The Proposed New Astoria Combustion Turbine Generator and New York State's Clean Energy Future

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EXECUTIVE SUMMARY

Astoria Gas Turbine Power LLC (Astoria) is proposing to build a new 437-megawatt gas-fired H-class simple cycle combustion turbine generator in Astoria, Queens County, New York that would come online in 2023. Astoria must receive approval from the New York State Department of Environmental Conservation to modify its Title V air permit, which requires a finding of compliance with the state's Climate Leadership and Community Protection Act. The compliance determination depends on whether the project is consistent with the Act and, if not, whether it is nevertheless justified, or its inconsistencies adequately mitigated.

Synapse Energy Economics was retained to evaluate several of the claims made by Astoria's parent company, NRG, in support of its application. NRG claims that the new Astoria combustion turbine is consistent with the New York Climate Leadership and Community Protection Act in that it results in both direct and indirect greenhouse gas emissions reductions. Direct emissions reductions are said to result from the displacement of less-efficient fossil generators. NRG's calculation of indirect emissions reductions is more complex, stemming from its conclusion that the new Astoria Project would avoid 3,000 megawatts of battery storage. NRG claims that avoiding the installation of battery storage results in cost savings that could be used to fund the installation of new offshore wind turbines that will displace existing fossil generation and indirectly reduce emissions. Synapse found that the methodology supporting these claims is flawed and does not support the magnitude of emissions reductions claimed to be associated with the project.

NRG makes several other claims about the benefits of the Astoria Project: (1) that the new combustion turbine is justified based on cost savings; (2) that it will facilitate renewables integration; (3) that it will address outstanding reliability shortfalls; and (4) that it can provide system restoration service. This report addresses the errors with each of these claims in the sections that follow.

1. THE NEW ASTORIA COMBUSTION TURBINE GENERATOR PROJECT

Astoria Gas Turbine Power LLC (Astoria) is proposing to build a new 437-megawatt (MW) gas-fired H-class simple cycle combustion turbine generator (CTG) in Astoria, Queens County, New York that would come online in 2023. There are currently 24 simple cycle combustion turbines located at the site that will be retired in 2023 due to regulations in New York limiting nitrogen oxide pollution from combustion turbines. The new Astoria CTG will use natural gas as the primary fuel with limited distillate oil firing for back-up. Two of the existing combustion turbines on the site will not be demolished but will remain operational to maintain black-start capability until they can be replaced by a battery energy storage system of approximately 24 megawatt electric (MWe); all other existing units will be permanently shut down once the new unit has come online.

Astoria must receive approval from the New York State Department of Environmental Conservation (NYSDEC) to modify its Title V air permit, which requires DEC to find that the Astoria CTG complies with the state's Climate Leadership Community Protection Act (CLCPA). The compliance determination depends on whether the project is consistent with the CLCPA and, if not, whether it is nevertheless justified, or its inconsistencies adequately mitigated.

2. THE NEW ASTORIA CTG IS NOT CONSISTENT WITH NEW YORK'S CLIMATE LEADERSHIP AND COMMUNITY PROTECTION ACT AND NRG'S JUSTIFICATIONS FOR THE PROJECT ARE MISPLACED

New York's CLCPA became law effective January 1, 2020. It requires reductions in statewide greenhouse gas (GHG) emissions[1] of 40 percent below 1990 levels by 2030 and 85 percent below 1990 levels by 2050. It also replaces New York's previous Clean Energy Standard, setting a requirement to obtain 70 percent of New York's electricity from renewable sources by 2030 and 100 percent from zero-emission sources by 2040.

[1] Statewide GHG emissions are defined as being the total annual emissions produced in the state, any emissions associated with the generation of electricity produced outside of the state but imported into the state, and emissions associated with the extraction and transmission of fossil fuels imported into the state. See: State of New York, Senate Bill S6599.

The CLCPA also includes several resource-specific individual capacity requirements for the procurement of renewables, demand-side resources, and battery storage that will help the state meet its energy targets.[2] These include the following:

- 6 GW of installed distributed solar PV by 2025;
- 185 trillion btu energy consumption reduction from energy efficiency by 2025 relative to the state's current forecast for that same year;
- 3 GW battery storage capacity installed by 2030; and
- 9 GW offshore wind capacity installed by 2035.

As part of its Draft Supplemental Environmental Impact Statement (DSEIS), NRG submitted analysis of the impact of the new Astoria CTG on the state's GHG emissions for the years 2023 through 2035. According to the authors, the results of this analysis show that the Astoria CTG is "…consistent with the CLCPA and provides significant GHG reduction, while minimizing costs and maximizing benefits to New York…."[3] The analysis claims that the Astoria CTG leads to emissions reductions in three ways. First, NRG claims a direct reduction in GHG emissions will result from the displacement of older, less efficient fossil generators in New York City, and also from the GHGs attributed to extraction and transportation of the fossil fuels used to power these generators.[4] Second, NRG asserts that the project provides quick-start and fast-ramping capacity in New York City, which avoids the installation of "very large amounts of marginal capacity from energy storage" and results in cost savings that accelerate additional renewable procurement like offshore wind, and thus lead to sizable indirect GHG reductions.[5] Third, NRG states that the new Astoria CTG technology would already be capable of being converted to use hydrogen as a fuel source once it is available in quantities large enough for commercial transportation. This report addresses the first two claims, while the claims around hydrogen are addressed elsewhere.

