MARIANO MARCOS STATE UNIVERSITY

LOW CARBON SOURCES TRACKER
(as of December 2023)

Introduction

The Low-Carbon Sources (LCS) Tracker represents a comprehensive initiative aimed at monitoring, assessing, and promoting the integration of low-carbon energy sources within the university. As the global community grapples with the challenges of climate change and the imperative to transition towards sustainable energy practices, MMSU recognizes the importance of actively tracking and fostering the adoption of low-carbon sources within its jurisdiction. This tracker serves as a vital tool in aligning university energy policies with environmental sustainability goals and contributing to a greener and more resilient academic community.

Objectives

1. The primary objective of the LCS Tracker is to monitor the adoption and utilization of low-carbon energy sources within the university and its affiliated areas. This includes renewable energy technologies such as solar, wind, biomass, and other eco-friendly alternatives.

2. Another key goal is to promote public awareness within the university community regarding the benefits of low-carbon energy sources. By disseminating information through various channels, MMSU seeks to educate students, faculty, and staff on the positive environmental, economic, and social implications of transitioning to sustainable energy practices.

3. The data collected through the tracker provides valuable insights to support the development and refinement of university energy policies. It aids in crafting policies that incentivize and facilitate the adoption of low-carbon sources while aligning with broader regional and national sustainability objectives.

Analysis

Shown in Figure 1 is the total energy consumption (GJ) of MMSU highlighting the energy consumed from fossil and low-carbon sources for the period of 2016-2023. Over the last 8 years, the total electricity consumption has exhibited a steady upward trend, increasing from 1,938,227 kWh (6,977.56 GJ) in 2016 to 2,602,443 kWh (9,368.72 GJ) in 2023. Except for 2020, where the mode of learning shifted to online due to lockdowns brought by COVID-19 pandemic. This rise suggests a growing demand for electricity in the university due to the increased infrastructure development particularly in establishment of new buildings such as the Food Processing and Innovation Center, National BioEnergy Research and Innovation Center, RDE Phase 2 Building, and College of Medicine Building; and

renovation of old buildings such as the Center for Flexible Learning, Library, Administration Building, and CBEA Building.

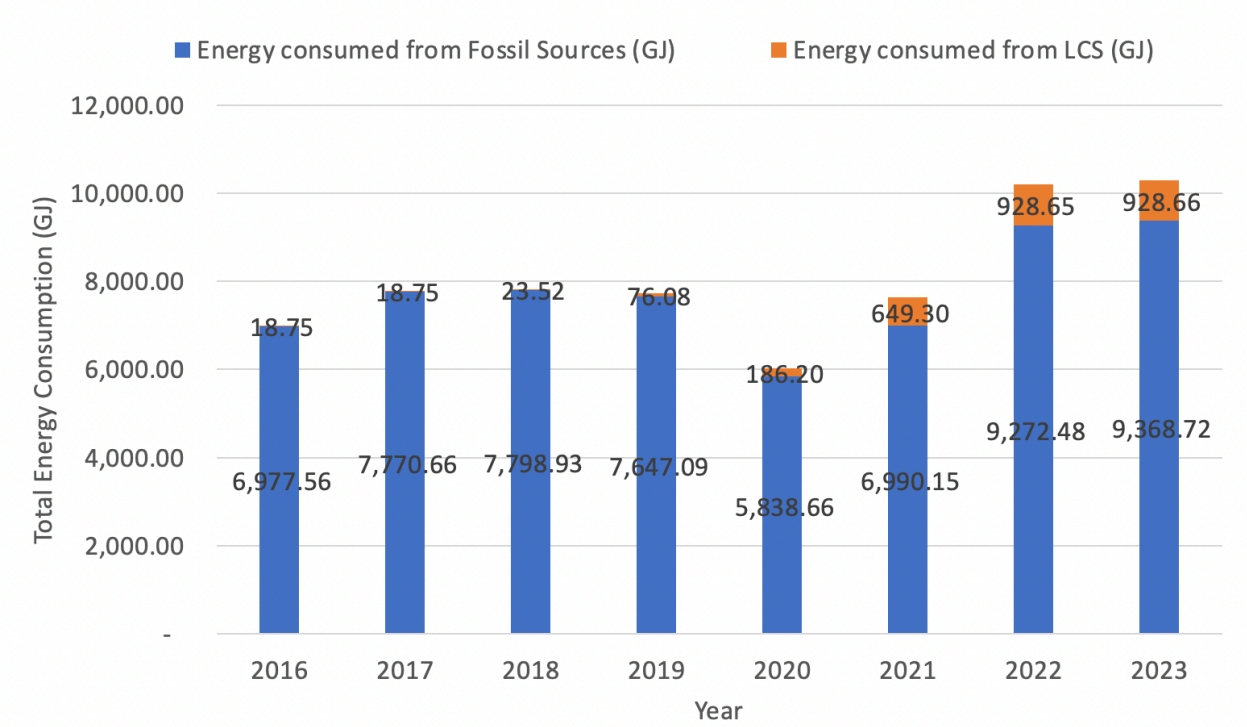

Figure 1. Total energy consumption (GJ) of MMSU showing the energy consumed from fossil and low-carbon sources for the period of 2016-2023.

