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SUNY Stony Brook University
Clean Energy Master Plan

April 2021

NEW YORK STATE OF OPPORTUNITY. | NY Power Authority

Stony Brook University

NREL Transforming ENERGY

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Glossary of Acronyms

AERTC	Advanced Energy and Research Technology Center
CES	Clean Energy Standard
CLCPA	Climate Leadership & Community Protection Act
COVID-19	Corona Virus Disease 2019
EBG	SUNY Energy Buying Group
EIA	US Energy Information Administration
EMP	Energy Master Plan
EO	Executive Order
EPA	US Environmental Protection Agency
EUI	Energy Use Intensity
EV	Electric Vehicle
GHG	Greenhouse Gas
HVAC	Heating Ventilation and Air Conditioning
ITC	Investment Tax Credit
LBMP	Location Based Marginal Pricing
LCOE	Levelized Cost of Energy
LIPA	Long Island Power Authority
LSE	Load Serving Entity
NENY	New Efficiency New York
NREL	National Renewable Energy Laboratory
NYGATS	New York Generation Attribution Tracking System
NYISO	New York Independent System Operator
NYPA	New York Power Authority
NYSERDA	New York State Energy Research and Development Authority
OAG	NYS Office of the Attorney General
OSC	NYS Office of State Comptroller
PPA	Power Purchase Agreement
PSEG	Public Service Enterprise Group
PTC	Production Tax Credit
PV	Photovoltaic
REC	Renewable Energy Credit
RES	Renewable Energy Standard
SAM	NREL's System Advisory Model
SBU	Stony Brook University
SUNY	State University of New York
VPPA	Virtual Power Purchase Agreement

1 Executive Summary

The State University of New York ("SUNY")'s Stony Brook University ("SBU" or "Campus") partnered with the New York Power Authority ("NYPA") to develop a Clean Energy Master Plan ("CEMP" or "Report") to identify clear targets for the Campus per New York State and SUNY's clean energy goals and define strategies and options available to achieve these targets. The CEMP details these different options and the cost to implement each of them with the objective to determine the optimal approach. The report is limited to the Main, South, Southampton and R&D campuses unless otherwise noted. In parallel with this study, NYPA is also preparing a CEMP for the East Campus due in April 2021. This Clean Energy Master Plan may be the first of its kind for any New York State agency and SBU leads by example through this initiative to identify pathways to accomplish the different goals.

After an in-depth analysis of various options, NYPA has determined that investing in offsite solar PV alongside implementing onsite solar PV is the most promising means for SBU to achieve its renewable energy goals. The estimated cost to SBU to achieve the renewable energy goals set by NYS is $89M over a twenty-year period between 2030 and 2050. The average annual cost is estimated at $3.7M between 2030 and 2040 and $5.2M between 2040 and 2050. This cost is in addition to the current utility costs the University pays annually and includes the Main, South, Southampton and R&D Campus (excludes East Campus).

Since 2017, NYS has set 10 goals within Executive Order ("EO") 166, New Efficiency NY, and most recently the NYS Climate Leadership and Community Protection Act ("CLCPA"). SBU has made significant investments of over $150M over the past decade, in projects to improve energy efficiency of its facilities and has been able to maintain its consumption at a constant level. This allowed the Campus to be ahead and on track to achieve 4 out of the 10 goals including increasing energy efficiency 23% by 2030 compared to energy use intensity for fiscal year ("FY") 2012 and reducing greenhouse gas ("GHG") emissions 40% by 2030 compared to baseline of FY 1990.

The remaining six goals are as follows:

- 2025 – 100% Renewable Energy (SUNY)
- 2025 – Reduce Carbon Emissions (NENY)
- 2030 – 50% Renewable Energy (EO166)
- 2030 – 70% Renewable Energy (CLCPA)
- 2040 – 100% Renewable Energy (CLCPA)
- 2050 – 85% GHG Emissions Reduction (CLCPA)

Of the remaining six goals the Campus is yet to meet, the 100% renewable electricity by 2025 set by SUNY is the most aggressive goal, that based on this analysis, NYPA does not believe there is sufficient time to implement enough on-site projects or availability of offsite renewable energy credits to achieve this goal by 2025. In addition, the cost to implement projects to achieve the 2025 New Efficiency NY (NENY) carbon reduction goal is being determined under the NYPA

Phase II Energy Master Plans and is not included in this report. Therefore, the $89M cost indicated above does not include the two 2025 goals listed.

The recommended approach to achieve the four remaining goals is to offtake energy from offsite solar PV as well as implement onsite solar PV. SBU has estimated that it could install 4 MW of solar on campus by 2030 which would account for approximately 7% of the renewable energy goals. SBU will require to purchase renewable energy credits equal to the amount of remaining power consumed by the Campus from fossil fuel burning sources. This study provides an in-depth analysis and comparison of the multiple ways these renewable energy credits can be purchased.

The Campus has already initiated the efforts to procure cost-beneficial onsite solar projects, through NYPA's Clean Energy Advisory Services program. Through the program, NYPA will solicit renewable developers that can develop, design, construct, own, and operate solar PV projects on behalf of the Campus to offset its energy needs.

2 Background

SBU's success in achieving their energy efficiency goal started with developing a number of energy master plans that included Academic, Residence, and Medical departments over time. The Campus and NYPA recognize the importance of developing a plan that identifies cost optimal measures and then following through in order to achieve the aggressive goals and targets that NYS sets. Following the same, the Campus partnered with NYPA to develop a Clean Energy Master Plan to determine approaches to achieve the different renewable electricity goals and the impact on the emissions goals identified in this report. The CEMP takes a strategic approach by summarizing the different goals set by the State and SUNY, specific targets as applicable to SBU, analyze the Campus' consumption, utility costs, and the impact before identifying opportunities available in the marketplace that can help achieve the goals. Economic analysis is performed for each approach identified and compared to determine the optimal path to reaching the targets. Certain assumptions are made to assess the worst case scenario for the costs the Campus may have to incur to achieve all of the goals.

3 Assumptions

Assumption #1 – LIPA to comply with CLCPA clean electricity goals

The Campus' energy needs are currently supplied by two sources. From Long Island Power Authority ("LIPA") owned and Public Service Enterprise Group ("PSEG") operated utility service, and through the combined heat and power or co-generation ("Cogen") plant onsite at SBU. Per the Annual Report to the Board of Trustees on Resource Planning and Renewable Energy by PSEG Long Island, and per the Clean Energy Standard ("CES") annual report published by the New York State Energy Research and Development Authority ("NYSERDA"), LIPA is expected to comply with the State's renewable electricity goals as defined in CLCPA despite not being mandated, as an unregulated load serving entity. LIPA is anticipated to serve 70% of its electrical load through renewable energy by 2030 and 100% carbon-free electricity by

year 2040. References to LIPA's and NYSERDA's CES annual reports are included in Appendix B.5. Based on these, this report assumes that LIPA will comply with the State's clean energy goals and hence excludes impact from electric loads of Southampton and R&D campuses of SBU on the goals, as they are directly served by LIPA.

Assumption #2 – SBU to remain on Cogeneration

Stony Brook University campus has a large hospital and numerous research buildings. This requires a resilient and reliable energy supply system to ensure uninterrupted hospital and research services. Assuming the energy price trend remains the same, onsite Cogen plant offers the resiliency and reliability the Campus seeks at a lower cost, despite the need to offset through RECs or offsite renewable energy procurement. While switching to LIPA/PSEG may seem like the path of least resistance, this may not be the lowest cost option as determined in the Master Plan for Energy Infrastructure developed by NYPA in 2017, in which potential future energy options for the Campus were evaluated. Switching to a new resource including procuring energy through PSEG will require the Campus to incur significant upfront costs and infrastructure upgrades. Continued operation of the Cogen plant avoids this along with offering cost stabilization of energy over time to the Campus. For these reasons, and to estimate the worst-case scenario, this report assumes that the Cogen plant will continue to remain operational through 2050, when the last goal is set to achieve.

Assumption #3 – Wholesale market REC's

Wholesale market RECs in New York State are administered by NYSERDA through New York Generation Attribution Tracking System ("NYGATS"). NYSERDA secures RECs through large renewable projects and offers them to regulated load serving entities ("LSEs") such as PSEG, ConEdison, and others through an auction program. Because of their obligation to comply with the clean energy mandates set through NYS' renewable energy standard ("RES"), NYSERDA prioritizes REC sales to LSEs under the program. As more renewable energy projects are deployed in the State, there will be more RECs available to be offered to any entity aiming to achieve its renewable energy goals. However, due to the aggressive goals and still in progress projects, NYPA believes there may not be sufficient RECs for SBU to purchase through NYSERDA. To assess the worst-case scenario, this report assumes no RECs will be available through NYSERDA for the Campus to procure.

Assumption #4 – On-Site Solar Capacity

Stony Brook University has been leading by example in all efforts to reduce carbon emissions. It has taken up the initiative to explore and implement solar PV systems on campus even before it was identified as a viable option in this report. SBU plans to install 2 MW of onsite renewables by 2025 and an additional 2 MW by 2030.

4 Goals & Mandates

New York State has set aggressive goals and standards towards achieving a cleaner future for its residents and provide a framework for reducing carbon emissions. These goals are set by the following:

4.1 Executive Order 88

Issued in the year 2012, EO 88 is the primary component of the Build Smart NY program and sets an energy efficiency goal for all state-owned buildings.

- 20% improvement in energy efficiency by 2020, compared to 2010 levels

This is measured as reduction in energy use intensity ("EUI") and the Campus, as a State agency, not only met but exceeded this goal in 2020.

4.2 Executive Order 166

In 2017, EO 166 established a statewide plan to further reduce carbon emissions in the State. It intends State agencies to achieve this through different means set as below:

- Reduction in GHG emissions by 40% compared to 1990 levels
- Increase energy efficiency by 23% by 2030
- Source 50% of electricity through renewable energy resources by 2030

These goals are incorporated into the CLCPA in 2019 and while the GHG emissions reduction and increased energy efficiency goals remain to be the same, CLCPA surpasses the renewable electricity target by requiring 70% of the State's electricity be sourced from renewable sources by 2030, compared to the 50% as required by EO 166.

4.3 New Efficiency NY ("NENY")

The New Efficiency NY goal directs State agencies to lead by example by complying with their share of reducing the emissions by 185 TBtu by 2025. This goal is administered through the Build Smart NY 2025 initiative launched by NYPA, similar to the previous Executive Order 88. As part of this initiative, NYPA worked with NYSERDA and other stakeholders to assess the targets that apply to individual State agencies with facilities over 5000 sqft in area. In addition, this group worked with SUNY to identify individual campus targets and assessed through proprietary studies that the Stony Brook University's target is 0.88 TBtu. Energy consumption for FY 2014-2015 is utilized for this purpose and the target is estimated to be approximately 35% of the baseline consumption.

SBU has made significant investments to reduce its energy consumption through various measures, over time. The NENY goal may require the Campus to incur additional investments of similar order to be able to meet the aggressive goal. While the target for SBU is set based on the information gathered and studied through the Build Smart 2025 program, NYPA is currently in the process of setting up discussions with individual agencies and SUNY campuses to ensure the targets are calibrated accurately. Based on this, the target set for SBU under New Efficiency NY may potentially change.

4.4 Climate Leadership and Community Protection Act ("CLCPA")

The CLCPA passed in 2019 sets aggressive goals and standards for NYS towards clean energy and carbon neutrality.

- Source 70% electricity through renewable energy by 2030
- Source 100% electricity through zero-emissions (carbon-free) resources by 2040

- Reduce GHG emissions by 85% compared to 1990 levels, by 2050

4.5 SUNY Chancellor's State of the University Address, 2019

SUNY identified various carbon emission reduction initiatives the campuses are expected to take through the SUNY Clean Energy Roadmap. A target year for sourcing all electricity through zero-carbon resources is determined by the Chancellor during the State of the University Address in 2019.

- Source 100% electricity through zero-carbon, renewable energy resources by 2025

A summary of the different goals, targets as applicable to SBU, reference for arriving at the targets, baseline and target years is shown in Table 1**: Goals, Targets, & Status** below. This table shows the Campus' status to date, projected status per currently planned initiatives and projects, both in actual metrics and as a percent of the target, assuming no additional mitigations are taken.

Table 1: Goals, Targets, & Status

Goal	Set by	Target Year	Baseline Year	Baseline Value	Target Value	Current Status	%Achieved (Current)	Projected Status	%Achieved (Projected)	Units
Reduce Energy Usage by 20%*	EO 88	2020	2010	361	289	286	104%	245	161%	EUI
Statewide Energy Savings of 185 TBtu*	New Efficiency NY	2025	2015	2.28	1.40	2.18	11.08%	1.92**	41%	TBtu
100% Renewable Electricity	SUNY	2025	-	114.40	114.40	0.01	0.01%	2.8	2.4%	GWh
Improve Energy Efficiency by 23%*	EO 166 / NYS CLCPA	2030	2012	361	289	286	104.7%	245	161%	EUI
Reduce GHG Emissions by 40%*	EO 166 / NYS CLCPA	2030	1990	250,049	150,029	149,958	99.95%	108,813**	141%	MT of CO2e
50% Renewable Electricity	EO 166	2030	-	120	60	0.01	0.02%	3.8	6.3%	GWh
70% Renewable Electricity	NYS CLCPA	2030	-	120	84	0.01	0.01%	3.8	4.5%	GWh
100% Renewable Electricity	NYS CLCPA	2040	-	133	133	0.01	0.01%	3.8	2.8%	GWh
Reduce GHG Emissions by 85%*	NYS CLCPA	2050	1990	250,049	37,507	149,958	25%	108,813**	34%	MT of CO2e

**Goals include East Campus*

***Since the data identified under Build Smart NY 2025 program is for the university as a whole, these values include not just the West Campus, but the East Campus as well along with Southampton and R&D, which are currently served by PSEG/LIPA*

- Current status values are based on projects and initiatives the Campus has completed.
- Projected status values are based on projects and initiatives the Campus has currently planned.
- References for arriving at baseline and target values are included in the Appendix.