NRG hired the consulting firm Navigant/Guidehouse (referred to hereafter as Guidehouse) to evaluate the GHG emissions impact of the new Astoria CTG. The results of that evaluation were attached to the DSEIS submitted by NRG as Appendix E. Each of the components of the Guidehouse emissions analysis contains numerous flaws that, when corrected, would demonstrate that the Astoria CTG is not in fact consistent with the CLCPA or justified based on GHG benefits, and thus should not be approved. Each of the two claims made about the emissions reductions benefits of the Astoria CTG are examined in more detail below.

[2] New York State Senate Bill S6599, Article 75, 75-0103.

[3] Guidehouse, Inc. February 2021. *Supplement to GHG Impacts of Astoria Replacement Project*. Prepared for Astoria Gas Turbine Power LLC, page 1.

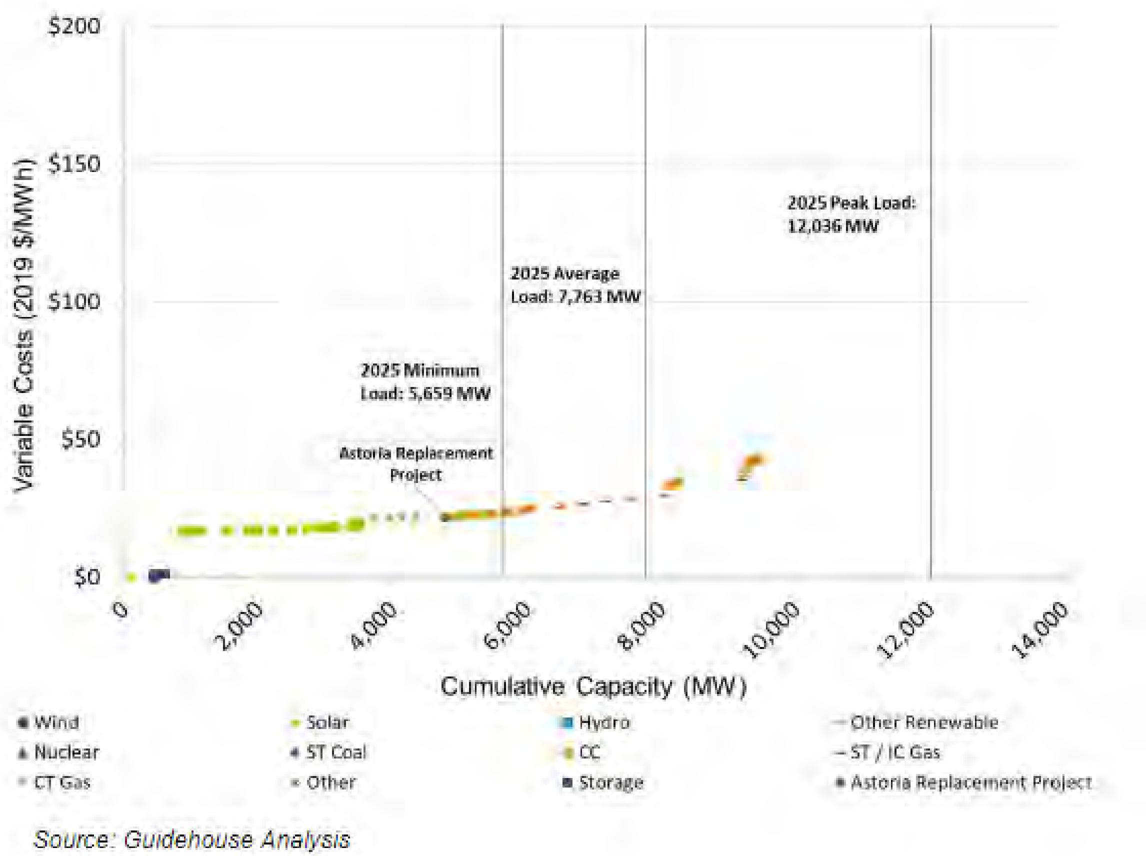
[4] *Ibid.*

[5] Ibid at 1.

2.1. Guidehouse's modeling approach for estimating direct emissions reductions

Guidehouse used two models in its estimate of direct emissions reductions created by the Astoria CTG. PROMOD IV, a widely used electric system dispatch (or production cost) model, was used to produce a forecast of hourly locational marginal prices for electricity within New York City. Guidehouse then used its proprietary Electric Value Model (EVM) to dispatch the Astoria CTG against this forecast of locational marginal prices, producing an hourly generation estimate for the Project over the analysis period. To estimate the direct emissions reductions associated with the Astoria CTG, Guidehouse took the hourly dispatch schedule produced by its EVM model and then attempted to determine which unit(s) would have come online in order to replace the Astoria CTG's forecasted generation. Guidehouse appears to have done this by looking at a supply stack, similar to the example shown in Figure 1, that orders the generators in New York City according to their variable cost of operation.

Figure 1. Illustrative New York City supply curve, 2025



Source: Guidehouse, Inc. February 2021. *Supplement to GHG Impacts of Astoria Replacement Project*. Prepared for Astoria Gas Turbine Power LLC., page 13.

