DEPARTMENT OF ENERGY
REPUBLIC OF THE PHILIPPINES

MARINDUQUE

ENERGY PLAN

2018 - 2040

MESSAGE

The Province of Marinduque, known as "**Heart of the Philippines"**, is a favorite tourist destination for its beautiful attractions, rich culture, and great heritage sites. It is also home to one of the country's oldest religious festival – the famous Moriones Festival.

Aside from its thriving tourism industry, the economic backbone of the province is also supported by agriculture, fishery, and agro-processing. These make Marinduque capable of opening its door to a myriad of opportunities for more jobs and investments that could stimulate local economic growth and development. These positive economic prospects along with increasing populace signal the need to identify interventions, initiatives and strategies that could empower the province in its quest towards industrialization.

The Department of Energy, together with our dedicated and committed stakeholders, share the vision of transforming Marinduque into a developed and economically sustainable province. And to build on this vision, the Marinduque Energy Plan (MarEP) was formulated to establish the long-term perspective of the Province's energy needs particularly responding to its power supply requirements for the next 23 years. The Plan will ultimately contribute in creating a conducive environment for investments and uplifting the socio-economic condition in the province consistent with the goal of alleviating poverty and promoting inclusive growth.

One of the potential areas for development is the unlocking of its renewable energy (RE) resources which requires the participation of local government units particularly their involvement in the formulation of local energy policies, as well as in the crafting of local energy plans to address energy needs of the province. Their role in the transition of energy systems from one that is completely dependent on fossil fuels to one that is diversified is highly significant.

I would like to express my gratitude to the members of the Energy Family especially to the Philippine National Oil Company – Renewable Energy Corporation (PNOC- RC) for taking the initiative in exploring the potentials of the province. I believe that the path to a better sustainable future for all of us is a continued partnership that is exerting concerted efforts between and among stakeholders and local government units striving to reduce poverty, promote a healthier environment and a better life for all Filipinos.

The MarEP will serve as a living document, signifying a dynamic partnership between the DOE and the Marinduqueños.

I wish Marinduque's success in all its endeavors.

FELIX WILLIAM B. FUENTEBELLA
Undersecretary
Department of Energy

MESSAGE

Warmest Greetings from the Heart of the Philippines, the beautiful island-province of Marinduque.

It is of great honor to have the opportunity to be a part of this edifying and revolutionary energy plan for Marinduque because we are sturdily visualizing and aiming for the overall advancement of the province's energy supply in order to support the greater demand in the near future.

Evidently, our province is on its Golden Era and we should be working and serving to let our people feel the progress. However, the vision of a wealthier and progressive Marinduque can be hardly achieved without an efficient, secured, and sustainable energy supply. Hence, the formulation of Marinduque Energy Plan (MarEP) 2018-2040 comes at most relevant time to serve as our guide in driving the province's energy sector forward on top of propelling our local economy.

MarEP envisions a diversified energy resources given the several potential sources of renewable energy identified in the plan. With the goal of accelerating the province's energy transition to renewable energy, the Provincial Government of Marinduque will surely be working hand-in-hand in the course of exploring, developing, and utilizing these indigenous sources in order to address our current dependence on fossil fuels.

The Plan also embodies the action plans and programs that we need to take to meet the present and future energy needs of our people. With this, we are confident that it will allow us to appropriately respond to emerging energy challenges and consequently, help us realize our desired energy state for the province.

To conclude, let me take this opportunity to extend my gratitude to the Department of Energy in taking the lead in formulating the MarEP 2018-2040.

Let us continue serving for the betterment of the lives of all Marinduqueños.

For the Golden Era of Marinduque.

PRESBITERO J. VELASCO, JR.
Provincial Governor
Marinduque

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ABBREVIATIONS and ACRONYMS

AGR	Average Growth Rate
ACSR	Aluminim conductor steel-reinforced
AHFF	Agriculture, Hunting. Forestry and Fishing
BFP	Bureau of Fire Protection
BLEP	Barangay Line Enhancement Program
CALABARZON	Calamba, Laguna, Batangas, Rizal, Quezon
CAPEX	Capital Expenditure
CBMS	Community-based Monitoring System
CO_2	Carbon Dioxide
COC	Coal Operating Contract
CREC	Centralized Review and Evaluation Committee
CSP	Competitive Selection Process
DC	Department Circular
DDP	Distribution Development Plan
DENR	Department of Environment and Natural Resources
DOE	Department of Energy
DTI	Department of Trade and Industry
DUs	Distribution Utilities
EBT	Energy Balance Table
ECs	Electric Cooperatives
EECO	Energy Efficiency and Conservation Office
EICC	Energy Investment Coordinating Council
EO	Executive Order
EPIRA	Electric Power Industry Reform Act
EPNS	Energy Project of National Significance
EPPB	Energy Policy and Planning Bureau
ERC	Energy Regulatory Commission
EVOSS	Energy Virtual One-Stop Shop
FiT	Feed-in-Tariff
GEOP	Green Energy Option
GESP	Geothermal Energy Service Contract
GDP	Gross Domestic Product
GFCE	Government Financial Consumption Expenditures
GRDP	Gross Regional Domestic Product
GSLFAP	Gasoline Station Lending and Financial Assistance Program
GVA	Gross Value Added
GWh	Gigawatt Hour
HECS	Household Energy Consumption Survey

HFCE	Household Final Consumption Expenditure
IEC	Information, Education and Communication
IP	Indigenous People
IRENA	International Renewable Energy Agency
IRR	Implementing Rules and Regulations
KM	kilometer
KPS	Key Performance Standards
KTOE	Thousand Tons of Oil Equivalent
KV	Kilovolt
KVAR	Kilovolt Ampere Reactive
LCOE	Levelized Cost of Electricity
LEAP	Long-range Energy Alternatives Planning
LEECP	Local Energy Efficiency and Conservation Plan
LFRO	Locations of Liquid Fuels Retail Outlets
LGU	Local Government Unit
LOLE	Loss-of-Load Expectation
LOLP	Loss of Load Probability
LPG	Liquefied Petroleum Gas
MARELCO	Marinduque Electric Cooperative, Inc.
MarEP	Marinduque Energy Plan
MEP	Missionary Electrification Plan
MIMAROPA	Mindoro. Marinduque, Romblon, Palawan
MIR	Minimum Inventory Requirement
$MTCO_2e$	Metric Tonnes of CO_2 equivalent
MOPS	Mean of Platts Singapore
MW	Megawatt
NDC	Nationally Determined Contribution
NEA	National Electrification Administration
NEDA	National Economic Development Authority
NGCP	National Grid Corporation of the Philippines
NPC	National Power Corporation
NPC-SPUG	National Power Corporation-Small Power Utilities Group
NPP	New Power Provider
NREL	National Renewable Energy Laboratory
NREB	National Renewable Energy Board
NREP	National Renewable Energy Program
OMPDP	Occidental Mindoro Power Development Plan
PAA	Performance Assessment and Audit
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCA	Philippine Coconur Authority
PDC	Philippine Distribution Code
PD	Planning Division
PDP	Philippine Development Plan
PGR	Population Growth Rate
PIPDP	Palawan Island Power Development Plan
PNP	Philippine National Police

PNOC-RC	Philippine National Oil Corporation-Renewable Corporation
PNS	Philippine National Standards
PSA	Philippine Statistical Authority
PSA	Power Supply Agreement
PSGG	Philippine Small Grid Guidelines
PSP	Private Sector Participation
PSPP	Power Supply Procurement Plan
QTP	Qualified Third Party
RA	Republic Act
RCP	Resiliency Compliance Plan
RDC	Regional Development Council
RDP	Regional Development Plan
RGDP	Regional Gross Domestic Product
RE	Renewable Energy
REDCI	Renewable Energy Developer Cash Incentive
REM	Renewable Energy Market
RORO	Roll-on/Roll-off
RPS	Renewable Portfolio Standard
RWMHEEF	Reforestation, Watershed Management, Health and/or Environment Enhancement Fund
SEP	Sitio Electrification Program
SIIG	Small Islands and Isolated Grids
TCPPF	Technical Committee on Petroleum Facilities and Processes
TDP	Transmission Development Plan
TEP	Total Electrification Program
TFEC	Total Final Energy Consumption
TFEM	Task Force E-Power Mo
TOE	Tons of Oil Equivalent
UCME	Universal Charge on Missionary Electrification
VRE	Variable Renewable Energy

OVERVIEW AND EXECUTIVE SUMMARY

MARINDUQUE ENERGY PLAN 2018-2040: *Building the Corridor to Progress through Energy Development and Utilization*

Poverty reduction remains an unfinished business for developing countries like the Philippines. Without strategies to address economic inequality, government gains will never be felt by all segments of society. It is in this context that the *Duterte Administration* has a prime banner program on *inclusive growth* to ensure that a level playing field is available for all Filipinos. And to usher in and enable inclusive growth, the Department of Energy (DOE) is tasked to work on improved energy policies and plans to provide a stable, adequate, reliable energy supply towards a sustainable growth path for the country.

Marinduque's economic potential is promising given its improving tourism sector that could bring a dynamic opportunity not only for the province but for MIMAROPA region as well. This provides greater prospect for businesses to expand and for more investments to pour in. However, the challenge that looms on the horizon is the need to ensure that there is sufficient energy supply and that required energy infrastructures are in place to meet and sustain the growing local economy. Thus, the first ever Marinduque Energy Plan (MarEP) was formulated by the DOE to serve as a "living energy plan" for all Marinduqueños, its local government units (LGUs), civil society and the private sector. The MarEP should be pursued through collective involvement of all key stakeholders to achieve the development targets. It intends to set forth a strategic vision of greater energy access and better services for Marinduqueños as it outlines all initiatives, strategies and programs towards energy development and utilization in the province.

A. ENSURING ENERGY ACCESS AND SUPPLY RELIABILITY IN THE POWER AND DOWNSTREAM SECTORS

Improvement in energy access and supply reliability eventually leads to increasing energy demand. It is within this backdrop that the country needs more investments and infrastructure in the downstream oil and power development. Below provides a brief assessment on the said sectors with an overview of developments and future progress for Marinduque.

Power and Electrification

As the country also afflicted by the Coronavirus Disease 2019 (COVID-19), a global pandemic, community lockdown had been imposed, particularly in Luzon, which restricted mobility of people and decelerated economic activities. Such resulted in lower electricity due to non-operation (or limited) operation of large industries and commercial establishments. Contextualizing the situation at the provincial level, specifically in Marinduque, impact on demand was nil as the

residential sector is the largest user of electricity with more than 60.0 percent share of total electricity consumption of the province.

Marinduque's peak demand and electricity consumption in the first quarter of 2020 were recorded at 10.52 MW and 13,983 MWh, respectively. These were higher by 4.8 percent and 11.7 percent compared to first quarter of 2019. Weighing on the difference between the first quarter of 2020 and fourth quarter of 2019, peak demand declined by 1.4 percent (down from 10.67 MW) while electricity consumption had a minimal increase of 4.1 percent (from 13,428 MWh to 13,983 MWh).

Marinduque Power Summit

As a response to growing power sector concerns in the province, a *"Virtual Marinduque Power Summit"* was held last 9 July 2020. The Power Summit was guided by the following objectives: (a) understand further the province's power supply situation; (b) identify the required support mechanism for its commercial and industrial transformation; and (c) harmonize local and national plans to have synergy of goals. The Summit pointed to the emergence of one of the concerns, which is the frequency of power interruptions. To address this, the concerned agencies have identified specific deliverables all aimed at improving supply security in the province. The following shall be the major actions to be undertaken to address the issues on electricity services affecting the province:

- Provision of adequate capacity by the National Power Corporation-Small Power Utilities Group (NPC-SPUG) through:
  a. Installation of new generating units in Boac Diesel Power Plant (DDP) and Torrijos DDP; and,
  b. Rehabilitation of existing generation units.
- Relocation of distribution lines of Marinduque Electric Cooperative (MARELCO) affected by road widening projects of the Department of Public Works and Highways (DPWH);
- Review of technical audit done in Marinduque and applicable lessons on similar activities in other off-grid islands;
- Establishment of technical parameters and harmonization of reports for a thorough analysis on the generation, transmission and distribution system;
- Conduct of engineering studies of the power system;
- Monitoring of System Operation and Outage Management Program;
- Implementation of Vegetation Management Plan;
- Formulation of a Small Grid Enhancement Program based on the result of the engineering studies to be conducted;
- Review of the ongoing Competitive Selection Process of MARELCO; and,
- Study on the Interconnection of Marinduque to the Luzon Grid.

The detailed description of the action plans is summarized in Table 37 under the Power and Electrification Section in Chapter V: Plans and Programs.

The upward trend in power demand is expected to continue due to foreseen robust growth of its local economy considering the priority investment plans of the province, such as the establishment of the Marinduque Economic Zone (MAREZ) and the Marinduque International Port. Indicatively, there are expressions of interest from both local and foreign investors to come

in and host potential projects like hotels, and resorts for tourism in the province. Hence, it is necessary to have strong policy support and mechanisms and implement new strategies to further improve the delivery of electricity services in the province.

Competitive Selection Process (CSP). All existing missionary areas are declared open for private sector participation. To ensure supply security and increase access to electricity, MARELCO is seeking for a new power provider (NPP) to deliver a sufficient and reliable supply of power for its entire coverage area. Currently, MARELCO is in the process of undertaking CSP to secure the least cost for its electricity supply. CSP is envisioned to improve reliability of supply, reduce government's subsidy for missionary electrification and rationalize the Universal Charge on Missionary Electrification (UCME). The NPP is targeted to be in full operation by September 2022.

Transmission Projects. The province's existing 69 kV transmission line has never been commissioned and energized due to right-of-way (ROW) problems and damaged lines caused by typhoons. With this, the NPC-SPUG is undertaking the rehabilitation and completion of the existing transmission backbone. Also, the rehabilitation and uprating of the 10-megavolt ampere (MVA) Boac Substation is on the process to match the demand growth in the province. The Mogpog-Buenavista 69-kV Transmission Line (approximately 40 circuit-kilometers) is also envisioned to be implemented as identified on NPC-SPUG's plan and programs.

On island interconnection, the Transmission Development Plan (TDP) of National Grid Corporation of the Philippines (NGCP) has included the initial conceptual plan for interconnection of Marinduque to the Luzon Grid via General Luna, Quezon. With the ongoing CSP of MARELCO, timeline of interconnection must synchronize with the MARELCO TOR's cooperation period of 15 years to avoid stranded contract. To lay the groundwork, detailed interconnection study is necessary to determine its viability with due consideration on the cost and possible sources of funding of the project. Note that based on the Electric Power Industry Reform Act's (EPIRA) Implementing Rules and Regulation (IRR), the off-grid will cease to receive government subsidy through UCME once interconnected.

Distribution Projects. To continually improve the operational efficiencies and performance of distribution network, several distribution rehabilitation and upgrades are set to be implemented as included in MARELCO's capital expenditure (CAPEX) program: (1) installation of additional 5-MVA Substation between Gasan and Buenavista to address impending voltage issues at the load end; (2) reconductoring of line segment from Brgy. Cagpo, Torrijos to Brgy. Manlibunan, Sta. Cruz; (3) installation of three 150-kilovolt ampere reactive (KVAR) single phase capacitor in Buyabod, Sta. Cruz; and (4) Replacement of rotten cross arms and poles, undersized poles, broken insulators, defective cut-outs, and defective lightning arresters.

MARELCO also planned to extend its distribution network using submarine cables to the island barangays (Polo, Maniwaya, Mongpong) that are isolated from the main grid to further improve the operating hours of electricity services in these barangays. Presently, Mongpong is the only remaining island-barangay that is not connected to the Marinduque main grid. The interconnection of Mongpong to Maniwaya via Sitio America is highly anticipated as the project will enable the province to have a single and unified distribution network.

Electrification Program. The province had made significant progress toward achieving greater access to electricity services. It achieved 100.0 percent barangay electrification since 2012. As of 2017, sitio electrification stood at 95.1 percent, while household electrification reached 90.36 percent. If based on the 2015 Census, MARELCO has already realized the target of 100.0 percent electrification to all households within its franchise.

NPC and MARELCO remain steadfast in extending their services and bringing light to the farthest corners of the country by continuously identifying new areas for electrification to include the Salamague Island and Gaspar Island with target implementation in 2020 and 2021, respectively.

Financial Benefits under E.R. 1-94. As of December 2018, the total collected financial benefits for the province amounted to PhP 3.83 million. On the administration of funds under E.R. 1-94, one of the major developments is the direct remittance of financial benefits to host communities as provided under DOE Department Circular (DC) No. 2008-08-0021 issued on 23 August 2018.

New Policy Directions towards Energy Development

- **DC 2019-01-0001** titled **"Prescribing the Omnibus Guidelines on Enhancing Off-Grid Power Development and Operation"** serves as the new framework for missionary electrification to rationalize and improve the Universal Charge on Missionary Electrification (UCME) subsidy system. It adopts appropriate tariff mechanisms and encourages private sector participation by introducing new technologies to lower electricity rates and help attain the national target of 100.0 percent electrification rate.

- Republic Act 11234 or the **"Energy Virtual One-Stop Shop (EVOSS) Act**" mandates the creation of an online platform which would facilitate the paperless applications for permits for new power generation, transmission or distribution project.

- **Executive Order 30 (EO 30)** signed by President Duterte in 2017 created the *Energy Investment Coordinating Council (EICC)* in order to streamline the regulatory procedures affecting energy projects for effective and timely implementation of projects.

- RA 11285, *"***An Act Institutionalizing Energy Efficiency and Conservation, Enhancing the Efficient Use of Energy, and Granting Incentives to Energy Efficiency and Conservation Projects,"** establishes a framework to internalize energy efficiency and conservation in all sectors of economy. In line with the provisions of the law, local government units shall establish their own Energy Efficiency and Conservation Office (EECO) with the main mandate of developing and implementing Local Energy Efficiency and Conservation Plan (LEECP).

- The **LGU Local Energy Code (DILG-DOE Joint Memorandum Circular No.2020-01**) mandates Local Development Councils to activate their respective Energy Sector Committee to facilitate the implementation of energy projects.

Downstream Oil Industry

Marinduque hosts one (1) oil depot/storage with a capacity of 2.04 thousand barrels (MB) used to stock petroleum product. As total oil demand stretches to 819 MB in 2040, corresponding total storage capacity requirement reaches 65 MB with a turnover rate of around 12.6, or a replenishment rate of 12 times in a year. Considering the 80.0 percent capacity utilization rate, a total storage capacity requirement of 81 MB in 2040 is needed to address the growing oil demand and ensure that petroleum products inventory levels are met. The required storage capacity assumes a 30-day inventory level for gasoline, diesel, kerosene and biofuels, and a 15-day inventory for liquefied petroleum gas (LPG). However, maintaining the minimum inventory level as prescribed by the DOE reduces the storage capacity requirement by half. The decision to put up additional storage capacity is vested on oil companies operating in the province in consideration of whether such is financially feasible to pursue.

In terms of monitoring, enforcement and consumer protection activities, the DOE ensures that policies, plans, programs, and regulations are properly and strictly implemented to protect the consumers from illegal business practices.

B. PRESERVATION OF ECOLOGICAL BALANCE IN THE QUEST FOR ENERGY DEVELOPMENT

A critical area of concern in energy development is the promotion of a balanced ecology and its importance toward sustaining national development. It is in this context that the DOE embarked on promoting green energy technologies that would interlink national development goals with environmental preservation.

Renewable Energy

The aspiration of Marinduque to expand its local economy bequeaths the need and urgency to realize energy solutions that are clean, sustainable, and cost-effective. As renewable energy (RE) becomes a viable and competitive fuel option, it is necessary to exploit available renewable potential in the province to reduce dependence on imported fossil fuel, as well as address the growing concerns on climate change.

Solar. The declining cost of solar technology increases its competitiveness against conventional energy sources. For this Plan, the installation of both land-based and floating solar PV are being considered to harness solar energy. For land-based, the province may look at some localized, non-arable lands/areas that can be used for building small-scale solar farm sites ranging from 1.0 to 2.0 MW. For floating solar PV farm, prospective areas are the lakes formed by abandoned open-pit mining such as the Capayang man-made lake and the Marcopper mining concession area.

Hydro. In terms of hydropower exploration, some potential areas include the Upper Makulapnit Dam, Bol River Dam, Tumagabok Falls, and Hinulugan Falls. Other low-head hydropower potential sites that can be explored are those within the irrigation system of the province that have an altitude of about 3 to 5 meters.

Wind. Being mountainous or near the seashore, the province may have suitable sites for wind farm projects. The wind resource assessment conducted by Marinduque State College in 2016 pointed out two (2) prospective sites for wind power development: Pulang Lupa in Torrijos and Daykitin in Buenavista. However, these areas still need thorough and full wind resource assessment to assess their technical and economic viability.

Geothermal. The identified potential geothermal site in the province is the Mt. Malindig, a potentially active volcano situated in the municipalities of Buenavista and Torrijos. The presence of a possible fumarole field and hot magma intrusion at shallow depths are good markers for a potential geothermal resource.

Biomass. Considering that the province is mainly agricultural, opportunities for biomass energy may also be explored. Utilizing this technology may be economically attractive because of the ready availability of agricultural residues that can be used as feedstock.

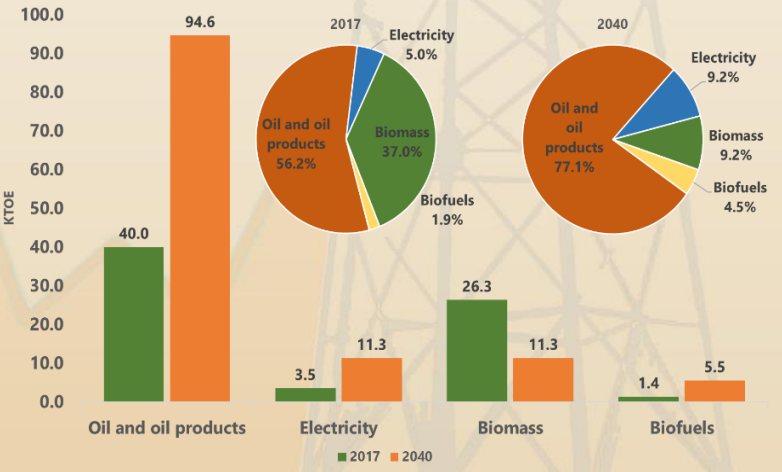
Biofuels. In compliance with the Biofuels Act of 2006, the DOE will continue to support the nationwide implementation of the biofuels blend. Evaluation of vehicle performance using higher blend of biofuels is also being conducted. In the context of research and development, the DOE initiated a partnership with the academe to implement biofuel projects using alternative feedstock.

In terms of policy development, the DOE formulated and implemented several important policy mechanisms to encourage private and foreign enterprises to invest in RE development: *Feed-in-Tariff (FiT), Net Metering, Renewable Portfolio Standards (RPS), Renewable Energy Market (REM)* and *Green Energy Option Program (GEOP).* To further accelerate the use of renewables, the DOE also issued the **Department Order (DO) 2017-04-0005** prescribing the new guidelines in the processing of applications for Renewable Energy Service/Operating Contracts. Likewise, the issuance of the E.O.30 and the signing of the EVOSS Act are seen to stimulate investments on RE projects. The DOE is also set to issue new and separate guidelines specific for off-grid areas to streamline the RE application process of distributed, small-scale renewable projects of not more than 1.0 MW in capacity.

C. ENERGY OUTLOOK

The MarEP's energy outlook shows the estimated long-term energy demand and supply scenario in Marinduque from 2018 to 2040. The outlook intends to aid the province in addressing the energy supply requirements for a higher economic target as espoused in the MIMAROPA Regional Development Plan. Over the planning horizon, the province's final energy demand is projected

Figure 1. TOTAL FINAL ENERGY CONSUMPTION, BY PRODUCT



to grow annually at 2.4 percent, from 71.2 Ktoe in 2017 to 122.8 Ktoe in 2040 *(Figure 1).*

- Oil and oil products remain as the largest contributor to energy demand growth. Oil demand reaches 94.6 Ktoe in 2040 with an annual increase of 3.8 percent.

- Significant switching from biomass to commercial fuels is expected to be observed prompting the share of biomass to decline from 37.0 percent in 2017 to 9.2 percent in 2040.

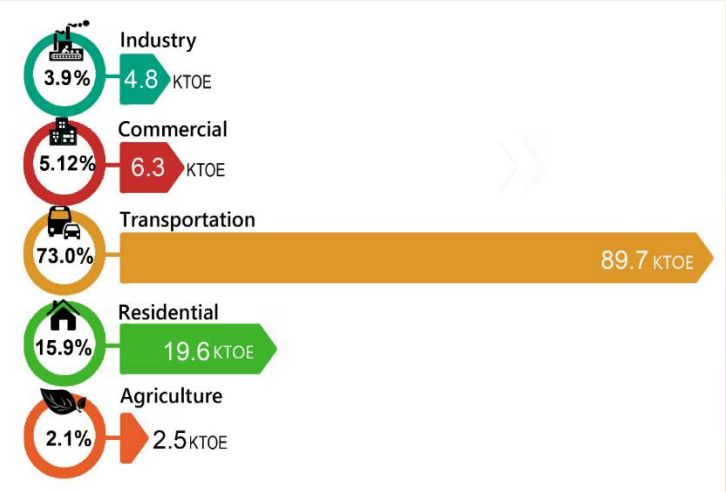
- Electricity shows a significant increase of 6.0 percent a year for the period 2020-2025, slows down to 5.2 percent in 2025-2030, and 4.2 percent post 2030 – translating to 4.5 Ktoe of electricity demand in 2020 to 11.3 Ktoe in 2040.

Sectoral Final Energy Demand Outlook

- Transportation sector remains the largest energy-consuming sector comprising a share of about 70.0 percent to total final energy demand in 2040, followed by residential sector with around 16.0 percent share.
- Commercial sector decreases its share to 5.1 percent despite increasing economic activities in the province.
- Industry and agriculture sectors have a combined share of only 5.9 percent of the total final energy demand.

Residential. The residential sector's historical energy consumption registered a sluggish growth rate of -3.6 percent a year from 2013 to 2017. But with increasing population and rising standard of living, the sector's energy consumption registers a negative growth of 1.0 percent annually over the planning period, translating to 19.6 Ktoe in 2040 from 24.5 Ktoe in 2017, a result of declining biomass consumption. Bulk of energy consumption is biomass though its share reduces to 34.6 percent in 2040 due to increasing use of petroleum product, particularly LPG, as a substitute fuel.

Figure 2. TOTAL FINAL ENERGY CONSUMPTION, BY SECTOR



Transportation. From 33.6 Ktoe energy consumption in 2017, the transportation sector's energy demand reaches 89.7 Ktoe in 2040. With increasing demand for road transport, energy consumption of the sector is seen to display an annual growth of 4.4 percent in the planning period.

Commercial. The commercial sector recorded a 3.1 percent growth in energy consumption for the period 2013-2017. The sector is projected to experience a modest growth of 0.8 percent

annually despite improving local economy, from 5.3 Ktoe in 2017 to 6.3 Ktoe in 2040. Such growth results from declining diesel consumption due to greater usage of electricity.

Industry. The industry sector consumed less than a tenth of the province total energy consumption and recorded a negative growth of 4.4 percent during the 2013-2017 period. Although the industry sector expands over the outlook, its overall energy consumption still posts a negative of 1.3 percent growth a year causes by decreasing biomass consumption. The sector's electricity demand picks up annually by almost 5.0 percent.

Agriculture. The agricultural sector, the least energy user, also shows an upward trend from 1.5 Ktoe in 2017 to 2.5 Ktoe in 2040. The sector consumes about 2.4 percent of the total energy consumption of the province.

Petroleum Products and Biofuels Demand Outlook

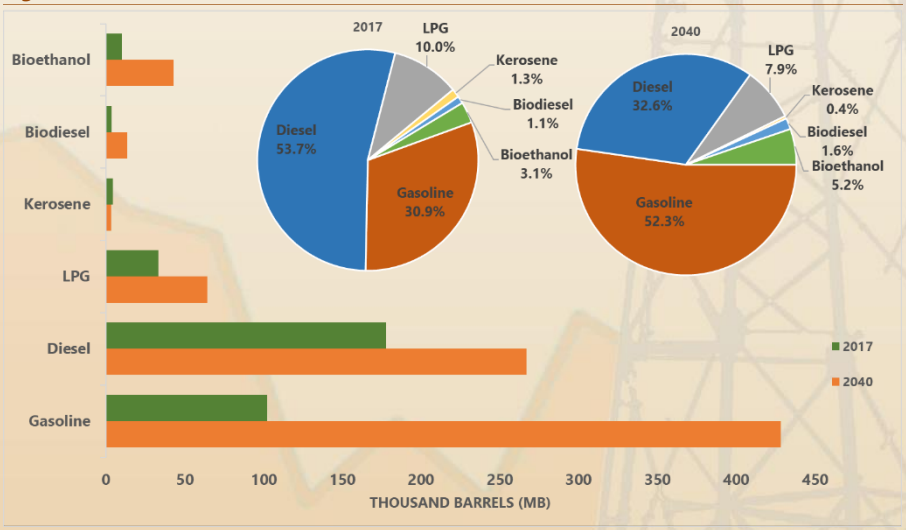
- Diesel and gasoline are expected to remain as the most consumed petroleum products constituting more than half of oil demand growth, and about four-fifths of oil demand mix in 2040. This is primarily driven by increasing demand in the road transport sector.

- Improvement in income level by households causes a shift in using a more convenient fuel from traditional biomass, which pushes up LPG demand from 33.2 MB in 2017 to 64.5 MB, a growth of 2.9 percent a year over the planning period.

- Kerosene continues to decline at an average of 1.1 percent annually because of income improvement and expanding access to electricity.

- With the mandated biofuel blends, the demand for biodiesel and bioethanol is expected to grow annually at 5.9 percent and 6.4 percent, respectively.

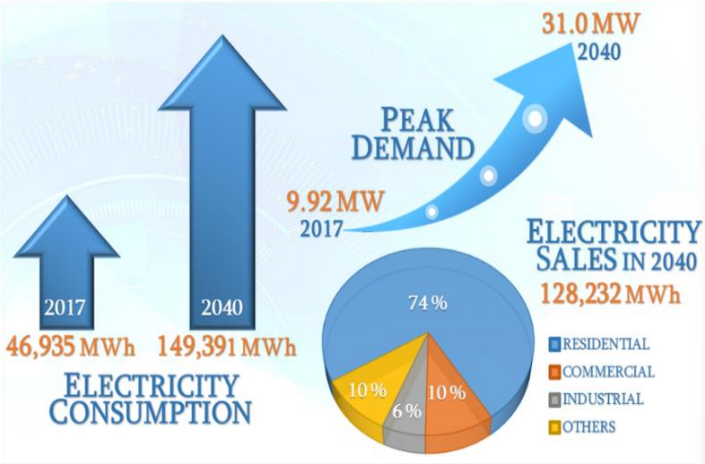
Figure 3. TOTAL OIL DEMAND OUTLOOK, BY PRODUCT



D. POWER OUTLOOK

DEMAND. Marinduque's peak demand is anticipated to accelerate from 9.92 MW in 2017 to 21.0 MW in 2030, and further stretches to 31 MW by the end of the planning period – an annual average growth rate of 5.1 percent within the planning horizon. The demand grows strongly for the period 2018-2025 at an average of 6.5 percent. On the other hand, electricity consumption of the province is projected to triple by 2040 as it reaches 149,391 MWh from 46,935 MWh in 2017, equivalent to 5.2 percent increase a year.

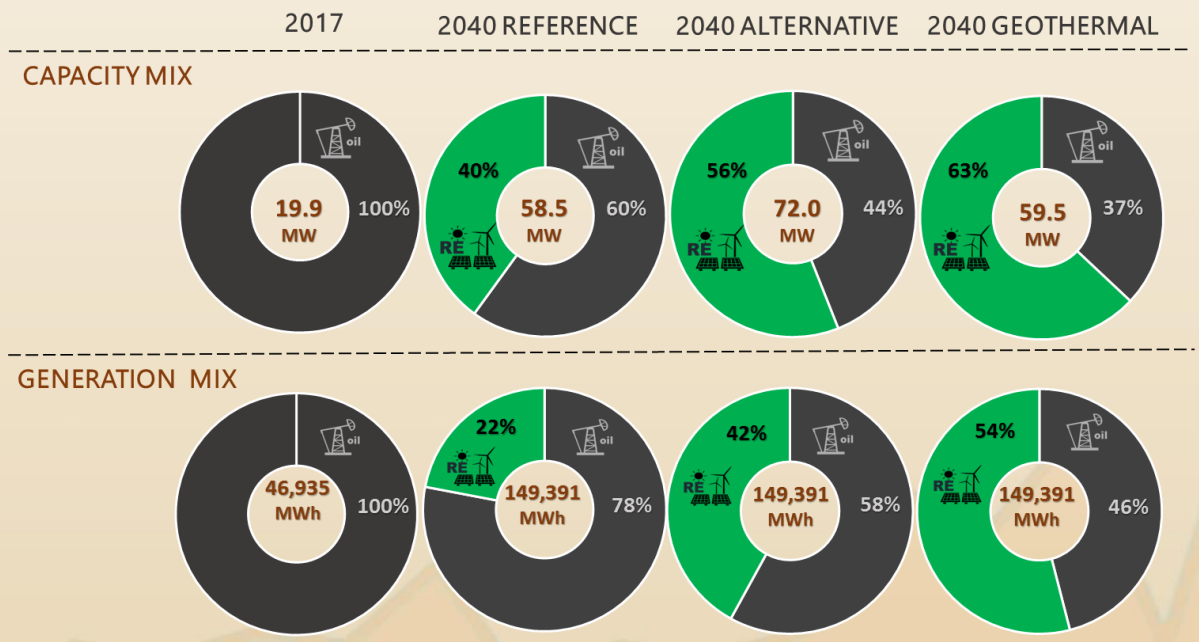
Figure 4. TOTAL ELECTRICITY DEMAND



The surge in demand is mainly propelled by the residential sector requiring about two-third of the total electricity demand by 2040. Electricity demand of the commercial sector also escalates by more than two-fold in 2040 as manifested by the expansion of economic activities in the province. Although the industry sector has the least electricity demand, it displays an annual average growth of 4.7 percent.

SUPPLY. The supply planning highlights three (3) scenarios representing the possible supply options for Marinduque, namely: (1) Reference or "Business-As-Usual," (2) Alternative, and (3) Geothermal.

Figure 5. SUPPLY OUTLOOK PER SCENARIO



The **Reference Scenario** assumes that the province's future development for power generation continues to be diesel-based. In this scenario, diesel still dominates the capacity mix with 60.0 percent share (34.5 MW) of total, while solar contributes 40.0 percent share (24 MW). The deployment of solar is only limited to supplementing the daytime peak demand. Since solar is assumed to be dispatched for a limited time only, diesel continues to be the major fuel for power generation with a share of 77.5 percent (115,753 MWh) in 2040. Solar provides 22.5 percent of the total electricity generation, displacing 33,638 MWh that is supposed to be supplied by diesel power plants.

For **Alternative Scenario,** new RE power plants will be introduced contributing at least 40.0 percent share in the generation mix by 2040. With the goal of limiting the use of diesel-based power plants and possibly lower the generation cost, this scenario intensifies the development and utilization of RE like solar, hydro, wind, and biomass. Total capacity requirement in 2040 stands at 72.0 MW, a seven-fold increase from the 2017 level of 10.91 MW and 23.0 percent higher compared with the *Reference Scenario* (58.5 MW). Although there is a high RE share in capacity mix, diesel remains to be the predominant source of electricity. It has the largest share in the generation mix equivalent to 58.0 percent of total in 2040. Such can be attributed to lower capacity factors and intermittency issues of additional renewables, specifically for solar and wind.

The **Geothermal Scenario** entails the possible entry of a geothermal power plant on the assumption that the potential geothermal resource in Mt. Malindig will be developed in the planning period. The required power generation capacity under this scenario sums up to 59.5 MW by 2040, 17.0 percent lower than the *Alternative Scenario* (72 MW), but almost the same level as the *Reference Scenario* (58.5 MW). This is due to higher capacity factor of geothermal, which replaces a certain portion of diesel capacity for baseload requirement. At the end of the planning period, renewables surpass diesel with a combined capacity of 36.5 MW, or more than 60.0 percent of the total capacity requirement. Renewables are seen to meet 54.0 percent of the electricity generation requirements, expanding its share from the *Reference Scenario* (22.5 percent) and *Alternative Scenario* (42.2 percent). The penetration of geothermal in the system has a noticeable impact in the mix as it further pushes down the share of diesel to 45.9 percent of the total generation in 2040.

E. SUPPLY SCENARIO IMPLICATIONS

Renewable Portfolio Standard Off-Grid. Similar with RPS On-Grid, the RPS Off-Grid Rules mandate an annual incremental requirement of not lower than 1.0 percent of the previous year's electricity sales. Assuming the 1.0 percent minimum incremental, the RPS requirement of Marinduque was projected vis-a-vis the generation from renewables for different scenarios.

The RPS requirement is expected to increase from 3,309 MWh in 2022 up to 30,496 MWh in 2040. With the supply assumption of new RE-based additional capacities coming into the system during the planning period, the RPS requirement can be met by the new renewable capacities for all scenarios. While no existing and eligible renewable generation facilities, which are covered by the PSAs of the DUs/ECs, the mandated participants may purchase or acquire Renewable Energy Certificate (REC) from the Renewable Energy Market (REM) to comply with the RPS Off-Grid Rules.

Cost-effectiveness. For an island province that is relying on only one power generation source, the integration of RE in the supply mix could have substantial merits in enhancing power supply, increasing energy access, and reducing costs of power generation.

Using the Levelized Cost of Electricity (LCOE) of technologies/fuels and their shares in the total generation, blend rates are projected for different scenarios within the planning period. Based on estimates, the *Reference Scenario* has the highest blend rate of PhP13.85 /kWh in 2040 due to heavy dependence on fossil fuel. As more renewables are considered in the *Alternative Scenario*, the blend rate is relatively lower estimated at PhP11.23 /kWh. *Geothermal Scenario* has the lowest blend rate at PhP10.26 /kWh with renewables over taking the share of diesel in the total generation. It is important to note that the estimated LCOE (PhP/kWh) is for power generation only and did not consider transmission, distribution, and other charges.

Environmental Sustainability. The carbon dioxide (CO_2) emission for each scenario is estimated to establish the potential advantage of using renewables in reducing emission level. As power generation continues to be diesel-based under the *Reference Scenario*, the CO_2 level is projected to be more than double by 2040, reaching 30,232 metric tons of CO_2 equivalent (MTCO2e) from only 13,502 MTCO2e in 2017. The *Alternative Scenario* is projected to produce 22,545 MTCO2e in 2040, an avoidance of 7,687 MTCO2e from the *Reference Scenario*. The lowest CO_2 emission level is observed in *Geothermal Scenario* with only 17,945 MTCO2e in 2040. In this scenario, emission level falls significantly by 40.6 percent (against *Reference Scenario*) and 20.4 percent (against *Alternative Scenario*).

F. INVESTMENT PORTFOLIO

To meet rising energy demand, the province needs investment in energy related infrastructures across all sectors of the energy industry over the next two decades. For the downstream oil sector, it includes the additional capacity for oil depot/storage to address the projected increase in oil demand. On the other hand, the cost requirement in the power sector is slated to be invested in additional generating capacity and for upgrade and expansion of the transmission and distribution networks.

For the planning period, the capital investment needed to develop the required oil storage capacity of 81 MB amounts to USD 4.7 million. This amount represents 4.0 to 6.0 percent of the total energy investment requirement for all scenarios.

In the power sector, the total investment reaches USD 73.2 million in the *Reference Scenario,* USD 99.0 million in the *Alternative Scenario*, and USD 121.6 million in the *Geothermal Scenario*. *Geothermal Scenario* demands the highest investment requirement or the most expensive due to high upfront cost in constructing geothermal power plant. In all power supply scenarios, bulk of the investment is allocated for power plant capacity additions wherein its share ranges from 81.0 to 89.0 percent of the total. The remaining portion in the amount of USD 5.2 million and USD 8.6 million are allotted for distribution and transmission development projects, respectively.

CHAPTER I:
INTRODUCTION

A. INTRODUCTION

A major economic concern of government is access to energy as it plays a vital role in fueling and sustaining economic growth and development. It is a key source and a fundamental driver of local economies considering that majority of the production and consumption activities relatively require energy as a basic input.

Notably, having a sufficient, reliable and affordable energy supply in small islands is considered as equally vital and crucial as the amount of energy being required by large and progressive areas. The lack of access by small islands to basic energy services deprives them of equal and competitive economic opportunities, which redound to unfavorable socio-economic impacts such as high poverty incidence and growing unemployment rate, among others.

Like many of the small islands in the country, the island province of Marinduque intensely rely on adequate, affordable, and sustainable energy sources to support its growing economy. It is in this context that the first ever **Marinduque Energy Plan (MarEP) 2018-2040** has been crafted to assure the advancement of the energy sector in the entire province, as a broad strategy that is responsive to the needs of the local economy and its people.

MARINDUQUE'S ROAD TO ENERGY DEVELOPMENT

Following the completion of the 2014-2035 Palawan Island Power Development Plan (PIPDP) in 2015 and the draft 2014-2045 Occidental Mindoro Power Development Plan (OMPDP) in 2016, the Department of Energy (DOE), as part of its strategic thrusts and mandate to formulate local energy plans in support of inclusive growth and economic development, initiated the simultaneous formulation of the Romblon and Marinduque Energy Plans 2018-2040.

The DOE's initiative was a response to MIMAROPA Regional Development Council (RDC) Resolution No. 2015-053-437 titled, "*Directing the Provinces to Complete their Respective Island Power Development Plans,*" and Resolution No. 2015-053-438 "*Requesting DOE to provide Technical Assistance in the preparation of the Island Power Development Plans,*" which primarily aims to ensure electric power supply security in all the Mindoro, Marinduque, Romblon and Palawan (MIMAROPA) provinces and to serve as an input to the Regional Power Development Plan (RDP).

Although the RDC Resolutions focused only on the power sector, the DOE deemed it vital to cover the entire energy system of the province (both power and non-power components such as oil, etc.), as both are considered to have significant contributions to the local economy.

To guarantee the sustainability of the local energy planning initiative, the DOE entered into a cooperative undertaking with the local stakeholders, spearheaded by the provincial government of Marinduque. As a partner Local Government Unit (LGU), the government of Marinduque is mandated to supervise and oversee the overall energy development of the province, taking off from the crafting and updating of the plan up to the actual implementation of the sectoral plans and programs.

Unlike the PIPDP and OMPDP that employed the government-enabled local energy participatory planning approach, the MarEP was formulated through a consultative top-down approach. The top-down approach kicked off with a coordination meeting between the DOE and local stakeholders to introduce the energy planning initiative. Succeeding activities involved: data collection and validation; capacity building workshops for local stakeholders; data processing, simulation and analysis; consultative meetings; revision and finalization of outputs; conduct of public consultation and information, education and communication (IEC) campaigns; and, preparation of the actual energy plan.

While DOE is still in the process of institutionalizing the technical expertise of local stakeholders with respect to the energy planning process, the top-down approach will be pursued until such expertise has been established.

VISION AND MISSION OF THE PLAN

Anchored on *Ambisyon Natin 2040* and the DOE's strategic directions for 2017-2040, the long-term vision of MarEP is the attainment of a responsive energy system for the entire province of Marinduque. Meanwhile, the MarEP's overall mission is to ensure a strongly-rooted, comfortable and secure life for Marinduqueños through the provision of sufficient, dependable, environment-friendly, and sustainable energy supply at reasonable prices and responsive to the needs of the people within the planning period.

At the local level, the plan is a collaborative blueprint of the government agencies that outlines the initiatives, strategies and programs towards energy development and utilization in the province. It underscores an all-encompassing detail of the province's energy demand and supply requirements for the next 23 years.

GOAL AND OBJECTIVES OF THE PLAN

As discussed above, the goal of the MarEP is to enable a secured energy system that embodies the entry and deployment of clean sources of energy at affordable rates, thereby accelerating economic development. Specifically, the objectives of the MarEP are as follows:

- Ensure adequate, reliable, and affordable energy and power supply throughout the planning period;
- Achieve 100 percent household electrification of all households by 2022, consistent with the Total Electrification Program (TEP) of the national government;
- Facilitate the entry, development, and deployment of renewable energy (RE) sources in the province consistent with existing policies of the government;
- Come up with sectoral plans and programs towards energy development;

- Identify energy development challenges and action plans; and,
- Propose policy recommendations to address energy issues and challenges.

B. SOCIO-ECONOMIC PROFILE

Marinduque is an island province located at the centermost part of the Philippine Archipelago and one of the provinces of the MIMAROPA Region. It is flaunted as the "heart" of the Philippines apparently because of its heart-shaped topographical landscape. The island is surrounded with clear waters where underwater life boasts of beauty of different species of corals and colorful marine creatures. Its untouched mountains and caves, springs, and stunning beaches are attractions to hikers, mountaineers and nature enthusiasts alike. At a first glance, the province may seem insignificant, perhaps because of its small land area. However, the island is blessed with the splendor and bounty of landscape and seascape, as well as rich cultural heritage. Despite increasing traffic of local and foreign tourist arrivals, the province has been able to preserve its natural beauty.

TRANSPORTATION

The province is accessible by sea and air transport. Inter-island ferries and cargo ships are the main vehicles in transporting people and goods from the province to other islands in Luzon. The main sea routes plying to Marinduque are Dalahican Pier in Barangay Talao-Talao, Lucena to Balanacan Port; Pinamalayan, Oriental Mindoro to Gasan Port; and Lucena City to Cawit Port.

Balanacan Port at Brgy. Balanacan Mogpog, Marinduque

Marinduque Airport at Brgy. Masiga, Gasan

For inland transportation, the province depends on the use of jeepneys, passenger motorcycles, minibuses and tricycles to serve around the inter-municipalities. One may also opt to take a direct bus route plying from Cubao, Quezon City Terminal to Marinduque via roll-on/roll-off (RORO) ships. The province is also accessible by air transportation where the Marinduque Airport at Barangay Masiga, Gasan serve as the terminal. After temporarily stopping operation in 2013 for rehabilitation and renovation of its terminal facilities, commercial operation of the airport resumed in April 2019.

CULTURE

Marinduque's unique way of welcoming guest known as "Pagpuputong"

Marinduque offers advantages in terms of the conserved nature, cultures, and traditions different from its neighboring provinces. The "Pagpuputong" and "Kalutang" are two (2) of its many well-preserved cultures. "Pagpuputong" is the indigenous custom of welcoming and honoring friends and visitors as a gesture of their warm hospitality. A crown handcrafted from "nito" (local vine) called "putong" or "tubong" is placed on the visitor's head while local women dance and sing a song of thanksgiving, hope, and prayer. "Kalutang", on the other hand, is a musical instrument consisting of two (2) pieces of wood, graduated in sizes to produce different notes and ranges, and played by a group of 10 to 12 people to create a special musical rendition.

