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Benefits of Retiring Logan and Chambers Coal-fired Power Plants

Prepared for: Starwood Energy Group Global, LLC

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Executive Summary

FTI Consulting, Inc. (“FTI”) was retained by Starwood Energy Group Global, LLC (“Starwood”) to assess the CO₂ reduction cost savings that would occur if two Starwood-owned coal-fired plants in New Jersey, Logan and Chambers — located in Logan Township and Carneys Point Township, respectively — were to be retired (“L&C Retirements”) prior to the expiration of their Power Purchase Agreements (“PPAs”) with Atlantic City Electric Company (“ACE” or “PPA Counterparty”) in 2024. In addition to CO₂ emissions avoidance and other benefits of the proposed retirements, Starwood would pay the PPA Counterparty \$7.5 million to retire both plants by the end of 2020, with the PPA obligations to be fulfilled with replacement power and capacity from the PJM wholesale market for the remaining term at the same economic cost to ACE as under the existing PPAs.

FTI’s analysis concludes that the proposed L&C Retirements would result in **avoided net CO₂ emissions of 3.9 million tons**, which is calculated by subtracting replacement power emissions from the estimated L&C gross emissions during 2021-2024. To put this in perspective, a reduction of 3.9 million tons of CO₂ is equivalent to taking 762,419 passenger vehicles off the road for one year in New Jersey.¹ This represents a meaningful step in progressing towards New Jersey’s goal of cutting CO₂ emission by 80 percent compared to 2006 levels.² Further, by achieving the net CO₂ reductions through the L&C Retirements rather than through alternative programs, New Jersey ratepayers would have **cost savings ranging from \$98 million to \$932 million during 2021-2024**, as shown in Figure ES-1.

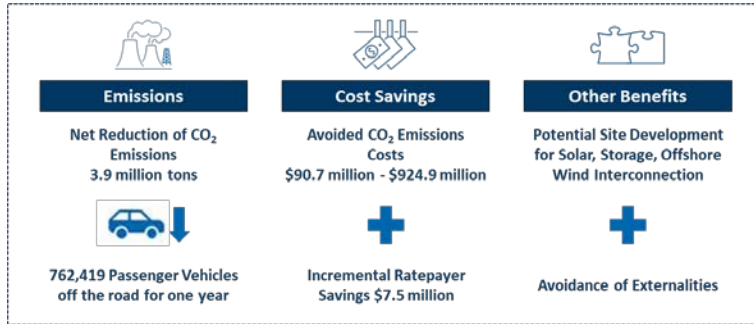
In addition, the L&C Retirements would provide the optionality to explore potential site redevelopment opportunities for solar, battery, or offshore wind interconnections, which are aligned with goals set in New Jersey’s 2019 Energy Master Plan.³ The Starwood offer eliminates other externalities that would otherwise occur along the coal value chain, but are not explicitly captured in the price of electricity.

¹ Based on United States Environmental Protection Agency’s estimates, a typical passenger vehicle emits about 4.6 metric tons of CO₂ per year, <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle>.

² The New Jersey Global Warming Response Act of 2007 (GWRA), N.J.S.A. 26:2C-37.

³ State of New Jersey, 2019 Energy Master Plan, https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.

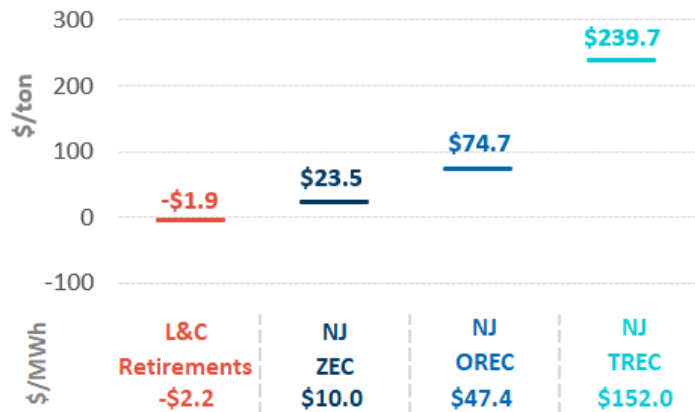
Figure ES-1: Summary of Starwood Offer Impacts Through 2024



The ratepayer impacts are assessed by comparing the potential CO₂ reduction cost savings associated with L&C Retirements to other state-level CO₂ reduction programs that incentivize the continued development and operation of carbon-free generation resources. The alternative programs evaluated include the Zero Emission Certificate (“ZEC”) program for nuclear generation resources, the Offshore Wind Renewable Energy Certificate (“OREC”) program, and the Transition Renewable Energy Certificates (“TRECs”) program for solar in New Jersey.^{4, 5, 6}

The alternative CO₂ reduction programs have shown a wide range of costs to ratepayers: \$24 per ton as implied by New Jersey ZECs, \$75 per ton as implied by the New Jersey ORECs, and \$240 per ton as implied by the New Jersey TRECs, as shown in Figure ES-2. In comparison, the L&C Retirements have an estimated \$2 per ton benefit (i.e., the opposite of a cost) to ratepayers enabled by the \$7.5 million payment from Starwood.⁷

Figure ES-1: Comparative CO₂ Emission Reduction Costs



Note: The L&C Retirements direct savings are calculated by dividing the negative of Starwood’s payment of \$7.5 million by the avoided net CO₂ emissions of 3.9 million tons. The NJ ZEC cost is based on NJBPU awards and is converted from \$/MWh to \$/ton at the 2019 average PJM CO₂ emission rates. The NJ offshore wind credit is calculated based on NJBPU’s net cost of OREC at \$46.46/MWh (in 2019 dollars) with 2 percent escalation. The NJ TREC is based on NJBPU order in 2020. Both NJ OREC and TREC are converted at the PJM 2019 marginal on-peak emission rate.

