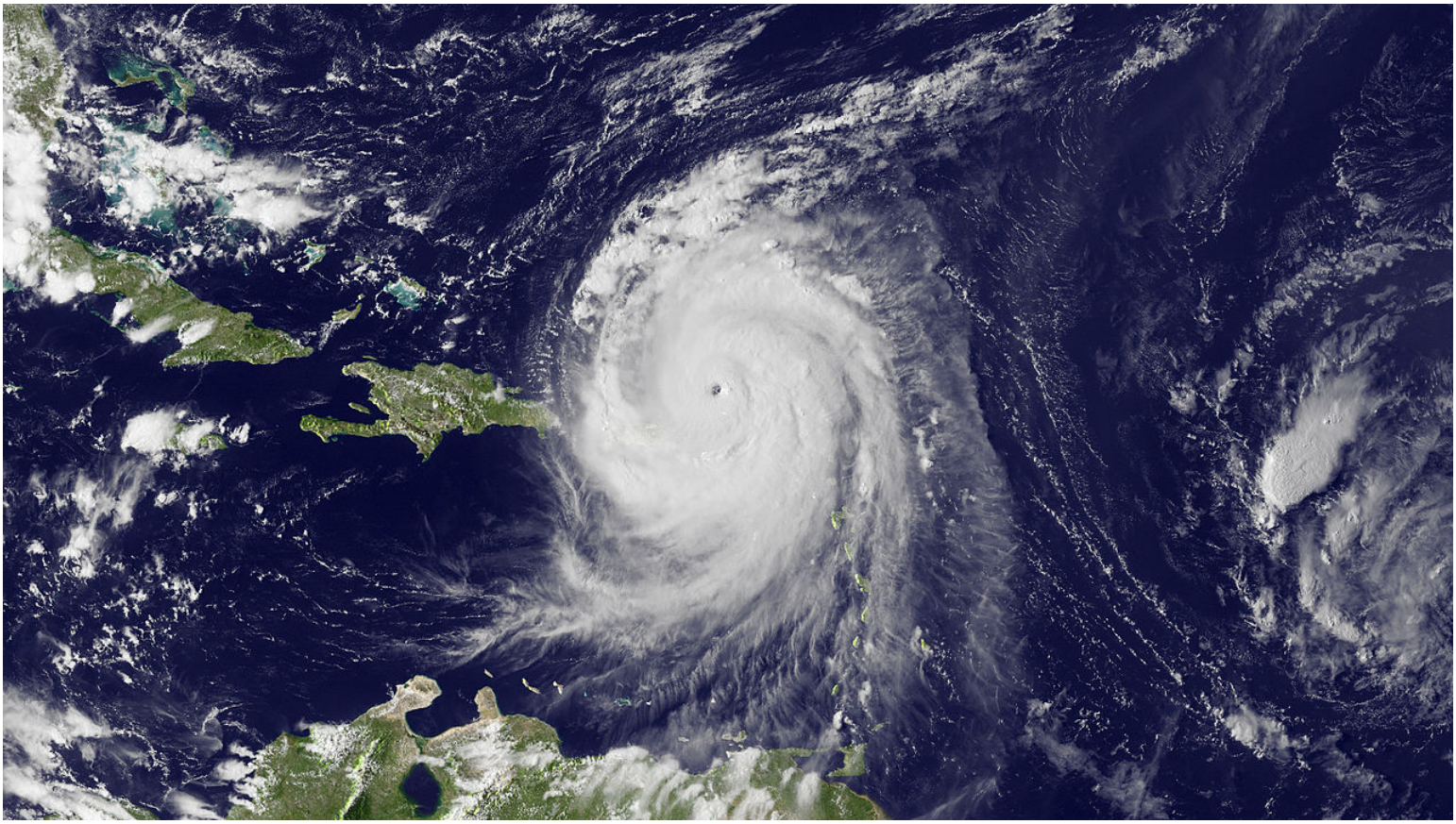
Island of Amerigo

HURRICANE OLIS

The Island of Amerigo and Hurricane Olis

Hurricane Olis was a Category 5 hurricane that devastated Dominica, Amerigo, and Puerto Rico in September 2021. Fueled by a warming Atlantic, Olis was the fifteenth named storm and third Category 5 hurricane of the hyperactive 2021 Atlantic hurricane season. At its peak, the hurricane caused catastrophic destruction and numerous fatalities across the Caribbean, compounding recovery efforts in the areas of the Leeward Islands already struck by previous hurricanes of the season. Total losses from the hurricane are estimated at upwards of $100-billion ranking it as one of the costliest tropical cyclones on record.

Hurricane Olis wrought catastrophic devastation to the entirety of Amerigo, which suffered an island-wide communication and power blackout. The island endured widespread flooding, damaged roofs, and uprooted trees. The storm caused the worst electrical blackout in the island's history.



