Replacement Energy for Indian Point Energy Center

Energy Efficiency and Renewable Energy Fully Displace the Output from Indian Point Energy Center

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1. Summary Findings

The planned retirement of the Indian Point Energy Center (IPEC) in April of 2020 (Unit 2) and April of 2021 (Unit 3) was announced in January 2017.[1] Five months earlier, New York's Clean Energy Standard (CES) Order was issued by the New York Public Service Commission (NY PSC),[2] in which accelerated renewable energy installation (50 percent by 2030) and aggressive pursuit of energy efficiency goals were a centerpiece. Subsequently, the NY PSC adopted specific and strengthened energy efficiency targets,[3] including annual energy reductions from energy efficiency of 3 percent of electricity sales by 2025. Then in 2019, New York passed the Climate Leadership and Community Protection Act (CLCPA), which boosted the renewable energy target (to 70 percent by 2030) and further codified the energy efficiency aims from the CES and accelerated energy efficiency adoption Orders.

This is the temporal framework and energy policy context in which we now assess how these zero-carbon emitting alternative energy sources—efficiency and renewable resources—stack up against the output level of the IPEC facility when it was operating. In this report we examine what has occurred in New York in the 4.5-year interval (2017–2021) since the IPEC retirement announcement and what is projected to occur as new renewables come online and efficiency gains accumulate (through 2035). When analytically appropriate, we look back

- *Energy efficiency resources installed in New York since the announced IPEC closure in 2017 will displace half of IPEC output by the end of this year. Coupled with wind and solar PV resources, this clean energy fully displaces IPEC output in 2021 or 2022.*
- *Annual reductions in New York load from energy efficiency resources alone, obtained through NYSERDA and utility-sponsored efforts since roughly 2009 already exceed IPEC's annual output.*
- *Energy efficiency and small solar PV are the main drivers behind a 2,865 MW reduction of grid peak load in 2021 from that forecast a decade ago. This amounts to roughly 1.4x the capacity provided by the IPEC units when operating.*
    - *The projected summer 2021 peak load is 1,540 MW lower than the actual peak load on the grid in 2011, even as New York State's economy has steadily grown.*
- *New York's onshore and offshore wind, and solar PV energy (existing plus CLCPA-driven) will reach 1.7 times IPEC's annual output by 2025, and more than 2.7 times its output by 2030. This is distinct from the energy efficiency contributions noted above.*
- *Natural gas use for electricity generation in New York will continue its declining trend (maximum was in 2012) even after IPEC closure as energy efficiency and renewable output steadily reduce ongoing needs for energy from fossil fuels – even when considering electrification needs.*

[1] NY.gov. 2017. "Governor Cuomo Announces 10th Proposal of the 2017 State of the State: Closure of the Indian Point Nuclear Power Plant by 2021." Press Release, January 9. Available at: https://www.governor.ny.gov/news/governor-cuomo-announces-10th-proposal-2017-state-state-closure-indian-point-nuclear-power.

[2] New York Public Service Commission, *Order Adopting a Clean Energy Standard*, Case 15 15-E-0302 and 16-E-0270, August 1, 2016.

[3] New York Public Service Commission, *Order Adopting Accelerated Energy Efficiency Targets*, Case 18-M-0084 - In the Matter of a Comprehensive Energy Efficiency Initiative. December 13, 2018.

to 2011 (and even to 2004) to capture the broader replacement energy trends that have been at work in New York since at least a decade ago.[4] In particular, we utilize New York State Department of Public Service (DPS) data on energy efficiency savings through utility program efforts from 2011 through the present, and projected to 2025, to inform our assessment.[5]

IPEC, when it was online, produced roughly 16–17 million MWh (or, TWh) per year, with variations depending on the refueling cycle effects and its performance. New York State's now-aggressive stance in acquiring all cost-effective energy efficiency resources has resulted in an annual cumulative reduction of total electricity consumption in New York that will reach 16.7 TWh—fully displacing IPEC output—by 2023, when counting energy efficiency installations that commenced in 2011.[6] As we further document in this report, NYISO data (vintage 2004 and later) indicates more broadly that actual exceedance of IPEC output from energy efficiency resource deployment alone has likely already occurred in New York State.

Considering only the accumulated energy efficiency improvements from 2017 forward (after the IPEC retirement announcement), incremental energy efficiency gains over five years reach 8.3 TWh/year by the end of this year (2021). Solar PV and wind installations in New York produced roughly 5.9 TWh per year in 2020, but output including new solar and wind resources is expected to increase to more than 10 TWh/year by the end of 2022.[7] We note that 2021 output levels depend on the success of projects currently under development that have been delayed in part due to permitting issues. We estimate production of total solar and wind resources in New York installed by the end of 2021 will range from 7.2 to 9.0 TWh/year, with the total solar, wind, and incremental energy efficiency output roughly equaling the production of IPEC pre-retirement. Table 1 below summarizes the energy efficiency and renewable energy resource outputs in the 2017–2021 timeframe.

Table 1. New York State Energy Efficiency, Solar PV, and Wind Energy Output (TWh), 2017–2021

Resource	2017	2018	2019	2020	2021 - Range
Energy Efficiency – Annual Increment	1.4	1.4	1.9	1.7	1.9
Energy Efficiency – Cumulative	1.4	2.8	4.7	6.4	8.3
Solar BTM (behind the meter)	0.9	1.1	1.4	1.7	3.5
Utility-Scale Solar + Wind	4.3	4.0	4.5	4.2	3.7-5.5
Total	6.6	8.0	10.6	12.3	15.6–17.4

Notes: IPEC output: 16–17 TWh/year. Solar and wind projects may see installation dates later than originally planned 2021 operation. The range shown thus includes reduced energy output expected in 2021 from the portfolio of CES-contracted projects. Pre-2017 energy efficiency effects excluded. Source: New York DPS; NYSERDA; NYISO. Portfolio output discount by Synapse.

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[4] New York Public Service Commission, *Order Instituting Proceeding and Soliciting Indian Point Contingency Plan,* Case 12-E-0503, November 30, 2012. This Order commenced assessment of the reliability aspects of IPEC's closure.

[5] We also extrapolate the effect of energy efficiency gains after 2025, assuming continued support for procurement of "all cost effective" energy efficiency resources.

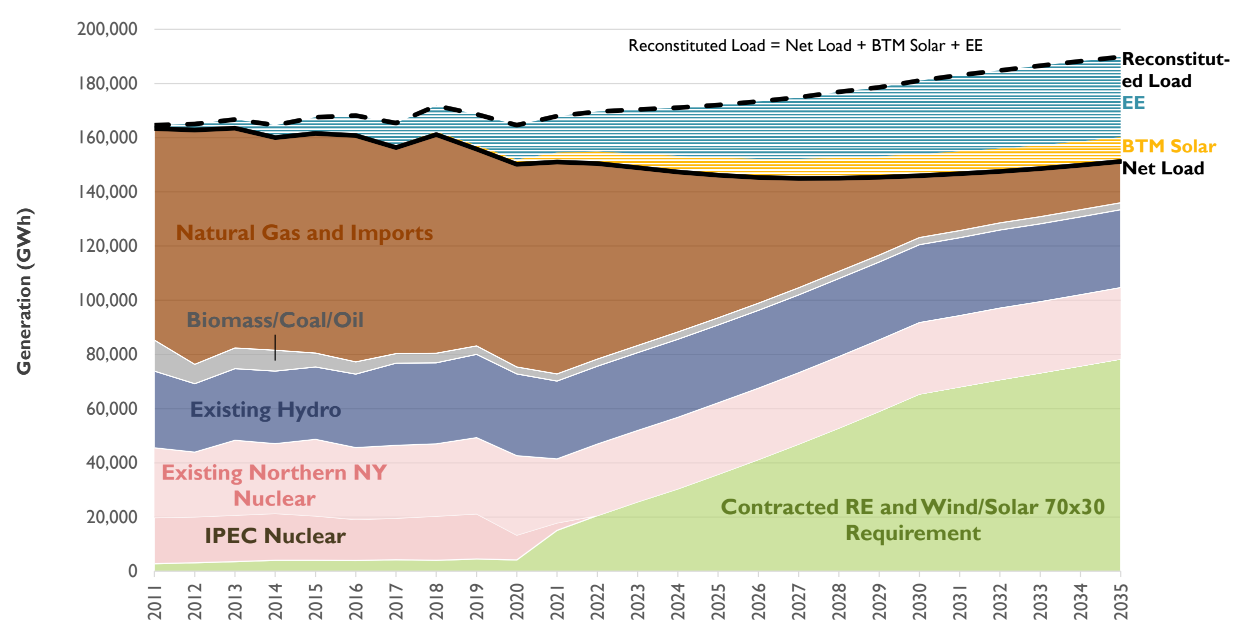
[6] See Section 2 of this report.

[7] Several relatively large (on the order of ~100 MW, or larger) wind and utility-scale solar facilities are in advanced developmental stages in New York, with initial operation dates slated for 2021, but with likely in-service dates of 2022 or later.

Projected deployments of additional wind and solar PV energy in New York State coupled with existing wind and solar resources will reach roughly 1.7 times the annual output of IPEC by 2025, and more than 2.7 times its annual output by 2030. Additional other renewable energy is provided by New York's hydroelectric resources, and by current imports of energy from Quebec.

Figure 1 below shows the broad pattern of electric energy resource deployment in New York State between 2011 and projected to 2035. It illustrates that output patterns for natural-gas-fired energy (along with import energy) have been of a similar magnitude for the past decade but will continue to shrink in output relative to its peak year production (2012, 62 million MWh), IPEC retirement notwithstanding, through 2035. The dominant drivers of the overall longer-term pattern of natural gas use for electricity production in New York will continue to be the effect of energy efficiency deployments, and now renewable energy deployments under the CLCPA. With strengthened policies in both the energy efficiency and renewable energy arena, natural gas use for electricity production will continue to decline over the next decade and beyond.