The Moriones Festival is the most popular and one of the oldest and most colorful festivals during the Lenten season. Local participants dressed in Roman soldier uniform march down the main road and stage a theatrical presentation of the moment when an unnamed Roman soldier (a blind "Morion"), struck Jesus in his side with a lance while crucified on the cross and was able to see after the blood droplets from the wound touched his eyes.

Moriones Festival, locally known as "Moryonan" is one of the oldest religious festivals in the country being held during Holy Week in the province of Marinduque.

A seascape from Marinduque Island

TOURISM

One of the priority thrusts of the provincial government is to develop the island's potential for tourism. From its current reputation as the country's top Holy Week destination, the island province is into a year-round destination through Community-Based Rural Tourism; pump priming the province's economic thrust as an emerging eco-adventure destination.

Each town showcases its own place of interest where local and foreign tourists may visit from historical markers, old churches, caves, and beaches – the Boac Church and Blessed Biglang-Awa Miraculous Shrine (Boac), Battle of Pulang Lupa and Poctoy White Sand Beach (Torrijos), Bathala Caves (Santa Cruz), Paadjao Fall (Mogpog), Tres Reyes Islands (Gasan), and Malbog Sulphur Spring (Buenavista), among others.

(L to R): Poctoy White Sand Beach (Torrijos), Gaspar Island (Gasan), and Maniwaya Island (Sta. Cruz)

PEACE AND ORDER

Marinduque is tagged as a generally peaceful province. In 2013, it got the distinction of being ranked no. 1 by the Philippine National Police and Philippine Security Forces as the Most Peaceful Province of the country due to its low crime rate statistics.

Another milestone is the declaration of Marinduque as an insurgency-free province in March 2019, the third in the country to achieve the status under the administration of President Duterte. The declaration means that the province is now free from politico-military organizations, and this no longer pose a threat to peace and order. The stable internal peace and security in the province facilitates conducive environment for business and tourism that, in turn, is needed for continuous growth and development of Marinduque.

LAND AREA

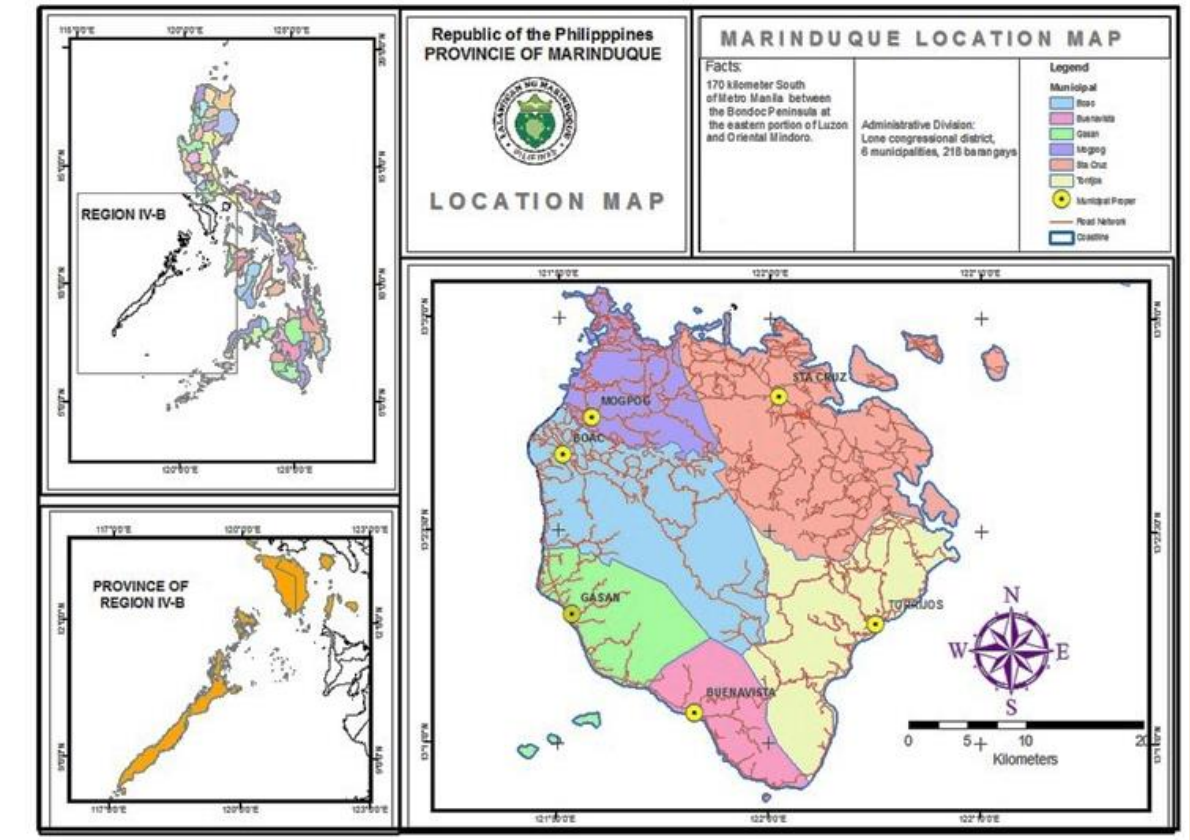
The total land area of Marinduque is 952.58 square kilometers. The province extends about 170 kilometers south of Metro Manila between the Bondoc Peninsula at the eastern portion of Luzon and Oriental Mindoro *(Figure 6)*. It is bounded on the north by Tayabas Bay, northeast by Mongpong Pass, and south-east by Tayabas Strait and Sibuyan Sea at the south.

The province is a lone congressional district composed of six (6) municipalities namely: Boac (the capital town), Buenavista, Gasan, Mogpog, Torrijos and Sta. Cruz) and comprises 218 barangays that are described as partially urban as shown in *Table 1*.

Being at the center of the Philippine Archipelago, the province is within the typhoon path of the Pacific tropical storms which adversely affects the whole island. It is surrounded by vast marine waters, open to strong southwest and northeast monsoon winds and storm surge phenomenon. It is also situated in the *Pacific Ring of Fire* where two major tectonic plates meet with regular occurrence of earthquakes and volcanic eruption. Also, the province is surrounded by active faults

and trenches from neighboring provinces that may create seismic waves or tsunami in the bodies of water surrounding the province and vulnerable to climate change.

Figure 6. MAP OF MIMAROPA REGION AND MARINDUQUE PROVINCE



Source: Provincial Planning Development Office - Marinduque

Table 1. LAND AREA AND INCOME CLASSIFICATION PER MUNICIPALITY

Province/Municipality	Land Area km²	No. of Barangay	Income Class	Rural / Urban
Boac	212.70	61	1st Class	Partially Urban
Buenavista	81.25	15	4th Class	Partially Urban
Gasan	100.88	25	3rd Class	Partially Urban
Mogpog	108.06	37	3rd Class	Partially Urban
Sta. Cruz	270.77	55	1st Class	Partially Urban
Torrijos	178.92	25	3rd Class	Partially Urban
Marinduque	**952.58**	**218**	**4th Class**	

Source: Philippine Statistics Authority (PSA), 2015 Census of Population and Housing

POPULATION

As of August 2015, the province's population stood at 234,521 persons, a figure higher by 6,693 from the previous data of 227,828 persons based on the 2010 Census of Population results. This translates to an annual increase in population growth rate (PGR) of 0.55 percent from 2010 to 2015, higher than the 0.47 percent annual PGR of the province between 2000 and 2010 census years

Based on the 2015 Census of Population, the Municipality of Gasan registered the highest population density with 345 persons per square kilometer (person/km^2), while Torrijos has the least population density of 171 persons/km^2. *Table 2* describes the population density of the province by municipality.

Table 2. POPULATION DENSITY PER MUNICIPALITY, 2015

Municipality	Population		Average Annual Growth Rate (2010-2015)	Area (km^2)	Density (No. of Persons/km^2)	Barangay
	2010	2015				
Boac	52,892	54,730	0.65%	212.7	257	61
Buenavista	23,111	23,988	0.71%	81.25	295	15
Gasan	33,402	34,828	0.79%	100.88	345	25
Mogpog	33,384	34,043	0.37%	108.06	315	37
Sta. Cruz	55,673	56,408	0.25%	270.77	208	55
Torrijos	29,366	30,524	0.73%	178.92	171	25
Total	**227,828**	**234,521**	**0.55%**	**952.58**	**246**	**218**

Source: PSA, 2015 Census of Population; and, DENR-Land Management Bureau, 2013 Master List of Land Areas of Cities and Municipalities

GROSS REGIONAL DOMESTIC PRODUCT (GRDP)

The Philippine Statistics Authority (PSA) GRDP 2016-2018 Report (April 2019 edition) shows that all economies of the country's 17 regions grew in 2018, with Bicol Region growing the fastest at 8.9 percent followed by Davao Region and MIMAROPA with 8.6 percent as presented in *Figure 7*.

Since 2010, MIMAROPA's economy continuous to grow at a faster rate. Records show that the region's economy accelerated at 8.6 percent in 2018, from 5.2 percent in 2017. The region's GRDP in 2018 exhibited the highest recorded growth, which could be attributed to the performance of the industry sector.

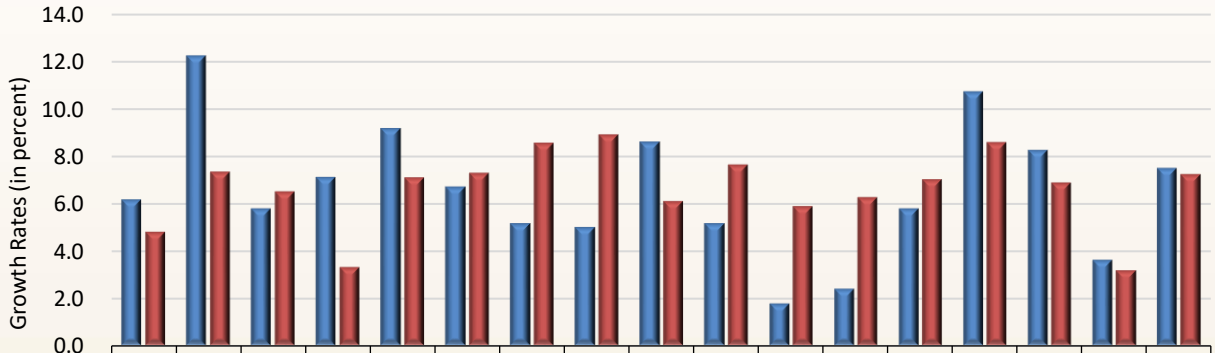
Looking into the performance of the economic sectors, the Industry Sector registered the highest growth rate in 2018 at 11.2 percent compared with its 1.6 percent in 2017. The construction sub-sector was the top contributor with 26.1 percent growth rate in 2018, followed by mining and quarrying sub-sector, which grew at 5.7 percent, a significant rebound from a 5.5 percent decline in previous year. Meanwhile, the manufacturing sub-sector posted a 7.2 percent growth, while electricity, gas, and water supply increased by 8.6 percent, albeit slower than the 2017 growth of 14.8 percent.

Services Sector stepped up with a 9.3 percent growth in 2018 as compared with the previous year's level of 8.7 percent. Among its six (6) sub-sectors, two (2) registered significant growths in 2018: public administration and defense with 15.2 percent; and transportation, storage and communication with 7.5 percent. The rest of the sub-sectors also improved but displayed a slower growth than previous year – trade with 6.9 percent, financial intermediation with 10.3 percent, and real estate, renting and business activities with 2.7 percent. Other services were able to maintain their 12.5 percent growth in 2018.

Although the Agriculture, Forestry and Fishing (AFF) Sector also registered a positive growth at 2.6 percent in 2018, its performance slightly decelerated from a 3.0 percent growth in 2017. The agriculture and forestry both exhibited a 3.1 percent growth, while fishery recovered with a 0.6 percent growth.

Among the major economic sectors, services remained to account for the largest share with 47.8 percent of the region's GRDP, followed by industry with 33.1 percent, and AFF with 19.1 percent.

Figure 7. GROWTH RATES OF REGIONAL ECONOMIES (At Constant 2000 Prices, in percent)



	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	IX	X	XI	XII	XIII	ARMM
2017	6.2	12.2	5.8	7.1	9.2	6.7	5.2	5.0	8.6	5.2	1.8	2.4	5.8	10.7	8.3	3.6	7.5
2018	4.8	7.3	6.5	3.3	7.1	7.3	8.6	8.9	6.1	7.6	5.9	6.3	7.0	8.6	6.9	3.2	7.2

Source: Philippine Statistics Authority (PSA)

In the case of Marinduque, the major industries that support its local economy are agriculture and tourism with available opportunities ranging from investments in agri-business enterprise to tourism-oriented establishments. The local fishery industry also contributed greatly to the employment sector as the province has significant aquaculture and fisheries resources. Commerce and industry are also seen to escalate over the years as manifested by the growing number of business establishments, construction of more commercial buildings, and expansion of financial-service enterprises.

MAJOR PRODUCTS

Agriculture and fishing are the main economic activities of the province. More than half of the total land area is devoted to crops. The province's primary crops are coconut, palay, banana, and root crop-based products such as sweet potato and arrowroot.

In the food processing industry, root crop-based products, such as arrowroot and processed fish (such as "bagoong and patis"), are being promoted as the province's specialties. Local farmers and entrepreneurs produce different products out of coconut and arrowroot, some of which are

coco coir for the production of coco geonet, coconut oil, coco water and coals, while arrowroot is processed to produce, among others, cookies, polvoron and starch that can be used in baking and cosmetic products.

Likewise, the province has identified several key priority industries for promotion and development in the recent years. For one, Buntal handloom woven products have been aggressively promoted locally and abroad. These products command better prices in any market because of their intricate weaves and the obvious good amount of labor spent to produce them.

CHAPTER II:
ENERGY SITUATIONER

Marinduque has a great potential as a tourism hub that could bring a dynamic opportunity not only for the province but for MIMAROPA region as well. The expected increasing influx of visitors provides greater prospect for businesses to expand and pour in more investment in the province. Hence, the province needs to ensure that there is sufficient energy supply and the required energy infrastructures are in place to meet the growing local economy.

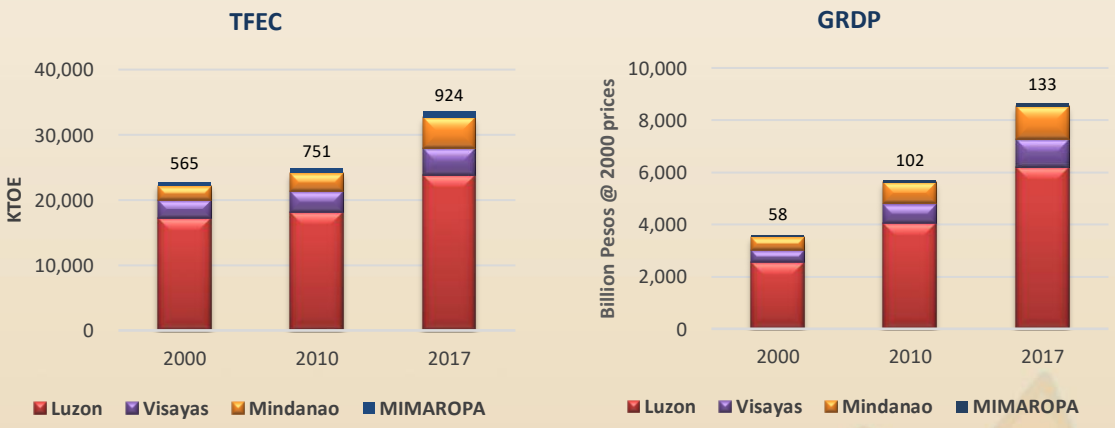
The province's inclusive growth and development require the provision of adequate electricity services and sufficient supply of petroleum products as requisites for improved quality of life of local people, particularly the marginalized sectors.

A. ENERGY PROFILE

MIMAROPA TOTAL FINAL ENERGY CONSUMPTION

MIMAROPA represents 2.8 percent of the Philippines' total final energy consumption (TFEC), and 1.5 percent of real gross domestic product (GDP) *(Figure 8)*. The economic performance of MIMAROPA, the value of goods and services produced, exhibited an average annual growth of 5.0 percent from 2000 to 2017. The regional economy of MIMAROPA covers the five (5) island provinces – Oriental and Occidental Mindoro, Marinduque, Romblon and Palawan – which is among the regions with minimal contribution to the national economy (1.0 percent to 4.0 percent).

Figure 8. MIMAROPA'S SHARE TO THE TOTAL FINAL ENERGY CONSUMPTION (TFEC) AND GROSS REGIONAL DOMESTIC PRODUCT (GRDP), 2000-2017



In 2017, MIMAROPA's TFEC stood at 924.4 thousand ton of oil equivalent (ktoe) from 565.1 ktoe in 2000, translated to 2.9 percent growth rate a year. The region manifested a little higher growth rate of 3.0 percent from 2010 to 2017. Share to the National TFEC slightly improved from 2.5 percent in 2000.

MIMAROPA provinces are characterized by different drivers of energy use, such as geographical conditions, population densities, and economic structures. Despite distinctive economic and physical attributes and resource endowments, these island provinces share common energy goals with a strong focus on having greater access to energy and enhancing energy security, while supporting the island's overall economic growth. Each province shall further develop according to distinct roles and emerging industries/business opportunities.

Among the five island provinces, Palawan recorded the highest energy consumption with 384.2 ktoe in 2017, which grew annually at 4.6 percent from 2013 level. Oriental Mindoro followed next with 284.9 ktoe, increasing by 4.1 percent a year for the same period. Occidental Mindoro, Romblon and Marinduque registered 105.0, 79.1 and 71.2 ktoe of energy consumption, respectively.

Palawan, as the largest energy user among the provinces with an average share of 40.7 percent to TFEC during the 2013-2017 period *(Table 3)*, is a major tourism hub in the region hosting two (2) world heritage sites (Tubattaha Reefs National Park and the Puerto Princesa Underground River). Further, the province has been a major contributor to the country's fisheries production.

On the other hand, Oriental Mindoro is the second largest energy user in the region with a 30.5 percent average share to TFEC. The province serves as a gateway for trade and investments in the eastern side of the country. Like Palawan, it is one of the premier tourism destinations. The province is also a food basket for Luzon and Visayas regions, providing a reliable and stable supply of agriculture products, aquaculture, marine products and livestock to Calamba, Laguna, Batangas, Rizal, Quezon (CALABARZON), the National Capital Region (NCR) and the Visayas. These economic activities pumped up the province's energy consumption over the historical period.

The combined energy consumption of these two provinces represents around 70.0 percent of MIMAROPA's energy demand, highlighting their critical roles in determining the energy future of the region. Notably, Palawan and Oriental Mindoro recorded the highest population growth of 2.4 percent and 1.6 percent, respectively.

Table 3. MIMAROPA TOTAL FINAL ENERGY CONSUMPTION, BY PROVINCE (KTOE)

Province	Actual					Growth Rate (%)	Average Share (%)
	2013	2014	2015	2016	2017		
Marinduque	63.63	63.79	68.99	72.92	71.22	2.86	7.87
Occidental Mindoro	102.38	97.36	101.84	103.97	105.02	0.64	11.80
Oriental Mindoro	242.89	243.75	267.27	280.20	284.87	4.07	30.49
Romblon	81.43	78.27	79.73	78.82	79.10	-0.72	9.18
Palawan	321.14	329.94	358.51	365.11	384.20	4.58	40.66
Total	**811.47**	**813.10**	**876.34**	**901.01**	**924.41**	**3.31**	**100**

The provinces of Occidental Mindoro, Marinduque and Romblon registered population growths of 1.4 percent, 0.7 percent and 0.5 percent, respectively, which relatively affect the energy consumption level in these provinces. With an energy consumption growth of 2.9 percent a year during 2013-2017, Marinduque displayed a relatively stable growth but lower than the MIMAROPA average. Meanwhile, the energy consumption of Occidental Mindoro and Romblon

remained flat, equivalent to an annual average growth of below 1.0 percent (and negative growth) over the same period. Both provinces are major supplier of fish and aquaculture products.

MIMAROPA Total Final Energy Consumption by Sector

The economic growth of MIMAROPA, as compared with other regions, is slower largely due to poor transport, communications and energy infrastructures. MIMAROPA as a developing region has relatively a low standard of living and a low energy consumption level. The low energy consumption in the region reflects a more traditional way of life which is characterized by poor standard of living. Conversely, the region's aggregate energy consumption level reached 924.4 ktoe from 811.5 ktoe in 2013, equivalent to an annual average growth rate of 3.3 percent a year *(Table 4).* Evidently, a link exists among the levels of energy demand and the standard of living of most people living in underdeveloped, less developed and developed areas of MIMAROPA.

Since MIMAROPA still has a relatively small industrial base, energy is primarily consumed by the residential sector, and thus the biggest contributor to the region's energy demand. On average, the sector accounted for about 40.0 percent of the region's energy consumption, albeit its growth over the 2013-2017 period remained flat. Moreover, differences in the lifestyles exist in developed, developing and underdeveloped areas. The existence of socio-economic disparities in these areas is evident how developed areas (urban) have better access to adequate basic services – electricity, water and food.

Growth in the service sector provided a bright spot and kept MIMAROPA's economy afloat. The service sector contributed for an average share of 44.2 percent to the region's GRDP with a yearly growth rate of 7.2 percent during the 2013-2017 period. In recent years, commercial activities in the region had become one of the major contributors to the region's TFEC. The sector posted an average growth of 2.9 percent a year in terms of its energy consumption with slower growth on diesel and biomass due to greater availability of electricity and higher LPG consumption. Despite such growth, the sector's average share to TFEC only stood at 8.0 period for the same period. The growth in the commercial sector was mainly driven by the growth of tourism related activities in the region.

Table 4. MIMAROPA TOTAL FINAL ENERGY CONSUMPTION, BY SECTOR (KTOE)

Sector	Actual					Growth Rate (%)	Average Share (%)
	2013	2014	2015	2016	2017		
Industry	158.13	163.42	166.10	157.52	167.33	1.42	18.78
Commercial	65.99	66.74	68.89	71.95	73.95	2.89	8.03
Transportation	224.66	220.86	276.75	302.92	311.27	8.49	30.89
Residential	351.91	351.76	353.01	355.52	356.26	0.31	40.88
Agriculture	10.77	10.32	11.60	13.09	15.60	9.70	1.42
Total	**811.47**	**813.10**	**876.34**	**901.01**	**924.41**	**3.31**	**100**

The industry sector contributed an average of 33.8 percent to the region's economy from 2013 to 2017. The industry's yearly growth stood at 4.5 percent, on average. Consequently, the growth in the production output of the industry sector, particularly in the food processing and manufacturing industries, resulted in a 1.4 percent annual average increase in its energy requirements for the same period. The modest growth was due to reduction in diesel and

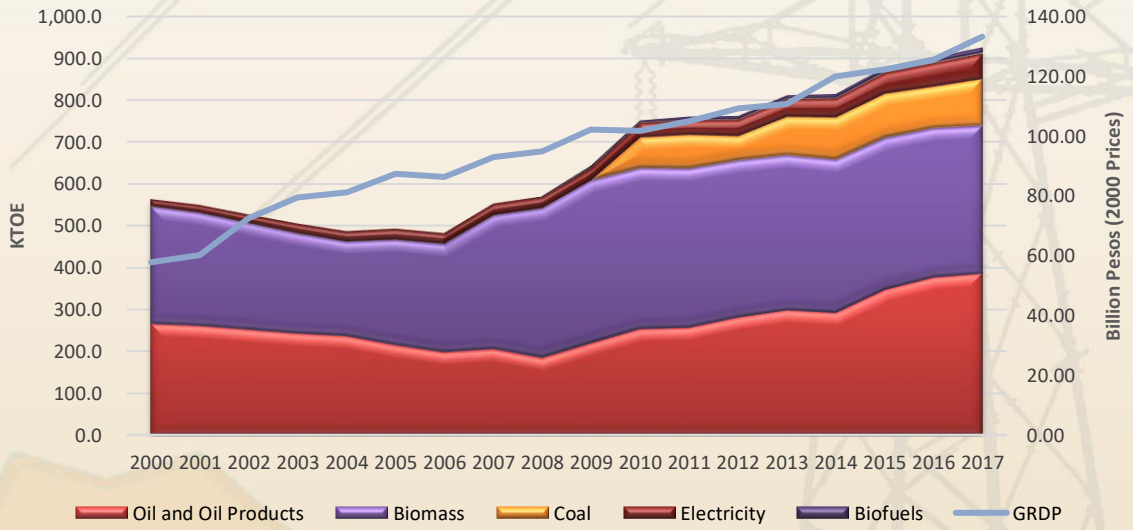
biomass consumption (as replaced by electricity). The sector's average share to TFEC was 18.8 percent.

Agriculture added an average of 22.0 percent to the region's economic output for the period 2013 to 2017. However, due to adverse effects of typhoons that hit the region, the agricultural sector only posted a nil growth. The sector had been highly dependent on fossil fuel for crop production. Its energy requirements increased by 9.7 percent a year over the 2013-2017 period.

MIMAROPA Total Final Energy Consumption by Product

Figure 9 illustrates the share of each fuel type to TFEC covering the period 2000-2017 timeframe. Given that MIMAROPA is a developing region with a relatively low energy consumption levels, the dynamics of its energy demand is evidently depicted on the importance of traditional biomass[1]. As an energy resource, traditional biomass is widely harvested, traded informally and non-commercially, and subsequently used in an unsustainable way. Based on the International Renewable Energy Agency (IRENA) report on *"Global Bioenergy Supply and Demand Projection,"* traditional biomass plays an important role for the residential sector in developing countries. It is the main energy source for cooking and, in some countries, also for heating. Currently, nearly 40.0 percent of the global population relies on the use of traditional biomass[2].

Figure 9. MIMAROPA's TOTAL FINAL ENERGY CONSUMPTION, BY PRODUCT (KTOE)



Being the dominant consumer of energy, the residential sector is also the largest user of traditional biomass. Thus, biomass contributed about 40.0 percent (38.2 percent) to TFEC in MIMAROPA 2017, down from 45.7 percent in 2013. However, biomass consumption exhibited a declining rate of 1.2 percent a year due to faster growth in oil and electricity demand *(Table 5)*. Biomass consisting of charcoal, fuel wood, agriculture by-products and manure is mainly used for cooking and heating purposes. The significant use of biomass is notable in the region particularly

[1] Traditional biomass energy refers to the direct combustion (often in very inefficient devices) of wood, charcoal, leaves, agricultural residue, animal/human waste and urban waste, for cooking, heating, drying and charcoal production.
Source: https://www.ren21.net/Portals/0/documents/irecs/renew2004/Traditional%20Biomass%20Energy.pdf

[2] Source: Global Bioenergy Supply and Demand Projections: A Working Paper for REmap 2030.
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_REmap_2030_Biomass_paper_2014.pdf

in rural areas with limited access to modern energy. Overall, biomass consumption in the region was about 5.0 percent of the country's total biomass consumption.

Oil surpassed biomass as the dominant fuel in 2016 with a 6.7 percent annual growth rate, increasing from 298.0 ktoe in 2013 to 385.7 ktoe in 2017. Such growth induced an increase in oil share from 36.7 percent in 2013 to 41.7 percent in 2017. The region's oil consumption represented around 2.5 percent of the country's total oil consumption.

Electricity consumption in the region experienced a strong growth at 9.7 percent a year, from 42.3 ktoe in 2013 to 61.3 ktoe in 2017, an outcome of continuous efforts to provide greater access to electricity and increasing urbanization rate. The upward trend towards greater use of electricity in the industry and commercial sectors, and intensified electrification in the unserved and underserved areas of the region resulted in growing importance of electricity, specifically in the residential sector. The region contributed about 1.0 percent to total electricity consumption of the country.

Table 5. MIMAROPA TOTAL FINAL ENERGY CONSUMPTION, BY PRODUCT (KTOE)

Product	Actual					Growth Rate (%)	Average Share (%)
	2013	2014	2015	2016	2017		
Coal	91.83	100.86	106.20	99.36	111.74	5.03	11.79
Oil and oil products	298.00	292.00	348.04	376.06	385.65	6.66	39.29
Electricity*	42.34	45.63	49.95	56.22	61.28	9.68	5.90
Biomass	370.44	365.95	361.54	357.22	352.97	-1.20	41.79
Biofuels	8.86	8.65	10.59	12.14	12.76	9.55	1.23
Total	**811.47**	**813.10**	**876.34**	**901.01**	**924.41**	**3.31**	**100**

**Includes own-use but excludes system loss*

ENERGY-ECONOMY

Energy is one of the development drivers and an essential commodity in the economy. Energy has two-fold contributions to economic growth: a) creates jobs and value by extracting, transforming and distributing energy goods and services throughout the economy; and, b) underpins the rest of the economy by serving as an input to goods and services. With the long-term vision of the *"AmBisyon Natin 2040,"* energy plays an important role in all the economic sectors in its realization, such as in the connectivity, manufacturing, housing and urban development, and agriculture.

Energy's role cannot also be discounted as the primacy (or increase in the presence of high order services) of cities and municipalities are set to be intensified primarily due to the government's dream of attaining the golden age of infrastructure. "Build, Build, Build" is the current government's ambitious infrastructure program that is seen to be the solution to lack of jobs, high prices, transportation and traffic. Eventually, development will trickle down to have spillover effects due to stimulated impacts of infrastructure on interlinking areas throughout the country.

MIMAROPA has been enjoying a modest economic growth over the last five years (2013-2017) with GRDP growing at an average of 4.7 percent a year *(Table 6)*. The forward drive towards sustaining this economic growth must always be complemented with diversified energy sources

leading to a more secured supply to satisfy the foreseen increase in energy demand. In the long-term, the government must explore a stable, sustainable and reliable energy options to augment existing supply and address the increase in demand. It is in this context that ensuring energy security remains at the top of the energy agenda.

The average annual growth rate of the country's real GDP from 2010 to 2017 was at 6.1 percent, an improvement from the 4.8 percent annual growth rate recorded for 2000 to 2010. This growth was fueled by domestic demand in terms of investment and consumption. Over the same period, there was continued robust expansion in investments, which grew by 11.5 percent per annum. Government financial consumption expenditures (GFCE) or public investment in infrastructure remained strong expanding by 6.9 percent, faster than the 3.4 percent growth in the period 2000 to 2010. Household Final Consumption Expenditure (HFCE), accounting for 69.0 percent of the country's total output, continued to grow faster at the annual growth rate of 6.1 percent compared to 4.3 percent registered in 2000 to 2010.

The economic growth of the country is expected to have spillover effects in the countryside. Consequently, the domestic economy of MIMAROPA will likely to experience an accelerated growth. The region's domestic economy posted an average annual growth rate of 5.0 percent from 2000 to 2017. Its strategic location and natural assets, such as abundant agricultural products, natural endowments and heritage resources, and industrious people are the advantages of the region. Agriculture and tourism are the primary productive sectors where more investments can contribute to the regional economy. Tourism-driven agricultural development is the main strategy of the regional development plan. Interventions supporting these sectors are vital in the regional development.

Table 6. MIMAROPA GROSS REGIONAL DOMESTIC PRODUCT 2013-2017, By Sector (billion pesos @ 2000 price)

Province	Actual					Growth Rate (%)	Average Share (%)
	2013	2014	2015	2016	2017		
GRDP	110.7	119.9	122.3	125.4	133.2	4.7	
Agriculture	26.5	27.1	27.8	25.9	26.7	0.2	21.9
Industry	36.8	43.1	41.0	41.8	43.8	4.5	33.8
Services	47.4	49.7	53.4	57.7	62.7	7.2	44.3
HFCE	108.5	114.5	122.2	130.3	138.2	6.2	100
GFCE	13.9	14.8	15.6	16.7	17.9	6.5	12.9
CF	13.7	17.8	20.1	22.4	24.7	15.9	16.1

The path towards national development entails contributions from the various economic sectors in the country. According to the National Economic and Development Authority (NEDA), this is attributed to high consumer confidence, modest inflation and interest rates, and improving labor market conditions. The country's demand for energy is increasing rapidly because of population and economic growth. This is evident in emerging regional economies. As the country aims to reduce regional disparities by supporting (employment and wealth-generating) economic activities, a high level of development requires a sustainable and reliable energy supply. Energy development is a fundamental part of economic development. The correlation among energy, other inputs, and economic activity noticeably changes significantly as the economy transforms through different stages of development.

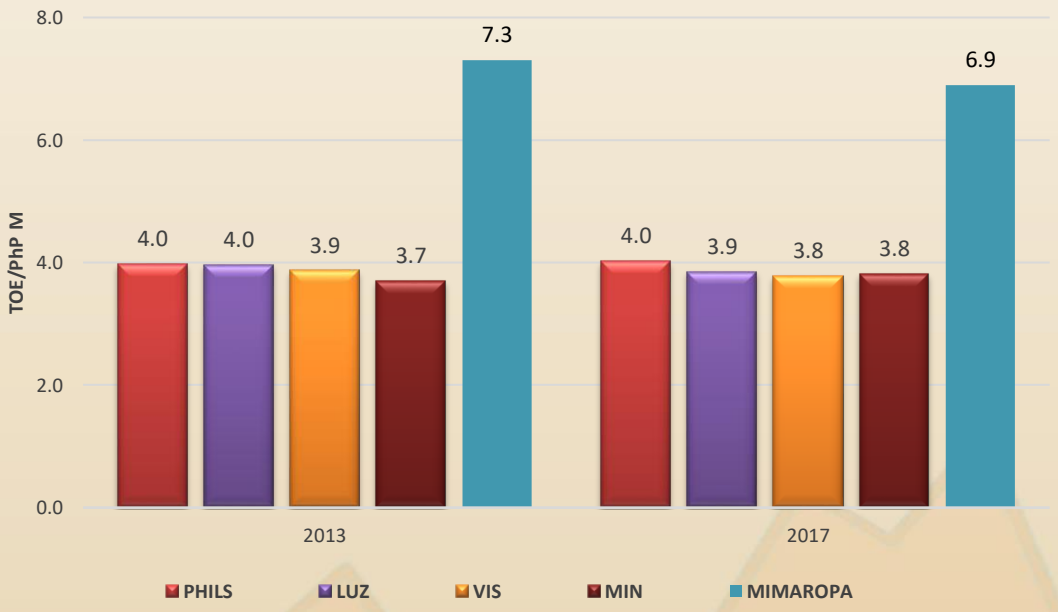
Energy Intensity

Energy intensity is one of the indicators for economic development and expressed as the ratio between domestic energy consumption (TFEC) and GDP (energy consumption per unit of GDP). Energy intensity, a measure of energy consumed per unit of GDP, reflects the amount of energy needed to produce all goods and services that an economy generates. It could also be considered as an indirect measure of energy efficiency and energy productivity. Energy consumption encompasses the use of solid and liquid fuels, natural gas, renewables, electricity and other fuels. By quantifying the volume of energy used to produce one unit of economic output (in monetary terms), energy intensity thus addresses one aspect of economic efficiency. Likewise, energy intensity has a strongly linked with economic cycle. Historically, energy intensity in MIMAROPA fell, from 7.3 ton of oil equivalent (TOE) in 2013 to 6.9 toe per million pesos (toe/PhPM) in 2017, similar to decreasing trend in intensity level of Luzon and the Visayas (except Mindanao). However, the region's intensity level was higher by about 3.0 toe compared with national and major islands *(Table 7 and Figure 10)*.

Table 7. MIMAROPA ENERGY-ECONOMY INDICATORS

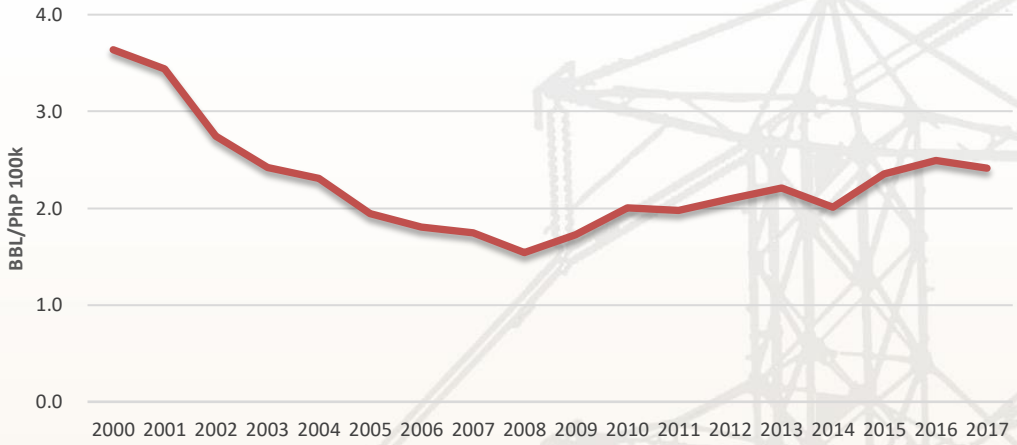
Province	Actual					Growth Rate (%)
	2013	2014	2015	2016	2017	
Energy Intensity						
Energy intensity[3] *(TOE/PhP Million)*	7.33	6.78	7.17	7.19	6.94	-1.4
Oil Consumption *(BBL/PhP 100 Thousand)*	2.21	2.01	2.35	2.49	2.41	2.2
Electricity Consumption/GDP *(GWh/PhP Billion)*	4.45	4.43	4.75	5.21	5.35	4.7
Energy per Capita						
Final Energy Demand	0.28	0.28	0.30	0.30	0.30	1.5
Oil Demand *(BBL/Person)*	0.85	0.83	0.97	1.04	1.04	5.2
Electricity *(kWh/Person)*	171.31	181.95	196.29	216.60	231.45	7.8

Figure 10. MIMAROPA ENERGY INTENSITY (TFEC/GRDP) VIS-À-VIS PHILIPPINES, 2013 VERSUS 2017



[3] Total Final Energy Consumption / Gross Regional Domestic Product @ constant 2000 price

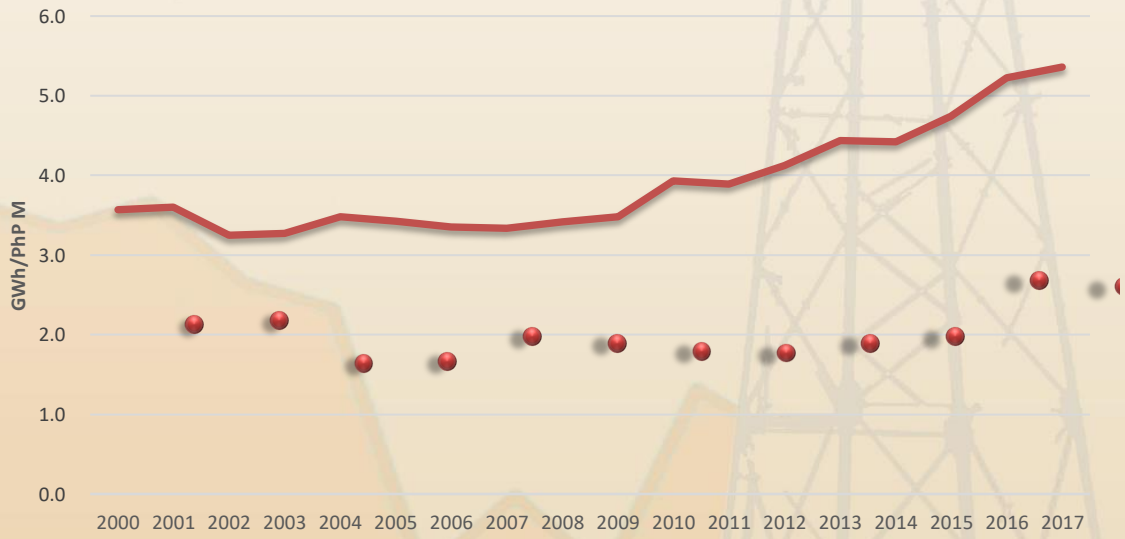
Figure 11. MIMAROPA OIL CONSUMPTION INTENSITY (BBL/GRDP)



In terms of oil intensity (oil consumed per one hundred thousand pesos of GRDP), the region burned 2.2 barrel in 2013, and increased to 2.4 barrel per PhP100,000 (bbl/PhP100k) in 2017 *(Table 7 and Figure 11)*. This can be translated to an average of 2.2 percent increase a year. Compared with the national intensity level, the country consumed 1.4 bbl/PhP100k in 2013, and then increased to 1.6 barrel in 2017.

Electricity consumed per billion pesos of GRDP (GWh/PhPB) in MIMAROPA rose to 5.4 GWh in 2017 from 4.4 GWh/PhPB in 2013 *(Table 7 and Figure 12).* At the national level, electricity consumption in 2017 stood at 3.0 GWh/PhPB. As of December 2017, household electrification level in MIMAROPA was 82.9 percent, lower than Luzon and Visayas levels at 99.0 percent and 89.4 percent, respectively, but higher than Mindanao at 70.2 percent.[4]

Figure 12. MIMAROPA ELECTRICITY CONSUMPTION INTENSITY (GWH/GRDP)



[4] As of 2018, MIMAROPA's household electrification level stood at 87.3 percent. In 2019, a new formula was adopted for computing the electrification level, which is (potential HH - unserved HH)/potential HH. Based on such formula, MIMAROPA household electrification level in 2019 was recorded at 90.3 percent.

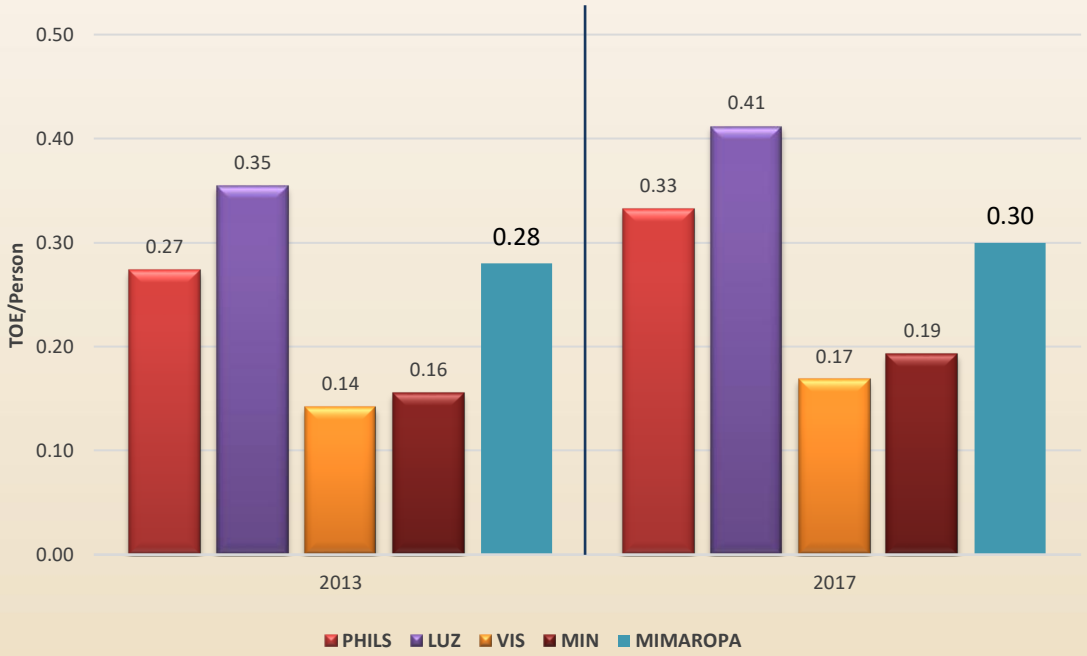
Energy per Capita

Energy per capita (toe/person) grew at an average of 1.5 percent annually from 2013 to 2017. Energy per capita in 2017 was registered at 0.30 toe/person, an increase from 0.28 toe/person *(Table 7 and Figure 13).* MIMAROPA's energy per capita is within the national level of 0.33 toe/person.

Theoretically, size and growth of the country's population affect the demand for energy. Relative to this, income and energy use are conspicuously correlated. Even at comparable levels of per capita GRDP, the volume of energy use varies among regions and provinces, as determined by a number of factors, such as structural characteristics of the regional economy, spatial features, climate, fuel and power prices, government conservation policies, and other elements.

The relationship between per capita income and energy reveals that as income per capita rises, per capita energy use likewise increases. It is evident that the degree of change for both indicators is dependent on how the application of energy by all the economic sectors supports a number of economic activities. There could also be a dynamic complement to investments for improving productivity and fueling economic growth. Consequently, economic growth gives life to the acquisition of household provisions and creates conveniences associated with increased energy usage.

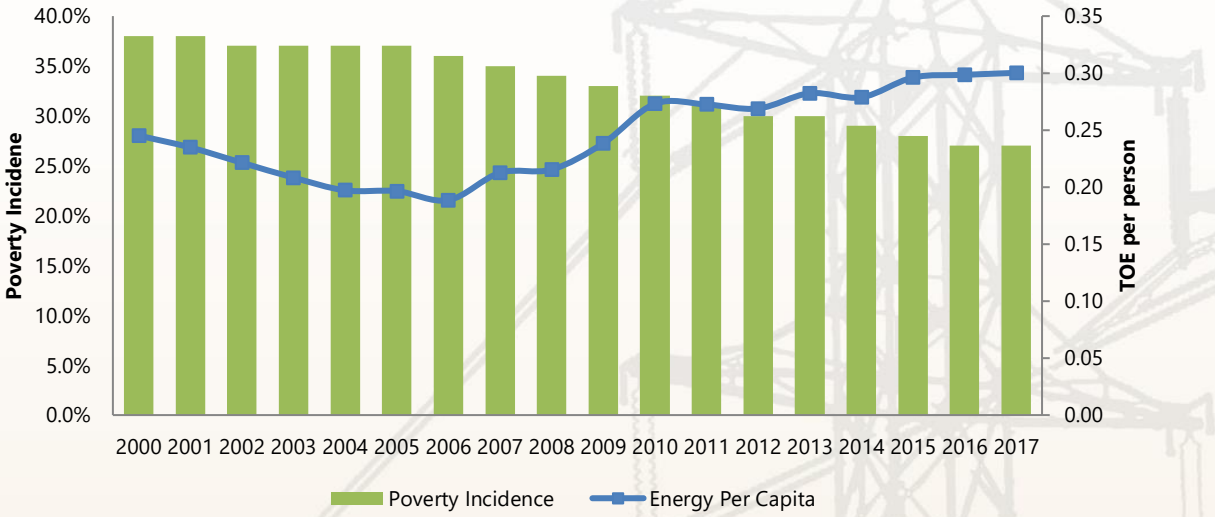
Figure 13. MIMAROPA ENERGY PER CAPITA (TOE/PERSON) VIS-À-VIS PHILIPPINES, 2013 VS 2017



To some extent the economic expansion in MIMAROPA lifted a number of people out of poverty prompting an increase in energy access and usage as average energy consumption per capita went up. *Figure 14* illustrates that as poverty incidence decreases, energy per capita increases. Increasing per capita energy consumption implies an improvement in the purchasing power of the individuals, and thus the ability to acquire more electrical devices to obtain the greatest degree of satisfaction from total expenditure. Consequently, energy consumption increases

along with the increases in personal income of the individuals. The intensified energization program of the government may also have impacted increasing energy per capita in the region.

