The Centre for International Governance Innovation

NUCLEAR ENERGY FUTURES PAPERS

The Nuclear Energy Futures Project

Nigeria and Nuclear Energy: Plans and Prospects

NATHANIEL LOWBEER-LEWIS

Nuclear Energy Futures Paper No. 11
January 2010

An electronic version of this paper is available for download at:
www.cigionline.org

Summary

Nigeria, the most populous country in Africa and a major oil exporter, suffers from chronic energy shortages. Years of under-investment, lack of maintenance and perpetual resource supply problems have elevated the situation to crisis levels. National policy makers have consequently expressed an interest in nuclear power as a source of stable electricity.

Although the federal government of Nigeria has explored the possibility of developing a nuclear energy program since the 1970s, in recent years the country has increased efforts towards commissioning its first nuclear power plant. A roadmap developed by the Nigerian Atomic Energy Agency (NAEC) calls for 1,000 MW of nuclear power by 2017 and 4,000 MW by 2027. Still in phase two of the IAEA assessment framework for states pursuing nuclear power for the first time – Nigeria has made a policy decision to pursue nuclear power and is currently undertaking the necessary preparatory work to invite a first bid for construction – it is unlikely Nigeria will begin construction of a nuclear power plant before 2020.

Despite progress in some areas, including the ratification of international treaties, development of regulatory infrastructure and signing of bilateral technical cooperation agreements, significant challenges remain: a substandard grid, underdeveloped electricity market, lack of technical capacity, widespread corruption and a dubious history of success in large, government-managed projects, render the proposed NAEC timeline unrealistic.

ISSN 1919-2134

CIGI's Nuclear Energy Futures Project

CIGI's Nuclear Energy Futures Project is chaired by CIGI distinguished fellow Louise Fréchette and directed by CIGI senior fellow Trevor Findlay, director of the Canadian Centre for Treaty Compliance at the Norman Paterson School of International Affairs, Carleton University, Ottawa. The project is researching the scope of the purported nuclear energy revival around the globe over the coming two decades and its implications for nuclear safety, security and nonproliferation. A major report to be published in 2010 will advance recommendations for strengthening global governance in the nuclear field for consideration by Canada and the international community. This series of papers presents research commissioned by the project from experts in nuclear energy or nuclear global governance. The resulting research will be used as intellectual ballast for the project report.

We encourage your analysis and commentary and welcome your thoughts. Please visit us online at www.cigionline.org to learn more about the Nuclear Energy Futures Project and CIGI's other research programs.

Canadian Centre for Treaty Compliance

CIGI's Nuclear Energy Futures Project is being conducted in partnership with the Centre for Treaty Compliance at the Norman Paterson School of International Affairs, Carleton University, Ottawa.

Acronyms and Abbreviations

AEC	Atomic Energy Commission
AU	African Union
CERD	Centre for Energy Research and Development
CERT	Centre for Energy Research and Training
CGC	China Geo-Engineering Corporation
CGGC	China Gezhouba Group Corporation
ECOWAS	Economic Community of West African States
ECOMOG	Economic Community of West African States Monitoring Group
IAEA	International Atomic Energy Agency
MAED	Model of Energy Analysis and Demand
MEND	Movement for the Emancipation of the Niger Delta
NAEC	Nigerian Atomic Energy Commission
NEPA	Nigerian Electric Power Authority
NERC	National Energy Regulation Commission
NIPP	National Integrated Power Project
NNRA	National Nuclear Regulatory Authority
NTC	Nuclear Technology Centre
NUMCO	Nigerian Uranium-Mining Company
PHCN	Power Holding Company of Nigeria
PDP	People's Democratic Party

Introduction

It is one of the great ironies of the world energy business that a major oil exporter such as Nigeria suffers from chronic power shortages. Indeed, the tenth largest exporter of oil in the world and Africa's second largest economy has a grid capacity of only 6,000 MW. Despite five domestic refineries, Nigeria imports 75 percent of domestically consumed oil products (Iwayemi, 2008). Suffering from years of mismanagement, lack of investment and general neglect, the domestic energy industry in Nigeria has consistently failed to meet the demands of consumers. Aware of the integral role that energy supply plays in development, President Umaru Musa Yar'Adua designated energy as one of seven key priorities of his administration (World Bank, 2009). In order to meet Nigeria's Millennium Development Goal obligations and the self-imposed policy objective of becoming one of the 20 biggest economies in the world by 2020 – articulated in "Vision 2020," which was adopted following Yar'Adua's election in 2007 – massive investment is required in energy infrastructure.