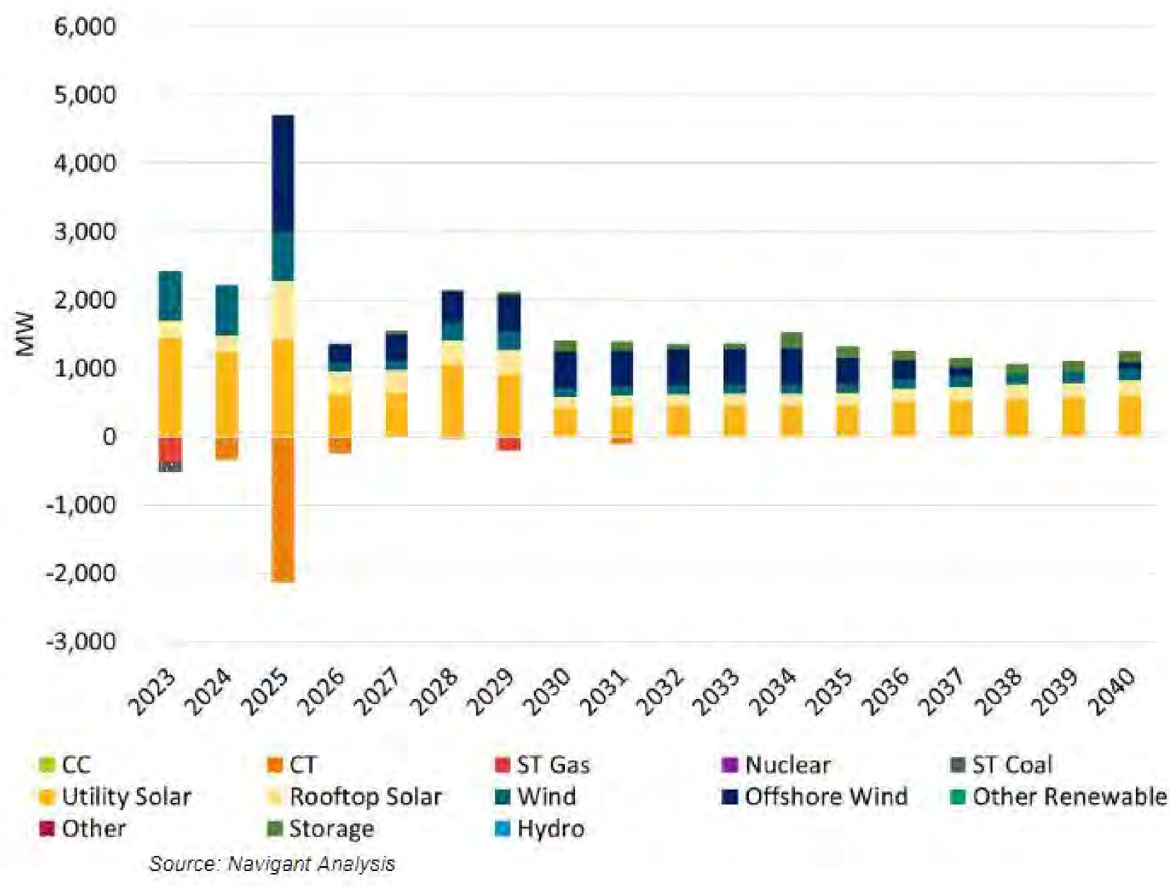
To arrive at the expected "direct emissions reductions" associated with the project, the GHG emissions from the proposed Astoria CTG were subtracted from the GHG emissions associated with the operation of the existing CT units whose generation the proposed Astoria CTG's generation is expected to replace.

The Guidehouse estimate of direct emissions reductions is dependent on several variables, two of which play a particularly important role in producing the emission numbers: (1) the assumed capacity additions over time; and (2) the simplified "supply stack" displacement methodology used in the analysis.

Guidehouse's forecasted capacity additions

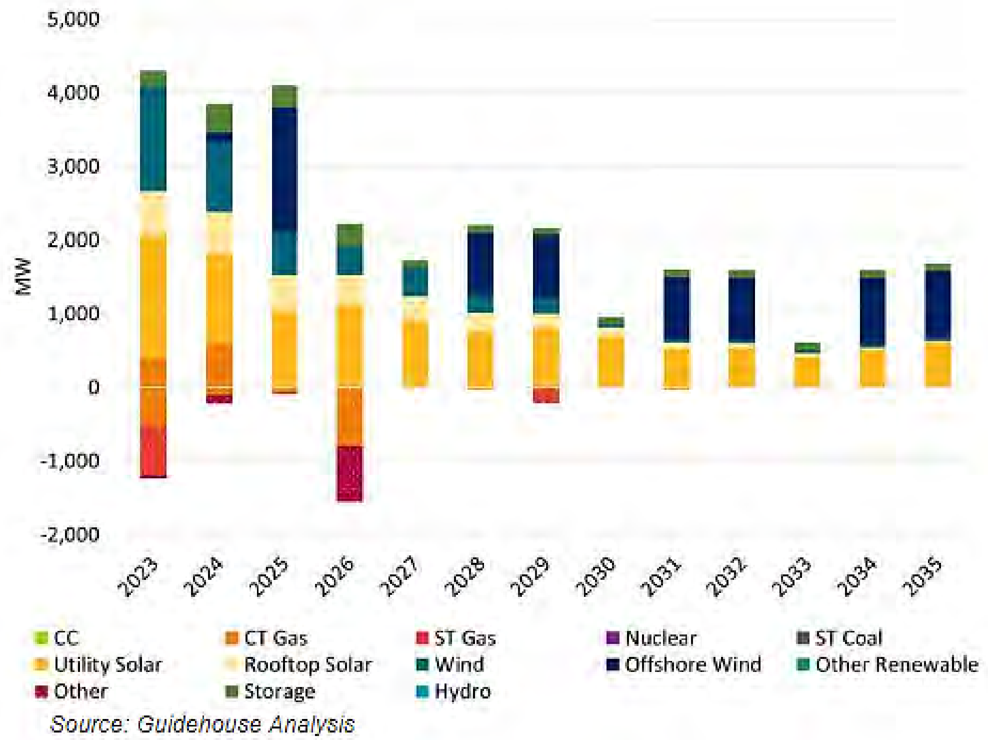
Guidehouse provided forecasts of resource capacity additions in New York in both its April 2020 report and its February 2021 supplemental report. Those forecasts are shown in Figure 2 and Figure 3, respectively.