Figure 14. MIMAROPA POVERTY INCIDENCE VERSUS ENERGY PER CAPITA, 2000 – 2017



MARINDUQUE TOTAL FINAL ENERGY CONSUMPTION

Marinduque Total Final Energy Consumption by Sector

Marinduque is considered as the smallest in terms of territorial size among the provinces in the country. The main economic activities of the province are agriculture and fishing. As an agricultural province, Marinduque primarily grows rice and coconuts. Root crop-based products, such as sweet potato and arrowroot, also grow abundantly in the province. Mining was once an important player in the local economy until a mining accident (Marcopper Mining Disaster) befell, bringing the industry to a halt on the province. Based on the data from the Bureau of Local Government Finance (BLGF), the annual regular revenue of Marinduque for the fiscal year of 2016 contributed 9.7 percent to MIMAROPA. With this economic background, the province only required nearly 8.0 percent of the estimated MIMAROPA's TFEC in 2017.

The transportation sector is the largest contributor to the province's energy demand, accounting for almost half (47.2 percent) of TFEC in 2017. Consumption showed an increasing trend from 21.9 Ktoe in 2013 to 33.6 Ktoe in 2017 *(Table 8)*. The growth in energy consumption at a rate of 11.3 percent from 2013-2017 is attributed to increased volume of motor vehicles.

The residential sector closely follows transport having a share of 34.3 percent in 2017, a decrease from 44.5 percent in 2013. Energy consumption in the sector gradually declined, from 28.3 Ktoe in 2013 to 24.5 Ktoe in 2017. Such can be correlated to fuel switching or transition from traditional biomass to more convenient fuels, such as liquefied petroleum gas (LPG) and electricity.

The industry and commercial sectors accounted for 9.0 and 7.4 percent of TFEC in 2017. The rising tourism industry in the province may have sparked the growth of 3.1 percent of the commercial sector for the period 2013-2017. On the other hand, the industry sector's energy

consumption declined as a result of a decreased in diesel and biomass consumption (as replaced by electricity).

Table 8. MARINDUQUE TOTAL FINAL ENERGY CONSUMPTION, BY SECTOR (KTOE)

Province	Actual					Growth Rate (in %)	Average % Share
	2013	2014	2015	2016	2017		
Industry	7.71	7.25	6.92	6.73	6.44	-4.41	10.36
Commercial	4.66	4.80	4.98	5.21	5.27	3.08	7.33
Transportation	21.91	22.55	29.24	32.66	33.58	11.27	40.82
Residential	28.33	28.20	26.71	27.01	24.46	-3.60	39.77
Agriculture	1.02	0.98	1.13	1.30	1.47	9.71	1.73
Total	**63.63**	**63.79**	**68.99**	**72.92**	**71.22**	**2.86**	**100**

Marinduque Total Final Energy Consumption by Fuel

Fossil fuels dominate the energy consumption mix of Marinduque with an average share 50.1 percent of the TFEC for the period 2013-2017 *(Table 9).* Consumption of biofuels and oil products recorded the fastest growth of 12.3 percent and 9.0 percent, respectively, over the same period, reaching a combined demand of 41.4 Ktoe in 2017. Overall, oil consumption in the province only represented around 10.0 percent of MIMAROPA's total oil consumption.

Biomass is the second most consumed energy source with an average share of 43.7 percent, although exhibiting a declining growth rate of 4.5 percent from 2013 to 2017 due to changes in energy consumption pattern by shifting to a more efficient fuel brought about by improvement in household income and urbanization. Biomass consumption of the province was only 7.5 percent of the MIMAROPA's total biomass consumption in 2017.

Electricity consumption experienced a strong 6.5 percent annual increase, from 2.7 Ktoe in 2013 to 3.5 Ktoe in 2017. The share of electricity consumption of the province to MIMAROPA's total electric power consumption only stood at 5.8 percent (2017).

Table 9. MARINDUQUE TOTAL FINAL ENERGY CONSUMPTION, BY PRODUCT (KTOE)

Province	Actual					Growth Rate (%)	Average Share (%)
	2013	2014	2015	2016	2017		
Oil and oil products	28.37	28.77	35.41	38.93	40.00	8.96	50.11
Electricity*	2.74	2.81	3.08	3.64	3.53	6.53	4.63
Biomass	31.66	31.32	29.39	29.05	26.32	-4.51	43.65
Biofuels	0.86	0.88	1.11	1.30	1.37	12.31	1.61
Total	**63.63**	**63.79**	**68.99**	**72.92**	**71.22**	**2.86**	**100.00**

**Includes own-use but excludes system loss*

B. POWER SITUATIONER

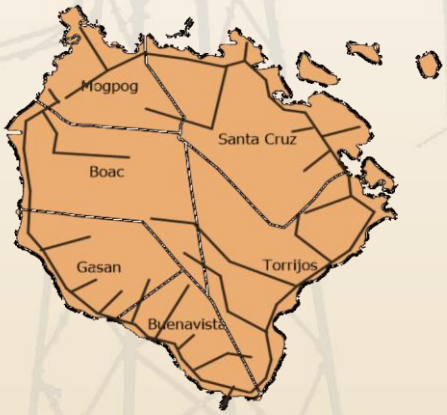
MARINDUQUE ELECTRIC COOPERATIVE, INC. PROFILE

Marinduque's electricity service is provided by its lone distribution utility, Marinduque Electric Cooperative, Inc. (MARELCO), a non-stock, non-profit electric cooperative established by virtue of Republic Act No. 6038 on 27 March 1973. It is the only electric service utility that has the franchise to provide electric service in the province per Certificate of Franchise No. 048 by the National Electrification Administration (NEA). It serves all the six (6) municipalities in the mainland composed of Boac, Mogpog, Gasan, Torrijos, Buenavista and Sta. Cruz.

With regard to performance standard[5], MARELCO used to fall under the Category A and was classified as a Large Electric Cooperative in 2004 and 2005. With the change in management in December 2012, MARELCO was able to improve its rating and had a remarkable turn-around starting 2013. Under the new Key Performance Standards (KPS), MARELCO was categorized as "AA" for the years 2015 and 2016 and Extra Large Electric Cooperative in terms of size classification in 2016. These impressive improvements continued as it achieved the highest Category Rating of "AAA" in 2017 based on the overall performance assessment representing its full compliance on four (4) parameters, namely: financial, institutional, technical and reportorial requirements.

EXISTING POWER SYSTEM

Historically, the power system in Marinduque is composed of one grid in the mainland and micro-grids for the three islets of Sta. Cruz – Polo, Maniwaya and Mongpong. But presently, the island barangays of Polo and Maniwaya are already interconnected to the Marinduque's main grid via submarine cables as funded under NEA's Barangay Line Enhancement Program (BLEP).



MARELCO's Franchise Map

MARELCO manages the operation and maintenance of the distribution system of the island grid and micro-grids, while the National Power Corporation's Small Power Utilities Group (NPC-SPUG) provides the power supply through its power generation units.

To strengthen member-consumer awareness and involvement in the efforts to achieve financial viability, MARELCO organized and launched Barangay Power Associations (BAPAs) in several barangays in the province. As shown in *Table 10*, there are currently 63 BAPAs operating all over the province with an aggregate annual energy demand of 4,249 MWh. *(See Annex 29 for the complete details of BAPAs)*

[5] The AAA rating is the highest score given by NEA to ECs and D rating is the lowest. Scores with corresponding ratings are as follows: 95-100 = AAA; 90-94 = AA; 85-89 = A; 75-84 = B; 50-74 = C; and 49 and below = D.

Table 10. LIST OF EXISTING BAPAS PER MUNICIPALITY

Municipality	Barangay/s	Average Energy Demand (MWh)
Boac	Bayuti, Binunga, Boi, Canat, Duyay, Hinapulan, Mahinhin, Putting buhangin, Tambunan, Tugos, Tumagabok	459
Buenavista	Bagacay, Bagtingon 1 Bagtingon 2, Bicas-Bicas, Lipata,Timbo,Tungib,Yook	921
Gasan	Tabionan	68
Mogpog	Argao, Guisian, Hinadharan, Hinanggayon, Malayak, Mampaitan, Mendez, Paye, Puting Buhangin, Sayao, Silangan	679
Sta. Cruz	Baguidbirin, Biga, Botilao, Dating Bayan, Devilla, Haguimit, Jolo, Kaganhao, Kalangkang, Kasily, Kilo-Kilo, Kinyaman, Labo, Makulapnit, Maniwaya, Masalukot, Mongpong, Polo, Punong, San Antonio, San Isidro, Tambangan	1432
Torrijos	Bangwayin, Bayakbakin, Bolo, Kay Duke, Malibago, Nangka, Pakaskasan, Payanas, Sibuyao, Talawan	689
Total		**4,249**

Source: MARELCO

POWER GENERATION

In 2017, the island's total installed capacity[6] was recorded at 19.94 MW, while the dependable capacity[7] stood at 11.40 MW *(Table 11)*. Due to lack of alternative energy resources, the province's electricity supply has been dependent on oil-based power plants operated by the NPC-SPUG. For the mainland, electricity supply is generated through the Power Barge 120 located in Balanacan Port, the Boac Diesel Power Plant in Bantad, Boac, and the Torrijos Diesel Power Plant in Cagpo, Torrijos. Meanwhile, the micro-grids in the islet barangays have their own respective diesel power plants from the NPC-SPUG.

Table 11. EXISTING CAPACITIES (As Of December 2017)

Plant	Installed Capacity (MW)	Dependable Capacity (MW)	Owner	Status
BOAC DDP	**8.92**	**5.60**		
Unit No. 1	1.22	0.60	NPC	Operational
Unit No. 2	1.22	0.50	NPC	Operational
Unit No. 3	1.22	0.50	NPC	Operational
Unit No. 7	1.05	1.00	NPC	Operational
Unit No. 8	1.05	1.00	NPC	Operational
Unit No. 9	1.05	-	NPC	Non-operational due to low EGT
Unit No. 10	1.05	1.00	NPC	Operational
Unit No. 11	1.05	1.00	NPC	Operational

[6] **Installed Capacity** – The total manufacturer-rated capacity of equipment as indicated in the nameplate. It is the maximum amount of electricity that the power plant can produce.

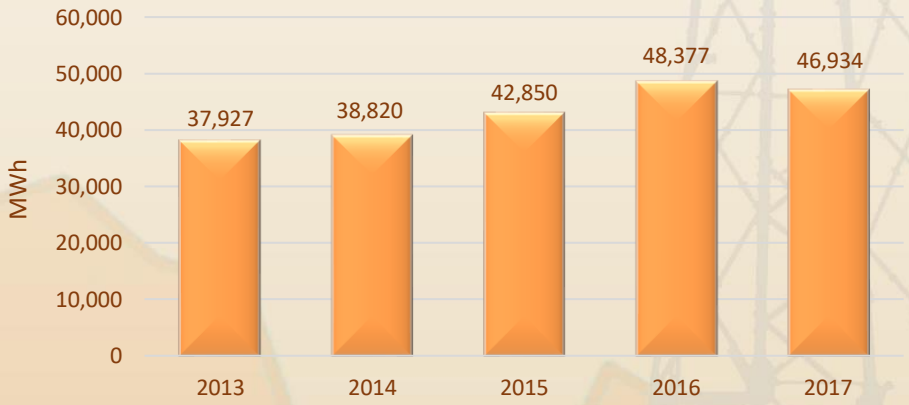
[7] **Dependable Capacity** – The load carrying ability of an electric power plant or a generating unit. It is the capacity that can be relied upon (monthly or annually).

Plant	Installed Capacity (MW)	Dependable Capacity (MW)	Owner	Status
Torrijos DPP	**1.10**	**0.45**		
Unit No. 1	0.55	0.45	NPC	Operational (for block loading only)
Unit No. 2	0.55	-	NPC	Awaiting for deep sea panel
Power Barge 120	**7.20**	**3.80**		
Unit No. 1	1.80	0.95	NPC	Operational
Unit No. 2	1.80	1.05	NPC	Operational
Unit No. 3	1.80	0.80	NPC	Operational
Unit No. 4	1.80	1.00	NPC	Operational
Rental (2MW)	**2.72**	**2.000**		
Unit No. 1	1`.36	1.00	Monark	Operational
Unit No. 2	1.36	1.00	Monark	Operational
Total	**19.94**	**11.40**		

MARELCO has an existing five-year Power Supply Agreement (PSA) with NPC, which will expire in September 2019.[8] For 2017, power supply agreement covered 51,697 MWh contracted energy with an equivalent demand of 9.486 MW.

Figure 15 shows the historical electricity generation in Marinduque, which grew by nearly 24.0 percent from 2013 level of 37,927 MWh to 46,934 MWh in 2017, equivalent to 5.5 percent growth rate a year. However, electricity generation in 2017 posted a negative growth rate of 3.1 percent due to the aftermath of Typhoon Nina (International name: Nock-Ten) in December 2016. The typhoon caused severe catastrophic damage and economic disruption in the province that resulted in a decline in electricity demand.

Figure 15. ELECTRICITY GENERATION, MWh



TRANSMISSION SYSTEM

The existing 69 kV transmission line of NPC-SPUG in Marinduque has a total length of 58.8 circuit-km composed of two segments. The first segment is the 9.8 circuit-km transmission line that stretches from Mogpog to Boac, while the second is the 49 circuit-km transmission line from Boac

[8] In 2019, MARELCO secured an interim PSA with NPC until August 2022.

to Torrijos. These transmission lines were built several years ago, but never commissioned and energized due to right-of-way problems. Thus, the state and conditions of these transmission lines deteriorated from the effect of wear and tear, and typhoons that hit the province.

DISTRIBUTION SYSTEM

The distribution system of MARELCO is a loop type primary feeder which provides two parallel path of power supply from the substation to the load. To monitor the system performance on the district level, primary metering was installed in selected locations in each of the six municipal districts. This aids substantially in the analysis of the entire distribution system so that appropriate measures can be done to further improve service efficiency.

As of December 2017, the distribution line has a total length of 1,641.7 circuit-kilometers for the entire network. The length of overhead distribution line per type of configuration is summarized in *Table 12.*

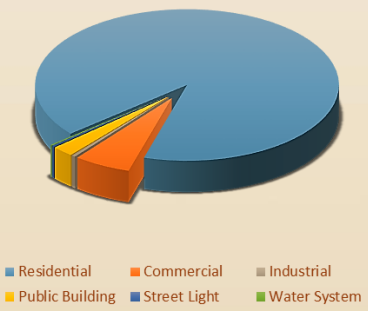
Table 12. OVERHEAD DISTRIBUTION LINE PER CONFIGURATION (AS OF DECEMEBER 2017)

Type of Circuit	Circuit-Kilometers
Three Phase	453.53
Vee Phase	20.54
Single Phase	383.03
Open Secondary	431.97
Under Built	352.58
Total	**1,641.65**

Consumer Profile

MARELCO serves a total of 49,857 active consumers as of December 2017. As shown in *Figure 16*, the consumer-based is predominantly residential customers representing around 91.0 percent of total. The commercial customers followed next which displayed the highest growth rate due to increasing number of commercial establishments in the province. The average growth rate of customers from residential, commercial and industrial in the last five years was 3.6 percent, 6.0 percent, and 3.7 percent, respectively.

Figure 16. TOTAL NUMBER OF CUSTOMERS

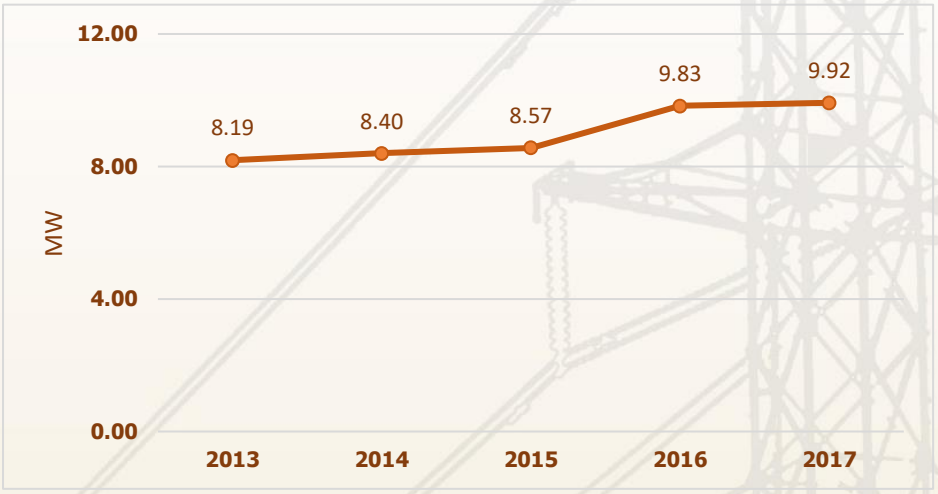


Customers	2017
Residential	45,212
Commercial	3,027
Industrial	208
Public Building	1,154
Street Light	160
Water System	96
Total Number of Customers	**49,857**

Peak Demand

Over the historical period, the recorded peak demand of Marinduque increased from 8.2 MW in 2013 to 9.9 MW in 2017 *(Figure 17),* equivalent to an annual average growth rate of 5.1 percent.[9] Such growth during the period was relatively moderate, but a dramatic increase of almost 16.0 percent was experienced from 2015 to 2016 due to influx of several business establishments.

Figure 17. PEAK DEMAND, 2013-2017



Based on the daily load curve, the rise in peak demand occurs in the evening (at around 7:00 o'clock). During the day, the peak reaches 8.4 MW at about 2:00 o'clock in the afternoon brought about by the connected loads of government agencies and other economic activities. *Table 13* shows the recorded peak demand per district during the day and night time.

Table 13. DEMAND LOADING PER DISTRICT, 2017

District	Peak Demand (Day)	Peak Demand (Night)
Feeder 1		
1. Mogpog	1,599	1,876
2. Sta. Cruz	2,027	2,379
3. Torrijos	878	1,031
Sub-Total	4,503	5,286
Feeder 2		
1. Boac	2,386	2,801
2. Gasan	1,054	1,237
3. Buenavista	456	536
Sub-Total	3,896	4,574

[9] In 2018 and 2019, the peak demand reaches 10.01MW and 11.59MW, respectively.

Figure 18. ANNUAL LOAD DURATION CURVE, 2017

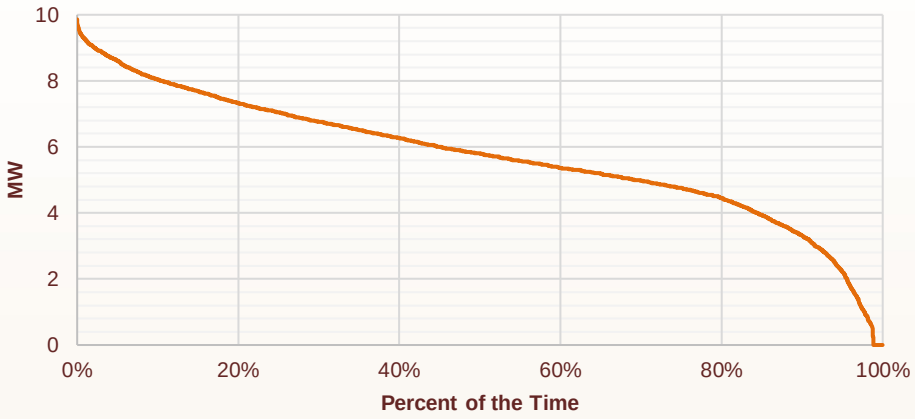


Figure 18 represents the annual load duration curve for 2017 which shows the load demand versus time duration. With peak demand reached 9.92 MW in 2017, only about 10.0 percent of the time that demand exceeded 8 MW persists. Meanwhile, almost 24.0 percent of the time, demand was below the average load of 4.68 MW. It also appeared that the load was even below 1 MW for 2.3 percent of the time, which could be attributed to insufficient and unreliable supply.

Electricity Sales

In 2017, total electricity sales were recorded at 41,071 MWh, a 28.5 percent increase from 2013 level of 31,959 MWh, translated to a 5.0 percent annual growth *(Table 14).*[10] The influx of several commercial establishments in the province from 2014 to 2016 induced electricity sales to accelerate at a much faster pace with a 13.7 percent average growth rate.

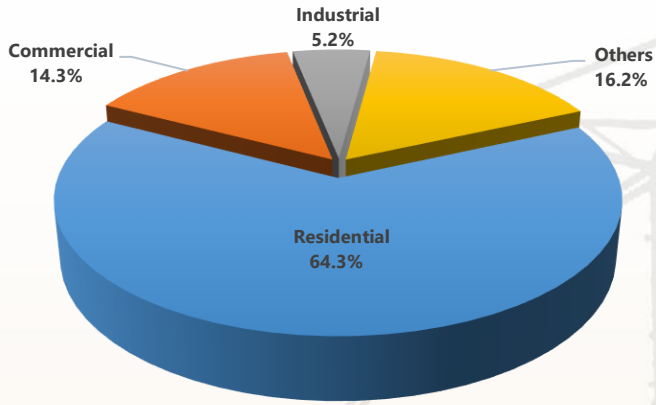
Table 14. ELECTRICITY SALES PER SECTOR, 2013-2017

Consumer Type	2013	2014	2015	2016	2017
Residential	20,959	21,281	23,115	26,713	26,022
Commercial	4,624	4,853	5,093	5,803	5,825
Industrial	1,157	1,244	1,748	3,027	2,776
Others	5,219	5,401	5,974	6,747	6,447
Total Sales	31,959	32,778	35,931	42,290	41,071

The share of each sector to total electricity sales remains almost the same over the historical period. The residential sector accounted for the largest average share with more than 60.0 percent of total *(Figure 19).* The commercial sector and industrial sector demanded average shares of 14.3 percent and 5.2 percent, respectively. The "others" sector, which comprised of public buildings, streetlights, agricultural and municipal water system and utility's station-use, recorded a share of 16.2 percent.

[10] In 2018 and 2019, total electricity sales reached 48,101 MWh and 52,167MWh, respectively.

Figure 19. AVERAGE SECTORAL SHARES ON ELECTRICITY SALES, 2013-2017

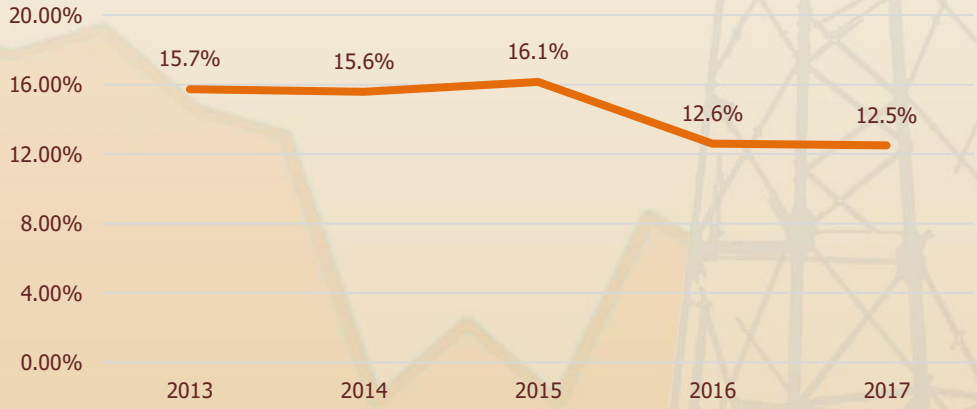


System Loss

For the historical period, MARELCO demonstrated a progressive reduction in system loss as a result of its continuous massive line clearing, line rehabilitation, and replacement of old and defective line materials and protection. With efforts to improve the operational efficiencies and performance of the distribution network, MARELCO managed to bring down the over-all system loss to 12.5 percent in 2017 from 15.7 percent in 2013 *(Figure 20)*.[11] This can be further reduced should the system's overall power factor,[12] which is at steady level of 98.0 percent, be raised to 99.0 percent. It must be noted that system loss reduction often leads to lower electricity rates easing the burden of paying system loss charges being billed to member-consumers.

Line rehabilitation and massive clearing activities of MARELCO.
© https://www.facebook.com/marelco.ihatub/

Figure 20. HISTORICAL SYSTEM LOSS, 2013-2017



[11] In 2018 and 2019, MARELCO's system loss is at 10.92 and 10.27 percent, respectively.
[12] Power factor is the ratio of real power (kilowatt) to apparent power (kilovolt-ampere/KVA) for any given load and time. (Source: U.S. Energy Information Administration)

Recently, the Energy Regulatory Commission (ERC) issued the rules on lowering the system loss cap through Resolution 20, Series of 2017. Electric Cooperatives are grouped into three clusters based on technical considerations to determine the allowable system loss that can be charged to their consumers. For MARELCO, the ERC imposes a 12.0 percent limit starting 2018 onwards from the standard cap of 13.0 percent.

System Reliability

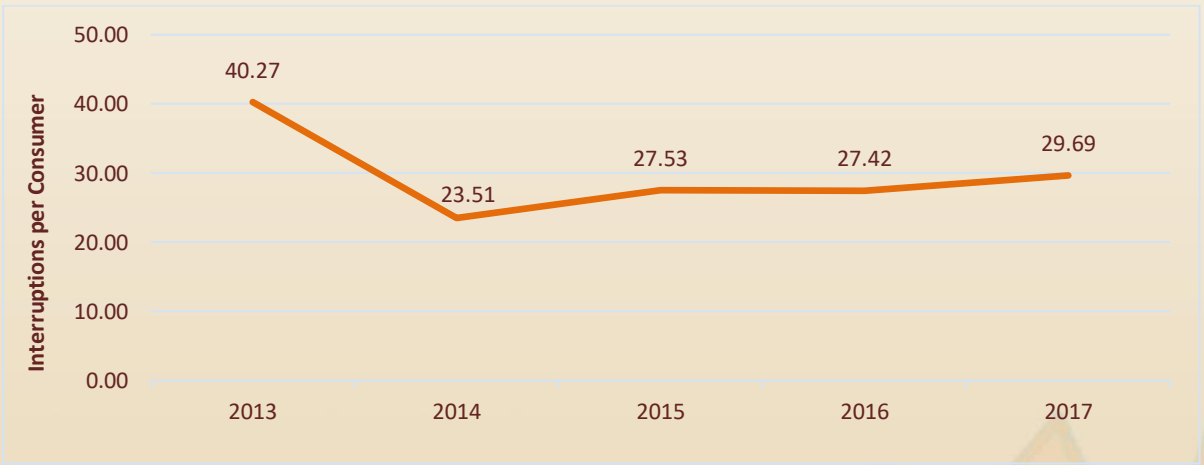
The System Average Interruption Frequency Index[13] (SAIFI) and System Average Interruption Duration Index[14] (SAIDI) are the most common reliability indices being used to assess the overall system reliability performance of the distribution system.

In 2013, each MARELCO consumer experienced an average of 40.27 power interruptions. This was beyond the NEA standard of 30 interruptions per consumer per year. However, MARELCO showed significant improvements on the succeeding years as the frequency of interruptions are all within the set standard on SAIFI *(Figure 21).*

For SAIDI, historical data shows that MARELCO managed to consistently comply with the standard time duration of 3,375 minutes (56.25 hours) per consumer annually *(Figure 22).*

It should be noted that these reliability indicators could vary significantly from year to year due to the random occurrence of a single major outage caused by extreme weather and natural disasters. For instance, it can be observed in *Figure 22* that the duration of power interruption slightly increased in 2016, a result of Typhoon Nina that hit the province in the month of December. The increase in frequency and duration of power interruption continued in 2017 as brought about by restoration and rehabilitation activities to replace the lines and equipment and repair the damages caused by typhoon. But despite this disturbance, MARELCO was still able to meet NEA's performance standard for SAIFI and SAIDI in 2016 and 2017.[15]

Figure 21. SAIFI, 2013-2017

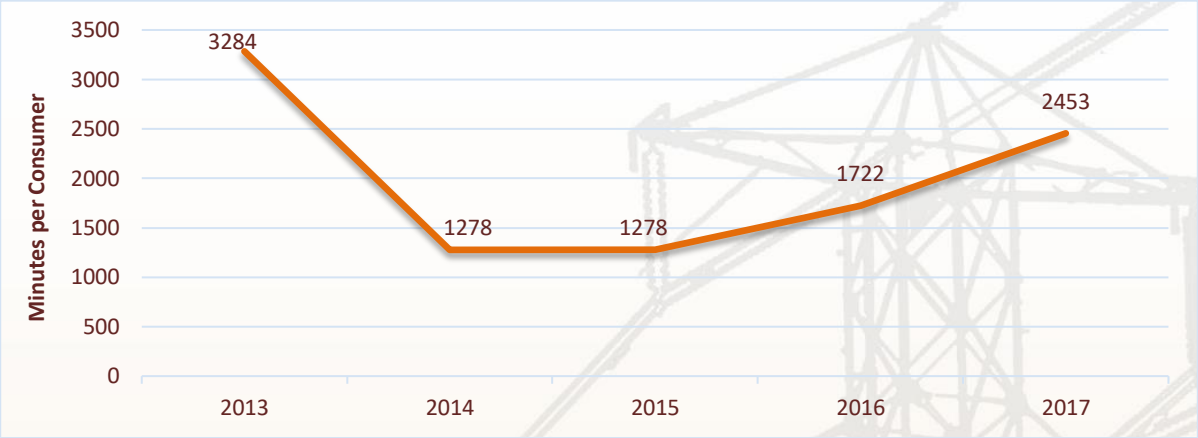


[13] System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period of time. (Source: Philippine Distribution Code)

[14] System Average Interruption Duration Index (SAIDI) indicates the total duration of interruption for the average customer during a predefined period of time. (Source: Philippine Distribution Code)

[15] Based on NEA's Compliance Report on the Performance of Electric Cooperatives for 2019, MARELCO is within the set standard for SAIFI and SAIDI recording 17.96 and 1,305.74, respectively.

Figure 22. SAIDI, 2013-2017



ELECTRIFICATION

In an archipelagic country like the Philippines, the provision of electricity in island provinces is critically important to the envisioned social and economic development of the country. It creates more opportunities for the marginalized sectors to improve quality of life with greater access to basic services and better infrastructures for rural development. Moving forward to achieving these aspirations, the government puts a premium on increasing and accelerating access to electricity services to meet the goal of total electrification by 2022.

Over the past years, Marinduque had made significant progress toward achieving greater access to electricity services. In December 2012, the province already achieved 100.00 percent barangay electrification level by energizing all the 218 barangays. Since the inception of Sitio Electrification Program (SEP) in 2011, MARELCO was able to energize 223 sitios with a total subsidy amounting to PhP 125,619,157 Out of 408 potential sitios, 388 have been energized as of December 2017 translating to 95.1 percent electrification level *(Table 15).*

Sec. Alfonso G. Cusi leads energization of NPC's new 5MW generating sets in Marinduque. ©https://www.spug.ph

Table 15. SITIO ELECTRIFICATION PER MUNICIPALITY, 2017

Municipality	Potential Sitios	No. of Sitios Energized	Electrification Level (Percent)
Boac	84	83	98.81
Buenavista	42	39	92.86
Gasan	77	72	93.51
Mogpog	49	46	93.88
Santa Cruz	111	109	98.20
Torrijos	45	39	86.67
Total	**408**	**388**	**95.10**

At the household level, Marinduque is among the top ten provinces in the country with highest electrification level. As of December 2017, household electrification level reached 90.36 percent with 55,163 out of 61,048 potential households now have access to electricity *(Table 16).*[16] The municipalities of Santa Cruz, Mogpog and Boac have the highest household electrification level, recorded at more than 90.0 percent.

Table 16. HOUSEHOLD ELECTRIFICATION PER MUNICIPALITY, 2017

City/Municipality	Total No. of Households	No. of Served Households	No. of Unserved Households	Electrification Level (Percent)
Boac	14,897	13,672	1,225	91.78
Buenavista	5,700	4,798	902	84.18
Gasan	8,589	7,627	962	88.80
Mogpog	9,277	8,544	733	92.10
Santa Cruz	15,209	14,092	1,117	92.66
Torrijos	7,376	6,430	946	87.17
Total	**61,048**	**55,163**	**5,885**	**90.36**

Source: 2018 MARELCO Distribution Development Plan

BENEFITS TO HOST COMMUNITIES

To recognize the contribution of communities hosting generation facilities or energy resources, host communities are entitled to financial benefits through Energy Regulation No. 1-94 (ER 1-94) under the Electric Power Industry Reform Act (EPIRA).

ER 1-94 stipulates that communities hosting power generation facilities or energy resources are entitled to one centavo per kilowatt-hour (P0.01/kWh) of the total electricity sales of generation companies or energy resource developers. This financial benefit can be availed by host communities on the following programs: electrification fund (EF), development and livelihood fund (DLF), and reforestation, watershed management, health and/or environment enhancement fund (RWMHEEF).

As of December 2018, the total collected financial benefits for the province of Marinduque amounted to nearly PhP 3.8 million *(Table 17).* The local government may avail the financial benefits to fund and pursue projects allowed under ER 1-94 program.

Table 17. SUMMARY OF COLLECTED FINANCIAL BENEFITS (December 2018)

NPC- SPUG	EF	DLF	RWMHEEF	Collected Financial Benefits
Boac DPP	628,489.53	314,245.04	314,245.04	1,256,979.61
Maniwaya DPP	1,100.76	550.38	550.38	2,201.52
Mongpong DDP	1,125.91	562.92	562.92	2,251.75
Polo DDP	723.55	361.78	361.78	1,447.11
Torrijos DPP	24,049.17	12,024.68	12,024.68	48,098.53
Power Barge 120	1,282,847.90	641,423.98	641,423.98	2,565,695.86
Total	**1,914,287.65**	**957,144.10**	**957,144.10**	**3,828,575.85**

[16] If based on 2015 Census of Population, MARELCO already achieved the 100 percent household electrification rate.

To enhance the ER 1-94 program and maximize its benefits to host communities, the DOE recently issued Department Circular (DC) No. 2018-08-0021, amending Rule 29 (A) of the Implementing Rules and Regulations (IRR) of EPIRA. One of the major changes is the direct remittance of financial benefits to host communities to streamline the release and for immediate utilization of the fund.

C. DOWNSTREAM OIL INDUSTRY

Access to basic services is fundamental to alleviate poverty in the province. As such, downstream oil facilities are necessary energy infrastructures to have continuous supply of petroleum products and should be regarded as equally important as the provision of electricity services.

The passage of Republic Act 8479 or the Downstream Oil Industry Deregulation Act of 1998 intends to achieve a truly competitive market through the entry of new players and meet social policy objectives of fair prices and uninterrupted supply of environmentally-clean and high quality petroleum products. The government likewise enforces the Minimum Inventory Requirement (MIR) as a buffer to continuing oil supply risks faced by the oil industry sector, such as geopolitical instability and supply delivery problems in areas affected by calamities (e.g. typhoon and earthquake). The current MIR level imposed for refiners is 30 days of in-country stocks, while 15 days stock is required for the bulk marketers and seven (7) days for the LPG players.

Fuel Depot at Barangay Buyabod, Sta. Cruz

Based on the data obtained, the province has a limited number of downstream oil facilities. Thus, expansion of these facilities is required in anticipation of rising oil demand from foreseen economic progress in the province.

The need for policy formulation and strategic decisions by the provincial government to encourage investments will not only aid local economy but will likewise promote energy security. Simply said, efficient energy infrastructures will have to be built to support inclusive growth of the Province.

To date, the province has one (1) oil depot to support its domestic oil requirement. Located in Buyabod, Sta. Cruz, the lone depot has a total storage capacity of 2.07 thousand barrels (MB), equivalent to 328.37 thousand liters (KL). Said depot is necessary for the storage of oil and/or petroleum products, and from which these products are transported to gasoline stations or

consumers. Having a single depot means that the province can only store one type of petroleum product as inventory. Therefore, most of the stocks of petroleum products are kept within the underground storage tanks of the liquid fuels retail outlets, which are gradually drawn daily and then replenish later. On the average, each underground storage tank per petroleum product (regular, premium and diesel) has a capacity of 15,000 per liter.

Figure 23. LOCATIONS OF GAS STATIONS, 2018

In terms of petroleum retail market, the province has a total of 31 gasoline stations located in different parts of the province *(Figure 23).* Of the total, ten (10) are operated by major oil players (Petron and Chevron), and 21 are operated by new and independent retailers *(Table 18).*[17] With the existing number of gasoline stations, the province has a gasoline density of five stations per municipality.

Table 18. MARINDUQUE'S LIQUID FUEL RETAIL OUTLETS AND GAS STATIONS, 2018

Municipality	Major Players	New Players		Total
		With Bulk Supply/Facilities	Independent*	
Boac	2	1	3	6
Buenavista	1	1	4	6
Gasan	2	1	0	3
Mogpog	1	2	1	4
Sta. Cruz	3	3	1	7
Torrijos	1	1	3	5
Total	**10**	**9**	**12**	**31**

*Notes: *With 1-5 retail outlets*

Table 19. MARINDUQUE'S LPG ESTABLISHMENTS, 2018

Municipality	Dealer	Retail Outlet*
Boac		2
Buenavista		1
Gasan	1	1
Mogpog		2
Sta. Cruz		7
Torrijos		3
Total	1	16

**Issued with Standards Compliance Certificate*

The province has 1 LPG refilling plant, an authorized 3rd party refiller of Fiesta Gas brand which serves 1 LPG dealer and 16 LPG retail outlets.[18] *Table 19* shows the number of LPG facilities in the province.

[17] As of March 2020, the province has a total of 39 gas stations; 10 operated by major oil players and 29 by new and independent players.
[18] As of March 2020, the province has 4 LPG dealers and 18 retail outlets.

CHAPTER III:
ENERGY DEMAND AND SUPPLY OUTLOOK

A. KEY MACROECONOMIC ASSUMPTIONS, PARAMETERS AND METHODOLOGY

The energy outlook of the MarEP 2018-2040 defines the potential long-term energy demand and supply scenario in MIMAROPA, which covers the period 2018 to 2040. The outlook will aid the region in addressing the energy supply requirements for a higher economic target as espoused in the MIMAROPA Regional Development Plan.

The Plan critically reviews developments over the period 2000 to 2017 in order to examine whether the applied energy demand models are suitable for capturing the specific features of the developing locale. It applies two types of approaches, end-use demand estimation and econometric. The end-use demand by sectoral representations serves as the baseline for projections. In the process of doing the outlook, difficulties emerged due to availability of data and limited data collection. The accounting of energy consumption at the regional and provincial levels for the types of fuel consumed by the economic sector is still a field that is relatively undeveloped. As such, disaggregation from national level data using the Energy Balance Table (EBT) as reference was undertaken to come up with regional and provincial energy data based on MIMAROPA's shares to national including the sectors' profiles (industry, commercial and agriculture). For biomass, the reference for disaggregation from national data is the Household Energy Consumption Survey (HECS) results.

In demand projection, the end-use demand covering the historical period of 2000 to 2017 is used as the foundation for energy demand outlook. Historical data on energy demand (e.g. regional sales) and socio-economic indicators like gross regional domestic product (GRDP) or gross value added (GVA), demographic profile, household income and expenditure, price, and other relevant data formed part of the working database to assess the energy situation. These are taken as the bases for projections on the region's final energy demand by economic sector (i.e., residential, industry, commercial and others) and fuel type.

The following parameters are the variables (indicators) included in the energy demand models for each type of fuel or energy consumed in MIMAROPA:

- **Electricity Consumption.** Historical data of electricity demand is obtained from the Distribution Development Plans (DDPs) of the Electric Cooperatives (ECs) in Romblon. In forecasting sectoral electricity consumption (residential, commercial, industrial and agriculture (including others), regression analysis is applied using the historical data and applicable explanatory variables mentioned above. Likewise, projection on household electricity demand considered the government's target of 100.0 percent household

electrification level by 2022 (based on the 2015 census), and full electrification level in 2030 (based on projected number of households in the same year).

- **Estimation of Oil Consumption by Product Type.** MIMAROPA's oil consumption on a per province is prorated from the national data using sales data (from EBT). Oil demand is divided into transport and non-transport. For each segment, the demand is measured on per fuel basis – gasoline, diesel, liquefied petroleum gas (LPG), kerosene, fuel oil, avgas and jet fuel.

  Oil demand of the transportation sector covers the three (3) modes – road, air and water. However, the sector's demand of the province is only confined to road transport, as oil consumption of air and water transport is accounted in the airport and port of origin of aircrafts and vessels. Likewise, oil consumption of inter-island vessel (within the province) and fishing boat are also excluded in the projection due to availability of data. Future demand levels of land transport are estimated by utilizing the following indicators: number of vehicles per type of fuel used, fuel efficiency and mileage, fuel conversion, and number of households.

  Meanwhile, the non-transport comprises of residential, commercial, industry, and agricultural sectors. Residential sector's oil demand is generated using intensity – residential oil demand over household final consumption expenditure (HFCE) – when explanatory variables failed to get acceptable results. In some instances, residential demand per capita is estimated and used for the projection. The other sectors' (industry, commercial and agriculture) oil demand is estimated based on their shares (proportion) in the total national oil demand. Demand intensity likewise is estimated vis-à-vis GVA of the sectors and other explanatory variables as an alternative approach in projection.

- **Estimation of Biomass Consumption.** Using the profile of distribution from the 2011 HECS data, MIMAROPA's regional data is disaggregated into provincial level. Biomass demand is divided into residential and non-residential (commercial and Industry) uses. Residential demand data is derived by getting its proportion from the total national demand by fuel type (fuelwood, charcoal and agricultural waste) based on the profile indicated in HECS data. Similarly, industry and commercial demands are generated from total national (share/proportion). In general, biomass demand of both industry and commercial sectors exhibits the same consumption pattern with the residential sector because demand is assumed to be dependent on the availability of resources.

  In residential sector, biomass demand is simulated on a per capita basis. Also, household income and HFCE are considered in modelling residential demand. For commercial and Industry demand model, the GVA is regressed with the consumption pattern.

Regression analysis is applied to determine the historical relationship between final energy demand by sectors and the explanatory socio-economic variables. It produces a set of sectoral energy consumption model equations, relating the energy consumption by sectors with corresponding socio-economic variables.

Despite limitations on the development and maintenance of more detailed energy databases, the energy models are developed to better reflect energy development in the local context. Implications for the institutionalizing the energy demand modelling is expected to deliver richer and more reliable inputs to policy formulation at the local level.

ECONOMIC GROWTH

> **The Philippines by 2040**: *Matatag, Maginhawa, at Panatag na Buhay. The country is a prosperous middle-class society where no one is poor. People live long and healthy lives and are smart and innovative. The Philippines is a high-trust society where families thrive in vibrant, culturally diverse, and resilient communities* - **AmBisyon Natin 2040.**

The Philippine Development Plan (PDP) 2017-2022 is anchored on the 10-point Socio-economic Agenda geared towards the Ambisyon Natin 2040. The Ambisyon articulates the Filipino people's collective vision of a "MATATAG, MAGINHAWA, AT PANATAG NA BUHAY PARA SA LAHAT," as well as accounts the country's international commitments, such as the 2030 Sustainable Development Goals. The PDP aggressively sets the country's overall economic growth target to be around 7.0 to 8.0 percent a year. Specifically, the PDP intends to achieve the following:

- An upper middle-income country by 2022. In the medium-term, GDP growth is expected to strengthen further to 7.0 – 8.0 percent, in real terms. This means that the economy expands by about 50.0 percent by 2022 from 2016 level, while per capita income increases from USD 3,550 in 2015 to at least USD 5,000 in 2022.

- Inclusive growth as manifested by a lower poverty incidence in the rural areas, from 30.0 percent in 2015 to 20.0 percent in 2022. Overall poverty rate declines from 21.6 percent to 14.0 percent in 2022 – lifting about 6 million Filipinos out of poverty. The proportion of subsistence poor individuals falls from 8.1 percent to 5.0 percent. Food inflation is also closely monitored to serve as an early warning indicator on the welfare of the poor. It should not go beyond the bounds set for overall inflation, around 2.0 to 4.0 percent.

With such growth target, the country requires more investment and better infrastructure given its expanding population, rapid urbanization and archipelagic landscape. To support a higher growth trajectory and improve the quality of life in both urban and rural communities, infrastructure development remains as among the top priorities of the government over the medium-term. Infrastructure investment has to be intensified, while addressing persistent issues and challenges hampering implementation, as an affirmation to the so-called "Golden Age of Infrastructure," which is a solid foundation for the realization of the country's overall long-term vision.

The country's economic performance has improved since 2010. The World Economic Forum's Global Competitiveness Report 2016-2017 ranked the Philippines as 57th of 138 economies[8] worldwide. Further, economic growth has become more inclusive with unemployment reaching historically low levels (5.5 percent in 2016 and 5.7 percent in 2017[9]) and poverty incidence (among population) decreased to 21.6 percent in 2015 from 25.2 percent in 2012 based on a poverty threshold of PhP 21,756[10] minimum annual income per capita. Poverty incidence for families also declined to 16.5 in 2015 from 19.7 in 2012.

As the Philippine economy remains robust in 2018 and beyond particularly that the outlook on the global economy is becoming more optimistic, GDP is expected to grow at around 6.0 percent, on average, from 2018 to 2040. With the future growth trend of the country's economy, there is a strong focus on MIMAROPA's progress and transformation. Over the planning period, MIMAROPA's GRDP is projected to increase by four-fold, from PhP133 billion in 2017 to around PhP 544 billion by 2040. It is seen to grow at 6.8 percent annually from 2020-2025, 6.3 percent from 2025-2030, and drops to 5.9 percent over the next decade between 2030 and 2040 *(Table 20)*.

Table 20. GRDP PROJECTION 2018-2040, By Sector (billion pesos @ 2000 price)

Region	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013 - '17	2017 -'40	2020 -'25	2025 -'30	2030 -'35	2035 -'40
GRDP	133.20	143.41	162.18	225.51	305.70	407.50	544.04	4.52	6.31	6.82	6.27	5.92	5.95
Agriculture	26.73	27.18	28.03	29.90	31.28	32.27	33.00	0.23	0.85	1.30	0.90	0.63	0.45
Industry	43.84	47.67	56.31	84.77	122.39	171.84	240.20	4.47	7.28	8.53	7.62	7.02	6.93
Services	62.66	67.39	77.85	110.84	152.03	203.39	270.83	7.24	6.23	7.32	6.52	5.99	5.89
HFCE	138.21	147.49	167.59	227.76	297.30	377.53	474.97	6.23	5.22	6.33	5.47	4.89	4.70
GFCE*	17.93	19.07	21.52	28.74	36.92	46.19	57.25	6.52	4.90	5.96	5.14	4.58	4.39
CF**	24.67	29.27	41.13	95.14	203.23	411.28	825.40	15.90	15.63	18.26	16.39	15.14	14.95

**Government Final Consumption and Expenditure*
***Capital Formation*

The industry and services sectors continue to fuel growth and contribute significantly to the economic expansion. The service sector with a GVA value of PhP62.7 billion in 2017 contributed 47.5 percent to MIMAROPA's domestic economy. It performed strong in 2013 to 2017 as it posted a 7.2 percent annual average increase. Over the planning period, region's GVA for the services sector increases by four times, reaching around PhP270.8 billion in 2040, growing annually at 6.2 percent.

