

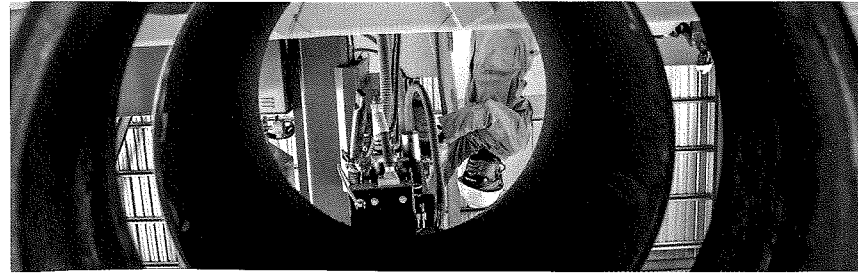
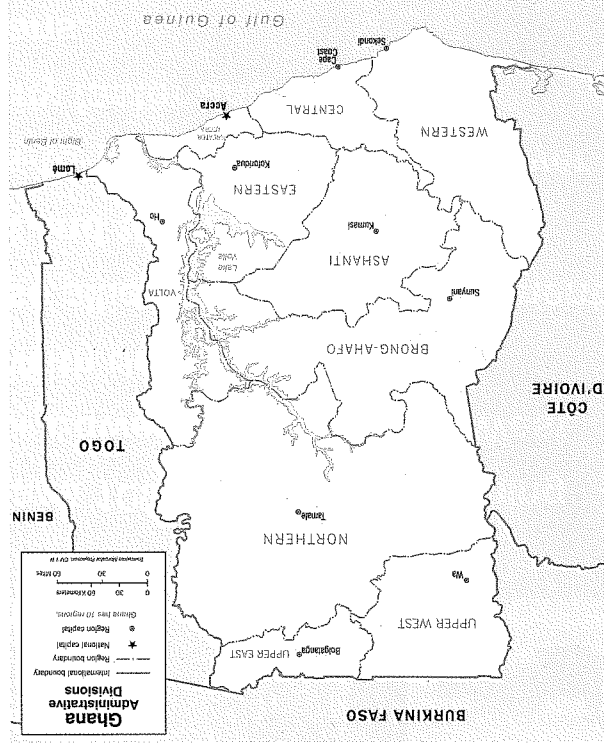
One Energy
brings power
to the people



The country

loses an
estimated 2-6%
of GDP annually
due to insufficient
wholesale power
supply.

Project location map
Abodeze in Western region of
Ghana. ▲



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it is an all too familiar event across the continent: the lights go out, and a generator fires up to bring them back on again. Patients in hospitals are put at risk. Children finish homework by kerosene lamp. Businesses are hit, translating to lost wages, and missed opportunities.

Ghana is not immune. The power crisis of the past three years has made life tough for everyone. Buying and running generators reduces the amount households can spend on other critical goods and services. The country loses an estimated 2-6% of GDP annually due to insufficient wholesale power supply.

Small wonder that fixing Ghana's energy crisis has become the number one priority for the government. "I do not intend to manage the situation as it has been done in the past, I intend to fix it," said President John Mahama during his February 2015 State of the Nation address. "I owe it to the Ghanaian people."

But in these difficult times of lower global commodity prices and stretched budgets, how to do it?

Introducing Ghana 1000

The Ghana 1000 project is transformational. It brings fuel solutions to enable secure power while waiting on indigenous gas. This innovation displaces expensive/dirty fuel. It pulls together leading international and local companies to build what will be one of Africa's largest single power parks, aiming to deliver 1300MW of generation capacity once its final phase is completed. Under its incorporated Ghanaian entity, One Energy, the consortium of GE, a global infrastructure leader, Endeavor – Africa focused Power company, Eranove – regional O&M leader and SAGE – strong local fuel importer brings integrated gas to power solution which will enable faster and cheaper generation of power. The floating storage regasification unit will enable Ghana 1000 to use Liquid Natural Gas in combination with indigenous gas to fuel a generation program that is phased to meet Ghana's needs.