Figure 2. Guidehouse forecast of NYISO capacity additions and retirements, April 2020



Source: Guidehouse, Inc. April 2020. *GHG Impacts of Astoria Replacement Project.* Prepared for Astoria Gas Turbine Power LLC, at page 12.

Figure 3. Guidehouse forecast of NYISO capacity additions and retirements, February 2021



Source: Guidehouse, Inc. February 2021. *Supplement to GHG Impacts of Astoria Replacement Project.* Prepared for Astoria Gas Turbine Power LLC, at page 7.

From April 2020 to February 2021, a period of less than a year, the forecasted capacity additions in 2023 and 2024 practically doubled, with increases to the volumes of utility-scale solar, rooftop solar, and onshore wind. Battery storage resources, which did not show up until 2030 in the April 2020 analysis, occur in all years in the February 2021 analysis. Guidehouse did not provide an explanation for these changes, however, they lead to a sizable drop in the amount of direct emissions reductions expected from the Astoria CTG in the Guidehouse analysis, particularly after 2025. A comparison of the direct emissions reductions estimates from the two reports is shown in Figure 4 on both an annual and cumulative basis.

Figure 4. Comparison of direct emissions reductions estimates in the Guidehouse April 2020 report (left) and February 2021 supplemental report (right)

Year	Emissions Reduction (000 Tons)	Cumulative Emissions Reduction (000 Tons)
2023	151	151
2024	154	305
2025	108	413
2026	84	497
2027	82	579
2028	86	665
2029	91	756
2030	75	830
2031	65	896
2032	95	991
2033	82	1,073
2034	78	1,151
2035	72	1,223

Source: Navigant Analysis

Year	Emissions Reduction (000 Tons)	Cumulative Emissions Reduction (000 Tons)
2023	72	72
2024	88	161
2025	57	218
2026	38	256
2027	40	296
2028	18	314
2029	27	341
2030	21	362
2031	15	377
2032	19	396
2033	7	403
2034	13	416
2035	5	421

Source: Guidehouse Analysis. Note: 2023 includes June – December 2023 only.

Despite the increase in projected capacity additions in the February 2021 supplement, both Guidehouse forecasts appear to have overlooked the potential for Tier 4 renewable resources from upstate New York and/or Canada to contribute to new capacity additions in New York City. In response to its request for proposal (RFP) for Tier 4 resources, the New York State Energy Research & Development Authority (NYSERDA) received 35 proposals from seven bidders for a total of more than 35 million MWh of renewable energy per year and nearly 7,500 MW of new renewable transmission capacity.[6] If even one or two of those proposals were selected, they would substantially change the assumed generation mix and resulting GHG emissions. The addition of these Tier 4 resources would decrease Guidehouse's projected direct emissions reductions from the new Astoria CTG. At a minimum, Guidehouse should have acknowledged this uncertainty and conducted sensitivity analyses around the potential impact of Tier 4 resource additions.

Guidehouse's "supply stack" methodology

Guidehouse's method of calculating direct emissions reductions, described above, simply stacks New York City generators in the order of their variable operating costs and assumes that the least-cost generators will always dispatch first. The Astoria CTG is thus assumed to displace the most-costly, least-efficient, and highest-emitting peaking units. This methodology does not consider that transmission

[6] NYSERDA. *Tier 4 – New York City Renewable Energy*. Available at: https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard/Renewable-Generators-and-Developers/Tier-Four.

within New York City can be constrained, and thus the least-cost generators are not always able to displace the highest-emitting peaking units in every hour during which they operate. Modeling the transmission constraints within Zone J would likely lead to a lowering of the direct emissions reductions estimated by Guidehouse in its analysis. The Guidehouse report also does not specify which generators are assumed to be displaced, or where those generators are located. There are nine sub-zonal load pockets in Zone J, and thus not all generators can be expected to serve all loads. This lack of data makes it impossible to discern whether the higher cost generators that were assumed to be displaced would actually be displaced by generation from the Astoria CTG.

