(The Ghana Nuclear Power Programme Organization (GNPPO) is mandated with the task of coordinating, overseeing and administering the phase-to-phase implementation of the Nuclear Power Programme in Ghana until the commissioning of Ghana's first nuclear power plant.)

GNPPO NEWSLETTER

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Economic Benefits of Nuclear Power

BACKGROUND

From the 1950's till date, Ghana's energy demand has experienced study growth. The growth in energy demand is projected to be substantial taking into consideration government of Ghana's development agenda and the National Development Planning Commission's (NDPC) 40-year Development plan. It will take careful planning and a shift from the usual in order to meet the projected energy demands.

A country's development is dependent on improved infrastructure, an enhanced educational system, robust economic activities and job opportunities. All these could be possible with sustainable energy and for that matter reliable and long-term base load electricity. This is where nuclear energy can play a significant role.

Building a nuclear power plant is capital intensive with long project schedules, high investment costs, and takes a longer time to come into operation. However, nuclear is more economically competitive and even becoming more competitive as climate change concerns continue to increase. It is refreshng to know that nuclear power has low operating cost due to low and stable cost of fuel. The average nuclear energy facility is on line at least 90 percent of the time, generating on-demand electricity around the clock.

Diversifying supply of fuels and technologies to generate electricity balances the benefits and risks associated with each source, including clean air, reliability and economics. Nuclear energy plays an important role in a diverse generating mix— it is critical to global efforts at reducing greenhouse gases. Compared to other base load options, nuclear energy has tremendous price stability because fuel accounts for just 31 percent of production costs. Fuel costs are closer to 80 or 90 percent when electricity is produced by burning coal or natural gas. This makes electricity from fossil-fuel plants highly susceptible to fluctuations in coal and gas prices. In addition to price stability, the nuclear energy industry plays an important role in job creation and economic growth, providing both near-term and lasting employment and economic benefits.

NKRUMAH'S NUCLEAR AGENDA FOR ECONOMIC DEVELOPMENT

Ghana recognized the role of nuclear energy in its socio-economic development since independence. This recognition was captured in a compelling and profound statement by Osagyefo Dr. Kwame Nkruamh, Ghana's first president on November 25, 19964 during the launching of the Atomic Project. He said "*We have been compelled to enter the field of Atomic energy, because this already promises to yield the greatest economic source of power since the beginning of man. Our success in this field would enable us to solve the many sided problems which face us in all the spheres of our development in Ghana and in Africa*".

Dr. Nkrumah as at that time of launching the Atomic Project understood the importance of having nuclear energy and its impact on all aspects of the economy. He clearly understood the energy-development nexus and considered the use of nuclear technology for electricity generation as an alternative that could not be ignored in the country's quest to have reliable energy infrastructure that would power industry for rapid economic growth. Ghana has, since the overthrow of Dr. Kwame Nkrumah, struggled with energy issues and has experienced erratic power supply over the years. It is, therefore, appropriate to revisit the economic benefits of nuclear energy and the reasons Dr. Kwame Nkrumah was so passionate about nuclear energy. The benefits would also show that nuclear energy is not a question, it is rather an answer; an answer to climate change concerns; an answer to energy reliability and sustainability; an answer to industrial revolution and economic development.

EMPLOYMENT AND JOB CREATION

All energy sources create jobs and the jobs come in different forms and categories but Nuclear Power Plant (NPP) construction and operation cannot be matched by any other energy source in terms of the number of jobs and remuneration packages. Indeed, there are two categories of jobs and they are:

1. Investment jobs, which include manufacturing, construction, and installation.
2. Operating jobs; jobs relating to the day-to-day operations of the energy-producing facility

Huge opportunities exist for employment in construction, installation and operational areas for Nuclear Power Plant more than any other energy source. Construction of a Nuclear Power Plant will create job opportunities for skilled artisans including masons, carpenters, welders, pipefitters, sheet metal workers, electricians, and heavy equipment operators. Engineers, project managers and construction supervisors will also be engaged at the construction stage. The nuclear energy industry can, therefore, play a significant role in job creation and economic growth, providing short, medium and long-term employment opportunities.

Indirect employment during the construction stage of a Nuclear Power Plant is also worth noting. The construction stage of a 1000 MWe (thousand megawatts electric) Nuclear Power Plant will give huge market for suppliers of cement, steel and other materials in very large quantities. To put this into context, a single new nuclear power plant construction will require about 400,000 cubic yards of concrete, 66,000 tons of steel, 44 miles of piping, 300 miles of electric wiring, and 130,000 electrical components and all these will bring job to a lot more people. For construction of a 1000 MWe of installed capacity, a gas plant requires about 1,000 jobs, wind requires 1,000 jobs, coal 1,500 jobs, and nuclear 3,500 jobs.