Both the Obasanjo (1999-2007) and Yar'Adua (2007 to present) administrations have looked to nuclear power as a potential solution to the country's energy woes. Although the government of Nigeria has explored the possibility of developing nuclear energy since the 1970s, there has been a renewed interest in nuclear power over the past seven years. The Nigerian Atomic Energy Commission (NAEC), established in 1976, has been revitalized and a strategy for nuclear power approved by the government. The first phase of the NAEC roadmap for nuclear power calls for commissioning one 1,000 MW plant by 2017 (Osaisai, 2007). Although there are some compelling reasons for pursuing a nuclear power program, Nigeria faces significant challenges to achieving its objectives, including a substandard national electricity grid, an underdeveloped electricity market, lack of technical capacity and a dubious history of success in large, government-managed projects.

This paper is an assessment of the plans and prospects of the nascent Nigerian nuclear energy program. The following section is a brief country profile. The third section

Author Biography

Nathaniel Lowbeer-Lewis holds a Masters degree in international relations from the Norman Patterson School at Carleton University, Ottawa. He spent a semester at the University of Lagos in 2009 where he was also a graduate fellow. Previously, he has worked for the International Consortium on Anti-Virals, a not-for-profit drug development organization as director of communications and Canada coordinator for the West African Viral Surveillance Network (WAVS) and is currently an intern in the Parlimentary Internship Program in Ottawa. He has a BA in political science from McGill, Montreal.

outlines key historical developments and provides a brief rationale for Nigeria's interest in nuclear power. The fourth section is a survey of the current status of Nigeria's nuclear plans and the fifth section is a discussion of potential limitations.

Country Profile

The Federal Republic of Nigeria is the most populous country in Africa, with an estimated 144.7 million people (World Bank, 2009). The second largest economy on the continent, this West African country remains plagued by poverty and underdevelopment. Despite a booming oil industry, which has netted the government more than US$150 billion over the last decade, Nigeria suffers from below-regional-average life expectancy and widespread impoverishment (Adenikinju, 2008).

The Nigerian economy is heavily dependent on oil extraction. The tenth largest exporter of oil in the world, Nigeria has proven reserves of over 35 billion barrels and a production capacity of 2.5 million barrels a day (BP, 2008). Recent average production has been considerably lower, however, due to militant action in the Niger Delta, Nigeria's principle oil-producing region. The Niger Delta has long been plagued by economic underdevelopment and environmental degradation, encouraging politically motivated insurgency and criminal activity. Militant groups such as the Movement for the Emancipation of the Niger Delta (MEND) continue to fight for a more equal distribution of oil rents, often targeting oil facilities and kidnapping foreign workers (Watts, 2007; Ikelegbe, 2005). For example, damage to one of Royal Dutch Shell's export terminals in 2008 led to a 25 percent reduction in Nigeria's oil exports (US Library of Congress, 2008: 13). More recently, similar militant action against pipelines has caused severe disruptions in oil and gas supplies and exports; the federal government authorized military action against the militants in June 2009. Despite these disturbances, oil rents still account for about 20 percent of GDP and 70-80 percent of government revenues. Agriculture, however, remains the largest sector of the economy, representing 40 percent of GDP, whereas manufacturing accounts for less than five percent (Economist Intelligence Unit, 2009).

