MAST Academy

A Nationally Recognized School of Excellence

Carbon-Free Pathways 2020

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Prepared for MAST Academy

Crafted by EcoMotion

216 W Kenneth Road, Glendale, CA 91202 ● (949) 292 - 7314 ● www.EcoMotion.us

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Section 1: Introduction

The purpose of this document is to present MAST with pathways to Carbon-Free Energy.

The energy world is in rapid transformation. Gone are the days that you buy power from "Edison," or more accurately Florida Power and Light. Now there are many choices… some that are carbon-free, some that cogenerate, some that make campuses more resilient. Thanks to rapidly advancing technologies, coupled with innovative financing, climate awareness and policy, the energy arena is dynamic.

Here's what's inside:

1. The stage is set with "MAST at a Glance"
2. We begin with digging into "Facility Energy Use"
3. Then "Transportation Energy Use"
4. "Carbon-Free Pathways" presents pathways for MAST consideration
5. There's a section addressing "Financing Options"
6. And the report wraps with concluding "Recommendations"

This Plan salutes early works with sustainability, notably energy efficiency, renewable energy, and sustainability at MAST. These actions build a foundation for additional steps in both governance and operations. Now we look forward: This Plan is intended to prepare the School for the carbon-free energy future, the future that in some ways is now!

MAST at a Glance

The Maritime and Science Technology Academy, commonly referred to as MAST Academy, or MAST, is located in Miami, Florida, on Virginia Key. It is the only magnet school under the governance of the Miami-Dade County Public School system. Established in September 1991, the school graduated its 27th senior class in 2020 -- consisting of 224 seniors that matriculated with a full range of honors, AP, Cambridge (AICE), and Dual Enrollment courses.

MAST Academy is staffed by a principal, two assistant principals, one lead teacher, and 84 full and part-time faculty members of whom approximately 84 percent hold a master's degree or higher. The school includes two large classroom buildings, a pool, boathouse, docks, fitness center, and a media center with over 22,000 print and non-print items. Students have immediate access to technology throughout the school.

MAST, home of the Makos, is a dynamic educational community that provides a marine setting and nurturing environment for studies leading to academic success, career preparation, an appreciation of the sea, and environmental awareness. The Magnet School educates a diverse population of approximately 1,534 students in grades 6-12, representing four ethnic groups. These include 70% Hispanic students, 25%, White Non-Hispanic, 3% Black, and 2% Asian/other.

Academic Excellence

The stakeholders of MAST Academy's mission is to work together to instill a commitment to life-long learning and to advance and approve a challenging curriculum integrated with the sciences and technology.

MAST Academy students are part of one of three highly acclaimed, academically rigorous magnet programs with distinct curriculums. The Maritime program weaves maritime studies throughout a student's high school career, culminating in an internship experience with local businesses, research institutions, or government offices. Student's in the school's Cambridge STEM and Global programs pursue a Cambridge Diploma. Advanced coursework in their discipline, STEM competitions, and language study are the norm for the students to become global citizens.

MAST Academy is a Florida Department of Environmental Protection Green Apple School. In 2019, MAST was the only Florida school to be named a United States Department of Education Green Ribbon School. It has annually been named a State of Florida High-Performing School, and has been listed on Washington Post's Best High Schools List for a decade. In addition to all of the awards and recognition, the MAST also offers AICE (Cambridge, AS and A Level), Dual Enrollment, and Advanced Placement (AP) programs.

MAST is dedicated to serving the academic, personal, and post-secondary needs of each student. Dedicated teachers and staff are committed to helping students explore their abilities, strengths, interests, and talents as their traits relate to their career, educational, and personal/social development. Comprehensive programs and a nurturing environment is considered an integral part of the educational process that enables all students to achieve success in school and in the future.

Section 2: Facility Energy Use

Energy use at MAST is driven by Miami's sub-tropical climate. Weather data statistics for Miami indicate that the region has 4,198 annual cooling degree days -- requiring considerable air conditioning (and electric use) -- and 200 annual heating degree days with respect to a base temperature of 65°F. Extremes recorded at the weather station show that temperatures have reached as high as 98°F and as low of 30°F. The average maximum temperature in July is 89°F; the average minimum temperature in December is 61.5°F.

There are three electricity meters on campus, one of which uses the vast majority of the power, and which is tabled below. MAST uses about $12,000 worth of electricity per month. The table presents specific values for the 2018 - 2019 baseline year for electricity, the last full school year of data given the pandemic.

Natural Gas

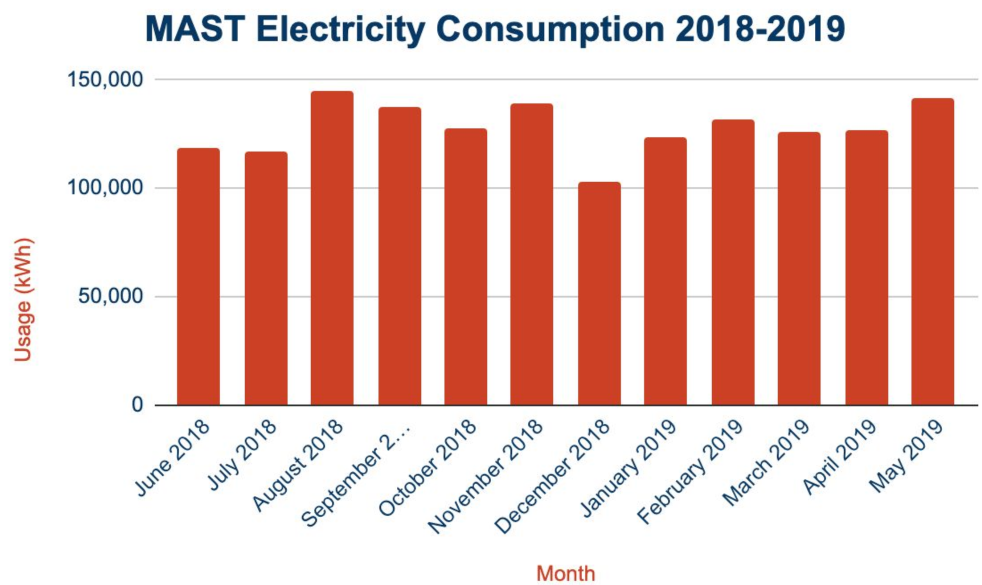
Natural gas data is not available, but we presume that the campus uses natural gas for limited space heating, domestic hot water production, and limited cooking. We assume that with little heating requirement, that the gas bill is likely to be ~ 10% of the electricity bill. EcoMotion recommends including natural gas use in future editions of this plan.

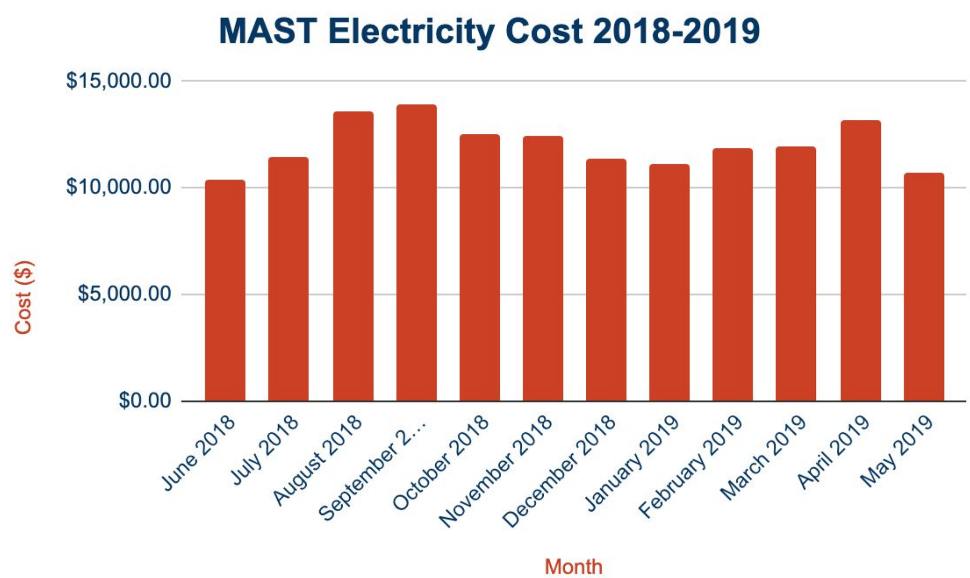
Electricity

Electricity consumption at MAST, unlike schools in many other parts of the country, is relatively flat -- 120,000 - 140,000 kWh a month year round. The months of October, January, and July in the baseline year had the highest electricity usage, with a maximum of 145,080 kWh used in August, 139,080 kWh in November, 141,600 kWh in May. The annual consumption value in the baseline year totaled 1,536,240 kWh.

