

Challenges in the Electricity Sector: Jamaica at the Crossroads

Presentation at the Geological Society Exhibition

University of the West Indies

By

Dr. Cezley Sampson, PhD, FJIM, CD

28 November 2006

The Challenges of the Energy Sector

Introduction

The macro-economic effects of the energy sector and especially that of the electricity sector have retarded the growth of the Jamaican economy over the last five years. The recent World Bank Country Assistance Report alluded to high cost of energy as a factor frustrating the realisation of the macro-economic policy objectives and high electricity prices are a barrier to economic growth.

The Macro Economic Effects

In the period 1998 to 2005 Jamaica's import energy bill grew from US\$323 million to US\$ 1.35 billion. Our export earning is now not sufficient to cover our energy bill and we have had to rely on remittances. Over the seven year period demand has grown by less than 20 %, whilst the cost has increased fivefold. Our demand has averaged about 25 million barrels over the last five years when we exclude oil sales involved in export trade: bunkering for ships and aircraft. Crude oil price itself has increased from US\$ 12 per barrel to over US\$70 per barrel. The high import bill has been a major source of pressure on the Jamaican exchange rate and the balance of payments.

Electricity prices increased from US\$ 16 c/kWh in 2001 to over US\$ 24 c/kWh in 2006, seriously impacting on inflation, whilst eroding disposable income. Although prices have gone up substantially we have failed to cut back on our energy expenditures, the result is that education and health expenditures are being short changed, with increasing pressure for government to meet more and more of these costs. In terms of the impact on the poor, a significant percentage is not able to afford the current electricity prices; despite the lifeline tariff for consumption less than 100 kWh per month.

Increasing prices have been affecting affordability right across the income groups and these are probably being reflected in higher levels of theft of electricity, not just by the poor but by commercial enterprises and people living in wealthy areas of our society. In fact systems losses at JPS have increased from 16 % in 2001 to 22.5% in 2006 and most of this increase comes from commercial losses, or theft of electricity. Although the regulator sets a cap on losses in the rates at 15.8%, this has not resolved the problem because the company has to absorb about US\$ 16 million per year, money which could have been spent to introduce more productive and efficient technology and equipment and reduce long term operating costs.

The manufacturing sector and large commercial service operators are currently paying 14c/kWh to 16c/ kWh for bulk electricity. These industries have to compete with Trinidad and Tobago entrepreneurs who are paying 3 c/kWh for bulk electricity. This put the Jamaican entrepreneur at a serious competitive disadvantage. Despite the improvements in energy efficiencies in the alumina industry, the fact that they rely exclusively on fuel oil as the main source of energy, weakens their competitive position on the global market. The sum total is that with the high energy cost which prevails in Jamaica our two key industries: bauxite especially and to a lesser extent tourism, will increasingly find it challenging to compete in global markets.

The Global Energy Context

If we look at the consumption pattern over 70 % of electricity consumption relates to public electricity generation and energy for the bauxite and alumina sector. In the alumina refining process fuel oil is used for both electricity generation and in the calcination process. The next major user is transportation with about 23 %. About 800,000 barrels a year are also used for cooking, as LPG. We therefore need to focus on these three sectors: public electricity, the bauxite industry and transportation in terms of resolving the energy problem. If we integrate the energy sectors of public electricity and the bauxite industry there are possible economies of scale in fuel procurement, transportation and terminal operations, as well as in electricity generation. Arrangements for example have more or less been finalized for JAMALCO as part of a major alumina refinery expansion to put in a 193 MW Combine cycle gas turbine power

plant and to supply about 85 MW as export power to the public system at less than half the current cost of production.

