

2019

AN EXCEPTIONAL ENERGY CASE STUDY
The role of LPG in a modern hybrid power system with renewable energy generation

ROATAN 28 MW LPG POWER PLANT

WLPGA member Wärtsilä has closely cooperated with Roatan Electric Company to deliver a modern, low-emissions LPG-fired power plant to the island of Roatan, Honduras. This plant has prepared the Roatan hybrid power system for the future large-scale integration of renewable sourced energy generation.

This Exceptional Energy case study looks at the story behind the successful development of the Roatan LPG power plant, and at how the Wärtsilä solution materialized.



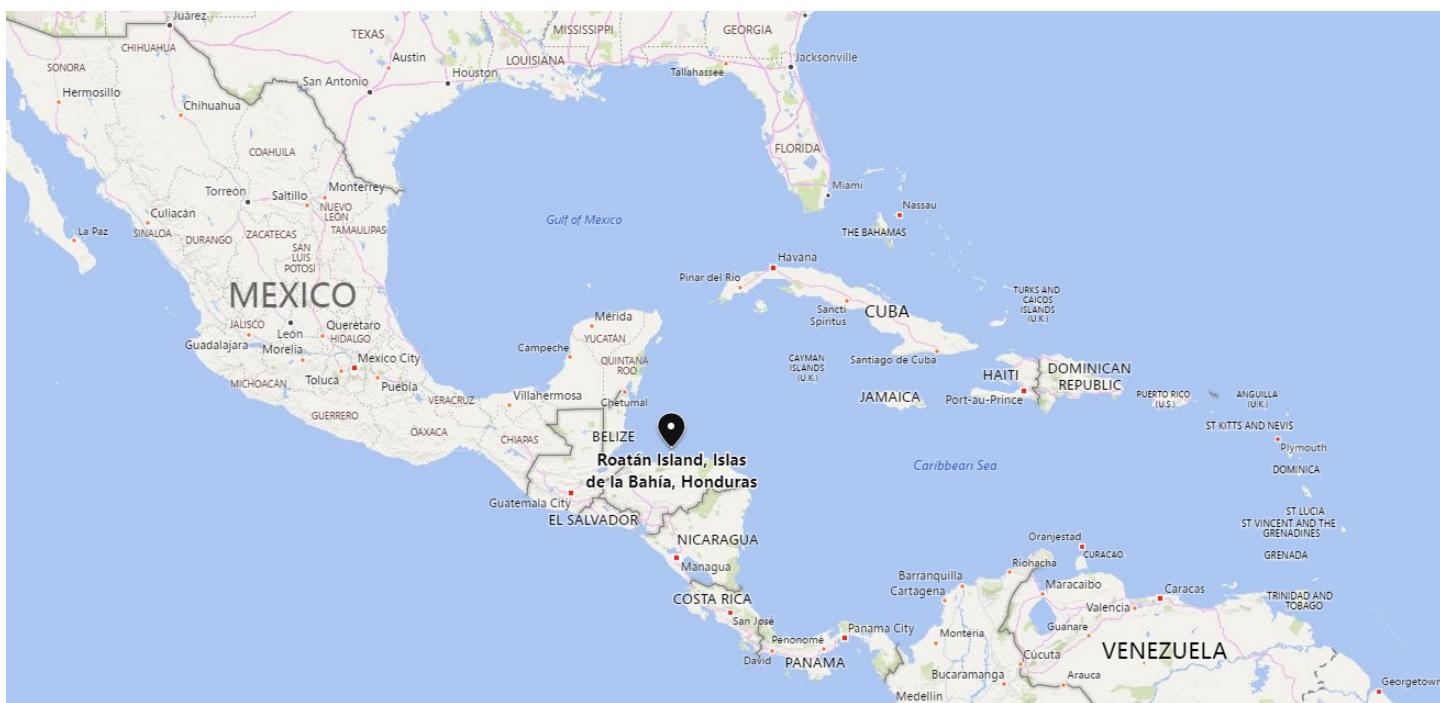
1. Roatan Electric Company

The Roatan Electric Company (RECO) operates in the Bay Islands, just off the northern coast of Honduras. The island of Roatan has 60.000 inhabitants and its growing tourism industry has increased the demand for electricity. The existing diesel power plant, built in the early 1990's, could not cope with this increasing demand, and consequently some hotels had to use their own diesel generators to provide sufficient electricity.

Roatan Electric Company began a project to both increase its power generation capacity and modernize the power system. The aim was for more efficient and environmentally friendly thermal power generation technologies, with the flexibility to allow the integration of significant amounts of renewable generation into the power system in the future. As an environmentally conscious and forward looking company, Roatan Electric Company installed their first wind power plants in 2015.