⁴ <https://nj.gov/bpu/newsroom/2018/approved/20181119.html>

⁵ <https://www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-srec/new-jersey-solar-renewable-energy>

⁶ <https://www.nj.gov/dep/aqes/offshorewind.html#:~:text=On%20November%202019%2C%202019%20Governor,than%20double%20the%20initial%20goal>

⁷ The L&C Retirements direct savings are calculated by dividing the negative of Starwood’s payment of \$7.5 million by the avoided net CO₂ emissions of 3.9 million tons.

Introduction

FTI Consulting, Inc. was retained by Starwood Energy Group Global, LLC (“Starwood”) to assess the CO₂ reduction cost savings that would occur if two Starwood-owned coal plants — Logan and Chambers — located in New Jersey were to retire by the end of 2020 (“L&C Retirements”) as originally proposed. Logan and Chambers each operates under a long-term PPA with ACE. Starwood would pay the PPA Counterparty \$7.5 million to retire both plants by the end of 2020, with the PPA obligations to be fulfilled with replacement power and capacity from the PJM wholesale market for the remaining term and for the same economic cost to ACE as under the existing PPAs. FTI’s analysis compares the cost of CO₂ reduction associated with the proposed retirement of Logan and Chambers to the cost of achieving the same amount of CO₂ reduction under other state programs designed to reduce CO₂ emissions by incentivizing the continued development and operation of carbon-free generation resources.⁸ The alternative CO₂ reduction programs evaluated include:

- **Zero Emission Certificate (“ZEC”)** for nuclear generation resources in New Jersey
- **Offshore Wind Renewable Energy Certificate (“OREC”)** program in New Jersey
- **Transition Renewable Energy Certificates (“TRECs”)** program for solar in New Jersey

The following sections of the white paper examine and compare the costs borne by ratepayers to achieve the same amount of net CO₂ reductions under each alternative, as well as the environmental, social, and economic benefits of the L&C Retirements.

Logan and Chambers Coal-fired Power Plants

The Logan and Chambers coal-fired power plants were placed in service in 1994, interconnecting to the PJM market. Both plants were built as “qualifying facilities” under the Public Utility Regulatory Policies Act (“PURPA”) given their cogeneration characteristics — they sell steam and electricity to two industrial counterparties.⁹

Logan is located in Logan Township, Gloucester County, and has an operating capacity of 219 megawatts (“MW”). It is 100 percent owned by Starwood and has a 30-year PPA with ACE that expires in December 2024. ACE is a wholly owned subsidiary of Exelon Corporation.

Chambers is located in Carneys Point Township, Salem County, and has an operating capacity of 262 MW. It is jointly owned by Starwood and Atlantic Power Corp. and has a 30-year PPA with ACE that expires in March 2024. Table 1 summarizes the ownership structure and PPA terms of both plants.

⁸This study focuses on the CO₂ emissions, though L&C Retirements will also have a disproportionately high concentration of other environmental benefits such as sulfur dioxide (SO₂) and nitrogen oxide (NO_x) emission reductions.

⁹<https://www.energy.gov/oe/services/electricity-policy-coordination-and-implementation/other-regulatory-efforts/public>

Table 1: Logan and Chambers Ownership and PPA Summary

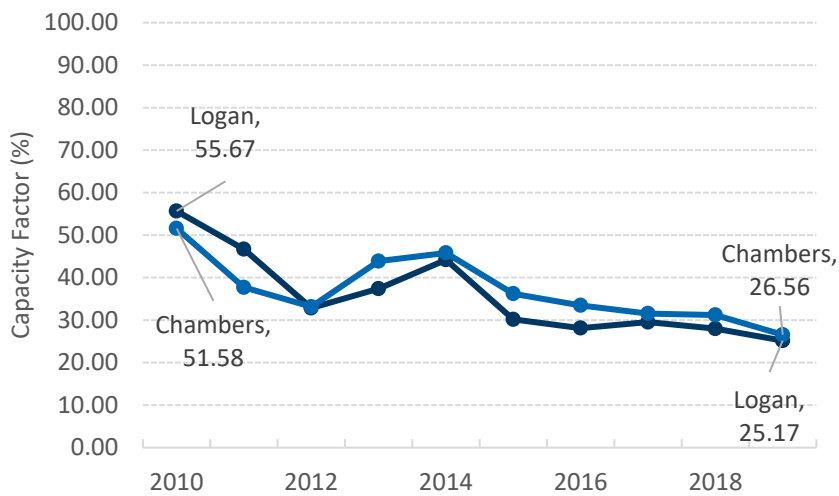
	Ownership	Percentage
Logan	Starwood Energy	100%
Chambers	Starwood Energy	60%
	Atlantic Power Corporation	40%

	PPA Counterparty	Start	End	Term (Years)	PPA Capacity (MW)
Logan	Atlantic City Electric Company	Dec 1994	Dec 2024	30	200
Chambers	Atlantic City Electric Company	Mar 1994	Mar 2024	30	184

Source: Starwood

As shown in Figure 1, in 2019, Logan and Chambers ran 25 percent and 27 percent of the time, respectively, slightly above the minimum take obligations of 50 MW for Logan and 46 MW for Chambers, per the PPAs’ terms. Those contractual minimum take obligations set a practical floor on the projected generation levels of both plants through to the expiration of the PPAs and serve as the basis for a conservative assumption of future production for both plants.