One Energy has also selected world-class power generation technology for the project and will partner with leading service and finance providers to build a state of the art power plant that will not only deliver reliable, low-cost electricity, but will have the flexibility to run clean natural gas produced from Ghana's burgeoning natural gas industry. Each member of the consortium brings more than just their individual skills to the project, they also bring strong ties from international funders. "Endeavor is supported by Denham Capital, a leading energy and resources-focused global private equity firm with more than \$7.9 billion of invested and committed capital that has made a number of power investments in Africa and other emerging economies, and by the U.S. Government's Power Africa initiative. We also maintain a very close relationship with various U.S. and international financial institutions," says Endeavor CEO Sean Long. "Additionally, we also serve as a strategic advisor to the World Bank's Global Infrastructure Initiative. Our role in the Ghana 1000 project is to be the lead investor and to co-lead the overall development, financing and construction of the project." The consortium has structured the project so that there are no direct costs for the government. "This allows the government to spend its resources where it's needed most like schools and hos-

When the Ghana 1000 consortium started to develop the project last year, everyone was focused on building a secure, cost-effective power supply to meet the growing country's needs. This year, the urgency of the power crisis became apparent and in a meeting with Hon Kwabena Donkor in January of this year, the GE Chairman, Jeff Immelt and Endeavor CEO, Sean Long, agreed that the consortium had to help to address the urgent power needs too. This is when the Bridge Power project was conceived.

In an effort to address Ghana's immediate power shortages, Endeavor, GE and SAGE are developing an additional 340MW power project to be located in TEMA. Using GE's aero-derivative technology fuelled initially by LPG, the Bridge Power consortium will be able to start bringing incremental power to Ghana by the end of 2015. This consortium, together with Eranove (in the form of the Ghana 1000 consortium), will ensure the delivery of a total of more than 1 GW of power over the next four years, timed to meet Ghana's power needs and evacuation capacity build-out. ■

Integrated Gas to Power Projects

The Bridge Power and Ghana 1000 projects are integrated gas to power projects which means that they incorporate their unique fuel solutions – LPG in the case of Bridge Power and LNG regasification technology in the case of Ghana 1000. The country has historically leaned on hydropower to run its power stations. But ever-lower reservoirs at the Akosombo dam have increased dependency on light crude oil (LCO) generators. And while oil remains dependable, it is one of the most expensive ways to generate electricity. The savings of displacing LCO as a fuel are significant. In the case of Ghana 1000, Liquid Natural Gas (LNG) is approximately a third less expensive than LCO and the average power tariff savings are estimated to be 4-6 cents per kWh. ■

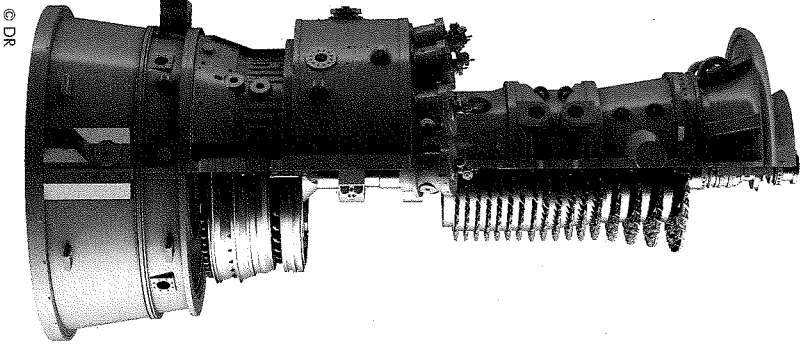
Today, Ghana's power situation is at an impasse. Though there is a nominal generation capacity of about 2,412 megawatts and dependable generation capacity of 1,750 MW, "Currently, Ghana has a power generation deficit in excess of 600MW as a result of lower than expected output from its hydroelectric installed base and the unavailability of many of its thermal power plants due to maintenance and fuel issues", explains Louis Josiah of Ghanaian partner, Sage Petroleum.