Island of Amerigo

ENERGY

50,601
Population

82 square miles
Total Area

5 MW solar PV
Current renewable energy installed

AESPHDS
Gov't Agencies focused on energy

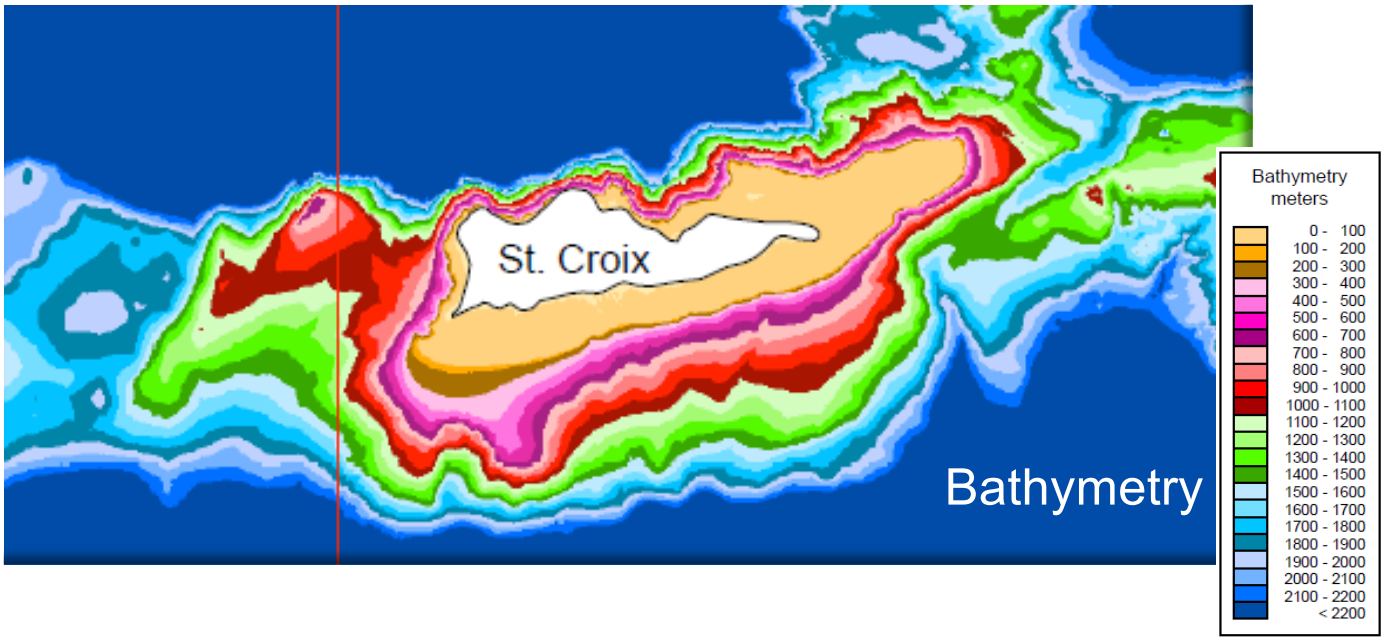
ADWP
Utility

75 MW
Installed Capacity (Diesel)

55 MW, 366 GWh
Peak Demand, Annual Electricity Use

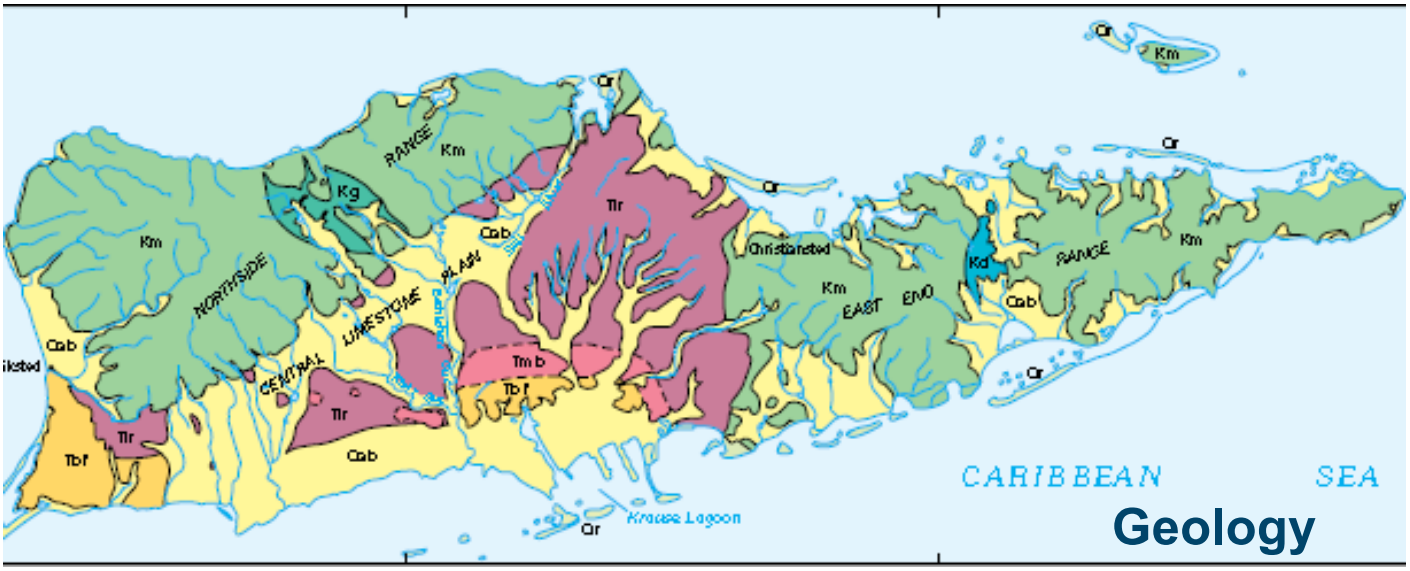
Island of Amerigo

TERRAIN & TOPOLOGY



Island of Amerigo

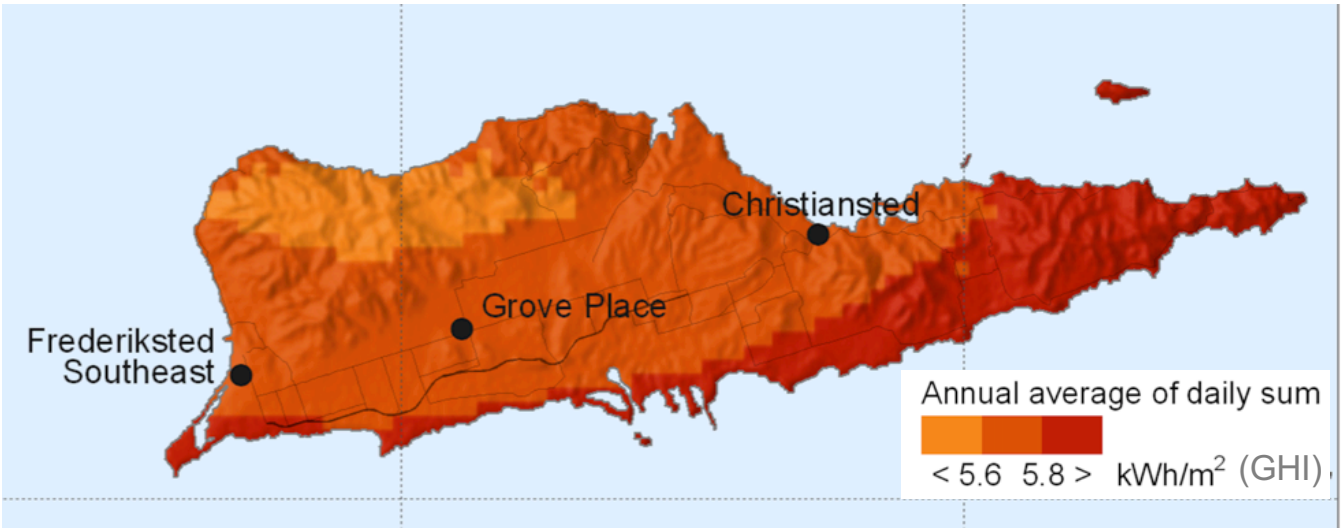
GEOLOGY



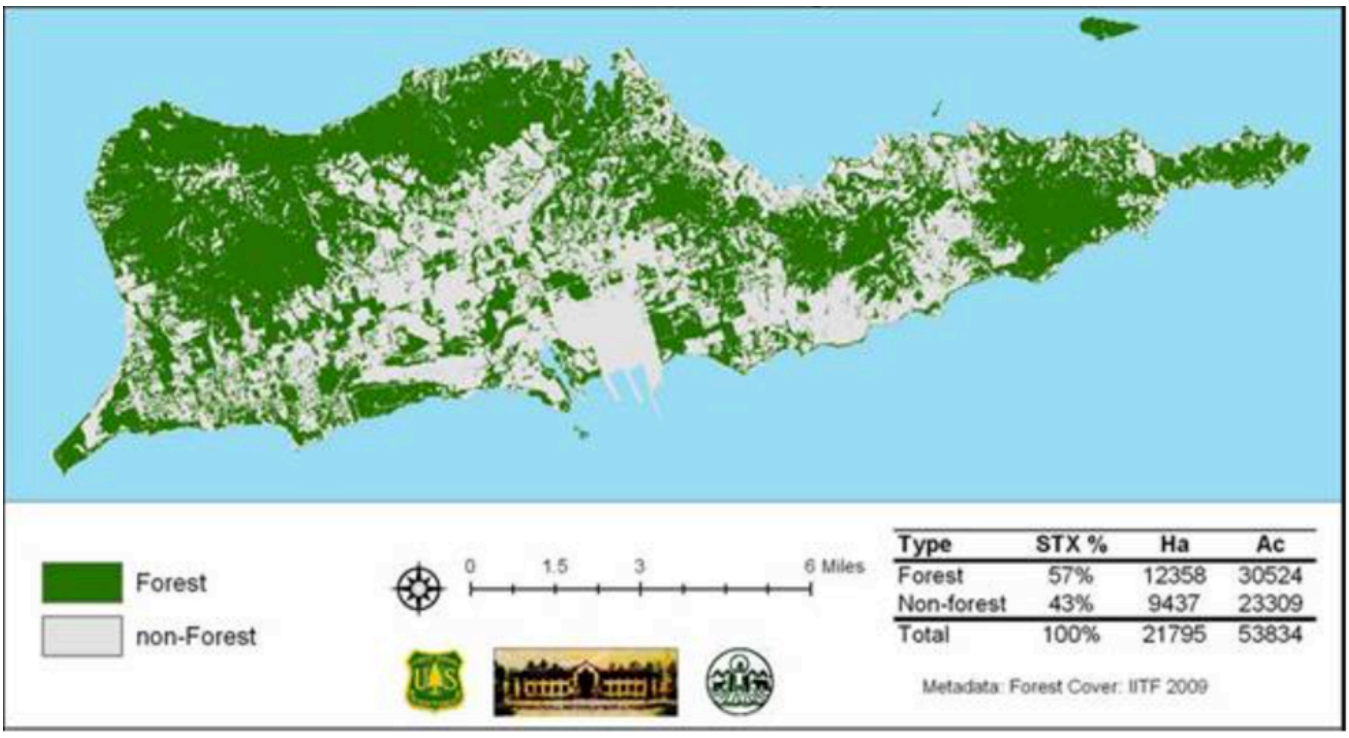
Km is the Cretaceous Mt. Eagle Group,
Kd is Cretaceous diorite,
Kg is Cretaceous gabbro,
Tbf is the Pliocene Blessing Formation,
Tmb and Tlr are
the Miocene Kingshall Limestone,
Qab is Quaternary alluvium, and
Qr is Quaternary reef.