Figure 1: Logan and Chambers Annual Capacity Factor During 2010-2019



Source: Starwood

Table 2 summarizes the key operating parameters for Logan and Chambers in 2019. Logan and Chambers collectively emitted 1.67 million tons of CO₂ in 2019, representing approximately 8 percent of total greenhouse gas emissions from the power sector in New Jersey.¹⁰ Retiring both plants by the end of 2020 will cease their operations and their carbon emissions. This is significant, especially considering that New Jersey’s average CO₂ emissions in 2019 have increased from 2018 levels, according to a PJM report.¹¹

¹⁰ State of New Jersey, Department of Environmental Protection, 2018 Statewide Greenhouse Gas Emissions Inventory.

¹¹ PJM, 2019 New Jersey State Infrastructure Report, page 4, <https://www.pjm.com/-/media/library/reports-notices/state-specific-reports/2019/2019-new-jersey-state-infrastructure-report.ashx?la=en>.

Table 2: Logan and Chambers Operation and Emission Profiles in 2019

	Capacity	Net Generation	Capacity Factor	Generation Costs	Heat Rate	CO ₂ Emission
	MW	MWh	%	\$/MWh	Btu/KWh	tons
Logan	219	482,817	25%	79	12,290	680,064
Chambers	262	554,931	27%	108	13,700	985,119
Total	481	1,037,748				1,665,183

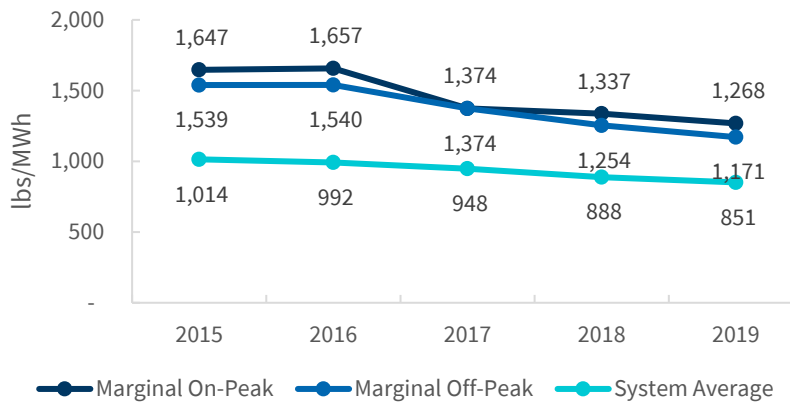
Source: Starwood

Overview of CO₂ Reduction Measures and Costs in PJM

CO₂ Emission Rates and Reduction Measures in PJM

Federal and state policies, regulations, legislation and subsidies have made significant impacts across the PJM footprint of 13 states and the District of Columbia. CO₂ emission rates in PJM have steadily declined, reaching a system average rate of 851 pounds per megawatt hour (“lbs/MWh”) in 2019, as shown in Figure 2, compared to 1,014 lbs/MWh in 2015. The decline in the emissions rate is a result of several factors, including the retirements of aging coal plants and the significant growth in the contribution from renewable resources.

Figure 2: PJM Marginal and Average CO₂ Emission Rates



Source: PJM 2015–2019 CO₂, SO₂ and NO_x Emission Rates

Federal production tax credits and investment tax credits for renewables have acted as significant drivers of renewable additions in PJM. State-level legislative programs in PJM states, such as Renewable Portfolio Standards (“RPS”), have also driven renewable additions through the issuance of Renewable Energy Credits (“RECs”). States have pursued further emissions reductions through mandated clean energy goals. To meet these goals in the power sector, some PJM states have created incentive programs that have: (1) allowed certain nuclear plants to remain in operation by receiving an additional revenue stream; (2) developed offshore wind targets and funding programs; and (3) set solar carve-outs within the RPS goals.

Nuclear

In PJM, nuclear power generation facilities are not RPS-qualifying resources and therefore are ineligible to receive RECs. Some PJM states, such as Ohio, New Jersey and Illinois, have established ZEC procurement mechanisms to recognize the environmental attributes of nuclear as a major source of power with no CO₂ emissions, thereby preserving economically at-risk nuclear generation facilities.

New Jersey established its ZEC program to maintain the state’s nuclear fleet. The New Jersey ZEC represents the “fuel diversity, air quality, and other environmental attributes of one MWh of electricity generated by an eligible nuclear power plant selected by the New Jersey Board of Public Utilities (“NJBP”) to participate in the program.”¹²

In April 2019, NJBP awarded three-year ZECs valued at up to \$300 million annually to the 1,291-MW Hope Creek and 2,340-MW Salem (unit 1 and 2) nuclear generating stations.¹³ The initial eligibility period ran from April 18, 2019 through May 31, 2019, plus an additional three energy years, from June 1, 2019 through May 31, 2022.¹⁴

The state’s electric distribution companies — Atlantic City Electric Company, Jersey Central Power & Light Company, Public Service Electric and Gas Company, Rockland Electric Company, and Butler Electric Utility — are authorized to collect a statutorily mandated rate of \$0.004 per kilowatt hour from the retail customers to fund ZEC payments. Eligible nuclear units are selected until the combined nuclear procurement reaches 40 percent of the total retail sales. As such, the New Jersey ZEC is valued at \$10 per MWh.¹⁵

Offshore Wind

New Jersey plans to procure 7.5 GW of offshore wind (“OSW”) by 2035, a goal that, if realized, would contribute to approximately 50 percent of the state’s electricity needs.¹⁶ The NJBP manages the Offshore Wind Renewable Energy Certificate (“OREC”) program, which grants OSW projects the right to sell, and electric power suppliers the obligation to buy, the ORECs generated by the OSW project. The all-in OREC prices include energy, capacity, and environmental attributes of electricity.

