This article is an extract from *Performance*, Volume 8, Issue 3, August 2016. The full journal is available at **ey.com/performance**

Powering Ghana's economic future

Making power generation sustainable is becoming a major issue for countries globally. For developing countries, it's compounded by the tension between driving growth and social prosperity, and doing it in an environmentally responsible way. Ghana is exploring a way to make both ambitions possible.

This article is an extract from *Performance*, Volume 8, Issue 3, August 2016. The full journal is available at **ey.com/performance**

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Like many countries, Ghana is trying hard to meet its energy needs without relying wholly on fossil fuels. So increasing power production using local and renewable energy sources aims to improve energy security and grid stability, with the added benefit of boosting private sector involvement in the industry.

Ghana currently relies on two primary types of generation: hydroelectric and thermal plants. Due to high power demand and low supply capacities, hydropower mainly provides the base load, and output is dependent on the water level of the dams, which has been in decline in recent years. All of Ghana's thermal power plants are located in the south of the country and, currently, most of the fuel is imported, leading to a dependency on sufficient supply, exposure to price fluctuation and currency risks. There can also be supply delays and production shortages due to technical issues.

> Ghana's Government intends to diversify the power sector with thermal fuel and renewable power projects.

In the industrial northern region of Ghana, there is no large power-generation plant at all, with the exception of the Bui dam, which has an installed capacity of 400MW. While this region's rural areas are mainly supplied with decentralized systems, such as diesel generators, mainstream power largely needs to be transported from the south. This situation leads to losses in transmission and potential stability problems in the grid. Demand for power is currently much greater than the available generation supply, so expanding generation capacity is one of the top priorities for Ghana's Government.

This is a big issue, because a lack of reliable power is a major constraint to economic growth. According to the Energy Commission of Ghana (EC), sales of power increased by an average of 7.2% a year from 2005 to 2013, driving up sales for the grid operator NEDCo by 9.2% in the same period. Yet, out of a total generation capacity of 2.2GW, only 1.4GW were utilized due to limited water elevation in the dams, technical problems and a shortage in the supply of conventional fuels.[1]

The challenge of grid stability

To provide reliable power that meets rising demand, and to reduce dependence on hydroelectric power, Ghana's Government intends to diversify the power sector with thermal fuel and renewable power projects. Currently, the percentage of renewable power generation (excluding hydropower) is very low – just 0.1% at the end of 2014[2] – but the country has set a target of 10% by 2020. To support this, the Renewable Energy Act 2011 (Act 832) has introduced 10-year feed-in tariffs for power production from solar PV, wind and biomass to create a renewable energy capacity of 500MW.

1. Volta River Authority (VRA), 2015 Tariff Proposal.
2. Energy Commission of Ghana, *National Energy Statistics 2005-2014*, April 2015.

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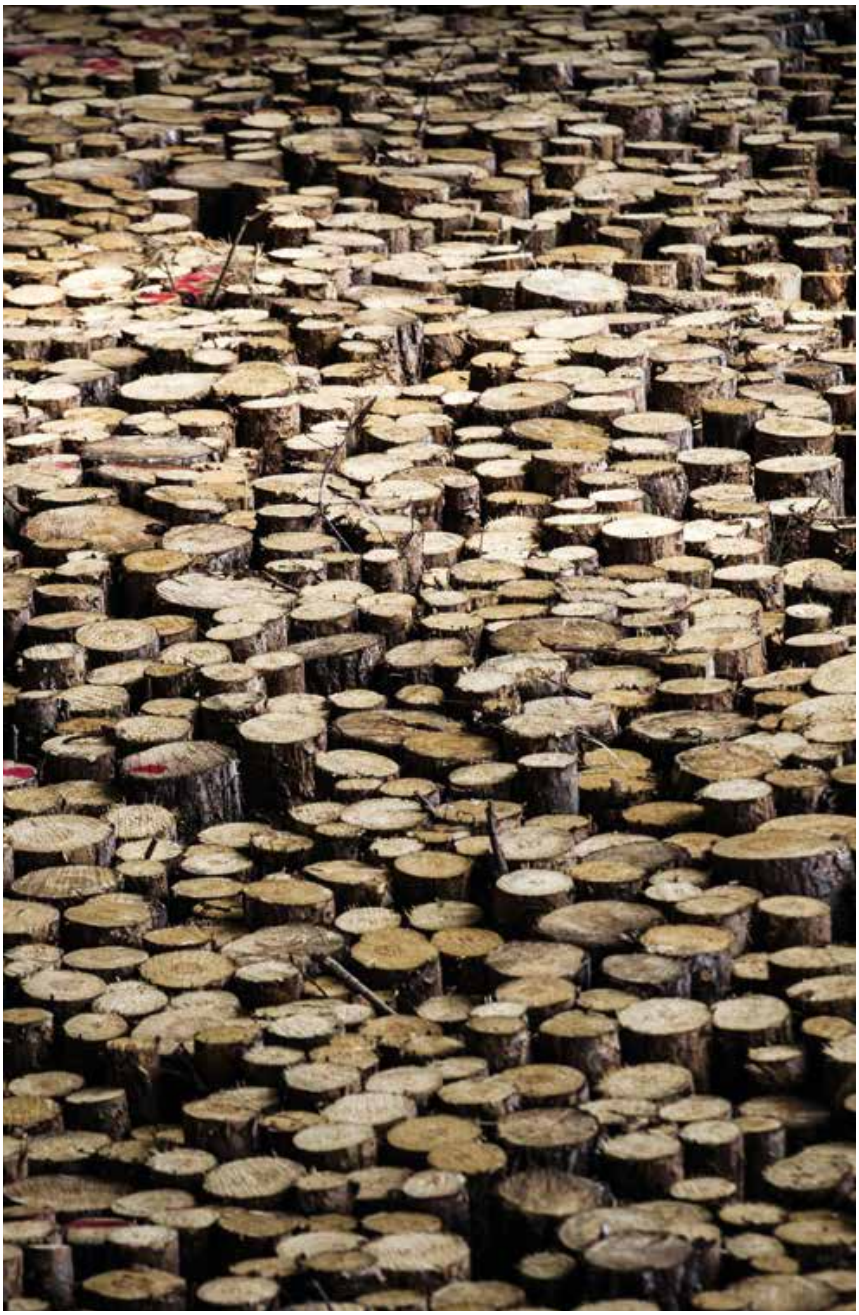