The Cost of Insufficient Power Generation

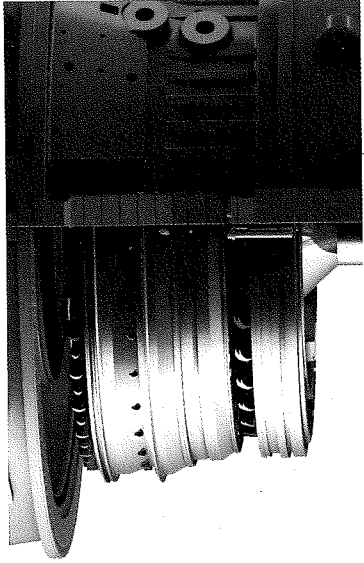
are students. However, low levels of attendance can be found and almost 50% of the unemployed 14.4% of the population. Access to primary schools is fairly good within a 10 km radius. The One Energy consortium is looking to change that, and will implement a program to help the citizens in the Shama District with enterprise development, education, training and skills development, as well as water and sanitation programs. Even though the power plant is not yet constructed, the consortium has already implemented youth career workshops to help those in the area understand the requirements needed to find their chosen careers and prepare them for the regional job market. "The consortium is committed to working with the youths within the district, helping them attain competitive jobs in the future," says Long. ■

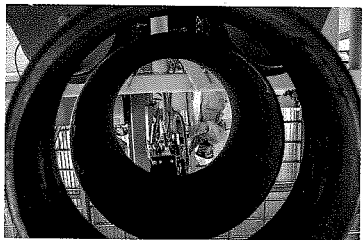
pitals," says Leslie Nelson, Executive GM, GE Power & Water – Africa. The government will facilitate a long-term agreement with the Electricity Company of Ghana (ECG) for the long-term purchase of power from the project. "This partnership is about job creation, skill and technology transfer as well as capacity development for Ghanaians," says Emmanuel Agyei-Mensah, CEO of Sage Petroleum. One key example to its commitment to local communities is a current program aimed at helping Ghanaian youths. The Ghana 1000 project will operate in the Shama District, the most densely populated area in Western Africa where the youth constitute 17.4% of the population. Access to primary schools is fairly good within a 10 km radius. However, low levels of attendance can be found and almost 50% of the unemployed

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▲ GE Gas Turbine.





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Economic Benefits

Independent consultants IHS believe that LNG will also stimulate electricity exports, with the combined savings and exports adding an extra \$500m by 2020. Given the pressures that Ghana's currency has faced in recent times, the reduction in spending in dollars on importing LCO will help strengthen the cedi. Indeed, the impact the Ghana 1000 project will have on the economy is significant: employment, government revenue, and a flip to GDP growth. IHS expect an extra 253,000 jobs to be created, 450 million cedi in government revenue, 2 billion cedi increase in annual labour wages, and a 4 billion cedi rise added to GDP.

"As we provide consistent power for Ghanaian residents and businesses, the quality of life will improve as well as the economic impact of Ghanaian industries", says Long. "This includes greater tax revenues, which will help bring down production costs and increase labour productivity, while providing capital investments in machinery and other technological advances for businesses. Additionally, by increasing power generation capacity alongside critical business reforms, Ghana will move closer to becoming a key industrial and manufacturing hub in West Africa."

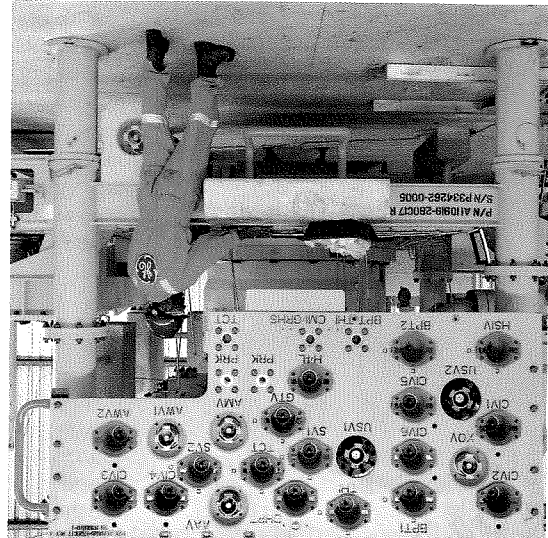
A flexible fuel solution

The first of its kind in Africa, the LNG solution will enable the power project to operate from the start on gas rather than LCO. The LNG will be brought by delivery vessels, transferred offshore to the floating storage and regasification unit (FSRU) located 3km offshore from the Takoradi enclave, where it will be regasified before it is piped onshore to the power plant.