Nuclear Power Plant operations also employ a lot more people than other energy sources. The long operational lifespan of NPPs (60 years and above) means nuclear jobs are more stable and rewarding. For operations, gas often requires only about 60 jobs per 1,000 MWe of installed capacity; wind requires 90 jobs, coal 220 jobs, 150 for hydro and nuclear 500 jobs.

Aside from management, all NPPs engage people with diverse backgrounds. Critical areas usually considered in the operation of an NPP are: Engineering (Mechanical, Electrical, Civil, Nuclear); Operations (Licensed Operators, Non-licensed Operators); Maintenance (Mechanical Technicians, Electrical Technicians); Instrument & Control Technicians; Chemistry Technicians; Radiation Protection Technicians; Security etc.

A lot of indirect jobs are also created in the area of real estate, catering services etc. The national and local economic effects of the power plant(s) are considerable because of the buying power created by the high wages, salaries and benefits paid to employees. In turn, plant employees stimulate their economies by buying goods and services provided locally. This spending supports many small businesses in the area. The tax by a Nuclear Power Plant extends beyond the tax revenue generated directly by the plant. Aside from the direct tax, licensing fees, and taxes paid on income there are secondary effects of plant purchases on other products and services, leading to additional income and value creation, as well as additional tax revenues. Direct corporate social investment, which is significant practice and strong tradition of nuclear power plant operating companies, creates a lot of secondary jobs for communities close to the NPP.

It is clear that an NPP could generate a chain of benefits for Ghana. Apart from providing reliable base load and sustainable electricity supply for rapid economic development, corporate and wage-related taxes as well as import duties and taxes on purchases, supplies and services would stimulate Ghana's economy immensely.

COST COMPETITIVENESS OF NUCLEAR POWER PLANTS

Even though the capital cost of a nuclear power plant is relatively high, the low cost of nuclear fuel and the relatively long operating lifetime make nuclear power economically competitive than thermal power plants in the long run. Nuclear fuel constitutes about 14% of the entire electricity generation cost compared to 89% in gas and 78% in coal. This makes nuclear power systems insensitive to fuel price volatility. A study by the International Energy Agency (IEA) in 2015 on levelised cost of electriciy generation from coal, gas and nuclear plants is presented in figure 1. The Study indicates the cost competiveness of nuclear power over the other energy options, particularly at low discount rate thus presenting a good opportunity for developing countries like Ghana.

Fig. 1. Levelised cost of electricity

NUCLEAR ENERGY AND THE ENVIRONMENT

Issues relating to the environment are sensitive in modern society because we now understand the vital role of the environment to our survival. Globally, a measure of greenhouse gases is the most acceptable indicator for the impact of an activity on the environement. Although all human endeavours have levels of effect on the environment, a report on greenhouse emissions indicated that electricity is the single largest source of greenhouse gas emission (30% of the total emmission) in United States (USEPA 2014). As Ghana is making effort to include nuclear energy in its energy generation mix, it is important to assess the environmental impact of nuclear energy, compared to other generation sources (e.g., coal, hydro, renewable, and thermal) in order to appreciate nuclear energy's ability to increase generation capacity while lowering green house emission. The Energy Commission of Ghana has already started this assessment and has observed that carbon dioxide emissions as a result of the energy usage rose by 1.8 million tonnes within two years . However, it dropped by 0.3 million tonnes when there was a reduction in thermal power generation within the subsequent two years.

Nuclear energy is seen as one of the cleanest source of energy because it produces almost no carbon dioxide, and no sulfur dioxide or nitrogen oxides whatsoever. These gases are produced in vast quantities in thermal plants. Figure 2 below, illustrates the various equivalent proportions of carbon dioxide emitted by different energy sources; hydro, renewables and nuclear clearly lead the pack in limited release of greenhouse gases.

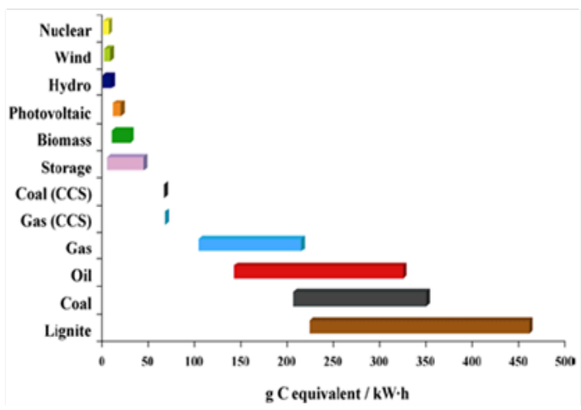

Fig. 2. CO_2 emission

If the values in Figure 2 are normalized by the amount of energy produced, nuclear would be the cleanest, a clear depiction of efficiency. In the US, where there is Clean Air Act meant to improve the quality of air, an assessment showed that nuclear power has played a significant role in over 40 years of the act's existence. For instance in 2009, the country's nuclear plants had been responsible for the emission of approximately 2 million tons of sulphur dioxide (SO2) and 560 000 tons of various oxides of nitrogen (NOx). IAEA also observed that globally, in 2011, the use of hydropower helped in avoiding 2.8 Gt of CO2 emissions, nuclear power 2.1 Gt and other rewables 0.8 Gt (Figure 3). It is clear that the use of nuclear power can help reduce significantly the amoung of GHG emitted.

