STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
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September 12, 2016

Via Regular U.S. Mail & Email

Todd A. Bianco
Coordinator
Rhode Island Energy Facility Siting Board
89 Jefferson Blvd.
Warwick, RI 02888

Re: Invenergy Thermal Development LLC – Clear River Energy Center
Docket No. SB 2015-06

Dear Mr. Bianco:

Enclosed, please find an original and ten (10) copies of the Office of Energy Resources' ("OER's") Advisory Opinion (Public Version) to the Energy Facility Siting Board ("EFSB").

In addition, enclosed is a confidential version of OER's Advisory Opinion to the EFSB. OER is submitting the confidential version in order to provide the EFSB with a version of its Advisory Opinion that contains information that is protected from public disclosure through an order by the EFSB and to protect information for which Invenergy has filed a Motion for Protective Treatment of Confidential Information.

Also enclosed is the curriculum vitae for Ellen G. Cool of Levitan & Associates, Inc. Ms. Cool will be the representative for OER who will appear at the final hearing of the EFSB to sponsor the enclosed Advisory Opinion.

If you have any questions or concerns, please do not hesitate to contact me at 401.222.3417 or at Andrew.Marcaccio@doa.ri.gov.

Sincerely,

Andrew S. Marcaccio
Legal Counsel

Enclosures

cc: Service List (via email only) (Public Version only)

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
ENERGY FACILITY SITING BOARD

IN RE: INVENERGY THERMAL DEVELOPMENT	:	DOCKET NO. SB 2015-06
APPLICATION TO CONSTRUCT AND OPERATE	:	
THE CLEAR RIVER ENERGY CENTER	:	

ADVISORY OPINION
OF THE RHODE ISLAND OFFICE OF ENERGY RESOURCES

The Rhode Island Office of Energy Resources ("OER") hereby submits this Advisory Opinion to the Rhode Island Energy Facility Siting Board ("EFSB") in accordance with R.I. Gen. Laws § 42-98-10 and Rule 1.1 of the State of Rhode Island and Providence Plantations Energy Facility Siting Board Rules of Practice and Procedure.

I. INTRODUCTION

Invenergy Thermal Development LLC ("Invenergy") filed an application with the EFSB on October 29, 2015 to construct and operate the Clear River Energy Center ("CREC" or the "Facility" or the "Project") in the town of Burrillville, Rhode Island ("Application").[1] The proposed Project is a 900 to 1,000 megawatt ("MW") combined-cycle gas-fired power plant, consisting of two units each approximately 500 MW, with ultra-low sulfur distillate oil ("ULSD") available as a backup fuel. On November 16, 2016, the above referenced docket SB-2015-06 (this "Docket") was opened for the purpose of considering Invenergy's Application. On January 12, 2016, a preliminary hearing was convened to determine the issues to be considered by the EFSB in evaluating Invenergy's Application and to designate governmental agencies of the State of Rhode Island ("State") and other local governmental entities to render advisory opinions on such issues.

[1]See Order 86 of the Energy Facility Siting Board, *Preliminary Decision and Order in re Invenergy Thermal Development LLC Application to Construct and Operate the Clear River Energy Center, Burrillville, Rhode Island*, SB-2015-06, March 10, 2016 ("EFSB Order 86"), § I.

In accordance with R.I. Gen. Laws § 42-98-9 and through its Preliminary Decision and Order, the EFSB directed OER, in collaboration with the Rhode Island Executive Climate Change Coordinating Council ("EC4") and with assistance from the Rhode Island Department of Environmental Management ("DEM"), to "render an advisory opinion as to: (i) the impacts of the Facility on anticipated greenhouse gas emissions that would result from the proposed Facility and the cumulative impact over the life of the project and (ii) whether the Facility will conform to the requirements and provisions of the Resilient Rhode Island Act, R.I. Gen. Laws §§ 42-6.2-1 to 42-6.2-8, and [State] energy policies."[2] OER has considered the issues assigned to it for review and now submits this Advisory Opinion in compliance with the EFSB's directives.

II. PROCESS & APPROACH

A. Non-Jurisdictional Agency

Pursuant to the Energy Facility Siting Act ("EFSA"), R.I. Gen. Laws § 42-98-1, et seq., the EFSB "is the licensing and permitting authority for all licenses, permits, assents, or variances which, under any statute of the [State] or ordinance of any political subdivision of the [State], would be required for siting, construction or alteration of a major energy facility in the [State]."[3] Agencies which, absent the EFSA, would be required to issue a permit, license, assent, or variance in order for the proposed Project to proceed must sit and function at the discretion of the EFSB.[4] These agencies are categorized by the EFSB as "Jurisdictional Agencies."[5] Jurisdictional Agencies have been directed, to the extent possible, to render their advisory opinions pursuant to the procedures that would be followed absent the EFSA, and their advisory opinions should conform to the provisions of the Rhode Island Administrative Procedures Act ("APA"), R.I. Gen.

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[2] See EFSB Order 86, § VII B 5.
[3] See R.I. Gen. Laws § 42-98-7(a)(1).
[4] See R.I. Gen. Laws § 42-98-7(a)(2).
[5] See EFSB Order 86, § VII A.

Laws § 42-35-1, et seq., regarding decisions and orders.[6]

In addition to mandating advisory opinions from the Jurisdictional Agencies, the EFSB also requested informational advisory opinions from "Non-Jurisdictional Agencies" which are agencies that do not possess any applicable licensing or permitting authority over the proposed Project.[7] In lieu of conducting formal proceedings, a Non-Jurisdictional Agency may have a representative appear at the final hearing to sponsor the agency's informational advisory opinion and be subject to cross examination.[8]

The EFSB expressly categorized OER as a Non-Jurisdictional Agency.[9] OER is not statutorily authorized or charged with conducting licensing or permitting proceedings that, absent the EFSA, would be required in order for the proposed Project to proceed. Accordingly, OER did not preside over a formal adversarial proceeding and, instead, will have a representative appear at the final hearing to sponsor this Advisory Opinion and be subject to cross examination.

B. Process

The process utilized by OER to issue this Advisory Opinion included collaboration with the EC4, assistance from DEM, a public workshop, and an opportunity for the public to provide input on the issues that OER was directed by the EFSB to consider.

At a public meeting held on May 11, 2016, OER first informed the EC4 of the EFSB's directives pertaining to the issuance of this Advisory Opinion. At the meeting, OER requested approval from the EC4 to utilize a process that included a public workshop and entailed collaboration between OER, DEM and the EC4. The EC4[10] unanimously approved the process.

[6] See EFSB Order 86, § VII A.
[7] See EFSB Order 86, § VII B.
[8] See EFSB Order 86, § VII B.
[9] See EFSB Order 86, § VII B 5.
[10] Members of the EFSB who are also members of the EC4 recused themselves from all discussions and votes pertaining to EFSB Docket SB-2015-06 that occurred at the EC4 public meetings held on May 11, 2016 and August 17, 2016.

Effective May 19, 2016, OER engaged Levitan & Associates, Inc. ("LAI") to provide technical assistance in developing this Advisory Opinion. On July 21, 2016, OER, with the assistance of LAI and DEM, held a public workshop at the University of Rhode Island in Kingston to provide the public with information regarding its approach to issuing this Advisory Opinion and to solicit comments from the public on the specific issues raised in the EFSB's Preliminary Decision and Order. The workshop was publically-noticed through multiple venues, including the Providence Journal, the website of the Rhode Island Secretary of State, OER's website, and a local Burrillville publication. In addition, invitations were extended to the EC4 member agencies and other stakeholders. A presentation was delivered to assembled guests that described OER's role within the siting process, provided OER's approach to developing its Advisory Opinion, and described DEM's air pollution control permit process. Importantly, the public workshop included a public comment period, and all members of the public that wished to provide comment were afforded that opportunity. Written public comment was also accepted by OER up until August 1, 2016, either by electronic or U.S. mail. In total, 26 individuals submitted public comment to OER either through the public workshop and/or written comment. All materials – including all public comment received and a transcript of the public hearing – were posted on OER's website.[11]

At a public meeting held on August 17, 2016, OER, with the assistance of LAI, provided the EC4 with an update on its Advisory Opinion which included the results of the public workshop, a summary of the public comments received, and a presentation on OER's approach.