Island of Amerigo

RENEWABLE ENERGY RESOURCES



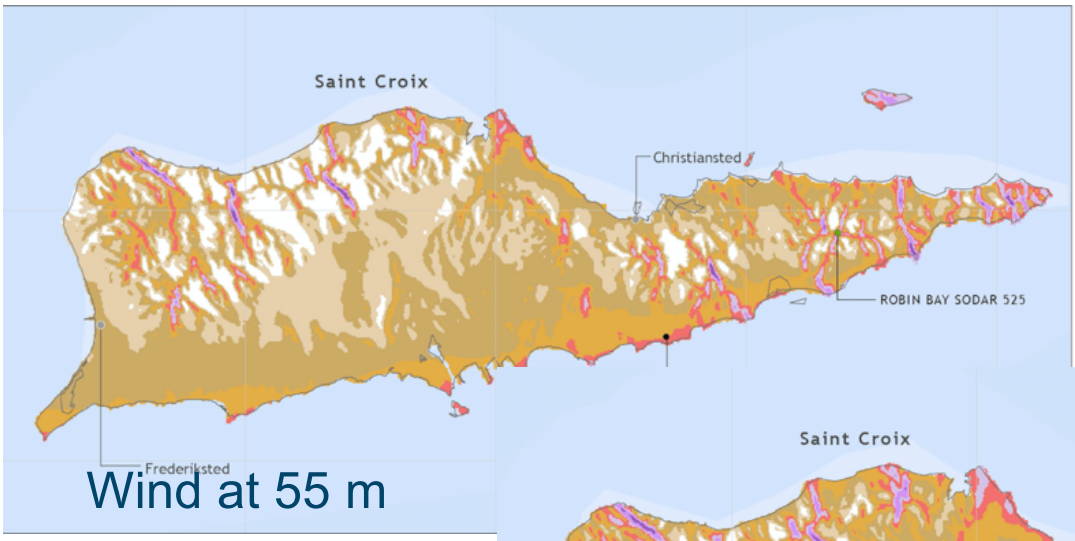
Solar Resource

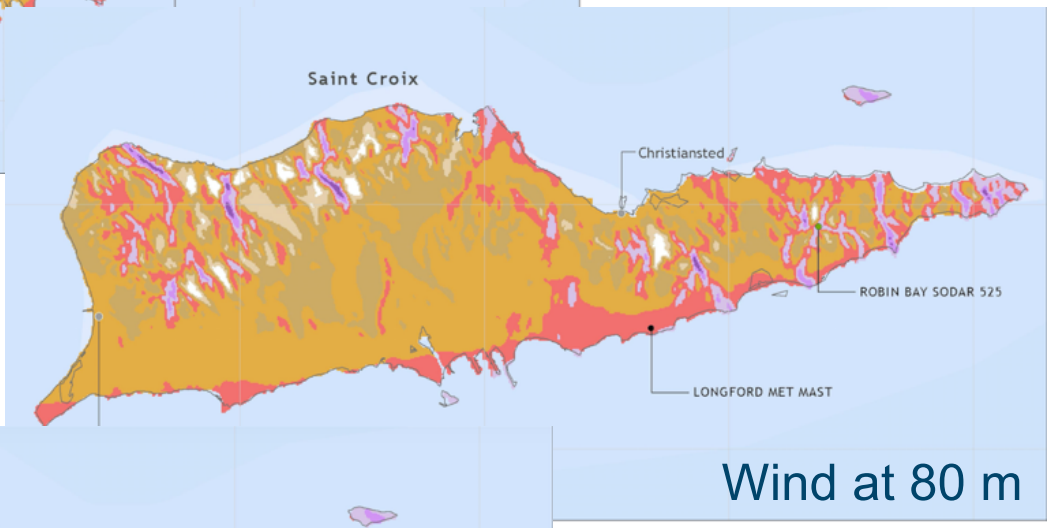


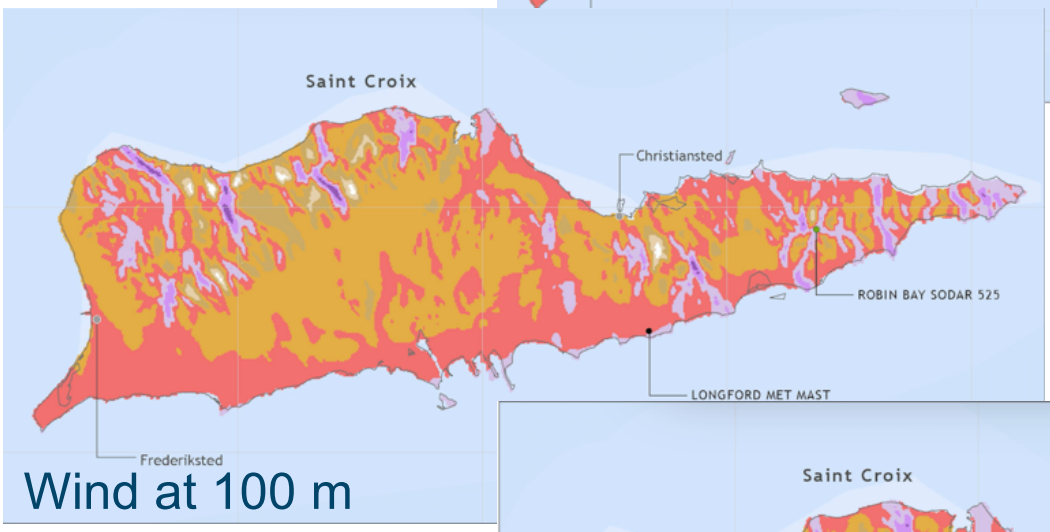
Biomass Resource

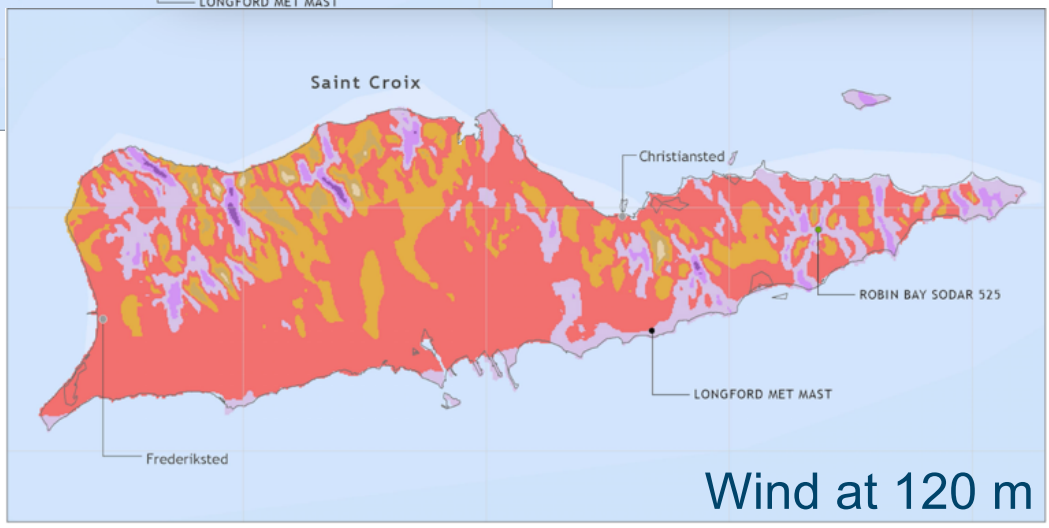
Island of Amerigo

RENEWABLE ENERGY RESOURCES



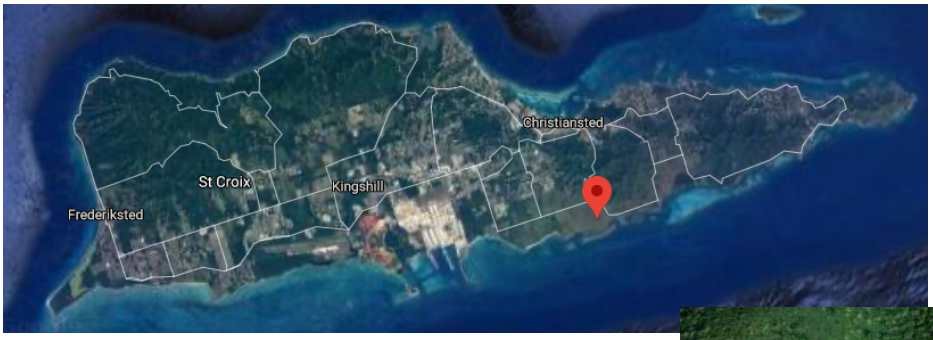




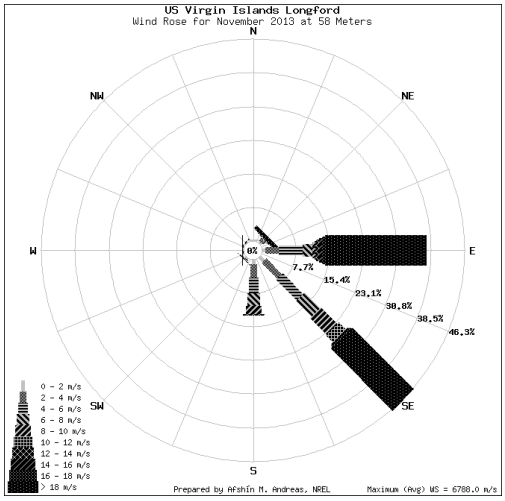


Island of Amerigo

WIND MEASUREMENT



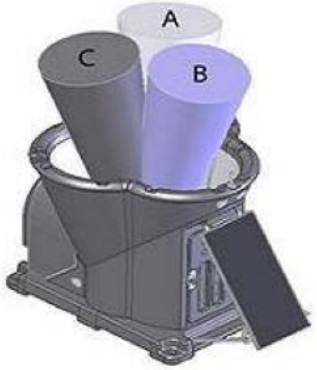
US Virgin Islands
St. Croix
Longford
Latitude: 17.71º North
Longitude: 64.69º West
Elevation: 28 meters AMSL
Time Zone: -4.0



Triton 525

Latest 10-minute data: 1/10/2013 20:50:00 UTC

Triton Serial Number:	00525	**Triton Firmware History:**	Dec 13, 2012 - Rev 2.0
Operational Status:	Running		
Barometric Pressure:	989.6 mBar	**Relative Humidity:**	86 %
True Azimuth:	0 °	**Speaker Volume:**	100 %
Tilt X (around Y axis):	0.4 °	**Battery Volts:**	13 V
Tilt Y (around X axis):	-0.9 °		
		Modem Power:	0.3 W
Ambient Temperature:	21.1 °C	**CPU Power:**	2.3 W
Internal Temperature:	27.2 °C	**Core Power:**	2.9 W
Mirror Temperature:	22.2 °C	**PWM Power:**	1.1 W

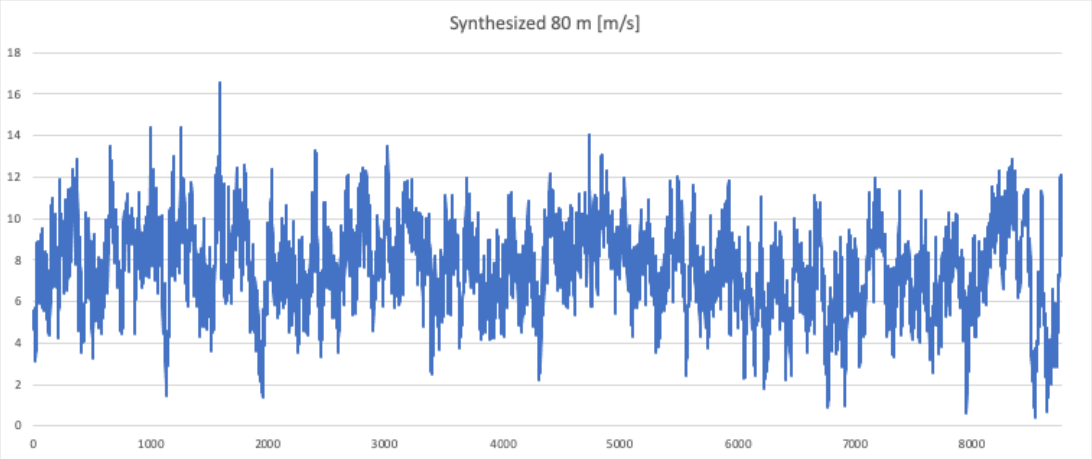


https://midcdmz.nrel.gov/apps/sitehome.pl?site=USVILONA

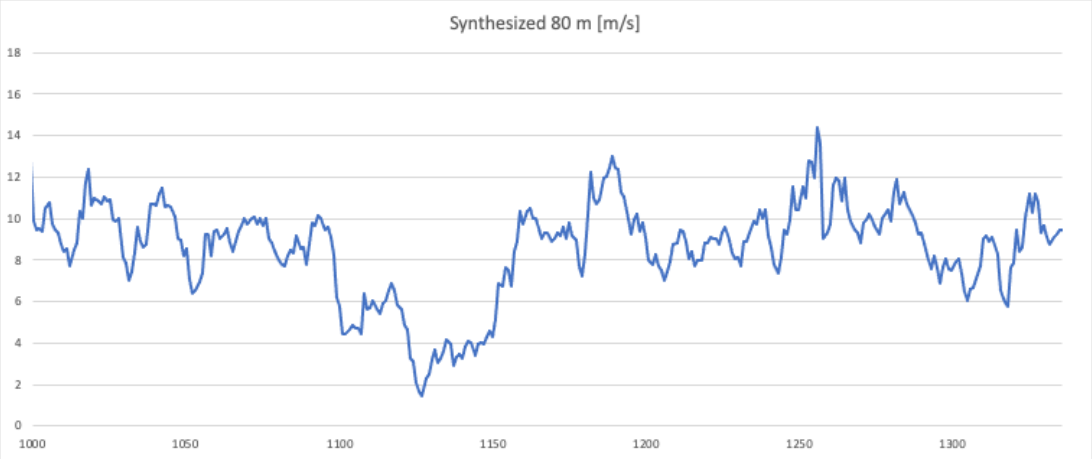
https://www.nrel.gov/docs/fy12osti/55415.pdf

