YAP RENEWABLE ENERGY DEVELOPMENT PROJECT

Breaking the Reliance on Fossil Fuels

A photo montage of the wind farm at the proposed project site.

- Electricity is expensive in Yap State in the Federated States of Micronesia, largely due to remoteness and dependence on fuel imports.
- In 2013, the Federated States of Micronesia and the Asian Development Bank (ADB) initiated the Yap Renewable Energy Development Project to reduce Yap's dependence on fuel imports.
- ADB is assisting Yap State in diversifying its energy mix through the introduction of an 825-kilowatt (kW) wind farm and a 300 kW solar farm, as well as installation of new efficient diesel generation to replace its aged existing plant.
- Upon completion of the planned investments, Yap may reap fuel savings of up to 250,000 gallons of diesel fuel per year.

CONTEXT

Yap State (Yap) is one of four small island states comprising the Federated States of Micronesia (FSM). A combination of forces threatens Yap's energy sector, including strong typhoons, remoteness, and volatile oil prices. Yap depends heavily on diesel imports to power its main island, which hosts 65% of the state's population.[1]

On Yap's main island, 97% of the population has access to electricity, which is distributed through an integrated network operated by Yap State Public Service Corporation (YSPSC), a state-owned utility. YSPSC has an installed capacity totaling 8.3 megawatts (MW); its peak load totals 2.4 MW. In 2010, electricity tariffs were $0.353 per kilowatt-hour (kWh) for residential customers, $0.423 per kWh for commercial clients, and $0.737 per kWh for government entities.[2]

Yap's remote location and dependence on diesel fuel contribute significantly to the steep cost of electricity and impose a great burden on Yap's small economy. In 2013, the state's most expensive import was diesel (footnote 2), accounting for about 15% of gross domestic product. The high cost of electricity hinders investments and tourism, pinches household budgets, and increases overhead for industry and business.

Strategically harnessed and maximized, Yap's abundant supply of sunlight and wind could increase renewable energy and reduce oil dependence. Thus, in 2013 FSM and the Asian Development Bank (ADB) collaborated to develop the Yap Renewable Energy Development Project. This 5-year project is due for completion by 2017.

PROJECT SNAPSHOT

LOAN APPROVAL DATE:
June 2013

LOAN AMOUNT:
$9 million

BORROWER:
Yap State guaranteed by the Federated States of Micronesia

EXECUTING AGENCY:
Yap State Public Service Corporation

GEOGRAPHICAL LOCATION:
Yap State

TYPE OF ENERGY PROJECT:
Power generation using renewable energy, conventional power plant efficiency