The industry sector's GVA of PhP36.8 Billion in 2013 rose to PhP43.8 billion in 2017, equivalent to a 4.5 percent annual average growth and with 33.8 percent share to the region's GRDP. Its GVA escalates by four-fold to around PhP240.2 billion by 2040. It is seen to grow at 7.3 percent annually from 2017 to 2040.

[8] In the Global Competitiveness Report 2017-2018, the Philippines ranked to 56th out of 137 economies.
[9] Source: Philippines Statistics Authority.
[10] PhP1, 813 average monthly income.

DEMOGRAPHICS

This analysis draws population assumptions from the Philippine Statistical Authority (PSA). On average, the country's population is growing at an average annual growth rate of 1.7 percent from 2010 to 2017. About 2.9 percent of the country's population is living in MIMAROPA and growing at almost at the same rate as the national average. The outlook assumes that population of the region shall increase from 3.08 million in 2017 to 4.39 million persons in 2040, translating to an annual growth rate of 1.6 percent. Regional population growth rate is seen to decelerate in the succeeding five-year interval to 1.6 percent in 2025-2030, 1.4 percent in 2030-2035, and 1.2 percent in 2035-2040 *(Table 21)*.

Table 21. POPULATION PROJECTION 2018-2040, By Region (million persons)

Region	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2018 vs'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Marinduque	0.24	0.25	0.26	0.28	0.30	0.32	0.34	1.73	1.47	1.66	1.52	1.36	1.20
Occidental Mindoro	0.51	0.52	0.54	0.59	0.63	0.68	0.71	2.01	1.50	1.77	1.53	1.31	1.10
Oriental Mindoro	0.88	0.89	0.93	1.01	1.10	1.17	1.25	1.97	1.55	1.77	1.57	1.38	1.21
Romblon	0.30	0.31	0.32	0.35	0.38	0.41	0.43	1.84	1.57	1.76	1.61	1.46	1.31
Palawan	1.15	1.17	1.22	1.34	1.46	1.56	1.65	2.11	1.59	1.87	1.63	1.38	1.15
Total	**3.08**	**3.14**	**3.27**	**3.57**	**3.86**	**4.14**	**4.39**	**2.00**	**1.55**	**1.80**	**1.58**	**1.38**	**1.18**

B. MARINDUQUE TOTAL FINAL DEMAND OUTLOOK

The energy sector plays a vital role in the economic growth and development of any province. Over the past few decades, the inadequate energy supply in Marinduque had led to a poor economic performance. As the province continues to secure its energy requirements, the path towards the development of every sector of its domestic economy has been enabled. The emergence of a growing middle class in the province as reflected in the significant reduction in poverty incidence in the last few years is an increasingly important factor shaping its economic and energy trends.

The total final energy consumption (TFEC) of Marinduque is expected to exhibit a slower growth rate in the next decades in comparison with the historical period *(Table 22)*. Between 2013 and 2017, the province's TFEC grew from 63.6 Ktoe to 71.2 Ktoe, a growth rate of 2.9 percent a year. In 2017, the final energy demand mix was dominated by oil with 56.2 percent share to TFEC, followed by biomass with 37.0 percent, electricity with 5.0 percent, and biofuels with 1.9 percent. Over the planning horizon, energy demand reaches 122.8 Ktoe in 2040 from 71.2 Ktoe in 2017.

Oil and oil products remain as the major energy source in the province over the planning period with demand posting a 3.8 percent growth rate annually translating to 94.6 Ktoe in 2040. Although a number of population in rural and remote areas are still relying on traditional biomass, its use gradually loses relevance in the province. Significant switching from biomass to oil is projected, prompting the share of biomass to decline from 37.0 percent in 2017 to an average of 18.7 percent from 2018 to 2040. Meanwhile, electricity shows a

significant increase in projected demand a robust of almost 6.0 percent annual growth rate for the period 2020-2025, slows down to 5.2 percent in 2025-2030, and 4.2 percent post 2030. This translates to 4.5 ktoe of electricity demand in 2020 to 11.3 ktoe in 2040. The increasing electricity demand aligns with the government policy to move towards total household electrification by 2022 (based on 2015 census).

Table 22. TOTAL FINAL ENERGY CONSUMPTION, By Product (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Oil and Oil products	40.00	41.68	45.55	56.94	69.77	81.55	94.64	8.96	3.82	4.57	4.15	3.17	3.02
Electricity*	3.53	4.14	4.46	5.96	7.68	9.44	11.30	6.53	5.19	5.96	5.20	4.22	3.67
Biomass	26.32	25.01	22.68	18.24	15.16	12.95	11.34	-4.51	-3.60	-4.27%	-3.63	-3.10	-2.63
Biofuels	1.37	1.45	2.39	3.09	3.89	4.67	5.54	12.31	6.26	5.23	4.75	3.69	3.51
Total	**71.22**	**72.27**	**75.08**	**84.22**	**96.50**	**108.61**	**122.82**	**2.86**	**2.40**	**2.32**	**2.76**	**2.39**	**2.49**

**Includes own-use but excludes system loss*

SECTORAL FINAL ENERGY DEMAND OUTLOOK

Table 23 and *Figure 24* show the projection of TFEC by sectors. The transport sector has been the major user of energy requiring almost half (47.2 percent) of TFEC in 2017, while the residential sector demanded more than one-third (34.3 percent) of total. Transport and residential sectors together accounted for a share of 81.5 percent (58.0 Ktoe) of TFEC. In 2040, these two sectors represent a share of about 89.0 percent (109.2 Ktoe) of TFEC.

The residential sector's energy demand decreases at 1.0 percent a year, from 24.5 Ktoe in 2017 to 19.6 Ktoe in 2040, demonstrating that the effort to switch away from traditional biomass to more efficient and modern fuels reduces the overall demand. On the other hand, the energy demand of the transportation sector escalates at 4.4 percent a year reaching 89.68 Ktoe in 2040. The commercial sector's energy demand shows a very slim increase in projected demand, corresponding to 0.8 percent annual growth rate. Agriculture sector's energy demand rises by 2.4 percent, while industry declines by 1.3 percent a year over the planning period.

Table 23. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, By Sector (KTOE)

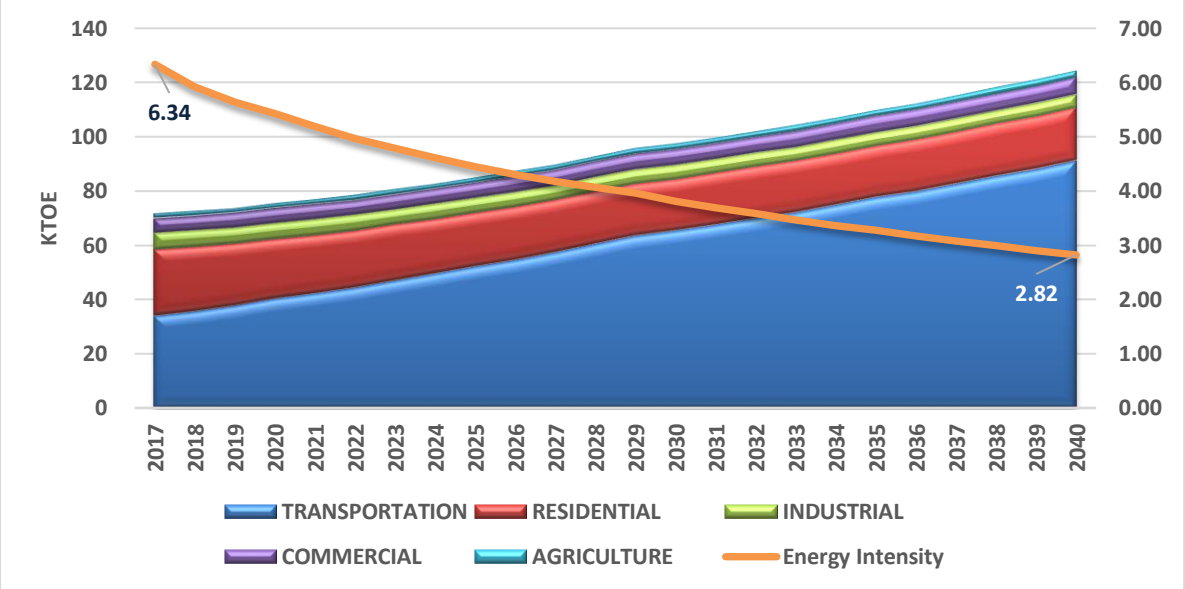
Sector	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Industry	6.44	6.33	6.17	5.71	5.33	5.02	4.77	-4.41	-1.29	-1.56	-1.34	-1.19	-1.02
Commercial	5.27	5.31	5.38	5.48	5.69	5.96	6.29	3.08	0.78	0.37	0.76	0.96	1.08
Transportation	33.58	35.29	39.78	51.33	64.38	76.31	89.68	11.27	4.36	5.23	4.63	3.46	3.28
Residential	24.46	23.75	22.08	19.86	19.03	19.01	19.55	-3.60	-0.97	-2.10	-0.84	-0.02	0.56
Agriculture	1.47	1.58	1.68	1.85	2.07	2.29	2.53	9.71	2.38	1.94	2.27	2.09	1.98
Total	**71.22**	**72.27**	**75.08**	**84.22**	**96.50**	**108.61**	**122.82**	**2.86**	**2.40**	**2.32**	**2.76**	**2.39**	**2.49**

The share of each sector to TFEC is expected to change throughout the planning period. *(Figure 24).* By 2040, the transportation sector is still the leading energy-consuming sector with a share of around 70.0 percent, followed by residential with 16.0 percent, and commercial

with 5.0 percent. In the same period, the industrial and agriculture sectors represent a lower share of 4.0 percent and 2.0 percent, respectively.

Over the planning period, energy intensity is seen to decline from 6.3 toe/PhP million of GRDP in 2017 to 2.8 toe/PhP million in 2040, translated to a 3.5 percent annual reduction. This is attributed to declining biomass consumption (specifically from residential and industry sectors), and to some extent from the reduction in diesel consumption of the commercial sector due to greater availability of electricity.

Figure 24. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, By Sector (KTOE)



Residential Sector. The residential sector's historical energy consumption registered a negative growth rate of 3.6 percent a year from 2013 to 2017. During the planning period, the sector's demand continuously declines at a slower rate of 1.0 percent annually. From 24.5 ktoe energy consumption in 2017, the sector's energy demand drops to 19.6 ktoe in 2040 *(Table 24)*. Contributing factor is the significant decrease in biomass consumption, which has a share of around 80.0 percent in 2017 but reduces to 35.0 percent in 2040 due to increasing use of substitute fuel, particularly LPG.

Table 24. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, Residential Sector (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Kerosene	0.51	0.49	0.49	0.45	0.43	0.41	0.40	-7.82	-1.03	-1.36	-1.04	-0.81	-0.69
LPG	2.33	2.42	2.58	2.97	3.35	3.70	4.02	12.31	2.40	2.87	2.42	2.03	1.65
Biomass	19.39	18.21	16.14	12.28	9.73	7.98	6.76	-5.55	-4.48	-5.31	-4.56	-3.89	-3.26
Electricity	2.24	2.63	2.87	4.15	5.52	6.92	8.37	5.56	5.91	7.64	5.90	4.59	3.90
Total	**24.46**	**23.75**	**22.08**	**19.86**	**19.03**	**19.01**	**19.55**	**-3.60**	**-0.97**	**-2.10**	**-0.84**	**-0.02**	**0.56**

As socio-economic structure becomes better in the province, the downward trend in biomass use continues because both electricity and oil consumption grows annually at 5.9 percent and

2.4 percent, respectively. LPG consumption of the sector grows from 2.3 ktoe in 2017 to 4.0 ktoe in 2040, increasing its share from 9.5 percent to 20.6 percent over the planning period. The improvement in the province's domestic economy and the accelerated household electrification program of the government pushes up the demand for electricity from 2.2 ktoe in 2017 to 8.4 ktoe in 2040.

The sector's demand for kerosene, which is primarily being used for lighting, decreases annually at 1.0 percent as more households are having access to electricity. From 2017 level of 0.5 ktoe, kerosene demand falls to 0.4 ktoe in 2040.

Transportation Sector. The transportation sector takes nearly half of Marinduque's energy requirement. With improving local economy, road transportation, an important part of the provincial transportation system, consumes a large amount of oil. In 2017, the transportation sector consumed 33.6 ktoe of energy, specifically oil. Overall, the sector's energy demand grew at an average rate of 11.3 percent from 2013 to 2017.

On-road use accounts for the largest share in transportation energy consumption of the province. Facing an increasing demand for road transport, total energy consumption of transportation sector is seen to display an annual growth of 4.4 percent in the planning period with total demand of 89.7 ktoe in 2040.

Diesel and gasoline are the major consumed oil products of the sector, which account for a combined share of 94.0 percent of the total oil demand by 2040. Gasoline shows a faster growth than diesel at 6.4 percent. Diesel increases only at 2.1 percent over the planning period *(Table 25).* The growth in the transportation demand is significantly affected by the rising income level, which increases demand for travel. Also, movement of freight (including trucks and domestic marine vessels) depicts the impact of economic growth. Freight travel demand is explicitly related to economic activity, including the production and consumption of goods in either intermediate or final form.

Demand for biofuels in the transport sector significantly rises from 1.3 ktoe in 2017 to 5.4 ktoe in 2040, equivalent to 6.4 percent annual average growth rate. This reflects the government strategies to increase the share of biofuels in total energy demand by mandating a minimum blend rate with diesel and gasoline fuels. However, it must be noted that the development of vehicle standards that can accommodate high blend rates will be necessary to support and encourage increased biofuels used in transportation sector's energy demand.

Table 25. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, Transportation Sector (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Gasoline	12.46	13.34	15.55	22.63	31.48	41.07	52.31	16.04	6.44	7.79	6.82	5.47	4.96
Diesel	19.83	20.59	22.03	25.81	29.20	30.77	32.01	8.59	2.10	3.22	2.50	1.05	0.80
Biofuels	1.29	1.37	2.19	2.89	3.70	4.47	5.35	13.56	6.38	5.68	5.05	3.87	3.65
Total	**33.58**	**35.29**	**39.78**	**51.33**	**64.38**	**76.31**	**89.68**	**11.27**	**4.36**	**5.23**	**4.63**	**3.46**	**3.28**

Commercial Sector. The commercial sector's energy use is highly linked with population growth, and primarily driven by electrical, heating (or cooking) and cooling requirements of buildings, commercial establishments, and other structures. From 2013 to 2017, biomass has been the major fuel of the sector. Meanwhile, LPG displayed the fastest growth rate at 7.1 percent followed by electricity at 5.9 percent.

With foreseen improvements in the sector's economic activities, electricity demand continues to accelerate at 3.5 percent a year during the planning period. Electricity demand in the sector is mostly associated with increasing urbanization as it will spur the need for more infrastructures such as offices, schools, health facilities and leisure/entertainment facilities, all of which use equipment and appliances that require electricity.

Consumption of biomass is seen to have a nil growth of 0.2 percent annually because of shifting the demand to oil and electricity. Although the growth of biomass is sluggish, it still maintains a majority share of about 40.7 percent of total in 2040.

Correspondingly, oil accounts for an average share of 41.2 percent to the sector's total energy demand. Notably, the sector reduces its dependence on diesel over time as its share significantly drops to 14.1 percent at the end of planning period (from 32.5 percent in 2017), allowing the electricity share to expand to 17.4 percent in 2040 *(Table 26).*

Table 26. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, Commercial Sector (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
LPG	0.55	0.58	0.66	0.88	1.14	1.42	1.70	7.10	5.08	6.05	5.29	4.49	3.68
Diesel	1.71	1.66	1.57	1.36	1.18	1.03	0.89	5.57	-2.80	-2.80	-2.80	-2.80	-2.80
Electricity	0.50	0.57	0.60	0.66	0.78	0.92	1.09	5.94	3.45	2.21	3.31	3.37	3.42
Biomass	2.48	2.47	2.48	2.50	2.52	2.54	2.56	0.28	0.15	0.19	0.18	0.16	0.15
Biodiesel	0.03	0.03	0.08	0.07	0.06	0.05	0.04	5.57	1.15	-2.80	-2.80	-2.80	-2.80
Total	**5.27**	**5.31**	**5.38**	**5.48**	**5.69**	**5.96**	**6.29**	**3.08**	**0.78**	**0.37**	**0.76**	**0.96**	**1.08**

Industry Sector. Considering a small manufacturing base, Marinduque has a low industrial energy demand (including the non-combusted use of fuels), less than 10.0 percent of the province's total energy consumption. The industry sector energy consumption reduced at an average of 4.4 percent year from 2013 to 2017. The demand continues to narrow in the planning horizon as it is expected to drop at 1.3 percent a year *(Table 27).* Such was attributed to declining biomass use, decreasing at annual rate of 3.4 percent, as oil and electricity replaced biomass being high quality energy source for industries.

A moderate shift on the use of fuel in industry is expected over the planning period. Oil replaces biomass and becomes the dominant fuel with its modest growth rate of 0.8 percent, from 1.7 ktoe in 2017 to 2.0 ktoe in 2040. Although oil is expensive, it is the only energy source that can be used with many types of moveable equipment.

Generally being used to power electronic and mechanical equipment, electricity records the fastest growth rate at 4.7 percent a year, from demand level of 0.2 Ktoe in 2017 to 0.7 Ktoe in 2040. As the province's industry sector would still be developing in future years, the industry

structure could become more power-intensive. In effect, the growth rate of industry electricity consumption gradually picks up in parallel with the expansion of industries in the province.

Table 27. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, Industry Sector (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Diesel	1.51	1.52	1.54	1.59	1.66	1.72	1.77	-12.05	0.70	0.67	0.81	0.71	0.61
LPG	0.18	0.15	0.17	0.19	0.20	0.21	0.22	1.95	0.84	2.53	1.10	0.92	0.76
Kerosene	0.02	0.02	0.02	0.01	0.01	0.01	0.01	-5.02	-5.78	-6.20	-5.84	-5.31	-5.31
Electricity	0.24	0.29	0.31	0.39	0.48	0.58	0.68	24.46	4.67	4.26	4.54	3.80	3.28
Biomass	4.46	4.33	4.06	3.45	2.91	2.43	2.01	-2.06	-3.40	-3.21	-3.38	-3.53	-3.67
Biodiesel	0.03	0.03	0.07	0.08	0.08	0.08	0.09	-12.05	4.79	0.67	0.81	0.71	0.61
Total	**6.44**	**6.33**	**6.17**	**5.71**	**5.33**	**5.02**	**4.77**	**-4.41**	**-1.29**	**-1.56**	**-1.34**	**-1.19**	**-1.02**

Agriculture Sector. The agriculture sector consumes only about 2.0 percent of total energy consumption of Marinduque, and thus the least energy-user in the province. Historically, the sector's energy consumption increased by 9.7 percent a year *(Table 28).* Oil consumption exhibited a higher growth of 12.5 percent annually during the period 2013-2017, while electricity use registered a 5.8 percent a year.

In the planning period, the sector's energy use shows an upward trend, from 1.5 ktoe in 2017 to 2.5 ktoe in 2040. Electricity consumption displays the fastest growth rate at 3.2 percent annually, which results in increasing its average share to 45.7 percent from 37.6 percent (historical). Oil registers an annual growth rate of 1.8 percent within the planning period, contributing an average share of 55.1 percent to total energy requirement of the sector. Utilization of energy (oil and electricity) to operate machineries and water pumps improves performance of the agricultural sector, and consequently increases its share in the province's income and economy.

Table 28. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, Agriculture Sector (KTOE)

Product	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Oil and oil products	0.92	0.94	1.00	1.09	1.18	1.28	1.38	12.48	1.76	1.78	1.63	1.53	1.53
Electricity	0.55	0.65	0.68	0.76	0.89	1.02	1.16	5.79	3.25	2.17	3.17	2.82	2.54
Biofuels	0.02	0.02	0.05	0.05	0.06	0.06	0.06	14.66	5.40	1.79	1.63	1.53	1.53
Total	**1.47**	**1.58**	**1.68**	**1.85**	**2.07**	**2.29**	**2.53**	**9.72**	**2.38**	**1.94**	**2.27**	**2.09**	**1.98**

OIL PRODUCTS AND BIOFUELS DEMAND OUTLOOK

Similar to national, oil remains as the major fuel consumed in Marinduque with historical average share of more than half of total energy consumption. Historically, oil consumption went up by 9.0 percent a year, on average, during the period 2013-2017 *(Table 29).* In spite of price volatility, growth continues in the planning period albeit at a slower rate than the historical average. Oil consumption rises at 4.1 percent a year.

Demand for oil and biofuels reaches 384.2 thousand barrels (MB) in 2020. The medium-term oil demand outlook (2020–2025) shows an increase of 4.7 percent, equivalent to an average

annual increase of almost 1.3 MB per day (MB/d). Long-term oil demand rises to 596.0 MB in 2030 and 818.7 MB in 2040, or an addition of 1.3 MB/d, from 0.9 MB/d in 2017 to 2.2 MB/d in 2040. It is interesting to observe that the share of oil in the province's total energy consumption expands further by around 20 percentage points, from 56.2 percent in 2017 to 77.1 percent in 2040. This indicates that oil remains as the main fuel in the energy mix up to 2040.

In the long-term, more than three-fourth of the oil demand growth is expected to be satisfied by diesel and gasoline being the most consumed petroleum products. Both products accounted for a combined share of 84.9 percent in oil demand mix in 2017. Historically, diesel fuel consumption increased by 5.0 percent annually from 138.9 MB in 2013 to 177.5 MB in 2017. During the planning period, demand for diesel fuel increases marginally at 1.8 percent a year, while gasoline fuel grows at 6.4 percent annually.

The increase in gasoline and diesel fuels is primarily driven by the soaring demand in the road transportation sector as the vehicle stock is expected to climb significantly over the planning period. The number of passenger cars and commercial vehicles is seen to almost double due to expansion of economic activity and improvement in income level. The fleet of "Diesel Vehicles in Truck Equivalent" grew at an average of 8.5 percent a year for the period 2010-2017 and continues to rise at 5.7 percent annually in the planning period. Further, the historical fleet of "Gasoline Vehicles in Car Equivalent" recorded a 9.8 percent annual growth rate (2010-2017), and keeps on growing at 7.7 percent a year until 2040. The volume of road transport vehicles significantly affects the consumption of diesel and gasoline of the sector.

Meanwhile, LPG consumption demonstrated a large growth of 10.6 percent a year (2013-2017) as more households shift to using a more convenient fuel instead of the traditional biomass. In the planning period, LPG demand increases at 2.9 percent a year as the projected economic growth improves income level that pushes up LPG demand from 33.2 MB in 2017 to 64.5 MB by the end of the planning period. Likewise, income improvement caused a decline in kerosene demand at an average of 6.3 percent annually (2013-2017). Over the planning period, kerosene demand still exhibits a downward trend, a drop of 1.1 percent a year.

Table 29. TOTAL OIL DEMAND OUTLOOK 2018-2040, By Product (MB)

Sector	Outlook							Annual Growth Rates (%)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Gasoline	102.18	109.33	127.43	185.34	257.72	336.21	428.13	16.10	6.43	7.78	6.82	5.46	4.95
Diesel	177.53	182.98	193.41	220.94	245.89	257.42	266.75	6.32	1.79	2.70	2.16	0.92	0.71
LPG	33.16	34.16	36.94	43.87	50.90	57.88	64.45	10.55	2.93	3.50	3.01	2.61	2.17
Kerosene	4.16	4.03	3.97	3.68	3.47	3.32	3.19	-7.75	-1.14	-1.51	-1.16	-0.90	-0.76
Biodiesel	3.55	3.66	9.67	11.05	12.29	12.87	13.34	6.32	5.92	2.70	2.16	0.92	0.71
Bioethanol	10.22	10.93	12.74	18.53	25.77	33.62	42.81	16.10	6.43	7.78	6.82	5.46	4.95
Total	**330.81**	**345.10**	**384.16**	**483.42**	**596.0**	**701.32**	**818.68**	**9.33**	**4.02**	**4.70**	**4.28**	**3.31**	**3.14**
Daily Average	0.91	0.95	1.05	1.32	1.63	1.92	2.24	9.33	4.02	4.74	4.28	3.31	3.14

Given the growing concern on price volatility of oil, the government intensifies its program on the utilization of alternative fuels to expand its share in total energy demand. With mandatory use of biofuels blend (10.0 percent for bioethanol and 2.0 percent for biodiesel) and target to further increase biodiesel blend rate by 5.0 percent in 2020, the biofuels demand is expected to increase its share to 6.9 percent in 2040. Bioethanol and biodiesel grow annually at 5.9

percent and 6.4 percent, respectively. From 13.8 MB in 2017, demand for biofuels picks up to 22.1 MB in 2020 and 56.2 MB in 2040.

Sectoral Petroleum Demand Outlook

Petroleum products have been overwhelmingly used across all sectors of the economy. Most of the demand for oil is heavily consumed for transport purposes. It is the sector where oil continues to face the weakest competition from alternative fuels. With an annual average growth rate of 11.5 percent between 2013 and 2017, the transportation sector accounted for more than three-fourth of total barrel consumed. Over the planning period, the transportation sector's oil demand growth is seen to decelerate at 4.5 percent annually. Nevertheless, the transportation sector manages to still increase its share to total oil demand from 79.5 percent in 2017 to 88.0 percent in 2040. This translates to total oil demand of 720.1 MB in 2040 *(Table 30).*

Primarily, residential and commercial sectors are the second and third largest users in terms of demand, with a total of 48.2 MB in 2017. The residential demand is anticipated to increase by 17.5 MB up to 2040, equivalent to a growth of 2.0 percent a year. Accounting for nearly 6.0 percent of total oil demand, the sector's demand growth is affected by the government's initiatives on energy poverty alleviation measures, coupled with rising income and urbanization level. Thus, households persist to foster a switch away from traditional fuels to oil-based product.

Oil demand of the commercial sector displayed an average annual rate of 6.0 percent (2013-2017). This growth momentum goes on during the planning period but decelerates at 1.3 percent per annum, resulting in an increase from 18.9 ktoe in 2017 to 25.4 ktoe in 2040.

Meanwhile, oil demand growth for industrial use exhibited a downward trend at 10.5 percent annually (2013-2017), on average. The demand for oil of the sector picks up with a narrow growth rate of 0.8 percent a year over the planning period. For the agriculture sector, it posts a lower yet relatively stable growth rate of 1.8 percent annually until 2040.

Table 30. TOTAL PETROLEUM DEMAND OUTLOOK 2018-2040, By Sector (MB)

Sector	Outlook							Growth Rates (in %)					
	2017	2018	2020	2025	2030	2035	2040	2013-'17	2017-'40	2020-'25	2025-'30	2030-'35	2035-'40
Industry	13.53	13.30	13.94	14.55	15.15	15.71	16.19	-10.50	0.79	0.86	0.81	0.72	0.62
Commercial	18.86	18.88	19.38	20.19	21.60	23.43	25.43	6.04	1.31	0.83	1.36	1.63	1.65
Transportation	262.27	275.84	311.59	404.73	510.75	609.25	720.05	11.48	4.49	5.37	4.76	3.59	3.40
Residential	29.29	30.08	31.82	35.82	39.73	43.44	46.75	8.12	2.05	2.40	2.09	1.80	1.48
Agriculture	6.86	6.99	7.44	8.12	8.81	9.50	10.25	12.57	1.76	1.78	1.63	1.53	1.53
Total	**330.81**	**345.10**	**384.16**	**483.42**	**596.05**	**701.32**	**818.68**	**9.33**	**4.02**	**4.70**	**4.28**	**3.31**	**3.14**

Oil Facility Requirement

Marinduque has existing one (1) oil depot/storage with a total capacity of 2.34 MB used to stock inventory for the different oil products. For the planning period, the allocation of depot/storage to oil products is based on the share of each to total oil demand.

Further, although the DOE requires a minimum of 15-day inventory level for oil products, except for LPG with a 7-day inventory, it is assumed that inventory level will be at 30 days for diesel, gasoline, biofuels and others, while LPG is 15 days. Even if the province is near from Port of Lucena (only 3 hours travel time by boat), higher inventory level is considered to have a buffer capacity to stock additional petroleum supply as a precautionary measure in the event of supply disruption.

Table 31. STORAGE CAPACITY, TURNOVER RATE AND INVENTORY DAYS

Year	Total Oil Demand (MB)	Oil Storage Requirements (MB)	Turnover Rate	Inventory (No. of Days)	Oil Storage Requirements (MB) 80 % Capacity Utilization Rate
2018	345	33	10.55	35	42
2019	363	33	11.10	33	42
2020	384	33	11.54	32	42
2021	401	33	12.05	30	42
2022	419	33	12.60	29	42
2023	441	33	13.25	28	42
2024	462	43	10.76	34	54
2025	483	43	11.14	33	54
2026	505	43	11.64	31	54
2027	528	43	12.16	30	54
2028	555	51	10.85	34	64
2029	580	53	10.89	34	67
2030	596	53	11.18	33	67
2031	616	53	11.55	32	67
2032	636	53	11.93	31	67
2033	655	53	12.28	30	67
2034	678	65	10.46	35	81
2035	701	65	10.82	34	81
2036	721	65	11.13	33	81
2037	745	65	11.49	32	81
2038	769	65	11.87	31	81
2039	792	65	12.22	30	81
2040	819	65	12.63	29	81

With the province growing oil demand, total storage capacity requirement in 2040 reaches 65 MB with a turnover rate of around 12.6, or a replenishment rate of 12 times in a year. But considering the capacity utilization rate, assumed at 80.0 percent, total storage capacity requirement stands at 81 MB in 2040 *(Table 31).* Of the total storage capacity, gasoline and diesel require 52.6 percent and 33.0 percent, respectively, of total, while LPG 4.2 percent, and biofuels 9.8 percent *(Table 32).* However, storage capacity requirement could be reduced by half if the mandatory inventory requirement is followed.

Table 32. TOTAL STORAGE CAPACITY REQUIREMENT BY PETROLEUM PRODUCT (2018-2040)

Petroleum Products	Oil Storage Requirements (MB)	Share (in %)
Gasoline	43.8	54.0
Diesel	27.5	34.0
LPG	3.5	4.3
Kerosene	0.4	0.5
Bioethanol	4.4	5.4
Biodiesel	1.5	1.9

Further, if the 31 gasoline stations (retail outlets) operating in the province in 2018 are taken into account, the average estimated capacity of the underground storage tank per oil product (premium and regular gasoline, and diesel) is 15,000 liters (or 0.09 MB). This means that gasoline (premium and regular) and diesel each has an estimated 2.9 MB of underground storage capacity, a total of 8.8 MB (total gasoline with 5.8 MB).

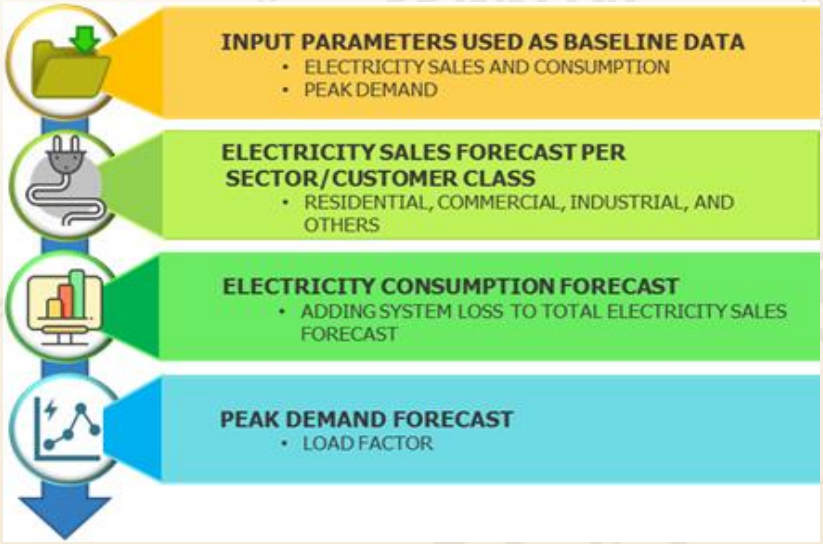
CHAPTER IV:
POWER DEMAND AND SUPPLY OUTLOOK

A. KEY ASSUMPTIONS AND METHODOLOGY

Understanding the long-term energy demand is of paramount importance as it sets out appropriate energy development strategies to ensure that future demand is met. With energy demand seen to continue increasing in the years to come, which could be further stirred by the country's promising socio-economic outlook through the "*Ambisyon Natin 2040,*" concern on the need to have a sufficient energy supply becomes among the top priorities of the government.

Demand Forecasting

Figure 25. DEMAND OUTLOOK PROCESS FLOW



This section discusses Marinduque's electricity demand outlook for the period 2018 to 2040, covering annual electricity sales and consumption, and peak demand. The outlook adopts 2017 as the base year for the forecast scenario. The historical data (electricity sales and consumption, and peak demand) were sourced from the MARELCO's Distribution Development Plan (DDP). *Figure 25* illustrates the methodology for electricity sales and peak demand forecast.

From the baseline data, forecast for electricity sales is simulated for each customer class – residential, commercial, industrial, and "others." Applying econometric modelling[11] approach, electricity sales as the dependent variable is expressed as a function of time and other driving factors such as population[12], number of households[13], household connections, and increase in electricity service operating hours.

In forecasting the demand for residential sector, an electrification scenario is incorporated to reflect the government's target of 100 percent household electrification level by 2022 based on the 2015 Census of Population. Since MARELCO has already achieved this target, the forecast

[11] The econometric modelling used the platform called "Simple Econometric Simulation System" (SEE/Simple-E) by Dr. Kaoru Yamaguchi of the Institute of Energy Economics, Japan (IEEJ). SEE/Simple-E is an add-in application in Microsoft Excel, which can simultaneously integrate the processes of data input, modeling, testing and forecasting/simulation.
[12] Population projection is based on the data from the Philippine Statistics Authority (PSA)
[13] The number of households from 2017 to 2027 is obtained from MARELCO's forecast as indicated in Distribution Development Plan (DDP) and only extended up to 2040 by the Planning Division (PD) of the Energy Policy and Planning Bureau (EPPB), Department of Energy.

considers full household electrification, using the projected number of households for each year of the planning period as the baseline, to be attained in 2030 until 2040. The annual average household consumption is assumed to reach 1 MWh by 2040.

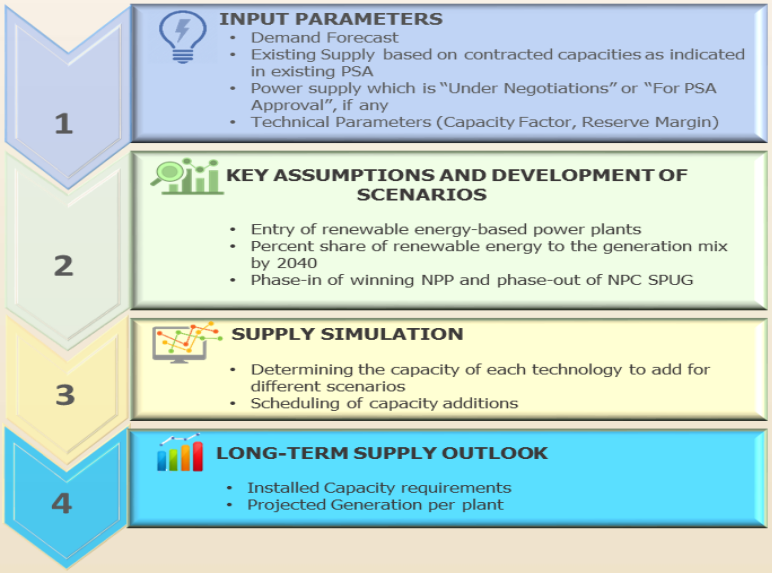
From the total electricity sales, the 12.0 percent[14] system loss is added to determine the electricity consumption. On the other hand, peak demand forecast is calculated from the assumed load factor of 55.0 percent.

The extension in electricity service hours contributes to the projected increase in demand. For the islet barangay of Mongpong with only 12-hour service operation, the 24-hour full service increases the projection of future load and/or peak demand by a multiplier of 1.3 starting 2018.

Power Supply Planning

On the aspect of supply planning, the Long-range Energy Alternatives Planning (LEAP)[15] System is used to determine the required generation capacity additions. The demand forecast serves as the main input in preparing the capacity expansion plan of the province. The existing contract was assessed vis-à-vis the demand forecast to identify the gap and determine the required generation capacities that must be installed to meet future load requirements. *Figure 26* demonstrates the process flow for the supply outlook.

Figure 26. SUPPLY OUTLOOK PROCESS FLOW



The provision for reserve capacity is also a major consideration to ensure supply sufficiency and maintain power system reliability. For this Plan, the level of reserve margin is pegged at 10.0 percent of the annual projected peak demand in reference to the Philippine Small Grid Guidelines.

The supply planning highlights three (3) scenarios representing the possible supply options in Marinduque, namely: (1) Reference or "Business-As-Usual," (2) Alternative, and (3) Geothermal.

The **Reference Scenario** assumes that the province's future development for power generation will continue to be diesel-based. There will be a minimal deployment of renewable energy (RE), concentrating on solar energy with at least 20.0 percent share in the generation mix by 2040. Only solar is deployed as it has the fastest development period compared with other renewable technologies and can be used to hybridize the existing diesel generators.

[14] Based on MARELCO's cluster as prescribed in ERC Resolution No. 20, S. 2017.
[15] LEAP is an integrated modelling tool that supports a wide range of different modeling methodologies to include electric sector generation and capacity expansion planning.

For **Alternative Scenario,** new renewable power plants will be introduced contributing at least 40.0 percent share in the generation mix by 2040. The entry of renewables under this scenario will change the landscape of the existing power supply mix in the province.

The **Geothermal Scenario** entails the possible entry of a geothermal power plant on the assumption that the potential geothermal resource in Mt. Malindig, which is situated in the vicinity of Buenavista and Torrijos municipalities, can be developed within the planning period. As further exploration is needed to determine its potential capacity, this scenario only considers a small-scale geothermal power plant with a capacity of 10 MW. Recognizing the long gestation period of more than 10 years, from exploration up to operation, the introduction of a geothermal power plant can be realized by 2030.

For all scenarios, part of the assumptions is that no RE-based plants will be deployed earlier than 2022, the target commercial operation date of the New Power Provider (NPP). Since the province has no existing service contracts involving renewables, the supply model considered the prospective RE potential identified by the Philippine National Oil Corporation- Renewable Corporation (PNOC-RC) as thoroughly discussed in Chapter V on Sectoral Plans and Programs.

Based on initial assessments, PNOC-RC has identified three potential mini-hydro sites and three potential wind farm sites which led them to propose for the development of 5-MW mini-hydro and 5-MW wind farm. In the absence of full feasibility studies for these sites, the potential capacities for hydro and wind are conservatively assumed at 1.5 MW and 1 MW, respectively, and to be operational by 2025.

For solar energy, the installation of both land-based and floating solar PV have likewise been incorporated. Considering the available land and water surface area of the prospective sites, the province has a huge potential capacity for solar. In effect, solar is assumed as endogenous capacity in the supply model, which means that the solar capacity addition is calculated internally by LEAP. Solar is integrated into the mix to displace the electricity produced from diesel during daytime.

Due to intermittency of solar, this technology is set to have zero capacity credits[16] in the supply simulation. This means that the capacity additions coming from this variable technology is not considered as firm capacity.

The possibility of hosting a 1-MW biomass facility with the use of agricultural residues is also considered in the supply planning given that Marinduque is an agricultural province having a total of 38,000[17] hectares of farmlands.

The power plant's electricity generation mainly depends on the type of fuel being used and how often it operates at its maximum capacity. *Table 33* summarizes the assumed capacity factors for each technology used as inputs in the simulation. In off-grid areas, diesel usually has the highest capacity factor as it runs as baseload plants. Capacity factor of variable renewable energies, such

[16] Capacity credit is defined as the fraction of the rated capacity considered firm for the purposes of calculating the module reserve margin. (Source: LEAP Module).
[17] Source: Philippine Statistics Authority's QuickStat for Marinduque (as of January 2018)

as wind and solar, is significantly lower due to intermittency of the resource. For biomass, although it can achieve a high over-all capacity factor ranging from 80.0 to 90.0 percent, it may not always operate at these levels due to availability of feedstocks especially those that depend on agricultural residues.

Table 33. ASSUMED CAPACITY FACTOR PER TECHNOLOGY

Technology	Capacity Factor
Diesel	80
Geothermal	90
Hydro	50
Solar	16
Biomass	35
Wind	26

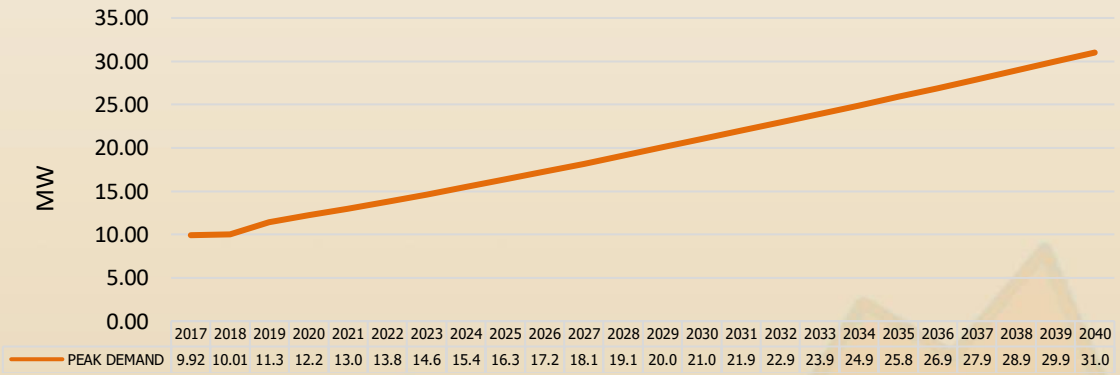
B. DEMAND OUTLOOK

The government's objective of bringing inclusive economic development in off-grid provinces certainly pushes up electricity demand across all sectors of the economy. In Marinduque, the peak demand is anticipated to accelerate at 6.0 percent annually from 9.92 MW in 2017 to 21.0 MW in 2030 and further stretches to 31.0 MW by the end of the planning period *(Figure 27* and *Table 34)*. This translates to annual average growth rate of 5.1 percent within the planning horizon.

Based on the projection, demand grows strongly at an average of 6.5 percent for the period 2018-2025. The high growth for the said period is an indication of a better overall economic performance of the province due to improving commercial sector and emerging tourism industry.

Mainland Marinduque is considered as the province's major driver of electricity demand constituting almost 98.0 percent of total. Meanwhile, the demands of islet barangays (Polo, Mongpong and Maniwaya) remain to be very minimal, recording an average combined share of 2.0 percent within the planning horizon. However, the islets display sharp increases in their demand at around 9.0 to 10.0 percent a year being the prime tourist destinations in the province.

Figure 27. FORECASTED PEAK DEMAND, 2018-2040



Note: 2018 Data is the actual Peak Demand as of December 2018

Table 34. PEAK DEMAND FORECAST PER ISLAND (MW), 2018-2040

		FORECAST						
ISLAND	**2017**	**2018**	**2020**	**2025**	**2030**	**2035**	**2040**	**AAGR, 2018-2040**
Mainland	9.77	9.86	11.98	15.89	20.36	24.92	29.74	5.0%
Polo	0.03	0.04	0.05	0.09	0.14	0.20	0.26	9.2%
Mongpong	0.05	0.05	0.09	0.15	0.23	0.32	0.42	10.0%
Maniwaya	0.08	0.06	0.12	0.21	0.32	0.45	0.59	9.4%
TOTAL MARINDUQUE	**9.92**	**10.01***	**12.24**	**16.34**	**21.05**	**25.89**	**31.01**	**5.1%**

**Actual 2018 Peak Demand as of December 2018*

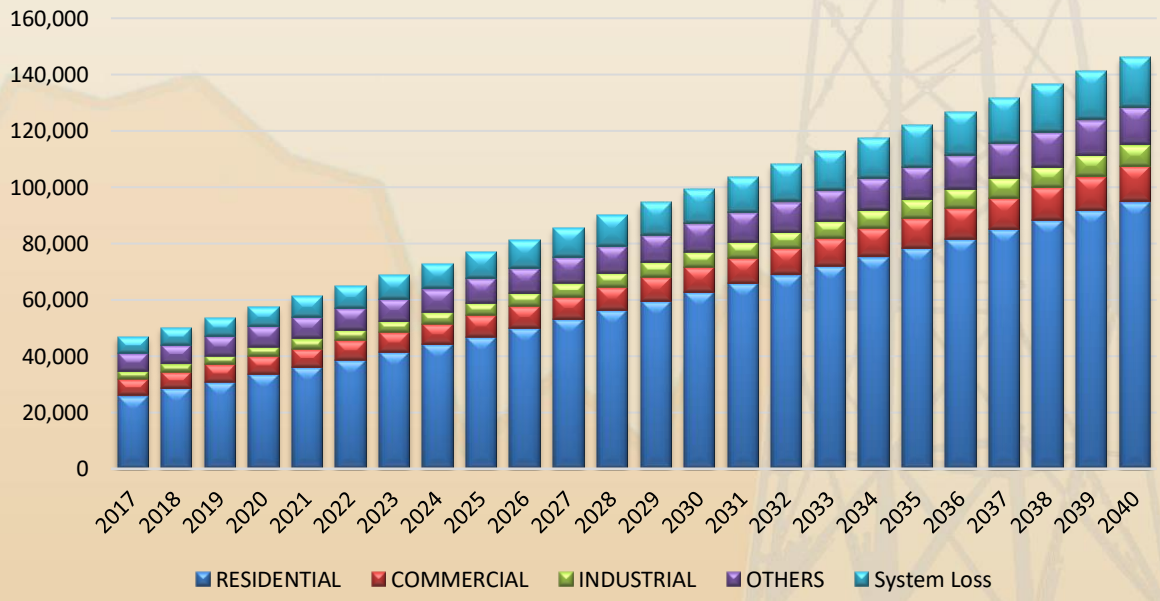
Electricity Sales and Consumption

Electricity consumption in the province is projected to grow significantly within the planning period as shown in *Figure 28*. From 46,935 MWh in 2017, consumption triples by 2040 as it reaches 149,391 MWh, translating to an annual average growth rate of 5.2 percent *(Table 35*).

The surge in demand is mainly propelled by the growth in the residential sector. With a two-third share of the total demand by end of the planning horizon, the sector remains as the largest user of electricity. Among the contributing factors for the growth is the government's thrust to increase access to electricity and the improvement in income allowing households to purchase more electrical appliances.

The electricity demand of the commercial sector also escalates by more than two-folds, from 5,825 MWh in 2017 to 12,710 MWh in 2040. The rising demand demonstrates the expansion of economic activities in the province as manifested by the growing number of services and business establishments such as hotel, resorts, restaurants, pawnshops, banking institutions, cell sites, including businesses in the wholesale and retail trading, among others. The growing consumption is also perceived as an offshoot of the flourishing tourism industry.