Island of Amerigo

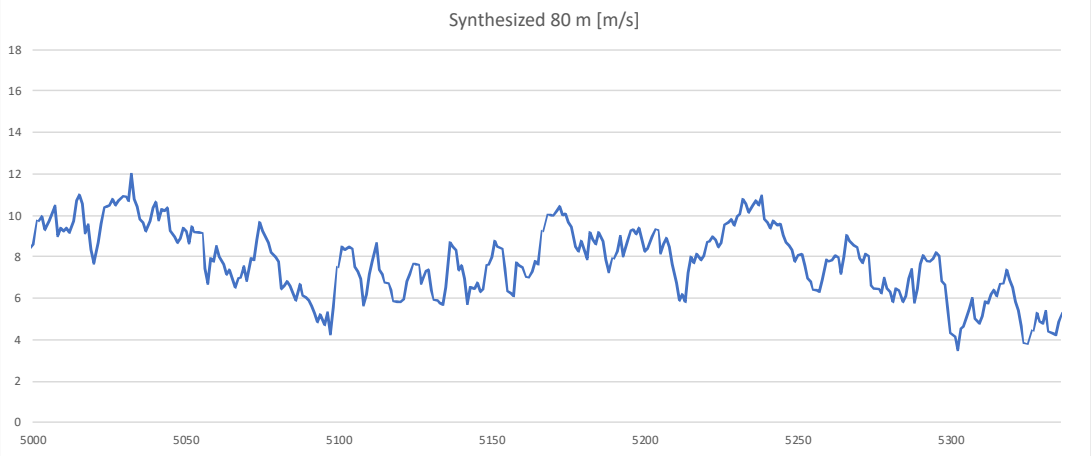
WIND DATA *see Excel file*



Annual Wind Speed (m/s)



