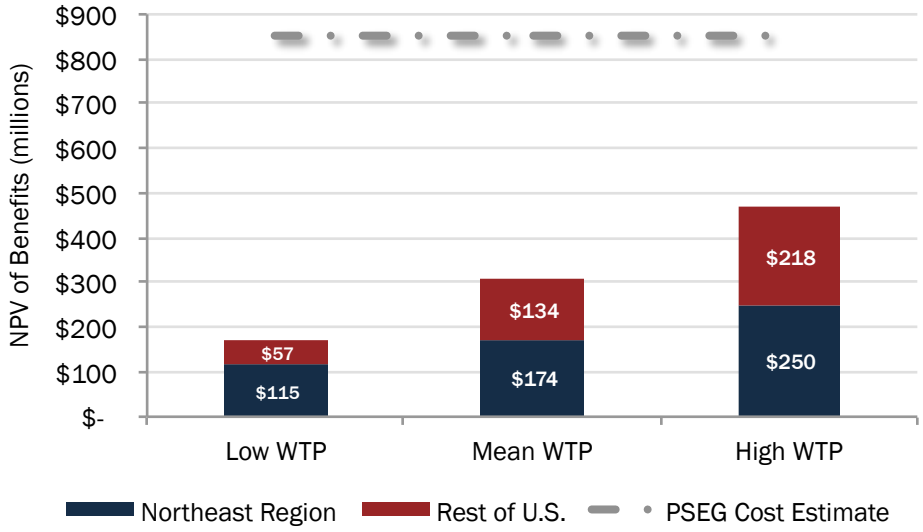
Figure 5. Monetized NPV Benefit Estimates, based on the EPA Survey



Source: ECONorthwest based on data from the EPA Survey

Discounting is included for benefits and costs over time to account for differences in preference regarding when a cost or benefit occurs. Receiving a benefit earlier than later often means opportunities to build on that benefit, and costs that occur earlier than later tend to have greater burden because of opportunity costs of the money (e.g. other investment opportunities) and related factors. For fish populations though, there might not always be strong reasons to prefer earlier benefits than later. In fact, a more uniform distribution of benefits over time, for population and general ecological stability, might be the most preferable. Convention holds to include discounting for calculation of net present values, but if the above benefit streams were not discounted, the total benefits over 20 years would range from $205 to $558 million. Furthermore, while the *EPA Survey* is designed for a 20 year timeframe, benefits of the capital investments for the Project Scenario would certainly continue beyond that range and in an undiscounted calculation could more than double the benefits.

4.1.3 Habitat Replacement Cost Estimates

Courts have shown a preference for market-based values when awarding compensation for damages, even when associated with natural resources. From this impetus and others, Habitat Equivalency Analysis was developed to identify the total restoration of ecological function necessary to fully compensate society on net for damages.[36] Typically the approach is used for consideration of damages that have already occurred. Applying it to ongoing future damages presents challenges. While the full details of the analysis are not available, NPDES permit support documentation for the nearby Delaware City Refinery and Power Plant (DCR) did

[36] National Oceanic and Atmospheric Administration. Habitat Equivalency Analysis. https://www.darrp.noaa.gov/economics/habitat-equivalency-analysis.

include a brief estimation of the restoration costs to offset losses from once-through cooling at the facility.[37]

The DCR has annual total I&E adult mortality of 1.8 million organisms. This is half of one percent of annual total adult mortality at Salem. Still, the Habitat Replacement Cost for DRC is estimated at $429 million (2011 dollars). This estimate is based on an assumption of restoration costs of $2023 per acre. There are several factors that suggest the equivalent habitat replacement costs for Salem would be greater, including:

- It is unlikely that sufficient restoration opportunities would exist for such a massive offset in Delaware Bay. If there were, diminishing returns would dictate that costs per acre would climb, and benefits per acre would likely decline with increasing total acreage involved.
- With such a sizable restoration effort, there would likely be extensive restoration project failures that would increase costs or increase the total acreage requirement over the project lifespan. Failures would be known and unknown (unperceived).
- It is likely infeasible to find extensive sites with no habitat function currently, and that means technically exist to restore such sites to full habitat production potential.