Fiscally, Nigeria has benefited immensely from the oil boom of the last few years. A landmark agreement with the Paris Club of lending countries in 2005 and a similar agreement with the London Club in 2006 all but eliminated Nigeria's foreign obligations: external debt fell from US$34.7 billion in 2003 to US$8 billion in 2007 (US Library of Congress, 2008: 10). Government deficits in 2007 were less than one percent of GDP. Sustainability of Nigeria's fiscal probity, however, depends a great deal on the price of oil. The federal and state budgets are almost entirely financed by energy revenues and the balanced budgets of late are more representative of the high price of oil than any significant attempt at fiscal restraint (Economist Intelligence Unit, 2009).

Despite the oil windfall, infrastructure development remains problematic. Roads, railways, ports and power infrastructure all suffer from chronic neglect (Economist Intelligence Unit, 2009). Endemic corruption has hampered improvements, despite large investments. Government offices are often used for personal enrichment, undermining efficient service delivery, development and economic equality. The World Bank estimates that 80 percent of energy revenues benefit only one percent of the population (US Library of Congress, 2008: 10). The *Corruption Perception Index*, authored by Transparency International, ranks Nigeria 121 out of 180 countries (2008).

Nigeria, a federation with 36 states, has had a turbulent political history. After achieving independence from the British in 1960, the government has remained predominantly in the hands of the military until recently. In 1966, General Yakubu Gowon took power in the first of a series of coups that have been endemic to Nigerian politics. A year later, civil war broke out after the Igbo leader, Lieutenant Colonel Ojukwu, declared the independence of the Biafran Republic in the Eastern region of Nigeria. After three years of fighting, Nigeria emerged, its territorial integrity intact, as a centralized republic with power concentrated in the hands of the federal government (US Library of Congress, 2008: 4-6). Since 1960, there has been only one successful transfer of power from one civilian leader to another – in 2007. Despite the dubious character of those elections, norms of civilian rule have been entrenched over the past ten years: the army has taken a backseat to civilian politicians and the re-emergence of a military government is considered unlikely by many analysts (Economist Intelligence Unit, 2009).

Nigeria is an ethnic mosaic, with over 200 different languages and countless tribal groupings. There are three major ethnic groups in the country: the Muslim Hausa in the North; the Yoruba in the West; and the Igbo in the East, both predominantly Christian. Nigeria, like many composite African countries, has a history of ethnic and religious tension. Although the Biafran war has been the only conflict to threaten the territorial integrity of Nigeria, religious and tribal strife has often turned violent. The recent clash between domestic Muslim fundamentalist groups and government forces in the North is just one example. The

conflict in the Niger Delta, motivated by perceived injustices in the distribution of oil rents, shows little sign of abating. Conflict in Nigeria, however, has largely been geographically and thematically isolated and rarely engulfs the entire country. As such, Nigeria enjoys pockets of relative stability, such as the South-West, the economic heartland surrounding Lagos (Adeleke, 2009).

With sub-Saharan Africa's largest army, Nigeria is a regional power. The country has a standing army of 85,000 troops and spent about US$768 million in 2006 on its military (US Library of Congress, 2008: 21). The country has spearheaded regional peacekeeping operations in Liberia, Sierra Leone and Guinea-Bissau through the Economic Community of West African States (ECOWAS) and its regional security monitoring arm, the Economic Community of West African States Monitoring Group (ECOMOG), as well as the African Union (AU). Nigerian troops also form one of the largest contingents of peacekeepers in the Sudan.

Perhaps due to a preponderance of power, Nigeria enjoys relatively benign relations with its neighbours. One of the principal regional security flashpoints, a long-running border dispute with neighbouring Cameroon over the oil-rich Bakassi peninsula, was diffused in 2008. Nigeria agreed to hand over the disputed land and cooperate on regional security following a decision of the International Court of Justice in 2002 (Economist Intelligence Unit, 2009).

Three elements pertaining to the viability of a nuclear energy program in Nigeria emerge from this profile. First, despite chronic underdevelopment, the high cost of a nuclear energy program is not necessarily prohibitive given Nigeria's massive oil wealth. Due to a relatively stable fiscal position and some remaining savings from the recent oil windfall – Nigeria has all but eliminated its foreign debt and enjoyed a current account balance of US$2.3 billion in 2007 (Economist Intelligence Unit, 2009) – the country has the potential to mobilize public finances in support of large, national projects. Second, Nigeria views itself as a regional power. The successful development of a nuclear energy program can thus be partially perceived of as a matter of national pride and a means of cementing the country's status as a leader on the African continent. Finally, due to its large population, formerly well-regarded university system, and large population of wealthy elites, Nigeria has enclaves of well-educated human capital and a successful diaspora network in the UK, US and other Western countries. Consequently, Nigeria's consistently low ranking in the UNDP's Human Development Index – 154 out of 179 countries – underemphasizes its sequestered human and capital potential (UNDP, 2008).

