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VIWAPA IRP REPORT

BLACK & VEATCH PROJECT NO. 402255

PREPARED FOR

Virgin Islands Water and Power Authority

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BLACK & VEATCH

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Acronym List

AGC	Automatic Generation Control
BAU	Business as Usual
CC	Combined Cycle Unit
CPWC	Cumulative Present Worth Cost
CT	Combustion Turbine Unit
DSM	Demand Side Management
EE	Energy Efficiency
EIA	Energy Information Administration of the U.S. Government
FCR	Fixed Charge Rate
FOM	Fixed Operating and Maintenance Costs
GWh	Gigawatt Hour
IDC	Interest During Construction
IRP	Integrated Resource Plan
ISO	Independent System Operator
kW	Kilowatt
kWh	Kilowatt Hour
LNG	Liquid Natural Gas
LOLH	Loss of Load Hours
LPG	Liquid Propane Gas
MW	Megawatt
MWh	Megawatt Hour
N-1-1	Reliability Criteria used by VIWAPA in which system load can be served with two outages of generation or transmission
NPHR	Net Plant Heat Rate
NREL	National Renewable Energy Laboratory
NYPA	New York Power Authority
PLEXOS	Production Costing and Expansion Planning Software Licensed by Energy Exemplar used for this IRP
PPA	Purchase Power Agreement
RE	Renewable Energy
RFP	Request for Proposals
RICE	Reciprocating Internal Combustion Engine
RTO	Regional Transmission Organization
STT	St. Thomas
STX	St. Croix
VIWAPA	U.S. Virgin Islands Water and Power Authority
VOM	Variable Operating and Maintenance Costs

1.0 Executive Summary

Black & Veatch has prepared this Integrated Resource Plan (IRP) to evaluate power supply options for the separate electric power systems on the islands of St. Croix (STX) and St. Thomas (STT, which also is linked to the island of St. John via an underwater power cable). The IRP covers a 25-year IRP planning horizon from 2020 to 2044. The importance of this IRP is magnified due to the destruction brought about by Hurricane Irma and Hurricane Maria in 2017. These two hurricanes devastated most of the transmission and distribution network on STT and STX and destroyed many of the industrial, commercial, and residential structures to which power was provided.

The overall objective of the IRP is to *identify the mix of incremental resources that will achieve a safe, adequate, and reliable supply of power at the lowest reasonable cost and in an environmentally acceptable manner*. Incorporated into this overall objective are the environmental targets of having at least 25 percent of installed capacity (as a percent of peak demand) from renewable energy (RE) resources by 2020, with the percentage increasing to 50 percent by 2044.

To achieve these environmental targets, several specific RE projects have been identified and evaluated for each power system. The IRP also evaluated the economics of complementing RE projects with energy storage options in the form of battery energy storage systems (BESS) that could help firm-up the RE resources. Firming-up means that energy generated from RE resources could be stored and used to meet energy requirements at times—such as during the evening peak period—that differ from when the energy is generated. While storage was prohibitively expensive for most applications only several years ago, capital costs decreases have occurred and are expected to continue, making energy storage options increasingly viable.

1.1 STAKEHOLDER INPUT

Stakeholder input was sought for this IRP and the study benefited from the involvement of several organizations that are working with VIWAPA to achieve financial stability and to recover from the 2017 hurricanes. On July 17th-19th, 2019, initial IRP meetings were held at the Black & Veatch offices in the Kansas City vicinity and individuals from the following organizations participated:

- VIWAPA
- Black & Veatch
- The National Renewables Energy Laboratory (NREL)
- New York Power Authority (NYPA)
- PA Consulting on behalf of the major VIWAPA bond holder

At these initial meeting, various issues related to the IRP study were discussed and major assumptions were developed. These assumptions, some of which were further modified over the subsequent two months, became the source of modeling inputs (see Section 3). In addition to those individuals at the meetings in Kansas City, VIWAPA has been in frequent contact with the Virgin Islands regulatory commission and other stakeholders.

1.2 ECONOMIC ANALYSIS OF PLANS

IRPs assess various power supply options under different assumption scenarios to arrive at an *economically* optimal plan. Identification of the optimal plan requires the use of sophisticated analytical tools that are capable of estimating and comparing the costs of competing supply and

demand resources. In this IRP, the software PLEXOS has been utilized as a production costing and expansion planning tool. Figure 2-1 illustrates the costs captured in the IRP economic methodology. In the methodology used, annual costs are stated on a present worth basis and then summed. The resulting cost is called the cumulative present worth cost (CPWC), which can be compared among competing plans.

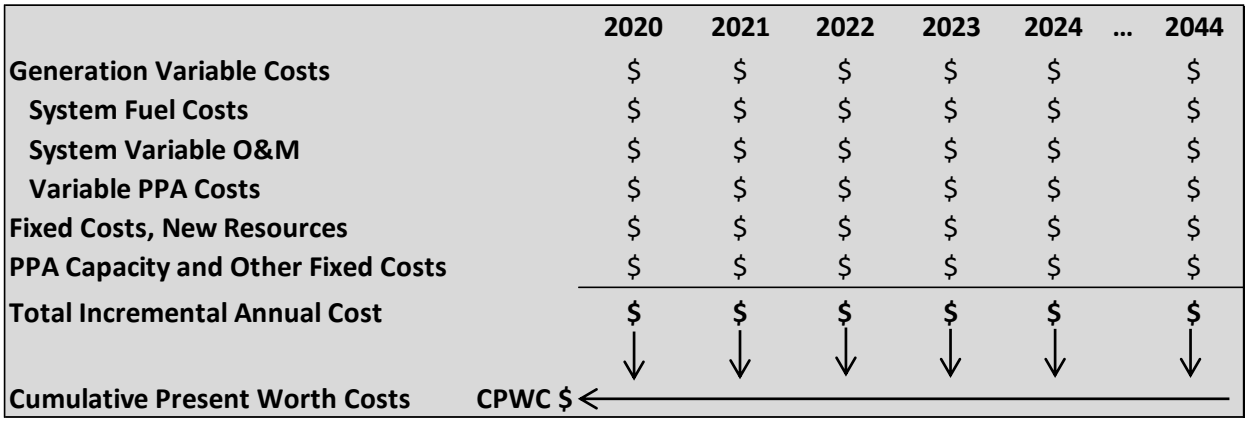

Figure 1-1 Deriving the Cumulative Present Worth Cost (CPWC) of an Expansion Plan

IRP studies require many assumptions that impact the overall economics of the plan. Section 3 of this report details the primary assumptions for the study. Among the most important is the assumption that U.S. government grant funding will occur for new capacity resources added to the STT and STX systems. As a result, this study evaluates the long-term cost of competing expansion plans on a total CPWC basis and in terms of the CPWC absent new capital-related costs. This second measure provides an indication of the cost to VIWAPA customers if U.S. government funding of new power projects does not need to be repaid.

Another key assumption is the load forecast, which was made difficult due to the destruction of the VIWAPA systems in 2017. The islands are still recovering from the destruction and have not yet reached pre-hurricane levels. Due to these events and based on current VIWAPA load information, the base load forecast assumes no growth during the 2020-2044 planning period. Thus, under the base load forecast, the peak demand for STT is 55.8 MW in 2020 and is assumed to stay flat. The peak demand for STX is 38.3 MW in 2020 and is also assumed to stay flat. High and low load growth sensitivities are also developed as part of this study.

The IRP evaluated the economics of meeting future load and energy requirements with a diverse set of generating options. New and efficient thermal generation units in the form of reciprocating internal combustion engines (RICE units), simple cycle combustion turbines (CTs) and combined cycle (CC) units were evaluated. The primary fuel for new thermal units was assumed to be LPG although the economics of switching to LNG was also evaluated.

The IRP also evaluated several specific RE projects for each system. These projects were wind and solar projects for which specific cost and performance assumptions had been developed by NREL, NYPA, or Black & Veatch. For STT and STX, site specific solar, wind, waste-to-energy, and BESS options were considered. The master list of solar, wind, and BESS projects considered are shown in Table 1-1.

Another important focus of the study was to evaluate whether it would be economical to retire some or all existing units on the STT or STX systems. The existing units are old, inefficient, and have had poor reliability. In the study, the PLEXOS model was allowed to retire the existing units if the benefit of keeping them in-service did not offset the on-going fixed O&M costs (primarily including staffing and fixed rental expenses) and, if applicable, added capital investments needed to return a unit to service or to maintain its operation.

Table 1-1 Candidate Renewable Energy Projects Considered for STT and STX in the IRP

PROJECT	RESOURCE TYPE	EVALUATED CAPACITY MW (AC)	ISLAND	EXPECTED ONLINE DATE
St. Croix				
West STX PV Airport (Hera)	Solar PV	10	St. Croix	1/1/2021
Estate Pearl (Limestone)	Solar PV	18	St. Croix	1/1/2021
Rooftop Solar Program	Solar PV	0.765	St. Croix	7/1/2020 – 6/30/2022
Southshore Wind	Wind	5 & 10	St. Croix	1/1/2023
BESS: Richmond STX	Storage	10 MW, 20 MWh	St. Croix	1/1/2022
BESS: Willock STX	Storage	30, 60 MWh	St. Croix	1/1/2022
St. Thomas/St. John				
Port Authority PV STT	Solar PV	0.45	St. Thomas	7/1/2020
Bovoni Ridge Solar	Solar PV	7	St. Thomas	12/1/2020
STJ Solar Cruz Bay	Solar PV	4	St. John	1/1/2021
WAPA Solar I STT (Donoe Replacement)	Solar	7	St. Thomas	1/1/2021
Bovoni Wind	Wind	18	St. Thomas	12/1/2021
STJ Rooftop Solar	Solar	0.510	St. John	7/1/2020-6/30/2022
STT Rooftop Solar Program	Solar	0.765	St. Thomas	7/1/2020-6/30/2022
BESS: St. John Cruz Bay	Storage	4 MW, 16 MWh	St. John	1/1/2022

Another key input was the fuel price assumption. The base case fuel prices assumed are shown in Table 1-2. High and low fuel cost sensitivities were also performed.

Table 1-2 Base Case, Delivered Fuel Price Forecasts for the 2019 VIWAPA IRP, 2020-2044 ($/MMBtu)

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2020	$9.11	NA	$19.92
2021	$9.52	NA	$19.81
2022	$9.71	NA	$19.51
2023	$9.82	NA	$19.54
2024	$9.94	NA	$19.85
2025	$10.42	$7.42	$20.60
2026	$10.84	$7.84	$21.43
2027	$11.21	$8.21	$22.47
2028	$11.55	$8.55	$23.06
2029	$12.20	$9.20	$24.07
2030	$12.48	$9.48	$24.70
2031	$12.82	$9.82	$25.29
2032	$13.18	$10.18	$26.12
2033	$13.57	$10.57	$27.03
2034	$13.96	$10.96	$27.66
2035	$14.34	$11.34	$28.51
2036	$14.75	$11.75	$29.55
2037	$15.14	$12.14	$30.13
2038	$15.52	$12.52	$30.93
2039	$15.91	$12.91	$31.82
2040	$16.31	$13.31	$33.50
2041	$16.69	$13.69	$33.60
2042	$17.11	$14.11	$34.66
2043	$17.55	$14.55	$35.50
2044	$18.00	$15.00	$36.29

1.3 LEAST COST PLANS FOR STT AND STX

The detailed characteristics for the STT and STX systems units were input into PLEXOS and the model was allowed to develop an optimized portfolio by selecting the best RE and conventional projects for the STT system. The expansion plan results were organized into a detailed CPWC table format as shown in Table 1-3. In this table, the components of total system cost for each year are listed in the bottom two-thirds of the table and unit additions, unit retirements, and other input information are shown at the top of the table. In bold, at the bottom of the final two columns in Table 1-3, the total CPWC for the optimized STT plan under base case assumptions is shown, as is the CPWC less capital-related costs (the cost to VIWAPA customers if U.S. government grant funding occurs).

As seen at the bottom of the CPWC column in Table 1-3, the total CPWC of the optimized expansion plan for STT is $841.19 million. The CPWC payable by VIWAPA customers is $732.70 million. The units added to STT in the optimized plan are as follows, with all units added in 2021 except the BESS resource that is added in 2022:

- STT Bovoni Solar in January of 2021
- STT Donoe Solar PPA in January of 2021
- An 8 MW RICE Unit in January of 2021
- 3 x 7 MW RICE Units in January of 2021
- A 7 MW RICE Unit in April of 2021
- The STJ Cruz Bay Battery Storage (BESS) unit in April of 2022

The STT base case optimization also chose to retire the following units:

- STT 15
- STT 25 (APR leased units)
- STT 26 (APR leased units)
- STT 27 (APR leased units)
- STT 14 (out of service, not selected to return and not shown as retired in Table 1-3)

Table 1-3 Optimized Base Case CPWC for STT

STT Base Case Plan

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost									
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Cumulative Present Worth Cost (CPWC) ($1,000)	CPWC without Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	11	$31,252	$4,672	$1,815	$3,315	$41,055	$112.17	$6,333	$47,388	$106,323	$100,354
2022	366.1	366.1	0.000	0	$31,195	$4,783	$1,406	$3,315	$40,699	$111.17	$7,316	$48,015	$148,176	$135,512
2023	366.1	366.1	0.000	1	$31,351	$4,882	$1,434	$3,315	$40,983	$111.93	$7,553	$48,536	$188,604	$169,228
2024	367.1	367.1	0.000	0	$31,838	$4,992	$1,467	$3,326	$41,623	$113.37	$7,553	$49,176	$227,732	$201,841
2025	366.1	366.1	0.000	1	$33,239	$5,080	$1,492	$3,315	$43,126	$117.79	$7,553	$50,679	$266,239	$234,022
2026	366.2	366.1	0.020	8	$34,635	$5,178	$1,522	$3,315	$44,651	$121.95	$7,553	$52,204	$304,113	$265,755
2027	366.2	366.2	0.010	9	$35,824	$5,282	$1,552	$3,315	$45,974	$125.56	$7,553	$53,527	$341,193	$296,871
2028	367.1	367.1	0.000	0	$36,905	$5,407	$1,588	$3,326	$47,226	$128.64	$7,553	$54,779	$377,424	$327,314
2029	366.2	366.1	0.140	38	$38,940	$5,494	$1,615	$3,315	$49,365	$134.85	$7,553	$56,918	$413,350	$357,619
2030	366.1	366.1	0.000	0	$39,886	$5,604	$1,647	$3,315	$50,453	$137.80	$7,553	$58,006	$448,306	$387,118
2031	366.2	366.1	0.040	10	$41,028	$5,713	$1,680	$3,315	$51,736	$141.31	$7,553	$59,289	$482,412	$415,926
2032	367.1	367.1	0.000	0	$42,275	$5,844	$1,719	$3,326	$53,164	$144.81	$7,553	$60,718	$515,750	$444,120
2033	366.2	366.2	0.010	5	$43,489	$5,940	$1,748	$3,315	$54,492	$148.83	$7,553	$62,046	$548,266	$471,643
2034	366.1	366.1	0.000	0	$44,534	$6,071	$1,783	$3,315	$55,703	$152.14	$7,553	$63,256	$579,908	$498,437
2035	366.2	366.0	0.120	24	$45,871	$6,183	$1,819	$3,315	$57,188	$156.23	$7,553	$64,741	$610,814	$524,635
2036	367.2	367.2	0.030	11	$47,277	$6,327	$1,860	$3,326	$58,791	$160.12	$7,553	$66,344	$641,034	$550,285
2037	366.1	366.1	0.000	0	$48,269	$6,443	$1,892	$3,315	$59,920	$163.67	$7,553	$67,473	$670,368	$575,183
2038	366.2	366.1	0.100	21	$49,477	$6,569	$1,930	$3,315	$61,292	$167.42	$7,553	$68,845	$698,931	$599,438
2039	366.2	366.1	0.090	33	$50,915	$6,692	$1,969	$3,315	$62,891	$171.77	$7,553	$70,445	$726,817	$623,142
2040	367.2	367.2	0.010	7	$52,295	$6,848	$2,014	$3,326	$64,483	$175.63	$7,553	$72,036	$754,023	$646,287
2041	366.2	366.1	0.010	4	$53,250	$6,972	$2,048	$3,315	$65,585	$179.13	$1,221	$66,806	$777,080	$668,707
2042	366.2	366.1	0.100	33	$54,619	$7,108	$2,089	$3,315	$67,131	$183.35	$238	$67,369	$799,057	$690,563
2043	366.2	366.2	0.010	11	$56,035	$7,251	$2,131	$3,315	$68,732	$187.71	$0	$68,732	$820,368	$711,875
2044	367.1	367.1	0.000	0	$57,599	$7,418	$2,180	$3,326	$70,523	$192.11	$0	$70,523	**$841,194**	**$732,701**

Table 1-4 lists similar information for the optimized STX expansion plan. As seen at the bottom of the CPWC column, the optimized expansion plan has a CPWC of $588.24 million. The CPWC payable by VIWAPA customers is $410.80 million.

The units added to STX are as follows, with all units added in 2021 or 2022:

- Estate Pearl Solar PV, 18 MW in January of 2021
- Hera (West Airport) PV, 10 MW in January of 2021
- Longford (Southshore) Wind 5 x 3.3 MW in July of 2021
- 3 x 8 MW RICE Units burning LPG in July of 2022
- Richmond Battery Storage (BESS) in July of 2022

The STX base case optimization also chose to retire the following units:

- STX 19
- Aggreko lease
- STX 11 (not selected for returning to service and not shown as retired in Table 1-4)

Table 1-4 Optimized Base Case CPWC for STX

STX Base Case Plan

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3MW	27,539	6	20	07/01/2021	28,793	2,099
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost									
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Cumulative Present Worth Cost (CPWC) ($1,000)	CPWC without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,264	$1,076	$2,026	$1,458	$25,825	$98.29	$9,964	$35,789	$108,576	$93,481
2023	263.2	263.2	0.070	26	$16,510	$1,845	$2,216	$1,458	$22,030	$83.72	$12,538	$34,567	$137,840	$111,605
2024	263.9	263.7	0.120	24	$16,781	$1,883	$2,267	$1,463	$22,394	$84.91	$12,538	$34,932	$166,201	$129,151
2025	263.3	263.0	0.320	51	$17,489	$1,912	$2,306	$1,458	$23,165	$88.09	$12,538	$35,703	$193,988	$146,438
2026	263.1	263.1	0.000	0	$18,380	$1,936	$2,352	$1,458	$24,126	$91.69	$12,538	$36,664	$221,328	$163,583
2027	263.3	263.1	0.160	40	$18,939	$1,965	$2,399	$1,458	$24,762	$94.12	$12,538	$37,300	$247,985	$180,343
2028	263.9	263.9	0.040	15	$19,598	$2,017	$2,453	$1,463	$25,531	$96.76	$12,538	$38,069	$274,052	$196,801
2029	263.2	263.2	0.000	0	$20,669	$2,046	$2,496	$1,458	$26,669	$101.31	$12,538	$39,206	$299,753	$213,173
2030	263.3	263.3	0.000	0	$21,042	$2,109	$2,546	$1,458	$27,155	$103.14	$12,538	$39,693	$324,688	$229,050
2031	263.4	263.4	0.000	0	$21,619	$2,137	$2,596	$1,458	$27,811	$105.58	$12,538	$40,349	$348,968	$244,536
2032	264.1	264.1	0.000	0	$22,287	$2,181	$2,656	$1,463	$28,587	$108.23	$12,538	$41,125	$372,666	$259,697
2033	264.0	264.0	0.000	0	$22,713	$2,232	$2,701	$1,458	$29,105	$110.26	$12,538	$41,642	$395,655	$274,396
2034	264.7	264.5	0.140	23	$23,279	$2,256	$2,755	$1,458	$29,749	$112.46	$12,538	$42,287	$418,012	$288,706
2035	265.6	265.5	0.110	17	$23,778	$2,287	$2,811	$1,458	$30,333	$114.25	$12,538	$42,871	$439,721	$302,602
2036	267.5	267.5	0.000	0	$24,021	$2,371	$2,875	$1,463	$30,730	$114.88	$12,538	$43,268	$460,714	$316,010
2037	268.8	268.8	0.000	2	$24,441	$2,343	$2,924	$1,458	$31,166	$115.93	$12,538	$43,704	$481,029	$328,960
2038	269.4	269.4	0.000	0	$24,770	$2,414	$2,983	$1,458	$31,624	$117.40	$12,538	$44,162	$500,694	$341,474
2039	269.6	269.6	0.000	0	$25,619	$2,430	$3,042	$1,458	$32,550	$120.74	$12,538	$45,088	$519,903	$353,742
2040	270.3	270.3	0.000	0	$26,430	$2,473	$3,112	$1,463	$33,478	$123.87	$12,538	$46,015	$538,659	$365,759
2041	269.5	269.5	0.040	10	$26,979	$2,523	$3,165	$1,458	$34,126	$126.63	$6,197	$40,323	$553,559	$377,425
2042	269.5	269.5	0.000	0	$27,500	$2,618	$3,228	$1,458	$34,804	$129.13	$2,574	$37,378	$566,195	$388,756
2043	269.6	269.5	0.030	13	$28,363	$2,662	$3,293	$1,458	$35,777	$132.74	$0	$35,777	$577,288	$399,849
2044	270.2	270.2	0.000	0	$29,588	$2,677	$3,368	$1,463	$37,096	$137.28	$0	$37,096	**$588,243**	**$410,804**

1.4 OPTIMIZED PLANS VERSUS BUSINESS AS USUAL COSTS

The most economical plans for STT and STX were compared to business as usual (BAU) cases in which no new conventional or renewable resources were added and no unit retirements were considered. This allowed an estimate of the benefits arising from the significant capital investments made in the optimized cases.

For STT, the CPWC under the BAU case is $1,380.89 million. Since there is assumed to be no U.S. funding in the BAU case, this full CPWC would be paid by VIWAPA customers. The CPWC of the optimized base case expansion plan for STT is $841.19 million while the CPWC payable by VIWAPA customers is $732.70 million. Thus, **compared to the optimized Base Case for STT, the BAU would cost an additional $539.37 million for the entire STT system and $648.17 million more for VIWAPA customers**. The optimized STT expansion plan is 61 percent of the BAU case in terms of the full CPWC and is 53 percent of the CPWC in terms of costs payable by VIWAPA customers.

For STX, the CPWC under the BAU case is $896.79 million. Since there is assumed to be no U.S. funding, the total CPWC would be paid by VIWAPA customers. The total CPWC for the optimized base case is $588.24 million and the CPWC cost to VIWAPA customers is $410.80 million in the base case. Thus, **compared to the optimized base case for STX, the BAU would cost an additional $308.54 million for the entire STX system and $485.98 million more for VIWAPA customers**. The optimized STX expansion plan is 66 percent of the BAU case in terms of the full CPWC and 46 percent of the BAU CPWC in terms of costs payable by VIWAPA customers.

On a combined basis, the BAU costs for STT and STX would be $2,277.66 million over the 2020-2044 study period. **This is $872.90 million higher than the total CPWC costs for STT and STX in the optimized cases ($1,404.76 million), and $1,178.09 million higher than the combined STT and STX cost (of $1,099.56 million) for VIWAPA customers in the optimized cases**. The optimized expansion plans are a combined 63 percent of the BAU case in terms of the full CPWC and 50 percent of the BAU CPWC in terms of costs payable by VIWAPA customers.

1.5 COMPARISON AMONG COMPETING EXPANSION PLANS (P0-P5)

The optimized economic plans for STT and STX were also compared against competing expansion plans determined by PLEXOS to be low cost, alternative expansion plans. In this study, the top five plans for each system were compared; these plans are designated as plans P0 through P4 for each system, with P0 referring to the initial optimized expansion plan.

Table 1-5 lists the CPWC results for the top five expansion plans identified by PLEXOS for STT. Also listed are the project additions and existing unit retirements associated with each plan. Again, the optimized case is marked as "P0" in the table and the other expansion plans are designated as P1 through P4.

Results indicate that the top five base case plans for STT have a total CPWC ranging from $841.19 million (P0) to $922.45 million (P4). The CPWC for Plan 4 is 9.6 percent higher than the optimized case, P0. The CPWC for P0 is also the lowest cost plan when the capital costs are not included under base case assumptions. The CPWC values for the without capital cost cases are closely bunched and only range by 2.3 percent for STT across all plans.

Table 1-5 shows that the top plans are all similar in that they rely heavily on the addition of several RE projects and efficient RICE capacity early in the expansion plan. All STT plans also involve the retirement of the same existing VIWAPA units or rentals (STT 14, STT 15, STT 25, STT 26, and STT 27).

Table 1-5 STT Resource Additions and Retirements Under the Top Five Expansion Plans

STT PLAN	CPWC ($1,000)	CPWC W/O CAPITAL COST ($1,000)	UNITS ADDED	YEAR ADDED	UNITS RETIRED
P0	$841,194	$732,701	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			RICE 8 MW LPG	01/01/2021	
			4 x RICE 7 MW LPG	01/01/2021	
			RICE 7 MW LPG	04/01/2021	
			STJ Cruz Bay BS	04/01/2022	
P1	$886,068	$733,876	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			4 x RICE 7 MW LPG	01/01/2021	
			2 x RICE 7 MW LPG	04/01/2021	
			RICE 7 MW LPG	10/01/2023	
			RICE 7 MW LPG	04/01/2024	
			STJ Cruz Bay BS	10/01/2023	
P2	$867,352	$742,115	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			2 x RICE 8 MW LPG	01/01/2021	
			RICE 8 MW LPG	04/01/2021	
			RICE 8 MW LPG	10/01/2023	
			RICE 8 MW LPG	04/01/2024	
			STJ Cruz Bay BS	10/01/2023	
			STJ Cruz Bay PV	04/01/2024	
P3	$862,805	$749,772	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			RICE 8 MW LPG	01/01/2021	
			2 x RICE 8 MW LPG	04/01/2024	
			2 x RICE 7 MW LPG	01/01/2021	
			RICE 7 MW LPG	10/01/2023	
P4	$922,453	$736,746	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			RICE 8 MW LPG	01/01/2021	
			RICE 8 MW LPG	04/01/2021	
			3 x RICE 7 MW LPG	01/01/2021	
			3 x RICE 7 MW LPG	10/01/2023	
			RICE 7 MW LPG	04/01/2024	

			RICE 7 MW LPG	2024	
			STJ Cruz Bay BS	2023	

Table 1-6 lists the CPWC results for the top five expansion plans identified by PLEXOS for STX. Also listed are the project additions and unit retirements associated with each plan.

Results indicate that the top five base case plans for STX have total CPWC values ranging from $588.24 million (P0) to $625.46 million (P2). The highest CPWC (for Plan 2) is 6.3 percent higher than the optimized case. The CPWC for plan P1 is the lowest cost plan when the capital costs are not included. The CPWC values for the highest plan (P4) without capital costs is 10.4 percent higher than the P1 CPWC.

Table 1-6 demonstrates that the top plans are all similar in that they rely heavily on the addition of several RE projects and efficiency RICE capacity very early on in the expansion plan. All STX plans also involve the retirement of the same VIWAPA units or rentals (STX 19, Aggreko, and STX 11).

Table 1-6 STX Project Additions and Existing Unit Retirements

STX PLAN	CPWC ($1,000)	CPWC W/O CAPITAL COST ($1,000)	UNITS ADDED	DATE ADDED	UNITS RETIRED
P0	$588,243	$410,804	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			3 x RICE 8 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P1	$593,103	$403,983	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			RICE 8 MW LPG	07/01/2022	
			3 x RICE 7 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P2	$625,455	$442,568	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 7 MW LPG	07/01/2022	
			RICE 7 MW LPG	07/01/2022	

STX PLAN	CPWC ($1,000)	CPWC W/O CAPITAL COST ($1,000)	UNITS ADDED	DATE ADDED	UNITS RETIRED
P3	$592,304	$405,002	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 7 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P4	$620,752	$445,910	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 8 MW LPG	07/01/2022	

1.6 SENSITIVITY CASES

Sensitivity cases were performed under high and low fuel cost assumptions as well as high and low load growth assumptions. These sensitivities are important due to the difficulty in projecting load and fuel costs 25 years into the future. Performing these sensitivities allows an understanding of how competing plans compare to one another under alternative but realistic future system loads or fuel prices.

Table 1-7 provides a summary of the CPWC results for the base case and sensitivity cases. In the table, the lowest cost plan corresponding to the column headings is highlighted in yellow. For STT, results indicate that plan P0 is least cost under base case assumptions and in several sensitivity cases. In total, plan P0 for STT is lowest in cost in seven of the ten case results reported.

For STX, results indicate that plan P0 is the least cost option for all cases when total CPWC costs are reported. If the capital costs of new additions are not included, then P1 becomes the least cost for all cases.

Two of the conclusions drawn from Table 1-7 are: 1) for STT, expansion plan P0 is robust in terms of providing a low cost across a wide range of possible future scenarios; and 2) For STX, P0 is robust when all CPWC costs are being considered, but P1 is preferred from an economic perspective if VIWAPA customers do not have to pay back the capital-related funds for new generation.

It is also concluded that, from a customer perspective, the highest benefit for funds invested occurs on STX based on the differential between the full CPWC cost and the CPWC when capital costs are not included. For example, in the base case, customers avoid paying approximately $184 million in CPWC on STX if the capital costs of new projects do not have to be repaid, while customers avoid approximately $109 million in CPWC on STT if government funding is not repaid. This suggests that if grant funding is limited, the STX projects are appropriate to target as a priority.

1.7 COMBINING PLAN ECONOMICS, RELIABILITY, ENVIRONMENT CHARACTERISTICS

In addition to system economics, the merits of the competing expansion plans were also evaluated based on system reliability and the achievement of RE targets. In this study, the reliability of a plan is measured by the loss of load hours each year of the 2020-2044 planning horizon. The adopted target for the IRP is the improvement on loss of load hours from one day per year at the start of the study period to one day in ten years by the end of the study period. For renewable energy, the goal is to increase capacity from at least 25 percent in 2020 to at least 50 percent in 2044 when measured as the ratio of installed capacity to peak demand.

Table 1-8 is a heat map indicating the relative economic, reliability, and renewable energy merits of the competing plans. The rating system utilized to assign colors to the competing plans is explained at the bottom of the table.

Table 1-7 CPWC Summary of the Base Case and All Sensitivity Cases for Plans P0 through P4

	BASE		HIGH LOAD		LOW LOAD		HIGH FUEL		LOW FUEL	
	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)
STT Plan										
P0	$841,194	$732,701	$1,042,248	$933,755	$784,088	$675,595	$937,221	$828,728	$777,531	$669,038
P1	$886,068	$733,876	$1,047,542	$895,350	$830,632	$678,440	$981,245	$829,053	$822,708	$670,516
P2	$867,352	$742,115	$1,049,776	$924,540	$809,770	$684,533	$964,851	$839,614	$803,627	$678,391
P3	$862,805	$749,772	$1,037,574	$924,542	$805,234	$692,201	$961,756	$848,724	$798,341	$685,308
P4	$992,453	$736,746	$1,082,034	$896,326	$866,853	$681,145	$1,017,751	$832,044	$859,096	$673,388
STX Plan										
P0	$588,243	$410,804	$588,242	$410,803	$552,803	$375,363	$635,903	$458,463	$559,190	$381,751
P1	$593,103	$403,983	$593,103	$403,983	$560,073	$370,953	$639,016	$449,895	$565,144	$376,024
P2	$625,455	$442,568	$625,455	$442,568	$595,371	$412,484	$680,632	$497,745	$588,681	$405,794
P3	$592,304	$405,002	$592,304	$405,001	$592,304	$405,002	$638,543	$451,241	$564,158	$376,856
P4	$620,752	$445,910	$620,753	$445,911	$589,803	$414,961	$676,575	$501,733	$583,460	$408,618

Table 1-8 Heat Map Considering Economics, Reliability, and Renewable Energy Targets

PLAN	FINAL RANKING	CPWC, BASE CASE	CPWC, COST TO VIWAPA CUSTOMERS	CPWC, (FULL COST) AVERAGE COST OF BASE & SENSITIVITY CASES	AVERAGE ANNUAL LOL HOURS, 2020-2044	AVERAGE RE% OF PEAK MET, 2020-2044
STT						
Plan 0	1	$841,194	$732,701	$876,456	8.73	71.77%
Plan 1	4	$886,068	$733,876	$913,639	0.15	71.61%
Plan 2	3	$867,352	$742,115	$899,075	3.31	75.20%
Plan 3	2	$862,805	$749,772	$893,142	5.38	67.85%
Plan 4	5	$992,453	$736,746	$963,637	0.15	71.61%
STX						
Plan 0	3	$588,243	$410,804	$584,876	13.23	71.77%
Plan 1	1	$593,103	$403,983	$590,088	6.96	71.77%
Plan 2	5	$625,455	$442,568	$623,119	6.12	61.96%
Plan 3	2	$592,304	$405,002	$595,923	7.38	71.77%
Plan 4	4	$620,752	$445,910	$618,269	7.85	61.96%

[1]Color key:

CPWC:	Avg. Annual Loss of Load Hours:	Average RE % of Peak (measured for both systems, combined, assuming each STX plan is paired with STT P0 and all STT plans are paired with STX P1:
Within 1.5% of best	0-4 hours	Average RE% of Peak Met >65%
>1.5%-3%	>4 to 8 hours	Average RE% of Peak Met from >53% to 65%
>3%-4.5%	>8 to 12 hours	Average RE% of Peak Met from 48% to 53%
More than 4.5%	>12 hours	Average RE% of Peak Met <48%

Results of the heat map—that considers economic, reliability, and environmental factors—indicate that for STT, the plan P0 scores relatively high in all categories, as indicated by the green shading in the three CPWC categories plus the RE category. Only in the loss of load hour category does Plan 0 receive a rating that is not green; the color rating is orange in this category as P0 is projected to average 8.73 loss of load hours per year over the plan. Nevertheless, this loss of load figure is not considered high enough to give the nod to a competing plan. Therefore, **the recommended expansion plan for STT is P0**, which is summarized in Table 1-9.

Table 1-9 The Recommended Expansion Plan for STT (Plan P0)

UNITS ADDED	DATE ADDED	UNITS RETIRED
Bovoni Solar	01/01/2021	STT 14, STT 15, STT 25, STT 26, STT 27
Donoe Solar PPA	01/01/2021	
RICE 8 MW	07/01/2021	
3 x 7 MW RICE	07/01/2022	
7 MW RICE	07/01/2022	
STJ Cruz Bay BESS	01/01/2021	

Results in the heat map indicate that, for STX, there are three plans that perform well overall. These plans are P0, P1, and P3. In terms of economics, P0 has the lowest total CPWC, but P1 and P3 are also shaded green as they are within 1.5 percent of P0. In addition, P1 has the lowest CPWC without capital costs while P0 receives a yellow shading in this category as it is just over 1.5 percent more costly than P0. In the loss of load category, P1 and P3 have a significant advantage over P0, which has approximately two times the average loss of load hours versus the other two plans. All three plans score well in terms of RE targets.

Given all the scoring categories, **the recommendation is that P1 be considered the preferred plan for STX.** This recommendation is strongest when assuming that grant funding occurs (if grant funding does not occur, P1 and P0 would be very close overall, as P0 would be lower in cost but higher in loss of load hours). The recommendation of P1 constitutes a change from the least cost plan (P0) when ranked according to the total CPWC. The recommended plan is summarized in Table 1-10.

Table 1-10 The Recommended Expansion Plan for STX (Plan P1)

UNITS ADDED	DATE ADDED	UNITS RETIRED
Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
Hera PV 10 MW	01/01/2021	
Longford Wind 5 x 3.3 MW	07/01/2021	
RICE 8 MW LPG	07/01/2022	
3 x RICE 7 MW LPG	07/01/2022	

Richmond BS 10/20	07/01/2022	

1.8 RECOMMENDATIONS

Expansion plan P0 is recommended for STT and P1 is recommended for STX under the assumption that VIWAPA would receive grant funding for capital cost additions (if grant funding is not obtained, STX plan P0 would be better economically, but very close in overall plan merits as P0 is not as reliable as P1). Implementing these plans will require significant effort to initiate the active development of individual projects and to achieve commercial operation according to the optimal timeframe. Concurrent with the development of new projects, VIWAPA will also be coordinating the planned retirement of existing units. Major activities include:

- Obtain internal and external approval of the recommended expansion plans for STT and STX. The approvals include those from the VIWAPA management and Board, plus approvals or agreement from bond holders and U.S. funding agencies such as FEMA and HUD.
- Pursue grant funding. Given that the recommended expansion plans call for the addition of new resources on STT and STX at the start of 2021, the availability of funds for the early projects should be secured early in 2020.
- Continue to refine cost and performance characteristics of selected RE projects. While information has been developed for candidate RE projects on STT and STX, the information is generally at the pre-feasibility study level. This means that the project costs are likely in the +/- 25 percent range, that the performance estimates are also approximate, and that unanticipated issues could arise that prevent site development. As updated information is obtained, the expansion planning model used in this IRP should be updated.
- Perform additional studies to support this IRP including a rate study and transmission studies. This IRP estimates the incremental costs that will be incurred over the planning period by VIWAPA customers. The incremental costs do not include sunk costs and costs common to all plans, such as general administrative costs and existing debt. A rate study will estimate the all-in costs and resulting VIWAPA rates by customer class. This information will provide a more complete picture of the future costs to be paid by VIWAPA customers.
- Transmission studies are needed to confirm that system stability and load flows will be within adopted standards for the preferred expansion plans. Transmission studies are especially important given the addition of significant new RE resources. The intermittent nature of these resources means that sufficient spinning reserves and frequency regulation capability must be available at all times to prevent outages should a sudden decrease in RE output occur. Should transmission studies indicate that additional investment in generation or transmission facilities are required for incremental resources, the economic planning model should be updated to reflect these refinements and to confirm that the preferred plan remains economically viable.
- Evaluate PPA vs. self-owned options for RE projects. VIWAPA has received unsolicited offers to sell power from proposed RE facilities. These PPA offers have been evaluated as part of this IRP and compared against VIWAPA-owed RE facilities. VIWAPA will face the decision as to whether additional PPA offers should be sought through a formal bidding process in which proposals for new RE power are sought. In part, this can be done through an avoided cost analysis of the PPA offers. Given the near-term need for new RE facilities, the decision about issuing a formal RE RFP should be made by the end of 2019.

- Issue an RFP for conventional power supply proposals (assuming LPG as primary fuel). VIWAPA should issue a conventional power supply RFP. The RFP should inform potential bidders of the preference for RICE units as determined in this study, but combustion turbine and combined cycle options should also be allowed. This RFP process should be initiated in the first half of 2020 due to the preferred in-service date of mid-2021 on STT and mid-2022 on STX.
- As bids from the conventional and possibly the RE RFP are received, they should be evaluated from a technical, commercial, and economic perspective. Part of this evaluation process will be to update the planning model to reflect the bids and to confirm that the preferred plan remains economic.
- VIWAPA should develop detailed timelines for new project development. These timelines should be updated as new information arises and any significant changes should be evaluated in the planning model to determine the impact on CPWC.
- This IRP has shown that it is economical to retire several of the existing units or not to renew leased units. VIWAPA should develop a retirement schedule, but this schedule should be flexible to accommodate possible delays in the development of new resources.
- The project development timeline should allow sufficient time to negotiate all agreements, secure permits and approvals, finalize financing, and to allow for sufficient construction and start-up time requirements.
- While the planning model used to develop this IRP should be updated on a continuous basis over the next three years, a long-term IRP cycle of three years is recommended.

2.0 Introduction

Black & Veatch has prepared this Integrated Resource Plan (IRP) to evaluate power supply options for the separate electric power systems on the islands of St. Croix (STX) and St. Thomas (STT, which also is linked to the island of St. John via an underwater power cable). The IRP covers a 25-year IRP planning horizon from 2020 to 2044. The importance of this IRP is magnified as the result of the destruction brought about by Hurricane Irma and Hurricane Maria in 2017. These two hurricanes devastated most of the transmission and distribution network on STT and STX and destroyed many of the industrial, commercial, and residential structures that consumed power.

The overall objective of the IRP is to *identify the mix of incremental resources that will achieve a safe, adequate, and reliable supply of power at the lowest reasonable cost and in an environmentally acceptable manner*. Incorporated into this overall objective are the environmental targets of having at least 25 percent of installed capacity (as a percent of peak demand) from renewable energy (RE) resources by 2020, with the percentage increasing to 50 percent by 2044.

To achieve these environmental targets, several specific RE projects have been identified and evaluated for each electric system. These RE projects have been evaluated with the option of also installing energy storage options that could help firm-up the RE resources, meaning that energy generated from renewable energy could be stored and used to meet energy requirements at times—such as during the evening peak period—that differ from when the energy is generated. While storage was prohibitively expensive for most applications only several years ago, capital costs decreases have occurred and are expected to continue, making energy storage options increasingly viable.

The remainder of Section 2 describes the IRP process. The section is followed by:

- Section 3, which discusses major assumptions for the IRP including the load forecast, the fuel price forecast, and the IRP planning criteria;
- Section 4, which discusses the candidate generating options considered for the IRP, including thermal and renewable energy plus storage options;
- Section 5, which discusses the economic model PLEXOS used in the analysis and the results of the base case generation expansion plans; and
- Section 6, which sets forth the results of expansion plan sensitivity evaluations
- Section 7, which sets for IRP conclusions and recommendations.

2.1 THE IRP PROCESS

Integrated resource planning is the process undertaken by utilities to select resources best able to meet future peak and energy requirements in an economical manner while maintaining system reliability and meeting environmental goals. Utilities are frequently required by state legislation or utility regulators to undertake planning efforts that are then reviewed and require approval. For this IRP, there is added focus on the study results as federal U.S. funding of the selected expansion plan capital costs is expected to occur as a means of helping the U.S. Virgin Islands recover from the recent hurricanes. It is the intent of all parties involved for these expenditures to be made in a cost-effective manner.

Identification of the optimal plan in an IRP requires the use of sophisticated analytical tools that are capable of fairly evaluating and comparing the costs and benefits of supply and demand resources

as well as the integration of utility-scale and distributed energy resources. In this IRP, the software PLEXOS, marketed by Energy Exemplar, is utilized as a production costing and expansion planning tool. Figure 2-1 indicates the costs captured in the IRP process and how these are stated on a present worth basis, called the cumulative present worth cost (CPWC), which economic allows comparisons among competing plans.

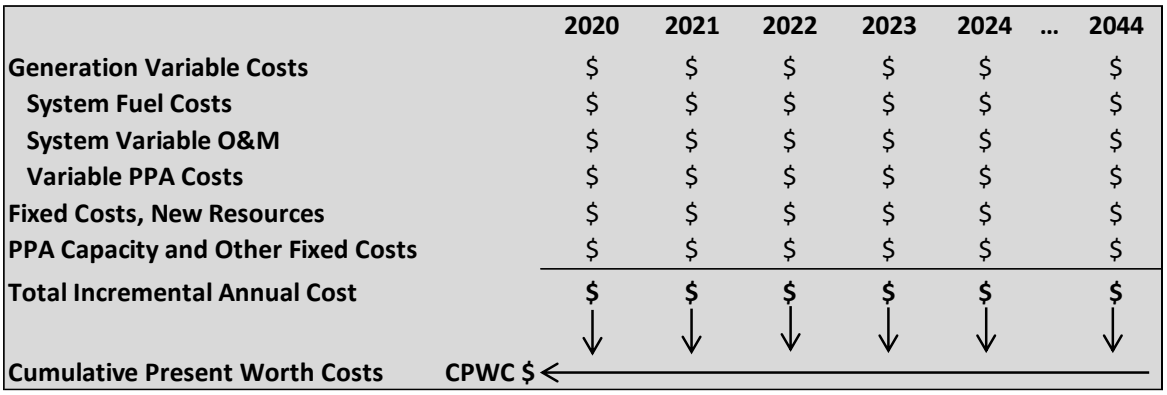

Figure 2-1 Deriving the Cumulative Present Worth Cost (CPWC) of an Expansion Plan

In the end, the plan tentatively identified through the IRP should also be evaluated through technical power system stability and load flow studies conducted to confirm that the preferred plan from the IRP will not violate system frequency, voltages, and other technical limits. Should these technical limits be violated, it would mean that the preferred plan may not be chosen or would need to be modified to avoid load shedding and system instability. Once the most viable expansion plan is tentatively identified through this IRP process, VIWAPA will engage in additional technical studies to ensure system stability and load flows. The final expansion plan will consider economic costs, environmental goals, and power system reliability and integrity.

Environmental goals usually include targeted RE resources and many systems also target reduction in carbon emissions. Given that most of the VIWAPA capacity is old, inefficient, and dependent on fossil fuel (fuel oil and LPG), a heavy emphasis of this IRP is to reduce costs while also reducing the dependence on fossil fuel. In this IRP, several specific solar and wind RE options are evaluated for STT and STX.

Due to the long-term planning period involved in the IRP process (2020-2044 in this study), it is apparent that projections of many future prices and conditions are required. Uncertainties or risks typically assessed through sensitivity analyses in IRPs include fuel prices, load growth, and sometimes capital costs, among other factors.

Key steps taken in developing an IRP include:

- receiving and responding to public participation
- forecasting future loads
- identifying potential resource options to meet those future loads
- determining an optimal mix of supply resources based on the goal of minimizing system costs

- determining how the leading economic resource plans fit other key objectives of the planning process
- reporting results and finalizing the IRP based on stakeholder comments and participation

These key steps in the resource planning process are illustrated in Figure 2-2.

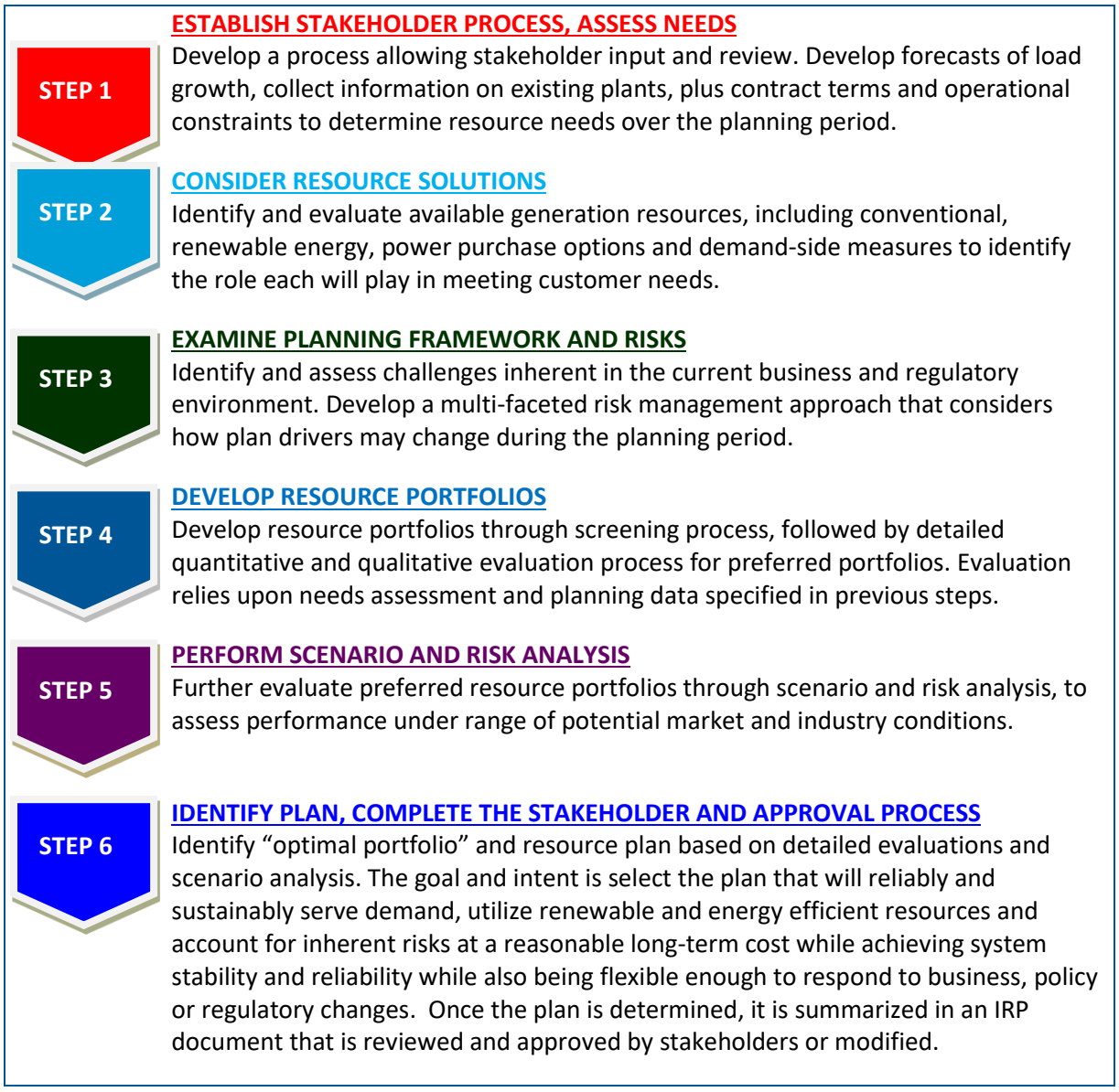

Figure 2-2 Integrated Resource Planning Process

In developing this IRP, VIWAPA established three key criteria to be achieved in conjunction with the overarching objective for cost minimization:

- Maintaining system reliability and integrity (measured in terms of loss of load hours)
- Expansion of renewable resources (measured against the adopted goal of at least 25 percent RE in 2020, growing to at least 50 percent of system peak in 2044, measured as the combined installed capacity for STT and STX as a percent of peak demand)
- Fuel diversity (especially a reduced reliance on fuel oil for generation)

The preferred expansion plan was developed by giving the PLEXOS model the ability to optimize the system in terms of evaluating the possible retirement of all existing thermal capacity and installing higher efficiency thermal units (reciprocating engines) plus solar and wind RE projects. The fuel options considered for thermal units include cleaner-burning LPG and LNG. The flowchart presented in Figure 2-3 illustrates how these considerations and objectives were incorporated into the VIWAPA IRP process. Fundamental activities key to the process included:

- Review of existing resources: both from an economic and operational perspective
- Evaluation of new resource options, both conventional and renewable
- Establishing metrics and parameters: for example, regulatory, environmental compliance, etc.
- Determining the optimal mix of resources based on the goals of minimizing future electric system costs, renewable resource targets, and other tangible and intangible objectives
- Receiving and responding to stakeholder participation
- Creating and implementing the resource plan when other technical studies are made the resource selection is finalized

The IRP process is *dynamic* in nature. It represents a snapshot of future conditions that can change and impact future resource decisions. The IRP should involve a methodology and framework that can assess a utilities ever-changing business and operating requirements and adapt to changing technology, regulations, and customer behavior. Assumptions, scenarios, and results are all challenged and updated as information and events unfold, and the process is continually revisited under formal or informal resource planning efforts.