The habitat replacement cost estimates for DRC, if even remotely correct, combined with the orders of magnitude of greater total mortality for Salem, and the confounding factors that would further increase costs, suggest that a Habitat Equivalency Analysis or Habitat Replacement Cost approach for estimating benefits of the Project Scenario at Salem would generate much higher value estimates than either of the reported methods above. Such a calculation would likely drive benefit estimates into the billions of dollars.

4.1.4 Unquantified Benefits

The benefit estimates presented here amount to roughly half of the estimated total cost of installing closed cycle cooling systems at Salem. However, we emphasize that these estimates reflect only the readily quantifiable and monetizeable benefits, which represent an unknown portion of total benefits. Unquantified benefits, described in this section, further narrow this gap.

Benefits from Reduced Thermal Pollution

Thermal pollution from Salem's intakes is likely to induce additional fish mortality, especially during the warm summer months. Effluent from Salem regularly exceeds the Delaware River Basin Commission's water quality regulations for temperature (see section 3.2). Thermal impacts from Salem occur during seasons of particular importance for critical life stages, and temperatures within the plume exceed thresholds for the spawning of federally-listed species

[37] State of Delaware Division of Water Resources. 2011. *BTA Determination – NPDES Permit Requirements For Cooling Water Intake and Discharges at Delaware City Refinery and Power Plant (DCR). Fact Sheet, Attachment A*. Pgs. 7, 49.

including Shortnose sturgeon and Atlantic sturgeon. Other important species have similar potential effects of elevated water temperatures including American shad, white perch, and striped bass. Temperatures are also outside of optimal for other life stages of these fish species as well as channel catfish, bluegill and others. Heightened temperature can stress species and, even when this stress does not directly lead to mortality, it can contribute to reduced overall population fitness.[38]

By and large, the literature describing the effects of thermal plumes on aquatic organisms uses qualitative terms rather than site-specific quantitative estimates. After reviewing the literature, we have found one study reporting plume-related fish deaths at the Oyster Creek Nuclear Generation Station (Oyster Creek), along Barnegat Bay in New Jersey.[39] From 1972–1982, researchers at Oyster Creek recorded an average of 240,450 plume-related fish deaths, per year. The average annual impingement at Oyster Creek from 1975–1977 was about 6.5 million aquatic organisms.

Operational Benefits

Installation of closed-cycle cooling at Salem would introduce several operational advantages, including fewer reactor shutdowns due to clogged intakes, as well as reduced need for maintenance dredging.[40]

Benefits Associated with Increased Survival of Forage and Juvenile Fish

Economic valuation of I&E losses is complicated by the lack of market value for forage species, which, in the case of Salem, comprise a large proportion of total losses. Bay anchovy have no direct market value, but nonetheless form a critical component of estuarine food webs. While the EPA included forage species impacts in its economic benefits calculations, the final estimates likely underestimate the full value of the losses imposed by I&E.[41]

As stated previously, only 3.3 percent of total baseline A1E mortality in the Delaware Estuary can be assigned a direct use value from recreational or commercial fishing.[42] According to a review of the environmental impacts caused by power plant cooling water intake structures in California, entrained and impinged species also *"…provide many other ecosystem services of value to humans. In addition to their importance in providing food and other goods of direct use to humans, the organisms lost to impingement and entrainment are critical to the continued functioning of the ecosystems of which they are a part. Examples of ecological and public services potentially disrupted by*

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[38] E.g., McBryan, T. L., et al. "Responses to temperature and hypoxia as interacting stressors in fish: implications for adaptation to environmental change."*Integrative and comparative biology* 53.4 (2013): 648-659.

[39] Samson, J. and N. Simmons. 2005. *Position Paper on Oyster Creek Nuclear Generation Station's Cooling Water System.*

[40] See, for example, Gallo, B. 2011. '*Salem 1 nuclear reactor taken offline again because of Delaware River 'grassing' clogging cooling water intake'*. South Jersey Times. Available online at: http://www.nj.com/salem/index.ssf/2011/04/salem_1_reactor_taken_offline.html

[41] EPA Benefits Analysis. Page C2-3.