5 Policy & Incentives

The economic viability of strategies depends on current market policy and available incentives at both federal and State level. At federal level, these incentives are available in the form of investment tax credits ("ITC") of up to 22% for qualified solar PV projects or as production tax credits ("PTC") for certain wind projects. To qualify for this incentive, the federal policy requires a project to be initiated in year 2021 and must achieve commercial operation by 2025.

As a State agency exempt from certain taxes, the Campus cannot take advantage of this incentive if it built onsite solar projects under a traditional capital-budgeted project. However, if the Campus implemented such projects under a third-party ownership model, such as a power purchase agreement ("PPA") explained in future sections of this report, the private asset owner can monetize the benefits of ITC and provide energy from the project at a lower cost to the Campus.

The Campus requires the project to be awarded to such 3rd party developer in the year 2021 to benefit from the 22% ITC. The value tapers down to 10% after 2021 and hence reduces project benefits to the Campus. There are no State level incentives available for Long Island region at the time of development of this report.

6 Strategies & Initiatives

Based on the current market conditions and policy, there are multiple ways to achieve the goals detailed above. NYPA has evaluated a number of strategies and identifies and describes them in this section.

6.1 Energy Reduction Solutions

The University is expanding its energy reduction plan which will allow further energy reduction and less reliance on power provided from fossil fuel plants. Energy reduction is an effective means to help the University achieve its renewable energy goals. NYPA is conducting Energy Master Plans ("EMP") to identify such energy reduction projects across campus including the East Campus. The EMPs will assess the opportunities and the costs to implement such projects. These solutions reduce the amount of energy the Campus consumes, in turn reducing the amount of energy or RECs the Campus must procure through offsite sources.

6.2 Renewable Energy Solutions

New York State has set aggressive goals for securing carbon free electricity for its residents. Renewable energy technologies such as solar PV, wind, geothermal, etc., are 100% zero emissions technologies and can be implemented at varied scale both onsite and offsite depending on consumption needs and spatial, resource and weather constraints.

6.2.1 Solar PV

Solar photovoltaic ("PV") is the most promising technology for clean, onsite generation at SBU. Current technologies are well-tested, cost-effective, durable, and require little to no maintenance. Concurrent with CEMP development, the Campus has taken up an initiative to evaluate and implement potential onsite solar PV projects.

Solar PV can be implemented onsite as ground mounted systems, or rooftop, and as carport canopies on parking lots. Project economics are dependent on these installation types with ground mounted systems being the lowest in cost compared to carport systems being the most expensive of the three. However, ground mounted systems will require significant amount of open ground space to be designated for solar PV for the term of the project's life, which exceeds 30 years based on current technology. This could hinder any future development on the property until the project term has expired.

If implemented under a 3rd party ownership model such as a power purchase agreement ("PPA"), where SBU will purchase the energy produced by the project for a negotiated, fixed price set in the contract. Cost of energy produced by solar PV systems vary depending on the system size, installation type, region, incentives available, and several other conditions. Current cost of energy to the Campus is estimated to be a blended rate in the range of $0.11/kWh - $0.13/kWh. Considering this high cost of electricity in Long Island region, NYPA deems that onsite solar PV will be a cost-competitive opportunity for the Campus and will contribute towards its clean energy goals. Offsite solar PV offers additional economies of scale lowering the project costs. NYPA estimates the cost of procuring offsite solar energy will be in the range of $0.06/kWh - $0.08/kWh, depending on the system size, location, and other factors. However, any offsite renewables procurement involves no physical delivery of power to the Campus and hence is in addition to the utility costs it already incurs. Section 6.4 further discusses how offsite renewable energy can be procured by SBU. Onsite and offsite solar PV may be the most cost- effective solution for the Campus to meet its renewable electricity goals.

6.2.2 Wind

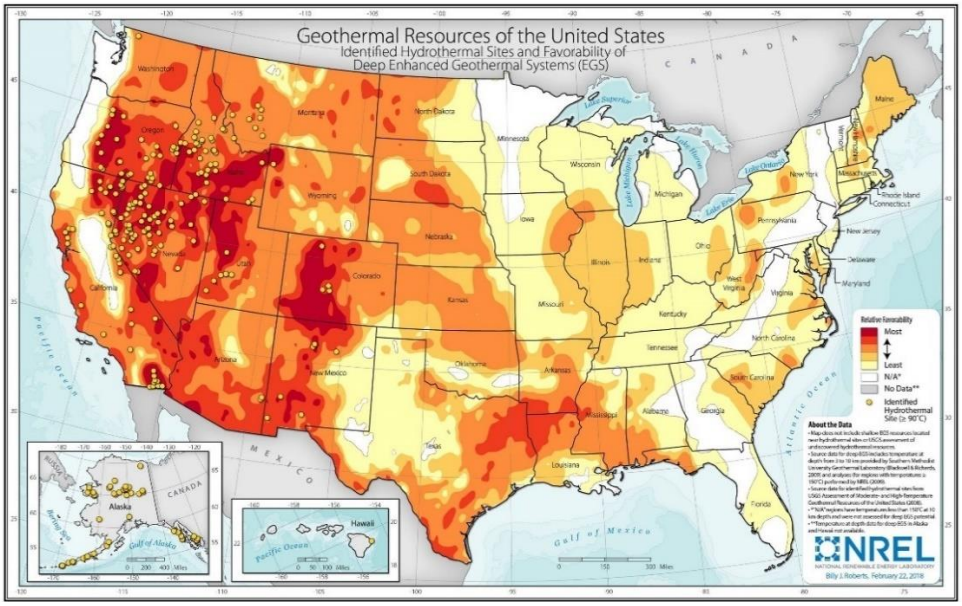
Although solar likely offers SBU the greatest benefits of any renewable energy technology, wind is responsible for far more generation across New York State than PV. That said, wind is not nearly as viable as a distributed energy resource, as it performs best at very large scales. To implement such large scale of wind onsite is not viable due to space constraints. Wind turbine installation also pose permitting challenges at small, distributed scale increasing the soft costs associated with the project further impacting its economics. These limit the Campus from implementing wind resources onsite. Nonetheless, the University can certainly procure wind power generated elsewhere, i.e., offsite, both on land and offshore, to meet its goals. Project costs for wind are typically higher than that for solar because of the complexity of technology and equipment involved. However, a wind project is expected to generate more energy annually compared to a solar PV project of same megawatt capacity. Of course, this is dependent on geographical location of the project, weather resources, and other factors that impact each project technology type. Cost of energy from offsite land-based wind project is estimated to be in the range of $0.065/kWh to $0.09/kWh while for an offshore wind project, it is estimated to be in the range of $0.08/kWh to $0.11/kWh. Similar to offsite solar PV, offsite wind energy procurement does not involve physical delivery of power and hence the cost is in addition to the utility costs the Campus already incurs. NYPA deems that offsite wind is a viable solution for the Campus, if it cannot procure energy from a solar project or if the actual costs at the time of procurement process prove to be more cost-effective than other technologies.

6.2.3 Geothermal

Geothermal energy is another well-tested and often cost-effective technology. Geothermal projects harness heat found underground as it radiates out from the earth's core. At large scale, this thermal energy can be used to heat water and spin a turbine to generate electricity, much like a traditional fossil fuel-fired power plant. At smaller scales, geothermal technology can be used to provide heat to buildings via ground source heat pumps.

A heat pump relies on a series of underground pipes to either heat or cool a conductive liquid, depending on the time of year. The pipes are buried at a depth where the temperature hardly changes year-round - that way, it will be relatively warm in the winter and relatively cool in the summer. By running the liquid through the pipes and up into the building HVAC system, heating can be provided in winter, and cooling in the summer. These pipes, or "ground loops," can be installed either horizontally over a wide area, or vertically to a great depth. Depending on the location either one or both methods could be viable options. The map below shows the best locations in darker colors where geothermal can be applied as a technology in the US.

Unfortunately, Long Island is shown to have the least favorable geothermal resources in the country. Even if the cost of energy produced through geothermal is competitive with onsite solar PV, the upfront capital cost is almost 35 times more than that of onsite solar. Considering the locational challenges and very high upfront costs, NYPA does not recommend the Campus pursue geothermal as a solution towards achieving clean energy goals at this point in time.



Source: https://www.nrel.gov/gis/assets/images/geothermal-identified-hydrothermal-and-egs.jpg

6.3 Alternative Energy Solutions

In addition to renewable energy solutions, NYPA also evaluated alternative energy solutions including energy storage, biomass, and fuel cells. These solutions may not be generation resources, or 100% emissions free compared to the renewable energy solutions explained above. The evaluation includes description of the technologies and pros and cons of each.

6.3.1 Energy Storage Systems

Energy storage is transforming the renewable energy sector. There are many methods of capturing potential energy, but most leading storage technologies take the form of electrochemical batteries. By charging when solar and wind facilities are productive, then discharging to the grid when they are not, storage can reduce or eliminate the intermittency of renewable resources. In effect, storage makes solar and wind dispatchable, and therefore more valuable, to the project owner and to the grid. Storage can perform many other helpful and lucrative functions, as well, from reducing behind-the-meter demand charges to regulating the frequency of the local grid. A typical 1MW, 2-hour to 4-hour duration lithium-ion battery energy storage system fits in a 40ftx8ftx10ft shipping container and will require approximately 2500sqft including all balance of system components. Although energy storage is at an additional cost to the typical $/kWh of the renewable project, its benefits could outweigh the extra costs and is recommended alongside solar and wind projects. At SBU, battery energy storage systems are considered in the solar RFP that is currently being developed alongside this CEMP.

6.3.2 Biomass – Wood Waste Energy

SBU may consider other options as well including a proposal it received for a biomass power plant at the Advanced Energy and Research Technology Center. This system would convert 25 tons of wood waste per day into 800-900 kW, with a relatively small footprint of half an acre. The proposed technology is compelling, but not very competitive with solar PV, for several reasons. First, it would take a full year to reach commercial operation, far slower than an equivalent solar project. Second, it is expensive, at $4.1 million, or roughly $5 per watt for the system described compared to a solar PV system that can be built for under $4 per watt. (It should be noted that there is potential for external funding to cover some or all of this cost). Third, this is not a zero-emissions power plant, and emits greenhouse gases, which is counter to the goals SBU is striving to achieve. Finally, the technology is not well-tested, particularly when compared to solar PV.

6.3.3 Fuel Cells

Fuel cells convert oxygen and a fuel (typically hydrogen) into electricity. While this may appear similar to traditional fossil-fuel fired reactors, the vital difference is that most fuel cells emit just water and waste heat. By utilizing both the electric output and the waste heat, fuel cells can act as a clean alternative to cogeneration plants much like SBU's current onsite generation. A 250kW fuel cell requires around 1,500-2,000 sqft in space not including the input fuel connections and is not necessarily linear in scale for larger systems. Although fuel cells have a cleaner emission, they are not 100% clean if the input fuel source is not clean such as green hydrogen. The most viable fuel source onsite at SBU for operating a fuel cell is natural gas, which is a fossil fuel. Hence fuel cells will not fully contribute towards the goals SBU is striving to achieve. Cost of energy from fuel cells can be 1.25 to 2 times more than that of onsite solar PV. While not a recommended solution at this time for meeting the renewable electricity targets, the Campus can explore fuel cells as an alternate to procuring fossil fuel sourced grid to support any new infrastructure.

6.4 Financial Solutions

Based on NYPA’s evaluation, opportunities for on-site renewable energy production are limited due to large areas required for equipment, unfavorable resources and conditions due to the

location, and economic reasons and do not provide the best value even if SBU could accommodate the capacity levels needed.

A common and fully acceptable alternative approach to achieving renewable energy goals is to procure large scale renewables offsite from the Campus or purchase environmental attributes such as renewable energy credits ("RECs"). These options do not involve physical delivery of power to a non-utility off-taker's facility and hence are just financial instruments that allow the Campus to achieve its goals. However, SBU can still incorporate some onsite renewables which will reduce its electrical consumption, requiring fewer environmental attributes to be procured through offsite projects and improving overall economics for the Campus in achieving its renewable goals.

6.4.1 Renewable Energy Credits

Renewable energy credits or renewable energy certificates are market instruments that represent proof of electricity generation from eligible renewable resources. A REC is issued for each 1 MWh of energy produced by a renewable energy system such as solar PV or wind. Currently, projects utilizing certain technologies and capacity, that have achieved commercial operation on or after January 2015 qualify as RECs that could be purchased by SBU and count towards the renewable energy goals.

