APPENDIX I

ENERGY INFRASTRUCTURE BASELINE ASSESSMENT

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TABLES

1 ENERGY SECTOR

The following section provides a sectoral analysis of the Solomon Islands' energy sector and identifies projects at a high level to improve the island of Malaita's energy infrastructure. It will also review national, provincial, and local policies related to the energy sector. The report will assess Mailata's capabilities, resources, and needs to highlight and prioritize energy opportunities. Finally, it will provide recommendations for improving public energy infrastructure service to meet local goals and meet international standards for health and safety.

1.1 OVERVIEW OF THE SOLOMON ISLANDS ENERGY SECTOR

The Solomon Islands exists across six major islands and over 900 small islands and a population over 500,000. The population is concentrated on the six major islands, but approximately 350 of these islands are inhabited.[1] Additionally, 76 percent[2] of the population lives in rural communities. The rural population spread across the many islands prevents the use of a centralized national electric grid and presents a challenge for providing electricity to the full population. Approximately 14 percent[3] of the Solomon Islands' residents have access to electricity, which is provided by the state-owned utility, Solomon Islands Electricity Authority (SIEA). The more populated provinces of Guadalcanal and Western Province have higher electricity access rates, but the other, more rural provinces are significantly lower. **Error! Reference source not found.** shows the electricity access rate for each province.

Table 1: Electricity Access Rate by Province

ELECTRICITY ACCESS RATE BY PROVINCE	
PROVINCE	ELECTRIFICATION RATE
Guadalcanal	20%
Western	17%
Malaita	3%
Temotu	3%
Choiseul	2%
Central	<1%
Isabel	<1%
Makira and Ulawa	<1%
Renbell	<1%

[1] FAO. 2016. AQUASTAT Country Profile – Solomon Islands. Food and Agriculture Organization of the United Nations (FAO). Rome, Italy
[2] FAO. 2019. FAOSTAT - Solomon Islands. Retrieved March 22, 2021, from http://www.fao.org/faostat/en/#country/25.
[3] ADB. (August 2012). Solomon Islands: Outer Island Renewable Energy Project. Asian Development Bank Concept Paper.

Nearly all the Solomon Islands' energy is generated using fossil fuels, especially diesel fuel. Diesel accounts for approximately 97 percent of the country's generation, with the remaining 3 percent from renewable energy sources (hydropower and solar)[4]. There is no domestic source for diesel, so it is all imported. This leads to high and unpredictable energy costs, which creates further electrification challenges. As of March 2020, the Solomon Islands had the highest electricity costs in the world at [redacted] per kWh, which is at least 30 percent higher than costs in neighboring Pacific Island countries, according to the Economics Association of Solomon Islands (EASI), which is difficult for businesses to afford.[5] Rates this high will also deter individuals from purchasing electricity.

Due to a lack of electricity access, many Solomon Island's residents are forced to use other sources for energy, including kerosene, wood, gas, and charcoal, which all propose health hazards for users due to their emissions from burning and their flammability. Those without access to the main grid largely rely on kerosene lamps, with a smaller share from solar, diesel generators, and wood, for their lighting, as shown in Figure 1.

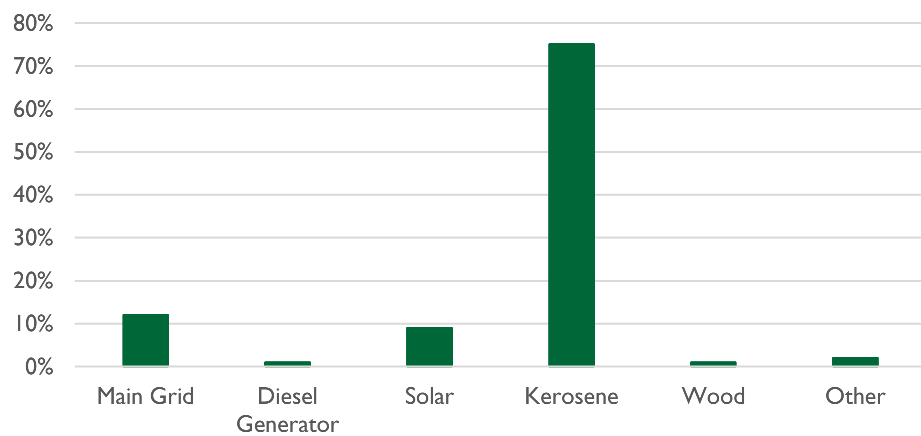

Figure 1 Fuel Sources for Lighting[6]

Wood is the most prominent cooking fuel with 93 percent of the population relying on it. This is true even in urban areas with higher electrification, where this figure is still over 50 percent.

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[4] IFC. (n.d.). Power Balance: Transitioning Solomon Islands from Diesel to Majority Renewable Energy by 2022. Retrieved March 23, 2021, from https://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/solomond+islands+renewable+energy.