Notably, solar photovoltaic (PV) capacity has seen significant advancement, starting at 0 kWp in 2016 and reaching 154.26 kWp in 2023 (Table 1). Correspondingly, energy generation from solar PV has witnessed substantial growth, escalating from 0 kWh in 2016 to 225,219.60 kWh (810.78 GJ) in 2023, indicating an increasing reliance on solar technology. Wind energy generation, on the other hand, has remained constant at 3,942 kWh (14.19 GJ) throughout the analyzed period, suggesting a need for exploration into ways to augment wind energy production. Bioethanol energy generation has shown fluctuations, with an initial increase from 1,267.20 kWh (4.56 GJ) in 2016 to 28,800.00 kWh (103.68 GJ) in 2023.

Overall, the total energy derived from low-carbon sources, including solar, wind, and bioethanol, has exhibited a positive trajectory, reaching 257,961.60 kWh (928.65 GJ) in 2023. Continued efforts to enhance solar, wind and bioethanol technologies are pivotal for achieving long-term sustainability goals in the university.

Table 1. Increasing MMSU's Low-Carbon Source capacities for the period 2016-2023.

Year	Solar PV Capacity (kWp)	Total Energy Generated from Solar PV (kWh)	Total Energy Generated from Wind (kWh)	Total Energy Generated from Bioethanol (kWh)	Total Energy Generated from Low Carbon Sources (kWh)
2016	-	-	3,942.00	1,267.20	5,209.20
2017	-	-	3,942.00	1,267.20	5,209.20
2018	-	-	3,942.00	2,592.00	6,534.00
2019	10.00	14,600.00	3,942.00	2,592.00	21,134.00
2020	13.00	18,980.00	3,942.00	28,800.00	51,722.00
2021	101.11	147,620.60	3,942.00	28,800.00	180,362.60
2022	154.26	225,219.60	3,942.00	28,800.00	257,961.60
2023	154.26	225,219.60	3,942.00	28,800.00	257,961.60

Sample Photos

Example of Solar roof-top PV installation at NBERIC Building

Example of a Wind-powered water pump used by DA-ATI inside the MMSU-Batac Campus	Example of a Residential Wind Turbine at Old NBERIC Laboratory

Example of Floatovoltaic Grid tie setup at MMSU Currimao Campus

Example of Solar-powered Irrigation Systems

Example of Gasoline blended with MMSU Hydrous Ethanol for use of university vehicles

Currently, Mariano Marcos State University is harnessing 3 sources of renewable energy - bioethanol, solar and wind. Solar power has been utilized for a variety of applications (i.e. solar powered irrigation pumps, solar-powered lights, solar PV generators). The breakdown of which are as follows:

Setup	Total Capacity (kWp)	Location	Storage (kWh)
Solar Pump DA	5	MMSU Cares, Batac	
Solar Pump DA	3	MMSU Cares, Batac	
Solar Pump DA	3	MMSU Cares, Batac	
Solar Pump NBERIC	1	Admin, Batac	
Solar Pump NBERIC	1	Admin, Batac	
Solar Pump NBERIC	1	Admin, Batac	
Solar Pump NBERIC	1	Admin, Batac	

Setup	Total Capacity (kWp)	Location	Storage (kWh)
Solar Pump DA	5	MMSU Cares, Batac	
Solar Pump DA	3	MMSU Cares, Batac	
Solar Pump NBERIC	1	CAFSD, Batac	
Solar Pump NBERIC	1	CAFSD, Batac	
Solar Pump NBERIC	1	CAFSD, Batac	
Solar Pump CAFSD	1.1	CAFSD, Dingras	
Hybrid Offgrid	5	Nagbacsan Piggery, Batac	9.60
Hybrid On/Offgrid	10	NBERIC Old, Batac	38.40
Hybrid On/Offgrid	10	NBERIC New, Batac	38.40
Hybrid Offgrid	3	NBERIC New, Batac	2.40
Offgrid	1	NBERIC New, Batac	2.40
Grid-tie	40	NBERIC New, Batac	
Hybrid On/Offgrid	15	NBERIC AREC, Batac	30.72
Grid-tie	20	COM, Batac	
Grid-tie	20	CTE, Laoag	
Hybrid On/Offgrid	6.37	CASAT, Currimao	19.20
Grid-tie	4.55	CASAT, Currimao	
MMSU Street Lights Old	0.05	Batac Campus	
MMSU Street Lights New	0.09	Batac Campus	
MMSU Street Lights New	0.1	Batac Campus	
Windmill HAWT	0.5	NBERIC Old, Batac	
Windmill Water Pumping	1	Nagbacsan, Batac	

Sample Calculations:

Solar

Assumptions:

154.26 kWp Solar PV Generation
80% Overall System Efficiency
5 average sun-hour in Ilocos Norte
365 days per year

225,219.6 kWh/yr

Wind

Assumptions:

1.5 kWp Wind Generation
30% Efficiency on Rated Capacity
365 days per year

3,942 kWh/yr

Bioethanol

Assumptions:

250 days of operation
2 # of units
6% EtOH Yield per batch
150 L fermented juice

9 L of 95% EtOH produced per unit per day
4,500 L of 95% EtOH produced per year (for all units)

18,000.0 L of Gasoline needed (E20)

22,500.0 L of E20 produced

6.4 kWh/L of EtOH

28,800 kWh equivalent from 4,500 L 95% EtOH produced per year (for all units)