History of the Nigerian Nuclear Industry and Rationale for Continued Development

The Nigerian nuclear program emerged tentatively in the 1976 with the establishment of the NAEC, primarily as a response to South Africa's acquisition of nuclear weapons and India's test of a nuclear device. Negotiations were undertaken with West Germany and Canada to explore the purchase of a nuclear power plant. The development of nuclear weapons was also briefly considered. With a view to achieving nuclear autarky, the Nigerian Uranium-Mining Company (NUMCO) was founded in 1978, a partnership between the Nigerian federal government and the French mining company Minatom (Quaker-Dokubo, 2000). The results of this partnership were aerial radiometric surveys of about 617,000 km^2 of land surrounding the Jos Plateau, which is thought to contain uranium reserves (National Energy Commission, 2003).

Two nuclear research centres were founded under the auspices of the NAEC: the Centre for Energy Research and Development (CERD) at Obafemi Awolowo University (formerly the University of Ife) and the Centre for Energy Research and Training (CERT) at Amadu Bello University in Zaria. These centres have mandates to conduct research and build a critical mass of indigenous nuclear expertise (NAEC, 2009). In order to build human capital, the NAEC has sent 60 graduate students to Europe and North America for training in nuclear-related disciplines since the 1970s (Mundu and Umar, 2004). Some, although not all, of the students sent abroad have returned home to teach in Nigerian universities (Adegbenro, 2009). In 1988, a third research centre, the Nuclear Technology Centre (NTC), was inaugurated at the Sheda Science and Technology Complex in Abuja (NAEC, 2009). The training program continues to this day under the auspices of the NAEC. Select federal universities, including the University of Lagos, have recently been directed to inaugurate nuclear physics programs (Boyo, 2009; Adegbenro, 2009).

In 1995, the Nigerian Nuclear Regulatory Authority (NNRA) was established by the Nuclear Safety and Radiation Protection Act. The NNRA began operation in 2001 and has subsequently begun implementing regulations. Nigeria's first research reactor was commissioned at Ahmadu Bello University in 2004. It is a 31.1 kW Chinese tank-in-pool Miniature Neutron Source Reactor, which uses 90 percent enriched uranium as fuel, light water as a moderator and coolant, and metallic beryllium as a reflector (Jonah and Balogun, 2005: 1). It is similar to other Chinese units operating in Ghana, Iran, Syria and China (World Nuclear Association, 2008).

Nuclear energy has received support, albeit primarily rhetorical, from the Yar'Adua administration. The *National Energy Policy* of 2003 explicitly calls for the development of nuclear power and exploitation of uranium resources in Nigeria (National Energy Commission, 2003). The *Draft National Energy Master Plan* of June 2007 reaffirms the government's support for nuclear energy (National Energy Commission, 2007). However, substantive action on policy objectives has been less advanced.

Rationale for Developing Nuclear Power: Energy Diversification and Independence

Currently, Nigeria's power generation infrastructure is insufficient to supply the demands of the country. For a country of over 140 million people, Nigeria's installed generating capacity is about 6,000 MW. Actual power generation, however, fluctuates between 1,500 and 3,000 MW. This pales in comparison, for example, with South Africa, a country of 44 million people and installed generating capacity of 46,000 MW. The United Arab Emirates, a country of four million inhabitants, has a generating capacity of 4,740 MW (Adenikinju, 2008). As a consequence, power outages are frequent and auto-generation is a necessity for industry and consumers who can afford it. Future economic growth will exert more pressure on an already inadequate system.