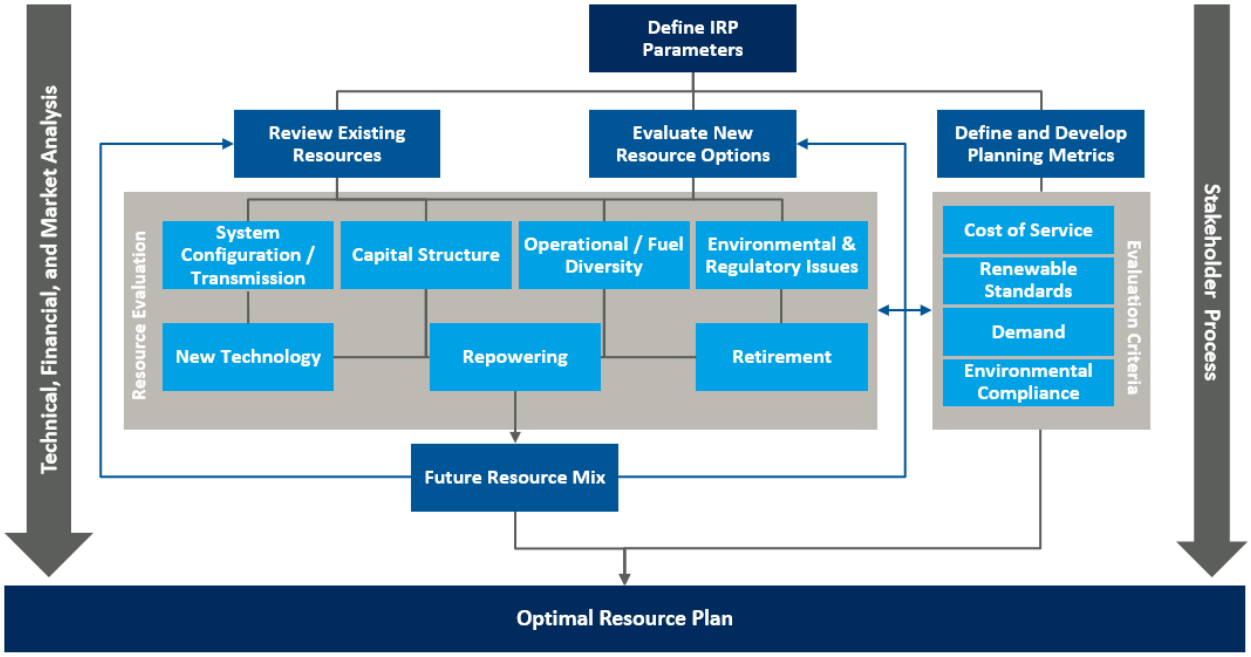

Figure 2-3 IRP Process Flowchart

2.2 THE STAKEHOLDER PROCESS

It is important for an IRP to be developed with input from various stakeholders outside the utility. Stakeholder input provides various perspectives as to the proper emphasis of the IRP, material issues that need to be addressed, and the merits of the competing resource plans.

For the current IRP, the stakeholder input has benefited from the involvement of several organizations that are working with VIWAPA to achieve financial stability and to recover from the 2017 hurricanes. On July 17-19, 2019, initial IRP meetings were held at the Black & Veatch offices in the Kansas City vicinity and individuals from the following organizations participated:

- VIWAPA
- Black & Veatch
- The National Renewables Energy Laboratory (NREL)
- New York Power Authority (NYPA)
- PA Consulting on behalf of the major VIWAPA bond holder

At these initial meeting, various issues related to the IRP study were discussed and major assumptions were developed. These assumptions, some of which were further modified over the subsequent two months, became the source of modeling inputs (see Section 3). In addition to those at the meetings in Kansas City, VIWAPA has been in frequent contact with their regulator and other stakeholders.

As this draft IRP document is reviewed and finalized, the opportunity for additional stakeholder input will be provided and will be considered. An opportunity for public input will also occur. The public input process will allow VIWAPA customers, regulators, power producers, lenders, the U.S. government, and other interested parties to have input into the final IRP.

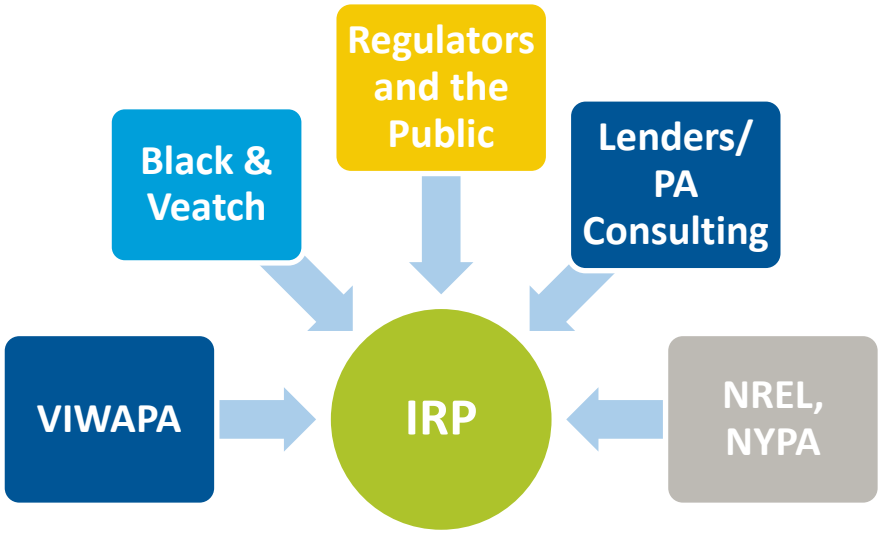

Figure 2-4 Stakeholder Engagement

3.0 Major IRP Assumptions

This section lists the major assumptions used in the 2019 VIWAPA IRP. The assumptions are the result of meetings held at Black & Veatch offices on July 17-19, 2019, plus additional information provided by VIWAPA or developed by Black & Veatch with VIWAPA and supporting organizations (primarily NREL and NYPA) since the meetings. For the load forecast and fuel prices, assumptions include base, high, and low values that form the basis for the sensitivity evaluations performed.

3.1 INFLATION AND ESCALATION RATES

For this IRP, the general inflation rate is assumed to be 2.0 percent per year in nominal terms. The general inflation rate applies to the escalation of capital costs, fixed O&M escalation, and nonfuel variable O&M cost escalation. This annual rate is applied to initial costs to derive estimates of future year costs.

3.2 FINANCING ASSUMPTIONS

VIWAPA is a public utility that has historically financed new generation using 100 percent debt. Following Hurricane Irma and Hurricane Maria, however, the U.S. federal government (through FEMA and HUD) committed to provide significant amounts of grant funding for new generation, contingent upon several conditions including the completion of the VIWAPA IRP.

At the July 2019 IRP meetings, it was initially assumed that grant funding in the amount of $200 million would be provided to VIWAPA. Once this amount was exhausted, it was assumed that there would be other funds will be provided on a cost share basis, with the U.S. federal government providing 90 percent of the funding and VIWAPA providing 10 percent of the funding. This assumption was later updated to reflect the assumption that once the initial grant funding was exhausted, additional grand funding from the U.S. government sufficient to cover all capital costs of new VIWAPA investments would be secured.

Consequently, this IRP estimates two measures of system costs going forward. One measure is the total CPWC that includes capital costs of new resources while a second measure of CPWC assumes that U.S. government funding will not be repaid by VIWAPA or the Virgin Island government. This second CPWC measure omits the capital costs of new resources and reflects the cost of expansion plans to VIWAPA customers.

3.3 PRESENT WORTH DISCOUNT RATE

The competing expansion plans in this study are compared on a present worth basis (CPWC) to account for the time value of money. As shown in Figure 2-1, determining the CPWC for an expansion plan involves discounting the estimated incremental cost of serving load each year back to the start of the study period (2020 in this IRP) and then summing up the discounted annual cost numbers to derive a single CPWC amount.

The normal convention in most planning studies is to use a discount rate equal to the utility's weighted cost of capital. For VIWAPA, the capital mix has traditionally involved 100 percent debt financing and the cost of debt funding would normally be used for the discount rate. However, the grant funding assumed for this study and VIWAPA's current lack of access to the capital market makes the selection of a discount rate less straight forward.

For the purposes of calculating the CPWC of competing expansion plans, all capital costs for projects funded through U.S. government grant funding (which is assumed to apply to all new unit

capital costs) are discounted at an assumed thee percent cost to account for the societal cost of U.S. government grant funds. Remaining costs are discounted at five percent, a proxy for the long-term VIWAPA cost of capital (even though the utility does not currently have access to the capital markets at reasonable rates). This approach is used for the total CPWC calculation. For the second CPWC calculation in which capital costs are not included (to reflect VIWAPA customer costs under grant funding), a discount rate of five percent is used.

3.4 LEVELIZED FIXED CHARGE RATE

The fixed charge rate (FCR), represents the sum of a project's fixed charges as a percent of the initial investment cost. When the FCR is applied to the initial investment, the product equals the revenue requirements needed to offset the fixed charges during a given year. The revenue required to repay fixed charges is roughly comparable to the notion of repaying a car loan or a home mortgage over time.

A separate FCR can be calculated and applied to each year of an economic analysis, but it is common practice to use a single, levelized FCR that has the same present value as the year-by-year fixed charge rate because the levelized FCR is easier to apply than is a series of annual fixed charge rates. The FCR reflects the cost of capital that is used to fund a project. In this IRP, the levelized fixed charge rate applied to generating alternatives reflects the cost of capital assumed for new investments in generation facilities. In this IRP, a 20-year FCR recover period is assumed.

For the CPWC analysis, a three percent cost of funds is used as the basis of the FCR calculation in the societal cost, total CPWC estimate.

3.5 OWNER'S COSTS

The total capital costs of a power plant are commonly divided into engineer-procure-construct (EPC) costs and owner's costs. The EPC costs include the cost of inside-the-fence plant equipment, construction costs, and other costs shown in Table 3-1 that would be not normally be included in a turn-key EPC bid and would be incurred by the owner. For this IRP, a 20 percent adder to the EPC costs has been added for all technologies.

Table 3-1 Potential Owner's Costs

Project Development:
- Site selection study, site survey
- Meteorological tower
- Land purchase / options / rezoning
- Transmission & gas pipeline rights of way
- Road modifications / upgrades
- Site cleanup, remediation
- Demolition
- Environmental permitting / offsets
- Public relations / community development
- Legal assistance
- Engineering studies – water and fuel supply, transmission
- Market assessments
- Financial model

Utility Interconnections:
- Natural gas service
- Gas system upgrades
- Electrical transmission
- Raw or grey water supply
- Potable water supply
- Wastewater / sewer

Spare Parts and Plant Equipment:
- Air quality control systems materials, supplies, and parts
- Acid gas treating materials, supplies and parts
- Combustion turbine and steam turbine materials, supplies, and parts
- HRSG materials, supplies, and parts
- Gasifier materials, supplies, and parts
- Balance-of-plant equipment materials, supplies and parts
- Rolling stock
- Plant furnishings and supplies
- Operating spares

Owner's Project Management:
- Preparation of bid documents and selection of contractor/s and suppliers
- Provision of project management
- Performance of engineering due diligence
- Provision of personnel for site construction management

Plant Startup/Construction Support:
- Owner's site mobilization
- O&M staff training
- Supply of trained operators to support equipment testing and commissioning
- Initial test fluids and lubricants
- Initial inventory of chemicals / reagents
- Consumables
- Cost of fuel not recovered in power sales
- Auxiliary power purchase
- Construction all-risk insurance
- Acceptance testing

Taxes/Advisory Fees/Legal:
- Taxes
- Market and environmental consultants
- Owner's legal expenses:
  - PPA
  - Interconnect agreements
  - Contracts--procurement & construction
  - Property transfer

Owner's Contingency:
- Owner's uncertainty and costs pending final negotiation
- Unidentified project scope increases
- Unidentified project requirements
- Costs pending final agreement (e.g., interconnection contract costs)

Financing:
- Development of financing sufficient to meet project obligations or obtaining alternate sources of funding
- Financial advisor, lender's legal, market analyst, and engineer
  - Allowance for Funds Used During Construction (AFUDC)
- Loan administration and commitment fees
- Debt service reserve fund

Miscellaneous
- All costs for above-mentioned Contractor-excluded items, if applicable

3.6 INTEREST DURING CONSTRUCTION INTEREST RATE

The interest during construction (IDC) rate accounts for the interest cost of drawing down borrowed funds during the plant construction period. IDC is the last adder to derive the total in-service capital cost of a new generating unit. The approach taken for this IRP is to follow the overnight/mid-point of construction convention used when a detailed monthly drawdown expenditure curve is not available. In this convention, the capital cost of a plant is escalated to the mid-point of construction using the general escalation rate (2.0 percent in this IRP), then overnight construction at the mid-point is assumed and interest is calculated from the mid-point to commercial operation using the IDC rate, which is usually set equal to the utility's cost of capital. In this IRP, the IDC rate is set to the assumed 3 percent for the CPWC calculation reflecting the social cost of U.S. government grant funds.

3.7 LOAD FORECAST

When performing an IRP, detailed assumptions are required about the utility peak demand over the forecast period and the energy required each year. The peak demand is the highest single hour demand value (in MW) experienced on a utility system. The energy requirements are the summation of all hourly demands on a system and are expressed in MWh. The hourly energy requirements on a system also produce a load shape, when plotted on a graph. The load shape will vary by utility system but will often reflect a high energy demand during afternoon or evening periods coinciding with high commercial and industrial demand and peak temperatures during the day and high residential use in the evening.

In most IRPs, the forecast of peak demand and energy requirements needed for system modeling software is developed through econometric or other statistical methods that project future requirements based on the historical relationship of peak demand and energy consumption with independent variables such as population, energy price, and temperature data. Due to the destruction of the VIWAPA systems in 2017 as the result of Hurricane Irma and Hurricane Maria, the power systems of the islands were essentially destroyed and the ability to project future power needs based on historical data has been compromised. The islands are still recovering from the destruction and have not yet reached pre-hurricane levels. Therefore, meaningful results cannot be obtained through traditional methods and an alternative forecasting method was needed.

Due to these events, the load forecast for use in this study relies heavily on the judgement of the VIWAPA staff and other stakeholders who closely track the rebuilding of the power system and have insight as to the customers that may not return to the grid. The VIWAPA staff is also aware of potential new loads that could be added to the power systems. Based on these observations and limited data, the IRP includes a base case (most likely) forecast, a high load forecast, and a low load forecast.

The **base load forecast** assumes no growth during the 2020-2044 planning period. In part, this assumption reflects the impacts of the 2017 hurricanes and the likelihood that some customers will not return to the grid, plus the expected behind-the-meter solar installations over the next 10 years and the resulting impact of reducing energy requirements from VIWAPA. Under the base load forecast, the peak demand for STT is 55.8 MW in 2020 and is assumed to stay flat. The peak demand for STX is 38.3 in 2020 and is assumed to stay flat.

The **high load forecast** assumes that peak demand and energy requirements are flat for five years, and then experience a stair-step increase in the amount of 25 MW in peak demand that occurs three days a week and ten hours per day (7:00 a.m. to 5:00 p.m.) as the result of a new cruise ship port

that has been proposed on St. Thomas. It is also assumed that when the 25 MW is not being used to power the port, 10 MW will be sold to the British Virgin Islands. The 25 MW increase in demand that begins in 2025 is assumed to increase by one-half of one percent (0.5 percent) annually for the remainder of the planning study. The assumed associated capital cost with the cruise ship port electrical infrastructure is $100 million and a capital cost of $46.5 million is assumed for the British Virgin Islands interconnection.

The **low load forecast** assumes that the load on the STT and STX systems decreases over time due to economic conditions, increased self-generation by consumers, or due to behind-the-meter installation of solar. The low load forecast assumes that the load decreases by ten percent on each system over the next ten years. The ten percent reduction over ten years is staged so that half of the decline occurs in the first three years and then the second half over the next seven years. After that, load is flat for the duration of the IRP. Note that this sensitivity was changed from the initial assumption document which projected the low load to be linked exclusively to behind-the-meter solar installations, but this option—as part of a VIWAPA-funded program—is now modeled as a supply-side option. Thus, the low load case now assumes that the solar installations are customer-funded and independent of the VIWAPA-funded behind-the-meter solar options.

3.8 LOAD SHAPE

PLEXOS is a detailed chronological production costing model that dispatches available generation to meet energy requirements on an hourly basis and, therefore, requires the total annual energy requirements to be allocated on an hourly basis (8,760 hours) during the year. This is the system load shape.

For this IRP, the load shape is based on the July 2018 through June 2019 energy requirements on each VIWAPA system. This allows the load shape to reflect post-hurricane system load characteristics. Load information received from VIWAPA was reviewed and obvious problematic data and outliers were adjusted based on load levels for comparable periods. The load shape data received for St. Croix is shown in Figure 3-1 and the adjusted load shape is shown in Figure 3-2. For St. Thomas, the received and corrected load shape data are shown in Figure 3-3 and Figure 3-4, respectively.

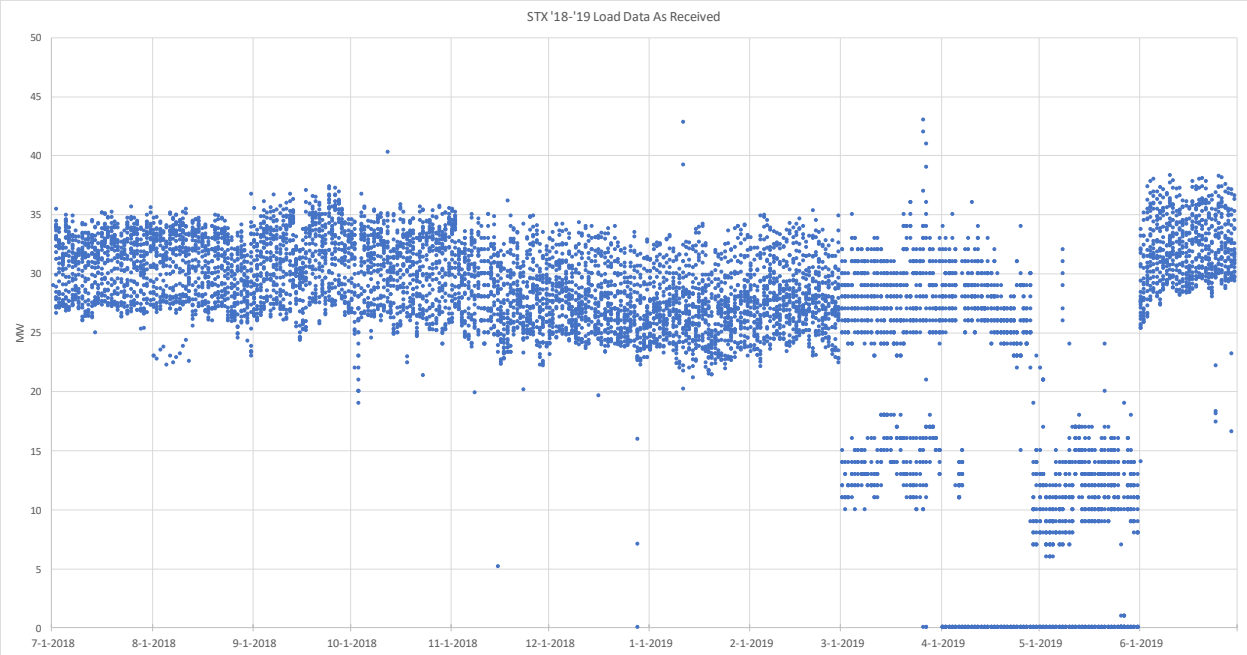

Figure 3-1 Received Load Shape Data for STX

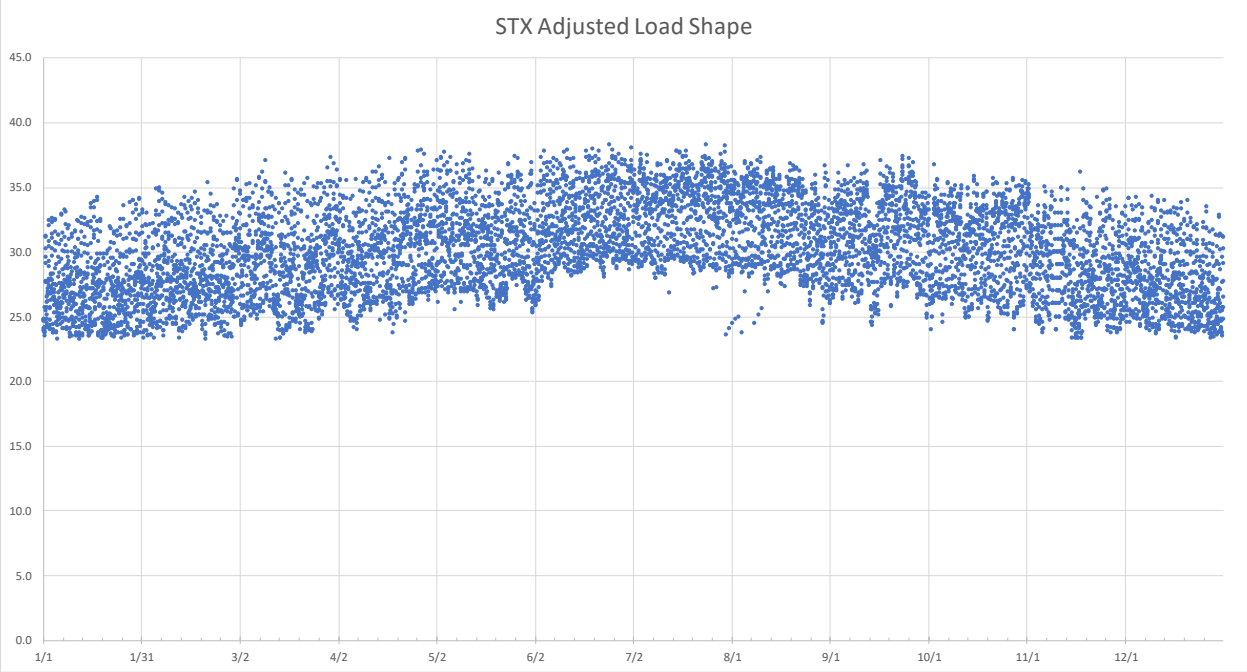

Figure 3-2 Adjusted Load Shape for STX after Adjusting Problematic Data

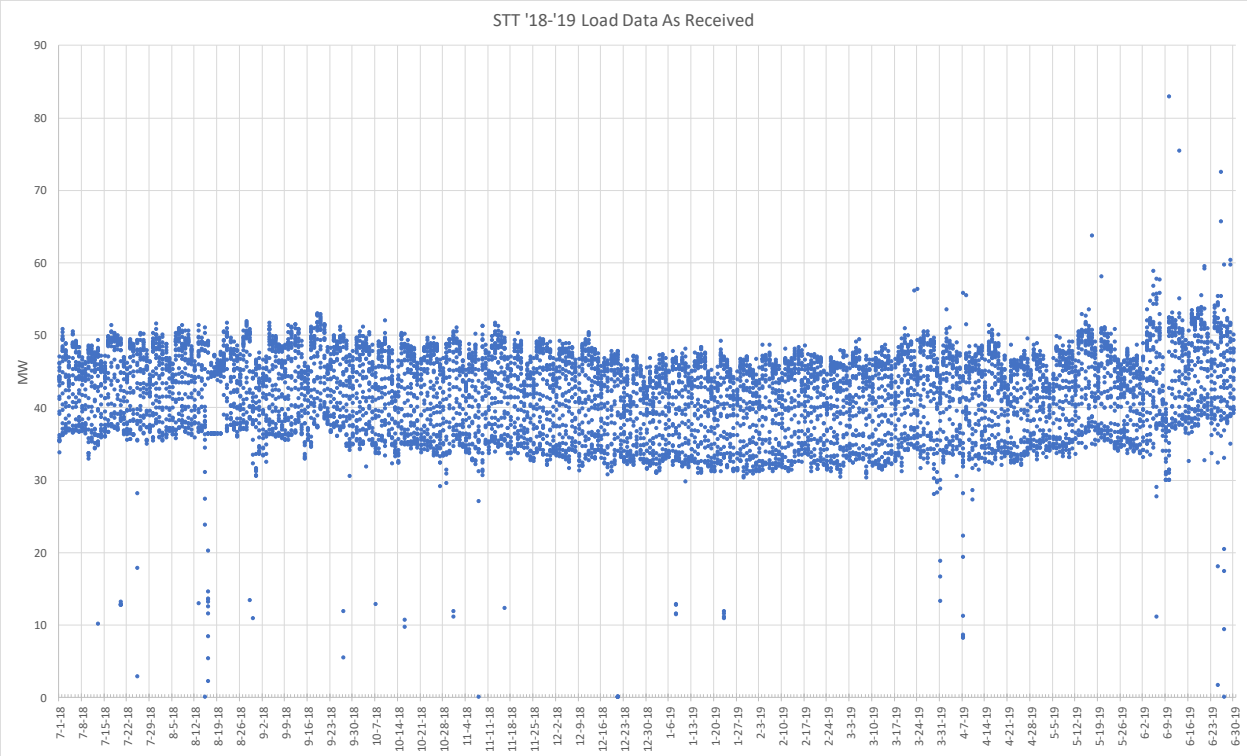

Figure 3-3 Received Load Shape Data for STT

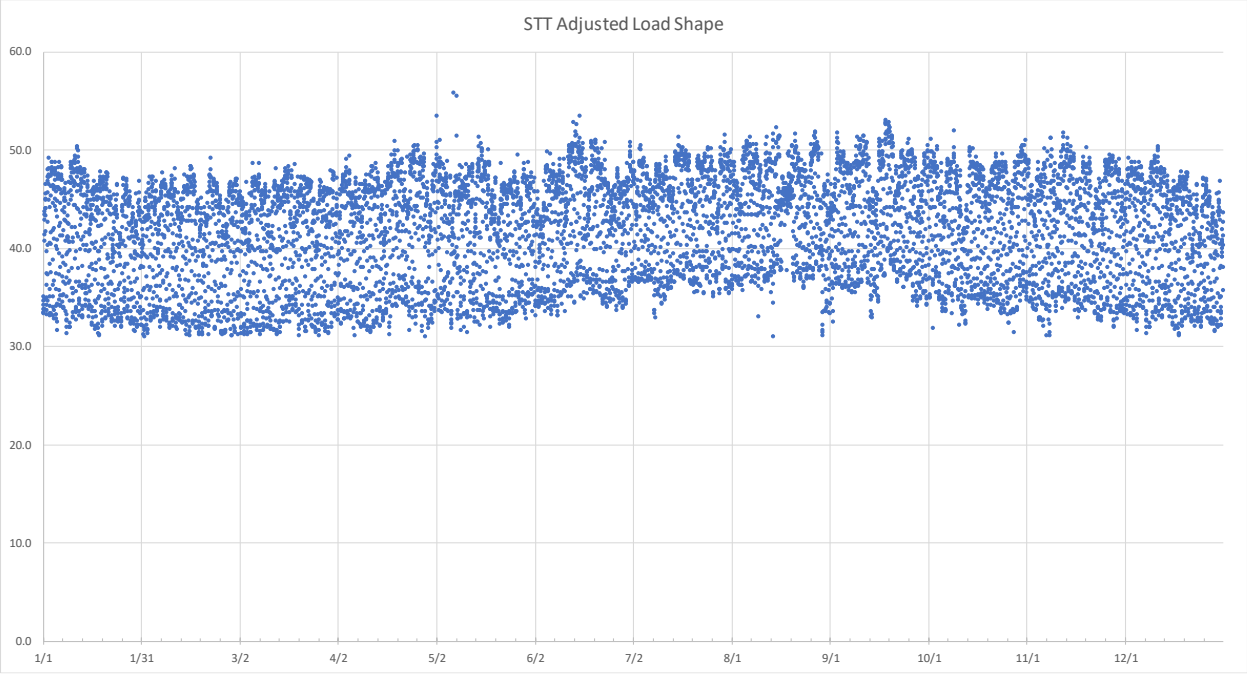

Figure 3-4 Adjusted Load Shape for STX after Adjusting Problematic Data

3.9 PLANNING RESERVE CRITERIA

Sound system planning requires utilities to have sufficient available capacity to meet peak demand. To meet peak demand, prudency also requires utilities to install additional capacity above peak demand such that shortages do not occur if the peak demand is higher than anticipated or if a generating unit or transmission line is out of service due to an outage event. The amount of additional capacity installed involves the adopted planning reserve criteria.

Some utilities adopt planning reserve criteria expressed as a percent reserve margin. This involves the installation of capacity above the anticipated peak demand. The planning reserve margin is expressed as a percentage is often in the 12 to 20 percent range, depending on the utility size, location, and interconnections. The larger the utility, the greater the interconnections with other utilities, and the less vulnerable is the utility to weather-related incidents, the lower is the adopted planning reserve margin.

Other utilities adopt a planning reserve criterion that allows them to meet peak demand if the largest single unit or transmission line is out of service. This approach is called "N-1" and it is widely used for smaller systems. VIWAPA has adopted an N-1-1 planning criterion meaning that it plans to have sufficient installed capacity to meet peak demand in the event that the largest two units or lines are out of service. For example, if one unit is on a planned outage and a second unit trips off-line, VIWAPA plans to have sufficient capacity to still serve its peak load in such a situation. This level of redundancy is appropriate for VIWAPA since it has two, small, island systems and it cannot rely on interconnections with other utilities (or even with its two systems) to serve loads. Given that the installed units are relatively small, the N-1-1 criterion results in a relatively modest amount of added capacity on each system to meet the reliability target.

In addition to the planning reserve criterion, VIWAPA has a loss of load reliability target of not exceeding one day of lost load per year currently, with the goal of meeting a one day in ten-year target by the end of the planning horizon. These criteria are applied in this IRP, but it is gradually introduced such that resources are added to meet the one day per year criterion no later than five years into the expansion plan (2024). This date avoids the need to install large amounts of capacity immediately and recognizes that funding and construction lead time present practical limits as to how soon the one day per year target can be met. Between 2024 and 2044, the loss of load requirement is gradually changed to reach the one day in ten-year target in the final year of the planning horizon.

Finally, because the loss of load criterion is not applied until 2024, a capacity reserve margin criterion is applied in the model from 2020 through 2024. For these years, a 10 percent capacity credit for solar and wind is assumed for these technologies, which contribute to the assumed 100 percent reserve margin requirement during that time short period (before the loss of load criterion becomes effective in 2024).

PLEXOS provides a calculation of loss of load hours (LOLH) as part of its simulation. Loss of load hours are reported in the CPWC results listed in Section 5, Section 6, and Appendix A.

3.10 SPINNING RESERVES AND FREQUENCY REGULATION

Spinning reserves refer to the ability of a utility to quickly increase generation if a unit trips and goes off-line unexpectedly. Utilities normally plan their dispatch such that synchronized units (on-line units) have sufficient unused generating capacity to quickly ramp-up and serve load if an outage occurs. Some utilities require all spinning reserves to be from synchronized units, while

other utilities may allow some of the spinning reserve requirements to come from quick-start units that are not synchronized but that can come on-line in 10 minutes or less.

Another operational consideration impacting unit dispatch and economics involves the need to provide system regulation and frequency response. This refers to the ability to increase or decrease electric output on a near-instantaneous basis in response to dispatch adjustments made to correct supply and demand imbalances. Resources that provide regulation must have the technical capability to ramp up or down quickly (measured by the MW/minute ramp rate) and are equipped with automatic generation control (AGC) such that the system operator can send signals electronically and achieve near immediate results.

Regulation consists of "regulation up" or "regulation down." Regulation up refers to the ability to increase unit output and regulation down refers to the ability decrease output. Examples of technologies that are well-suited to provide regulation include battery storage systems (BESS), hydroelectric generation with reservoirs, and reciprocating internal combustion turbines. Simple cycle and combined cycle units can also provide some regulation support while coal-fired units are not well suited to provide system regulation.

The importance of planning for adequate regulation has grown dramatically in recent years as intermittent, renewable resources such as wind and solar have penetrated most markets. While these technologies provide many benefits and have become increasingly cost competitive, they can also result in wide swings in output. This means that any system integrating intermittent RE resources must plan and operate such that sufficient resources to provide frequency regulation is on-line in the event that RE output encounters a sudden increase or decrease. For small, isolated systems such as those serving STT and STX, a failure to provide adequate regulation can result in load shedding and unstable power networks.

Figure 3-5 provides an illustrative example of the sudden increase and decrease of solar generation possible on a utility system. Note that not only does solar generation fluctuate widely during each day, but the pattern of production across days is not the same and makes it very difficult to plan for sufficient system regulation.

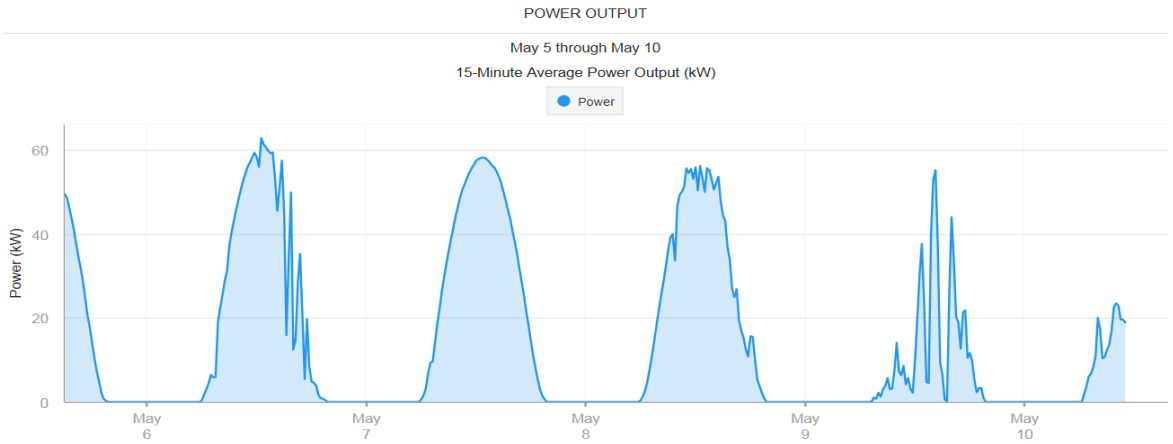

Figure 3-5 Solar Production Variation and the Need for System Regulation[1]

[1] Source: Black & Veatch

A similar pattern can exist with wind generation. Figure 3-6 is an actual wind production profile for an island system in the Caribbean. The sudden decrease of wind generation shown in the graph resulted in frequent outages that required energy storage and changes in system regulation requirements.

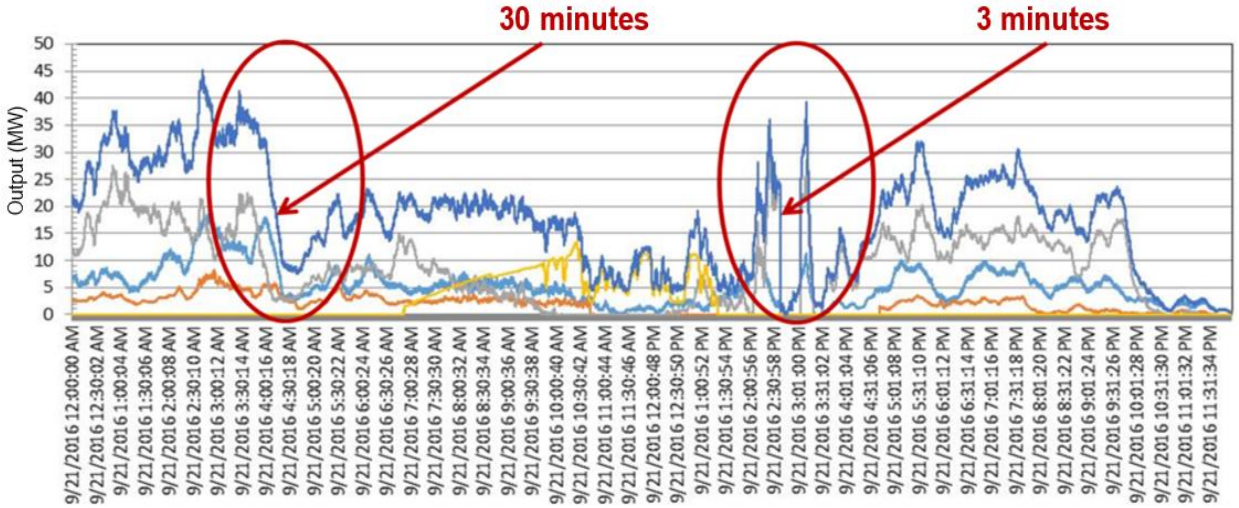

Figure 3-6 Sudden Decrease in Wind Production and the Need for System Regulation[2]

In the U.S., all regional transmission organizations (RTOs) and independent system operators (ISOs) have requirements for spinning reserves and frequency regulation. Table 3-2 summarizes the requirements for these U.S. markets.

Table 3-2 U.S. RTO/ISO Spinning Reserves and Regulation Requirements

RTO/ISO	SPINNING RESERVES	NON-SPINNING RESERVES	REGULATION
CAISO (California Independent System Operator)	Resources must be synchronized and able to respond within 10 minutes and run for at least two hours.	Resources need not be synchronized but must respond within 10 minutes and run for at least two hours.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.
ERCOT (Electric Reliability Council of Texas)	Synchronized resources must be able to respond in the first few minutes of an event causing a deviation in system frequency.	Resources must respond within 30 minutes and be able to run for an hour or more.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.
New England ISO (New England Independent System Operator)	Resources must be synchronized and able to respond within 10 minutes.	Two classifications: 10-minute response time non-synchronized reserves; 30-minute response time reserves that need not be synchronized.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.

[2] Source: Black & Veatch

RTO/ISO	SPINNING RESERVES	NON-SPINNING RESERVES	REGULATION
MISO (Midcontinent Independent System Operator)	Resources must be synchronized and able to respond within 10 minutes.	Referred to as supplemental reserves in MISO. Resources need not be synchronized but must be able to respond within 10 minutes.	Resources must be synchronized and able to increase (regulation up) or decrease (regulation down) output within five minutes in response to automated signals.
NYISO (New York Independent System Operator)	Two classifications: 10 minute and 30-minute spinning reserves that require resources to be synchronized to the grid.	Two classifications: 10 minute and 30-minute non-synchronized reserves.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.
PJM (Pennsylvania, New Jersey, Maryland)	Resources must be synchronized and able to respond within 10 minutes.	Resources must respond within 10 minutes.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.
SPP (Southwest Power Pool)	Resources must be synchronized and able to respond within 10 minutes.	Resources must be able to respond within 10 minutes.	Resources must be able to immediately increase (regulation up) or decrease (regulation down) output in response to automated signals.

Source: Zhi Zhou, Todd, Levin, and Guenter Conzelmann, Argonne National Laboratory, *Survey of U.S. Ancillary Services Markets*, June 2016.

VIWAPA recognizes that sound operating practices require it to have sufficient spinning reserves on-line such that it can quickly cover any single unit outage. However, this practice would result in high spinning reserve costs as units on-line would need to be operated at less than full load levels, which is not efficient. Therefore, in practice, VIWAPA often has not operated its systems to meet the targeted spinning reserve standard. Historically, no separate frequency regulation standard has been applied to the system.

In this IRP, the PLEXOS model was established to provide 8 MW of synchronized spinning reserves for each system (STT and STX). In addition, frequency regulation requirements were set equal to fifty percent of the RE capacity on-line during any hour.

3.11 RENEWABLE ENERGY TARGETS AND EMISSION COSTS

A major focus of this VIWAPA IRP is to identify the amount of renewable energy that can cost-effectively be added to the VIWAPA system and meets or exceeds the environmental requirements in place. At a minimum, the recommended expansion plan—expressed in terms of the percent of renewable capacity installed as a share of the STT plus STX peak demand—must be 25 percent in 2020, 30 percent in 2025, and 50 percent by 2044.

The modeling assumes that VIWAPA is charged a fee of $50/ton of emissions for NOx, SOx, VOC, and Particulate Matter. The PLEXOS model determines this cost and adds it as a production cost based upon the unit capacity factor and the emission rates of each model. This is a fairly minor cost as in 2018, VIWAPA paid approximately $20,000 in emission fees on STX and $30,000 on STT.

3.12 DEMAND SIDE MANAGEMENT AND ENERGY EFFICIENCY PROGRAMS

Demand side management (DSM) and energy efficiency (EE) measures and programs can be cost-effective means of reducing overall power costs. For systems facing high fuel costs, DSM/EE measures can especially help reduce the utility peak demand and energy requirements that are met by thermal units that are costly to run.

DSM/EE measures that may be cost-effective can vary significantly by climate, customer mix (residential, commercial, industrial), and other factors. Further, measures that appear to be cost-effective may face limited adoption and penetration levels if the disposable income of end-users is low. Given the impact of the Hurricane Irma and Hurricane Maria, the current reality is that VIWAPA has limited data available on residential housing and commercial and industrial facilities, and this makes it extremely difficult to identify potential cost-effective DSM/EE measures. Further, given the devastating impact of the hurricanes on the financial condition of most residents and power users, even identifying programs that should be cost-effective may not be adopted due to the lack of surplus disposable income by most end users at the current time.

Due to these considerations, this IRP does not include an extensive DSM/EE analysis. However, one of the recommendations of the study is that detailed end user information be collected through a thorough end use analysis to be conducted in a four-to-five-year time frame.

3.13 FUEL PRICE FORECAST

The fuel price forecast is one of the most important input assumptions in IRP studies because fuel costs are typically the largest single cost item for electric utilities. Nevertheless, it is difficult to accurately project fuel prices as the fuel sector has historically experienced high price volatility over a period of many decades. For this reason, IRP studies usually evaluate resource selection choices under more than one fuel price forecast.

In this IRP, expansion plans are developed under base fuel price projections and then the preferred plan for each system is also evaluated under high fuel price and low fuel price projections for the current fuels used by VIWPA, which consist of #2 distillate fuel oil and liquid propane (LPG). In addition, the IRP evaluates the economics of importing LNG and using it for existing units capable of burning natural gas as well as new units that could be designed with this capability.

The economic analysis incorporates the obligations VIWAPA has incurred related to the delivery of LPG. VIWAPA has an existing contract with VITROL LPG for handling and delivery facilities. Payments VOTROL LPG include a monthly fixed cost payment and O&M payment. VIWAPA has an option to buy-out the VITROL LPG facilities on St. Croix and St. Thomas that are used to provide LPG. This buy-out would end the monthly fixed cost payment and VIWAP could choose to either continue operation of the LPG facilities and encounter on-going O&M costs, or it could shut down the facilities altogether.

3.13.1 Base Case Fuel Price Forecast

The fuel prices assumed in the base case fuel price forecast are shown in Table 3-3. The forecast of distillate fuel prices is based on the short-term price forecast for distillate fuel for power generation published by the *Energy Information Administration* (EIA) in their July 2019 *Short-Term Energy Outlook* (Table 2 Energy Prices). The commodity price ($17.40/MMBtu in 2020) is then escalated according to the long-term percentage increase in diesel fuel assumed in the 2019 *Annual Energy Outlook* (AEO) published by the EIA. A delivery charge (escalated at 2 percent per year) is also included in the price shown in Table 3-3. All prices are nominal delivered prices in $/MMBtu.

The delivered price for distillate fuel oil is $19.92 per MMBtu in 2020. The projection of LPG is adopted from the VIWAPA delivered price projection for 2020-2024 and includes a delivery charge escalated at 2 percent per year. Beyond 2024, the delivered price is then escalated per the percent change projected for propane (transportation sector, no utility propane forecast is provided) in the 2019 AEO (Table 3) published by the EIA.

For LNG, the analysis assumes that VIWAPA will have the option to pursue bulk LNG imports, with the LNG gasified once it is off-loaded in the Virgin Islands. It is assumed that this could be an option as early as 2025. The assumed price for these deliveries is $3.00/MMBtu lower than the assumed price of LPG, based on information provided to VIWAPA by potential LNG providers.

Table 3-3 Base Case, Delivered Fuel Price Forecasts for the 2019 VIWAPA IRP, 2020-2044 ($/MMBtu)

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2020	$9.11	NA	$19.92
2021	$9.52	NA	$19.81
2022	$9.71	NA	$19.51
2023	$9.82	NA	$19.54
2024	$9.94	NA	$19.85
2025	$10.42	$7.42	$20.60
2026	$10.84	$7.84	$21.43
2027	$11.21	$8.21	$22.47
2028	$11.55	$8.55	$23.06
2029	$12.20	$9.20	$24.07
2030	$12.48	$9.48	$24.70
2031	$12.82	$9.82	$25.29
2032	$13.18	$10.18	$26.12
2033	$13.57	$10.57	$27.03
2034	$13.96	$10.96	$27.66
2035	$14.34	$11.34	$28.51
2036	$14.75	$11.75	$29.55
2037	$15.14	$12.14	$30.13
2038	$15.52	$12.52	$30.93
2039	$15.91	$12.91	$31.82

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2040	$16.31	$13.31	$33.50
2041	$16.69	$13.69	$33.60
2042	$17.11	$14.11	$34.66
2043	$17.55	$14.55	$35.50
2044	$18.00	$15.00	$36.29

3.13.2 High Fuel Forecast

The fuel prices assumed in the high fuel price case are shown in Table 3-4. The forecast of distillate fuel oil is adopted from the forecast for electric power distillate fuel in Table 3 of the *Long-Term Energy Outlook 2019* published by the *Energy Information Administration* (EIA) with the addition of VIWAPA's estimated delivery charge.

The projection of LPG assumes that the price will increase to $9.80 in 2020 and $10.80 in 2021. The 2022-2044 price would be 17 percent higher than the base case forecast for LPG. This percent differential is lower (by 50 percent) than the EIA short-term and long-term differential for distillate, but VIWAPA believes that the 17 percent differential is appropriate for a high forecast given its mid-term (through 2024) outlook for LPG.

For LNG, the assumed price for 2025 and beyond is $3.00/MMBtu lower than the assumed price of LPG, per information provided to VIWAPA.

Table 3-4 High Case, Delivered Fuel Price Forecasts for the 2019 VIWAPA IRP, 2020-2044 ($/MMBtu)

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2020	$9.80	NA	$25.86
2021	$10.80	NA	$25.70
2022	$11.37	NA	$25.27
2023	$11.50	NA	$25.30
2024	$11.64	NA	$25.70
2025	$12.20	$9.20	$26.69
2026	$12.69	$9.69	$27.78
2027	$13.13	$10.13	$29.16
2028	$13.52	$10.52	$29.92
2029	$14.28	$11.28	$31.26
2030	$14.61	$11.61	$32.08
2031	$15.01	$12.01	$32.86
2032	$15.43	$12.43	$33.95
2033	$15.88	$12.88	$35.14
2034	$16.34	$13.34	$35.96
2035	$16.79	$13.79	$37.08
2036	$17.27	$14.27	$38.46
2037	$17.72	$14.72	$39.21
2038	$18.16	$15.16	$40.26
2039	$18.62	$15.62	$41.43
2040	$19.09	$16.09	$43.66
2041	$19.54	$16.54	$43.77
2042	$20.04	$17.04	$45.16
2043	$20.55	$17.55	$46.26
2044	$21.08	$18.08	$47.29

3.13.3 Low Fuel Forecast

The prices assumed in the low fuel price case are shown in Table 3-5. The low forecast for distillate fuel oil is set equal to the base case cost in 2020-2023, and then is assumed to increase at half of the annual percentage increase in the distillate fuel oil price occurring in the base case forecast; the VIWAPA delivery charge is also added. The LPG forecast is set equal to the base case forecast for 2020-2023 and then is adjusted by one half of the yearly percentage change in the low versus the base forecast for distillate fuel projected by the EIA. The LNG forecast is based on an assumed $3.00/MMBtu discount to LPG prices.

Table 3-5 Low Case, Delivered Fuel Price Forecasts for the 2019 VIWAPA IRP, 2020-2044 ($/MMBtu)

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2020	$9.11	NA	$19.92
2021	$9.52	NA	$19.81
2022	$9.71	NA	$19.51
2023	$9.82	NA	$19.54
2024	$9.88	NA	$19.73
2025	$10.12	$7.12	$20.13
2026	$10.32	$7.32	$20.56
2027	$10.50	$7.50	$21.08
2028	$10.66	$7.66	$21.38
2029	$10.96	$7.96	$21.88
2030	$11.09	$8.09	$22.19
2031	$11.23	$8.23	$22.49
2032	$11.39	$8.39	$22.89
2033	$11.56	$8.56	$23.32
2034	$11.73	$8.73	$23.62
2035	$11.89	$8.89	$24.01
2036	$12.06	$9.06	$24.48
2037	$12.22	$9.22	$24.76
2038	$12.37	$9.37	$25.12

YEAR	LPG	LNG (CONTAINER, AVAILABLE IN 2025)	DISTILLATE FUEL OIL
2039	$12.52	$9.52	$25.51
2040	$12.68	$9.68	$26.21
2041	$12.83	$9.83	$26.29
2042	$12.99	$9.99	$26.74
2043	$13.16	$10.16	$27.10
2044	$13.33	$10.33	$27.44

3.14 EXISTING UNIT CHARACTERISTICS AND RETIREMENT ASSUMPTIONS

VIWAPA's existing generation facilities on St. Croix are located at the Estate Richmond site on the north shore of the island near Christiansted. VIWAPA's generating facilities on St. Thomas are located at the Randolph E. Harley Generating Station at Krum Bay, on the southwestern end of the island. All electric generation for the islands of St. Thomas and St. John, and the two smaller islands, Hassel Island and Water Island, are located at this site, except for an emergency diesel-generating unit located on the island of St. John. In addition to generation facilities, the Krum Bay site includes water production, fuel oil unloading and storage, transportation, and warehouse facilities.

The existing VIWAPA units are part of the integrated modeling in the planning study. The expansion planning and production costing modeling requires detailed cost and performance characteristics for the existing units. Key information for the VIWAPA units and for units it is leasing is shown in Table 3-6. Information includes fixed O&M costs (FOM), variable O&M costs (VOM), scheduled outage and forced outage rate (FOR) assumptions, full load net plan heat rate (NPHR) figures, plus the primary fuel and, if applicable, the secondary fuel.

The fuel options listed in the final column of Table 3-6 reflect VIWAPA's fuel enhancement of selected units over the past few years. The ability of selected units to burn LPG lowers the fuel cost verses burning fuel oil alternative, but the LPG delivery system has had availability issues that have reduced LPG usage below the optimum level. Recent improvements to the delivery system seem to have correct most of the issues and since May of 2019, the LPG system has been highly available. To reflect this improvement, the IRP assumes that the LPG fuel delivery system will be available 97 percent of the time.

The total modeled capacity for the STT units is 159.2 MW and this compares to a projected 2020 peak demand of 55.8 MW. For STX, the modeled unit capacity of 133.8 MW compares to a projected 2020 peak demand of 38.3 MW.

Table 3-6 Unit Characteristics for VIWAPA and Leased Units on STT and STX

EXITING VIWAP UNIT CHARACTERISTICS FOR 2019								
ST. THOMAS	UNIT TYPE	MW OUTPUT	VOM $/MWH	FOM $/KW-YEAR	SCHED. MAINT. DAYS/YR.	FOR, %	NPHR, MMBTU/MWH	PRIMARY & SECONDARY FUEL
Wärtsilä @ Randolf Harley Fac.	RICE	3 x 7.03	$13.28	$11.00	11	14.58	9.003	LPG
STT 14	CT	14.00	$8.63	$35.77	14	6.84	15.700	#2FO
STT 15	CT	21.00	$5.65	$42.16	14	4.16	16.025	LPG/#2FO
STT 23	CT	40.00	$3.57	$17.27	14	5.00	12.271	#2FO
STT 25(1)	CT	20.10	$20.00	$3.77	14	4.28	10.911	#2FO
STT 26(1)	CT	22.00	$2.74	$259.81	14	2.37	11.178	#2FO
STT 27(1)	CT	21.00	$2.74	$272.18	14	8.60	11.340	#2FO
ST. CROIX	**UNIT TYPE**	**MW OUTPUT**	**VOM**	**FOM**	**SCHED. MAINT.**	**FOR**	**NPHR MMBTU/MWH**	**PRIMARY & SECONDARY FUEL**
STX 17	CT	20.00	$1.41	$45.65	14	2.23	15.865	LPG/#2FO
STX 17 w. STG11	CC	27.00	$1.41	$46.77	14	2.23	11.752	LPG
STX 19	CT	20.00	$4.62	$42.05	14	1.00	17.658	#2FO
STX 20	CT	20.00	$1.20	$42.79	14	4.87	16.578	LPG/#2FO
STX 20 w. STG 11	CC	27.00	$1.20	$44.66	14	4.87	12.280	LPG
Aggreko(2)	RICE	19.80	$10.50	$401.71	0	0	9.827	LPG

1. Units 25-27 are the APR CTs that are under lease through 2020; the fixed O&M is adjusted to reflect the lease cost of units 26 and 27; for unit 25, the lease cost is tied to operating hours and is reflected in the VOM.
2. The Aggreko units are leased through 2021 and it is assumed that they can be extended by VIWAPA. The fixed O&M for these units reflects the lease cost.