C. Materials Reviewed and Redacted Information

In issuing this Advisory Opinion, OER and LAI reviewed and relied upon the following sources of information:

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[11] These materials currently remain available for viewing at http://www.energy.ri.gov/EFSB%20Materials/.

- Materials filed in EFSB Docket SB-2015-06 including, but not limited to, Invenergy's Application and written testimony;
- Materials filed in the proceedings held before the Rhode Island Public Utilities Commissions ("PUC") pertaining to the need of the proposed Project [PUC Docket No. 4609];
- Responses to data requests ("DR") issued by OER and other parties in EFSB Docket SB-2015-06;
- Responses to data requests in PUC Docket No. 4609; and
- Independent System Operator - New England ("ISO-NE") data and publications, including the (i) results from the 10th Forward Capacity Auction; (ii) 2014 ISO New England Electric Generator Air Emissions Report;[12] (iii) 2016 Regional Electricity Outlook;[13] and (iv) ISO Express databases.

The public version of this Advisory Opinion redacts information that is protected from public disclosure through an order by the EFSB as well as information for which Invenergy has filed a Motion for Protective Treatment of Confidential Information. Specifically, the information redacted in the public version of this Advisory Opinion is or cannot be reasonably segregated from confidential information contained within the following documents for which Invenergy has sought protective treatment:

- A July 29, 2015 Memorandum prepared by Invenergy's advisors, PA Consulting Group, Inc. ("PA"), that describes PA's methodology for projecting capacity prices for the 2019/20 Forward Capacity Auction, with price projections and cash flow projections for CREC. (Invenergy's *Motion for Protective Treatment* dated November 9, 2015 was granted by the EFSB through a written order dated March 10, 2016);
- A June 19, 2015 Memorandum prepared by PA that describes PA's analysis, market assumptions and modeling methodology, as well as PA's projections of the operations and energy margins of the proposed CREC Project. (Invenergy's *Motion for Protective*

[12] The 2014 ISO New England Electric Generator Air Emissions Report is currently available at http://www.iso-ne.com/static-assets/documents/2016/01/2014_emissions_report.pdf.
[13] The 2016 Regional Electricity Outlook is currently available at http://www.iso-ne.com/static-assets/documents/2016/03/2016_reo.pdf.

Treatment dated November 9, 2015 was granted by the EFSB through a written order dated March 10, 2016);

- Excel File entitled *Clear River Market Assumption and Results – With Clear River*. (Invenergy filed a *Motion for Protective Treatment* dated August 18, 2016 with the EFSB with its response to OER's Second Set of Data Requests);
- Excel File entitled *Clear River Market Assumption and Results – Without Clear River*. (Invenergy filed a *Motion for Protective Treatment* dated August 18, 2016 with the EFSB with its response to OER's Second Set of Data Requests); and
- Excel File entitled *Clear River Emissions Generation and Heat Input Results*. (Invenergy filed a *Motion for Protective Treatment* dated August 18, 2016 with the EFSB with its response to OER's Second Set of Data Requests).

D. Timing & Agency Coordination

In accordance with the EFSA, the EFSB has been given a specific time period in which it must review an application, review advisory opinions, and issue a final decision.[14] The overlapping of agency roles or duplication of work would make it even more challenging for the EFSB to comply with the EFSA's timing requirements. The EFSA stresses the importance of coordination between various state agencies and the elimination of overlap and duplication of work. "…the role of each agency in energy siting should be delineated, to eliminate overlap and duplication…"[15] The EFSA further states, "[t]he board shall limit the scope of any agency's investigation where it finds that more than one agency has jurisdiction over a matter at issue in the licensing process."[16] Accordingly, OER has interpreted the EFSB's directive as to not overlap with work being done by other State agencies or entities otherwise designated as having to render an advisory opinion.

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[14] See R.I. Gen. Laws §§ 42-98-10 and 42-98-11.
[15] See R.I. Gen. Laws § 42-98-1(c).
[16] See R.I. Gen. Laws § 42-98-9(c).

E. Invenergy's Analysis and Conclusions

As part of the Application before the EFSB in this Docket, Invenergy, through its advisors, PA, provided an analysis of the regional environmental impacts of the Project.[17] PA utilized several software packages to support its analysis, including AURORAxmp, a production cost model that simulates the regional wholesale electric market.[18] AURORAxmp was used to analyze the impact of the Project on ISO-NE market energy prices and also on regional emissions of greenhouse gases ("GHG"), including carbon dioxide (CO_2), oxides of nitrogen (NOx), and sulfur dioxide (SO_2), over a forecast period of 2019 through 2025. By comparing a forecast of emissions across the system with the Project to a reference case without the Project, PA concluded that operation of the Project will reduce CO_2 emissions by about 1% per year across the combined ISO-NE and New York Independent System Operator ("NYISO") regions. Results of PA's analysis for CO_2 are reproduced in Table 1 below. The negative values indicate a net *reduction* in emissions with the Project in service.

Table 1. Impact of CREC on Total Emissions Reductions on ISO-NE/NYISO Footprint[19]

	2019	2020	2021	2022	2023	2024	2025
CO_2 Emission Change (thousand short tons)	-783	-1,233	-1,122	-1,011	-998	-985	-1,002

Based on the model results, Invenergy concluded:

> "[t]he net system-wide decrease is a result of CREC being a highly efficient natural gas-fired combined cycle power plant. CREC requires less fuel per MWh generated than its gas-fired peers, resulting in economic and emissions advantages relative to existing gas-fired generators. As such, CREC will displace less efficient

[17] See Invenergy Thermal Development LLC, "Rhode Island Energy Facility Siting Board Application, Clear River Energy Center, Burrillville, Rhode Island," prepared by ESS Group, Inc., October 28, 2015, ("Application"), Sections 5.2 and 7.2.4.

[18] AURORAxmp is a commercially available software package licensed by EPIS, Inc. The model emulates the load-following dispatch instructions issued by ISO-NE (and other ISOs/RTOs), which minimizes system-wide production costs.

[19] See Application, Table 7.2-1, p. 120.

> (and less environmentally-friendly) resources that are currently dispatched on the power system."[20]

Invenergy also stated that the Project will "[m]odernize the electric generating infrastructure by providing new, highly efficient generation that has fast start and high ramp rate (flexible) generating capability, replacing older, less flexible generation. The fast start and flexible generating capability will support the integration of new and existing renewable generation onto the power grid."[21] Relevant operating parameters of the proposed gas turbine model that are indicative of flexible operation—including start-up time, minimum down time, ramp rate, and minimum operating level—were provided in Invenergy's responses to data requests in PUC Docket No. 4609.[22]

F. Approach

On behalf of OER, LAI conducted a comprehensive review of Invenergy's approach, available model input data, and model results in order to evaluate the basis and reasonableness of Invenergy's conclusions regarding GHG impacts of the Project. In accordance with the EFSB's directive to OER, LAI considered the following key questions:

- What assumptions underlie Invenergy's forecast of CREC operations and associated CO_2 emissions?
- What assumptions were used to model the operation of CREC and the region's electric system?
- Are the assumptions reasonable and documented?
- Does the model provide a reasonable basis for predicting GHG impacts ascribable to CREC?
- Has Invenergy's application appropriately considered all types of potential GHG impacts ascribable to CREC, including CO_2 emissions from CREC while burning backup fuel and other GHGs

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[20] See Application, p. 120.
[21] See Application, p. 3
[22] See PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Division of Public Utilities and Carriers Third Set of Data Requests*, DR 3-1; PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Second Data Request*, 2-15.

derived from upstream processes?

