PEAK LOAD SHAVING ANALYSIS FOR YALE NEW HAVEN HOSPITAL

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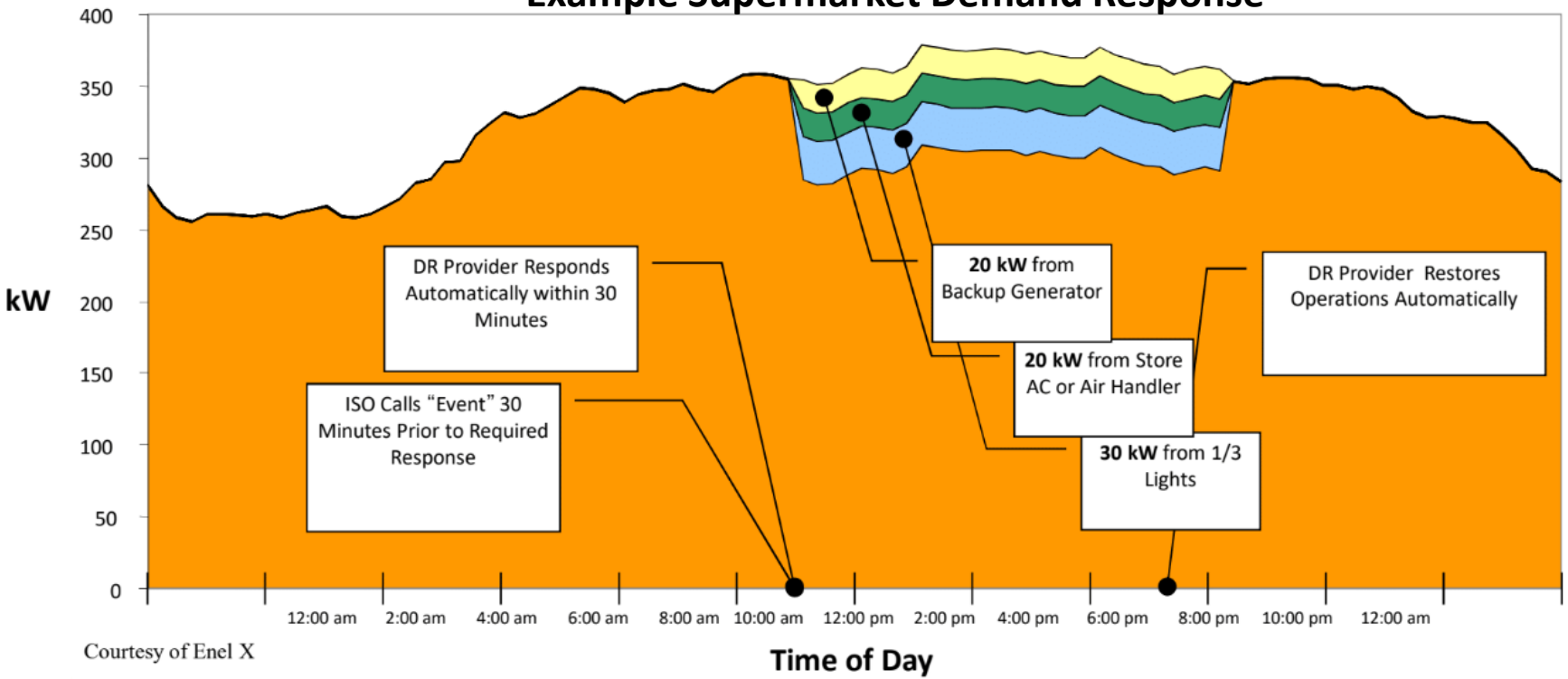
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

DEMAND RESPONSE

- **Reducing** electric usage or **shifting** electricity generation from **grid to on-site generation**
- Increases **reliability** of electric grid
- Motivated by **financial incentives** and **time-based rates**

Example Supermarket Demand Response[1]