In 2015, the African Project of Sustainable Development (APSD) approached EY to investigate the potential benefits of a renewable fuel power plant in Ghana. Working together, the cross-functional, multinational team helped APSD to instigate a major biomass-powered energy project. Because the lack of electricity access is particularly acute in the northern region of Ghana (lower than 50% in some parts) the APSD chose this area to locate the facility. Based on a large-scale eucalyptus plantation in the Brong Ahafo Region, the source and plant will be fully integrated from an operational and legal perspective, and the large-scale plantation will also help reverse the rapid deforestation of Ghana, while capturing and permanently storing carbon dioxide.

A sustainable closed-loop energy model

Eventually, the facility will have a total area of 22,809ha, with 60% used as plantation, 25% reserved as environmental protection areas and the remaining area set aside for villages, infrastructure such as roads, and other protected areas, including burial grounds.

Plantation seedlings are grown in the nursery (which currently has space for 20 million seedlings, rising to 25 million eventually), planted and harvested five years later (see Figure 1). The plantation is on degraded or deforested land, meaning that no existing forest formations or crops have been replaced. The most fertile land will be reserved to grow food

> It's widely accepted that a direct increase in employment will entail an indirect employment effect caused by a higher demand for food, short-term shelter, long-term housing and living space, and consumables in general.

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Figure 1. Integrated supply process of the power plant

in cooperation with the local population. As the plantation will be a monoculture with limited biodiversity, the design includes protection areas, for example, close to water resources. Biodiverse areas will be preserved and natural vegetation maintained or re-established.

The plantation should not need any watering, instead relying on readily available rain water – boreholes show that groundwater sits at depths of about 50 to 180 meters, whereas the average rooting depth of a fully grown eucalyptus tree at felling age is only around 3 meters, so does not drain groundwater. After five years, the trees will be felled, debranched and stacked to dry for four to six weeks without additional heat. After logging, the area will be replanted immediately. Logging and replanting will be done continuously to reduce seasonal work, and wood ashes will be continuously taken out and recycled in the plantation or in areas of food production as fertilizer. It represents the main residual and amounts to approximately 0.5% of the biomass fired.

Firing all this wood is a biomass power plant, located in the center of the plantation so it can easily be reached, lowering transport costs and enabling future expansion. The plant will only burn wood fuel produced in the plantation. Construction is scheduled to begin in late 2016, and the plant will be operational in 2019. Power production is estimated to be 426GWh a year – 12% of the total renewable energy target.

Powering economic development with employment

Despite Ghana's progress in poverty reduction and human development, a significant proportion of the population still lacks decent work opportunities – the north of the country and rural areas in general are a major concern. Women in rural areas, in particular, face greater difficulties

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in transforming their labor into more productive employment with higher and more secure income. Similarly, the young rural population faces barriers in joining the labor market, and migration is often a livelihood strategy.[3]

The northern, upper western and upper eastern regions of Ghana remain the most affected by extreme poverty, and there is a concerning shortage of employment opportunities for young people. While official statistics point to a low unemployment rate (2.5% of economically active males over the age of 15 – a rate that is seldom achieved by industrialized countries), there are a number of possible factors influencing why this might be:

- The definition used for labor and workforce
- The system for registering unemployment
- Gender inequalities that have not been taken into account
- The impact of agriculture being a low-wage sector

> Construction is scheduled to begin in late 2016, and the plant will be operational in 2019.