[5] EASI. (2020, March 11). EASI Supports Sicci Call for Reduction of Electrical Tariffs. Solomon Times. https://www.citationmachine.net/apa/cite-a-newspaper/custom.

[6] MDPAC. 2013. Solomon Islands National Infrastructure Investment Plan. Ministry of Development Planning and Aid Coordination. Honiara, Solomon Islands.

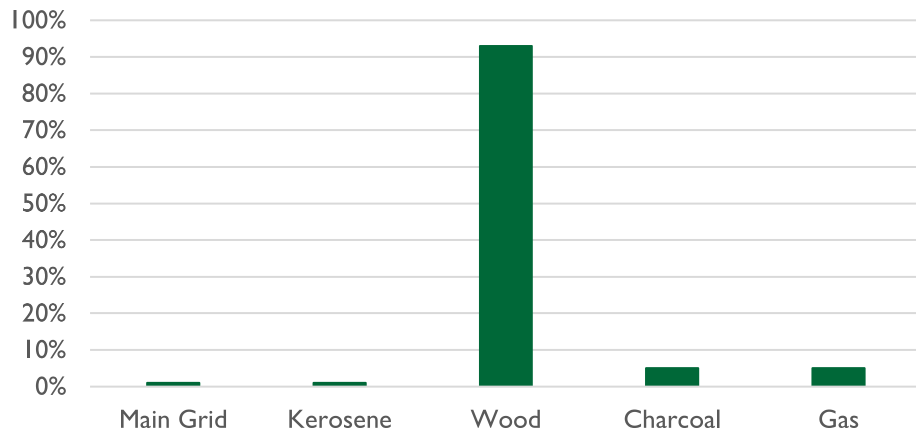

Figure 2 Fuel Sources for Cooking[7]

1.2 SOLOMON ISLANDS ELECTRICITY AUTHORITY

The Solomon Islands Electricity Authority (SIEA), also called Solomon Power, is a state-owned utility responsible for generation and distribution of electricity to customers across the Solomon Islands and established under the Electricity Act 1969. It operates, maintains, and develops all assets to achieve these objectives. It also performs several regulatory duties including regulation of electrical contractors, inspection of electrical installations to confirm they comply with national standards, licensing standby generators and independent power producers (IPP), and cogeneration of power. SIEA predominately serves the residential sector, which accounts for 77 percent of its customers. Commercial customers represent approximately 22 percent, while industrial customers account for less than 1 percent.[8]

SIEA operates two large diesel power stations that generate most of the power for the capital city region of Honiara – Lungga Power Station and Honiara Power Station. Outside of Honiara, there are several outstations that operate as minigrids and consist of diesel power stations and hybrid minigrids. The hybrid minigrids are composed of diesel generators and solar. There are also two operating solar plants on Guadalcanal that supply power to Honiara customers. The Henderson solar farm is ground mounted and is located east of Honiara. The Ranadi solar system is installed at the SIEA head office and helps power the office loads. In total, SIEA has 16.18 megawatts (MW) of generation capacity. There is one large hydropower project being developed in the country. On Guadalcanal and on the Tina River, a 15 MW hydropower project began construction in February 2020 with completion expected in 2024. **Error! Reference source not found.** shows an overview of SIEAs generation assets.

[7] MDPAC. 2013. Solomon Islands National Infrastructure Investment Plan. Ministry of Development Planning and Aid Coordination. Honiara, Solomon Islands.

[8] SolPower. 2019. Solomon Power Annual Report. Solomon Power. Honiara, Solomon Islands.

Table 2 SIEA Generation Overview

SIEA GENERATION OVERVIEW			
TYPE	SIZE (KW)	LOCATION	GENERATION TYPE
Power station	10,000	Lunnga	Diesel
	3,000	Honiara	Diesel
Outstation	2,126	Buala	Diesel
		Kirakira	Diesel
		Lata	Diesel
		Malu'u*	Diesel
		Auki*	Diesel
		Gizo	Diesel
		Munda	Diesel
		Noro	Diesel
		Tulagi	Diesel
		Seghe	Renewable minigrid
		Taro	Renewable/diesel minigrid
Solar Power Systems	1,000	Henderson	Solar power
	50	Ranadi	Solar power
Hydropower	15,000	Guadalcanal	Tina River hydropower (in progress)

* Located on Mailata

As **Error! Reference source not found.** shows, there are two outstations on Malaita, one in Auki and one in Malu'u. These two outstations largely serve customers in those two locations. Through 2019, the Auki outstation served 1,480 customers and Malu'u served 155. SIEA's total customer base was 21,043, so the Malaita outstations represents nearly 8 percent of all of SIEA's customers.[9] There is minimal transmission or distribution to the rest of the island, so there are large portions of Malaita that are unserved by SIEA. Some rural customers own small solar home systems, mostly used to charge mobile phones and power small appliances. Overall, the Malaita electrification rate is 3 percent.