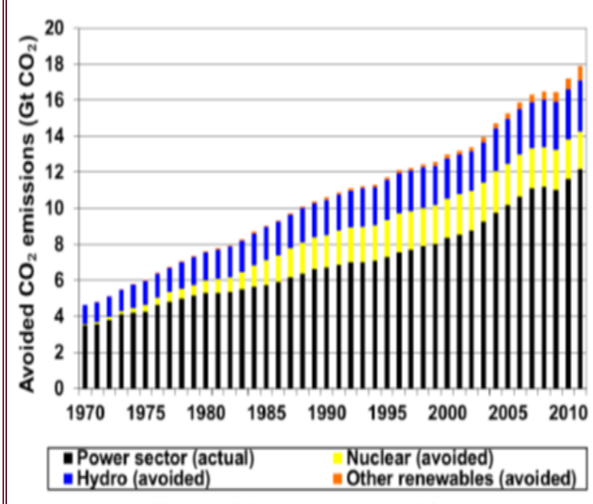

Fig. 3. CO_2 emission avoidance

Fig. 3. Global CO2 emissions from the electricity sector and emissions avoided by using three low carbon generation technologies. Source: IAEA calculations based on IEA Projected Cost of Generating Electricity, Paris 2015.

Often safety and environmental concerns associated with a nuclear power plant are centered around risk of radiation exposure and nuclear waste management. The main safety concern is the release of radioactive material into the environment with the possible radiation exposure to organisms. It is assuring to note that nuclear reactor technology has advanced over the years inculcating high-quality design and construction to achieve optimum safety.

There is provision of several layers of barriers so that in the event of accidental radiation release, the radiation can be confined in a containment building and dealt with without any exposure to the environment. It is also important to observe that the design does not allow discharge of waste directly into the water body which is employed for the cooling. The tubes used for piping provide a barrier between the steam and the environment, preventing physical contact between the plant's steam and the cooling water source. There is, therefore, no release of radioactive material into the cooling water. A condenser operates at a vacuum so that any tube leakage in this system will produce an "inflow" of water into the condenser rather than an "outflow" of water into the environment.

Lastly, concerns regarding the management of nuclear wastes should be the least of anybody's worries. Compared to fossil fuels, the amount of nuclear fuel used to generate equivalent energy is several times smaller as illustrated in ***Figure 4.***

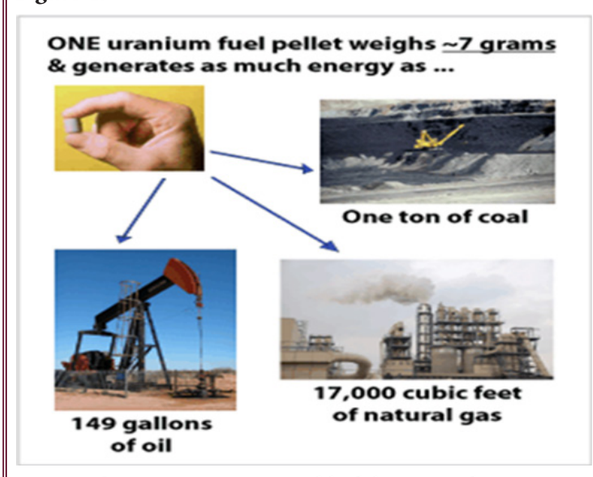

Fig. 4. Comparing amount of fuel for equivalent energy

Correspondingly, nuclear waste is about a million times smaller than fossil fuel waste, and it is totally confined. It is interesting to note that nuclear power plant is not the only source of nuclear waste. Large amount of radioactive waste is produced through medical, industrial and research activities and there are various management methods for the waste. The various disposal techniques for nuclear waste include near surface, engineered structures, mined cavities, and deep geological repositories with less chance of the waste entering the biosphere. Generally, the hazard associated with nuclear waste decreases with time due to radioactive decay of the nuclear material. The spent fuel which is the main waste from the nuclear power plants can be reprocessed into new fuel elements to produce more energy. In effect, the impact of nuclear energy on the ecosystems is minimal.

No. NPID-127541-NWL-002 | Editor: Elikem K. Ahialey | Mobile: 233507011480 | Email: info@npi.gaecgh.org