Figure 28. ELECTRICITY SALES AND CONSUMPTION, MWh



Although the industry sector has the least electricity demand, requiring only 5.3 percent of the total demand, it displays a strong annual average growth of 4.7 percent. The increase in private and public constructions in the province may spur the growth in the industrial sector.

Table 35. ELECTRICITY SALES AND CONSUMPTION PER SECTOR, MWh

Consumer Type	2017	2018	2020	2025	2030	2035	2040	% Share	AAGR
Residential	26,022	30,604	33,375	48,233	64,250	80,426	97,386	65.19	5.9%
Commercial	5,825	6,644	6,931	7,732	9,100	10,743	12,710	8.51	3.5%
Industrial	2,776	3,351	3,640	4,484	5,599	6,747	7,928	5.31	4.7%
Others	6,447	7,503	7,932	8,830	10,320	11,857	13,440	9.00	3.2%
Total Sales	**41,071**	**48,101**	**51,879**	**69,280**	**89,270**	**109,773**	**131,464**	**88.00**	**5.2%**
System Loss	5,864	5,897	7,074	9,447	12,173	14,969	17,927	12.00	
Total Consumption	**46,935**	**53,998**	**58,953**	**78,727**	**101,443**	**124,742**	**149,391**	**100.00**	**5.2%**

Note: "Others" Includes public buildings, street lights, irrigation and utility's station use, among others.

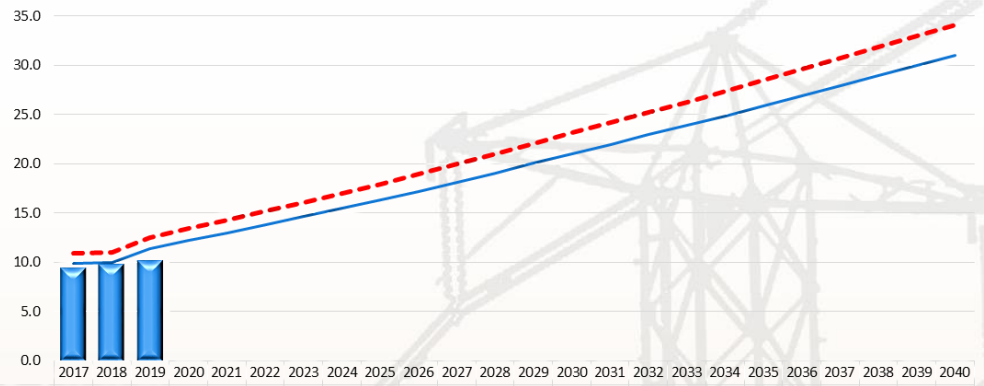
Meanwhile, the "others" sector has the second largest share, next to the residential sector, comprising 9.0 percent of total. Though the sector exhibits the slowest growth at 3.2 percent a year, it results in more than two times increase in its demand reaching 13,440 MWh by 2040 from 6,447 MWh in 2017. The agri-economic activities expected to prosper in the future may contribute to the growth of the sector as agriculture remains the biggest sector-employer of the province.

C. SUPPLY OUTLOOK

MARELCO has a five-year Power Supply Agreement (PSA) with the National Power Corporation-Small Power Utilities Group (NPC-SPUG), which will expire in December 2019. Based on the existing contract, there was a supply shortfall in 2017 as the contracted capacity of 9.48 MW did not match the actual peak demand of 9.92 MW. Considering the 10.0 percent reserve requirement, the contracted supply resulted in a negative capacity margin of 13.1 percent.

As illustrated in *Figure 29*, a total of 9.9 MW and 10.2 MW of capacities have already been contracted for 2018 and 2019, respectively. However, it is noticeable that the contracted capacities are still insufficient to meet the projected demand. To address this, it requires MARELCO to propose a PSA amendment to contract additional capacities that will cover the supply deficit of 2.3 MW including the reserve requirement within the contract period.

Figure 29. FORECASTED PEAK DEMAND VS. CONTRACTED CAPACITY



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Contracted Capacity (Diesel)	9.5	9.9	10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reserve Requirement	0.99	1.00	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.82	1.91	2.01	2.11	2.20	2.29	2.39	2.49	2.59	2.69	2.79	2.89	3.00	3.10
Peak Demand	9.92	10.01	11.39	12.24	13.01	13.81	14.63	15.47	16.34	17.23	18.15	19.10	20.06	21.05	21.99	22.95	23.91	24.90	25.89	26.90	27.91	28.94	29.97	31.01

Upon the expiration of PSA in 2019, it is recommended that MARELCO should extend or secure an Interim Power Supply Agreement with NPC to meet the projected demand and reserve requirements until August 2022.[18] This will be done on the premise that the winning NPP through a Competitive Selection Process (CSP) commences full delivery of service by September 2022.

The objective is to facilitate the effective phase-in of the winning NPP and phase-out of NPC-SPUG by 2022. Simply put, the four-year period from 2018 to 2022 will be allotted for the conduct of CSP to include processing of permits and construction of new power plants of the winning NPP.

In effect, the NPP fully takes over the generation function of NPC-SPUG in the province. MARELCO, being the sole distribution utility operating in the area, continues to be the default System Operator[19] (SO) as defined in the PSGG. For the transmission system, the ownership and maintenance of the existing 69-kV Transmission Line remains within the function of NPC, but MARELCO has also the option to acquire such asset from NPC in accordance with applicable laws.

Reference Scenario

To meet the projected demand of 31.0 MW plus the 10.0 percent reserve requirement of 3.1 MW by 2040, a capacity addition[20] of 58.5 MW will be needed. This translate to an almost six-fold increase from the capacity requirement including reserves of 10.91 MW in 2017.

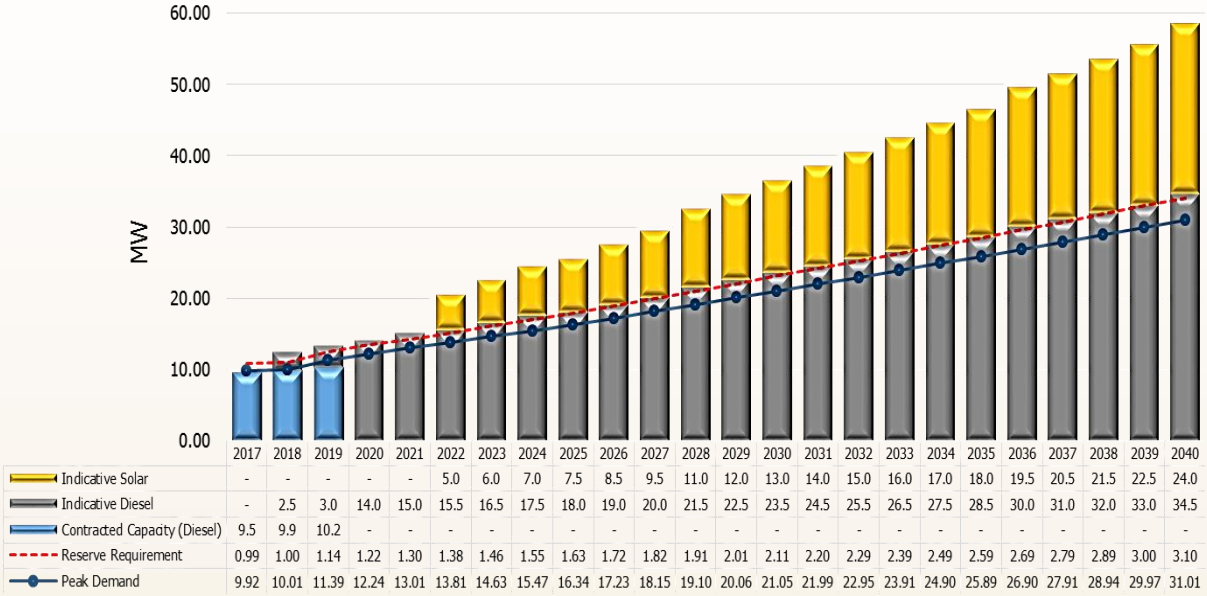
In this scenario, diesel still dominates the capacity mix with 60.0 percent share (34.5 MW) of total, while solar contributes 40.0 percent share (24 MW). Although *Figure 30* shows an oversupply of capacity, it must be noted that without energy storage, solar could not be considered as a firm capacity due to its intermittent nature. Thus, there must be available capacity that can still produce sufficient generation during times that solar is not generating electricity.

As shown in *Figure 30*, it can be observed that even in the absence of solar, the diesel capacity is deemed enough to cover the projected demand requirement. This is very important in the case

[18] In 2019, MARELCO secured an interim PSA with NPC until August 2022, increasing its contracted capacity.
[19] System Operator (SO) in off-grid areas shall be responsible to operate and manage the system in accordance to standards set under the Philippine Small Grid Guidelines (PSGG)
[20] Rated capacity

of Marinduque considering that its system peak demand occurs at nighttime. In such case, the deployment of solar is only limited to supplementing the daytime peak demand.

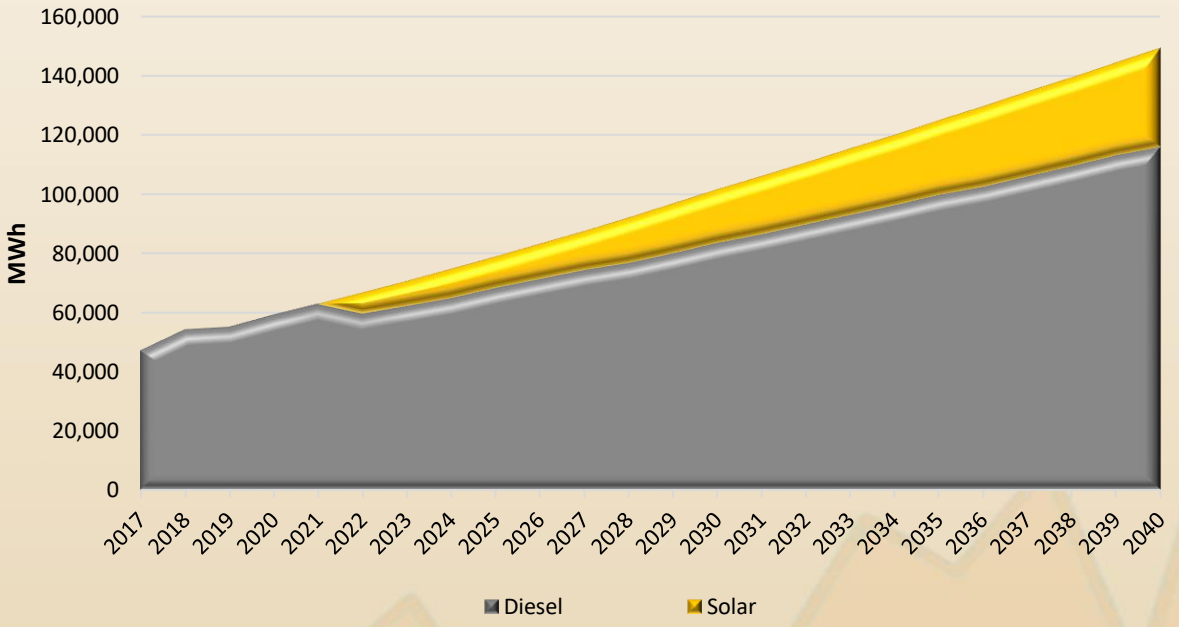
Figure 30. DEMAND- SUPPLY, 2018-2040 (REFERENCE)



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Indicative Solar	-	-	-	-	-	5.0	6.0	7.0	7.5	8.5	9.5	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.5	20.5	21.5	22.5	24.0
Indicative Diesel	-	2.5	3.0	14.0	15.0	15.5	16.5	17.5	18.0	19.0	20.0	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5	30.0	31.0	32.0	33.0	34.5
Contracted Capacity (Diesel)	9.5	9.9	10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reserve Requirement	0.99	1.00	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.82	1.91	2.01	2.11	2.20	2.29	2.39	2.49	2.59	2.69	2.79	2.89	3.00	3.10
Peak Demand	9.92	10.01	11.39	12.24	13.01	13.81	14.63	15.47	16.34	17.23	18.15	19.10	20.06	21.05	21.99	22.95	23.91	24.90	25.89	26.90	27.91	28.94	29.97	31.01

Solar is integrated to the mix to displace the energy supplied by diesel during the day. *Figure 31* shows the power generation per technology to cover the required electricity generation of 149,000 MWh at the end of the planning period. Since solar is assumed to be dispatched for a limited time only, diesel continues to dominate the power generation mix with a share of 77.5 percent (115,753 MWh) in 2040. Solar provides 22.5 percent of the total electricity generation, displacing 33,638 MWh that is supposed to be supplied by diesel power plants.

Figure 31. POWER GENERATION (REFERENCE)

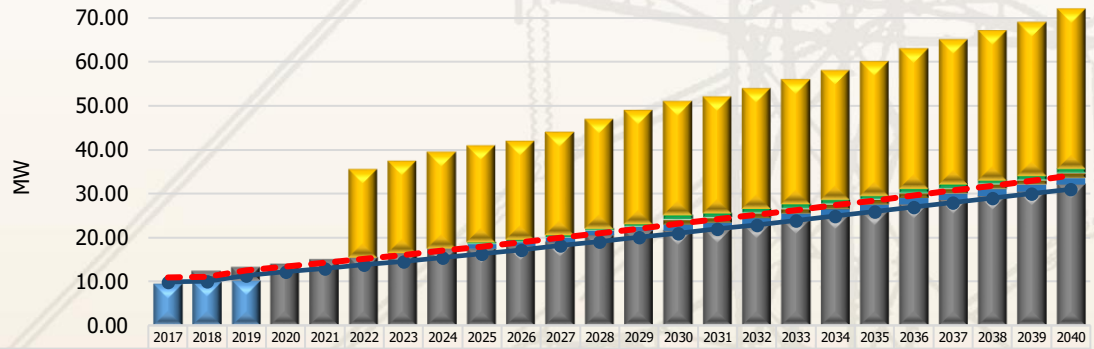


Alternative Scenario

With the goal of limiting the use of diesel-based power plants and possibly lower the generation cost, this scenario intensifies the development and utilization of renewable energy like solar, hydro, wind, and biomass.

As shown in *Figure 32*, total capacity requirement in 2040 stands at 72.0 megawatt (MW), a seven-fold increase from the 2017 level of 10.91 MW and 23.0 percent higher compared with the Reference Scenario (58.5 MW). This is due to higher penetration of RE which constitutes 56.0 percent (39 MW) of total capacity mix. The introduction of solar (35.5 MW), hydro (1.5 MW), wind (1 MW), and biomass (1MW) resulted in a more diversified capacity mix for the province.

Figure 32. DEMAND- SUPPLY, 2018-2040 (ALTERNATIVE)

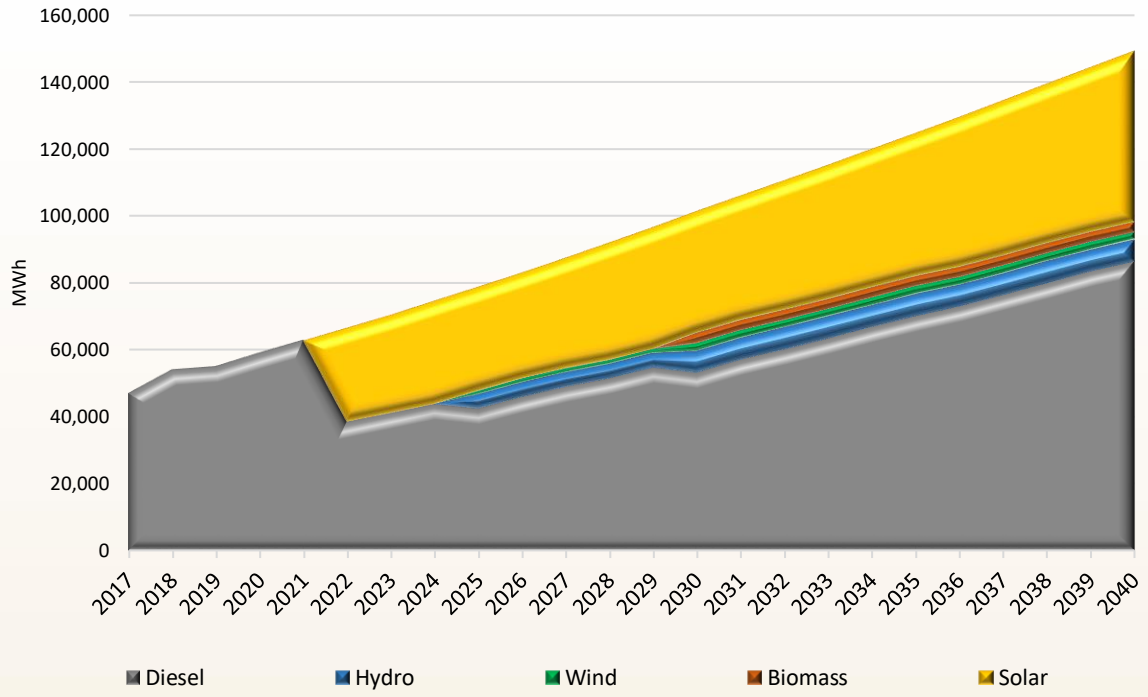


	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Indicative Solar	-	-	-	-	-	20.0	21.0	22.0	22.0	22.5	23.5	25.0	26.0	26.0	26.5	27.5	28.5	29.5	30.5	32.0	33.0	34.0	35.0	36.5
Indicative Wind	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Hydro	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Indicative Diesel	-	2.5	3.0	14.0	15.0	15.5	16.5	17.5	17.5	18.0	19.0	20.5	21.5	21.5	22.0	23.0	24.0	25.0	26.0	27.5	28.5	29.5	30.5	32.0
Contracted Capacity (Diesel)	9.5	9.9	10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reserve Requirement	0.99	1.00	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.82	1.91	2.01	2.11	2.20	2.29	2.39	2.49	2.59	2.69	2.79	2.89	3.00	3.10
Peak Demand	9.92	10.01	11.39	12.2	13.0	13.8	14.6	15.5	16.3	17.2	18.2	19.1	20.1	21.1	22.0	22.9	23.9	24.9	25.9	26.9	27.9	28.9	30.0	31.0

Despite the integration of additional renewables to the system, it can be observed that the capacity from diesel is almost the same level as in Reference Scenario. This is because most of the additional capacities from renewables like solar has zero capacity credit due to its intermittency. Since most often these technologies are non-dispatchable, there should be additional capacity from diesel to stabilize the supply in the absence or limited generation from RE.

Although there is a high share of capacity coming from renewables, diesel remains to be the predominant source of electricity. It has the largest share in the generation mix equivalent to 58.0 percent of total in 2040 *(Figure 33).* Such can be attributed to lower capacity factors of additional renewables. But as a result of additional sources from renewables, generation from diesel drops by 25.4 percent, producing only 86,319 MWh in 2040 from 115,753 MWh in the Reference Scenario.

Figure 33. POWER GENERATION (ALTERNATIVE)



Electricity generation from renewables almost doubles reaching 63,072 MWh in 2040 from 33,638 MWh in the Reference Scenario. This improves the contribution from renewables to 42.2 percent of the generation mix by 2040. Solar, assumed to supply the daytime peak demand, accounts for 34.2 percent of the total generation, displacing 51,158 MWh of supposed to be produced by diesel.

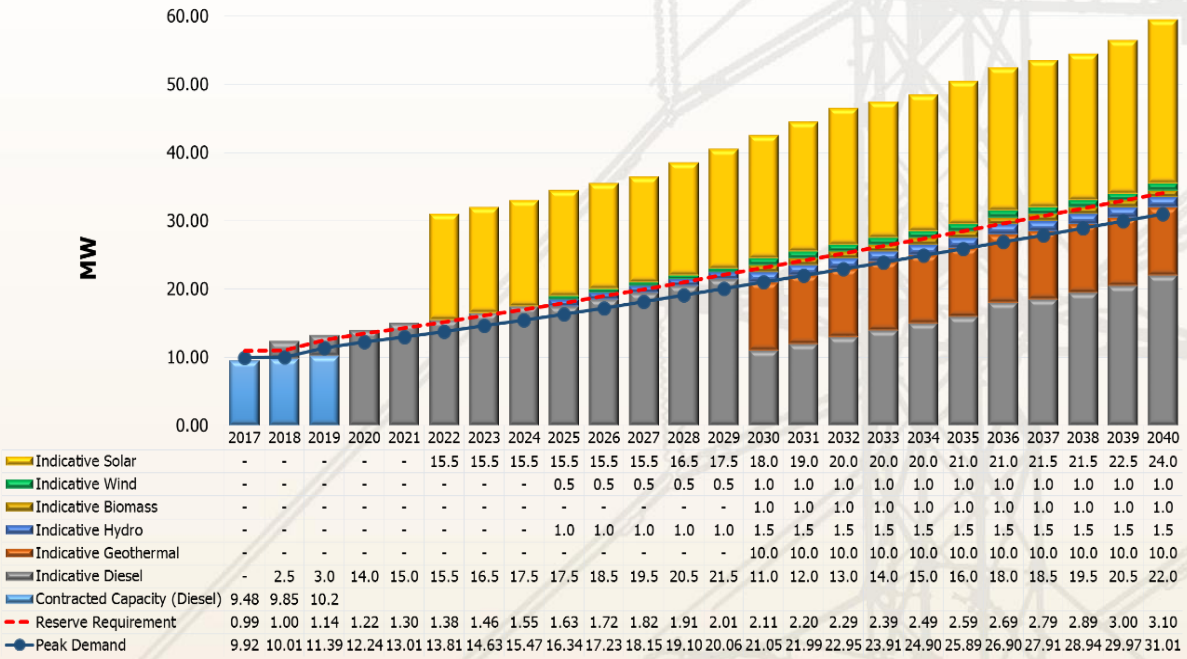
Geothermal Scenario

This scenario assumes that the Mt. Malindig Geothermal Power Project will be explored and developed to supply the long-term energy requirements of the province. Since the potential capacity is yet to be determined, the entry of a 10-MW small-scale geothermal power plant by 2030 is considered for the purpose of determining its possible implications to the generation mix and blended rate should it become part of the supply options. While for other renewables such as hydro, wind, and biomass, the assumed capacity addition is consistent with the Alternative Scenario. Similarly, solar remains to be an endogenous capacity and displacer of diesel during daytime peak.

To supply the projected load requirements of 34.1 MW including reserves, the required power generation capacity under this scenario sums up to 59.5 MW by 2040, almost the same level as the Reference (58.5 MW) and 17.0 percent lower than the Alternative (72 MW). This is due to higher capacity factor of geothermal which is expected to replace a certain portion of diesel capacities for baseload requirement. In *Figure 34*, diesel capacity drops significantly in 2030 mainly due to the introduction of geothermal in the system. However, it slightly increases again starting the following year (2031) to augment the supply deficits reaching 22 MW in 2040, 36.0 percent and 31.3 percent lower than the Reference (34.5 MW) and Alternative (32 MW).

At the end of the planning period, renewables surpass diesel with a combined capacity of 36.5 MW, or more than 60.0 percent of the total capacity requirement, an improvement from Reference (40.0 percent) and Alternative (56.0 percent) scenarios. Bulk of the renewable capacities come from solar (63.0 percent) and geothermal (27.4 percent).

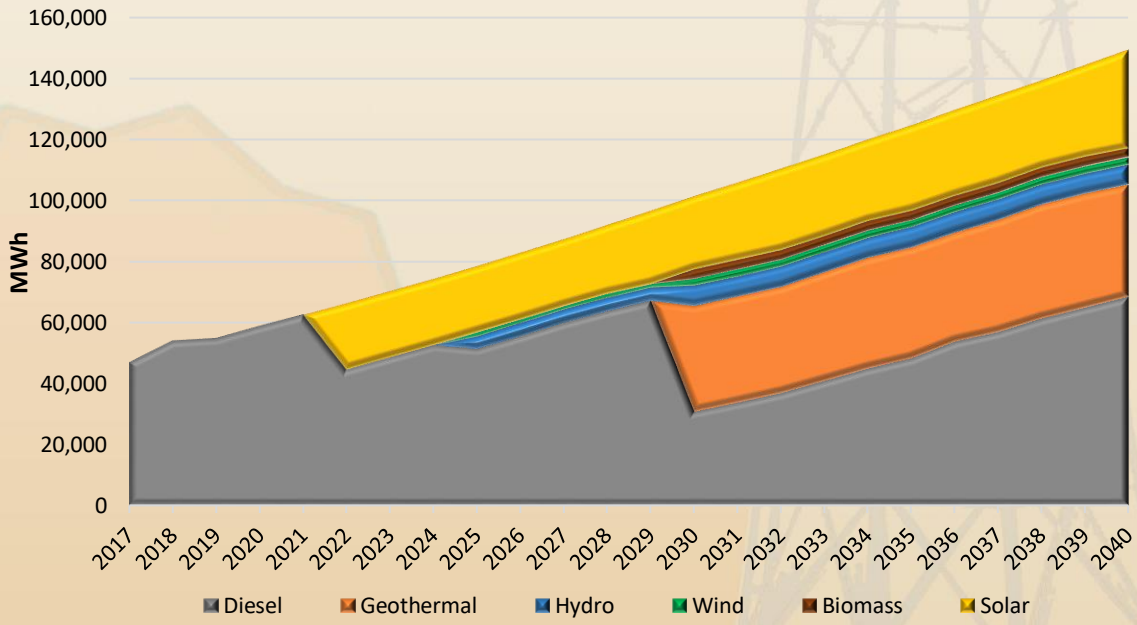
Figure 34. DEMAND- SUPPLY, 2018-2040 (GEOTHERMAL)



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Indicative Solar	-	-	-	-	-	15.5	15.5	15.5	15.5	15.5	15.5	16.5	17.5	18.0	19.0	20.0	20.0	20.0	21.0	21.0	21.5	21.5	22.5	24.0
Indicative Wind	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Hydro	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Indicative Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Indicative Diesel	-	2.5	3.0	14.0	15.0	15.5	16.5	17.5	17.5	18.5	19.5	20.5	21.5	11.0	12.0	13.0	14.0	15.0	16.0	18.0	18.5	19.5	20.5	22.0
Contracted Capacity (Diesel)	9.48	9.85	10.2																					
Reserve Requirement	0.99	1.00	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.82	1.91	2.01	2.11	2.20	2.29	2.39	2.49	2.59	2.69	2.79	2.89	3.00	3.10
Peak Demand	9.92	10.01	11.39	12.24	13.01	13.81	14.63	15.47	16.34	17.23	18.15	19.10	20.06	21.05	21.99	22.95	23.91	24.90	25.89	26.90	27.91	28.94	29.97	31.01

Renewables are seen to meet 54.0 percent of the electricity generation requirements, expanding its share from the Reference (22.5 percent) and Alternative (42.2 percent) scenarios. Although solar has the highest capacity, geothermal produces a significant portion of electricity generation from renewables as it runs at a much higher capacity factor, thus more electricity generation per MW of capacity.

Figure 35. POWER GENERATION (GEOTHERMAL)



As illustrated in *Figure 35*, geothermal accounts for 32.0 percent (32,511 MWh) of the total generation on its initial year but declines to 24.0 percent in 2040. This is due to capacity addition from diesel which is slowly building up starting 2031, while geothermal capacity remains steady throughout the planning period. Notwithstanding, the penetration of geothermal in the system still has a noticeable impact in the mix as it further pushes down the share of diesel to 45.9 percent of the total generation in 2040, equivalent to 68,706 MWh, a decline of 40.0 percent and 21.0 percent from Reference (115,753 MWh) and Alternative (87,721 MWh) scenarios, respectively.

By 2040, solar contributes a share of 22.5 percent, same level with the Reference but lower than the Alternative (33.3 percent). The generation from solar declines since during daytime peak hours, bulk of the required energy can now be covered by the generation from geothermal. Nevertheless, solar generates 33,638 MWh of electricity that displace generation from diesel.

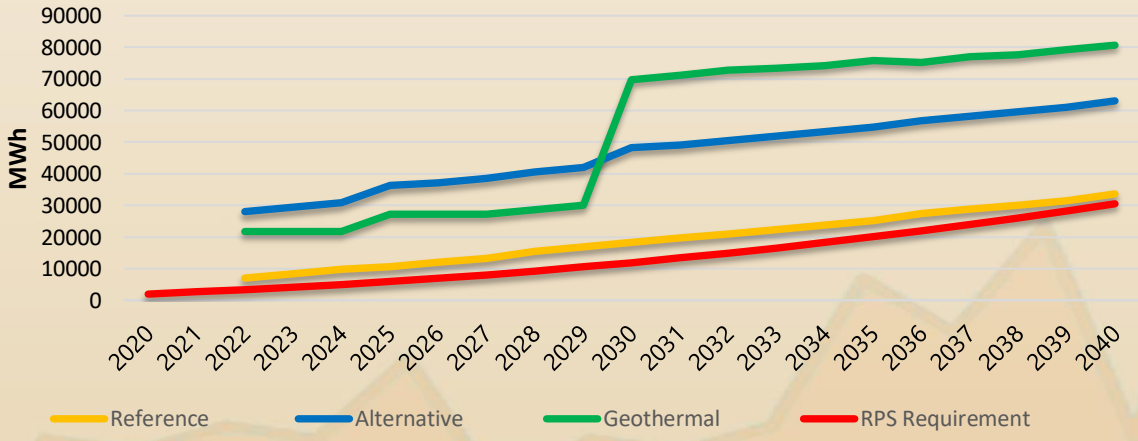
C. SUPPLY SCENARIO IMPLICATIONS

The supply scenarios display the possible evolutions of power supply in the province in light of pursuing renewable energy generation. Each scenario provides the power capacity and generation mix, which can be used to explore the implications of different sets of assumptions on the province's future power system. The analysis considers three indicators such as compliance to Renewable Portfolio Standard (RPS) Off-grid, cost effectiveness, and environmental sustainability that the province may consider in deciding on which supply mix to adopt in its grid system.

Renewable Portfolio Standard Off-Grid

The RPS is a market-based policy stipulated under RE Act of 2008 that requires distribution utilities (DUs) / electric cooperatives (ECs), and retail electricity suppliers (RES) and generating companies including NPC-SPUG, NPPs and Qualified Third Parties (QTPs) to source or produce a minimum percentage of their electricity requirements from eligible renewable energy resources. Similar with RPS On-Grid, the RPS Off-Grid Rules mandate an annual incremental requirement of not lower than 1.0 percent of the previous year's electricity sales. Assuming the 1.0 percent minimum incremental, *Figure 36* shows the RPS requirement of Marinduque vis-a-vis the generation from renewables for different scenarios covering the period 2020-2040.

Figure 36. RPS REQUIREMENT VERSUS RE GENERATION PER SCENARIO



For 2020 and 2021, the RPS requirement is projected at 1,924 MWh and 2,594 MWh, respectively. However, there are still no renewables in the supply mix for the 2020-2021 period based on the different scenario assumptions. While no existing and eligible renewable generation facilities, which are covered by the PSAs of the DUs/ECs, the mandated participants may purchase or acquire Renewable Energy Certificate (REC) from the Renewable Energy Market (REM) to comply with the RPS Off-Grid Rules as defined by the Department of Energy (DOE) in a separate issuance.

Starting 2022, the RPS requirement is expected to increase from 3,309 MWh up to 30,496 MWh in 2040. With the supply assumption of new RE-based additional capacities coming into the system during the planning period, the RPS requirement can be met by the new renewable capacities from 2022 until 2040 for all scenarios. It is evident that the projected generation from renewables particularly for Alternative and Geothermal Scenarios are more than enough to cover the RPS requirement.

Cost-effectiveness (Blend Rate)

There have been renewed efforts to adopt new and more efficient technologies with lower capital and fuel costs in line with the goals of lowering power rates and providing reliable energy in off-grid areas. With the sharp and sustained declines in capital costs, the deployment of renewables in off-grid areas, particularly solar technology, is becoming an attractive solution to enhance power supply, increase energy access and reduce costs of power generation. Amid intermittency issues, the integration of variable renewable energy (VRE) as part of the supply options has gained additional importance to modernize the power grid in isolated islands.

Table 36. BLENDED RATE PER SCENARIO (PhP/kWh)

Resource	Reference Scenario			Alternative Scenario			Geothermal Scenario		
	2020	2030	2040	2020	2030	2040	2020	2030	2040
Diesel	14.75	12.91	12.61	14.75	8.23	9.41	14.75	4.93	7.49
Solar	0.00	1.09	1.24	0.00	1.41	1.34	0.00	0.97	0.88
Hydro	0.00	0.00	0.00	0.00	0.39	0.24	0.00	0.39	0.24
Wind	0.00	0.00	0.00	0.00	0.14	0.09	0.00	0.14	0.09
Geothermal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.97	1.41
Biomass	0.00	0.00	0.00	0.00	0.22	0.15	0.00	0.22	0.15
Blend Rate (Php/kWh)	**14.75**	**13.99**	**13.85**	**14.75**	**10.39**	**11.23**	**14.75**	**8.62**	**10.26**

Notes: Investment costs based on international prices.
LCOE (PhP/kWh) for power generation only; excluding transmission, distribution and other charges.

Using the Levelized Cost of Electricity (LCOE) of technologies/fuels *(Annex 22)* and their shares in the total generation, *Table 36* presents the projected blend rates for the different scenarios within the planning period. The analysis using LCOE covers key parameters such as capital cost, fuel cost, capacity factor, variable and fixed O&M cost, among others. As the result indicates, it compares the production cost per kWh of output by having different combinations of generation technologies.

Under Reference Scenario, diesel is still the predominant source of power. As expected, the blend rate is the highest among all scenarios reaching 13.85 PhP/kWh in 2040. From the 2020 level, the blend rate falls by merely 6.1 percent due to utilization of solar. Since the technology is

commercially matured, the capital cost of solar is projected to further decline in the long-term resulting in generation cost reduction.

As more renewables are considered in the Alternative Scenario, the blend rate is relatively lower compared with the Reference Scenario given the continuous cost reduction of renewables. At the end of the planning period, the blend rate is estimated at 11.23 PhP/kWh, almost 24.0 percent lower than the 2020 level. The rate is even lower in 2030 when renewables have gained much higher share in the generation mix.

The estimated blend rate in Geothermal Scenario is the lowest among scenarios with renewables over taking the share of diesel in the total generation. With the entry of geothermal in 2030, it pushes down the projected blend rate to an all-time low of 8.62 Php/kWh as it takes a considerable portion of the baseload requirements. It may be noted that the rate increases a bit until 2040 reaching 10.26 Php/kWh due to gradual growth of diesel share to total generation. Nevertheless, the rate is still significantly reduced by 30.4 percent from the 2020 level as a result of a more diverse supply mix.

The ability of renewables to compete effectively against fossil fuel technologies like diesel corresponds to the current setting of Marinduque's power sector. For an island province that is relying on only one (1) power generation source, the integration of renewable energy in the supply mix could have substantial merits in reducing diesel fuel consumption and consequently, lower the power rates. This is evident in all scenarios wherein the cost of production of electricity is mainly defined by the share of renewable energies to total generation. The main contributing factor is the consistent fall in the cost of new RE-based power plants brought about by the advancements in the technology, declining costs of production materials, and/or improved learning rate to produce these RE technologies.

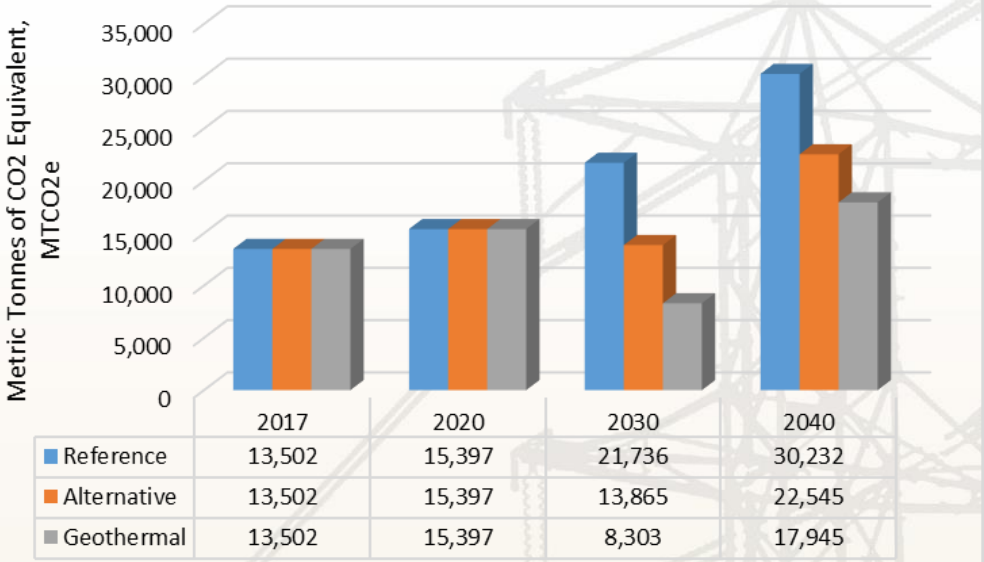
Environmental Sustainability

To meet long-term climate and other sustainability goals, analyzing the overall benefits of various generation systems from an environmental perspective is required. The amount of carbon dioxide (CO_2) emission from electricity production is an important factor in evaluating environmental sustainability as CO_2 contributes the most to total greenhouse gas (GHG) emissions.

Figure 37 illustrates the projected CO_2 emissions from diesel power plants for all scenarios within the planning horizon. The CO_2 emission for each scenario is estimated to establish the potential advantage of using renewables in reducing emission level.

Prior to the integration of RE in 2022, it can be clearly seen that the amount of emissions is at the same level for all scenarios. As power generation continues to be diesel-based under the Reference Scenario, it is expected to have the highest CO_2 emission level among all scenarios. The CO_2 level is projected to be more than double by 2040, reaching 30,232 Metric Tonnes of CO_2 equivalent (MTCO2e) from only 13, 502 MTCO2e in 2017.

Figure 37. CO_2 EMISSION LEVEL, $MTCO_2e$



	2017	2020	2030	2040
Reference	13,502	15,397	21,736	30,232
Alternative	13,502	15,397	13,865	22,545
Geothermal	13,502	15,397	8,303	17,945

Note: CO_2 Emission is internally calculated by LEAP which uses the Intergovernmental Panel on Climate Change's (IPCC) Standard Tier 1 energy-sector emission factors.

With renewables contributing more than 40.0 percent to total generation mix, the Alternative Scenario results in second lowest emission level. Under this scenario, diesel generation is projected to produce 22,545 MTCO2e in 2040, an avoidance of 7,687 MTCO2e from the Reference Scenario, or 22.4 percent decline in emission level.

The lowest CO_2 emission level is observed in Geothermal Scenario with only 17,945 MTCO2e in 2040. Compared with other scenarios, the emission level falls significantly by 40.6 percent (Reference Scenario) and 20.4 percent (Alternative Scenario). This can be associated with the technology supply options considered in the scenario as demonstrated by high presence of renewables comprising 54.0 percent of the generation mix.

Based on the results, it is evident that the increase in deployment of renewable energy has a large net positive effect on the environment in comparison with the development of diesel-fed power plants. The result indicates that the use of renewables and energy-efficient technologies in electricity generation drives down carbon footprints since it reduces the need to produce electricity from other carbon-intensive sources.

CHAPTER V:
PLANS AND PROGRAMS

In view of the continuous developments in the energy sector, the Department of Energy (DOE), as a policy-making entity, remains resolute in initiating and implementing appropriate policies to meet the present and future energy requirements of all the economic sectors in the country. The DOE unceasingly strives to keep up with all the emerging energy issues and challenges through the implementation of various policy initiatives and energy programs that significantly contribute to sustaining the growth of domestic economy.

This Chapter highlights the DOE's national policies, programs and major priorities that are seen to be vital in meeting the development goals of the province. It also incorporates the future directions and strategies that will advance the province's energy sector towards building a positive economic environment on top of achieving sustainable and clean energy solutions.

NEW POLICY DIRECTIONS

LGU Energy Code

The DOE sees the local government units (LGUs) as indispensable stakeholders in implementing the pertinent energy laws. The Department of Interior and Local Government (DILG), in support of the DOE, issued the Joint Memorandum Circular No. 2020-001, which provides the guidelines for LGUs to facilitate the implementation of energy projects. The Circular orders a unified and streamlined permit process harmonizing the implementation of RA 11234 or the "Energy Virtual One-Stop Shop (EVOSS) Act," Executive Order No. 30 (EO 30), Administrative Order No. 23 (AO 23), which eliminates over regulation, and R.A. 11032 or the "Ease of Doing Business."

Among the provisions is the creation of an Energy Sector Committee through its Local Development Council (LDC) to facilitate the implementation of the said circular, which incorporates the energy programs, policies, and projects into the spatial plan (Physical Framework Plan or Comprehensive Land Use Plan, whichever is applicable) and its Comprehensive Development Plan.

As part of the Spatial Plan, the cities and municipalities, in consultation with concerned stakeholders, shall identify upstream conventional (coal, oil, or natural gas) and/or renewable energy resources within their area of jurisdiction and to be posted on website, if available. The LGUs are also ordered to monitor and collect the benefits from energy projects (ER1-94 and National Wealth Tax) and incorporate these benefits in their Comprehensive Development Plan. Development plans, which include all local energy policies, plans, and programs, shall be submitted to respective Regional Development Council and integrated in Regional Development Plan. For the regulatory reforms, LGUs shall streamline the processes in issuing the necessary permits on energy-related projects in accordance with Section 14 of the EVOSS Act and EO 30.

Executive Order No. 30

The EO 30 is a vital energy policy development for DOE as it intends to shorten bureaucratic processes in securing permits/certificates/licenses, which have caused delays in the development of critical infrastructure projects and the needed investments in the energy sector. Signed in June 2017, the EO created the Energy Investment and Coordinating Council (EICC) tasked to spearhead the streamlining of regulatory procedures affecting the implementation of energy projects identified as "Energy Projects of National Significance" or EPNS.

Among the salient features of the EO is the "Action within 30 Days," for securing permits upon submission of complete documentary requirements. Meanwhile, the provision on "Presumption of Prior Approvals" mandates all government permitting agencies (including government instrumentalities and local government units/LGUs) to process EPNS applications without awaiting action from other agencies.

To support the implementation of EO 30, related policy issuances were promulgated to include the Implementing Rules and Regulations (IRR) of EO 30 (Department Circular/DC No. 2018-04-0013), and the Operationalizing the Procedures for the Effective and Efficient Implementation of EO 30 (Department Order/DO No.2017-10-0012). The DOE also created the Centralized Review and Evaluation Committee (CREC) through the DO 2018-03-003 to simplify the review and evaluation process of energy projects relative to the issuances of service and operating contracts, and notice to proceed.

Energy Virtual One Stop Shop Act

As a complementary reform, the Republic Act (RA) 11234 or the *"EVOSS Act"* is a welcome development in the country's energy policy. Recently signed in March 2019, it aims to streamline the permitting process of power generation, transmission, and distribution projects by creating and establishing an online platform that will remove duplications and redundancies in the documentary requirements. Under the new law, prospective developers can apply, monitor, and receive all the needed permits and applications, submit all documentary requirements, and even pay for charges and fees through this platform. Modernizing and streamlining the permitting process of power projects reduce the cost of doing business and increase efficiency, thus encourage more energy investments in the country.

Resiliency Policy

Vulnerability to natural and human-induced hazards is deemed as a serious threat to the country's energy security. This is also evident in Marinduque as manifested by a series of destructive typhoons that severely damaged the province in the past few years. One of the associated challenges for the energy sector in time of disasters is to ensure continuous and reliable supply before, during and after natural or man-made calamities.

As a lesson learned from the past experiences and in support to the government's efforts towards reinforcing the country's disaster resiliency, the DOE issued the DC 2018-01-0001 titled *"Adoption of Energy Resiliency in the Planning and Programming of the Energy Sector to Mitigate Potential Impacts of Disasters."* Said DC aims to institutionalize the adoption of a policy on energy resiliency

to strengthen existing infrastructure facilities, incorporate mitigation improvements into reconstruction and rehabilitation plans, improve operational and maintenance standards and practices, and develop resiliency standards.

This policy promotes the mainstreaming of disaster risk reduction programs into the work and investments planning in all energy projects/initiatives to ensure the continuous delivery of energy services to the consumers, while at the same time ensuring minimal consequence to life and property. With an energy resiliency policy already in place, all energy industry participants are now required to prepare and implement their "Resiliency Compliance Plan" (RCP). The RCP must contain the adaptation of measures, including engineering and non-engineering options, to gauge infrastructure and human resource preparedness during and in the aftermath of disruptive events.

Energy Efficiency and Conservation Act

The recent enactment of RA 11285 or the *"Energy Efficiency and Conservation Act"* is another long-awaited milestone for the sector after almost three (3) decades of lobbying in Congress. The law, as signed in April 2019, establishes a framework for introducing and institutionalizing fundamental policies to promote the development and use of efficient renewable energy technologies, reinforce related laws on energy conservation and ensure a market-driven approach to energy sufficiency, conservation, and sustainability in the country. The measure also provides for the formulation and implementation of National Energy Efficiency and Conservation Plan, Local Energy Efficiency and Conservation Plan, as well as grants of incentives for energy efficiency projects. The DOE is currently working on its IRR so as to effectively fulfill the objectives of the law.

E-Power Mo Campaign

The *"E-Power Mo"* is a strategic energy information, education and communication (IEC) campaign of the DOE, which seeks to empower consumers by providing them information and options on the smart utilization of energy resources. It takes a more inclusive approach that would encourage ordinary Filipinos to actively contribute in securing the country's energy future by using energy responsibly. The E-Power Mo consists of three sub-campaigns: *E-Safety Mo* for safety and savings measures through energy efficiency; *E-Secure Mo* for the delivery of quality, reliable and affordable energy services and the energy resiliency efforts of the government; and *"E-Diskarte Mo"* for a wide range of options in utilizing conventional, renewable and alternative energy sources.

A. POWER AND ELECTRIFICATION

As Marinduque thrives to accelerate and sustain its economic development through a boost in trade and tourism, the need to have a reliable and adequate power supply should be addressed to support the province's growing domestic economy. This primarily upholds the government's vision of national progress in which inclusive growth and developments shall be felt at the grassroots level to create equal opportunities for all. Acknowledging that electricity drives the country's economic development, the DOE is taking a more proactive role to ensure security, reliability, adequacy, quality, and affordability of electric power services in off-grid areas.

DEVELOPMENT CHALLENGES

Tracing the power sector developments in Marinduque in the past decades, the power situation has relatively improved as demonstrated by a high level of electrification in the barangay, sitio, and household level. Despite this encouraging development, the province is still confronted with several key challenges in achieving long-term security, reliability, and adequacy of power supply.