MAST gets its power from Florida Power and Light (FPL). As of December 2016, FPL's fuel generation mix was 70% natural gas, 23% nuclear, 4% coal, and 3% purchased power. FPL has been consistently ranked one of the lowest-cost utilities in the nation. An Edison Electric Institute study found FPL to be the 5th lowest cost provider of 1,000 kWh of residential power each month, and 30% less than the national average.

Electricity Consumption 2018-2019				
Month	Meter	kWh	Maximum Demand	Cost
June 2018	67904-73075	118,200	323	$10,348.97
July 2018	67904-73075	116,520	417	$11,450.98
August 2018	67904-73075	145,080	541	$13,553.73
September 2018	67904-73075	137,400	546	$13,879.11
October 2018	67904-73075	127,800	477	$12,499.89
November 2018	67904-73075	139,080	431	$12,410.87
December 2018	67904-73075	102,720	465	$11,379.38
January 2019	67904-73075	123,600	367	$11,086.32
February 2019	67904-73075	131,400	395	$11,841.53
March 2019	67904-73075	125,760	419	$11,907.39
April 2019	67904-73075	127,080	502	$13,134.19
May 2019	67904-73075	141,600	443	$10,710.88
TOTAL		**1,536,240**	**5326**	**$144,203.24**


MAST Electricity Consumption 2018-2019
150,000
100,000
50,000
0
Usage (kWh)
June 2018
July 2018
August 2018
September 2…
October 2018
November 2018
December 2018
January 2019
February 2019
March 2019
April 2019
May 2019
Month


MAST Electricity Cost 2018-2019
$15,000.00
$10,000.00
$5,000.00
$0.00
Cost ($)
June 2018
July 2018
August 2018
September 2…
October 2018
November 2018
December 2018
January 2019
February 2019
March 2019
April 2019
May 2019
Month

Section 3: Transportation Energy

This Carbon-Free Pathways Plan focuses largely on electricity. These are the primary energy forms related to Building Energy Use. Another form of energy use that is discussed here is Transportation Energy Use. It's a big deal, especially when accounting for teacher, staff, student commuting, plus student drop offs and pickups. For many schools in America, transportation energy costs can be nearly twice the energy used within campus school buildings and facilities.

MAST Transportation Energy Use

	Vehicle Type	Number	Days / Year	Miles / Day	Miles / Gallon	Gallons	Fuel Cost *
Buses							
	Diesel	16	200	22	10	7,040	$15,840
District Annual Cost						**7,040**	**$15,840**
Commuters							
	Teachers	17	200	10	25	1,360	$2,720
	Teachers	53	200	25	25	10,600	$21,200
	Staff	5	200	10	25	400	$800
	Staff	15	200	25	25	3,000	$6,000
	Bus drivers	16	200	20	25	2,560	$5,120
	Students	200	200	10	25	16,000	$32,000
Drop-Offs / Pick-Ups **							
	Parent with Student	563	200	10	25	45,040	$90,080
	Parent with Student	187	200	25	25	37,400	$74,800
	Carpools	75	200	20	25	12,000	$24,000
	Carpools	75	200	50	25	30,000	$60,000
Teacher, Staff, Student, Parent Costs						**158,360**	**$316,720**
Grand Total						**165,400**	**$332,560**

** Assumed fuel costs per gallon: Diesel $2.25, Gasoline $2.00* *** Two students per car*

District Transportation Fuel Costs

Bus Services

There are 16 buses in total at MAST Academy. The buses are fueled by diesel. Two buses shuttle ~400 students -- about 25% of all students -- to the Metro Rail (Vizcaya Station), which is less than five miles from campus. Nine buses transport approximately 560 students (60 students per bus) to and from Key Biscayne, which is five miles from campus each way, 10 miles roundtrip.

The remaining five buses transport ~100 students longer distances, 10-15 miles each way, approximately 30 miles round trip. These buses drive students to North Miami Beach, Hialeah, Coral Gables, Homestead, and Miami Springs.

Commuting Energy Use

Teacher and Staff Commuting

There are ~70 teachers and 20 staff that work at MAST Academy each day. EcoMotion sent out Google Forms in July 2020 to gain insight on how far teachers and staff are commuting. Thirty-five teachers and staff responded. Based on the responses, most teachers reportedly live throughout Miami-Dade County. The primary mode of transportation to and from school is driving and some carpool. Two teachers are known to bicycle to and from campus. No one walks to school as it is too far to do so.

For this analysis, we assume that 25% of teachers and staff drive 10 miles round trip each school day, and the other 75% drive an average of 25 miles round trip. We assume average fuel efficiencies of 25 MPG and 15% carpool with 2 other people.

Student Drop-Off and Pick-up

Out of the ~1,500 students that attend MAST, two-thirds or ~1,000 students live in Key Biscayne, which is five miles from the school. In the mornings, 750 students are dropped off by parents, and in the afternoons they generally take the bus.

EcoMotion also sent out Google Forms to track students commuting to and from school. Based on the 201 parents and students respondes, most parents drop-off/pick-up students to and from school, or students take the bus. Approximately 10% of the students take public transportation.

There are another ~ 300 families that carpool or who have seniors who drive themselves and park their cars at MAST each day. Of those 300, half come from Key Biscayne. None of the students walk as it is too far a distance. Apparently, four students ride their bicycles to and from campus intermittently.

Future Vehicular Considerations

Teacher and Staff EV Charging

Many teachers have to drive considerable distances to work. In some cases, this limits the ability of a teacher or staff member to use a highly efficient electric vehicle (EVs) due to their range limitations. As a perk, MAST offers trickle charging to teachers and staff that need to recharge their EVs for their return commute. EV charging could also be available to the public, potentially, with fees charged per kilowatt-hour of charge and using real-time pricing creating a revenue-neutral program.

Vehicle-to-Grid

A technological trend that continues forward, and that MAST ought to be aware of, is "Vehicle-to-Grid" technology. Thanks to "V2G," our idle cars, buses, and trucks may become integral parts of the power system. For MAST, and perhaps in the next 3 - 5 years, this provides a means for the electric buses owned by MAST to be part of the electric utility grid infrastructure, charging and discharging like lungs of the power system, providing revenues to MAST when students are on vacation and not at school. Cajon Valley Unified School District in California is in the midst of a V2G pilot program with San Diego Gas and Electric at the time of this writing.

Imagine a school district with electric buses: Each of these has 100 – 150 kWh of battery energy storage on board. With V2G capability, a bus or two could be plugged into a school building that is dark; buses plugged into school buildings can power the campus through the outage. School bus fleets will also be used to provide demand response services for utilities, and ancillary services for grids, representing secondary and tertiary revenue streams for the buses and their batteries, maximizing utilization of costly assets.

In fact, the nearby City of West Palm Beach Parks and Recreation Department is getting five electric school buses at a total cost of $1.5 million, split between the City and FPL, that will discharge their extra battery energy to the grid during times of peak demand. According to the Palm Beach Post, the electric buses will be used to take students to park events, camp, and after-school programs. As part of the pilot program agreement, FPL will own and maintain the charging stations and the batteries, while the city will own the buses.

Section 4: Carbon-Free Pathways

On-Site Power Generation

This plan presents onsite generation options for MAST Academy's pathway to being carbon free. These include both onsite and offsite generation, and the purchase of offsets.

Energy Efficiency

While not a generating source of kilowatt-hours, energy efficiency is the first recommended step for MAST in terms of carbon pathways. It is a step that makes sense no matter what generation is ultimately installed or procured. Addressing inefficiencies in lighting, cooling, and other loads are often the least-cost approach to powering a campus.