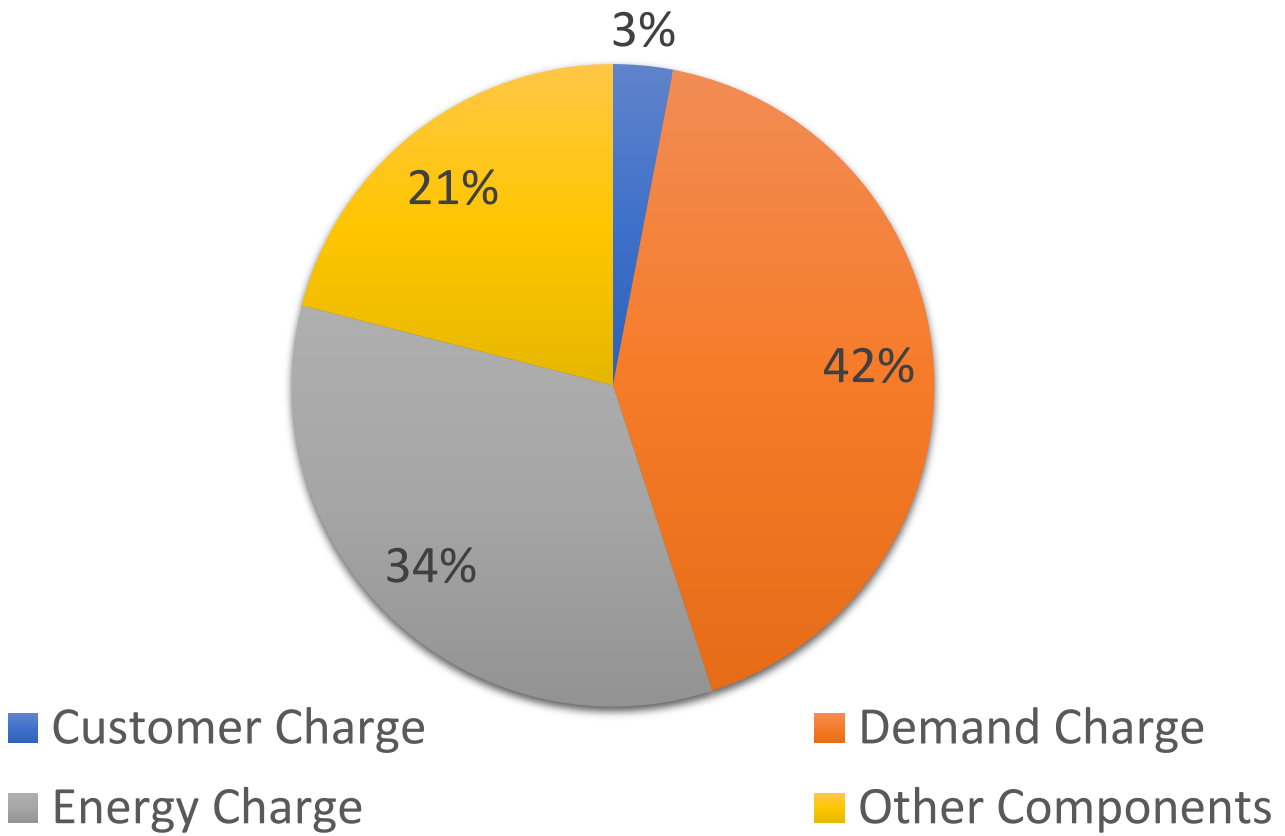


Courtesy of Enel X

ELECTRIC RATE STRUCTURE

- **Electric rate** is a combination of:
  - Ancillary charges
  - Energy charge
  - Customer charge
  - Demand charge

Example Monthly Electric Bill[1]



NATURAL GAS RATE STRUCTURE

- **Natural gas** rate is a combination of:
  - Ancillary charges
  - Customer charge
  - Distribution charge
  - Ratchet rate
- Influences on rate:
  - Weather
  - Economy
  - Drilling activity
  - Foreign/Domestic politics

ARNCILLARY CHARGES

Ancillary **electric charges** include[1]:

- Fuel adjustment charge
- Power factor adjustment
- Voltage level charge
- Capacity cost
- Conservation recovery clause environmental recovery clause
- Solar programs
- Sales Tax

*Independent of energy use

Ancillary **natural gas charges** include[1]:

- Purchased gas adjustment charge
- Conservation cost recovery clause
- Competitive rate adjustment
- Max daily quantity
- Environmental charge
- Franchise fee adjustment gross receipts
- State and city tax
- Gas market charge

RATE STRUCTURE

CUSTOMER CHARGE

- Independent of energy and power
- Cost to provide/read meter, and cover maintenance and operation

DEMAND CHARGE

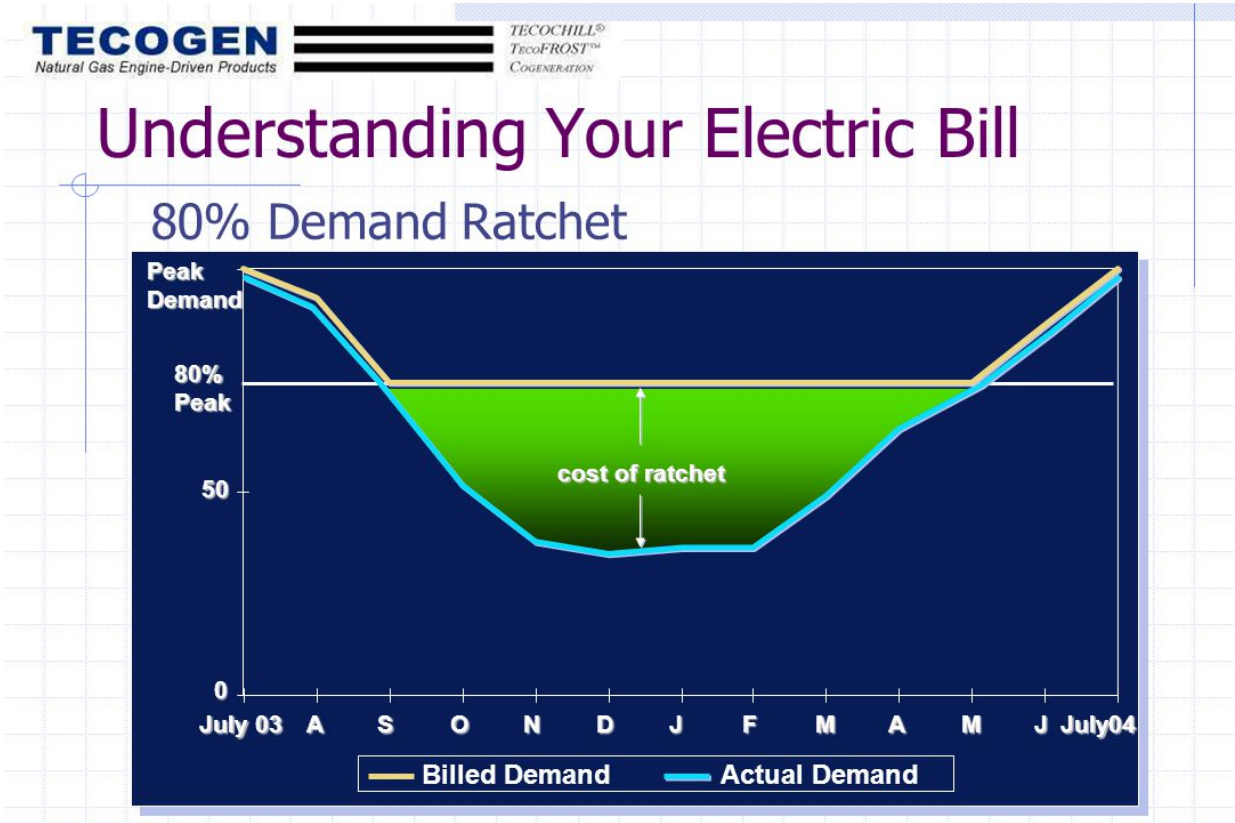
- Cost of electric generation and grid capacity
- Dependent on peak power usage
- Demand window typically 15 minutes
- Units: $/Kw
- Demand can be broken down by:
  - Peak
  - Off-peak
  - Shoulder