The aging and poor maintenance of the National Power Corporation-Small Power Utilities Group's (NPC-SPUG) generating facilities remain as one of the major challenges in power generation in off-grid areas mainly caused by the delayed approval of NPC's capital expenditure (CAPEX) projects to include replacement, expansion, and rehabilitation. Failure to replace old and unreliable generating equipment results in high fuel rates and low capability ratings of generators that often lead to incidence of power interruptions. And while the rule on awarding contracts through bidding allows the procurement of low-cost generators, such may come with a cost on quality (if caught unawares), and thus compromises the reliability of generating units. With NPC-SPUG being the sole generator in the province, it underscores the need to focus on creating a competitive environment in the power sector to encourage the inflow of private capital investment to engage in missionary electrification.

Other prevailing issues would be the lack of indigenous energy resources and high dependence on costly diesel power plants. This could have a serious drawback in ensuring supply security as it is very much exposed to fuel price fluctuations and sudden fuel shortages, resulting in high power generation costs and eventually blackouts due to lack of fuel. This highlights the need for more alternative sources of energy to diversify the supply mix of the province. Due to generation subsidies and absence of incentives, the electric cooperatives (ECs) are hesitant to pursue the adoption of new and emerging low-cost technologies so as to modernize the small grids and ensuring affordable and reliable supply of power that is available to all.

Power supply contracting is another major consideration affecting supply security in the province. For one, the power supply agreement (PSA) of MARELCO with NPC-SPUG for year 2017 and 2018 is under-contracted. This implies the importance of an accurate demand forecast to precisely determine the volume of demand to be procured in the future. In view of this, there should be a continuing technical capacity building in formulating load forecast to avoid power shortages brought about by insufficient contracted supply.

The lack of cooperation and coordination between the ECs and the concerned local government units (LGUs) is also a contributing factor to properly forecast the province's electricity demand. The long-term economic development plan of the province, such as the entry of commercial, ecotourism, industrial and other large load customers, must be integrated in the forecast. Accordingly, the electric power development in the province must be consistent with local development plans to avoid conflicts in terms of land use and environmental plans in the area.

The provision of reserve capacity greatly contributes to the reliability of the power system. Keeping the available supply above and beyond the expected peak load prevents supply shortfall when there is a sudden increase in demand or when a power plant is on forced outage. However, for off-grid areas, the issue is that whether the 10.0 percent reserve capacity margin, as prescribed in the Philippine Small Grid Guidelines, is sufficient to ensure reliability of the system. There is

also no clear-cut procedure for the procurement of reserve capacity. Compared to areas connected to the main grid, small island grids present much higher probability of having insufficient generation since bigger grids are more robust and resilient to failure. Models that calculate loss-of-load probability (LOLP) or related metrics such as loss-of-load expectation (LOLE) may be needed to assess the appropriate level of reserve margin in off-grid areas.

Keeping the distribution lines free from any obstructions (i.e. vegetation) also poses a threat in the stability of supply. Vegetation usually breaches the safety clearance from the distribution lines, which is one of the leading causes of line fault incidents and power outages. Failure to perform vegetation management has also been identified as a negative factor in maintaining the desired level of distribution efficiency and reliability.

Considering the age and the deteriorating condition of various distribution equipment, timely implementation of CAPEX requirements that involve rehabilitations and upgrading also becomes critical to further improve the system reliability and enhance the operational flexibility during events of natural calamities. With delayed implementation, maintenance and repair works are expected to occur more frequently and at a longer duration.

Another concern specific for the province is the rehabilitation and development of the transmission lines including substations to make the grid more flexible and resilient. Rehabilitating and energizing the existing 69 KV Boac-Torrijos Transmission Line of NPC-SPUG could serve as an initial strategy to increase the power capability and quality of the grid so as to cater the growing demand in the province. This infrastructure may be needed to accommodate and better utilize variable renewable energy that may come online in the future.

Aside from these challenges, there are other related concerns affecting the power situation in the province, to wit:

- Lack of expressed efforts in the promotion of investment opportunities to entice interest of new power providers (NPPs) and other private entities to invest in power generation;
- Delays in the Energy Regulatory Commission's (ERC) approval of CAPEX programs, requested subsidies and cost adjustments;
- Need to conduct continuing assessment studies to evaluate the overall condition of the distribution system and prioritize the required improvements; and,
- Need for a new business model to expand and better service missionary electrification.

The role of the power sector to fully accelerate economic development is clear. If these challenges will not be addressed through appropriate solutions, it will affect the development efforts, weaken economic activities, limit the overall competitiveness, and undermine the province's ability to attract private investments.

PLANS AND PROGRAMS

Recognizing the development need of off-grid provinces for quality electric service, it is deemed necessary to come up with strong policy support and mechanisms, and implement new strategies to further improve the delivery of electricity services in missionary areas.

In response to the growing power concerns in the province, a virtual Marinduque Power Summit was conducted on 9 July 2020. The Summit provided a platform to achieve greater coordination and consultation between the national policies and programs with the local development plans in Marinduque and therefore generate the needed synergy to ensure that all plans and programs in the province are properly laid down to support its accelerated socio-economic development.

The discussions in the Summit pointed to the emergence of one of the perennial concerns in the province – the frequency of power interruptions. To address the issues on electricity services, *Table 37* summarizes the major actions to be undertaken to move the power sector forward and attain the province's full economic potential.

Table 37. ACTION PLAN FOR MARINDUQUE

Recommended Actions	Responsible Agency	Timeline/ Target	Remarks
GENERATION SYSTEM			
Conduct technical evaluation of other NPC generating set assets.	NPC	Immediate	
Provide adequate generation capacity including spinning reserves to avoid Load Shedding.	NPC	Immediate	
Deliver, install, commission and operate the 4-MW generating sets from Singapore (to be supplied by DMCI).	NPC	End of July 2020	
Rehabilitate the 4-MW MAN Diesel Engine	NPC	October 2020	
Deliver, install, commission the 3-MW generating sets (2 X 1.5 MW containerized) from Europe.	NPC	2nd Sem. 2020-1st Sem. 2021	
DISTRIBUTION SYSTEM			
Relocate distribution lines (posts and wires) due to DPWH road widening.	MARELCO, LGUs, DPWH	Immediate	
Vegetation Management Plan a. Formulate and implement a Vegetation Management Plan in coordination with LGUS. b. Conduct IEC on the Implementation of Power Line Corridors Act.	MARELCO, NPC, LGUs	2020-2021	
ASSESSMENT OF MARINDUQUE POWER SYSTEM			
Revisit existing technical audits and reports on Marinduque's small grid (and applicable lessons from other Performance Assessment and Audit/PAA).	All (DOE as lead)	Immediate	Also lessons from other PAA reports
Establish/consolidate of technical information/parameters/ Data useful for detailed analysis (generation, distribution, Transmission).	NPC, MARELCO, NEA	Immediate	Single Line Diagram, Feeder Loading, Machine Loadings, etc.
Harmonize the Power Interruption Data and Reports.	NPC, MARELCO, NEA	Immediate	
Conduct of Engineering Studies of Marinduque's Small Grid System, such as: a. Power/Load Flow Analysis b. Protection Coordination Study c. Insulation Study d. Stability Study e. Fault Analysis	NPC, MARELCO, NEA, TRANSCO	Sept. 2020 to 1st Sem 2021	Entire system – generation, distribution, and even transmission
Implement System Monitoring and Outage Management a. Enhanced System Operations b. Monitoring System c. Communication and Coordination d. Outage Management e. Customer Information and Relation	MARELCO, NEA, NPC, TRANSCO (inputs)	2021-2022	
Formulate the Marinduque Small Grid Enhancement Program, based on the Results of Engineering Studies, to focus on the following: a. MARELCO CAPEX Program b. NPC CAPEX Program	MARELCO, NPC, NEA, TRANSCO	2021-2022	NPC to study alternative method of procurement for better quality

c. Resource Allocation/Budgeting d. Regulatory Approvals and Budgeting			
MEDIUM- TO LONG-TERM PROGRAMS			
Revisit ongoing Competitive Selection Process a. Revise Terms of Reference to incorporate benchmark rate based on existing generation rate charged to customers. b. Factor in the timeline of interconnection	MARELCO, NEA	Immediate	Note: TRANSCO's proposal for three power plants in Marinduque was already incorporated in the latest Terms of Reference (TOR) of MARELCO.
Conduct an Interconnection Study of Marinduque to Luzon Grid with consideration on the following: a. Engineering and Financial Studies b. Implementation Schedule c. Regulatory Approvals d. Strategies to address possible stranded contracts and related issues e. Implementation	MARELCO, NEA, NPC, TRANSCO (lead), National Grid Corporation of the Philippines (NGCP)	2020-2022	

1. POWER DEVELOPMENT

The recent issuance of DC 2019-01-0001 titled *"Prescribing the Omnibus Guidelines on Enhancing Off-Grid Power Development and Operation"* serves as the new framework for missionary electrification to rationalize and improve the Universal Charge on Missionary Electrification (UCME) subsidy system. The Omnibus Guidelines will adopt appropriate tariff mechanisms, and encourages private sector participation by introducing new technologies to lower electricity rates and help attain the national target of 100.0 percent electrification rate. The Guidelines will likewise introduce the implementation of new technical standards towards achieving capacity adequacy, reliability and efficiency of electric power systems in off-grid areas.

Consistent with the 2016-2020 Missionary Electrification Development Plan and the Missionary Electrification Roadmap as incorporated in the Philippine Energy Plan (PEP) 2017-2040, the DOE will continue to work on its plans and programs, such as identifying appropriate schemes to promote and improve the private sector participations, creating a new business model to bring the operations and services in missionary areas to commercial viability levels, and commencing a policy study that will provide more definitive guidelines in the rationalization of missionary electrification subsidies. The development of an optimal energy mix for off-grid areas will also be considered taking into account the required RE generation. Recognizing the critical roles of government agencies in realizing these plans, institutional cooperation among the DOE, NPC and the National Electrification Administration (NEA) will also be strengthened.

To complement these initiatives, the DOE is committed to continually and effectively implement the following policy frameworks that are already in place:

Private Sector Participation (PSP) Program

Since the enactment of the Electric Power Industry Reform Act (EPIRA) of 2001, substantial privatization of the government power assets has been achieved as part of the power sector

restructuring. Part of the directive is for the NPC-SPUG to privatize its generation function and to implement its electrification efforts and associated power delivery systems in missionary areas[19].

All existing missionary areas are declared open for private sector participation. The PSP Program in missionary areas is possible under two (2) general schemes: (1) the NPP Program where a private sector, deemed technically and financially capable takes over the generation function of the NPC-SPUG; and (2) the Qualified Third Party (QTP) Program where a private sector will be the alternate electric service provider for unviable and waived areas that the franchised distribution utilities (DUs) / ECs are unable to serve.

The NPP can only work in missionary areas through a Competitive Selection Process (CSP). As mandated by the DC 2018-02-0003[20], all DUs are required to undertake competitive bidding to secure power supply agreement (PSA) with the generation companies. The full implementation of CSP institutionalizes a transparent system of power supply contracting towards achieving reasonably priced electricity rates. This reform will no longer allow unsolicited proposals from suppliers as all proposals should be bid out on fair and competitive terms in accordance with all pertinent rules and regulations of the DOE and the ERC.

At present, the province, through MARELCO, is still sourcing its power supply from NPC-SPUG and has yet to enter a PSA with the private sector. To this end, MARELCO is determined to seek for an NPP that will ensure reliable and efficient supply of power for its entire coverage area. It is now in the process of undertaking CSP to invite and find a reliable and efficient power provider with the least cost. The NPP is targeted to be in full operation by September 2022.

In the long run, the PSP Program is envisioned to improve reliability of supply, reduce government's subsidy for missionary electrification and rationalize the UCME.

Performance Assessment and Audit

The performance assessment and audit (PAA) of all power plants serves as the DOE's tool to achieve operational efficiency and continuous improvement of power sector's performance. Guided by DC 2017-12-0016,[21] the DOE, through the Performance Assessment and Audit Task Force, conducts annual performance assessment on the power industry, including technical audit of power plants of NPC-SPUG and NPPs. The DOE may also perform an incidental/special audit when it deems necessary, such as significant incidents causing power disruption, during emergency situations from natural or human-induced calamities, and as directed by the DOE Secretary. Adopting the policy will allow for the effective enforcement and monitoring of various compliance requirements in accordance with the Philippine Small Grid Guidelines.

[19] Missionary area, as defined and/or understood under RA 9136, refers to areas that are not connected to the main transmission system. It can be interchangeably used to mean: off-grid; far-flung; remote; or unviable areas. Source: https://www.spug.ph

[20] Department Circular titled "Adopting and Prescribing the Policy for the Competitive Selection Process in the Procurement by the Distribution Utilities of Power Supply Agreement for the Captive Market"

[21] Department Circular titled "Adopting the Guidelines for the Performance Assessment and Audit of All Power Generation, Transmission and Distribution systems and Facilities"

2. DISTRIBUTION DEVELOPMENT PLAN[22]

In accordance with the Section 4, Rule 7 of EPIRA-IRR, all DUs must prepare and submit to the DOE an annual Distribution Development Plan (DDP) and in the case of the ECs, their plans should be submitted through the NEA.

The DDP is a comprehensive development plan of the DUs mainly comprised of a 10-year outlook of supply-demand requirements of their customers, the actual number of customers and energy sales per customer type, level of household electrification, and the necessary investment requirements for distribution infrastructure expansion, rehabilitation and upgrading. Further, in compliance with the CSP Policy, the DDP should also contain the Power Supply Procurement Plan (PSPP).

Proposed Capital Expenditure Projects

To continually improve the operational efficiencies and performance of its distribution network, MARELCO is spurring significant investments on several distribution projects generally consist of line upgrading and rehabilitations, additional substation and feeders, and replacements of some distribution system components.

Network Requirements

Following are the network requirements included in MARELCO's capital expenditures (CAPEX) program that intends to address the distribution system's technical deficiencies:

1. Installation of Additional Substation

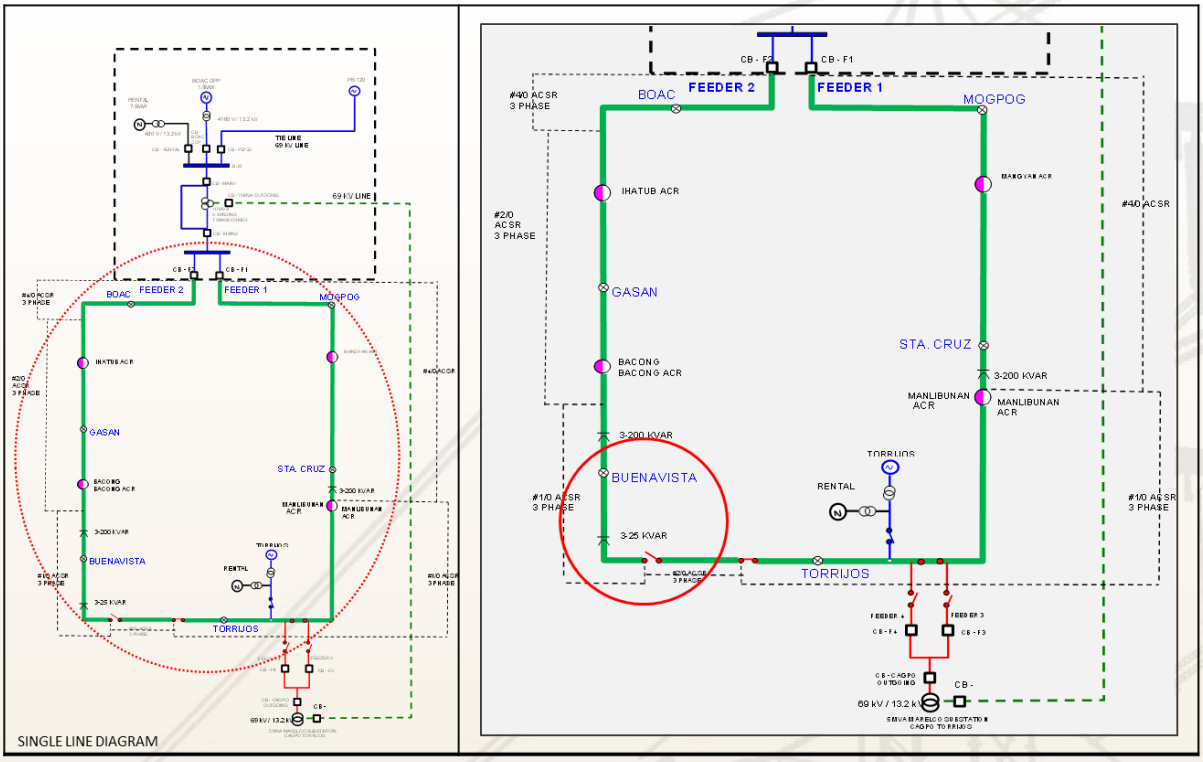
Based on the overall analysis and assessment of the existing distribution network, there will be an impending low voltage issue in Feeder 2[23] of the system due to the long stretch of line coupled with the growth in demand. As shown in *Figure 38*, the problem is foreseen to occur in the southern part of the Buenavista line section, which is located at the load end of the feeder.

As a remedial solution, construction of an additional 5-MVA Substation between Gasan and Buenavista is needed to have good quality voltage at the load end. Once completed and energized, the existing Feeder 2 will be divided into three feeders to increase the reliability of the system. This project is the initial stage of the envisioned extension of the 69-kilovolt (kV) line connecting Bantad and Gasan Substation provided that the existing 69 kV line in the province will be energized. Target completion of the project is by 2020, entailing a capital investment of PhP 27 million.

[22] Based on the MARELCO's DDP and PSPP

[23] Feeder line is an electrical line that extends radially from a distribution substation to supply electrical energy within an electric area or sub-area. (Source: U.S. Energy Information Administration) For Marinduque, Feeder 1 serves municipalities of Mogpog, Sta. Cruz and Torrijos while Feeder 2 serves municipalities of Boac, Gasan, and Buenavista.

Figure 38. MARELCO'S DISTRIBUTION SYSTEM CONFIGURATION



2. Distribution Rehabilitation and Upgrading

Based on the surveys and inspections conducted by MARELCO, rehabilitation and upgrading of distribution components are deemed necessary to improve reliability of the system as well as the integrity of infrastructures to better withstand future calamities. This project includes the following activities which are targeted to be completed within the period 2019-2021:

- Replacement of rotten cross arms and poles, undersized poles, broken insulators, defective cut-outs, and defective lightning arresters with an estimated cost of about PhP 2.8 million. If not implemented, it may result in unscheduled power outages in the province.

- Re-conductoring of Line Segment from Barangay Cagpo, Torrijos to Barangay. Manlibunan, Sta. Cruz by changing the size of the primary conductor from #1/0 aluminum conductor steel-reinforced (ACSR) to #3/0 ACSR with a total length of 21.5 kilometers (km). This voltage improvement project is set for implementation in 2019 with an approved funding of PhP 19 million.

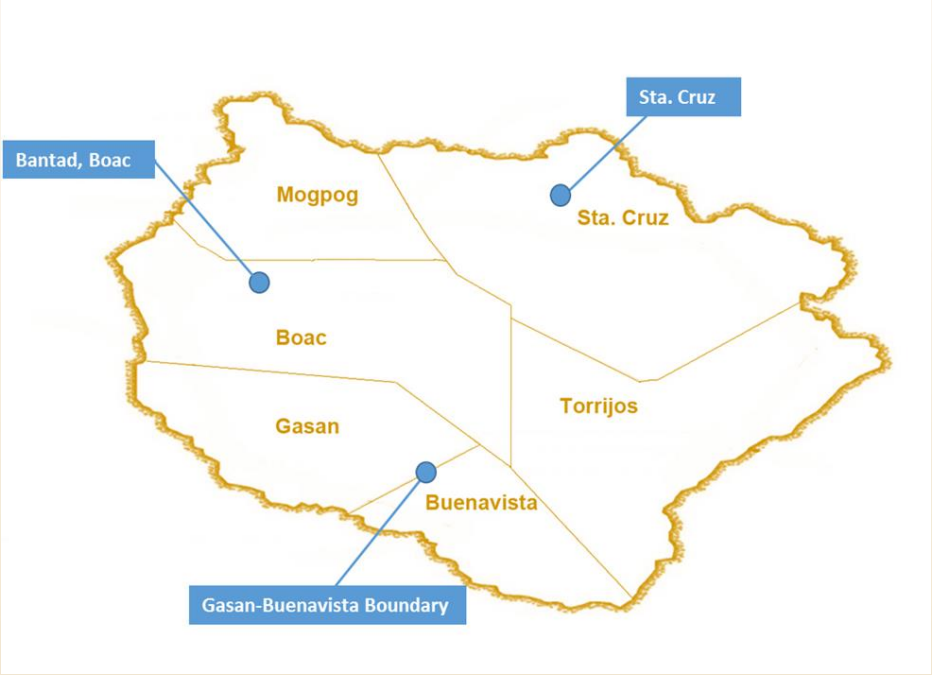
- Installation of three 150-Kilovolt ampere reactive (KVAR) single phase capacitor in Buyabod, Sta. Cruz. With an implementation cost of PhP 168 thousand, this project intends to maintain the voltage profile at the area within the prescribed limits.

- Relocation of poles along the circumferential road of the province affected by the road-widening project of the Department of Public Welfare and Highways (DPWH). This issue is considered critical acknowledging the concern on public safety especially for the motorists and passengers. The required funding is estimated at Php 13.5 million.

In addition to the above-mentioned projects, MARELCO is conferring several strategies to further improve the power quality in the province. As such, power plants are proposed to be strategically installed in the load centers of the province to address the low voltage problems. The identified three economic locations are Barangay Bantad of Boac, Municipality of Sta. Cruz and in the boundary of Gasan and Buenavista as illustrated in *Figure 39*.

Similarly, the existing two feeders must be converted into six (6) feeders or one (1) feeder per municipality to increase reliability. In this case, the long stretch of line will be shortened and high concentration of load will be minimized resulting in an improved voltage that is within the allowable range as prescribed by the Philippine Distribution Code (PDC).

Figure 39. PROPOSED LOCATION OF POWER PLANTS



As part of maintenance and distribution planning, the following are other required network upgrades due to anticipated increase in load demands of existing and additional customers, as well as replacement of other distribution assets that have reached the end of their economic life:

1. Procurement and installation of pole mounted distribution transformers, electric meter, service drop and accessories for additional customers;
2. Replacement of 27 units of old and deteriorated transformers in the coverage area; and,
3. Replacement of Fuse Cut Out at lateral lines with big loads to Three-Phase Automatic Circuit Reclosers.

Non-Network Requirements

Along with the efforts to improve the performance of the distribution system, MARELCO also needs to acquire additional property, equipment and accessories to promptly deliver better and efficient service to its consumers to include:

1. Acquisition of vehicles, such as boom truck, maintenance vehicles, motorcycles and motorbanca;
2. Construction of office building, open garage, and fuel and gas station;
3. Purchase of tools, shop and safety gadgets and other necessary tools for operation and maintenance; and,
4. I.T. equipment (computer software and hardware)

Island Barangays Interconnection

MARELCO planned to extend its distribution network using submarine cables to the island barangays isolated from the main grid to further improve the operating hours in these areas. There are three island barangays in the municipality of Sta. Cruz, namely: Polo, Maniwaya and Mongpong with a stand-alone system for the provision of electricity. *Figure 40* illustrates the project location map of the proposed interconnections.

Congressman Lord Allan Velasco with Governor Romulo Bacorro and officials of NEA, MARELCO, DENR and PCA during the switch-on ceremony in the island-barangay of Maniwaya. http://marinduquegov.blogspot.com/

On the other hand, the Polo-Maniwaya Interconnection project was also completed in February 2019. The project involved the installation of a three-phase submarine cable extending from Sitio Punta, Polo to Sitio Baguio 2, Maniwaya. This project was also funded under the Barangay Line Enhancement Program (BLEP) with an implementation cost of PhP 69.6 million.

The last stage of interconnection is the island barangay of Mongpong to Maniwaya, which is in the offing. This project involves the installation of submarine cable extending from Sitio America, Maniwaya to Mongpong. At present, preparation of project design and bill of materials are already in process.

The full implementation of these interconnection projects will result in a 24-hour operation of electricity service to better serve the increasing tourism activities in the islands. Remarkably, it will also transform the distribution network of the province into a single and unified grid, thus increasing the reliability of electricity supply system in the province.

Figure 40. PROJECT LOCATION MAP

3. TRANSMISSION DEVELOPMENT

Transmission Development Plan

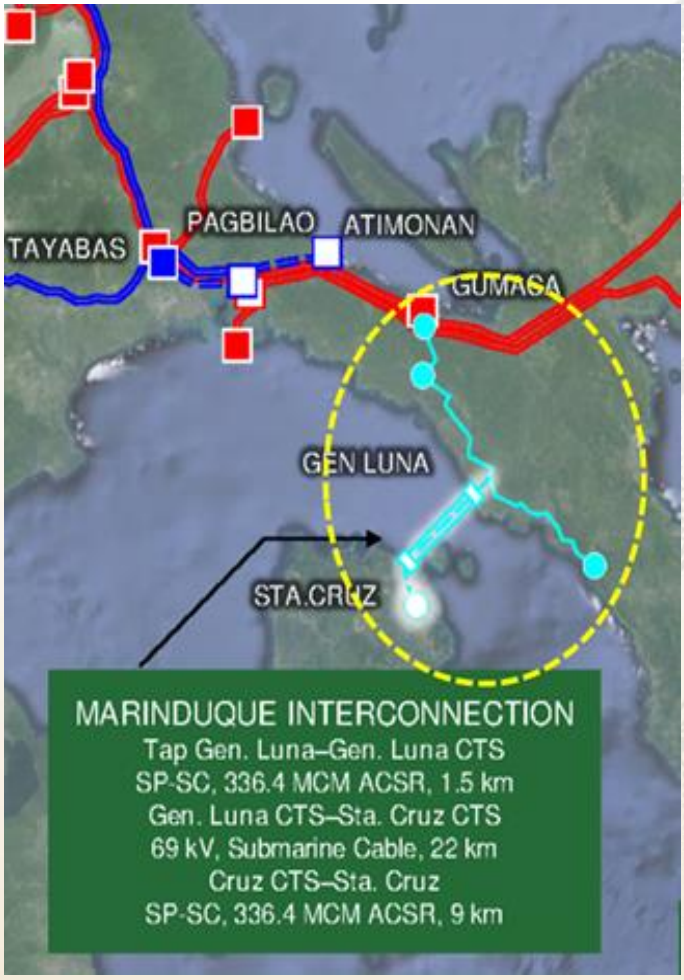
The Transmission Development Plan 2016-2040 (TDP) of the National Grid Corporation of the Philippines (NGCP), as approved by the DOE, serves as the 25-year roadmap for the expansion of the Philippine power grid. It provides the overall long-term view of the country's transmission network containing all ERC-approved projects for the 4th Regulatory Period (2016-2020), crucial projects for implementation in the 5th Regulatory Period (2021-2025) and the indicative transmission projects for the succeeding five-year intervals until 2040.

Recognizing the specific power needs of small islands and isolated grids (SIIG), the NGCP includes in the TDP the potential small island interconnection projects in off-grid areas. Pursuing island interconnection is envisioned to improve security and adequacy of power supply in the island having the ability to import power when required and export power when there is surplus. The importance of such kind of projects also relates to the government's commitment of expanding energy access and the total electrification in off-grid areas.

One of the potential island interconnections identified in the TDP is the interconnection of Marinduque to Luzon Grid via Quezon Province. This is primarily composed of a 23-kilometer submarine cable and 11-kilometer overhead power lines running from a cable terminal station in Marinduque mainland towards General Luna, Quezon. The NGCP noted that the project still requires further assessments to determine its viability and no feasibility study has been conducted yet to determine the least-cost possible transmission route. For this specific interconnection, only

the nearest existing facility available for connection in Marinduque and Quezon side was considered.

Figure 41. PROPOSED MARINDUQUE INTERCONNECTION



In case that the Marinduque-Quezon Interconnection is successfully implemented, this would significantly boost supply security and reliability of the province as brought about by its direct access to the bulk generations in the main grid. However, once it becomes connected to the main grid, the province will cease to receive government subsidy through UCME as implied in existing regulations. Thus, it is appropriate to have a full technical and financial feasibility study prior to the implementation of the proposed interconnection. With the ongoing CSP, timeline of interconnection should also be considered as it must synchronize with the MARELCO TOR's cooperation period of 15 years to avoid stranded contract.

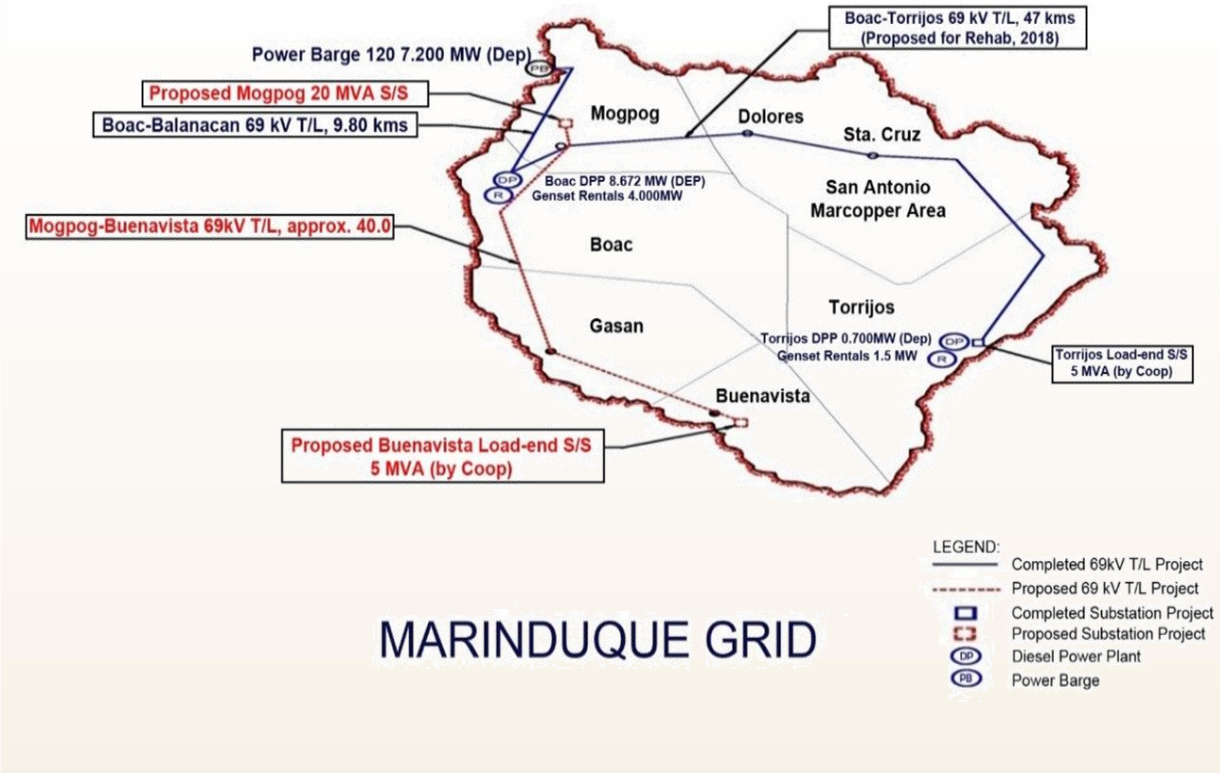
On the other hand, MARELCO also conceptualized Catanauan, Quezon as a possible interconnection point since it is nearer to the island barangay of Mongpong in Sta. Cruz, Marinduque. If feasible, such project may first require the interconnections of the island barangays to the mainland to serve as the interconnection points to deliver the power to the province's main grid.

Transmission Projects

The ownership, operations, and maintenance of the transmission lines in off-grid areas remained within the functions of the NPC. To date, the NPC-SPUG continuously undertakes transmission system expansion and rehabilitation to strengthen its existing system in SPUG areas as represented in its 2018-2022 Missionary Electrification Plan (MEP).

As mentioned in Chapter 2 under the Power Situationer Section, the NPC-SPUG has an existing 69 KV transmission line in Marinduque that runs through the municipalities of Mogpog, Sta. Cruz, and Torrijos. However, this is still not operational due to right-of-way issues and damaged lines and poles caused by typhoons. As such, one of the identified transmission projects in the province is the Rehabilitation of the Boac-Torrijos 69 kV Transmission Line as illustrated in *Figure 42*. This project was recently completed in 2019, still subject for testing and commissioning prior to its energization. With an implementation cost of about PhP 369.6 million, the project intends to complete and strengthen the existing transmission backbone in the province.

Figure 42. MARINDUQUE GRID



Another proposed project is the Mogpog 20 MVA Substation also known as the uprating of 10 MVA Boac Substation. It involves the rehabilitation and transfer of the existing 10 MVA power transformer at Boac Substation and the installation of new 10 MVA Mogpog Substation in Barangay Janagdong, Mogpog. Costing about PhP 188.5 million, the project is expected to improve the reliability of the system and match the demand growth through the installation of additional power transformer. To date, the preparation of Notice of Award (NOA) is in the process. The project started in 2019 but was suspended in March 2020 due to the pandemic.

The construction of Mogpog-Buenavista 69-kV Transmission Line (approximately 40 circuit-kilometers) is also envisioned to be implemented as included in the NPC-SPUG's plan and programs. The project has an estimated cost of PhP 447.7 million and is targeted to be implemented in 2022.

4. ELECTRIFICATION

A priority target of the government is the attainment of the 100 percent household electrification by 2022 (based on the 2015 Census of Population). To attain this, the "Task Force E-Power Mo" (TFEM)[24] was created by the DOE for the purpose of ensuring access to electricity for communities that remain unserved[25] and underserved[26] by DUs/ECs as mandated by their respective franchises.

[24] Department Order No. DO2018-05-0010 titled "Creation of a Task Force to Ensure Access to Electricity for the Communities that Remain Unserved and Underserved by Distribution Utilities"
[25] Areas without electricity access
[26] Areas whose electricity services are less than 24 hours, with service parameters non-compliant with PDC or currently served with individual PV Solar Home System (SHS)

One of the programs that complements the country's electrification target is the Electrification Fund Program under Energy Regulations (ER) 1-94 or the financial benefits to host communities. It aims to utilize 50.0 percent of the one centavo per kilowatt-hour (P0.01/kWh) of the total electricity sales of all generation facilities as financial benefits. This is used to fund electrification projects for households located in cities/municipalities hosting energy projects. Based on the revised rules, the financial benefits will now be directly remitted by the generation companies and/or resource developers to the concerned DUs that will implement the project.

In the case of Marinduque, MARELCO is on track in terms of achieving the electrification goal of the country as it has already surpassed the target of bringing power to all its households within its franchise area based on the 2015 Census. It is in this context that for this Plan, the full electrification target was moved to 2030 wherein the projected total number of households for each year from 2030 up to 2040 will be used as the baseline number.

By 2040, the total number of households is projected to reach 110,627 as a result of the anticipated increase in the total population within the 23-year period. And in the course of achieving total electrification by 2030, the DOE expects to energize a total of 90,134 households by end-2030. And to sustain this target up to 2040, the electrification of 110,627 projected households must be realized by the end of the planning period.

Table 38. TOTAL HOUSEHOLD PROJECTION UNDER THE MARELCO FRANCHISE AREA

	2017*	2020	2025	2030	2035	2040
Total Households Projection	61,048	67,068	78,650	90,134	100,992	110,627
Electrification Target (100% by 2030 to 2040)	55,163	63,057	76,589	90,134	100,992	110,627
Additional Households to be Electrified	5,885	19,083	33,292	37,550	37,550	37,550

Notes: Household Projection up to 2027 is sourced from 2018 DDP of MARELCO and extended by DOE-EPPB up to 2040
**Actual Electrification Data*

There are also available electrification programs spearheaded by NEA that strongly support the target energization of the country: (1) Sitio Electrification Program (SEP), which involves the provision of electricity to far-flung areas and sitios within the barangays; and (2) the BLEP that involves the extension of distribution lines from off-grid (using solar or small generating sets) to grid (EC distribution lines) and enhancement of lines and/or submarine cables. In Marinduque, the interconnection of its island barangays to the main grid was among the approved projects under BLEP.

In support to the missionary electrification, the NPC-SPUG and MARECLO remain steadfast in extending their services and bringing light to the farthest corners of the country by continuously identifying new areas to be provided with electricity.

Gaspar Island Electrification Project. The NPC-SPUG is planning to include the Gaspar Island in Barangay Pinggan in Gasan as a new area for electrification under its plans and programs for 2021 by transferring the generating unit from Polo to provide electricity supply to the island. Gaspar is the largest island of Tres Reyes Islands, also called the "Three Kings," the chain of three islands off

the coast of Gasan. As it turns into one of the most popular tourist destinations in the province, the island starts to become inhabited giving rise to the call for the provision of electricity service.

Salamague Island Electrification Project. MARELCO proposed the extension of overhead line for island sitio electrification. The target implementation of the project is in 2020, subject to NEA's approval.

B. RENEWABLE ENERGY

Renewable energy shall play a huge role in providing better quality of life for Marinduqueños as it could provide them with clean, affordable and sustainable energy that can constantly be replenished. Just like any development project, renewable development stimulates creation of additional economic activities, indirect jobs and generates taxes and revenues.

The DOE is taking a great leap in the aggressive development and utilization of the country's vast renewable energy resources in missionary areas. This is seen as an option and a suitable strategy to reduce electricity rates, and thus subsidy level. It may also extend the operating hours in areas where electricity service is less than 24 hours.

DEVELOPMENT CHALLENGES

The province's energy transition to renewable energy (RE) will not be realized without resolving first the standing issues associated with the entry and integration of RE-based power plants.

The most prominent challenge relates to the need to conduct a detailed system impact study to analyze the effects of integrating RE to the grid. At present, MARELCO has yet to conduct a detailed study to determine the penetration limit of RE generation in its distribution system. With this uncertainty, MARELCO cannot just simply allow the proliferation of renewables without knowing the acceptable level as it could prompt operational concerns and power quality issues that will violate the reliability and performance of the system.

Aside from the technical limitation on the amount of RE that could be connected to the grid, another issue is the long and arduous process of securing permits for RE projects, particularly during the pre-development stage, which impairs and discourages investments. The inefficient administrative permitting processes or the involvement of multitude of different authorities from all levels of government (i.e. from the barangay, municipal, provincial, regional, and departmental agencies) in the approval process cause unreasonable delays hampering the timely delivery of energy projects.

In most of the RE projects, the contemporaneous recognition of the rights of indigenous people (IP) or cultural communities by virtue of Republic Act (RA) 8371 or the Indigenous Peoples Right Act of 1997 is also a major concern as the development of the resource often leads to the encroachment of the ancestral domains. Favorably, Marinduque has been spared from this concern being a non-IP province.

While the country's regulatory framework for RE is already established, each renewable technology still has its own unique technical and economic challenges when it comes to its development.

Solar. The development of solar power requires a considerably wide area of land to be dedicated for solar farm sites. For Marinduque, such vast of land will be difficult to find and be converted to solar farms, as mostly are utilized for agricultural purposes. Additional challenge will be the intermittency of the resource since electricity produced from solar varies over the day.

Wind. Development of wind energy resource requires higher initial investment cost than fossil-based generators, not to mention the limited local manufacturers, fabricators and suppliers of RE equipment and components. Being site-specific, good wind site is often located in remote locations or far from electricity consumers. This will require additional lines to transmit the generated power, which significantly adds up to investment costs. Moreover, the intermittent nature or the variability of wind speed remains a challenge in providing a continuous power generation. There is also a lack of an updated database that limits options to optimizing development of such resource.

Hydropower. Due to the intertwining nature of water and energy usage, the utilization of water for hydropower generation faces some challenges. As such, the Water Code of the Philippines strictly provides for the descending purposes and uses of water. Priority is given to domestic usage, such as for drinking, cooking, washing, among others. It is followed by the municipal use for the supply of requirements of a community, and then for irrigation purposes in producing agricultural crops. Power generation is ranked as fourth in terms of priority use of water. This could be a potential barrier for the development of hydropower in the province as some of its untapped hydro resources are being utilized for domestic and irrigation purposes. Likewise, the high upfront investment requirement and the long gestation period, which prolongs the commissioning of the project also pose a challenge in harnessing hydro resources.

Biomass. With regard to biomass resource, one significant barrier is the harmonization of energy related programs with agro-forestry policies for an integrated use and other applications of the resource, specifically in power generation. Another issue is the sustainability or long-term availability of feedstock supply to continuously produce power. Thus, there is a need to formulate standards and sharing of best practices for sustainable biomass supply to encourage investments in power generation.

Geothermal. One notable barrier that obstruct the development of geothermal energy is the inherent risk in financing geothermal projects. The significant amount of investment needed to explore geothermal reservoirs makes it difficult to encourage investors as it may possibly turn out to be uneconomical afterwards. Although a mature technology, geothermal development lags behind other technologies due to lack of or absence of a meaningful risk mitigation tools and sound policy frameworks. Likewise, most geothermal resources are located in remote and protected areas and more often, requires resettlement of households to facilitate the construction of the project.

PLANS AND PROGRAMS

With the passage of RA 9513, otherwise known as the "Renewable Energy Act of 2008," the development and utilization of renewable energy for power generation has been constantly gaining headway in the country. The launching of the National Renewable Energy Program (NREP) serves as the government's "green energy" roadmap to achieve the objectives set forth in the RE Act towards the realization of the country's renewable energy targets and trajectories for the short- and long-term.

To boost the implementation of RE projects, the RE Act provided several policy mechanisms – Feed-in-Tariff (FiT), Net Metering, Renewable Portfolio Standards (RPS), Renewable Energy Market (REM) and Green Energy Option Program (GEOP). To date, most of these support policies are being adopted and implemented except for REM, which is yet to be finalized and approved.

One of the recent issuances specific for missionary areas is the DC 2018-08-0024, which promulgates the rules and guidelines governing the establishment of the RPS for off-grid areas. The RPS requires all mandated participants to source or produce a minimum percentage of their total annual electricity generation from eligible RE resources available in their respective areas as set by the National Renewable Energy Board (NREB). The RPS Off-Grid Rules (same with On-Grid Rules) has an annual incremental requirement of not lower than 1.0 percent of the previous year's generation. With 2018 as the baseline year, the full implementation of this policy shall be in 2020.

The provisions and granting of fiscal and non-fiscal incentives as provided in the law enable the lowering of investment costs, thus further encouraging greater private sector participation. For missionary areas, a cash incentive mechanism was put in place to entice private investment for the development of renewable energy. Under the Renewable Energy Developer Cash Incentive (REDCI), any RE developer operating in missionary areas is entitled to a cash generation-based incentive per kilowatt-hour rate generated, which is chargeable to the UCME.

On top of this, the RE Law is expected to provide cleaner energy to mitigate climate change and transform the country into a low carbon economy. It also intends to reduce dependency on imported fuels, which minimizes exposure to price fluctuations in the world market.

The DOE has also developed the necessary regulatory framework for the RE industry to enhance the transparency and shorten the time frame for the processing of permits. As such, DO 2017-04-0005 prescribes the new guidelines in the processing of applications for Renewable Energy Service/Operating Contracts (RESC/REOC), which set the processing period to not more than 25 working days. The issuance of E.O. 30 and the creation of CREC also complement the government's initiative of creating a better business environment for renewable energy development. Likewise, the recent signed EVOSS Act is seen to stimulate the power generation investments, especially for RE projects as it addresses the lengthy processing of permits confronted by the energy project proponents.

To accelerate the deployment of RE projects across off-grid areas, the DOE is also set to issue new and separate guidelines to streamline the RE application process of distributed, small-scale RE projects of not more than 1.0 MW in capacity. The proposed DC also offers the end-users the option to develop and produce their electricity requirements as part of demand-side

management through qualified and eligible RE developer. The draft policy is currently in circulation for industry stakeholders' inputs and comments.

Resource Potential[27]

There is a need to maximize all available resources and technologies available to meet the power supply requirement of the province. When all available renewable potentials in the province are harnessed and utilized, the local economy could advance to a higher stage of development, thereby accelerating progress in the communities.

Regardless if Marinduque has neither existing RE Service/Operating Contract nor any renewable resource that has been developed nor being developed, this section discusses some of the untapped renewable potentials of the province.

The Philippine National Oil Corporation-Renewable Energy (PNOC-RC), an attached agency of the DOE, conducted initial assessments and studies of the province's potential renewable resources and sites for possible development as follows:

1. Nine Potential Solar PV Farm sites;
2. Three Potential Mini-Hydro site;
3. Three Potential Wind Farm sites; and
4. One Potential Geothermal Resource.

Figure 43. POTENTIAL RENEWABLE ENERGY SITES IN MARINDUQUE

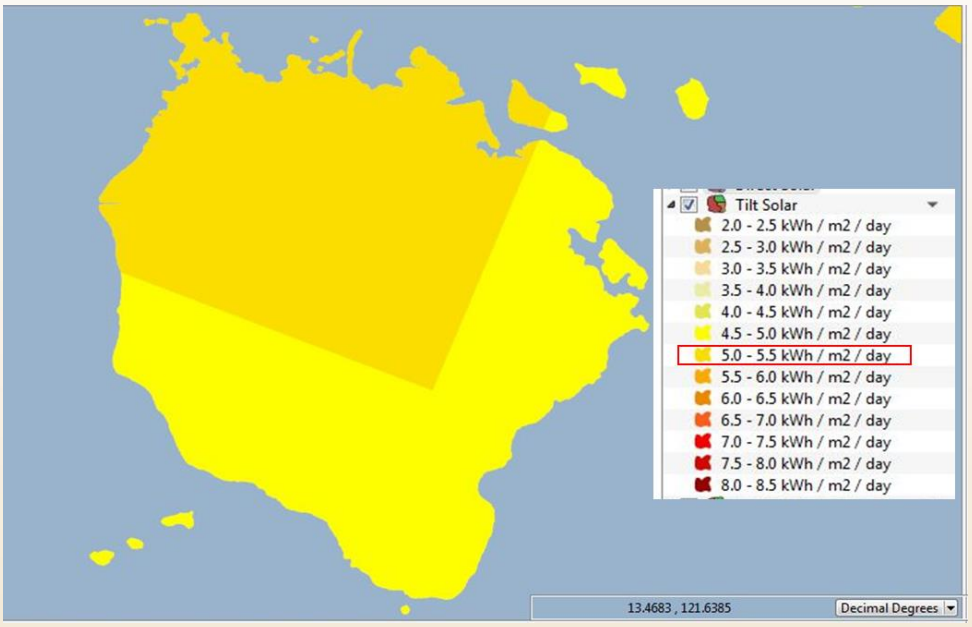
However, detailed studies are still necessary to support and determine the viability of these prospective resources/sites *(Figure 43).*

[27] Based on the PNOC-RC's proposed Renewable Energy Development for Marinduque.

Solar

Solar energy is enormous in Marinduque. According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the island has an average solar irradiance[28] of about 4.8 kW/m^2 and an average temperature of 27°C that makes it ideal for solar energy generation. *Figure 44* shows the solar resource map of the province extracted from GeoSpatial Toolkit Software of the United States–National Renewable Energy Laboratory (NREL). The acceptable solar irradiation[29] for solar PV project is 5 kWh/m^2/day. In harnessing solar energy resources, the installation of both land based and floating solar PV are being considered in the Plan.