SIEA stated in its 2019 Annual Report that it is in strong financial standing. Its revenue grew by 6 percent from 2018 to 2019 with profits of [redacted]. With its earnings, SIEA has funded infrastructure

[9] SolPower. 2019. Solomon Power Annual Report. Solomon Power. Honiara, Solomon Islands.

projects (solar hybrid outstations, outstation upgrades, and network extensions) and makes loan payments to the World Bank.

1.3 MINISTRIES, POLICIES, AND REGULATIONS

1.3.1 RELEVANT GOVERNMENT MINISTRIES

1.3.1.1 MINISTRY OF MINES, ENERGY, AND RURAL ELECTRIFICATION

The Ministry of Mines, Energy, and Rural Electrification (MME&RE) is responsible for the Solomon Islands' minerals, petroleum, energy, water resources, and rural electrification sectors. Among its key responsibilities is overseeing SIEA and Solomon Water. It also provides licenses and permits for mineral and hydrocarbon exploration, exploitation, and commercial development. It is split into five divisions to perform its responsibilities – Geological Survey Division, Mines Division, Water Resources Division, Petroleum Division, and Energy Division. The Energy Divisions manages the Ozone, Energy Efficiency and Conservation, Renewable Energy, Petroleum, and Power Units.

1.3.1.2 MINISTRY FOR THE ENVIRONMENT, CLIMATE CHANGE, DISASTER MANAGEMENT, CONSERVATION, AND METEOROLOGY

The Ministry for the Environment, Climate Change, Disaster Management, Conservation, and Meteorology (MECDM) is responsible for sustainable environmental management, climate change adaptation and mitigation, disaster risk management, and meteorological services for the Solomon Islands. It is mandated to promote sustainable and resilient communities, coordinate and guide the sustainable use of natural resources and ecosystems, and provide data services such as meteorological information and disaster risk reduction and management strategies. It will play a role in the development of renewable energy projects, while also overseeing projects' environmental impacts.

1.3.1.3 MINISTRY OF DEVELOPMENT PLANNING AND AID COORDINATION

Ministry of Development Planning and Aid Coordination (MDPAC) assists the Solomon Islands Government with creating national development strategies, medium term development plans, and annual development budgets. It works with the other ministries to develop and implement their plans and programs.

1.3.2 KEY POLICIES AND REGULATIONS

1.3.2.1 ELECTRICITY ACT 1969

As stated earlier, the Electricity Act 1969 established SIEA as a state-owned organization that oversees and manages the electricity system in the Solomon Islands. The act dictates that SIEA do the following:

- Manage and operate any electrical installations transferred to SIEA by the government or any other installations acquired by SIEA
- Establish, manage, and operate any installations as the government may require
- Secure the supply of electricity at reasonable prices
- Promote and encourage the generation of electricity with consideration of the economic development of the Solomon Islands
- Advise the government on all matters relating to the generation, transmission, distribution, and use of electricity

To achieve these duties, the act allows SIEA to generate, transmit/distribute, and sell electricity in bulk and/or to individual customers. SIEA is also permitted to operate and maintain the energy infrastructure as needed, including hiring personnel, procuring new equipment or components, and developing projects.

1.3.2.2 ELECTRICITY TARIFF (BASE TARIFF AND TARIFF ADJUSTMENTS) REGULATIONS 2016

These regulations dictate how SEIA calculates and sets electricity tariffs and charges for customers across all categories (domestic, commercial, and industrial).

1.3.2.3 NATIONAL DEVELOPMENT STRATEGY – 2016 TO 2035

In 2016, the Ministry for Development Planning and Aid Coordination released an update of the National Development Strategy (NDS) 2011 to 2020 to cover the years 2016 to 2035. The purpose of the NDS is to identify country wide and cross sector strategies, visions, missions, and objectives for development in the Solomon Islands. It sets out a framework for development policies, priorities, and programs over a twenty-year span.

1.3.2.4 SOLOMON ISLANDS NATIONAL ENERGY POLICY AND STRATEGIC PLAN[10]

In 2014, the Ministry of Mines, Energy, and Rural Electrification prepared the National Energy Policy and Strategic Plan (SINEP) with the purpose to inform decision makers on policy directions and strategies for improving the effectiveness of the Solomon Island energy sector by increasing access to reliable, affordable, and clean sources of electricity. It was developed following the release of the 2011-2020 NDS. Its findings and recommendations are still relevant with regards to the updated 2016 to 2035 NDS.

The SINEP's purpose is to establish an "enabling platform that will inform decision makers on policy directions and strategies for improving the effectiveness of the Solomon Island energy sector and achieving the NDS 2011-2020 through increased access to reliable, affordable, and clean sources of energy." It specifies six specific goals assigned to six subsectors to achieve this purpose, as shown in **Error! Reference source not found.**.