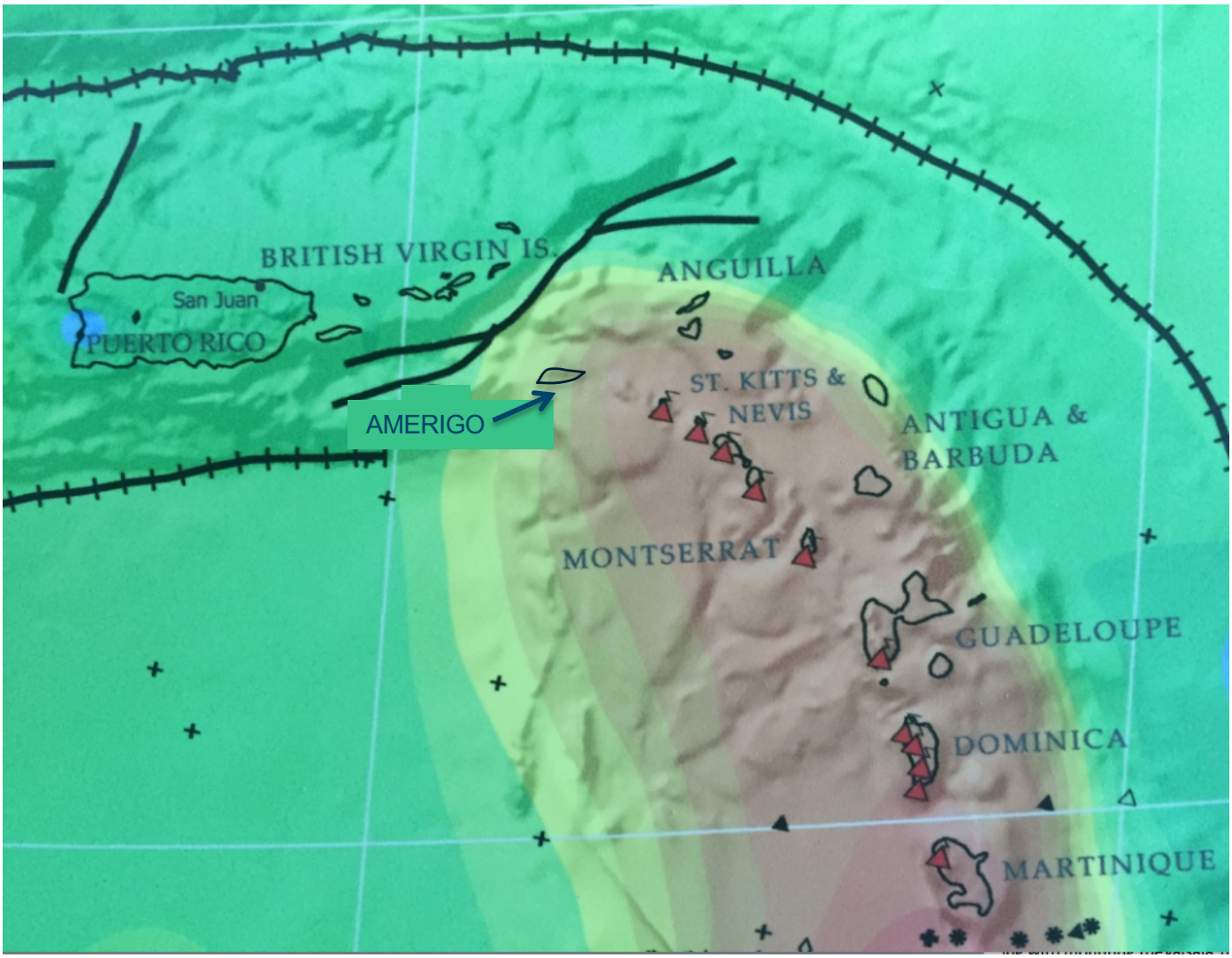
Two Weeks in February

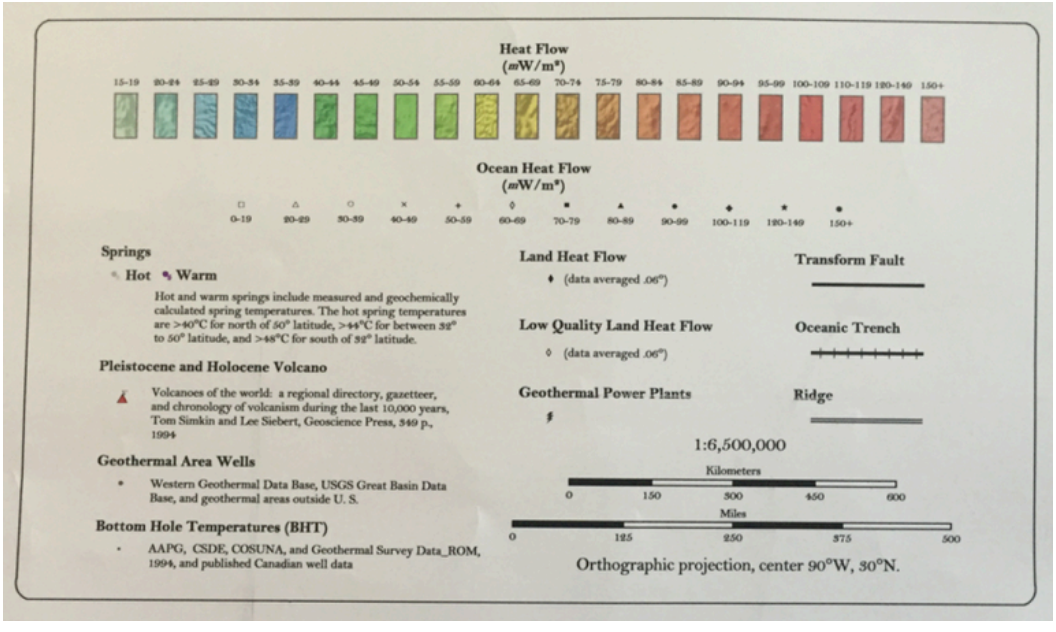


Two Weeks in August

Island of Amerigo

RENEWABLE ENERGY RESOURCES

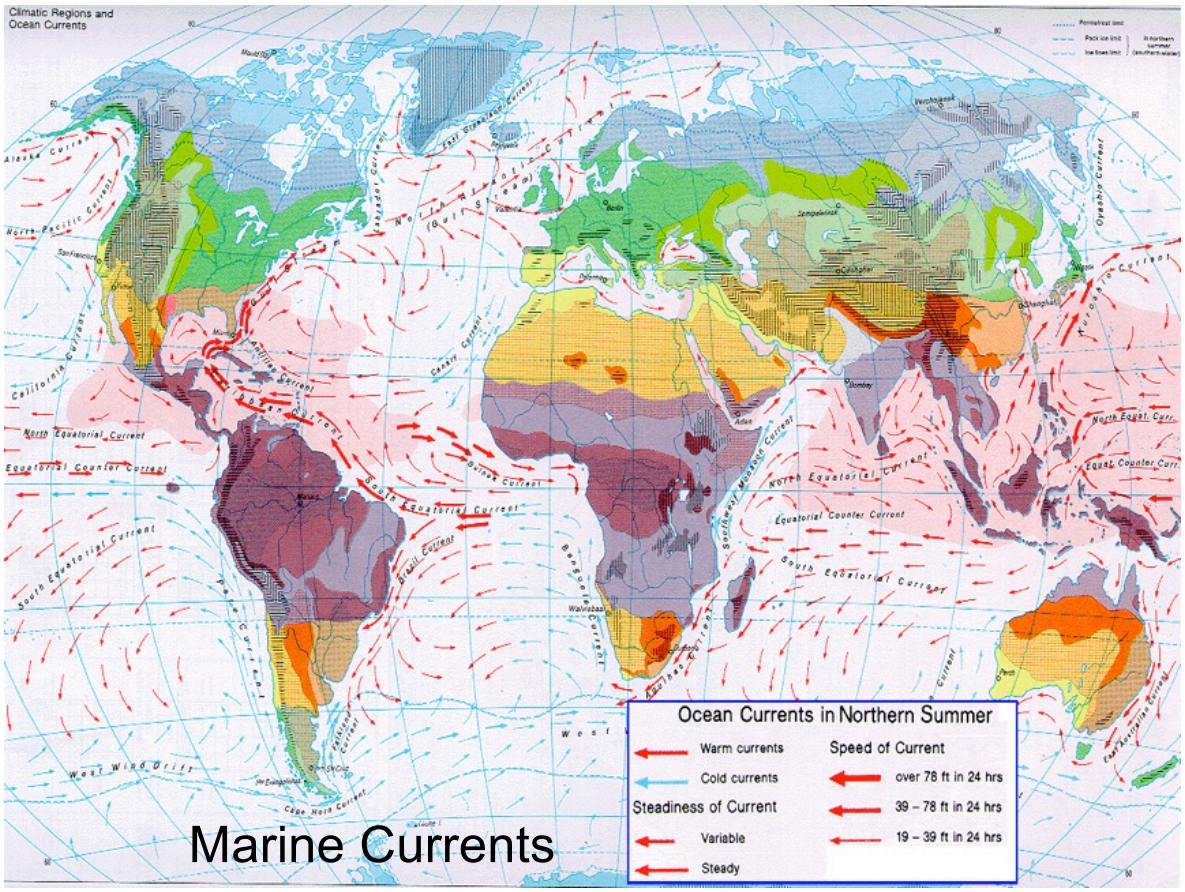




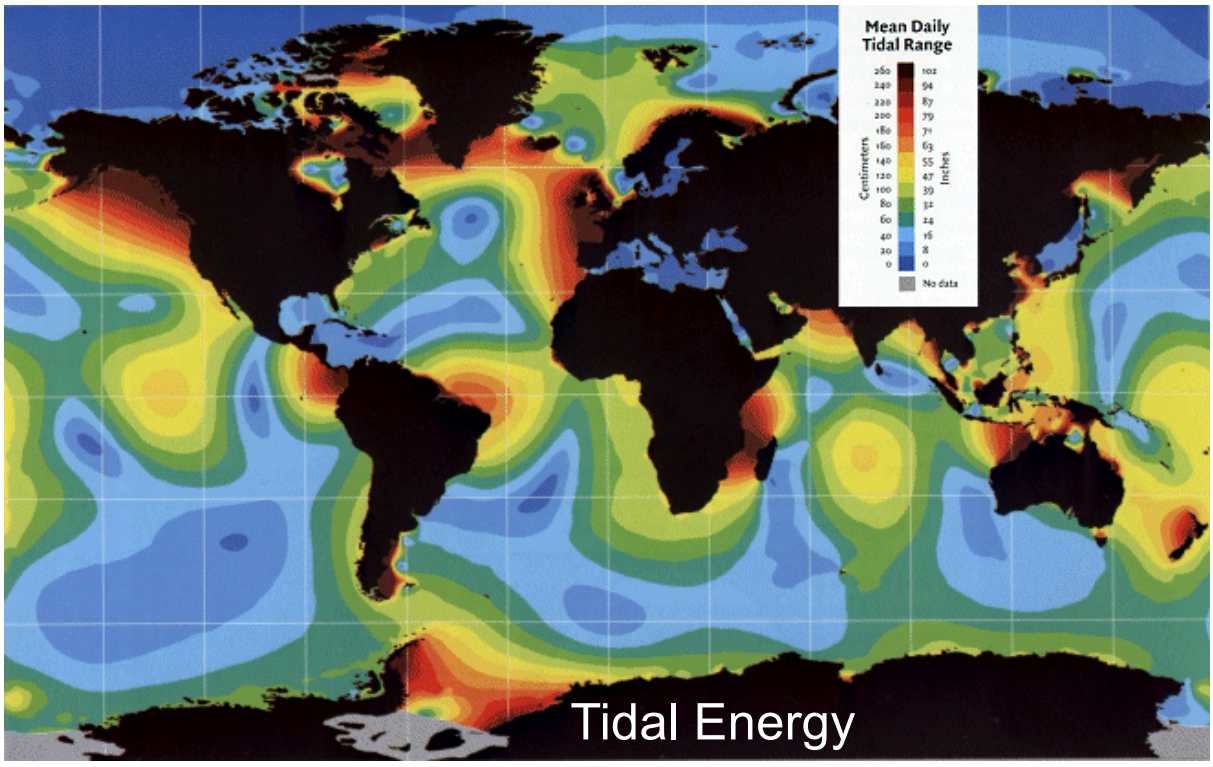
Note: units are in milli-Watts (1/1000 W/m^2), not mega-Watts (1000 W/m^2)

Island of Amerigo

OCEAN ENERGY



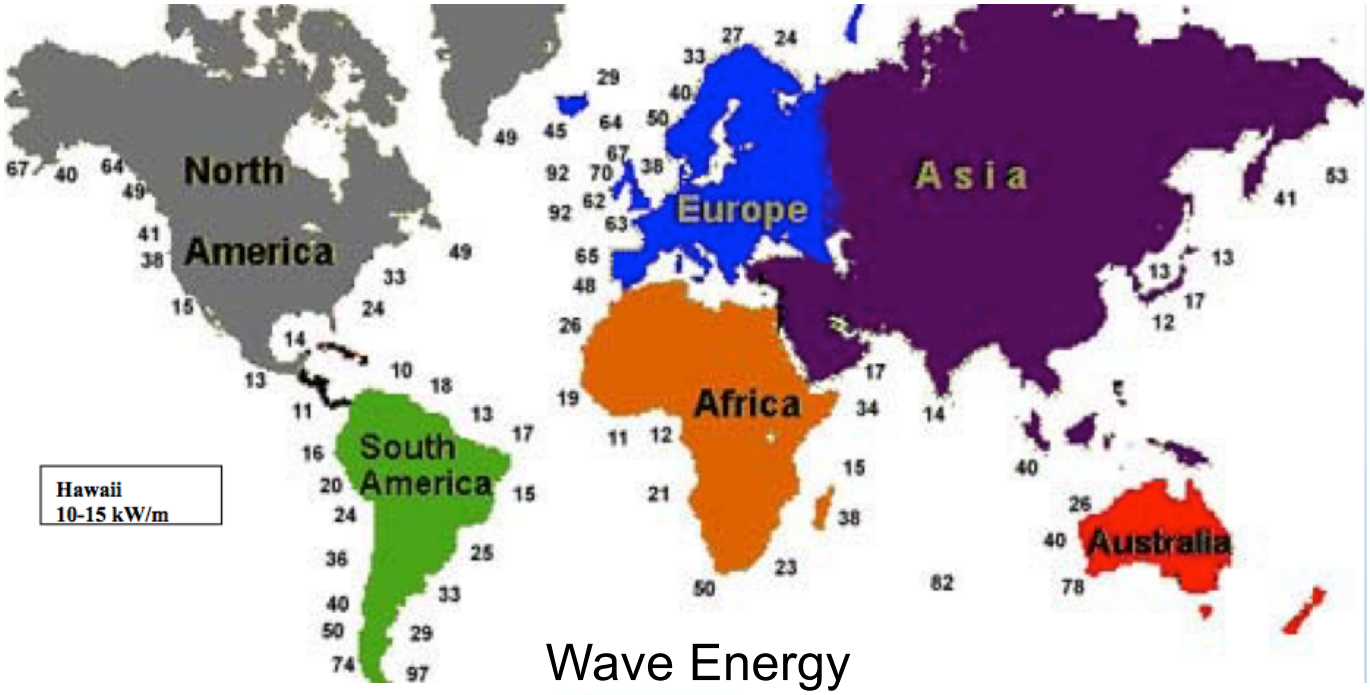
Marine Currents



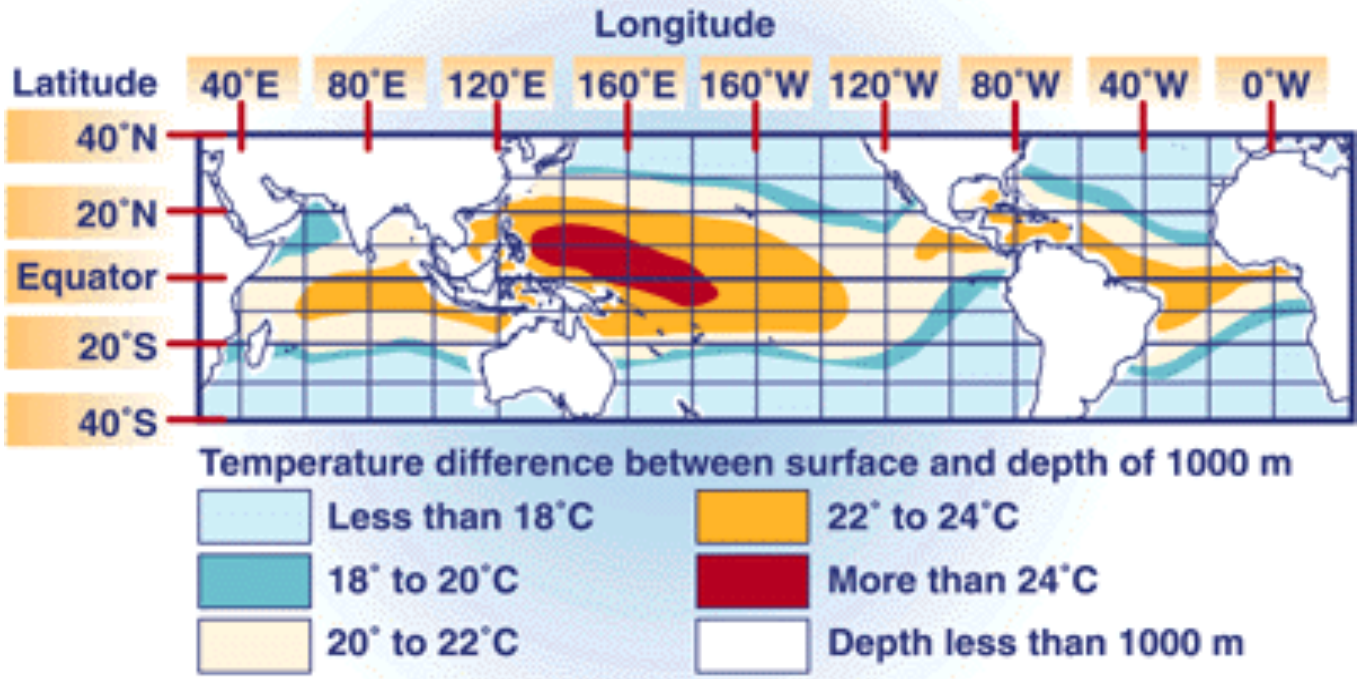
Tidal Energy

Island of Amerigo

OCEAN ENERGY



Wave Energy



OTEC

Island of Amerigo

AMERIGO UTILITY - ADWP

Essential services from energy-enabled critical infrastructure including water, wastewater, municipal waste, telecommunications, and transportation must be consistently and reliably operational to support safety, health, and economic growth. Manufacturing and retail operations must be open and employable to support economic wellbeing. A strong recovery and revitalization effort is critical to Amerigo and to the region as a whole.