With respect to evaluating the consistency of the Project with provisions of State energy policies, OER and LAI considered:

- Will operation of CREC impact the ability of Rhode Island to meet its GHG reduction targets under the Resilient Rhode Island Act?
- Will operation of CREC impact the State's initiatives to expand renewable energy resources?
- Will operation of CREC impact the State's ability to meet its Least Cost Procurement mandate, including the effective deployment of comprehensive energy efficiency programs?

In addressing these questions, OER and LAI utilized a consumption-based accounting method for analyzing GHG impacts. This approach is consistent with a unanimous endorsement by the EC4 on May 11, 2016 to adopt a consumption-based methodology for measuring GHG's in the electric sector. Consumption-based accounting considers GHG emissions associated with electricity used within the State, whereas generation-based accounting considers GHG emissions from the fossil generators within the footprint of the State. Because electricity in New England is dispatched by the regional operator (ISO-NE) and transmitted across state and regional boundaries through the integrated transmission and bulk power system, the consumption-based method best reflects measures and programs that can be implemented through state-jurisdictional entities to reduce carbon emissions in this sector. Moreover, this methodology aligns with State policies and programs, such as the Regional Greenhouse Gas Initiative ("RGGI"), the Renewable Energy Standard ("RES"), and long-term renewable contracting statutes that recognize the potential flow of economic, energy, and/or environmental benefits to local consumers across an integrated regional electric grid.

To promote the EFSA's objectives relating to agency coordination and to comply with the EFSB's Preliminary Decision and Order, OER worked with DEM in assessing the GHG impacts of the Project and in evaluating the consistency of the Project with State energy policies. Accordingly, certain State energy policies will be addressed in DEM's advisory opinion as opposed to this Advisory Opinion.

III. FINDINGS OF FACT

A. Findings Related to Invenergy and PA's Analysis of GHG Impacts

> **AURORAxmp, the computer simulation model used by PA to analyze the hourly dispatch and operation of CREC, its emissions, and the regional electric grid, is a commonly used, industry standard software package. Although the model input data furnished through data requests was limited, the data provided appears to be reasonably consistent with currently available market and infrastructure information. Certain assumptions may give rise to an under- or overestimate the expected CO_2 reduction benefit of the Project, but would not change the overall conclusion that operation of CREC produces net emissions benefits.**

In response to several data requests from OER and other parties, Invenergy and PA furnished the following information relevant to the input factors and assumptions for their simulation model:

- Load forecasts were based on each ISO's/RTO's most current planning studies including ISO-NE's 2015 CELT Load Report, the 2016 PJM Load Report, and New York's 2015 Load and Capacity Data Report.[23, 24]
- Fuel prices were based on NYMEX futures, Energy Information Administration ("EIA") data, Bentek (Platts natural gas prices) Hellerworx, and EPIS, Inc. (the licensor of AURORAxmp).[25]
    - Henry Hub and ISO-NE delivered prices were based on NYMEX forwards, EIA data, and Bentek data
    - Oil prices were based on NYMEX forwards and EIA data

[23] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Set of Data* Requests, DR 2-2.
[24] ISO-NE and NYISO have released updated versions of these reports since PA completed its analysis. ISO-NE released its 2016 CELT Load Report on 05/02/2016. NYISO released its 2016 Load and Capacity Data Report on 4/30/2016.
[25] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Set of Data* Requests, DR, CONFIDENTIAL attachment.

  - Coal prices were based on Hellerworx forecasts
  - Nuclear fuel prices were based on EPIS, Inc. data
- Generating resources included all units that have cleared the most recent ISO-NE Forward Capacity Auction.
- Expansion of renewable resources was intended to meet the renewable energy standard, renewable portfolio standard, and Clean Energy Standard (RES/RPS/CES) annual target aggregated for all states in the modeled footprint.[26]
- Resource attrition was based on publically-announced plant retirements
- The transmission topology and transfer limits between electric zones appears to reasonably reflect interface limits provided by ISO-NE's Regional System Plan and the New York State Reliability Council Installed Capacity Requirement documents, although PA did not specifically identify the source for this information.
- The forecast of RGGI CO_2 allowance prices was based on PA's own forecast.[27]

LAI notes the following limitations and observations regarding PA's model and the input data and assumptions provided:

- The forecast was limited to a seven-year time horizon, beginning with the in-service date of the first CREC unit (2019 through 2025). Project operations and CO_2 emissions beyond 2025 were not modeled by PA.
- Although the model footprint area appears to have covered the entire Eastern Interconnection, most of the model input data, including plant retirements, new resource additions, delivered gas prices, behind-the-meter distributed generation, and reserve margins were only provided for ISO-NE. Information on transmission limits was provided for ISO-NE, NYISO, and PJM. Annual generation by resource type was provided for the combined ISO-NE and NYISO footprint, and CO_2 emissions by zone were provided for ISO-NE and NYISO. The schedule of plant retirements and new additions (including new renewable resources) was provided only for ISO-

[26] We note that states' RES/RPS rules generally allow the renewable resources to be located anywhere within the control area or in an adjacent control area, so specific new wind and solar resources were not earmarked for any specific state's compliance.
[27] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' First Set of Data* Requests, DR 1-1: CONFIDENTIAL PA Memo June 16 2015.

NE.

- Invenergy indicated that the "analysis includes a representation of the Renewable Portfolio Standards/Renewable Energy Standards for each state within the modeled footprint."[28] The resource buildout includes [redacted] MW (expressed on a de-rated, qualified capacity basis) of additional renewable resources in ISO-NE between 2016 and 2025.[29] Between 2019 and 2025, the annual renewable energy generated within the combined ISO-NE and NYISO footprint in the model appears to fall short of the weighted aggregate New England/New York target of approximately 23% to 28% over the same time period.[30] The aggregate New England/New York target is a weighted percentage of the New England states' RES and RPS, and New York's CES, taking into account Rhode Island's updated 38.5% by 2035 standard and New York's aggressive plan of obtaining 50% of energy generation from renewable sources by 2030.[31] This target percentage does not, however, include the prospective addition of 1,600 MW of off-shore wind and 1,200 MW of hydropower to be procured under recent Massachusetts legislation.[32] Both the New York CES and the new Massachusetts law post-date the analysis, and therefore PA's model does not include these new resources. LAI has not been able to quantify the shortfall of renewable resources in the model, since the available data does not include renewable imports from outside of the region that may be counted toward RES/RPS/CES, behind-the-meter distributed generation that contributes to the targets, nor existing large scale hydropower that qualifies for a portion of the target.[33] However, as discussed on pages 19-21, LAI concludes that increasing the penetration of renewable resources and renewable energy generation in the model would diminish, but not eliminate, the claimed CO_2 emissions benefit of the Project.