Table 3: SINEP Goals

SINEP GOALS		
SUBSECTOR	GOALS	ESTIMATED BUDGET [redacted]
Planning, coordination, leadership, and partnership	Strengthen the energy sector leadership and planning	[redacted]
Electric power (urban)	Increase access to electricity in urban areas to 100% by 2020	[redacted]
Electric power (rural)	Increase access to electricity in rural households to 35% by 2020	[redacted]
Renewable energy	Increase the use of renewable energy sources for power generation in urban and rural areas to 79% by 2030	[redacted]
Petroleum and alternative and gaseous fuels	Increase access of safe, affordable, and reliable petroleum fuels to outer islands and remote rural locations Increase the development and penetration of gaseous fuels and	

[10] Ministry of Mines, Energy, and Rural Electrification. (2014). Solomon Islands National Energy Policy and Strategic Plan 2014 (Rep.).

SINEP GOALS		
SUBSECTOR	GOALS	ESTIMATED BUDGET [redacted])
	alternative liquid fuels from indigenous raw materials	
Energy efficiency and conservation	Improve energy efficiency and conservation in all sectors by 10.7% by 2019	[redacted]

The document lays out general policy guidelines, strategies, and responsible agencies for passing and implementing the policies for all six subsectors.

1.4 BARRIERS TO ENERGY PROJECT DEVELOPMENT

There are several challenges to increasing electrification in Malaita. These are economic, political, and social and often are inter-related. These can help explain the current low levels of electrification on Malaita and highlight issues with energy project development. These factors should be considered when identifying projects. **Error! Reference source not found.** lists the barriers to energy sector projects.

Table 4: Barriers to Energy Sector Development

BARRIERS TO ENERGY SECTOR DEVELOPMENT	
BARRIER	DESCRIPTION
High electricity rates	The Solomon Islands have among the most expensive electricity rates in the region, with costs around [redacted] per kWh. These rates are prohibitively expensive for many and limit or prevent usage.
High rural population	Approximately 4 percent of the Malaita population is urban, with the remaining 96 percent being rural.[11] Having few and small population centers creates challenges for large, centrally located generating stations. A large, centrally located power plant will generally have lower costs than several smaller ones. However, the centrally located plant will require transmission and distribution networks to reach customers. The more dispersed the population is, the larger more complicated the transmission and distribution network must be.
Unreliable power	Power delivery for the customers served by SIEA can be unreliable due to issues with diesel supply and maintenance problems. This leads to potential customers to self-generation (such as with small backup diesel generators) or to learn to live without electricity.

[11] Solomon Islands National Statistics Office. *Solomon Islands Provisional Count 2019 National Population and Housing Census*. Retrieved June 10, 2021, from https://solomons.popgis.spc.int/.

BARRIERS TO ENERGY SECTOR DEVELOPMENT	
BARRIER	DESCRIPTION
Land ownership and land rights	Large portions of Malaita are owned by tribal groups. It is difficult to purchase or obtain rights to build on this land. This limits locations for new generation and transmission projects.

1.5 ENERGY TECHNOLOGIES

As described above, there are two important characteristics of the Malaita electricity sector – (1) low electrification rate of approximately 3 percent and (2) high reliance on diesel fuel for power generation. The low electrification rate signifies that there is considerable room to grow the sector and potentially strong demand for new power generation. Low electrification also forces individuals and businesses to use alternative fuel sources for purposes like lighting and cooking. Kerosene is the most common fuel for lighting and wood for cooking. Both create indoor pollution harmful to people and pose fire risks. Replacing them with electricity can eliminate these risks. The reliance on diesel may create several problems. There is no domestic diesel supply, meaning it must be imported. This can be expensive and adds uncertainties to power generation. Diesel costs can fluctuate, and supply can be disrupted, leading to very expensive electricity rates that are difficult for businesses and individuals to afford. Diesel combustion also emits greenhouse gasses (GHG). Alternative energy could help address all of these issues.

1.5.1 SOLAR PHOTOVOLTAICS

Solar photovoltaic (PV) power converts energy from the sun into electricity. Solar PV systems can range from single solar modules powering a water pump or streetlight to solar farms covering hundreds of acres. The strongest solar resource is found throughout Africa, the Middle East, Australia, the southern United States, Central America, and large parts of South America. Still, regions with a weaker resource have developed economically viable projects (such as Germany), largely due to supportive policies and incentives, and more recently, due to falling prices. Also, higher energy costs can also make new solar PV development more attractive. Solar PV has no fuel requirements and low operations and maintenance (O&M) costs. Figure 3 is a solar resource map showing the global horizontal irradiance (GHI) on Malaita.