ENERGY CHARGE

- Cost of total energy used
- Independent of peak power usage
- Units: $/kWh

DEMAND RATCHET

- ***Ratchet***- The period of time over which demand charge is dependent
- Demand ratchet is the greater of:
  - Current month's peak power usage
  - Set fraction (%) of peak power usage in ratchet



DOE | CHILLER SYSTEM OPTIMIZATION OPPORTUNITIES WITH GAS ENGINE-DRIVEN COOLING SYSTEMS[7]

CASE STUDY: YALE NEW HAVEN HOSPITAL SAINT RAPHAEL CAMPUS

- Motivation:
  - Significant demand charge over 750 kW
  - 12 month long ratchet at 80%
  - Generator required to provide electricity to chiller plant in case of emergency
- Generator options investigated:
  - Tier 2 oil-fired generator
  - Natural gas generator
  - Fuel cell(s)
  - Natural gas turbine(s)

PROJECT VARIABLES

Project Variables	
Process Load (Tons)	200
Minimum Engine Turndown (%)	30%
Generator Consumables ($/kWh)	$ 0.02
Fuel Rate: Diesel ($/gallon)*	$ 2.50
Fuel Rate: Natural Gas ($/1000ft^3)*	$ 0.56
Electric Grid Usage Rate ($/kWh)*	$ 0.06
Summer On-Peak Demand Cost ($/kW)*	$ 28.88
Winter On-Peak Demand Cost ($/kW)*	$ 25.37
Base Demand Cost ($/kW)*	$ 11.35
Capacity Charge (kW-mo)	$ 11.05
Total Pump and Fan Loads (kW/ton)	0.15
Hours Before Engine Overhaul: Diesel	7,000
Engine Overhaul Cost: Diesel	$ 50,000
Hours Before Engine Overhaul: Natural Gas	7,000
Engine Overhaul Cost: Natural Gas	$ 50,000
Electricity Escalation Rate	3%
Demand Escalation Rate	3%
Fuel Oil Escalation Rate	3%
Natural Gas Escalation Rate	3%
Consumables/ Maintenance Escalation Rate	0%
Discount Rate	4.5%
Base Generator Construction Cost[4]	$ 10,017,000
Tier 2 Generator Cost[4]	$ 12,100,000
Diesel Fuel Oil Storage	$ 940,000
Natural Gas Generator Cost[4]	$ 11,540,500
Natural Gas Infrastructure	$ 75,000
Utility Company Allowance	$ 1,500,000

*UTILITY RATES PROVIDED BY YALE NEW HAVEN HOSPITAL

CHILLER PLANT

- 3,000 ton electric chiller plant
- Efficiency modeled as a function of dry-bulb temperature
  - Ranges from 0.15 kW/ton in Winter to 0.75 kW/ton in Summer
- Ancillary equipment rate of 0.15 kW/ton
- Cooling load assumption based on 8,760-hr model
- Assumed no cooling load below 50°F dry-bulb

CHILLER PLANT

Month	ENERGY USAGE PROFILE								
	Total Plant Load (Ton-hrs)	Energy Consumption (kWh)	Average Chiller Plant Efficiency (kW/ton)	On Peak Demand (kWh)	Shoulder Peak Demand (kWh)	Off-Peak Demand (kWh)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)
January	150,347	48,599	0.17	101	101	318	2,158	-	217
February	134,641	42,457	0.16	201	162	101	2,158	-	-
March	194,949	106,378	0.31	1,060	615	713	2,158	-	-
April	276,819	201,869	0.46	1,424	1,309	1,139	2,158	-	-
May	516,468	438,127	0.63	1,853	1,711	1,538	2,158	-	-
June	884,163	779,583	0.69	2,698	2,625	2,530	2,698	-	-
July	1,346,466	1,208,767	0.74	2,599	2,864	2,690	2,599	266	91
August	1,154,754	1,032,425	0.72	2,635	2,534	2,678	2,635	-	43
September	699,882	609,488	0.66	2,264	1,986	2,356	2,264	-	91
October	323,663	245,843	0.51	1,630	2,087	1,969	2,158	457	339
November	181,272	100,660	0.34	845	432	921	2,158	-	76
December	148,800	46,946	0.16	121	101	101	2,158	-	-
Totals	6,012,223	4,861,143	0.46	n/a	n/a	n/a	n/a	n/a	n/a