6.4.2 Virtual Power Purchase Agreement ("VPPA")

Offsite renewable energy projects are typically implemented under a virtual power purchase agreement ("VPPA") model, which is a contract mechanism where an off-taker or buyer agrees to purchase energy, capacity and/or environmental attributes produced by or associated with the renewable energy system for a fixed price. Since the project may be located remote from the off-taker's facility, the physical delivery of power is to the project's local grid, sold in the wholesale market administered by the New York Independent System Operator ("NYISO"). If the market price for this electricity is lower than the fixed price in the VPPA, the off taker pays the seller the difference between the two prices. And if the wholesale market price is higher than the VPPA price, the off taker receives the difference between the two prices. A VPPA, thus allows for hedging electricity price risk with a long-term contract for differences. The benefits or costs to the Campus through such an approach are detailed in later sections of this report. Based on the market data available to it and per the REC price for current compliance year, NYPA estimates the cost of procurement under a VPPA model to be 2 to 3 times that of purchasing RECs through the wholesale market. However, as indicated in Assumption #3 under Section 3 of this report, NYPA does not believe wholesale market RECs will be available for SBU to purchase.

6.4.3 Renewable Energy Procurement Mechanisms

SBU can procure RECs and offsite renewable energy through different options. The costs of such procurement may vary based on the option chosen, approval processes involved, availability of attributes or projects, location, timeline, and collaborations providing possible economies of scale and other factors.

6.4.3.1 Wholesale Market

Sale of RECs in the wholesale market in NY state are administered through NYSERDA. NYSERDA announces the dates and trading periods for each quarter in a compliance year for sale of RECs and concludes such sales 21 days after each announcement. A screenshot of the

trading period for the past 4 quarters along with REC prices for the past 4 years is as shown below.

Trading Period	Date Range for Tier 1 REC Sale Announcement
Q1	March 31 – April 30, 2021
Q2	June 30 – July 31, 2021
Q3	September 30 – October 31, 2020
Q4	December 30, 2020 – January 31, 2021

RES 2020 Compliance Year Resources

2018 Tier 1 REC Sale Price: $17.01

2019 Tier 1 REC Sale Price: $22.43

2020 Tier 1 REC Sale Price:$22.09

Source: https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/LSE-Obligations/2020-Compliance-Year

However, NYSERDA prioritizes sale of RECs to load serving entities or utilities in the State which makes availability of RECs difficult through this method for non-utility entities. For this reason, the Campus may have to rely on other mechanisms or a combination of them including wholesale market purchase of RECs to fulfill its obligations towards the State's clean energy goals. SBU can purchase RECs from NYSERDA registering through NYGATS and submitting an order for the required quantity of RECs each quarter of the compliance period. Links to NYSERDA's frequently asked questions about RECs procurements and NYGATS registration webpages are included under Section C.1 of the Appendix.

6.4.3.2 SUNY Energy Buying Group ("EBG")

SUNY EBG is an aggregated electricity purchasing group for most upstate SUNY campuses. SBU may choose to join the group for purchasing renewable electricity or RECs either directly from the wholesale market or through VPPAs explained above. Aggregation of energy needs may provide economies of scale potentially resulting in lower costs to all participating campuses. For SBU to purchase renewable energy through EBG, the Campus needs to contact SUNY's Energy Procurement and Utility Affairs Office. A link to this Office's webpage with contact information is included in the Appendix under Section C.2.

6.4.3.3 New York Power Authority

SBU also has the option to purchase attributes or renewable energy through NYPA. Similar to SUNY EBG, NYPA may be able to aggregate needs of several customers and procure renewable energy either directly from the wholesale market or through VPPAs. Alternately, NYPA can provide Advisory Services through which it can streamline the procurement process for the Campus to secure energy from onsite or offsite renewable projects.

6.4.3.4 Summary of Renewable Energy Procurement Methods

It is difficult to predict costs or compare benefits between the different options without soliciting bids for energy or attributes through these methods. Each method has its pros and cons associated with it and these are listed below.

Table 2: Summary – Renewable Energy Procurement Methods

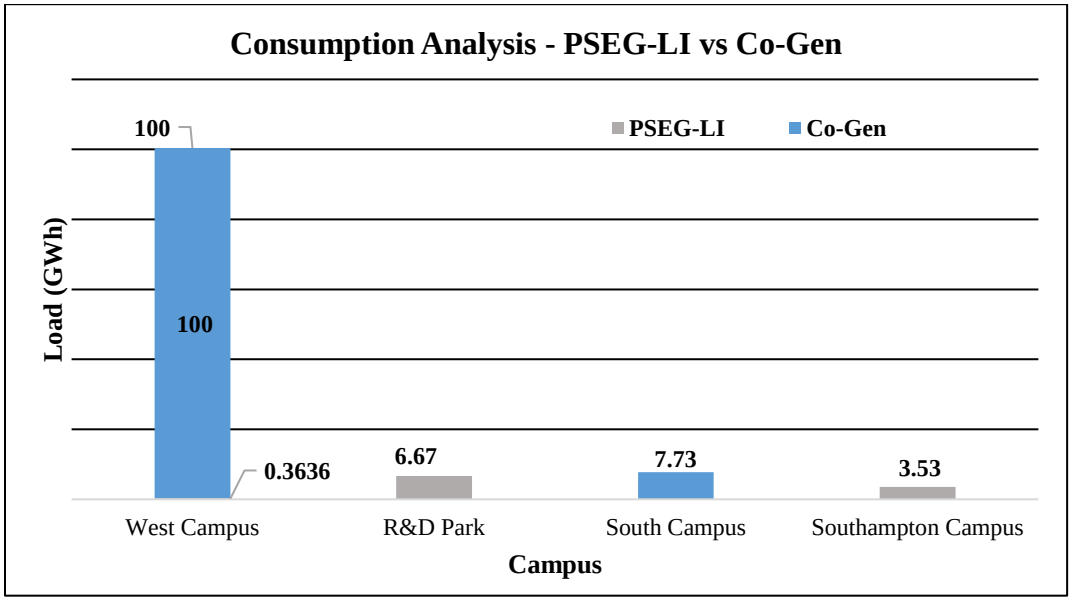
Contract Mechanism	Purchasing Commodity	Procurement Methods	Pros	Cons
Wholesale Market	RECs	NYSERDA	• No long-term obligation	• May not have enough RECs available to fulfill goals due to LSE prioritization • May involve time consuming processes with NYS OSC/AG approval requirements
Virtual PPA/Bilateral REC Agreements	Energy/ Capacity/ RECs	SBU	• Allows SBU to hedge long-term energy price risk	• Long-term obligation • May involve time consuming processes with NYS OSC/AG approval requirements
		SUNY EBG	• May provide economies of scale if collaborating with other campuses • Allows to hedge long-term energy price risk • Eliminates the need for NYS OSC/AG approval	• Long-term obligation
		NYPA	• May provide economies of scale if collaborating with other NYPA customers • Allows to hedge long-term energy price risk	• Long-term obligation • May involve time consuming processes with NYS OSC/AG approval requirements

Notes:
Per the University's Purchasing and Contracting Procedures, energy contracts may require the NY Office of State Comptroller's and the Office of Attorney General's review and/or approval.

7 Consumption Analysis

NYPA and NREL assessed the electrical consumption data provided by SBU for FY18/19 and FY19/20. A 9% decline in consumption from FY18/19 to FY19/20 is observed in the data. This reduction is due to two factors – the COVID-19 pandemic and Campus energy efficiency projects that have recently come online. Such measures helped the campus reduce its loads significantly. To assume a conservative estimate, FY 18/19 is used as the baseline load for the purposes of this analysis.

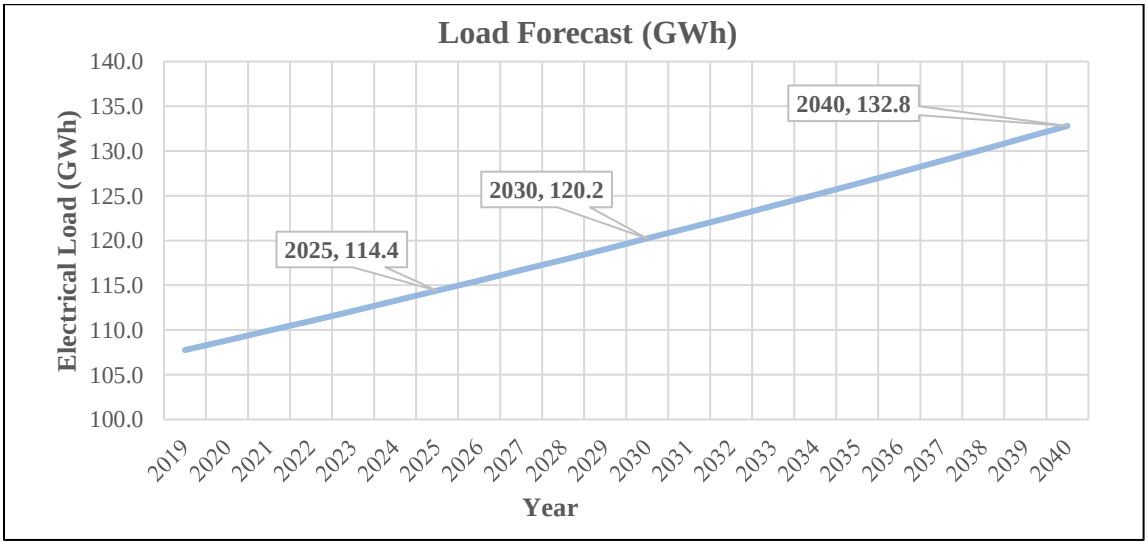
SBU's load is served by both PSEG-LI and an onsite co-generation plant operated by Calpine. Approximately 90% of the Campus' load is served by the onsite co-gen plant while PSEG-LI serves the remainder of 10%.



As stated in earlier sections of this report, PSEG-LI has committed to complying with the State's goals. This requires only the co-gen supplied load of SBU to be offset through renewables procurement to meet its goals. So, load forecast and economic impact is analyzed only for that portion of load that is offset by the co-gen plant.

7.1 Load Forecast

SBU has been successful in keeping its electricity loads low through several energy efficiency measures. A 1% annual increase in load is assumed to analyze the worst case over the next two decades, with fiscal year 2018/2019 as the baseline from the data provided by the Campus and summarized above.



The forecasted load for each goal target year is used for the economic impact analysis below.

8 Economic Analysis

This section includes the economic evaluation performed on the renewable energy options described in this report and provides recommendations for SBU to meet its aggressive goals. The recommendations are based on ease of implementation of evaluated solutions and costs to the Campus.

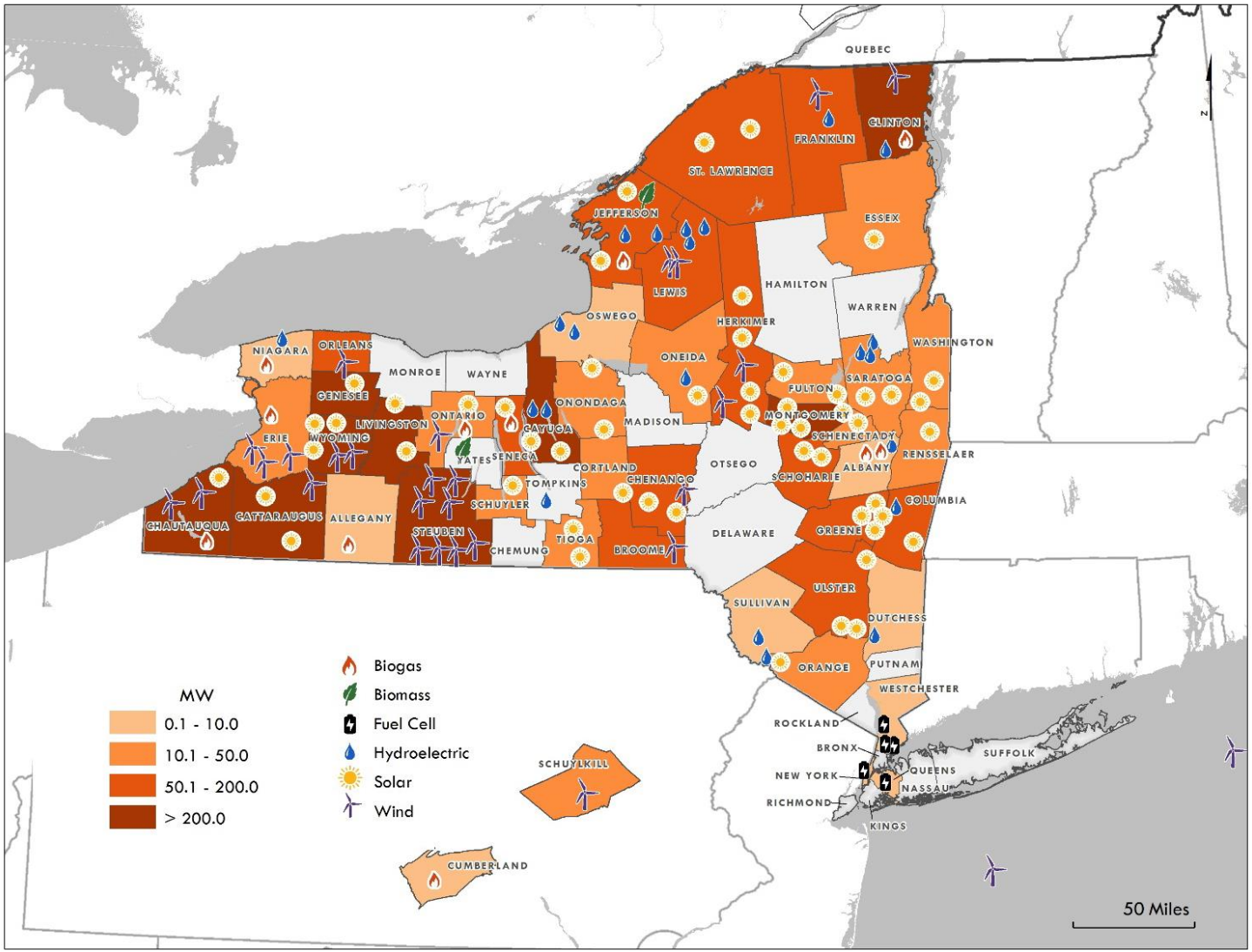
8.1 Overview

Of the strategies explained in the above sections, onsite and offsite renewable generation, procurement of RECs or a combination of these strategies will allow the Campus to achieve its clean electricity related targets. The economics of each of these is dependent on contract mechanism, timeline for project commercial operation, and location of project. Renewable energy credits ("RECs") can be purchased from the wholesale market through NYSERDA, without partaking in any specific renewable projects, or by executing bilateral contracts such as VPPAs or REC agreements with private renewables developers who will own and operate these projects. Although REC purchasing on the wholesale market is evaluated, it is NYPA's opinion that these RECs through NYSERDA may not be available and are therefore not recommended.