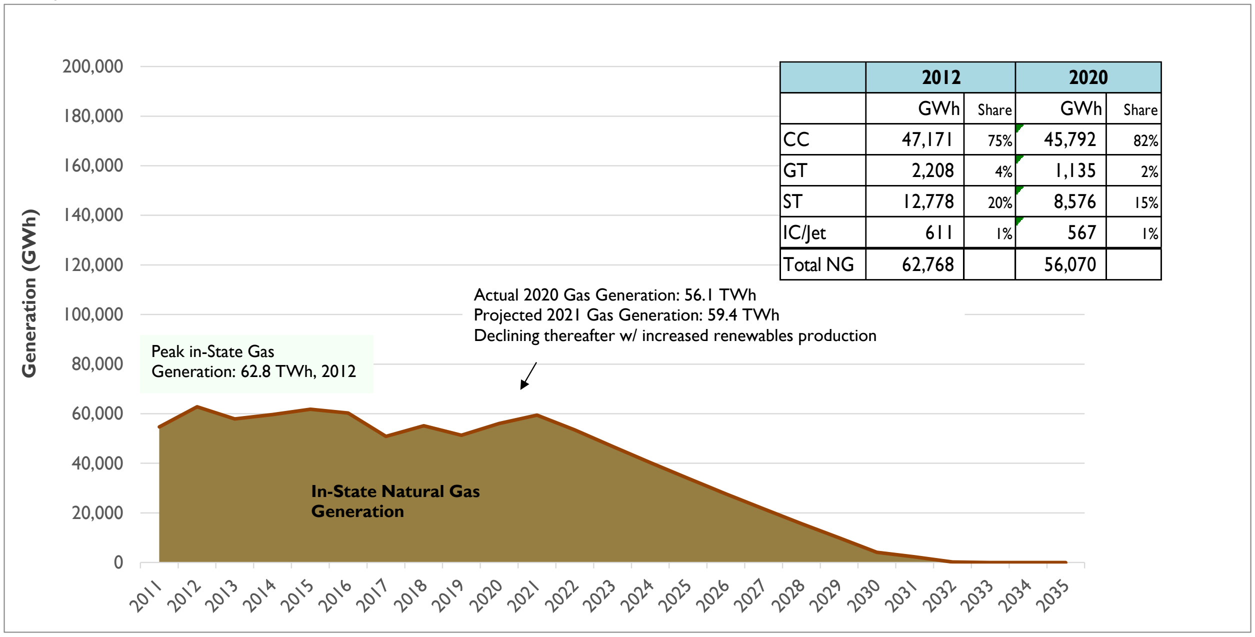
Figure 1. Summary Historical and Projected Electric Energy Production by Source, New York, 2011–2035



Source: Synapse, based on NYISO, NY DPS, and U.S. Energy Information Administration (EIA) data. See detailed report sections. Note: "Reconstituted load" reflects total consumption if energy efficiency gains were not secured; and includes the load served by BTM solar PV generation, which is not reflected in net load or "baseline" load levels from NYISO Gold Book Table I-1a and I-1b. "Existing Northern NY Nuclear" reflects current output from those units; upon retirement, we presume 1:1 energy replacement by a combination of additional solar, onshore and offshore wind not already represented in the additional resources shown.

Figure 2 shows the consumption of natural gas for in-state electricity production between 2011 and 2020, with projected consumption for 2021 through 2035.

Figure 2. Summary Historical and Projected Electric Energy Production from Natural Gas Fueled Generation, New York, 2011–2035



	2012		2020	
	GWh	Share	GWh	Share
CC	47,171	75%	45,792	82%
GT	2,208	4%	1,135	2%
ST	12,778	20%	8,576	15%
IC/Jet	611	1%	567	1%
Total NG	62,768		56,070	

Source: NYISO Gold Books, 2011–2021, Table III-a; projections, tabulation and graphic by Synapse. CC: combined cycle, plus de minimis amount from cogeneration units. GT: gas turbine (peaker). ST: steam turbine. IC/Jet: Internal combustion or jet engine (peaker).

As seen in Figure 2, natural gas use for electricity production peaked in 2012 in New York, with an aggregate output of roughly 62 TWh across various types of thermal resources. While one expected near-term effect of IPEC's closure is an increase in marginal energy from gas resources,[8] seen by comparing 2019 and 2021 (expected) values for gas-fired generation, the overall trend is one of continuing reduction of aggregate electricity production from natural gas fuels as efficiency and renewable sources continue to displace the need for fossil-fueled electricity.

Newer combined cycle plants such as Cricket Valley and CPV Valley also contribute to steady declines in production at older, less efficient and more highly emitting units such as steam plants, gas turbines, and older combined cycle units.[9] The insets in Figure 2 and Tables 3 and 4 in Section 3 of this report illustrate that one of the results of the commencement of operation at those two newer combined cycle power plants is a reduction in production at older gas-fired steam and gas turbine plants in New York, and also a reduction of output at older gas-fired combined cycle facilities. The 2020 output from the Cricket

[8] See Section 3 of this report.

[9] For example, in 2012, New York's peak year for gas use for electricity production, older steam and gas turbine plants, and other peaking units made up 25 percent of the total natural gas produced electricity. By 2020, that share had declined to 18 percent. See inset to Figure 2 (data from Table III-2 of the 2021 NYISO Gold Book).

Valley and CPV Valley plants combined (about 8.8 TWh) has displaced output from older, less efficient gas plants.[10]

2. BACKGROUND

In Synapse's 2017 *Clean Energy for New York* report,[11] we concluded that reduced New York State fossil fuel consumption and continuing reductions in greenhouse gas (GHG) emissions—relative to a status quo, IPEC retention scenario—was feasible at similar or lower costs, if New York instituted an aggressive energy efficiency policy framework. At the time, New York lacked such an aggressive framework because it had yet to commit to the types of best practices in programmatic energy efficiency delivery seen by then-leading states. We also noted that accelerated production of renewable energy beyond the then-applicable 50 percent by 2030 CES, coupled with high levels of energy efficiency, could lead to reduced fossil fuel consumption under IPEC retirement. This would be the case even relative to a more stringent IPEC-in-service baseline, such as one assuming New York achieved its then-aspirational CES-based energy efficiency goals.

Synapse's 2017 *Clean Energy for New York* report modeled replacement energy and capacity resources for IPEC.[12] Using the National Renewable Energy Laboratory's ReEDS model,[13] we analyzed future resource scenarios under different levels of energy efficiency and renewable energy installation trajectories under the CES as it existed in 2016. The analysis considered replacement effects under a more aggressive energy efficiency deployment trajectory, and it included scenarios in which the Champlain Hudson Power Express (CHPE) was either in service in 2022, or not part of New York's electric resource expansion.[14]

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[10] Reduced collective output at natural-gas-fired steam plants in New York between 2012 and 2020 was 4.2 TWh; reduced output at gas turbines and other peaking resources across the same time period was 1 TWh; and at remaining combined cycle units, more than 10 TWh. [NYISO Gold Book data, Table III, comparing 2020 to 2012]. This reduction in annual electricity production exceeds the output seen at the CPV and Cricket Valley Plants in 2020.

[11] Report available at https://www.synapse-energy.com/sites/default/files/Clean-Energy-for-New-York-16-121.pdf.

[12] Report available at https://www.synapse-energy.com/sites/default/files/Clean-Energy-for-New-York-16-121.pdf. Previous analyses by Synapse in 2013/2014 evaluated replacement energy and capacity impacts of IPEC retirement at earlier points in time (2016), prior to CES development, as part of a proceeding before the New York Department of Environmental Conservation. Those analyses resulted in initial estimates of the trajectory of replacement resource development in the (then) 15-year timeframe after IPEC retirement. *Indian Point Energy Center: Effects of the Implementation of Closed-Cycle Cooling on New York Emissions and Reliability (*2014). https://www.synapse-energy.com/project/reliability-indian-point-energy-center.

[13] National Renewable Energy Laboratory (NREL), Regional Energy Deployment System (ReEDS). https://www.nrel.gov/analysis/reeds/about-reeds.html.

[14] The CHPE is an up-to-1,250 MW transmission project proposed for connection between Quebec and Queens. Other competing projects for renewable energy delivery into New York City have also applied to NYSERDA's 2021 Tier 4 renewable energy certificate solicitation. https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Renewable-

The analyses modeled deployed (and planned) energy efficiency for each year, with the cumulative effects of such deployment eventually exceeding IPEC's annual output level by the early-to-mid 2020s. The exact year in which the resource exceeds IPEC's output depended on the scenario considered. Other resources were accounted for in the model (i.e., old resources were retired, new resources were built, and all resources dispatched) using economic fundamentals.[15] In replacement scenarios using high levels of energy efficiency compared to the "status quo" (i.e., IPEC retention and absent any CES efficiency improvements) IPEC's energy output was replaced with zero-emission renewables and reduced consumption of energy, with accompanying net decreases in fossil energy and import energy for New York by 2022, 2027, or 2030 depending on the scenario. In scenarios comparing replacement to a higher baseline inclusive of some CES efficiency improvements, additional renewable energy beyond then-CES standards were required by 2030 in order to ensure net decreases in fossil and import energy for New York by 2030. Those effects were shown in the detailed modeling results tables included in the 2017 report.[16]

The annual energy production from modeled marginal-energy-providing resources varies depending on total load, the pace of renewable resource additions, and the presence or absence of IPEC. Those marginal resources (in reality, and as modeled) consist of a combination of in-state fossil-fueled resources and imports from PJM, New England, and Ontario.[17] The load input is critically affected by the pace of energy efficiency deployment. As expected, the marginal energy resources in the NYISO's market construct—i.e., import energy and gas-fired energy—were the immediate replacement in the dispatch. However, the overall patterns of import and gas-fired energy between 2016 and 2030 demonstrated the overarching effect of the combination of energy efficiency and renewable resource deployment in New York State: a steadily declining need for energy from these marginal resources. Replacement capacity analysis showed the effect of peak load reduction from energy efficiency implementation and incorporated the planned deployment of new merchant gas-fired capacity.[18]

Generators-and-Developers/Tier-Four. For the purpose of this analysis we make no assumptions about the specific resource used to meet Tier 4 REC requirements, except that it will be renewable energy contributing to New York's CLCPA requirements.

[15] In all scenarios, the ReEDS optimization resulted in retirement of more than 10 GW of then-existing fossil capacity, and some buildout of new gas resource capacity (between 2.4 and 3.9 GW maximum by 2030). Current, more stringent CLCPA law requiring 70 percent renewable energy by 2030 would alter this result, if re-executed. In all scenarios, on the order of 7–12 GW of new renewables were optimally built (or directly included, such as for small-scale solar PV under the then-current NY Sun targets for BTM solar PV). Some offshore wind was included as in-service in the analyses, but current targets under CLCPA are greater than those modeled in 2016.

[16] See, e.g., Tables 5 through 10 in the 2017 *Clean Energy for New York* report. Tables 7 and 8 show explicit comparisons between retirement and baseline scenarios.

[17] Unlike imports from Ontario, New England, and PJM, the short-term marginal cost of imports from Hydro Quebec are not directly dependent on natural gas prices.

[18] The CPV Valley plant was included in our 2017 analysis. The Cricket Valley Plant was not; we note that the effect of its operation will likely lead to both accelerated retirement of older gas-fired plants and reduced energy output from the aggregate of older gas-fired plants in New York.