2.2. Guidehouse's modeling approach for estimating indirect emissions reductions

Guidehouse also estimated the indirect emissions reductions that it claims would be associated with the Astoria CTG. It argues that the project provides quick-start and fast-ramping capacity required to maintain reliability in New York City and thereby avoids the installation of "very large amounts of marginal capacity from energy storage."[7] According to Guidehouse, the savings associated with installation of the project, rather than battery storage resources, could be used to accelerate the development of an additional 543 MW of offshore wind. Guidehouse assumes that this additional offshore wind generates at a 50 percent capacity factor and displaces 2,400 GWh of fossil generation, resulting in an indirect GHG reductions benefit of approximately 1 million tons per year.[8] Notably, the Guidehouse estimate of indirect emissions reductions remains the same between the April 2020 report and the February 2021 supplement, even though the updated capacity forecast adds what appears to be more than 1,000 MW of battery storage resources between 2023 and 2026, as shown in Figure 3. Battery storage on the order of 1,000 MW between 2023 and 2026 would in general directly support integration of the pipeline of new renewables without the inclusion of a new gas turbine and would lower the initial emissions baseline, such that the indirect emissions reductions should be changed in the Guidehouse update.

The Guidehouse analysis is not a standard estimate of indirect emissions and makes several unorthodox and unjustified assumptions. As described above, it assumes that the alternative to the Astoria Project would be 3,000 MW of battery storage capacity and that avoiding this alternative investment would result in substantial cost savings. It then, without justification, assumes that those savings would be re-spent specifically on additional offshore wind capacity. Guidehouse then erroneously assumes that the generation from the offshore wind would exclusively displace fossil fueled generators, thereby avoiding up to approximately one million tons of GHGs each year. In sum, Guidehouse is claiming emissions reductions from effects that are many steps removed—well beyond the scope of a traditional indirect emissions analysis—and none of its assumptions have been justified with any supporting evidence,

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[7] Guidehouse, Inc. April 2020. *GHG Impacts of Astoria Replacement Project*. Prepared for Astoria Gas Turbine Power LLC. Page 1.

[8] Guidehouse, Inc. February 2021. *Supplement to GHG Impacts of Astoria Replacement Project*. Prepared for Astoria Gas Turbine Power LLC. Page 13.

much less capacity optimization and/or dispatch modeling. It is thus highly probable that the estimates of indirect emissions reductions are overstated, and likely dramatically overstated.

The analysis does not appear to directly examine the costs and benefits of replacing the Astoria Project with new battery storage. Instead, it assumes that New York City (Zone J) replaces half of the current peaking resources (approximately 3,000 MW) with battery storage. Increasing penetrations of battery storage resources cause the firm capacity values of new resources to go down; thus, the firm capacity value of storage after the addition of these resources is calculated to be 30 percent. Guidehouse calculates the cost savings of the Astoria Project versus battery storage based on this 30 percent firm capacity value. This approach is flawed. Guidehouse should instead have looked at the costs and benefits of replacing the Astoria CTG with a battery storage alternative starting in 2023. Moreover, because Guidehouse looked at the amount of storage that would have been required to replace half of Zone J's current peaking resources rather than just the project capacity and calculated its capacity value for storage based on this significantly larger amount, Guidehouse understates the capacity value of a storage resource that would be an alternative to the Astoria Project and thus overestimates the costs.

Even accepting Guidehouse's flawed methodology, described above, the Guidehouse estimates do not account for the falling costs of battery storage resources or expected technological improvements. The overnight capital costs for battery storage in the Guidehouse analysis were shown to be approximately $354/kWh in 2020, falling to approximately $239/kWh in 2030 (2020$).[9] Forecasts of battery storage costs get lower every year, and the anticipated overnight capital cost for battery storage from the U.S. Energy Information Administration's (EIA) *2021 Annual Energy Outlook* is $745/kW in 2030, or approximately $186/kWh,[10] which is lower than the Guidehouse assumption. Even the EIA figure may be a conservative estimate. Data from Bloomberg New Energy Finance predicts that by 2023, the average global battery pack price will be $101/kWh, with its expectation being that prices will fall to $58/kWh by 2030.[11] Battery storage technologies also continue to evolve, with long-duration and "multi-day" storage options getting closer to commercial operation. One example is the iron-air-exchange battery from the Massachusetts-based startup Form Energy, which could deliver electricity for 100 hours at a price of less than $20/kWh.[12]

The Guidehouse calculations of the cost savings associated with the Astoria CTG also ignore the operating costs of new combustion turbines versus other replacement renewable and storage

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[9] The Guidehouse values were taken from the Energy Information Administration's *Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies*, published in February 2020. These values were in 2019 dollars, and we have inflated them to 2020 dollars using an inflation rate of 2 percent.

[10] US EIA. February 3, 2021. *Annual Energy Outlook 2021: Reference Case Projections Tables*. Table 55: Overnight Capital Costs for New Electricity Generating Plants, Diurnal Storage.

[11] Bloomberg New Energy Finance. December 16, 2020. *Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, while Market Average Sits at $137/kWh.* Available at: https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/.

[12] Plautz, Jason. July 26, 2021. *Form Energy's $20/kWh, 100-hour iron-air battery could be a 'substantial breakthrough.'* Utility Dive. Available at: https://www.utilitydive.com/news/form-energys-20kwh-100-hour-iron-air-battery-could-be-a-substantial-br/603877/.

resources. The Astoria CTG would incur both fuel and emissions costs associated with its operations and is subject to fluctuations in those commodity price forecasts. The Guidehouse analysis is silent on the costs of carbon dioxide (CO_2) allowances the Astoria CTG would pay under the Regional Greenhouse Gas Initiative (RGGI). The clearing price from the most recent RGGI auction on September 8, 2021 was $9.30/ton. [13] The assumptions from the Brattle Group that inform the *2020 Grid in Transition Study* were that the price would reach $12.60/ton by 2030.[14] Averaging the RGGI auction prices from 2021 results in a price of $8.29/ton in 2021. If we assume a straight line increase from the average RGGI auction price for 2021 to the 2030 Brattle estimate, and carry that increase forward in time, we can estimate the annual cost of emissions under one specific trajectory of allowance prices. Those costs are shown in Table 1, below. Total emissions costs would be more than $2 million in 2023, and while costs decline over time, this estimate does not consider potential increases in RGGI prices that might cause these estimates to be even higher. Discounting the summation of the values leads to a total cost of $10.4 million (using a 6 percent discount rate) and $12.0 million (using a 3 percent discount rate).