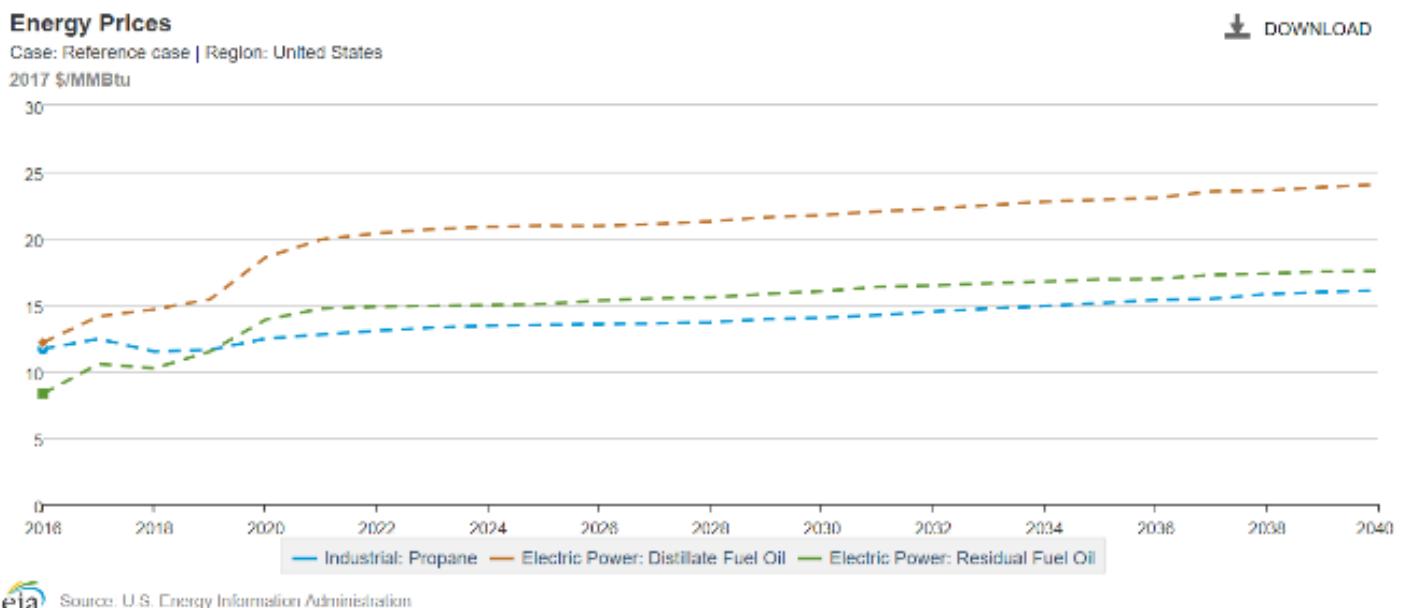
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2. The case for LPG as fuel

For this project, Roatan Electric Company evaluated LPG and LNG, both of which are cleaner fuels than distillate (LFO) and residual oil (HFO). Whereas LNG would require significant investment and a lengthy construction period for the cryogenic storage on site, LPG can be stored in industry standard pressurized bullet tanks. Furthermore, the worldwide fleet of small pressurized LPG tankers is large, and existing vessels could be used for the Roatan trade while at the same time supplying LPG to existing other consumers in the region. For LNG, small LNG tankers would have to be sourced and tailored for the specific trade. On the basis of these considerations, LPG was found to be the most attractive choice of fuel for the new environmentally friendly power plant.

The US shale gas boom has increased the production of LPG considerably, and propane is also now competitively priced compared to LFO and HFO. The US Energy Information Administration forecasts that propane will be significantly cheaper than both LFO and HFO in the region in the future. Furthermore, the recent expansion of the Panama Canal has also given US exporters better access to the Asian markets, resulting in higher export volumes. In fact, US and Canadian exports in 2017 were on a par with those of the Middle East, and North American LPG export volumes now have a significant impact on the world's LPG markets



3. Wärtsilä's solution for LPG to Power on Roatan island

After extensive benchmarking of the available power generation technologies capable of burning LPG, Roatan Electric Company opted for Wärtsilä's reciprocating engine solution. For the Roatan 28 MW project, Wärtsilä specified four Wärtsilä 34SG-LPG reciprocating engines, the specially tuned LPG version of its proven Wärtsilä 34SG gas engine. Wärtsilä's reference list includes SG engines having a combined output of close to 15 GW (status December 2018).