Table 3**: Renewable Energy Contract Mechanisms** below shows the various renewable energy contract mechanisms that are available to the Campus and evaluated. These are assessed by subtracting the loads served by LIPA/PSEG and the anticipated onsite renewables that will be installed prior to the target dates which will reduce the quantity of energy to be procured through offsite renewables to achieve the goals.

Locations for offsite renewable energy projects chosen for this analysis are based on market data available to maximize production from the projects and based on the number of projects per technology currently contracted or in development in a region as shown in the map below. While the CLCPA or the SUNY Roadmap do not require offsite projects to be located within the State, the CEMP considers all projects to be within New York State to support the State's ambition to maximize renewable energy deployment. It can be observed from the map a large number of solar PV and land-based wind projects are being developed in western NY region. While several solar PV projects are shown even in the eastern NY region, it can be observed that the western region projects are also larger in scale attributing to greater availability to offtake energy from. Hence, the analysis assumes Genesee, NY for offsite solar PV and land-based wind projects. This allows for a fair and accurate comparison between the costs of these two technologies.

It can also be noted from the map that the limited number of offshore wind energy projects are located around 30 miles off the east coast of Long Island. While the number of offshore wind projects is limited, these projects are very large in capacity and typically have a higher capacity factor (amount of energy produced per installed capacity) compared to land-based wind projects and are higher in efficiency. As such, Long Island region is chosen for offshore wind projects.



Source: https://www.nyserda.ny.gov/-/media/Files/Programs/Clean-Energy-Standard/2020/CES-2019-annual.pdf

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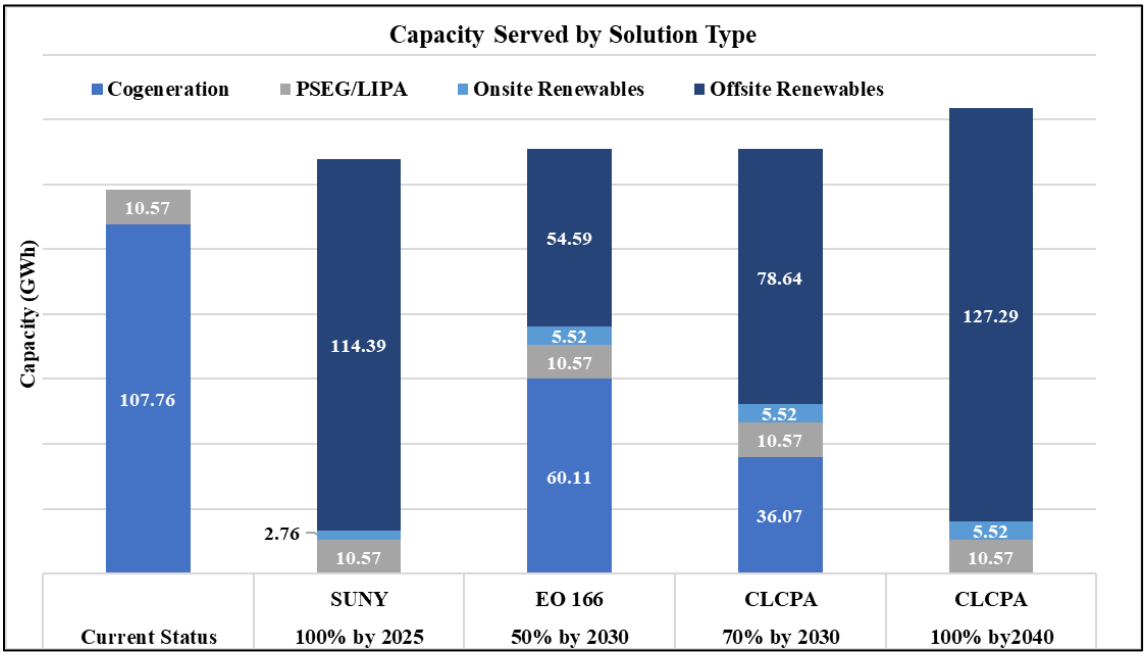
Table 3: Renewable Energy Contract Mechanisms

Strategy	Description*	Contract Mechanism	Selected Project Location
RECs	Remaining SBU load met with RECs	Wholesale Market Purchase	N/A
Offsite Solar PV	Remaining SBU load met with offsite PV	Virtual PPA / Bilateral Agreement for RECs or RECs Bundled with energy and capacity	Genesee County (Western NY)
Offsite Land-based Wind	Remaining SBU load met with land-based wind		Genesee County (Western NY)
Offsite Offshore Wind	Remaining SBU load met with offshore wind		Long Island, NY
PV + Land-based	Remaining SBU load met with 50% offsite PV and 50% land-based wind		Genesee County (Western NY)
PV + Offshore Wind	Remaining SBU load met with 50% offsite PV and 50% offshore wind		Solar PV: Genesee County OSW: Long Island, NY

*Remaining load refers to load that is not served by LIPA/PSEG and anticipated onsite renewable generation.

8.2 Capacity & GHG Analysis

The number of RECs and/or offsite renewable energy to be purchased is calculated based on the goal to be met, the Campus' current status against the goal, and the target year. It is believed that SBU has plans to install 2 MW of onsite renewables by 2025 and an additional 2 MW by 2030. Energy generated from these projects will directly offset the Campus facilities' electrical consumption and count towards its renewable energy goals. This energy is approximately 7% of SBU's goal. The R&D, Southampton, and portions of the South Campuses' electrical loads served by PSEG/LIPA are expected to meet the State's renewable energy goals and account for approximately 9% of SBU's goal. Hence, only 84% of the Campus' load is considered for offsite procurement with a forecasted increase in load by 1% annually.



Amount of offsite renewable energy assessed above can be procured through solar PV, land-based wind, offshore wind, or from a combination of projects of these technologies. Project location also impacts the energy produced from renewable energy systems as the weather resources for solar PV and wind projects vary by location. Table 4**: Summary of #RECs/Offsite Renewable Energy to be Procured** below shows the number of RECs or amount of energy that the Campus must procure to meet each of the goals. Offsite renewable capacity by technology type takes into consideration the location assumed for each project technology as explained in section 8.1.

Table 4: Summary of #RECs/Offsite Renewable Energy to be Procured

	100% by 2025 (SUNY)	50% by 2030 (EO166)	70% by 2030 (NYS CLCPA)	100% by 2040 (NYS CLCPA)
SBU Target (GWh)	114.4	60.11	84.15	132.2
Onsite Renewables (GWh)	2.76	5.52	5.52	5.52
#of RECs	111,634	54,600	78,643	127,289
Estimated Offsite Solar PV Energy (GWh)	N/A	55.4	79.85	129.2
Estimated Offsite Land-based Wind Energy (GWh)	N/A	61.9	85.68	132.51
Estimated Offshore Wind Energy (GWh)	N/A	73.0	97.34	146.01
Estimated Offsite Solar PV + Land-based Wind (GWh)	N/A	Solar PV: 30.05 Wind: 31.08	Solar PV: 42.08 Wind: 46.50	Solar PV: 66.40 Wind: 69.59
Estimated Offsite Solar PV + Offshore Wind (GWh)	N/A	Solar PV: 30.05 Wind: 48.67	Solar PV: 42.08 Wind: 48.67	Solar PV: 66.40 Wind: 73.0

Notes:

- Amount of energy is estimated based on technology type, resource data for the region, and capacity factors as modeled by NREL using its System Advisory Model ("SAM").
- Renewable energy technologies are modular in nature making it difficult to achieve the exact production levels needed to meet required targets. Meaning, while SBU may require ~55 GWh of offshore wind energy to meet the 50% renewable electricity by 2030 goal, the project it offtakes from may produce more or less in any given year depending on a lot of conditions including weather resources for the project geographical location. This will require the Campus to true up over a certain period to ensure compliance fulfillment.
- For strategies with combination of technologies, the goal is assumed to be met by procuring 50% capacity from projects of each technology.

8.2.1 GHG Emissions Reduction by 85%

One of the goals SBU requires to meet is 85% reduction in GHG emissions by 2050. SBU will achieve this goal when it achieves the 100% renewable electricity by 2040 goal. The GHG reduction goal sets a target of reducing the Campus emissions to 37,507 MT of CO2e by 2050. Based on the projected status of the Campus, (108,813 MT of CO2e), the Campus will have to further offset 71,306 MT of CO2e by 2050. Based on the data published by the US EPA and

EIA, the emissions conversion factor for Long Island region is 0.538 to convert the CO2e to electricity equivalent in MWh. This results in the 71,306 MT of CO2e to equate to approximately 132.77 GWh of electrical energy. Coincidentally, this is the same amount of energy the Campus has to procure to be able to meet 100% renewable electricity by 2040. Hence, the costs to meet the 100% electricity will suffice the goal of 85% reduction in GHG emissions set by NYS CLCPA.

8.3 Economic Analysis

NYPA and NREL performed an economic analysis for the different approaches suggested and per capacities shown above and assumptions stated below. Costs and pricing assumed or assessed in this Report are best estimations based on the information available at the time of its development and referenced throughout, as applicable. Actual costs can only be determined if and when the Campus chooses to procure from a real project and firm pricing is received from the project developer.

8.3.1 Assumptions

- Consumption is based on load data provided by the Campus for FY18/19
- Onsite renewables generation
    - 2,000 kW by 2025 and 4000 kW by 2030 to be operational.
    - Estimated to generate 2,758 MWh and 5,516 MWh in year 1, respectively.
- REC pricing
    - REC pricing is shown under two mechanisms, wholesale auction through NYSERDA and through a bilateral contract with a developer.
    - It is assumed that the pricing shown will be the same irrespective of the procurement method, as it is difficult to predict pricing under each procurement method without soliciting actual bids.
    - RECs price in the wholesale market is based on auction price for Tier 1 REC price for RES compliance year 2020.
      Source: https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/LSE-Obligations/2020-Compliance-Year
    - REC prices shown under a bilateral arrangement is based on market data available to NYPA.
    - REC prices are assumed to remain constant through 2040.
- Wholesale cost of energy or location based marginal pricing ("LBMP") pricing
    - LBMP data is based on actual marginal pricing data published by NYISO for the specified load zone.
    - LBMP is calculated as the average of annual average price for the past four years (2020, 2019, 2018, & 2017).
    - Annual escalator of 1% is applied on LBMP to forecast future energy prices.
- Offsite renewable project pricing
    - Cost of purchasing energy, capacity, and environmental attributes for offsite renewable projects under a VPPA model is based on market data available to NYPA, publicly available price data published by NYSERDA, and levelized cost of energy ("LCOE") by technology published by NREL.

- VPPA price estimation for offshore wind is based on data published by NYSERDA in the "Launching New York's Offshore Wind Industry: Phase I Report", October 2019
  Source: *https://www.nyserda.ny.gov/-/media/Files/Programs/offshore-wind/osw-phase-1-procurement-report.pdf*
- Prices shown under a VPPA or a bilateral agreement assume that the projects will be third party owned and hence take into account the 22% federal ITC currently available to build projects.

VPPAs are typically structured as contracts for differences as explained in earlier sections. This makes the project location critical for economics as the value of energy in the wholesale market (LBMP) varies from region to region. However, not every region is viable or available to implement large scale renewable projects. Cost to SBU under a VPPA model will be the difference between the fixed cost in the contract and the LBMP value of energy.

Table 5: Pricing Summary by Contract Mechanism

Project Technology	Location Assumed (NYISO Zone)	Estimated VPPA Fixed Price ($/MWh)	Wholesale or LBMP ($/MWh)	Cost to SBU ($/MWh)
RECs (Wholesale)	N/A	N/A	$22.09	$22.09
RECs (Bilateral)	N/A	$44.07	N/A	$44.07
Offsite Solar PV	Genesee	$66.32	$22.37	$43.95
Offsite Land-based Wind	Genesee	$67.37	$22.37	$45.00
Offsite Offshore Wind	Long Island	$83.36	$35.99	$45.37

8.3.2 Cost Analysis Summary

A summary of costs for each approach considered above is shown in Table 6**: Cost Analysis Summary ($/Year)** below. Costs shown are incremental to the electric utility bills the Campus currently incurs on an annual basis. Please note that the summary below assumes indicative projected costs for each of the considered technology in the year the goal is to be met and no future projections on REC pricing are included. Recommended option to meet each goal is highlighted in Yellow in the table. Procurement of RECs through wholesale market is not included in the color-scale, as this option may not be available to the Campus due to NYSERDA's prioritizing the LSEs to obtain such RECs. This may hinder the Campus from meeting the 100% renewable electricity by 2025 goal set by SUNY. Hence no option under this goal is highlighted. Meeting the 100% renewable electricity by 2040 offsets enough greenhouse gas emissions for the Campus to achieve its goal of reducing emissions by 85% by 2050 goal. Hence, no additional costs are shown for this goal.