Subsequent to the 2017 Synapse analyses, New York State strengthened its protocols for deployment of energy efficiency and renewable energy resources, including enactment in 2019 of the CLCPA. Critically, a January 2020 NY PSC Order incorporating the requirements of CLCPA directed an increase in deployment of utility-sponsored energy efficiency to 3 percent of retail sales of electricity by 2025, or roughly 3.0 million MWh (or, 3.0 TWh) per year of incremental deployment of such resources.[19]

Those energy efficiency resources, with average measure lives on the order of 10 years,[20] accumulate savings each year such that roughly 15 TWh/year[21] can be expected after five years of deployment once the efforts reach that 3 percent pace, akin to the output of the 2-unit IPEC plant. With each successive year thereafter, the effective annual output (i.e., load reduction) of the accumulated energy efficiency resource continues to increase, reaching (e.g.) 30 TWh per year after 10 years.

In addition to the impact energy efficiency deployment has had on reducing marginal energy needs in New York, deployment of incremental amounts of renewable resources (above the levels provided by existing hydroelectric, wind, and solar resources) also lowers the demand for fossil-fueled energy. Current projections for increases in offshore wind, onshore wind, and solar PV deployment exceed the projections made in the 2017 Synapse report, since the CLCPA raised the requirement for such resources in New York. Those increases will further dampen the demand for gas-fired and import resources in New York, as we show in this report.

The remaining sections of this report provide further detail on the following:

i) the effect that energy efficiency deployment has had on New York State's electrical energy balance, inclusive of the effect increasing electrification will have on electricity need;

ii) the role that deployment of existing in-service renewable resources and projected new renewable resources play in continuing to displace fossil-fired energy from New York's electricity sector; and

iii) the year-over-year residual need for import energy and in-state gas-fired energy, and how those levels will continue to decline as New York reaches its CLCPA renewable energy targets and eventual 2040 targets for net zero carbon emissions across the electric grid.

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[19] NY PSC, Case 18-M-0084.

[20] Average energy efficiency portfolio measure life depends on the mix of measures: e.g., HVAC measures usually exhibit long (i.e., >15 years) lives tied to equipment reliability; lighting measures have a shorter lifespan. Consideration of replacement options and energy efficient equipment market transformation trends also influence the portfolio life for purposes of assessing future impacts. Synapse uses a 10-year energy efficiency portfolio life in this analysis.

[21] In short, 3 TWh/year x 10 years equals a cumulative 15 TWh/year reduction by the end of year five.

3. ENERGY EFFICIENCY AND NEW RENEWABLE RESOURCE DEPLOYMENTS REPLACE INDIAN POINT OUTPUT

Incrementally more efficient use of energy (since 2017) and deployment of renewable resource generation—solar PV and onshore wind—has already significantly displaced output from the IPEC units. Combined with new solar PV and onshore wind resources coming on-line over the next few years, these resources in total will easily exceed IPEC units' historical annual output over the next few years, possibly as early as this year as seen in Table 1 of our Summary Findings.[22] By 2025, the combined effect of load reductions from incremental energy efficiency and continuing increases in solar and wind generation will be displacing roughly two and one-half times IPEC's annual output. New offshore wind resources will also be coming online over the next decade. By 2030, these combined clean energy resources will be producing (or reducing consumption needs) at a level more than three times the annual output of the IPEC units. This is unsurprising given the favorable economics for investing in these resources and the State policies that aim to steadily reduce GHG emissions through support of these clean energy options.

This section of the report describes the underlying energy efficiency and renewable resource deployments planned, or already implemented, across New York. The analyses rely on NYISO and NY DPS data sources. Supplemental data from EIA is also employed when necessary.

Energy Efficiency and Behind-the-Meter Solar PV

New York has recently strengthened its energy efficiency policies and currently ranks fifth in the nation in the ACEEE annual State Energy Efficiency Scorecard.[23] The rankings consider in large part the efforts of electric utilities to plan, invest in, and deploy efficiency resources that reduce the load seen on the grid. The scorecard ranking reflects New York's strengthening of its energy efficiency policy targets[24] and

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[22] When considering pre-2011 energy efficiency efforts in New York State, along with post-2010 energy efficiency deployments (depending on the accounting conventions used for the earlier load-reducing resource installations), energy efficiency resource output in New York has likely already exceeded the annual production of the IPEC units. This is especially the case when adding the effects of codes and standards improvements to utility-based energy efficiency programmatic successes.

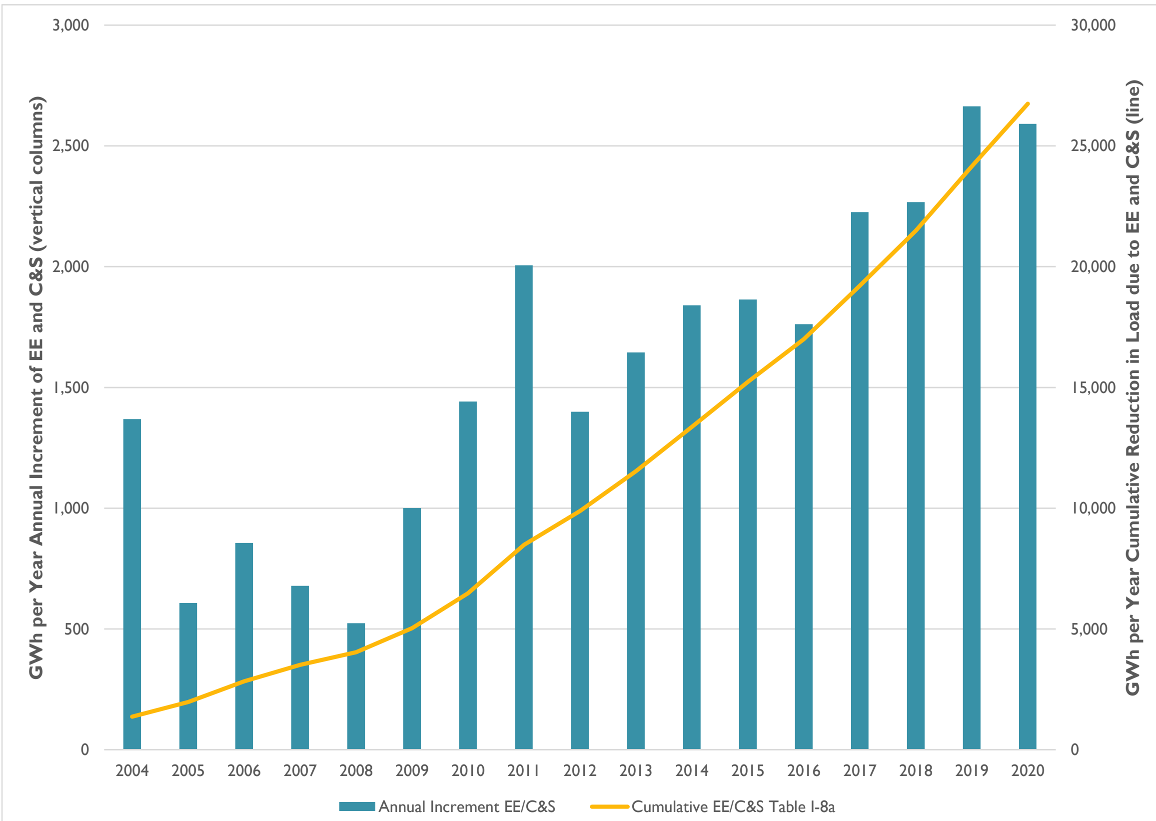
[23] American Council for an Energy-Efficient Economy (ACEEE), *2020 State Energy Efficiency Scorecard,* "New York rounds out the top five for the second straight year. The state's utilities and energy community worked to update policies and programs to meet ambitious goals to achieve a net-zero carbon economy under the 2019 Climate Leadership and Community Protection Act (CLCPA). In January the state's Public Service Commission issued an order setting ambitious energy efficiency and building decarbonization targets in pursuit of the state goal to achieve 185 TBtus of savings by 2025. The state's efficiency goals are notable for being among the first in a next generation of fuel-neutral energy efficiency resource standards that integrate beneficial electrification and include a separate heat pump target." p.11. https://www.aceee.org/sites/default/files/pdfs/u2011.pdf.

[24] Id. "In January the New York Public Service Commission also issued a major new efficiency order. It calls for the achievement of 185 TBtus of savings by 2025 per the state's Climate Leadership and Community Protection Act (CLCPA), translating to nation-leading annual goals of 3% electric savings and 1.3% natural gas savings. The order also includes a 3.6 TBtu carve-out target for savings from heat pumps, alongside a $454 million combined budget with $27 million set aside for low-to-moderate-income heat pump adoption. Shortly afterward, Con Edison announced a $1.5 billion initiative tripling efficiency investments in 2025 with a focus on heat pump deployment." p.26.

recognizes NY PSC's 2020 increase of the efficiency target to 3.0 percent of retail sales by 2025.[25]

New York State has developed, deployed, and tracked the effects of utility-based energy efficiency programs and the impacts of appliance and building efficiency codes and standards since at least 2004.[26] The NYISO 2021 Load and Capacity Data (Gold Book) report shows the cumulative effects of those policies, illustrating reductions in energy usage across the state.[27] Figure 3 below illustrates the accumulation of energy savings over time, with an order of magnitude that approaches IPEC-level energy output over the course of roughly 10 years, during periods when New York State's programmatic energy efficiency efforts were less aggressive overall than they are now.

Figure 3. Historical Cumulative Reduction in Annual Energy from Energy Efficiency and Codes and Standards



Source: NYISO, Table I-8a, 2021 Gold Book.

[25] The target of 3 percent of retail sales by 2025 is equal to 2.96 TWh of incremental, annual savings from spending in that year for that increment of efficiency. Measures installed in any given year continue to save energy in subsequent years, accumulating the benefits associated with the utility programs.

[26] The NYISO Gold Book series contains information on energy efficiency effects back to at least 2004.

[27] NYISO, 2021 Load & Capacity Data Report ("Gold Book"). April 28, 2021. https://www.nyiso.com/documents/20142/2226333/2021-Gold-Book-Final-Public.pdf/b08606d7-db88-c04b-b260-ab35c300ed64. Table I-8a; and page 13, "The [data] listed in Table I-8a are separated into estimated historical impacts and forecasted impacts from programs and activities expected to occur from 2021 onwards."