"A key principle for the consortium was to structure a flexible LNG solution to ensure that it will not unnecessarily burden Ghana should Ghana's fuel needs ever change to the point that LNG is no longer required" emphasizes Michele van der Westhuizen, Project Lead for GE. "The LNG supply can be tailored to meet Ghana's changing needs - either decreased as indigenous gas comes on line, or increased as Ghana's need for power increases beyond that which can be supported by the current fuel mix" indicates van der Westhuizen. So LNG will complement domestic natural gas supply which even at its peak will not be enough to meet the nation's ever-growing demand for gas.

Also with an eye to flexibility, Exxcelerate has agreed to lease an existing floating storage and regasification unit (FSRU) to the project. This significantly reduces the cost and lead time for the project compared to having to design and build a new vessel. Further, "the mobile nature of an FSRU means that it can be redeployed in a different part of the world when it is no longer needed versus a permanent onshore facility which will become obsolete if no longer needed in Ghana" says Nelson. The FSRU brings additional benefits. Its excess capacity will allow other power generators to shift from liquid fuels to LNG which could save Ghana up to \$1bn per year and its storage capacity will enable power plants with low capacity utilization to get access to gas.

Like-minded strategic partners who can deliver like Shell and Exxcelerate have been a critical component in tailoring a solution to meet Ghana's needs," says van der Westhuizen. The multiplicity of strategic partners and, other key stakeholders in this project is an advantage. CEO of Erano, Marc Albeirolo says "in the case of Ghana 1000 project, the large size of the plant allows to reach a critical size in order to have access to gas via FSRU Optimization of operations and maintenance with a positive effect on production cost. For example it allows to rationalize the stock of spare parts - an important cost item in a power plant." Erano's subsidiary, CIPREL has a longstanding experience of operating and maintaining gas-fuelled power stations. Built in 1994, CIPREL was one of the first IPF operated in West Africa. Erano and CIPREL will use their expertise to serve Ghanaian businesses and individuals and apply the same key success factors: notably, hiring mainly local staff to be able to adapt to the context and culture of the country, focus on staff training and daily coaching, Quality - security - Environment certifications, and a CSR approach. By bringing in both the technology and the fuel partner, the Ghana 1000 project removes a traditional thorn from African power projects: the fuel supply. "Fuel



© DR

From tanker to Power plant - Local content key

availability is a critical bottleneck for projects across Africa", says Steve Jernigan, CFO of Endeavor Energy, "and the approach we have taken on the Ghana 1000 project helps to significantly de-risk the project for our investors. However, local producers will also play a key role in the Ghana 1000 project. As Ghana 1000's LNG facility and domestic gas fields like Sankofa begin to displace oil for power generation, the overall cost of power for Ghana will fall. This could raise the GDP by 1.7%, produce 250,000 new jobs and boost the economy by \$2.5 billion. In addition, by becoming a stable, long-term downstream user of Sankofa gas, Ghana 1000 will help to develop and bolster the local hydrocarbons industry and provide more local jobs. "Currently, the downstream gas market in Ghana is in its infancy so Ghana 1000 will play a vital role for the Sankofa project as a substantial anchor off-taker of gas", explains Long.