In 2019, as result of the state’s first solicitation, NJBP awarded Ørsted for the 1.1 GW Ocean Wind project, which offers a first-year OREC price at \$98.10 per MWh in 2024, when the first project is expected to be operational, and a levelized OREC price of \$116.82 per MWh. The levelized OREC cost, net of expected energy and capacity revenues, is estimated at \$46.46 per MWh.¹⁷

¹² NJBP, <https://www.bpu.state.nj.us/bpu/pdf/boardorders/2019/20190710/7-10-19-9C.pdf>, pages 1-2.

¹³ Hope Creek is 100 percent owned by PSEG Nuclear LLC. Salem Unit 1 and 2 are jointly owned by PSEG Nuclear LLC (57.41 percent ownership interest) and Exelon Generation Company LLC (42.59 percent ownership).

¹⁴ NJBP, <https://www.bpu.state.nj.us/bpu/pdf/boardorders/2019/20190710/7-10-19-9C.pdf>, page 4.

¹⁵ NJBP, https://www.nj.gov/rpa/docs/EO18080899_ZEC_Chang_Fagan_Certification_REDACTED.pdf.

¹⁶ State of New Jersey, “Governor Murphy Signs Executive Order to Increase Offshore Wind Goal to 7,500 Megawatts by 2035” <https://www.nj.gov/governor/news/news/562019/20191119b.shtml>.

¹⁷ NJBP, Docket No. Q018121289, <https://www.state.nj.us/bpu/pdf/boardorders/2019/20190621/6-21-19-8D.pdf>.

Solar

New Jersey's Energy Master Plan recommends that New Jersey install 12.2 GW of solar by 2030 and 17.2 GW by 2035, and that in-state solar provide 34 percent of the state's energy mix by 2050.¹⁸ New Jersey has administered the Solar Renewable Energy Certificate ("SREC") program since 2004, which has transitioned to the Transition Renewable Energy Certificates ("TRECs") program in 2020.

New Jersey's RPS requires load-serving entities to procure 50 percent of the electricity from renewable sources by 2030, with a solar carve-out of 5.1 percent by 2021. The SREC program allows solar projects to generate an SREC for each MWh of solar power produced. Load-serving entities must purchase enough SRECs to meet their solar carve-out requirement either through direct purchases or trading of SRECs. In 2019, the SREC program incentivized record-setting solar installations of 447 DC MW.¹⁹

In 2020, upon attaining the 5.1 percent milestone goal, NJBPU directed the closing out of the SREC program and the creation of a transition incentive program, which is composed of fixed-price, factorized TRECs. New Jersey offers a fixed compensation of \$152 per TREC (one MWh of production of utility-scale solar) for each year of an eligible project's 15-year Transition Incentive Qualification Life, which is 15 years following the commencement of commercial operations.²⁰ After the 15 years, projects may be eligible for a New Jersey Class I REC, incurring potential additional ratepayer costs.²¹

Comparative Analysis of CO₂ Emissions Reduction Costs

In summary, states have used a range of programs to reduce CO₂ emissions. The CO₂ emissions reduction costs have shown a wide range of costs of reducing the same amount of CO₂ as would result from the retirements: \$24 per ton for New Jersey ZEC, \$75 per ton for the New Jersey ORECs, and \$240 per ton for the New Jersey TRECs, as shown in Figure 3. Table 3 summarizes the alternative CO₂ reduction program costs.

In comparison, to achieve the same reductions, the Logan and Chambers retirements have an estimated \$2 per ton benefit (i.e., the opposite of a cost) to ratepayers enabled by the \$7.5 million payment from Starwood, in addition to avoided CO₂ emission reduction costs ranging from \$24 per ton to \$240 per ton, based on the costs of alternative programs that are currently in place in New Jersey.

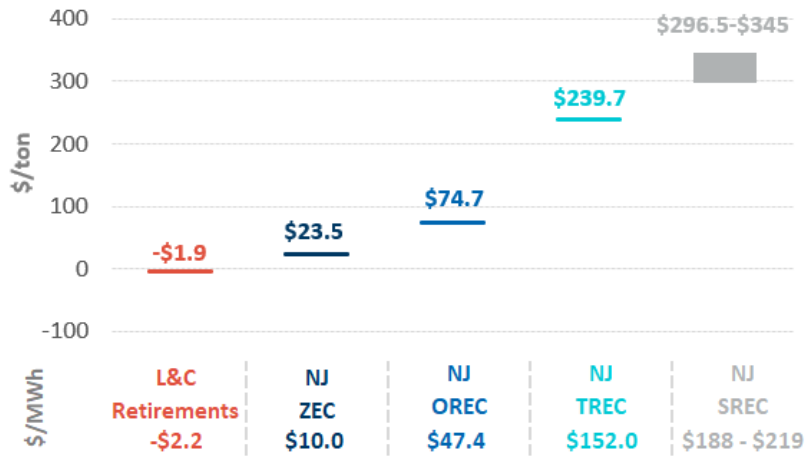
¹⁸ State of New Jersey, 2019 New Jersey Energy Master Plan, page 124 and Figure 16, https://www.nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.