[42] EPA Benefits Analysis. Page 3-8.

impingement and entrainment losses but not addressed by commercial and recreational fishing valuations include…:

- *disruption of public uses other than fishing, such as diving and nature viewing*
- *disruptions of ecological niches and ecological strategies used by aquatic species*
- *disruptions of organic carbon and nutrient transfer through the food web*
- *alterations of food web structure*
- *decreased local biodiversity*
- *disruption of predator-prey relationships*
- *disruption of age class structures of species because a disproportionate number of eggs, larvae, and juveniles are lost*
- *disruption of public satisfaction with a healthy ecosystem.*

Many of these services are provided by the early life stages lost to impingement and entrainment, and can be maintained only by the continued presence of these life stages in their natural habitats. For example, aquatic food webs require orders of magnitude more organisms in the lower trophic levels to support harvested species and other top level consumers…"[43]

Additionally, stated preference studies, if interpreted as representing the total economic value, rely upon the knowledge and survey context education of respondents to consider secondary effects. For example, fish saved are likely to have additional trophic effects in terms of support for other species.[44] There might be important cultural significance to certain communities of the fish saved or trophic effects, and those benefits might be relevant to respondents not bearing those benefits directly themselves. In short, such a study for practical reasons is limited to the set of benefits respondents are aware of or can be made aware of during the survey process. Uncertainties in secondary effects make discrete specification of these effects difficult, but there are likely to be some.

At an ecosystem-scale, the benefits offered by PSEG for commercial and recreational fishing, and the fish-specific benefits of the *EPA Survey* do not comprehensively capture the benefits to the regional ecosystem of maintaining the important resources and actors provided under the Project Scenario. As scientific understanding improves of ecological linkages and interdependencies in the Delaware Bay, particularly as society sees unintended consequences of

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[43] Strange, E., D. Allen, D. Mills, and P. Raimondi. 2004. *Research on Estimating the Environmental Benefits of Restoration to Mitigate or Avoid Environmental Impacts Caused by California Power Plant Cooling Water Intake Structures*. Stratus Consulting, Inc. California Energy Commission, PIER Energy-Related Environmental Research. 500-04-092. Available online at:
http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/diablo_canyon/docs/09_09_05_staff_report/item15_attachment5.pdf

[44] Desmond Kahn, Ph.D (retired, Delaware Division of Fish and Wildlife) personal communication. September 8, 2015.

declines in particular elements such as sturgeon, new categories of benefits will likely come to light that would be provided by the Project Scenario.

Potential Benefits Associated with Endangered Species

Two endangered sturgeon species (Atlantic & Shortnose) and three threatened or endangered turtle species (Kemp's Ridley sea turtle; Green sea turtle, and the Loggerhead sea turtle) are harmed by Salem's operations under the Baseline Scenario. In its 2014 biological opinion on Salem's reactor site operations, the National Marine Fisheries Service concluded that the site is "likely to adversely affect but not likely to jeopardize continued existence" of these species. Despite this finding, a certain level of annual mortality for each of these species is still expected and (to a certain extent) allowed at Salem.

For example, between 1978 and 2010 an estimated 71 sea turtles were impinged or entrained at Salem, with an annual value of 0 to 6 turtles killed a year.[45] These E&I rates are also subject to the same year-to-year variability that we observe for other species; for example, in the first half of 2014, rates of E&I of endangered Shortnose sturgeon were four times higher than rates predicted in the 2014 NMFS Bi-Op cited above. Additionally, two Kemp's Ridley sea turtles were taken over the same period, compared with a predicted one every three years.[46] Due to low population sizes, even low levels of E&I can represent a substantial portion of the annual reproduction of these populations – lengthening recovery time, or hastening the demise of the population and the species as a whole.[47]

The Project Scenario would help to alleviate many of the adverse effects on endangered and threatened species. While the *EPA Survey* considers the potential value associated with fish and aquatic ecosystems, it does not attempt to tease out additional value associated with preventing harm to endangered or threatened species. Passive use values are of particular relevance for rare species, and all else being equal, people are willing to pay to protect organisms of endangered species, and typically are willing to pay more than for abundant species.[48] The *EPA Survey* does not address the benefits of reducing mortality for endangered species, and PSEG in no way addresses these values. A complete economic analysis of the Project Scenario requires information sufficient to more precisely describe the effects of once-through cooling at Salem on listed species.