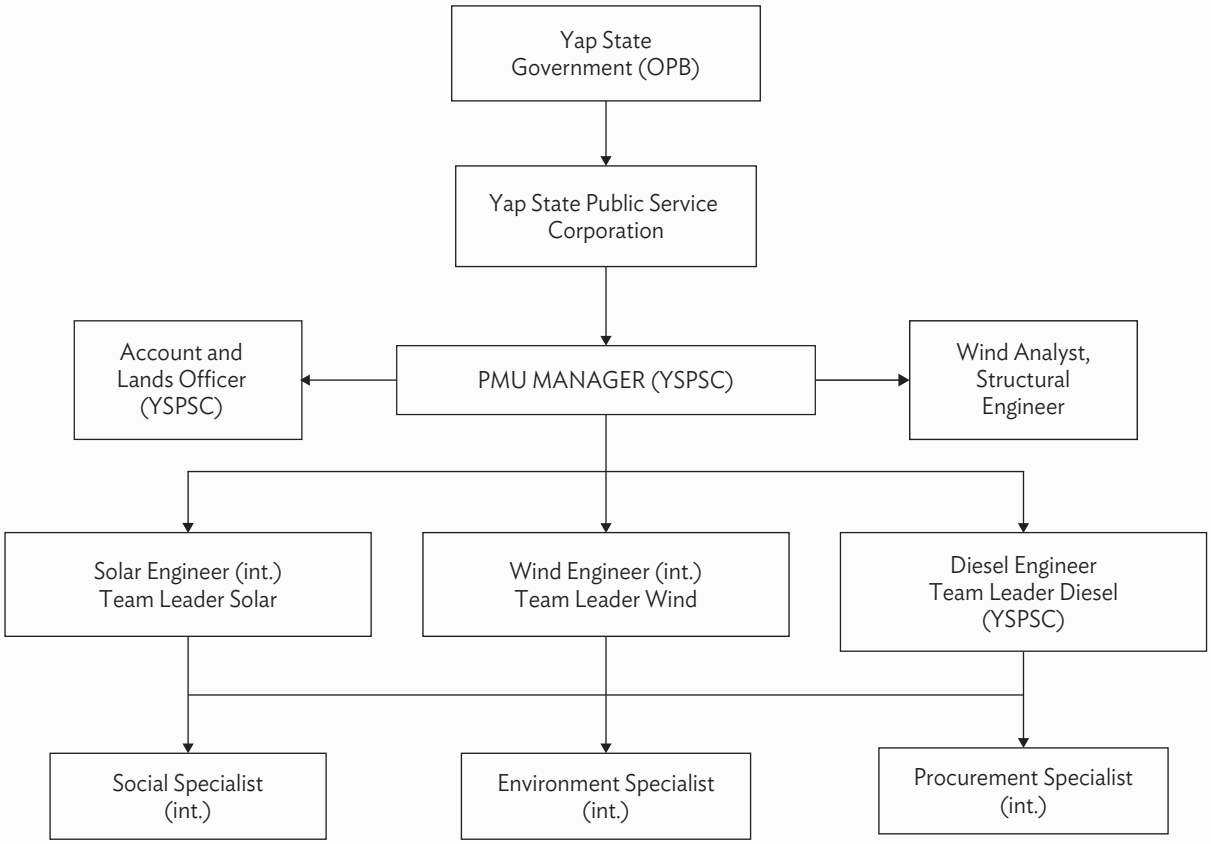
PROJECT COMPLETION DATE:
June 2017

SOLUTIONS

Wind power. The project conducted a comprehensive assessment of Yap's wind resources and selected a site about 1 kilometer northwest of Colonia, on a ridge 150 meters above sea level. The assessment included more than 2 months of wind data, long-term measurements at the Yap Airport Meteorological Station, topographical information, on-site terrain complexity, and slope and surface roughness (footnote 2). In a wind flow model,

1 ADB. 2013. *Report and Recommendations of the President to the Board of Directors: Proposed Loans to the Federated States of Micronesia for the Yap Renewable Energy Development Project.* May. Manila.
2 ADB. 2012. *Strengthening the Capacity of Pacific Developing Member Countries to Respond to Climate Change.* Consultant's report. October. Manila.

Figure 2.9.1: Yap Renewable Energy Development Project Organization Structure



int = International, OPB = Office of Planning and Budget, PMU = project management unit, YSPSC = Yap State Public Service Corporation.

Source: ADB. 2013. *Project Administration Manual: Yap Renewable Energy Development Project in the Federated States of Micronesia.* May. Manila.

WAsP[3] and WindPRO[4] software predicted a 25-meter variation in wind speed at the proposed site, and determined an optimal area for the new wind farm. Overall, the study reported with 90% probability that wind machines with a capacity totaling 1.4 MW could produce average net energy totaling 2,127 megawatt-hours per year.

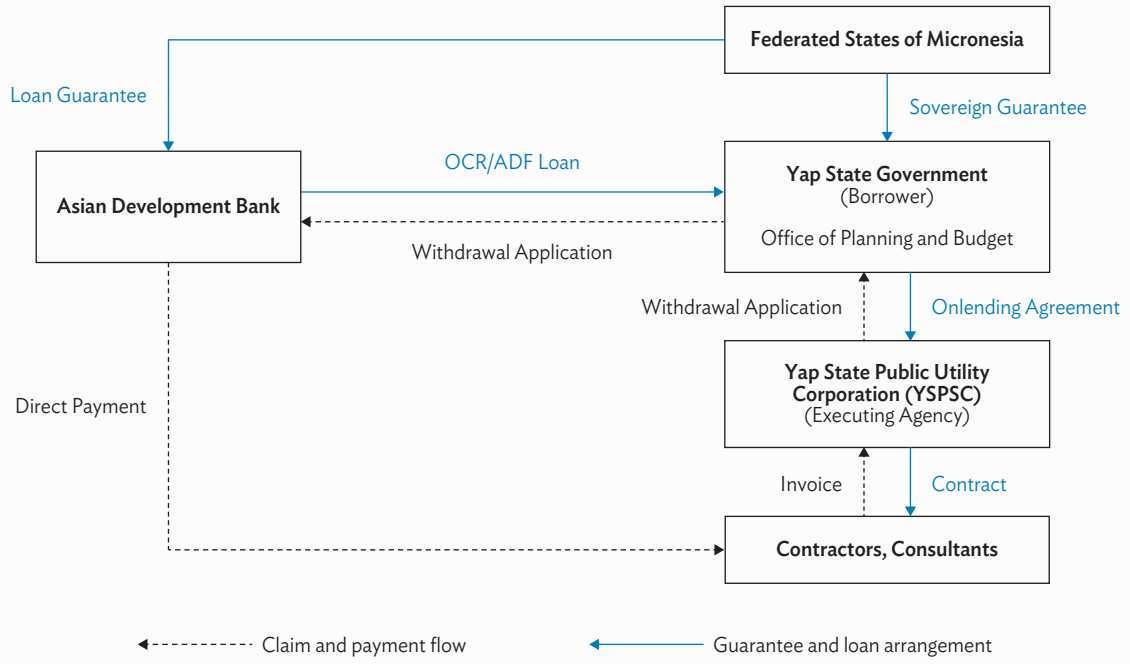
Based on a supplementary geotechnical study to ensure maximum wind availability and typhoon-proof operation, the layout of the initial 825-kilowatt (kW) wind farm considered turbine spacing, number of turbines, annual energy production, wake loss, and steep slopes. Additional wind turbines could produce another 550 kW.