¹⁹ NJBPU, "NJBPU Announces Record-Setting Year for Solar Installations in New Jersey," https://www.state.nj.us/bpu/pdf/2019%20Solar%20Record%20Press%20Release_FINAL_032020.pdf.

²⁰ NJBPU, Docket No. QO19010068, <https://www.bpu.state.nj.us/bpu/pdf/boardorders/2020/20200309/3-9-20-8H.pdf>.

²¹ PJM-EIS describes the New Jersey Class I REC category as follows: "Renewable sources include solar technologies, photovoltaic technologies, wind energy, fuel cells powered by renewable fuels, geothermal technologies, wave or tidal action, methane gas from landfills, or a biomass facility, provided that the biomass is cultivated and harvested in a sustainable manner. As a result of S.B. 1925, Class I renewable energy also includes hydroelectric facilities of 3 MW or less that are located in NJ and placed in service after July 23, 2012 (the effective date of S.B. 1925)." <https://www.pjm-eis.com/program-information/new-jersey.aspx>.

Figure 3: Comparative CO₂ Emission Reduction Costs



Note: The L&C Retirements savings are calculated by dividing the negative of Starwood’s \$7.5 million payment by the avoided CO₂ emissions of 3.9 million tons. The NJ ZEC cost is based on NJBPU ZEC awards and is converted from \$/MWh to \$/ton based on 2019 average PJM CO₂ emission rates. NJ offshore wind credit is calculated based on NJBPU’s net cost of OREC at \$46.46 (in 2019 dollars) with 2 percent escalation. The NJ TREC is based on NJBPU order in 2020. The NJ SREC is based on the New Jersey SREC Trading Statistics Energy Year 2020 (July 2019 – June 2020). The NJ OREC, TREC, and SREC are converted from \$/MWh to \$/ton at the PJM 2019 marginal on-peak emission rate.

Table 3: New Jersey CO₂ Reduction Programs Costs

CO ₂ Reduction Programs	NJ ZEC	NJ OREC	NJ SREC	NJ TREC
Term	2019-2021	2024-2045	EY 2020	EY 2021
Estimated Costs (\$ million)	\$900	\$6,199	\$725	\$521
Estimated Production (GWh)	90,000	97,096	3,429	3,429

Note: The NJ ZEC costs are based on \$300 million per year for three years, which could potentially be re-applied for another three years. The NJ OREC costs account for the awarded contract, not including the ongoing and future solicitations. The NJ SREC costs are based on traded SRECS in Energy Year 2020 (July 2019 – June 2020). The NJ TREC program costs for EY 2021 are estimated assuming the same volume as NJ SREC for EY 2020.

Logan and Chambers Retirements

Value Proposition: Environmental and Ratepayer Impacts

In addition to the avoidance of CO₂ emissions and other intangible benefits of retirement, Starwood would pay \$7.5 million in total to the PPA Counterparty to retire both plants by the end of 2020, while the PPA obligations would continue to be fulfilled with replacement power and capacity from the PJM wholesale market for the remaining term and for the same economic cost to ACE as under the existing PPAs. The value proposition of Starwood’s offer can be summarized through the following environmental and economic metrics:

- **Elimination of 5.3 million tons of gross CO₂ emissions from 2021 to 2024** (line 2 in Table 4). The gross CO₂ emissions for Logan and Chambers through the expiration of their respective PPAs are calculated assuming that both plants operate at the contractual minimum take levels of their respective PPAs and using 2019 monthly emission rates as a proxy for their go-forward emission rates.²²
- **Avoided net CO₂ emissions of 3.9 million tons** (line 4 in Table 4), which are the gross CO₂ emissions of 5.3 million tons, net of the emissions of PJM replacement power, assumed at PJM 2019 average monthly CO₂ emission rates. To put this in perspective, reduction of 3.9 million tons of CO₂ is equivalent to taking 762,419 passenger vehicles

off the road for one year in New Jersey.²³ This represents a meaningful step in progressing towards New Jersey’s goal of cutting CO₂ emissions by 80 percent compared to 2006 levels.²⁴

- **Avoided CO₂ emissions costs range from \$91 million to \$925 million** (line 6 in Table 4). This is calculated by multiplying the avoided net CO₂ emissions of 3.9 million tons by the respective CO₂ reduction costs in \$/ton for New Jersey ZEC, OREC and TREC (line 5 in Table 4) to derive the total costs for each alternative to achieve the same amount of CO₂ reduction.
- **\$7.5 million incremental ratepayer benefit** created by Starwood’s proposed payment to the PPA Counterparty to be passed on to ratepayers (line 7 in Table 4). For the same amount of CO₂ reduction, Starwood’s offer of L&C Retirements and payment of \$7.5 million would translate into an estimated benefit of approximately \$2 per ton of avoided CO₂ emissions.²⁵
- **Estimated ratepayer cost savings of \$25 to \$242 per ton for L&C Retirements.** Retiring Logan and Chambers by the end of 2020 would lead to 3.9 million net tons of avoided CO₂ emissions through 2024 (line 5 in Table 4). Offsetting the same level of CO₂ emissions using other programs would cost New Jersey ratepayers \$91 million to \$925 million (line 6 in Table 4). When considering the benefit payment of \$7.5 million that would go back to ratepayers (line 7 in Table 4), the full opportunity cost of achieving the reductions through the retirements versus the alternative programs would be \$98 million to \$932 million (line 8 in Table 4), or \$25 to \$242 per ton (line 9 in Table 4).