The table below, from the NYISO 2021 Gold Book, reproduces the historical data shown in Figure 3 above and contains data on the projected accumulations from energy efficiency effects commencing with 2021 efforts. For all years after 2020, it shows incremental reductions relative to a 2020 baseline. Figure 3 shows the effects relative to a 2004 baseline and assumes continuing accumulations each year equal to the savings seen in the initial year of resource increment deployment.[28]

Table 2. Reproduction of NYISO Table I-8a: Energy Efficiency and Codes and Standards Energy Impacts, 2004–2025

Estimated Historical Cumulative Reductions in Annual Energy by Zone - GWh

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA	Synapse Incremental Annual EE
2004	228	114	224	21	105	168	46	29	42	371	21	1,369	1,369
2005	320	163	316	29	148	237	68	42	63	555	36	1,977	608
2006	451	236	447	41	210	334	100	61	92	804	57	2,833	856
2007	540	287	537	49	253	401	131	76	118	1,039	81	3,512	679
2008	588	347	587	53	275	441	153	82	130	1,125	255	4,036	524
2009	703	423	698	63	331	535	228	99	157	1,371	429	5,037	1,001
2010	873	507	838	75	411	672	297	120	207	1,840	639	6,479	1,442
2011	1,124	651	1,049	94	525	865	439	152	273	2,433	880	8,485	2,006
2012	1,279	758	1,192	107	602	988	534	172	311	2,768	1,173	9,884	1,399
2013	1,442	886	1,353	121	687	1,125	643	197	356	3,206	1,513	11,529	1,645
2014	1,641	1,031	1,542	137	787	1,284	771	225	412	3,687	1,852	13,369	1,840
2015	1,859	1,170	1,742	154	896	1,471	897	252	459	4,105	2,228	15,233	1,864
2016	2,052	1,260	1,898	168	989	1,643	1,055	271	504	4,508	2,647	16,995	1,762
2017	2,279	1,397	2,097	186	1,102	1,839	1,258	302	580	5,195	2,986	19,221	2,226
2018	2,500	1,517	2,290	203	1,212	2,030	1,467	333	658	5,901	3,377	21,488	2,267
2019	2,745	1,650	2,501	222	1,333	2,244	1,711	369	760	6,814	3,803	24,152	2,664
2020	2,987	1,778	2,709	241	1,452	2,455	1,934	404	855	7,664	4,264	26,743	2,591

Forecast of Cumulative Reductions in Annual Energy by Zone Relative to 2020 - GWh

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA	Synapse Incremental Annual EE
2021	241	153	218	19	121	206	244	35	83	748	427	2,495	2,495
2022	490	319	452	40	247	416	487	74	172	1,547	852	5,096	2,601
2023	785	520	740	65	398	659	743	123	277	2,491	1,262	8,063	2,967
2024	1,099	746	1,062	93	562	913	992	180	390	3,505	1,668	11,210	3,147
2025	1,433	994	1,418	124	739	1,178	1,238	245	516	4,640	2,068	14,593	3,383
2026	1,763	1,238	1,769	154	913	1,439	1,479	309	641	5,759	2,470	17,934	3,341
2027	2,083	1,475	2,111	183	1,082	1,694	1,715	371	762	6,849	2,875	21,200	3,266
2028	2,387	1,700	2,434	211	1,242	1,934	1,936	430	876	7,877	3,287	24,314	3,114
2029	2,660	1,902	2,725	236	1,387	2,151	2,137	483	980	8,806	3,711	27,178	2,864
2030	2,888	2,071	2,968	257	1,507	2,332	2,303	528	1,066	9,580	4,159	29,659	2,481
2031	3,119	2,230	3,207	278	1,628	2,517	2,454	573	1,163	10,459	4,517	32,145	2,486
2032	3,342	2,385	3,439	298	1,745	2,697	2,599	617	1,258	11,308	4,868	34,556	2,411
2033	3,551	2,529	3,655	317	1,854	2,864	2,736	658	1,346	12,097	5,208	36,815	2,259
2034	3,741	2,661	3,853	334	1,954	3,017	2,858	696	1,428	12,836	5,506	38,884	2,069
2035	3,916	2,781	4,033	350	2,045	3,157	2,971	730	1,502	13,502	5,786	40,773	1,889

Source: New York ISO 2021 Gold Book, and Synapse computation of the annual incremental effect.

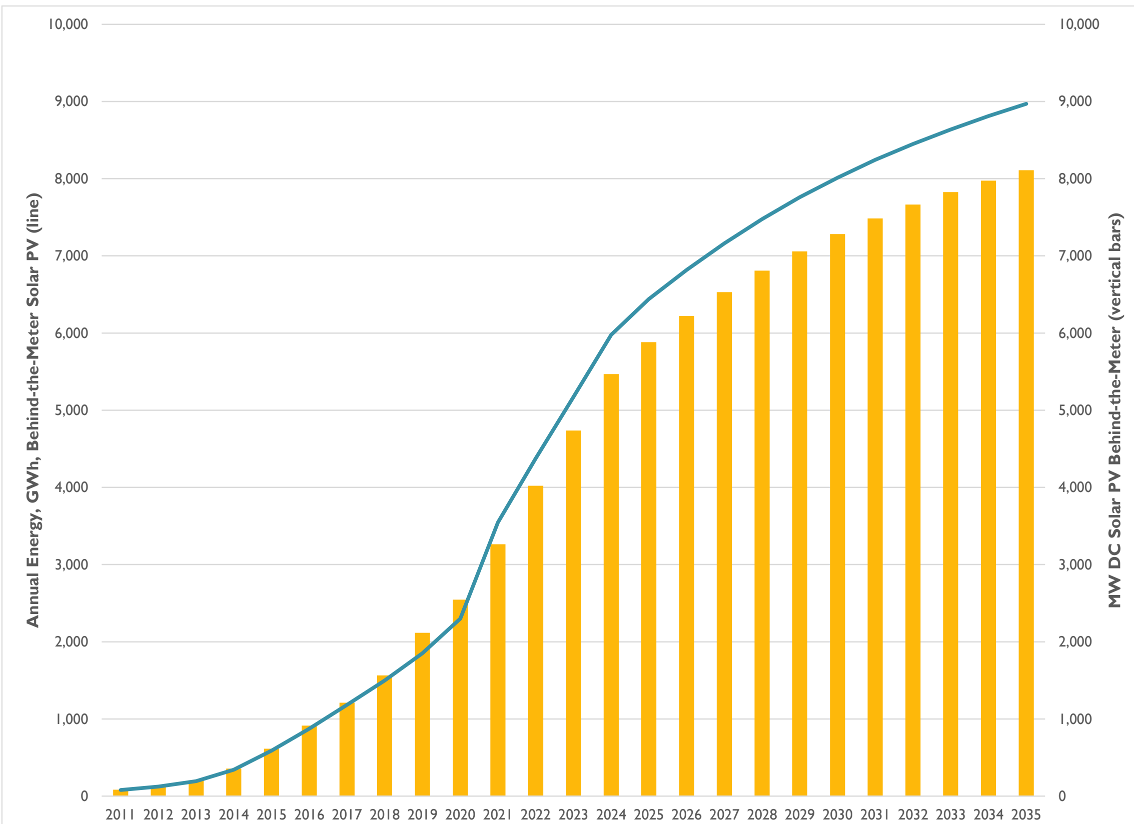
The first part of the table above is useful to provide direct context for the magnitude of historical deployments of energy efficiency technologies. However, it is less directly useful when forecasting

[28] This means that the table effectively presumes replacement equipment of equal efficiency as the originally installed measure.

future load, although indirectly the energy efficiency effects are captured by the NYISO in its forecasting process. Each year, NYISO updates its load forecast, using in large part econometric regression analysis that includes the effects energy efficiency installations have had on historical energy consumption, but which does not capture the effects of future incremental energy efficiency efforts. NYISO combines the effect of previous installations of energy efficiency with projections of future energy efficiency (and other load drivers) when developing its forecasts of annual energy requirements.[29]

NYISO also publishes data on the historical nameplate capacity and projected future energy reduction effects of BTM solar PV, which serves to reduce the required supply of energy to the grid necessary to meet load. Figure 4 below shows the historical and projected patterns of this small-scale solar PV resource. New York currently has announced plans for roughly 6 gigawatts (GW) of distributed solar PV by 2025,[30] reflected in the chart below.

Figure 4. New York State Behind-the-Meter Solar PV, 2011–2035



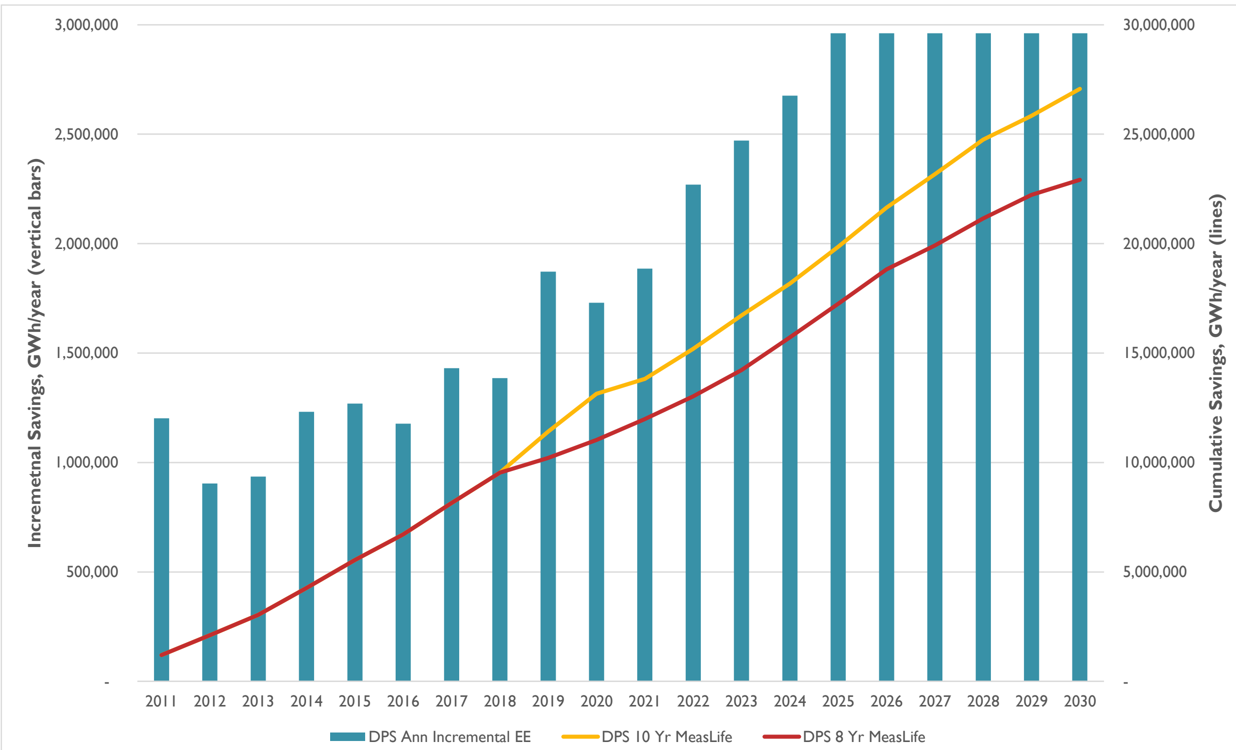
Sources: NYISO, 2021 Gold Book, Tables I-9a, I-9b. EIA electricity data browser, NY Small Scale Solar PV.