Solar power. A solar power feasibility study used satellite measurements to determine the cost effectiveness of solar power at 2011 fuel prices. The project trained local companies to build the solar installations and establish local maintenance capacity (footnote 2). Roof-mounted solar photovoltaic panels on 11 government buildings, including schools, courthouses, and a sport center, will have a total capacity of 300 kW (Map 2.9.1).

[3] WAsP software is commonly used in the wind energy industry to assess wind resource and the effect of terrain on wind energy production.

[4] WindPRO software is used in wind energy project design and planning.

Figure 2.9.2: Yap Renewable Energy Development Project Fund Flow



ADF = Asian Development Fund, OCR = ordinary capital resources.

Source: ADB. 2013. *Project Administration Manual. Yap Renewable Energy Development Project in the Federated States of Micronesia.* May. Manila.

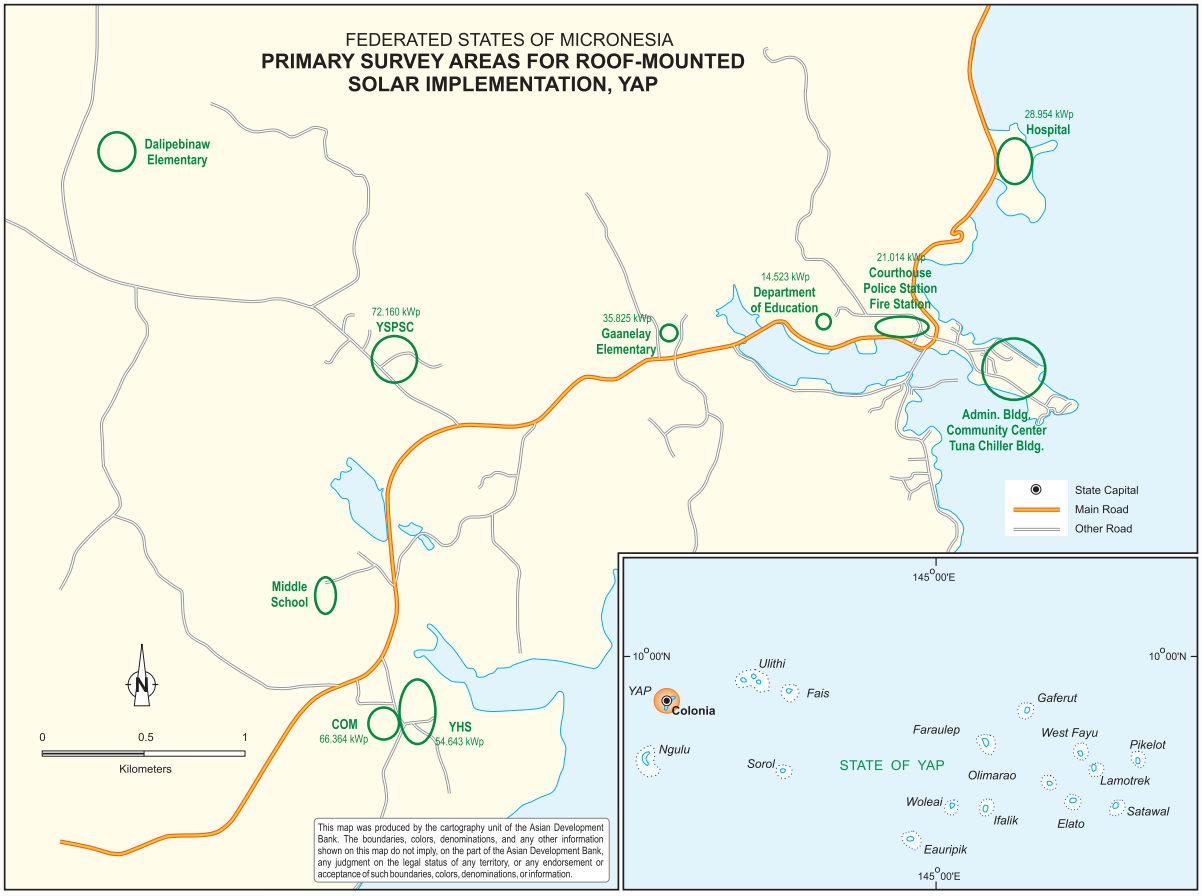
Roof installations provide the most rapid, low-cost, and typhoon-proof approach. In addition, the varying orientation of the roofs allows for a more even collection of energy over the day than an array with the panels all oriented in the same direction.

