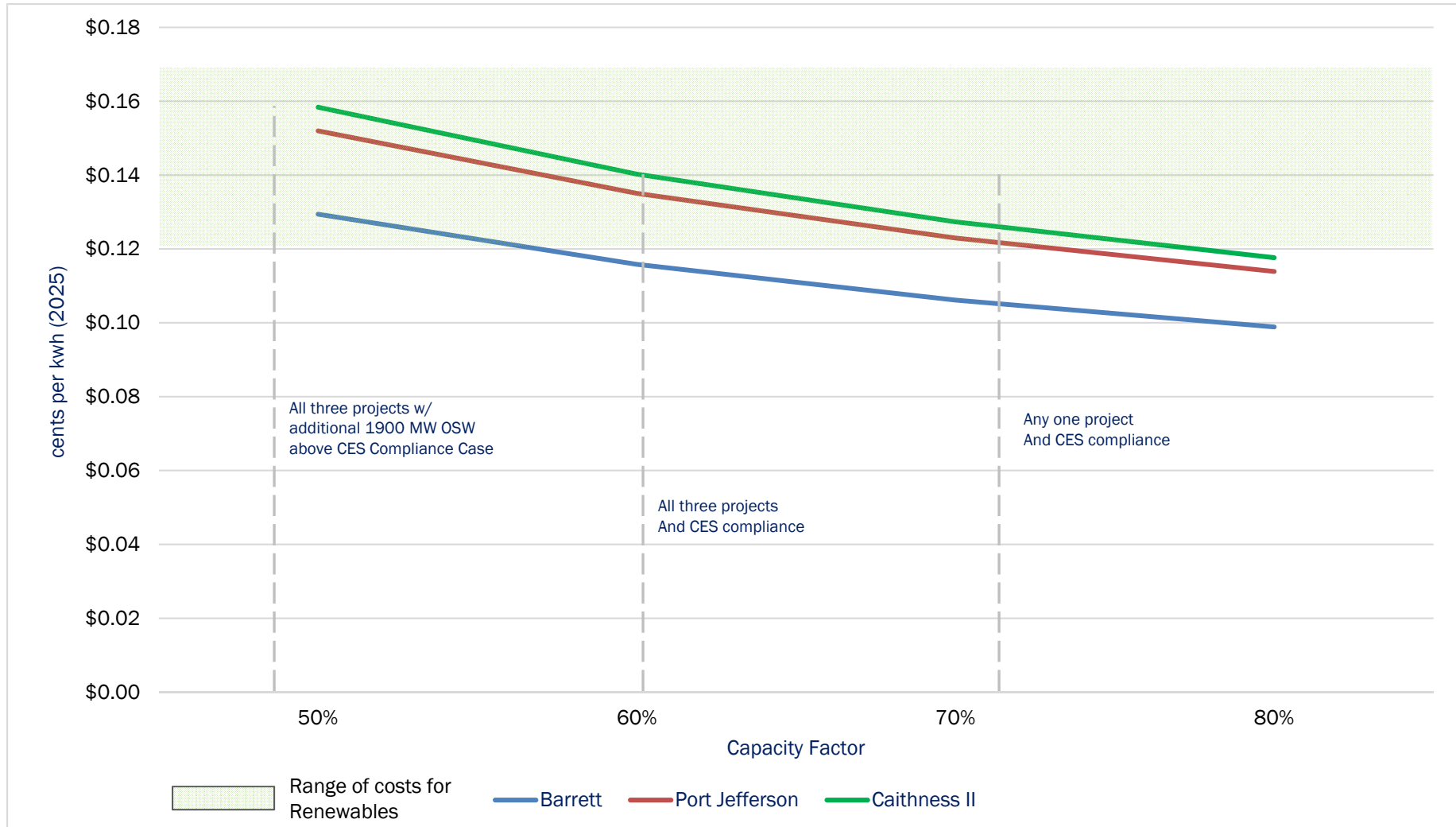


* Incremental cost for additional 1,900 MW OSW not included, assumed to be paid by rest of state.