Surprisingly, there was no significant investment in the power sector between 1979 and 1999 (Iwayemi, 2008). During that time, the sector was fully owned and operated by the notoriously inefficient National Electric Power Authority (NEPA). A privatization scheme started under the Obasanjo administration with support from the World Bank has since transferred ownership of Nigeria's generating stations to the Power Holding Company of Nigeria (PHCN). PHCN remains wholly owned by the Nigerian federal government. The program has yet to deliver the desired results; most plants still remain under government control (Ikeme and Ebohon, 2005). For example, the Egbin generating plant, which has an installed generating capacity of 1,300 MW but operates at around 600-700 MW, was sold to a South Korean company in 2007. It is still operated by the PHCN and no investment in upgrades has materialized (Haider, 2009).

Neglect and disrepair mar every facet of the Nigerian energy industry. The national grid has one of the worst transmission-and-distribution loss rates in the world, five to six times higher than an international-standard grid (Iwayemi, 2008). In 1999, only 19 of 79 generating units in Nigeria were operating (Sambo, 2008). The few functional plants suffer from recurrent supply problems. Militants frequently target gas and oil pipelines in the Niger Delta, disrupting the gas supply. Furthermore, Nigeria's five oil refineries currently operate at below 40 percent capacity, posing further domestic supply problems (Iwayemi, 2008).

The three hydroelectric power stations in Nigeria suffer from significant leakage, maintenance problems, and inconsistent water supply, a concern expected to be exacerbated by climate change (Iwayemi, 2008). The hydroelectric dams at Jebba and Kainji were built in the 1980s with a combined generating capacity of 720 MW. Due to maintenance problems with some of the turbines, the dams currently produce only 360 MW of power. The World Bank, however, has just announced a US$135 million rehabilitation project (Haider, 2009). An added complication is the dependence of Nigeria's hydroelectric dams on rivers originating in neighbouring states, leaving the generating capacity vulnerable to the whims of other nations.

A new 2,600 MW hydroelectric project, the Mambilla generating station in North-Eastern Nigeria, has been in the planning stages for the last few years. The project is slated to be carried out in cooperation with the China Gezhouba Group Corporation (CGGC) and China Geo-Engineering Corporation (CGC). Despite significant and ongoing government expenditures, construction has yet to begin (Haider, 2009).

The National Integrated Power Project (NIPP), a US$9 billion infrastructure program to develop generation, transmission and distribution capacity, was inaugurated under the Obasanjo administration. The NIPP was forecasted to bring 2,256 MW of new power, mostly from gas-fired stations, to the grid. Less than US$3 billion was spent, with many projects remaining unfinished (This Day, 2008). The efficient operation of the few completed plants has been undermined by inadequate investments in fuel supply and power evacuation infrastructure. For example, gas pipelines were neither budgeted nor connected to power plants and adequate connections to the main electricity grid were not installed. The Yar'Adua administration has commenced an investigation into the fraudulent use of funds, although work has continued on select projects (Haider, 2009).

The World Bank has undertaken small-scale projects in the energy sector since its re-engagement with Nigeria in 2000. The Bank has focused on projects designed to ensure energy reaches consumers, as opposed to increasing overall generating capacity. US$600 million dollars have been spent over the past nine years to upgrade Nigeria's transmission and distribution capacity, develop small-scale renewable energy projects in rural areas and build

capacity. On June 10, 2009, the Nigerian Electricity and Gas Improvement Project was inaugurated, promising US$200 million of new investments and US$250 million of investment guarantees to secure necessary fuels, such as gas and oil, at cost-reflective prices for power plants. Currently, over two billion cubic feet of natural gas is flared a day in Nigeria because the government has set the price too low for companies to recoup harvesting costs (Haider, 2009).

The stagnation of the Nigerian power industry contrasts sharply with forecasted demand. At the request of the president, an analysis was undertaken by the Nigerian Energy Commission in 2006, using the International Atomic Energy Agency's (IAEA) Model for Analysis of Energy Demand (MAED). Forecasts were produced for the period from 2000 to 2030 using various economic growth projections. Based on low-, medium- and high-growth scenarios, electricity demand is forecasted to grow from the base value of 3,420 MW to 19,920 MW, 33,000 MW and 73,940 MW, respectively (Sambo et al., 2006). If Nigeria is to realize its "Vision 2020," similar studies suggested Nigeria would require an operational grid capacity of over 100,000 MW by 2020 (Sambo, 2008).

