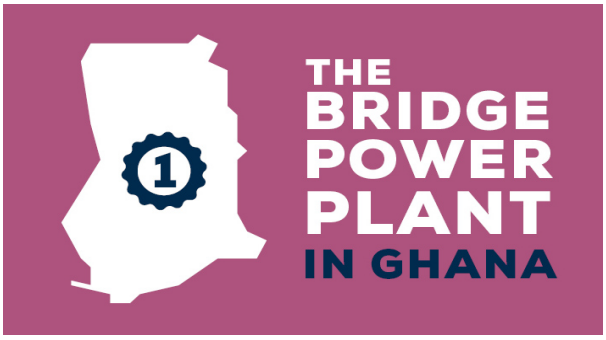
AN EXCEPTIONAL ENERGY CASE STUDY

# BRIDGE POWER PROJECT IN TEMA, GHANA




LPG is a clean, modern fuel that brings comfort to tens of millions of consumers worldwide. Its versatility makes it efficient and easy to use and its clean burning qualities allow for lower carbon emissions with the same, if not better, results.

This case study looks at the Bridge Power project, a LPG fuelled power plant, which uses high efficiency turbine generators. The $953m power plant is the biggest of its kind, being built in two phases with the first stage having a capacity of 194MW and the second having a capacity of 206MW. This study looks at this exciting project and its use of LPG.

LPG
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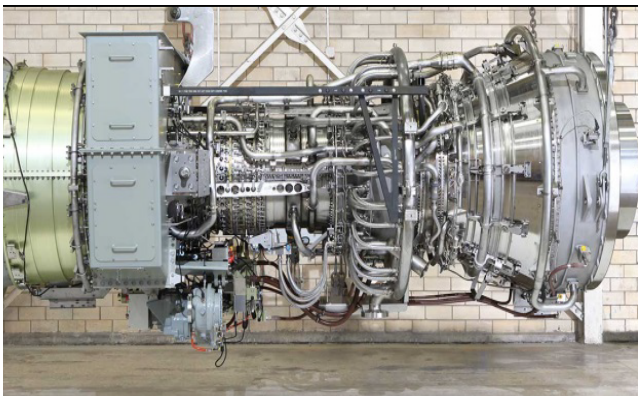
WLPGA

# 1. The Bridge Power Project, Tema

Located in the Tema Heavy Industrial Area, the project includes the development of power plant facilities in two stages: Stage one and Stage two a 9 km+ pipeline for transporting LPG, a storage tank farm, and additional pipelines for transporting raw water and diesel to the project site.

Stage One is expected to use 771t of LPG a day, while Stage Two will use 1,679t a day. The project will use imported LPG as the primary fuel, and diesel as the secondary fuel during the first five years of operation. Natural gas is expected to become available to serve as the primary fuel, and LPG will become the secondary fuel later.

"FIRST of it's kind in Africa, BIGGEST of its kind in the world."

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# 2. General Electric's combined cycle engines

A combined-cycle power plant uses both a gas and a steam turbine together to produce up to 50% more electricity from the same fuel than a traditional simple-cycle plant. The waste heat from the gas turbine is routed to the nearby steam turbine, which generates extra power. Stage One of the Bridge Power Project, which will be constructed by engineering firm METKA, will use five GE TM2500+ gas turbines and one purpose built GE steam turbine in a combined cycle turbine (CCGT) configuration that will collectively generate 200MW of capacity. Stage two will add another 200MW through four GE LM6000 gas turbines and one purpose-built GE steam turbine, also in a CCGT configuration.

# 3. LPG's suitability to fulfil Ghanaian energy demand

In the WLPGA report, "The Ideal Market for LPG Power Generation", key market characteristics which make a country 'ideal' for LPG-fueled power generation are examined. When mapped against the characteristics, Ghana scores quite high. One characteristic highlighted is that an ideal market for LPG and power generation must be seeking to fill power gaps of up to 250MW. The case of Ghana is larger at 400MW, but using the GE combined cycle generators makes it very efficient for the size and scale.

Anther characteristic highlighted is that existing power plants are fueled by diesel or Heavy Fuel Oil (HFO). Currently Ghana relies mostly on light crude oil from its refineries and diesel to generate power. A further characteristic that makes the Ghanaian market suitable for using LPG for power generation, is high wholesale electricity prices. According to Ghana Electricity Company's website, the electricity tariffs are $0.33 USD per KWh for the residential and $2.6 USD per KWh for industrial consumption which is high for a country with Ghana's GDP and level of development.

Regarding usage of LPG and existing infrastructure, Ghana has two oil refineries, LPG storage facility and a jetty at Tema Port, which as part of this project, will be upgraded for more storage and fast and easy transfer of LPG from the vessels to tanks. Ghana produced 36% (116,000t) of their annual 326,000t LPG demand in 2017 – 29% of the produced volume was from oil refinery and the rest from gas processing. Currently 56% of Ghanaian demand comes from residential sector, 31% from transport, and a mere 13% from commercial and

"The Bridge power project will help make Ghana self-sufficient in electricity by meeting both its near-term and long-term energy needs."