Because the solar panels to be installed are made of polycrystalline cells, the panels' inverters will be sealed against salt air and will be capable of providing full output in Yap's ambient air conditions. A digital data logger will measure solar radiation (footnote 2). Estimates suggest that solar power will generate 0.46 gigawatt-hours (GWh) per year, equal to 4.0% of current energy delivery.

Diesel power. To improve the efficiency of Yap's diesel-fired power plant, the project will largely replace YSPSC's diesel generator with a smaller and highly efficient 2.6 MW unit that closely matches Yap's 1.5 MW base load. An upgraded powerhouse control and switching system will reduce outages and generally improve reliability (footnote 2).The new generator will provide 9.9 GWh of electricity per year. During off-peak hours, it will achieve significantly higher fuel efficiency compared with the current 15.0 kWh and 13.8 kWh per gallon diesel generators (footnote 2).

Focal persons and teams for three types of power generation development. The Yap Renewable Energy Development Project aims to develop solar (300 kilowatts) and wind energy (1.4 MW) as well as a modern diesel engine suitable to Yap's base load. A YSPSC project management unit, comprising designated focal persons for each project component, will implement all project activities. Figure 2.9.1 shows the project organization structure. Figure 2.9.2 illustrates its fund flow.

Map 2.9.1: Aerial Map of Government Buildings Included in the Planned Solar Panel Installation



Note: Also surveyed was the Yap Sports Complex located 4.87 miles in a direction of 62.33° from the YSPSC office. Project total is 303,493 kilowatt peak.

Source: Asian Development Bank. 2012. *Strengthening the Capacity of Pacific Developing Member Countries to Respond to Climate Change.* Consultant's report. October. Manila.

RESULTS

Energy savings. Once all of these power-generating components are operational, they will provide thousands of fossil fuel savings for the small island-state. The enhanced diesel power generation plants will provide savings of up to 66,000 gallons per year through increased fuel efficiency. Fully installed, the 1.4 MW wind turbines will save up to 151,000 gallons per year, and the solar arrays will save an additional 33,000 gallons per year.

Reduction of greenhouse gas emissions. The project will also reap benefits for the environment. Renewable energy and increased efficiency of Yap's diesel-fired power plants will decrease greenhouse gas emissions. Specifically, a 250,000-gallon reduction will eliminate 2,500 tons of carbon dioxide emissions per year.

Other potential benefits. The development of Yap's energy sector will bring about stable power tariffs, benefiting the state's population. It will also help residents reduce dependency on kerosene lamps for lighting, which they often use to reduce electricity expenses. Thus, a reliable power supply will help households as well as businesses.

LESSONS

Electricity stability. One of the key lessons in this project is planning the practical amount of solar or wind power that can be added into the energy mix so that power instability will not be a threat to electricity generation. To avoid grid instability, any power generation project must include proper controls. The size and type of renewable energy farms require thorough assessment and planning, and the criteria for grid connection must be well studied, published, and strictly enforced.

Climate change. Energy generation projects must include features for adaptation to climate change. This is especially true for renewable energy projects, because they rely on nature for power. These considerations can maximize wind availability and solar irradiation. Construction and installation of the wind farm factored in the increasing frequency and force of typhoons in the Pacific, and wind turbines were designed to prevent wind damage. Roof-mounted solar panels use roof angles to minimize additional framing and vulnerable gaps. In addition, they are less vulnerable to cyclone damage than ground-mounted arrays, mainly because they are flushed against the roof and the back of each panel is well protected. Further, wind flowing over a large roof tends to be less turbulent than that passing around ground-mounted panels that tilt to best accept the solar input (footnote 2).

Energy buffer. Remote and typhoon-battered islands should consider developing an energy buffer, because prolonged and extreme weather events can cause major damage to renewable energy plants and delay oil transport. This project not only improved the performance of Yap's diesel-fired power plants, but also increased fuel storage, thus providing a buffer against isolation during a power blackout resulting from damaged renewable energy facilities.

Keywords

Energy, renewable energy, wind farm, solar farm, wind power, solar power, wind turbines, solar panels, solar energy, wind energy, Pacific, Federated States of Micronesia, Yap

For further reading

- http://adb.org/projects/details?page=overview&proj_id=44469-013
- http://www.adb.org/sites/default/files/project-document/65075/43901-prc-rrp.pdf

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