In most IRPs, existing units are assumed to remain in operation or, if old, they may be assigned an assumed retirement date. The normal assumption is that it remains economical to keep existing generating units in commercial operation until their forced retirement date.

For the VIWAPA IRP analysis, the modeling allows the retirement of each existing VIWAPA unit if it is economical to do so. The potential for economic retirement arises due to the age, inefficiency, high overall installed capacity levels, and poor reliability of the units. When modeling the economics of retirement, the model has the option to keep a unit in service, in which case it incurs the unit fixed O&M expense, or it can retire the unit and avoid the fixed O&M cost if the fuel cost savings associated with keeping the unit in-service are not greater than the fixed O&M costs.

It is also noted that to keep some of the existing units in-service, additional capital costs would be required. For STT 14, an expenditure of $4.5 million is required if it is to be returned to service. For STT 17, an expenditure of $1.5 million is estimated. For STT 23, the unit is currently operational but VIWAPA wished to determine if converting the unit to burn LPG would be economical, and this would require an estimated expenditure of $1.5 million. In the expansion planning optimization, the PLEXOS model evaluates whether it is economical to make these expenditures.

Table 3-7 lists the RE projects currently in place on STT and STX. This list is reduced from what had been installed on the islands before the 2017 hurricanes.

Table 3-7 RE Projects for STT and STX

NAME	TYPE	CAPACITY MW (AC)	ESTIMATED ANNUAL ENERGY (MWH/YR)	ESTIMATED CAPACITY FACTOR (%)
Net Metering - St. Croix	Solar PV	6	7,897	21.5
Toshiba Solar STX (Spanish Town)	Solar PV	3.9	8,633	24.6
Net Metering - St. Thomas	Solar PV	11	15,006	18.3

4.0 The Expansion Planning Model and Candidate Generating Options

4.1 EXPANSION PLANNING AND PRODUCTION COST CALCULATION METHOD

Supply-side evaluations of generating unit alternatives are performed in this study using PLEXOS. The program has an optimal generation expansion planning optimization module (LT plan) in addition to a chronological production costing module (ST plan). PLEXOS is licensed from and developed by Energy Exemplar. These programs have been benchmarked against other optimization programs and have been shown to be effective modeling programs.

PLEXOS is a computer-based chronological production costing model for use in power supply system planning. PLEXOS simulates the hour-by-hour operation of an electric power system over a specified planning period. Required inputs include the operating and performance characteristics of generating units, fuel costs, peak and energy demand forecasts, and system hourly load profiles for each year.

PLEXOS summarizes each unit's operating characteristics for every year of the planning horizon. These characteristics include, among others, each unit's annual generation, fuel consumption, fuel cost, average net operating heat rate, the number of hours each unit is online, capacity factors, variable operations and maintenance (O&M) costs, and number of starts and associated start costs. Fixed O&M costs are also included where applicable. Fixed O&M costs for existing units are generally considered sunk costs in the short term and PLEXOS does not consider Fixed O&M in developing the dispatch costs of the units but does report it as part of the operating costs.

After the optimum expansion plan is developed by the PLEXOS LT plan module, the expansion plan is processed by the ST plan module's chronological production costing routines. The ST plan module is an hourly chronological dispatch tool that dispatches the units against load and/or market prices to determine units' specific and system operating costs for all hours and years in the study period. PLEXOS simulates hourly operation of the VIWAPA systems over the planning horizon and calculates each system's fuel and variable operating and maintenance costs and fixed O&M costs including those of new unit additions. Incremental capital costs are accounted for in the LT plan module but are not considered in the detailed chronological production costing routines (the capital costs are added outside the model using an Excel spreadsheet). Total system costs are then estimated for each year in the planning horizon and are summed on a present value basis to determine the CPWC of a plan.

Generally, the CPWC determined using the output from the PLEXOS ST planning module of PLEXOS are considered more accurate than the results obtained from the LT plan module because the LT plan module uses a representative load duration curve approach and does not consider all unit performance information as does the PLEXOS ST plan module. In some instances, the least cost plan selected in the LT planning module may not emerge from the detailed hourly modeling in the ST plan as the least cost option.

4.2 CANDIDATE GENERATING UNITS

The objective of this IRP is to determine the best mix of resources for the STT and STX electric systems going forward. Options evaluated include new conventional and RE generation, plus the retirement of existing units, if economical. In this section, the conventional and RE generation options for VIWAPA are identified and the cost and performance characteristics assumed are listed. Generally, the cost and performance of conventional technologies were developed by Black &

Veatch. The specific performance of RE options was developed primarily by NREL, while cost assumptions were developed primarily by NYPA and Black & Veatch. The RE options evaluated for STT and STX included projects at specific locations and estimated solar or wind resource information for that site measured directly or estimated based on the best available information. These estimates are at the pre-feasibility study level and should continue to be evaluated and updated.

It is important to note that to develop cost and performance assumptions, information was based on specific technologies and manufacturer units. However, these units are not identified for most categories in this section because *all cost and performance information is representative of the cost and performance reasonably achievable by multiple manufacturers within the same technology class*. Selection of a specific unit and manufacturer would come about only as the result of a competitive bidding process and an economic, commercial, and technical evaluation of bids.

4.2.1 Candidate Conventional Technologies

In the July 2019 meetings in Kansas City, it was agreed that the IRP would consider the conventional technologies listed in Table 4-1. The selection was based on the need for unit efficiency, fuel options (LPG, fuel oil, and possibly LNG), and unit sizes that would balance unit efficiencies with the need to avoid a single, large unit that, under an N-1-1 criteria, would require VIWAPA to maintain large levels of spinning reserves and frequency regulation in the event that a unit goes off-line. Among the options listed is the possible extension of the Aggreko lease from three to four years and the extension of the APR unit lease (covering STT 25, STT 26, and STT 27).

Table 4-1 Initial Conventional Technologies Identified

UNIT TYPE	APPROXIMATE UNIT SIZE, MW	PRIMARY AND BACKUP FUEL
Reciprocating Engine	7-10 MW	LPG/Diesel
Reciprocating Engine	7-10 MW	Natural Gas/Diesel
Small Frame CTG	4.6	1. LPG/Diesel 2. LNG/Diesel
Small Frame CCGT	6.9	1. LPG/Diesel 2. LNG/Diesel
Small Frame CTG	12.9	1. LPG/Diesel 2. LNG/Diesel
Evaluate Aggreko Lease Extension from 3 Years to 4 Years Evaluate APR unit Lease Extension		

Based upon this initial selection, cost and performance characteristics were developed by Black & Veatch for use in the PLEXOS model. Key cost and performance inputs for the combustion turbine and combined cycle technologies evaluated are shown in Table 4-2.

Brief technology descriptions are provided in the following text. These technology descriptions include combustion turbines (CTs), combined cycles (CCs), and reciprocating internal combustion engines (RICE).

Combustion turbines (CTs) are sophisticated power generating machines that operate following the Brayton thermodynamic power cycle. In the power cycle, a simple cycle combustion turbine

generates power by compressing ambient air and heating the pressurized air to approximately 2,000° F or more by burning oil or natural gas, and then expanding those hot gases through a turbine. The turbine drives both the air compressor and an electric generator. A typical combustion turbine converts 30 to 35 percent of the fuel energy to electric power. A substantial portion of the fuel energy is wasted in the form of hot (900-1,100° F) gases exiting the turbine exhaust. The power cycle is referred to as a "simple cycle" or "open cycle" power plant when the combustion turbine is used to generate power and no energy is captured and utilized from the hot exhaust gasses.

Combustion turbines are mass flow devices and their performance changes with ambient conditions. As temperatures rise, combustion turbine efficiency and output decrease due to the lower density of the air. When performing detailed production cost modeling, the model should reflect the differences in performance between summer and winter conditions in the unit characteristics input into the model.

Combustion turbines are popular and used worldwide. Some of the advantages of CT projects include relatively low capital costs, short design and installation schedules, and availability of many unit sizes. Simple cycle technology also provides many of the same positive attributes as reciprocating engines (discussed below), including rapid startup and modularity for ease of maintenance. In addition, combustion turbines have several advantages over reciprocating engines, including lower emissions and slightly lower capital cost.

The primary drawback of combustion turbines is that, due to the cost of natural gas and fuel oil, the variable cost per kWh is high compared to more efficient combined cycle units. As a result, simple cycle combustion turbines are often the technology of choice for peaking service in the power industry but are not usually economical for base load or intermediate usage.

Combustion turbines produce emissions that in many jurisdictions are subject to permitting and regulation. However, turbines using natural gas as fuel are considered cleaner than using solid or liquid fuels. Combustion turbine pollutant emission rates are typically higher at part-load conditions, in which the unit is operating at less than its full output capability. These part-load emission characteristics act to limit how far plant output can be decreased without exceeding emission limits. Aero-derivative turbines tend to have better part-load operating performance than the larger, heavy-duty industrial gas turbines. In most cases, the CT plant output can be reduced to approximately 50 percent load and maintain emission levels within required permitting limits.

Combined cycle (CC) power plants use combustion turbine technology and are designed to capture some of the heat that results from combustion turbine operations and convert this to added power production. Specifically, a combined cycle configuration produces high pressure (HP) steam when the hot exhaust gas from the combustion turbine generator passes through a heat recovery steam generator (HRSG). The HP steam expands through a steam turbine, which spins an electric generator, thereby producing electricity from what otherwise would be wasted heat exhaust.

Combined cycle configurations are proven technologies that have been used in the power industry for decades. Combined cycle technology has several advantages over simple cycle combustion turbines, such as increased efficiency and potentially greater operating flexibility when using duct burners. The combined cycle unit efficiency makes it a good option for systems needing baseload generation. Disadvantages of combined cycles relative to simple cycles include a small reduction in plant reliability, a higher per kilowatt (kW) capital cost, and an increase in the overall staffing and maintenance requirements due to added plant complexity.

In addition to the combustion turbine and combined cycle options, the *reciprocating internal combustion engine (RICE)* technology was selected as a candidate unit in this IRP. RICE units are widely utilized for electric generation, industrial processes, and many other applications. RICE units operate very much like a personal automobile engine and usually require limited space compared to combustion turbine and, especially, combined cycle units.

Table 4-2 Cost and Performance Information for Conventional Combustion Turbine (CT) and Combined Cycle (CC) Units Evaluated

ASSET TYPE	SMALL CT-LPG	SMALL CC – LPG	LARGER CT – LPG	SMALL CT - LNG	CC - LNG	LARGER CT - LNG
Technology	CT	CC	CT	CT	CC	CT
Prim. Fuel	LPG	LPG	LPG	LNG	LNG	LNG
Alternate Fuel	No. 2 FO	No. 2 FO	No. 2 FO	No. 2 FO	No. 2 FO	No. 2 FO
Earliest COD	2022	2022	2022	2022	2021	2021
EPC Cost ($/kW)	2,300	2,800	1,700	2,200	2,800	1,700
Total Cost ($/kW)	2,875	3,500	2,125	2,750	3,500	2,125
Total COD Cost, $ Millions	11.4	19.1	14.5	11.0	19.3	15.2
Output (kW)(1)	3,959	5,465	6,820	4,009	5,522	7,132
Full Load NPHR(1) (Btu/kWh)	13,446	9,740	11,498	13,650	9,909	11,589
Planned Outage Hours/Yr.	168	444	168	168	444	168
Forced Outage Hours/Yr.	175	263	175	175	263	175
Fixed O&M ($/kW-year)	130	250	70	130	250	70
Variable O&M(2) ($/MWh)	11	9	11	11	9	11

1. The output and NPHR listed are when operating on the primary fuel. Operation on secondary fuel was also input and differed slightly from the values shown in this table. NPHR is in higher heating value (HHV)
2. Major maintenance costs are reflected in the VOM numbers listed.

RICE units contain multiple individual pistons attached by connecting rods to a single crankshaft. The RICE unit burns fuel at the other end of the piston's sealed combustion chambers. A mixture of fuel and air is injected into the combustion chamber, where, after compression, an explosion occurs. The explosion provides energy to force the pistons down; this linear motion is translated into the angular rotation of the crankshaft by the connecting rods. The combustion chambers of the RICE unit are vented, and the piston pushes the exhaust gases out, completing two rotations of the crankshaft. The process is repeated, and work is performed.

RICE units are commonly used in the power industry for emergency backup and for peak load shaving. However, there is also a well-established market in which RICE technology is the primary power source for small power systems and isolated facilities located away from the grid. Due to the relatively small size of RICE units, it is often a strategy to install multiple, small units in isolated systems to provide redundancy such that load can be served when one (or more) RICE units may be unavailable to generate power.

RICE units tend to be medium speed engines, meaning that they operate at less than 1,000 rpm, and are more efficient and have lower O&M costs than smaller, higher speed machines. RICE units have relatively constant efficiency rates from 100 to 50 percent load, they have excellent load-following characteristics, and RICE emissions rates are relatively stable down to approximately 25 percent load, thus providing superior part-load performance. Typical startup times for larger reciprocating engines are on the order of 15 minutes. However, some engines can be configured to start up and reach full operation within 10 seconds for use as emergency backup power.

Spark ignition RICE units operate on gaseous fuels such as natural gas, propane, and waste gases from industrial processes. Compression ignition engines operate on liquid fuels such as diesel fuel oil and biodiesel. RICE units are well-suited for use as conventional generators or to supplement renewable power generation because of their flexibility.

As with any of the conventional generation alternatives, reciprocating engines produce air emissions that are often subject to permitting and regulation. In general, alternatives which burn natural gas are considered cleaner than alternatives which burn liquid fuels.

Table 4-3 lists the cost and performance data used in PLEXOS for the selected RICE options. The unit size for the two options selected was narrow and under 10 MW due to the intent to avoid an increase in the amount of spinning reserves and regulation requirements under the N-1-1 criterion that would be associated with a larger unit.

Table 4-3 Cost and Performance Information for Selected Reciprocating Internal Combustion Engine (RICE) Units Evaluated

ASSET TYPE	SMALL RICE	LARGER RICE
Technology	Reciprocating Internal Combustion Engine	Reciprocating Internal Combustion Engine
Prim. Fuel	LPG	LPG
Alternate Fuel	NG	#2FO, NGL
Earliest COD	2022	2022
EPC Cost ($/kW)	1,611	1,500
Total Cost ($/kW)	2,014	1,875
Total COD Cost, $ Millions	14.2	15.8
Output (kW)(1)	7,027	8,444
Full Load NPHR(1) (Btu/kWh)	9,453	9,543
Planned Outage Hours/Yr.	350	350
Forced Outage Hours/Yr.	175.2	175.2
Fixed O&M ($/kW-year)	11.00	11.00
Variable O&M(2) ($/MWh)	13.28	13.28

1. The output and NPHR listed are when operating on the primary fuel. Operation on secondary fuel was also input and differed slightly from the values shown in this table. NPHR is in higher heating value (HHV)
2. Major maintenance costs are reflected in the VOM numbers listed.

4.3 CANDIDATE RENEWABLE ENERGY TECHNOLOGY OVERVIEW

One of the improvements of this IRP compared to the 2016 IRP is that VIWAPA, primarily through NREL and NYPA, has developed site-specific evaluations of the potential for VIWAPA-owned solar and wind projects. In other instances, developers have approached VIWAPA with specific RE projects for consideration. The cost and performance estimates available through these efforts allow the IRP to, in turn, evaluate the benefit of specific RE locations and the estimated cost and performance associated with a particular site and project.

The dominant RE technology projects considered for this analysis are solar and wind projects. These projects are evaluated independently and the PLEXOS model is also allowed to install battery energy storage systems BESS if economical to help “firm up” the RE technologies. Essentially, this means that the energy generated a one period can be stored and used when most advantageous for the system. Brief descriptions of these technologies follow.

4.3.1 Solar Generation

A variety of technologies can capture solar radiation. Total solar installations reached a worldwide output of approximately 305,000 MW in 2016, a considerable increase over approximately 50,000

MW of total installed capacity in 2010.[3] The two major groups of technologies are solar thermal and solar photovoltaic (PV).

The amount of power produced by PV installations depends on the material used and the intensity of solar radiation incident on the photovoltaic cell. Gallium arsenide cells are among the most efficient solar cells and have other technical advantages, but they are also costlier and typically are used only where high efficiency is required even at a high cost, such as space applications or in concentrating PV applications.

Solar facilities require a significant amount of space but can be installed in complex terrain as shown in the Figure 4-1 photo of an existing solar site located in the U.S. Virgin Islands prior to the 2017 hurricanes. The space requirements and the intermittent nature of output are the primary drawbacks of the solar technology. However, there are on-going design improvements incorporating complementary technologies such as battery storage aimed at allowing power produced during the day to be used during evening and nighttime periods. The cost to firm up solar can increase the effective cost by a magnitude of 300 percent or more, depending on the circumstances. This has meant that, historically, only niche applications of storage have been cost-effective. As explained below, however, energy storage costs have undergone cost decreases that are expected to continue in the future.

Figure 4-1 USVI Solar I Project Site (Complex Terrain)

A key attribute of solar PV cells is that they have virtually no emissions after installation. Some thin film technologies have the potential for discharge of heavy metals during manufacturing, however, proper monitoring and control can address this issue.

4.3.2 Wind Generation

Wind power systems convert the movement of air to power by means of a rotating turbine and a generator. Use of wind power as an energy source has increased rapidly over the last two decades. The Global Wind Energy Council estimated cumulative worldwide wind capacity to be more than

[3] Adam Vaughan, *Solar Power Growth Leaps by 50 percent Worldwide Thanks to U.S. and China*, appearing in The Guardian, available on-line at https://www.theguardian.com/environment/2017/mar/07/solar-power-growth-worldwide-us-china-uk-europe, accessed May 1, 2019.

591,000 MW at the end of 2018, a year that saw installation of more than 51,000 MW of new wind generation capacity.[4]

Typical utility-scale wind energy systems consist of multiple wind turbines that range in size from 1 MW to 2 MW. Wind energy projects may total 5 MW to 300 MW, although the use of single, smaller turbines is also common in the United States for powering schools, factories, water treatment plants, and other distributed loads.

As wind technology has continued to improve, wind generation has become increasingly competitive. In fact, in many locations, the all-in wind generation cost is less than the fuel cost of conventional generation. The key factor in wind generation is the quality of the wind resource and the resulting capacity factor (average production) of the wind generator. In good locations, capacity factors of more than 50 percent are possible and this greatly impacts the economics compared to a location that may only yield capacity factors in the 30 percent range. Due to the economic impact of wind speed and wind patterns, developing a wind generation resource normally requires at least a year's worth of recorded wind speed data on the potential generation site. Regarding wind patterns, the time-of-day and seasonal patterns are also important as the value of energy on most utility systems varies widely depending on the time of day and season.

Since wind is an intermittent resource, wind generation is normally not relied upon as firm capacity for peak power demand. However, as mentioned, some markets allow partial capacity credit where historical production data is available and shows consistent production during peak demand periods. This partial capacity credit has value in markets paying for capacity resources and for utilities who have reserve margin obligations.

To provide a dependable resource, wind energy systems may be coupled with some type of energy storage to provide power when required. Historically, energy storage systems such as battery storage have not been cost-effective except in unusual cases, such as for island or other isolated systems, but the cost of battery storage has dramatically declined in recent years and is expected to become even more economical in the future. Therefore, it is appropriate to continue to monitor the cost-effectiveness of "firming up" otherwise intermittent generation such as wind and solar through storage technologies in planning studies.

Wind is a clean generation technology from an emissions perspective. However, there are still environmental considerations associated with wind turbines. Opponents of wind energy frequently cite visual impacts and noise as drawbacks. Turbines are approaching and exceeding heights of 400 feet and, for maximum wind capture, tend to be located on ridgelines and other elevated topography. Turbines can cause avian fatalities and impact other wildlife if sited in sensitive areas. Proper siting, environmental review, and public involvement during the planning process can mitigate these issues.

4.3.3 Energy Storage

Battery energy storage systems (BESS) employ multiple (up to several thousand) batteries that are connected in series and/or parallel and are charged via an external source of electrical energy. The BESS discharges this stored energy to provide a specific electrical function.

[4] Global Wind Energy Council, *Global Wind Energy Report, 2018*, (April, 2019) available for download at www.gwec.net, accessed May 1, 2019.

A fully operational BESS comprises of an energy storage system that is combined with a bidirectional converter (also called a power conversion system). The BESS also contains a Battery Management System (BMS) and a Site or BESS Controller (Table 4-4).

Table 4-4 BESS Components

COMPONENT	DEFINITION
Energy Storage System (ESS)	The ESS consists of the battery modules or components as well as the racking, mechanical components and electrical connections between the various components.
Power Conversion System (PCS)	The PCS is a bi-directional converter that converts AC to DC and DC to AC. The PCS also communicates with the BMS and BESS controller.
Battery Management System (BMS)	The BMS can be comprised of various BMS units at the cell, module and system level. The BMS monitors and manages the battery state of charge (SOC) and charge and discharge of the ESS.
BESS/ Site Controller	The BESS controller communicates with all the components and is also the utility communication interface. Most of the advanced algorithms and control of the BESS resides in the BESS/ Site Controller.

When considering energy storage technologies, there are several key performance parameters to consider:

Power Rating: The rated power output (MW) of the entire ESS.

Energy Rating: The energy storage capacity (MWh) of the entire ESS.

Discharge Duration: The typical duration that the BESS can discharge at its power rating

Response Time: How quickly an ESS can reach its power rating (typically in milliseconds).

Ramp-rate: how quickly an energy storage system can change its power output, typically in MW/ min

Charge/Discharge Rate (C-Rate): A measure of the rate at which the ESS can charge/discharge relative to the rate at which will completely charge/discharge the battery in one hour. A one hour charge/ discharge rate is a 1C rate. Furthermore, a 2C rate completely charges/discharges the ESS in 30 minutes.

Round Trip Efficiency: The amount of energy that can be discharged from an ESS relative to the amount of energy that went into the battery during charging (as a percentage). Typically stated at the point of interconnection and includes the ESS, PCS and transformer efficiencies.

Depth of Discharge (DOD): The amount of energy discharged as a percentage of ESS overall energy rating.

State of Charge (SOC): The amount of energy an ESS has charged relative to its energy rating, noted as a percentage.

Cycle Life: Number of cycles before ESS reaches 80 percent (typical of lithium ion chemistries) of initial energy rating. The cycle life typically varies for various DODs.

These battery characteristics dictate how the batteries are configured and operated which will influence the appropriate sizing and economics and overall life of the systems.

4.3.3.1 Lithium Ion Batteries

Lithium ion batteries are a form of energy storage where all the energy is stored electrochemically within each cell. During charging or discharging, lithium ions are created and are the mechanism for charge transfer through the electrolyte of the battery. In general, these systems vary from vendor to vendor by the composition of the cathode or the anode. Some examples of cathode and anode combinations are shown in Figure 4-2.

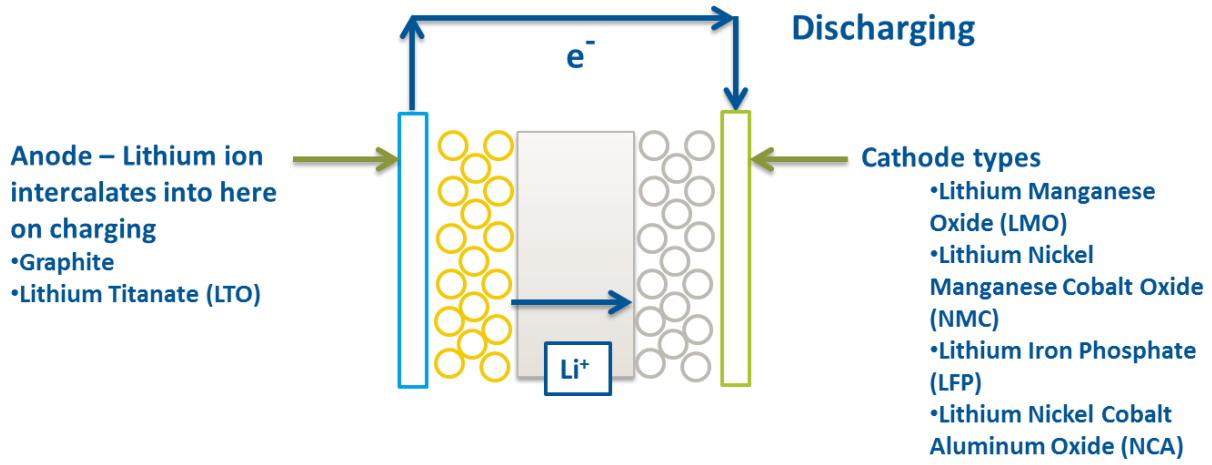

Figure 4-2 Lithium Ion Battery Showing Different Electrode Configurations

The battery cells are integrated to form modules. These modules are then strung together in series and/or parallel to achieve the appropriate power and energy rating to be coupled to the PCS.

Lithium ion battery energy storage systems are typically used for both power and energy applications. Lithium ion batteries have strong cycle life. For shallow, frequent cycles, which are quite common for power applications, lithium ion systems demonstrate good cycle life characteristics. Additionally, lithium ion systems demonstrate good cycle life characteristics for deeper discharges common for energy applications. Overall, this technology offers the following benefits:

Excellent Cycle Life: Lithium ion technologies have superior cycling ability to other battery technologies such as lead acid.

Fast Response Time: Lithium ion technologies have a fast response time which is typically less than 100 milliseconds.

High Round Trip Efficiency: Lithium ion energy conversion is efficient and has ranges from the low 90s to high 90s for applications 4C-1/4C (DC-DC).

Versatility: Lithium ion solutions can provide many relevant operating functions.

Commercial Availability: There are many top tier lithium ion vendors.

Energy Density: Lithium ion solutions have a high energy density to meet space constraints.

An image of a sample lithium ion BESS is shown in Figure 4-3.

Figure 4-3 Lithium Ion Battery Energy Storage System Located at the Black & Veatch Headquarters

Operation and Maintenance (O&M) activities for Li-Ion energy storage systems typically involve annual scheduled maintenance. During this maintenance, visual inspection of the system components and status check is performed as well as expendable parts such as filters are replaced. Software updates regarding BMS can be applied during this maintenance period.

4.4 CANDIDATE RENEWABLE ENERGY PROJECTS EVALUATED FOR STT AND STX

In this section, the technology and site-specific options developed for this IRP are described for the STT and STX systems. For each system, solar, wind, and battery storage options are considered. The master list of RE projects considered are shown in Table 4-5. This table includes candidate options for the STT and STX systems.

Additional details about the specific assumptions made for each RE option are provided below Table 4-5. These details are input into PLEXOS and the model develops an optimized portfolio by selecting the best RE and conventional projects for the STT and STX systems. The BESS options were not forced to be associated with a specific solar or wind project.

Table 4-5 Candidate Renewable Energy Projects Considered for STT and STX in the IRP

PROJECT	RESOURCE TYPE	EVALUATED CAPACITY MW (AC)	ISLAND	EXPECTED ONLINE DATE
St. Croix				
West STX PV Airport (Hera)	Solar PV	10	St. Croix	1/1/2021
Estate Pearl (Limestone)	Solar PV	18	St. Croix	1/1/2021
Rooftop Solar Program	Solar PV	0.765	St. Croix	7/1/2020 – 6/30/2022
Southshore Wind	Wind	5 & 10	St. Croix	1/1/2023
BESS: Richmond STX	Storage	10 MW, 20 MWh	St. Croix	1/1/2022
BESS: Willock STX	Storage	30, 60 MWh	St. Croix	1/1/2022
St. Thomas/St. John				
Port Authority PV STT	Solar PV	0.45	St. Thomas	7/1/2020
Bovoni Ridge Solar	Solar PV	7	St. Thomas	12/1/2020
STJ Solar Cruz Bay	Solar PV	4	St. John	1/1/2021
WAPA Solar I STT (Donoe Replmnt)	Solar	7	St. Thomas	1/1/2021
Bovoni Wind	Wind	18	St. Thomas	12/1/2021
STJ Rooftop Solar	Solar	0.510	St. John	7/1/2020-6/30/2022
STT Rooftop Solar Program	Solar	0.765	St. Thomas	7/1/2020-6/30/2022
BESS: St. John Cruz Bay	Storage	4 MW, 16 MWh	St. John	1/1/2022

4.4.1 West STX PV Airport (Hera Solar), St. Croix

A potential solar project at the STX airport (also called the Hera Solar site) has been identified and included in this IRP. NYPA performed a cost estimate for PV with BESS at the site. Total installed cost to develop the site and construct a 10 MW_{ac} solar PV facility is $25,000,000. Table 4-6 indicates the estimated monthly production estimates at the West STX Airport site.

Table 4-6 Utility Scale PV Characteristics and monthly production estimates at the West STX PV Airport Site

HERA SOLAR	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (MW)	10	10	10	10	10	10	10	10	10	10	10	10	10
Energy (MWh)	21836	1685	1703	1984	1948	1937	1930	2040	1947	1825	1764	1512	1562
Capacity Factor AC (%)	24.9%	22.6%	25.3%	26.7%	27.1%	26.0%	26.8%	27.4%	26.2%	25.3%	23.7%	21.0%	21.0%

4.4.2 Estate Pearl Solar (Limetree Terminal)

A potential solar project on STX called the Estate Pearl Solar project (also called Limetree Terminal Solar) has been identified and is evaluated in this IRP. NREL performed a PV potential initial assessment for the Limetree site. Initial results indicate the 60.5 acre site could physically host up to 13 to 19 MW-DC depending on row spacing and panel efficiency. Space is not likely the limiting constraint on PV capacity; size likely to be determined by available budget and/or results of system impact study. The PV energy potential 1,665 MWh/MW-DC annual generation potential in Year 1 resulting in a 19.0 percent annual capacity factor (for DC rated nameplate). A summary of the typical meteorological year hourly production profile for 1 MW-DC unit plant size is provided in Table 4-7. The site will need to be cleared of vegetation but is near flat and requires relatively little civil work compared to hillside sites on St. Thomas. Row spacing distance should consider ease for mowing since vegetation management is likely going to be a significant portion of overall maintenance costs. Total cost to develop the site to accommodate 18 MW_{ac} solar PV is $45,000,000.

Table 4-7 Utility Scale PV Characteristics for Estate Pearl Solar

KW PER MW_{DC}	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (kW)	803	736	789	796	803	753	727	730	754	746	731	693	692
Energy (MWh)	1664	133.7	135.2	152.3	147.1	142.7	142.8	149.6	150.5	137.8	133.5	115.9	123.9
Capacity Factor AC (%)	23.7%	22.4%	25.1%	25.5%	25.4%	23.9%	24.7%	25.0%	25.2%	23.8%	22.3%	20.0%	20.7%

4.4.3 Distributed (Rooftop) Solar PV Program: STX, STT, STJ

A distributed solar rooftop lease program has been identified for STX, STT, and STJ. The proposed plan is to locate installations so that 37.5 percent occurs on STT, 25 percent on STJ, and 37.5 percent on STX. The estimates prepared by NREL estimate the installed cost of the rooftop PV at approximately $3/W-DC. The rooftop solar program assumes a total of 2.04 MW_{ac} across the three islands. Obtaining 2.04 MW_{ac} will require approximately 2.684 MW_{dc} based on the hourly profiles provided by NREL. Table 4-8 and Table 4-9 include the primary cost assumptions for the program.

Table 4-8 Cost Assumptions for Solar Rooftop Systems

LOCATION	PROJECT CAPACITY [MW_{AC}]	CAPITAL COST [$/$KW_{DC}$]	PEAK KW_{AC} OUTPUT PER KW_{DC} INSTALLED	PROJECT CAPACITY [KW_{DC}]	CAPITAL COST [$/$KW_{AC}$]	CAPITAL COST [$1,000]	DEGRA-DATION (ANNUAL)
St. Croix	0.765	2,981	0.7603	1.01	3,921	$3,000	0.7%
St. Thomas	0.765	2,981	0.7603	1.01	3,921	$3,000	0.7%
St. John	0.510	2,981	0.7603	0.67	3,921	$2,000	0.7%

Table 4-9 Distributed (Rooftop) Solar PV Profile Summary (per kW_{dc})

ROOFTOP SOLAR	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (kW_{ac})	0.7603	0.683	0.736	0.743	0.760	0.715	0.695	0.693	0.713	0.695	0.685	0.640	0.632
Energy (kWh_{ac})	1582.5	124.3	127.0	144.4	141.5	138.8	139.2	145.7	145.0	128.0	125.9	108.1	114.5
Capacity Factor (%)	23.8	22.0	24.9	25.5	25.8	24.5	25.4	25.8	25.6	23.4	22.3	19.8	20.2

4.4.4 Southshore Wind (Longford) Project

A potential wind project on St. Croix has been identified and evaluated. NREL provided estimated wind turbine production profiles for possible installations on the south shore of St. Croix. These estimates were modeled based on the measured data from the 60-meter meteorological tower that was installed at Longford in 2012 and 2013. This data was recommended by NREL to utilized in the IRP for assessing the cost-benefit of wind on St. Croix.

The prevailing wind direction is from the east so wind turbines would have to be spread out from east to west to avoid significant reduction in power output due to wake effects. The wind data shows a unidirectional flow from the predominant easterly trade winds. This unidirectional wind from the east will require a potential wind farm at the Longford site or a similar site along the southern shore to have wider spacing of turbines because the coast is oriented roughly east to west. Turbines will need to be spaced farther apart than if the turbines were oriented north to south, as the wakes generated by the turbines not only affect the energy production of the turbines but cause turbulence that can damage the downwind turbines. Developers would need to coordinate with turbine manufacturers to determine the appropriate spacing of turbines, as the spacing will determine the total number of turbines and the amount of land to be leased. It is assumed that up to 16.5 MW of wind capacity could be installed at the site.

The development of the utility scale wind turbine generation profiles is based on assumptions of wind turbine characteristics shown in Table 4-10. Data was provided for single turbine installations for four representative units.

Capital costs for wind installations at Longford (and Bovoni, discussed below) shown in Table 4-10 are based on NREL's capital cost estimates for on-shore wind in the NREL Wind-2019 Data file from the 2019 Annual Technology Baseline data (available at https://atb.nrel.gov/electricity/data.html). The capital costs for on-shore wind in the NREL estimates are in 2017 dollars. The figures were adjusted and expressed in 2020 dollars using a 2 percent inflation rate, the costs were further adjusted to reflect assumed higher per kW costs of the smaller units and a 5 percent adder for costs associated with locational factors on the Virgin Islands were added (to cover transportation, insurance, and other risk factors).

Table 4-10 Utility Scale Wind Turbine Characteristics at Southshore

	EWT DW61-1000	VERGNET MP C/R	VESTAS V110 - 2.0 MW	VESTAS V117 - 3.3 MW
Rated Power (kW)	1000	275	2000	3300
Estimated annual capacity factor	0.332	0.302	0.579	0.435
Max power output (kW)	1000	275	2000	3300
Total per unit (MWh/yr)	2912	726	10143	12569
Unit production (kWh/kW)	2912	2641	5072	3809
Hub height (m)	46	55	80	80
Rotor diameter (m)	60.9	32	110	117
Installed Capital Cost/kW, 2020	$1,836	$1,929	$1,753	$1,669

Wind production data for the four turbines was provided by NREL. Table 4-11 shows the monthly capacity factors and production estimated for the four turbines.

Table 4-11 Utility Scale Individual Wind Turbine Profile Summary at Southshore

EWT DW61-1000	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (kW)	961.1	993.9	1000.0	949.2	961.0	850.3	987.2	855.2	835.3	851.2	781.0	925.1
Energy (MWh)	254.63	296.49	261.09	248.17	286.18	191.49	357.15	224.76	166.08	190.89	165.95	268.11
Capacity Factor (%)	35.6%	45.9%	36.5%	35.9%	40.0%	27.7%	49.9%	31.4%	24.0%	26.7%	24.0%	37.5%
VERGNET MP C/R	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	274.22	275.00	275.00	273.50	274.21	251.24	275.00	252.65	247.53	251.46	226.54	272.45
Energy (MWh)	63.826	75.973	66.409	62.314	72.172	45.662	91.843	54.468	38.970	46.076	38.701	69.642
Capacity Factor (%)	31.2%	41.1%	32.5%	31.5%	35.3%	23.1%	44.9%	26.6%	19.7%	22.5%	19.5%	34.0%
VESTAS V110	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Energy (MWh)	878.58	992.77	873.49	853.21	986.45	716.89	1187.85	823.83	632.06	694.81	638.32	860.25
Capacity Factor (%)	59.0%	73.9%	58.7%	59.3%	66.3%	49.8%	79.8%	55.4%	43.9%	46.7%	44.3%	57.8%
VESTAS V117	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	3300	3300	3300	3297	3300	3255	3300	3260	3240	3256	3168	3290
Energy (MWh)	1092.0	1273.7	1113.2	1065.5	1232.4	839.51	1534.34	980.97	728.11	834.91	729.06	1139.6
Capacity Factor (%)	44.5%	57.4%	45.3%	44.8%	50.2%	35.3%	62.5%	40.0%	30.6%	34.0%	30.7%	46.4%

4.4.5 BESS Projects: STX and STT

Three batter storage projects were evaluated as part of this IRP. Two of the projects were candidate options on STX (Richmond and Willock) and one BESS option was developed for the STT system (St. John Cruz Bay). The installed capital cost estimates for these options are $30.61 million for Richmond, $72.92 million for Willock, and $18.44 million for St. John Cruz Bay. Technical characteristics for these options are shown in Table 4-12.

Table 4-12 Characteristics for the BESS Options Evaluated

PARAMETER	RICHMOND	WILLOCK	ST. JOHN CRUZ
Facility Power Rating, MW	10	30	4
Facility Energy Rating, MWh	20	60	16
Ramp Rate, MW/min	Instantaneous	Instantaneous	Instantaneous
Response Time	< 100 ms	< 100 ms	< 100 ms
Round-Trip Efficiency, percent	85	85	85
Cycle life, cycles at 80 percent DOD	3,000	3,000	3,000
Fixed O&M Costs, $/kW-yr	7.5	7.5	7.5
Variable O&M Costs including life cycle replacement cost, $/MWh	150	150	150

4.4.6 Port Authority PV STT

Another utility solar project evaluated is the Port Authority PV project on St. Thomas. Table 4-13 shows the monthly production estimates for the 0.45 MW Port Authority PV STT solar facility that will be used in the IRP assessment. The 0.45 MW Port Authority PV STT solar facility has an assumed in-service date of July 1, 2020.

Table 4-13 Utility Scale PV Characteristics at the Port Authority PV STT Site

PORT AUTHORITY PV STT	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (MW)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Energy (MWh)	996.7	76.44	77.01	89.36	88.69	87.62	87.76	89.79	91.13	84.35	81.48	71.97	71.09
Capacity Factor AC (%)	25.3%	22.8%	25.5%	26.7%	27.4%	26.2%	27.1%	26.8%	27.2%	26.0%	24.3%	22.2%	21.2%

4.4.7 Bovoni Ridge Solar PV

A potential solar site at the Bovoni Ridge on STT has been identified. Initial results indicate that the three separate parcels on the Bovoni Peninsula (one of which is currently government owned) could physically host up to up to 7 MW-DC of PV. The complex terrain presents challenges for PV power however the topology does not preclude development. With careful layouts NREL believes that PV plants could be developed. Bovoni's land use for industrial facilities, wastewater treatment, and a landfill and its lack of residences likely make it compatible with PV development. Table 4-14 and Table 4-15 indicate the project characteristics used for modeling the option. The in-service capital cost is estimated to be $14.33 million.

Table 4-14 Utility Scale PV Characteristics and Production Estimates on Bovoni Peninsula Site

BOVONI SITE	APPROXIMATE AREA (ACRES)	ESTIMATED SYSTEM SIZE* (MW-DC)	UNIT PRODUCTION ESTIMATE YR1 (KWH/KW-DC)**	PRODUCTION ESTIMATE YR1 (KWH/YEAR)
East Area 1	4.8	0.80	1589	1,271,508
East Area 2	4.3	0.71	1631	1,154,973
East Area 3	6.4	1.07	1628	1,736,242
South	15.9	2.65	1631	4,322,860
West	12.0	2.00	1641	3,281,216
Total	43.4	7.23	1629	11,766,798

Table 4-15 Utility Scale PV Characteristics and Monthly Production Estimates on Bovina Peninsula Site

ALL SITES AGGREGATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (kW)	5065.5	5507.4	5584.0	5730.4	5438.3	5292.5	5264.9	5390.6	5239.2	5145.2	4769.3	4699.4
Energy (MWh)	905.9	933.8	1073.8	1060.8	1044.3	1049.0	1097.2	1089.0	954.6	929.9	793.7	834.6
Capacity Factor AC (%)	21.2%	24.3%	25.2%	25.7%	24.5%	25.4%	25.7%	25.5%	23.1%	21.8%	19.2%	19.6%

4.4.8 St. John Cruz Bay Solar

A potential solar project at St. John Cruz Bay has been identified and evaluated in this IRP. Table 4-16 lists performance assumptions for solar at this location. The in-service capital cost for this facility is estimated to be $22.68 million.

Table 4-16 St. John Cruz Bay PV Characteristics and Monthly Production Estimates

ST. JOHN CRUZ BAY SOLAR	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (MW)	4.0	4	4	4	4	4	4	4	4	4	4	4	4
Energy (MWh)	7705	547	575	694	701	714	714	732	739	663	604	520	502
Capacity Factor AC (%)	22.0%	18.4%	21.4%	23.3%	24.3%	24.0%	24.8%	24.6%	24.8%	23.0%	20.3%	18.1%	16.8%

4.4.9 VIWAPA Solar 1 STT (Donoe Replacement)

A potential solar project called the Donoe Replacement project has been identified and evaluated in this IRP. Table 4-17 lists performance assumptions for solar at this location. The in-service capital cost for this facility is estimated to be $10 million.

Table 4-17 VIWAPA Solar 1 STT (Donoe Replacement) PV Characteristics and Monthly Production Estimates

ST. JOHN CRUZ BAY SOLAR	ANNUAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (MW)	7.00	6.95	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.71	6.64
Energy (MWh)	13476.4	957.51	1006.09	1213.42	1225.24	1249.52	1248.95	1280.08	1292.55	1159.33	1056.62	909.94	877.17
Capacity Factor AC (%)	22.0%	18.4%	21.4%	23.3%	24.3%	24.0%	24.8%	24.6%	24.8%	23.0%	20.3%	18.1%	16.8%

4.4.10 Bovoni Wind

In addition to the wind profiles developed to assess the economics of wind generation at the Longford site, NREL also performed an assessment of wind power at the Bovoni Peninsula. The estimates were deemed appropriate by NREL for capacity expansion analyses and production cost modeling. Some discussion regarding the representative hourly production profiles based on typical meteorological years are provided below. The wind power profiles are per machine and are based on the average estimated resource over the peninsula.

NREL provided an estimate of the number of wind turbines of each size that will fit on Bovoni. Initial results indicate that the three separate parcels on the Bovoni Peninsula (one of which is currently government owned) could physically host up to 3.3-16.5 MW of wind (depending on turbines selected). The complex terrain presents challenges for both PV and wind facilities, however the topology does not preclude development of either resource, as NREL believes that with careful layouts, wind or PV facilities could be developed.

A 2012/13 wind resource measurement effort showed that Bovoni has a strong wind resource and is likely the only developable location on the STT system that could host a utility-scale wind plant. Bovoni's land use for industrial facilities, wastewater treatment, and a landfill and its lack of residences likely make it compatible with wind development. Initial results indicate that Bovoni could physically host 3.3 to 16.5 MW wind farm depending on the size of turbines selected. System sizes and generation potential are likely to change based on closer review of slopes, geology, availability of properties, shadow analyses, environmental review, utility hosting capacities, etc.

Wind resource measurements on Bovoni indicate wind speeds of 6.0–7.0 m/s, predominately westerly winds. Wind speeds are higher during daytime hours but also potential for good overnight generation. Stronger potential for generation in summer and winter and weaker in shoulder months. The strength of wind weakens at the north end of peninsula.

The development of the utility scale wind turbine generation profiles for the Bovoni peninsula is based on assumptions of wind turbine characteristics shown below in Table 4-18. The total installed cost for this option is estimated based on the installed capital costs provided in Table 4-18.

Table 4-18 Utility Scale Wind Turbine Characteristics on Bovoni Peninsula Site

	EWT DW61-1000	VERGNET MP C/R	VESTAS V110 - 2.0 MW	VESTAS V117 - 3.3 MW
Rated Power (kW)	1000	275	2000	3300
Estimated annual capacity factor	0.301	0.246	0.460	0.322
Max power output (kW)	976	274	2000	3287
Total per unit (MWh/yr)	2637	593	8068	9306
Unit production (kWh/kW)	2637	2157	4034	2820
Hub height (m)	46	55	80	80
Rotor diameter (m)	60.9	32	110	117
Max turbine count estimate	9	12	5	5
Bovoni wind capacity (MW)	9	3.3	10	16.5
Total annual energy (MWh/yr)	23,735	7,118	40,338	46,529
Installed Capital Cost/kW, 2020	$1,836	$1,929	$1,753	$1,669

Table 4-19 indicates the estimated production and seasonal variation in production estimates by NREL. It should be emphasized that NREL acknowledged significant differences in the wind speeds predicted by the wind flow model with those measured at Bovoni and Longford. NREL also cautioned about the high uncertainty in extrapolating the measured data at Bovoni beyond the met tower location. These discrepancies are not unusual for complex terrain regions. For any utility-scale wind development, a robust resource assessment campaign utilizing multiple met towers, ideally over a multiple-year period, is recommended to reduce the uncertainty in the long-term wind speed and resulting energy estimates. The resulting energy estimates for use in this IRP are only preliminary values to provide a high-level understanding of the potential energy generation and cost-effectiveness of wind resources. NREL noted in their report that significant civil work will

be required for wind installations and logistic challenges will exist for installation of large wind turbine generators.

The cost and performance information provided by NREL assumed VIWAPA ownership of the Bovoni wind resource. VIWAPA also received a PPA offer for the development of wind resources at Bovoni and considers this the more realistic alternative. Thus, for the economic analysis, a PPA structure for the Bovoni wind resource was assumed. The PPA price was several times higher than a VIWAPA-owned resource at Bovoni, starting at $225/MWh in 2020 and escalated to $269/MWh in 2044. It will be seen that at this high price, the resource was not selected in the optimization runs even though, should VIWAPA ownership be feasible, the resource would be selected due to the much lower price under utility ownership.

Table 4-19 Utility Scale Individual Wind Turbine Profile Summary on Bovoni Peninsula Site

EWT DW61-1000	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Peak (kW)	942.2	963.1	856.3	895.4	976.3	710.3	887.1	849.4	851.7	734.7	627.0	853.4
Energy (MWh)	240.36	260.02	246.11	254.46	242.92	204.72	326.29	228.43	153.86	181.29	88.14	208.73
Capacity Factor (%)	33.1%	39.6%	33.9%	36.2%	33.4%	29.1%	44.9%	31.4%	21.9%	25.0%	12.5%	28.7%
VERGNET MP C/R	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	272.16	273.39	244.87	257.81	274.17	182.44	255.06	242.86	243.49	191.56	152.77	243.95
Energy (MWh)	54.906	60.667	57.083	57.819	54.937	44.748	76.726	50.687	32.909	38.923	17.085	46.215
Capacity Factor (%)	26.9%	32.9%	28.0%	29.3%	26.9%	22.7%	37.6%	24.8%	16.7%	19.1%	8.7%	22.7%
VESTAS V110	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	2000	2000	1999	2000	2000	1961	2000	1999	1999	1977	1853	1999
Energy (MWh)	727.80	778.48	740.28	777.31	739.50	641.48	975.89	704.55	480.20	569.84	282.81	644.02
Capacity Factor (%)	48.9%	57.9%	49.7%	54.0%	49.7%	44.5%	65.6%	47.3%	33.3%	38.3%	19.6%	43.3%
VESTAS V117	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Peak (kW)	3264	3278	3124	3212	3287	2677	3199	3110	3114	2769	2289	3117
Energy (MWh)	850.17	922.02	879.23	899.73	857.09	715.76	1163.82	801.93	540.08	632.08	305.36	731.77
Capacity Factor (%)	34.8%	41.7%	35.9%	38.0%	35.0%	30.2%	47.6%	32.8%	22.8%	25.8%	12.9%	29.9%

5.0 Economic Results Under Base Case Assumptions

This section describes the optimized and five leading expansion plans for STT and STX under base case assumptions. The economic results are also compared to the business as usual (BAU) case. While the BAU cases are not considered to be acceptable options, they nevertheless allow an estimate of future savings when compared to historical system configurations and fuel usage. The savings can also be used to provide an approximate measure of the benefits of using U.S. government funding to transform the VIWAPA systems.

5.1 MODEL CALIBRATION

Once the IRP modeling assumptions were input into PLEXOS, several checks were performed to verify that the model was accurately estimating production costs. Given that the highest system cost is fuel, particular attention was paid to whether the production costing estimates from PLEXOS were reasonably close to historical 2018 actual fuel costs. Initial differences were largely attributed to the historical availability issues associated with LPG delivery. These issues caused the LPG fuel to be unavailable approximately 25 percent of the time historically, while recent improvements have resulted in an IRP assumption that the delivery system would be available 97 percent of the time. When the PLEXOS model was adjusted to reflect the historical reduced availability of LPG, the production costs were reasonably close and differences could be explained largely by unit outages differing from the long-term averages reflected in the PLEXOS model.

The dispatch order and capacity factors for existing units on STT and STX as estimated by PLEXOS were also compared to recent experience. The results were consistent between the model and expectations based on historical dispatch. Once the model was calibrated, the base case and BAU runs were developed.

Prior to performing detailed production costing analysis, Black & Veatch performed spreadsheet calculations to determine whether the savings from switching from LPG to LNG would be cost-effective and overcome the cost for VIWAPA to buy-out the LPG contract. Calculations indicate that the savings from operating on LNG would be significantly short of offsetting the buy-out amount and so LNG was dropped from further consideration in the expansion planning models.

5.2 THE OPTIMIZED BASE CASE EXPANSION FOR STT AND STX

Base case expansion plans were developed for STT and STX using the base case assumptions described in Section 3. Additional sensitivities for fuel and load growth were also developed and are reported in Section 6.

The optimization process involves allowing PLEXOS to evaluate the economics of developing alternative expansion plans comprised of various combinations of candidate units. The candidate units for each system include the conventional and RE options described in Section 4. For an expansion planning study with a relatively large number of options, as in this IRP, PLEXOS develops hundreds of competing expansion plans. The expansion plans are developed to meet the renewable targets and include environmental costs of emissions. The plans also meet the reliability criteria in the long-term, although occasional deviations are tolerated by the model.

The plans developed by PLEXOS are ranked according to economics. The optimized plan is that which meets the environmental and reliability requirements and has the lowest present worth cost. To evaluate the hundreds of possible expansion plans, PLEXOS utilizes a load duration approach in the internal LT plan. The leading plans are then be run through an hourly chronological program

within the PLEXOS ST plan module that provides detailed system costs and unit performance information.

Expansion plan economics include the system-wide fuel cost, variable O&M costs, and fixed O&M costs. Also considered are the incremental capital costs associated with new resource additions. In IRP studies, existing debt associated with units already in-service are not included as expansion plan costs because these are sunk costs that are common to all plans.