Efficiency typically costs less than generation of any kind. Typically, seasoned facilities officials can point to 5 - 10% potential savings through efficiency at any given time. Behavioral savings -- that involve deep interactions and community engagement -- can yield an additional 5 – 10% of energy, cost, and carbon savings.

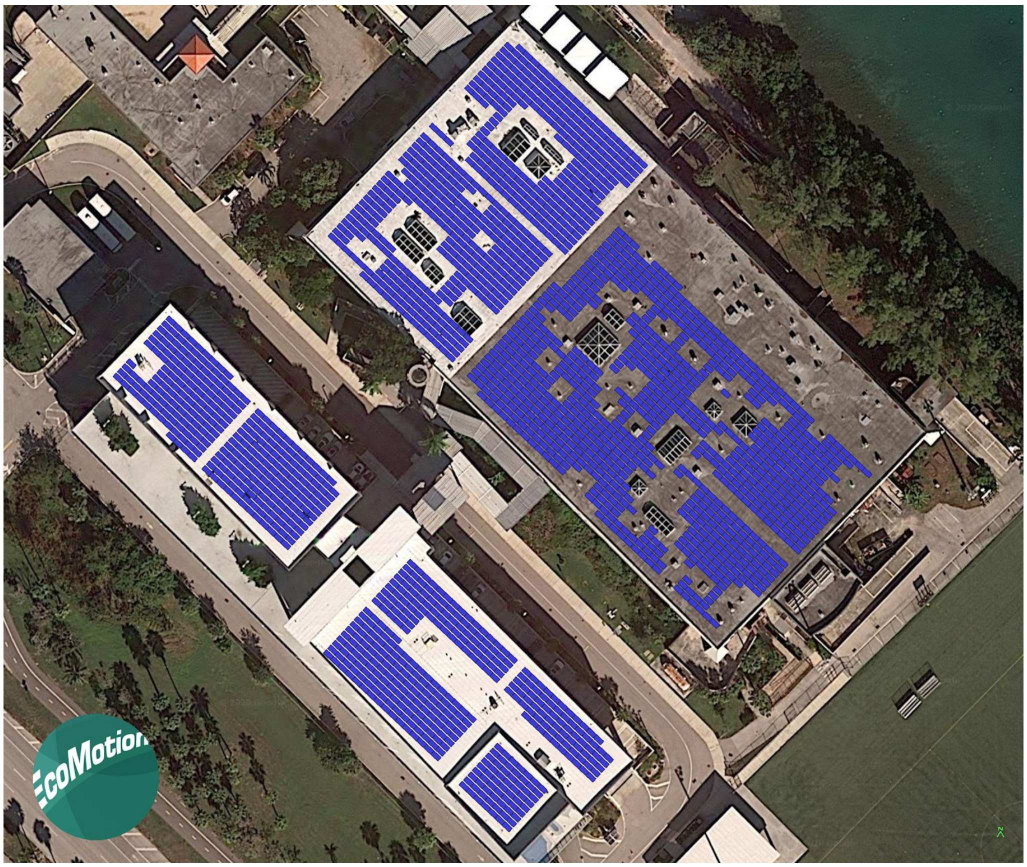
An exterior and interior lighting fixture retrofit, for example, would increase energy efficiency, save utility and maintenance costs in the long-term, and standardize fixtures for MAST Academy -- notably, relamping with LED lighting. MAST Academy could also establish monitoring-based commissioning systems for the school facilities to maintain controls and assure proper scheduling.

Onsite Solar

Existing Solar: MAST had a small demonstration solar system used for educational purposes. Regrettably, the panels were stolen from campus in the summer of 2020. EcoMotion presumes that the system represented less than 2 kW of capacity, and thus provided limited savings of energy and carbon.

A group of particularly environmentally-engaged students that attend MAST leveraged an educational component to advocate for a solar installation on the P.E. field in the nearby village of Key Biscayne. The $40,000 project will provide 10 kW solar on shade structures.

Additional Solar: EcoMotion has modeled the costs and benefits of solar on campus. Our team modeled a 757 kW DC solar system as depicted in the aerial image below that will provide 1,154,390 kWh in the first year (thereafter declining by 0.5% per year) offsetting 74.94% of the school's load on its main meter. The remaining 24.06% (386,050 kWh) would continue to be purchased from FPL.



Given FPL's low power rates, marked by short on-peak periods and then ~three cent/kWh power most of the time, solar economics are not good: The modeled system is anticipated to have a 22-year payback, an IRR of only 1.34%, and a slightly negative net present value. With solar systems operating for 30+ years, solar does make sense, but is not particularly attractive through a strict financial lens.

The State of Florida does not allow Power Purchase Agreements (PPAs), a common financing mechanism for schools. That said, EcoMotion believes that if allowed, a likely PPA rate of 12 - 15 cents/kWh would be significantly more than is currently paid to the utility, thus MAST would "be upside down." Another concept explored later in this plan is to get donations and grants to pay for solar, or to buy down its cost.

The following tables are generated in Energy Toolbase for 757 kW of solar MAST:

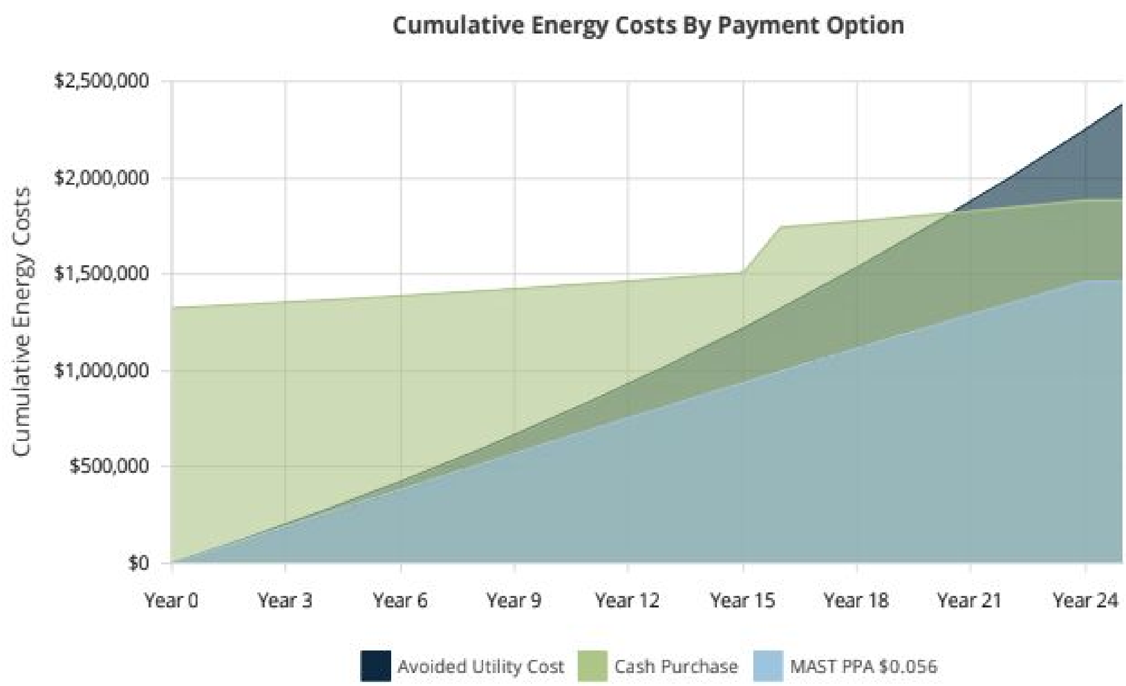
1 Project Summary

Payment Options	Cash Purchase	MAST PPA $0.056
Upfront Payment	$1,324,000	-
Total O&M / Equipment Replacement	$577,780	-
Starting PPA Rate	-	$0.056/kWh
Term	-	25 Years
Total Payments	$1,324,000	$1,519,177
Rebates and Incentives	-	-
Net Payments	$1,324,000	$1,519,177
25-Year Electric Bill Savings	$2,383,706	$2,383,706
25-Year IRR	2.3%	0%
25-Year LCOE PV	$0.049	$0.056
25-Year NPV	($33,508)	$565,426
Payback Period	20.5 Years	-

Combined Solar PV Rating
Power Rating: 757,080 W-DC
Power Rating: 666,261 W-AC-CEC

The Project Summary above shows that in addition to the initial price, the costs of a solar investment include Operations and Maintenance (O&M), as well as equipment replacement, notably the replacement of inverters.