The Wärtsilä 34SG-LPG engine has multi-fuel capability and can also be operated on methane and ethane, if available in the future. Besides its best-in-class single cycle efficiency, the engine's excellent high ambient temperature performance was important for Roatan Electric Company due to the local climate. The Wärtsilä 34SG-LPG engine is insensitive to high ambient temperatures and derates marginally compared to other technologies. Thanks to the closed loop cooling system in Wärtsilä combustion engine plants, water consumption is minimal.



The integration of renewable energy into the Roatan power system was high on the agenda, and the inherent intermittency of wind and solar energy was a factor that needed to be overcome. Wärtsilä's latest generation advanced control systems provide accurate control that facilitates large scale renewable energy generation. For quick dispatch of back-up thermal generation, fast starting capability is required, which is met by the fast 5-minute start-up ability (from pushing the start button to full load) of the Wärtsilä engines. Furthermore, reciprocating engines offer an unlimited number of starts and

stops without any negative impact on maintenance intervals and costs. Finally, the four-unit plant configuration also supports renewable generation, since the engines can be started and stopped according to demand, and the running units can be maintained at higher loads and efficiency. Wärtsilä tailored the power plant design according to the Roatan site requirements and customer specifications. As hurricanes occur in the region, the power plant was designed to withstand extreme wind loads.



4. LPG supply chain and storage infrastructure

The LPG is shipped in pressurized LPG tankers from the US Gulf Coast to Roatan and other off-takers in the region. The Roatan power plant's LPG storage capacity is 4100 m³, which is sufficient for some 3-4 weeks of operation based on the typical dispatch profile of the power plant. The pressurized LPG tanks were manufactured by Transtech Energy.

5. Power plant EPC construction, operation and field experience

The remote island location and the demanding time schedule put Wärtsilä's engineering, procurement and construction (EPC) delivery capabilities to the test. Meticulously prepared and backed by its extensive experience in the Caribbean and Central America (totally 4,5 GW installed), Wärtsilä accepted the challenge. The logistics operations were extensive, and just-in-time deliveries were arranged. The generator sets, the mechanical and the electrical balance of plant equipment as well as materials comprised breakbulk shipments and a total of 76 containers. Thanks to the modularized design and good cooperation and support from the customer, Wärtsilä was able to complete the construction

of the plant in record time. It took only 9 1/2 months following the entering into force of the EPC contract. An extensive training program was arranged for the Roatan Electric Company team, both at Wärtsilä's training center and on site, and the plant is now being independently operated by Roatan Electric Company. The Roatan LPG power plant started commercial operations early in 2017. Since then the control system has been tuned to improve the dynamic capabilities of the generating sets, and the LPG supply system settings were also adjusted based on field experience from other LPG power plants.



6. Environmental impact and savings in generation cost

The Roatan LPG power plant delivers significant environmental advantages. In addition to a ≈20% reduction of CO₂ emissions (greenhouse gas) the new LPG power plant has significantly lowered nitrogen oxide (NOx), CO₂, sulphur and particulate emissions compared to the former LFO-fired diesel power plant. With the new flexible Wärtsilä LPG power plant, Roatan Electric Company can now invest in more renewable generation capacity. Using the LPG power plant for load following and back-up, the company can rest assured that the power system is stable even when the wind doesn't blow or the sun doesn't shine. Besides saving fuel costs, every MWh generated with renewables reduces the

environmental footprint of Roatan Electric Company. The new modern plant operates very quietly and emits significantly less noise than the existing diesel power plant. The lower noise level has a major positive impact on the quality of life for the people living in the adjacent residential areas.

The two first years of operation of the LPG power plant have confirmed the expected significant savings in operating costs. In 2018 the operating costs per GWh electricity generated were as much as 1/3 lower than in 2016 when the diesel plant was generating all electricity.



Richard Warren, Vice President and General Manager of RECO:

"Wärtsilä's solution will provide cleaner, more reliable and more efficient energy to our customers. The multi-fuel capability gives us the advantage of changing fuels in the future. We can use propane, ethane or methane, depending on cost and availability. This will directly reduce the price of electricity for consumers."



Andrey Borgmästars, Senior Manager LPG to Power at Wärtsilä Energy Solutions:

"At Wärtsilä, we believe that LPG is an excellent fuel, not only for the Caribbean and Central America where we already have LPG plants in operation, but for any site that needs clean energy and does not have access to pipeline natural gas. Furthermore, thanks to the flexibility of our LPG power plants, they represent the optimal solution for the integration of renewable energy generation into any power system."

Acknowledgements

Roatan Electric Company
<https://recoroatan.com/>

Wärtsilä Energy Solutions
<https://www.wartsila.com/energy/solutions/lpg-to-power>