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[45] NMFS and USFWS. 2014. *Endangered Species Act Section 7 Consultation Programmatic Biological Opinion*. Page 27. Available online at: http://www2.epa.gov/sites/production/files/2015-04/documents/final_316b_bo_and_appendices_5_19_2014.pdf

[46] Montgomery, J. 2014. *'US agency's Salem fish-kill study condemned'*. The News Journal. Available online at: http://www.delawareonline.com/story/news/local/2014/07/23/us-agencys-salem-fish-kill-study-condemned/13070641/

[47] EPA Benefits Analysis. Page 2-12.

[48] Brown, G. M., & Shogren, J. F. 1998. Economics of the Endangered Species Act. *The Journal of Economic Perspectives*, *12*(3), 3-20; Loomis, J. B., & White, D. S. 1996. Economic benefits of rare and endangered species: summary and meta-analysis. *Ecological Economics*,*18*(3), 197-206; See, for example, Richardson, L., and J. Loomis. 2009. "The Total Economic Value of Threatened, Endangered and Rare Species: An Updated Meta-Analysis." *Ecological Economics*. 68(5): 1535-1548.

One study looked specifically at the public's willingness to pay for efforts aimed at protecting bottlenose sturgeon.[49] In this study, researchers used a referendum contingent valuation survey to determine the relationship between non-use values for two endangered species, Peregrine falcons and Shortnose sturgeon, and the respondents' environmental attitudes. The researchers elicited responses by mailing questionnaires to a random sample of 1,200 Maine residents over the age of 18. The researchers constructed survey mechanism according to the National Oceanic and Atmospheric Administration's guidelines on conducting stated preference studies. In the surveys, researchers asked respondents if they would vote for a referendum that would protect a population of bottlenose sturgeon at the mouth of the Kennebec River from future dredging and water pollution. The respondents were also told that supporting these efforts would cost them a one-time fee of $1–$49 (2015$). The results of the analysis suggest that, on average, individuals were willing to pay a one-time fee of about $37 (2015$).

Another way to consider the value society derives from protecting threatened or endangered species is to consider federal and state expenditures aimed at protecting a particular population, which can be considered a revealed preference value. The US government relies on the Endangered Species Act (ESA) to prevent extinction and to help promote the health of threatened and endangered species populations. In 2013, there were a total of 1,466 species listed as threatened or endangered under the ESA. The US Fish and Wildlife Service oversees ESA-related spending, and in fiscal year 2013, it reported a total of $1.7 billion in ESA-related expenditures.[50] Table 5 shows expenditures for each of the endangered species impacted by Salem's operations. Federal spending on these five species alone totaled nearly $22 million in FY 2013 ($2015).

These studies and data along with the extensive literature on the high economic value of protecting listed species because of their rarity suggest that there would be a high premium for reduced mortality of listed species in comparison to non-listed species. While an appropriate estimate that is completely additive to the stated preference total economic value estimates reported earlier is likely difficult to estimate, evidence suggests something likely in the tens of millions of dollars annually or greater.

[49] Kotchen, M.J. And S. Reiling. 2000. "Environmental Attitudes, Motivations, and Contingent Valuation of Nonuse Values: A Case Study Involving Endangered Species." *Ecological Economics*. 32: 93-107.

[50] US Fish and Wildlife Service. 2013. *FY 2013 Federal and State Endangered and Threatened Species Expenditures.*

Table 5. Total FY2013 Reported Expenditures (2015$)

Species	Spending
Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)	$3,698,859
Shortnose sturgeon (*Acipenser brevirostrum*)	$3,327,189
Green sea turtle (*Chelonia mydas*)	$2,829,495
Kemp's ridley sea turtle (*Lepidochelys kempii*)	$5,725,572
Loggerhead sea turtle (*Caretta caretta*) - Northwest Atlantic DPS	$6,229,931

Source: US Fish and Wildlife Service. 2013. *Federal and State Endangered and Threatened Species Expenditures.* http://www.fws.gov/Endangered/esa-library/pdf/2013.EXP.FINAL.pdf

Notes: All annual expenditures were adjusted for inflation, using the consumer price index, to 2015 dollars. These cost estimates are based only on state and federal expenditures that are specifically assigned to each species. They do not include any land acquisition costs.