The following graph shows project cash flow by showing the avoided utility costs in dark blue, and the price of solar in light green. Clearly, the solar investment dwarfs grid power… until year 22 when the cumulative costs of the solar investment (including new inverters at year 15) are eclipsed by 22 years of "investing" in utility power. Note that these values are based on assumptions of both discount rates and utility-cost escalation.



2.1.1 PV System Details

General Information
Facility: Acct 69704-73075
Address: 3939 Rickenbacker Causeway Miami FL 33149

Solar PV Equipment Description
Solar Panels: (2103) Jinko Solar JKM360M-72
Inverters: (26) SMA Sunny Tripower 24000TL-US

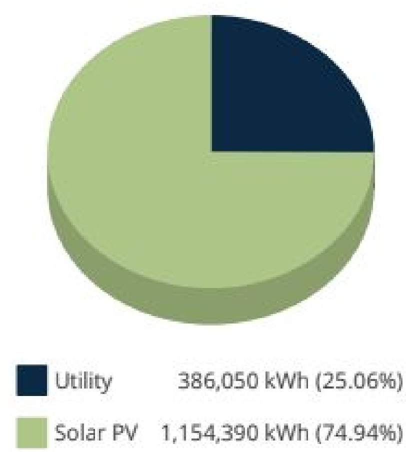
Solar PV Equipment Typical Lifespan
Solar Panels: Greater than 30 Years
Inverters: 15 Years

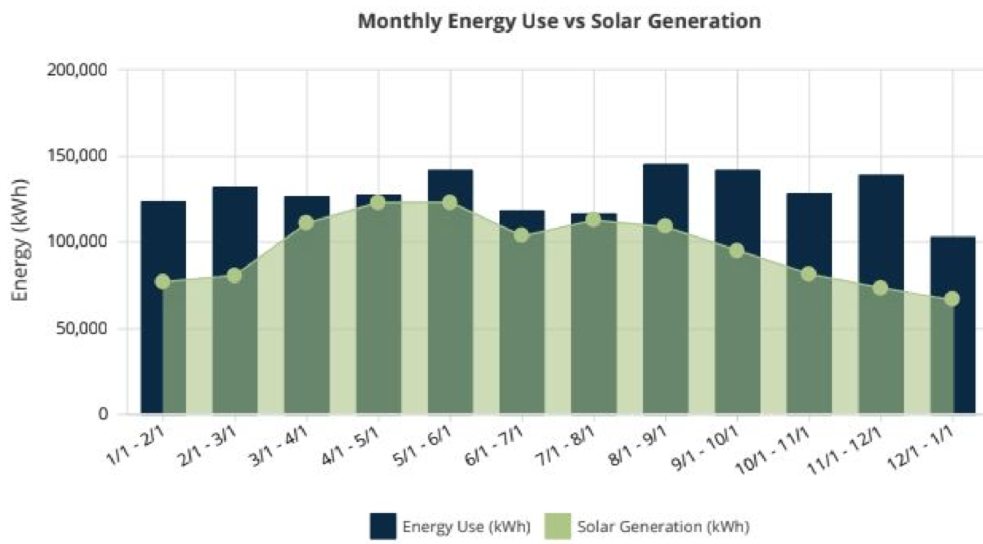
Solar PV System Cost And Incentives

Solar PV System Cost	$1,324,000
Net Solar PV System Cost:	**$1,324,000**

Solar PV System Rating
Power Rating: 757,080 W-DC
Power Rating: 666,261 W-AC-CEC

Energy Consumption Mix
Annual Energy Use: 1,540,440 kWh





The graph above shows how solar generation offsets power consumption throughout the year. Maximum generation is in summer when the days are longest.

The table below provides a snapshot of the rate relevant to MAST. Note that the energy charges are in the three to four cent/kWh range, peaking out in summer at 9.238 cents. These rates keep power costs low for Floridians, but retard investments in renewable energy systems.

2.1.3 Utility Rates

The table below shows the rates associate with your current utility rate electric bills after solar are shown on the following page.

Fixed Charges		Energy Charges	
Type	SDTR-2A	Type	SDTR-2A
S1 Monthly	$79.45	S1 Flat Rate	$0.04107
S2 Monthly	$79.45	S2 Flat Rate	$0.00138
S3 Monthly	$79.45	S3 Flat Rate	$0.04107
		S2 On Peak	$0.09283
		S2 Off Peak	$0.03372

The next two tables present a FLP bill analysis of current conditions, and then the bill with solar. Note that in this scenario solar will offset ~75% of campus electricity consumption, and will cut about 50% of the cost, with savings of ~$65,000 each year.

2.1.4 Current Electric Bill

The table below shows your annual electricity costs based on the most current utility rates and your previous 12 months of electrical usage.

Rate Schedule: FPL - SDTR-2A

Time Periods	Energy Use (kWh)			Max Demand (kW)		Charges			
Bill Ranges & Seasons	Total	On Peak	Off Peak	NC / Max	On Peak	Other	Energy	Demand	Total
1/1/2020 - 2/1/2020 S1	123,600	0	0	367	0	$79	$5,076	$4,899	$10,055
2/1/2020 - 3/1/2020 S1	131,400	0	0	395	0	$79	$5,397	$5,273	$10,749
3/1/2020 - 4/1/2020 S1	125,760	0	0	419	0	$79	$5,165	$5,594	$10,838
4/1/2020 - 5/1/2020 S1	127,080	0	0	502	0	$79	$5,219	$6,702	$12,000
5/1/2020 - 6/1/2020 S1	141,600	0	0	443	0	$79	$5,816	$5,914	$11,809
6/1/2020 - 7/1/2020 S2	0	15,488	102,712	0	443	$79	$5,064	$6,193	$11,337
7/1/2019 - 8/1/2019 S2	0	17,557	98,963	0	323	$79	$5,128	$4,516	$9,723
8/1/2019 - 9/1/2019 S2	0	17,770	127,310	0	417	$79	$6,143	$5,830	$12,052
9/1/2019 - 10/1/2019 S2	0	4,002	137,598	0	541	$79	$5,207	$7,563	$12,849
10/1/2019 - 11/1/2019 S3	127,800	0	0	477	0	$79	$5,249	$6,368	$11,696
11/1/2019 - 12/1/2019 S3	139,080	0	0	431	0	$79	$5,712	$5,754	$11,545
12/1/2019 - 1/1/2020 S3	102,720	0	0	465	0	$79	$4,219	$6,208	$10,506
Totals:	1,019,040	54,817	466,583	-	-	$953	$63,393	$70,813	$135,160

2.1.5 New Electric Bill

Rate Schedule: FPL - SDTR-2A

Time Periods	Energy Use (kWh)			Max Demand (kW)		Charges			
Bill Ranges & Seasons	Total	On Peak	Off Peak	NC / Max	On Peak	Other	Energy	Demand	Total
1/1/2020 - 2/1/2020 S1	46,796	0	0	337	0	$79	$1,922	$4,499	$6,500
2/1/2020 - 3/1/2020 S1	50,778	0	0	360	0	$79	$2,085	$4,806	$6,971
3/1/2020 - 4/1/2020 S1	14,924	0	0	362	0	$79	$613	$4,833	$5,525
4/1/2020 - 5/1/2020 S1	4,285	0	0	364	0	$79	$176	$4,859	$5,115
5/1/2020 - 6/1/2020 S1	18,675	0	0	363	0	$79	$767	$4,846	$5,692
6/1/2020 - 7/1/2020 S2	0	-1,174	16,047	0	334	$79	$453	$4,669	$5,201
7/1/2019 - 8/1/2019 S2	0	-1,629	5,574	0	255	$79	$42	$3,565	$3,687
8/1/2019 - 9/1/2019 S2	0	-2,418	38,912	0	266	$79	$1,138	$3,719	$4,936
9/1/2019 - 10/1/2019 S2	0	-11,525	58,112	0	181	$79	$954	$2,530	$3,564
10/1/2019 - 11/1/2019 S3	46,493	0	0	408	0	$79	$1,909	$5,447	$7,436
11/1/2019 - 12/1/2019 S3	65,719	0	0	388	0	$79	$2,699	$5,180	$7,958
12/1/2019 - 1/1/2020 S3	36,479	0	0	395	0	$79	$1,498	$5,273	$6,851
Totals:	284,149	-16,746	118,645	-	-	$953	$14,257	$54,226	$69,436