[29] NYISO 2021 Gold Book, pages 12-13.

[30] NYISO 2021 Gold Book, Table I-9a. And, New York Public Service Commission, Case 19-E-0735, Proceeding on Motion of New York State Energy Research and Development Authority Requesting Additional NY-Sun Program Funding and Extension of Program Through 2025. Order Extending and Expanding Distributed Solar Initiatives, May 14, 2020.

NY DPS and NYSERDA collect data on the savings associated with energy efficiency program implementation in New York State. Figure 5 below presents current data on programs implemented through 2020, and also includes projections of planned savings based on the NY PSC's January 2020 Order.[31] The data are a snapshot of the energy efficiency installations excluding the effects of codes and standards, which are reflected in the NYISO data noted above.[32]

Figure 5. New York State Historical and Projected Energy Efficiency Program Savings, 2011–2030, Annual Incremental and Cumulative



Source: NY DPS. Accumulations based on 10-year (and as a sensitivity, 8-year) average portfolio measure lives by Synapse. Note that these savings exclude the impact of codes and standards, which are reflected in the NYISO data in Table 2 and Figure 3.

These data sources indicate the quantities of energy efficiency resources and small-scale, BTM solar PV that displace the need for utility-scale production of energy for delivery to customers. The effect of more efficient use of electric energy and installation of BTM solar PV is to reduce the need for any form of utility-scale energy production for delivery to customers. These two sources of reduction in the need

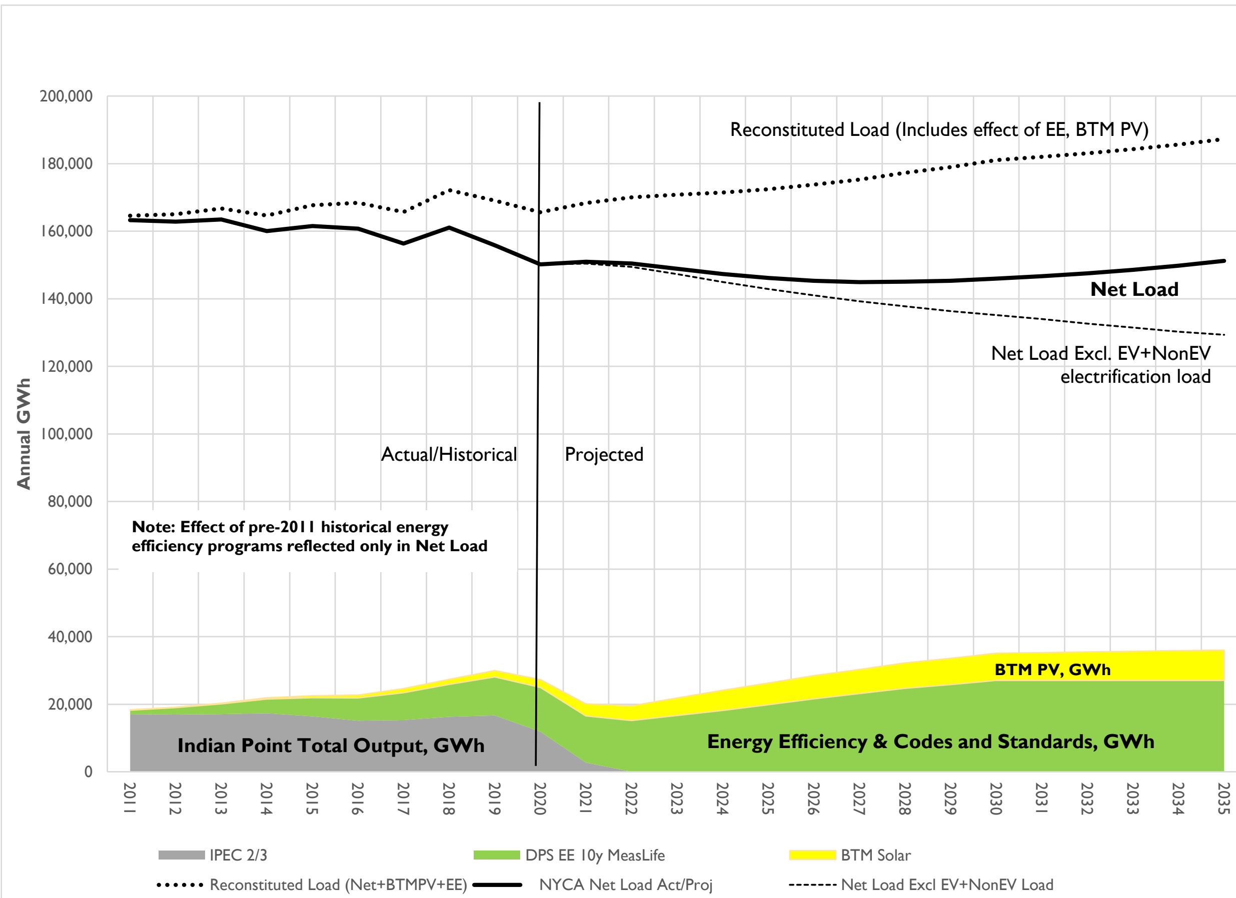
[31] NY PSC, Case 18-M-0084 – In the Matter of a Comprehensive Energy Efficiency Initiative. Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025. January 16, 2020.

[32] NYISO 2021 Gold Book, Table I-8a.

for grid-scale electric power generation have been substantial in New York State, as seen in Figure 6 below.

Figure 6 illustrates the overall effect on baseline energy demand in New York—after accounting for energy efficiency and BTM solar PV—for the 2011 through 2020 period and projected through to 2035, based on the NYISO and NY DPS projections.

Figure 6. New York State Baseline Annual Energy, Net and Reconstituted Load (Reflecting Impact of BTM PV and Energy Efficiency), 2011–2035 with Comparison to 2011–2021 Indian Point Energy Center Output



Source: NYISO, New York DPS, Synapse. Note: "Reconstituted Load" refers to terminology used in New York and in New England to reflect what the system load would have been in the absence of energy efficiency and behind-the-meter solar resource impacts.

The figure above combines data from both NYISO and NY DPS. It includes a Synapse estimate of "reconstituted" load (i.e., load that would have been seen on the utility grid but for the presence of programmatic energy efficiency gains and BTM solar PV). It clearly shows the general trend in New York State of declining grid energy needs (net load decreased by 13.1 TWh between 2011 and 2020). This trend would continue except for the presence of additional expected load due to electrification of transport and heating end uses, which is projected to accelerate over the next 15 years. Even with that additional load (which brings accompanying GHG emission reductions from reduced fossil fuel use for heating and transportation fuels) the net load of 151 TWh projected for 2035 is still more than 12 TWh lower than seen in 2011 and more than 5 TWh lower than seen in 2017 (the year in which the IPEC closure was announced).

Critically, the data underlying the graphic demonstrate the following:

- The level of annual output of the IPEC units is roughly matched by the effect of post-2010 programmatic energy efficiency installations by 2023.
- By 2030, energy efficiency gains reach 1.6 times the average annual level of IPEC's output during the 2011–2019 period.
- In 2021, the combined energy efficiency and small solar PV resource reaches 17.4 TWh/year, exceeding IPEC's best performing year (2014, 17.3 TWh).

Utility-Scale Renewable Energy Resources

New York implemented its CES policies in 2016, with stringent requirements to meet 50 percent of electricity need with renewable resources by 2020.[33] In 2019, New York's CLCPA legislation mandated even greater levels of renewable energy, reaching 70 percent by 2030 and fully 100 percent carbon-free energy on the electricity grid by 2040.[34] As of the end of 2020, existing renewable resources on the grid (and BTM solar PV) comprise roughly 24.8 percent of the total electric energy provided to consumers (inclusive of grid losses and including existing in-state hydro, wind, biomass/landfill gas, and solar PV).

Figure 7 below illustrates the expected contribution and historical pattern of renewable resources to New York's electric production.

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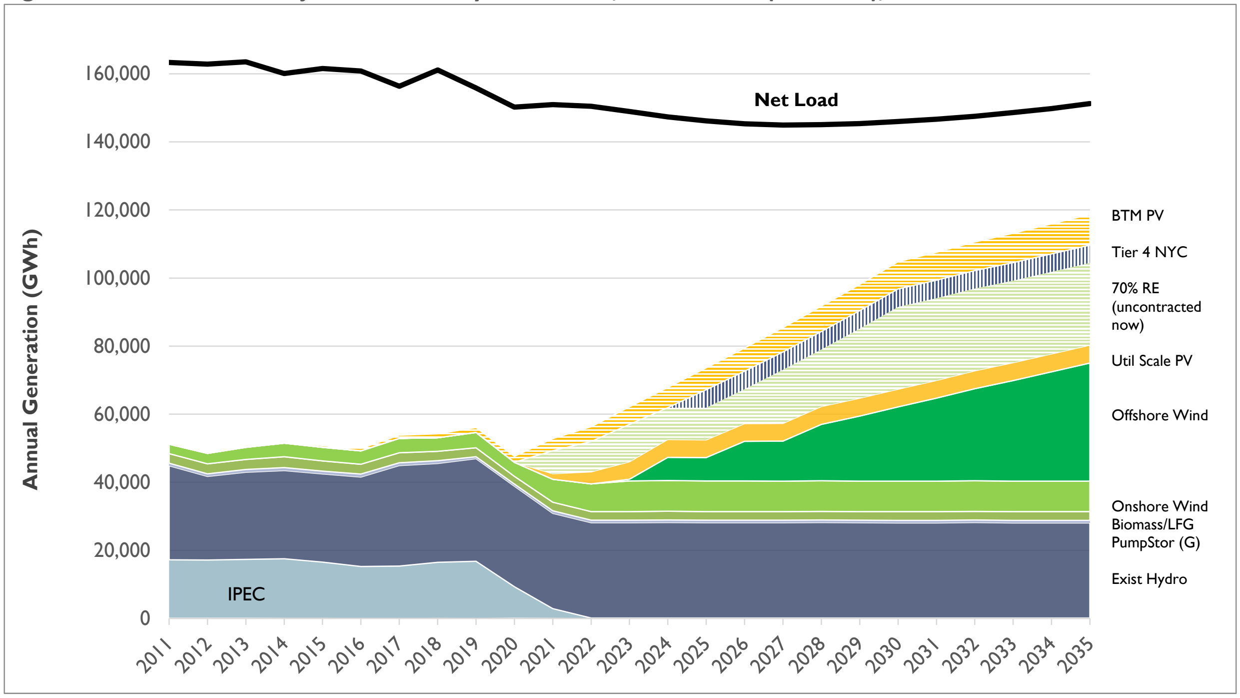
[33] New York Public Service Commission, Case 15-E-0302, Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard. *Order Adopting a Clean Energy Standard,* August 1, 2016. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={44C5D5B8-14C3-4F32-8399-F5487D6D8FE8}

[34] https://climate.ny.gov/.