From tanker to Power plant - Local content key

To manage that LNG flow, local partners are critical. "For us, localization is not an option - it's a business imperative. Ghana 1000 was birthed by a team in Ghana", says Nelson. "Local partnerships and capacity building are not only critical for this project's success but the overall business environment and quality of human capital". GE is supporting the engineering programs at Ashesi University, the Kwame Nkrumah University of Science and Technology and the Applied Sciences program at the University of Ghana. And Ghana's Sage Petroleum is certainly not just here for the ride. One contribution will be to ensure that the plant, once commissioned, is optimized for minimal downtime. "To make this happen, it is important that the fuel supply chain for the project is robust and adjusted for the specific local circumstances of Ghana's market", explains Sage Petroleum's Josiah. "We have extensive experience in fuel trading and management and bring deep sector and market expertise to the project, right from its development through to production, in a manner that very few players can. This will ensure optimal plant uptime."

It's not just local partners that are evolving with the Ghana 1000 project. For example, for Endeavor, this is the first gas-to-power project where they have taken an active role in finding a suitable fuel solution to power the plant. And for GE, though its involvement in power projects in Africa has traditionally been limited to equipment supply and long term maintenance agreements, "now the company is more active in facilitating earlier stage development of power projects by dedicating resources and risk capital" explains Ron Mincy, Managing Director of GE's project finance team in Kenya. "In addition, GE provides advocacy support, technical assistance, and engages the capital markets to meet long term financing and credit enhancement needs. Ghana 1000 is a great example of this 'total solutions' approach."

GE in Ghana

GE works in Ghana to support economic growth through infrastructure development in power, healthcare, oil and gas and transport. GE is a government provider in Ghana, working with the stakeholders to solve infrastructure challenges. In Oil & Gas, GE gas turbines and compressors to invest in the country's rail infrastructure, par-



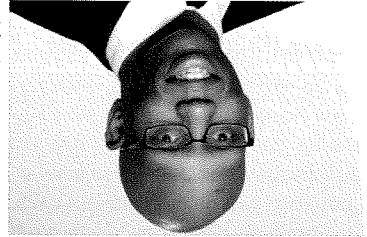
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play a critical role on the FPSO Kwame Nkrumah, powering the vessel and compressing natural gas for storage and transportation. In healthcare, GE has begun rolling out a massive health-care professional training program that will substantially improve maternal and infant care in rural areas using GE's unique portable ultrasound devices. In transport, GE remains committed to partnering with the government to invest in the country's rail infrastructure, par-

power and healthcare. GE in collaboration with the US Africa Development Foundation (USADF) and US Agency for International Development (USAID) recently launched a \$2m off-grid Energy challenge, a competition which allows innovators in Africa to showcase off-grid energy solutions that address energy gaps. Three Ghanaian companies recently won \$100,000 each.

Ghana will serve as an energy hub for power and fuel that will unlock the economies for millions beyond the border.

▲ Ron Mincy



© John Apocicio

▲ Patrick Awuah, President and Founder, Ashesi University College signing the MOU between Ashesi and GE on training and capacity building.



© BRITIKON



By bringing in both the technology and the fuel partner, the Ghana 1000 project removes a traditional thorn from African power projects: the fuel supply.

Money freed up for government

The project has also been helped by the continent-wide shift to an independent Power Plant (IPP) model, where the government helps arrange power purchasing guarantees and a platform, but does not run or build the plants themselves. The shift towards the IPP model in Africa has made it possible for governments in the region to tap into private capital markets both domestically and abroad to fund investments in the power sector," says Jernigan. "This has freed up government resources for other areas of the economy where private capital may be more difficult to attract. So with the transformative Ghana 1000 project, the government and people of Ghana win twice: first, by the 1300MW of power delivered fast and more cheaply than before; second, money no longer diverted to power can be spent on the education, housing and healthcare that citizens need. Last but not perhaps most important, by foregoing gas in their energy mix, Ghana will take a step towards eliminating carbon emissions. A far greener energy than oil, Ghana can bet on gas as the ideal stepping stone towards a carbon neutral future, as solar and hydropower projects eventually step up to take the weight."