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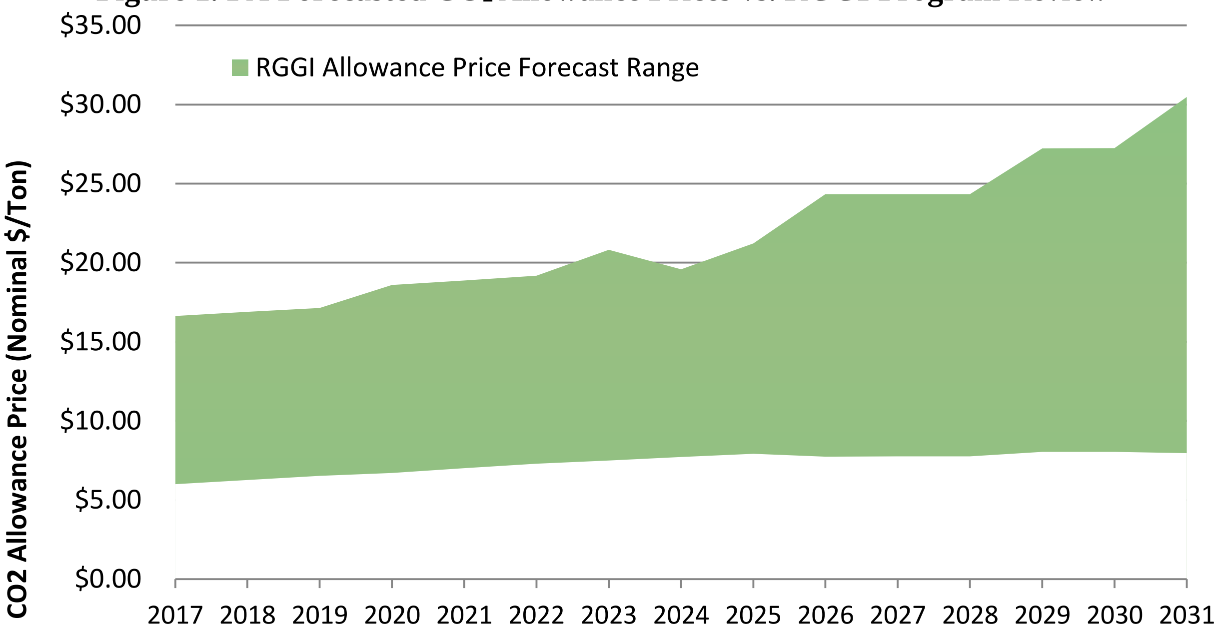
[28] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Set of Data* Requests, DR 2-2.
[29] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Set of Data* Requests, DR 2-1 CONFIDENTIAL.
[30] The load-weighted aggregate New England/New York renewables target was calculated using load forecasts from ISO-NE's 2016 CELT Load Report and New York's 2016 Load and Capacity Data Report, and the most up-to-date RES/RPS targets per DSIRE.
[31] New York has not yet developed a long-term plan for achieving this target. See NY Public Service Commission's Order Adopting a Clean Energy Standard, August 1, 2016.
Source: New York State Energy Plan: http://energyplan.ny.gov/
[32] Codified under new Section 83(c) of the Green Communities Act, Chapter 169 of the Acts of 2008.
[33] PA reported hydropower generation separate from renewable generation over the forecast period. It was not specified whether the hydropower category includes any qualified renewable resources.

- PA's RGGI CO_2 allowance prices appear to be based on recent RGGI auction clearing prices, increasing only with inflation over the forecast period. This price trajectory appears to be low compared to forecasts prepared as part of the ongoing RGGI 2016 Program Review.[34] These forecasts are scenario-based, spanning a broad range of assumptions regarding the stringency of the RGGI annual cap and implementation of the federal Clean Power Plan. All of the six scenarios analyzed resulted in RGGI allowance prices higher than the forecast utilized by PA. See Figure 1. As discussed on page 21, LAI concludes that utilizing a low RGGI allowance price is a conservative modeling assumption and may underestimate the potential emission reduction benefit from this Project.

Figure 1. PA Forecasted CO_2 Allowance Prices vs. RGGI Program Review*



**The confidential version of Figure 1 submitted to the EFSB includes PA's forecast.*

- Fuel price projections for natural gas and oil are reasonable compared to open source forecasts such as the EIA's Annual Energy Outlook ("AEO"). PA Consulting's forecasted Henry Hub prices are [redacted] lower in the first two years and around [redacted] higher in the subsequent five years of the EIA's 2016 AEO in nominal dollars.[35] West Texas Intermediate oil prices used by PA Consulting are an average of [redacted] lower than EIA's forecasted prices in the first three years of the study period, however the forecasts match beyond

[34] RGGI Program Review Materials are available at http://www.rggi.org/design/2016-program-review/rggi-meetings.
[35] EIA AEO 2016, Table 13.

2022.[36] Coal and uranium prices are escalated with inflation, which is a reasonable assumption. It should be noted that all commodity price forecasts are subject to uncertainty. However, because the analysis of GHG impacts is oriented around the difference between two forecasts – the operation of the grid and regional emissions *with* the Project in operation compared to a reference case *without* the Project – some uncertainty with respect to the trajectory of the fuel or allowance price forecast is not expected to materially change PA's overall findings or conclusions.

Invenergy/PA's analysis and information in the Application indicates that CREC would generate approximately 6 million MWh per year when both units are operating, and emit approximately 2.4 million tons of CO_2 per year when burning natural gas.[37] On an annual average, CREC's output-based emission rate is expected to be 760 lb/MWh when burning natural gas.[38]

According to Invenergy's Application, the Facility will be configured as a two-unit one-on-one (1x1), duct fired, combined cycle generation station. Each unit will consist of an advanced class H class gas turbine operated in a combined-cycle configuration with a heat recovery steam generator (HRSG) equipped with natural gas-fired duct burners and one steam turbine.[39] As one of the most efficient gas-fired generating resources in New England, the Project would be expected to operate at a high capacity factor, at times operating at base load, and other times cycling to minimum load, as determined by market conditions. Duct firing is expected to occur most frequently during peak hours during summer months, when demand for electricity is high, but may also occur outside of summer months. The gas turbines will be dual-fuel capable; the duct burners

[36] EIA, AEO 2016, Table 12.
[37] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Set of Data* Requests, DR 2-4; annual emissions calculated from average emission rate provided in *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Sixth Set of Data Requests*, DR 6-3(4).
[38] Source: *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Sixth Set of Data Requests*, DR 6-3(4). Slightly different emission rates are reported in Table 1 of Invenergy's air permit application, included as Appendix B to the Application, which was based on preliminary project technology specifications and may have assumed a different amount of duct firing.
[39] Application, p. 6.

will operate only on gas.[40] Based on PA's model, when both units are operational the Project is expected to generate approximately 6 million MWh per year, or a capacity factor of approximately 70%.

In the Application, annual CO_2 emissions from the Project were expressed on a "potential to emit" ("PTE") basis, as required for the facility's Major Source Permit. That is, maximum emissions from the Project, if operated at full load, 365 days per year, 24 hours a day, would be 3.6 million tons per year on a PTE basis.[41] The annual CO_2 emissions based on the expected operation of the facility would be less, since it would not operate around the clock, but would participate in the Day-Ahead and Real-Time energy markets and follow ISO-NE's hourly dispatch instructions. LAI estimated the CO_2 emissions as approximately 2.4 million tons per year when firing natural gas, based on Invenergy's modeling of the expected hourly plant dispatch and total annual generation.

In its air permit application, Invenergy requested that it be permitted to burn ultra-low sulfur distillate ("ULSD") for up to 30 days for each unit, or a total of 60 days on ULSD. The maximum CO_2 emissions if both units operate for the full 30 days on ULSD would be 415,440 tons during only those days, which is an increase of approximately 128,000 tons over burning only natural gas on those days.[42] Fewer days of operation on ULSD would emit proportionately less CO_2.

> **PA's model indicates that operation of CREC will displace an equivalent MWh/year of other dispatchable generation resources, primarily from coal and oil-fired resources, as well as less efficient gas-fired generation, which all have a higher CO_2 emission rate on a lb/MWh basis. Consequently, operation of CREC will result in a net**

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[40] Source: *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Sixth Set of Data Requests*, DR 6-3(4).
[41] Application, Table 6.1-1, p. 32.
[42] Application, Appendix B, Major Source Permit Application, Table 1.

decrease in regional CO_2 emissions over the forecast period.