BASE OPTION: ELECTRICITY ONLY

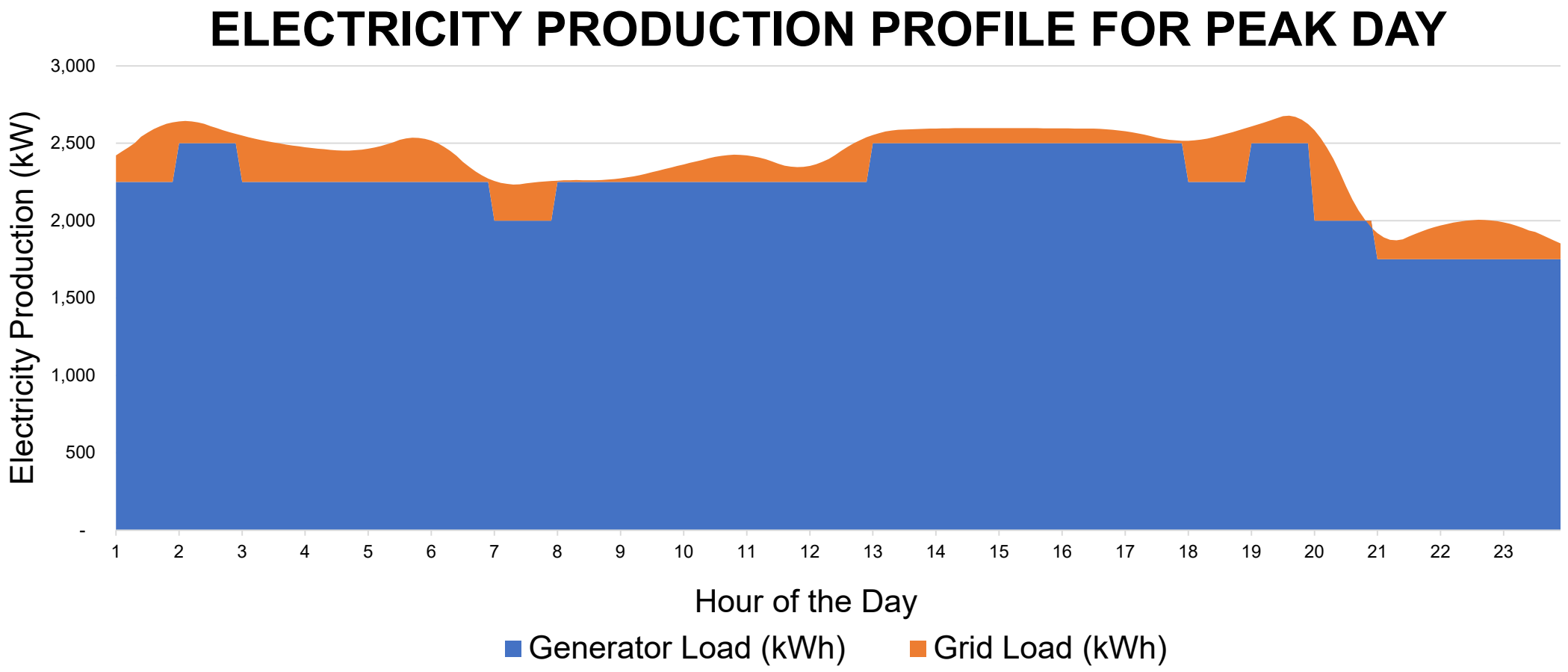
- All electricity purchased from utility provider
- Emergency generator still required by code
- Will not shave peak demand
- >50% ($750,000) annual cost due to demand charge

BASE OPTION: GRID ELECTRICITY ONLY										
Grid Electricity Consumption (kWh)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)	Grid Electricity Consumption Cost	Billed On-Peak Demand Cost	Billed Shoulder Peak Demand Cost	Billed Off-Peak Demand Cost	Grid Electricity Demand Cost	Capacity Charge	Total Grid Electricity Cost
48,599	2,158	-	217	$ 2,683	$ 54,754	$ -	$ 2,468	$ 57,221	$ 31,652	$ 91,556
42,457	2,158	-	-	$ 2,344	$ 54,754	$ -	$ -	$ 54,754	$ 31,652	$ 88,749
106,378	2,158	-	-	$ 5,872	$ 54,754	$ -	$ -	$ 54,754	$ 31,652	$ 92,277
201,869	2,158	-	-	$ 11,143	$ 54,754	$ -	$ -	$ 54,754	$ 31,652	$ 97,548
438,127	2,158	-	-	$ 24,184	$ 54,754	$ -	$ -	$ 54,754	$ 31,652	$ 110,590
779,583	2,698	-	-	$ 43,032	$ 77,911	$ -	$ -	$ 77,911	$ 31,652	$ 152,595
1,208,767	2,599	266	91	$ 66,723	$ 75,055	$ 3,014	$ 1,033	$ 79,102	$ 31,652	$ 177,476
1,032,425	2,635	-	43	$ 56,989	$ 76,096	$ -	$ 490	$ 76,587	$ 31,652	$ 165,228
609,488	2,264	-	91	$ 33,643	$ 65,389	$ -	$ 1,037	$ 66,426	$ 31,652	$ 131,721
245,843	2,158	457	339	$ 13,570	$ 54,754	$ 5,187	$ 3,844	$ 63,784	$ 31,652	$ 109,006
100,660	2,158	-	76	$ 5,556	$ 54,754	$ -	$ 863	$ 55,616	$ 31,652	$ 92,825
46,946	2,158	-	-	$ 2,591	$ 54,754	$ -	$ -	$ 54,754	$ 31,652	$ 88,997
4,861,143	n/a	n/a	n/a	$ 268,330	$ 732,479	$ 8,201	$ 9,734	$ 750,415	$ 379,822	$ 1,398,567

Option 1: TIER 2 DEISEL GENERATOR

- 2,500 kW PACKAGED GENSET
- Model: GTB6251BN-48T-1.24[2]
- External Selective Catalytic Reduction (SCR) and diesel filtration required
- Generator is follows electric usage in stages
- Generator cannot run below 30% of max load to avoid wet stacking
- Purchased electricity load follows
- Tier 4 generator does not meet the particulate matter emission requirements for distributed generation per Sec. 22a-174-42b-1D of Regulations of Connecticut State Agencies[3]