Figure 7. Historical and Projected Electricity Production, Renewables (and IPEC), New York State 2011–2035



Source: NYISO Gold Books, 2011–2021, Table III-a; baseline (net) load, actual and forecast; energy efficiency and BTM PV estimates (NY DPS, EIA). Tabulation and graphic by Synapse.

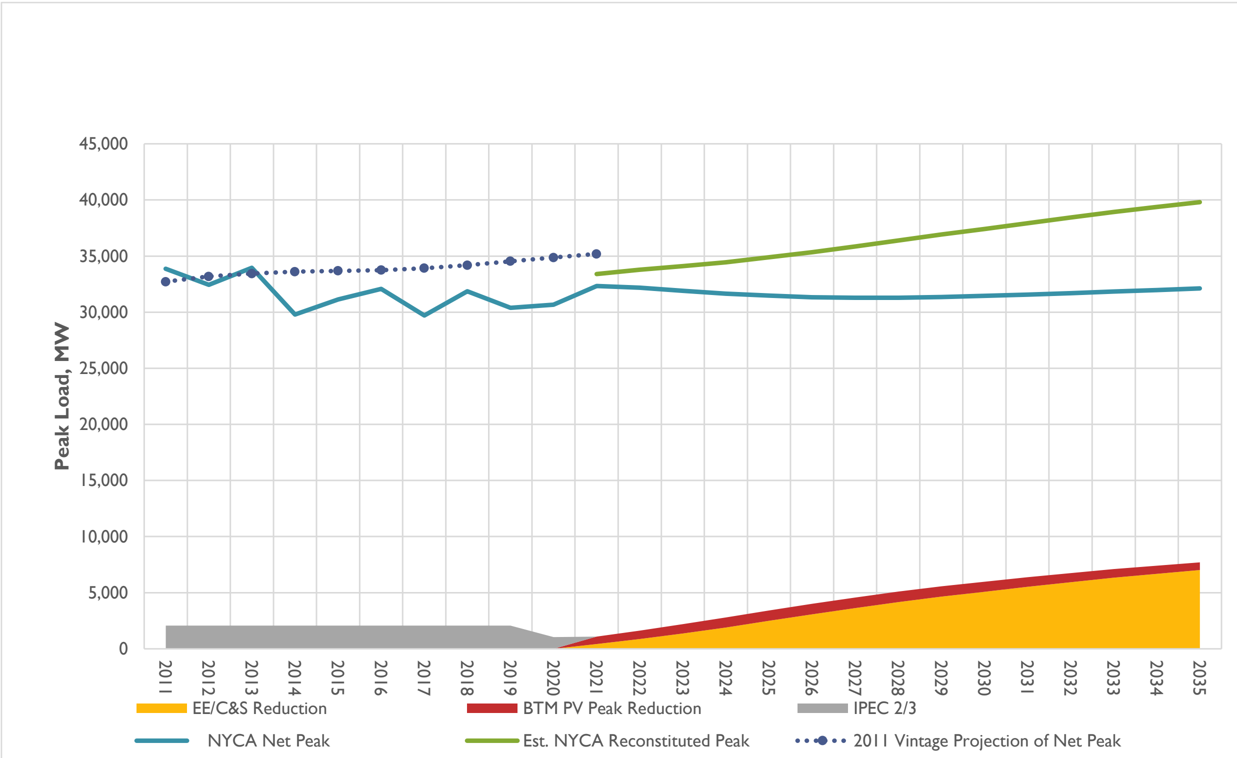
As seen above, expected increases in renewable energy production from wind and solar resources is such that total renewable resources (excluding large hydro) will exceed IPEC's energy production within a few years. By 2025, renewable output from total wind and solar resources will be roughly 1.7 times IPEC's output, and by 2030 it will equal roughly 2.7 times its output.

Effective Capacity Provision by Renewable Energy and Energy Efficiency Resources

Energy efficiency and BTM solar PV resources reduce the net peak load on the electric power system and thus reduce the need for firm capacity resources such as IPEC. Since summer coincident peak in New York occurs in the late afternoon when the sun is still shining, solar PV still contributes to reducing that peak. Utility-scale solar, and utility-scale wind also provide a contribution towards capacity requirements, at a discount to their nameplate capacity.

Figure 8 below shows how BTM solar PV and increases in energy efficiency reduce the peak load on the grid and thus reduce the requirements for firm capacity resources such as IPEC.

Figure 8. Effect of Incremental Energy Efficiency, Codes and Standards, and Cumulative BTM Solar PV on Grid Peak Load in New York, 2011–2035



Source: NYISO 2021 Gold Book, Tables I-3a, I-8b, I-9c, and III-2. Note: The BTM solar PV reflects reductions in summer coincident peak demand, in MW AC, based on the cumulative impact of all BTM solar PV installed and projected for installation. The energy efficiency reductions also reflect reductions to summer coincident peak demand, relative to 2020; i.e., peak reductions from energy efficiency and codes and standards from prior to 2021 are not shown on this chart.

Accumulating energy efficiency and BTM solar PV resources have been and will continue to contribute dramatically to reducing peak load on the grid, at scales easily shown to exceed the peak MW output of the IPEC units. Historically, energy efficiency has been a primary driver of maintaining the pattern of reduced summer net peak load as seen in Figure 8 above. The projected summer 2021 peak load is *1,540 MW lower* than the *actual* peak load on the grid in 2011, even as New York State's economy has steadily grown.[35] As a further example, in 2011 NYISO projected a 2021 peak load of 35,192 MW. This projection was inaccurate; the projection from this years' Gold Book for the summer of 2021 is 32,327 MW, or 2,865 MW below the forecast from 10 years ago. While the difference in forecast value includes macroeconomic effects, the primary driver was the presence of more energy efficiency and BTM solar

[35] Real GDP has grown roughly 11 percent (2010–2020) in New York, including the effect of COVID. Excluding COVID (through 2019), real GDP had grown roughly 17 percent (2010–2019). Source: New York - Real GDP 2000-2020, Statista Research Department, Apr 15, 2021. https://www.statista.com/statistics/188087/gdp-of-the-us-federal-state-of-new-york-since-1997/.

PV than was envisioned by NYISO at the time. The magnitude of the accumulated capacity and production of many distributed resources across NY easily exceeds that of the two-unit IPEC facility.

4. Effect of IPEC Retirement on Natural Gas Generation

Natural-Gas-Fired Generation as Marginal Fuel

Natural-gas-fueled electricity generation from in-state New York supply resources are the primary short-term marginal energy source[36] used by NYISO to meet energy demands when other resources' output is reduced.[37] Conversely, when other resources' output is increased, natural gas generation is turned down to maintain balance. Over any given period of time, the net effect of these patterns is observable in the data available for electricity output. Import energy from PJM, New England, and Ontario also serves this marginal resource need, although the energy from these locations is "scheduled" into the New York region by wholesale market participants based on the market price signals available from the New York, New England, PJM, and Ontario marketplaces. Generally, such scheduling quantities depend on the supply/demand balances in other regions, New York's balances, the price for natural gas, and the nature of the natural-gas-fueled resources that serve as the marginal resource within each region, across those regions.

Additionally, Quebec delivers energy into the New York marketplace. Its economic basis for energy quantity scheduling decisions, unlike PJM, New England, and Ontario, is tied to longer-term assessments of the value of its energy in the market. Quebec effectively stores its energy in reservoirs, rather than using natural gas to generate electricity on the margin.

When considering the effect of IPEC's retirement, longer-term and shorter-term factors drive energy outcomes. As noted in the above sections, New York's policies on energy efficiency and renewable energy deployment have impacted, and will continue to impact, the longer-term trends associated with replacement of energy from resources as they retire. In the shorter term, marginal energy provision—by in-state gas and import resources—dominates the energy balances. Long-term and short-term factors also include other activity in the market for electricity in New York: retirement of coal-fired energy production; retirement of older gas-fired energy resources; the effect of New York's policy on "peaker" generation, which will lead to 2023 and 2025 retirements or ozone season shut-down of resources

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[36] This is in respect of day-ahead and real-time market timeframes.

[37] See, e.g., Potomac Economics, *2020 State of the Market Report*, Table 2: Fuel Type of Real-Time Generation and Marginal Units in New York 2018-2020 (page 6). Also, "Gas-fired units and hydro resources were most frequently on the margin in recent years. Lower load levels and decreased congestion (particularly in New York City) led gas-fired peakers and steam units to be on the margin less often in 2019 and 2020. Most marginal hydro units have storage capacity, leading their offers to include the opportunity cost of foregone sales in other hours (when gas units are marginal). Thus, the prices set by hydro units are also affected by natural gas prices. Other fuel types set prices much less frequently." Page 7. https://www.potomaceconomics.com/wp-content/uploads/2021/05/NYISO-2020-SOM-Report.pdf.

located in cities;[38] and the effect of merchant decisions to build natural-gas-fired generation resources. All of these factors are at play when looking at the historical and projected patterns of electric energy resource use in New York.

Since natural gas as an electricity-producing fuel is on the margin, its use relative to immediate earlier years would be expected to increase after the retirement of a source as large as the Indian Point units, until planned replacement resources come online. However, IPEC's retirement would not mean that New York State would not reach its emission-reduction goals, nor does it imply that gas is the ultimate replacement fuel in a generic sense over time, as Synapse has demonstrated in multiple earlier analyses[39] and as we illustrate in this report. Notably, a similar situation exists in California today. Policymakers there decided in 2018 to close the 2-unit Diablo Canyon nuclear plant in 2024 and 2025, a timeline not dissimilar in pattern to New York's choices. California energy regulators clearly stated that policy goals to reduce GHG emissions do not depend on seeing a one-for-one increase in renewable energy output in the immediate period after shutdown of a nuclear plant, which would be illogical and costly.[40]

Figure 9 below shows the historical use of natural gas for power generation in New York State from 2011–2020. It also includes a projection for 2021–2035, based on the NYISO 2021 Gold Book projection for net energy needs, the existing resources in place in New York, and projected additions and retirements of resources (especially new solar and wind procurements) or planned procurements.

Figure 10 that follows Figure 9 shows an aggregation (by source) of New York's electricity resource patterns from 2011–2020 and projected from 2021–2035.