Annual Electricity Savings: $65,723

The following table presents a cash flow analysis for a 757 kW solar system paid with cash:

3.1 Cash Purchase

Inputs and Key Financial Metrics

Total Project Costs	$1,324,000	25-Year NPV	($33,508)	Discount Rate	2.50%
10-Year IRR	-11.05%	Payback Period	20.5 Years	Electricity Escalation Rate	3.50%
20-Year IRR	-0.34%	25-Year ROI	36.40%	Federal Income Tax Rate	0%
25-Year IRR	2.30%	PV Degradation Rate	0.50%	State Income Tax Rate	0%

Years	Project Costs	O&M / Equipment Replacement	Electric Bill Savings	Total Cash Flow	Cumulative Cash Flow
Upfront	($1,324,000)	-	-	($1,324,000)	($1,324,000)
1	-	($9,842)	$65,723	$55,881	($1,268,119)
2	-	($10,137)	$67,684	$57,546	($1,210,572)
3	-	($10,441)	$69,701	$59,259	($1,151,313)
4	-	($10,755)	$71,776	$61,021	($1,090,292)
5	-	($11,077)	$73,911	$62,834	($1,027,458)
6	-	($11,410)	$76,107	$64,698	($962,761)
7	-	($11,752)	$78,367	$66,615	($896,145)
8	-	($12,104)	$80,692	$68,588	($827,558)
9	-	($12,468)	$83,083	$70,616	($756,942)
10	-	($12,842)	$85,544	$72,702	($684,240)
11	-	($13,227)	$88,074	$74,847	($609,393)
12	-	($13,624)	$90,677	$77,053	($532,340)
13	-	($14,032)	$93,354	$79,322	($453,018)
14	-	($14,453)	$96,107	$81,654	($371,364)
15	-	($14,887)	$98,939	$84,052	($287,312)
16	-	($234,280)	$101,852	($132,428)	($419,740)
17	-	($15,794)	$104,847	$89,053	($330,687)
18	-	($16,267)	$107,926	$91,659	($239,028)
19	-	($16,755)	$111,093	$94,338	($144,690)
20	-	($17,258)	$114,350	$97,092	($47,598)
21	-	($17,776)	$117,698	$99,922	$52,324
22	-	($18,309)	$121,141	$102,832	$155,156
23	-	($18,858)	$124,680	$105,822	$260,978
24	-	($19,424)	$128,319	$108,895	$369,873
25	-	($20,007)	$132,060	$112,053	$481,927
Totals:	($1,324,000)	($577,780)	$2,383,706	$481,927	-

Distributed Wind

There are currently no wind turbines that meet Miami-Dade hurricane standards so wind for MAST is not feasible at this time. But that may well change as wind systems -- particularly smaller wind systems suitable for a school -- advance.

There are two common types of onsite or “distributed” wind power: pole-mounted turbines and building integrated systems. Pole-mounted wind turbines can be on a horizontal or vertical axis. Building-integrated systems represent a brave new world in which architecture is deliberate in its capture of prevailing winds.

Distributed wind systems face safety concerns with locating turbines in urban areas, where “shedding a blade” could be very dangerous. Zoning rules often stipulate that if a wind tower falls in any direction, it must fall on the owner’s property. Wind turbines mounted on buildings, or designed into them, can bring on undue noise and vibration, and physical stresses in high winds can be transferred from the wind turbine tower to the building.

Pole-Mounted Turbines: Pole-mounted turbines are common in wind farms. Their towers elevate their nacelles and turbine blades into the best wind regimes. Smaller-scale pole-mounted wind turbines suitable for homes, farms, and other distributed generation activities are common in windy areas where a lot of sizes are large and the wind blows quite steadily.

Vertical Axis Wind: Another pole-mounted configuration is the vertical-axis Windspire. Twenty of these 30-foot tall turbines have been installed at Adobe's headquarters in San Jose, California where a wind tunnel effect is created between two buildings.

Building-Integrated Wind: The most futuristic cases of building integrated wind involve new and large commercial buildings that have been designed to funnel wind through vortexes deliberately formed by their architects. Building geometry can enhance performance, scooping winds into the structures of buildings and through integrated wind turbines to generate power.

The Bahrain World Trade Center, with twin 50-story towers, was completed in 2008. It has three 225 kW turbines on bridges spanning its twin towers; it’s heralded as the first building to integrate commercial-scale wind turbines. The turbines tie the two towers, known as sails.
The Pearl River Tower in Guangzhou features advanced under floor ventilation, heat recovery, double glazing, high-efficiency lighting, solar used on east and west sides for partial shading,

and wind. In addition, the 309-meter, 71-story skyscraper has massive funnels that channel prevailing winds through vertical-axis wind turbines.

Parapet Wind: Back to scale in Miami…. Parapet wind turbines take advantage of a vortex that naturally occurs as wind currents rise up on the building face and then crest its parapets. Each turbine's axle rod is centered in this vortex, capturing maximum electrical power generation capability from the wind. One manufacturer, Aerovironment, has measured a 40% increase in wind speed at these parapet vortexes, translating into 2.7 times as much energy in the wind. Maximum wind performance, however, comes from laminar wind in which air flows in a single direction. At parapets, the fairly narrow band of higher velocity wind limits potential size.

Parapet wind can result in highly visible demonstrations. Massport installed 20 building integrated wind turbines at Boston's Logan International Airport. Each parapet-mounted wind turbine is six feet in diameter. The turbines are installed on the roof and generate 100,000 kWh annually.

Microturbines

Microturbines cogenerate electricity and heat, and are thus highly efficient thermodynamically. Capstone Microturbines boast highly efficient, "clean energy," and "ultra-low emissions" forms of natural gas combustion. By ganging together a series of 30 kW microturbines, they can be dispatched based on thermal and electric loads on site.

Given this report's focus on electricity, EcoMotion has not evaluated this option in great depth. Why, however, ought microturbines be dismissed? They are highly efficient, and like fuel cells, in the future, microturbines can also be a carbon-neutral option if run on biogas or hydrogen or combined with carbon offsets. In terms of thermodynamics, the efficiency of microturbines when harvesting waste heat for heating and cooling can be as high as 85 – 90%. That compares very favorably with Bloom fuel cell's guaranteed efficiency of 56% and power plants at ~40%.

Microturbines may be worthy of further investigation if MAST has an appetite for this kind of highly integrated system. They have the potential to decarbonize both electricity and heating (for space and hot water) on campus. Microturbine advocates claim that they are more cost effective and provide much greater reliability than fuel cells. Microturbines are much like commercial aircraft engines.

Unlike solar systems or fuel cells, microturbines would tap into the district heating and cooling loop, a significant engineering and construction endeavor. They would provide heating and cooling in a more efficient and environmentally benign way.

Capstone’s case study of the Ronald Reagan Library in Simi Valley, California involves 16 microturbines that provide 960 kW of power, providing 95% of the facility’s electricity requirement. The turbines’ exhaust heat is captured for absorption chilling; a subset of the units is connected to the facility’s heating loop.

Fuel Cells

Fuel cells are a viable technology for MAST consideration. Described simply as “continuous batteries,” they have guaranteed production efficiencies for converting natural gas to electricity. Several chemistries are being deployed. Bloom Energy states that its solid oxide fuel cells operate like baseload power plants, and result in less costs and net greenhouse gas reductions compared to grid power.