The projected ratepayer cost savings as summarized in Table 4 are conservative, due to the following key assumptions applied in the analysis.

- **Generation at minimum take levels of the PPAs for both plants.** If either power plant is dispatched during peak periods in excess of these minimum levels — as has been observed historically — and ends up running at higher capacity factors, the CO₂ emissions will be higher than estimated.
- **Flat emission rate for PJM replacement power.** In reality, the PJM system-average CO₂ emission rates have shown a steady decline year-over-year from 2015 to 2019, as shown in Figure 2 — a trend that is likely to persist due to continued addition of renewables and retirement of coal resources. If we assume a declining emission rate for PJM replacement power in the analysis, the avoided CO₂ emission will be higher, because the offset associated with emissions from replacement power will be lower.
- **No operations after the PPAs’ expiration.** Our analysis assumed that both plants will not operate beyond the PPAs’ expiration dates, although both plants are permitted to operate until the end of their useful lives — which could be at least an additional 10 years after 2024. The recent operating performance of the plants suggests the plants could continue to operate reliably. Assuming a longer period of operations would increase avoided CO₂ emissions and ratepayer savings.

²² Appendix A provides annual generation, capacity factor, and emissions of Logan and Chambers, as well as the replacement power from PJM.

²³ Based on United States Environmental Protection Agency’s estimates, a typical passenger vehicle emits about 4.6 metric tons of CO₂ per year.

²⁴ The New Jersey Global Warming Response Act of 2007 (GWRA), N.J.S.A. 26:2C-37.

²⁵ The L&C Retirements direct savings are calculated by dividing the negative of Starwood’s payment of \$7.5 million by the avoided net CO₂ emissions of 3.9 million tons.

Table 4: Ratepayer Savings of the Starwood Offer

Logan and Chambers Retirements CO ₂ Reduction Costs Savings (2021-2024)				
[1] Logan and Chambers Generation	MWh	3,442,426		
[2] Logan and Chambers Gross CO ₂ Emissions	ton	5,321,857		
[3] Replacement Power CO ₂ Emissions	ton	1,464,017		
[4] Avoided Net CO ₂ Emissions	ton	3,857,839		
		Alternative Reduction Programs		
		NJ ZEC	NJ OREC	NJ TREC
[5] CO ₂ Emissions Reduction Alternative Program Costs	\$/ton	23.5	74.7	239.7
[6] CO ₂ Emissions Reduction Alternative Program Costs	\$ million	90.7	288.4	924.9
[7] L&C Retirements Proposed Starwood Payment	\$ million	7.5	7.5	7.5
[8] L&C Retirements Total Ratepayer Savings	\$ million	98.2	295.9	932.4
[9] L&C Retirements Total Ratepayer Savings	\$/ton	25.4	76.7	241.7

Note: The total generation, CO₂ emissions, and savings are for the period of January 2021 to December 2024 for Logan and to March 2024 for Chambers. The generation levels are based on estimates provided by Starwood and reflect minimum take levels of the PPAs. The CO₂ emissions are based on 2019 monthly emission rates. The avoided CO₂ emissions are the total CO₂ emissions net of replacement power emissions, which are assumed at PJM 2019 average monthly CO₂ emission rates. The CO₂ emissions costs are based on \$/ton costs presented in Figure 3. The total CO₂ emissions savings and total ratepayer savings are undiscounted nominal amounts during 2021-2024. Total ratepayer savings in \$/ton is calculated by dividing total ratepayer savings (line 8) by avoided CO₂ emissions (line 4).

Other Benefits

Starwood’s offer to retire Logan and Chambers directly supports New Jersey’s plan to transition to 100 percent clean energy by 2050 and to reduce state greenhouse gas emissions 80 percent below 2006 levels by 2050.²⁶ Retiring both coal plants early is economically and environmentally aligned with the interests of New Jersey ratepayers and its economy. These benefits could be further explained in the context of New Jersey’s rejoining of the Regional Greenhouse Gas Initiative (“RGGI”), the intangible benefits of repurposing the sites for potential renewable energy infrastructure development, and the avoidance of externalities associated with the coal value chain.²⁷

RGGI Benefits

On June 17, 2019, New Jersey rejoined RGGI, a market-based program of the New England and Mid-Atlantic states to reduce greenhouse gas emissions from the power sector. Based on the “Investment of RGGI Proceeds in 2018” report, the benefits from RGGI investments included energy efficiency, clean and renewable energy, direct bill assistance and greenhouse gas abatement. RGGI investments in 2018 are estimated to return \$2 billion in lifetime energy bill savings and avoid 4.6 million tons of CO₂ emissions. Logan and Chambers are among the 36 power plants in New Jersey that are currently regulated under RGGI.²⁸ The June 3, 2020 RGGI auction for the 2018-2020 compliance period cleared at \$5.75 per ton.²⁹ However, as legacy PURPA assets, Logan and Chambers are subject to CO₂ costs that are capped at \$2 per ton for MWhs generated under the PPAs.³⁰

Sites Redevelopment Opportunities

L&C Retirements will open doors for potential redevelopment opportunities for renewables and/or battery storage projects, especially in light of New Jersey’s mandates of 2.5 GW battery storage by 2035.³¹ Logan’s waterfront site provides the potential for use as an offshore wind interconnection hub, staging area and/or manufacturing support

facility. If PJM interconnection capacity at the project nodes is released as a result of the proposed retirements, it may allow offshore wind projects new interconnection points into New Jersey. The potential for use as an offshore wind interconnection hub directly aligns with New Jersey’s goal of having 7.5 GW of OSW in operations by 2035.³²