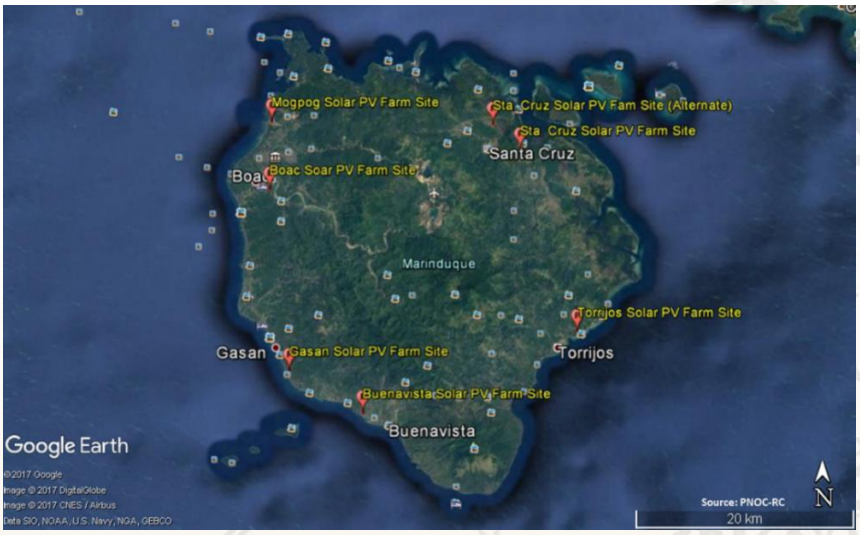
Figure 44. SOLAR RESOURCE MAP OF MARINDUQUE



Land Based Potential PV Farm. The common problem in the installation of solar is the scale of land required and the change in land use. The rule of thumb is that one hectare of land will be needed to implement a 1-MW solar project. This could be a serious concern especially for a province where most of the lands are for agricultural purposes. To address land use issues, the installation of small ground-mounted solar farm projects can be considered. With the area of the province recorded at about 95,920 hectares, it may have some localized, non-arable lands/areas that can be used for building small-scale solar farm sites with capacities ranging from 1.0 to 2.0 MW.

[28] Solar irradiance is the instantaneous power of sunlight on a defined surface measured in watt per square meter (W/m^2).
[29] Solar irradiation is the solar energy received within a specified time period on a defined surface (kWh/m^2/day)

Figure 45. POTENTIAL LAND -BASED SOLAR PV FARM SITES



Since localized solar projects are distributed or embedded in nature, it could potentially help in improving voltage regulation and reducing system loss of the distribution system given its proximity to the consumers. *Figure 45* shows the seven (7) identified prospective sites for the development of localized solar projects: Mogpog, Boac, Sta. Cruz (2 sites), Torrijos, Gasan, and Buenavista.

Floating Solar PV Farm. The development of floating solar technology (or the deployment of solar panels on the surface of a body of water) has an advantage in the promotion and expansion of RE. In this age where land is scarce and expensive, and access to energy is an issue, an emerging technology, such as the installation of solar PV in non-conventional locations, will significantly contribute to the provision of clean and affordable energy in off-grid areas.

In Marinduque, the technology could be deployed by the use of lakes formed through abandoned open-pit mining. The installation of floating solar PV on lakes filled with mine tailings would be appropriate as it utilizes unusable areas, as well as helps eliminate the problem of land use competition. However, there is a need to ensure that the area is safe and the installation will not do further harm to the environment.

The durability of the floating solar PV and the ability to perform under high temperatures makes it more technically efficient than ground-mounted as it performs much better on cooler conditions. The surrounding water that host floating solar arrays act as a heat sink or natural cooling system resulting in much lower ambient temperatures for the floating solar PV system. The easy scalability of the system due to the even surface of the water basin can also help improve the efficiency of the system.

Figure 46. POTENTIAL FLOATING SOLAR PV FARM SITE AT CAPAYANG MAN-MADE LAKE

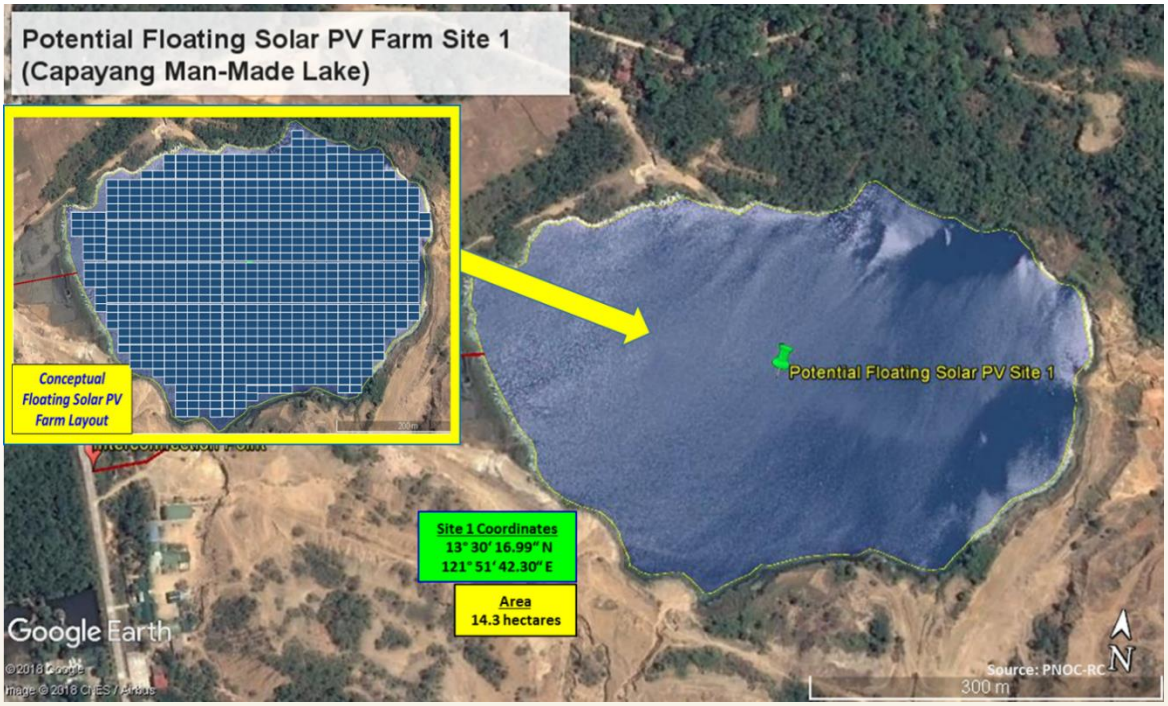
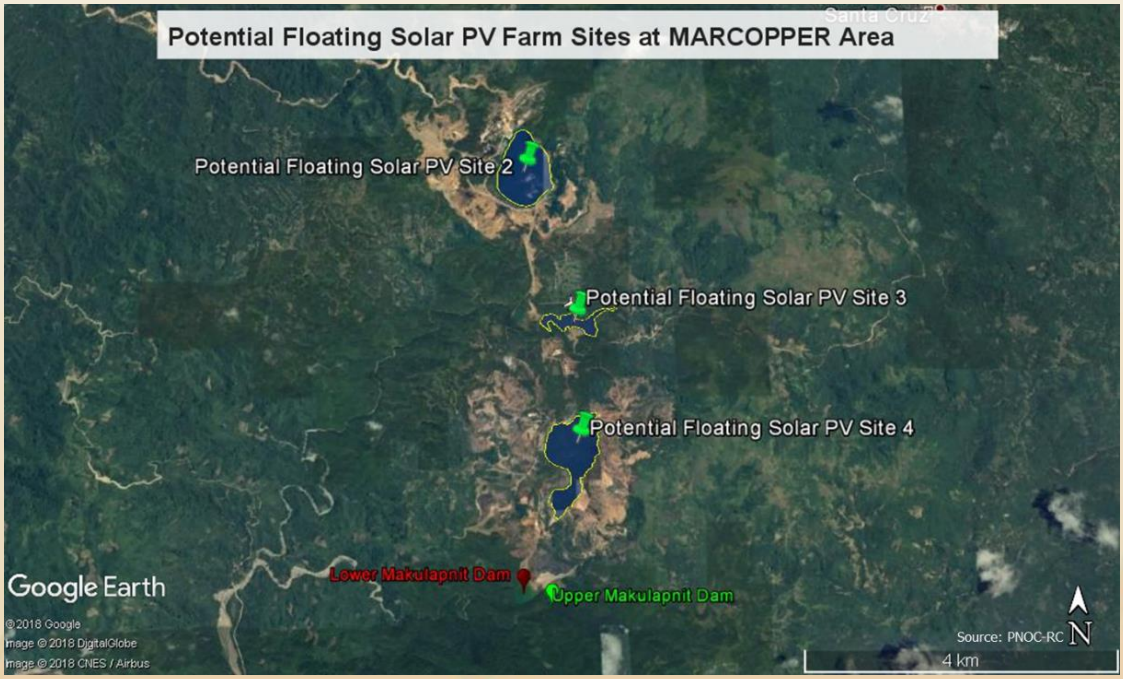


Figure 46 shows the conceptual floating solar PV farm layout of Capayang man-made lake found in Mogpog, Marinduque. From formerly an open-pit where copper and ore were extracted, the area has become an inland water body, much like a man-made lake. The lake, which is still left largely unused until now, has an available water surface area of 14 hectares that can accommodate about 5.0 to 10.0 MW floating solar PV farm. If this project is developed and implemented, the energy requirements of the province will properly be provided. The project also has the potential to improve the community and boost local tourism and economy.

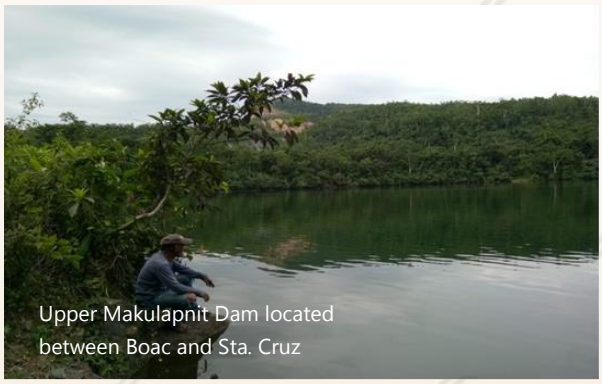
Figure 47. POTENTIAL FLOATING SOLAR PV FARM SITE AT MARCOPPER AREA



Another prospective area for floating solar PV is the MARCOPPER mining concession area, also declared as an abandoned mine site as shown in *Figure 47*. The former open-pit mining site has a total surface area of 114.6 hectares. If developed, the estimated capacity of 114.6 MW is more than enough to cover the province's energy needs. In which case, interconnecting Marinduque to the Luzon Grid through Quezon province may be considered to dispatch the excess energy.

Hydropower

Small run-of-river or low-head hydropower generation projects, which do not require reservoirs or dams across rivers, are being explored as local energy solutions. Such applications utilize rivers with a head of 20 meters or less to produce energy. Relying mainly in natural flows of rivers, these applications offer cheaper development cost and are seen to have less environmental impacts as compared with conventional turbines since they do not block the continuity of the flow.



Upper Makulapnit Dam located between Boac and Sta. Cruz

Source: PNOC-RC

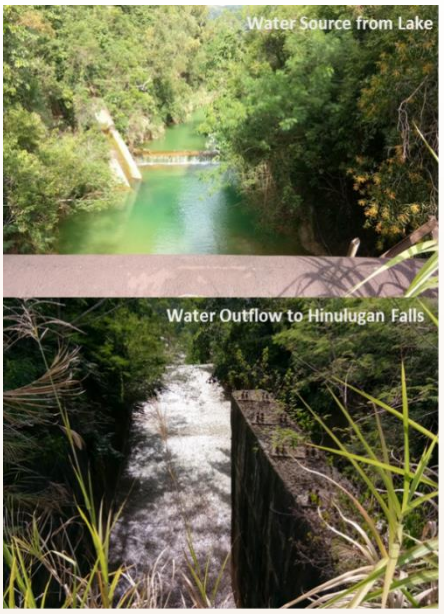
A reasonably swift transition to hydropower energy resource is feasible in the province since potentials can be explored in some areas, namely: The Upper Makulapnit Dam located between Boac and Sta. Cruz; Bol River Dam located near the Marcopper Airstrip; and, the Tumagabok Falls in Boac. Other low-head hydropower potential sites are those with an altitude of about 3 to 5 meters that can be explored within the irrigation system of the province.

With sustainable and reliable water supply, mini-hydro power plants could provide power on a continuous basis which can replace the diesel generating power plants and is therefore ideal for baseload power plant. Project development usually takes three to five (5) years as it involves longer data gathering and resource assessment aside from the civil/ structural requirements.

The 20-meter high Tumagabok Falls can be accessed via the Tumagabok-Sibuyao Road where the interior roads of Boac and Torrijos meet. This potential mini-hydro power is scheduled for site reconnaissance by the PNOC-RC.

Tumagabok Falls

The Hinulugan Falls in Boac, located between Barangay Sabong and Sitio Kitay is another prospective site for hydropower project.



In 2012, Japan International Cooperation Agency (JICA), in partnership with the DOE, published a study titled *"The Study Project on Resource Inventory on Hydropower Potential in the Philippines"* identfying the promising hydopower potential sites in the country. For Marinduque, the hydropower potential sites as indicated in the study is listed in *Table 39.* If these untapped hydro sites are all proven to be technically and economically viable, the full potential of hydro power would be 15.0 MW. This could supply the majority of the total electricty demand of the province, accelerating its energy transition to move away from fossil and further increasing the share of renewables to generation mix.

Table 39. POTENTIAL MINI-HYDRO SITES IN MARINDUQUE

Project Name	Max Output (MW)	Power Generation Type	Municipality	Barangay
Boac No.1	3.2	Run of River	Boac	Sabong
Boac No.2	6.6	Reservoir	Boac	Boi
Makulapnit	0.9	Run of River	Boac	Hinapulan
Dawis	0.34	Run of River	Boac	Duyay
Libtangin	0.53	Run of River	Gasan	Tabionan
Catangon	0.68	Run of River	Gasan	Tabionan
Sabang	0.55	Run of River	Buenavista	Malbog
Jolo	0.86	Run of River	Santa Cruz	Devilla
Tawiran	0.77	Run of River	Santa Cruz	Pulong-Parang
Cabuyo	0.6	Run of River	Torrijos	Payanas
Total	15.03			

Wind

Marinduque also has a potential for wind energy development. Characterized as being mountainous or near the seashore, a full wind resource assessment should be conducted to assess

the economic viability of wind power projects. *Figures 48* and *49* show the moderate to high wind potential resources in the areas of Buenavista and Torrijos.

Based on one of the studies conducted by the Marinduque State College in 2016, there are two prospective sites for wind power development: Pulang Lupa in Torrijos with an average data wind speed of 5.2 meter per second (m/s) and wind power density of 77W/m^2; and Daykitin in Buenavista with an average data wind speed of 5.1 m/s and wind powerdensity of 75 w/m^2. From the wind speed and wind power density, these potential sites fall under Class 1[30] of the NREL wind classification, making them suitable for rural application.

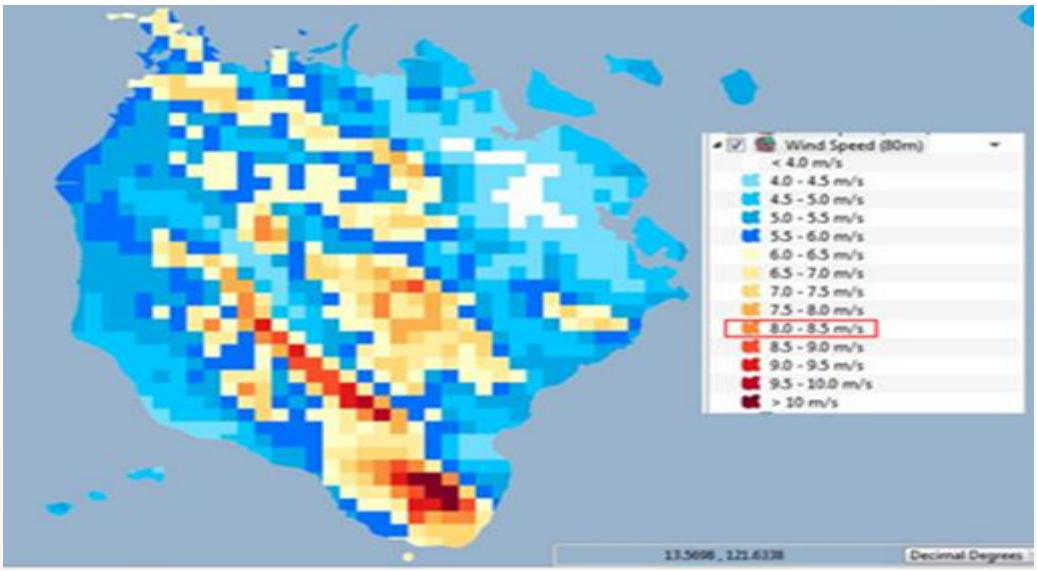
Figure 48. POTENTIAL WIND FARM SITE 1

Figure 49. POTENTIAL WIND FARM SITES 2 AND 3

With reference to the wind resource map extracted from NREL's GeoSpatial Toolkit Software *(Figure 50)*, the minimum average wind speed for wind power project is 8.0 m/s.

[30] Wind Power Class 1 represents Wind Power Density ranging between 0 to 200 W/m^2 and Wind Speed ranging between 0 to 5.6 m/s.

Figure 50. WIND RESOURCE MAP OF MARINDUQUE



Geothermal

The development of geothermal energy is expected to contribute significantly to the attainment of the government's target of doubling the current installed capacity of renewables. Notwithstanding the fact that geothermal energy has the longest and more expensive development among renewable technologies, the country's geologic setting has made it one of the world's largest producers of geothermal energy.

Marinduque possesses a notable concentration of geothermal energy, which can be tapped for power generation. The identified potential site in the province as shown in *Figure 51* is the Mt. Malindig, situated in the municipalities of Buenavista and Torrijos.

Figure 51. MT. MALINDIG

Mt. Malindig (formerly Mt. Marlanga) is known to be a potential active volcano near the solfataric[31] springs of Barangay Malbog. Solfataric springs observed on the periphery of the volcano indicate the presence of a possible fumarole field and hot magma intrusion at shallow depths that are good markers for a potential geothermal resource.

If Mt. Malindig is proved to be viable for power generation, it is expected to provide the baseload capacity displacing the diesel power plants supplying the province. Part of the exploration process is the assessment of the low-enthalpy geothermal potential that requires shallow wells for geothermal extraction to lessen the cost of development.

Based on the DOE records as of December 2017, a private firm signified its interest to apply for a Geothermal Energy Service Contract (GESC) to conduct the necessary geological and geophysical studies to determine the geothermal resource potential of Mt. Malindig. The application, found to be pending for a long period of time, has already been denied due to proponent's non-compliance with the documentary and technical mandatory requirements for the issuance of a service contract.

C. DOWNSTREAM OIL INDUSTRY

The downstream energy sector encompasses major activities, such as actual processing, selling, and distribution of petroleum products. Improving efficiency in this industry results in a more reliable supply of petroleum products in the market and the availability of storage facilities and depots. This sector offers several products such as gasoline, diesel, LPG, kerosene and other petroleum products that consumers use in everyday life. In fact, this is the energy sector that is closest to the energy consumers.

As a result, the DOE continues to strengthen its capacity to promote fair trade practices in a market-driven competitive environment and its monitoring activities to ensure that consumers are protected against illegal business practices.

DEVELOPMENT CHALLENGES

There are several challenges affecting the downstream oil industry. For Marinduque in particular, the following are the noted issues that need to be addressed within the planning period:

- Need for Additional Oil Depots. Having a lone oil depot is not sufficient to service the petroleum requirements of Marinduque. As a result, oil consumers in the province would need to depend on other nearby provinces for additional supply of petroleum products. This would entail additional add-on transport cost resulting in higher fuel prices.

- One of the major challenges in the downstream industry in the province is the violation of the DC on *"Promulgating a Revised Rules and Regulations Governing the Business of Retailing Liquid Fuels."* There were cases of under delivery, operation without Certificate

[31] The word solfataric relates to a volcanic vent emitting only sulphurous gases and water vapour or sometimes hot mud. (Source: https://educalingo.com/en/dic-en/solfataric)

of Compliance (COC)[32] and the absence of appropriate test measure[33] among the industry players. Cases were also reported on the failure to meet the quality standards specified by the Philippine National Standards (PNS) from among the product samples collected and endorsed to the DOE's Geo-scientific Research Testing Laboratory for quality testing.

With the deregulation of the downstream oil industry in place, the government allows market competition. However, there is still much room for additional investments in the different business aspects of the industry like in storage, marketing and infrastructure development.

PLANS AND PROGRAMS

In compliance with its mandate, the DOE ensures that the policies, plans, programs and regulations with respect to the importation, exportation, stockpiling, storage, shipping transportation, refining, processing, marketing and distribution of petroleum crude oils, products and by products are properly and strictly implemented.

The Philippine downstream oil industry has been deregulated since 1988 as provided for under RA 8479. Said law seeks to promote fair prices, adequate supply of clean and high quality petroleum products. It also promotes a free market atmosphere, encouraging more investors/players in the downstream sector.

Under the law, the DOE is mandated to work on the following:

- Monitor and publish daily international crude oil prices and the movement of domestic oil prices (create link to Oil Monitor);
- Monitor the quality of petroleum products and compliance with the national standards;
- Monitor refining and manufacturing processes of local petroleum products to ensure clean and safe technologies are applied; and,
- Maintain a periodic schedule of present and future total industry inventory of petroleum products to determine level of supply.

To implement the abovementioned efforts, several ongoing activities are being implemented by the DOE.

Oil Supply Security

To ensure that sufficient investments are in place for the downstream oil industry, the DOE promotes the participation of more players in the sector to have the stable supply of petroleum products in the country. Although Marinduque has a good number of retail outlets, there is a need to expand the bulk supply facilities (e.g. oil depots) that will secure its petroleum inventory levels. Likewise, logistical infrastructure support such as wharf/pier improvements, improved roads and bridges will also contribute to the accessibility of petroleum for all energy consumers.

[32] The DOE issues the COC upon completion of documentary requirements and payment of required fees. An oil player or retailer is considered engaging in illegal trading if it operates without COC.
[33] Test measure refers to a calibration bucket that is used to measure the quantity of Liquid Fuels.

Oil Price Monitoring

The DOE closely monitors the prices of petroleum products as part of its commitment to protect the interest of the consumers. Daily oil price and weekly oil price situationer reports are prepared to monitor movements in oil prices. The domestic oil industry uses the Mean of Platts Singapore (MOPS) as the benchmark for prices of oil products. MOPS is the daily average of all trading transactions of diesel and gasoline as assessed and summarized by Standard and Poor's Platts.

Moreover, the DOE is proposing a new policy calling for the unbundling of the base prices of gasoline, automotive and industrial diesel, kerosene, jet fuel, bunker fuel oil, and household and automotive liquefied petroleum gas (LPG). The proposed policy also mandates oil companies to inform the government of their price adjustments weekly and provide computations of products' components based on items affected by global price movements, the cost of biofuels, and capital/operational cost recovery. Such is intended to help energy consumers make informed decisions and assist in managing their energy requirements.

Gasoline Station Lending and Financial Assistance Program (GSLFAP)

Established under Section 10 of RA 8479, the DOE implements the GSLFAP, which is designed to provide credit assistance to new industry participants in the retail sector. Interested participants will undergo and complete a series of management and skills development training in retail marketing of petroleum products. The training covers the areas specific to the establishment, operation, improvement, management and maintenance of gasoline retail stations.

Under DC 2011-03-0005, the loan program includes the establishment/construction of new gasoline stations and auto-LPG stations, as well as the improvement and maintenance of existing gasoline stations.

Standards Formulation

To build a culture of safety, and at the same time protection of the environment, the DOE gives high priority in the development of the Philippine National Standards (PNS) for petroleum products. RA 8479 advocates for the use of clean and safe technologies, while the Clean Air Act of 1999 sets the specifications for all types of fuel and fuel-related products. On the other hand, the Biofuels Act of 2006 establishes the technical fuel quality standards for biofuels and biofuel-blended gasoline and diesel which comply with the PNS.

The DOE chairs the Technical Committee on Petroleum Facilities and Processes (TCPPF) which oversees the appropriate quality, safety and environmental standards for downstream facilities and processes. Following are the PNS to be implemented by the DOE:

- Fuel Quality Standards

    1. E-Gasoline Specification (E10) – DPNS/DOE QS 008:2017
    2. PNS for Residual Marine Fuels Specification – ONS/DOE QS 014:2018
    3. PNS for Industrial Fuel Oils Specification – PNS/DOE 006:2018
    4. PNS for Kerosene (ongoing)

5. PNS for Emulsified Fuel (ongoing)

- Facilities Standards

1. Code of Safety Practices for Liquid Petroleum Product in Retail Outlet
2. Handbook on Code of Safety Practices in LPG Refilling Plant
3. LPG Refilling Plant
4. Code of Safety Practices in Liquid Petroleum Products Depot
5. Formulation of Training Module for Middle Level Manpower in the Downstream Oil Industry

It should also be noted that the DOE has developed its Roadmap on Standards Development for implementation for the planning period 2018-2040.

Monitoring and Enforcement for Safety and Consumer Protection

The DOE implements inspection and compliance monitoring activities on the downstream oil industry establishments located nationwide. This activity covers monitoring of dispensing pump of gasoline stations, and the quantity of LPG sold at local retailers. Meanwhile, the DOE's monitoring partners (Department of Trade and Industry (DTI), Bureau of Fire Protection (BFP), LGU, Philippine National Police (PNP)) focus on compliance to prescribed industry regulations and local ordinances.

The DOE's main objective is to promote safety and consumer protection to ensure that retailers are abiding by the standards on selling liquid petroleum products, promote trade practices, and strengthen coordination with various government agencies that are responsible in implementing regulations in this sector.

Likewise, IEC activities, such as the E-Power Mo! Campaign, are part of the DOE's Communication Plan to help promote awareness and empower consumers in the downstream oil industry and the other sectors of the energy industry.

CHAPTER VI:
INVESTMENT PORTFOLIO

Marinduque's local economy is expected to gain steam in the next decades driven by growing tourism and accelerated economic activities in agriculture, industry, and service sectors. This anticipated economic growth translates into a significant increase in energy demand with substantial requirements for new investments in the energy sector.

The need to meet the necessary investment requirements and the ability to attract sufficient investment capital should be of greater interest to ensure energy remains steadily available to fuel economic growth. As the main government body responsible for the energy sector, the Department of Energy (DOE) has embarked on introducing and promoting policy reforms to encourage both domestic and foreign investments in energy development of the country.

This chapter evaluates the magnitude of future investment requirement for much needed energy infrastructures in Marinduque covering the energy sub-sectors of downstream oil and power. The investment outlook specifies the estimated financing needs in constructing energy facilities such as oil storage, power transmission and distribution system upgrades, and power plant capacity additions based on the assumptions, data, and results of the demand-supply outlook simulations.

The estimates for the needed capital requirements are calculated in a per unit price of an energy facility or infrastructure capacity using the prevailing international prices expressed in million U.S. dollars (USD) at 2017 prices. It excludes projects that are currently on various stages of implementation; that is, funding is already granted and/or contracts have been signed.

OVERALL INVESTMENT REQUIREMENT

The overall investment requirement represents the possible capital spending of Marinduque to further develop its energy sector covering the downstream oil and power sub-sectors. The varying level of the total required capital investment is due to different power supply options considered – Reference, Alternative, and Geothermal.

To meet rising energy demand, investment in related infrastructures must be poured in across all sectors of the energy industry over the next two decades. For the downstream oil sector, it includes the additional capacity for oil depot/storage to address the projected increase in oil demand. On the other hand, the cost requirement in the power sector is slated to be invested in additional generating capacity, upgrading and expansion of transmission and distribution network.

The summary of the total estimated investment requirement per scenario is shown in *Table 40*. Bulk of the total energy capital requirement over the planning period is allocated for power sector infrastructures representing 93.9 percent, 95.5 percent, and 96.3 percent of total for the

Reference, Alternative, and Geothermal Scenarios, respectively. The remainder is shared out to the downstream sector for additional oil storage.

Table 40. TOTAL INVESTMENT REQUIREMENTS (USD Million)

Sector	Scenario		
	Reference	Alternative	Geothermal
Downstream	4.72	4.72	4.75
Power	73.19	99.02	121.60
Total	**77.90**	**103.73**	**126.32**

A. Downstream Oil Investments

The rapid growth of Marinduque's oil demand based on projection calls the need for constant efforts in developing new oil storage facilities to ensure oil supply security. Being utilized heavily in transportation, oil is expected to remain as the dominant fuel used in the province.

The demand for petroleum products is projected to reach 819 thousand barrels (MB) by 2040 driven by the rising demand in gasoline, diesel, and liquefied petroleum gas (LPG). This foreseen increase in demand requires to scale up the existing oil storage capacity to 65 MB in 2035 to support oil demand up to 2040. Assuming that oil storage utilization rate is at 80.0 percent of total storage capacity, the required storage capacity stands at 81 MB.

Table 41. DOWNSTREAM OIL CUMULATIVE INVESTMENT REQUIREMENT

	2020	2025	2030	2035	2040
Oil Demand, MB	384	483	596	701	819
Storage Requirement, MB	33	43	53	65	65
Storage Requirement @ 80% Capacity Utilization Factor, MB	42	54	67	81	81
Total Investment Cost, USD Million	2.36	3.11	3.86	4.72	4.72

Note: Investment Cost Estimate = USD 60/ barrel capacity

For the planning period, the total capital investment needed to develop the required oil storage amounts to USD 4.72 million, as seen in *Table 41*. Necessary investments must be highly promoted to sustain the inventory level of 30 days for diesel, gasoline, and biofuels and the 15 days for LPG, as assumed in the plan. As explained in Chapter III, though the province is near the Port of Lucena, additional oil storage facilities is seen as a precautionary measure to address possible supply disruption in the future.

B. Power Sector Investments

The restructuring of the country's power sector has opened up opportunities for private sector participation since the government shifted the responsibility of financing power projects to private investors. In a bid to meet the expanding electricity demand of the province, generating significant investments is required to build new capacities, rehabilitate and strengthen existing power assets, and to diversify the generation by infusing renewables in the supply mix.

Table 42 shows the power sector investments comprised of plant capacity additions, transmission development, and distribution-related projects. For all scenarios, the large portion

of investment requirement is projected to be taken up by power plant capacity additions accounting for more than 80.0 percent of the total power sector investments.

Table 42. POWER SECTOR'S TOTAL INVESTMENT REQUIREMENT (in Million USD)

Power Sector	Scenario		
	Reference	Alternative	Geothermal
Capacity Additions	59.34	85.17	107.76
Distribution	5.24	5.24	5.24
Transmission	8.61	8.61	8.61
Total	**73.19**	**99.02**	**121.60**

Note: Distribution only includes projects for implementation up to 2021 (Source: DDP)

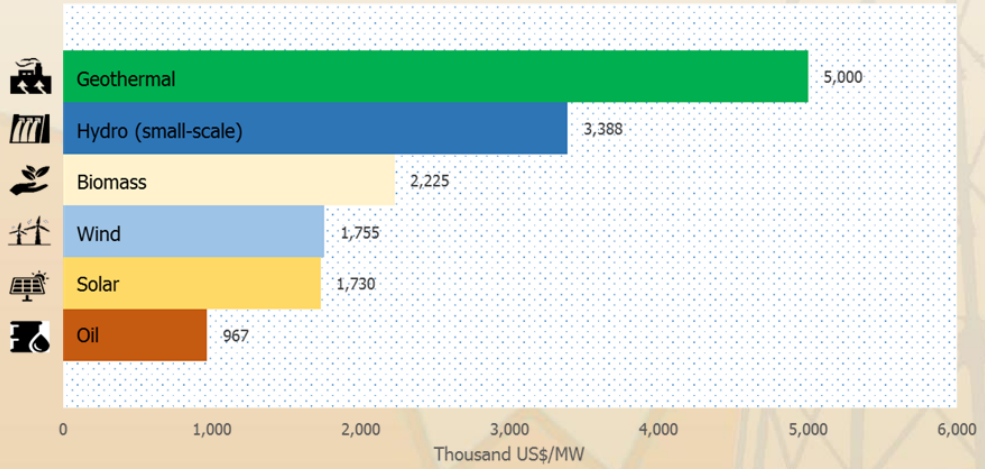
Among scenarios, investment under *Geothermal Scenario* is expected to be the most expensive option with total capital investment reaching USD 121.60 million – 22.0 percent and 66.0 higher than *Alternative and Reference Scenarios*, respectively. The overwhelming increase in the investment cost is attributed to high upfront cost in building geothermal power plant.

1. Power Plant Capacity Additions

The capacity additions for the planning period are based on the results of the demand and supply simulations for Marinduque to augment existing capacities and ensure adequate and reliable electricity supply for the province. The new capacities are needed to cover the projected peak demand and the assumed 10.0 percent reserve requirement.

Figure 52 shows the 2017 capital cost of power plants per technology (USD/kW), excluding annual fixed and variable costs. The references used in investment estimation are the World Economic Outlook (WEO) 2016 by the IEA[34] for biomass, hydropower, solar photovoltaic (PV) and wind technologies; b) the Institute for Sustainable Futures (ISF) for oil-based power plant; and c) the Kalinga Geothermal Power Project for geothermal resource based on local setting.

Figure 52. POWER PLANT COST PER TECHNOLOGY, 2017 PRICE (USD/MW)



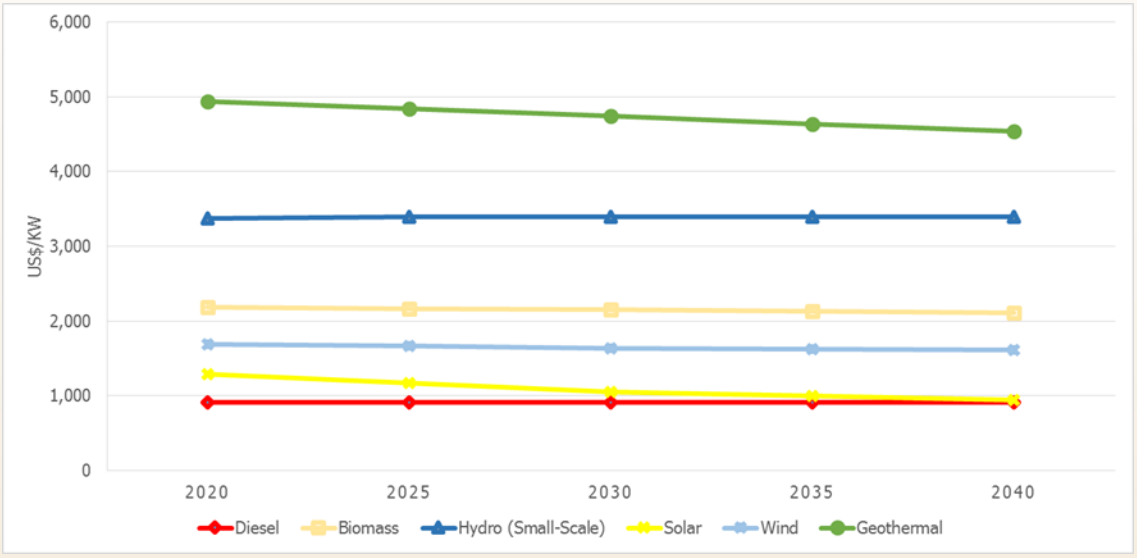
At USD 5,000/kW, geothermal is the most expensive technology in terms of capital cost, while oil-based at USD 967/kW is the least expensive. The cost estimates for the other renewable

[34] IEA projection on capital cost of power plants per technology until 2040.

technologies are USD 3,388/kW for hydro (small-scale); USD 2,225/kW for biomass; USD 1,755/kW for wind; and USD 1,730/kW for solar PV system.

The projected power plant cost per technology for the period 2020 to 2040 is presented in *Figure 53*. From 2020 onwards to 2040, renewables (biomass, solar, wind and geothermal) exhibit declining capital costs primarily because of technology innovations and improved manufacturing and equipment performance. On the other hand, hydro (smalls-scale) is seen to slightly increase towards 2040. Oil-based plant is also expected to have a declining capital cost. *Please see Annex 21 for capital cost of power plant per technology.*

Figure 53. POWER PLANT COST PER TECHNOLOGY (USD/KW), 2020 - 2040



The total investment requirement for capacity additions only reflects the new power plant to be installed starting 2022, the target operation year of the new power provider (NPP). Among all scenarios, the *Geothermal Scenario* yields the highest investment requirement due to high share of renewables.

Reference Scenario. In the *Reference Scenario*, the total investment for new power plant capacities stands at USD 59.34 million within the planning period *(Table 43).* Oil-based capacity additions take more than half (52.7 percent) of total amounting to USD 31.29 million, and the remaining for solar capacity additions equivalent to USD 28.05 million.

Table 43. CAPACITY ADDITION CUMULATIVE INVESTMENT (MILLION USD), Reference Scenario

	2020	2025	2030	2035	2040
Diesel	-	16.33	21.31	25.85	31.29
Solar	-	10.79	17.17	22.27	28.05
Total	**-**	**27.12**	**38.48**	**48.12**	**59.34**

Alternative Scenario. The minimal shift of investment away from diesel power plants and toward more renewables entails a total investment of USD 85.17 million for new capacity additions *(Table 44).* This scenario requires higher investment, up by 43.5 percent translating to additional USD 25.83 million of investment from the *Reference Scenario*.

Among the technology options, solar has the highest share to total investment. As it can be readily set up in areas without any renewables, capacity addition from solar comprises more than half of the total investments or 55.5 percent (USD 47.24 Million). Oil-based plants followed next with 34.1 percent of total equivalent to (USD 29.02 Million). Other renewables – hydro, wind, and biomass – constitute minimal shares of 6.0 percent (USD 5.10 Million), 1.9 percent (USD 1.66 Million) and 2.5 percent (USD 2.15 Million), respectively.

The investment requirement also relates to capacity factor of renewable energy technologies considered in the simulation. To meet the target share of renewables in the generation mix, low capacity factor of variable renewable energy (VRE), particularly solar and wind, require higher installed capacities, which equate to higher investment cost.

Table 44. CAPACITY ADDITION CUMULATIVE INVESTMENT (Million USD), Alternative Scenario

	2020	2025	2030	2035	2040
Diesel	-	15.87	19.50	23.58	29.02
Solar	-	32.19	36.88	41.46	47.24
Hydro	-	3.40	5.10	5.10	5.10
Biomass	-	-	2.15	2.15	2.15
Wind	-	0.84	1.66	1.66	1.66
Total	**-**	**52.30**	**65.29**	**73.95**	**85.17**

Geothermal Scenario. While this scenario shows the largest percentage of installed capacities coming from renewables, it has also the highest capital investment requirement for capacity additions. As seen in *Table 45*, the total investment amounts to USD 107.76 million representing an increase of 81.6 percent and 26.5 percent relative to the *Reference and Alternative Scenarios*, respectively. This is primarily due to the high upfront cost of developing small-scale geothermal power plant, which accounts for about 45.0 percent of the total investment.

Table 45. CAPACITY ADDITION CUMULATIVE INVESTMENT (Million USD), Geothermal Scenario

	2020	2025	2030	2035	2040
Diesel	-	15.87	19.50	19.50	19.95
Solar	-	22.79	25.58	28.66	31.51
Hydro	-	3.40	5.10	5.10	5.10
Biomass	-	-	2.15	2.15	2.15
Wind	-	0.84	1.66	1.66	1.66
Geothermal	-	-	47.39	47.39	47.39
Total	**-**	**42.90**	**101.38**	**104.46**	**107.76**

Generally, the results of all the supply scenarios indicate that the transition towards clean energy through the promotion of renewable energy accounts for a substantial share of investments in the power sector, and that diverse fuel mix in power generation significantly incurs different investment needs.

2. Transmission Development Projects

The allocation of investment for transmission development, which amounts to PhP 447.70 million[35] (USD 8.61 million), only pertains to the proposed Mogpog-Buenavista 69 kV Transmission Line, a 42-circuit kilometer transmission project scheduled to be implemented in

[35] Initial Cost Estimate of NPC-SPUG

2022. The investment projection did not take into consideration the transmission projects that are already on various stage of implementation, such as the Boac-Torrijos 69 KV Transmission Line Rehabilitation and the 20-MVA Mogpog Substation of National Power Corporation-Small Power Utilities Group (NPC-SPUG). On the other hand, the proposed interconnection of Marinduque to General Luna, Quezon as contained in the TDP still needs further assessment to determine the total project cost for engineering, procurement, and construction.

3. Distribution Development Projects

For the benefit of the customers, increasing network efficiency and improving the performance of distribution services also necessitate large amounts of new investments to achieve long-time reliability. MARELCO's distribution-related projects are identified in its DDP and part of Capital Expenditure (CAPEX) program.

Table 46 enumerates on an annual basis the needed investments in Marinduque for distribution development projects planned to be implemented in the next three years. These projects translate into an estimated investment requirement of PhP 272.2 million (USD 4.2 million) wherein almost 75.0 percent of cost is needed for distribution projects planned for 2019.

Table 46. INVESTMENTS IN DISTRIBUTION DEVELOPMENT PROJECTS (in Million PhP)

Project Category	Total Project Cost	2019	2020	2021
Distribution (Rehabilitation/Upgrading)	*16.5*	*14.6*	*1.0*	*0.9*
Substation (Additional)	*27.0*	*27.0*	-	-
Other Network Assets	*73.7*	*25.5*	*25.1*	*23.1*
Network Projects	**117.2**	**67.2**	**26.1**	**24.0**
Non-Network (Property/Equipment/Others)	**56.9**	**36.0**	**15.7**	**5.1**
Sub-Total	**174.1**	**103.2**	**41.8**	**29.1**
Mongpong-Maniwaya Interconnection	**98.1**	**98.1**	**0.0**	**0.0**
Total	**272.2**	**201.3**	**41.8**	**29.1**

The network projects identified by MARELCO total PhP 117.2 million (USD 2.3 million) while non-network projects amount to PhP 56.9 million (USD 1.1 million). The network projects consist of line upgrading and rehabilitations, additional substation and feeders, and replacement of some distribution system components to maintain an adequate, safe, and efficient distribution network. On the other hand, non-network projects range from acquisition of property, equipment, safety gadgets, software, vehicles and others that assist MARELCO in its operations and delivery of services.

With the island barangays of Polo and Maniwaya already interconnected to the Marinduque main grid, another major development that is envisioned to come next is the interconnection of the island barangay of Mongpong via submarine cable through the Maniwaya grid. Mongpong is the only remaining island-barangay that is not connected to the main distribution system of MARELCO. The project has an estimated cost of PhP 98.1 million (USD 1.89 million), more than one-third of the total investment required for distribution projects.

CHAPTER VII:
RECOMMENDATIONS

Compared to large provinces connected to the main transmission grid, development strategies for small island provinces would have to consider their distinctive geographic location (remoteness/isolation), economic characteristics (poverty incidence, population growth), environment (available natural resources), and even vulnerability to natural disasters. In view of this, local and national policymakers need to pursue development priorities that would serve as the backbone for economic growth of these island provinces. One basic priority is sustainable energy development.

Based on the assessment of this plan, as well as the energy/power outlook and identified development challenges in the province, following are the policy recommendations for the local government of Marinduque to stimulate economic growth through energy sustainability and resiliency:

- **Creation of an Energy Development Advisory Group**

The Marinduque Energy Development Advisory Group will provide the necessary management guidance and control in the planning formulation and implementation of energy projects and initiatives identified in this plan. The Advisory Group is recommended to have multi-sectoral representation of experts in all economic sectors to ensure that initiatives and concerns of all the sectors are heard and considered in the planning phase, thus getting their full support in the plan implementation.

The Advisory Group will provide oversight functions to make sure that the plan is a living document that is continuously updated and progress is properly tracked.

- **Harmonize and Update Development Plans**

The formulation of a localized development plan for Marinduque will aid the province better map out its socio-economic endeavors to create more opportunities for employment and investment generation, thereby creating a more enabling environment for growth. Municipal/provincial/regional development plans must involve partnership, consultations and cooperation between the government and the private sectors during the plan formulation and implementation, and monitoring phases of the planning cycle. Said plans should highlight local government's priority targets/outputs, specific timelines of completion, responsible agencies/offices, as well as required resources. These are important references and firm bases for the energy industry players with respect to the economic targets and future energy demand of the province.

Accordingly, the electric cooperatives (ECs) are urged to coordinate with concerned agencies and the local government in order to incorporate into its Distribution Development Plan (DDP) all the related development plans and programs in the province.

- **Enable a Business-friendly Environment**

With the Ease of Doing Business and Efficient Government Service Delivery Act of 2018 (RA 11032) now in place, government sees an end to the perennial problem of bureaucratic red tape in government institutions. The law is expected to enhance the country's business competitiveness and good governance. For island provinces like Marinduque, the law is a welcome development as it promotes the timely implementation of critical energy projects that will help create small to medium enterprises, attract investments, create more job opportunities and subsequently redound to the province's overall competitiveness.

Likewise, the law creates an environment to enable businesses and investments to thrive. Marinduque may consider the development of an investment promotion campaign concept (e.g. "Invest in Marinduque") to attract investors, particularly on renewable energy projects that are feasible for implementation.

- **Boost Private Sector Participation in the Electric Power Industry**

The private sector leads a vital role in a country's economic development. Cooperative efforts between the private sector and local/national government are often used to ensure the successful delivery of basic services to the community, such as electricity service.

Specific to the electric power industry, the government has institutionalized private sector participation in rural and missionary areas through its New Power Provider (NPP) Program and Qualified Third Party Program (QTP). In this connection, MARELCO must pursue the conduct of the Competitive Selection Process (CSP) to seek for a new power provider that will take over the generation function of NPC-SPUG to ensure reliable and efficient supply of power for the province.

The recent signing of the Energy Virtual One-Stop Shop (EVOSS) law by President Rodrigo Duterte streamlines the permitting process of power generation, transmission and distribution of power projects. The law is envisioned to attract more investments—foreign or local—in the power sector regardless of technology with the elimination of red tape, which is affecting the cost and ease of doing business in the country. This is complemented by the Executive Order (EO) 30 creating the Energy Investment Coordinating Council (EICC), which is tasked to streamline the procedure for the issuances of permits/licenses/certificates, including certifying energy projects as *"Energy Project of National Significance (EPNS)."*

- **Achieve 100% Household Electrification**

The Department of Energy (DOE) is aggressively pursuing greater access to electricity for the unserved/under-served areas of the country by 2022 to promote inclusive growth for all. Currently, having a household electrification level of 90.4 percent, Marinduque needs to develop strategies to sustain efforts in line with the electrification targets possibly through the use of

micro-grid and/or distributed generation. Aligned efforts of the DOE, the National Electrification Administration (NEA), the National Power Corporation-Small Power Utilities Group (NPC-SPUG), distribution utilities (DUs)/ECs are strengthened to ensure that the country's total electrification target is met on time. This will help alleviate poverty in the province and make way for improved living standards.