The World Bank commissioned an independent national load demand study, which was undertaken by Tractor Bell Consulting of Belgium in January and February 2009. The report, which has not been made public, presents significantly lower demand estimates than the officially available figures, casting some doubt on the suitability of nuclear power as part of the national energy mix. A least-cost generation planning study has been commissioned by the World Bank that will provide further detail on this and related questions (Haider, 2009). Upgrading and securing inputs to existing plants and transmission infrastructure is likely to be a more cost effective route to meeting short- and medium-term energy demands than large investments in nuclear power.

Despite its complexity and cost, nuclear power has four specific attractions for the Nigerian government. First, nuclear power would provide base-load generation at relatively stable prices, avoiding the inherent price fluctuations of oil products. Second, a reduction in the domestic demand for petroleum would increase foreign exchange earnings from the oil industry. Third, the dependence of a large share of generating capacity on natural gas from the Niger Delta has left Nigeria's energy stability at the mercy of militants in the region. Recurrent natural gas supply problems can also be attributed to the failure of the government to price natural gas at cost-reflective levels, encouraging gas-flaring and waste. Nuclear power would reduce the country's dependence on the volatile Niger Delta for its power needs. Finally, if a long-term supply of domestic uranium could be secured, nuclear power would contribute to national energy self-sufficiency by reducing Nigeria's reliance on fossil fuels and water resources emanating from neighbouring states (Osaisai, 2009a). Nuclear power would also help Nigeria contribute to global efforts to combat climate change, especially if large developing countries like Nigeria are assigned binding carbon reduction targets under a post-Kyoto climate change regime. Complete energy independence is an elusive goal, however, especially in the case of nuclear power. Nigeria would still be required to import enriched uranium and the fuel assemblies to power light-water reactors, the likely choice of plant, not to mention all of the technology for its first and future nuclear reactors and power plants.

Current Status and Recent Developments

The IAEA delineates three distinct phases in the development of a national nuclear energy program: (1) considerations; (2) preparatory work to develop infrastructure for construction of a nuclear power plant; and (3) activities to implement the first power plant. Each phase has a set of milestones that demarcate concrete progress along the path to the successful inauguration of a nuclear energy industry (IAEA, 2007b).

During the first phase of development, the pre-project phase, a state entertains the idea of pursuing a nuclear power program. Upon entry into the second phase of development, a state is considered aware of the various obligations and commitments involved in pursuing nuclear power. States have studied their energy needs and the appropriateness of nuclear power to address those needs, and instituted a strategy for developing a nuclear power program. Finally, a state should have in place infrastructure for radiation, waste and transport safety as well as an established nuclear energy implementing organization with the necessary human capital to effectively coordinate the development strategy.

During the second phase, the country is expected to carry out the work required to prepare for construction of a first nuclear power plant: this includes developing a regulatory body with the capacity to certify nuclear power plants and ensure their safe and secure operation; establishing procurement and bid processes; and identifying the owner/operator. At the end of phase two, the country is ready to invite bids. The third milestone is reached when the

country is ready to commission and operate its first nuclear power plant (IAEA, 2008f: 5).

Based on available information, it is clear Nigeria is in phase two of the three-phase IAEA assessment framework. Nigeria has made a policy decision to pursue nuclear power and is currently undertaking preparatory work to set the ground for an eventual bid and construction of a nuclear plant. It has adopted policies to build up human and regulatory capacity, but is not yet ready to invite calls for construction. Significant work remains before Nigeria will achieve the second milestone and enter into the construction phase.