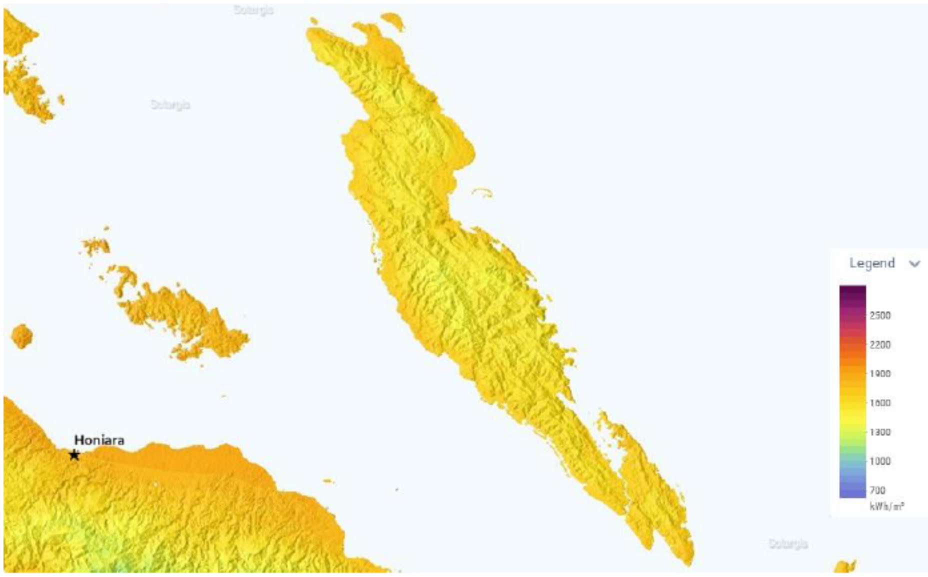

Figure 3 Malaita Solar Resource Map[12]

Malaita has a strong solar resource. It does not reach the levels of the sunniest locations on earth. However, it is comparable to many cities with several locations with successful PV projects (such as Frankfurt, Washington, DC, Sydney, and Madrid). Table 5**Error! Reference source not found.** shows a comparison of the solar resource for various locations around the world. Solar PV is likely a viable technology for Malaita.

Table 5: Comparison of Solar Resources

COMPARISON OF SOLAR RESOURCE	
LOCATION	ANNUAL AVERAGE GHI (kWh/m²)[13]
Auki	1,661
Mexico City, Mexico	2,156
Dubai, UAE	2,130
Phoenix, USA	2,117
Cairo, Egypt	2,102
Addis Ababa, Ethiopia	2,046
Santiago, Chile	2,029
Cape Town, South Africa	1,927

[12] Global Solar Atlas (n.d.). Global Solar Atlas – Malaita. Retrieved May 19, 2021, from https://globalsolaratlas.info/map?c=-9.003095,161.317749,9&m=site.
[13] Global Solar Atlas (n.d.). Global Solar Atlas. Retrieved May 19, 2021, from https://globalsolaratlas.info/map.

COMPARISON OF SOLAR RESOURCE	
LOCATION	ANNUAL AVERAGE GHI (kWh/m²)[13]
Madrid, Spain	1,741
Sydney, Australia	1,643
Washington, DC, USA	1,533
Frankfurt, Germany	1,117

1.5.2 WIND

Wind turbines generate electricity when the wind pushes the turbines blades causing it to rotate around a rotor and spin a generator. While small, kilowatt scale wind turbines exist, the majority are large, hundreds of kilowatt to multi megawatt scale turbines to form large wind farms. The larger turbines tend to be more economical. Most commonly, wind farms are located on land; however, an increasing number are being installed offshore in the ocean. Offshore installations allow the turbines to capture the typically higher winds over the ocean. Offshore turbines are taller with higher capacities than their onshore counterparts. Figure 4 shows Malaita's wind resource map.