For each MWh that CREC generates, a MWh from another generation resource will be displaced, maintaining a balance between electricity generation and electric demand. ISO-NE (and other system operators) dispatch the generating resources available in the system to minimize the total system-wide cost of producing electricity while safely operating the transmission system. Electric generator dispatch follows a merit order, where lower operating cost units are dispatched (subject to transmission security requirements and operating characteristics of the resources) until demand is ultimately met by the dispatch of the unit with the highest operating cost in the supply stack, referred to as the "marginal unit." The marginal unit sets the clearing price in each hour. Heat rates, expressed in terms of fuel burned per unit of electric energy produced, measure the efficiency of generators that burn fuel to generate electricity; a lower heat rate signifies a more efficient generator. The cost of fuel and other variable operating costs also factor into the total production cost and, consequently, the merit order in which ISO-NE dispatches resources. Clear River's natural gas units have an estimated net plant heat rate of 6,254 Btu/kWh, which would make it one of the most efficient combined cycle plants in the region.[43] Its low heat rate, combined with the competitive cost of natural gas over the forecast period, make it reasonable to expect that CREC will be dispatched early in merit order and therefore displace less efficient dispatchable generating resources with higher unit costs of production - primarily resources that burn coal or oil as a fuel source, as well as less efficient gas-fired resources, all of which have a higher CO_2 emission rate on a lb/MWh basis. Typical heat rates and emission rates for different fossil fuel resources are provided in Table 2.

[43] Source: PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Second Data Request*, 2-1 (Unredacted Version).

Table 2. Generic CO_2 Emissions per MWh by Fuel and Technology Type[44]

Fuel	Prime Mover	Lbs CO_2/MMBtu	Heat rate (Btu/kWh)	Lbs CO_2/MWh
Coal				
Bituminous	Steam Generator	205.73	10,080	2,074
Subbituminous	Steam Generator	214.33	10,080	2,160
Lignite	Steam Generator	215.43	10,080	2,172
Natural gas				
	Steam Generator	117.02	10,408	1,218
	Gas Turbine	117.02	11,378	1,331
	Internal Combustion	117.02	9,375	1,097
	Combined Cycle	117.02	7,658	896
Distillate oil (No. 2)				
	Steam Generator	161.32	10,156	1,638
	Gas Turbine	161.32	13,457	2,171
	Internal Combustion	161.32	10,403	1,678
	Combined Cycle	161.32	9,924	1,601
Residual oil (No. 6)				
	Steam Generator	173.73	10,156	1,764
	Gas Turbine	173.73	13,457	2,338
	Internal Combustion	173.73	10,403	1,807
	Combined Cycle	173.73	9,924	1,724

Because energy from less efficient and higher-emitting sources across the state and region are displaced, there is a net decrease in overall CO_2 emissions. Over the seven year forecast period, CO_2 emissions across ISO-NE and NYISO are forecasted to be reduced by a total of 7.1 million short tons with the CREC addition, shown on an annual basis in Figure 2. Figure 2 was prepared

[44] Source: 2014 U.S. Energy Information Administration; Tables A.3. Carbon Dioxide Uncontrolled Emission Factors, 8.2. Average Tested Heat Rates by Prime Mover and Energy Source, 2007 – 2014.

using CO_2 emissions results for ISO-NE and NYISO from PA's model runs with and without CREC. PA's model did not consider whether development of CREC would induce further retirements of aging, less efficient plants by putting downward pressure on wholesale electricity prices. This is a conservative assumption; to the extent that retirement of old plants can be attributable to development of CREC, the Project would contribute to further reducing CO_2 emissions.

Figure 2. ISO-NE & NYISO CO_2 Emissions Reduction with CREC[45]

[redacted]

ISO-NE annually releases a report on air emissions from the region's fleet of generating resources. For 2014, the most current year that this report is available, the average CO_2 emission rate across the entire ISO-NE system was reported to be 726 lb/MWh, a 0.5% decrease from the prior year.[46] This average takes into account all generating resources in the region, including non-emitting plants such as nuclear, hydropower, wind, and solar, which combined comprised 50% of generation in 2014.[47] ISO-NE also compiles the average marginal emission rate, that is, the weighted average of the emission rates from the identified marginal unit(s) that set the energy

[45] Source: PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Second Data Request*, 2-1 (Unredacted Version).
[46] ISO New England, Inc. System Planning, "2014 ISO New England Electric Generator Air Emissions Report," January 2016, p 2 and 22.
[47] With retirement of Vermont Yankee at the end of 2014, and anticipated retirement of Pilgrim in 2019, the percentage of non-carbon emitting generation will decrease, and the average system emission rate will increase.

market hourly locational marginal prices. ISO-NE's average marginal emission rate for CO_2 in 2014 was 941 lb/MWh.[48] As noted above, CRECs' average annual emission rate is 760 lb/MWh when burning only natural gas, and would be approximately 815 lb/MWh when the maximum permissible ULSD burn is incorporated in the average annual rate, all else being the same.[49] ISO-NE's marginal emission rate of 941 lb/MWh, and not the average system rate of 726 lb/MWh, is the appropriate comparison against CREC's average annual emission rate. This is because CREC will generally operate as an infra-marginal unit, meaning that it will be dispatched before higher-cost and less-efficient generators. Energy generated from CREC will displace generation from the higher-emitting marginal unit each hour that CREC operates, thereby lowering the system average emission rate.

By lowering the system average CO_2 emission rate, the Project will contribute to lowering the consumption-based annual CO_2 emissions for Rhode Island within the electric generation sector.

On a consumption accounting basis, Rhode Island's annual CO_2 emissions for the energy sector of the economy are computed as the state's share of the emissions associated with generating the electricity used by the region. Using the formula applied by the U.S. EPA State Inventory Tool, the annual consumption-based CO_2 emissions equals the average annual emission rate for the system (in lbs of CO_2 per MWh), multiplied by the state's annual electricity consumption (in MWh per year), multiplied by a loss factor.[50] The loss factor accounts for energy losses that occur across the transmission and distribution system as power is transmitted from the generators to the homes and businesses that consume the power. The loss factor is a property of the transmission and distribution system, and not affected by the operation of CREC. Since CREC will lower the

[48] ISO New England, Inc. op cit p. 3 and 24.
[49] Calculated from emission rates for gas and ULSD provided in the Application, Appendix B, Table 1.
[50] EPA, State Inventory and Projection Tool, currently available for download at: https://www.epa.gov/statelocalclimate/state-inventory-and-projection-tool.

average annual CO_2 emission rate across the power grid, it will contribute to lowering the state's consumption-based CO_2 annual emissions.

> **We expect that beyond the reported forecast period (post-2025), the Project will continue to displace less efficient and higher-emitting resources, but the impact will diminish over time as the region's resource mix continues to become more efficient and increasingly reliant on renewable resources.**

LAI expects that, over the long term, the region's generation fleet will evolve to reflect further retirements of aging fossil-fueled plants, continued expansion of carbon-free resources such as wind (on-shore and off-shore) and solar generation, and state and federal policies that will increase the cost of emitting carbon. All of these likely future events will contribute to the further "decarbonization" of the bulk power system. Continued operation of CREC will foster this objective, or at least not impede progress.