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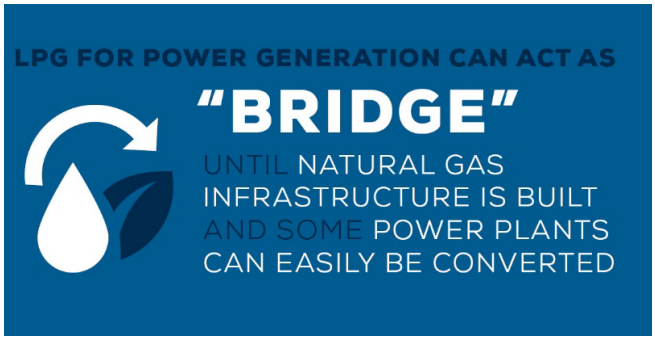
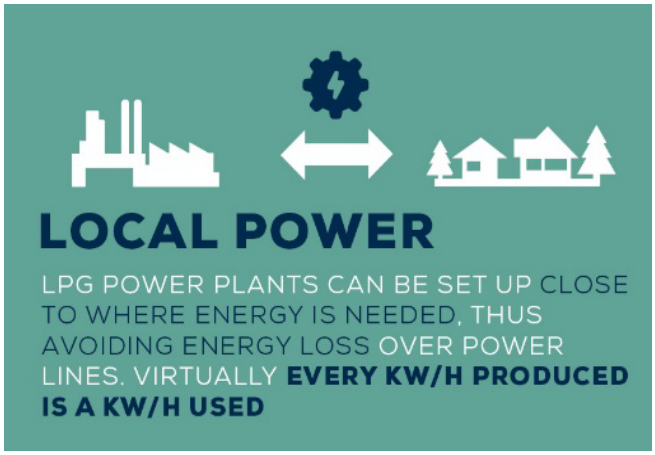
industrial sectors combined. There has been no power generation from LPG until now.

Regarding a focus on emission reductions and the presence of well-functioning regulatory policies, Ghana ranks very high among African countries. In a 2015 United Nations report Ghana's Intended Nationally Determined Contributions (INDCs) to achieve sustainable development goals included large scale adoption of LPG use for cooking from 5.5% in 2015 to 50% in peri-urban and rural households by 2030.

## 4. LPG The Charter of Benefits

- LPG is easier and less expensive to compress, ship, and store than LNG.
- LPG power plants can be set up close to where energy is needed, thus avoiding energy loss over power lines. Virtually every kw/h produced is a kw/h used.
- An LPG power plant can be combined with wind, solar, hydro or other renewable sources.
- Power generation fueled by LPG has a lower emissions profile compared to heavy fuel oil and diesel.
- LPG can be stored on site thus increasing up-time.
- In countries where LPG is used for other applications the infrastructure to grow LPG for power generation will already be in place.
- LPG fueled power plants are the perfect solution for islands, remote areas and emerging economies with no, or limited, access to natural gas.
- LPG for power generation can act as "bridge" until natural gas infrastructure is built and some power plants can easily be



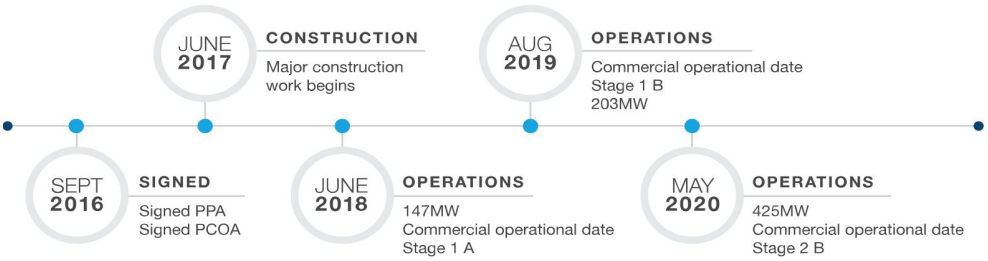
## 5. Agreement and project partners

Bridge Power is being developed by the Early Power Limited (EPL) consortium under a Power Purchase Agreement (PPA) with the Electricity Corporation of Ghana (ECG) with a term of 20 years. The EPL consortium is comprised of Endeavor Energy, a leading independent power development and generation company focused on Africa; Sage, a leading independent energy trading firm in Ghana and GE.

Endeavor is the largest shareholder in Bridge Power and is leading the development together with GE. The consortium members will collectively be responsible for operations and maintenance of the project with the support of a long-term service agreement from GE. Endeavor will be responsible for commercial and construction management.


## 6. Timeline

The total construction timeline is 34 months




"GE is proud to be contributing technology and expertise to this significant project that will help Ghana meet its growing energy demand. Power is central to economic development and this new plant is going to go a long way towards supporting the overall development of the country."

GE Ghana CEO, Leslie Nelson

"When one considers the extent of the direct and indirect impacts on the country as a whole, as well as on individual lives, there is no doubt that Bridge Power will have a sustained transformative socio-economic impact on Ghana."

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## 6. Acknowledgements