The Nigerian Atomic Energy Commission (NAEC)

The NAEC is the national coordinating body for the Nigerian nuclear energy program. Although the NAEC was established in the 1970s, the board was not formally activated until July 2007, when the president of Nigeria assumed the chairmanship. Other members of the NAEC Board include the ministers of science and technology, energy, defence, solid minerals and steel, and finance, the national security advisor, the special advisor to the president on energy, and the director general of the NAEC. There are five directorates in the Commission: International Cooperation and Liaison; Manpower Training and Capacity Development; Nuclear Energy Planning; Nuclear Power Plant Development; and Research and Infrastructure Development. The extent to which these directorates are fully staffed with relevant experts, however, is unclear. The NAEC is responsible for the three Nigerian nuclear research centres currently in operation, including the recently commissioned 31.1 kW research reactor at Amadu Bello University in Zaria. A second, 7 MW research reactor is slated for construction at the NTC research centre at Abuja, although the timelines for the project are unclear (NAEC, 2009).

Under the direction of Dr. F. Erepamo Osaisai, who received his PhD from the University of California, Berkeley, in Nuclear Engineering, the Commission produced a roadmap for developing Nigeria's nuclear energy program. The plan, which was endorsed by the federal government, called for establishing a site selection committee in May 2007 that would conclude its work in 2008. Design certification and regulatory approval would be in place by 2009 and construction would begin in 2011. The ultimate goal of the roadmap is to build 1,000 MW of generation capacity at a single nuclear power plant by 2017, and 4,000 MW of capacity by 2027 (Osaisai, 2007). It is clear, however, that the roadmap deadlines have not been met. While the site selection committee has been formed, it has not yet concluded its work (Daily Trust, 2009), and work has yet to begin on the bid and certification processes.

The NAEC has coordinated the signing of various international agreements over the past few years to facilitate international nuclear cooperation and build national capacity. In 2008, Nigeria reportedly signed a Memorandum of Cooperation with Iran (Associated Press, 2008). Two international agreements to share and assist in developing nuclear technology and exploiting uranium resources were recently signed with Russia – one on the occasion of Russian President Dmitry Medvedev's visit to Abuja in June 2009 (World Nuclear News, 2009; Energy Today, 2009). Cooperation agreements have also been signed with India and South Korea over the past year (The Punch, 2009; This Day, 2009).

National Nuclear Regulatory Agency (NNRA)

Establishing regulatory infrastructure is a key step towards developing a national nuclear energy program. In 1995, the Nuclear Safety and Radiation Protection Act established the NNRA. The Agency began operations in 2001 and has subsequently worked to develop regulations pertaining to nuclear energy. The *Basic Ionizing Radiation Regulations*, issued in 2003, implement international best practices as contained in the *International Basic Safety Standard for Protection against Ionizing Radiation* and the *International Basic Safety Standards* (NNRA, 2003). In 2006, the NNRA developed regulations for transporting radioactive sources, the safety and security of radioactive sources, and the safety of industrial radiography, nuclear medicine and radiotherapy (NNRA, 2006). The NNRA has 50 technical staff in three departments: radiological safety, nuclear safety and inspection (NNRA, 2009). This system coincides with general guidelines outlined by the IAEA for a competent regulatory agency (IAEA, 2007a).

International Agreements

Nigeria was among the first countries to sign and ratify the 1968 Nuclear Non-Proliferation Treaty (NPT) and is therefore committed to using nuclear energy exclusively for peaceful purposes. In recent years, Nigeria has made an effort to sign and ratify the panoply of international agreements pertaining to nuclear energy safety and security. In 2007, it ratified the IAEA Convention on Nuclear Safety (IAEA, 2008a). In the same year, Nigeria signed – but has yet to ratify – the 1997 Joint Convention on Safety of Spent Fuel Management and Safety of Radioactive Waste Management (IAEA, 2009a), the Convention on the Physical Protection of Nuclear Materials (IAEA, 2009b), and the Vienna Convention on Civil Liability for Nuclear Damage (IAEA, 2008b). Nigeria has ratified the

1986 Convention on Early Notification of a Nuclear Accident (IAEA, 2008c), the Revised Supplementary Agreement Concerning Provision of Technical Assistance by the IAEA (IAEA, 2007c), and the 1968 Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency (IAEA, 2008d).