More efficient gas-fired combined cycle plants may also be developed in the future as technologies improve, electric demand increases across the region, and/or market economics incentivize private capital investment in such resources. CREC and other more efficient gas-fired plants will continue to put downward pressure on energy prices, narrowing the gap between the price paid to a generator and the cost of the fuel and other variable costs to produce electricity. This gap is commonly known as the "spark spread" and is directly related to the profitability of a power plant. Narrowing the spark spread puts increased economic burden on the remaining oil and coal-fired plants in the region. As these aging plants retire, generation will likely be replaced by renewable resources, more efficient gas-fired generation, and potentially large-scale hydropower imports from Canada, lowering the CO_2 emissions from electricity consumed in the state and region.

Since they burn no fuel, wind and solar resources have very low operating costs, and will generate electricity whenever the wind blows or the sun shines. Hydropower imports are also base-load resources. Therefore renewable and hydropower generation, in turn, will continue to displace dispatchable gas- and other fossil fuel-fired generation, not vice versa. As renewable penetration increases over the long term to meet the region's aggressive RPS/RES/CES goals, we expect that generation from all gas-fired resources (including CREC) will diminish and emit less CO_2.[51] Importantly, economic risks due to diminished operation of CREC as it competes with renewable generation and more efficient, cleaner plants in the future are not borne by customers in Rhode Island, but solely by the Project owner.

Finally, more restrictive carbon caps that may be implemented in the future (through RGGI or other programs and policies at the state or federal levels) will increase the production cost for all fossil fuel-fired resources, and reduce the GHG footprint system-wide. If carbon caps are reduced in the future (that is, if a higher RGGI allowance price forecast were to be utilized in PA's model), emitting carbon would become more costly. More carbon-intensive coal and oil-fired plants will be more economically burdened than gas-fired plants, and gas-fired plants will be more burdened than renewable resources. Therefore, over the long term, generation from CREC will continue to displace any remaining coal, oil, and less-efficient gas-fired plants, and in turn, generation from renewable resources will displace generation from CREC and other gas-fired resources.

PA reported CO_2 emissions across a footprint that includes New England and New York. Consistent with consumption-based GHG accounting, emissions associated with electricity used in-state is derived from regional sources, including imports from other states and regions. LAI therefore concurs that it is appropriate to consider CREC impacts on regional emissions, including all of ISO-NE and neighboring

[51] ISO-NE, "ISO-NE New England Wind Integration Study" p. 4. Currently available at: http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/reports/2010/newis_report.pdf.

NYISO.

PA's model illustrates the expected impact of adding a new, efficient combined cycle unit to the electric grid. Relative to a reference case without the Project, CO_2 emissions decrease in each ISO-NE and NYISO zone, except within Rhode Island, where CO_2 emissions increase when the Project is operating.[52] Figure 3 shows the net impact of the CREC project on CO_2 emissions in ISO-NE and NYISO, relative to the reference case without CREC. This chart breaks out the CO_2 emissions impact of: (1) NYISO, (2) ISO-NE without Rhode Island, (3) Rhode Island excluding CREC, and (4) CREC alone.[53] The total net effect of the Project on CO_2 emissions across the NYISO and ISO-NE footprint is represented by the red line, and illustrates a net reduction in CO_2 emissions for each year of the forecast period. Importantly, the figure illustrates that while operation of CREC increases the CO_2 emissions within Rhode Island, the other fossil-fired plants within Rhode Island are expected to decrease net emissions over the forecast period due to operation of CREC.

Figure 3. Regional Reductions (Increases) in CO_2 Emissions with CREC[54]

[redacted]

[52] Rhode Island includes all generation electrically connected in the ISO-NE Rhode Island zone.
[53] Emissions data by ISO-NE and NYISO zone from *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*, DR 2-1(b), CONFIDENTIAL Attachment. The effects of CREC have been estimated using data available in the Application. Note that 2019 reflects only one unit of CREC in service.
[54] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*,

The impact on CO_2 emissions outside of ISO-NE and NYISO was not reported by PA. However, PA's model results suggest that operation of CREC would result in a small net decrease in generation and emissions outside of this footprint.

Based on PA's model, it appears that the first year of the forecast period, operation of the Project (2019) would result in a small net decrease in MWh of generation within the combined ISO-NE and NYISO footprint, as shown in Figure 4. In 2021 and 2022, the difference is nearly zero. From 2022 to 2025, there would be a small net increase in MWh. Both cases (the reference case without the Project and the case with the Project) use the same annual load forecast. Therefore, in the first year (2019) when only one CREC unit operates, since generation within ISO-NE and NYISO decreases slightly, there would need to be a small *increase* in imports from neighboring regions to meet the same system load. In 2020 and 2021, the change in imports would be negligible and in the latter four years there would be a *decrease* in imports from neighboring regions ascribable to operation of CREC (and therefore a concomitant increase in generation within ISO-NE and NYISO to meet the same system load.) The total impact over the seven year forecast is a small net decrease in imports. The change in the flow of power across regional boundaries arises from changes in the relative energy prices, and is not driven by CO_2 emissions. CO_2 emissions associated with imported energy is referred to as "leakage." Since net imports are reduced over the modeled period, leakage of CO_2 from neighboring regions outside of ISO-NE and NYISO would be reduced. Although we do not have information on the source of the leakage from outside of the modeled region, a reduction in leakage means that there is less power generated outside of the region. This would either have no impact on overall CO_2 emissions (if the marginal resource outside of the region is non-emitting), or would reduce CO_2 emissions outside of the

DR 2-1.

region, to some small degree, if the marginal unit is fossil-fueled. Therefore, we conclude that reporting CO_2 impacts for only ISO-NE and NYISO is conservative; expanding the footprint would contribute to a small, further reduction in CO_2 emissions ascribable to the Project.

Figure 4. Change in Total Annual ISO-NE and NYISO Generation with Clear River[55]

[redacted]

> **"Upstream" emissions of methane associated with production and transportation of natural gas and other fossil fuels was not considered by Invenergy. Upstream GHG emissions of methane could, in principle, be ascribable to the Project, but only to the extent that operation of CREC would be expected to directly result in a net increase in fossil fuel production and usage across the region. LAI's analysis of PA's model results indicates that there is a net decrease in all fuel types due to operation of the Project. Therefore, we infer that there is no incremental production of fossil fuel that can be ascribable to the Project, and no associated increase in upstream methane emissions.**

Methane is a potent greenhouse gas with a global warming potential more than 25 times greater than that of CO_2. Approximately one-third of the methane emissions in the U.S. comes

[55] Source: *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*, DR 2-1.

from oil production and the production, transmission, and distribution of natural gas.[56] Production of natural gas through hydraulic fracturing releases fugitive emissions of methane and other hydrocarbons, as the fluid injected into the well under high pressure is returned as flowback. Associated methane may also be produced from oil wells, where it is typically flared or captured as a product. EPA has recognized that fugitive methane emissions from oil and gas production and transportation are a significant source of GHGs, and recently promulgated new regulations under the New Source Performance Standards to reduce emissions from the oil and natural gas industry. These regulations now mandate that all new oil and gas wells utilize reduced emission completions ("green completions") to capture methane, and they also require more frequent inspections and repair of compressor stations along natural gas pipelines. Green completions are currently employed extensively in shale gas formation such as the Marcellus shale, where fuel for CREC is likely to be sourced.[57]

Invenergy did not consider potential upstream releases of methane in its Application. However, LAI observes from model results that operation of the Project would lead to an annual reduction in consumption of all fossil fuel types used in the region, including natural gas, oil, and coal. Over the seven year study period, the approximately 6 million MWh per year that CREC generates replaces predominantly gas-fired generation, followed by oil-fired generation, and then coal-fired generation. The displaced generation by fuel type, as a percentage of the total annual displaced generation, is shown in Figure 5. The corresponding fuel that is displaced by operation of the Project is shown in Figure 6. The Project is expected to decrease the total utilization of coal,

[56] U.S. EPA, "Actions to Reduce Methane and VOC Emissions from the Oil and Natural Gas Industry: Final Rules and Draft Information Collection Request," May 2016. Currently available at: https://www3.epa.gov/airquality/oilandgas/may2016/EPA-OilandGasActions-May2016.pdf.