Option 1: TIER 2 DEISEL GENERATOR



Option 1: TIER 2 DEISEL GENERATOR

Month	GENERATOR OPTION 1: OPTIMIZE GENERATOR OPERATION (DIESEL)													GENERATOR OPTION 1: OPTIMIZE GENERATOR OPERATION (DIESEL)								Annual Energy Cost Savings
	Grid Electricity Consumption (kWh)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)	Grid Electricity Consumption Cost	Billed On-Peak Demand Cost	Billed Shoulder Peak Demand Cost	Billed Off-Peak Demand Cost	Capacity Charge	Grid Electricity Demand Cost	Electricity Produced by Generator (kWh)	Oil Consumption (gal)	Oil Cost	Generator Overhaul Cost	Overhead and Maintenance Cost	Total Grid Electricity Cost	Total Generator Cost	Total Energy Cost	
January	48,599	101	101	318	695	-	217	$ 2,683	$ 17,626	$ -	$ 2,468	$ 9,794	$ 20,094	-	-	$ -	$ 1,359	$ -	$ 32,570	$ 1,359	$ 33,929	$ 57,627
February	42,457	201	162	101	695	-	-	$ 2,344	$ 17,626	$ -	$ -	$ 9,794	$ 17,626	-	-	$ -	$ 1,227	$ -	$ 29,763	$ 1,227	$ 30,991	$ 57,758
March	100,628	775	615	713	775	-	-	$ 5,555	$ 19,667	$ -	$ -	$ 9,794	$ 19,667	5,750	564	$ 1,411	$ 1,359	$ 115	$ 35,015	$ 2,885	$ 37,900	$ 54,378
April	144,369	868	721	862	868	-	-	$ 7,969	$ 22,033	$ -	$ -	$ 9,794	$ 22,033	57,500	5,352	$ 13,379	$ 1,315	$ 1,150	$ 39,796	$ 15,844	$ 55,639	$ 41,909
May	185,127	776	757	764	776	-	-	$ 10,219	$ 19,682	$ -	$ -	$ 9,794	$ 19,682	253,000	22,915	$ 57,287	$ 1,359	$ 5,060	$ 39,695	$ 63,706	$ 103,401	$ 7,189
June	168,833	736	748	783	736	12	47	$ 9,319	$ 21,256	$ 131	$ 534	$ 9,794	$ 21,921	610,750	50,072	$ 125,180	$ 1,315	$ 12,215	$ 41,034	$ 138,710	$ 179,744	$ (27,149)
July	121,767	250	743	781	695	494	287	$ 6,721	$ 20,065	$ 5,602	$ 3,258	$ 9,794	$ 28,925	1,087,000	85,337	$ 213,341	$ 1,359	$ 21,740	$ 45,440	$ 236,440	$ 281,880	$ (104,404)
August	135,675	675	886	788	695	211	113	$ 7,489	$ 20,065	$ 2,398	$ 1,284	$ 9,794	$ 23,747	896,750	71,955	$ 179,888	$ 1,359	$ 17,935	$ 41,029	$ 199,182	$ 240,211	$ (74,984)
September	166,738	757	829	760	757	72	3	$ 9,204	$ 21,867	$ 821	$ 32	$ 9,794	$ 22,720	442,750	37,407	$ 93,517	$ 1,315	$ 8,855	$ 41,717	$ 103,687	$ 145,404	$ (13,683)
October	155,843	735	656	761	735	-	26	$ 8,602	$ 18,648	$ -	$ 290	$ 9,794	$ 18,938	90,000	7,937	$ 19,844	$ 1,359	$ 1,800	$ 37,334	$ 23,002	$ 60,336	$ 48,670
November	96,910	845	432	656	845	-	-	$ 5,349	$ 21,436	$ -	$ -	$ 9,794	$ 21,436	3,750	382	$ 956	$ 1,315	$ 75	$ 36,579	$ 2,346	$ 38,925	$ 53,899
December	46,946	121	101	101	695	-	-	$ 2,591	$ 17,626	$ -	$ -	$ 9,794	$ 17,626	-	-	$ -	$ 1,359	$ -	$ 30,011	$ 1,359	$ 31,370	$ 57,627
Totals	1,413,893	n/a	n/a	n/a	n/a	n/a	n/a	$ 78,046	$ 237,598	$ 8,952	$ 7,865	$ 117,523	$ 254,415	3,447,250	281,921	$ 704,803	$ 16,000	$ 68,945	$ 449,984	$ 789,748	$ 1,239,731	**$ 158,836**

ANNUAL ENERGY COST SAVINGS: **$160,000**

Option 2: NATURAL GAS GENERATOR

- 2,500 kW generator
- Model: G3520[3]
- External Selective Catalytic Reduction (SCR) Generator is follows electric usage in stages
- Generator cannot run below 30% of max load to avoid wet stacking
- Purchased electricity load follows

Option 2: NATURAL GAS GENERATOR

Month	GENERATOR OPTION 2: OPTIMIZE GENERATOR OPERATION (NATURAL GAS)													GENERATOR OPTION 2: OPTIMIZE GENERATOR OPERATION (NATURAL GAS)									Annual Energy Cost Savings
	Grid Electricity Consumption (kWh)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)	Billed On-Peak Demand (kW)	Billed Shoulder Peak Demand (kW)	Billed Off-Peak Demand (kW)	Grid Electricity Consumption Cost	Billed On-Peak Demand Cost	Billed Shoulder Peak Demand Cost	Billed Off-Peak Demand Cost	Grid Electricity Demand Cost	Capacity Charge	Electricity Produced by Generator (kWh)	Natural Gas Maximum Daily Demand (kWh)	Natural Gas Cost	Natural Gas Demand Cost	Generator Overhaul Cost	Overhead and Maintenance Cost	Total Grid Electricity Cost	Total Generator Cost	Total Energy Cost	
January	48,599	101	101	318	695	-	217	$ 2,683	$ 17,626	$ -	$ 2,468	$ 20,094	$ 9,794	-	-	$ -	$ -	$ 1,359	$ -	$ 32,570	$ 1,359	$ 33,929	$ 57,627
February	42,457	201	162	101	695	-	-	$ 2,344	$ 17,626	$ -	$ -	$ 17,626	$ 9,794	-	-	$ -	$ -	$ 1,227	$ -	$ 29,763	$ 1,227	$ 30,991	$ 57,758
March	100,628	775	615	713	775	-	-	$ 5,555	$ 19,667	$ -	$ -	$ 19,667	$ 9,794	5,750	676	$ 378	$ 4,085	$ 1,359	$ 115	$ 35,015	$ 5,938	$ 40,952	$ 51,325
April	144,369	868	721	862	868	-	-	$ 7,969	$ 22,033	$ -	$ -	$ 22,033	$ 9,794	57,500	1,461	$ 3,697	$ 8,836	$ 1,315	$ 1,150	$ 39,796	$ 14,997	$ 54,793	$ 42,755
May	185,127	776	757	764	776	-	-	$ 10,219	$ 19,682	$ -	$ -	$ 19,682	$ 9,794	253,000	2,585	$ 16,077	$ 15,627	$ 1,359	$ 5,060	$ 39,695	$ 38,123	$ 77,818	$ 32,772
June	168,833	736	748	783	736	12	47	$ 9,319	$ 21,256	$ 131	$ 534	$ 21,921	$ 9,794	610,750	4,948	$ 37,249	$ 29,917	$ 1,315	$ 12,215	$ 41,034	$ 80,696	$ 121,730	$ 30,866
July	121,767	250	743	781	695	494	287	$ 6,721	$ 20,065	$ 5,602	$ 3,258	$ 28,925	$ 9,794	1,087,000	5,671	$ 65,169	$ 34,290	$ 1,359	$ 21,740	$ 45,440	$ 122,558	$ 167,998	$ 9,478
August	135,675	675	886	788	695	211	113	$ 7,489	$ 20,065	$ 2,398	$ 1,284	$ 23,747	$ 9,794	896,750	5,213	$ 54,226	$ 31,520	$ 1,359	$ 17,935	$ 41,029	$ 105,040	$ 146,069	$ 19,158
September	166,738	757	829	760	757	72	3	$ 9,204	$ 21,867	$ 821	$ 32	$ 22,720	$ 9,794	442,750	4,466	$ 27,332	$ 27,001	$ 1,315	$ 8,855	$ 41,717	$ 64,504	$ 106,221	$ 25,500
October	155,843	735	656	761	735	-	26	$ 8,602	$ 18,648	$ -	$ 290	$ 18,938	$ 9,794	90,000	2,705	$ 5,655	$ 16,356	$ 1,359	$ 1,800	$ 37,334	$ 25,170	$ 62,504	$ 46,502
November	96,910	845	432	656	845	-	-	$ 5,349	$ 21,436	$ -	$ -	$ 21,436	$ 9,794	3,750	448	$ 251	$ 2,710	$ 1,315	$ 75	$ 36,579	$ 4,351	$ 40,930	$ 51,894
December	46,946	121	101	101	695	-	-	$ 2,591	$ 17,626	$ -	$ -	$ 17,626	$ 9,794	-	-	$ -	$ -	$ 1,359	$ -	$ 30,011	$ 1,359	$ 31,370	$ 57,627
Totals	1,413,893	n/a	n/a	n/a	n/a	n/a	n/a	$ 78,046	$ 237,598	$ 8,952	$ 7,865	$ 254,415	$ 117,523	3,447,250	n/a	$ 210,034	$ 170,343	$ 16,000	$ 68,945	$ 449,984	$ 465,322	$ 915,306	**$ 483,262**