Table 1. Estimated cost of new Astoria CTG emissions under forecasted RGGI prices ($nominal)

Year	RGGI Price ($/ton)	Astoria CTG CO_2e (metric tonnes)	Astoria CTG CO_2e (short tons)	Total Cost of Astoria CTG CO_2e
2021	$8.29			
2022	$8.77			
2023	$9.25	221,694	244,307	$2,259,295
2024	$9.73	203,131	223,850	$2,177,318
2025	$10.21	145,765	160,633	$1,639,349
2026	$10.68	95,454	105,190	$1,123,900
2027	$11.16	95,844	105,620	$1,179,072
2028	$11.64	46,666	51,426	$598,712
2029	$12.12	63,520	69,999	$848,466
2030	$12.60	48,840	53,822	$678,153
2031	$13.08	36,823	40,579	$530,773
2032	$13.56	46,215	50,929	$690,596
2033	$14.04	19,077	21,023	$295,161
2034	$14.52	35,747	39,393	$571,989
2035	$15.00	9,083	10,009	$150,142
2036	$15.48	27,027	29,784	$461,053
2037	$15.96	16,844	18,562	$296,251
2038	$16.44	20,470	22,558	$370,853
2039	$16.92	15,076	16,614	$281,105

[13] RGGI, Inc. *Allowance Prices and Volumes*. Available at: https://www.rggi.org/auctions/auction-results/prices-volumes.

[14] Brattle Group. March 30, 2020. *NYISO Grid in Transition Study: Detailed Assumptions and Modeling Description.* Presented to NYISO ICAP/MIWG/PRLWG Stakeholders, at slide 9.

Lastly, the Guidehouse analysis ignores the additional benefits associated with storage resources. Strategic siting of modular battery storage resources can defer or avoid more investments in transmission capacity. As renewable penetration increases, storage becomes increasingly valuable as a means of reducing curtailment from those resources and shifting the dispatch from renewable resources from lower priced hours to higher priced hours. Additionally, batteries provide a faster and more accurate operating reserve response to fluctuations in supply and demand than do gas-fired generators. Guidehouse did not model an alternative scenario to the Astoria CTG, however, and thus was unable to capture any of these benefits in its analysis.

It should be noted that NRG's analysis actually highlights what a poor GHG reduction strategy a new gas combustion turbine is relative to installation of new renewable capacity. The Astoria CTG is projected to have a direct emissions reductions benefit, in the NRG estimate, of 421,000 tons of CO_2 between 2023 and 2035.[15] Meanwhile, a 543 MW offshore wind facility would have a GHG reduction of up to approximately 1 million tons a year. Based on NRG's own numbers, building new fossil fuel facilities is not an effective GHG mitigation strategy.

3. NRG and Guidehouse's Other Individual Claims Are Unsupported

In instances where proposed projects are not consistent with the CLCPA, they might still be approved if they are sufficiently justified. NRG claims that the Astoria CTG is justified based on cost savings, through its facilitation of renewables integration and based on its ability to address a claimed reliability need. This section evaluates those claims and finds them all to be deficient.

3.1. NRG claims that the Project is justified based on cost savings

NRG also retained Navigant/Guidehouse (referred to again as Guidehouse) to prepare a report assessing the direct, indirect, and induced jobs, associated earnings, output, and economic value added that would result from the Astoria CTG. This report was submitted as part of the DSEIS as Appendix C. Guidehouse found that the project would support 1,022 local job-years during the construction phase and 73 additional local annual jobs related to spending on operations and maintenance (O&M) during the operations phase. The Value Added attributable to the construction phase is $156 million and $10.6 million annually in the operations phase. We identify several shortcomings with the Guidehouse report.

[15] AECOM. Revised June 2021. *Astoria Replacement Project Draft Supplemental Environmental Impact Statement*. Page ES-5.

First, the Guidehouse analysis does not appear to be an economic analysis of ***net*** impacts, as it exclusively refers to benefits, but never costs. This is therefore a partial analysis, looking only at the benefits of the Astoria CTG itself. A full analysis would also incorporate the cost components—things like displaced generation from the project, retired resources from the project, etc. Second, the analysis looks at the benefits of the Astoria CTG only but does not look at the benefits that might accrue from any alternative resource(s), which could be greater than those from the project. It is important to bear in mind that any large investment will create some degree of economic benefit; to claim those benefits justify an otherwise CLCPA-inconsistent project would require more analysis of the economic benefits of the alternatives.

Guidehouse also analyzed New York Zone J wholesale electricity and capacity prices with and without the Astoria CTG in order to determine energy and capacity cost savings for ratepayers. Similar to the above criticism, Guidehouse seems not to assume that any other new resources (i.e., transmission, storage, or renewables) were included in the "without the Astoria CTG" scenario in place of the Astoria project. This is problematic in that Guidehouse did not examine the effect of an alternative resource or set of resources, and thus did not analyze whether there is a portfolio of alternative resources that would lead to lower wholesale electricity prices and capacity prices than the Astoria CTG.