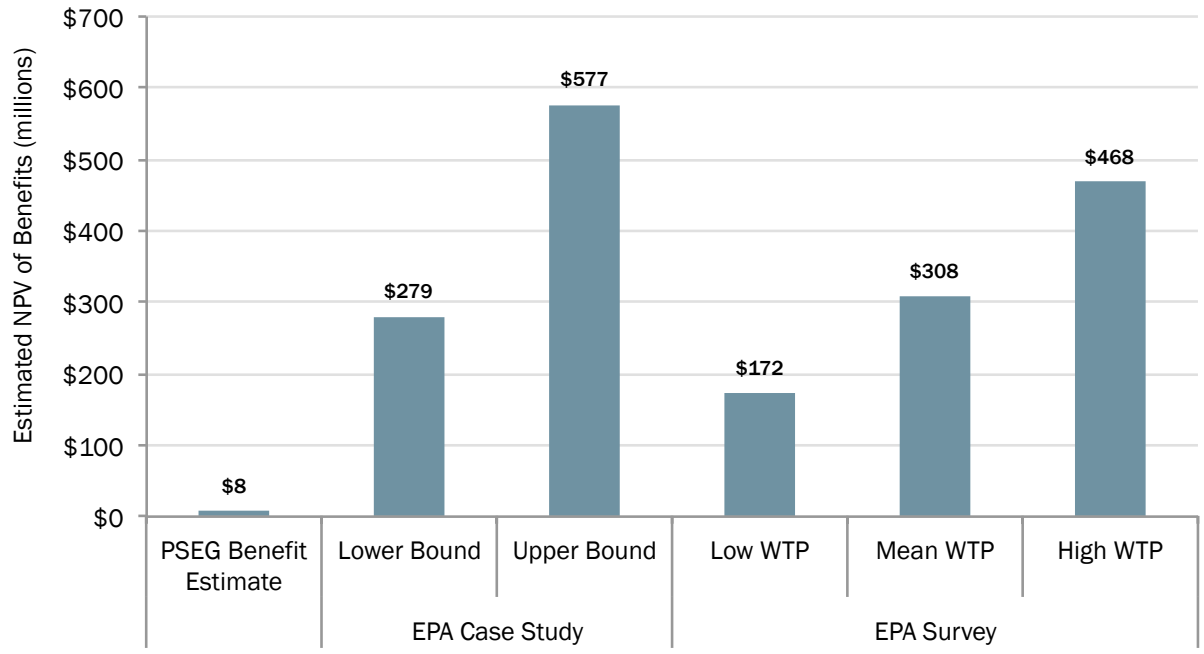
Climate Change-Related Benefits

Climate change is likely to affect aquatic ecosystems in ways that are detrimental to native species adapted to prior conditions. The Project Scenario contributes to mitigating the detrimental conditions, and therefore, Project Scenario benefits will likely become more important and valuable in the future. If climate change drives fish populations down, at least for the local fish populations currently affected by Salem's operation, then the increased scarcity increases the marginal value of fish. In other words, as fish become more rare, each individual fish becomes more valuable. Thus, for the same number of fish saved, the percent of the baseline population saved increases, and those fish saved were each individually more valuable than the marginal fish when populations were higher. Data do not allow an estimate of the magnitude of this potential population difference, and corresponding additional value.

4.1.5 Summary of Benefits

Overall, federal guidance, economic theory, biological data, and valuation research by the EPA all suggest that the benefit estimates provided by PSEG fail to represent and capture the total economic value of benefits of the Project Scenario. We present multiple estimates in the range of hundreds of millions of dollars and higher that more fully account for these values. We emphasize, however, that there are other (as-yet unquantified) factors that would magnify and add to these monetized values. These factors include increasing regional scarcity of affected species due to other disturbances in the Delaware Estuary, changing climate conditions, and the large number of endangered species as well as species with documented population declines involved.

Figure 6. Summary of Alternative Monetized NPV Benefit Estimates



Source: ECONorthwest based on data from sources cited above

4.2 Affordability to PSEG and Exelon

The comparison of benefits and costs for regulations under Section 316(b) of the Clean Water Act is not a strict benefit-cost analysis, but rather an effort to do what is most protective of water quality, while making accommodations for extreme cost disparities. The current test in use within New Jersey and many other states is that the best technology available (BTA) must be used (best from a water quality perspective) at an existing facility unless the costs are wholly disproportionate to their environmental benefits.