Figure 5-1 shows the general approach of capturing the costs associated with an expansion plan. As seen in the figure, the costs captured include costs over the entire duration of the planning horizon. The costs estimated for each year are then discounted and the present worth costs are summed to arrive at a cumulative present worth cost (CPWC). The plan having the lowest CPWC is the least cost plan.

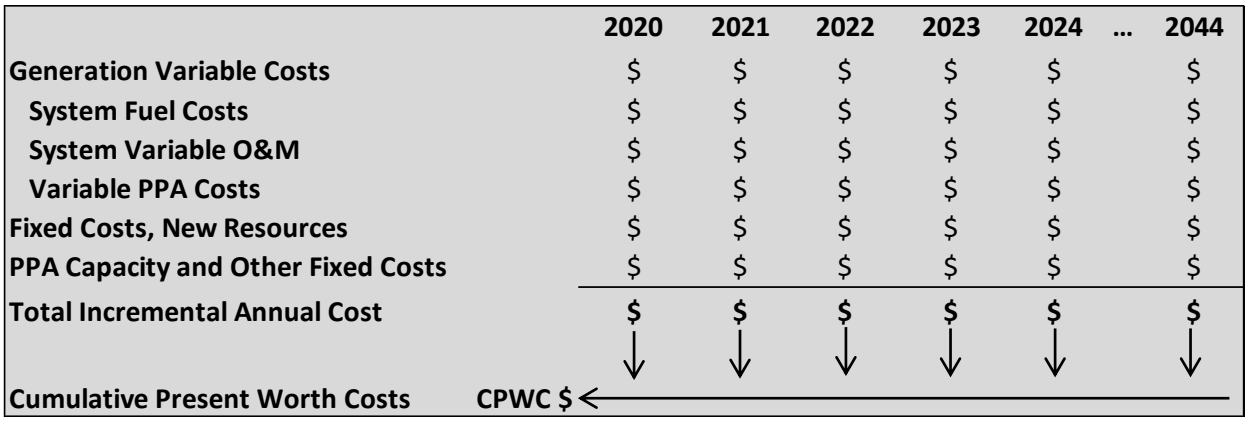

Figure 5-1 Deriving the Cumulative Present Worth Cost (CPWC) of an Expansion Plan

The actual CPWC calculation for any expansion plan is more involved than that shown in the figure above but can be shown in a table consisting of output from PLEXOS. This output is shown in Table 5-1 for the STT optimized expansion plan and in Table 5-2 for the STX optimized expansion plan. The organization of these CPWC tables is explained below using the results for STT as an example.

The lower two-thirds of Table 5-1 are arranged in columns that display the components of the total annual cost each year of the 2020-2044 planning horizon. Listed in the columns from left to right are the *Year* of the plan, annual *Load* and *Generation* totals, in GWh, followed by *Curtailed Load* and *Loss of Load Hours*. Production costs are then presented and include columns for *Fuel Costs*, *Variable O&M* and *Fixed O&M* costs. *Power Purchase Costs* are then listed. The sum of the *Production Costs* and *Purchase Costs* is shown in the *Total Generating Cost* column, which is also stated on a $/MWh basis. In the next column are the *New Unit Capital Costs*, assuming a 3 percent cost of debt. The *Total System Cost* is the *Total Generation Cost* amount plus the *New Unit Capital Cost* for each year. In the second to last column, the total *CPWC* is calculated. In the final column, the CPWC is calculated but the capital costs are subtracted out each year to reflect the effective *CPWC that VIWAPA customers would pay* under the assumption that all capital costs are grant funded by the U.S. government.

As seen at the bottom of the CPWC column, the CPWC of the optimized expansion plan is $841.19 million. The CPWC payable by VIWAPA customers is $732.70 million.

In the upper portion of Table 5-1, the unit additions and retirements comprising the optimized base case plan for STT are summarized. On the right upper most portion of the table, the generating unit additions are shown, along with the 2019 installed cost, the date of installation, and the installed cost in the year the unit goes into commercial operation. On the left upper portion of the table, the debt cost assumptions are listed, followed by a listing of the units on the VIWAPA system that are retired in the optimized case. Thus, the units added to STT are as follows:

- STT Bovoni Solar in January of 2021
- STT Donoe Solar PPA in January of 2021
- An 8 MW RICE Unit in January of 2021
- 3 x 7 MW RICE Units in January of 2021
- A 7 MW RICE Unit in April of 2022
- The STJ Cruz Bay Battery Storage unit in April of 2022

The STT base case optimization also chose to retire the following units:

- STT 15
- STT 25 (APR lease)
- STT 26 (APR lease)
- STT 27 (APR lease)
- STT 14 (out of service, not selected to return so it is not listed as a retirement)

For the units retired, it means that the fixed O&M cost of keeping these units in-service was greater than the economic benefit of generating power from these facilities. As stated previously, STT 14 also would need to overcome $4.5 million in capital cost improvements to return and stay in service for the planning period.

This plan for STT averages nine loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 38 hours in 2029.

Table 5-1 Optimized Base Case CPWC for STT

STT Base Case Plan

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost									
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Cumulative Present Worth Cost (CPWC) ($1,000)	CPWC without Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	11	$31,252	$4,672	$1,815	$3,315	$41,055	$112.17	$6,333	$47,388	$106,323	$100,354
2022	366.1	366.1	0.000	0	$31,195	$4,783	$1,406	$3,315	$40,699	$111.17	$7,316	$48,015	$148,176	$135,512
2023	366.1	366.1	0.000	1	$31,351	$4,882	$1,434	$3,315	$40,983	$111.93	$7,553	$48,536	$188,604	$169,228
2024	367.1	367.1	0.000	0	$31,838	$4,992	$1,467	$3,326	$41,623	$113.37	$7,553	$49,176	$227,732	$201,841
2025	366.1	366.1	0.000	1	$33,239	$5,080	$1,492	$3,315	$43,126	$117.79	$7,553	$50,679	$266,239	$234,022
2026	366.2	366.1	0.020	8	$34,635	$5,178	$1,522	$3,315	$44,651	$121.95	$7,553	$52,204	$304,113	$265,755
2027	366.2	366.2	0.010	9	$35,824	$5,282	$1,552	$3,315	$45,974	$125.56	$7,553	$53,527	$341,193	$296,871
2028	367.1	367.1	0.000	0	$36,905	$5,407	$1,588	$3,326	$47,226	$128.64	$7,553	$54,779	$377,424	$327,314
2029	366.2	366.1	0.140	38	$38,940	$5,494	$1,615	$3,315	$49,365	$134.85	$7,553	$56,918	$413,350	$357,619
2030	366.1	366.1	0.000	0	$39,886	$5,604	$1,647	$3,315	$50,453	$137.80	$7,553	$58,006	$448,306	$387,118
2031	366.2	366.1	0.040	10	$41,028	$5,713	$1,680	$3,315	$51,736	$141.31	$7,553	$59,289	$482,412	$415,926
2032	367.1	367.1	0.000	0	$42,275	$5,844	$1,719	$3,326	$53,164	$144.81	$7,553	$60,718	$515,750	$444,120
2033	366.2	366.2	0.010	5	$43,489	$5,940	$1,748	$3,315	$54,492	$148.83	$7,553	$62,046	$548,266	$471,643
2034	366.1	366.1	0.000	0	$44,534	$6,071	$1,783	$3,315	$55,703	$152.14	$7,553	$63,256	$579,908	$498,437
2035	366.2	366.0	0.120	24	$45,871	$6,183	$1,819	$3,315	$57,188	$156.23	$7,553	$64,741	$610,814	$524,635
2036	367.2	367.2	0.030	11	$47,277	$6,327	$1,860	$3,326	$58,791	$160.12	$7,553	$66,344	$641,034	$550,285
2037	366.1	366.1	0.000	0	$48,269	$6,443	$1,892	$3,315	$59,920	$163.67	$7,553	$67,473	$670,368	$575,183
2038	366.2	366.1	0.100	21	$49,477	$6,569	$1,930	$3,315	$61,292	$167.42	$7,553	$68,845	$698,931	$599,438
2039	366.2	366.1	0.090	33	$50,915	$6,692	$1,969	$3,315	$62,891	$171.77	$7,553	$70,445	$726,817	$623,142
2040	367.2	367.2	0.010	7	$52,295	$6,848	$2,014	$3,326	$64,483	$175.63	$7,553	$72,036	$754,023	$646,287
2041	366.2	366.1	0.010	4	$53,250	$6,972	$2,048	$3,315	$65,585	$179.13	$1,221	$66,806	$777,080	$668,707
2042	366.2	366.1	0.100	33	$54,619	$7,108	$2,089	$3,315	$67,131	$183.35	$238	$67,369	$799,057	$690,563
2043	366.2	366.2	0.010	11	$56,035	$7,251	$2,131	$3,315	$68,732	$187.71	$0	$68,732	$820,368	$711,875
2044	367.1	367.1	0.000	0	$57,599	$7,418	$2,180	$3,326	$70,523	$192.11	$0	$70,523	**$841,194**	**$732,701**

Table 5-2 lists similar information for the optimized STX expansion plan. As seen at the bottom of the CPWC column, the CPWC of the optimized expansion plan is $588.24 million. The CPWC payable by VIWAPA customers is $410.80 million.

The units added to STX are as follows, with all units added in 2021 or 2022:

- Estate Pearl Solar PV, 18 MW in January of 2021
- Hera (West Airport) PV, 10 MW in January of 2021
- Longford (Southshore) Wind 5 x 3.3 MW in July of 2021
- 3 x 8 MW RICE Units burning LPG, in July of 2022
- Richmond Battery Storage in July of 2022

The STX base case optimization also chose to retire the following units:

- STX 19
- Aggreko lease
- STX 11 (not selected for returning to service and not shown as retired in Table 5-2)

For the units retired, the fixed O&M cost of keeping these units in-service is greater than the economic benefit of generating power from these facilities. As stated previously, STX 11 would also need to overcome $1.5 million in capital cost improvements to return to service for the planning period. It was not selected to return to service in the Base Case STX expansion plan.

This plan for STX averages 14 loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 88 hours in 2022.

Table 5-2 Optimized Base Case CPWC for STX

STX Base Case Plan

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3MW	27,539	6	20	07/01/2021	28,793	2,099
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative Present Worth	CPWC without Capital
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Cost (CPWC) ($1,000)	Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,264	$1,076	$2,026	$1,458	$25,825	$98.29	$9,964	$35,789	$108,576	$93,481
2023	263.2	263.2	0.070	26	$16,510	$1,845	$2,216	$1,458	$22,030	$83.72	$12,538	$34,567	$137,840	$111,605
2024	263.9	263.7	0.120	24	$16,781	$1,883	$2,267	$1,463	$22,394	$84.91	$12,538	$34,932	$166,201	$129,151
2025	263.3	263.0	0.320	51	$17,489	$1,912	$2,306	$1,458	$23,165	$88.09	$12,538	$35,703	$193,988	$146,438
2026	263.1	263.1	0.000	0	$18,380	$1,936	$2,352	$1,458	$24,126	$91.69	$12,538	$36,664	$221,328	$163,583
2027	263.3	263.1	0.160	40	$18,939	$1,965	$2,399	$1,458	$24,762	$94.12	$12,538	$37,300	$247,985	$180,343
2028	263.9	263.9	0.040	15	$19,598	$2,017	$2,453	$1,463	$25,531	$96.76	$12,538	$38,069	$274,052	$196,801
2029	263.2	263.2	0.000	0	$20,669	$2,046	$2,496	$1,458	$26,669	$101.31	$12,538	$39,206	$299,753	$213,173
2030	263.3	263.3	0.000	0	$21,042	$2,109	$2,546	$1,458	$27,155	$103.14	$12,538	$39,693	$324,688	$229,050
2031	263.4	263.4	0.000	0	$21,619	$2,137	$2,596	$1,458	$27,811	$105.58	$12,538	$40,349	$348,968	$244,536
2032	264.1	264.1	0.000	0	$22,287	$2,181	$2,656	$1,463	$28,587	$108.23	$12,538	$41,125	$372,666	$259,697
2033	264.0	264.0	0.000	0	$22,713	$2,232	$2,701	$1,458	$29,105	$110.26	$12,538	$41,642	$395,655	$274,396
2034	264.7	264.5	0.140	23	$23,279	$2,256	$2,755	$1,458	$29,749	$112.46	$12,538	$42,287	$418,012	$288,706
2035	265.6	265.5	0.110	17	$23,778	$2,287	$2,811	$1,458	$30,333	$114.25	$12,538	$42,871	$439,721	$302,602
2036	267.5	267.5	0.000	0	$24,021	$2,371	$2,875	$1,463	$30,730	$114.88	$12,538	$43,268	$460,714	$316,010
2037	268.8	268.8	0.000	2	$24,441	$2,343	$2,924	$1,458	$31,166	$115.93	$12,538	$43,704	$481,029	$328,960
2038	269.4	269.4	0.000	0	$24,770	$2,414	$2,983	$1,458	$31,624	$117.40	$12,538	$44,162	$500,694	$341,474
2039	269.6	269.6	0.000	0	$25,619	$2,430	$3,042	$1,458	$32,550	$120.74	$12,538	$45,088	$519,903	$353,742
2040	270.3	270.3	0.000	0	$26,430	$2,473	$3,112	$1,463	$33,478	$123.87	$12,538	$46,015	$538,659	$365,759
2041	269.5	269.5	0.040	10	$26,979	$2,523	$3,165	$1,458	$34,126	$126.63	$6,197	$40,323	$553,559	$377,425
2042	269.5	269.5	0.000	0	$27,500	$2,618	$3,228	$1,458	$34,804	$129.13	$2,574	$37,378	$566,195	$388,756
2043	269.6	269.5	0.030	13	$28,363	$2,662	$3,293	$1,458	$35,777	$132.74	$0	$35,777	$577,288	$399,849
2044	270.2	270.2	0.000	0	$29,588	$2,677	$3,368	$1,463	$37,096	$137.28	$0	$37,096	**$588,243**	**$410,804**

5.3 BAU CASE AND BENEFITS FROM THE SYSTEM CAPACITY UPGRADES

The optimized base case expansion plan for STT and STX project the long-term cost of serving load on each system. The sensitivity cases in the next section indicate the CPWC under high and low load cases and under high and low fuel cost cases.

It is also useful to compare the optimized CPWCs with the CPWC of serving future load with the existing VIWAPA units and without making the significant capital investment required in the optimized cases. This is called the business as usual (BAU) case. The BAU case can serve to demonstrate the net benefit of investing U.S. government funds in the VIWAPA system.

The BAU cases were run using the same process as used for the optimized cases, except no new units were added and no unit retirements were considered. The results for STT and STX are shown in the following two CPWC tables.

For STT, the CPWC under the BAU case is $1,380.89 million. Since there is assumed to be no U.S. grant funding, this total CPWC would be paid by VIWAPA customers. The CPWC of the optimized base case expansion plan for STT is $841.19 million while the CPWC payable by VIWAPA customers is $732.70 million. Thus, **compared to the optimized base case for STT, the BAU would cost an additional $539.37 million in total CPWC and $648.17 million more for VIWAPA customers**. The optimized STT expansion plan is 61 percent of the BAU case in terms of total CPWC and is 53 percent of the CPWC in terms of costs payable by VIWAPA customers.

For STX, the CPWC under the BAU case is $896.79 million. Since there is assumed to be no U.S. funding, this total CPWC would be paid by VIWAPA customers. The total CPWC for the optimized base case is $588.24 million and the CPWC cost to VIWAPA customers is $410.80 million in the base case. Thus, **compared to the optimized base case for STX, the BAU would cost an additional $308.54 million in total CPWC and $485.98 million more for VIWAPA customers**. The optimized STX expansion plan is 66 percent of the BAU case in terms of the full CPWC and 46 percent of the BAU CPWC in terms of costs payable by VIWAPA customers.

On a combined basis, the BAU costs for STT and STX would be $2,277.66 million over the 2020-2044 study period. **This is $872.90 million higher than the total CPWC costs for STT and STX in the optimized cases ($1,404.76 million), and $1,178.09 million higher than the combined STT and STX cost (of $1,099.56 million) for VIWAPA customers in the optimized cases**. The optimized expansion plans are a combined 63 percent of the BAU case in terms of the total CPWC and 50 percent of the BAU CPWC in terms of costs payable by VIWAPA customers.

The BAU plan for STT averages five loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 51 hours in 2042. The BAU plan for STX averages 26 loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 119 hours in 2035.

Table 5-3 CPWC for STT in the Business As Usual (BAU) Case

STT Base Case

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):	
20 yr FCR:	7.29%

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)

	Energy Balance				Production Cost								Cumulative Present Worth	CPWC without Capital
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Emissions ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Cost (CPWC) ($1,000)	Costs ($1,000)
2020	367.1	367.1	0.000	0	$59,336	$3,414	$13,619	$17.69	$76,387	$208.11	$0	$76,387	$72,750	$72,750
2021	366.1	366.1	0.000	0	$60,122	$3,619	$13,854	$17.53	$77,612	$212.00	$0	$77,612	$143,146	$143,146
2022	366.1	366.1	0.020	3	$60,530	$3,652	$14,131	$17.61	$78,331	$213.97	$0	$78,331	$210,811	$210,811
2023	366.1	366.1	0.000	0	$61,315	$3,705	$14,413	$17.59	$79,451	$217.02	$0	$79,451	$276,176	$276,176
2024	367.1	367.1	0.000	2	$62,284	$3,778	$14,742	$17.68	$80,821	$220.15	$0	$80,821	$339,501	$339,501
2025	366.1	366.1	0.000	0	$64,559	$3,858	$14,996	$17.70	$83,430	$227.89	$0	$83,430	$401,758	$401,758
2026	366.1	366.1	0.000	2	$67,496	$3,916	$15,296	$17.67	$86,725	$236.89	$0	$86,725	$463,392	$463,392
2027	366.1	366.1	0.000	0	$69,861	$4,008	$15,601	$17.63	$89,488	$244.44	$0	$89,488	$523,961	$523,961
2028	367.1	367.1	0.000	10	$72,543	$4,061	$15,957	$17.76	$92,579	$252.18	$0	$92,579	$583,638	$583,638
2029	366.1	366.1	0.000	0	$76,000	$4,114	$16,232	$17.68	$96,363	$263.22	$0	$96,363	$642,796	$642,796
2030	366.1	366.0	0.100	22	$77,425	$4,250	$16,556	$17.62	$98,249	$268.44	$0	$98,249	$700,240	$700,240
2031	366.1	366.1	0.000	0	$79,302	$4,331	$16,887	$17.56	$100,538	$274.62	$0	$100,538	$756,223	$756,223
2032	367.1	367.1	0.020	8	$82,235	$4,389	$17,272	$17.69	$103,914	$283.08	$0	$103,914	$811,331	$811,331
2033	366.1	366.1	0.000	0	$85,067	$4,442	$17,570	$17.69	$107,096	$292.53	$0	$107,096	$865,422	$865,422
2034	366.1	366.1	0.000	0	$86,231	$4,598	$17,921	$17.61	$108,768	$297.10	$0	$108,768	$917,741	$917,741
2035	366.1	366.1	0.000	0	$89,287	$4,648	$18,280	$17.65	$112,232	$306.56	$0	$112,232	$969,156	$969,156
2036	367.1	367.1	0.000	0	$91,983	$4,795	$18,696	$17.66	$115,492	$314.60	$0	$115,492	$1,019,545	$1,019,545
2037	366.1	366.1	0.000	0	$94,457	$4,789	$19,018	$17.66	$118,282	$323.09	$0	$118,282	$1,068,693	$1,068,693
2038	366.1	366.1	0.000	0	$96,788	$4,934	$19,398	$17.61	$121,138	$330.89	$0	$121,138	$1,116,632	$1,116,632
2039	366.1	366.1	0.000	0	$98,443	$5,068	$19,786	$17.59	$123,315	$336.83	$0	$123,315	$1,163,108	$1,163,108
2040	367.1	367.1	0.000	0	$103,395	$5,113	$20,237	$17.73	$128,763	$350.74	$0	$128,763	$1,209,326	$1,209,326
2041	366.1	366.0	0.060	26	$104,432	$5,180	$20,586	$17.61	$130,215	$355.74	$0	$130,215	$1,253,840	$1,253,840
2042	366.1	365.7	0.400	51	$106,739	$5,361	$20,997	$17.58	$133,115	$364.00	$0	$133,115	$1,297,178	$1,297,178
2043	366.1	366.1	0.000	0	$109,651	$5,437	$21,417	$17.58	$136,522	$372.91	$0	$136,522	$1,339,510	$1,339,510
2044	367.1	367.1	0.000	0	$112,570	$5,560	$21,906	$17.62	$140,052	$381.53	$0	$140,052	**$1,380,868**	**$1,380,868**

Table 5-4 CPWC for STX in the Business As Usual (BAU) Case

STX Base Case

Financing Parameters		Economic Parameters	
Bond Rate yr:	3.00%	CPW Discount Rate:	5.00%
IDC:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):			
20 yr FCR:	7.29%		

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)

	Energy Balance				Production Cost									Cumulative Present Worth	CPWC without Capital
						Plant O&M									
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Emissions ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.3	0.500	61	$37,554	$2,976	$10,645	$12.63	$51,187	$194.44	$0	$51,187	$48,750	$48,750
2021	263.1	263.1	0.000	0	$38,470	$3,006	$10,669	$12.56	$52,158	$198.22	$0	$52,158	$96,058	$96,058
2022	263.1	262.4	0.710	78	$38,968	$3,018	$10,723	$12.55	$52,721	$200.90	$0	$52,721	$141,601	$141,601
2023	263.1	262.8	0.350	44	$38,580	$3,066	$10,779	$12.40	$52,437	$199.55	$0	$52,437	$184,741	$184,741
2024	263.8	263.3	0.470	50	$40,281	$3,023	$10,865	$12.65	$54,182	$205.77	$0	$54,182	$227,194	$227,194
2025	263.1	262.9	0.270	32	$41,716	$3,011	$10,893	$12.59	$55,632	$211.64	$0	$55,632	$268,707	$268,707
2026	263.1	263.1	0.000	0	$43,132	$3,045	$10,952	$12.54	$57,141	$217.16	$0	$57,141	$309,317	$309,317
2027	263.1	263.0	0.170	27	$44,820	$3,031	$11,012	$12.54	$58,875	$223.90	$0	$58,875	$349,165	$349,165
2028	263.8	263.5	0.290	26	$46,838	$3,044	$11,103	$12.66	$60,998	$231.49	$0	$60,998	$388,485	$388,485
2029	263.1	263.1	0.000	0	$47,755	$3,077	$11,135	$12.41	$61,980	$235.55	$0	$61,980	$426,536	$426,536
2030	263.1	263.1	0.000	0	$50,497	$3,011	$11,199	$12.69	$64,719	$245.96	$0	$64,719	$464,376	$464,376
2031	263.1	263.0	0.120	10	$49,667	$3,128	$11,264	$12.30	$64,071	$243.61	$0	$64,071	$500,053	$500,053
2032	263.8	263.5	0.290	46	$52,831	$3,032	$11,361	$12.62	$67,236	$255.18	$0	$67,236	$535,709	$535,709
2033	263.1	263.1	0.000	0	$53,881	$3,060	$11,397	$12.52	$68,351	$259.76	$0	$68,351	$570,231	$570,231
2034	263.1	262.5	0.640	60	$54,853	$3,076	$11,466	$12.44	$69,408	$264.42	$0	$69,408	$603,618	$603,618
2035	263.1	262.4	0.760	119	$57,502	$3,058	$11,536	$12.57	$72,110	$274.84	$0	$72,110	$636,652	$636,652
2036	263.8	263.8	0.000	0	$58,131	$3,130	$11,640	$12.43	$72,913	$276.44	$0	$72,913	$668,464	$668,464
2037	263.1	263.1	0.000	0	$62,304	$3,015	$11,681	$12.82	$77,013	$292.68	$0	$77,013	$700,464	$700,464
2038	263.1	263.1	0.060	6	$61,427	$3,107	$11,756	$12.47	$76,302	$290.04	$0	$76,302	$730,660	$730,660
2039	263.1	262.9	0.190	21	$63,670	$3,089	$11,832	$12.56	$78,603	$298.94	$0	$78,603	$760,284	$760,284
2040	263.8	263.5	0.300	45	$66,612	$3,091	$11,942	$12.66	$81,658	$309.92	$0	$81,658	$789,595	$789,595
2041	263.1	263.1	0.020	1	$64,953	$3,208	$11,988	$12.25	$80,161	$304.67	$0	$80,161	$816,998	$816,998
2042	263.1	263.1	0.000	1	$69,400	$3,050	$12,069	$12.69	$84,532	$321.27	$0	$84,532	$844,519	$844,519
2043	263.1	263.1	0.000	0	$69,311	$3,147	$12,151	$12.42	$84,622	$321.60	$0	$84,622	$870,758	$870,758
2044	263.8	263.7	0.100	12	$72,725	$3,138	$12,269	$12.61	$88,145	$334.26	$0	$88,145	**$896,787**	**$896,787**

5.4 COMPARISON OF CPWC AMONG THE TOP FIVE EXPANSION PLANS FOR STT AND STX

In evaluating the economic merits of the least cost plan for STT and STX, it is useful to have alternative plans to compare against. This is useful as it may be that the CPWC of the optimized base case plan is only slightly above the CPWC of competing plans that have other benefits not attained in the optimized plan. These benefits could include, for example, higher renewable penetration, higher system reliability (lower loss of load hours), or the selection of projects that are more likely to be developed according to the projected time frame.

Table 5-5 lists the CPWC results for the top five expansion plans identified by PLEXOS for STT. Also listed are the project additions and existing unit retirements associated with each plan. The optimized case is marked as "P0" in the table and the other expansion plans are designated as P1 through P4.

Results indicate that the top five base case plans for STT have a total CPWC ranging from $841.19 million (P0) to $922.45 million (P4). The CPWC for P4 is 9.6 percent higher than the optimized case. The CPWC for P0 is also the lowest cost plan when the capital costs are not included. The CPWC value without capital costs provides an estimate of the effective cost of the plan to VIWAPA customers if the U.S. government funding does not need to be repaid. The CPWC values for the without capital cost cases are closely bunched and only range by 2.3 percent for STT.

Table 5-5 indicates that the top five plans all rely heavily on the addition of significant amounts of RE projects and efficient RICE capacity early in the expansion plan. All STT plans also involve the

retirement of the same existing VIWAPA units or rentals (STT 14, STT 15, STT 25, STT 26, and STT 27). The detailed CPWC sheets for the STT alternative expansion plans, P1-P4, are included in Appendix A. The format of these CPWC sheets is the same as that shown above for the optimized STT case.

Table 5-5 STT Resource Additions and Retirements Under the Top Five Expansion Plans

STT PLAN	CPWC ($1,000)	CPWC W/O CAPITAL COST ($1,000)	UNITS ADDED	YEAR ADDED	UNITS RETIRED
P0	$841,194	$732,701	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			RICE 8 MW LPG	01/01/2021	
			4 x RICE 7 MW LPG	01/01/2021	
			RICE 7 MW LPG	04/01/2021	
			STJ Cruz Bay BS	04/01/2022	
P1	$886,068	$733,876	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			4 x RICE 7 MW LPG	01/01/2021	
			2 x RICE 7 MW LPG	04/01/2021	
			RICE 7 MW LPG	10/01/2023	
			RICE 7 MW LPG	04/01/2024	
			STJ Cruz Bay BS	10/01/2023	
P2	$867,352	$742,115	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			2 x RICE 8 MW LPG	01/01/2021	
			RICE 8 MW LPG	04/01/2021	
			RICE 8 MW LPG	10/01/2023	
			RICE 8 MW LPG	04/01/2024	
			STJ Cruz Bay BS	10/01/2023	
			STJ Cruz Bay PV	04/01/2024	
P3	$862,805	$749,772	STT Bovoni Solar	01/01/2021	STT14, STT15, STT25, STT26, STT27
			STT Donoe Solar PPA	01/01/2021	
			RICE 8 MW LPG	01/01/2021	
			2 x RICE 8 MW LPG	04/01/2024	
			2 x RICE 7 MW LPG	01/01/2021	
			RICE 7 MW LPG	10/01/2023	
P4	$922,453	$736,746	STT Bovoni Solar	01/01/2021	
			STT Donoe Solar PPA	01/01/2021	

			RICE 8 MW LPG	01/01/2021	STT14, STT15, STT25, STT26, STT27
			RICE 8 MW LPG	04/01/2021	
			3 x RICE 7 MW LPG	01/01/2021	
			3 x RICE 7 MW LPG	10/01/2023	
			RICE 7 MW LPG	04/01/2024	
			RICE 7 MW LPG	2024	
			STJ Cruz Bay BS	2023	

The detailed CPWC sheets for the STT alternative expansion plans, P1-P4, are included in Appendix A. The format of these CPWC sheets is the same as that shown above for the optimized STT case.

Table 5-6 lists the CPWC results for the top five expansion plans identified by PLEXOS for STX in terms of lowest CPWC. Also listed are the project additions and existing unit retirements associated with each plan.

Results indicate that the top five base case plans for STX have total CPWC values ranging from $588.24 million (P0) to $625.46 million for Plan 2. The highest CPWC (for Plan 2) is 6.3 percent higher than the optimized case. The CPWC for plan P1 is the lowest cost plan when the capital costs are not included, which estimates the effective cost of the plan to VIWAPA customers under U.S. government grant funding. The CPWC values for the highest plan (P4) without capital costs is 10.4 percent higher than the lowest cost CPWC.

Table 5-6 demonstrates that the top plans are all similar in that they rely heavily on the addition of significant amounts of RE projects and efficiency RICE capacity very early on in the expansion plan. All STX plans also involve the retirement of the same VIWAPA units or rentals (STX 19, Aggreko, and STX 11).

The detailed CPWC sheets for the STX alternative expansion plans, P1-P4, are included in Appendix A. The format of these CPWC sheets is the same as that shown above for the optimized STX case.

Table 5-6 STX Project Additions and Existing Unit Retirements

STX PLAN	CPWC ($1,000)	CPWC W/O CAPITAL COST ($1,000)	UNITS ADDED	DATE ADDED	UNITS RETIRED
P0	$588,243	$410,804	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			3 x RICE 8 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P1	$593,103	$403,983	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			RICE 8 MW LPG	07/01/2022	
			3 x RICE 7 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P2	$625,455	$442,568	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 7 MW LPG	07/01/2022	
			RICE 7 MW LPG	07/01/2022	
P3	$592,304	$405,002	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 7 MW LPG	07/01/2022	
			Richmond BS 10/20	07/01/2022	
P4	$620,752	$445,910	Estate Pearl PV 18 MW	01/01/2021	STX 19, Aggreko, STX 11
			Hera PV 10 MW	01/01/2021	
			Longford Wind 5 x 3.3 MW	07/01/2021	
			4 x RICE 8 MW LPG	07/01/2022	

6.0 Sensitivity Case Results

Four primary sensitivity cases were performed for the STT and STX systems. The primary sensitivity cases consist of the high and low load growth cases and the high and low fuel cost cases. The high and low values for these sensitivities were presented in Section 3.

The results of these sensitivity cases are presented in Section 6.1 through Section 6.4, with the detailed CPWC sheets for all sensitivity cases included in Appendix A. The results indicate whether the base case plan rankings among the top five expansion plans changes under each sensitivity, and how much the CPWC of the base case changes under selected alternative assumptions.

6.1 CPWC OF THE OPTIMIZED BASE CASE UNDER THE HIGH LOAD GROWTH SENSITIVITY

As discussed in Section 3, the high load case assumes that higher load growth occurs on STT due to the addition of a cruise ship port and power exchanges with the British Virgin Islands starting in 2025. For this sensitivity, the optimized base case expansion plan for STT (P0) is assumed to be adopted to determine the impact on economics and loss of load hours.

For STX, the high load growth does not impact the island load compared to the base case. Therefore, the CPWC is the same as presented in Table 5-2.

The CPWC of the optimized base case plan for STT under the high load case is shown in Table 6-1. The CPWC increases significantly with the additional load and is $1,042.25 million (compared to $841.19 million in the STT base case), of which $933.76 million (compared to $732.70 million in the base case) is the cost to VIWAPA customers due to the grant funding of unit addition capital costs.

If the base case STT expansion plan is maintained under the high load growth scenario, the loss of load hours increases substantially beginning in 2025. Under this sensitivity, the average loss of load is 205 hours over the planning horizon and peaks at 401 hours in 2042. This loss of load hour level suggests that additional resources above those added in the optimized case would be required to maintain target levels of reliability.

Table 6-1 CPWC for STT in the High Load Sensitivity

STT High Load Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M+H44								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	11	$31,252	$4,672	$1,815	$3,315	$41,055	$112.17	$6,333	$47,388	$106,323	$100,354
2022	366.1	366.1	0.000	0	$31,195	$4,783	$1,406	$3,315	$40,699	$111.17	$7,316	$48,015	$148,176	$135,512
2023	366.1	366.1	0.000	1	$31,351	$4,882	$1,434	$3,315	$40,983	$111.93	$7,553	$48,536	$188,604	$169,228
2024	367.1	367.1	0.000	0	$31,838	$4,992	$1,467	$3,326	$41,623	$113.37	$7,553	$49,176	$227,732	$201,841
2025	477.7	476.4	1.300	198	$47,453	$6,516	$1,492	$3,315	$58,777	$123.37	$7,553	$66,331	$277,918	$245,701
2026	477.8	477.0	0.860	139	$49,385	$6,660	$1,522	$3,315	$60,882	$127.64	$7,553	$68,436	$327,327	$288,969
2027	478.2	476.6	1.600	281	$51,065	$6,782	$1,552	$3,315	$62,715	$131.58	$7,553	$70,268	$375,738	$331,417
2028	479.5	478.3	1.160	199	$52,375	$6,974	$1,588	$3,326	$64,263	$134.35	$7,553	$71,816	$422,952	$372,841
2029	478.4	477.2	1.200	215	$55,783	$7,057	$1,615	$3,315	$67,770	$142.02	$7,553	$75,323	$470,177	$414,446
2030	479.0	476.9	2.040	329	$56,671	$7,212	$1,647	$3,315	$68,846	$144.35	$7,553	$76,400	$515,887	$454,699
2031	479.0	477.9	1.100	182	$58,726	$7,351	$1,680	$3,315	$71,073	$148.73	$7,553	$78,627	$560,761	$494,275
2032	480.5	478.6	1.960	275	$60,399	$7,508	$1,719	$3,326	$72,952	$152.44	$7,553	$80,505	$604,592	$532,963
2033	479.2	477.9	1.340	234	$62,808	$7,610	$1,748	$3,315	$75,481	$157.95	$7,553	$83,035	$647,709	$571,086
2034	479.4	477.8	1.650	249	$64,010	$7,795	$1,783	$3,315	$76,904	$160.96	$7,553	$84,457	$689,549	$608,078
2035	479.7	476.6	3.100	387	$65,567	$7,931	$1,819	$3,315	$78,632	$164.98	$7,553	$86,185	$730,278	$644,100
2036	481.6	479.5	2.010	334	$68,026	$8,131	$1,860	$3,326	$81,344	$169.63	$7,553	$88,898	$770,339	$679,590
2037	480.2	479.0	1.190	203	$70,030	$8,271	$1,892	$3,315	$83,509	$174.34	$7,553	$91,063	$809,475	$714,290
2038	480.3	478.2	2.060	313	$71,171	$8,448	$1,930	$3,315	$84,864	$177.47	$7,553	$92,418	$847,367	$747,874
2039	480.4	478.2	2.150	221	$74,174	$8,553	$1,969	$3,315	$88,011	$184.03	$7,553	$95,565	$884,719	$781,044
2040	481.8	480.7	1.120	186	$75,873	$8,817	$2,014	$3,326	$90,031	$187.31	$7,553	$97,584	$921,096	$813,360
2041	481.1	479.7	1.430	254	$76,977	$8,991	$2,048	$3,315	$91,331	$190.39	$1,221	$92,552	$952,954	$844,581
2042	481.4	477.9	3.560	401	$78,711	$9,125	$2,089	$3,315	$93,241	$195.12	$238	$93,478	$983,431	$874,938
2043	481.6	479.1	2.440	293	$80,859	$9,341	$2,131	$3,315	$95,645	$199.62	$0	$95,645	$1,013,088	$904,595
2044	482.8	481.2	1.570	232	$83,692	$9,551	$2,180	$3,326	$98,749	$205.21	$0	$98,749	**$1,042,248**	**$933,755**

6.2 CPWC OF THE OPTIMIZED BASE CASE UNDER THE LOW LOAD GROWTH SENSITIVITY

The low load growth CPWC and expansion plan for STT is shown in Section 6.3. The CPWC for the optimized plan in this sensitivity is $784.09 million, of which VIWAPA customers are projected to incur $675.60 million in CPWC costs.

This plan for STT averages two loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 13 hours in 2025.

Table 6-2 CPWC for STT in the Low Load Sensitivity

STT Low Load Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M							Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	364.0	364.0	0.000	0	$48,490	$3,408	$13,619	$127	$65,645	$180.35	$0	$65,645	$62,519	$62,519
2021	356.9	356.9	0.050	11	$30,352	$4,551	$1,815	$3,315	$40,034	$112.17	$6,333	$46,367	$104,800	$98,831
2022	350.8	350.8	0.000	0	$29,681	$4,574	$1,406	$3,315	$38,977	$111.10	$7,316	$46,293	$145,165	$132,501
2023	346.5	346.5	0.000	0	$29,461	$4,604	$1,434	$3,315	$38,815	$112.02	$7,553	$46,368	$183,809	$164,434
2024	344.8	344.8	0.000	0	$29,677	$4,670	$1,467	$3,326	$39,139	$113.50	$7,553	$46,693	$220,991	$195,100
2025	341.3	341.3	0.000	0	$30,757	$4,711	$1,492	$3,315	$40,275	$118.02	$7,553	$47,829	$257,371	$225,154
2026	338.7	338.7	0.000	0	$31,749	$4,765	$1,522	$3,315	$41,351	$122.11	$7,553	$48,905	$292,900	$254,542
2027	336.0	336.0	0.000	0	$32,534	$4,820	$1,552	$3,315	$42,222	$125.65	$7,553	$49,775	$327,441	$283,119
2028	334.3	334.3	0.000	0	$33,284	$4,890	$1,588	$3,326	$43,087	$128.87	$7,553	$50,641	$361,004	$310,894
2029	330.8	330.8	0.010	4	$34,780	$4,931	$1,615	$3,315	$44,642	$134.95	$7,553	$52,195	$394,031	$338,300
2030	329.5	329.5	0.000	0	$35,452	$5,007	$1,647	$3,315	$45,422	$137.86	$7,553	$52,975	$426,045	$364,857
2031	329.5	329.5	0.010	2	$36,438	$5,106	$1,680	$3,315	$46,540	$141.24	$7,553	$54,093	$457,258	$390,772
2032	330.4	330.4	0.000	0	$37,577	$5,221	$1,719	$3,326	$47,843	$144.80	$7,553	$55,397	$487,774	$416,145
2033	329.5	329.5	0.000	1	$38,621	$5,309	$1,748	$3,315	$48,993	$148.69	$7,553	$56,547	$517,513	$440,890
2034	329.5	329.5	0.000	0	$39,615	$5,422	$1,783	$3,315	$50,135	$152.16	$7,553	$57,689	$546,477	$465,006
2035	329.5	329.5	0.030	13	$40,771	$5,526	$1,819	$3,315	$51,432	$156.09	$7,553	$58,985	$574,746	$488,567
2036	330.4	330.4	0.000	2	$42,011	$5,654	$1,860	$3,326	$52,851	$159.96	$7,553	$60,405	$602,374	$511,626
2037	329.5	329.5	0.000	0	$42,956	$5,754	$1,892	$3,315	$53,918	$163.64	$7,553	$61,471	$629,215	$534,030
2038	329.5	329.5	0.020	12	$44,027	$5,868	$1,930	$3,315	$55,141	$167.35	$7,553	$62,694	$655,344	$555,851
2039	329.5	329.5	0.000	4	$45,216	$5,983	$1,969	$3,315	$56,483	$171.40	$7,553	$64,036	$680,814	$577,139
2040	330.4	330.4	0.000	0	$46,490	$6,118	$2,014	$3,326	$57,948	$175.38	$7,553	$65,501	$705,674	$597,939
2041	329.5	329.5	0.000	0	$47,380	$6,226	$2,048	$3,315	$58,970	$178.97	$1,221	$60,191	$726,470	$618,098
2042	329.5	329.5	0.020	6	$48,577	$6,351	$2,089	$3,315	$60,332	$183.10	$238	$60,570	$746,233	$637,740
2043	329.5	329.5	0.000	0	$49,833	$6,477	$2,131	$3,315	$61,757	$187.43	$0	$61,757	$765,382	$656,889
2044	330.4	330.4	0.000	0	$51,212	$6,626	$2,180	$3,326	$63,344	$191.74	$0	$63,344	**$784,088**	**$675,595**

The low load growth CPWC and expansion plan for STX is shown in Section 6.3. The CPWC for the optimized plan in this sensitivity is $552.80 million, of which VIWAPA customers are projected to incur $375.36 million in CPWC costs.

This plan for STX averages seven loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 77 hours in 2022.

Table 6-3 CPWC for STX in the Low Load Sensitivity

STX Low Load Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3MW	27,539	6	20	07/01/2021	28,793	2,099
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	261.6	261.6	0.000	0	$29,440	$1,780	$10,645	$1,463	$43,328	$165.66	$0	$43,328	$41,265	$41,265
2021	256.5	256.4	0.090	21	$19,365	$1,261	$9,794	$1,458	$31,879	$124.31	$6,341	$38,220	$76,157	$70,180
2022	252.2	251.9	0.290	77	$20,180	$1,020	$2,026	$1,458	$24,684	$98.00	$9,964	$34,648	$106,599	$91,503
2023	249.1	249.1	0.000	1	$15,316	$1,728	$2,216	$1,458	$20,718	$83.18	$12,538	$33,256	$134,783	$108,548
2024	247.8	247.8	0.000	2	$15,447	$1,741	$2,267	$1,463	$20,917	$84.42	$12,538	$33,455	$161,988	$124,938
2025	245.5	245.3	0.140	26	$15,903	$1,755	$2,306	$1,458	$21,422	$87.33	$12,538	$33,960	$188,473	$140,923
2026	243.4	243.4	0.000	0	$16,493	$1,765	$2,352	$1,458	$22,068	$90.67	$12,538	$34,606	$214,351	$156,606
2027	241.5	241.5	0.000	2	$16,856	$1,777	$2,399	$1,458	$22,490	$93.11	$12,538	$35,028	$239,471	$171,829
2028	240.3	240.3	0.000	0	$17,278	$1,799	$2,453	$1,463	$22,993	$95.68	$12,538	$35,531	$263,901	$186,650
2029	237.8	237.8	0.000	0	$17,996	$1,810	$2,496	$1,458	$23,760	$99.90	$12,538	$36,297	$287,817	$201,236
2030	236.9	236.9	0.000	0	$18,239	$1,853	$2,546	$1,458	$24,096	$101.70	$12,538	$36,634	$310,963	$215,325
2031	237.0	237.0	0.000	0	$18,752	$1,876	$2,596	$1,458	$24,683	$104.13	$12,538	$37,221	$333,501	$229,069
2032	237.7	237.7	0.000	0	$19,319	$1,917	$2,656	$1,463	$25,354	$106.67	$12,538	$37,892	$355,485	$242,515
2033	237.5	237.5	0.000	0	$19,691	$1,959	$2,701	$1,458	$25,809	$108.66	$12,538	$38,347	$376,809	$255,551
2034	238.1	238.0	0.070	17	$20,213	$1,979	$2,755	$1,458	$26,405	$110.94	$12,538	$38,943	$397,558	$268,252
2035	239.0	238.9	0.060	13	$20,625	$2,004	$2,811	$1,458	$26,898	$112.60	$12,538	$39,436	$417,693	$280,574
2036	240.5	240.5	0.000	0	$20,865	$2,071	$2,875	$1,463	$27,273	$113.39	$12,538	$39,811	$437,178	$292,474
2037	243.0	243.0	0.000	0	$20,910	$2,034	$2,924	$1,458	$27,326	$112.46	$12,538	$39,864	$455,897	$303,828
2038	244.0	244.0	0.000	0	$21,081	$2,084	$2,983	$1,458	$27,607	$113.16	$12,538	$40,145	$473,972	$314,753
2039	244.4	244.4	0.000	0	$21,776	$2,096	$3,042	$1,458	$28,372	$116.10	$12,538	$40,910	$491,607	$325,446
2040	244.9	244.9	0.000	0	$22,519	$2,134	$3,112	$1,463	$29,227	$119.33	$12,538	$41,765	$508,838	$335,937
2041	244.2	244.2	0.010	6	$23,017	$2,178	$3,165	$1,458	$29,819	$122.10	$6,197	$36,016	$522,266	$346,131
2042	244.1	244.1	0.000	0	$23,524	$2,255	$3,228	$1,458	$30,466	$124.79	$2,574	$33,039	$533,488	$356,049
2043	244.1	244.1	0.000	0	$24,289	$2,297	$3,293	$1,458	$31,338	$128.37	$0	$31,338	$543,205	$365,766
2044	244.6	244.6	0.000	0	$25,354	$2,314	$3,368	$1,463	$32,500	$132.85	$0	$32,500	**$552,803**	**$375,363**

6.3 CPWC FOR THE HIGH FUEL COST SENSITIVITIES

The high and low fuel cost assumptions are listed in Section 3. In Table 6-4, the STT CPWC for the optimized expansion plan is shown under the high fuel prices. In this sensitivity, no change in the units added were made; the impact in CPWC is driven entirely by changes in the fuel prices.

The CPWC at the end of the study period for the high fuel cost case is $937.22 million for STT. This is significantly higher (11.4 percent) than the base case results. Of the total CPWC, VIWAPA customers would incur $828.73 million of the total CPWC after U.S. government funding of new generating unit additions was considered.

This plan for STT averages nine loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 37 hours in 2029.

Table 6-4 CPWC for STT in the High Fuel Cost Sensitivity

STT High Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M							Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	367.1	367.1	0.000	0	$55,474	$3,366	$13,619	$127	$72,587	$197.76	$0	$72,587	$69,130	$69,130
2021	366.1	366.0	0.080	11	$35,569	$4,661	$1,815	$3,315	$45,361	$123.93	$6,333	$51,693	$116,242	$110,273
2022	366.1	366.1	0.000	0	$36,574	$4,783	$1,406	$3,315	$46,079	$125.86	$7,316	$53,394	$162,742	$150,078
2023	366.1	366.1	0.000	1	$36,746	$4,882	$1,434	$3,315	$46,378	$126.67	$7,553	$53,931	$207,608	$188,233
2024	367.1	367.1	0.000	0	$37,320	$4,992	$1,467	$3,326	$47,105	$128.31	$7,553	$54,658	$251,032	$225,141
2025	366.1	366.1	0.000	1	$38,948	$5,080	$1,492	$3,315	$48,836	$133.39	$7,553	$56,389	$293,800	$261,583
2026	366.2	366.1	0.020	9	$40,589	$5,178	$1,522	$3,315	$50,605	$138.21	$7,553	$58,158	$335,905	$297,547
2027	366.2	366.2	0.010	9	$42,006	$5,282	$1,552	$3,315	$52,156	$142.44	$7,553	$59,709	$377,169	$332,848
2028	367.1	367.1	0.000	0	$43,229	$5,407	$1,588	$3,326	$53,550	$145.86	$7,553	$61,103	$417,477	$367,366
2029	366.2	366.1	0.140	37	$45,625	$5,494	$1,615	$3,315	$56,050	$153.12	$7,553	$63,603	$457,507	$401,776
2030	366.1	366.1	0.000	0	$46,746	$5,604	$1,647	$3,315	$57,313	$156.54	$7,553	$64,867	$496,474	$435,286
2031	366.2	366.1	0.040	9	$48,103	$5,713	$1,680	$3,315	$58,812	$160.64	$7,553	$66,365	$534,520	$468,034
2032	367.1	367.1	0.000	0	$49,557	$5,844	$1,719	$3,326	$60,445	$164.65	$7,553	$67,999	$571,719	$500,090
2033	366.2	366.2	0.010	5	$50,977	$5,940	$1,748	$3,315	$61,980	$169.28	$7,553	$69,534	$608,017	$531,394
2034	366.1	366.1	0.000	0	$52,168	$6,071	$1,783	$3,315	$63,337	$173.00	$7,553	$70,891	$643,332	$561,860
2035	366.2	366.0	0.120	22	$53,779	$6,183	$1,819	$3,315	$65,096	$177.84	$7,553	$72,650	$677,860	$591,682
2036	367.2	367.2	0.030	13	$55,421	$6,327	$1,860	$3,326	$66,935	$182.30	$7,553	$74,488	$711,634	$620,885
2037	366.1	366.1	0.000	0	$56,536	$6,443	$1,892	$3,315	$68,187	$186.25	$7,553	$75,740	$744,403	$649,218
2038	366.2	366.1	0.100	21	$57,942	$6,569	$1,930	$3,315	$69,757	$190.54	$7,553	$77,310	$776,316	$676,823
2039	366.2	366.1	0.090	33	$59,675	$6,692	$1,969	$3,315	$71,651	$195.70	$7,553	$79,204	$807,503	$703,828
2040	367.2	367.2	0.010	5	$61,289	$6,848	$2,014	$3,326	$73,476	$200.13	$7,553	$81,030	$837,937	$730,201
2041	366.2	366.1	0.010	3	$62,398	$6,972	$2,048	$3,315	$74,733	$204.11	$1,221	$75,954	$864,122	$755,749
2042	366.2	366.1	0.100	28	$64,036	$7,108	$2,089	$3,315	$76,549	$209.07	$238	$76,787	$889,164	$780,671
2043	366.2	366.2	0.010	12	$65,681	$7,251	$2,131	$3,315	$78,379	$214.06	$0	$78,379	$913,467	$804,974
2044	367.1	367.1	0.000	0	$67,515	$7,418	$2,180	$3,326	$80,439	$219.13	$0	$80,439	**$937,221**	**$828,728**

For the STX system, the high fuel cost case results in a CPWC of $635.90 million, of which $458.46 million is paid by VIWAPA customers after the U.S. government grant financing of new resources is considered. These results are seen at the bottom of Table 6-5. The generation capacity added and retired is the same in this sensitivity case as in the base case plan for STX.

This plan for STX averages 14 loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 88 hours in 2022.