Lastly, Guidehouse did not provide any of the raw data used as primary inputs to the Jobs and Economic Development Impact (JEDI) model, nor did it provide any calculations or workpapers. As a result, it is impossible for the interested public to determine whether or not the data and methodology are, in fact, reasonable and can be relied upon to support a justification under the CLCPA.

3.2. NRG claims that the Project will facilitate renewable integration

NRG claims that the Astoria CTG is necessary to provide long-duration firm capacity that will facilitate the integration of renewable energy resources, with the ability to provide energy during sustained periods of low renewable output. However, other states with ambitious renewable targets are choosing to forgo investments in new gas, at least in the near term. As an example, California will require that renewable and zero-carbon energy resources supply 100 percent of electric retail sales to customers by 2045.[16] In a very recent procurement decision, the California Public Utilities Commission confirmed that the state will require 11,500 MW of additional net capacity in 2023–2025 to replace retiring nuclear and other thermal power plants, and stated that its expectation is that all of the resources procured pursuant to the order will be zero-emitting or otherwise qualify as renewables.[17] Fossil-fueled resources

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[16] The 100 Percent Clean Energy Act of 2018, California Senate Bill 100.

[17] Before the Public Utilities Commission of the State of California. Order Instituting Rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes. Rulemaking 20-05-003. Decision Requiring Procurement to Address Mid-Term Reliability. Decision 21-06-035. June 24, 2021.

are not authorized to count toward the 11,500 MW for the next procurement, but will be reevaluated at a later date.[18]

The best way to facilitate renewable integration is not to build new fossil generation but to deploy a number of different approaches that instead increase the flexibility of the grid on both the electricity supply and demand sides. Those approaches could include: (1) a reliance on difference types of renewables (solar, wind, hydro, geothermal, etc.) to decrease volatility in production associated with a single resource type, and balance variability of production; (2) energy storage to further balance fluctuations in renewable output; (3) transmission upgrades to facilitate the transfer of electricity, particularly within constrained areas; and (4) demand-side management to both lower demand and shift flexible loads. NRG's alternatives analysis examined certain of those approaches described above, but only one at a time, (e.g., a standalone battery storage replacement for the Astoria Project). A full consideration of alternatives would have examined a portfolio of these approaches in order to promote flexibility in the electric grid and better facilitate the integration of renewables.

According to the EIA, generation from gas made up almost 40 percent of New York's fuel mix in 2019, with 29 percent of generation coming from renewable sources.[19] As the penetration of renewables increases over time, there may be a future need for the kind of long-duration firm capacity that can indeed be helpful to integrate renewables if expectations around storage do not materialize. However, the new Astoria CTG has no CLCPA-compliant plan for operation post-2040, and so the plant would be retiring at the point in time when its capacity contribution would be most helpful for renewables integration.

3.3. NRG claims the Project will address outstanding reliability shortfalls

In NRG's application, the company claims that the project is needed to maintain local and bulk system reliability. NRG points to two reports by the New York Independent System Operator (NYISO)—*2020 Q3 Short Term Assessment of Reliability* and a long-term reliability needs assessment. These reports discuss reliability impacts of New York's regulation that would phase in nitrogen oxide (NO_X) emissions control requirements from 2023 to 2025, with the intention to replace peaking plants in favor of battery storage. The two reports summarize that there will likely be both local (non-Bulk Power Transmission Facilities, or non-BPTF) and system-wide (BPTF) reliability issues from 2023 to 2030 in the New York City Transmission Load Area due to the Peaker Rule. Since the release of those reports, however, Con Edison has received Public Service Commission approval for the construction of three new transmission projects, collectively called the "TRACE Projects," and has authorization from NYISO to perform an alternative operating procedure for summer 2023. Together, these solutions are intended to address local and bulk reliability needs.

[18] *Ibid.*

[19] U.S. Energy Information Administration. *New York State Energy Profile*. Accessed September 4, 2021. Available at: https://www.eia.gov/state/print.php?sid=NY.

In addition, NRG cites to a February 2021 NYISO presentation to claim that the TRACE Projects and alternative operating procedure will reduce, but not eliminate, Con Edison's local transient voltage response issues.[20] At that time, it was unclear to the NYISO what the magnitude of the voltage deficiencies would be and how the local reliability issues would interact with the BPTF reliability issues expected to arise in 2029. However, in March 2021, the NYISO provided an updated set of modeling results. In this presentation, NYISO concluded that a dynamic voltage response deficiency of 150 MVAr is first observed on the local system (non-BPTF) in 2025, increasing to 475 MVAr in 2030.[21] NYISO states that Con Edison will be addressing this non-BPTF violation with a Corrective Action Plan as required by North American Electric Reliability Corporation (NERC) Standard TPL-001-04, and that addressing the non-BPTF deficiencies prior to 2025 will also address the BPTF deficiency that would arise in 2029. In other words, if the local voltage issue is addressed prior to 2025, there will no longer be a bulk transmission reliability issue in 2029.