An additional consideration is the overall affordability of the technology to the facility's owner(s). As explained in the Delaware City Refinery's BTA determination:

"Decades of court cases have established the idea that if a technology is not "affordable", then it is not really "available". To the limited extent that considerations of "Affordability" are allowable in BTA Determinations under Clean Water Act §316(b), the assessment of "Economic Achievability" considers the resources available from the parent corporation of a NPDES permittee."[51]

In this section, we discuss three measures of financial affordability within the context of the costs that PSEG and Exelon would incur under the Project Scenario: (1) the increase in assets the companies would require to install the technology and annual loan payments in the context of annual revenues and cash flow, (2) the capital outlay associated with the Project Scenario

[51] State of Delaware Division of Water Resources. 2011. *BTA Determination – NPDES Permit Requirements For Cooling Water Intake and Discharges at Delaware City Refinery and Power Plant (DCR). Fact Sheet, Attachment A*. Page 3.

relative to historical levels of each companies capital expenditures, and (3) the potential interest charges for the debt component of financing. Note that wherever we refer to PSEG or Exelon in the following paragraphs, we are specifically referring to the subsidiaries PSEG Power, LLC and Exelon Generation Company, LLC.

Required increase in assets

The estimated total installed cost of the Project Scenario is $815 to 852 million.[52] We accept this estimate by PSEG without replication or review by engineers. The yearly amortized cost (assuming a 20-year repayment period and an interest rate of 4.91percent) for this amount would be 68 million, not including tax deductions. We assume that PSEG and Exelon would share costs according to their ownership shares in the station (57.41 percent, and 42.59 percent, respectively).[53]

Property, Plant, and Equipment (PPE) asset base: According to PSEG's Form 10-K for the fiscal year ending December 31, 2014, PSEG held assets for PPE of about $7.5 billion.[54] According to Exelon's Form 10-K for the fiscal year ending December 31, 2014, Exelon held assets for PPE of about $23 billion.[55] **The total installed cost of the Project Scenario would represent about 2.8 percent of PSEG and Exelon's combined PPE asset base.**

Annual operating revenues: According to PSEG's Form 10-K for the fiscal year ending December 31, 2014, PSEG's annual operating revenues were $5.4 billion.[56] According to Exelons's Form 10-K for the fiscal year ending December 31, 2014, Exelon's operating revenues were $17.4 billion.[57] **The annual amortized cost of the Project Scenario would represent 0.3 percent of PSEG and Exelon's combined annual operating revenues.**

Based on the firms' annual revenues, it would take just over a day of operations to cover the annual loan associated with the Project Scenario (the loan would cost $67.9 million a year, while the firms make roughly $62.5 million a day).

To further conceptualize and contextualize these costs (while acknowledging that these companies both rely on a much broader array of revenue generating facilities and activities, as

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[52] According to the 2006 permit application, the capital cost for retrofitting mechanical draft cooling towers is estimated at $814,844,200 and the capital cost for retrofitting natural draft cooling towers $852,440,200. For this affordability analysis we use the highest cost ($852 million), but overall affordability is even greater given that there is a cheaper cost option ($812 million). We also assume that these figures include all installation costs, including costs associated with debt and equity charges on construction work in progress (CWIP).

[53] Exelon Corporation. 2014. *Summary Annual Report*. Page 27. Available online at: http://www.exeloncorp.com/performance/investors/financialreports.aspx

[54] PSEG Investor FACT Book 2014-2015. PSEG Power Consolidated Balance Sheets. Page 52. Available online at: https://www.pseg.com/info/investors/pdf/factbook.pdf.

[55] Exelon Corporation. 2014. *Form 10-K*. Page 221. Available online at: http://www.exeloncorp.com/performance/investors/financialreports.aspx

[56] PSEG Investor FACT Book 2014-2015. PSEG Power Consolidated Balance Sheets. Page 52.