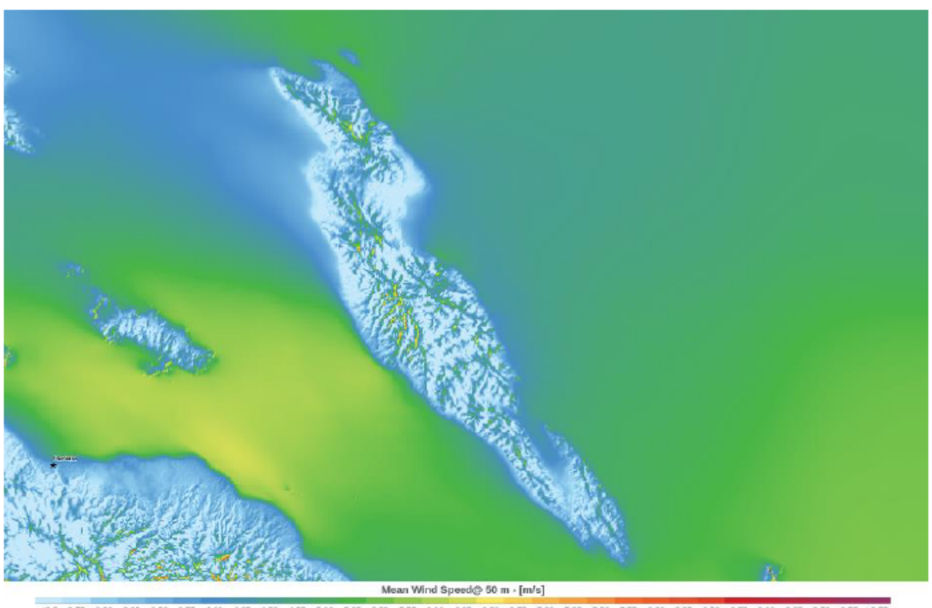

Figure 4 Malaita Wind Resource Map[14]

Malaita has a below average wind resource. The average annual mean wind speed on the island at 100 meters is 5.29 meters per second. Generally, locations with mean wind speeds of 6.5 meters per second or higher at 80 meters are considered viable for wind development. Further, large scale wind farms are

[14] Global Wind Atlas. (n.d.). Global Wind Atlas – Solomon Islands. Retrieved May 20, 2021, from https://globalwindatlas.info/area/Solomon%20Islands.

typically the most viable which would, at a minimum be several megawatts and cost several million dollars. A project of this scale would likely not be reasonable for Malaita.

1.5.3 HYDROPOWER

Hydropower systems convert energy from flowing water in rivers into electricity. There are several different strategies for converting water's energy into electricity, including impoundment, run of river, and diversion. In storage systems, a dam in a river creates a reservoir. The water is released from the reservoir and directed to flow through turbines, using the elevation difference between the reservoir and the bottom of the dam to provide the energy. In run of river systems, the forces from the flow of a river applies pressure on a turbine causing it to spin. In diversion systems, part of a river will be diverted through a channel or pipe flow through a turbine. Systems can range from several kilowatts to gigawatts.

Small run of river systems have been considered for implementation in Malaita. Little development has occurred yet, but the technology could offer opportunities for power generation. Homes, businesses, farms, or communities located near rivers and streams could be good fits for run of river hydropower installations. Malaita is a tropical island with significant rain and no dry season, so rivers will likely have a consistent flow rate and provide a consistent and predictable amount of energy. Large impoundment type systems are unlikely to be viable. High capital costs, high land requirements, and the need for transmission and distribution infrastructure to deliver the large amount of electricity around the island make these projects unfeasible. Figure 5 shows the major rivers on Malaita. These could potentially be sites for hydropower projects. Closer examination and studies would need to be completed to determine the energy available from the rivers and viability of the projects.

Figure 5 Rivers on Malaita

1.5.4 BIOMASS AND WASTE TO ENERGY

Biomass and waste to energy (WTE) power represent a large and diverse category of energy generation technologies. Biomass and WTE power plants convert energy stored in organic materials into electricity. Fuels (or the feedstock) may include any plant-based material, such as crop waste, forest residues, grasses, wood, microalgae, food waste, municipal solid waste (MSW), organic waste product like human sewage or animal dung. Electricity generation can be accomplished through burning, bacterial decay, or conversion to a gas or liquid fuel.

- Burning – The most common form of biomass power plant is through burning the feedstock in a boiler to produce steam that drives a turbine. Biomass can also be combined with coal in an existing power plant and burned together (called co-firing) to create a less carbon intensive coal power plant.
- Bacterial decay – Also called anaerobic digestion, organic waste material is gathered in digesters, which are oxygen-free tanks. The waste is decomposed by anaerobic bacteria producing methane and other by-products to form natural gas that can be used to generate electricity.
- Conversion to a gas or liquid fuel – Biomass can be converted to gas or liquid fuels through processes called gasification or pyrolysis. Gasification creates a synthetic gas (or syngas) that can be burned in a conventional boiler to generate electricity. Pyrolysis creates a crude bio-oil that can be used in fuel oil or diesel furnaces, turbines, or engines. Burning syngas for electricity generates similar levels of GHGs as natural gas.

Malaita has coconut, casava, and cocoa production on the island. Each have components that can be used for energy generation. The coconut husk and shell can be burned to generate steam or used for gasification. Coconut oil can be processed into biodiesel. Cassava can be processed into biodiesel or biogas through anaerobic digestion. Cocoa pod husks can be burned or converted to syngas.

One challenge with any biomass or WTE power facility is source and supply of the feedstock. In the case of coconut, casava, or cocoa products, they may already be used for other purposes and not available for power production, most notably as food. The most preferrable forms of biomass feedstock are crop byproducts that would otherwise be waste. Additionally, the collection and transport of the feedstock to the facility must be accounted for. Both of these should be assessed early in the project to identify any potential issues.