Maintaining and enhancing the resilience of the electric grid at fair and reasonable costs is essential. The energy infrastructure of Amerigo must be designed, built, managed, and maintained in such a way to withstand environmental and man-made disasters, ameliorate disruptions when they inevitably occur, recover quickly, and incorporate lessons learned into post-event planning and operations. This is a continual process of improvement, one involving a reassessment and adaptation of solutions and technologies to address changing needs.

In support of those goals, ENGY 692 groups are asked to develop proposals to improve the resilience and reduce the cost of the island's power system. The utility has released a request for proposal (RPF) seeking the development of an independent power provider (IPP) that will augment the current generators located in Christiansted Harbor. Items to consider:

- *Resilience* – The site of the current generation is subject to flooding. To improve the resilience of the island, the utility is looking to have the new IPP support the critical loads of the island (estimated at 1/3 of the islands load) for a period of seven days.
- *Location* – The new system should be located near existing transmission but not co-located in Christiansted Harbor due to flooding concerns.
- *Technologies* – The population is irrationally concerned that wind turbines cause cancer. Therefore, the utility is interested in solar PV and storage.
- *Alternative technologies* – The utility is interested in proposals that include additional options (in addition to the required solar+storage proposal) to include technologies such as wind (onshore or offshore), geothermal, biomass, marine hydrokinetic and/or ocean thermal energy conversion (OTEC).
- *Microgrids, energy storage, system segmentation, and resilience planning* – The utility is interested in options that might improve the overall resilience of the grid.

Special considerations:

- During the months of January-March there is peak season for whale migration. During these months, any offshore hydrokinetics systems have to be shut off.
- Every day from 8 am to 4 pm, four to five cruise ships dock at Amerigo. Currently, these ships operate under their own power which causes considerable air pollution in Amerigo. The utility is exploring options to require shore power to these vessels if economically and technically feasible.
- Utility is a publicly owned municipal utility. They are interested in purchasing power from the renewable energy systems either by purchasing the system directly or via a power purchase agreement.

Island of Amerigo

UTILITY DATA

Amerigo Department of Water and Power

Existing generation fleet*	Capacity (MW)	Nominal Heat Rate (Btu/kWh)	Fuel Cost ($/gallon)	O&M Cost ($/kWh)
Reciprocating engines (MW)	40	9827	$2.50	$0.0105
Combustion Turbine (MW)	35	17,680	$2.50	$0.0046
Solar PV (MW-DC)	5	0	0	0

* Developed scenario details partially from US Virgin Islands draft Integrated Resource Plan here:
http://www.viwapa.vi/news-information/press-releases/press-release-details/2019/11/22/public-notice
Heat rates and variable O&M costs taken from Table 3-6 for CT Unit 19 and reciprocating engine generators ('Aggreko')
Unit sizes were increased for this Case Study example

Additional Data

Developer's maximum investment limit	$200,000,000	
General inflation rate	2%	(for non-fuel O&M)
Fuel cost escalation rate (%/year)	2.50%	
Utility discount rate	5.50%	
Higher Heating Value diesel (Btu/gallon)	137,380	

Divide oil prices ($/bbl) by 35 to get approximate prices for No. 2 or No. 6 oil ($/gal)
Use 139,000 BTU/gal as the heating value for all fuel oil used

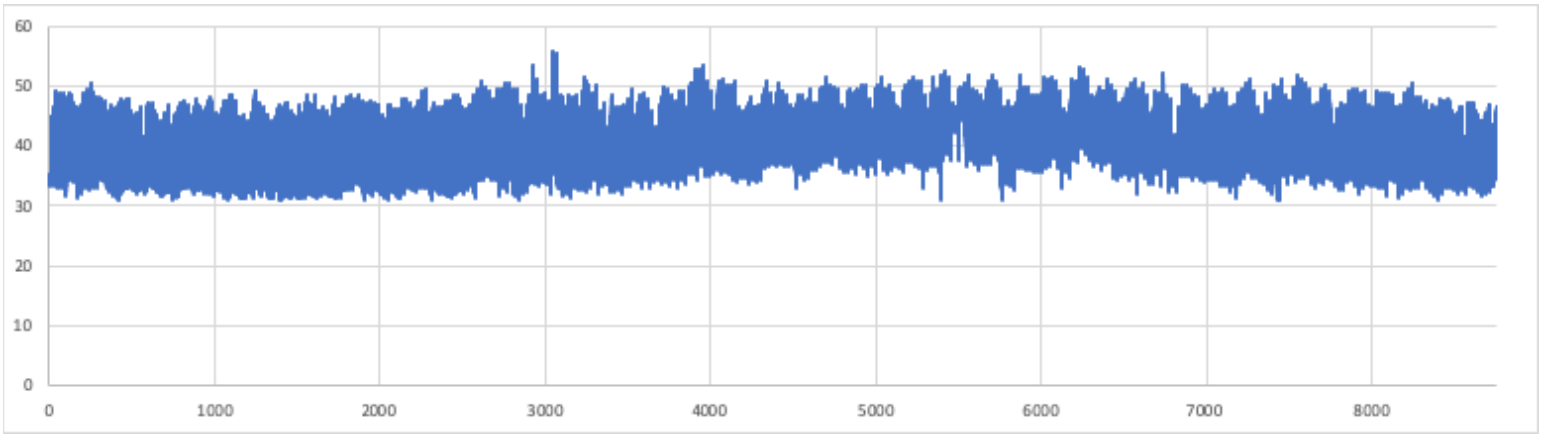
37,000
Total Water Desalinization (m^3/day)

150,000
Tons of Municipal Solid Waste (MSW) per year

http://www.viwapa.vi/docs/default-source/default-document-library/draft----2019-wapa-integrated-resource-plan.pdf?sfvrsn=7a383714_2