Bloom Energy is currently the leading fuel cell provider, offering clients 10 – 15 year contracts, and an attractive no-money-down business proposition. It has been highly successful at selling its economic solution to big box stores and others. Its natural gas fuel cells have been installed throughout California. In the future, these fuel cells will run on renewable natural gas, and ultimately hydrogen, providing carbon-free generation.

Net Positive Emissions: Bloom argues that its fuel cell emissions are lower than solar emissions since they are baseload and deliver 24/7 savings. Since solar is backed up with non-renewables, the daily carbon emissions of the combined system are greater than the fuel cells. Bloom also argues that there are times of the day when California’s grid is overloaded with renewables. Thus, the addition of more solar may not really offset any carbon. On the other hand, fuel cells operate all night long when there are limited renewables on the grid, and thus the carbon offset is significant. Could MAST engage Bloom for 10-15 years, earn the financial benefits of doing so, while reaping minor environmental benefits at the same time?

Paying for Fuel Cells: There are two cost components of Bloom’s fuel cells. The first is that there is no upfront cost for the equipment. Instead, customers pay a “tolling” rate of ~$0.10/kWh for use of the equipment installed. Second, customers buy their own natural gas. Customers work with gas providers to lock in favorable gas prices. Bloom’s gas specialists are on hand to advise clients as to whether they ought to float with the market, buy an option of 50% hedge, or engage in other strategies.

Bloom generates for ~13 cents per kWh with gas included. Note that FPL is currently providing power with a blended rate of ~$0.08/kWh. Often, Bloom will pair its fuel cells with energy storage in the form of “ultracaps,” advanced batteries but at present, and through a strict financial lens, the fuel cell option is not yet cost effective in Miami.

Renewable Natural Gas

There is a strong debate about whether the benefits of Renewable Natural Gas (RNG) outweigh its costs--true. Methane has a strong Global Warming Potential, 30 times that of CO_2… and gas systems leak. Perhaps there is no reason to form the RNG production industry, because it is fundamentally based on wasteful habits. Ideally, there will be no methane as organic materials are smartly reused without the anaerobic digestion that produces methane. Could RNG be a step on the path to a “solar-hydrogen economy?” Isn't RNG a bridge to that future? Could RNG have value for MAST… a means to cut CO_2 emissions?

There are three primary sources of RNG:

1. Anaerobic Digestion occurs in the absence of air in landfills, animal manure on farms, water resources reclamation plants, and food materials.
2. Gasification produces RNG from agricultural residues, forestry and forest product resources, "energy crops," and municipal solar wastes.
3. Power to Gas (P2G) results from the production of hydrogen from electrolytic or photolytic processes that splits water using renewable energy resources, and the methanation of hydrogen to use in natural gas pipelines.

Sparking the debate about RNG is another acronym: CAFO for Concentrated Animal Feeding Operations. CAFOs are problematic as articulated by the Sierra Club in a policy brief on methane digesters using manure. It claims that CAFOs are problematic in many ways - diseases, antibiotics, growth hormones, waste run-off, mistreatment of animals, disruptions to community farming -- so their fundamental operations are unsustainable. On a case-by-case basis, the Sierra Club sees merit, in some instances, for methane digesters on smaller farms.

In addition to digesters at CAFOs, there are digesters for aquaculture products, organic wastes, wastewater, food wastes, garden and lawn clippings, plant material, paper, cardboard, and wood. The methane is produced in the decomposition of organic materials. For farms, there are alternatives. Instead of collecting and centralizing manure production for anaerobic digestion, farmers can create compost through aerobic digestion (bacteria in the presence of oxygen that releases CO_2, not methane), or in cases, can spread manure on their fields providing enrichment to the soils without fermentation.

Clearly, given methane's greenhouse gas intensity, and the fact that our society has landfills, it is better to collect methane emanating from landfills than to release landfill gases into the air. RNG collection that keeps methane out of the atmosphere is carbon negative...meaning that more CO2-equivalent gas is captured than is given off in combustion or fuel cell use of the methane. Gasification holds promise for a broad spectrum of organic materials. A pilot plant in Gothenburg, Sweden effectively used forest residues to produce RNG. Municipal solid waste can be gasified to create fuel.

Hydrogen

The Power to Grid (P2G) concept utilizes "excess renewables," using the infamous utility “Duck Curve's” excesses (which highlight the intermittency of renewables… and getting too much solar all at once) rather than allowing the duck curve to thwart further development of wind and solar. The hydrogen fuel can be "bottled" and sold for vehicle fuel, or can be injected in natural gas pipelines to a point, creating "hydrogen-rich" natural gas. That, however, has its limits at about 10% concentration. For widespread pipeline use, the gas distribution system and all end-use appliances would have to be converted for hydrogen.

The near-term pathway for P2G hydrogen is methanation, so that the hydrogen gas can be mixed with geologic or renewable natural gas in the existing gas pipeline and distribution infrastructure. This is done using the Sabatier Reaction that was developed in 1897 by a Frenchman who won the Nobel Prize for his chemistry works. The process uses electrolysis to split water into oxygen and hydrogen. By adding CO2, methane is created. This process of methanation provides for synthetic natural gas that can be used readily in existing natural gas systems.

Until society is radically transformed and centralized waste streams are totally eliminated, RNG has a role in our society and represents a positive step forward. The reputation of CAFOs ought not shadow other beneficial sources of RNG. Clearly, unless we abandon them, we must tighten our natural gas pipelines. While a bit complex, there are reasons to value this carbon negative fuel source as a piece of the puzzle on a pathway to a sustainable future.

Off-Site Power Generation

This section of the report presents the off-site power generation options available today, as well as options that may be beneficial to MAST in the future. These include paying a premium and purchasing green power, Community Solar, Direct Access, and Community Choice Aggregation pathways that have been explored and tapped in investor-owned utility territories.

Imagine that MAST could own and operate a solar farm in the center of the state, and transmit to the campus through direct access!

Green Power

FPL offers the SolarNow program that “greens” a customer’s power use. Like many green power pricing programs across the country, through the program, FPL adds a premium to the bill, and in turn builds solar projects throughout its service territory. Residential customers pay $9/month to participate in the program. Certainly MAST can support local green power.

Community Solar

Florida Power and Light boasts the nation’s largest community solar program. Just launched in March 2020, we salute that. SolarTogether provides all FPL customers with clever means for those that rent or live in homes that are not conducive to solar to get their power from the sun. The new solar program will make going 100% solar an option for FPL customers, and will more than double the amount of community solar in the U.S. The program plans for the addition of 20 new solar power plants – totaling 1,490 megawatts of solar – by mid-2021.

Like a community garden, Community Solar is a collective array for its members that don’t have garden space at their home. Thus, unit costs are cut, and maintenance contracts can be in place to assure proper functioning and performance.

Direct Access

Direct Access is a term that refers to the purchase of power from a specific producer, a third-party generator located off-site. In this construct, not currently available in the State of Florida, MAST could buy from a wind farm, for example, and pay a “wheeling charge” to use utilities’ transmission and distribution lines to bring that power to campus. Cities such as Santa Monica, California that are in the Southern California Edison territory, buy green power through direct access at a discount. The California Public Utilities Commission has required Edison to open up certain percentages (“tranches”) of its retail load for Direct Access.

Community Choice Aggregation

Community Choice Aggregation is a huge trend nationwide. Enabled by state legislation, Community Choice Aggregation allows consumers to buy power from a CCA with the promise that it is indeed green, and that its cost will be less than grid power. CCAs provide win-wins for many communities... providing both economic and environmental benefits. In Florida, this is not allowed. Imagine if MAST could join a community choice aggregation initiative; they are now authorized in nine states: CA, IL, MA, NJ, NY, OH, RI, VA, but not yet Florida. Then it could potentially get 100% green power at no extra cost.

Purchasing Offsets

MAST could conceptually wipe clean its carbon footprint by buying its way out. This could be done with RECs – Renewable Energy Certificates – to green its electricity purchases, and with Carbon Offsets for all other energy uses that cause greenhouse gases, such as faculty and student commuting, and space and water heating on campus.

In ancient times, indulgences allow the rich to feel better about sinful behavior. In modern times, indulgences are available to green dirty power.