[57] The American Petroleum Institute claims that green completions associated with hydraulically fractured wells have reduced methane emissions from these wells by 83% since 2013.

oil, and gas by an average of [redacted] MMBtu annually during the seven-year study period.[58]

Figure 5. Displaced Generation by Fuel Type[59]

[redacted]

Figure 6. Annual Total ISO-NE & NYISO Fuel Burn Reduction with CREC[60]

[redacted]

[58] Calculated from CONFIDENTIAL Attachment to *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*, DR 2-1(a).
[59] Source: CONFIDENTIAL Attachment to *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*, DR 2-1(a).
[60] Source: CONFIDENTIAL Attachment to *Invenergy Thermal Development LLC's Responses to the Office of Energy*

As illustrated in Figure 6, despite the primary fuel source for CREC being natural gas, significantly less natural gas is still forecast to be used in the region. The model holds power plant retirements constant across the two cases, so that any reduction in fuel burn achieved with CREC comes from a reduction in generation from existing sources rather than by inducing further power plant retirements. With both units in service, CREC burns an average of approximately [redacted] MMBtu of natural gas annually, assuming it operates only on natural gas, while it displaces an average of approximately [redacted] MMBtu of other natural gas burned annually between 2020 and 2025. Compared to the average heat rate of displaced gas-fired generation, the more efficient CREC burns an average of approximately [redacted] less over the forecasted period.[61] Since CREC reduces the overall regional consumption of all types of fossil fuels used for generation, it is reasonable to conclude that the Project does not increase upstream methane emissions, and may actually contribute to reducing upstream impacts.

GHG impacts when gas pipelines are constrained and CREC burns backup liquid fuel were not considered in the analysis by PA. However, the CO_2 emissions associated with the Project's maximum annual allowable ULSD burn would be only a small offset to the total annual net reduction in CO_2 ascribable to the Project.

Though it was not modeled by PA, Invenergy has requested to be permitted for up to 30 days of ULSD use for each unit, or 60 total days of ULSD use (assuming only one unit operates on ULSD each day). Gas pipelines in the Northeast have been constrained during winter cold snaps, running at very high utilization levels when pipeline capacity is largely dedicated to serve gas utilities' core heating load. On those days, generators may not be able to schedule delivery of gas, and in some cases pipeline operators may curtail gas that has been scheduled for delivery.

Resources' Second Data Request, DR 2-1(a).

[61] Calculated from CONFIDENTIAL Attachment to *Invenergy Thermal Development LLC's Responses to the Office of Energy Resources' Second Data Request*, DR 2-1(a).

During those events, generators with dual fuel capability can switch to backup fuel, to the extent allowed by their air operating permit.

LAI calculated the anticipated increase in annual emissions if it is assumed that CREC would operate on ULSD for the maximum number of days it has requested in its air permit application. Burning 60 days of ULSD instead of natural gas at CREC would result in an increase of approximately 128,000 tons of CO_2 emissions by CREC annually.[62] This increase would be a small offset to the roughly 1 million tons per year of avoided CO_2 that can be ascribable to the Project running exclusively on natural gas. It should be noted, however, that if gas pipeline constraints cause CREC to operate on its backup fuel, other dual fuel plants in the region will be similarly affected, increasing baseline CO_2 emissions across the region.

B. Findings Related to Consistency with Rhode Island Energy Policy

The potential construction and dispatch of CREC will not prevent Rhode Island from achieving its GHG reduction targets as defined under the Resilient Rhode Island Act.

The Resilient Rhode Island Act requires submittal of "a plan that includes strategies, programs, and actions to meet targets for greenhouse gas emissions reductions as follows: (i) Ten percent (10%) below 1990 levels by 2020; (ii) Forty-five percent (45%) below 1990 levels by 2035; (iii) Eighty percent (80%) below 1990 levels by 2050." This plan is under development by EC4 and not anticipated to be completed until or around December 31, 2016.

In order to assess progress towards achieving the Resilient Rhode Island Act GHG reduction targets, the EC4 adopted a consumption-based emissions accounting methodology. As previously discussed, electric sector emissions will be calculated based on the emissions associated with in-state electric consumption, not in-state electric generation. Therefore, because electric

[62] Calculation based on maximum heat input (MMBtu/hr) for operation on gas and ULSD provided in Invenergy's air permit application, Table 1 in Appendix B to the Application.

sector emissions will be considered based on reductions in system GHG due to Rhode Island policy, construction of the Project would not prevent the state from achieving the Resilient Rhode Island Act GHG reduction targets, as long as the state maintains its dedicated commitment to aggressive energy efficiency and other clean energy policies.

In fact, scenario modeling for the State Energy Plan, which considered electric sector emissions using consumption-based accounting, indicated that Rhode Island could achieve the intermediate Resilient Rhode Island GHG reduction target (45% below 1990 levels by 2035) even with the addition of new natural gas-fired generation. The scenario modeling underlying the Plan assumed – under all scenarios through 2035 – that future electric demand would be met, in part, by new natural gas-fired generation. As noted in Statewide Planning's Advisory Opinion, "it is reasonable to consider the Facility [CREC] as representing a portion of this natural gas generating capacity that was anticipated to be built under base case conditions within the Navigant modeling – a market-driven outcome of the broader ISO capacity market that was expected to occur within the region under business-as-usual conditions."

Furthermore, the targets set forth under the Resilient Rhode Island Act are economy-wide and are not sector-specific. While Rhode Island has established robust policies and programs to diversify its energy supply portfolio and reduce electric sector emissions (such as through its participation in RGGI), the State Energy Plan also recognizes that nearly 75% of statewide emissions (and around 70% of energy costs) come from the thermal and transportation sectors.[63] A comprehensive carbon reduction strategy will, by definition, need to account for GHG reduction potential in those two sectors.

Analyzing the potential for carbon reduction in any sector beyond 2035 – let alone all

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[63] Source: Energy 2035 – Rhode Island State Energy Plan, Page 31. Currently available at: http://www.planning.ri.gov/documents/LU/energy/energy15.pdf

sectors – is a challenging exercise at best. However, as noted in this Advisory Opinion, the construction of CREC will not impact existing statutory mandates designed to diversify and decarbonize Rhode Island's electric supply portfolio. For instance, at the time of this filing, the nine-member RGGI bloc is actively conducting a program review that includes consideration of more stringent emissions caps, as noted above. Also, the Governor and General Assembly recently extended the state's Renewable Energy Standard through 2035. Moreover, this Advisory Opinion concludes that the operation of CREC will lower regional emissions in the short- and mid-term by displacing less efficient and more carbon intense resources. This, in turn, will also place downward pressure on electric sector emissions within a consumption-based construct. Therefore, it is reasonable to conclude that Rhode Island can and will continue to reduce consumption-based emissions from the generation sector as new no-to-low carbon energy resources penetrate the grid and do so at increasing scale, even when CREC is factored into the mix. Furthermore, the construction of CREC will not impede Rhode Island from tackling emissions reduction potential in other carbon-intense areas of the economy (transportation, thermal).

Dispatch of CREC does not affect programs undertaken by the State to diversify its sources of electricity, such as expansion of intermittent resources that include wind and solar, which are non-GHG emitting sources of electricity.