According to the NERC, dynamic voltage violations can be addressed with various dynamic reactive support solutions, including synchronous condensers, synchronous generators, static synchronous compensators (STATCOMs), static Var compensators (SVCs), or battery solutions.[22] Therefore, synchronous generators (like the Astoria Project) are not the only available solutions to address dynamic voltage violations. Con Edison will determine what the best solution is to meet the voltage needs of the system as part of its Corrective Action Plan.

NYISO stated in March 2021 that, once Con Edison addresses the anticipated voltage deficiency, there are no remaining reliability needs on the local or bulk system due to the Peaker Rule, therefore the NYISO will not solicit solutions in the 2020–2021 Reliability Planning Process. Given this latest information, the Astoria project is not necessary for either local or bulk reliability issues in New York City.

3.4. NRG claims that the Project can provide system restoration service

System restoration—or black-start—service is a reliability service called upon to help restore the power system in the event of a widespread outage. This is typically done by starting up very small generators, like a small onsite diesel generator, and then using those generators to start operation of slightly larger target generators, like a combustion turbine. This creates small islands of generation and load, which are then expanded until the grid is fully restored. Generators providing black-start need to be small and

[20] New York Independent System Operator. *2021-2021 Reliability Planning Process: Post-RNA Base Case Updates.* February 23, 2021. Available at: https://www.nyiso.com/documents/20142/19415353/07%202020-2021RPP_PostRNABaseCaseUpdates.pdf/b81547bc-0411-7958-de0c-7b74244904a5.

[21] New York Independent System Operator. *2021-2021 Reliability Planning Process: Post-RNA Base Case Updates – Dynamics.* March 26, 2021. Available at: https://www.nyiso.com/documents/20142/20255668/03%202020-2021RPP_PostRNABaseCaseUpdates_Dynamics.pdf/60e9535a-a5c2-2b43-7d24-97046c54575e.

[22] North American Electric Reliability Corporation (NERC). *Reliability Guideline: Reactive Power Planning.* December 2016. Available at: https://www.nerc.com/comm/PC_Reliability_Guidelines_DL/Reliability%20Guideline%20-%20Reactive%20Power%20Planning.pdf, at pages 3–8.

highly flexible to balance supply and demand within those pockets of generation and load, so large and inflexible coal, nuclear, and combined cycle generators are not typically used.

NRG states that the project has been designed with black-start capability to restore electric service to New York City following a total system outage. NRG explains that black-start service will be provided by two of the existing simple cycle units (fueled by natural gas) that will eventually be replaced by a 24 MW battery storage system. In other words, the new CT unit at Astoria will not be used for black-start service; the existing units will be used for this purpose.

NRG includes black-start service under the section of its Draft EIS titled "Project Need and Purpose" (Section 1.4.1). However, NRG did not make any statement that the project is *needed* for black-start capability in the New York City region. NRG should provide justification from the NYISO that the project is needed for black-start service in this region if that is the case. If the project is needed for black-start capability, NRG can provide that service with the existing units, eliminating the need for a new 437 MW combustion turbine at the site. However, we believe that is unlikely, given that 86 MW of peaker units in New York City will be reclassified as black-start-only units by 2023–2025. [23]

Alternative options for black-start service

If additional black-start capacity is needed in the New York City region, we recommend considering the use of non-emitting technologies to provide New York City with fast-acting black-start service that will align with the goals of the CLCPA. Wind, solar, and battery storage are digitally-controlled inverter-based resources, allowing them to respond to grid disturbances more quickly (by orders of magnitude) than mechanically controlled conventional generators, with a full response in a few seconds or less. This frequency response is fast enough that it can offset the need for inertial response from conventional generators, while also reducing the need for conventional generators' slower frequency response. Wind and solar resources are also highly flexible, able to fully dispatch up or down in seconds, compared to many minutes for conventional generators.

Batteries can provide black-start service if they are outfitted with grid-forming inverters that can set their own frequency and voltage signal. When outfitted in this way, batteries have a strong potential for use as black-start resources because of their small modular size and extremely fast response. Batteries can ramp from full charge to full discharge output in seconds or less in response to dispatch signals. In contrast, even quick-start natural gas generators typically take nearly 10 minutes to start and ramp up to full load. Therefore, it is much more likely that a battery will be used for black-start service to New York City than the proposed combustion turbine at the Astoria Project. Indeed, NRG itself proposes using battery storage to provide black-start capability at the site after it retires the final two existing

[23] Anderson, Jared. SPS Global. April 7, 2020. *Nearly 650 MW of New York City peaking capacity will retire to comply with tighter regulations.* Available at: https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/040720-nearly-650-mw-of-new-york-city-peaking-capacity-will-retire-to-comply-with-tighter-regulations.

combustion turbines. There are currently 10 MW of battery storage technologies providing capacity on Long Island.[24]

The use of batteries as black-start resources is also aligned with the goals of the CLCPA. Batteries have the unique ability to absorb excess renewable output by charging, which gas and conventional generators cannot do. Because of their modularity and small footprint, batteries can be located near renewable generators to absorb excess output that would have been curtailed, and then release that output later when transmission capacity is available. In contrast, inflexible fossil generators tend to increase renewable curtailment, as these resources cannot change their level of output as quickly and often have high minimum output levels.

[24] New York Independent System Operator. *2021 Load and Capacity Data*. April 2021. Available at: https://www.nyiso.com/documents/20142/2226333/2021-Gold-Book-Final-Public.pdf/b08606d7-db88-c04b-b260-ab35c300ed64, at 89 tbl.III-2.