Critics claim that RECs and Carbon Offsets allow for slovenly behavior to continue, that they're a means for buying one's way out... often at a price that is a fraction of an actual investment in onsite or offsite generation. From one point of view, buying RECs is merely buying a label, an environmental tag for the commodity. On the other hand, buying RECs allows schools to support the renewable market without having to buy panels.

Many leading organizations have gained notoriety for their green power. In many cases, this has been accomplished offsite, buying wind in Wyoming or solar from the desert. In some cases, the purchaser has invested in onsite generation, and then augments that value with offsite credit. University of Pennsylvania has been the largest university purchaser of RECs. Intel was an early corporate leader. In 2007, Whole Foods bought enough RECs to offset its entire needs. Some years ago, the U.S. EPA claimed to have the highest percentage of green power use by any federal agency when it offset 100% of its electricity. In that same year, the Air Force was the largest consumer of RECs in absolute terms.

<u>Renewable Energy Certificates</u>

Renewable energy certificates are also known as green tags, renewable energy credits, renewable electricity certificates, or tradable renewable certificates (TRCs). They are tradable, non-tangible commodities that represent 1 MWh of electricity generated from a renewable source.

RECS can be sold, traded, or bartered. The owner of the REC can claim to have purchased renewable energy. Inversely, the seller of RECs cannot claim to have green power. RECs represent only the environmental attributes. Certifying agencies give RECs a unique identification number to make sure that RECs do not get double counted. Once retired, a REC cannot be sold, donated, or transferred to another party.

<u>Certification and Technologies</u>: The United States does not have a national registry of RECs. The Center for Resource Solutions administers the voluntary Green-e program that provides for audits and annual certifications. Some RECs are Green-e certified. Different technologies qualify: Solar electric systems, wind power, geothermal, "low-impact hydro" (eg. small run-of-the-river facilities), biomass biofuels, landfill-to -gas recovery, and hydrogen fuel cells. In some states, combined heat and power systems qualify. Purchasers can shop markets for the types of RECs desired and the locations from which the RECs are created.

<u>Compliance and Voluntary Markets:</u> Most university, corporate, and household purchases of RECs are voluntary. In all 29 states with Renewable Portfolio Standards, utilities must demonstrate compliance by purchasing energy and/or RECs from regional generators. This has boosted prices for RECs. Some states rank RECs into tiers, depending on their generation source and environmental impact. Generally, Tier 1 RECs are newly generated and from the cleanest renewable resources.

<u>Price Volatility</u>: Sixteen of the 29 states with Renewable Portfolio Standards have specific solar requirements. Solar RECs, or SRECs, are more valuable than generic RECs. Solar generators in New Jersey, at one point, could get a subsidy in the form of an SREC that went as high as $665 in 2010. That's 6.6 cents per kWh. It then dropped to $160 in 2014, a value of 1.6 cents per kWh. In slightly less dynamic markets, REC prices vary significantly. In 2011, RECs were worth $35 in Ohio, before falling to $8 there in 2015. In New England, RECs were below $20, and then climbed to $50 in 2015. In Canada, BC Hydro offers $3 for RECs for the green attributes of long-term contracts.

<u>Virtual Power Purchase Agreements</u>: Another means of obtaining RECs is through Virtual Power Purchase Agreements (VPPA). This mechanism allows a power-using institution, such as MAST, to engage in a VPPA in a distant location. The institution strips off the RECs and then sells the power to others. While the institution takes the risk for the whole deal – and hopes to recover much of its costs through sale of the power – the VPPA allows for institutions to lock in REC prices over time.

<u>Carbon Offsets</u>

Carbon offsets are reductions in GHG to compensate for, or to offset an emission made elsewhere. While RECs that are measured in MWh, carbon offsets are measured in metric tonnes of CO_2 equivalent. Typical sources for offsets are renewable energy projects, energy efficiency projects, and forestry projects.

Terra Pass: There are a number of companies that sell offsets to consumers so that they can offset their auto emissions, vacation air travel, etc. To be credible, these companies have to buy from certified sources. How can the purchaser of these offsets be assured that the forest growth in British Columbia is indeed what expert foresters predicted? How can purchasers be sure that the environmental attributes have not been sold beforehand? Organizations such as Climate Action Reserve develop protocols for measurement and verification of offset tonnes.

Offsets can be generated from a reduction in multiple greenhouse gases: CO_2, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride. They are identified by vintage (year in which reduction takes place), source, and certification regime.

Compliance and Voluntary Markets: As with RECs, carbon offsets are at work in both the compliance and voluntary markets. The compliance markets are marked by utilities and others that must comply with carbon caps. Voluntary markets mitigate GHG emissions from automobile transportation, electricity use, and other sources such as personal air travel.

Kyoto Protocol was signed in December of 1997, and sanctioned efforts to trade offsets through Clean Development Mechanisms (CDMs). The Kyoto Protocol required that offsets result in additionality. Between 2001, the first year of CDMs, and 2012, the end of the first Kyoto Commitment Period, CDMs are estimated to have produced 1.5 billion tons of CO_2e in emissions reductions. In 2016, $191.3 million of offsets were purchased in the voluntary market representing 63.4 million metric tons of CO_2e. Today an offset is worth about $12 a tonne.

Section 5: Financing Options

The State of Florida does not allow for Power Purchase Agreements (PPAs), one of the most common and viable financing mechanisms for solar on school campuses. PPAs might also be used for wind installations. Since schools are non-profit, they cannot monetize tax credits and depreciation benefits that cover over 50% of a renewable energy system's cost. Thus through PPAs, third parties -- private companies with "tax appetites" -- own and operate solar systems, selling green kilowatt-hours to the host site.

Barriers to Financing

Two renewable energy financing issues arise for MAST:

First, PPAs are not allowed. A back-up to consider may be Equipment Leases which have somewhat less benefit on the depreciation side, but which are used, for instance, in Los Angeles, where the municipal utility (LADWP) does not allow PPAs.

The second issue relates to price. While the price of solar is way down -- for a roof like the one at MAST, if in California the job would come in at ~$1.75/watt… a total of $1,324,750. Given FPL's low rates, that results in a long payback.

Similarly, the low rate impacts the viability of a financed deal. When financed, at a likely PPA price of 12 - 115 cents per kWh, the cost of the power will be considerably higher than grid power given FPL's low rates (~$0.08/kWh). Thus PPA solar -- if possible from a regulatory standpoint -- would still suffer from being more expensive than grid power. EcoMotion has calculated that MAST would need a $0.056 cent/kWh PPA price to break even. This is grossly unrealistic. Some PPA pricing structures start with low prices, which then escalate. EcoMotion believes that it will be hard for solar to pencil using financing for years to come.

<u>Donation Support</u>: Imagine, now, a successful PTA effort to raise money for solar! Imagine that parents and other community benefactors could donate panels. Instead of dollars, they donate panels that will leverage their contribution over time for student and school benefit, and the benefit of the environment. If half of the cost of the system is raised through panel donations, the payback is cut in half too. Note that any utility incentives for solar and grants would similarly cut the payback period, and ultimately provide greater value to MAST.

Benefactor Investment Model

EcoMotion's Benefactor Investment Model (BIM) was developed to allow not-for-profit institutions to go 100% solar with no capital out of pocket, and the benefit of a "Very Friendly" Power Purchase Agreement (PPA). Note that its use is dependent on FPL allowing PPAs in its service territory.

The cost of a solar system in the "for-profit" world is generally paid off under a traditional PPA in 6 - 10 years (that may be 10 - 15 years in Florida.) Why, then, can't a friendly third-party solar system provider be formed such that, once paid off, the entire system could be donated to the not-for-profit, giving them free energy thereafter?

In the BIM Model, Benefactors are tax-paying investors who, through a combination of cash flow, tax incentives and rebates, earn a reasonable ROI, and the institution gets free power for 20+ years! Here's how it works:

Step 1: Group of Benefactors Creates and Funds a Special Purpose Corporation (SPC)

First, we assemble a group of investors, Benefactors, who can benefit by the tax incentives related to solar energy investments. These are normally friends of the church, school or institution, parishioners, alumni, parents, members, neighbors, and others who care. We offer them a simple business proposition: invest now, get all their money back in about 8 years, and earn a decent ROI. The capital goes into an SPC, a Special Purpose Company (Sub-S Corp or LLC), where all profits, losses and tax credits flow through to the investors. The investors' personal "tax appetite" enables the Model to monetize tax credits and benefits that not-for-profits cannot get.