OER concludes that CREC will not impede Rhode Island's ongoing commitment to clean energy investment through policies and programs that include, but are not limited to, Least Cost Procurement, the Renewable Energy Standard, the Renewable Energy Growth Program, net metering, and participation in multi-state clean energy procurement initiatives as authorized by the Affordable Clean Energy Security Act (such as the Multi-State Clean Energy RFP between RI, MA, and CT).[64] These policies will continue to help Rhode Island achieve its fuel diversity and GHG reduction targets by supporting the continued penetration of clean energy resources in the state's energy supply portfolio. The construction of CREC does not alter or hinder, in any way, the statutory and policy provisions underlying these key initiatives.

Even at a market level, the construction of CREC will not impede renewable generation. Wind and solar resources are intermittent, generating electricity only when the wind blows or the sun shines. They are non-dispatchable and generally self-scheduled, and the operation of CREC will have no impact on the output of wind or solar resources.[65] In contrast, continued penetration of wind and solar resources will most likely displace dispatchable resources such as gas-fired combined cycle plants, since these plants are most frequently on the margin.[66] Similarly, hydropower imports and biomass facilities tend to run at a baseload operation, with biomass typically deriving revenues from energy sales as well as from renewable energy credits (RECs). Therefore, even efficient combined cycle plants such as CREC would not displace generation from qualified biomass or from hydropower imports. Economically, within our deregulated environment, the risk of CREC not being dispatched in any given hour (whether displaced by cleaner resources or not) is born by Invenergy, not Rhode Island ratepayers).

Dispatch of CREC does not affect the expansion of State programs that promote energy efficiency. Least Cost Procurement will ensure that cost-effective energy efficiency will continue to be pursued in Rhode Island.

Development and operation of CREC will not be a barrier to initiatives that Rhode Island

[64] The potential impacts of CREC on achievement of state energy policy goals are also discussed as part of Statewide Planning's Advisory Opinion submitted elsewhere in this docket. We aim not to repeat those findings here.
[65] We note that in certain constrained areas of New England, such as northern Maine, wind resources are sometimes curtailed during low load periods if the transmission system cannot be safely and securely operated. However, this is not known to occur with wind resources in Southeast New England (ISO-NE SENE Zone).
[66] ISO-NE, "ISO-NE New England Wind Integration Study," Dec. 5, 2010, p. 15. Available at: http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/reports/2010/newis_report.pdf.

has undertaken to procure all least cost supply. The state's Least Cost Procurement Policy, which was recently extended through 2024, requires electric and gas distribution companies to invest in all cost-effective energy efficiency measures before procuring more expensive conventional supplies. Cost-effective energy efficiency measures reduce electric load, which not only reduces electric generation and emissions of GHG, but also costs to customers. Future operation of CREC will not change this policy. Reducing the state's total electric load may contribute - to a small degree - to a reduction of hours of CREC's operation, but this has not been quantified. Even so, the financial risk associated with any potential change in unit dispatch falls on the merchant owner, not on local ratepayers.

CREC will have fast start and rapid ramp rate generating capability that may facilitate integration of new and existing renewable generation in the regional power grid.

According to ISO-NE, "adding more wind- and solar-powered resources in New England will paradoxically increase the region's need for more fast-response, flexible resources – which in many cases will be natural-gas-fired generators. Until grid-scale energy storage technologies become economic and widespread, the region will be calling on natural-gas resources to counter fluctuations in output from renewables."[67] The integration of intermittent resources can add to the complexity of operating the bulk power system and forecasting hour-to-hour load. As an example, the ISO-NE Wind Integration Study analyzed the operational effects of large-scale penetration of wind generation in New England. The study analyzed scenarios with up to 24% wind penetration, and concluded that, at those levels of intermittent resources, ISO-NE would still require more than 25% of its annual electric generation to come from natural-gas-fired resources. Importantly, the study reported that "…balancing of net load—an essential requirement for large-scale wind

[67] ISO-NE, "2016 Regional Electricity Outlook" p. 4. Available at: http://www.iso-ne.com/static-assets/documents/2016/03/2016_reo.pdf.

integration—was largely provided by the flexibility of the natural-gas-fired generation fleet."[68]

Invenergy claims that CREC "…has fast start and high ramp rate (flexible) generating capability, replacing older, less flexible generation. The fast start and flexible generating capability will support the integration of new and existing renewable generation onto the power grid."[69] Invenergy reports that CREC can start up and achieve minimum emissions compliance load in 13 minutes, for cold, warm, and hot starts.[70] Its ramp rate when firing natural gas is 50 MW per minute for each combustion turbine, or a total of 100 MW per minute.[71] These performance characteristics potentially allow CREC to offer into ISO-NE's ancillary services markets. Ancillary services provided by quick start and fast-response resources are used to follow variable load and can help integrate intermittent resources into the power supply. These types of services can be provided by quick-start resources that can come up to load within 10 minutes (Ten Minute Non-Spinning Reserves, or TMNSR), flexible resources that can ramp up within 30 minutes (Thirty Minute Operating Reserves, or TMOR), and resources that can respond to frequent signals from ISO-NE to respond to minute-by-minute changes in load (Automatic Generation Control, or AGC). Ancillary services markets for TMNSR and TMOR, as administered by ISO-NE, compensate resources for remaining in reserve, prepared to ramp up quickly if called upon. It is important to note that PA modeled the operation of CREC in response to energy market signals, and not as an ancillary service resource. As primarily an energy resource, it will operate at a relatively high capacity factor. If CREC were to provide ancillary service resource to support penetration of intermittent resources, it would operate at a lower level and therefore emit less CO_2.

[68] Ibid. p. 25.
[69] Application, p. 3.
[70] PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Division of Public Utilities and Carriers Third Set of Data Requests*, DR 3-1(d).
[71] Ibid, and PUC Docket No. 4609, *Invenergy Thermal Development LLC's Responses to the Conservation Law Foundation's Second Data Request*, 2-15.

IV. CONCLUSIONS

A. Impact of CREC on GHG Emissions

PA's model utilized an industry standard chronological dispatch simulation model, AURORAxmp, to forecast hourly energy prices and CO_2 emissions with and without CREC, from 2019 to 2025. OER concludes that the key assumptions regarding the regional market structure, fuel and emission allowance prices, supply and demand forecasts, and transmission all appear to be reasonable and the model supports a reasonable forecast of the Project's impact on CO_2 emissions in the region. Based on this analysis, OER concludes that operation of CREC will contribute to a reduction in the region's GHG emissions from the energy sector, on the order of approximately 1% across New England and New York, thereby resulting in a decrease in the CO_2 emissions ascribable to electricity usage in Rhode Island, over at least the first 7 years of Project operations. As renewable resources, energy efficiency, and other sustainability initiatives expand the region's and Rhode Island's reliance on carbon-free resources, over the life of the Project, CREC will have a continued but diminishing impact on reducing GHG emissions associated with electricity supply.

B. Conformance with Resilient Rhode Island Act and other State Energy Policies

OER concludes that development and operation of CREC will not prevent Rhode Island from achieving its economy-wide GHG reduction targets. State energy policies that promote investment in diversified no-to-low carbon clean energy resources, including renewables and energy efficiency, will not be adversely impacted by the Project.

V. OER ADVISORY OPINION

OER finds that:

- The Facility will contribute to reducing CO_2 emissions associated with electricity used in Rhode Island, which is derived from generating resources across New England, as well as imports from neighboring regions. In the long term, over the life of the Project, CREC will not cause CO_2 emissions across the region to increase, although its contribution to reducing regional emissions is likely to diminish.

- Development and operation of the Project is consistent with State energy policies, and will not hinder Rhode Island from meeting its GHG reduction targets under the Resilient Rhode Island Act.
- Development and operation of the Project will not be detrimental to implementing Rhode Island's policies and statutory initiatives to increase energy efficiency and the expansion of renewable sources of electricity.

Carol Grant, Commissioner
Rhode Island Office of Energy Resources

Dated: September 12, 2016