1.5.5 BATTERY ENERGY STORAGE

Batteries are an electrochemical technology that are charged with electricity, which can then be deployed when the electricity is needed. There are several different battery technologies, including lithium ion (Li-ion), flow, lead acid, sodium sulfur, and nickel-cadmium. These technologies have different applications and can serve a diverse set of consumers. Li-ion are the most widely used batteries with majority of new installed capacity.[15] Li-ion's dominance is relatively new. Before its growth, lead acid batteries were the leading technology. Flow batteries have a small market share today, but there is potential for growth. Figure 6 shows the growth of energy storage in general, as well as the growth in deployment of Li-ion batteries.

[15] IEA (2020), Energy Storage, IEA, Paris. https://www.iea.org/reports/energy-storage

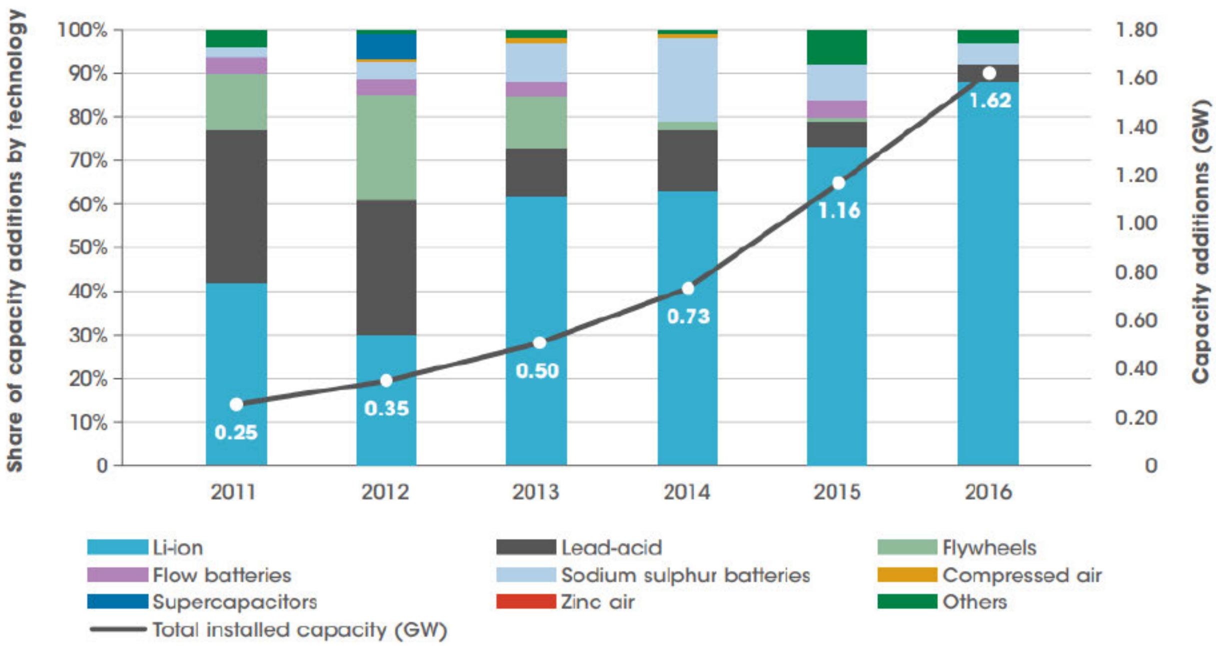

Figure 6 Increasing Energy Storage Installations[16]

Battery storage systems offer a wide array of applications for a diverse set of end-users. The end-users range from the grid operator and utility to individual consumers. In the case of Malaita, the utility and grid operator is SIEA. **Error! Reference source not found.** provides a list of the various applications.

Table 6: Battery Storage System Applications

Battery Storage System Applications		
END-USER	APPLICATION	DESCRIPTION
Grid operator	Energy arbitrage	Purchase of electricity at low prices and sell at high prices
	Frequency regulation	Energy provided to grid to avoid system level frequency spikes or dips
	Spinning reserves	Energy available to serve load immediately due to unplanned event
	Voltage support	Energy (voltage injection) for volt-var support
	Black start	Support to bring the grid online after outage
Utility	Resource adequacy	Alternative to gas or coal combustion turbines
	Distribution deferral	Delaying, reducing the size of, or avoiding investments in distribution upgrades
	Transmission congestion relief	Storage deployed downstream from congested transmission locations can reduce strain on the transmission network

[16] IRENA (2019), Innovation landscape brief: Utility-scale batteries, International Renewable Energy Agency, Abu Dhabi.