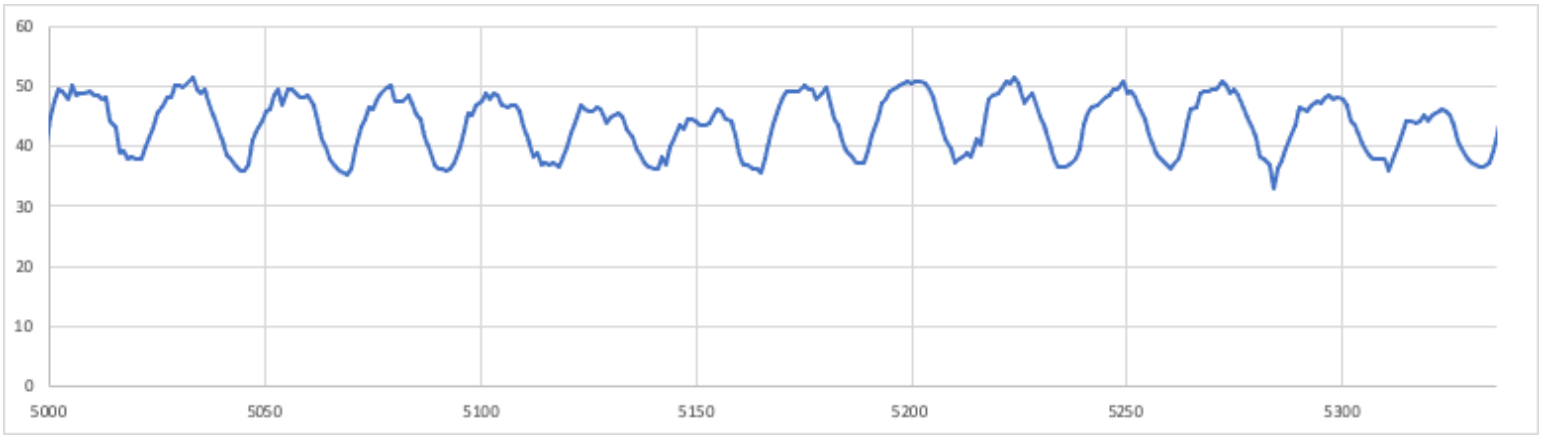
Island of Amerigo

LOAD DATA - *see Excel file*



Annual Load Data

Two Weeks in February

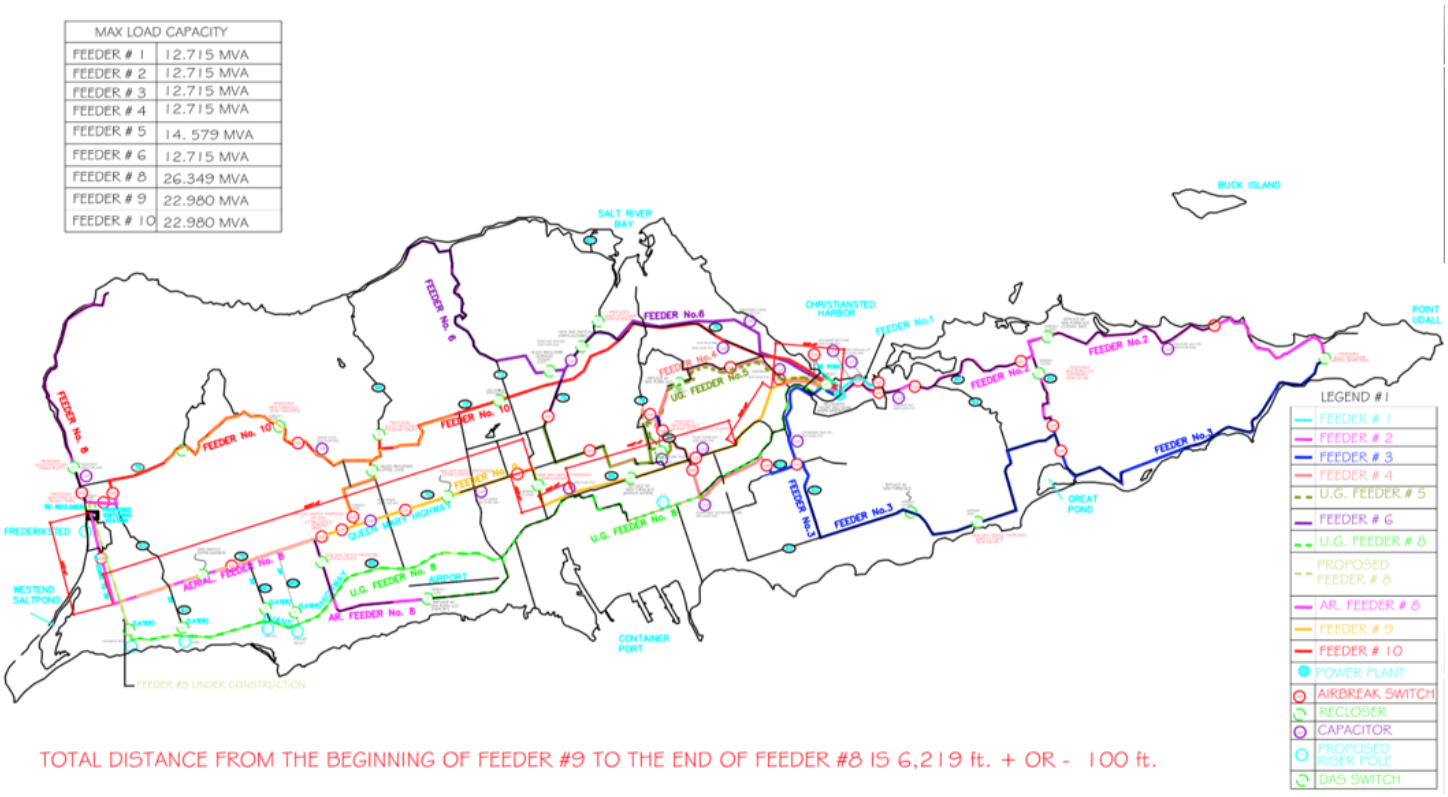


Two Weeks in August

Island of Amerigo

GRID INFORMATION

MAX LOAD CAPACITY	
FEEDER # 1	12.715 MVA
FEEDER # 2	12.715 MVA
FEEDER # 3	12.715 MVA
FEEDER # 4	12.715 MVA
FEEDER # 5	14. 579 MVA
FEEDER # 6	12.715 MVA
FEEDER # 8	26.349 MVA
FEEDER # 9	22.980 MVA
FEEDER # 10	22.980 MVA



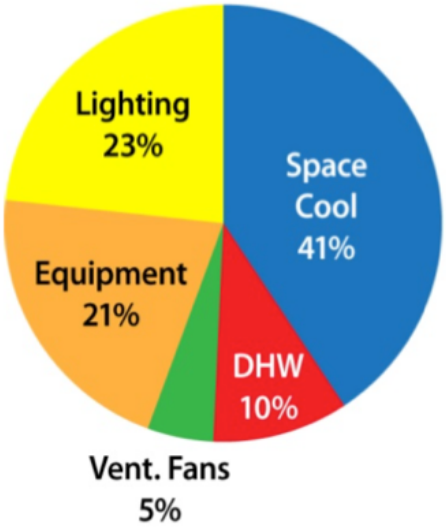
TOTAL DISTANCE FROM THE BEGINNING OF FEEDER #9 TO THE END OF FEEDER #8 IS 6,219 ft. + OR - 100 ft.

Island of Amerigo

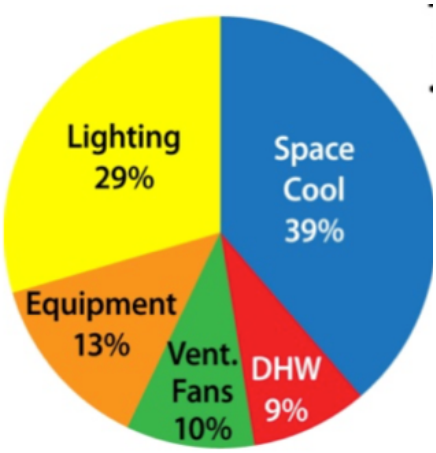
ENERGY USE

Electricity in Residential Sector

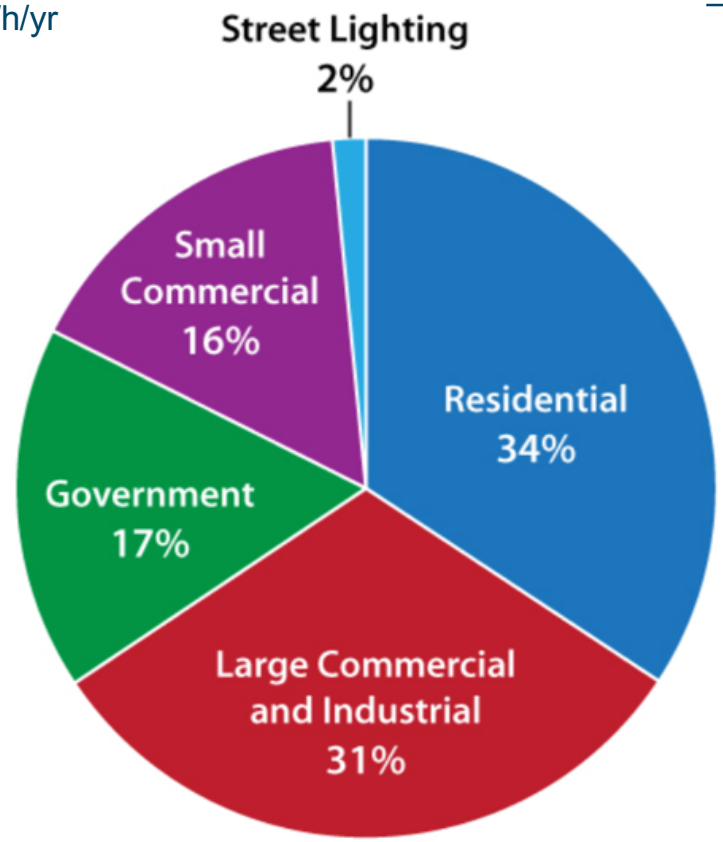
(DHW = Domestic Hot Water)



Energy end-use and savings potential —900 ft^2, 8000 kWh/yr



Energy end-use and savings potential —3000 ft^2, 28,000 kWh/yr



Electricity Use by Sector

The Royal Mail Inn

While plans are underway to rebuild the island's infrastructure, local businesses are busy rebuilding and planning for the next hurricane to hit Amerigo. The owners of the *Royal Mail Inn* have requested a proposal to rebuild the power and water systems of the largest hotel complex in Amerigo with the goals of reducing costs, improving reliability, and improving system resilience.

The Royal historically has procured power from the Amerigo utility and is now seeking options to allow for inn to electrically island itself during times of grid outages. The hotel would prefer to be able to maintain operations at 75% during a week-long utility outage. The cost-effectiveness of any proposed technologies must be thoroughly considered.

Hotel management is also concerned about frequent, day-long power outages that occur due both to aging utility infrastructure and frequent tropical storms. The hotel had no backup power system before this previous storm. The hotel might be interested in procuring solar, storage, and a diesel generator to operate their facility even when utility power is lost.

Special considerations

- The hotel gets its water from a local well, but tests have shown periodic contamination of the well, forcing the hotel to rely on expensive, trucked-in water. The hotel would like to investigate a salt-water desalinization system.
- The hotel is investigating electric vehicles to shuttle passangers to-from the local airport.
- The hotel is privately owned. They are interested in purchasing power from the renewable energy systems either by purchasing the system directly or via a power purchase agreement.
- *Alternative technologies* – The hotel is interested in proposals that include additional options (in addition to the required solar+storage+generator proposal) to include technologies such as wind (onshore or offshore), geothermal, biomass, marine hydrokinetic and/or ocean thermal energy conversion (OTEC).