Jamaica is over 96 % dependent on petroleum based fuel and especially heavy fuel oil for its energy requirements. We currently have about 22 MW of small run-of-the-river mini hydro plants, a 20 MW wind plant and about 20 MW of sugar refinery bagasse power. Even when oil was US \$20 a barrel very few countries's public electricity system relied on fuel and diesel as their main sources for fuel. In fact in the USA less than 3% of public electricity is generated from oil, and the global average is more like 8 %. The main fuel used globally for electricity generation is coal. In the USA over 50 % is fuelled by coal and in South Africa it is over 85 %. In China, Australia and Germany coal is the major source for electricity generation and for industrial processes. In the USA no coal plants were built in the 1990s because of environmental reasons: however since 2000 over 140 coal plants using clean coal technology have been built or are under construction involving over 8000 MW of new capacity. Today coal is the cheapest fuel when taken in terms of British thermal units and efficiency factor. Coal is working out at about US\$1.5 to US\$2 per million Btu.

In the period 1980-1990 natural gas became the 'fuel of choice' for electricity generation. Today about 20 % of electricity in the USA comes from natural gas. In the UK in 1990 natural gas fuelled less than 1% of public electricity supplies. By 2004 the share of electricity fuelled by natural gas in the UK increased to over 30%. Combined cycle gas turbine technology has revolutionised the electricity industry in Britain over the last 15 years, transforming it from a vertically integrated monopoly industry to unbundled competitive industry. Any consumer can now buy electricity from a supermarket in the UK.

The attractiveness of CCGT system stems from low capital cost, the ability to build in modules of about 40 MW (from packaged factory built systems) and the relatively short construction time, resulting in short investment recovery time. Additionally, because of the high operating temperature, efficiencies of 60 % are now obtainable in modern CCGT plants and this compare to coal and oil where efficiencies are below 40 %. Most importantly the lower nitrous oxide (NOX) and CO2 emissions per unit of electrical energy produced makes GT the cleanest of the fossil fuels. New generation GT being developed will provide the option of using multiple fuels. When environmental cost is factored natural gas compares with coal in terms of generation cost

Major developments are also taking place in new clean coal technologies involving a set of pulverized or fluid-bed combustion technologies. In addition, developments are taking place in integrated gasification combined cycle systems and non-integrated gasification fuel cell technology. The pulverized and fluid-bed combustion technologies are now being commercially deployed. The key factors to the success of gasification based on coal are related to the building of more durable gasifiers to achieve higher performance, the increase in feedstock flexibility and the development of advanced gas cleaning technologies that can capture virtually all the pollutants; ash, sulphur, nitrogen oxides, etc.

The Jamaican Energy Context

If we take Jamaica, the total system size is currently 818 MW for the public electricity system and about 200 MW for the self-generators—mainly in the alumina and sugar sectors to make a total size of 1000 MW and this compares with Trinidad and Tobago with a system size of just over 1100 MW. Of the public system JPS owns about 621 MW and the independent power producers and self- generators about 197 MW. The IPPs currently produce about 33 % of the bulk power. JPS no longer has monopoly on bulk electricity generation. Its exclusive franchise is limited to transmission, distribution and retail supply. Peak demand is currently just above 600 MW and electricity demand is growing at 3% to 4 % per annum. By 2015 we can expect peak demand to be about 900 MW and the size of the public system to be about 1150 MW, providing a reserve margin of about 23 %. We need about 350 MW of new capacity by 2015 to satisfy new demand.

More than 50% of the JPS's capacity is over 30 years old. Most of this capacity has served its economic life and will be approaching 40 years if not replaced by 2015. The average thermal efficiency of JPS plants is 28 %. This means that for every US\$100 of oil imported, US\$ 72 goes into the atmosphere as waste heat. The question we need to ask is this sustainable?

The thermal efficiency of some of these units exceeds 1500 kj/kWh and this is against a background with crude oil prices in the region of US\$ US\$ 70 per barrel. More than that, over 22.5 % of the electricity generated by JPS reflects itself as system losses. When we factor transmission and distribution technical loss which is about 9-10 %, only about 22 % of imported fuel is efficiently used. If we replace the old equipment used as base load plants and also meet the new capacity requirements with coal and CCGT plants by 2015 we could cut bulk electricity average production cost to about 8-9c/kWh, almost down by almost 100 %. This would have a favourable impact on the exchange rate, as the import fuel bill would be smaller comparatively, industry would be more competitive and consumers would benefit from lower prices, hence there would be a beneficial effect also on the inflation levels.