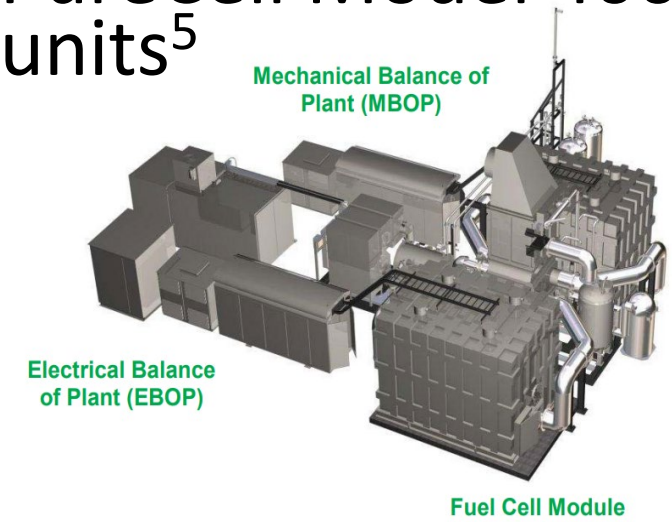
ANNUAL ENERGY COST SAVINGS: **$480,000**

Option 3: FUEL CELLS

- Two 1.4MW *FuelCell Energy* fuel cells[4]

OR

- Five 460kW DOOSAN PureCell Model 400 units[5]

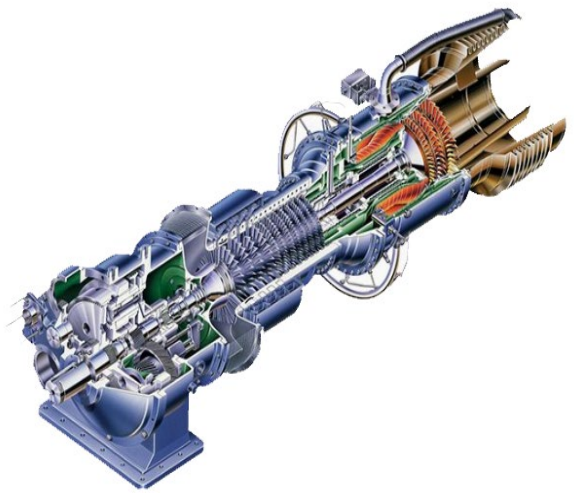


Fuel Cell

- **48hr full load start** time
- **Not viable for emergency power**
- Size constraints
  - 43’x70’ footprint
  - ~350,000lbs
- **Limited turndown** capability
- Cannot load follow

Option 4: NATURAL GAS TURBINES

- Two *Solar Turbine Saturn 20* gas natural gas turbine generator sets[6] 1,210kW each



Gas Fired Turbine

- Required post-purge and pre-purge upon restart **exceeds demand window**
- **Footprint** of turbines and maintenance units exceeds size constraints