Table 6-5 CPWC for STX in the High Fuel Cost Sensitivity

STX High Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3MW	27,539	6	20	07/01/2021	28,793	2,099
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost									
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Cumulative Present Worth Cost (CPWC) ($1,000)	CPWC without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$31,917	$1,878	$10,645	$1,463	$45,903	$174.04	$0	$45,903	$43,717	$43,717
2021	263.1	262.9	0.260	35	$22,889	$1,291	$9,794	$1,458	$35,433	$134.79	$6,341	$41,773	$81,832	$75,855
2022	263.2	262.8	0.380	88	$24,919	$1,079	$2,026	$1,458	$29,482	$112.19	$9,964	$39,446	$116,418	$101,323
2023	263.3	263.2	0.070	24	$19,344	$1,849	$2,216	$1,458	$24,867	$94.49	$12,538	$37,405	$148,016	$121,781
2024	263.9	263.8	0.120	24	$19,663	$1,887	$2,267	$1,463	$25,279	$95.83	$12,538	$37,817	$178,638	$141,588
2025	263.4	263.0	0.320	51	$20,482	$1,916	$2,306	$1,458	$26,162	$99.46	$12,538	$38,700	$208,661	$161,111
2026	263.4	263.4	0.000	0	$21,475	$1,941	$2,352	$1,458	$27,227	$103.38	$12,538	$39,764	$238,205	$180,460
2027	263.5	263.4	0.160	43	$22,136	$1,972	$2,399	$1,458	$27,965	$106.18	$12,538	$40,503	$267,030	$199,388
2028	264.8	264.8	0.040	18	$22,736	$2,023	$2,453	$1,463	$28,676	$108.30	$12,538	$41,213	$295,124	$217,873
2029	265.3	265.3	0.000	0	$23,707	$2,047	$2,496	$1,458	$29,707	$111.99	$12,538	$42,245	$322,691	$236,111
2030	265.9	265.9	0.000	0	$24,016	$2,111	$2,546	$1,458	$30,131	$113.30	$12,538	$42,668	$349,365	$253,727
2031	267.8	267.8	0.000	0	$24,318	$2,121	$2,596	$1,458	$30,494	$113.89	$12,538	$43,032	$375,139	$270,707
2032	269.6	269.6	0.000	0	$24,871	$2,149	$2,656	$1,463	$31,138	$115.52	$12,538	$43,676	$400,190	$287,221
2033	269.6	269.6	0.000	0	$25,374	$2,191	$2,701	$1,458	$31,725	$117.68	$12,538	$44,263	$424,502	$303,244
2034	269.8	269.7	0.140	22	$26,222	$2,218	$2,755	$1,458	$32,654	$121.09	$12,538	$45,192	$448,257	$318,951
2035	269.8	269.7	0.110	18	$27,127	$2,250	$2,811	$1,458	$33,646	$124.77	$12,538	$46,183	$471,483	$334,365
2036	270.5	270.5	0.000	0	$27,786	$2,345	$2,875	$1,463	$34,469	$127.44	$12,538	$47,006	$494,108	$349,403
2037	269.7	269.7	0.000	2	$28,860	$2,344	$2,924	$1,458	$35,586	$131.93	$12,538	$48,124	$516,259	$364,190
2038	269.7	269.7	0.000	0	$29,415	$2,423	$2,983	$1,458	$36,280	$134.53	$12,538	$48,818	$537,766	$378,547
2039	269.6	269.6	0.000	0	$30,526	$2,444	$3,042	$1,458	$37,471	$138.99	$12,538	$50,009	$558,831	$392,670
2040	270.3	270.3	0.000	0	$31,479	$2,494	$3,112	$1,463	$38,547	$142.59	$12,538	$51,085	$579,407	$406,506
2041	269.6	269.6	0.040	12	$32,139	$2,546	$3,165	$1,458	$39,309	$145.81	$6,197	$45,506	$596,078	$419,943
2042	269.6	269.6	0.000	0	$32,801	$2,640	$3,228	$1,458	$40,128	$148.87	$2,574	$42,702	$610,447	$433,008
2043	269.5	269.5	0.030	13	$33,849	$2,684	$3,293	$1,458	$41,284	$153.21	$0	$41,284	$623,248	$445,809
2044	270.2	270.2	0.000	0	$35,320	$2,702	$3,368	$1,463	$42,853	$158.63	$0	$42,853	**$635,903**	**$458,463**

6.4 CPWC FOR THE LOW FUEL COST SENSITIVITIES

In Table 6-6, the STT CPWC for the optimized expansion plan is shown under low fuel price assumptions. In this sensitivity, no change in the optimized unit additions are made; the impact in CPWC is driven entirely by changes in the fuel prices.

The CPWC at the end of the study period for the low fuel cost case is $777.53 million for STT. This is significantly lower (7.6 percent) than the base case results. Of the total CPWC, VIWAPA customers would incur $669.04 million of the total CPWC after U.S. government funding of new generating unit additions was considered. The system reliability in this sensitivity peaks at 37 hours in 2029.

This plan for STT averages nine loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 37 hours in 2029.

Table 6-6 CPWC for STT in the Low Fuel Cost Sensitivity

STT Low Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
RICE 7MW LPG	14,257	6	20	04/01/2021	14,833	1,081
STJ Crus Bay BS	12,288	6	20	04/01/2022	13,041	951

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M							Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	11	$31,252	$4,672	$1,815	$3,315	$41,055	$112.17	$6,333	$47,388	$106,323	$100,354
2022	366.1	366.1	0.000	0	$31,195	$4,783	$1,406	$3,315	$40,699	$111.17	$7,316	$48,015	$148,176	$135,512
2023	366.1	366.1	0.000	1	$31,351	$4,882	$1,434	$3,315	$40,983	$111.93	$7,553	$48,536	$188,604	$169,228
2024	367.1	367.1	0.000	0	$31,646	$4,992	$1,467	$3,326	$41,431	$112.85	$7,553	$48,984	$227,581	$201,690
2025	366.1	366.1	0.000	1	$32,283	$5,080	$1,492	$3,315	$42,171	$115.18	$7,553	$49,724	$265,375	$233,158
2026	366.2	366.1	0.020	10	$32,976	$5,178	$1,522	$3,315	$42,992	$117.42	$7,553	$50,545	$302,071	$263,712
2027	366.2	366.2	0.010	9	$33,556	$5,282	$1,552	$3,315	$43,705	$119.36	$7,553	$51,259	$337,615	$293,294
2028	367.1	367.1	0.000	0	$34,062	$5,407	$1,588	$3,326	$44,383	$120.89	$7,553	$51,937	$372,014	$321,903
2029	366.2	366.1	0.140	37	$34,986	$5,494	$1,615	$3,315	$45,411	$124.05	$7,553	$52,964	$405,512	$349,781
2030	366.1	366.1	0.000	0	$35,447	$5,604	$1,647	$3,315	$46,014	$125.68	$7,553	$53,568	$437,873	$376,685
2031	366.2	366.1	0.040	10	$35,946	$5,713	$1,680	$3,315	$46,654	$127.43	$7,553	$54,208	$469,150	$402,664
2032	367.1	367.1	0.000	0	$36,540	$5,844	$1,719	$3,326	$47,429	$129.19	$7,553	$54,982	$499,446	$427,816
2033	366.2	366.2	0.010	5	$37,054	$5,940	$1,748	$3,315	$48,058	$131.25	$7,553	$55,611	$528,712	$452,089
2034	366.1	366.1	0.000	0	$37,424	$6,071	$1,783	$3,315	$48,594	$132.73	$7,553	$56,147	$556,934	$475,463
2035	366.2	366.0	0.120	24	$38,041	$6,183	$1,819	$3,315	$49,358	$134.84	$7,553	$56,911	$584,253	$498,074
2036	367.2	367.2	0.030	13	$38,660	$6,327	$1,860	$3,326	$50,174	$136.65	$7,553	$57,728	$610,714	$519,965
2037	366.1	366.1	0.000	0	$38,964	$6,443	$1,892	$3,315	$50,615	$138.25	$7,553	$58,168	$636,182	$540,997
2038	366.2	366.1	0.100	21	$39,441	$6,569	$1,930	$3,315	$51,255	$140.01	$7,553	$58,809	$660,773	$561,280
2039	366.2	366.1	0.090	34	$40,076	$6,692	$1,969	$3,315	$52,053	$142.17	$7,553	$59,606	$684,573	$580,898
2040	367.2	367.2	0.010	7	$40,659	$6,848	$2,014	$3,326	$52,847	$143.94	$7,553	$60,400	$707,603	$599,867
2041	366.2	366.1	0.010	3	$40,940	$6,972	$2,048	$3,315	$53,275	$145.51	$1,221	$54,496	$726,452	$618,080
2042	366.2	366.1	0.100	29	$41,473	$7,108	$2,089	$3,315	$53,986	$147.45	$238	$54,223	$744,149	$635,656
2043	366.2	366.2	0.010	12	$42,025	$7,251	$2,131	$3,315	$54,723	$149.45	$0	$54,723	$761,117	$652,623
2044	367.1	367.1	0.000	0	$42,662	$7,418	$2,180	$3,326	$55,586	$151.42	$0	$55,586	**$777,531**	**$669,038**

In Table 6-7, the STX CPWC for the optimized expansion plan is shown under the low fuel prices. In this sensitivity, no change in the units added were made; the impact in CPWC is driven entirely by changes in the fuel prices.

The CPWC at the end of the study period for the low fuel cost case is $559.19 million for STX. This is significantly lower (4.9 percent) than the base case results. Of the total CPWC, VIWAPA customers would incur $381.75 million of the total CPWC after U.S. grant government funding of new resources is considered.

This plan for STX averages 14 loss of load hours per year over the planning horizon. The maximum loss of load hours in any year is 88 hours in 2022.

Table 6-7 CPWC for the STX Low Fuel Cost Sensitivity

STX Low Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3MW	27,539	6	20	07/01/2021	28,793	2,099
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost									
						Plant O&M							Cumulative	CPWC
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,264	$1,076	$2,026	$1,458	$25,825	$98.29	$9,964	$35,789	$108,576	$93,481
2023	263.2	263.2	0.070	26	$16,510	$1,845	$2,216	$1,458	$22,030	$83.72	$12,538	$34,567	$137,840	$111,605
2024	263.9	263.7	0.120	22	$16,680	$1,883	$2,267	$1,463	$22,293	$84.53	$12,538	$34,831	$166,122	$129,072
2025	263.3	263.0	0.320	51	$16,990	$1,912	$2,306	$1,458	$22,666	$86.20	$12,538	$35,204	$193,536	$145,986
2026	263.1	263.1	0.000	0	$17,500	$1,935	$2,352	$1,458	$23,245	$88.34	$12,538	$35,783	$220,251	$162,506
2027	263.3	263.1	0.160	40	$17,740	$1,965	$2,399	$1,458	$23,563	$89.56	$12,538	$36,101	$246,096	$178,454
2028	263.9	263.9	0.040	15	$18,094	$2,017	$2,453	$1,463	$24,027	$91.06	$12,538	$36,565	$271,194	$193,943
2029	263.2	263.2	0.000	0	$18,587	$2,046	$2,496	$1,458	$24,587	$93.44	$12,538	$37,125	$295,618	$209,037
2030	263.1	263.1	0.000	0	$18,737	$2,110	$2,546	$1,458	$24,851	$94.44	$12,538	$37,389	$319,205	$223,567
2031	263.2	263.2	0.000	0	$18,995	$2,139	$2,596	$1,458	$25,189	$95.72	$12,538	$37,727	$342,025	$237,593
2032	263.8	263.8	0.000	0	$19,325	$2,182	$2,656	$1,463	$25,626	$97.13	$12,538	$38,164	$364,153	$251,183
2033	263.2	263.2	0.000	0	$19,517	$2,231	$2,701	$1,458	$25,908	$98.45	$12,538	$38,446	$385,527	$264,269
2034	263.3	263.1	0.140	23	$19,857	$2,255	$2,755	$1,458	$26,325	$100.05	$12,538	$38,863	$406,237	$276,932
2035	263.3	263.2	0.110	17	$20,186	$2,292	$2,811	$1,458	$26,747	$101.64	$12,538	$39,285	$426,304	$289,185
2036	263.9	263.9	0.000	0	$20,343	$2,388	$2,875	$1,463	$27,069	$102.59	$12,538	$39,607	$445,699	$300,995
2037	263.3	263.3	0.000	2	$20,756	$2,385	$2,924	$1,458	$27,523	$104.51	$12,538	$40,061	$464,500	$312,431
2038	263.3	263.3	0.000	0	$20,839	$2,468	$2,983	$1,458	$27,748	$105.40	$12,538	$40,286	$482,631	$323,412
2039	263.4	263.4	0.000	0	$21,231	$2,487	$3,042	$1,458	$28,219	$107.14	$12,538	$40,756	$500,208	$334,047
2040	264.1	264.1	0.000	0	$21,560	$2,536	$3,112	$1,463	$28,671	$108.58	$12,538	$41,208	$517,239	$344,338
2041	263.5	263.4	0.030	11	$21,679	$2,587	$3,165	$1,458	$28,889	$109.67	$6,197	$35,086	$530,349	$354,214
2042	263.5	263.5	0.000	0	$21,752	$2,686	$3,228	$1,458	$29,124	$110.54	$2,574	$31,698	$541,135	$363,696
2043	263.6	263.6	0.020	11	$22,072	$2,729	$3,293	$1,458	$29,553	$112.13	$0	$29,553	$550,298	$372,859
2044	264.8	264.8	0.000	0	$22,542	$2,737	$3,368	$1,463	$30,110	$113.73	$0	$30,110	**$559,190**	**$381,751**

6.5 MASTER LIST OF RENEWABLE ENERGY PROJECTS SENSITIVITY

One additional sensitivity was run for STT and STX. The sensitivity involved adding all RE projects on the VIWAPA master list of RE projects. The purpose was to confirm that the optimized results involving only selected RE projects are lower in cost than the option to add all RE projects.

Table 6-8 indicates the CPWC for STT if all VIWAPA master list RE projects are added to the system. This expansion plan includes six RE and storage projects, as well as four RICE units. The CPWC of this expansion plan is $938.88 million, of which $784.80 million would be paid by VIWAPA customers assuming U.S. government grant funding of capital costs. The full CPWC cost figure is 11.6 percent higher than the CPWC for STT P0 under base case assumptions. The costs payable by VIWAPA consumers is 7.1 percent higher than for STT P0 under base case assumptions.

Table 6-9 indicates the CPWC for STX if all VIWAPA master list RE projects are added to the system. This expansion plan includes five RE and storage projects, as well as three RICE units. The CPWC of this expansion plan is $623.39 million, of which $419.67 million would be paid by VIWAPA customers assuming U.S. grant funding of capital costs. The full CPWC cost figure is 6.0 percent higher than the CPWC for STX P0 under base case assumptions. The costs payable by VIWAPA consumers is 2.6 percent higher than for STT P0 under base case assumptions.

The loss of load hours in this sensitivity for STT peaks at 61 hours in 2032. For STX, the loss of load hours peak at 199 in 2022.

Table 6-8 Master List of RE Projects Added for STT

STT Master RE Project List

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	7/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	07/01/2021	14,979	1,092
STJ Rooftop Solar	5,000	0	20	12/01/2021	5,306	387
STT Rooftop Solar	7,500	0	20	12/01/2021	7,959	580
STJ Crus Bay PV & BS	22,288	6	20	12/31/2021	23,536	1,716
9xBovoni Wind 2MW	30,935	6	20	01/01/2023	33,375	2,433
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	07/01/2021	16,676	1,216
RICE 7MW LPG	14,257	6	20	01/01/2021	14,784	1,078

	Energy Balance				Production Cost									
						Plant O&M							Cumulative	CPWC
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$68	$66,213	$180.39	$0	$66,213	$63,060	$63,060
2021	366.1	366.0	0.060	29	$33,230	$4,643	$1,739	$2,156	$41,769	$114.11	$4,866	$46,635	$105,532	$100,945
2022	366.2	366.1	0.070	12	$30,607	$4,659	$1,357	$2,059	$38,682	$105.66	$8,479	$47,161	$146,706	$134,360
2023	366.1	366.1	0.000	0	$24,807	$18,577	$1,384	$2,079	$46,847	$127.95	$10,912	$57,759	$194,943	$172,901
2024	367.2	367.2	0.040	15	$25,065	$18,820	$1,416	$2,113	$47,414	$129.14	$10,912	$58,326	$241,505	$210,051
2025	366.1	366.1	0.000	0	$26,247	$18,958	$1,440	$2,138	$48,784	$133.25	$10,912	$59,696	$287,047	$246,454
2026	366.1	366.1	0.000	2	$27,342	$19,149	$1,469	$2,172	$50,132	$136.92	$10,912	$61,044	$331,547	$282,082
2027	366.1	366.1	0.010	3	$28,226	$19,346	$1,498	$2,203	$51,273	$140.05	$10,912	$62,185	$374,865	$316,786
2028	367.2	367.2	0.050	21	$29,117	$19,595	$1,533	$2,242	$52,486	$142.96	$10,912	$63,398	$417,061	$350,619
2029	366.2	366.1	0.110	26	$30,752	$19,737	$1,559	$2,273	$54,322	$148.40	$10,912	$65,234	$458,529	$383,968
2030	366.2	366.2	0.000	2	$31,564	$19,936	$1,590	$2,311	$55,401	$151.31	$10,912	$66,313	$498,804	$416,360
2031	366.1	366.1	0.010	5	$32,275	$20,149	$1,622	$2,339	$56,385	$154.00	$10,912	$67,297	$537,855	$447,757
2032	367.2	366.8	0.420	61	$33,217	$20,402	$1,659	$2,385	$57,663	$157.22	$10,912	$68,575	$575,865	$478,337
2033	366.2	366.1	0.020	8	$34,218	$20,563	$1,687	$2,411	$58,879	$160.82	$10,912	$69,791	$612,817	$508,075
2034	366.1	366.1	0.000	2	$35,217	$20,776	$1,721	$2,449	$60,163	$164.32	$10,912	$71,075	$648,761	$537,015
2035	366.2	366.1	0.040	12	$36,164	$20,991	$1,756	$2,483	$61,394	$167.69	$10,912	$72,305	$683,686	$565,140
2036	367.2	367.1	0.010	8	$37,237	$21,268	$1,796	$2,529	$62,830	$171.13	$10,912	$73,742	$717,700	$592,552
2037	366.1	366.1	0.000	0	$38,105	$21,435	$1,827	$2,557	$63,923	$174.60	$10,912	$74,835	$750,671	$619,114
2038	366.1	366.1	0.010	5	$39,009	$21,661	$1,863	$2,595	$65,127	$177.88	$10,912	$76,039	$782,667	$644,887
2039	366.1	366.1	0.000	0	$40,032	$21,886	$1,900	$2,637	$66,455	$181.51	$10,912	$77,367	$813,755	$669,933
2040	367.2	367.1	0.100	20	$41,061	$22,170	$1,944	$2,723	$67,897	$184.97	$10,912	$78,809	$843,992	$694,304
2041	366.2	366.0	0.180	37	$41,908	$22,342	$1,977	$2,757	$68,985	$188.49	$6,046	$75,030	$870,730	$717,887
2042	366.1	366.1	0.000	0	$43,053	$22,579	$2,017	$2,796	$70,446	$192.41	$2,433	$72,879	$894,897	$740,822
2043	366.2	366.2	0.030	9	$44,126	$22,819	$2,057	$2,845	$71,847	$196.22	$0	$71,847	$917,175	$763,099
2044	367.1	367.1	0.030	6	$45,366	$23,121	$2,104	$2,900	$73,490	$200.20	$0	$73,490	**$938,877**	**$784,801**

Table 6-9 Master List of RE Projects Added for STX

STX Master RE Project List

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	7/1/2022
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Hera PV 10 MW	25,000	6	20	07/01/2021	26,139	1,905
Estate Pearl PV 18 MW	45,000	6	20	07/01/2021	47,050	3,430
Hera PV 10 MW	25,000	6	20	12/01/2021	26,356	1,921
Longford Wind 5x3.3MW	27,539	6	20	12/31/2022	29,661	2,162
3xRICE 8MW LPG	47,848	6	20	07/01/2022	51,029	3,720
Richmond BS 10/20	18,367	6	20	01/01/2022	19,427	1,416

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.6	0.520	50	$27,821	$1,615	$9,794	$1,458	$40,689	$154.94	$2,828	$43,517	$81,079	$78,414
2022	263.6	262.3	1.280	199	$25,878	$1,335	$2,026	$1,458	$30,698	$117.02	$10,712	$41,411	$117,401	$104,932
2023	263.2	263.2	0.070	23	$16,391	$1,817	$2,216	$1,458	$21,882	$83.15	$14,554	$36,436	$148,335	$122,935
2024	263.9	263.7	0.120	24	$16,661	$1,854	$2,267	$1,463	$22,245	$84.34	$14,554	$36,799	$178,319	$140,364
2025	263.3	263.0	0.320	48	$17,362	$1,882	$2,306	$1,458	$23,009	$87.49	$14,554	$37,563	$207,677	$157,533
2026	263.1	263.1	0.000	0	$18,247	$1,906	$2,352	$1,458	$23,963	$91.07	$14,554	$38,517	$236,541	$174,563
2027	263.3	263.1	0.150	38	$18,800	$1,935	$2,399	$1,458	$24,592	$93.47	$14,554	$39,146	$264,675	$191,208
2028	263.9	263.9	0.040	19	$19,457	$1,986	$2,453	$1,463	$25,359	$96.11	$14,554	$39,914	$292,177	$207,555
2029	263.2	263.2	0.000	0	$20,519	$2,014	$2,496	$1,458	$26,487	$100.62	$14,554	$41,041	$319,268	$223,816
2030	263.3	263.3	0.000	0	$20,890	$2,076	$2,546	$1,458	$26,971	$102.44	$14,554	$41,525	$345,551	$239,585
2031	263.4	263.4	0.000	0	$21,461	$2,104	$2,596	$1,458	$27,621	$104.86	$14,554	$42,175	$371,140	$254,965
2032	264.2	264.2	0.000	0	$22,117	$2,148	$2,656	$1,463	$28,384	$107.45	$14,554	$42,938	$396,103	$270,018
2033	264.0	264.0	0.000	0	$22,539	$2,197	$2,701	$1,458	$28,896	$109.46	$14,554	$43,451	$420,320	$284,612
2034	264.8	264.6	0.140	20	$23,089	$2,220	$2,755	$1,458	$29,522	$111.56	$14,554	$44,077	$443,862	$298,813
2035	265.8	265.7	0.110	16	$23,558	$2,250	$2,811	$1,458	$30,077	$113.20	$14,554	$44,631	$466,711	$312,592
2036	267.9	267.9	0.000	0	$23,754	$2,329	$2,875	$1,463	$30,421	$113.55	$14,554	$44,975	$488,789	$325,864
2037	269.5	269.5	0.000	2	$24,113	$2,297	$2,924	$1,458	$30,792	$114.27	$14,554	$45,347	$510,133	$338,659
2038	270.0	270.0	0.000	0	$24,444	$2,366	$2,983	$1,458	$31,251	$115.74	$14,554	$45,805	$530,800	$351,026
2039	270.2	270.2	0.000	0	$25,306	$2,382	$3,042	$1,458	$32,188	$119.14	$14,554	$46,743	$550,990	$363,158
2040	270.8	270.8	0.000	0	$26,123	$2,425	$3,112	$1,463	$33,123	$122.31	$14,554	$47,677	$570,702	$375,047
2041	270.1	270.0	0.040	11	$26,679	$2,474	$3,165	$1,458	$33,776	$125.08	$11,727	$45,503	$588,369	$386,593
2042	270.0	270.0	0.000	0	$27,219	$2,566	$3,228	$1,458	$34,471	$127.66	$3,842	$38,313	$601,538	$397,816
2043	270.0	270.0	0.030	12	$28,094	$2,610	$3,293	$1,458	$35,455	$131.33	$0	$35,455	$612,532	$408,809
2044	270.6	270.6	0.000	0	$29,326	$2,623	$3,368	$1,463	$36,781	$135.91	$0	$36,781	**$623,393**	**$419,671**

6.6 SENSITIVITY SUMMARY FOR THE TOP FIVE EXPANSION PLANS IDENTIFIED IN THE BASE CASE

Table 6-10 provides a summary of CPWC costs for the base case and sensitivity case results. In the table, the lowest cost option corresponding to the column headings is highlighted in yellow. For STT, results indicate that case P0 is least cost in under base case assumptions and in several sensitivity cases. In total, case P0 for STT is lowest in cost in seven of the ten case results reported.

For STX, results indicate that case P0 is the least cost option for all cases when all CPWC costs are included. If the capital costs of new additions are not included, then P1 becomes the least cost for all cases.

Two of the conclusions drawn from Table 6-10 are: 1) for STT, expansion plan P0 is robust in terms of providing a low cost across a wide range of possible future scenarios; and 2) for STX, P0 is robust when all CPWC costs are being considered, but P1 is preferred from a customer cost perspective if VIWAPA customers do not have to pay back the capital-related funds for new resources. It is also noted, however, that non-economic considerations also influence optimal plan selection. These additional considerations are discussed in Section 7.

It is also concluded that, from a customer perspective, the highest benefit for funds invested occurs on STX, based on the differential between the total CPWC cost and the CPWC when capital costs are not included. For example, in the base case, customers avoid paying approximately $184 million in CPWC on STX if the capital costs of new projects do not have to be repaid, while customers avoid

approximately $109 million in CPWC on STT if government funding is not repaid. This suggests that if grant funding is limited, the STX projects are appropriate to target as a priority.

Table 6-10 CPWC Summary of the Base Case and All Sensitivity Cases for Plans P0 through P4

	BASE		HIGH LOAD		LOW LOAD		HIGH FUEL		LOW FUEL	
	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)
STT Plan										
P0	$841,194	$732,701	$1,042,248	$933,755	$784,088	$675,595	$937,221	$828,728	$777,531	$669,038
P1	$886,068	$733,876	$1,047,542	$895,350	$830,632	$678,440	$981,245	$829,053	$822,708	$670,516
P2	$867,352	$742,115	$1,049,776	$924,540	$809,770	$684,533	$964,851	$839,614	$803,627	$678,391
P3	$862,805	$749,772	$1,037,574	$924,542	$805,234	$692,201	$961,756	$848,724	$798,341	$685,308
P4	$992,453	$736,746	$1,082,034	$896,326	$866,853	$681,145	$1,017,751	$832,044	$859,096	$673,388
STX Plan										
P0	$588,243	$410,804	$588,242	$410,803	$552,803	$375,363	$635,903	$458,463	$559,190	$381,751
P1	$593,103	$403,983	$593,103	$403,983	$560,073	$370,953	$639,016	$449,895	$565,144	$376,024
P2	$625,455	$442,568	$625,455	$442,568	$595,371	$412,484	$680,632	$497,745	$588,681	$405,794
P3	$592,304	$405,002	$592,304	$405,001	$592,304	$405,002	$638,543	$451,241	$564,158	$376,856
P4	$620,752	$445,910	$620,753	$445,911	$589,803	$414,961	$676,575	$501,733	$583,460	$408,618

7.0 Conclusions and Recommendations

In this section multiple conclusions are made for STT and STX and the preferred expansion plan for each system is identified. This section also includes recommended next steps associated with the development of the preferred expansion plan for each island.

7.1 CONCLUSIONS

The following general conclusions apply:

- Significant savings are realized if VIWAPA moves away from its existing units to new RE generation and efficient RICE generation.
- The sooner the RE units are available to put into serve the better from an economic standpoint.
- It is economical to retire most existing units on STT and STX, but this must be coordinated to ensure sufficient system reliability.
- The PLEXOS model made unit additions based on primarily on economics rather than a need for capacity.
- It is economical to add significant amounts of RE, even beyond the target of 50 percent (for both systems combined).
- The new portfolios show increased system reliability versus historical outages.
- For the top five expansion plans on each system, the units added are similar and feature a mix of solar and wind projects and small, efficient RICE units. Battery storage (BESS) is added in the leading plans for STT and STX.

7.1.1 Economic Considerations

For STT, plan P0 is lower in cost in most scenarios evaluated. The units added, retired, and not selected in STT plan P0 are as shown in Table 7-1:

Table 7-1 Summary of the Most Economic STT Expansion Plan (STT P0)

UNITS ADDED	UNITS RETIRED	CANDIDATES NOT SELECTED
	STT P0	
Bovoni Solar, 1/2021	STT 14	Port Authority PV
Donoe Solar PPA, 1/2021	STT 15	Bovoni Wind PPA*
8 MW RICE Unit, 1/2021	STT 25	STJ Rooftop Solar
3 x 7 MW RICE Units, 1/2021	STT 26	STT Rooftop Solar
7 MW RICE, 4/2022	STT 27	STJ Cruz Bay Solar
STJ Cruz Bay BESS, 4/2022		CTs and CCs
*Note that if VIWAPA ownership of the Bovoni wind resource is assumed, the project would be selected in the optimization.		

For STX, and under base case assumptions, the units added, retired, and not selected are shown in Table 7-2 for plans P0 and P1. The results for these two plans are shown as both are least cost in half of the ten CPWC plans measured.

Table 7-2 Summary of the Most Economic STX Expansion Plans (STX P0 and STX P1)

UNITS ADDED	UNITS RETIRED	CANDIDATES NOT SELECTED
STX Plan P0		
Estate Pearl PV, 18 MW, 1/2021	STX 19	Rooftop Solar Program
Hera PV, 10 MW, 1/2021	Aggreko lease	BESS, Willock
Longford Wind 5x3.3 MW, 7/2021	STX 11	CTs and CCs
3 x 8 MW RICE, 7/2022		
Richmond BESS, 7/2022		
STX Plan P1		
Estate Pearl PV, 18 MW, 1/2021	STX 19	Rooftop Solar Program
Hera PV, 10 MW, 1/2021	Aggreko lease	BESS, Willock
Longford Wind 5x3.3 MW, 7/2021	STX 11	CTs and CCs
8 MW Rice, 7/2021		
3 x 7 MW RICE, 7/2022		
Richmond BESS, 7/2022		

In terms of economics, the CPWC of the top plans for STT and STX are shown in Table 7-3. For each system and expansion plan, the total CPWC of a plan is indicated, along with the plan's CPWC without capital costs. For STT, the preferred plan is P0 in seven of the ten expansion plans, including both CPWC measures in the base case. For STX, plan P0 is preferred when considering the full CPWC and plan P1 is preferred when capital costs are excluded.

From the standpoint of grant funding benefits, the largest benefits from a VIWAPA customer perspective are realized on STX, where the difference between the full CPWC and the CPWC without capital costs is larger than on STT. Thus, if grant funds are limited, projects on STX seem to provide the greatest benefit to VIWAPA customers.

7.1.2 The Economic, Reliability, and Renewable Energy Heat Map

In addition to system economics, the merits of the competing expansion plans must also consider system reliability and the achievement of renewable energy targets. In this study, the reliability of plan is measured by the loss of load hours each year of the 2020-2044 planning horizon. The target is to improve from one day per year at the start of the study period to one day in ten years by the end of the period. For renewable energy, the goal is to achieve 50 percent renewable energy in terms of the ratio of installed capacity to peak demand.

Table 7-4 is a heat map indicating the relative economic, reliability, and renewable energy merits of the competing plans. The heat map shows, for each of five categories, how the plan fares relative to

other competing plans. Green shading in the table means that a plan is the best option or comparable to the best option. Yellow means it is not as beneficial as the best option but it is not dramatically worse. An orange colored cell means that the option is clearly less beneficial than the best plan in the category and a red colored cell means that the plan is significantly less beneficial than the best plan and may be a candidate for exclusion based on the result.

The heat map evaluated performance in five areas, three of which are CPWC related (base case CPWC, base case cost to VIWAPA customers, and the average of total CPWC across the base case and all sensitivity cases). While the heat maps are somewhat subjective in terms of where the break in colors assigned among the plans occurs, the following boundaries (also shown at the bottom of Table 7-4) were established for the five categories adopted:

- For these three cost categories, *green* is awarded to the least cost plan plus any other plan within 1.5 percent, as this is generally considered the approximate margin of error between two competing plans. A difference of 1.5 percent to 3.0 percent versus the least cost plan is assigned a *yellow* color; 3.0 percent to 4.5 percent receives an *orange* color, and *red* is a CPWC higher than 4.5 percent more costly than the lowest CPWC plan.
- For loss of load hours, *green* is assigned to plans averaging less than 4 loss of load hours per year over the planning horizon; *yellow* is assigned to plans averaging between 4 and 8 loss of load hours per year; *orange* is assigned to plans averaging between 8 and 12 loss of load hours per year; and *red* is assigned to plans averaging more than 12 loss of load hours per year.
- Finally, concerning renewable energy target color schemes, *green* is assigned if the plan averaged more than 65 percent RE over the planning period, *yellow* if between 53 and 65 percent; *orange* if between 48 and 52 percent, and *red* if below 48 percent.

Results indicate that for STT, the P0 plan scores relatively high in all categories, as indicated by the green shading in the three CPWC categories and also in the RE category. Only in the loss of load hour category does Plan 0 receive a rating that is not green. The rating for Plan 0 is orange in the loss of load category as the plan is projected to average 8.73 loss of load hours per year over the plan. Nevertheless, even this loss of load figure is well below the historical average and is not considered high enough to give the nod to a competing plan. Therefore, **the recommended expansion plan for STT is P0.**

Results in the heat map indicate that, for STX, there are three plans that perform well overall. These plans are P0, P1, and P3. In terms of economics, P0 has the lowest total CPWC, but P1 and P3 are also shaded green as they are within 1.5 percent of P0. In addition, P1 has the lowest CPWC without capital costs while P0 receives a yellow shading in this category as it is just over 1.5 percent more costly than P0. In the loss of load category, P1 and P3 have a significant advantage over P0, which has approximately two times the average loss of load hours versus the other two plans. All three plans score well in terms of RE targets.

Given all the scoring categories, **the recommendation is that P1 be considered the preferred plan for STX.** This recommendation is strongest when assuming that grant funding occurs (if grant funding does not occur, P1 and P0 would be very close overall, as P0 would be lower in cost but higher in loss of load hours). The recommendation of P1 constitutes a change from the least cost plan (P0) when ranked according to the total CPWC only.

Table 7-3 CPWC Summary of the Base Case and All Sensitivity Cases

	BASE		HIGH LOAD		LOW LOAD		HIGH FUEL		LOW FUEL	
	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)	CPWC ($1,000)	CPWC W/O CAPITAL COSTS ($1,000)
STT Plan										
P0	$841,194	$732,701	$1,042,248	$933,755	$784,088	$675,595	$937,221	$828,728	$777,531	$669,038
P1	$886,068	$733,876	$1,047,542	$895,350	$830,632	$678,440	$981,245	$829,053	$822,708	$670,516
P2	$867,352	$742,115	$1,049,776	$924,540	$809,770	$684,533	$964,851	$839,614	$803,627	$678,391
P3	$862,805	$749,772	$1,037,574	$924,542	$805,234	$692,201	$961,756	$848,724	$798,341	$685,308
P4	$922,453	$736,746	$1,082,034	$896,326	$866,853	$681,145	$1,017,751	$832,044	$859,096	$673,388
STX Plan										
P0	$588,243	$410,804	$588,242	$410,803	$552,803	$375,363	$635,903	$458,463	$559,190	$381,751
P1	$593,103	$403,983	$593,103	$403,983	$560,073	$370,953	$639,016	$449,895	$565,144	$376,024
P2	$625,455	$442,568	$625,455	$442,568	$595,371	$412,484	$680,632	$497,745	$588,681	$405,794
P3	$592,304	$405,002	$592,304	$405,001	$592,304	$405,002	$638,543	$451,241	$564,158	$376,856
P4	$620,752	$445,910	$620,753	$445,911	$589,803	$414,961	$676,575	$501,733	$583,460	$408,618

Table 7-4 Heat Map Considering Economics, Reliability, and Renewable Energy Targets

PLAN	FINAL RANKING	CPWC, BASE CASE	CPWC, COST TO VIWAPA CUSTOMERS	CPWC, (FULL COST) AVERAGE COST OF BASE & SENSITIVITY CASES	AVERAGE ANNUAL LOL HOURS, 2020-2044	AVERAGE RE% OF PEAK MET, 2020-2044
STT						
Plan 0	1	$841,194	$732,701	$876,456	8.73	71.77%
Plan 1	4	$886,068	$733,876	$913,639	0.15	71.61%
Plan 2	3	$867,352	$742,115	$899,075	3.31	75.20%
Plan 3	2	$862,805	$749,772	$893,142	5.38	67.85%
Plan 4	5	$992,453	$736,746	$963,637	0.15	71.61%
STX						
Plan 0	3	$588,243	$410,804	$584,876	13.23	71.77%
Plan 1	1	$593,103	$403,983	$590,088	6.96	71.77%
Plan 2	5	$625,455	$442,568	$623,119	6.12	61.96%
Plan 3	2	$592,304	$405,002	$595,923	7.38	71.77%
Plan 4	4	$620,752	$445,910	$618,269	7.85	61.96%

[1]Color key:

CPWC:	Avg. Annual Loss of Load Hours:	Average RE % of Peak (measured for both systems, combined, assuming each STX plan is paired with STT P0 and all STT plans are paired with STX P1:
Within 1.5% of best	0-4 hours	Average RE% of Peak Met >65%
>1.5%-3%	>4 to 8 hours	Average RE% of Peak Met from >53% to 65%
>3%-4.5%	>8 to 12 hours	Average RE% of Peak Met from 48% to 53%
More than 4.5%	>12 hours	Average RE% of Peak Met <48%

7.2 RECOMMENDATIONS

Expansion plan P0 is recommended for STT and P1 is recommended for STX under the assumption that VIWAPA would receive grant funding for capital cost additions (if grant funding is not obtained, STX plan P0 would be better economically, but very close to P1 in overall plan merits as P0 is not as reliable as P1). Implementing the adopted plans will require significant effort to initiate the active development of individual projects and to achieve commercial operation according to the optimal timeframe. Concurrent with the development of new projects, VIWAPA will also be coordinating the planned retirement of existing units. Major activities to be pursued by VIWAPA include:

- Obtain internal and external approval of the recommended expansion plans for STT and STX. The approvals include those from the VIWAPA management and Board, plus approvals or agreement from bond holders and U.S. funding agencies such as FEMA and HUD.
- Pursue grant funding. Given that the recommended expansion plans call for the addition of new resources on STT and STX at the start of 2021, the availability of funds for the early projects should be secured early in 2020.
- Continue to refine cost and performance characteristics of selected RE projects. While information has been developed for candidate RE projects on STT and STX, the information is generally at the pre-feasibility study level. This means that the project costs are likely in the +/- 25 percent range, that the performance estimates are also approximate, and that unanticipated issues could arise that prevent site development. As updated information is obtained, the expansion planning model used in this IRP should be updated.
- Perform additional studies to support this IRP including a rate study and transmission studies. This IRP estimates the incremental costs that will be incurred over the planning period by VIWAPA customers. The incremental costs do not include sunk costs and costs common to all plans, such as general administrative costs and existing debt. A rate study will estimate the all-in costs and resulting VIWAPA rates by customer class. This information will provide a more complete picture of the future costs to be paid by VIWAPA customers.
- Transmission studies are needed to confirm that system stability and load flows will be within adopted standards for the preferred expansion plans. Transmission studies are especially important given the addition of significant new RE resources. The intermittent nature of these resources means that sufficient spinning reserves and frequency regulation capability must be available at all times to prevent outages should a sudden decrease in RE output occur. Should transmission studies indicate that additional investment in generation or transmission facilities are required for incremental resources, the economic planning model should be updated to reflect these refinements and to confirm that the preferred plan remains economically viable.
- Evaluate PPA vs. self-owned options for RE projects. VIWAPA has received unsolicited offers to sell power from proposed RE facilities. These PPA offers have been evaluated as part of this IRP and compared against VIWAPA-owed RE facilities. VIWAPA will face the decision as to whether additional PPA offers should be sought through a formal bidding process in which proposals for new RE power are sought. In part, this can be done through an avoided cost analysis of the PPA offers. Given the near-term need for new RE facilities, the decision about issuing a formal RE RFP should be made by the end of 2019.

- Issue an RFP for conventional power supply proposals (assuming LPG as primary fuel). The RFP should inform potential bidders of the preference for RICE units as determined in this study, but combustion turbine and combined cycle options should also be allowed. This RFP process should be initiated in the first half of 2020 due to the preferred in-service date of mid-2021 on STT and mid-2022 on STX.
- As bids from the conventional and possibly the RE RFP are received, they should be evaluated from a technical, commercial, and economic perspective. Part of this evaluation process will be to update the planning model to reflect the bids and to confirm that the preferred plan remains economic.
- VIWAPA should develop detailed timelines for new project development. These timelines should be updated as new information arises and any significant changes should be evaluated in the planning model to determine the impact on CPWC.
- This IRP has shown that it is economical to retire several of the existing units or not to renew leased units. VIWAPA should develop a retirement schedule, but this schedule should be flexible to accommodate possible delays in the development of new resources.
- The project development timeline should allow sufficient time to negotiate all agreements, secure permits and approvals, finalize financing, and to allow for sufficient construction and start-up time requirements.
- While the planning model used to develop this IRP should be updated on a continuous basis over the next three years, a long-term IRP cycle of three years is recommended.

Appendix A. CPWC Results for STT and STX Plan 1 through Plan 4

Table A-1 STT Plan 1

STT Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
4xRICE 7MW LPG	57,029	6	20	01/01/2021	59,138	4,311
2xRICE 7MW LPG	28,515	6	20	04/01/2021	29,667	2,163
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost									
						Plant O&M		Power	Total	Total	New Unit	Total	Cumulative Present	CPWC without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,108	$4,679	$1,860	$3,315	$40,962	$111.89	$7,016	$47,977	$106,882	$100,269
2022	366.1	366.1	0.000	4	$31,403	$4,790	$1,472	$3,315	$40,980	$111.94	$7,556	$48,536	$149,197	$135,669
2023	366.1	366.1	0.000	0	$31,615	$4,886	$1,522	$3,315	$41,339	$112.92	$8,086	$49,425	$190,391	$169,679
2024	367.1	367.1	0.000	0	$31,674	$4,999	$1,685	$3,326	$41,685	$113.55	$10,536	$52,221	$232,141	$202,340
2025	366.1	366.1	0.000	0	$33,107	$5,086	$1,736	$3,315	$43,243	$118.12	$10,823	$54,066	$273,473	$234,609
2026	366.1	366.1	0.000	0	$34,451	$5,187	$1,770	$3,315	$44,723	$122.16	$10,823	$55,546	$314,057	$266,393
2027	366.1	366.1	0.000	0	$35,622	$5,291	$1,806	$3,315	$46,034	$125.74	$10,823	$56,857	$353,758	$297,551
2028	367.1	367.1	0.000	0	$36,792	$5,412	$1,847	$3,326	$47,376	$129.05	$10,823	$58,199	$392,592	$328,090
2029	366.1	366.1	0.000	0	$38,764	$5,504	$1,879	$3,315	$49,463	$135.11	$10,823	$60,285	$431,011	$358,456
2030	366.1	366.1	0.000	0	$39,662	$5,614	$1,916	$3,315	$50,508	$137.96	$10,823	$61,330	$468,360	$387,987
2031	366.1	366.1	0.000	0	$40,737	$5,727	$1,955	$3,315	$51,734	$141.31	$10,823	$62,556	$504,758	$416,794
2032	367.1	367.1	0.000	0	$41,998	$5,857	$1,999	$3,326	$53,180	$144.86	$10,823	$64,003	$540,331	$444,997
2033	366.1	366.1	0.000	0	$43,115	$5,958	$2,034	$3,315	$54,422	$148.65	$10,823	$65,245	$574,973	$472,483
2034	366.1	366.1	0.000	0	$44,364	$6,077	$2,074	$3,315	$55,831	$152.50	$10,823	$66,654	$608,775	$499,339
2035	366.1	366.1	0.000	0	$45,576	$6,199	$2,116	$3,315	$57,205	$156.26	$10,823	$68,028	$641,726	$525,546
2036	367.1	367.1	0.000	0	$46,993	$6,340	$2,164	$3,326	$58,822	$160.23	$10,823	$69,645	$673,937	$551,210
2037	366.1	366.1	0.000	0	$48,112	$6,449	$2,201	$3,315	$60,077	$164.10	$10,823	$70,900	$705,258	$576,173
2038	366.1	366.1	0.000	0	$49,298	$6,578	$2,245	$3,315	$61,437	$167.81	$10,823	$72,259	$735,742	$600,485
2039	366.1	366.1	0.000	0	$50,550	$6,709	$2,290	$3,315	$62,865	$171.71	$10,823	$73,687	$765,428	$624,178
2040	367.1	367.1	0.000	0	$51,962	$6,862	$2,343	$3,326	$64,493	$175.67	$10,823	$75,316	$794,395	$647,328
2041	366.1	366.1	0.000	0	$53,030	$6,980	$2,383	$3,315	$65,708	$179.48	$3,807	$69,515	$818,844	$669,790
2042	366.1	366.1	0.000	0	$54,369	$7,120	$2,431	$3,315	$67,235	$183.65	$3,266	$70,501	$842,389	$691,680
2043	366.1	366.1	0.000	0	$55,758	$7,262	$2,479	$3,315	$68,815	$187.97	$2,737	$71,551	$865,072	$713,017
2044	367.1	367.1	0.000	0	$57,349	$7,427	$2,536	$3,326	$70,637	$192.43	$287	$70,924	**$886,068**	**$733,876**

Table A-2 STX Plan 1

STX Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
RICE 8MW LPG	15,949	6	20	07/01/2022	17,010	1,240
3xRICE 7MW LPG	42,772	6	20	07/01/2022	45,615	3,325
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,013	$1,115	$2,051	$1,458	$25,637	$97.57	$10,387	$36,023	$108,800	$93,318
2023	263.2	263.1	0.050	13	$16,034	$1,925	$2,266	$1,458	$21,684	$82.41	$13,383	$35,067	$138,531	$111,158
2024	263.9	263.8	0.050	12	$16,157	$1,994	$2,318	$1,463	$21,933	$83.14	$13,383	$35,316	$167,260	$128,343
2025	263.2	263.2	0.000	0	$16,931	$2,028	$2,358	$1,458	$22,775	$86.54	$13,383	$36,158	$195,462	$145,337
2026	263.1	263.1	0.000	0	$17,622	$2,064	$2,405	$1,458	$23,549	$89.49	$13,383	$36,932	$223,080	$162,073
2027	263.2	263.1	0.060	15	$18,202	$2,098	$2,453	$1,458	$24,211	$92.01	$13,383	$37,594	$250,032	$178,460
2028	263.9	263.9	0.000	0	$18,858	$2,144	$2,509	$1,463	$24,974	$94.65	$13,383	$38,357	$276,387	$194,558
2029	263.2	263.2	0.000	0	$19,910	$2,169	$2,552	$1,458	$26,089	$99.12	$13,383	$39,472	$302,361	$210,575
2030	263.3	263.3	0.000	0	$20,345	$2,215	$2,603	$1,458	$26,622	$101.13	$13,383	$40,005	$327,595	$226,140
2031	263.3	263.3	0.000	0	$20,776	$2,274	$2,655	$1,458	$27,163	$103.15	$13,383	$40,546	$352,107	$241,265
2032	264.1	264.1	0.000	0	$21,533	$2,299	$2,715	$1,463	$28,011	$106.07	$13,383	$41,394	$376,075	$256,120
2033	263.7	263.7	0.000	0	$21,982	$2,347	$2,762	$1,458	$28,549	$108.25	$13,383	$41,932	$399,342	$270,539
2034	264.2	264.1	0.040	14	$22,513	$2,396	$2,817	$1,458	$29,186	$110.50	$13,383	$42,569	$421,971	$284,578
2035	264.9	264.9	0.000	2	$23,010	$2,431	$2,874	$1,458	$29,773	$112.41	$13,383	$43,156	$443,950	$298,218
2036	266.7	266.7	0.000	0	$23,430	$2,480	$2,939	$1,463	$30,312	$113.65	$13,383	$43,695	$465,272	$311,443
2037	268.3	268.3	0.000	0	$23,580	$2,482	$2,990	$1,458	$30,510	$113.70	$13,383	$43,893	$485,810	$324,120
2038	269.3	269.3	0.000	0	$23,926	$2,526	$3,050	$1,458	$30,960	$114.97	$13,383	$44,343	$505,694	$336,372
2039	269.6	269.6	0.000	0	$24,639	$2,553	$3,111	$1,458	$31,762	$117.80	$13,383	$45,145	$525,075	$348,342
2040	270.3	270.3	0.000	0	$25,344	$2,616	$3,182	$1,463	$32,605	$120.63	$13,383	$45,988	$543,972	$360,046
2041	269.6	269.6	0.000	2	$25,905	$2,664	$3,236	$1,458	$33,264	$123.38	$7,042	$40,307	$559,019	$371,417
2042	269.6	269.6	0.000	0	$26,475	$2,745	$3,301	$1,458	$33,980	$126.02	$2,996	$36,976	$571,600	$382,480
2043	269.6	269.6	0.000	0	$27,315	$2,790	$3,367	$1,458	$34,931	$129.56	$0	$34,931	$582,431	$393,311
2044	270.3	270.3	0.000	0	$28,403	$2,830	$3,444	$1,463	$36,140	$133.72	$0	$36,140	**$593,103**	**$403,983**

Table A-3 STT Plan 2

STT Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	4/1/2024
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
RICE 8MW LPG	15,949	6	20	10/01/2023	17,465	1,273
RICE 8MW LPG	15,949	6	20	04/01/2024	17,609	1,284
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981
STJ Crus Bay PV	10,000	6	20	04/01/2024	11,041	805

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	15	$33,982	$4,501	$2,147	$3,315	$43,946	$120.07	$4,401	$48,348	$107,125	$102,977
2022	366.1	366.1	0.010	5	$33,910	$4,657	$2,215	$3,315	$44,097	$120.45	$4,704	$48,800	$149,522	$141,069
2023	366.1	366.1	0.000	4	$33,453	$4,795	$2,284	$3,315	$43,847	$119.77	$5,267	$49,115	$190,276	$177,142
2024	367.1	367.1	0.000	0	$31,955	$4,990	$1,754	$3,326	$42,025	$114.47	$8,524	$50,549	$230,556	$210,070
2025	366.1	366.1	0.000	0	$33,367	$5,079	$1,562	$3,315	$43,324	$118.34	$9,046	$52,371	$270,461	$242,399
2026	366.1	366.1	0.000	0	$34,677	$5,184	$1,594	$3,315	$44,770	$122.29	$9,046	$53,816	$309,634	$274,216
2027	366.1	366.1	0.000	0	$35,802	$5,290	$1,626	$3,315	$46,033	$125.73	$9,046	$55,079	$347,932	$305,373
2028	367.1	367.1	0.000	0	$37,021	$5,409	$1,663	$3,326	$47,418	$129.16	$9,046	$56,465	$385,431	$335,940
2029	366.1	366.1	0.000	0	$38,998	$5,502	$1,691	$3,315	$49,506	$135.23	$9,046	$58,552	$422,555	$366,332
2030	366.1	366.1	0.000	0	$39,896	$5,612	$1,725	$3,315	$50,548	$138.07	$9,046	$59,594	$458,645	$395,887
2031	366.1	366.1	0.000	0	$40,980	$5,724	$1,760	$3,315	$51,779	$141.43	$9,046	$60,825	$493,822	$424,719
2032	367.2	367.2	0.010	7	$42,283	$5,853	$1,800	$3,326	$53,262	$145.07	$9,046	$62,308	$528,227	$452,965
2033	366.1	366.1	0.000	0	$43,356	$5,956	$1,831	$3,315	$54,458	$148.75	$9,046	$63,504	$561,713	$480,470
2034	366.1	366.1	0.000	0	$44,593	$6,076	$1,867	$3,315	$55,852	$152.56	$9,046	$64,898	$594,385	$507,335
2035	366.1	366.1	0.000	0	$45,922	$6,192	$1,905	$3,315	$57,334	$156.60	$9,046	$66,380	$626,287	$533,601
2036	367.1	367.1	0.000	0	$47,294	$6,336	$1,948	$3,326	$58,904	$160.45	$9,046	$67,950	$657,460	$559,300
2037	366.1	366.1	0.010	3	$48,428	$6,444	$1,981	$3,315	$60,169	$164.34	$9,046	$69,215	$687,775	$584,301
2038	366.1	366.1	0.010	3	$49,530	$6,577	$2,021	$3,315	$61,443	$167.83	$9,046	$70,489	$717,249	$608,617
2039	366.1	366.1	0.000	0	$50,817	$6,708	$2,062	$3,315	$62,901	$171.81	$9,046	$71,947	$745,964	$632,324
2040	367.1	367.1	0.000	0	$52,237	$6,861	$2,109	$3,326	$64,532	$175.78	$9,046	$73,579	$773,991	$655,487
2041	366.1	365.8	0.360	48	$53,266	$6,971	$2,145	$3,315	$65,697	$179.61	$4,645	$70,342	$798,873	$677,945
2042	366.1	366.1	0.000	1	$54,693	$7,117	$2,188	$3,315	$67,313	$183.86	$4,342	$71,655	$822,989	$699,861
2043	366.1	366.1	0.000	0	$56,059	$7,260	$2,231	$3,315	$68,865	$188.11	$3,779	$72,644	$846,201	$721,214
2044	367.1	367.1	0.000	0	$57,751	$7,421	$2,282	$3,326	$70,781	$192.82	$522	$71,303	**$867,352**	**$742,115**