Table 6: Cost Analysis Summary ($/Year)

	100% by 2025 (SUNY)	50% by 2030 (EO166)	70% by 2030 (NYS CLCPA)	100% by 2040 (NYS CLCPA)
RECs (Wholesale Market)	$2,526,911	$1,327,904	$1,859,066	$2,933,665
RECs (Bilateral)	$5,041,239	$2,649,196	$3,708,875	$5,852,722
Offsite Solar PV	N/A	***$2,501,056***	***$3,501,479***	***$5,182,054***
Offsite Land-based Wind	N/A	$2,559,967	$3,583,954	$5,312,203
Offshore Wind	N/A	$2,621,211	$3,669,696	$5,238,518
Offsite Solar PV + Land-based Wind	N/A	$2,530,512	$3,542,717	$5,247,129
Offsite Solar PV + Offshore Wind	N/A	$2,561,134	$3,585,587	$5,275,361

Offsite solar PV is shown to be the most cost-effective option for SBU to achieve its renewable goals. Based on the offsite solar PV projects currently in development in New York State, NYPA believes that SBU should be able to offtake from one or more of these projects, as required, to meet the different goals targeted from year 2030. RECs under a bilateral agreement are the least economic option to the Campus. In the event that the Campus is not served by onsite co-gen plant after 2030, the Campus does not have to procure any additional renewable energy or credits, as it is assumed that PSEG-LI will comply with the State's goals and hence all energy consumed by the Campus will also be carbon free. However, as assessed in the Energy Master Plan developed in 2017 by NYPA for SBU, there are significant capital costs involved in making changes to the Campus' current energy supply configuration through the Cogen plant. In addition it is anticipated that the cost of energy would go up since electricity is being produced separately from steam and the inefficiencies would drive up energy costs. This is due to any removal and restoration of facilities costs to new utility infrastructure upgrades required to purchase from PSEG-LI or other electric supply company. Continued operation through an extended contract for onsite Cogen plant through 2050 may also provide added benefits of minimal to no additional capital costs, minimal impact to current operations, and familiarity with the plant, operations, and the operator. This is not including the reliability and resiliency benefits that are discussed in the Background section of this report.

8.3.3 Emissions Reduction Summary

Attributes procured from each of the above methods help reduce the carbon footprint generated by the Campus' electric usage. Such reduction in emissions can be counted towards some of the other goals set by the State and measured in metric tons of carbon dioxide equivalent (MT of CO2e). A summary of CO2e that is offset through each method is shown below. Emissions are calculated by converting the amount of energy (kWh) to amount of carbon (MT) for the Long Island region. Per US EPA, the electrical equivalent of carbon in Long Island is 1184 lbs/MWh. Emissions values shown in Table 7**: Emissions Reduction Summary (MT of CO2e)** below are for electrical energy only.

- Emissions reduced from procuring renewable energy also fulfills the 85% reduction in GHG emissions by 2050 goal the Campus has to achieve.

Table 7: Emissions Reduction Summary (MT of CO2e)

	100% by 2025 (SUNY)	50% by 2030 (EO 166)	70% by 2030 (NYS CLCPA)	100% by 2040 (NYS CLCPA)
RECs	61,434	32,284	45,198	71,323
Offsite Solar PV	N/A	32,284	45,198	71,324
Offsite Land-based Wind	N/A	33,252	46,016	71,169
Offshore Wind	N/A	39,208	52,277	78,415
Offsite Solar PV + Land-based Wind	N/A	32,839	47,572	73,035
Offsite Solar PV + Offshore Wind	N/A	42,281	48,737	74,869

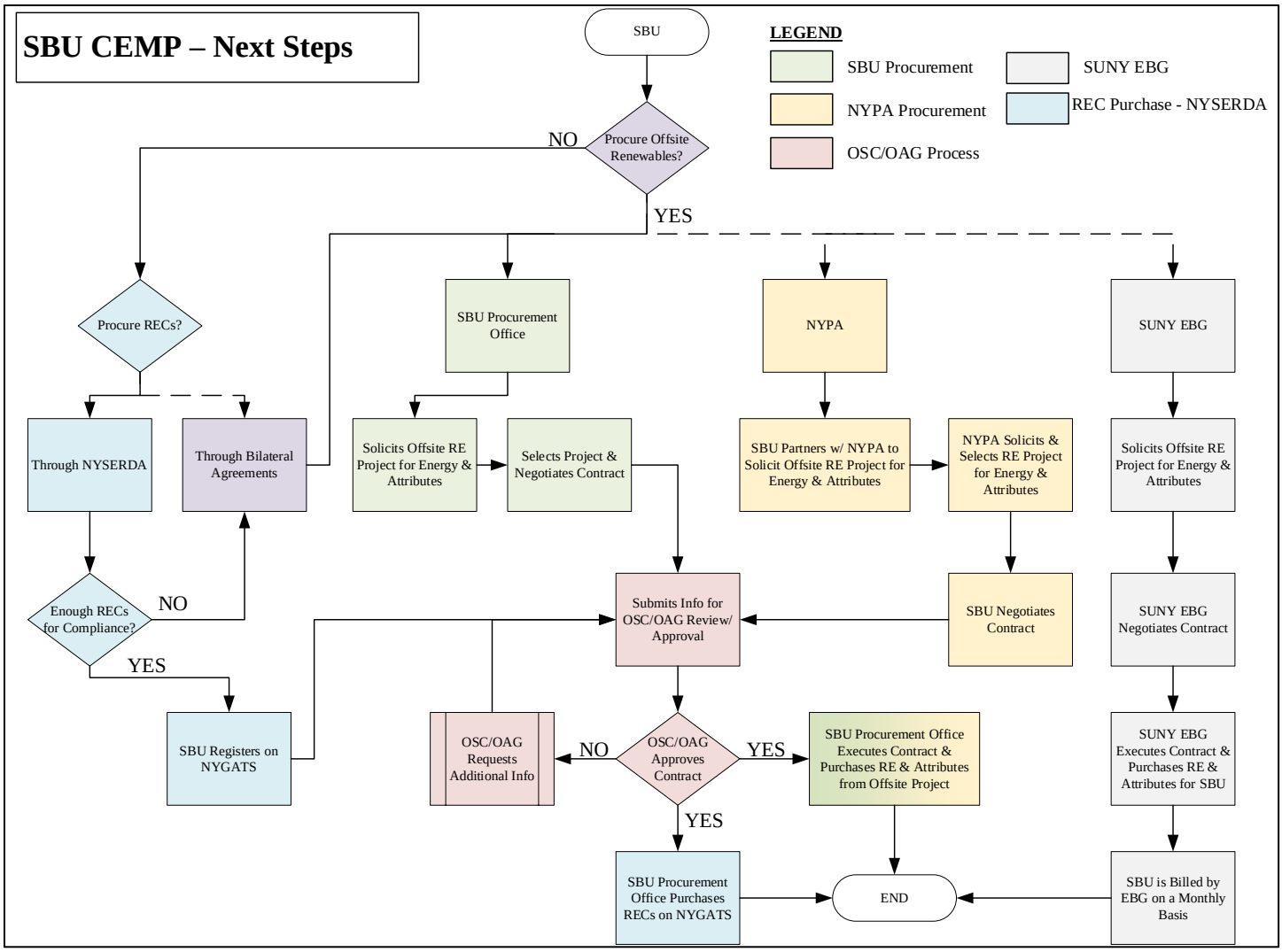
9 Conclusion

Based on the analysis, NYPA believes that off-taking from an offsite solar PV project is the most cost-effective option for the Campus to achieve a majority of its 2030, 2040, and 2050 goals. The estimated cost to achieve the goals is $89M over a twenty-year period between 2030 and 2050. The average annual cost is estimated at $3.7M between 2030 and 2040 and $5.2M between 2040 and 2050. This cost is in addition to the current utility costs the University pays annually and includes the Main, South, Southampton, and R&D Campuses (excluded East Campus).

Based on the current market conditions, NYPA believes that there may not be enough RECs available for SBU to purchase through NYSERDA to meet its 2025 SUNY renewable energy goal. Other options to procure RECs require extensive processes that are time consuming and will be extremely difficult to complete by 2025. This is doable for the remainder of the goals with target years starting in year 2030. NYPA can support the Campus to identify such projects or develop request for proposals to procure energy and attributes through an offsite solar PV project, if the Campus chooses this option.

10 Next Steps

SBU has more than one pathway it can choose to procure clean energy required to meet its goals. The flowchart below identifies the different steps and processes involved in each pathway including any NYS Office of State Comptroller (“OSC”) and/or Office of Attorney General (“OAG”) review or approval of different procurement methods and contracts prior to execution.


SBU CEMP – Next Steps
SBU
LEGEND
SBU Procurement
NYPA Procurement
OSC/OAG Process
SUNY EBG
REC Purchase - NYSERDA
Procure Offsite Renewables?
NO
YES
Procure RECs?
SBU Procurement Office
NYPA
SUNY EBG
Through NYSERDA
Through Bilateral Agreements
Solicits Offsite RE Project for Energy & Attributes
Selects Project & Negotiates Contract
SBU Partners w/ NYPA to Solicit Offsite RE Project for Energy & Attributes
NYPA Solicits & Selects RE Project for Energy & Attributes
Solicits Offsite RE Project for Energy & Attributes
Enough RECs for Compliance?
NO
YES
Submits Info for OSC/OAG Review/ Approval
SBU Negotiates Contract
SUNY EBG Negotiates Contract
SBU Registers on NYGATS
OSC/OAG Requests Additional Info
NO
OSC/OAG Approves Contract
YES
SBU Procurement Office Executes Contract & Purchases RE & Attributes from Offsite Project
SUNY EBG Executes Contract & Purchases RE & Attributes for SBU
YES
SBU Procurement Office Purchases RECs on NYGATS
END
SBU is Billed by EBG on a Monthly Basis

Appendix

A. Other Technologies Analyzed

While not part of the goals identified in this report, fuel consumption for transportation contributes to emissions and hence NYPA and the Campus chose to assess the impact of transportation and reduction in emissions through electrification. This is a high-level summary that does not include any detailed studies on the costs for electrifying the fleet or required infrastructure upgrades.

A.1. Transportation Electrification

Approximately 33% of State's greenhouse gas emissions are generated by the transportation sector. Switching to alternative fuel vehicles or electrification of vehicles will result in significant reduction in such emissions. Electric vehicles ("EV"), while have higher upfront costs, have lower operating costs. The comparison of emissions reductions from fossil fuel-based vehicles to electric vehicles is not one to one. This is because of the increased electricity consumption to chare the EVs. If the vehicles are charged from renewable sources, EVs result in zero emissions. However, if charged from the grid that is supplied by fossil fuel-based resources, emissions caused by such consumption must be discounted from the overall benefits.

Analysis below shows the impact of fleet electrification at SBU based on the Campus' current fuel consumption. This analysis is shown as a comparison between reduction in emissions from conversion to electric vehicles, considering the additional electricity consumption because of electrification.

Traditional Vehicles			Electric Vehicles		
Fuel	**Volume (gal) - FY 18/19**	**CO2e (lb)**	**Equivalent Electricity (kWh)**	**CO2e (lb) – Corrected for MPGe**	**%Reduction in Emissions**
Gasoline	140,375	2,750,295	4,730,638	2,240,430	18.54%
Diesel	93,697	2,102,855	3,647,015	1,727,226	17.86%
	Total	**4,853,150**	**8,377,653**	**3,967,656**	**18.20%**

Assumptions:

- Gasoline gallon equivalent (GGE) of electricity
  - Electrical energy (kWh) = 33.7 * Gallons of gas or 38.9235 * Gallons of diesel
- MPGe – Miles per gallon equivalent for electric vehicles
- 1 MPGe = 0.4 MPG for traditional internal combustion engine vehicles
- Electrical equivalent CO2 for Long Island region: 1184 lbs/MWh

References:

https://www.fueleconomy.gov/feg/label/learn-more-PHEV-label.shtml
https://afdc.energy.gov/vehicles/electric_emissions_sources.html
https://epact.energy.gov/fuel-conversion-factors
https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

B. References

The references identified throughout this report are included in this section, either as whole documents, screen/snapshots from such documents or as hyperlinks to ensure all background information and basis for assumptions and analyses is provided.

B.1. Executive Order 88, 2012

https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/EO88_0.pdf

State of New York

DEC 28 2012

Department of State
Secretary of State

State of New York

Executive Chamber

No. 88

EXECUTIVE ORDER

DIRECTING STATE AGENCIES AND AUTHORITIES TO IMPROVE THE ENERGY EFFICIENCY OF STATE BUILDINGS

WHEREAS, New York is dedicated to the mutually compatible goals of environmental protection, energy security, and economic growth; and

WHEREAS, increasing energy efficiency has been identified as among the most cost-effective methods for reducing greenhouse gas and other environmental pollutant emissions and increasing energy security; and

WHEREAS, increasing energy efficiency can lead to increased jobs and a reduction in building operating expenses; and

WHEREAS, New York is committed to implementing new policies to promote the efficient use of energy and natural resources in the interest of the long-term protection and enhancement of the State's environment, economy and public health;

NOW, THEREFORE, I, Andrew M. Cuomo, Governor of the State of New York, by virtue of the authority vested in me by the Constitution and the Laws of the State of New York, do hereby order as follows:

I. DEFINITIONS

For the purposes of this Executive Order, the following terms are defined as follows:

A. "Affected State Entities" means (i) all agencies and departments over which the Governor has Executive Authority, and (ii) all public-benefit corporations, public authorities and commissions, for which the Governor appoints the Chair, the Chief Executive, or the majority of Board Members, except for the Port Authority of New York and New Jersey.