Step 2: The SPC Builds a Solar System and Sells its kWh Output to Host at a Discount

The SPC hires a solar installation company to build the solar system. The SPC enters into a PPA with the church/school/institution that commits the institution to buying 100% of the power output of the system at a predetermined price for the life of the system (25+ years). The pricing is generally at a discount of 5 - 10%, or more to current utility rates. That way, savings accrue to the institution right from the commissioning of the field.

Step 3: The SPC Monetizes Value for the Benefactors

The SPC engages an Owner's Rep to manage the solar installation company – project engineering, procurement, construction, commissioning -- to find and assess installation sites, identify grants, rebates, and incentives that are available, and through a competitive RFP process, to qualify and engage a solar company to construct the array. The system is designed, specified, procured, and built under the watchful eye of the Owner's Rep, all underwritten by the invested capital. The real estate for the solar installation is typically provided by the institution.

Step 4: By Year 6 - 8 the Benefactors Donate the System to the Host Site

The Benefactors, with the flow-through tax status of the SPC, personally recoup their entire investment from a combination of cash (payments by the institution for electricity consumed), and tax benefits from investment tax credits and depreciation. This "payback" normally takes 6 - 10 years, which coordinates well with the five-years stipulated by the IRS as the minimum to avoid "tax recapture."

Step 5: Benefactors Take Tax Deduction for their Charitable Contribution to the Host

When the Benefactors have (a) passed the tax recapture threshold and (b) recouped their investment, they are then poised to donate the system to the institution for its "fair market value." Around Year 8, the SPC changes its status to legitimize the gift of the solar operation without impacting the tax-free status of the not-for-profit entity. Benefactors then donate it to the institution after its payback. In doing so, they are entitled to a tax deduction for their charitable contribution, valued at the fair market value of the system.

Step 6: Host Site Gets "Free Power" for the Remaining Life of the System

Once the transfer is completed, the institution continues to pay the SPC for its energy per the terms of the PPA. The SPC pays tax on its profits and remits the remaining cash to the institution as a dividend, tax free. To manage the SPC's tax exposure, the institution and its wholly owned SPC "renegotiate" the PPA's energy pricing (down), mitigating or eliminating profits and related taxes, and the institution receives effectively free power for the next 15 - 20 years, paying only the negligible cost of periodic system maintenance.

Energy Independence

Before leaving this section, the most radical notion of all would be to develop MAST as a microgrid, separate from the utility altogether. The microgrid might have solar wind, storage, V2G storage, and smart energy management controls to handle the microgrid's peak periods. In this far-out scenario, the BIM model may well work… as the investors are selling power (or systems) backed up by significant storage directly to MAST. A legal review would need to be conducted to validate this mechanism.

Section 6: Recommendations

#1 Bring Students into the Process

MAST's pursuit of being carbon free is ideally suited to a student-driven, teacher-guided learning experience. Students spearhead the initiative, they can calculate the school's footprint, and then develop action steps to reduce that footprint. They can also be highly instrumental in "taking it to the streets" and representing the importance of climate action. To codify student action, we recommend a Student Climate Protection Council that meets monthly and is guided by faculty or involved parents.

#2 Determine the MAST Greenhouse Gas Footprint

The Student Climate Action Committee can be used to develop MAST's first greenhouse gas inventory. Students will be organized to collect data and to populate inventory software. We recommend establishing a 2020 baseline…all with a goal of being carbon free by 2045.

#3 Develop a Sustainability Committee

EcoMotion recommends that MAST develop a Sustainability Committee to promote and guide the climate actions on campus. The Sustainability Committee will be made up of student reps, teachers, school officials, and community members. The Committee will be responsible for goal-setting and securing budgets for planned and committed actions.

#4 Set Goals

Goal setting will be one of the most important steps in the "greenprint" suggested. To start off the process, EcoMotion recommends the following goals for carbon neutrality:

- 25% reduction in carbon intensity by 2025
- 50% reduction in carbon intensity by 2030
- 75% reduction in carbon intensity by 2038
- 100% reduction in carbon intensity by 2045

Note that carbon intensity includes building energy use, transportation energy use, as well as embedded energy in water, wastewater, and in waste management. MAST may elect to establish other goals, for instance, to cut water use or to cut its solid waste stream.

#5 Develop a Climate Action / Sustainability Plan

With aggressive goals in hand, the process shifts to developing a climate action plan (CAP) to achieve the carbon free objectives and goals. The CAP will document myriad measures for consideration, then will present costs and benefits (offset values) for screening and ultimately selection.

The plan will feature plausible carbon-free pathways for MAST. It will focus on maximizing energy efficiency through LED lighting, advanced HVAC, potential geothermal heat pumps, and controls. The plan will cover choices for energy generation -- from wind to solar, fuel cells, microturbines, etc. It will measure the benefits of energy storage, and provide a focus on energy resilience and its duration and costs.

The plan will dig into MAST's transportation energy use… considering the use of going electric with Ebuses, tracking Ebus and transportation electrification infrastructure grants. The plan will cover the notion of developing EV charging stations for teachers, staff, and students, and will address opportunities to organize carpooling. The plan will also develop a Recognition and Rewards program.

#6 Hire an Energy Manager /Sustainability Coordinator

For larger school districts, cities, and corporations, EcoMotion recommends hiring an energy manager to maximize energy efficiency to track energy costs, and to find means to lower these costs as well as the carbon footprint. Perhaps for MAST, the Energy Manager position can be melded into a broader Sustainability Coordinator position. In that way, the Coordinator will not only be focused on driving down energy consumption, but also on other resource use such as cutting water consumption through drought-tolerant landscaping, removal of nonessential turf, and the installation of water-efficient fixtures throughout campus.

#7 Maximize Energy Efficiency

Some say that you have to eat your efficiency vegetables first, before you can have the main entree of solar power! Efficiency is the first step. It's the least costly resource. It prepares a campus for renewable power. MAST ought to fully explore its efficiency options and fund a bundle of options that digs deeply in the School's carbon footprint.

#8 Pursue Renewable Energy

Solar Power: Florida's abundant sunshine is a natural for powering the school. That said, the economics of solar are not strong in Florida given the low power rates provided by Florida Power and Light. EcoMotion has modelled 757 kW on the School site.

Low rates result in long paybacks for solar… 20+ years. Furthermore, the State of Florida does not allow for Power Purchase Agreements (PPAs), commonly used mechanisms to allow for third-party financing of solar and other renewable technologies.

EcoMotion recommends that MAST pursue solar in the following ways:

- Advocate for regulatory changes to allow PPAs
- Explore the option of using equipment leases for financing solar
- Consider a modification to EcoMotion's Benefactor Investment Model
- Pursue solar thermal for domestic hot water

Wind Power: Florida has both tremendous wind energy potential and incentives to promote wind power. Given the steady wind in the region coming in off the ocean, MAST may well explore this renewable energy option. MAST will need to examine local ordinances. If there are no clear barriers, EcoMotion suggests having wind developers examine the site and load and make proposals for MAST consideration.

#9 Track Results and Revolve Savings

With a climate action plan in hand, complete with goals tied to specific dates and related to accountable parties, the next step is to make sure that there is a protocol for reporting savings, and tracking results… and success! EcoMotion recommends that MAST develop a "CAP Accountability Matrix" to carefully track results, flagging any discrepancies and noting responsible parties. One of the best mechanics for climate action is the creation of a revolving fund that takes a portion of the savings -- from efficiency, solar, ebuses, etc. -- and saves it to fund projects that beget more climate action. Some revolving funds are established with 50% of the savings.

#10 Recognition and Rewards

The last recommendation is about people, and recognizing exemplary actions taken by people. We recommend that MAST develop a Recognition and Rewards program such that students, teachers, staff, and administrators -- as well as PTA and community members -- can be recognized for the contributions they are making for climate action on MAST's behalf.