It is my view that the old equipment, old technology, inappropriate vertically integrated single buyer structure, with weak incentives for efficiency enhancing behaviour, along with the wrong fuel policy which accounts for the high cost of electricity in Jamaica. Jamaica is at the wrong side of the energy spectrum. Recently we have been experiencing frequent power cuts and voltage fluctuations; poor quality electricity. Jamaica could not build a competitive information technology industry in today global market on the quality of power presently produced from the public system.

We need about 500 MW of new capacity to meet new demand and replace aged equipment conservatively estimated at US\$ 500 million over the next 5 to 7 years. One of the current suggestions is that GOJ reacquire JPS. Purchasing JPS does not solve the energy problem. It is what we do with it after we acquire it that matters. The simple question I would like to pose. Where would the public sector obtain the funds to reacquire JPS and on top of that finance the modernization? What would be the consequence for the exchange rate if were to take on this new debt? Even if we could find this sum could this money not be spent in education and health at better returns? Part of the reason for privatisation in 2001, after the experiences of the regular power outages over an 18 month period was that the public sector could not finance the company's capital investment programme. Our memories are short.

We talk repeatedly about renewable energy. Surely, renewable energy has a role to play, however with today's technology thermal power will remain globally and in Jamaica as the main source of energy for electricity generation for the next 20 years. We have very limited hydro resources. In fact the estimate is that only 30 MW of additional mini-hydro capacity could be developed without encountering serious environmental problems. Solar photovoltaic is not yet competitive and countries like Germany where PV has made significant progress the industry benefits from massive subsidies which Jamaica could not afford with the current debt burden. Bagasse presents good prospects.

In fact Mauritius meets 30 % of its electricity fuel needs from bagasse. Until we can grow cane efficiently in large volumes and manufacture sugar efficiently at the refineries, bagasee can only be seen as a good prospect. Bagasse is also only available for six months of the year. We would need to grow large acreages of energy grass or high fibre cane to be able to supply electricity from biomass all year round. The sugar industry needs well over US\$ 300 million to modernise itself to become globally competitive and to be able to supply competitively priced co-generated power.

At the present moment we do not have a wind map of Jamaica to inform us where large additional quantities of wind power could be produced. Because of its unreliability, Wind invariably does not provide capacity. There is however a benefit in that it comes from domestic a source and once the capital is invested there is no further fuel (energy) charge

and therefore saves scarce foreign exchange. If wind energy is to provide capacity we need to develop several sites, then it may be possible to factor about 20 % of wind as capacity.

In the case of solid waste, I am informed that the current volume of waste is insufficient to provide for more than 25 MW of capacity. We would need to resort to the importation of waste for waste to energy to make a significant contribution to our power needs.

Lastly, we still talk of nuclear power as one of the energy solution for Jamaica. First, it takes ten years to bring nuclear plants into operation. Second, with today's technology nuclear plants are far too large for our system size. Plants above 120 MW would compromise system security in Jamaica. As far as I know the Chinese technology provides for about 160 MW as the smallest plant. Both the South African pebble bed technology and the Chinese technology are at the test plant stage. Lastly there is the problem of dealing with the spent fuel and the environmental problem of decommissioning the plant at the end of its life.

Conclusion

The technology to address our energy problem and significantly reduce electricity prices over the next 10 years is known. We do not have to experiment. I do not feel the problem is also one of raising the capital, which estimated at about US\$ 500 million. With the right incentives the private sector will rise to the challenge. The experiences of Mirant over the last five years are not a good basis to judge the performances of the private sector. The private sector has been a major source of financing for the power sector in Latin America and the Caribbean over the last 15 years. Government involvement in securing long term supplies of natural gas in the form of CNG or LNG and also securing coal supplies is critical. This is where government's involvement is needed. What is needed is the commitment and not to relax our position just because oil prices have fallen in recent weeks. High crude oil prices are here to stay and we will not see US\$ 20 per barrel oil again for a long time if ever.