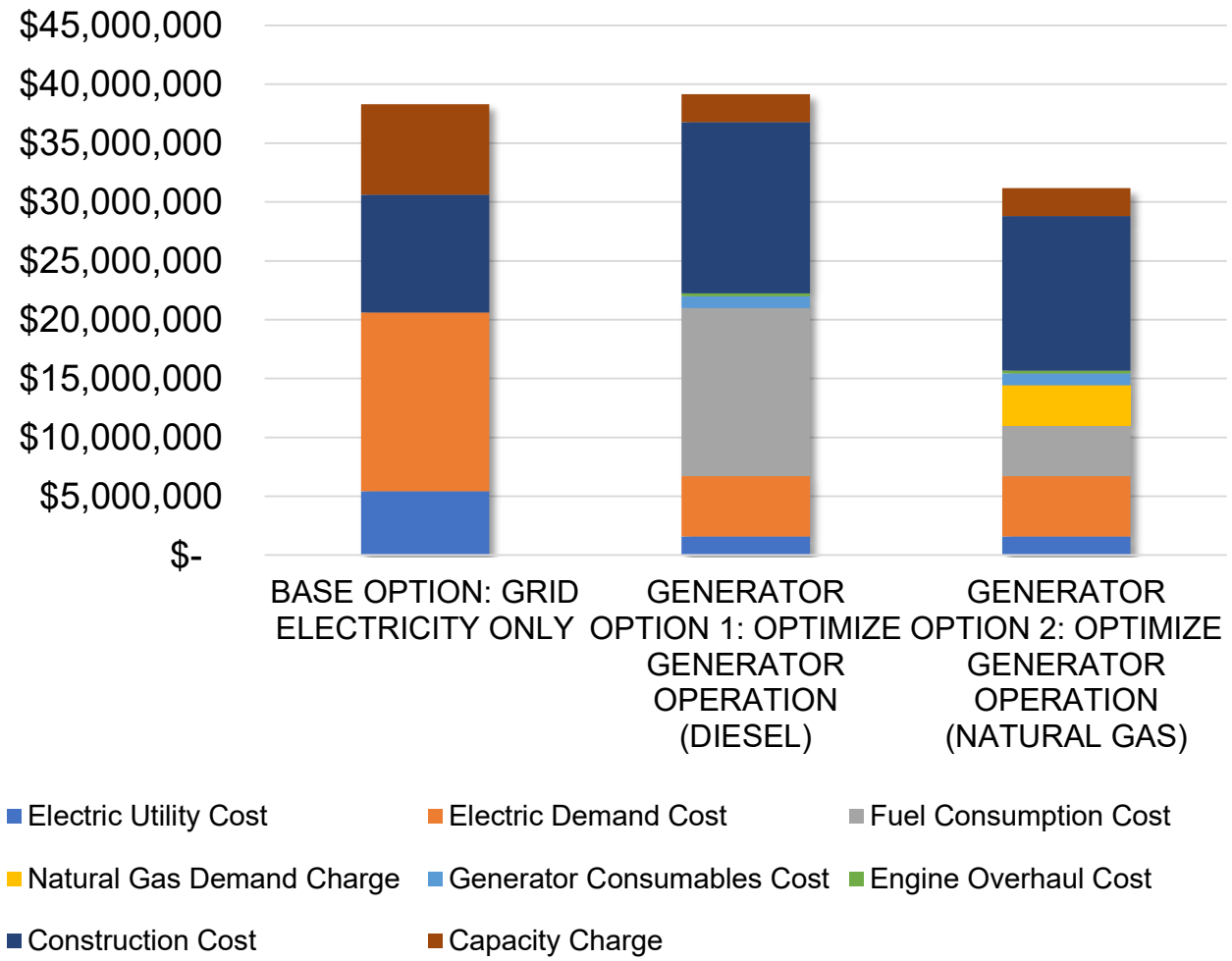
SUMMARY OF RESULTS

Net Present Cost	BASE OPTION: GRID ELECTRICITY ONLY	GENERATOR OPTION 1: OPTIMIZE GENERATOR OPERATION (DIESEL)	GENERATOR OPTION 2: OPTIMIZE GENERATOR OPERATION (NATURAL GAS)
Electric Utility Cost	$ 5,426,282	$ 1,578,268	$ 1,578,268
Electric Demand Cost	$ 15,175,184	$ 5,144,887	$ 5,144,887
Capacity Charge	$ 7,680,918	$ 2,376,593	$ 2,376,593
Fuel Consumption Cost		$ 14,252,799	$ 4,247,391
Natural Gas Demand Charge			$ 3,444,746
Generator Consumables Cost		$ 1,022,331	$ 1,022,331
Engine Overhaul Cost		$ 237,251	$ 237,251
Construction Cost	$ 10,017,000	$ 14,540,000	$ 13,115,500
Total Cost	$ 38,299,384	$ 39,152,128	$ 31,166,966