Table A-4 STX Plan 2

STX Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
RICE 7MW LPG	14,257	6	20	07/01/2022	15,205	1,108

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.400	92	$21,989	$1,131	$2,084	$1,458	$26,662	$101.48	$10,161	$36,823	$109,480	$94,204
2023	263.1	263.1	0.000	0	$18,051	$1,962	$2,333	$1,458	$23,804	$90.46	$12,932	$36,736	$140,553	$113,788
2024	263.8	263.8	0.010	6	$18,358	$2,003	$2,386	$1,463	$24,210	$91.79	$12,932	$37,142	$170,678	$132,757
2025	263.1	263.1	0.010	6	$19,174	$2,036	$2,427	$1,458	$25,095	$95.37	$12,932	$38,027	$200,234	$151,483
2026	263.1	263.1	0.000	0	$20,042	$2,067	$2,476	$1,458	$26,043	$98.97	$12,932	$38,975	$229,257	$169,991
2027	263.1	263.1	0.000	2	$20,600	$2,114	$2,525	$1,458	$26,697	$101.46	$12,932	$39,629	$257,536	$188,061
2028	263.8	263.8	0.030	6	$21,379	$2,157	$2,583	$1,463	$27,582	$104.57	$12,932	$40,514	$285,227	$205,841
2029	263.1	263.1	0.030	7	$22,525	$2,189	$2,627	$1,458	$28,800	$109.46	$12,932	$41,732	$312,530	$223,521
2030	263.1	263.1	0.000	0	$23,054	$2,235	$2,680	$1,458	$29,427	$111.84	$12,932	$42,359	$339,077	$240,726
2031	263.1	263.1	0.000	0	$23,732	$2,269	$2,733	$1,458	$30,193	$114.74	$12,932	$43,125	$364,960	$257,539
2032	263.8	263.8	0.000	0	$24,390	$2,330	$2,796	$1,463	$30,979	$117.44	$12,932	$43,911	$390,195	$273,968
2033	263.1	263.1	0.000	0	$25,085	$2,366	$2,844	$1,458	$31,754	$120.68	$12,932	$44,686	$414,782	$290,005
2034	263.1	263.1	0.000	0	$25,672	$2,434	$2,901	$1,458	$32,465	$123.38	$12,932	$45,397	$438,699	$305,622
2035	263.1	263.1	0.000	0	$26,544	$2,467	$2,959	$1,458	$33,428	$127.04	$12,932	$46,360	$462,071	$320,935
2036	263.8	263.8	0.000	3	$27,285	$2,528	$3,026	$1,463	$34,302	$130.05	$12,932	$47,234	$484,861	$335,901
2037	263.1	263.1	0.000	0	$27,952	$2,576	$3,078	$1,458	$35,065	$133.26	$12,932	$47,997	$507,028	$350,471
2038	263.1	263.1	0.000	0	$28,662	$2,619	$3,140	$1,458	$35,878	$136.35	$12,932	$48,810	$528,601	$364,670
2039	263.1	263.1	0.000	0	$29,387	$2,683	$3,202	$1,458	$36,731	$139.59	$12,932	$49,663	$549,605	$378,513
2040	263.8	263.8	0.000	0	$30,197	$2,736	$3,275	$1,463	$37,671	$142.81	$12,932	$50,603	$570,078	$392,035
2041	263.1	263.1	0.000	2	$30,741	$2,785	$3,332	$1,458	$38,316	$145.62	$6,591	$44,907	$586,616	$405,133
2042	263.1	263.1	0.000	0	$31,497	$2,849	$3,398	$1,458	$39,203	$148.99	$2,771	$41,974	$600,784	$417,896
2043	263.1	263.1	0.000	0	$32,368	$2,897	$3,466	$1,458	$40,190	$152.74	$0	$40,190	$613,245	$430,358
2044	263.8	263.8	0.000	0	$33,375	$2,963	$3,545	$1,463	$41,346	$156.74	$0	$41,346	**$625,455**	**$442,568**

Table A-5 STT Plan 3

STT Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
2xRICE 8MW LPG	31,899	6	20	04/01/2024	35,219	2,567
2xRICE 7MW LPG	28,515	6	20	01/01/2021	29,569	2,155
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.010	6	$34,175	$4,496	$2,139	$3,315	$44,125	$120.53	$4,444	$48,569	$107,328	$103,139
2022	366.1	366.1	0.020	7	$34,799	$4,597	$2,182	$3,315	$44,893	$122.63	$4,444	$49,337	$150,175	$141,919
2023	366.1	366.0	0.110	38	$34,459	$4,730	$2,246	$3,315	$44,750	$122.27	$4,728	$49,478	$191,192	$178,735
2024	367.1	367.1	0.000	1	$32,514	$4,982	$2,023	$3,326	$42,845	$116.71	$7,507	$50,352	$231,238	$212,305
2025	366.1	366.1	0.000	0	$33,682	$5,084	$1,614	$3,315	$43,696	$119.35	$8,149	$51,845	$270,669	$244,912
2026	366.1	366.1	0.010	5	$35,040	$5,186	$1,647	$3,315	$45,187	$123.43	$8,149	$53,337	$309,409	$277,026
2027	366.1	366.1	0.000	0	$36,227	$5,290	$1,680	$3,315	$46,511	$127.05	$8,149	$54,661	$347,323	$308,506
2028	367.1	367.1	0.000	1	$37,405	$5,411	$1,718	$3,326	$47,860	$130.37	$8,149	$56,009	$384,420	$339,357
2029	366.1	366.1	0.010	7	$39,413	$5,503	$1,747	$3,315	$49,979	$136.52	$8,149	$58,128	$421,166	$370,040
2030	366.1	366.1	0.000	0	$40,397	$5,612	$1,782	$3,315	$51,106	$139.60	$8,149	$59,256	$456,934	$399,921
2031	366.1	366.0	0.120	42	$41,462	$5,722	$1,818	$3,315	$52,317	$142.95	$8,149	$60,466	$491,782	$429,053
2032	367.1	367.1	0.000	0	$42,777	$5,853	$1,859	$3,326	$53,815	$146.59	$8,149	$61,965	$525,871	$457,592
2033	366.1	366.1	0.000	3	$43,877	$5,956	$1,891	$3,315	$55,039	$150.34	$8,149	$63,188	$559,057	$485,391
2034	366.1	366.1	0.000	0	$45,144	$6,076	$1,929	$3,315	$56,463	$154.23	$8,149	$64,613	$591,447	$512,551
2035	366.1	366.1	0.000	0	$46,349	$6,198	$1,968	$3,315	$57,830	$157.96	$8,149	$65,979	$623,018	$539,043
2036	367.1	367.1	0.000	3	$47,848	$6,337	$2,013	$3,326	$59,523	$162.14	$8,149	$67,672	$653,918	$565,013
2037	366.1	366.1	0.000	0	$48,947	$6,447	$2,047	$3,315	$60,757	$165.96	$8,149	$68,906	$683,951	$590,259
2038	366.1	366.1	0.000	0	$50,183	$6,575	$2,088	$3,315	$62,162	$169.79	$8,149	$70,311	$713,198	$614,858
2039	366.1	366.1	0.020	7	$51,385	$6,708	$2,130	$3,315	$63,539	$173.57	$8,149	$71,688	$741,657	$638,805
2040	367.1	367.1	0.000	0	$52,933	$6,857	$2,179	$3,326	$65,295	$177.86	$8,149	$73,444	$769,475	$662,242
2041	366.1	366.1	0.000	8	$53,922	$6,979	$2,216	$3,315	$66,432	$181.46	$3,705	$70,138	$794,118	$684,952
2042	366.1	366.1	0.010	4	$55,279	$7,119	$2,260	$3,315	$67,974	$185.67	$3,705	$71,679	$818,126	$707,083
2043	366.1	366.1	0.010	5	$56,749	$7,259	$2,306	$3,315	$69,629	$190.20	$3,421	$73,050	$841,398	$728,672
2044	367.1	367.1	0.000	3	$58,341	$7,425	$2,358	$3,326	$71,450	$194.65	$642	$72,092	**$862,805**	**$749,772**

Table A-6 STX Plan 3

STX Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	Capital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power					Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.2	262.7	0.430	96	$21,034	$1,108	$2,042	$1,458	$25,642	$97.60	$10,321	$35,963	$108,745	$93,323
2023	263.2	263.1	0.030	6	$16,075	$1,918	$2,249	$1,458	$21,701	$82.47	$13,252	$34,952	$138,372	$111,176
2024	263.8	263.8	0.000	2	$16,325	$1,964	$2,300	$1,463	$22,052	$83.59	$13,252	$35,304	$167,081	$128,455
2025	263.2	263.2	0.020	6	$16,976	$2,013	$2,340	$1,458	$22,787	$86.57	$13,252	$36,039	$195,183	$145,459
2026	263.1	263.1	0.000	0	$17,818	$2,024	$2,387	$1,458	$23,687	$90.02	$13,252	$36,938	$222,792	$162,293
2027	263.2	263.2	0.040	20	$18,370	$2,066	$2,435	$1,458	$24,329	$92.44	$13,252	$37,580	$249,719	$178,759
2028	263.9	263.9	0.010	2	$18,966	$2,120	$2,490	$1,463	$25,038	$94.89	$13,252	$38,290	$276,015	$194,899
2029	263.2	263.2	0.000	0	$19,994	$2,150	$2,533	$1,458	$26,135	$99.29	$13,252	$39,386	$301,920	$210,944
2030	263.3	263.3	0.000	0	$20,478	$2,190	$2,584	$1,458	$26,710	$101.46	$13,252	$39,962	$327,110	$226,561
2031	263.3	263.3	0.000	0	$21,017	$2,228	$2,635	$1,458	$27,339	$103.82	$13,252	$40,591	$351,628	$241,784
2032	264.1	264.1	0.000	0	$21,637	$2,278	$2,695	$1,463	$28,074	$106.30	$13,252	$41,325	$375,540	$256,672
2033	263.9	263.9	0.000	0	$22,157	$2,314	$2,742	$1,458	$28,671	$108.67	$13,252	$41,923	$398,781	$271,153
2034	264.3	264.2	0.040	10	$22,667	$2,363	$2,797	$1,458	$29,286	$110.84	$13,252	$42,537	$421,374	$285,240
2035	265.1	265.1	0.000	0	$23,133	$2,403	$2,852	$1,458	$29,847	$112.61	$13,252	$43,099	$443,305	$298,913
2036	266.9	266.9	0.000	0	$23,584	$2,445	$2,917	$1,463	$30,409	$113.93	$13,252	$43,661	$464,590	$312,181
2037	268.3	268.3	0.000	0	$23,559	$2,491	$2,968	$1,458	$30,476	$113.58	$13,252	$43,727	$485,037	$324,844
2038	269.3	269.3	0.000	0	$24,113	$2,495	$3,027	$1,458	$31,094	$115.47	$13,252	$44,345	$504,899	$337,149
2039	269.6	269.6	0.000	0	$24,706	$2,549	$3,088	$1,458	$31,801	$117.95	$13,252	$45,052	$524,222	$349,134
2040	270.3	270.3	0.000	0	$25,522	$2,595	$3,158	$1,463	$32,738	$121.12	$13,252	$45,989	$543,096	$360,885
2041	269.7	269.6	0.100	15	$26,006	$2,647	$3,212	$1,458	$33,324	$123.63	$6,911	$40,235	$558,095	$372,277
2042	269.6	269.6	0.000	0	$26,841	$2,690	$3,277	$1,458	$34,266	$127.08	$2,931	$37,196	$570,736	$383,433
2043	269.6	269.6	0.000	0	$27,509	$2,764	$3,342	$1,458	$35,073	$130.09	$0	$35,073	$581,611	$394,308
2044	270.3	270.3	0.000	0	$28,511	$2,819	$3,418	$1,463	$36,211	$133.97	$0	$36,211	**$592,304**	**$405,002**

Table A-7 STT Plan 4

STT Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	#NUM!
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
3xRICE 7MW LPG	42,772	6	20	10/01/2023	46,836	3,414
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
RICE 7MW LPG	14,257	6	20	07/01/2024	15,819	1,153
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,295	$4,672	$1,828	$3,315	$41,109	$112.29	$6,429	$47,538	$106,463	$100,403
2022	366.1	366.1	0.020	4	$31,665	$4,781	$1,423	$3,315	$41,184	$112.50	$6,731	$47,915	$148,200	$135,980
2023	366.1	366.1	0.000	0	$31,686	$4,884	$1,514	$3,315	$41,400	$113.08	$7,830	$49,230	$189,216	$170,040
2024	367.1	367.1	0.000	0	$31,673	$5,000	$1,848	$3,326	$41,847	$113.99	$12,563	$54,410	$232,842	$202,828
2025	366.1	366.1	0.000	0	$33,105	$5,086	$1,945	$3,315	$43,451	$118.69	$13,427	$56,878	$276,510	$235,252
2026	366.1	366.1	0.000	0	$34,449	$5,187	$1,984	$3,315	$44,935	$122.74	$13,427	$58,362	$319,362	$267,186
2027	366.1	366.1	0.000	0	$35,621	$5,291	$2,024	$3,315	$46,251	$126.33	$13,427	$59,677	$361,266	$298,491
2028	367.1	367.1	0.000	0	$36,790	$5,412	$2,070	$3,326	$47,598	$129.65	$13,427	$61,024	$402,238	$329,172
2029	366.1	366.1	0.000	0	$38,761	$5,505	$2,105	$3,315	$49,686	$135.72	$13,427	$63,113	$442,732	$359,675
2030	366.1	366.1	0.000	0	$39,655	$5,615	$2,147	$3,315	$50,732	$138.57	$13,427	$64,159	$482,094	$389,337
2031	366.1	366.1	0.000	0	$40,733	$5,727	$2,190	$3,315	$51,966	$141.94	$13,427	$65,392	$520,447	$418,274
2032	367.1	367.1	0.000	0	$41,995	$5,857	$2,240	$3,326	$53,419	$145.51	$13,427	$66,846	$557,919	$446,603
2033	366.1	366.1	0.000	0	$43,113	$5,958	$2,279	$3,315	$54,665	$149.32	$13,427	$68,092	$594,406	$474,213
2034	366.1	366.1	0.000	0	$44,363	$6,077	$2,324	$3,315	$56,080	$153.18	$13,427	$69,506	$629,999	$501,188
2035	366.1	366.1	0.000	0	$45,574	$6,199	$2,371	$3,315	$57,459	$156.95	$13,427	$70,886	$664,689	$527,511
2036	367.1	367.1	0.000	0	$46,991	$6,340	$2,425	$3,326	$59,082	$160.94	$13,427	$72,508	$698,589	$553,288
2037	366.1	366.1	0.000	0	$48,106	$6,449	$2,467	$3,315	$60,337	$164.81	$13,427	$73,764	$731,547	$578,359
2038	366.1	366.1	0.000	0	$49,296	$6,578	$2,516	$3,315	$61,705	$168.55	$13,427	$75,132	$763,623	$602,778
2039	366.1	366.1	0.000	0	$50,547	$6,709	$2,566	$3,315	$63,138	$172.46	$13,427	$76,565	$794,853	$626,574
2040	367.1	367.1	0.000	0	$51,960	$6,862	$2,625	$3,326	$64,773	$176.44	$13,427	$78,200	$825,321	$649,823
2041	366.1	366.1	0.000	0	$53,028	$6,980	$2,670	$3,315	$65,994	$180.26	$6,998	$72,991	$851,533	$672,383
2042	366.1	366.1	0.000	0	$54,367	$7,120	$2,723	$3,315	$67,525	$184.44	$6,696	$74,221	$876,910	$694,368
2043	366.1	366.1	0.000	0	$55,756	$7,262	$2,778	$3,315	$69,112	$188.78	$5,597	$74,708	$901,092	$715,797
2044	367.1	367.1	0.000	0	$57,347	$7,427	$2,841	$3,326	$70,941	$193.26	$863	$71,804	**$922,453**	**$736,746**

Table A-8 STX Plan 4

STX Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 8MW LPG	63,798	6	20	07/01/2022	68,039	4,960

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.380	88	$22,107	$1,118	$2,076	$1,458	$26,759	$101.85	$9,870	$36,629	$109,297	$94,288
2023	263.1	263.1	0.000	0	$18,331	$1,929	$2,317	$1,458	$24,036	$91.35	$12,350	$36,385	$140,044	$114,062
2024	263.8	263.6	0.150	25	$18,586	$1,974	$2,369	$1,463	$24,392	$92.52	$12,350	$36,742	$169,809	$133,174
2025	263.1	263.1	0.020	5	$19,487	$2,002	$2,410	$1,458	$25,357	$96.37	$12,350	$37,707	$199,074	$152,096
2026	263.1	263.1	0.000	0	$20,359	$2,030	$2,458	$1,458	$26,306	$99.97	$12,350	$38,656	$227,811	$170,791
2027	263.1	263.1	0.020	14	$20,937	$2,076	$2,508	$1,458	$26,980	$102.55	$12,350	$39,329	$255,821	$189,052
2028	263.8	263.8	0.000	0	$21,647	$2,134	$2,565	$1,463	$27,809	$105.42	$12,350	$40,159	$283,212	$206,978
2029	263.1	263.1	0.000	2	$22,886	$2,154	$2,609	$1,458	$29,108	$110.63	$12,350	$41,458	$310,271	$224,848
2030	263.1	263.1	0.000	0	$23,317	$2,215	$2,661	$1,458	$29,651	$112.68	$12,350	$42,001	$336,529	$242,184
2031	263.1	263.1	0.000	0	$24,011	$2,246	$2,714	$1,458	$30,429	$115.64	$12,350	$42,779	$362,134	$259,128
2032	263.8	263.8	0.000	1	$24,779	$2,289	$2,776	$1,463	$31,308	$118.68	$12,350	$43,657	$387,147	$275,731
2033	263.1	263.1	0.000	0	$25,436	$2,331	$2,824	$1,458	$32,050	$121.80	$12,350	$44,400	$411,499	$291,918
2034	263.1	263.1	0.000	0	$26,119	$2,388	$2,880	$1,458	$32,845	$124.82	$12,350	$45,195	$435,225	$307,717
2035	263.1	263.1	0.000	0	$26,884	$2,435	$2,938	$1,458	$33,716	$128.13	$12,350	$46,065	$458,367	$323,163
2036	263.8	263.8	0.000	3	$27,727	$2,485	$3,005	$1,463	$34,680	$131.49	$12,350	$47,030	$480,969	$338,294
2037	263.1	263.1	0.020	4	$28,217	$2,557	$3,057	$1,458	$35,289	$134.12	$12,350	$47,638	$502,887	$352,957
2038	263.1	263.1	0.000	0	$29,086	$2,578	$3,118	$1,458	$36,240	$137.73	$12,350	$48,590	$524,271	$367,299
2039	263.1	263.1	0.000	0	$29,767	$2,651	$3,180	$1,458	$37,056	$140.83	$12,350	$49,406	$545,075	$381,265
2040	263.8	263.8	0.000	0	$30,662	$2,689	$3,253	$1,463	$38,067	$144.31	$12,350	$50,417	$565,377	$394,928
2041	263.1	263.1	0.000	3	$31,170	$2,748	$3,309	$1,458	$38,685	$147.03	$6,009	$44,694	$581,738	$408,153
2042	263.1	263.0	0.110	24	$31,876	$2,809	$3,375	$1,458	$39,519	$150.25	$2,480	$41,998	$595,861	$421,019
2043	263.1	263.1	0.000	0	$32,854	$2,844	$3,442	$1,458	$40,599	$154.29	$0	$40,599	$608,449	$433,608
2044	263.8	263.8	0.000	0	$33,746	$2,932	$3,521	$1,463	$41,662	$157.94	$0	$41,662	**$620,752**	**$445,910**

Table A-9 STT High Fuel Case Plan 1

STT High Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
4xRICE 7MW LPG	57,029	6	20	01/01/2021	59,138	4,311
2xRICE 7MW LPG	28,515	6	20	04/01/2021	29,667	2,163
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost									
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Cumulative Present Worth Cost (CPWC) ($1,000)	CPWC without Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$55,474	$3,366	$13,619	$127	$72,587	$197.76	$0	$72,587	$69,130	$69,130
2021	366.1	366.1	0.000	0	$35,378	$4,671	$1,860	$3,315	$45,224	$123.53	$7,016	$52,240	$116,763	$110,150
2022	366.1	366.1	0.000	4	$36,795	$4,790	$1,472	$3,315	$46,371	$126.66	$7,556	$53,928	$163,735	$150,207
2023	366.1	366.1	0.000	0	$37,042	$4,886	$1,522	$3,315	$46,765	$127.74	$8,086	$54,851	$209,393	$188,681
2024	367.1	367.1	0.000	0	$37,099	$5,000	$1,685	$3,326	$47,110	$128.32	$10,536	$57,646	$255,394	$225,593
2025	366.1	366.1	0.000	0	$38,771	$5,086	$1,736	$3,315	$48,907	$133.59	$10,823	$59,730	$300,953	$262,089
2026	366.1	366.1	0.000	0	$40,339	$5,187	$1,770	$3,315	$50,612	$138.25	$10,823	$61,434	$345,721	$298,057
2027	366.1	366.1	0.000	0	$41,733	$5,291	$1,806	$3,315	$52,145	$142.43	$10,823	$62,968	$389,559	$333,351
2028	367.1	367.1	0.000	0	$43,077	$5,412	$1,847	$3,326	$53,661	$146.17	$10,823	$64,484	$432,444	$367,942
2029	366.1	366.1	0.000	0	$45,383	$5,504	$1,879	$3,315	$56,082	$153.19	$10,823	$66,905	$474,926	$402,371
2030	366.1	366.1	0.000	0	$46,442	$5,614	$1,916	$3,315	$57,288	$156.48	$10,823	$68,111	$516,240	$435,866
2031	366.1	366.1	0.000	0	$47,707	$5,727	$1,955	$3,315	$58,704	$160.35	$10,823	$69,526	$556,519	$468,554
2032	367.1	367.1	0.000	0	$49,179	$5,857	$1,999	$3,326	$60,361	$164.42	$10,823	$71,184	$595,899	$500,565
2033	366.1	366.1	0.000	0	$50,466	$5,958	$2,034	$3,315	$61,773	$168.73	$10,823	$72,596	$634,254	$531,765
2034	366.1	366.1	0.000	0	$51,940	$6,077	$2,074	$3,315	$63,406	$173.19	$10,823	$74,229	$671,700	$562,264
2035	366.1	366.1	0.000	0	$53,374	$6,199	$2,116	$3,315	$65,004	$177.56	$10,823	$75,826	$708,224	$592,043
2036	367.1	367.1	0.000	0	$55,034	$6,340	$2,164	$3,326	$66,864	$182.13	$10,823	$77,686	$743,944	$621,216
2037	366.1	366.1	0.000	0	$56,324	$6,449	$2,201	$3,315	$68,290	$186.53	$10,823	$79,112	$778,677	$649,592
2038	366.1	366.1	0.000	0	$57,697	$6,578	$2,245	$3,315	$69,836	$190.76	$10,823	$80,658	$812,485	$677,228
2039	366.1	366.1	0.000	0	$59,174	$6,709	$2,290	$3,315	$71,489	$195.27	$10,823	$82,311	$845,421	$704,171
2040	367.1	367.1	0.000	0	$60,833	$6,862	$2,343	$3,326	$73,364	$199.84	$10,823	$84,187	$877,572	$730,505
2041	366.1	366.1	0.000	0	$62,100	$6,980	$2,383	$3,315	$74,778	$204.26	$3,807	$78,585	$905,121	$756,068
2042	366.1	366.1	0.000	0	$63,695	$7,120	$2,431	$3,315	$76,560	$209.12	$3,266	$79,827	$931,702	$780,994
2043	366.1	366.1	0.000	0	$65,305	$7,262	$2,479	$3,315	$78,361	$214.04	$2,737	$81,098	$957,346	$805,291
2044	367.1	367.1	0.000	0	$67,177	$7,427	$2,536	$3,326	$80,466	$219.21	$287	$80,753	**$981,245**	**$829,053**

Table A-10 STX High Fuel Case Plan 1

STX High Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
RICE 8MW LPG	15,949	6	20	07/01/2022	17,010	1,240
3xRICE 7MW LPG	42,772	6	20	07/01/2022	45,615	3,325
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$31,917	$1,878	$10,645	$1,463	$45,903	$174.04	$0	$45,903	$43,717	$43,717
2021	263.1	262.9	0.260	35	$22,889	$1,291	$9,794	$1,458	$35,433	$134.79	$6,341	$41,773	$81,832	$75,855
2022	263.2	262.8	0.380	88	$24,624	$1,117	$2,051	$1,458	$29,250	$111.31	$10,387	$39,636	$116,604	$101,122
2023	263.2	263.2	0.050	11	$18,793	$1,928	$2,266	$1,458	$24,445	$92.89	$13,383	$37,828	$148,606	$121,233
2024	263.9	263.8	0.050	10	$18,935	$1,997	$2,318	$1,463	$24,713	$93.67	$13,383	$38,096	$179,513	$140,596
2025	263.2	263.2	0.000	0	$19,832	$2,029	$2,358	$1,458	$25,677	$97.55	$13,383	$39,060	$209,882	$159,757
2026	263.3	263.3	0.000	0	$20,612	$2,066	$2,405	$1,458	$26,541	$100.80	$13,383	$39,924	$239,626	$178,619
2027	263.4	263.3	0.060	14	$21,296	$2,099	$2,453	$1,458	$27,306	$103.69	$13,383	$40,690	$268,673	$197,101
2028	264.6	264.6	0.000	0	$21,919	$2,143	$2,509	$1,463	$28,034	$105.96	$13,383	$41,417	$297,001	$215,173
2029	264.6	264.6	0.000	0	$22,992	$2,164	$2,552	$1,458	$29,166	$110.23	$13,383	$42,549	$324,864	$233,078
2030	265.1	265.1	0.000	0	$23,405	$2,209	$2,603	$1,458	$29,675	$111.94	$13,383	$43,058	$351,883	$250,428
2031	266.9	266.9	0.000	0	$23,530	$2,245	$2,655	$1,458	$29,889	$112.00	$13,383	$43,272	$377,913	$267,071
2032	269.3	269.3	0.000	0	$24,041	$2,249	$2,715	$1,463	$30,468	$113.15	$13,383	$43,851	$403,184	$283,229
2033	269.6	269.6	0.000	0	$24,444	$2,285	$2,762	$1,458	$30,950	$114.81	$13,383	$44,333	$427,663	$298,861
2034	269.8	269.8	0.040	13	$25,163	$2,337	$2,817	$1,458	$31,776	$117.78	$13,383	$45,159	$451,538	$314,146
2035	269.8	269.8	0.000	2	$25,975	$2,376	$2,874	$1,458	$32,683	$121.12	$13,383	$46,066	$474,851	$329,118
2036	270.5	270.5	0.000	0	$26,831	$2,436	$2,939	$1,463	$33,670	$124.46	$13,383	$47,053	$497,638	$343,808
2037	269.8	269.8	0.000	0	$27,655	$2,469	$2,990	$1,458	$34,573	$128.13	$13,383	$47,956	$519,865	$358,174
2038	269.7	269.7	0.000	0	$28,349	$2,528	$3,050	$1,458	$35,385	$131.18	$13,383	$48,768	$541,500	$372,177
2039	269.7	269.7	0.000	0	$29,311	$2,563	$3,111	$1,458	$36,443	$135.11	$13,383	$49,826	$562,645	$385,912
2040	270.5	270.5	0.000	0	$30,143	$2,631	$3,182	$1,463	$37,419	$138.35	$13,383	$50,802	$583,270	$399,343
2041	269.7	269.7	0.000	4	$30,844	$2,680	$3,236	$1,458	$38,219	$141.70	$7,042	$45,261	$600,010	$412,408
2042	269.6	269.6	0.000	0	$31,569	$2,759	$3,301	$1,458	$39,087	$144.96	$2,996	$42,084	$614,254	$425,134
2043	269.6	269.6	0.000	0	$32,566	$2,806	$3,367	$1,458	$40,198	$149.09	$0	$40,198	$626,718	$437,598
2044	270.3	270.3	0.000	0	$33,888	$2,848	$3,444	$1,463	$41,643	$154.08	$0	$41,643	**$639,016**	**$449,895**

Table A-11 STT High Fuel Case Plan 2

STT High Fuel Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	4/1/2024
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
RICE 8MW LPG	15,949	6	20	10/01/2023	17,465	1,273
RICE 8MW LPG	15,949	6	20	04/01/2024	17,609	1,284
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981
STJ Crus Bay PV	10,000	6	20	04/01/2024	11,041	805

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$55,474	$3,366	$13,619	$127	$72,587	$197.76	$0	$72,587	$69,130	$69,130
2021	366.1	366.0	0.080	15	$39,073	$4,417	$2,147	$3,315	$48,953	$133.74	$4,401	$53,354	$117,681	$113,532
2022	366.1	366.1	0.010	5	$40,035	$4,637	$2,215	$3,315	$50,201	$137.12	$4,704	$54,905	$165,351	$156,898
2023	366.1	366.1	0.000	4	$39,428	$4,784	$2,284	$3,315	$49,811	$136.06	$5,267	$55,079	$211,011	$197,878
2024	367.1	367.1	0.000	0	$37,441	$4,988	$1,754	$3,326	$47,508	$129.41	$8,524	$56,032	$255,588	$235,102
2025	366.1	366.1	0.000	0	$39,096	$5,079	$1,562	$3,315	$49,053	$133.99	$9,046	$58,099	$299,768	$271,706
2026	366.1	366.1	0.000	0	$40,616	$5,184	$1,594	$3,315	$50,709	$138.51	$9,046	$59,755	$343,161	$307,744
2027	366.1	366.1	0.000	0	$41,945	$5,290	$1,626	$3,315	$52,176	$142.51	$9,046	$61,222	$385,617	$343,059
2028	367.1	367.1	0.000	0	$43,356	$5,409	$1,663	$3,326	$53,754	$146.41	$9,046	$62,800	$427,200	$377,709
2029	366.1	366.1	0.000	0	$45,668	$5,502	$1,691	$3,315	$56,176	$153.44	$9,046	$65,222	$468,418	$412,195
2030	366.1	366.1	0.000	0	$46,726	$5,612	$1,725	$3,315	$57,378	$156.72	$9,046	$66,424	$508,501	$445,743
2031	366.1	366.1	0.000	0	$48,001	$5,724	$1,760	$3,315	$58,799	$160.61	$9,046	$67,846	$547,587	$478,485
2032	367.2	367.2	0.010	7	$49,530	$5,853	$1,800	$3,326	$60,508	$164.81	$9,046	$69,555	$585,836	$510,574
2033	366.1	366.1	0.000	0	$50,756	$5,956	$1,831	$3,315	$61,857	$168.96	$9,046	$70,903	$623,059	$541,816
2034	366.1	366.1	0.000	0	$52,211	$6,076	$1,867	$3,315	$63,469	$173.37	$9,046	$72,516	$659,395	$572,346
2035	366.1	366.1	0.000	0	$53,805	$6,192	$1,905	$3,315	$65,217	$178.14	$9,046	$74,263	$694,909	$602,223
2036	367.1	367.1	0.000	0	$55,403	$6,336	$1,948	$3,326	$67,012	$182.54	$9,046	$76,058	$729,620	$631,460
2037	366.1	366.1	0.010	3	$56,712	$6,444	$1,981	$3,315	$68,453	$186.97	$9,046	$77,499	$763,377	$659,903
2038	366.1	366.1	0.010	3	$57,969	$6,577	$2,021	$3,315	$69,882	$190.88	$9,046	$78,929	$796,190	$687,558
2039	366.1	366.1	0.000	0	$59,492	$6,708	$2,062	$3,315	$71,576	$195.51	$9,046	$80,622	$828,175	$714,535
2040	367.1	367.1	0.000	0	$61,161	$6,861	$2,109	$3,326	$73,457	$200.08	$9,046	$82,503	$859,405	$740,901
2041	366.1	365.8	0.360	47	$62,386	$6,971	$2,145	$3,315	$74,816	$204.54	$4,645	$79,461	$887,405	$766,477
2042	366.1	366.1	0.000	1	$64,087	$7,117	$2,188	$3,315	$76,707	$209.52	$4,342	$81,050	$914,579	$791,451
2043	366.1	366.1	0.000	0	$65,664	$7,260	$2,231	$3,315	$78,471	$214.34	$3,779	$82,250	$940,769	$815,782
2044	367.1	367.1	0.000	0	$67,675	$7,421	$2,282	$3,326	$80,704	$219.85	$522	$81,226	**$964,851**	**$839,614**

Table A-12 STX High Fuel Case Plan 2

STX High Fuel Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
RICE 7MW LPG	14,257	6	20	07/01/2022	15,205	1,108

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$31,917	$1,878	$10,645	$1,463	$45,903	$174.04	$0	$45,903	$43,717	$43,717
2021	263.1	262.9	0.260	35	$22,889	$1,291	$9,794	$1,458	$35,433	$134.79	$6,341	$41,773	$81,832	$75,855
2022	263.1	262.7	0.400	92	$25,775	$1,133	$2,084	$1,458	$30,451	$115.90	$10,161	$40,612	$117,435	$102,160
2023	263.1	263.1	0.000	0	$21,166	$1,968	$2,333	$1,458	$26,925	$102.33	$12,932	$39,857	$151,077	$124,311
2024	263.8	263.8	0.010	6	$21,526	$2,009	$2,386	$1,463	$27,384	$103.82	$12,932	$40,316	$183,688	$145,767
2025	263.1	263.1	0.010	6	$22,474	$2,045	$2,427	$1,458	$28,405	$107.95	$12,932	$41,337	$215,714	$166,963
2026	263.1	263.1	0.000	0	$23,490	$2,077	$2,476	$1,458	$29,501	$112.12	$12,932	$42,433	$247,195	$187,929
2027	263.1	263.1	0.000	2	$24,155	$2,125	$2,525	$1,458	$30,263	$115.02	$12,932	$43,195	$277,887	$208,412
2028	263.8	263.8	0.030	6	$25,054	$2,169	$2,583	$1,463	$31,268	$118.55	$12,932	$44,200	$307,954	$228,568
2029	263.1	263.1	0.030	7	$26,395	$2,200	$2,627	$1,458	$32,681	$124.22	$12,932	$45,613	$337,640	$248,632
2030	263.1	263.1	0.000	0	$27,019	$2,248	$2,680	$1,458	$33,405	$126.95	$12,932	$46,337	$366,514	$268,163
2031	263.1	263.1	0.000	0	$27,816	$2,282	$2,733	$1,458	$34,290	$130.32	$12,932	$47,222	$394,678	$287,257
2032	263.8	263.8	0.000	0	$28,587	$2,342	$2,796	$1,463	$35,188	$133.39	$12,932	$48,120	$422,145	$305,918
2033	263.1	263.1	0.000	0	$29,390	$2,379	$2,844	$1,458	$36,071	$137.08	$12,932	$49,003	$448,913	$324,136
2034	263.1	263.1	0.000	0	$30,085	$2,445	$2,901	$1,458	$36,890	$140.20	$12,932	$49,822	$474,958	$341,881
2035	263.1	263.1	0.000	0	$31,112	$2,484	$2,959	$1,458	$38,013	$144.46	$12,932	$50,945	$500,431	$359,295
2036	263.8	263.8	0.000	3	$31,983	$2,544	$3,026	$1,463	$39,016	$147.92	$12,932	$51,948	$525,278	$376,317
2037	263.1	263.1	0.000	0	$32,753	$2,592	$3,078	$1,458	$39,882	$151.57	$12,932	$52,814	$549,445	$392,889
2038	263.1	263.1	0.000	0	$33,576	$2,635	$3,140	$1,458	$40,809	$155.09	$12,932	$53,741	$572,970	$409,039
2039	263.1	263.1	0.000	0	$34,434	$2,699	$3,202	$1,458	$41,794	$158.83	$12,932	$54,726	$595,882	$424,790
2040	263.8	263.8	0.000	0	$35,386	$2,753	$3,275	$1,463	$42,878	$162.55	$12,932	$55,810	$618,224	$440,181
2041	263.1	263.1	0.000	2	$36,031	$2,803	$3,332	$1,458	$43,624	$165.79	$6,591	$50,216	$636,577	$455,094
2042	263.1	263.1	0.000	0	$36,939	$2,862	$3,398	$1,458	$44,658	$169.72	$2,771	$47,428	$652,520	$469,633
2043	263.1	263.1	0.000	0	$37,950	$2,911	$3,466	$1,458	$45,786	$174.01	$0	$45,786	$666,717	$483,830
2044	263.8	263.8	0.000	0	$39,140	$2,974	$3,545	$1,463	$47,122	$178.64	$0	$47,122	**$680,632**	**$497,745**

Table A-13 STT High Fuel Case Plan 3

STT High Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
2xRICE 8MW LPG	31,899	6	20	04/01/2024	35,219	2,567
2xRICE 7MW LPG	28,515	6	20	01/01/2021	29,569	2,155
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$55,474	$3,366	$13,619	$127	$72,587	$197.76	$0	$72,587	$69,130	$69,130
2021	366.1	366.1	0.010	6	$39,376	$4,409	$2,139	$3,315	$49,239	$134.50	$4,444	$53,683	$117,980	$113,791
2022	366.1	366.1	0.020	7	$41,206	$4,567	$2,182	$3,315	$51,270	$140.05	$4,444	$55,714	$166,336	$158,080
2023	366.1	366.0	0.110	38	$40,722	$4,710	$2,246	$3,315	$50,993	$139.33	$4,728	$55,722	$212,489	$200,032
2024	367.1	367.1	0.000	1	$38,125	$4,979	$2,023	$3,326	$48,453	$131.98	$7,507	$55,960	$256,929	$237,996
2025	366.1	366.1	0.000	0	$39,449	$5,084	$1,614	$3,315	$49,463	$135.11	$8,149	$57,612	$300,664	$274,906
2026	366.1	366.1	0.010	5	$41,033	$5,186	$1,647	$3,315	$51,181	$139.80	$8,149	$59,330	$343,663	$311,280
2027	366.1	366.1	0.000	0	$42,443	$5,290	$1,680	$3,315	$52,728	$144.03	$8,149	$60,877	$385,785	$346,968
2028	367.1	367.1	0.000	1	$43,797	$5,411	$1,718	$3,326	$54,251	$147.78	$8,149	$62,401	$427,001	$381,939
2029	366.1	366.1	0.010	7	$46,146	$5,503	$1,747	$3,315	$56,712	$154.91	$8,149	$64,861	$467,881	$416,755
2030	366.1	366.1	0.000	0	$47,319	$5,612	$1,782	$3,315	$58,028	$158.50	$8,149	$66,177	$507,696	$450,682
2031	366.1	366.0	0.120	42	$48,570	$5,722	$1,818	$3,315	$59,425	$162.37	$8,149	$67,574	$546,502	$483,772
2032	367.1	367.1	0.000	0	$50,107	$5,853	$1,859	$3,326	$61,146	$166.56	$8,149	$69,295	$584,478	$516,199
2033	366.1	366.1	0.000	3	$51,368	$5,956	$1,891	$3,315	$62,530	$170.80	$8,149	$70,679	$621,447	$547,781
2034	366.1	366.1	0.000	0	$52,860	$6,076	$1,929	$3,315	$64,180	$175.31	$8,149	$72,330	$657,550	$578,653
2035	366.1	366.1	0.000	0	$54,285	$6,198	$1,968	$3,315	$65,765	$179.64	$8,149	$73,914	$692,756	$608,781
2036	367.1	367.1	0.000	3	$56,051	$6,337	$2,013	$3,326	$67,726	$184.49	$8,149	$75,876	$727,235	$638,330
2037	366.1	366.1	0.000	0	$57,310	$6,447	$2,047	$3,315	$69,120	$188.80	$8,149	$77,269	$760,743	$667,051
2038	366.1	366.1	0.000	0	$58,747	$6,575	$2,088	$3,315	$70,726	$193.19	$8,149	$78,875	$793,379	$695,039
2039	366.1	366.1	0.020	7	$60,154	$6,708	$2,130	$3,315	$72,307	$197.52	$8,149	$80,456	$825,142	$722,291
2040	367.1	367.1	0.000	0	$61,993	$6,857	$2,179	$3,326	$74,355	$202.54	$8,149	$82,504	$856,212	$748,980
2041	366.1	366.1	0.000	8	$63,148	$6,979	$2,216	$3,315	$75,658	$206.66	$3,705	$79,364	$884,010	$774,844
2042	366.1	366.1	0.010	4	$64,764	$7,119	$2,260	$3,315	$77,459	$211.58	$3,705	$81,164	$911,106	$800,062
2043	366.1	366.1	0.010	5	$66,479	$7,259	$2,306	$3,315	$79,359	$216.78	$3,421	$82,780	$937,395	$824,669
2044	367.1	367.1	0.000	3	$68,348	$7,425	$2,358	$3,326	$81,458	$221.91	$642	$82,100	**$961,756**	**$848,724**

Table A-14 STX High Fuel Case Plan 3

STX High Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power					Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	263.8	263.8	0.000	0	$31,917	$1,878	$10,645	$1,463	$45,903	$174.04	$0	$45,903	$43,717	$43,717
2021	263.1	262.9	0.260	35	$22,889	$1,291	$9,794	$1,458	$35,433	$134.79	$6,341	$41,773	$81,832	$75,855
2022	263.2	262.8	0.430	96	$24,648	$1,110	$2,042	$1,458	$29,259	$111.35	$10,321	$39,580	$116,552	$101,130
2023	263.2	263.2	0.030	6	$18,839	$1,922	$2,249	$1,458	$24,468	$92.98	$13,252	$37,719	$148,456	$121,260
2024	263.9	263.9	0.000	2	$19,125	$1,968	$2,300	$1,463	$24,857	$94.21	$13,252	$38,109	$179,363	$140,736
2025	263.3	263.3	0.020	6	$19,885	$2,016	$2,340	$1,458	$25,699	$97.62	$13,252	$38,950	$209,637	$159,913
2026	263.3	263.3	0.000	0	$20,830	$2,026	$2,387	$1,458	$26,701	$101.40	$13,252	$39,953	$239,388	$178,889
2027	263.4	263.4	0.040	23	$21,488	$2,067	$2,435	$1,458	$27,448	$104.21	$13,252	$40,700	$268,427	$197,467
2028	264.5	264.5	0.010	2	$22,063	$2,120	$2,490	$1,463	$28,136	$106.36	$13,252	$41,387	$296,720	$215,604
2029	264.7	264.7	0.000	0	$23,064	$2,146	$2,533	$1,458	$29,202	$110.32	$13,252	$42,453	$324,507	$233,531
2030	265.4	265.4	0.000	0	$23,476	$2,187	$2,584	$1,458	$29,705	$111.92	$13,252	$42,956	$351,448	$250,899
2031	267.1	267.1	0.000	0	$23,768	$2,203	$2,635	$1,458	$30,065	$112.58	$13,252	$43,316	$377,484	$267,640
2032	269.3	269.3	0.000	0	$24,162	$2,231	$2,695	$1,463	$30,551	$113.43	$13,252	$43,802	$402,709	$283,842
2033	269.6	269.6	0.000	0	$24,690	$2,257	$2,742	$1,458	$31,148	$115.54	$13,252	$44,400	$427,202	$299,574
2034	269.9	269.8	0.040	8	$25,357	$2,310	$2,797	$1,458	$31,922	$118.30	$13,252	$45,174	$451,063	$314,929
2035	269.9	269.9	0.000	0	$26,182	$2,353	$2,852	$1,458	$32,845	$121.71	$13,252	$46,097	$474,367	$329,976
2036	270.5	270.5	0.000	0	$27,080	$2,403	$2,917	$1,463	$33,864	$125.19	$13,252	$47,115	$497,160	$344,750
2037	269.8	269.8	0.000	0	$27,645	$2,476	$2,968	$1,458	$34,547	$128.04	$13,252	$47,799	$519,298	$359,105
2038	269.8	269.8	0.000	0	$28,582	$2,497	$3,027	$1,458	$35,565	$131.83	$13,252	$48,816	$540,930	$373,179
2039	269.8	269.8	0.000	0	$29,407	$2,556	$3,088	$1,458	$36,509	$135.34	$13,252	$49,760	$562,027	$386,939
2040	270.5	270.5	0.000	0	$30,379	$2,607	$3,158	$1,463	$37,607	$139.04	$13,252	$50,859	$582,649	$400,438
2041	269.8	269.7	0.100	16	$30,988	$2,661	$3,212	$1,458	$38,319	$142.11	$6,911	$45,230	$599,355	$413,537
2042	269.7	269.7	0.000	0	$32,023	$2,701	$3,277	$1,458	$39,459	$146.33	$2,931	$42,390	$613,686	$426,384
2043	269.6	269.6	0.000	0	$32,819	$2,777	$3,342	$1,458	$40,396	$149.82	$0	$40,396	$626,212	$438,910
2044	270.3	270.3	0.000	0	$34,044	$2,832	$3,418	$1,463	$41,757	$154.50	$0	$41,757	**$638,543**	**$451,241**

Table A-15 STT High Fuel Case Plan 4

STT High Fuel Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	#NUM!
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
3xRICE 7MW LPG	42,772	6	20	10/01/2023	46,836	3,414
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
RICE 7MW LPG	14,257	6	20	07/01/2024	15,819	1,153
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$55,474	$3,366	$13,619	$127	$72,587	$197.76	$0	$72,587	$69,130	$69,130
2021	366.1	366.1	0.000	0	$35,616	$4,660	$1,828	$3,315	$45,419	$124.06	$6,429	$51,848	$116,386	$110,327
2022	366.1	366.1	0.020	4	$37,142	$4,781	$1,423	$3,315	$46,661	$127.46	$6,731	$53,392	$162,854	$150,634
2023	366.1	366.1	0.000	0	$37,132	$4,884	$1,514	$3,315	$46,846	$127.96	$7,830	$54,676	$208,351	$189,174
2024	367.1	367.1	0.000	0	$37,098	$5,000	$1,848	$3,326	$47,271	$128.76	$12,563	$59,835	$256,227	$226,213
2025	366.1	366.1	0.000	0	$38,768	$5,086	$1,945	$3,315	$49,114	$134.15	$13,427	$62,541	$304,121	$262,863
2026	366.1	366.1	0.000	0	$40,337	$5,187	$1,984	$3,315	$50,823	$138.82	$13,427	$64,250	$351,157	$298,982
2027	366.1	366.1	0.000	0	$41,731	$5,291	$2,024	$3,315	$52,360	$143.02	$13,427	$65,787	$397,196	$334,421
2028	367.1	367.1	0.000	0	$43,075	$5,412	$2,070	$3,326	$53,882	$146.77	$13,427	$67,309	$442,219	$369,154
2029	366.1	366.1	0.000	0	$45,379	$5,505	$2,105	$3,315	$56,304	$153.80	$13,427	$69,731	$486,776	$403,720
2030	366.1	366.1	0.000	0	$46,433	$5,615	$2,147	$3,315	$57,510	$157.09	$13,427	$70,937	$530,101	$437,345
2031	366.1	366.1	0.000	0	$47,702	$5,727	$2,190	$3,315	$58,934	$160.98	$13,427	$72,361	$572,335	$470,161
2032	367.1	367.1	0.000	0	$49,175	$5,857	$2,240	$3,326	$60,599	$165.07	$13,427	$74,025	$613,614	$502,298
2033	366.1	366.1	0.000	0	$50,463	$5,958	$2,279	$3,315	$62,015	$169.39	$13,427	$75,442	$653,813	$533,620
2034	366.1	366.1	0.000	0	$51,937	$6,077	$2,324	$3,315	$63,654	$173.87	$13,427	$77,081	$693,050	$564,239
2035	366.1	366.1	0.000	0	$53,372	$6,199	$2,371	$3,315	$65,257	$178.25	$13,427	$78,684	$731,312	$594,134
2036	367.1	367.1	0.000	0	$55,031	$6,340	$2,425	$3,326	$67,122	$182.84	$13,427	$80,549	$768,721	$623,419
2037	366.1	366.1	0.000	0	$56,316	$6,449	$2,467	$3,315	$68,547	$187.24	$13,427	$81,974	$805,090	$651,901
2038	366.1	366.1	0.000	0	$57,694	$6,578	$2,516	$3,315	$70,103	$191.49	$13,427	$83,530	$840,489	$679,644
2039	366.1	366.1	0.000	0	$59,170	$6,709	$2,566	$3,315	$71,761	$196.01	$13,427	$85,187	$874,969	$706,689
2040	367.1	367.1	0.000	0	$60,830	$6,862	$2,625	$3,326	$73,643	$200.60	$13,427	$87,070	$908,620	$733,123
2041	366.1	366.1	0.000	0	$62,097	$6,980	$2,670	$3,315	$75,062	$205.03	$6,998	$82,060	$937,933	$758,783
2042	366.1	366.1	0.000	0	$63,691	$7,120	$2,723	$3,315	$76,850	$209.91	$6,696	$83,545	$966,345	$783,803
2043	366.1	366.1	0.000	0	$65,302	$7,262	$2,778	$3,315	$78,657	$214.85	$5,597	$84,254	$993,488	$808,192
2044	367.1	367.1	0.000	0	$67,175	$7,427	$2,841	$3,326	$80,769	$220.03	$863	$81,632	**$1,017,751**	**$832,044**

Table A-16 STX High Fuel Case Plan 4

STX High Fuel Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 8MW LPG	63,798	6	20	07/01/2022	68,039	4,960