Benefits for West Africa

This will also have positive spill-overs to the rest of the region. West African countries suffer similar electricity shortages. The LNG import infrastructure created by the project can help provide low cost fuel for power stations in Togo, Benin, Burkina Faso and Côte d'Ivoire. Ghana will serve as an energy hub for power and fuel that will unlock the economic integration agenda of ECOWAS and other regional bodies. There are lessons from abroad that provide a parallel to Ghana's situation. Argentina and Brazil both face similar challenges and opportunities – for example, pipeline gas supply uncertainty, from Bolivia to Argentina and Brazil, and in Ghana's case from Nigeria; increased gas-fired power generation supplementing low hydropower output because of lower rains; and LNG is cheaper than other liquid fuel alternatives. Argentina and Brazil both moved quickly to push through LNG import projects, and discovered that pent-up demand was far greater than initially expected. This suggests that when Ghana unlocks its LNG supply, it should prepare itself for consumption levels that exceed forecasts, ushering in a new era of cheap power driving the Ghanaian economy. The additional uses could include regional power generation (either through the export of power generated in Ghana or through exported natural gas) or other domestic industries, like fertilizers, plastics, and pharmaceuticals. ■

Meet the partners

The Ghana 1000 project features an impressive roster of international and local companies, each with deep expertise in their field.



Emmanuel Agyei Mensah, CEO Sage Petroleum.



Sean Long, CEO Endeavor Energy.



Marc Albero, CEO Endeavor Energy.



Project sponsors:



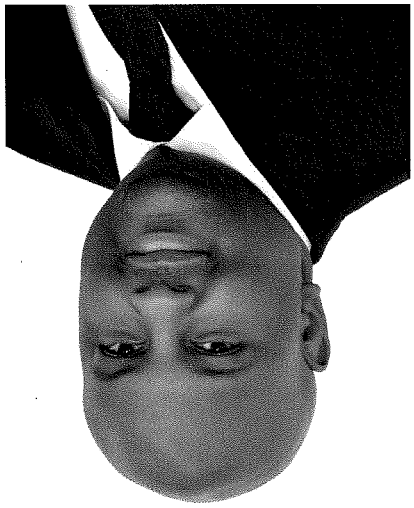
GE (NYSE: GE) imagines things others don't, builds things international independent power producer (IPP) company, headquartered in Houston, Texas, focused on developing and investing in power generation facilities in Africa.



SAGE PETROLEUM

Sage is the largest licensed Oil Trading Company in Ghana. The company's activities are carried out by experienced and highly trained professionals and supported by our key partnerships with ref-

ported by our key partnerships with ref-



Leslie Nelson
Executive GM, GE Power & Water - Africa

INTERVIEW

We all want this to happen.

This is a private sector led project, what role for government?
A project of this magnitude will not be successful without government support.

The Ministries of Energy and Power have forward thinking leadership that see how affordable and reliable power can drive economic success and are playing a critical role in getting this project to a bankable stage. Government's of renowned local and international players such as Sage Petroleum, the fuel supplier, together with Shell, Endeavour Company of Ghana (ECG), the World Energy, developer and lead investor; Bank and ADB's partial risk guarantee support for the project and the fast-tracking of processes to move the project quickly are examples of the urgency government attaches to this project - we all want this to happen.

What is GE's participation in the project?

GE is a premier infrastructure and technology company that provides solutions to some of the world's biggest problems. For this project, we are offering a bouquet of services – we are co-developers, investors, original equipment manufacturer and service providers, unlike competition. Power presents a great opportunity here in Africa and with our technical leadership and scale, we are rightly positioned to solve the continent's toughest energy problems. We have taken the strategic decision to actively facilitate the development of landmark power projects that have the potential to open up the market for more investment in key

How will the Ghana 1000 project cope with a scenario where another party is elected into power before the project is completed?

We are happy to note that this project is not political. We are talking of Power here, which affects the lives of everyone. We have no doubt in our minds that no matter the government of the day, it will continue to enjoy government support. Besides government is not really funding this, so the issue of a new government refusing to fund does not really arise. ■

GENERAL ELECTRIC



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