Battery Storage System Applications		
END-USER	APPLICATION	DESCRIPTION
	Transmission deferral	Delaying, reducing the size of, or avoiding investments in transmission upgrades
Individual customers and electricity consumers	Time-of-use bill management	Shifting electricity usage from on-peak to off-peak period
	Increased PV customer site consumption	Maximizing use and financial benefit of solar PV
	Demand reduction	Minimizing electricity purchase during peak periods
	Backup power	Energy storage paired with a local generator can provide power for use when grid power is unavailable

Batteries could be installed in Malaita as part of solar home systems, providing residents access to electricity during the night and when the sun is not shining. The most likely benefit to SIEA on Malaita is storage of renewable generation like solar PV and transmission and distribution deferrals. The grid operator applications will be less valuable due to the sparseness of the power grid on Malaita.

1.5.6 MINIGRIDS

Minigrids are self-sufficient energy systems that consist of energy generation, distribution infrastructure, and energy consumers. They serve a distinct area and can be connected to the main power grid or operate independently. Minigrids can be a range of sizes with different generation technologies and energy consumers, but all minigrids feature three key characteristics:

1. They are **local**. Minigrids provide energy for customers near the source of generation.
2. They are **independent**. Minigrids are able to operate and meet customer's energy needs without supply from a central grid.
3. They are **intelligent**. Minigrids have controls to manage the generators, batteries, and all other energy systems while monitoring the customer's energy usage.

Minigrids connected to the main power grid will use grid power to supplement their own generation. When grid power is disrupted, they can disconnect and continue to operate using the local generation (called "islanding"). Off-grid minigrids will rely only on their own power. While minigrids have different features with different technologies that serve different customers, they typically consist of the following components:

- Power source (e.g., solar photovoltaic systems, wind turbines, diesel, or biomass generator)
- Inverters
- Distribution system
- Metering
- Monitoring and controls
- Software
- Energy storage

- Balance of system components.

There is a strong case for minigrids with solar PV and battery storage on Malaita. They can harness the island's strong solar resource and provide reliable and dispatchable electricity. They can reduce or replace demand for diesel fuel, which can reduce energy costs. They can also be installed around the island to serve local customers so that transmission lines do not need to be installed to connect remote communities to central generation. Solar minigrids with battery storage can also be paired with diesel generators. The generators can serve as additional backup power.

There are already minigrids in operation or under development in the Solomon Islands and on Malaita.

1.6 PROJECT RECOMMENDATIONS

Section 1.1 provided an overview of the Solomon Islands' energy sector, including a low electrification rate and minimal energy infrastructure, especially on Malaita, showing the need for new energy infrastructure development. Section 1.4 highlighted the challenges facing developing energy projects in Malaita. Section 1.5 describes several technologies that could be implemented in Malaita. This section will outline different technologies and project approaches may be used to overcome those challenges and address the limitations of the Malaita energy sector.

Table 7: Barriers to Energy Sector Development

BARRIERS TO ENERGY SECTOR DEVELOPMENT		
BARRIER	SOLUTION	OUTCOME
High electricity rates	Alternative generation sources will reduce need for diesel fuel, which is costly to purchase with generators that are expensive to operate and maintain. Solar PV minigrids with battery storage, small run of river hydropower, or biomass could be cost competitive with current electricity rates. Government assistance to offset high costs.	Lower rates will increase the pool of consumers that can afford electricity, increasing adoption of grid energy use, for both people and businesses.
High rural population	Minigrids, located in the communities they serve, could provide electricity to urban and rural customers. They can be sized to match the local population's demand. For very small communities and remote homes, small solar home systems could provide power for individual needs.	Rural communities have been unserved by SIEA on Malaita. Small solar minigrids can provide power to remote areas of the island without the need for transmission infrastructure or diesel fuel supply.
Unreliable power	Solar PV and hydropower do not have the fuel supply concerns of diesel generation. Minigrids will be sized and designed to provide reliable power to its customers. Solar PV has very low maintenance requirements and typically suffer little downtime. Battery systems do have maintenance requirements, but if done properly, they can provide reliable and uninterruptible power.	If customers can expect a reliable supply of electricity, they will be more likely to use it and may even be accepting of high costs.

BARRIERS TO ENERGY SECTOR DEVELOPMENT		
BARRIER	SOLUTION	OUTCOME
Land ownership and land rights	Project sites that are either publicly owned or controlled or owned by a customer avoids issues with land ownership. Potential locations include schools, airports, government buildings, or community centers.	Schools are typically centrally located in communities with homes nearby. An energy system could supply power to both the school and the community. A solar PV minigrid could also serve as a teaching tool for the students. Airports are an important piece of infrastructure in the Solomon Islands. Air travel is vital for moving around the country and reliable and resilient power is important for airport operations. Government facilities are generally centrally located with homes and businesses nearby that could be served by the energy system. Community centers will be located near homes and businesses while also providing economic and leisure activities for communities. Electricity supply can be valuable for both of these.