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$31,917	$1,878	$10,645	$1,463	$45,903	$174.04	$0	$45,903	$43,717	$43,717
2021	263.1	262.9	0.260	35	$22,889	$1,291	$9,794	$1,458	$35,433	$134.79	$6,341	$41,773	$81,832	$75,855
2022	263.1	262.7	0.380	88	$25,912	$1,121	$2,076	$1,458	$30,567	$116.34	$9,870	$40,437	$117,270	$102,261
2023	263.1	263.1	0.000	0	$21,493	$1,936	$2,317	$1,458	$27,203	$103.38	$12,350	$39,553	$150,623	$124,641
2024	263.8	263.6	0.150	25	$21,790	$1,981	$2,369	$1,463	$27,603	$104.71	$12,350	$39,953	$182,904	$146,269
2025	263.1	263.1	0.020	5	$22,841	$2,009	$2,410	$1,458	$28,719	$109.15	$12,350	$41,069	$214,677	$167,699
2026	263.1	263.1	0.000	0	$23,862	$2,037	$2,458	$1,458	$29,816	$113.31	$12,350	$42,166	$245,908	$188,889
2027	263.1	263.1	0.020	14	$24,553	$2,083	$2,508	$1,458	$30,602	$116.31	$12,350	$42,951	$276,370	$209,602
2028	263.8	263.8	0.000	0	$25,369	$2,143	$2,565	$1,463	$31,540	$119.56	$12,350	$43,889	$306,166	$229,932
2029	263.1	263.1	0.000	2	$26,814	$2,168	$2,609	$1,458	$33,049	$125.61	$12,350	$45,399	$335,645	$250,222
2030	263.1	263.1	0.000	0	$27,324	$2,228	$2,661	$1,458	$33,671	$127.97	$12,350	$46,021	$364,253	$269,909
2031	263.1	263.1	0.000	0	$28,140	$2,260	$2,714	$1,458	$34,572	$131.39	$12,350	$46,922	$392,166	$289,160
2032	263.8	263.8	0.000	1	$29,038	$2,303	$2,776	$1,463	$35,581	$134.88	$12,350	$47,931	$419,445	$308,029
2033	263.1	263.1	0.000	0	$29,794	$2,348	$2,824	$1,458	$36,424	$138.43	$12,350	$48,774	$446,007	$326,426
2034	263.1	263.1	0.000	0	$30,600	$2,405	$2,880	$1,458	$37,344	$141.92	$12,350	$49,693	$471,897	$344,389
2035	263.1	263.1	0.000	0	$31,507	$2,452	$2,938	$1,458	$38,356	$145.77	$12,350	$50,705	$497,164	$361,960
2036	263.8	263.8	0.000	3	$32,498	$2,500	$3,005	$1,463	$39,465	$149.63	$12,350	$51,815	$521,854	$379,179
2037	263.1	263.1	0.020	4	$33,060	$2,571	$3,057	$1,458	$40,146	$152.58	$12,350	$52,496	$545,790	$395,860
2038	263.1	263.1	0.000	0	$34,068	$2,594	$3,118	$1,458	$41,238	$156.72	$12,350	$53,587	$569,152	$412,179
2039	263.1	263.1	0.000	0	$34,871	$2,670	$3,180	$1,458	$42,179	$160.30	$12,350	$54,529	$591,887	$428,076
2040	263.8	263.8	0.000	0	$35,922	$2,710	$3,253	$1,463	$43,348	$164.34	$12,350	$55,698	$614,085	$443,636
2041	263.1	263.1	0.000	3	$36,526	$2,769	$3,309	$1,458	$44,063	$167.46	$6,009	$50,072	$632,284	$458,699
2042	263.1	263.0	0.110	24	$37,370	$2,830	$3,375	$1,458	$45,034	$171.22	$2,480	$47,513	$648,202	$473,360
2043	263.1	263.1	0.000	0	$38,505	$2,866	$3,442	$1,458	$46,272	$175.85	$0	$46,272	$662,550	$487,708
2044	263.8	263.8	0.000	0	$39,559	$2,952	$3,521	$1,463	$47,496	$180.05	$0	$47,496	**$676,575**	**$501,733**

Table A-17 STT Low Fuel Case Plan 1

STT Low Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
4xRICE 7MW LPG	57,029	6	20	01/01/2021	59,138	4,311
2xRICE 7MW LPG	28,515	6	20	04/01/2021	29,667	2,163
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,108	$4,679	$1,860	$3,315	$40,962	$111.89	$7,016	$47,977	$106,882	$100,269
2022	366.1	366.1	0.000	4	$31,403	$4,790	$1,472	$3,315	$40,980	$111.94	$7,556	$48,536	$149,197	$135,669
2023	366.1	366.1	0.000	0	$31,615	$4,886	$1,522	$3,315	$41,339	$112.92	$8,086	$49,425	$190,391	$169,679
2024	367.1	367.1	0.000	0	$31,483	$4,999	$1,685	$3,326	$41,494	$113.02	$10,536	$52,029	$231,991	$202,190
2025	366.1	366.1	0.000	0	$32,154	$5,086	$1,736	$3,315	$42,291	$115.52	$10,823	$53,113	$272,612	$233,748
2026	366.1	366.1	0.000	0	$32,799	$5,187	$1,770	$3,315	$43,071	$117.65	$10,823	$53,894	$312,022	$264,358
2027	366.1	366.1	0.000	0	$33,366	$5,291	$1,806	$3,315	$43,778	$119.58	$10,823	$54,601	$350,197	$293,989
2028	367.1	367.1	0.000	0	$33,957	$5,412	$1,847	$3,326	$44,542	$121.33	$10,823	$55,364	$387,203	$322,701
2029	366.1	366.1	0.000	0	$34,825	$5,504	$1,879	$3,315	$45,524	$124.35	$10,823	$56,346	$423,204	$350,648
2030	366.1	366.1	0.000	0	$35,245	$5,614	$1,916	$3,315	$46,091	$125.90	$10,823	$56,914	$457,971	$377,597
2031	366.1	366.1	0.000	0	$35,686	$5,727	$1,955	$3,315	$46,682	$127.51	$10,823	$57,505	$491,556	$403,591
2032	367.1	367.1	0.000	0	$36,295	$5,857	$1,999	$3,326	$47,478	$129.33	$10,823	$58,300	$524,104	$428,770
2033	366.1	366.1	0.000	0	$36,730	$5,958	$2,034	$3,315	$48,037	$131.21	$10,823	$58,859	$555,521	$453,032
2034	366.1	366.1	0.000	0	$37,279	$6,077	$2,074	$3,315	$48,745	$133.15	$10,823	$59,568	$585,915	$476,479
2035	366.1	366.1	0.000	0	$37,790	$6,199	$2,116	$3,315	$49,420	$134.99	$10,823	$60,242	$615,299	$499,119
2036	367.1	367.1	0.000	0	$38,423	$6,340	$2,164	$3,326	$50,253	$136.89	$10,823	$61,076	$643,772	$521,044
2037	366.1	366.1	0.000	0	$38,834	$6,449	$2,201	$3,315	$50,800	$138.76	$10,823	$61,622	$671,238	$542,152
2038	366.1	366.1	0.000	0	$39,294	$6,578	$2,245	$3,315	$51,432	$140.49	$10,823	$62,255	$697,763	$562,506
2039	366.1	366.1	0.000	0	$39,780	$6,709	$2,290	$3,315	$52,095	$142.30	$10,823	$62,918	$723,389	$582,140
2040	367.1	367.1	0.000	0	$40,398	$6,862	$2,343	$3,326	$52,929	$144.17	$10,823	$63,751	$748,205	$601,139
2041	366.1	366.1	0.000	0	$40,767	$6,980	$2,383	$3,315	$53,445	$145.99	$3,807	$57,252	$768,463	$619,409
2042	366.1	366.1	0.000	0	$41,279	$7,120	$2,431	$3,315	$54,144	$147.90	$3,266	$57,411	$787,745	$637,037
2043	366.1	366.1	0.000	0	$41,812	$7,262	$2,479	$3,315	$54,869	$149.87	$2,737	$57,605	$806,105	$654,050
2044	367.1	367.1	0.000	0	$42,472	$7,427	$2,536	$3,326	$55,760	$151.90	$287	$56,047	**$822,708**	**$670,516**

Table A-18 STX Low Fuel Case Plan 1

STX Low Fuel Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
RICE 8MW LPG	15,949	6	20	07/01/2022	17,010	1,240
3xRICE 7MW LPG	42,772	6	20	07/01/2022	45,615	3,325
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,013	$1,115	$2,051	$1,458	$25,637	$97.57	$10,387	$36,023	$108,800	$93,318
2023	263.2	263.1	0.050	13	$16,034	$1,925	$2,266	$1,458	$21,684	$82.41	$13,383	$35,067	$138,531	$111,158
2024	263.9	263.8	0.050	12	$16,060	$1,994	$2,318	$1,463	$21,835	$82.77	$13,383	$35,218	$167,183	$128,266
2025	263.2	263.2	0.000	0	$16,448	$2,028	$2,358	$1,458	$22,292	$84.71	$13,383	$35,675	$195,026	$144,901
2026	263.1	263.1	0.000	0	$16,777	$2,064	$2,405	$1,458	$22,704	$86.29	$13,383	$36,087	$222,043	$161,036
2027	263.2	263.2	0.060	13	$17,048	$2,098	$2,453	$1,458	$23,057	$87.62	$13,383	$36,440	$248,214	$176,642
2028	263.8	263.8	0.000	0	$17,410	$2,144	$2,509	$1,463	$23,525	$89.17	$13,383	$36,908	$273,635	$191,807
2029	263.2	263.2	0.000	0	$17,902	$2,170	$2,552	$1,458	$24,082	$91.52	$13,383	$37,465	$298,378	$206,592
2030	263.1	263.1	0.000	0	$18,112	$2,217	$2,603	$1,458	$24,390	$92.69	$13,383	$37,773	$322,307	$220,852
2031	263.1	263.1	0.000	0	$18,244	$2,277	$2,655	$1,458	$24,634	$93.62	$13,383	$38,017	$345,410	$234,569
2032	263.8	263.8	0.000	0	$18,669	$2,299	$2,715	$1,463	$25,146	$95.32	$13,383	$38,529	$367,859	$247,904
2033	263.2	263.2	0.000	0	$18,847	$2,349	$2,762	$1,458	$25,417	$96.58	$13,383	$38,800	$389,544	$260,742
2034	263.2	263.2	0.040	16	$19,113	$2,400	$2,817	$1,458	$25,790	$98.00	$13,383	$39,173	$410,539	$273,147
2035	263.2	263.2	0.000	1	$19,410	$2,442	$2,874	$1,458	$26,184	$99.47	$13,383	$39,567	$430,874	$285,142
2036	263.9	263.9	0.000	0	$19,713	$2,501	$2,939	$1,463	$26,617	$100.87	$13,383	$40,000	$450,584	$296,755
2037	263.3	263.3	0.000	0	$19,986	$2,532	$2,990	$1,458	$26,965	$102.42	$13,383	$40,348	$469,650	$307,959
2038	263.2	263.2	0.000	0	$20,169	$2,594	$3,050	$1,458	$27,271	$103.60	$13,383	$40,654	$488,074	$318,751
2039	263.4	263.4	0.000	0	$20,487	$2,627	$3,111	$1,458	$27,683	$105.12	$13,383	$41,066	$505,917	$329,185
2040	264.0	264.0	0.000	0	$20,757	$2,692	$3,182	$1,463	$28,093	$106.41	$13,383	$41,477	$523,195	$339,269
2041	263.4	263.4	0.000	1	$20,905	$2,742	$3,236	$1,458	$28,342	$107.61	$7,042	$35,384	$536,559	$348,957
2042	263.4	263.4	0.000	0	$21,046	$2,825	$3,301	$1,458	$28,630	$108.69	$2,996	$31,627	$547,399	$358,278
2043	263.5	263.5	0.000	0	$21,364	$2,869	$3,367	$1,458	$29,059	$110.29	$0	$29,059	$556,409	$367,289
2044	264.5	264.5	0.000	0	$21,773	$2,901	$3,444	$1,463	$29,582	$111.83	$0	$29,582	**$565,144**	**$376,024**

Table A-19 STT Low Fuel Case Plan 2

STT Low Fuel Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	4/1/2024
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
RICE 8MW LPG	15,949	6	20	10/01/2023	17,465	1,273
RICE 8MW LPG	15,949	6	20	04/01/2024	17,609	1,284
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981
STJ Crus Bay PV	10,000	6	20	04/01/2024	11,041	805

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	15	$33,982	$4,501	$2,147	$3,315	$43,946	$120.07	$4,401	$48,348	$107,125	$102,977
2022	366.1	366.1	0.010	5	$33,910	$4,657	$2,215	$3,315	$44,097	$120.45	$4,704	$48,800	$149,522	$141,069
2023	366.1	366.1	0.000	4	$33,453	$4,795	$2,284	$3,315	$43,847	$119.77	$5,267	$49,115	$190,276	$177,142
2024	367.1	367.1	0.000	0	$31,762	$4,990	$1,754	$3,326	$41,832	$113.95	$8,524	$50,356	$230,405	$209,919
2025	366.1	366.1	0.000	0	$32,408	$5,079	$1,562	$3,315	$42,365	$115.72	$9,046	$51,411	$269,594	$241,532
2026	366.1	366.1	0.000	0	$33,015	$5,184	$1,594	$3,315	$43,108	$117.74	$9,046	$52,154	$307,585	$272,168
2027	366.1	366.1	0.000	0	$33,535	$5,290	$1,626	$3,315	$43,766	$119.54	$9,046	$52,812	$344,349	$301,790
2028	367.1	367.1	0.000	0	$34,169	$5,409	$1,663	$3,326	$44,566	$121.39	$9,046	$53,612	$380,010	$330,518
2029	366.1	366.1	0.000	0	$35,036	$5,502	$1,691	$3,315	$45,544	$124.40	$9,046	$54,590	$414,701	$358,478
2030	366.1	366.1	0.000	0	$35,454	$5,612	$1,725	$3,315	$46,106	$125.94	$9,046	$55,152	$448,194	$385,436
2031	366.1	366.1	0.000	0	$35,899	$5,724	$1,760	$3,315	$46,698	$127.56	$9,046	$55,744	$480,542	$411,439
2032	367.2	367.2	0.010	6	$36,544	$5,853	$1,800	$3,326	$47,522	$129.43	$9,046	$56,568	$511,903	$436,641
2033	366.1	366.1	0.000	0	$36,936	$5,956	$1,831	$3,315	$48,038	$131.21	$9,046	$57,084	$542,146	$460,903
2034	366.1	366.1	0.000	0	$37,472	$6,076	$1,867	$3,315	$48,730	$133.11	$9,046	$57,776	$571,392	$484,343
2035	366.1	366.1	0.000	0	$38,080	$6,192	$1,905	$3,315	$49,492	$135.18	$9,046	$58,538	$599,703	$507,016
2036	367.1	367.1	0.000	0	$38,671	$6,336	$1,948	$3,326	$50,281	$136.96	$9,046	$59,327	$627,113	$528,953
2037	366.1	366.1	0.010	3	$39,091	$6,444	$1,981	$3,315	$50,832	$138.84	$9,046	$59,878	$653,548	$550,075
2038	366.1	366.1	0.010	3	$39,479	$6,577	$2,021	$3,315	$51,392	$140.37	$9,046	$60,438	$679,045	$570,413
2039	366.1	366.1	0.000	0	$39,991	$6,708	$2,062	$3,315	$52,076	$142.24	$9,046	$61,122	$703,680	$590,039
2040	367.1	367.1	0.000	0	$40,612	$6,861	$2,109	$3,326	$52,907	$144.11	$9,046	$61,953	$727,534	$609,030
2041	366.1	365.8	0.360	48	$40,949	$6,971	$2,145	$3,315	$53,380	$145.94	$4,645	$58,025	$748,206	$627,278
2042	366.1	366.1	0.000	1	$41,526	$7,117	$2,188	$3,315	$54,146	$147.89	$4,342	$58,488	$768,034	$644,906
2043	366.1	366.1	0.000	0	$42,038	$7,260	$2,231	$3,315	$54,845	$149.81	$3,779	$58,624	$786,899	$661,912
2044	367.1	367.1	0.000	0	$42,773	$7,421	$2,282	$3,326	$55,802	$152.02	$522	$56,324	**$803,627**	**$678,391**

Table A-20 STX Low Fuel Case Plan 2

STX Low Fuel Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
RICE 7MW LPG	14,257	6	20	07/01/2022	15,205	1,108

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.400	92	$21,989	$1,131	$2,084	$1,458	$26,662	$101.48	$10,161	$36,823	$109,480	$94,204
2023	263.1	263.1	0.000	0	$18,051	$1,962	$2,333	$1,458	$23,804	$90.46	$12,932	$36,736	$140,553	$113,788
2024	263.8	263.8	0.010	6	$18,247	$2,003	$2,386	$1,463	$24,100	$91.37	$12,932	$37,032	$170,591	$132,670
2025	263.1	263.1	0.010	6	$18,623	$2,035	$2,427	$1,458	$24,544	$93.28	$12,932	$37,476	$199,737	$150,986
2026	263.1	263.1	0.000	0	$19,083	$2,067	$2,476	$1,458	$25,084	$95.33	$12,932	$38,016	$228,078	$168,812
2027	263.1	263.1	0.000	2	$19,296	$2,113	$2,525	$1,458	$25,393	$96.51	$12,932	$38,325	$255,474	$185,999
2028	263.8	263.8	0.030	6	$19,733	$2,157	$2,583	$1,463	$25,936	$98.33	$12,932	$38,868	$282,103	$202,717
2029	263.1	263.1	0.030	7	$20,239	$2,189	$2,627	$1,458	$26,514	$100.77	$12,932	$39,446	$308,003	$218,995
2030	263.1	263.1	0.000	0	$20,490	$2,235	$2,680	$1,458	$26,863	$102.09	$12,932	$39,795	$333,052	$234,701
2031	263.1	263.1	0.000	0	$20,793	$2,269	$2,733	$1,458	$27,254	$103.58	$12,932	$40,186	$357,298	$249,877
2032	263.8	263.8	0.000	0	$21,082	$2,330	$2,796	$1,463	$27,671	$104.90	$12,932	$40,603	$380,778	$264,551
2033	263.1	263.1	0.000	0	$21,374	$2,365	$2,844	$1,458	$28,042	$106.57	$12,932	$40,974	$403,491	$278,714
2034	263.1	263.1	0.000	0	$21,577	$2,433	$2,901	$1,458	$28,369	$107.81	$12,932	$41,301	$425,437	$292,360
2035	263.1	263.1	0.000	0	$22,015	$2,466	$2,959	$1,458	$28,898	$109.82	$12,932	$41,830	$446,735	$305,598
2036	263.8	263.8	0.000	3	$22,317	$2,524	$3,026	$1,463	$29,330	$111.20	$12,932	$42,262	$467,355	$318,395
2037	263.1	263.1	0.000	0	$22,570	$2,573	$3,078	$1,458	$29,679	$112.79	$12,932	$42,611	$487,284	$330,727
2038	263.1	263.1	0.000	0	$22,854	$2,615	$3,140	$1,458	$30,067	$114.27	$12,932	$42,999	$506,557	$342,626
2039	263.1	263.1	0.000	0	$23,135	$2,679	$3,202	$1,458	$30,475	$115.82	$12,932	$43,407	$525,203	$354,112
2040	263.8	263.8	0.000	0	$23,482	$2,732	$3,275	$1,463	$30,952	$117.34	$12,932	$43,884	$543,265	$365,222
2041	263.1	263.1	0.000	2	$23,641	$2,781	$3,332	$1,458	$31,212	$118.62	$6,591	$37,803	$557,374	$375,891
2042	263.1	263.1	0.000	0	$23,925	$2,840	$3,398	$1,458	$31,622	$120.18	$2,771	$34,393	$569,074	$386,187
2043	263.1	263.1	0.000	0	$24,286	$2,887	$3,466	$1,458	$32,098	$121.98	$0	$32,098	$579,026	$396,139
2044	263.8	263.8	0.000	0	$24,731	$2,954	$3,545	$1,463	$32,693	$123.94	$0	$32,693	**$588,681**	**$405,794**

Table A-21 STT Low Fuel Case Plan 3

STT Low Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
2xRICE 8MW LPG	31,899	6	20	04/01/2024	35,219	2,567
2xRICE 7MW LPG	28,515	6	20	01/01/2021	29,569	2,155
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.010	6	$34,175	$4,496	$2,139	$3,315	$44,125	$120.53	$4,444	$48,569	$107,328	$103,139
2022	366.1	366.1	0.020	7	$34,799	$4,597	$2,182	$3,315	$44,893	$122.63	$4,444	$49,337	$150,175	$141,919
2023	366.1	366.0	0.110	38	$34,459	$4,730	$2,246	$3,315	$44,750	$122.27	$4,728	$49,478	$191,192	$178,735
2024	367.1	367.1	0.000	1	$32,317	$4,982	$2,023	$3,326	$42,649	$116.17	$7,507	$50,156	$231,084	$212,152
2025	366.1	366.1	0.000	0	$32,713	$5,084	$1,614	$3,315	$42,727	$116.71	$8,149	$50,876	$269,792	$244,035
2026	366.1	366.1	0.010	5	$33,360	$5,186	$1,647	$3,315	$43,507	$118.84	$8,149	$51,657	$307,338	$274,955
2027	366.1	366.1	0.000	0	$33,932	$5,290	$1,680	$3,315	$44,217	$120.78	$8,149	$52,366	$343,699	$304,882
2028	367.1	367.1	0.000	1	$34,523	$5,411	$1,718	$3,326	$44,978	$122.52	$8,149	$53,127	$378,938	$333,876
2029	366.1	366.1	0.010	7	$35,408	$5,503	$1,747	$3,315	$45,974	$125.58	$8,149	$54,123	$413,226	$362,100
2030	366.1	366.1	0.000	0	$35,900	$5,612	$1,782	$3,315	$46,609	$127.31	$8,149	$54,758	$446,365	$389,351
2031	366.1	366.0	0.120	42	$36,322	$5,722	$1,818	$3,315	$47,177	$128.91	$8,149	$55,326	$478,350	$415,621
2032	367.1	367.1	0.000	0	$36,970	$5,853	$1,859	$3,326	$48,008	$130.77	$8,149	$56,158	$509,359	$441,081
2033	366.1	366.1	0.000	3	$37,379	$5,956	$1,891	$3,315	$48,542	$132.59	$8,149	$56,691	$539,264	$465,598
2034	366.1	366.1	0.000	0	$37,934	$6,076	$1,929	$3,315	$49,254	$134.54	$8,149	$57,404	$568,187	$489,290
2035	366.1	366.1	0.000	0	$38,432	$6,198	$1,968	$3,315	$49,913	$136.34	$8,149	$58,062	$596,131	$512,156
2036	367.1	367.1	0.000	3	$39,124	$6,337	$2,013	$3,326	$50,799	$138.38	$8,149	$58,949	$623,225	$534,319
2037	366.1	366.1	0.000	0	$39,509	$6,447	$2,047	$3,315	$51,319	$140.18	$8,149	$59,468	$649,336	$555,644
2038	366.1	366.1	0.000	0	$40,001	$6,575	$2,088	$3,315	$51,980	$141.98	$8,149	$60,129	$674,553	$576,214
2039	366.1	366.1	0.020	7	$40,438	$6,708	$2,130	$3,315	$52,592	$143.66	$8,149	$60,741	$698,887	$596,035
2040	367.1	367.1	0.000	0	$41,153	$6,857	$2,179	$3,326	$53,515	$145.77	$8,149	$61,665	$722,476	$615,244
2041	366.1	366.1	0.000	8	$41,453	$6,979	$2,216	$3,315	$53,963	$147.40	$3,705	$57,669	$742,857	$633,691
2042	366.1	366.1	0.010	4	$41,970	$7,119	$2,260	$3,315	$54,665	$149.32	$3,705	$58,370	$762,532	$651,488
2043	366.1	366.1	0.010	5	$42,556	$7,259	$2,306	$3,315	$55,437	$151.43	$3,421	$58,857	$781,404	$668,678
2044	367.1	367.1	0.000	3	$43,208	$7,425	$2,358	$3,326	$56,317	$153.42	$642	$56,959	**$798,341**	**$685,308**

Table A-22 STX Low Fuel Case Plan 3

STX Low Fuel Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.2	262.7	0.430	96	$21,034	$1,108	$2,042	$1,458	$25,642	$97.60	$10,321	$35,963	$108,745	$93,323
2023	263.2	263.1	0.030	6	$16,075	$1,918	$2,249	$1,458	$21,701	$82.47	$13,252	$34,952	$138,372	$111,176
2024	263.8	263.8	0.000	2	$16,226	$1,964	$2,300	$1,463	$21,954	$83.22	$13,252	$35,205	$167,004	$128,378
2025	263.2	263.2	0.020	6	$16,489	$2,013	$2,340	$1,458	$22,300	$84.73	$13,252	$35,552	$194,743	$145,018
2026	263.1	263.1	0.000	0	$16,964	$2,024	$2,387	$1,458	$22,833	$86.78	$13,252	$36,085	$221,744	$161,245
2027	263.2	263.2	0.040	23	$17,208	$2,066	$2,435	$1,458	$23,167	$88.03	$13,252	$36,418	$247,885	$176,926
2028	263.9	263.9	0.010	2	$17,509	$2,120	$2,490	$1,463	$23,582	$89.38	$13,252	$36,833	$273,243	$192,127
2029	263.2	263.2	0.000	0	$17,977	$2,151	$2,533	$1,458	$24,119	$91.65	$13,252	$37,371	$297,910	$206,934
2030	263.1	263.1	0.000	0	$18,228	$2,192	$2,584	$1,458	$24,462	$92.96	$13,252	$37,713	$321,786	$221,236
2031	263.2	263.2	0.000	0	$18,454	$2,230	$2,635	$1,458	$24,778	$94.16	$13,252	$38,029	$344,877	$235,033
2032	263.8	263.8	0.000	0	$18,762	$2,277	$2,695	$1,463	$25,197	$95.51	$13,252	$38,449	$367,263	$248,396
2033	263.2	263.2	0.000	0	$19,023	$2,313	$2,742	$1,458	$25,536	$97.03	$13,252	$38,788	$388,922	$261,293
2034	263.2	263.2	0.040	10	$19,266	$2,366	$2,797	$1,458	$25,887	$98.37	$13,252	$39,138	$409,879	$273,745
2035	263.2	263.2	0.000	0	$19,557	$2,412	$2,852	$1,458	$26,280	$99.85	$13,252	$39,531	$430,176	$285,784
2036	263.9	263.9	0.000	0	$19,877	$2,464	$2,917	$1,463	$26,722	$101.28	$13,252	$39,973	$449,852	$297,443
2037	263.3	263.3	0.000	0	$19,966	$2,537	$2,968	$1,458	$26,930	$102.30	$13,252	$40,181	$468,826	$308,633
2038	263.2	263.2	0.000	0	$20,314	$2,559	$3,027	$1,458	$27,359	$103.94	$13,252	$40,611	$487,210	$319,460
2039	263.3	263.3	0.000	0	$20,546	$2,615	$3,088	$1,458	$27,708	$105.23	$13,252	$40,959	$504,990	$329,902
2040	264.0	264.0	0.000	0	$20,889	$2,662	$3,158	$1,463	$28,173	$106.71	$13,252	$41,424	$522,225	$340,015
2041	263.4	263.3	0.100	14	$20,975	$2,718	$3,212	$1,458	$28,364	$107.72	$6,911	$35,275	$535,528	$349,711
2042	263.4	263.4	0.000	0	$21,310	$2,760	$3,277	$1,458	$28,805	$109.34	$2,931	$31,735	$546,391	$359,089
2043	263.5	263.5	0.000	0	$21,488	$2,836	$3,342	$1,458	$29,124	$110.52	$0	$29,124	$555,422	$368,120
2044	264.6	264.6	0.000	0	$21,817	$2,884	$3,418	$1,463	$29,583	$111.79	$0	$29,583	**$564,158**	**$376,856**

Table A-23 STT Low Fuel Case Plan 4

STT Low Fuel Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	#NUM!
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
3xRICE 7MW LPG	42,772	6	20	10/01/2023	46,836	3,414
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
RICE 7MW LPG	14,257	6	20	07/01/2024	15,819	1,153
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,295	$4,672	$1,828	$3,315	$41,109	$112.29	$6,429	$47,538	$106,463	$100,403
2022	366.1	366.1	0.020	4	$31,665	$4,781	$1,423	$3,315	$41,184	$112.50	$6,731	$47,915	$148,200	$135,980
2023	366.1	366.1	0.000	0	$31,686	$4,884	$1,514	$3,315	$41,400	$113.08	$7,830	$49,230	$189,216	$170,040
2024	367.1	367.1	0.000	0	$31,482	$5,000	$1,848	$3,326	$41,656	$113.47	$12,563	$54,219	$232,692	$202,678
2025	366.1	366.1	0.000	0	$32,152	$5,086	$1,945	$3,315	$42,498	$116.08	$13,427	$55,925	$275,650	$234,391
2026	366.1	366.1	0.000	0	$32,797	$5,187	$1,984	$3,315	$43,283	$118.23	$13,427	$56,710	$317,327	$265,152
2027	366.1	366.1	0.000	0	$33,365	$5,291	$2,024	$3,315	$43,995	$120.17	$13,427	$57,421	$357,704	$294,929
2028	367.1	367.1	0.000	0	$33,956	$5,412	$2,070	$3,326	$44,763	$121.93	$13,427	$58,190	$396,849	$323,783
2029	366.1	366.1	0.000	0	$34,822	$5,505	$2,105	$3,315	$45,747	$124.96	$13,427	$59,174	$434,925	$351,868
2030	366.1	366.1	0.000	0	$35,239	$5,615	$2,147	$3,315	$46,316	$126.51	$13,427	$59,743	$471,705	$378,948
2031	366.1	366.1	0.000	0	$35,682	$5,727	$2,190	$3,315	$46,915	$128.15	$13,427	$60,342	$507,246	$405,072
2032	367.1	367.1	0.000	0	$36,293	$5,857	$2,240	$3,326	$47,716	$129.98	$13,427	$61,143	$541,694	$430,377
2033	366.1	366.1	0.000	0	$36,728	$5,958	$2,279	$3,315	$48,280	$131.88	$13,427	$61,707	$574,955	$454,762
2034	366.1	366.1	0.000	0	$37,277	$6,077	$2,324	$3,315	$48,994	$133.83	$13,427	$62,421	$607,140	$478,329
2035	366.1	366.1	0.000	0	$37,789	$6,199	$2,371	$3,315	$49,674	$135.68	$13,427	$63,100	$638,264	$501,085
2036	367.1	367.1	0.000	0	$38,422	$6,340	$2,425	$3,326	$50,513	$137.60	$13,427	$63,940	$668,426	$523,124
2037	366.1	366.1	0.000	0	$38,829	$6,449	$2,467	$3,315	$51,060	$139.47	$13,427	$64,487	$697,529	$544,340
2038	366.1	366.1	0.000	0	$39,292	$6,578	$2,516	$3,315	$51,701	$141.22	$13,427	$65,128	$725,646	$564,800
2039	366.1	366.1	0.000	0	$39,778	$6,709	$2,566	$3,315	$52,369	$143.05	$13,427	$65,796	$752,817	$584,538
2040	367.1	367.1	0.000	0	$40,396	$6,862	$2,625	$3,326	$53,209	$144.94	$13,427	$66,636	$779,134	$603,637
2041	366.1	366.1	0.000	0	$40,765	$6,980	$2,670	$3,315	$53,731	$146.77	$6,998	$60,729	$801,154	$622,005
2042	366.1	366.1	0.000	0	$41,277	$7,120	$2,723	$3,315	$54,435	$148.69	$6,696	$61,131	$822,269	$639,727
2043	366.1	366.1	0.000	0	$41,811	$7,262	$2,778	$3,315	$55,166	$150.69	$5,597	$60,763	$842,128	$656,832
2044	367.1	367.1	0.000	0	$42,470	$7,427	$2,841	$3,326	$56,064	$152.73	$863	$56,928	**$859,096**	**$673,388**

Table A-24 STX Low Fuel Case Plan 4

STX Low Fuel Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 8MW LPG	63,798	6	20	07/01/2022	68,039	4,960

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.380	88	$22,107	$1,118	$2,076	$1,458	$26,759	$101.85	$9,870	$36,629	$109,297	$94,288
2023	263.1	263.1	0.000	0	$18,331	$1,929	$2,317	$1,458	$24,036	$91.35	$12,350	$36,385	$140,044	$114,062
2024	263.8	263.6	0.150	25	$18,474	$1,974	$2,369	$1,463	$24,280	$92.10	$12,350	$36,630	$169,721	$133,086
2025	263.1	263.1	0.020	5	$18,927	$2,002	$2,410	$1,458	$24,797	$94.25	$12,350	$37,147	$198,568	$151,591
2026	263.1	263.1	0.000	0	$19,387	$2,028	$2,458	$1,458	$25,331	$96.27	$12,350	$37,681	$226,612	$169,593
2027	263.1	263.1	0.020	14	$19,613	$2,074	$2,508	$1,458	$25,654	$97.51	$12,350	$38,003	$253,725	$186,957
2028	263.8	263.8	0.000	0	$19,982	$2,132	$2,565	$1,463	$26,142	$99.10	$12,350	$38,492	$280,041	$203,808
2029	263.1	263.1	0.000	2	$20,566	$2,152	$2,609	$1,458	$26,784	$101.80	$12,350	$39,134	$305,674	$220,251
2030	263.1	263.1	0.000	0	$20,725	$2,212	$2,661	$1,458	$27,056	$102.83	$12,350	$39,406	$330,415	$236,070
2031	263.1	263.1	0.000	0	$21,039	$2,243	$2,714	$1,458	$27,455	$104.34	$12,350	$39,805	$354,365	$251,358
2032	263.8	263.8	0.000	1	$21,420	$2,286	$2,776	$1,463	$27,946	$105.94	$12,350	$40,296	$377,595	$266,179
2033	263.1	263.1	0.000	0	$21,674	$2,329	$2,824	$1,458	$28,285	$107.50	$12,350	$40,635	$400,045	$280,465
2034	263.1	263.1	0.000	0	$21,953	$2,385	$2,880	$1,458	$28,677	$108.99	$12,350	$41,027	$421,767	$294,259
2035	263.1	263.1	0.000	0	$22,297	$2,434	$2,938	$1,458	$29,127	$110.69	$12,350	$41,477	$442,806	$307,602
2036	263.8	263.8	0.000	3	$22,680	$2,478	$3,005	$1,463	$29,626	$112.32	$12,350	$41,975	$463,203	$320,528
2037	263.1	263.1	0.020	4	$22,785	$2,550	$3,057	$1,458	$29,850	$113.45	$12,350	$42,200	$482,861	$332,931
2038	263.1	263.1	0.000	0	$23,193	$2,571	$3,118	$1,458	$30,340	$115.31	$12,350	$42,690	$501,911	$344,938
2039	263.1	263.1	0.000	0	$23,438	$2,640	$3,180	$1,458	$30,717	$116.74	$12,350	$43,067	$520,325	$356,515
2040	263.8	263.8	0.000	0	$23,849	$2,677	$3,253	$1,463	$31,242	$118.44	$12,350	$43,592	$538,178	$367,729
2041	263.1	263.1	0.000	3	$23,975	$2,737	$3,309	$1,458	$31,480	$119.64	$6,009	$37,489	$552,075	$378,490
2042	263.1	263.0	0.110	24	$24,221	$2,791	$3,375	$1,458	$31,845	$121.08	$2,480	$34,325	$563,700	$388,858
2043	263.1	263.1	0.000	0	$24,656	$2,827	$3,442	$1,458	$32,384	$123.07	$0	$32,384	$573,741	$398,899
2044	263.8	263.8	0.000	0	$25,012	$2,915	$3,521	$1,463	$32,911	$124.76	$0	$32,911	**$583,460**	**$408,618**

Table A-25 STT Low Load Case Plan 1

STT Low Load Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
4xRICE 7MW LPG	57,029	6	20	01/01/2021	59,138	4,311
2xRICE 7MW LPG	28,515	6	20	04/01/2021	29,667	2,163
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	364.0	364.0	0.000	0	$48,490	$3,408	$13,619	$127	$65,645	$180.35	$0	$65,645	$62,519	$62,519
2021	356.9	356.9	0.000	0	$30,229	$4,556	$1,860	$3,315	$39,960	$111.95	$7,016	$46,975	$105,377	$98,764
2022	350.8	350.8	0.010	3	$29,975	$4,576	$1,472	$3,315	$39,338	$112.13	$7,556	$46,894	$146,273	$132,745
2023	346.5	346.5	0.000	0	$29,804	$4,605	$1,522	$3,315	$39,245	$113.27	$8,086	$47,331	$185,745	$165,033
2024	344.8	344.8	0.000	0	$29,602	$4,673	$1,685	$3,326	$39,286	$113.93	$10,536	$49,822	$225,615	$195,814
2025	341.3	341.3	0.000	0	$30,686	$4,714	$1,736	$3,315	$40,451	$118.54	$10,823	$51,274	$264,864	$226,000
2026	338.6	338.6	0.000	0	$31,668	$4,768	$1,770	$3,315	$41,521	$122.61	$10,823	$52,344	$303,172	$255,508
2027	336.0	336.0	0.000	0	$32,471	$4,823	$1,806	$3,315	$42,415	$126.22	$10,823	$53,238	$340,424	$284,216
2028	334.3	334.3	0.000	0	$33,254	$4,891	$1,847	$3,326	$43,318	$129.56	$10,823	$54,140	$376,641	$312,139
2029	330.8	330.8	0.000	0	$34,737	$4,933	$1,879	$3,315	$44,864	$135.63	$10,823	$55,687	$412,237	$339,682
2030	329.5	329.5	0.000	0	$35,387	$5,010	$1,916	$3,315	$45,629	$138.48	$10,823	$56,451	$446,734	$366,360
2031	329.5	329.5	0.000	0	$36,349	$5,110	$1,955	$3,315	$46,729	$141.82	$10,823	$57,551	$480,345	$392,381
2032	330.4	330.4	0.000	0	$37,475	$5,226	$1,999	$3,326	$48,027	$145.36	$10,823	$58,849	$513,184	$417,850
2033	329.5	329.5	0.000	0	$38,473	$5,316	$2,034	$3,315	$49,138	$149.13	$10,823	$59,960	$545,157	$442,668
2034	329.5	329.5	0.000	0	$39,588	$5,423	$2,074	$3,315	$50,400	$152.97	$10,823	$61,223	$576,347	$466,912
2035	329.5	329.5	0.000	0	$40,669	$5,531	$2,116	$3,315	$51,631	$156.70	$10,823	$62,454	$606,745	$490,565
2036	330.4	330.4	0.000	0	$41,933	$5,657	$2,164	$3,326	$53,080	$160.65	$10,823	$63,902	$636,451	$513,723
2037	329.5	329.5	0.000	0	$42,929	$5,754	$2,201	$3,315	$54,200	$164.50	$10,823	$65,022	$665,329	$536,244
2038	329.5	329.5	0.000	0	$43,988	$5,869	$2,245	$3,315	$55,419	$168.19	$10,823	$66,241	$693,432	$558,175
2039	329.5	329.5	0.000	0	$45,106	$5,987	$2,290	$3,315	$56,698	$172.08	$10,823	$67,521	$720,793	$579,544
2040	330.4	330.4	0.000	0	$46,366	$6,123	$2,343	$3,326	$58,158	$176.02	$10,823	$68,981	$747,486	$600,420
2041	329.5	329.5	0.000	0	$47,320	$6,229	$2,383	$3,315	$59,247	$179.81	$3,807	$63,053	$769,727	$620,673
2042	329.5	329.5	0.000	0	$48,515	$6,353	$2,431	$3,315	$60,614	$183.96	$3,266	$63,880	$791,116	$640,407
2043	329.5	329.5	0.000	0	$49,754	$6,480	$2,479	$3,315	$62,029	$188.26	$2,737	$64,765	$811,695	$659,640
2044	330.4	330.4	0.000	0	$51,174	$6,627	$2,536	$3,326	$63,663	$192.70	$287	$63,950	**$830,632**	**$678,440**

Table A-26 STX Low Load Case Plan 1

STX Low Load Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
RICE 8MW LPG	15,949	6	20	07/01/2022	17,010	1,240
3xRICE 7MW LPG	42,772	6	20	07/01/2022	45,615	3,325
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	261.6	261.6	0.000	0	$29,440	$1,780	$10,645	$1,463	$43,328	$165.66	$0	$43,328	$41,265	$41,265
2021	256.5	256.4	0.090	21	$19,365	$1,261	$9,794	$1,458	$31,879	$124.31	$6,341	$38,220	$76,157	$70,180
2022	252.2	251.9	0.290	76	$19,996	$1,048	$2,051	$1,458	$24,552	$97.48	$10,387	$34,939	$106,871	$91,390
2023	249.0	249.0	0.000	0	$14,942	$1,787	$2,266	$1,458	$20,453	$82.13	$13,383	$33,836	$135,589	$108,216
2024	247.8	247.8	0.000	0	$14,933	$1,826	$2,318	$1,463	$20,540	$82.89	$13,383	$33,923	$163,227	$124,310
2025	245.3	245.3	0.000	0	$15,485	$1,835	$2,358	$1,458	$21,136	$86.17	$13,383	$34,519	$190,207	$140,082
2026	243.4	243.4	0.000	0	$15,989	$1,841	$2,405	$1,458	$21,693	$89.13	$13,383	$35,076	$216,505	$155,499
2027	241.5	241.5	0.000	0	$16,356	$1,855	$2,453	$1,458	$22,122	$91.59	$13,383	$35,506	$242,043	$170,472
2028	240.3	240.3	0.000	0	$16,801	$1,873	$2,509	$1,463	$22,645	$94.26	$13,383	$36,028	$266,898	$185,069
2029	237.8	237.8	0.000	0	$17,514	$1,878	$2,552	$1,458	$23,402	$98.40	$13,383	$36,785	$291,223	$199,436
2030	236.9	236.9	0.000	0	$17,814	$1,908	$2,603	$1,458	$23,784	$100.39	$13,383	$37,167	$314,797	$213,342
2031	237.0	237.0	0.000	0	$18,205	$1,957	$2,655	$1,458	$24,275	$102.44	$13,383	$37,658	$337,701	$226,859
2032	237.7	237.7	0.000	0	$18,842	$1,982	$2,715	$1,463	$25,002	$105.20	$13,383	$38,385	$360,073	$240,119
2033	237.3	237.3	0.000	0	$19,253	$2,020	$2,762	$1,458	$25,494	$107.43	$13,383	$38,877	$381,797	$252,995
2034	237.7	237.7	0.000	0	$19,709	$2,064	$2,817	$1,458	$26,049	$109.59	$13,383	$39,432	$402,918	$265,525
2035	238.4	238.4	0.000	0	$20,147	$2,090	$2,874	$1,458	$26,570	$111.47	$13,383	$39,953	$423,429	$277,697
2036	239.9	239.9	0.000	0	$20,527	$2,132	$2,939	$1,463	$27,062	$112.82	$13,383	$40,445	$443,333	$289,504
2037	242.1	242.1	0.000	0	$20,449	$2,122	$2,990	$1,458	$27,019	$111.59	$13,383	$40,403	$462,422	$300,731
2038	243.9	243.9	0.000	0	$20,541	$2,147	$3,050	$1,458	$27,195	$111.50	$13,383	$40,578	$480,816	$311,493
2039	244.4	244.4	0.000	0	$21,130	$2,166	$3,111	$1,458	$27,866	$114.02	$13,383	$41,249	$498,728	$321,995
2040	245.0	245.0	0.000	0	$21,765	$2,221	$3,182	$1,463	$28,632	$116.88	$13,383	$42,015	$516,199	$332,273
2041	244.3	244.3	0.000	0	$22,270	$2,263	$3,236	$1,458	$29,228	$119.65	$7,042	$36,270	$529,866	$342,264
2042	244.2	244.2	0.000	0	$22,839	$2,326	$3,301	$1,458	$29,924	$122.52	$2,996	$32,920	$541,127	$352,006
2043	244.2	244.2	0.000	0	$23,590	$2,368	$3,367	$1,458	$30,784	$126.07	$0	$30,784	$550,672	$361,552
2044	244.7	244.7	0.000	0	$24,518	$2,411	$3,444	$1,463	$31,836	$130.09	$0	$31,836	**$560,073**	**$370,953**

Table A-27 STT Low Load Case Plan 2

STT Low Load Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	4/1/2024
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
RICE 8MW LPG	15,949	6	20	10/01/2023	17,465	1,273
RICE 8MW LPG	15,949	6	20	04/01/2024	17,609	1,284
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981
STJ Crus Bay PV	10,000	6	20	04/01/2024	11,041	805

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	New Unit Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	364.0	364.0	0.000	0	$48,490	$3,408	$13,619	$127	$65,645	$180.35	$0	$65,645	$62,519	$62,519
2021	356.9	356.9	0.060	12	$32,744	$4,409	$2,147	$3,315	$42,616	$119.42	$4,401	$47,017	$105,322	$101,173
2022	350.8	350.8	0.000	0	$31,914	$4,478	$2,215	$3,315	$41,922	$119.49	$4,704	$46,625	$145,840	$137,387
2023	346.5	346.5	0.030	7	$30,973	$4,555	$2,284	$3,315	$41,128	$118.71	$5,267	$46,395	$184,356	$171,223
2024	344.8	344.8	0.000	0	$29,801	$4,667	$1,754	$3,326	$39,548	$114.69	$8,524	$48,072	$222,696	$202,210
2025	341.3	341.3	0.000	0	$30,871	$4,711	$1,562	$3,315	$40,459	$118.56	$9,046	$49,506	$260,464	$232,402
2026	338.6	338.6	0.000	0	$31,828	$4,767	$1,594	$3,315	$41,504	$122.56	$9,046	$50,550	$297,315	$261,898
2027	336.0	336.0	0.000	0	$32,608	$4,823	$1,626	$3,315	$42,371	$126.09	$9,046	$51,417	$333,134	$290,576
2028	334.3	334.3	0.000	0	$33,402	$4,890	$1,663	$3,326	$43,280	$129.45	$9,046	$52,327	$367,966	$318,475
2029	330.8	330.8	0.000	1	$34,898	$4,932	$1,691	$3,315	$44,836	$135.53	$9,046	$53,882	$402,223	$346,000
2030	329.5	329.5	0.000	0	$35,542	$5,009	$1,725	$3,315	$45,591	$138.37	$9,046	$54,637	$435,414	$372,656
2031	329.5	329.5	0.000	0	$36,505	$5,110	$1,760	$3,315	$46,690	$141.70	$9,046	$55,736	$467,757	$398,655
2032	330.4	330.4	0.000	0	$37,656	$5,225	$1,800	$3,326	$48,007	$145.30	$9,046	$57,053	$499,376	$424,114
2033	329.5	329.5	0.000	0	$38,635	$5,316	$1,831	$3,315	$49,096	$149.01	$9,046	$58,143	$530,154	$448,911
2034	329.5	329.5	0.000	0	$39,753	$5,422	$1,867	$3,315	$50,358	$152.84	$9,046	$59,404	$560,183	$473,134
2035	329.5	329.5	0.000	0	$40,874	$5,529	$1,905	$3,315	$51,623	$156.67	$9,046	$60,669	$589,470	$496,783
2036	330.4	330.4	0.000	0	$42,126	$5,656	$1,948	$3,326	$53,055	$160.58	$9,046	$62,101	$618,090	$519,931
2037	329.5	329.5	0.000	0	$43,124	$5,753	$1,981	$3,315	$54,174	$164.41	$9,046	$63,221	$645,915	$542,441
2038	329.5	329.5	0.000	0	$44,163	$5,869	$2,021	$3,315	$55,368	$168.04	$9,046	$64,414	$672,985	$564,352
2039	329.5	329.5	0.000	0	$45,290	$5,986	$2,062	$3,315	$56,653	$171.94	$9,046	$65,699	$699,345	$585,704
2040	330.4	330.4	0.000	0	$46,555	$6,123	$2,109	$3,326	$58,113	$175.88	$9,046	$67,159	$725,067	$606,563
2041	329.5	329.4	0.160	36	$47,496	$6,225	$2,145	$3,315	$59,181	$179.68	$4,645	$63,825	$747,722	$626,794
2042	329.5	329.5	0.000	0	$48,725	$6,352	$2,188	$3,315	$60,581	$183.86	$4,342	$64,923	$769,646	$646,518
2043	329.5	329.5	0.000	0	$49,961	$6,480	$2,231	$3,315	$61,987	$188.13	$3,779	$65,766	$790,725	$665,738
2044	330.4	330.4	0.000	0	$51,415	$6,625	$2,282	$3,326	$63,648	$192.66	$522	$64,170	**$809,770**	**$684,533**

Table A-28 STX Low Load Case Plan 2

STX Low Load Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
RICE 7MW LPG	14,257	6	20	07/01/2022	15,205	1,108

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	261.6	261.6	0.000	0	$29,440	$1,780	$10,645	$1,463	$43,328	$165.66	$0	$43,328	$41,265	$41,265
2021	256.5	256.4	0.090	21	$19,365	$1,261	$9,794	$1,458	$31,879	$124.31	$6,341	$38,220	$76,157	$70,180
2022	252.2	251.9	0.290	76	$21,028	$1,058	$2,084	$1,458	$25,628	$101.75	$10,161	$35,789	$107,594	$92,319
2023	249.0	249.0	0.010	1	$17,076	$1,810	$2,333	$1,458	$22,677	$91.06	$12,932	$35,609	$137,741	$110,975
2024	247.8	247.8	0.000	0	$17,222	$1,834	$2,386	$1,463	$22,905	$92.44	$12,932	$35,837	$166,842	$128,922
2025	245.3	245.2	0.030	7	$17,859	$1,837	$2,427	$1,458	$23,581	$96.16	$12,932	$36,513	$195,269	$146,518
2026	243.4	243.4	0.000	0	$18,527	$1,846	$2,476	$1,458	$24,308	$99.87	$12,932	$37,240	$223,059	$163,793
2027	241.5	241.5	0.000	0	$18,916	$1,867	$2,525	$1,458	$24,766	$102.55	$12,932	$37,698	$250,031	$180,556
2028	240.2	240.2	0.000	0	$19,507	$1,885	$2,583	$1,463	$25,438	$105.88	$12,932	$38,370	$276,340	$196,954
2029	237.8	237.7	0.010	5	$20,335	$1,893	$2,627	$1,458	$26,314	$110.68	$12,932	$39,246	$302,117	$213,108
2030	236.8	236.8	0.000	0	$20,757	$1,919	$2,680	$1,458	$26,815	$113.23	$12,932	$39,747	$327,137	$228,786
2031	236.8	236.8	0.000	0	$21,341	$1,951	$2,733	$1,458	$27,484	$116.06	$12,932	$40,416	$351,511	$244,090
2032	237.4	237.4	0.000	0	$21,955	$2,002	$2,796	$1,463	$28,215	$118.85	$12,932	$41,147	$375,280	$259,053
2033	236.8	236.8	0.000	0	$22,582	$2,031	$2,844	$1,458	$28,915	$122.10	$12,932	$41,847	$398,434	$273,657
2034	236.8	236.8	0.000	0	$23,131	$2,089	$2,901	$1,458	$29,579	$124.91	$12,932	$42,511	$420,963	$287,885
2035	236.8	236.8	0.000	0	$23,874	$2,121	$2,959	$1,458	$30,412	$128.42	$12,932	$43,344	$442,953	$301,817
2036	237.4	237.4	0.000	0	$24,562	$2,170	$3,026	$1,463	$31,221	$131.52	$12,932	$44,153	$464,399	$315,439
2037	236.8	236.8	0.000	0	$25,173	$2,211	$3,078	$1,458	$31,920	$134.79	$12,932	$44,852	$485,259	$328,702
2038	236.8	236.8	0.000	0	$25,804	$2,246	$3,140	$1,458	$32,648	$137.87	$12,932	$45,580	$505,554	$341,622
2039	236.8	236.8	0.000	0	$26,461	$2,301	$3,202	$1,458	$33,422	$141.14	$12,932	$46,354	$525,310	$354,219
2040	237.4	237.4	0.000	0	$27,182	$2,349	$3,275	$1,463	$34,270	$144.35	$12,932	$47,202	$544,563	$366,520
2041	236.8	236.8	0.000	0	$27,670	$2,392	$3,332	$1,458	$34,852	$147.17	$6,591	$41,443	$559,917	$378,434
2042	236.8	236.8	0.000	0	$28,378	$2,442	$3,398	$1,458	$35,677	$150.66	$2,771	$38,448	$572,936	$390,049
2043	236.8	236.8	0.000	0	$29,136	$2,486	$3,466	$1,458	$36,547	$154.33	$0	$36,547	$584,269	$401,381
2044	237.4	237.4	0.000	0	$30,043	$2,545	$3,545	$1,463	$37,596	$158.36	$0	$37,596	**$595,371**	**$412,484**