B. "Average Source Energy Use Intensity" or "average EUI" means the average source energy use per square foot for all state-owned and managed buildings.

C. "Source energy" means all the energy used in delivering energy to a site, including power generation, transmission and distribution losses.

II. ENERGY REDUCTION TARGET

By April 1, 2020, all Affected State Entities shall collectively reduce the average EUI in State-owned and managed buildings by at least 20% from a baseline of the average EUI of such buildings for State fiscal year 2010/2011 ("Target").

III. OBLIGATIONS TO MEET TARGET

A. Central Management and Implementation Team: The New York Power Authority ("NYPA") shall establish a central management and implementation team ("CMIT") to administer this Executive Order.

(1) The CMIT is hereby directed and authorized to:

(a) Take all appropriate measures to ensure that the Target is met;

(b) Direct Affected State Entities to comply with the requirements of this Executive Order;

(c) Create guidelines ("Guidelines") within nine months of the issuance of this Executive Order to assist Affected State Entities in complying with this Executive Order, and thereafter update such Guidelines as necessary;

(d) Provide strategic, technical, and other assistance to each Affected State Entity to support implementation of this Executive Order;

(e) Develop annual milestones for achieving the Target over the next seven years within 12 months of the issuance of this Executive Order;

(f) Develop and implement reporting requirements to document each Affected State Entity's progress toward meeting the Target;

(g) Develop a comprehensive operations and maintenance plan for the State's building portfolio to help achieve no cost and low cost efficiency improvements and ensure that efficiency savings are sustained; and

(h) Submit an annual report to the Governor by January 15th of each year, beginning in 2014, detailing the overall progress Affected State Entities are making toward meeting the Target. Requirements for the annual report shall be contained in the Guidelines.

(2) The Office of General Services and the New York State Energy Research and Development Authority are hereby directed to provide technical assistance to the CMIT and each of the Affected State Entities with respect to complying with and implementing the requirements of this Executive Order and those established by the CMIT pursuant to this Executive Order.

B. Affected State Entities

In addition to the requirements established above, each of the Affected State Entities shall comply with the following:

(1) Benchmarking. For each State fiscal year, each Affected State Entity shall measure the energy use in State-owned and managed buildings having an area greater than 20,000 square feet. Buildings on master-metered campuses shall be benchmarked at the campus level until they are sub-metered at the building level, after which point those buildings shall be benchmarked at the building level.

(2) Audits. Buildings that receive low benchmark scores, as defined by the Guidelines, shall undergo an American Society of Heating, Refrigeration, and Air-Conditioning Engineers ("ASHRAE") Level II energy audit, or any other comparable audit that the CMIT approves. Campuses that have above-average EUIs or poor benchmark scores, as defined by the Guidelines, or are otherwise prioritized by the Affected State Entities and the CMIT, shall undergo a campus-wide ASHRAE Level II energy audit or any other comparable audit approved by the CMIT. In addition to energy efficiency measures, the audits shall identify opportunities for cost-effective on-site renewable generation and high-efficiency combined heat and power.

(3) Required Capital Projects and Energy Optimization Measures. Affected State Entities shall implement a cost-effective portfolio of measures identified and recommended in the audit and shall complete or make substantial progress toward completion of such measures within two years of completion of the audit. A portfolio may include, but shall not be limited to, no- and low-cost operational improvements, retrocommissioning, capital energy efficiency retrofits, on-site renewable and high-efficiency combined heat and power, and other measures identified by the CMIT.

(4) Submetering. Affected State Entities shall work with the CMIT to prioritize sub-metering for all relevant energy sources of buildings larger than 100,000 square feet on a master-metered campus to identify ways to finance such sub-metering. All buildings having an area larger than 100,000 square feet on

master-metered campuses shall be sub-metered for all fuels and other energy sources by December 31, 2016, to enable individual building benchmarking, unless the Affected State Entity that owns or operates the building can demonstrate to the CMIT that it is not cost-effective or feasible to do so.

(5) Incorporating Energy Efficiency Analysis in the Capital Planning Process. As part of the capital planning process, all Affected State Entities shall include an energy efficiency analysis in the design phase of all capital project plans. The capital project should include energy efficient measures or technologies determined to be the most cost-effective, as defined by the Guidelines.

(6) Credits. Affected State Entities may receive credit towards the Target for increasing energy efficiency in leased space. In addition, Affected State Entities may receive credit towards meeting the Target for installing on-site renewable generation if the host site for such renewable generation has deployed all cost-effective energy efficiency improvements consistent with the goals of this Executive Order. Affected State Entities shall consult with and apply to the CMIT concerning such credits.

(7) Reporting. No later than October 1st of each calendar year, each Affected State Entity shall submit all information requested by the CMIT on all State-owned and managed buildings having an area over 20,000 square feet, as well as any other information related to assessing compliance with this Executive Order.

C. Exemptions

Electric usage attributable to vehicle charging shall not be included in the Target and requirements of this Executive Order. The CMIT is authorized to provide other exemptions for good cause shown pursuant to criteria and procedures established in the Guidelines, including exceptions associated with buildings that have obtained and maintained ENERGY STAR or similar certification, or have benchmark scores placing such buildings in the top quartile of comparable buildings for the particular year at issue. Affected State Entities shall submit requests for annual exemptions to the CMIT. Any such request for exemptions and resulting determination by the CMIT shall be included in the annual report.

IV. REPEAL OF PRIOR EXECUTIVE ORDERS

Executive Order No. 111, promulgated on June 10, 2001, is hereby revoked and superseded by this Executive Order as of the date hereof.

GIVEN under my hand and the Privy Seal of the State in the City of Albany this twenty-eighth day of December in the year two thousand twelve.

BY THE GOVERNOR

Secretary to the Governor

B.2. **Executive Order 166, 2017**

https://www.governor.ny.gov/news/no-166-redoubling-new-yorks-fight-against-economic-and-environmental-threats-posed-climate

State of New York

Executive Chamber

No. 166

EXECUTIVE ORDER

REDOUBLING NEW YORK'S FIGHT AGAINST THE ECONOMIC AND ENVIRONMENTAL THREATS POSED BY CLIMATE CHANGE AND AFFIRMING THE GOALS OF THE PARIS CLIMATE AGREEMENT

WHEREAS, the federal government's withdrawal from the United Nations Framework Convention on Climate Change's Paris Agreement (Paris Agreement), adopted on December 12, 2015, represents an abdication of leadership on climate change that threatens the environmental and economic health of all New Yorkers; and

WHEREAS, New Yorkers have witnessed firsthand the damaging effects of climate change, including severe storm events, rising sea levels, droughts, and electricity outages that cause both environmental and economic harm; and

WHEREAS, I, Andrew M. Cuomo have previously issued executive orders that call for greenhouse gas emission reductions totaling eighty percent by 2050; and

WHEREAS, in recognition of the challenges posed by climate change and the economic opportunities created by the clean energy economy, New York has adopted a State Energy Plan that establishes nation-leading climate and clean energy goals, including a forty percent reduction in greenhouse gas emissions from 1990 levels by 2030, a commitment to source fifty percent of New York's electricity from renewables by 2030, and a twenty-three percent increase in energy efficiency by 2030; and

WHEREAS, New York has already committed to aggressive investments and initiatives to turn the State Energy Plan goals into action through its Clean Energy Standard program, the $5 Billion Clean Energy Fund, the $1 Billion NY-Sun solar program, the nation's largest Green Bank, and unprecedented reforms to make the electricity grid more resilient, reliable, and affordable; and

WHEREAS, New York State is engaged in greenhouse gas reduction activities throughout the state's economy, including through the issuance of the Methane Reduction Plan and participation in regional collaborations seeking greenhouse gas emissions reductions including the Regional Greenhouse Gas Initiative ("RGGI") and the Transportation and Climate Initiative ("TCI"); and

WHEREAS, New York's State Energy Plan goals and actions are even more aggressive and ambitious than the agreement executed by the United States implementing the terms of the Paris Agreement and ensure that New York will be a leader in achieving the goals for our nation that had been embodied in the Paris Agreement; and

WHEREAS, in addition to our leading efforts to reduce greenhouse gas emissions and advance the clean energy economy, the state has prioritized investments in helping communities adapt to the changing climate by advancing programs, such as Climate Smart New York, to improve resiliency, protect important habitats and natural infrastructure, and plan for our uncertain future; and

WHEREAS, these efforts have included using natural sources like oyster reefs and living shorelines to protect New York's hundreds of miles of coastlines, investing millions of dollars through the Environmental Protection fund, adopting the Climate Risk and Resiliency Act to ensure that funding and permits take storm surge and sea level rise into account, and issuing an Ocean Action Plan in 2016, which recognizes the detrimental impacts climate change is having on our critical marine resources, including our multimillion dollar shellfishery industry; and

WHEREAS, notwithstanding the United States federal government's withdrawal from the Paris Agreement, it is essential that states such as New York, working with all concerned organizations, businesses and citizens, continue to fulfill, uphold, and even exceed the objectives of the Paris Agreement; and

NOW, THEREFORE, I, Andrew M. Cuomo, Governor of the State of New York, by virtue of the authority invested in me by the Constitution and the Laws of the State of New York, do hereby order as follows:

I. DEFINITION

For the purposes of this Executive Order, the following term is defined as follows:

A. "Affected State Entities" means (i) all agencies and departments over which the Governor has Executive Authority, and (ii) all public-benefit corporations, public authorities and commissions, for which the Governor appoints the Chair, the Chief Executive, or the majority of Board Members, except for the Port Authority of New York and New Jersey.

II. GREENHOUSE GAS EMISSIONS POLICY

It is the policy of the State of New York to reduce greenhouse gas emissions by forty percent by 2030, and eighty percent by 2050 from 1990 levels, across all emitting activities of the economy. Therefore, all actions of all Affected State Entities shall be reasonably consistent with the policies stated herein, and of those expressed in the 2015 State Energy Plan, to achieve such objectives.

III. ACTIONS TO MEET POLICY GOALS

In order to achieve these objectives, each Affected State Entity shall adopt by March 31, 2018 a plan demonstrating activities and programs that will contribute to the State of New York's achievement of these important policy goals.

The Department of Environmental Conservation ("DEC") and the New York State Energy Research and Development Authority ("NYSERDA") are hereby directed to develop an approach to emissions reductions measurement and accounting that shall be adopted by the Affected State Entities.

DEC and NYSERDA are also hereby directed to make staff available to provide the Affected State Entities with any technical assistance that may be necessary to ensure that those entities's adopted plans are effective and achievable.

Affected State Entities are hereby directed to implement a portfolio of measures that may include but shall not be limited to no- and low-cost operational improvements, retro-commissioning, capital energy efficiency retrofits, and onsite renewable and high efficiency combined heat and power projects.

GIVEN under my hand and the Privy Seal of the State in the City of Albany this first day of June in the year two thousand seventeen.

BY THE GOVERNOR

Secretary to the Governor

B.3. New Efficiency NY, 2018

https://www.nyserda.ny.gov/-/media/Files/Publications/New-Efficiency-Fact-Sheet.pdf

New Efficiency: **New York**

A milestone energy efficiency target and comprehensive strategy —
New York State's ambitious approach.



2025 STATEWIDE ENERGY EFFICIENCY TARGET

185 TBtu

end-use savings in buildings and industrial facilities
below the 2025 energy-use forecast

equivalent to fueling and powering more than **1.8 million New York homes** by 2025

delivering **nearly one-third** of the greenhouse gas emissions reductions needed to meet **40% reduction by 2030**

Energy efficiency is a cornerstone of New York State's national leadership on clean energy and combatting climate change. Governor Andrew M. Cuomo has set New York on a path to accelerate energy efficiency and reduce greenhouse gas emissions, decrease consumer energy costs, and create job opportunities.

The most aggressive energy efficiency strategy in New York's history, this initiative will support the growth of energy efficiency businesses and further Reforming the Energy Vision opportunities for market innovation. Benefits to New York consumers will be advanced through building retrofits, efficient appliances, high-performance new construction, and solutions like heat pumps and advanced buildings controls.

Accelerating utility energy efficiency

New York's electric and gas utilities are called upon to achieve more in both scale and innovation through their energy efficiency activities. Under the New Efficiency framework, utility portfolios will include more comprehensive energy efficiency measure mixes; effective program structures that reflect grid value; steady improvement in the cost effectiveness of energy efficiency solutions; fostering of active private sector energy efficiency business delivering value to customers; and greater leverage of public funds with private capital. Utilities are encouraged to partner with private sector business to bring new efficiency solutions to New Yorkers.

Lead by example

Accelerating energy efficiency achievement in New York's own facilities and construction activities will directly save energy costs, prove value, and catalyze market adoption for the best solutions. New York's own facilities and construction investments will embrace greater levels of energy efficiency, building on progress through Build Smart and other Executive Orders. This includes undertaking energy master planning; advancing net-zero energy new construction in State buildings; accelerating LED retrofits; and annual energy benchmarking.

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Building a skilled workforce

Availability of a skilled workforce is critical to accelerating energy efficiency investments and realizing the significant associated economic and environmental benefits. NYSERDA will support additional training for more than 19,500 workers for high-quality energy efficiency jobs across the State.