Avoidance of Externalities

According to the “Full Cost Accounting for the Life Cycle of Coal” study published by Epstein et al. in 2011, “*each stage in the life cycle of coal—extraction, transport, processing, and combustion—generates a waste stream and carries multiple hazards for health and the environment.*”³³ The study estimated that the externalities, when normalized to a \$/MWh of electricity basis, are equivalent to \$178.4 per MWh, ranging from \$94.2 per MWh to \$268.9 per MWh.³⁴ Assuming a conversion rate of 1.105 ton of CO₂ per MWh of electricity, the externalities’ costs average \$161 per ton.³⁵ These are potential costs to society that are not explicitly captured in the price of electricity.

²⁶ The New Jersey Global Warming Response Act of 2007 (GWRA), N.J.S.A. 26:2C-37.

²⁷ <https://www.rggi.org/>

²⁸ The Regional Greenhouse Gas Initiative, “The Investment of RGGI Proceeds in 2018,”

https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2018.pdf.

²⁹ See Regional Greenhouse Gas Initiative, “Auction Results,” <https://www.rggi.org/auctions/auction-results> (Accessed August 12, 2020).

³⁰ Based on information provided by Starwood.

³¹ State of New Jersey, 2019 New Jersey Energy Master Plan, page 13.

³² State of New Jersey, 2019 New Jersey Energy Master Plan, https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.

³³ Paul R. Epstein, Jonathan J. Buonocore, Kevin Eckerle, Michael Hendryx, Benjamin M. Stout III, Richard Heinberg, Richard W. Clapp, Beverly May, Nancy L. Reinhart, Melissa M. Ahern, Samir K. Doshi, and Leslie Glustrom. 2011. Full cost accounting for the life cycle of coal in “Ecological Economics Reviews.” Robert Costanza, Karin Limburg & Ida Kubiszewski, Eds. Ann. N.Y. Acad. Sci. 1219: 73–98.

³⁴ The externalities include land disturbance, methane emissions from mines, carcinogens, public health burden of communities in Appalachia, fatalities in the public due to coal transport, emissions of air pollutants from combustion, lost productivity from mercury emissions, excess mental retardation cases from mercury emissions, excess cardiovascular disease from mercury emissions, climate damage from combustion emissions of CO₂, N₂O and black carbon.

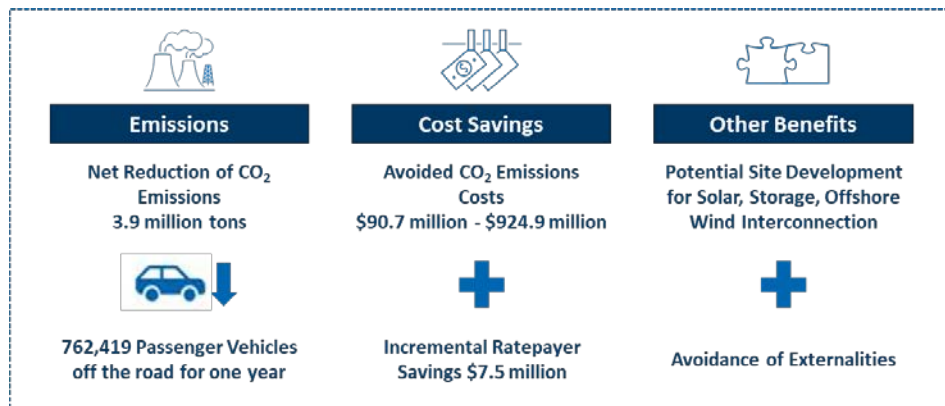
³⁵ Conversion is derived from EPA resources. <https://www.eia.gov/tools/faqs/faq.php?id=74&t=11>.

Summary Findings

Our comparative analysis of Starwood’s proposal to retire Logan and Chambers by the end of 2020 shows compelling attributes in terms of environmental benefits, ratepayer impacts, economic opportunities, and avoidances of externalities, as shown in Figure 4.

- L&C Retirements would eliminate 5.3 million tons of CO₂ emissions at the sources of the power plants during 2021-2024. This directly supports the state’s goal of cutting CO₂ emissions by 80 percent compared to 2006 levels.
- After factoring in the estimated emissions due to the replacement power from the PJM wholesale market, L&C Retirements would avoid net CO₂ emissions of 3.9 million tons by 2024, assuming a flat emission rate at the 2019 PJM system level for the replacement power. This is equivalent to taking 762,419 passenger vehicles off the road for one year in New Jersey.
- New Jersey ratepayers would benefit from cost savings ranging from \$98 million to \$932 million by achieving the net CO₂ reduction of 3.9 million tons under Starwood’s proposal rather than under alternative programs such as ZEC, OREC, and TRECs.
- Retiring the coal plants opens the opportunity to explore potential site redevelopment opportunities for solar, battery, or offshore wind interconnections, which are aligned with goals set in New Jersey’s 2019 Energy Master Plan.³⁶
- The Starwood offer eliminates other potential externalities that could occur along the coal value chain, but are not explicitly captured in the cost of electricity.

Figure 4: Summary of Starwood Offer Impacts



Source: FTI analysis

³⁶State of New Jersey, 2019 Energy Master Plan, https://nj.gov/emp/docs/pdf/2020_NJBPU_EMP.pdf.