3. *Gender Inequalities in Rural Employment in Ghana*, Gender, Equity and Rural Employment Division of the Food and Agriculture Organization (FAO), 2012, http://www.statsghana.gov.gh/docfiles/Gender/FAO_GHANA_COUNTRY_PROFILE_FINAL2012.pdf, accessed June 2016.

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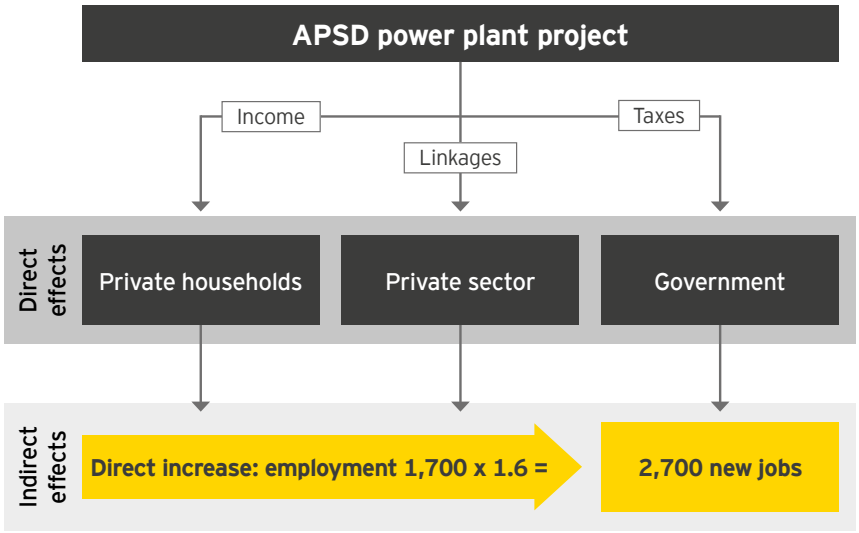
Figure 2. Estimate of factors influencing direct and indirect employment effects



It's widely accepted that a direct increase in employment will entail an indirect employment effect caused by a higher demand for food, short-term shelter, long-term housing and living space, and consumables in general. Aaron (1999)[4] calculated a factor of 1.6 to describe the direct and indirect effect caused by an increase in employment. Combined with a low share of seasonal workers, this would further strengthen the development of the region.

The APSD estimates that the plant needs a labor force of 1,500 to 1,700 people and a staff of 30 for the power plant when it reaches its full scale (see Figure 2). In October 2015, the APSD employed a total of 1,024 people, and the remaining roles left to fill will largely be

4. C. Aaron, " The contribution of FDI to poverty alleviation," Washington, DC: Foreign Investment Advisory Service, 1999, cited in S. Z. A. Rizvi and Dr. M. Nishat, *The Impact of Foreign Direct Investment on Employment Opportunities: Panel Data Analysis, Empirical Evidence from Pakistan, India and China, 2009*, http://pide.org.pk/psde/pdf/Day3/Syed%20Zia%20Abbas%20Rizvi.pdf, accessed June 2016.

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from within a lower-income group. However, all employees receive health insurance and pension scheme contributions, and high labor standards have been established. Based on the application of the multiplier effect "k" (see "Calculating the multiplier effect" for an explanation of k), it's estimated that the power plant project will have the employment effect of creating 2,700 jobs (direct and indirect). This will increase disposable incomes and therefore drive greater private consumption. Applying a multiplier effect k of 3.0 on annual payments for salaries and wages, the added value amounts to US$3.4m in 2015 and US$5.7m in 2019.[5]

> The new plant will help to increase grid stability and power supply, and will promote the local economy in the Brong Ahafo Region of Ghana.

Conclusion

This project has generated a lot of enthusiasm, and it remains to be seen how positive an effect it will have on employment and wider social factors. Either way, the new plant will help to increase grid stability and power supply and, in addition, will promote the local economy in the Brong Ahafo Region of Ghana. It's a strong example of how it's possible to combine economic growth with sustainable development. ■

Calculating the multiplier effect

To quantify the positive side effects, a multiplier factor "k" was defined. This factor is a macroeconomic concept to measure the effect that a change of an exogenous variable has on an endogenous variable – so k is a proportionality ratio. In this context, the team used the change of consumption caused by an increase in disposable income (the "marginal propensity to consume" (MPC). Optimistic approximations state a multiplier effect of k equals 3.6 based on progressive assumptions founded on a MPC of 0.8. A more conservative approach finds a multiplier effect of k equals 2.6 based on a MPC of 0.61.[6] A realistic approximation of the multiplier effect, which neither overvalues nor underestimates the impact, is assumed with a multiplier factor of k equals 3.0.

5. Based on management information on paid salaries.
6. This amount has been calculated by taking 0.8 (the MPC of GDP, as stated by the World Bank) corrected by a factor of 0.9 to include Ghana´s trade deficit. Conservative k based on an MPC = 0.61, in accordance with C. Altshuler, "A macroeconomic model of Ghana," in D. Salavtore, *African Development Prospects*, 1989, page 298.