Table A-29 STT Low Load Case Plan 3

STT Low Load Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
2xRICE 8MW LPG	31,899	6	20	04/01/2024	35,219	2,567
2xRICE 7MW LPG	28,515	6	20	01/01/2021	29,569	2,155
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	364.0	364.0	0.000	0	$48,490	$3,408	$13,619	$127	$65,645	$180.35	$0	$65,645	$62,519	$62,519
2021	356.9	356.9	0.020	10	$32,875	$4,400	$2,139	$3,315	$42,730	$119.72	$4,444	$47,174	$105,465	$101,276
2022	350.8	350.8	0.010	5	$32,665	$4,434	$2,182	$3,315	$42,596	$121.41	$4,444	$47,040	$146,328	$138,072
2023	346.5	346.3	0.210	60	$31,817	$4,504	$2,246	$3,315	$41,883	$120.95	$4,728	$46,611	$184,986	$172,529
2024	344.8	344.8	0.000	0	$30,321	$4,662	$2,023	$3,326	$40,332	$116.97	$7,507	$47,840	$223,063	$204,130
2025	341.3	341.3	0.000	0	$31,226	$4,713	$1,614	$3,315	$40,869	$119.76	$8,149	$49,018	$260,385	$234,627
2026	338.6	338.6	0.000	0	$32,226	$4,768	$1,647	$3,315	$41,956	$123.89	$8,149	$50,105	$296,828	$264,444
2027	336.0	336.0	0.000	0	$33,048	$4,822	$1,680	$3,315	$42,865	$127.56	$8,149	$51,014	$332,274	$293,457
2028	334.3	334.3	0.000	0	$33,842	$4,891	$1,718	$3,326	$43,777	$130.93	$8,149	$51,926	$366,739	$321,676
2029	330.8	330.8	0.000	0	$35,362	$4,932	$1,747	$3,315	$45,357	$137.12	$8,149	$53,506	$400,647	$349,521
2030	329.5	329.5	0.000	0	$36,043	$5,009	$1,782	$3,315	$46,150	$140.06	$8,149	$54,299	$433,517	$376,504
2031	329.5	329.5	0.020	11	$37,010	$5,109	$1,818	$3,315	$47,252	$143.42	$8,149	$55,401	$465,545	$402,816
2032	330.4	330.4	0.000	0	$38,188	$5,224	$1,859	$3,326	$48,598	$147.09	$8,149	$56,747	$496,866	$428,588
2033	329.5	329.5	0.000	0	$39,176	$5,316	$1,891	$3,315	$49,698	$150.83	$8,149	$57,847	$527,355	$453,689
2034	329.5	329.5	0.000	0	$40,305	$5,422	$1,929	$3,315	$50,972	$154.70	$8,149	$59,121	$557,104	$478,207
2035	329.5	329.5	0.000	0	$41,399	$5,531	$1,968	$3,315	$52,213	$158.46	$8,149	$60,362	$586,101	$502,126
2036	330.4	330.4	0.000	0	$42,711	$5,656	$2,013	$3,326	$53,705	$162.55	$8,149	$61,855	$614,463	$525,558
2037	329.5	329.5	0.000	0	$43,706	$5,754	$2,047	$3,315	$54,823	$166.39	$8,149	$62,972	$642,030	$548,338
2038	329.5	329.5	0.000	0	$44,803	$5,868	$2,088	$3,315	$56,075	$170.19	$8,149	$64,224	$668,868	$570,529
2039	329.5	329.5	0.000	1	$45,911	$5,986	$2,130	$3,315	$57,343	$174.03	$8,149	$65,492	$694,992	$592,141
2040	330.4	330.4	0.000	0	$47,245	$6,121	$2,179	$3,326	$58,871	$178.17	$8,149	$67,020	$720,504	$613,272
2041	329.5	329.5	0.000	0	$48,168	$6,228	$2,216	$3,315	$59,928	$181.88	$3,705	$63,633	$742,924	$633,758
2042	329.5	329.5	0.000	0	$49,383	$6,353	$2,260	$3,315	$61,311	$186.08	$3,705	$65,017	$764,763	$653,719
2043	329.5	329.5	0.000	0	$50,666	$6,479	$2,306	$3,315	$62,766	$190.49	$3,421	$66,187	$785,907	$673,181
2044	330.4	330.4	0.000	0	$52,099	$6,626	$2,358	$3,326	$64,410	$194.96	$642	$65,051	**$805,234**	**$692,201**

Table A-30 STX Low Load Case Plan 3

STX Low Load Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power					Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	261.6	261.6	0.000	0	$29,440	$1,780	$10,645	$1,463	$43,328	$165.66	$0	$43,328	$41,265	$41,265
2021	256.5	256.4	0.090	21	$19,365	$1,261	$9,794	$1,458	$31,879	$124.31	$6,341	$38,220	$76,157	$70,180
2022	252.2	251.9	0.290	76	$20,014	$1,042	$2,042	$1,458	$24,557	$97.50	$10,321	$34,878	$106,815	$91,393
2023	249.0	249.0	0.000	0	$14,962	$1,783	$2,249	$1,458	$20,452	$82.13	$13,252	$33,704	$135,415	$108,220
2024	247.8	247.8	0.000	0	$15,032	$1,808	$2,300	$1,463	$20,604	$83.16	$13,252	$33,856	$162,990	$124,363
2025	245.3	245.3	0.000	0	$15,535	$1,823	$2,340	$1,458	$21,156	$86.24	$13,252	$34,408	$189,875	$140,150
2026	243.4	243.4	0.000	0	$16,092	$1,821	$2,387	$1,458	$21,758	$89.40	$13,252	$35,010	$216,113	$155,614
2027	241.5	241.5	0.000	0	$16,466	$1,835	$2,435	$1,458	$22,193	$91.89	$13,252	$35,445	$241,595	$170,635
2028	240.3	240.3	0.020	8	$16,810	$1,866	$2,490	$1,463	$22,629	$94.17	$13,252	$35,881	$266,338	$185,222
2029	237.8	237.8	0.000	0	$17,551	$1,871	$2,533	$1,458	$23,413	$98.44	$13,252	$36,665	$290,572	$199,596
2030	236.9	236.9	0.000	0	$17,874	$1,899	$2,584	$1,458	$23,815	$100.53	$13,252	$37,066	$314,070	$213,520
2031	237.0	237.0	0.000	0	$18,348	$1,931	$2,635	$1,458	$24,372	$102.85	$13,252	$37,624	$336,935	$227,091
2032	237.6	237.6	0.000	0	$18,896	$1,973	$2,695	$1,463	$25,028	$105.33	$13,252	$38,279	$359,232	$240,364
2033	237.4	237.4	0.000	0	$19,331	$2,007	$2,742	$1,458	$25,538	$107.58	$13,252	$38,790	$380,891	$253,263
2034	237.8	237.8	0.010	5	$19,782	$2,048	$2,797	$1,458	$26,085	$109.71	$13,252	$39,336	$401,944	$265,810
2035	238.5	238.5	0.000	0	$20,196	$2,079	$2,852	$1,458	$26,585	$111.49	$13,252	$39,837	$422,381	$277,989
2036	240.0	240.0	0.000	0	$20,605	$2,112	$2,917	$1,463	$27,098	$112.90	$13,252	$40,350	$442,221	$289,812
2037	241.9	241.9	0.000	0	$20,444	$2,136	$2,968	$1,458	$27,006	$111.63	$13,252	$40,257	$461,226	$301,033
2038	243.9	243.9	0.000	0	$20,653	$2,130	$3,027	$1,458	$27,269	$111.81	$13,252	$40,520	$479,575	$311,824
2039	244.4	244.4	0.000	0	$21,115	$2,171	$3,088	$1,458	$27,832	$113.88	$13,252	$41,083	$497,401	$322,314
2040	245.0	245.0	0.000	0	$21,850	$2,212	$3,158	$1,463	$28,683	$117.09	$13,252	$41,934	$514,820	$332,609
2041	244.3	244.2	0.050	14	$22,320	$2,255	$3,212	$1,458	$29,245	$119.74	$6,911	$36,156	$528,424	$342,607
2042	244.3	244.3	0.000	0	$23,073	$2,293	$3,277	$1,458	$30,102	$123.24	$2,931	$33,032	$539,709	$352,407
2043	244.2	244.2	0.000	0	$23,676	$2,356	$3,342	$1,458	$30,833	$126.27	$0	$30,833	$549,270	$361,967
2044	244.7	244.7	0.000	0	$24,567	$2,406	$3,418	$1,463	$31,854	$130.18	$0	$31,854	**$558,676**	**$371,374**

Table A-31 STT Low Load Case Plan 4

STT Low Load Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	#NUM!
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
3xRICE 7MW LPG	42,772	6	20	10/01/2023	46,836	3,414
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
RICE 7MW LPG	14,257	6	20	07/01/2024	15,819	1,153
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	364.0	364.0	0.000	0	$48,490	$3,408	$13,619	$127	$65,645	$180.35	$0	$65,645	$62,519	$62,519
2021	356.9	356.9	0.010	5	$30,356	$4,550	$1,828	$3,315	$40,049	$112.21	$6,429	$46,478	$104,905	$98,845
2022	350.8	350.8	0.000	3	$30,134	$4,572	$1,423	$3,315	$39,444	$112.43	$6,731	$46,175	$145,138	$132,918
2023	346.5	346.5	0.000	0	$29,830	$4,604	$1,514	$3,315	$39,264	$113.32	$7,830	$47,094	$184,397	$165,220
2024	344.8	344.8	0.000	0	$29,602	$4,673	$1,848	$3,326	$39,448	$114.40	$12,563	$52,012	$226,143	$196,129
2025	341.3	341.3	0.000	0	$30,685	$4,714	$1,945	$3,315	$40,659	$119.15	$13,427	$54,086	$267,728	$226,470
2026	338.6	338.6	0.000	0	$31,667	$4,768	$1,984	$3,315	$41,734	$123.24	$13,427	$55,161	$308,305	$256,129
2027	336.0	336.0	0.000	0	$32,470	$4,823	$2,024	$3,315	$42,632	$126.87	$13,427	$56,058	$347,759	$284,984
2028	334.3	334.3	0.000	0	$33,252	$4,891	$2,070	$3,326	$43,539	$130.22	$13,427	$56,966	$386,115	$313,049
2029	330.8	330.8	0.000	0	$34,736	$4,933	$2,105	$3,315	$45,090	$136.31	$13,427	$58,516	$423,787	$340,730
2030	329.5	329.5	0.000	0	$35,385	$5,010	$2,147	$3,315	$45,858	$139.18	$13,427	$59,284	$460,299	$367,542
2031	329.5	329.5	0.000	0	$36,347	$5,110	$2,190	$3,315	$46,963	$142.53	$13,427	$60,390	$495,867	$393,693
2032	330.4	330.4	0.000	0	$37,474	$5,226	$2,240	$3,326	$48,266	$146.08	$13,427	$61,693	$530,606	$419,290
2033	329.5	329.5	0.000	0	$38,471	$5,316	$2,279	$3,315	$49,382	$149.87	$13,427	$62,808	$564,424	$444,231
2034	329.5	329.5	0.000	0	$39,587	$5,423	$2,324	$3,315	$50,649	$153.72	$13,427	$64,076	$597,405	$468,594
2035	329.5	329.5	0.000	0	$40,668	$5,531	$2,371	$3,315	$51,885	$157.47	$13,427	$65,312	$629,541	$492,363
2036	330.4	330.4	0.000	0	$41,931	$5,657	$2,425	$3,326	$53,339	$161.44	$13,427	$66,766	$660,936	$515,635
2037	329.5	329.5	0.000	0	$42,926	$5,754	$2,467	$3,315	$54,463	$165.29	$13,427	$67,889	$691,454	$538,265
2038	329.5	329.5	0.000	0	$43,987	$5,869	$2,516	$3,315	$55,688	$169.01	$13,427	$69,114	$721,148	$560,302
2039	329.5	329.5	0.000	0	$45,104	$5,987	$2,566	$3,315	$56,972	$172.91	$13,427	$70,399	$750,055	$581,775
2040	330.4	330.4	0.000	0	$46,364	$6,123	$2,625	$3,326	$58,439	$176.87	$13,427	$71,865	$778,248	$602,751
2041	329.5	329.5	0.000	0	$47,318	$6,229	$2,670	$3,315	$59,532	$180.68	$6,998	$66,530	$802,251	$623,102
2042	329.5	329.5	0.000	0	$48,513	$6,353	$2,723	$3,315	$60,905	$184.85	$6,696	$67,600	$825,473	$642,931
2043	329.5	329.5	0.000	0	$49,753	$6,480	$2,778	$3,315	$62,326	$189.16	$5,597	$67,922	$847,551	$662,256
2044	330.4	330.4	0.000	0	$51,172	$6,627	$2,841	$3,326	$63,966	$193.62	$863	$64,830	**$866,853**	**$681,145**

Table A-32 STX Low Load Case Plan 4

STX Low Load Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 8MW LPG	63,798	6	20	07/01/2022	68,039	4,960

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	261.6	261.6	0.000	0	$29,440	$1,780	$10,645	$1,463	$43,328	$165.66	$0	$43,328	$41,265	$41,265
2021	256.5	256.4	0.090	21	$19,365	$1,261	$9,794	$1,458	$31,879	$124.31	$6,341	$38,220	$76,157	$70,180
2022	252.2	251.9	0.290	76	$21,123	$1,048	$2,076	$1,458	$25,705	$102.06	$9,870	$35,575	$107,395	$92,385
2023	249.0	249.0	0.000	0	$17,308	$1,786	$2,317	$1,458	$22,868	$91.83	$12,350	$35,218	$137,181	$111,199
2024	247.8	247.7	0.020	7	$17,447	$1,808	$2,369	$1,463	$23,087	$93.19	$12,350	$35,437	$165,923	$129,289
2025	245.3	245.2	0.030	14	$18,076	$1,818	$2,410	$1,458	$23,763	$96.90	$12,350	$36,113	$193,998	$147,021
2026	243.4	243.4	0.000	0	$18,752	$1,824	$2,458	$1,458	$24,493	$100.63	$12,350	$36,843	$221,447	$164,428
2027	241.5	241.5	0.000	0	$19,164	$1,843	$2,508	$1,458	$24,974	$103.41	$12,350	$37,323	$248,099	$181,331
2028	240.2	240.2	0.000	0	$19,686	$1,871	$2,565	$1,463	$25,584	$106.49	$12,350	$37,934	$274,056	$197,822
2029	237.8	237.8	0.000	1	$20,636	$1,866	$2,609	$1,458	$26,570	$111.76	$12,350	$38,920	$299,557	$214,134
2030	236.8	236.8	0.000	0	$20,945	$1,907	$2,661	$1,458	$26,971	$113.89	$12,350	$39,321	$324,248	$229,903
2031	236.8	236.8	0.000	0	$21,547	$1,935	$2,714	$1,458	$27,655	$116.78	$12,350	$40,005	$348,309	$245,303
2032	237.4	237.4	0.000	0	$22,241	$1,974	$2,776	$1,463	$28,455	$119.86	$12,350	$40,805	$371,809	$260,393
2033	236.8	236.8	0.000	0	$22,829	$2,010	$2,824	$1,458	$29,121	$122.97	$12,350	$41,470	$394,682	$275,101
2034	236.8	236.8	0.000	0	$23,453	$2,059	$2,880	$1,458	$29,850	$126.05	$12,350	$42,200	$416,967	$289,459
2035	236.8	236.8	0.000	0	$24,126	$2,100	$2,938	$1,458	$30,622	$129.31	$12,350	$42,972	$438,691	$303,488
2036	237.4	237.4	0.000	1	$24,890	$2,142	$3,005	$1,463	$31,500	$132.69	$12,350	$43,850	$459,906	$317,231
2037	236.8	236.8	0.010	3	$25,362	$2,200	$3,057	$1,458	$32,078	$135.46	$12,350	$44,427	$480,490	$330,560
2038	236.8	236.8	0.000	0	$26,118	$2,221	$3,118	$1,458	$32,915	$138.99	$12,350	$45,265	$500,558	$343,585
2039	236.8	236.8	0.000	0	$26,730	$2,282	$3,180	$1,458	$33,650	$142.10	$12,350	$46,000	$520,078	$356,268
2040	237.4	237.4	0.000	0	$27,524	$2,319	$3,253	$1,463	$34,559	$145.57	$12,350	$46,909	$539,122	$368,673
2041	236.8	236.8	0.000	0	$27,993	$2,369	$3,309	$1,458	$35,129	$148.34	$6,009	$41,138	$554,267	$380,681
2042	236.8	236.8	0.060	15	$28,647	$2,420	$3,375	$1,458	$35,900	$151.63	$2,480	$38,380	$567,211	$392,369
2043	236.8	236.8	0.000	0	$29,498	$2,452	$3,442	$1,458	$36,851	$155.61	$0	$36,851	$578,637	$403,796
2044	237.4	237.4	0.000	0	$30,297	$2,530	$3,521	$1,463	$37,811	$159.26	$0	$37,811	**$589,803**	**$414,961**

Table A-33 STT High Load Case Plan 1

STT High Load Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
4xRICE 7MW LPG	57,029	6	20	01/01/2021	59,138	4,311
2xRICE 7MW LPG	28,515	6	20	04/01/2021	29,667	2,163
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,108	$4,679	$1,860	$3,315	$40,962	$111.89	$7,016	$47,977	$106,882	$100,269
2022	366.1	366.1	0.000	4	$31,403	$4,790	$1,472	$3,315	$40,980	$111.94	$7,556	$48,536	$149,197	$135,669
2023	366.1	366.1	0.000	0	$31,615	$4,886	$1,522	$3,315	$41,339	$112.92	$8,086	$49,425	$190,391	$169,679
2024	367.1	367.1	0.000	0	$31,674	$4,999	$1,685	$3,326	$41,685	$113.55	$10,536	$52,221	$232,141	$202,340
2025	477.3	477.3	0.000	0	$44,115	$6,741	$1,736	$3,315	$55,907	$117.14	$10,823	$66,730	$282,923	$244,059
2026	477.5	477.5	0.000	0	$45,944	$6,878	$1,770	$3,315	$57,908	$121.28	$10,823	$68,730	$332,877	$285,213
2027	477.5	477.5	0.000	0	$47,460	$7,019	$1,806	$3,315	$59,600	$124.81	$10,823	$70,423	$381,760	$325,552
2028	479.0	479.0	0.000	0	$49,042	$7,181	$1,847	$3,326	$61,396	$128.19	$10,823	$72,218	$429,631	$365,129
2029	477.9	477.9	0.000	0	$51,744	$7,305	$1,879	$3,315	$64,244	$134.43	$10,823	$75,066	$477,124	$404,569
2030	478.3	478.3	0.010	6	$53,067	$7,453	$1,916	$3,315	$65,752	$137.47	$10,823	$76,574	$523,386	$443,012
2031	478.5	478.5	0.000	1	$54,432	$7,611	$1,955	$3,315	$67,313	$140.68	$10,823	$78,136	$568,459	$480,495
2032	480.0	479.8	0.210	31	$56,080	$7,785	$1,999	$3,326	$69,191	$144.21	$10,823	$80,013	$612,522	$517,188
2033	478.7	478.7	0.000	2	$57,606	$7,925	$2,034	$3,315	$70,880	$148.07	$10,823	$81,703	$655,477	$552,988
2034	478.9	478.9	0.000	0	$59,384	$8,083	$2,074	$3,315	$72,857	$152.13	$10,823	$83,680	$697,469	$588,033
2035	479.2	479.1	0.050	12	$61,040	$8,247	$2,116	$3,315	$74,718	$155.95	$10,823	$85,541	$738,443	$622,262
2036	480.9	480.9	0.000	0	$63,030	$8,442	$2,164	$3,326	$76,963	$160.04	$10,823	$87,785	$778,569	$655,841
2037	479.7	479.7	0.020	6	$64,485	$8,593	$2,201	$3,315	$78,595	$163.85	$10,823	$89,418	$817,584	$688,499
2038	479.7	479.7	0.000	2	$65,998	$8,770	$2,245	$3,315	$80,329	$167.45	$10,823	$91,152	$855,545	$720,288
2039	480.0	479.8	0.190	28	$67,683	$8,946	$2,290	$3,315	$82,235	$171.40	$10,823	$93,057	$892,530	$751,281
2040	481.4	481.4	0.040	10	$69,654	$9,154	$2,343	$3,326	$84,476	$175.48	$10,823	$95,299	$928,670	$781,603
2041	480.5	480.5	0.000	3	$71,203	$9,321	$2,383	$3,315	$86,222	$179.43	$3,807	$90,029	$960,132	$811,078
2042	480.7	480.7	0.000	0	$73,172	$9,504	$2,431	$3,315	$88,422	$183.93	$3,266	$91,688	$990,575	$839,866
2043	481.0	481.0	0.010	7	$74,945	$9,705	$2,479	$3,315	$90,444	$188.04	$2,737	$93,180	$1,019,965	$867,910
2044	482.2	482.2	0.000	1	$77,137	$9,923	$2,536	$3,326	$92,922	$192.69	$287	$93,208	**$1,047,542**	**$895,350**

Table A-34 STX High Load Case Plan 1

STX High Load Case Plan 1

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
RICE 8MW LPG	15,949	6	20	07/01/2022	17,010	1,240
3xRICE 7MW LPG	42,772	6	20	07/01/2022	45,615	3,325
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.8	0.380	88	$21,013	$1,115	$2,051	$1,458	$25,637	$97.57	$10,387	$36,023	$108,800	$93,318
2023	263.2	263.1	0.050	13	$16,034	$1,925	$2,266	$1,458	$21,684	$82.41	$13,383	$35,067	$138,531	$111,158
2024	263.9	263.8	0.050	12	$16,157	$1,994	$2,318	$1,463	$21,933	$83.14	$13,383	$35,316	$167,260	$128,343
2025	263.2	263.2	0.000	0	$16,931	$2,028	$2,358	$1,458	$22,775	$86.54	$13,383	$36,158	$195,462	$145,337
2026	263.1	263.1	0.000	0	$17,622	$2,064	$2,405	$1,458	$23,549	$89.49	$13,383	$36,932	$223,080	$162,073
2027	263.2	263.1	0.060	14	$18,202	$2,098	$2,453	$1,458	$24,211	$92.01	$13,383	$37,594	$250,032	$178,460
2028	263.9	263.9	0.000	0	$18,858	$2,144	$2,509	$1,463	$24,973	$94.65	$13,383	$38,356	$276,387	$194,558
2029	263.2	263.2	0.000	0	$19,910	$2,169	$2,552	$1,458	$26,089	$99.12	$13,383	$39,472	$302,361	$210,574
2030	263.3	263.3	0.000	0	$20,345	$2,215	$2,603	$1,458	$26,622	$101.13	$13,383	$40,005	$327,594	$226,140
2031	263.3	263.3	0.000	0	$20,776	$2,274	$2,655	$1,458	$27,163	$103.15	$13,383	$40,546	$352,106	$241,265
2032	264.1	264.1	0.000	0	$21,533	$2,299	$2,715	$1,463	$28,011	$106.07	$13,383	$41,394	$376,074	$256,120
2033	263.7	263.7	0.000	0	$21,981	$2,347	$2,762	$1,458	$28,549	$108.25	$13,383	$41,932	$399,341	$270,539
2034	264.2	264.1	0.040	11	$22,513	$2,396	$2,817	$1,458	$29,185	$110.50	$13,383	$42,568	$421,970	$284,578
2035	264.9	264.9	0.000	2	$23,010	$2,431	$2,874	$1,458	$29,773	$112.41	$13,383	$43,156	$443,949	$298,217
2036	266.7	266.7	0.000	0	$23,430	$2,480	$2,939	$1,463	$30,312	$113.65	$13,383	$43,695	$465,271	$311,442
2037	268.3	268.3	0.000	0	$23,579	$2,482	$2,990	$1,458	$30,509	$113.69	$13,383	$43,892	$485,810	$324,119
2038	269.3	269.3	0.000	0	$23,926	$2,526	$3,050	$1,458	$30,960	$114.98	$13,383	$44,343	$505,694	$336,371
2039	269.6	269.6	0.000	0	$24,640	$2,553	$3,111	$1,458	$31,762	$117.80	$13,383	$45,145	$525,074	$348,342
2040	270.3	270.3	0.000	0	$25,344	$2,616	$3,182	$1,463	$32,605	$120.63	$13,383	$45,988	$543,972	$360,045
2041	269.6	269.6	0.000	2	$25,905	$2,664	$3,236	$1,458	$33,264	$123.38	$7,042	$40,306	$559,019	$371,417
2042	269.6	269.6	0.000	0	$26,475	$2,745	$3,301	$1,458	$33,980	$126.02	$2,996	$36,976	$571,600	$382,479
2043	269.6	269.6	0.000	0	$27,315	$2,790	$3,367	$1,458	$34,931	$129.56	$0	$34,931	$582,431	$393,310
2044	270.3	270.3	0.000	0	$28,403	$2,830	$3,444	$1,463	$36,140	$133.72	$0	$36,140	**$593,103**	**$403,983**

Table A-35 STT High Load Case Plan 2

STT High Load Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	4/1/2024
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
2xRICE 8MW LPG	31,899	6	20	01/01/2021	33,078	2,411
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
RICE 8MW LPG	15,949	6	20	10/01/2023	17,465	1,273
RICE 8MW LPG	15,949	6	20	04/01/2024	17,609	1,284
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981
STJ Crus Bay PV	10,000	6	20	04/01/2024	11,041	805

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.0	0.080	15	$33,982	$4,501	$2,147	$3,315	$43,946	$120.07	$4,401	$48,348	$107,125	$102,977
2022	366.1	366.1	0.010	5	$33,910	$4,657	$2,215	$3,315	$44,097	$120.45	$4,704	$48,800	$149,522	$141,069
2023	366.1	366.1	0.000	4	$33,453	$4,795	$2,284	$3,315	$43,847	$119.77	$5,267	$49,115	$190,276	$177,142
2024	367.1	367.1	0.000	0	$31,955	$4,990	$1,754	$3,326	$42,025	$114.47	$8,524	$50,549	$230,556	$210,070
2025	477.5	477.2	0.310	66	$46,101	$6,635	$1,562	$3,315	$57,614	$120.73	$9,046	$66,660	$281,125	$253,063
2026	477.7	477.4	0.340	74	$48,158	$6,758	$1,594	$3,315	$59,825	$125.32	$9,046	$68,871	$330,996	$295,579
2027	478.0	477.3	0.670	146	$49,252	$6,924	$1,626	$3,315	$61,116	$128.05	$9,046	$70,162	$379,503	$336,945
2028	479.3	478.4	0.950	142	$50,883	$7,078	$1,663	$3,326	$62,950	$131.59	$9,046	$71,996	$427,014	$377,523
2029	478.0	478.0	0.040	21	$54,101	$7,194	$1,691	$3,315	$66,301	$138.71	$9,046	$75,348	$474,449	$418,226
2030	478.7	478.0	0.640	109	$55,300	$7,338	$1,725	$3,315	$67,678	$141.58	$9,046	$76,724	$520,554	$457,796
2031	478.7	478.6	0.170	59	$56,880	$7,495	$1,760	$3,315	$69,449	$145.12	$9,046	$78,496	$565,570	$496,468
2032	480.4	479.0	1.370	183	$58,366	$7,657	$1,800	$3,326	$71,149	$148.54	$9,046	$80,195	$609,462	$534,200
2033	479.0	478.4	0.640	99	$60,178	$7,794	$1,831	$3,315	$73,118	$152.85	$9,046	$82,164	$652,372	$571,129
2034	479.3	478.6	0.700	109	$61,976	$7,949	$1,867	$3,315	$75,108	$156.94	$9,046	$84,154	$694,307	$607,257
2035	479.5	478.1	1.450	163	$63,860	$8,084	$1,905	$3,315	$77,164	$161.41	$9,046	$86,210	$735,294	$642,607
2036	481.3	480.2	1.150	162	$65,615	$8,303	$1,948	$3,326	$79,192	$164.93	$9,046	$88,238	$775,318	$677,158
2037	480.0	478.8	1.120	128	$67,508	$8,431	$1,981	$3,315	$81,235	$169.65	$9,046	$90,281	$814,387	$710,913
2038	480.0	479.6	0.400	83	$68,730	$8,647	$2,021	$3,315	$82,714	$172.46	$9,046	$91,760	$852,278	$743,646
2039	480.3	479.8	0.510	101	$71,057	$8,790	$2,062	$3,315	$85,224	$177.64	$9,046	$94,270	$889,407	$775,766
2040	481.7	481.4	0.270	61	$73,150	$9,001	$2,109	$3,326	$87,586	$181.95	$9,046	$96,632	$925,708	$807,204
2041	480.9	479.6	1.280	179	$74,077	$9,165	$2,145	$3,315	$88,702	$184.95	$4,645	$93,347	$958,455	$837,527
2042	481.4	479.4	2.060	304	$75,812	$9,344	$2,188	$3,315	$90,658	$189.13	$4,342	$95,001	$990,171	$867,043
2043	481.3	480.6	0.720	120	$78,464	$9,536	$2,231	$3,315	$93,547	$194.65	$3,779	$97,325	$1,021,036	$896,049
2044	482.5	481.9	0.630	109	$81,140	$9,733	$2,282	$3,326	$96,482	$200.21	$522	$97,004	**$1,049,776**	**$924,540**

Table A-36 STX High Load Case Plan 2

STX High Load Case Plan 2

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
RICE 7MW LPG	14,257	6	20	07/01/2022	15,205	1,108

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M								
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Power Purch Costs ($1,000)	Total Generation Cost ($1,000)	Total Generation Cost ($/MWh)	Unit Additions Capital Costs ($1,000)	Total System Cost ($1,000)	Present Worth Cost (CPWC) ($1,000)	without Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.400	92	$21,989	$1,131	$2,084	$1,458	$26,662	$101.48	$10,161	$36,823	$109,480	$94,204
2023	263.1	263.1	0.000	0	$18,051	$1,962	$2,333	$1,458	$23,804	$90.46	$12,932	$36,736	$140,553	$113,788
2024	263.8	263.8	0.010	6	$18,358	$2,003	$2,386	$1,463	$24,210	$91.79	$12,932	$37,142	$170,678	$132,757
2025	263.1	263.1	0.010	6	$19,174	$2,036	$2,427	$1,458	$25,095	$95.37	$12,932	$38,027	$200,234	$151,483
2026	263.1	263.1	0.000	0	$20,042	$2,067	$2,476	$1,458	$26,043	$98.97	$12,932	$38,975	$229,257	$169,991
2027	263.1	263.1	0.000	2	$20,600	$2,114	$2,525	$1,458	$26,697	$101.46	$12,932	$39,629	$257,536	$188,061
2028	263.8	263.8	0.030	6	$21,379	$2,157	$2,583	$1,463	$27,582	$104.57	$12,932	$40,514	$285,226	$205,841
2029	263.1	263.1	0.030	7	$22,525	$2,189	$2,627	$1,458	$28,800	$109.46	$12,932	$41,732	$312,530	$223,521
2030	263.1	263.1	0.000	0	$23,054	$2,235	$2,680	$1,458	$29,427	$111.84	$12,932	$42,359	$339,077	$240,726
2031	263.1	263.1	0.000	0	$23,732	$2,269	$2,733	$1,458	$30,193	$114.74	$12,932	$43,125	$364,960	$257,539
2032	263.8	263.8	0.000	0	$24,390	$2,330	$2,796	$1,463	$30,979	$117.44	$12,932	$43,911	$390,195	$273,968
2033	263.1	263.1	0.000	0	$25,085	$2,366	$2,844	$1,458	$31,754	$120.68	$12,932	$44,686	$414,782	$290,005
2034	263.1	263.1	0.000	0	$25,672	$2,434	$2,901	$1,458	$32,465	$123.38	$12,932	$45,397	$438,699	$305,622
2035	263.1	263.1	0.000	0	$26,544	$2,467	$2,959	$1,458	$33,428	$127.04	$12,932	$46,360	$462,072	$320,935
2036	263.8	263.8	0.000	3	$27,285	$2,528	$3,026	$1,463	$34,302	$130.05	$12,932	$47,234	$484,862	$335,901
2037	263.1	263.1	0.000	0	$27,952	$2,576	$3,078	$1,458	$35,065	$133.26	$12,932	$47,997	$507,028	$350,472
2038	263.1	263.1	0.000	0	$28,662	$2,619	$3,140	$1,458	$35,878	$136.35	$12,932	$48,810	$528,601	$364,670
2039	263.1	263.1	0.000	0	$29,387	$2,683	$3,202	$1,458	$36,731	$139.59	$12,932	$49,663	$549,605	$378,513
2040	263.8	263.8	0.000	0	$30,197	$2,736	$3,275	$1,463	$37,671	$142.81	$12,932	$50,603	$570,078	$392,035
2041	263.1	263.1	0.000	2	$30,740	$2,785	$3,332	$1,458	$38,315	$145.61	$6,591	$44,906	$586,616	$405,133
2042	263.1	263.1	0.000	0	$31,497	$2,849	$3,398	$1,458	$39,203	$148.99	$2,771	$41,974	$600,784	$417,896
2043	263.1	263.1	0.000	0	$32,368	$2,897	$3,466	$1,458	$40,190	$152.74	$0	$40,190	$613,245	$430,358
2044	263.8	263.8	0.000	0	$33,375	$2,963	$3,545	$1,463	$41,346	$156.74	$0	$41,346	**$625,455**	**$442,568**

Table A-37 STT High Load Case Plan 3

STT High Load Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	1/1/2021
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
2xRICE 8MW LPG	31,899	6	20	04/01/2024	35,219	2,567
2xRICE 7MW LPG	28,515	6	20	01/01/2021	29,569	2,155
RICE 7MW LPG	14,257	6	20	10/01/2023	15,612	1,138

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.010	6	$34,175	$4,496	$2,139	$3,315	$44,125	$120.53	$4,444	$48,569	$107,328	$103,139
2022	366.1	366.1	0.020	7	$34,799	$4,597	$2,182	$3,315	$44,893	$122.63	$4,444	$49,337	$150,175	$141,919
2023	366.1	366.0	0.110	38	$34,459	$4,730	$2,246	$3,315	$44,750	$122.27	$4,728	$49,478	$191,192	$178,735
2024	367.1	367.1	0.000	1	$32,514	$4,982	$2,023	$3,326	$42,845	$116.71	$7,507	$50,352	$231,238	$212,305
2025	477.3	477.0	0.210	48	$45,753	$6,694	$1,614	$3,315	$57,376	$120.27	$8,149	$65,525	$280,878	$255,120
2026	477.5	477.3	0.200	37	$47,612	$6,831	$1,647	$3,315	$59,405	$124.47	$8,149	$67,554	$329,722	$297,338
2027	477.5	477.1	0.370	81	$49,084	$6,973	$1,680	$3,315	$61,052	$127.96	$8,149	$69,202	$377,478	$338,661
2028	479.0	478.4	0.520	103	$50,623	$7,133	$1,718	$3,326	$62,800	$131.26	$8,149	$70,949	$424,205	$379,142
2029	477.9	477.7	0.170	49	$53,497	$7,262	$1,747	$3,315	$65,821	$137.78	$8,149	$73,970	$470,677	$419,551
2030	478.2	477.8	0.500	108	$55,058	$7,390	$1,782	$3,315	$67,545	$141.38	$8,149	$75,694	$516,056	$459,043
2031	478.4	477.6	0.870	140	$56,541	$7,533	$1,818	$3,315	$69,207	$144.92	$8,149	$77,356	$560,309	$497,580
2032	479.9	478.9	0.990	143	$58,310	$7,703	$1,859	$3,326	$71,199	$148.67	$8,149	$79,348	$603,617	$535,338
2033	478.7	478.0	0.730	118	$59,715	$7,854	$1,891	$3,315	$72,776	$152.26	$8,149	$80,925	$645,761	$572,095
2034	478.9	478.4	0.510	93	$61,833	$8,004	$1,929	$3,315	$75,082	$156.95	$8,149	$83,231	$687,107	$608,211
2035	479.1	478.6	0.520	120	$63,296	$8,178	$1,968	$3,315	$76,758	$160.39	$8,149	$84,907	$727,349	$643,374
2036	480.9	480.2	0.680	129	$65,411	$8,364	$2,013	$3,326	$79,114	$164.76	$8,149	$87,263	$766,797	$677,892
2037	479.7	479.5	0.190	44	$67,136	$8,519	$2,047	$3,315	$81,017	$168.97	$8,149	$89,167	$805,248	$711,556
2038	479.7	479.4	0.280	67	$68,585	$8,698	$2,088	$3,315	$82,686	$172.47	$8,149	$90,836	$842,617	$744,278
2039	479.9	479.6	0.320	70	$70,512	$8,869	$2,130	$3,315	$84,826	$176.87	$8,149	$92,975	$879,099	$776,248
2040	481.4	481.1	0.280	59	$72,661	$9,069	$2,179	$3,326	$87,234	$181.32	$8,149	$95,384	$914,792	$807,560
2041	480.5	479.9	0.570	100	$74,201	$9,223	$2,216	$3,315	$88,955	$185.35	$3,705	$92,660	$947,135	$837,969
2042	480.7	479.5	1.280	221	$75,601	$9,417	$2,260	$3,315	$90,593	$188.95	$3,705	$94,299	$978,507	$867,464
2043	480.9	479.8	1.100	152	$77,575	$9,615	$2,306	$3,315	$92,811	$193.42	$3,421	$96,232	$1,008,968	$896,241
2044	482.2	481.5	0.660	102	$80,326	$9,824	$2,358	$3,326	$95,835	$199.02	$642	$96,476	**$1,037,574**	**$924,542**

Table A-38 STX High Load Case Plan 3

STX High Load Case Plan 3

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 7MW LPG	57,029	6	20	07/01/2022	60,820	4,433
Richmond BS 10/20	18,367	6	20	07/01/2022	19,588	1,428

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
5	6	7	10	9	9	14	20	17	18					
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.2	262.7	0.430	96	$21,034	$1,108	$2,042	$1,458	$25,642	$97.60	$10,321	$35,963	$108,745	$93,323
2023	263.2	263.1	0.030	6	$16,075	$1,918	$2,249	$1,458	$21,701	$82.47	$13,252	$34,952	$138,372	$111,176
2024	263.8	263.8	0.000	2	$16,325	$1,964	$2,300	$1,463	$22,052	$83.59	$13,252	$35,304	$167,081	$128,455
2025	263.2	263.2	0.020	6	$16,976	$2,013	$2,340	$1,458	$22,787	$86.57	$13,252	$36,039	$195,183	$145,459
2026	263.1	263.1	0.000	0	$17,818	$2,024	$2,387	$1,458	$23,687	$90.02	$13,252	$36,938	$222,792	$162,293
2027	263.2	263.2	0.040	23	$18,370	$2,066	$2,435	$1,458	$24,329	$92.44	$13,252	$37,580	$249,719	$178,759
2028	263.9	263.9	0.010	2	$18,966	$2,120	$2,490	$1,463	$25,038	$94.89	$13,252	$38,290	$276,015	$194,899
2029	263.2	263.2	0.000	0	$19,994	$2,150	$2,533	$1,458	$26,135	$99.29	$13,252	$39,386	$301,920	$210,944
2030	263.3	263.3	0.000	0	$20,477	$2,190	$2,584	$1,458	$26,710	$101.46	$13,252	$39,961	$327,110	$226,560
2031	263.3	263.3	0.000	0	$21,017	$2,228	$2,635	$1,458	$27,339	$103.82	$13,252	$40,591	$351,628	$241,784
2032	264.1	264.1	0.000	0	$21,636	$2,278	$2,695	$1,463	$28,073	$106.30	$13,252	$41,325	$375,539	$256,672
2033	263.9	263.9	0.000	0	$22,157	$2,314	$2,742	$1,458	$28,671	$108.67	$13,252	$41,923	$398,781	$271,153
2034	264.3	264.2	0.040	10	$22,668	$2,363	$2,797	$1,458	$29,287	$110.85	$13,252	$42,538	$421,374	$285,240
2035	265.1	265.1	0.000	0	$23,133	$2,403	$2,852	$1,458	$29,847	$112.61	$13,252	$43,099	$443,305	$298,914
2036	266.9	266.9	0.000	0	$23,583	$2,445	$2,917	$1,463	$30,408	$113.93	$13,252	$43,660	$464,590	$312,181
2037	268.3	268.3	0.000	0	$23,559	$2,491	$2,968	$1,458	$30,476	$113.58	$13,252	$43,727	$485,037	$324,844
2038	269.3	269.3	0.000	0	$24,113	$2,495	$3,027	$1,458	$31,093	$115.46	$13,252	$44,345	$504,899	$337,149
2039	269.6	269.6	0.000	0	$24,706	$2,549	$3,088	$1,458	$31,800	$117.95	$13,252	$45,052	$524,221	$349,134
2040	270.3	270.3	0.000	0	$25,522	$2,595	$3,158	$1,463	$32,738	$121.12	$13,252	$45,989	$543,096	$360,885
2041	269.7	269.6	0.100	14	$26,006	$2,647	$3,212	$1,458	$33,324	$123.63	$6,911	$40,235	$558,094	$372,277
2042	269.6	269.6	0.000	0	$26,841	$2,690	$3,277	$1,458	$34,266	$127.08	$2,931	$37,197	$570,735	$383,433
2043	269.6	269.6	0.000	0	$27,509	$2,764	$3,342	$1,458	$35,074	$130.09	$0	$35,074	$581,610	$394,308
2044	270.3	270.3	0.000	0	$28,511	$2,819	$3,418	$1,463	$36,211	$133.97	$0	$36,211	**$592,304**	**$405,001**

Table A-39 STT High Load Case Plan 4

STT High Load Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%

Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STT15	#NUM!
		STT25	12/31/2020
		STT26	12/31/2020
		STT27	12/31/2020

Generation Additions

Unit	2019 Total Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
STT Bovoni Solar	14,326	6	20	01/01/2021	14,856	1,083
STT Donoe Solar PPA	0	6	20	01/01/2021	0	0
RICE 8MW LPG	15,949	6	20	01/01/2021	16,539	1,206
RICE 8MW LPG	15,949	6	20	04/01/2021	16,594	1,210
3xRICE 7MW LPG	42,772	6	20	01/01/2021	44,353	3,233
3xRICE 7MW LPG	42,772	6	20	10/01/2023	46,836	3,414
RICE 7MW LPG	14,257	6	20	04/01/2024	15,741	1,147
RICE 7MW LPG	14,257	6	20	07/01/2024	15,819	1,153
STJ Crus Bay BS	12,288	6	20	10/01/2023	13,456	981

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	New Unit	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	367.1	367.1	0.000	0	$49,105	$3,420	$13,619	$127	$66,272	$180.55	$0	$66,272	$63,116	$63,116
2021	366.1	366.1	0.000	0	$31,295	$4,672	$1,828	$3,315	$41,109	$112.29	$6,429	$47,538	$106,463	$100,403
2022	366.1	366.1	0.020	4	$31,665	$4,781	$1,423	$3,315	$41,184	$112.50	$6,731	$47,915	$148,200	$135,980
2023	366.1	366.1	0.000	0	$31,686	$4,884	$1,514	$3,315	$41,400	$113.08	$7,830	$49,230	$189,216	$170,040
2024	367.1	367.1	0.000	0	$31,673	$5,000	$1,848	$3,326	$41,847	$113.99	$12,563	$54,410	$232,842	$202,828
2025	477.3	477.3	0.000	0	$43,968	$6,748	$1,945	$3,315	$55,976	$117.29	$13,427	$69,403	$285,857	$244,598
2026	477.5	477.5	0.000	0	$45,778	$6,886	$1,984	$3,315	$57,963	$121.40	$13,427	$71,389	$337,967	$285,791
2027	477.5	477.5	0.000	0	$47,333	$7,024	$2,024	$3,315	$59,696	$125.02	$13,427	$73,123	$388,971	$326,196
2028	479.0	479.0	0.000	0	$48,901	$7,187	$2,070	$3,326	$61,484	$128.37	$13,427	$74,910	$438,894	$365,829
2029	477.9	477.9	0.000	0	$51,551	$7,314	$2,105	$3,315	$64,286	$134.52	$13,427	$77,712	$488,351	$405,295
2030	478.2	478.2	0.000	0	$52,788	$7,466	$2,147	$3,315	$65,717	$137.41	$13,427	$79,144	$536,474	$443,718
2031	478.4	478.4	0.000	0	$54,247	$7,619	$2,190	$3,315	$67,372	$140.82	$13,427	$80,799	$583,407	$481,233
2032	479.9	479.9	0.000	0	$55,939	$7,795	$2,240	$3,326	$69,301	$144.41	$13,427	$82,727	$629,301	$517,985
2033	478.7	478.7	0.000	0	$57,444	$7,931	$2,279	$3,315	$70,969	$148.26	$13,427	$84,396	$674,022	$553,829
2034	478.9	478.9	0.000	0	$59,141	$8,093	$2,324	$3,315	$72,874	$152.17	$13,427	$86,301	$717,694	$588,883
2035	479.1	479.1	0.000	0	$60,783	$8,259	$2,371	$3,315	$74,728	$155.98	$13,427	$88,155	$760,295	$623,116
2036	480.9	480.9	0.000	0	$62,751	$8,455	$2,425	$3,326	$76,957	$160.04	$13,427	$90,384	$801,994	$656,692
2037	479.7	479.7	0.000	0	$64,242	$8,603	$2,467	$3,315	$78,627	$163.92	$13,427	$92,054	$842,552	$689,364
2038	479.7	479.7	0.000	0	$65,836	$8,776	$2,516	$3,315	$80,443	$167.69	$13,427	$93,870	$882,043	$721,198
2039	479.9	479.9	0.000	0	$67,535	$8,956	$2,566	$3,315	$82,373	$171.64	$13,427	$95,799	$920,523	$752,243
2040	481.4	481.4	0.000	0	$69,444	$9,163	$2,625	$3,326	$84,558	$175.65	$13,427	$97,984	$958,092	$782,594
2041	480.5	480.5	0.000	0	$70,942	$9,330	$2,670	$3,315	$86,257	$179.51	$6,998	$93,255	$991,231	$812,081
2042	480.7	480.7	0.000	0	$72,768	$9,521	$2,723	$3,315	$88,327	$183.74	$6,696	$95,023	$1,023,380	$840,838
2043	480.9	480.9	0.000	0	$74,673	$9,715	$2,778	$3,315	$90,481	$188.13	$5,597	$96,078	$1,054,189	$868,893
2044	482.2	482.2	0.000	0	$76,795	$9,935	$2,841	$3,326	$92,897	$192.65	$863	$93,761	**$1,082,034**	**$896,326**

Table A-40 STX High Load Case Plan 4

STX High Load Case Plan 4

Financing Parameters		Economic Parameters	
Bond Rate:	3.00%	CPW Discount Rate:	5.00%
IDC Rate:	3.00%	apital Escalation Rate:	2.0%
Bond Issue Fee:	1.00%	Base Year for $	2019
Insurance:	0.5%	General Inflation Rate	2.0%
Fixed Charge Rates (FCR):		Units Retired:	
20 yr FCR:	7.29%	STX19	1/1/2021
		Aggreko	12/31/2021

Generation Additions

Unit	2019 Installed Cost ($1,000)	Construction Period (months)	Financing Life (years)	Date Installed mm/dd/yyyy	Installed Cost ($1,000)	Levelized Cost ($1,000)
Estate Pearl PV 18 MW	45,000	6	20	01/01/2021	46,664	3,402
Hera PV 10 MW	25,000	6	20	01/01/2021	25,924	1,890
Longford Wind 5x3.3M'	27,539	6	20	07/01/2021	28,793	2,099
4xRICE 8MW LPG	63,798	6	20	07/01/2022	68,039	4,960

	Energy Balance				Production Cost								Cumulative	CPWC
						Plant O&M		Power	Total	Total	Unit Additions	Total	Present	without
Year	Load (GWh)	Generation (GWh)	Curtailed Load (GWh)	Loss of Load Hours	Fuel Cost ($1,000)	Variable[1] ($1,000)	Fixed ($1,000)	Purch Costs ($1,000)	Generation Cost ($1,000)	Generation Cost ($/MWh)	Capital Costs ($1,000)	System Cost ($1,000)	Worth Cost (CPWC) ($1,000)	Capital Costs ($1,000)
2020	263.8	263.8	0.000	0	$29,685	$1,790	$10,645	$1,463	$43,583	$165.24	$0	$43,583	$41,508	$41,508
2021	263.1	262.9	0.260	35	$20,162	$1,291	$9,794	$1,458	$32,705	$124.42	$6,341	$39,046	$77,149	$71,172
2022	263.1	262.7	0.380	88	$22,107	$1,118	$2,076	$1,458	$26,759	$101.85	$9,870	$36,629	$109,297	$94,288
2023	263.1	263.1	0.000	0	$18,331	$1,929	$2,317	$1,458	$24,036	$91.35	$12,350	$36,385	$140,044	$114,062
2024	263.8	263.6	0.150	25	$18,586	$1,974	$2,369	$1,463	$24,392	$92.52	$12,350	$36,742	$169,809	$133,174
2025	263.1	263.1	0.020	5	$19,487	$2,002	$2,410	$1,458	$25,357	$96.37	$12,350	$37,707	$199,074	$152,096
2026	263.1	263.1	0.000	0	$20,359	$2,030	$2,458	$1,458	$26,306	$99.97	$12,350	$38,656	$227,811	$170,791
2027	263.1	263.1	0.020	14	$20,937	$2,076	$2,508	$1,458	$26,980	$102.55	$12,350	$39,329	$255,821	$189,052
2028	263.8	263.8	0.000	0	$21,647	$2,134	$2,565	$1,463	$27,809	$105.42	$12,350	$40,159	$283,212	$206,978
2029	263.1	263.1	0.000	2	$22,886	$2,154	$2,609	$1,458	$29,108	$110.63	$12,350	$41,458	$310,271	$224,848
2030	263.1	263.1	0.000	0	$23,317	$2,215	$2,661	$1,458	$29,651	$112.68	$12,350	$42,001	$336,529	$242,184
2031	263.1	263.1	0.000	0	$24,011	$2,246	$2,714	$1,458	$30,429	$115.64	$12,350	$42,779	$362,135	$259,128
2032	263.8	263.8	0.000	1	$24,779	$2,289	$2,776	$1,463	$31,308	$118.68	$12,350	$43,657	$387,147	$275,731
2033	263.1	263.1	0.000	0	$25,436	$2,331	$2,824	$1,458	$32,050	$121.80	$12,350	$44,400	$411,499	$291,919
2034	263.1	263.1	0.000	0	$26,119	$2,387	$2,880	$1,458	$32,846	$124.83	$12,350	$45,195	$435,225	$307,718
2035	263.1	263.1	0.000	0	$26,884	$2,435	$2,938	$1,458	$33,716	$128.13	$12,350	$46,066	$458,367	$323,164
2036	263.8	263.8	0.000	3	$27,727	$2,485	$3,005	$1,463	$34,680	$131.48	$12,350	$47,030	$480,970	$338,294
2037	263.1	263.1	0.020	4	$28,218	$2,556	$3,057	$1,458	$35,290	$134.13	$12,350	$47,640	$502,888	$352,958
2038	263.1	263.1	0.000	0	$29,086	$2,578	$3,118	$1,458	$36,240	$137.73	$12,350	$48,590	$524,272	$367,300
2039	263.1	263.1	0.000	0	$29,767	$2,651	$3,180	$1,458	$37,056	$140.83	$12,350	$49,406	$545,076	$381,266
2040	263.8	263.8	0.000	0	$30,662	$2,689	$3,253	$1,463	$38,067	$144.31	$12,350	$50,417	$565,379	$394,929
2041	263.1	263.1	0.000	3	$31,169	$2,749	$3,309	$1,458	$38,685	$147.02	$6,009	$44,694	$581,739	$408,154
2042	263.1	263.0	0.110	24	$31,876	$2,809	$3,375	$1,458	$39,519	$150.25	$2,480	$41,998	$595,862	$421,020
2043	263.1	263.1	0.000	0	$32,854	$2,844	$3,442	$1,458	$40,599	$154.29	$0	$40,599	$608,450	$433,608
2044	263.8	263.8	0.000	0	$33,746	$2,932	$3,521	$1,463	$41,662	$157.94	$0	$41,662	**$620,753**	**$445,911**