[57] Exelon Corporation. 2014. *Form 10-K*. Page 221.

reflected in the preceding calculations), we can also place these costs in terms of Salem's own operations and profits. Based on available data (specifically, PSEG's current realized price of $53 per MWh, the station's average annual production level of 19 million MWh and an assumed 300 days of operation a year, with 65 for refueling activities), we calculate that **the annual cost of the loan could be easily covered by production at the facility itself, and would require about 20 days of operation a year.**[58]

Annual cash flow: According to PSEG's Form 10-K for the fiscal year ending December 31, 2014, PSEG's annual net cash flow from operating activities was $1.4 billion.[59] Meanwhile, Exelon's operating revenues are projected to be $3.5 billion in 2015.[60] **The annual amortized cost of the Project Scenario would represent 1.4 percent of PSEG and Exelon's combined annual cash flows.**

According to Moody's, PSEG Power has a long term rating of Baa1, while Exelon Generation has a rating of Baa2. [61] Neither are currently on watch, and both ratings fall within Moody's range of investment-grade ratings.[62] The Project Scenario's installed cost relative to PSEG's PPE asset base along with PSEG's credit ranking suggest that the increase in assets the Project Scenario requires would be affordable to PSEG in terms of available credit and ability to pay the loan.

Capital outlay in historical context

In its Form 10-K for the fiscal year ending December 31, 2014, PSEG Power projected its capital construction and investment expenditures (excluding nuclear fuel purchases) for the next three years. PSEG's projected expenditures total $555 million in 2015, $395 million in 2016, and $265 million in 2017.[63] PSEG's average expenditures on capital construction and investments from 2015-2017 total about $405 million per year. In its Form 10-K for the fiscal year ending December 31, 2014, Exelon Generation projected its capital expenditures (excluding nuclear fuel purchases) for 2015 to be $2,375 million.

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[58] PSEG. 2015. "*PSEG Announces 2015 Second Quarter Results*". Available online at: https://www.pseg.com/info/media/newsreleases/2015/2015-07-31.jsp#.Vfhdl51VhBc

[59] PSEG Investor FACT Book 2014-2015. PSEG Power Consolidated Balance Sheets. Page 52.

[60] Exelon Corporation. 2014. *Form 10-K*. Page 221.

[61] Current rating from Moody's company report, 2015: https://www.moodys.com/research/Moodys-changes-PSEG-Inc-outlook-to-positive-affirms-subsidiary-ratings--PR_333720 and http://www.streetinsider.com/Credit+Ratings/Exelon+Corp.+(EXC),+Pepco+(POM)+Ratings+Affirmed+by+Moodys%3B+Pepco+Outlook+to+Positive/10855998.html

[62] Moody's Investors Services. 2015. *Moody's Rating Symbols & Definitions*. March. https://www.moodys.com/sites/products/AboutMoodysRatingsAttachments/MoodysRatingsSymbolsand%20Definitions.pdf

[63] PSEG. 2014. *Form 10-K*. Available online at: http://investor.pseg.com/sites/pseg.investorhq.businesswire.com/files/report/additional/PSEG_10K2014.pdf

The total installed cost of the Project Scenario ($852 million) represents about 31 percent of the companies combined annual capital expenditure, and the annual loan payment just 2 percent.

Potential interest charges

According to Barron's index of 10 medium-grade corporate bonds, the current yield on intermediate grade corporate bonds is 4.91 percent.[64] The annual interest payment in the first year (based on a total installed cost of $852 million) would be about $42 million. In 2012, 2013, and 2014, PSEG and Exelon's combined interest expenses totaled $490 million, $473 million, and $480 million respectively.[65] **The Project Scenario's annual interest payment in the first year ($32 million) represents about 8.7 percent of the two companies average annual interest expenses over the past three years (about $481 million).**

4.3 Affordability to Residential Ratepayers

PSEG and Exelon are members of the Pennsylvania, New Jersey, Maryland Interconnection, L.L.C. (PJM) regional transmission organization and Salem sells its electricity in the PJM power pool.[66] In order to determine the affordability of the Project Scenario from the perspective of ratepayers, we first estimate the annual cost of the Project Scenario, and then put that cost within the context of the rates customers currently pay. Assuming a 20-year loan period, and an interest rate of 4.91 percent, the annual payment on the $852 million total installed cost of the Project Scenario totals about $68 million each year (split between the two owners).