- **Promote Mainstreaming of Energy Efficiency and Conservation at LGU Level**

The DOE recognizes the critical role of the local governments to help maintain energy security of the country through efficient use and conservation of energy in their respective offices and daily operations, as well as jurisdictions. In line with the provision of RA 112851 (Energy Efficiency and Conservation Act of 2019), the local government of Marinduque shall establish its own Energy Efficiency and Conservation Office (EECO) with the main mandate of developing and implementing Local Energy Efficiency and Conservation Plan (LEECP). In addition to being cost effective, energy efficiency measures can effectively reduce greenhouse gas emission (GHG)/carbon footprint, thereby promoting a sustainable tourism industry for the province.

- **Introduction of Energy Efficient Automotive Technology**

Efficient automotive technologies are considered the future of the transportation system. Electric and electric-hybrid vehicles enable the use of clean and high-efficienct technologies benefiting the local economy through increased energy security, reduction in energy imports and GHG emissions.

The plan highlights the E-Trike Project of the DOE, which promotes energy efficient and clean energy in the transport sector. It aims to reduce the sector's annual petroleum consumption by 2.8 percent (based on 20 million barrels annual consumption in 2010) and to avoid CO2 emission of estimated 259,008 tons annually by shifting to 100,000 electric tricycles (e-trikes). Part of the project's implementation is the deployment of e-trikes among targeted beneficiaries (LGUs/transport groups). In support of this endeavor, Marinduque may consider the issuance of a Provincial Council resolution promoting the use of e-trikes among transport operators/associations, as well as resort operators in the province. The local government may also consider the development of financing mechanisms to support prospective users of e-vehicles.

- **Diversify Energy Resources**

Energy diversification is the use of all available forms of energy resources and technologies to reduce dependence on a single resource. Having various sources of energy would protect the province from energy supply disruptions, and provide an environment for innovation, research and development.

The DOE encourages the use of cleaner fuels and the entry of modern technologies as alternative options for conventional energy technologies. It also promotes the development of an optimal energy mix through a technology-neutral approach in energy planning. To achieve this, local government of Marinduque may consider a partnership with the private sector for the

identification of energy resources and technologies, as well as the formulation of the ideal energy mix that is feasible for the province.

- **Spur the Development and Entry of Renewable Energy**

Blessed with potential renewable energy resources/sites (solar, hydro, wind, and geothermal), Marinduque should ensure the full utilization of these clean forms of energy. As a number of important policy initiatives have been put in place to scale up renewable energy systems deployment in the country, it shall help stimulate investor interest in conducting more detailed exploration studies and developing the potential sites of the province as identified in the plan.

To date, the DOE has set forth critical policy issuances, such as the Department Circular (DC) No. 2018-08-0024 "Promulgating the Rules and Guidelines Governing the Establishment of the Renewable Portfolio Standards (RPS) for Off-Grid Areas." Hence, accelerated exploration and development of renewable energy resources in the province is deemed necessary to meet the minimum RE share requirements specified in the RPS Rules.

Likewise, the use of renewable energy is one of the mitigation efforts of the country in addressing the negative impact of climate change, as well as help the nation achieve its nationally determined contribution (NDC) to attain the climate goals of the Paris Agreement.

- **Pursue Island Inter/Intra-connection**

As Marinduque remains isolated from the main grid, identifying corridors for power connectivity by pursuing grid interconnection or intra-connection among off-grid areas may be pursued to increase reliability and adequacy of power supply. Correspondingly, implementation of such kind of project could significantly contribute in reducing the burden of high power rates in off-grid areas and provide the basis for the graduation from subsidy through the Universal Charge on Missionary Electrification (UCME) as specified under Rule 13 of the Implementing Rules and Regulations Rule (IRR) of the Electric Power Industry Reform Act.

Considered as one of the potential transmission options to interconnect the island province to the main grid, the proposed interconnection of Marinduque to General Luna, Quezon must continuously be explored and assessed as part of the development planning. This interconnection project must be supported by a full feasibility study to determine its financial and technical viability and to quantify the overall benefits of the project to the province. Likewise, the ongoing interconnections of island barangays to Marinduque mainland must also be taken into account in determining the least-cost possible route of interconnection given that these island barangays could possibly serve as interconnection points at the Marinduque side.

- **Establishment of an Energy Database System**

Energy policies are based on the results of energy modelling programs built on the basis of a reliable and updated energy database. Given the critical role of data for decision makers, updated energy data should then be readily available for researchers, policymakers and the general public.

In view of this, the local government of Marinduque is encouraged to develop its own Community-based Monitoring System (CBMS) to include energy datasets/statistics that will support energy analysis and policymaking initiatives of the government. The CBMS can be lodged at the provincial development planning office for better updating and monitoring.

- **Institutionalize Technical Capability Building Programs**

Capacity building for the development of energy experts is a key factor in the successful implementation of energy programs or projects. Thus, capacity building programs should be a continuing strategic commitment of ECs, DUs, and other energy project developers, as well as the public sector to address gaps in knowledge and skills. Capacity building programs may target both technical and management capacities.

ANNEXES

ANNEX 1. MIMAROPA GROSS REGIONAL DOMESTIC PRODUCT LONG-TERM PROJECTION 2018-2040 (BILLION PESOS @ 2000 CONSTANT PRICES)

INDICATORS	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
GRDP	133.23	142.24	151.88	162.18	173.20	184.99	197.60	211.08	225.51	239.84	255.11	271.36	288.68	305.70	323.75	342.89	363.18	384.69	407.50	431.70	457.35	484.56	513.43	544.04
Agriculture	26.73	27.18	27.61	28.03	28.43	28.82	29.20	29.56	29.90	30.21	30.50	30.78	31.04	31.28	31.50	31.71	31.90	32.09	32.27	32.43	32.59	32.74	32.88	33.00
Industry	43.84	47.67	51.82	56.31	61.16	66.40	72.06	78.17	84.77	91.38	98.49	106.11	114.29	122.39	131.04	140.27	150.12	160.63	171.84	183.81	196.57	210.18	224.71	240.20
Services	62.66	67.39	72.45	77.85	83.61	89.77	96.34	103.36	110.84	118.25	126.12	134.48	143.34	152.03	161.21	170.91	181.15	191.97	203.39	215.45	228.19	241.64	255.84	270.83
HFCE	138.21	147.49	157.28	167.59	178.44	189.87	201.88	214.50	227.76	240.68	254.19	268.31	283.07	297.30	312.11	327.51	343.54	360.20	377.53	395.55	414.27	433.73	453.95	474.97
GFCE	17.93	19.07	20.27	21.52	22.83	24.21	25.65	27.16	28.74	30.27	31.87	33.53	35.26	36.92	38.65	40.43	42.28	44.20	46.19	48.25	50.38	52.59	54.88	57.25
CF	24.67	29.27	34.71	41.13	48.70	57.63	68.15	80.55	95.14	111.08	129.64	151.22	176.30	203.23	234.17	269.73	310.56	357.45	411.28	473.06	543.94	625.25	718.49	825.40

ANNEX 2. MIMAROPA POPULATION PROJECTION 2018-2040, BY PROVINCE (THOUSAND PERSONS)

PROVINCES	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Marinduque	242.59	246.79	251.06	255.40	259.64	263.95	268.33	272.78	277.31	281.52	285.79	290.13	294.53	299.00	303.06	307.17	311.33	315.56	319.84	323.69	327.59	331.54	335.53	339.58
Occ. Mindoro	506.62	516.81	527.20	537.79	547.29	556.95	566.78	576.78	586.96	595.92	605.01	614.24	623.62	633.13	641.41	649.79	658.28	666.88	675.60	683.01	690.50	698.07	705.73	713.47
Or. Mindoro	876.56	893.78	911.35	929.26	945.70	962.44	979.47	996.81	1014.45	1030.35	1046.50	1062.90	1079.56	1096.49	1111.66	1127.04	1142.64	1158.45	1174.48	1188.73	1203.15	1217.75	1232.53	1247.48
Romblon	303.49	309.07	314.75	320.53	326.18	331.92	337.77	343.72	349.77	355.40	361.13	366.95	372.86	378.87	384.39	389.99	395.67	401.44	407.29	412.61	418.01	423.47	429.01	434.62
Palawan	1149.78	1174.05	1198.83	1224.14	1247.02	1270.32	1294.06	1318.25	1342.88	1364.71	1386.89	1409.43	1432.34	1455.63	1475.78	1496.21	1516.93	1537.93	1559.22	1577.13	1595.24	1613.56	1632.09	1650.84
Total	**3,079.04**	**3,140.50**	**3,203.18**	**3,267.12**	**3,325.82**	**3,385.58**	**3,446.41**	**3,508.33**	**3,571.37**	**3,627.90**	**3,685.32**	**3,743.66**	**3,802.92**	**3,863.12**	**3,916.29**	**3,970.20**	**4,024.85**	**4,080.25**	**4,136.42**	**4,185.17**	**4,234.49**	**4,284.39**	**4,334.89**	**4,385.98**

ANNEX 3. MARINDUQUE TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, BY SECTOR (IN KTOE)

PROVINCES	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Industry	6.437	6.335	6.221	6.174	6.071	5.969	5.878	5.791	5.708	5.628	5.550	5.476	5.404	5.334	5.267	5.203	5.141	5.082	5.024	4.970	4.917	4.867	4.819	4.774
Commercial	5.267	5.314	5.301	5.376	5.379	5.386	5.412	5.442	5.475	5.511	5.551	5.593	5.638	5.686	5.737	5.791	5.846	5.904	5.965	6.027	6.091	6.157	6.224	6.293
Transportation	33.584	35.291	37.370	39.775	41.757	43.858	46.435	48.816	51.332	53.860	56.470	59.661	62.650	64.379	66.584	68.898	70.976	73.591	76.313	78.534	81.228	84.011	86.594	89.677
Residential	24.463	23.752	22.778	22.078	21.501	21.009	20.568	20.181	19.859	19.595	19.384	19.223	19.108	19.034	18.970	18.939	18.937	18.963	19.013	19.085	19.177	19.287	19.413	19.553
Agriculture	1.473	1.581	1.593	1.677	1.704	1.731	1.758	1.802	1.846	1.890	1.934	1.978	2.022	2.066	2.110	2.155	2.200	2.245	2.291	2.338	2.385	2.432	2.480	2.528
Total	**71.22**	**72.27**	**73.26**	**75.08**	**76.41**	**77.95**	**80.05**	**82.03**	**84.22**	**86.48**	**88.89**	**91.93**	**94.82**	**96.50**	**98.67**	**100.99**	**103.10**	**105.79**	**108.61**	**110.95**	**113.80**	**116.75**	**119.53**	**122.82**

ANNEX 4 . MARINDUQUE TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, BY PRODUCT (IN KTOE)

SECTOR	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Oil Products	39.996	41.681	43.765	45.547	47.511	49.589	52.119	54.465	56.941	59.429	61.995	65.114	68.040	69.774	71.960	74.248	76.310	78.881	81.551	83.745	86.388	89.111	91.640	94.640
Electricity	3.531	4.136	4.153	4.461	4.742	5.033	5.332	5.640	5.957	6.283	6.618	6.961	7.314	7.676	8.018	8.365	8.718	9.076	9.439	9.806	10.176	10.550	10.926	11.304
Biomass	26.325	25.007	23.799	22.682	21.649	20.694	19.812	18.995	18.236	17.532	16.875	16.264	15.692	15.158	14.658	14.190	13.751	13.338	12.951	12.587	12.245	11.923	11.621	11.336
Biofuels	1.371	1.449	1.546	2.391	2.510	2.637	2.788	2.933	3.086	3.240	3.401	3.591	3.776	3.892	4.033	4.182	4.323	4.490	4.666	4.815	4.989	5.170	5.344	5.544
Total	**71.22**	**72.27**	**73.26**	**75.08**	**76.41**	**77.95**	**80.05**	**82.03**	**84.22**	**86.48**	**88.89**	**91.93**	**94.82**	**96.50**	**98.67**	**100.99**	**103.10**	**105.79**	**108.61**	**110.95**	**113.80**	**116.75**	**119.53**	**122.82**

ANNEX 5. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, RESIDENTIAL SECTOR (IN KTOE), BY PRODUCT

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Kerosene	0.51	0.49	0.49	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.45	0.44	0.44	0.43	0.43	0.42	0.42	0.42	0.41	0.41	0.41	0.41	0.40	0.40
LPG	2.33	2.42	2.50	2.58	2.66	2.74	2.82	2.90	2.97	3.05	3.13	3.20	3.28	3.35	3.42	3.49	3.57	3.64	3.70	3.77	3.84	3.90	3.96	4.02
Biomass	19.39	18.21	17.13	16.14	15.23	14.40	13.63	12.93	12.28	11.69	11.14	10.63	10.16	9.73	9.33	8.95	8.60	8.28	7.98	7.70	7.44	7.20	6.97	6.76
Electricity	2.24	2.63	2.66	2.87	3.13	3.40	3.65	3.90	4.15	4.41	4.67	4.95	5.23	5.52	5.79	6.07	6.35	6.63	6.92	7.20	7.49	7.79	8.08	8.37
Total	**24.46**	**23.75**	**22.78**	**22.08**	**21.50**	**21.01**	**20.57**	**20.18**	**19.86**	**19.59**	**19.38**	**19.22**	**19.11**	**19.03**	**18.97**	**18.94**	**18.94**	**18.96**	**19.01**	**19.09**	**19.18**	**19.29**	**19.41**	**19.55**

ANNEX 6. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, TRANSPORTATION SECTOR (IN KTOE), BY PRODUCT

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline	12.46	13.34	14.45	15.55	16.77	18.08	19.49	21.02	22.63	24.26	26.02	27.90	29.91	31.48	33.19	35.01	36.92	38.94	41.07	43.10	45.22	47.47	49.82	52.31
Diesel	19.83	20.59	21.45	22.03	22.67	23.34	24.35	25.05	25.81	26.55	27.24	28.36	29.15	29.20	29.55	29.90	29.93	30.35	30.77	30.81	31.21	31.56	31.62	32.01
Biofuels	1.29	1.37	1.47	2.19	2.31	2.44	2.59	2.74	2.89	3.05	3.21	3.40	3.58	3.70	3.84	3.99	4.13	4.30	4.47	4.62	4.80	4.98	5.15	5.35
Total	**33.58**	**35.29**	**37.37**	**39.78**	**41.76**	**43.86**	**46.43**	**48.82**	**51.33**	**53.86**	**56.47**	**59.66**	**62.65**	**64.38**	**66.58**	**68.90**	**70.98**	**73.59**	**76.31**	**78.53**	**81.23**	**84.01**	**86.59**	**89.68**

ANNEX 7. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, COMMERCIAL SECTOR (IN KTOE)

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
LPG	0.55	0.58	0.62	0.66	0.70	0.74	0.79	0.84	0.88	0.93	0.98	1.04	1.09	1.14	1.20	1.25	1.31	1.37	1.42	1.48	1.54	1.59	1.65	1.70
Diesel	1.71	1.66	1.61	1.57	1.53	1.48	1.44	1.40	1.36	1.32	1.29	1.25	1.22	1.18	1.15	1.12	1.09	1.05	1.03	1.00	0.97	0.94	0.92	0.89
Electricity	0.50	0.57	0.56	0.60	0.60	0.60	0.62	0.64	0.66	0.69	0.71	0.73	0.76	0.78	0.81	0.84	0.86	0.89	0.92	0.96	0.99	1.02	1.06	1.09
Biomass	2.48	2.47	2.47	2.48	2.48	2.48	2.49	2.49	2.50	2.50	2.51	2.51	2.52	2.52	2.53	2.53	2.54	2.54	2.54	2.55	2.55	2.56	2.56	2.56
Biodiesel	0.03	0.03	0.03	0.08	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04
Total	**5.27**	**5.31**	**5.30**	**5.38**	**5.38**	**5.39**	**5.41**	**5.44**	**5.48**	**5.51**	**5.55**	**5.59**	**5.64**	**5.69**	**5.74**	**5.79**	**5.85**	**5.90**	**5.96**	**6.03**	**6.09**	**6.16**	**6.22**	**6.29**

ANNEX 8. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, INDUSTRY SECTOR (IN KTOE), BY PRODUCT

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	1.51	1.52	1.53	1.54	1.55	1.56	1.57	1.58	1.59	1.60	1.62	1.63	1.64	1.66	1.67	1.68	1.69	1.70	1.72	1.73	1.74	1.75	1.76	1.77
LPG	0.18	0.15	0.16	0.17	0.17	0.18	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22
Kerosene	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Electricity	0.24	0.29	0.29	0.31	0.32	0.33	0.35	0.37	0.39	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68
Biomass	4.46	4.33	4.19	4.06	3.94	3.81	3.69	3.57	3.45	3.34	3.23	3.12	3.01	2.91	2.81	2.71	2.61	2.52	2.43	2.34	2.26	2.17	2.09	2.01
Biodiesel	0.03	0.03	0.03	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09
Total	**6.44**	**6.33**	**6.22**	**6.17**	**6.07**	**5.97**	**5.88**	**5.79**	**5.71**	**5.63**	**5.55**	**5.48**	**5.40**	**5.33**	**5.27**	**5.20**	**5.14**	**5.08**	**5.02**	**4.97**	**4.92**	**4.87**	**4.82**	**4.77**

Annex 9. TOTAL FINAL ENERGY DEMAND OUTLOOK 2018-2040, AGRICULTURE SECTOR (IN KTOE), BY PRODUCT

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Oil Products	0.92	0.93	0.95	0.97	0.98	1.00	1.02	1.04	1.06	1.07	1.09	1.11	1.13	1.14	1.16	1.18	1.20	1.22	1.24	1.25	1.27	1.29	1.31	1.33
Biodiesel	0.02	0.02	0.02	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Bioethanol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electricity	0.55	0.65	0.64	0.68	0.69	0.70	0.71	0.73	0.76	0.78	0.81	0.84	0.86	0.89	0.91	0.94	0.97	0.99	1.02	1.05	1.07	1.10	1.13	1.16
Total	**1.49**	**1.60**	**1.61**	**1.70**	**1.72**	**1.75**	**1.78**	**1.82**	**1.87**	**1.91**	**1.95**	**2.00**	**2.04**	**2.09**	**2.13**	**2.18**	**2.22**	**2.27**	**2.31**	**2.36**	**2.41**	**2.46**	**2.50**	**2.55**

Annex 10. TOTAL PETROLEUM DEMAND OUTLOOK 2018-2040, BY PRODUCT (IN MB)

PRODUCT	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Gasoline	102.18	109.33	118.47	127.43	137.42	148.13	159.66	172.21	185.34	198.71	213.12	228.45	244.94	257.72	271.72	286.63	302.21	318.76	336.21	352.77	370.16	388.57	407.79	428.13
Diesel	177.53	182.98	189.24	193.41	198.03	202.82	210.26	215.39	220.94	226.37	231.42	239.73	245.55	245.89	248.47	250.99	251.22	254.36	257.42	257.77	260.70	263.32	263.79	266.75
LPG	33.16	34.16	35.55	36.94	38.34	39.75	41.12	42.49	43.87	45.26	46.66	48.07	49.48	50.90	52.31	53.71	55.11	56.51	57.88	59.24	60.59	61.90	63.19	64.45
Kerosene	4.16	4.03	4.00	3.97	3.90	3.83	3.78	3.73	3.68	3.63	3.59	3.55	3.51	3.47	3.44	3.41	3.38	3.35	3.32	3.29	3.27	3.24	3.22	3.19
Biodiesel	3.55	3.66	3.78	9.67	9.90	10.14	10.51	10.77	11.05	11.32	11.57	11.99	12.28	12.29	12.42	12.55	12.56	12.72	12.87	12.89	13.04	13.17	13.19	13.34
Bioethanol	10.22	10.93	11.85	12.74	13.74	14.81	15.97	17.22	18.53	19.87	21.31	22.85	24.49	25.77	27.17	28.66	30.22	31.88	33.62	35.28	37.02	38.86	40.78	42.81
Total	**330.81**	**345.10**	**362.89**	**384.16**	**401.33**	**419.49**	**441.29**	**461.81**	**483.42**	**505.17**	**527.68**	**554.64**	**580.25**	**596.05**	**615.53**	**635.95**	**654.70**	**677.56**	**701.32**	**721.24**	**744.77**	**769.06**	**791.96**	**818.68**

ANNEX 11. TOTAL PETROLEUM DEMAND OUTLOOK 2018-2040, BY SECTOR (IN MB)

SECTOR	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Industry	13.53	13.30	13.45	13.94	14.08	14.22	14.32	14.43	14.55	14.67	14.80	14.92	15.04	15.15	15.27	15.38	15.49	15.60	15.71	15.81	15.91	16.01	16.10	16.19
Commercial	18.86	18.88	18.94	19.38	19.48	19.62	19.79	19.98	20.19	20.43	20.70	20.98	21.28	21.60	21.94	22.30	22.66	23.04	23.43	23.82	24.22	24.62	25.02	25.43
Transportation	262.27	275.84	292.43	311.59	327.57	344.52	365.12	384.39	404.73	425.19	446.39	472.02	496.30	510.75	528.88	547.95	565.34	586.84	609.25	627.82	650.02	673.00	694.60	720.05
Residential	29.29	30.08	30.96	31.82	32.62	33.42	34.22	35.02	35.82	36.61	37.40	38.18	38.96	39.73	40.49	41.25	41.99	42.72	43.44	44.14	44.82	45.49	46.13	46.75
Agriculture	6.86	6.99	7.11	7.44	7.57	7.70	7.84	7.98	8.12	8.26	8.40	8.53	8.68	8.81	8.94	9.08	9.22	9.36	9.50	9.65	9.80	9.95	10.10	10.25
Total	**330.81**	**345.10**	**362.89**	**384.16**	**401.33**	**419.49**	**441.29**	**461.81**	**483.42**	**505.17**	**527.68**	**554.64**	**580.25**	**596.05**	**615.53**	**635.95**	**654.70**	**677.56**	**701.32**	**721.24**	**744.77**	**769.06**	**791.96**	**818.68**

ANNEX 12. ELECTRICITY SALES AND CONSUMPTION 2018-2040, BY SECTOR (IN MWH)

SECTOR	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Residential	26,021.8	30,604.0	30,902.1	33,375.4	36,406.0	39,538.4	42,468.5	45,305.2	48,233.3	51,253.1	54,364.7	57,567.9	60,863.0	64,249.9	67,387.9	70,579.5	73,820.1	77,104.3	80,426.4	83,780.4	87,160.1	90,558.9	93,969.9	97,386.2
Commercial	5,825.3	6,644.0	6,559.0	6,931.3	6,977.0	7,023.2	7,251.0	7,487.2	7,732.3	7,986.5	8,250.0	8,523.3	8,806.6	9,100.4	9,405.6	9,722.0	10,050.0	10,390.1	10,742.6	11,108.2	11,487.1	11,880.0	12,287.3	12,709.7
Industrial	2,776.3	3,351.0	3,376.7	3,639.7	3,734.6	3,829.6	4,046.6	4,264.9	4,484.4	4,705.0	4,926.8	5,149.8	5,373.8	5,599.2	5,826.2	6,054.5	6,284.1	6,515.0	6,747.2	6,980.6	7,215.4	7,451.6	7,689.3	7,928.2
Others	6,447.2	7,503.0	7,457.0	7,932.4	8,036.5	8,140.9	8,245.7	8,537.0	8,830.1	9,124.8	9,421.1	9,719.2	10,018.7	10,320.1	10,624.0	10,929.6	11,237.0	11,546.3	11,857.2	12,170.0	12,484.6	12,801.2	13,119.7	13,440.1
Total Sales	41,070.6	48,102.0	48,294.8	51,878.7	55,154.1	58,532.1	62,011.9	65,594.4	69,280.1	73,069.4	76,962.6	80,960.2	85,062.1	89,269.6	93,243.7	97,285.6	101,391.2	105,555.6	109,773.4	114,039.2	118,347.1	122,691.6	127,066.3	131,464.1
System Loss	5,864.0	6,168.3	6,585.7	7,074.4	7,521.0	7,981.6	8,456.2	8,944.7	9,447.3	9,964.0	10,494.9	11,040.0	11,599.4	12,173.1	12,715.1	13,266.2	13,826.1	14,393.9	14,969.1	15,550.8	16,138.2	16,730.7	17,327.2	17,926.9
Total Sales	**46,934.7**	**54,270.3**	**54,880.5**	**58,953.1**	**62,675.1**	**66,513.7**	**70,468.0**	**74,539.0**	**78,727.4**	**83,033.4**	**87,457.5**	**92,000.2**	**96,661.5**	**101,442.7**	**105,958.8**	**110,551.8**	**115,217.2**	**119,949.6**	**124,742.5**	**129,590.0**	**134,485.4**	**139,422.3**	**144,393.5**	**149,391.1**

Note: "Others" Includes public buildings, street lights, irrigation and utility's station use, among others.

ANNEX 13. SYSTEM PEAK DEMAND 2017-2040 (IN MW)

PROVINCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Marinduque	9.9	10.0	11.4	12.2	13.0	13.8	14.6	15.5	16.3	17.2	18.2	19.1	20.1	21.1	22.0	22.9	23.9	24.9	25.9	26.9	27.9	28.9	30.0	31.0

ANNEX 14. TOTAL CAPACITY 2017-2040, BY SOURCE (IN MW) REFERENCE SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel (Contracted)	9.5	9.9	10.2			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indicative Diesel	0.0	2.5	3.0	14.0	15.0	15.5	16.5	17.5	18.0	19.0	20.0	21.5	22.5	23.5	24.5	25.5	26.5	27.5	28.5	30.0	31.0	32.0	33.0	34.5
Indicative Solar	0.0	0.0	0.0	0.0	0.0	5.0	6.0	7.0	7.5	8.5	9.5	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.5	20.5	21.5	22.5	24.0
Total	**9.5**	**12.4**	**13.2**	**14.0**	**15.0**	**20.5**	**22.5**	**24.5**	**25.5**	**27.5**	**29.5**	**32.5**	**34.5**	**36.5**	**38.5**	**40.5**	**42.5**	**44.5**	**46.5**	**49.5**	**51.5**	**53.5**	**55.5**	**58.5**

ANNEX 15. POWER GENERATION 2017-2040, BY SOURCE (IN MWh) REFERENCE SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	46,935	53,998	54,880	58,953	62,675	59,506	62,058	64,728	68,215	71,120	74,142	76,583	79,842	83,222	86,336	89,528	92,792	96,122	99,514	102,259	105,753	109,288	112,857	115,753
Solar	-	-	-	-	-	7,008	8,410	9,811	10,512	11,914	13,315	15,418	16,819	18,221	19,622	21,024	22,426	23,827	25,229	27,331	28,733	30,134	31,536	33,638
Total	**46,935**	**53,998**	**54,880**	**58,953**	**62,675**	**66,514**	**70,468**	**74,539**	**78,727**	**83,033**	**87,457**	**92,000**	**96,661**	**101,443**	**105,959**	**110,552**	**115,217**	**119,950**	**124,742**	**129,590**	**134,485**	**139,422**	**144,393**	**149,391**

ANNEX 16. TOTAL CAPACITY 2017-2040, BY SOURCE (IN MW) ALTERNATIVE SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel (Contracted)	9.5	9.9	10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indicative Diesel	-	2.5	3.0	14.0	15.0	15.5	16.5	17.5	17.5	18.0	19.0	20.5	21.5	21.5	22.0	23.0	24.0	25.0	26.0	27.5	28.5	29.5	30.5	32.0
Indicative Hydro	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Indicative Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Wind	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Solar	-	-	-	-	-	20.0	21.0	22.0	22.0	22.5	23.5	25.0	26.0	26.0	26.5	27.5	28.5	29.5	30.5	32.0	33.0	34.0	35.0	36.5
Total	**9.5**	**12.4**	**13.2**	**14.0**	**15.0**	**35.5**	**37.5**	**39.5**	**41.0**	**42.0**	**44.0**	**47.0**	**49.0**	**51.0**	**52.0**	**54.0**	**56.0**	**58.0**	**60.0**	**63.0**	**65.0**	**67.0**	**69.0**	**72.0**

ANNEX 17. POWER GENERATION 2017-2040, BY SOURCE (IN MWh) ALTERNATIVE SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	46,935	53,998	54,880	58,953	62,675	38,482	41,034	43,704	42,373	45,979	49,001	51,441	54,701	53,088	56,903	60,094	63,358	66,689	70,080	72,825	76,319	79,854	83,424	86,319
Hydro	-	-	-	-	-	-	-	-	4,380	4,380	4,380	4,380	4,380	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570
Wind	-	-	-	-	-	-	-	-	1,139	1,139	1,139	1,139	1,139	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066
Solar	-	-	-	-	-	28,032	29,434	30,835	30,835	31,536	32,938	35,040	36,442	36,442	37,142	38,544	39,946	41,347	42,749	44,851	46,253	47,654	49,056	51,158
Total	**46,935**	**53,998**	**54,880**	**58,953**	**62,675**	**66,514**	**70,468**	**74,539**	**78,727**	**83,033**	**87,457**	**92,000**	**96,661**	**101,443**	**105,959**	**110,552**	**115,217**	**119,950**	**124,742**	**129,590**	**134,485**	**139,422**	**144,393**	**149,391**

ANNEX 18. TOTAL CAPACITY 2017-2040, BY SOURCE (IN MW) GEOTHERMAL SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel (Contracted)	9.5	9.9	10.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indicative Diesel	-	2.5	3.0	14.0	15.0	15.5	16.5	17.5	17.5	18.5	19.5	20.5	21.5	11.0	12.0	13.0	14.0	15.0	16.0	18.0	18.5	19.5	20.5	22.0
Indicative Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Indicative Hydro	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Indicative Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Wind	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Indicative Solar	-	-	-	-	-	15.5	15.5	15.5	15.5	15.5	15.5	16.5	17.5	18.0	19.0	20.0	20.0	20.0	21.0	21.0	21.5	21.5	22.5	24.0
Total	**9.5**	**12.4**	**13.2**	**14.0**	**15.0**	**31.0**	**32.0**	**33.0**	**34.5**	**35.5**	**36.5**	**38.5**	**40.5**	**42.5**	**44.5**	**46.5**	**47.5**	**48.5**	**50.5**	**52.5**	**53.5**	**54.5**	**56.5**	**59.5**

ANNEX 19. POWER GENERATION 2017-2040, BY SOURCE (IN GWh) GEOTHERMAL SCENARIO

SOURCE	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	46,935	53,998	54,880	58,953	62,675	44,789	48,743	52,814	51,484	55,790	60,214	63,355	66,615	31,789	34,795	37,851	41,735	45,717	48,966	54,303	57,482	61,750	65,176	68,706
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	32,511	32,620	32,755	33,537	34,287	34,429	33,940	34,955	35,625	35,768	35,134
Hydro	-	-	-	-	-	-	-	-	4,380	4,380	4,380	4,380	4,380	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570	6,570
Wind	-	-	-	-	-	-	-	-	1,139	1,139	1,139	1,139	1,139	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278	2,278
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	-	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066	3,066
Solar	-	-	-	-	-	21,725	21,725	21,725	21,725	21,725	21,725	23,126	24,528	25,229	26,630	28,032	28,032	28,032	29,434	29,434	30,134	30,134	31,536	33,638
Total	**46,935**	**53,998**	**54,880**	**58,953**	**62,675**	**66,514**	**70,468**	**74,539**	**78,727**	**83,033**	**87,457**	**92,000**	**96,661**	**101,443**	**105,959**	**110,552**	**115,217**	**119,950**	**124,742**	**129,590**	**134,485**	**139,422**	**144,393**	**149,391**

ANNEX 20. RPS REQUIREMENT AND RE GENERATION PER SCENARIO 2020-2040 (MWh)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
RPS Requirement	1,924.0	2,593.9	3,309.2	4,097.2	4,960.9	5,903.5	6,928.0	8,037.6	9,235.5	10,524.8	11,908.7	13,390.4	14,919.0	16,538.6	18,250.4	20,055.6	21,954.7	23,948.2	26,036.4	28,219.1	30,495.9
Reference	-	-	7,008.0	8,409.6	9,811.2	10,512.0	11,913.6	13,315.2	15,417.6	16,819.2	18,220.8	19,622.4	21,024.0	22,425.6	23,827.2	25,228.8	27,331.2	28,732.8	30,134.4	31,536.0	33,638.4
Alternative	-	-	28,032.0	29,433.6	30,835.2	36,354.0	37,054.8	38,456.4	40,558.8	41,960.4	48,355.2	49,056.0	50,457.6	51,859.2	53,260.8	54,662.4	56,764.8	58,166.4	59,568.0	60,969.6	63,072.0
Geothermal	-	-	21,724.8	21,724.8	21,724.8	27,243.6	27,243.6	27,243.6	28,645.2	30,046.8	69,653.8	71,164.1	72,701.1	73,482.5	74,233.0	75,776.4	75,286.8	77,003.3	77,672.7	79,217.1	80,685.5

ANNEX 21. POWER PLANT COST PER TECHNOLOGY 2018-2040 (USD/KW)

PLANT TYPE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0
Hydro (Small-Scale)	3,383.3	3,379.2	3,375.0	3,377.5	3,380.0	3,382.5	3,385.0	3,387.5	3,390.0	3,392.5	3,395.0	3,397.5	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0	3,400.0
Solar	1,585.0	1,440.0	1,295.0	1,271.0	1,247.0	1,223.0	1,199.0	1,175.0	1,151.0	1,127.0	1,103.0	1,079.0	1,055.0	1,043.5	1,032.0	1,020.5	1,009.0	997.5	986.0	974.5	963.0	951.5	940.0
Wind	1,733.3	1,711.7	1,690.0	1,685.0	1,680.0	1,675.0	1,670.0	1,665.0	1,660.0	1,655.0	1,650.0	1,645.0	1,640.0	1,637.0	1,634.0	1,631.0	1,628.0	1,625.0	1,622.0	1,619.0	1,616.0	1,613.0	1,610.0
Biomass	2,212.7	2,200.3	2,188.0	2,184.2	2,180.4	2,176.6	2,172.8	2,169.0	2,165.2	2,161.4	2,157.6	2,153.8	2,150.0	2,146.3	2,142.5	2,138.8	2,135.0	2,131.3	2,127.5	2,123.8	2,120.0	2,116.3	2,112.5
Geothermal	4,979.9	4,959.8	4,939.8	4,919.7	4,899.6	4,879.5	4,859.5	4,839.4	4,819.3	4,799.2	4,779.2	4,759.1	4,739.0	4,719.5	4,700.0	4,680.5	4,661.0	4,641.5	4,622.0	4,602.5	4,583.0	4,563.5	4,544.0

ANNEX 22. LEVELIZED COST OF ELECRICITY 2018-2040, (PHP/KWh)

PLANT TYPE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Bunker	9.9	10.0	10.3	10.4	10.5	10.6	10.6	10.7	10.8	10.8	10.9	11.0	11.0	11.1	11.1	11.2	11.2	11.2	11.3	11.3	11.4	11.4	11.4
Diesel	14.2	14.3	14.7	14.8	14.9	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.8	15.9	16.0	16.0	16.1	16.1	16.2	16.2	16.3
Hydro (Small-Scale)	4.0	4.1	4.1	4.1	4.1	4.1	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Solar	9.3	9.3	9.3	8.9	8.6	8.3	8.0	7.7	7.3	7.0	6.7	6.4	6.1	6.0	5.9	5.9	5.8	5.8	5.7	5.7	5.6	5.5	5.5
Wind	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0
Biomass	6.5	6.5	6.6	6.6	6.7	6.8	6.8	6.9	7.0	7.0	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Geothermal	4.3	4.3	4.3	4.5	4.7	4.9	5.1	5.2	5.4	5.6	5.8	6.0	6.1	6.1	6.1	6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0

Note: Investment costs based on international prices.

ANNEX 23. BLEND RATE 2018-2040, BY POWER SUPPLY SCENARIO (PHP/KWh)

SCENARIO	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Reference	14.2	14.3	14.7	14.8	14.3	14.2	14.2	14.2	14.2	14.2	14.1	14.0	14.0	14.0	14.0	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.8
Alternative	14.2	14.3	14.7	14.8	10.4	10.5	10.5	10.3	10.5	10.6	10.6	10.7	10.4	10.6	10.7	10.7	10.8	10.9	10.9	11.0	11.1	11.2	11.2
Geothermal	14.2	14.3	14.7	14.8	11.4	11.7	11.9	11.6	11.8	12.0	12.1	12.1	8.6	8.8	8.9	9.1	9.4	9.5	9.8	9.9	10.1	10.2	10.3

Note: Investment costs based on international prices.

ANNEX 24. CO_2 EMISSION LEVEL 2018-2040, BY POWER SUPPLY SCENARIO (PHP/KWh)

SCENARIO	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Reference	14,103.1	14,333.7	15,397.4	16,369.5	15,541.7	16,208.4	16,905.6	17,816.5	18,575.1	19,364.5	20,001.8	20,853.2	21,735.9	22,549.3	23,382.9	24,235.3	25,105.2	25,991.0	26,708.0	27,620.5	28,543.8	29,476.1	30,232.3
Alternative	14,103.1	14,333.7	15,397.4	16,369.5	10,050.7	10,717.4	11,414.6	11,067.1	12,008.7	12,798.1	13,435.5	14,286.8	13,865.4	14,861.9	15,695.4	16,547.9	17,417.8	18,303.5	19,020.5	19,933.0	20,856.3	21,788.6	22,544.8
Geothermal	14,103.1	14,333.7	15,397.4	16,369.5	11,698.0	12,730.8	13,794.0	13,446.5	14,571.2	15,726.7	16,547.1	17,398.4	8,302.6	9,087.7	9,885.9	10,900.3	11,940.2	12,788.9	14,182.9	15,013.2	16,127.8	17,022.8	17,944.5

Note: CO2 Emission is internally calculated by LEAP which uses the Intergovernmental Panel on Climate Change's (IPCC) standard Tier 1 energy-sector emission factors.

ANNEX 25. DOWNSTREAM INVESTMENT REQUIREMENTS 2018-2040, (CUMULATIVE, IN MILLION USD)

DOWNSTREAM FACILITY	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Oil Storage	2.31	2.31	2.36	2.36	2.36	2.36	3.08	3.11	3.11	3.11	3.69	3.86	3.86	3.86	3.86	3.86	4.72	4.72	4.72	4.72	4.72	4.72	4.72

ANNEX 26. POWER CAPACITY ADDITION INVESTMENT REQUIREMENTS 2018-2040, (CUMULATIVE, IN MILLION USD) REFERENCE SUPPLY

PLANT TYPE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	-	-	-	-	14.06	14.97	15.87	16.33	17.23	18.14	19.50	20.41	21.31	22.22	23.13	24.04	24.94	25.85	27.21	28.12	29.02	29.93	31.29
Solar	-	-	-	-	7.35	8.77	10.14	10.79	12.06	13.27	15.01	16.11	17.17	18.21	19.24	20.26	21.27	22.27	23.75	24.72	25.69	26.64	28.05
Total	**-**	**-**	**-**	**-**	**21.41**	**23.74**	**26.01**	**27.12**	**29.29**	**31.41**	**34.51**	**36.52**	**38.48**	**40.43**	**42.37**	**44.30**	**46.22**	**48.12**	**50.96**	**52.84**	**54.71**	**56.57**	**59.34**

ANNEX 27. POWER CAPACITY ADDITION INVESTMENT REQUIREMENTS 2018-2040, (CUMULATIVE, IN MILLION USD) ALTERNATIVE SUPPLY

PLANT TYPE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	-	-	-	-	14.06	14.97	15.87	15.87	16.33	17.23	18.59	19.50	19.50	19.95	20.86	21.77	22.68	23.58	24.94	25.85	26.76	27.66	29.02
Solar	-	-	-	-	29.41	30.83	32.19	32.19	32.82	34.03	35.77	36.88	36.88	37.40	38.43	39.45	40.46	41.46	42.94	43.91	44.88	45.83	47.24
Hydro	-	-	-	-	-	-	-	3.40	3.40	3.40	3.40	3.40	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
Wind	-	-	-	-	-	-	-	0.84	0.84	0.84	0.84	0.84	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66
Total	**-**	**-**	**-**	**-**	**43.47**	**45.79**	**48.07**	**52.30**	**53.39**	**55.51**	**58.60**	**60.62**	**65.29**	**66.26**	**68.20**	**70.13**	**72.05**	**73.95**	**76.79**	**78.67**	**80.54**	**82.40**	**85.17**

ANNEX 28. POWER CAPACITY ADDITION INVESTMENT REQUIREMENTS 2018-2040, (CUMULATIVE, IN MILLION USD) GEOTHERMAL SUPPLY

PLANT TYPE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Diesel	-	-	-	-	14.06	14.97	15.87	15.87	16.78	17.69	18.59	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.95
Solar	-	-	-	-	22.79	22.79	22.79	22.79	22.79	22.79	23.95	25.06	25.58	26.63	27.66	27.66	27.66	28.66	28.66	29.14	29.14	30.10	31.51
Hydro	-	-	-	-	-	-	-	3.40	3.40	3.40	3.40	3.40	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10	5.10
Biomass	-	-	-	-	-	-	-	-	-	-	-	-	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.15
Wind	-	-	-	-	-	-	-	0.84	0.84	0.84	0.84	0.84	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	47.39	47.39	47.39	47.39	47.39	47.39	47.39	47.39	47.39	47.39	47.39
Total	**-**	**-**	**-**	**-**	**36.85**	**37.76**	**38.66**	**42.90**	**43.81**	**44.71**	**46.78**	**48.79**	**101.38**	**102.43**	**103.46**	**103.46**	**103.46**	**104.46**	**104.46**	**104.94**	**104.94**	**105.89**	**107.76**

ANNEX 29. LIST OF BARANGAY POWER ASSOCIATION (BAPA) OF MARELCO

BARANGAY	MUNICIPALITY	AVERAGE ENERGY DEMAND (Kwh/month)
Bayuti	Boac	244.5
Binunga	Boac	3,623.5
Boi	Boac	1,578.7
Canat	Boac	1,821.5
Duyay	Boac	8,817.6
Hinapulan	Boac	2,319.0
Mahinhin	Boac	2,012.5
Puting Buhangin	Boac	3,101.5
Tambunan	Boac	1,191.8
Tugos	Boac	11,475.7
Tumagabok	Boac	2,092.8
Bagacay	Buenavista	5,459.0
Bagtingon 1	Buenavista	10,295.4
Bagtingon 2	Buenavista	4,395.6
Bicas-Bicas	Buenavista	3,918.3
Lipata	Buenavista	5,084.2
Timbo	Buenavista	11,167.7
Tungib	Buenavista	16,828.5
Yook	Buenavista	19,628.9
Tabionan	Gasan	5,672.4
Argao	Mogpog	10,074.2
Guisian	Mogpog	4,255.8
Hinadharan	Mogpog	1,091.6
Hinanggayon	Mogpog	8,836.1
Malayak	Mogpog	879.9
Mampaitan	Mogpog	872.2
Mendez	Mogpog	4,150.6
Paye	Mogpog	6,437.6
Puting Buhangin	Mogpog	4,051.5
Sayao	Mogpog	10,600.6
Silangan	Mogpog	5,344.6
Baguidbirin	Sta. Cruz	1,206.2
Biga	Sta. Cruz	3,370.1
Botilao	Sta. Cruz	9,132.6
Dating Bayan	Sta. Cruz	2,965.9
Devilla	Sta. Cruz	3,280.2
Haguimit	Sta. Cruz	3,270.6
Jolo	Sta. Cruz	2,264.5
Kaganhao	Sta. Cruz	4,216.1
Kalangkang	Sta. Cruz	3,813.9
Kasily	Sta. Cruz	7,359.8
Kilo-Kilo	Sta. Cruz	9,855.8
Kinyaman	Sta. Cruz	1,779.4
Labo	Sta. Cruz	4,813.7
Makulapnit	Sta. Cruz	1,950.8
Maniwaya	Sta. Cruz	9,554.3
Masalukot	Sta. Cruz	3,488.3
Mongpong	Sta. Cruz	7,442.0
Polo	Sta. Cruz	7,179.0
Punong	Sta. Cruz	6,888.4
San Antonio	Sta. Cruz	17,617.8
San Isidro	Sta. Cruz	4,164.7
Tambangan	Sta. Cruz	3,684.5
Bangwayin	Torrijos	1,263.3
Bayakbakin	Torrijos	1,257.9
Bolo	Torrijos	3,609.1
Kay Duke	Torrijos	4,023.5
Malibago	Torrijos	27,487.1
Nangka	Torrijos	5,446.9
Pakaskasan	Torrijos	2,238.6
Payanas	Torrijos	2,580.1
Sibuyao	Torrijos	8,676.3
Talawan	Torrijos	849.4

PHOTO DOCUMENTATION

DOE's Kick-off Meeting with the Provincial Government of Marinduque together with the representatives from MARELCO and NPC-SPUG. (4 May 2017)

2nd Coordination Meeting with local stakeholders in preparation for the data gathering activities. (21 June 2017)

Capacity Building Workshop for Marinduque Stakeholders.
(23-25 October 2017)

Exposure Trip to 54-MW Pililia Wind Farm as part of the Capacity
Building Workshop. (26 October 2017)

Late **Governor Carmencita O. Reyes** gives her welcome remarks during the Public Consultation on **MarEP 2018-2040.** (13 November 2018)

Mr. Michael O. Sinocruz, Chief of Planning Division-Energy Policy and Planning Bureau, presenting the highlights of the Plan.

Consultative Meeting and presentation of the final draft of MarEP 2018-2040 to the newly-elected Provincial Governor of Marinduque, **Hon. Presbitero J. Velasco, Jr.** with the members of the Sangguniang Panlalawigan, NEDA-MIMAROPA, MARELCO and NPC-SPUG. (10 December 2019)

Acknowledgements

The Department of Energy (DOE) wishes to acknowledge the unwavering support of the Provincial Government of Marinduque and our Energy family in preparing the **Marinduque Energy Plan 2018-2040**.

The Plan was formulated by the Planning Division of the Energy Policy and Planning Bureau (EPPB) in collaboration with the Electric Power Industry Management Bureau (EPIMB), specifically the Power Planning and Development Division (PPDD), and through the assistance extended by the Renewable Energy Management Bureau (REMB), Oil Industry Management Bureau (OIMB), Energy Resource Management Bureau (ERDB), and Energy Utilization Management Bureau (EUMB).

We also would like to thank the initiatives made by the Philippine National Oil Company-Renewable Energy Corporation (PNOC-RC) in providing the initial assessments of various renewable energy potentials of Marinduque, which we took pride in incorporating in the Plan.

The DOE also takes this opportunity to recognize the efforts of the local government of Marinduque for spearheading the local energy planning as we move towards one vision of providing a responsive energy system for the entire province of Marinduque. The Plan serves a blueprint of the collaborative partnership of the DOE and the Marinduqueños.