	Barrett	Port Jefferson	Caithness II	All Three
Net Cost	\$1.2 billion	\$0.9 billion	\$2.9 billion	\$5 billion
Typical Residential Customer	\$536	\$378	\$1,297	\$2,210

- Average annual cost for steam plant modernization for a typical residential customer is about ~\$170/year over the period 2017 - 2030.
- Cost impacts are measured against the IRP CES compliance case.

Steam Plant Modernization: Cost per kWh for Proposed Combined Cycle Facilities



Steam Plant Modernization: Operating Characteristics

The proposed combined cycle (CC) plants have operating characteristics that are more flexible than the PSA steam units but less flexible than typical peaking units. Peaking units may better balance intermittent renewable resources.

Characteristic	Existing PSA Units		New Units			
	Steam Units	Combustion Turbines	Combined Cycle	Peaking Units (Simple Cycle)		
				Large Frame	Small Frame	Aero
Cold Start Time	26 - 30 hours	10 - 30 min	3 - 4 hours	10 min	10 min	≤ 10 min
Minimum Run Time (hours)	16	1	4	No technical minimum limit		
Ramp Rate (MWs/min)	2 - 4	NA	15 - 40	50 - 100+	25	25
Heat rate (Btu/kWh)	10,000 - 11,300	13,000 - 16,500	6,600 - 6,800	8,000 - 8,200	9,700	8,900 - 9,500

Steam Plant Modernization: Benefits Comparison

Modernizing the steam plants has fuel efficiency and emissions rate benefits. Similar or greater benefits may be available from other proposals.

Comparison of New Combined Cycle Plant to Existing Steam Plants		
Characteristic	<i>Repower Barrett and Port Jefferson</i>	<i>Caithness II</i>
Reliability	Same	Same
Capacity	Same	Increased*
Fuel efficiency	Higher	Higher
Emissions rate	Lower	Lower
Storm Resiliency	Same	Same
Operational flexibility	Higher	Higher
Future flexibility to meet changing system needs	Lower	Lower
Cost	Higher	Higher

* Increased capacity is a negative characteristic in the current LIPA system environment given the excess on-island capacity.

Independent Brattle Group Assessment

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Independent Brattle Group Assessment

The Brattle Group was retained by LIPA to provide an assessment and recommendation on whether it was reasonable and appropriate for LIPA to adopt the NYISO reliability planning criteria in 2014 and whether it is in the best interest of customers to proceed with either Caithness II and/or the repowering projects.

Brattle found that:

- It was appropriate for LIPA to adopt the NYISO reliability planning criteria in 2014.
- Deferring consideration of Caithness II in 2014 for further study was reasonable at the time and events since have validated that action.
- There is no compelling reason for LIPA to proceed with Caithness II or the Barrett or Port Jefferson repowering projects as none of the projects are needed for reliability or economic purposes.

Key Assumptions

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Key Assumptions

- Load (peak and energy) forecasts approved by NYISO
 - Assumes meeting the 50x30 Clean Energy Standard
 - Assumes continuation of the Energy Efficiency Program over the study period
 - Due to Demand Side Management (DSM) and Energy Programs, load growth is relatively flat through 2024, thereafter load growth averages ~65 MW/year through 2035 (~36 MW/year with the current 2017 NYISO peak load forecast).
- Fuel and emissions forecasts developed by Energy Ventures Analysis, Inc. for base, high, and low scenarios; dated 8/25/2016
- Unit capacity updated as per NYISO's 2015 Load & Capacity Data (Gold Book)
- Transmission model based on NYISO's 715 FERC Base case for 2015
- Existing/recent RFP's:
 - South Fork: offshore wind, capacity resources, DSM, transmission
 - Glenwood and Far Rockaway: transmission
- Upon contract expiration, units are assumed to continue operate as merchant units