Appendix A: Logan and Chambers Operations and Emissions

Starwood Global - Economic Analysis

Logan and Chambers Retirement

		2021	2022	2023	2024	Total	Notes
Logan							
Production	MWh	497,054	497,054	497,054	497,054	1,988,216	Annual generation during 1/1/2021 - 12/31/2024, provided by Starwood
Capacity Factor	%	25.9%	25.9%	25.9%	25.9%	25.9%	Calculated based on 219 MW capacity
Emissions Rate	lb/MWh	2,820	2,820	2,820	2,820	2,820	Monthly emissions are based on 2019 actual monthly emission / net generation
Annual Emissions	tons	700,919	700,919	700,919	700,919	2,803,675	Production * emission rates / 2,000 (lbs/ton), calculated at monthly level
Chambers							
Production	MWh	442,529	442,529	442,529	126,623	1,454,210	Annual generation during 1/1/2021 - 3/31/2024 provided by Starwood
Capacity Factor	%	19.3%	19.3%	19.3%	22.4%	19.5%	Calculated based on 262 MW capacity
Emissions Rate	lb/MWh	3,488	3,488	3,488	3,205	3,463	Monthly emissions are based on 2019 actual monthly emission / net generation
Annual Emissions	tons	771,756	771,756	771,756	202,915	2,518,182	Production * emission rates / 2,000 (lbs/ton), calculated at monthly level
Total							
Production	MWh	939,583	939,583	939,583	623,677	3,442,426	Logan and Chambers total production
Capacity Factor	%	22.30%	22.30%	22.30%	25.10%	22.8%	Calculated at 219 MW for Logan and 262 MW for Chambers
Emissions Rate	lb/MWh	3,135	3,135	3,135	2,898	3,092	Logan and Chambers total emission divided by total production
Annual Emissions	tons	1,472,675	1,472,675	1,472,675	903,833	5,321,857	Logan and Chambers total emission
Less: Replacement Capacity							
Production	MWh	939,583	939,583	939,583	623,677	3,442,426	Logan and Chambers total production to be replaced
Emissions Rate	lb/MWh	850	850	850	855	851	Based on 2019 PJM system average monthly CO ₂ emission rates
Annual Emissions	tons	399,090	399,090	399,090	266,748	1,464,017	Production * Emission Rates / 2,000 (lbs/ton), calculated at monthly level
Net Emissions Impact	tons	1,073,585	1,073,585	1,073,585	637,085	3,857,839	Logan and Chambers total emission net of replacement total emissions

Appendix B: Summary of Comparative Analysis

Starwood Global - Economic Analysis

Comparative Analysis

Implied Costs			Notes
NJ ZEC	\$/MWh	10.0	NJBPU
NJ OREC	\$/MWh	47.4	NJBPU's net cost of OREC at \$46.46 (in 2019 dollar), escalated by 2 percent
NJ TREC	\$/MWh	152.0	NJBPU
NJ SREC	\$/MWh	211.5	NJ SREC weighted average price for Energy Year 2020 (July 2019 - June 2020)
NJ ZEC	\$/ton	23.5	NJ ZEC costs are converted from \$/MWh to \$/ton based on 2019 average PJM CO ₂ emission rates.
NJ OREC	\$/ton	74.7	NJ OREC cost is converted at the PJM 2019 marginal off-peak emission rate.
NJ TREC	\$/ton	296.5	NJ TREC is converted at the PJM 2019 marginal on-peak emission rate.
NJ SREC	\$/ton	333.6	NJ SREC is converted at the PJM 2019 marginal on-peak emission rate.
NJ ZEC			
Period		2019-2021	
ZEC Price	\$/MWh	10.0	NJBPU
Nuclear Production	MWh	90,000,000	Estimated 3-year total costs, divided by ZEC price
Cost to Ratepayers	\$ million	\$900	Estimated at \$300 million per year based on NJBPU award
NJ OREC			
Period		2024-2045	
OREC Price	\$/MWh	47.4	NJBPU's net cost of OREC at \$46.46 (in 2019 dollar), escalated by 2 percent
OSW Production	MWh	97,096,239	MWh to be delivered under the awarded contract, not including ongoing & future solicitations
Cost to Ratepayers	\$ million	\$6,199	Net OREC escalated at 2 percent per year
NJ TREC			
Period		Energy Year 2021	NJBPU
TREC Price	\$/MWh	152	NJBPU
TREC Volume	MWh	3,428,564	Assumed same level as NJ SRECs in Energy Year 2020.
Cost to Ratepayers	\$ million	\$521	Total estimated costs for Energy Year 2021.
NJ SREC			
Period		Energy Year 2020	
SREC Price	\$/MWh	211.5	NJ SREC weighted average price for Energy Year 2020 (July 2019 - June 2020)
SREC Volume	MWh	3,428,564	Total traded SRECs in Energy Year 2020
Cost to Ratepayers	\$ million	\$725	Total SREC costs for Energy Year 2020

Glossary

Lbs/MWh: pounds per megawatt hour

MWh: megawatt hour

NJBPU: New Jersey Board of Public Utilities

OREC: Offshore Wind Renewable Energy Certificate

PPA: Purchase Power Agreement

PURPA: Public Utility Regulatory Policies Act

REC: Renewable Energy Credit

RGGI: Regional Greenhouse Gas Initiative

RPS: Renewable Portfolio Standard

SREC: Solar Renewable Energy Certificate

TREC: Transition Renewable Energy Certificate

ZEC: Zero Emission Certificate