From 2007–2010, average annual net generation at Salem totaled about 19 million MWh.[67] Assuming that all the energy Salem generates goes to residential customers, and that all costs associated with the Project Scenario would be transferred to these residential customers through increases in their electricity rates, the Project Scenario would increase electricity rates by $0.0036 per kWh.[68] As of 2015, PSEG's residential service rates ranged from $0.180361–$0.195146 per kWh depending on the season and the energy used by each household, along with a monthly service charge of $2.43.[69] Taken alone, the potential increase in costs associated with the Project Scenario represent about 1.8 percent–2.0 percent of PSEG's per-unit electricity rates for residential customers. PSEG's average residential customer uses 7,360 kWh of electricity each year. Given the range of per-unit rates and the monthly service charge, an average customer pays about $1,360–$1,470 for electricity each year. **The potential increase in electricity costs**

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[64] Barron's. September 07, 2015. Weekly Bond Statistics. Retrieved on Sept 11th, 2015 from http://www.barrons.com/public/page/9_0210-weeklybondstats.html

[65] Exelon Corporation. 2014. *Form 10-K*. Page 221.

[66] New Jersey Department of Environmental Protection. 2015. PSEG NUCLEAR LLC SALEM GENERATING STATION NJPDES - Surface Water Renewal Permit Action. Page 2.

[67] US EPA. 2010. eGRID. Available online at: http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

[68] $0.0036/kWh = ($67,880,996 / 19,069,767 MWh) * 0.001 MWh/kWh

[69] Residential Service Rates for PSE&G Effective on Jaunary, 2015. http://www.pseg.com/info/environment/ev/rlm-rs_rates.jsp

associated with the Project Scenario total about $26 per customer per year, which represents about 1.9 percent of an average customer's current annual cost.

Because the New Jersey energy market is deregulated and supplied competitively though, the actual share of costs borne by ratepayers is likely to be lower than the $26 estimate above. Energy consumers in New Jersey exist under utility jurisdictions known as the "incumbent provider". Under New Jersey energy deregulation law the supply portion of the bill is separate from the delivery portion of the bill.[70] Consumers can choose between numbers of suppliers. Electricity is delivered throughout New Jersey by the regional transmission organization PJM.[71] 51 million people and 164,900 MW of generating capacity across 14 states are connected through 62,550 miles of transmission lines by PJM. PJM has 1,376 generation sources. The energy generation market that supplies New Jersey with capacity has become increasingly competitive in recent years. Consumers can choose where they buy their electricity, so there is an incentive for suppliers to lower prices. This competition has also spurred more long-term contracts between utilities and their suppliers in order to avoid price spikes.[72]

In general, residential and commercial demand in New Jersey is inelastic.[73] This means that a change in price generates a percent change in demand that is less than the percent change in price. Consequently in general, more of the change in price is borne by consumers than producers, but producers do bear a share of that cost. Furthermore, evidence across the country demonstrates that a share of communities is typically willing to pay more for "green energy" supply that is less destructive for the environment.[74] Overall then, ratepayers will bear a share of the increased costs, but if properly communicated, they can receive benefit from knowing that their energy consumption is more environmentally responsible than otherwise.

5 Summary of Results

Our analysis suggests that closed-cycle cooling would provide a range of economically-valuable goods and services that OMB and EPA guidance suggest should be included in consideration of benefits and costs. Available data suggest annual benefits in the tens of millions of dollars per year and net present benefits over time into the hundreds of millions and even billions of dollars, particularly in the context of other factors reducing fish populations in the Delaware

[70] State of New Jersey, Public Utility Board, "Shop for Energy Suppliers". http://www.nj.gov/bpu/commercial/shopping.html

[71] http://www.pjm.com/about-pjm.aspx

[72] Johnson, Tim. "Shopping Around for Cheaper Power". NJ Spotlight. http://www.njspotlight.com/stories/10/0624/2022/

[73] Regional Differences in the Price-Elasticity of Demand For Energy, Rand Corporation, 2005

[74] Roe, B., Teisl, M. F., Levy, A., & Russell, M. 2001. US Consumers' Willingness to Pay for Green Electricity. Energy Policy, 29(11), 917-925.

Bay. Thus, costs are not wholly disproportionate to environmental benefits nor are they significantly greater than benefits.

Moreover, these costs are likely affordable to PSEG and Exelon, the plants owners, based on similar and ongoing expenditures and financing conditions. Ratepayers would likely bear some of the costs, but ratepayers have shown a willingness to pay additional for energy generated by more environmentally-responsible means.