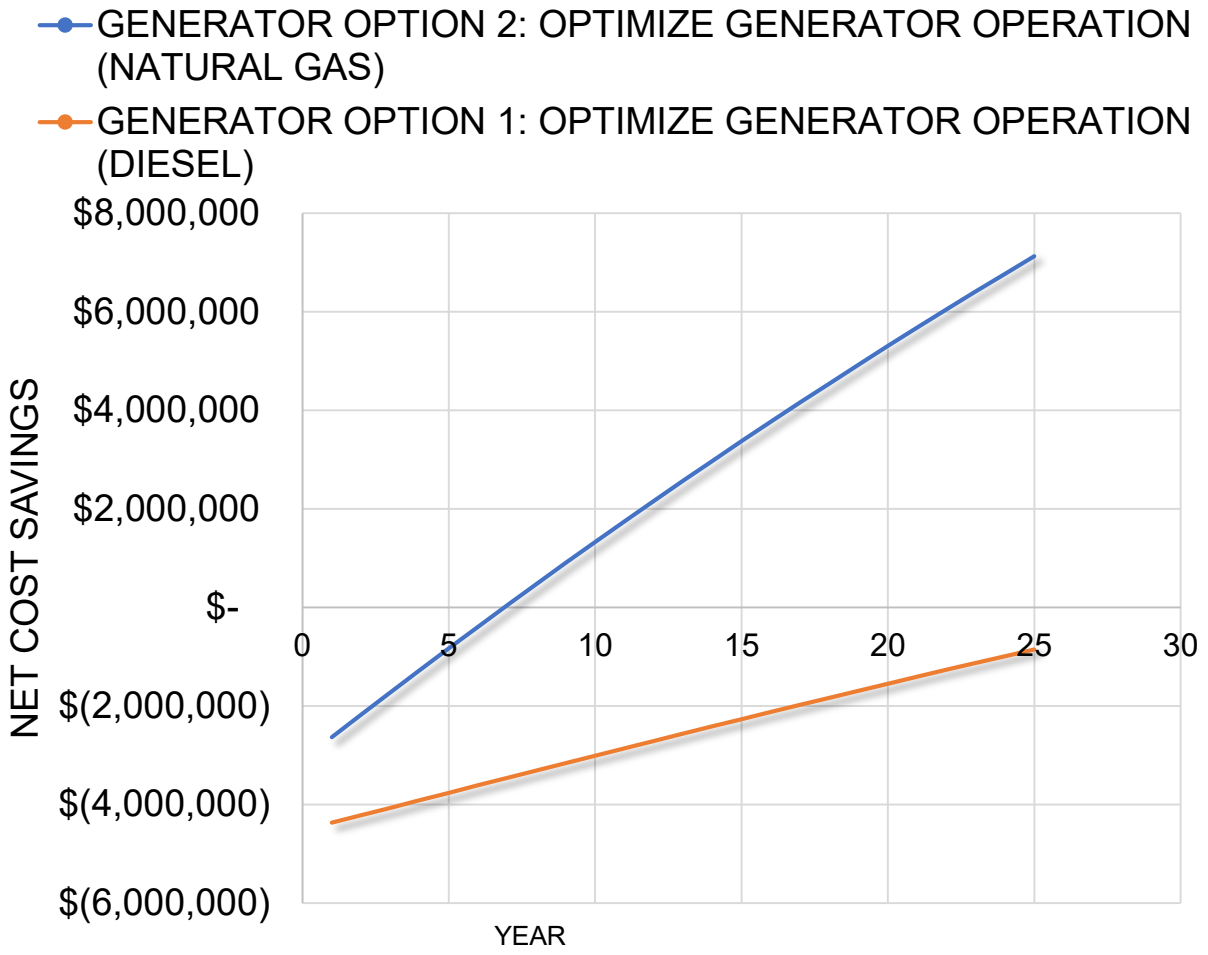
Month	MONTHLY COST COMPARISON				
	Baseline Cost	Option 1 Cost	Option 2 Cost	Option 1 Savings	Option 2 Savings
January	$ 91,600	$ 33,900	$ 33,900	$ 57,700	$ 57,700
February	$ 88,700	$ 31,000	$ 31,000	$ 57,700	$ 57,700
March	$ 92,300	$ 37,900	$ 41,000	$ 54,400	$ 51,300
April	$ 97,500	$ 55,600	$ 54,800	$ 41,900	$ 42,700
May	$ 110,600	$ 103,400	$ 77,800	$ 7,200	$ 32,800
June	$ 152,600	$ 179,700	$ 121,700	$ (27,100)	$ 30,900
July	$ 177,500	$ 281,900	$ 168,000	$ (104,400)	$ 9,500
August	$ 165,200	$ 240,200	$ 146,100	$ (75,000)	$ 19,100
September	$ 131,700	$ 145,400	$ 106,200	$ (13,700)	$ 25,500
October	$ 109,000	$ 60,300	$ 62,500	$ 48,700	$ 46,500
November	$ 92,800	$ 38,900	$ 40,900	$ 53,900	$ 51,900
December	$ 89,000	$ 31,400	$ 31,400	$ 57,600	$ 57,600
Totals	$ 1,398,600	$ 1,239,700	$ 915,300	$ 158,900	$ 483,300

LIFE-CYCLE COST ANALYSIS

RELATIVE 25-YEAR NET PRESENT COST



NET PRESENT COST SAVINGS OVER TIME



EMISSIONS ANALYSIS

- There is an expected ~20% reduction in total CO2e emissions by moving to a natural gas generator from the baseline option

CO2e EMISSIONS COMPARISON*					
Option	Electricity Use (kWh/yr)	Diesel Energy Use (kWh/yr)	Natural Gas Energy Use (kWh/yr)	Total Energy Use (kWh/yr)	CO2e (Metric Ton)
BASE OPTION	4,861,143	-	-	4,861,143	1,242.9
GENERATOR OPTION 1: DIESEL	1,413,893	3,447,250	-	4,861,143	1,243.4
GENERATOR OPTION 2: NATURAL GAS	1,413,893	-	3,447,250	4,861,143	986.3

*CO2e compared using 'Energy Star: *Portfolio Manager*'[12]

CoGEN SYSTEM ANALYSIS

	Temp. (°F)
Diesel Generator[1]	
Aftercooler Temperature	115
Jacket Water Temperature	210
Exhaust Manifold Temperature	1,126
Engine Outlet Temperature	850
Natural Gas Generator[2]	
Compressor Out Temperature	396
Aftercooler Air Out Temperature	159
Exhaust Stack Temperature	952
Two (2) 1.4MW Fuel Cells[8]	
Exhaust Temperature	700
Saturn 20 Natural Gas Turbine[9]	
Ehaust Temperature	940

	Btu/min
Diesel Generator[1]	
Heat Rejection to Jacket Water	78,075
Heat Rejection to Atmosphere	9,978
Heat Rejection to Exhaust	176,964
Exhaust Recovery (to 350°F)	92,438
Heat from Oil Cooler	23,866
Heat from Aftercooler - Stage 2	21,574
Work Energy	185,557
Natural Gas Generator[2]	
Heat Rejection to Jacket	36,866
Heat Rejection to Atmosphere	9,775
Heat Rejection to Lube Oil	8,169
Heat Rejection to Exhaust (LHV to 77°F)	115,056
Heat Rejection to Exhaust (LHV to 350°F)	74,664
Heat Rejection to A/C - Stage 1	21,035
Heat Rejection to A/C - Stage 2	6,912
Two (2) 1.4MW Fuel Cells[8]	
Heat Available for Recovery (to 250°F)	73,883
Heat Available for Recovery (to 120°F)	124,333
Six (6) 460kW Fuel Cells	
High Grade Heat Output (to 250°F)	72,000
Low Grade Heat Output (to 140°F)	103,000
Saturn 20 Natural Gas Turbine[9]	
Heat Rate	565,675

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[3] *Gas Engine Technical Data*, Natural Gas Model: G3520, 2012.

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[5] PureCell Model 400, DOOSAN, 2018.

[6] PureCell Model 400, DOOSAN, 2018.

[7] *Chiller System Optimization*, DOE, 2020.

QUESTIONS?

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