Energy codes and appliance standards

Driving energy efficiency and carbon reduction through building energy codes allows New York to leverage existing market activity and the natural cycle of building upgrades into long-term benefits. Continuous advancement of new efficiency standards for products and appliances is another core component to maximizing efficiency and emission reduction. As the federal government scales back its role in setting and enforcing appliance efficiency requirements, rigorous standards at the State level are essential.

Improving access for low- to moderate-income consumers

The State will advance energy affordability initiatives focused on energy solutions for low- to moderate-income consumers, while dedicating at least 20 percent of any additional levels of public investment in energy efficiency to the low- to moderate-income sector.

PATH FORWARD

In April 2018, Governor Cuomo announced the energy efficiency target along with the policy framework and the commitment by the State to lead by example. Next steps to advance and implement the policy include stakeholder engagement; technical conferences; Public Service Commission deliberations and actions; legislative proposals; State agency climate and capital planning; and development of Clean Energy Fund initiatives.

See Case 18-M-0084, In the Matter of a Comprehensive Energy Efficiency Initiative.

Read the new energy efficiency strategy at nyserda.ny.gov/New-Efficiency

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Department of Public Service

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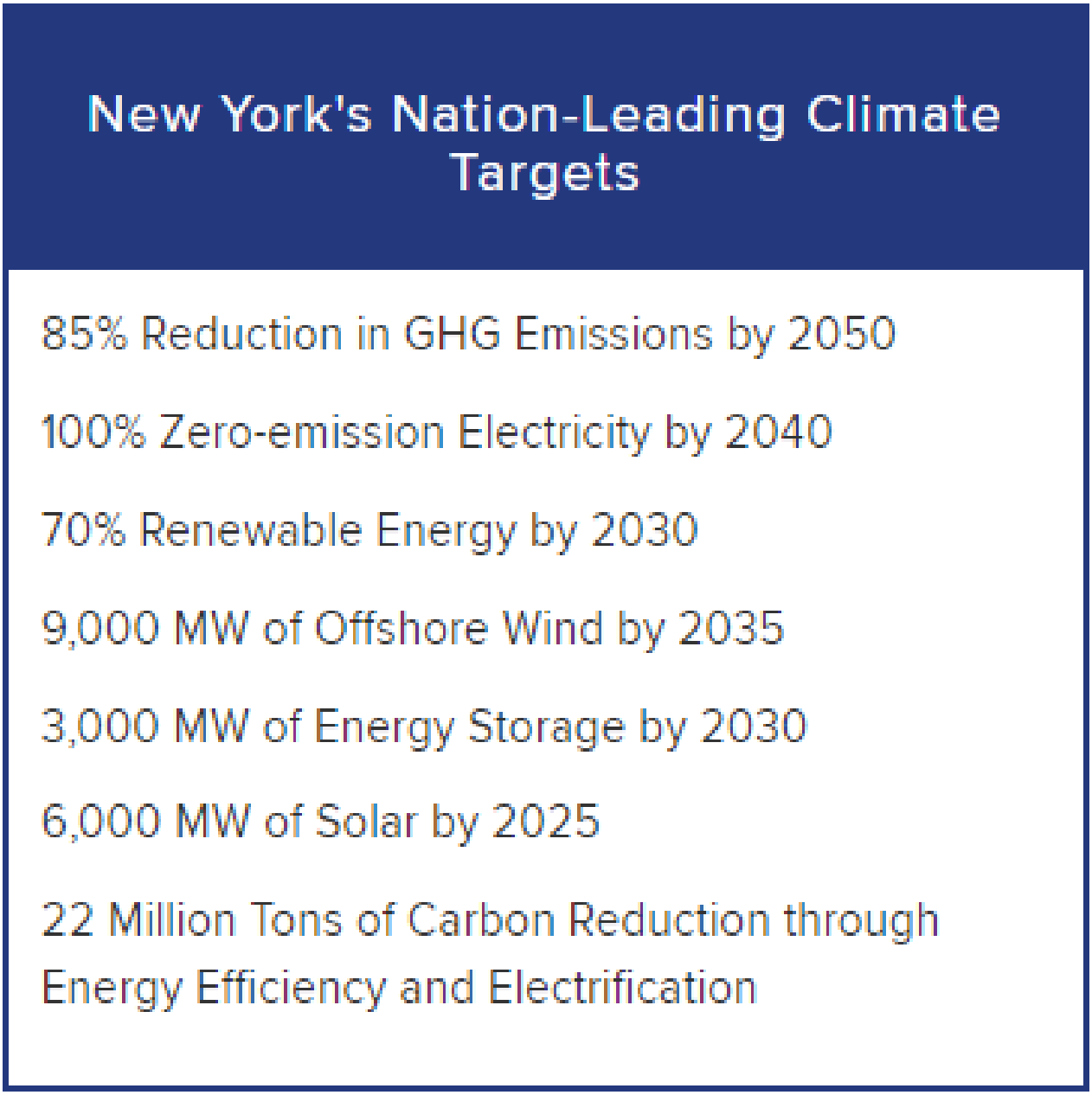
B.4. NYS Climate Leadership and Community Protection Act ("CLCPA"), 2019

https://www.nysenate.gov/legislation/bills/2019/s6599
https://climate.ny.gov/
https://climate.ny.gov/-/media/CLCPA/Files/CLCPA-Fact-Sheet.pdf



NEW YORK'S CLIMATE LEADERSHIP and COMMUNITY PROTECTION ACT

New York's landmark new law, the Climate Leadership and Community Protection Act (Climate Act), is demonstrating to the nation how to confront the greatest threat facing life as we know it — a rapidly changing climate. Signed by Governor Andrew M. Cuomo in July 2019, this law will empower every New Yorker to fight climate change and provide the opportunity to improve all our daily lives.

This is our planet. This is our time to fight for it.

By 2040: achieve 100% zero-emission electricity | By 2050: reduce emissions at least 85% below 1990 levels

Achieving the ambitious goals of this law will mean transforming the way we generate and use electricity, the way we heat our homes, and the way we get to school and work. New Yorkers will tackle climate change and create new opportunities for our children and grandchildren. Through thoughtful planning, this effort will breathe life into our economy with well-paying clean energy jobs, new industries and business opportunities, and improved health and quality of life for New York families and communities. New York's course on climate action also means spending less on fossil fuels and keeping our energy dollars in the local economy, and in the pockets of hardworking New Yorkers.

As we experience record temperatures and extreme storms, the Climate Act compels us to take action. New York will undertake a sweeping set of measures to reduce our carbon footprint, make our communities more resilient, and adapt to a changing climate. The State's new climate law sets the stage for this and creates the opportunity for citizens and communities to partner with businesses, schools, and government to create a green economy and build a climate-proof future.

What the Climate Act means for New York State

CLEAN ELECTRIC GRID OF TOMORROW | Solar, wind, and other renewables, combined with energy storage will deliver affordable and reliable electricity over the next decade and beyond

COMFORTABLE, AFFORDABLE, AND SAFE ENERGY EFFICIENT HOMES AND BUSINESSES | New clean heating and cooling technologies, such as electric heat pumps and smart thermostats, combined with energy efficiency, will save New Yorkers energy and money

CLEAN, RELIABLE TRANSPORTATION | Zero emission transportation options for families and neighborhoods will enable New York to trade gridlock and diesel fumes for fresh air and cleaner communities

A CLEAN ENERGY ECONOMY FOR EVERYONE | Every community, every trade, and every region will have access to clean energy solutions and the economic opportunities that the transition to a just and equitable energy system provides

Benefits of New York State's climate leadership

JOBS | Creating thousands of green jobs in communities across the State — from building trades and technicians to engineers and financiers — making New York a hub of clean energy economic growth

A HEALTHIER NY | Reducing greenhouse gases and local pollution to keep our communities healthier, reduce respiratory illnesses and premature deaths, and avoid healthcare costs that limit our progress and success

AFFORDABLE ENERGY | Reducing energy consumption and utility bills by increasing access to ever-improving clean, efficient, and reliable energy solutions

EMPOWERMENT | Providing a seat at the table for disadvantaged communities, and ensuring good paying job opportunities for all New Yorkers

Find out more and learn what you can do climate.ny.gov
Send all of your questions and feedback to climateact@dec.ny.gov

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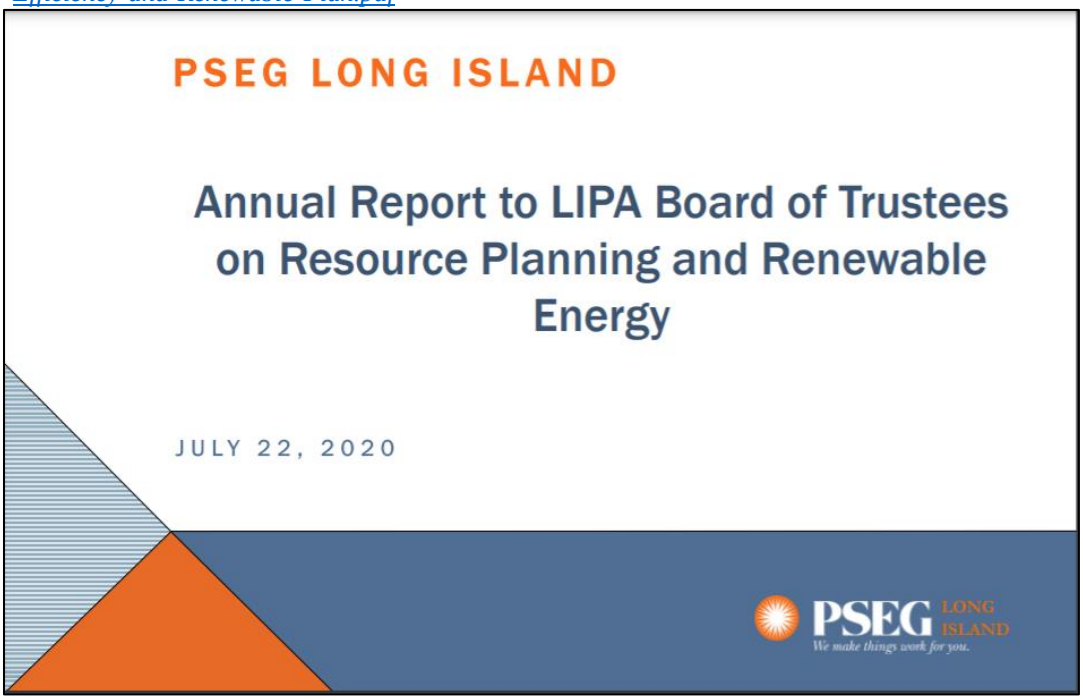
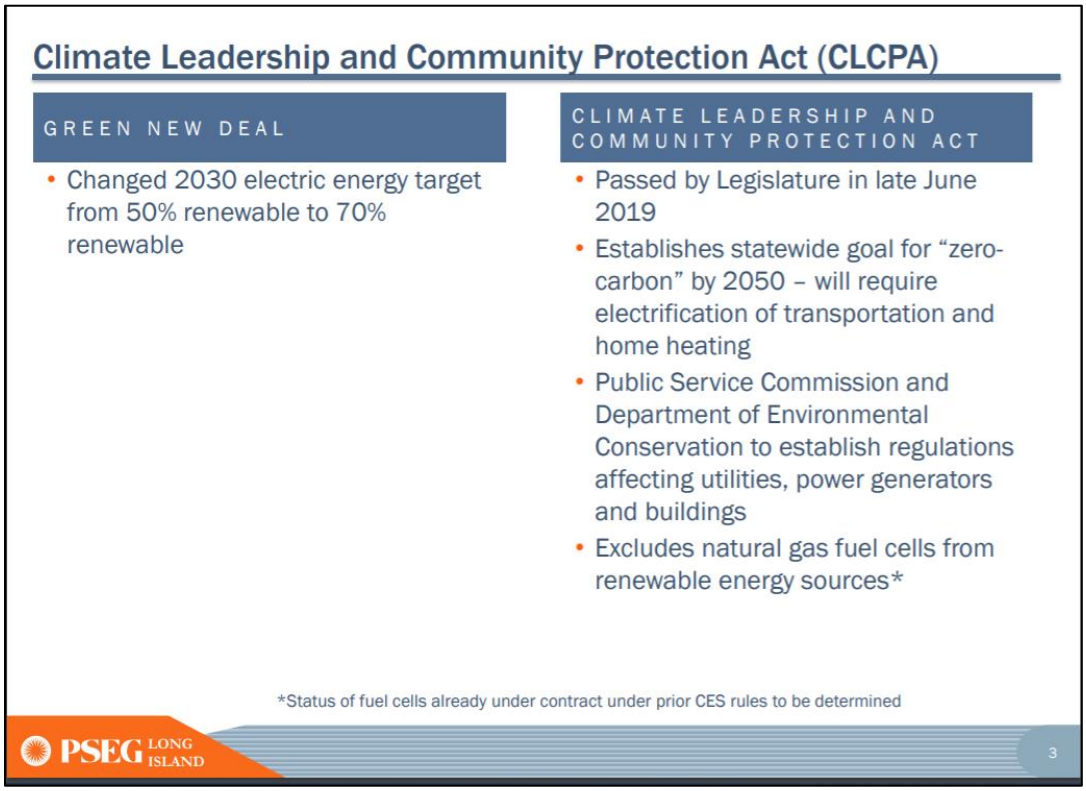
B.5. LIPA to Meet CLCPA Clean Electricity Goals, 2020