The Royal Mail Inn

ENERGY

122,120 sq ft
Floor area

6
Floors

5,074,748 kWh/yr
Annual electricity use

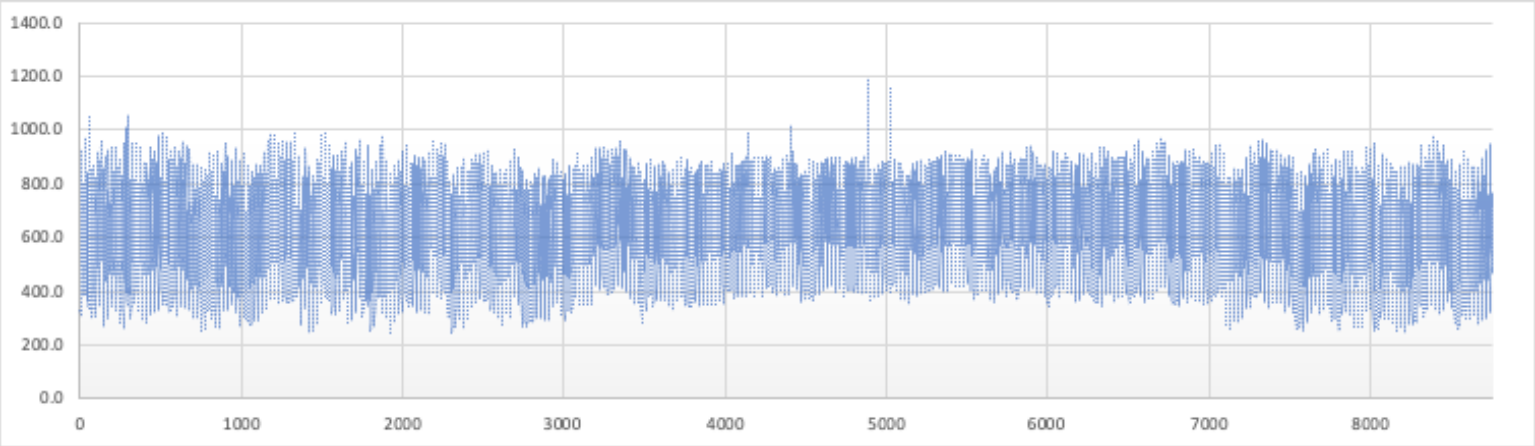
1007 kW
Peak Load

\

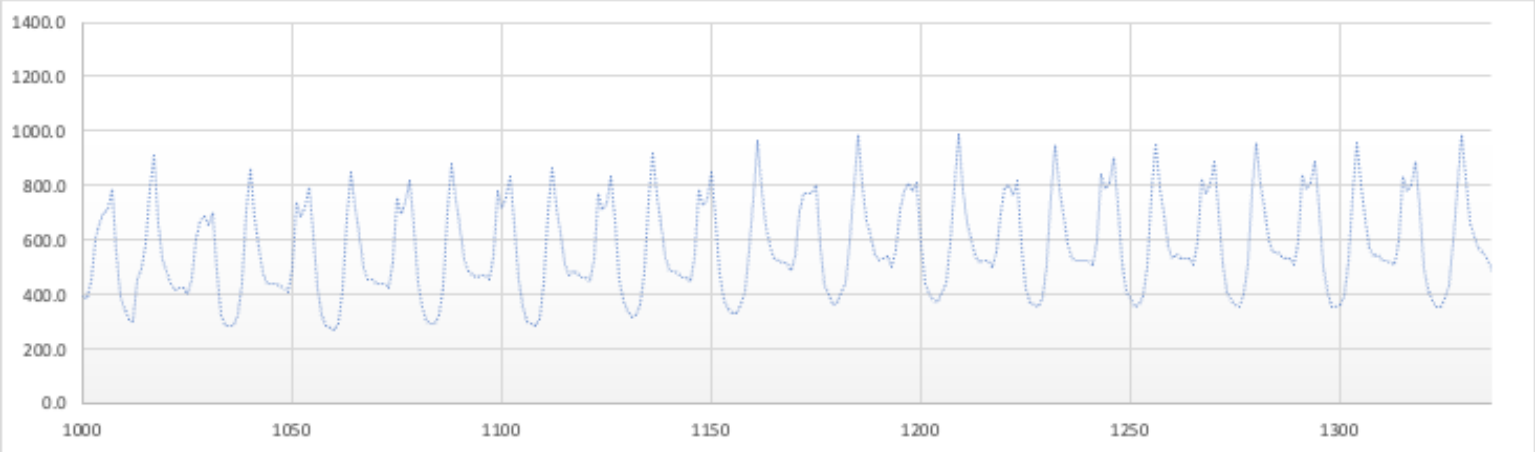
https://www.energy.gov/eere/buildings/commercial-reference-buildings

The Royal Mail Inn

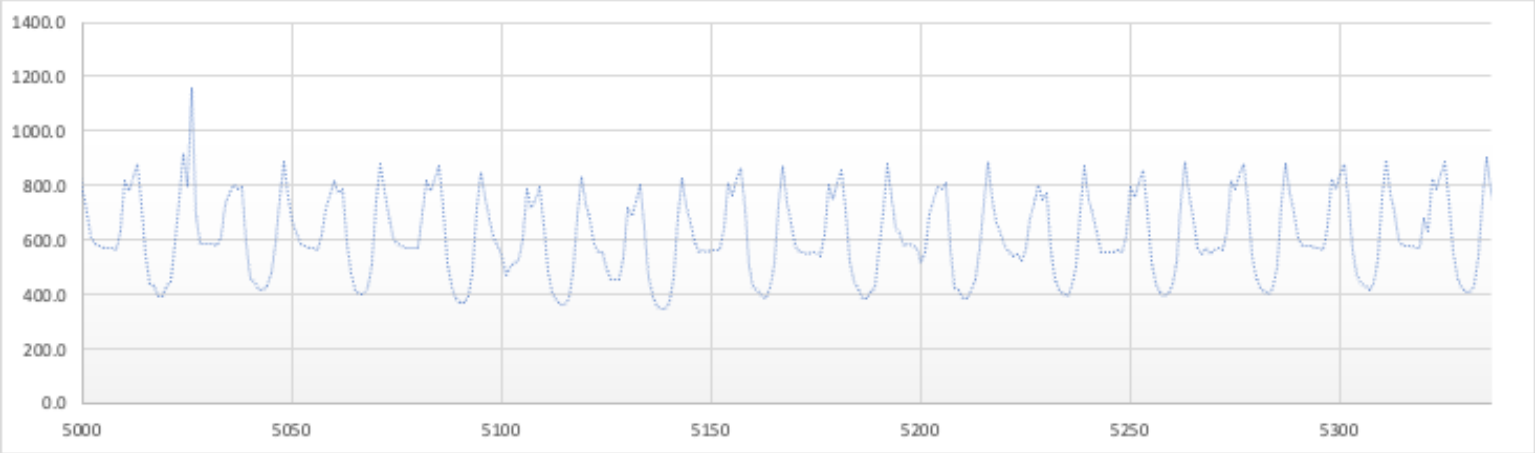
LOAD DATA - *see Excel file*



Annual Load Data



Two Weeks in February



Two Weeks in August

The Royal Mail Inn

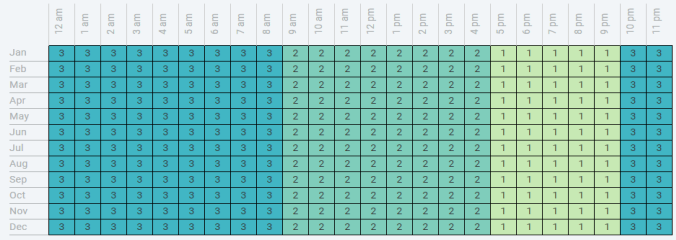
RATE TARIFF *see Excel file*

Energy Charges

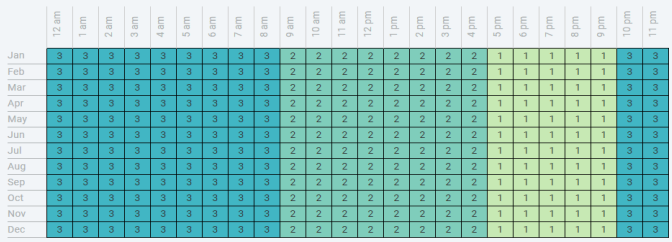
Energy Charges - ***Rate*** *Periods*

Period	Tier in Period	Max. Energy Purchases (kWh/month)	Energy Charge ($/kWh)
1	1	unlimited	0.32
2	1	unlimited	0.21
3	1	unlimited	0.19

Energy Charges - ***Weekday*** *Schedule*



Energy Charges - ***Weekend*** *Schedule*

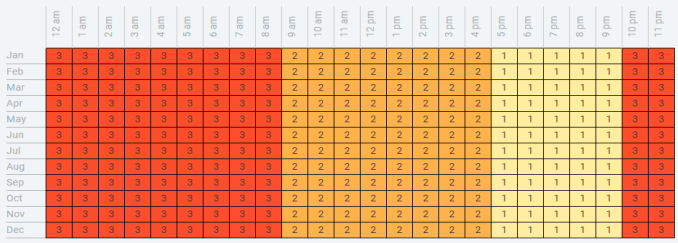


Demand Charges

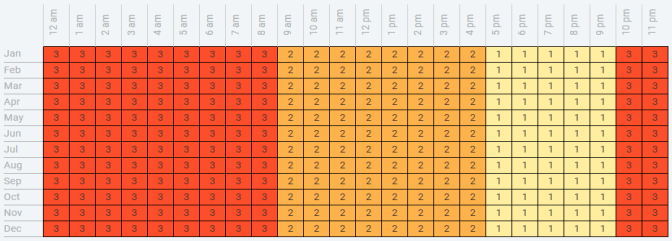
Demand Charges - ***Rate*** *Periods*

Period	Tier in Period	Max Demand (kW)	Demand Charge ($/kWh)
1	1	unlimited	18.0
2	1	unlimited	11.8
3	1	unlimited	0.0

Demand Charges - ***Weekday*** *Schedule*



Demand Charges - ***Weekend*** *Schedule*



Available development area (acres)	30		
General inflation rate	2%(for non-fuel O&M)		
Fuel cost escalation rate (%/year)	2.50%		
Hotel discount rate	8.50%		

Amerigo Public Policy	
Interconnection Limit (kW)	unlimited
Net metering limit (kW)	0
Net billing ($/kWh)	$0.095

ENGY 692

GRADING RUBIC

Writing Dimensions/ Weight	Does Not Meet Expectations (1-3 points)	Meets Expectations (4 - 7 points)	Exceeds Expectations (8 - 10 points)
Depth of Analysis - 30%	Economic metrics are not clearly or logically calculated or determined and fail to be adequately supported. Technical and engineering analysis is so sketchy and inadequate that the reader is not able to evaluate the validity of the interpretation of findings.	Economic metrics are clearly and logically explained and accurate and adequately supported by facts presented and reasoning. Technical and engineering analysis is detailed enough to aid understanding but is not enhanced with equations, models, or theories.	Economic metrics are clearly and logically explained and accurate and strongly supported by facts presented and reasoning. Results are carefully and objectively analyzed. Interpretations are made using appropriate equations, models, or theories.
Depth and Accuracy of Content - 30%	The explanation is sufficiently inaccurate, incomplete, or confusing that the reader gains little information from the report. It appears that little attempt has been made to help the reader understand the material. The information in the report is incorrect or unclear to the point of being misleading.	An accurate and complete explanation of key concepts and theories is made, drawing on relevant literature. Enough detail is presented to allow the reader to understand the content and make judgments about it. With some minor exceptions, the information (names, facts, etc.) included in the report is accurate.	An accurate and complete explanation of key concepts and theories is made, drawing on relevant literature. Enough detail is presented to allow the reader to understand the content and make judgments about it. In addition, applications of theory are included to illuminate issues. Readers gain insights. Information (names, facts, etc.) included in the report is consistently accurate.
Creativity - 20%	Fail to suggest solutions beyond the original requirements.	Suggest interesting solutions beyond the original requirements that address the suggested additions.	Suggest well-researched, creative solutions beyond the original requirements.
Formatting and Graphics - 10%	Document is formatted poorly and lacks a quality cover page and index Graphical documents, sketches, maps, etc. are of poor quality and fail to support the text.	Formatting of the document is generally consistent and adequate, and includes a good quality cover page and index Graphical documents, sketches, maps, etc. are of good quality and adequately support the text	Formatting of the document is professional and includes a professional cover page and index All graphical documents, sketches, maps, etc. are creative, professional and strongly support the text
Documentation and References - 10%	Fails to correctly document any sources or to utilize appropriate citation forms	Most sources are correctly documented; appropriate citation forms are generally utilized	All sources are correctly and thoroughly documented; appropriate citation forms are utilized throughout

FAQ

- When are our reports / proposals due?
  - The approximately 20-page report is due April 20th. If the reviewers have questions, you will have a chance to append and update by May 6th
- What are our deliverables?
  - Approximately 20-page report
  - Copy of spreadsheet or program used to conduct analysis (show your work)
  - PowerPoint presentation (to be given in class the week of April 27th
- Should we consider wind as an alternative or in addition to solar?
  - Yes
- Can we share provided data publicly?
  - Yes