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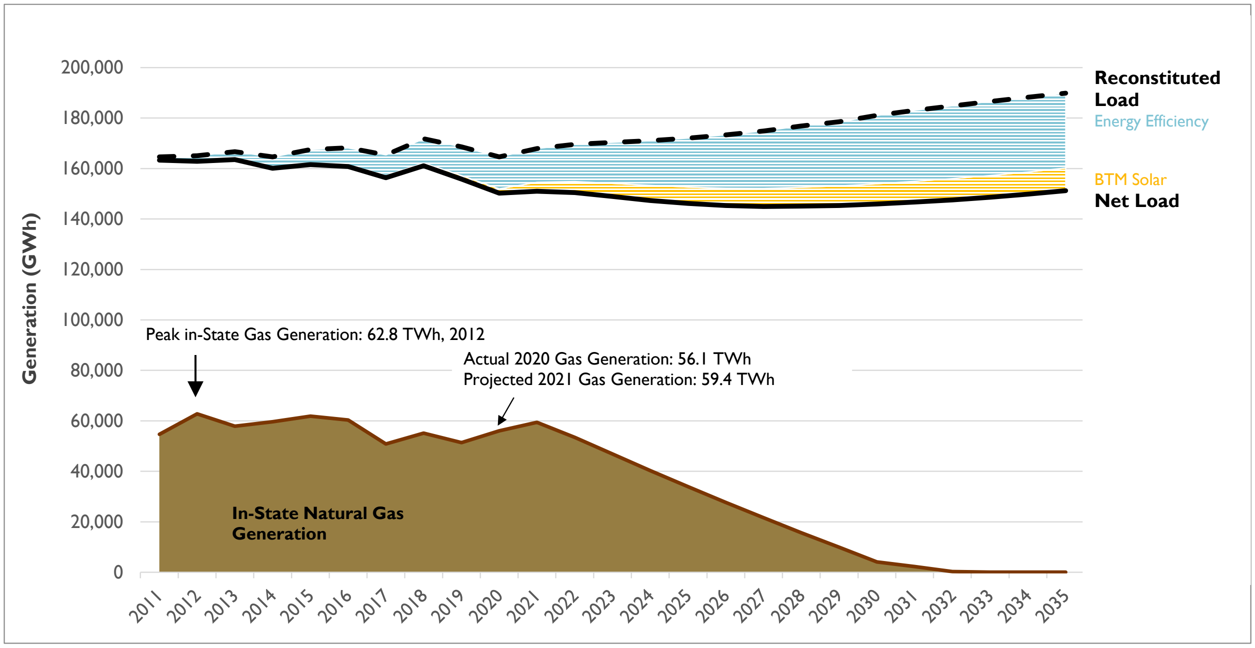
[38] See, e.g., NYISO 2021 Gold Book, Table IV-6: *Proposed Generator Status Changes to Comply with DEC Peaker Rule*, page 121.

[39] *Clean Energy for New York* (2017), and *Indian Point Energy Center: Effects of the Implementation of Closed-Cycle Cooling on New York Emissions and Reliability (*2014).

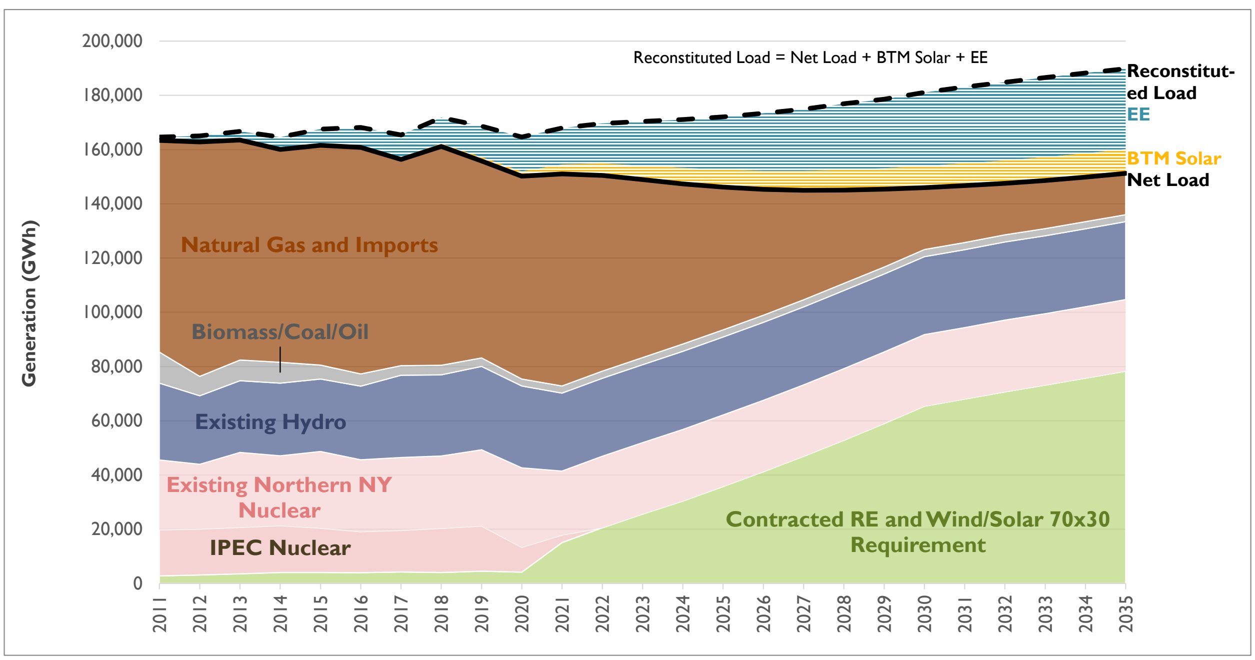
[40] California Public Utility Commission, *Decision Adopting Preferred System Portfolio and Plan for 2017-2018 Integrated Resource Plan Cycle*, D.19-04-040 in Proceeding R.16-02-007. "The Joint Parties to the PFM would have us read the SB 1090 requirements and the D.18-01-022 commitments more narrowly, such that there would not be any increase in emissions at the very moment that the Diablo Canyon units go offline. For a number of reasons, this is not a reasonable reading of the intentions of the Legislature or the Commission. Emissions from the electric sector in California vary considerably every year depending on the hydroelectric production, the retirement of power plants, the growth in load, the functioning of the natural gas system, and many other factors. Expecting an exact one-for-one replacement of energy from Diablo Canyon that is timed perfectly to coincide with the Diablo Canyon closure would be a costly and illogical way to ensure that the emissions trajectory of the electric sector is on track to meet the State's goals." Page 148. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M331/K772/331772681.PDF.

Figure 9. Historical and Projected Natural Gas Electricity Generation for New York, 2010–2035



Source: NYISO Gold Books, 2011–2021, Table III-a; baseline (net) load, actual and forecast; energy efficiency and BTM PV estimates (NY DPS, EIA). Tabulation and graphic by Synapse.

Figure 10. Historical and Projected Electricity Generation and Imports for New York, 2011–2035



Source: NYISO Gold Books, 2011–2021, Table III-a; baseline (net) load, actual and forecast; energy efficiency and BTM PV estimates (NY DPS, EIA). Tabulation and graphic by Synapse. Note: "Reconstituted load" reflects total consumption if energy efficiency gains were not secured; and includes the load served by BTM solar PV generation, which is not reflected in net load or "baseline" load levels from NYISO Gold Book Table I-1a and I-1b.

Figure 9 demonstrates the following concerning natural-gas-fueled resources, import energy, and the effect that IPEC retirement has on longer and shorter trends in New York's electric energy balances:

- New York's highest annual use of natural gas for in-state electricity generation has already occurred (in 2012). It is not expected to exceed that level under the current framework for GHG reduction in New York, which includes planned installations of new renewable resources.
- While an increase in gas for electricity consumption is seen between 2019 and 2021, reflecting in part the effect of IPEC's retirement, the downward trend for gas-fired consumption continues over the next decade and beyond, as New York's efficiency and renewable energy policies continue to accrue benefits in GHG reduction and lower fossil fuel use for electricity production.

Figure 10 demonstrates the following:

- New renewables and projected declining net load (through about 2030) will continue to lead to steadily decreasing natural gas consumption for electricity in New York. Slightly increasing net load after 2030, reflecting the effects of electrification, will be generally served by renewable resources.
- The *combination* of key marginal resources—gas and imports—continuing to decline, with import energy from Quebec continuing to provide sizable contributions to New York even after in-state gas consumption for net load falls to zero.[41]

Figure 11 below shows the full complement of all resources. Notably, electricity production from natural gas (within New York) and non-Quebec sourced imports into New York[42] are seen (in combination) to be slightly declining on average between 2012 and 2021.[43] This decline reflects the effect of energy efficiency gains and increasing renewable energy installations offsetting reductions from coal-fired and oil-fired resources. This decline is projected to continue steadily and more steeply the next decade as renewable resources come online. Quebec imports seen in Figure 11 are based on existing trends (current imports); and some remaining non-Quebec import energy is seen in the last years, between 2032 and 2035.

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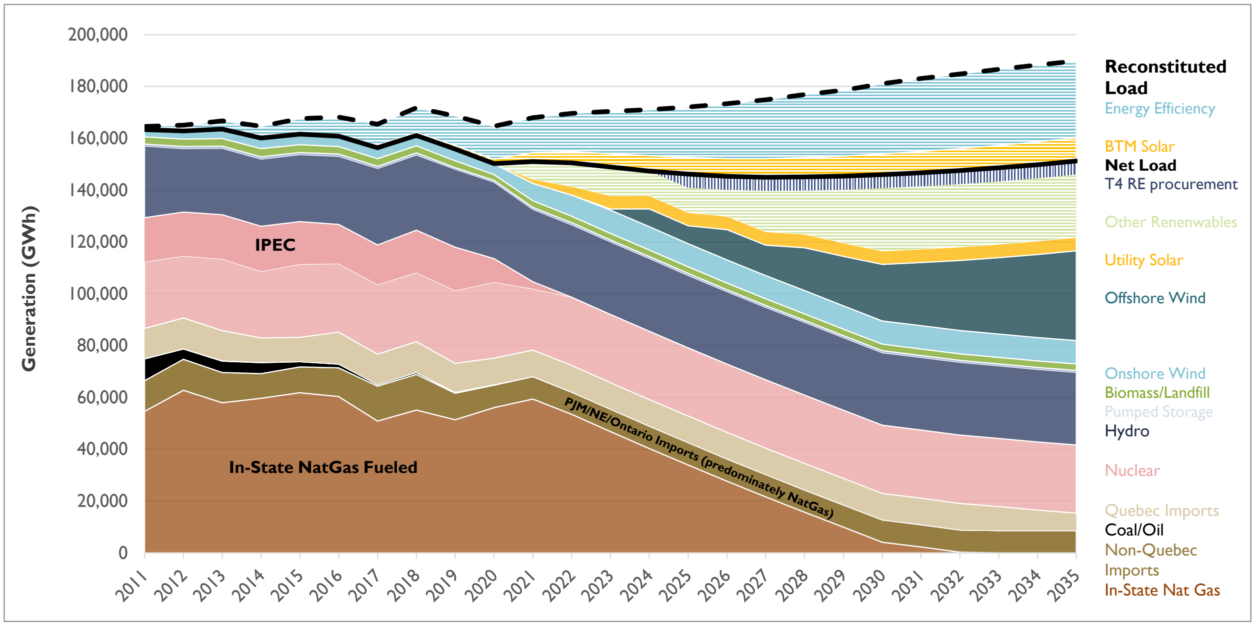
[41] We have not modeled the surrounding regions, and under net export scenarios, it is possible that New York continues to retain some natural gas in-state generation after 2030.