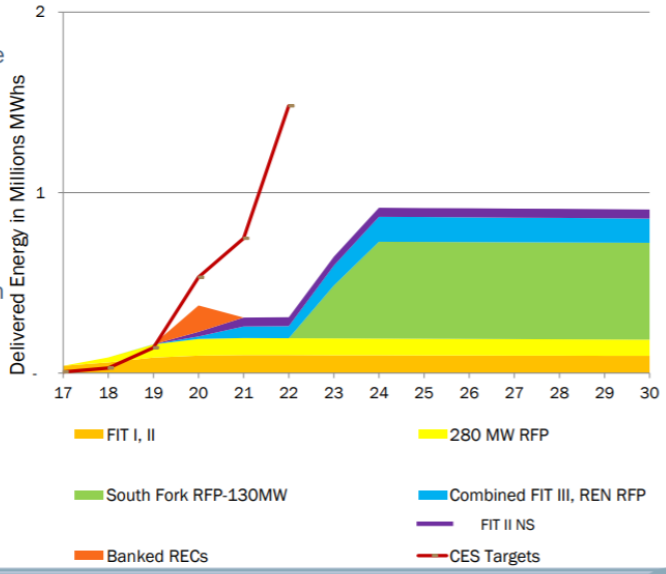
https://www.lipower.org/wp-content/uploads/2020/07/Implementation-Reports-7-2020.pdf
https://www.lipower.org/wp-content/uploads/2019/08/2019-08-01-PSEG-Long-Island-2020-Energy-Efficiency-and-Renewable-Plan.pdf





Projected CES Targets and Anticipated Supply

- REC deficiency expected in 2020
- LIPA established Clean Energy Compliance Fund to fund future REC purchases in the event of shortfalls
- LIPA's estimated 2030 REC requirement increased from 3.6 million under the old CES program to 7.0 million under CLCPA
- Future needs to be met through REC purchases or additional procurements
- CLCPA rules may change eligibility of gas-fired fuel cells
- COVID-19 situation has impact on targets as well as on the supply of RECs



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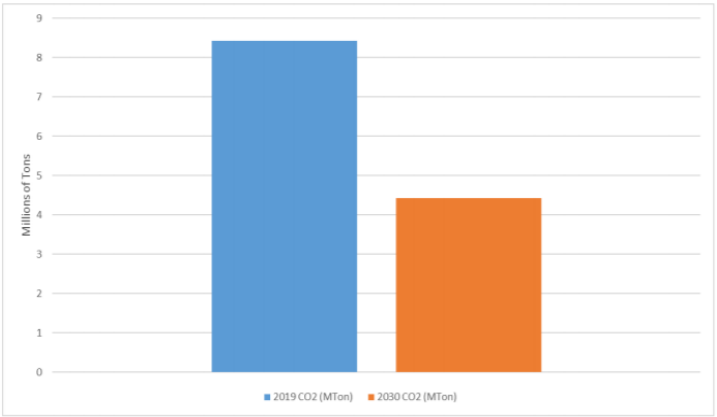
LIPA's Carbon Footprint (2019 vs. 2030)

- LIPA's carbon emissions expected to decrease approximately 48% by 2030 due to statewide 70% renewable energy target
- Graph below shows existing versus projected carbon footprint assuming 532 MW of solar and 1,810 MW of off-shore wind by 2030



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1 New York's Clean Energy Standard

The CES requires that 50% of New York State's electricity come from renewable energy sources by 2030, starting with a 2014 baseline of 25.9% as documented in the CES Order. In July of 2019, Governor Cuomo signed the Climate Leadership and Community Protection Act (CLCPA), which builds on the CES objectives. The CLCPA codifies Governor Cuomo's nation-leading goals as called for under his Green New Deal, expanding the CES mandate to require that at least 70% of New York's electricity come from renewable energy sources such as wind and solar by 2030, and the State's power system is 100% carbon free by 2040.

All renewable energy consumed by end-use customers in New York contributes to the CES, including energy supported by past, present, and future State renewable energy policies such as the RES, RPS, NY-Sun, Clean Energy Fund (CEF), Value of Distributed Energy Resources (VDER), Offshore Wind Standard, renewable energy procurements by LIPA and NYPA, and voluntary renewable energy purchases. Increasing amounts of energy efficiency is also an important contributor in achieving the CES. The ZEC requirement ensures continued operation of certain existing at-risk upstate nuclear power plants, which produce emissions-free generation and contribute to meeting the State's greenhouse gas goals. Each component is described in detail in the following sections.

1.1 The Renewable Energy Standard

The RES is comprised of two sub-components: Tier 1, an obligation on LSEs to support new renewable energy resources; and Tier 2, which provides support to existing, at-risk renewables.

1.1.1 Tier 1

To comply with the Tier 1 obligation, each LSE must demonstrate the delivery of renewable energy, from certified facilities, sufficient to meet a PSC-specified percentage of its annual load. LSEs include the investor owned utilities, energy services companies (ESCOs), jurisdictional municipal utilities, and direct customers of the NYISO.[8] NYPA and LIPA are voluntarily undertaking activities to meet RES goals proportional to their respective loads. Each LSE's Tier 1 obligation is a function of its actual load in the subject compliance year and the PSC-determined compliance obligation percentage for that same compliance year.[9]

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B.5.2. White Paper: Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act

https://www.nyserda.ny.gov/-/media/Files/Programs/Clean-Energy-Standard/20200714-CLCPA-white-paper.pdf

Role of NYPA and LIPA

The 2016 CES Order explained that NYPA and LIPA "will participate in the CES not only to conform to a carbon requirement but to engage in an integrated statewide policy."

The ambition of the CLCPA's 70 by 30 Target makes "integrated statewide policy" even more necessary than it was for the 50 by 30 goal.

> In the most recent CES Annual Progress Report, **NYPA and LIPA committed to adopting renewable targets that achieve the CES mandate.**

It will be important to ensure ongoing coordination with NYPA and LIPA with respect to their participation in NYSERDA's procurements of environmental attributes.

Role of NYPA and LIPA

NYSERDA and Staff expect that NYPA and LIPA will participate in the 70 by 30 subject only to minor modifications as may be appropriate.

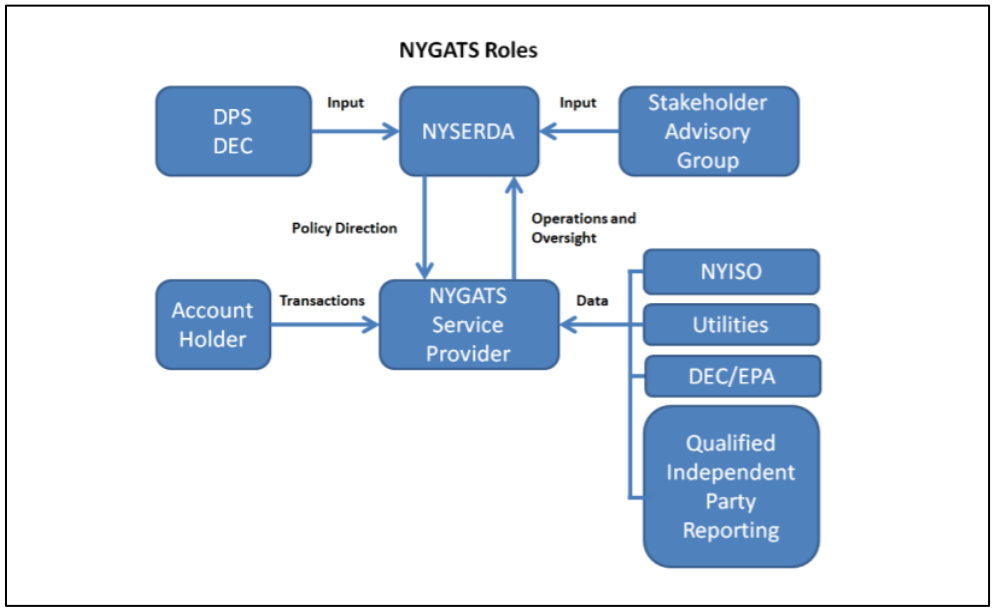
NYPA and LIPA have agreed to notify the Commission annually by filing a report on:

- How they have contributed to the achievement of the CLCPA Targets in the prior year
- A notice indicating the extent to which they intend to participate in NYSERDA's annual CES procurements
- And/or fund their *pro rata* share of attributes procured by NYSERDA in the coming year

C. Additional Information

C.1. Procurement of RECs through NYSERDA

https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/LSE-Obligations/FAQs-for-Load-Serving-Entities
https://www.nyserda.ny.gov/All-Programs/Programs/NYGATS/How-to-Use
https://www.nyserda.ny.gov/All-Programs/Programs/NYGATS/Registration-Documents
https://nygats.ny.gov/ng/Admin/Account



C.2. SUNY Energy Buying Group

https://system.suny.edu/capital-facilities/energy-procurement/

Energy Procurement and Utility Affairs Office

The Energy Procurement and Utility Regulatory Affairs Office, oversees the administration and purchasing of utilities and related services for SUNY campuses. Our office works with local regulated utilities, energy and fuel suppliers, state agencies and authorities, consumer groups, and local governments. The SUNY budget for utility expense is a significant portion of its overall costs. Our goal is to reduce costs incurred by our facilities and mitigate the volatility of prices, while working within the state regulatory and purchasing requirements.

Our office coordinates the aggregated purchasing of electricity and natural gas commodities. A significant portion of our efforts is to manage the daily operations of the SUNY Energy Buying Group (EBG), our aggregated purchasing group of electricity for most of our upstate campuses. The EBG members purchase their electricity supply needs at wholesale rates through direct participation in the NYISO markets. Since 2004, the EBG campuses have collectively saved over $26 million. Participation in this group is available to all state operated campuses, community colleges, and affiliated organizations.

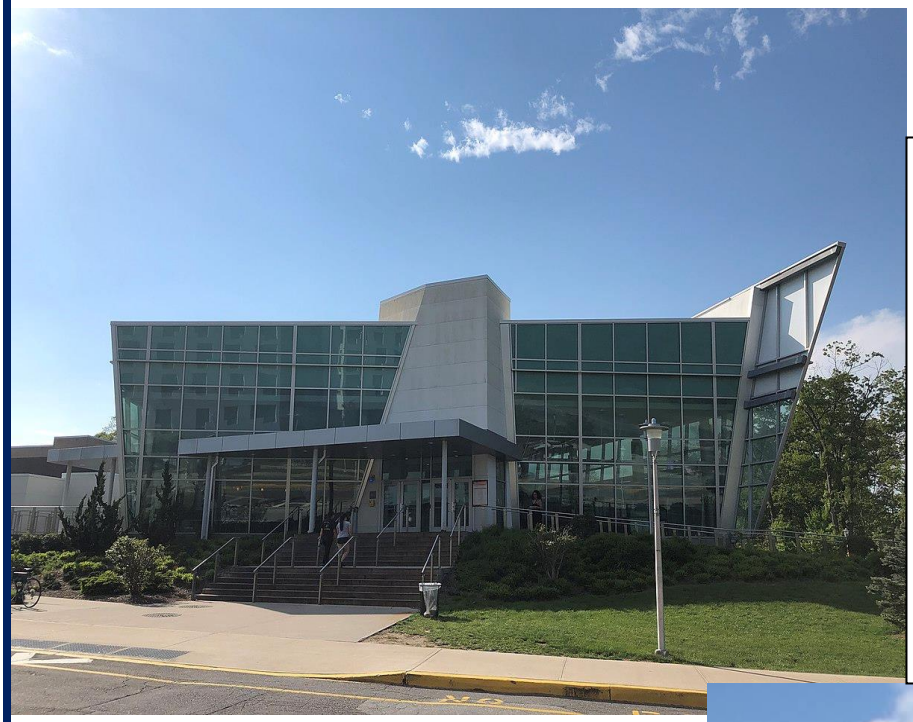
D. Clean Energy Master Plan Development & Advisory Team

- **Derek Nelson** – *Project Manager, Clean Energy Advisory Services*
- **Christina Iwaniw** – *Distributed Energy Engineer, Clean Energy Advisory Services*
- **Vennela Yadhati** – *Manager, Clean Energy Advisory Services*
- **Evan Kolkos** – *Director, Clean Energy Advisory Services*
- **Jeff Laino** – *Sr. Key Account Executive, Clean Energy Solutions*
- **Palwinder Singh** – *Project Engineer II, Engineering & Construction Management*
- **Ravi Shankar** – *Lead Program Engineer II, Engineering & Construction Management*

- **Jal Desai** – *Engineer I, Integrated Applications Center*
- **Karlynn Cory** – *Group Manager, Integrated Applications Center*
- **Paul Schwabe** – *Financial Analysis Team Lead*

- **Michael Martino** – *Director of Utilities, Energy Management/ Sustainability*
- **Thomas Lanzilotta** – *Campus Sustainability & Energy Manager*
- **Christian Guzman** – *Energy Coordinator*
- **Terence Harrigan** – *Assoc. Vice President, Facilities & Services*
- **Dean Tufts** – *Vice President, Facilities & Services*
- **David Hamilton** – *COO, AERTC, & Executive Director, CEBIP*
- **Dr. Richard Reeder** – *Vice President, Research, & Operations Manager, Research Foundation*
- **Dr. Paul Shepson** – *Dean, School of Marine & Atmospheric Sciences*
- **Dr. Jon Longtin** – *Assoc. Dean, Research & Entrepreneurship, & Professor, Dept. of Mechanical Engineering*

For any questions or queries about this report, contact:



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