[42] Total New York electricity imports combine those from Quebec (hydroelectric reservoirs), with those from Ontario, PJM, and New England, whose marginal generation sources are predominately natural-gas-fired.

[43] Projected 2021 electricity production from the combination of in-state natural gas resources plus imports from PJM, New England, and Ontario is 9 percent lower than production seen in 2012.

Figure 11. New York Electricity Sources—Historical 2011–2020 and Projected 2021–2035, by Type



Source: Synapse, based on NYISO 2021 Gold Book Net Load ("Baseline Annual Energy Forecast"), NY DPS utility program energy efficiency trajectory, NYISO BTM solar PV trajectory, CES contracts for renewable energy, existing hydroelectric and nuclear energy output trajectory, and remaining effect of requirements to meet 70 percent of electricity needs with renewable energy by 2030. Note: Tier 4 ("T4") renewable energy credit (REC) procurement is assumed to be tied to new renewable resources. Those could include any of a number of sources currently responding to NYSERDA proposals for Tier 4 energy RECs. See https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Renewable-Generators-and-Developers/Tier-Four.

Shifts in Electricity Production Across Different Natural-Gas-Fueled Plant Types

Table 3 below summarizes natural-gas-fired output across four categories of generation types in New York in 2012, 2017, and 2020. It shows absolute and relative amounts of production across the groups.

Table 3. Gas-Fired Electricity Production in New York—2012, 2017, and 2020, by Unit Type

	2012		2017		2020	
	GWh	Share	GWh	Share	GWh	Share
CC (combined cycle)	47,171	75%	40,243	79%	45,792	82%
ST (steam)	12,778	20%	8,678	17%	8,576	15%
GT (gas turbine)	2,208	4%	1,080	2%	1,135	2%
IC/Jet (Internal combustion/jet engine)	611	1%	831	2%	567	1%
Total NG	62,768	100%	50,833	100%	56,070	100%

Source: NYISO Gold Book, Table III-2, 2013, 2018, and 2021 vintage publications.

In addition to the effect of increasing levels of renewable energy production and energy efficiency gains, the presence of newer combined cycle plants such as Cricket Valley Energy Center and CPV Valley has caused steady declines in production at older, less efficient, and more highly emitting units such as steam plants, gas turbines, and older combined cycle units. As seen in Table 3, in 2012 (the year in which New York saw its greatest level of gas use for electricity production) older steam and gas turbine plants, and other peaking units made up 25 percent of the total natural-gas-produced electricity. By 2020, that share had declined to 18 percent.

Table 4 below further shows how production at the new merchant plants (CPV and Cricket Valley) displaced energy that otherwise would be generated by the older units in the natural gas fleet. Total 2020 output from the Cricket Valley and CPV Valley plants combined (about 8.8 TWh) has effectively displaced output that otherwise would have come from natural-gas-fired steam, gas turbine, and older combined cycle plants in New York.[44] And since IPEC's announced retirement, output at the Hudson River plants (Bowline and Roseton) and the larger steam units in New York City has declined, even with the first unit at IPEC out of service for two-thirds of 2020.

Table 4. New York Natural-Gas-Fueled Electricity Production, Selected Units and by Type

	2012		2017		2020	
	GWh	Share	GWh	Share	GWh	Share
CPV + Cricket Valley	-	0%	-	0%	8,840	16%
Bowline & Roseton	803	1%	1,523	3%	769	1%
NYC Steam (AK 2/3; Astoria 2/3/5; East River 6/7; Ravenswood 1/2/3)	6,626	11%	3,819	8%	2,838	5%
All Other CCs	47,171	75%	40,243	79%	36,953	66%
All Other Steam	5,349	9%	3,337	7%	4,969	9%
GTs and IC/Jets	2,819	4%	1,912	4%	1,701	3%
Total NG	62,768	100%	50,833	100%	56,070	100%

Source: NYISO Gold Book, Table III-2, 2013, 2018, and 2021 vintage publications.

As renewable resources and battery storage resources continue to come online in New York, the pollution reducing effect from CPV Valley and Cricket Valley will see diminishing returns, as older steam and combustion turbine units retire. Eventually, new renewables and storage resources will displace output from these newer CC units, lead to declining output and reduction in direct emissions from these resources.

[44] Reduced collective output at natural-gas-fired steam plants in New York between 2012 and 2020 was 4.2 TWh; at gas turbines and other peaking resources, 1 TWh; and at remaining combined cycle units, more than 10 TWh.

5. CONCLUSION

Since the completion of Synapse's 2017 *Clean Energy for New York* report, New York has aimed higher and is on track to deliver on the goal for greater levels of energy efficiency than the original Clean Energy Standard targets. New York has also increased its clean energy supply reach with the passage of the CLCPA and a 70 percent by 2030 renewable energy target. The combination of these events has resulted in a continuing downward trajectory of GHG emissions and generally reduced fossil fuel consumption trajectories for New York electricity production through 2030 and beyond, even absent IPEC.

The core conclusions from the analyses in this report are the following:

- Energy efficiency resources (installed in New York just since the announced IPEC closure in 2017) coupled with existing and in-development wind and solar PV resources in New York fully displace Indian Point Energy Center output this year or next year.
- Reduced electricity consumption in New York from energy efficiency resources alone, obtained through NYSERDA and utility-sponsored efforts since roughly 2009, already exceed IPEC's annual output.
- Small solar PV installations and ongoing energy efficiency efforts over the past decade have led to a 1,540 MW *lower* peak load than seen in 2011, even as New York State's economy has steadily grown.
- New York's onshore and offshore wind, and solar PV energy (existing plus CLCPA-driven) will reach 1.7 times IPEC's annual output by 2025, and more than 2.7 times its output by 2030. This is distinct from and in addition to the energy efficiency gains noted above.
- Natural gas use for electricity generation in New York will continue its declining long-term trend even after IPEC closure as energy efficiency and renewable output steadily reduce ongoing needs for energy from fossil fuels – even when considering electrification needs.

We analyzed the 2016–2030 period for our *Clean Energy for New York* report in 2017. We further support those results with current evidence in this report using a trajectory through 2035 of consumption from NYISO and New York's planned deployment of wind and solar energy resources at distributed and grid scale. Energy efficiency is a particularly inexpensive[45] and powerfully accumulating resource. It plays a central role in reducing natural gas use for electricity generation by steadily reducing electricity consumption that would otherwise occur.

[45] For example, in the latest NY PSC "*Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025*, Case 18-M-0084, January 16, 2020, the five-year budget (2021–2025) for utility electric portfolio energy efficiency programs is roughly $893 million, producing first-year incremental savings of roughly 3.68 million MWh [Appendix A, Table A-1]. This translates to a utility cost of saved energy on the order of roughly 2.4 cents/kWh when assuming 10-year measure life. As noted in the Order text, "[t]hese targets and budgets meet the intended principle of an "all cost-effective measures policy, dramatically scaling energy efficiency, while retaining budget boundaries to ensure cost containment," page 4.

In its annual Gold Book ledgers and updated forecasts, NYISO shows quite clearly how energy efficiency and BTM solar PV affect New York's electricity need for grid-scale resources. NYISO projections show a continuing trend downward in such need, only offset in the future by increases in electrification of fossil-fueled end uses. Those increases in electric energy consumption will be fed primarily by renewable energy sources and will reduce GHG emissions in other sectors of the economy—for example by reducing heating (natural gas and oil) and transportation (gasoline) consumption.

Within a few years, at most, after IPEC's retirement, just the incremental efforts alone on energy efficiency and BTM solar PV installations since 2011 will lead to annual electricity resource needs in New York that are lower than baseline levels (absent the energy efficiency resource) by more than the output from IPEC. A more directed accounting for earlier-year efforts on energy efficiency installations reveals that New York's energy efficiency gains alone have likely already surpassed the annual output of the IPEC units. Beyond these clean resource output levels, incremental renewable energy production—wind and solar deployed since 2016—is poised to increase dramatically over the next decade, and by 2025 will reach almost 1.5 times the annual output of IPEC. By 2030, new wind and solar resources at utility-grid scale installed since 2016 will reach roughly two and one-half times the annual output of IPEC.

Between 2009 and 2019 (the last year with both IPEC units in service), average annual natural-gas-fueled electricity generation in New York comprised between 35 percent and 45 percent of in-state sources (i.e., excluding imports). In absolute terms, such generation amounted to between 47 and 62 TWh/year. This works out to an average of roughly 40 percent (56 TWh) but demonstrates swings appropriate to natural gas's role as a marginal fuel source for the New York electric grid.

Over the next five years, we project natural-gas-fueled generation to range between 33.9 and 59.4 TWh/year. We project the high of 44 percent (59.4 TWh) for this year, after reaching almost 43 percent (56.1 TWh) in 2020; and declines thereafter. Both 2020 and 2021 generation amounts reflect the immediate and expected "bounce" of natural-gas-fueled electricity production in its role as a marginal source following IPEC's closure. This projection will decline to roughly 30 percent of total electricity production by 2025, and the steady declines thereafter result from New York's continuing efficiency gains and renewable energy source installations.

Increases in gas-fired generation from New York's newest gas-fired combined-cycle plants (CPV Valley and Cricket Valley, roughly 9 TWh in 2020) has effectively displaced energy that would otherwise have come from less-efficient gas-fired resources. Between 2012 and 2020, output at steam plants was lower by 4.2 TWh/year; at existing older combined cycle resources, output has dropped 10 TWh/year; and has decreased by 1 TWh at other gas turbine and peaking resources. This displacement also leads to reduced pollutant emitting rates, as the newer CC units have lower heat rates than the older steam and gas turbine units.[46]

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[46] See, for example, average annual heat rate differences for different gas-fueled power plants. The heat rate differences translate into reduced emissions for gas-fired combined cycle plants relative to gas-fired combustion

Notably, the historical high for natural gas generation was 45 percent in 2012, which was more than 62 TWh of generation. This high will likely never be reached again. New York is already on an irreversible downward trend in the use of natural gas for electricity generation. The prevalence of incremental deployment of clean energy alternatives such as efficiency, solar PV, and wind energy is seen in today's data. These increases will continue to demonstrate how New York will convincingly meet its GHG emission goals in a future without IPEC, and with declining natural gas use for electricity generation.

turbine or steam plants because less gas is required to produce the same electricity (kWh) output. https://www.eia.gov/electricity/annual/html/epa_08_02.html.