Most importantly, Nigeria concluded a Comprehensive Safeguards Agreement and Additional Protocol with the IAEA, to permit the Agency to verify that Nigeria does not divert peaceful nuclear technology and materials to weapons development (IAEA, 2009c). In 2001, Nigeria ratified the Treaty of Pelindaba, establishing an African nuclear weapon-free zone (Centre for Non-Proliferation Studies, 2009). The treaty, however, is awaiting further ratifications and has not yet come into force.

Nigeria has neither signed nor ratified the Joint Protocol Relating to the Application of the Vienna Convention (IAEA, 2007d), the Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage (IAEA, 2003), or the Convention on Supplementary Compensation for Nuclear Damage (IAEA, 2008e).

Limitations and Future Prospects

Nigeria has made progress over the last six years towards its stated policy goal of bringing 1,000 MW of nuclear power online by 2017. Significant challenges remain, however, and there are numerous obstacles Nigeria will need to address before constructing a nuclear power plant.

The National Electricity Grid

The size and configuration of the national power grid is essential to the implementation of a nuclear power plant. According to the IAEA, a single plant should consist of no more than 5-10 percent of the total installed generating capacity of a national grid. Nuclear plants are most efficiently run as base-load generators, and thus require constant demand. Second, reliable independent power is necessary to safely operate a nuclear power plant; an electric grid that can guarantee the supply of stable, off-site power is required to begin construction (IAEA, 2007b).

The NIPP and private-sector actors are slated to increase generating capacity by over 6,000 MW by December 2009 (Guardian, 2009). The failure, however, of the NIPP and other public-private ventures to realize their objectives in a timely fashion calls into question whether the promised generating capacity will come on line in the near future. A similar situation exists with regard to the Mambilla hydroelectric generating station, which is expected to add an additional 2,600 MW of power to the national grid. Despite significant expenditure by the federal government, construction has not yet begun.

Improvement of the national grid and increased generating capacity are imperative for the development of a nuclear program in Nigeria. Regardless of Nigeria's decision to pursue nuclear power, these investments must be made at some point to accommodate forecasted growth. The principal question is whether they will be completed in time to stay reasonably close to the NAEC roadmap; without significant investment in the national electricity grid, nuclear power will remain a distant dream.

Site and Supportive Infrastructure

Site selection is another crucial factor in establishing a nuclear power program. The poor state of Nigerian infrastructure poses problems for transportation and physical infrastructure delivery. Roads and ports in Nigeria are of notoriously bad quality, which could significantly raise the cost of procurement or necessitate further investment before plant construction is possible. For example it would be difficult to locate a nuclear power plant close to Abuja – Nigeria's growing capital city, located in the centre of the country – as there are no large roadways or rail connections. Consequently, a nuclear plant would likely be situated near Lagos, Nigeria's largest city and the source of a large portion of Nigeria's electricity demand. Port congestion is another problem: Lagos is also Nigeria's main port and port delays stretch up to one year. According to the roadmap produced by the NAEC, the site selection committee was supposed to finish its work by 2008. Although the committee has been inaugurated, it has not yet produced its final report (Daily Trust, 2009).

Security Concerns

Nigeria's relative stability belies its ethnic composition. Despite isolated incidents of ethnic strife, there has been little widespread political instability over the last decade. For example, the federal elections of 2007 were relatively peaceful, despite claims of vote rigging and fraud (Economist Intelligence Unit, 2009). Furthermore, international terrorist groups have not traditionally operated in Nigeria. The religiously motivated violence that often plagues the northern states of Nigeria is predominantly domestic in character (Adeleke, 2009). Unless a nuclear plant was situated in the Niger Delta – about 10 percent of Nigeria's territory – which is unlikely, it does not represent a significant target for the militias. Moreover, nuclear power can be seen as a way of removing the leverage that Delta militants currently wield over the

national power supply. The thematic and geographical isolation of militancy and religious and ethnic strife in Nigeria, coupled with the probable location of Nigeria's first nuclear power plant in the South-West near Lagos, reduce, but do not eliminate, security concerns.

Financing and Electricity Market Reform

Nigeria has earned over US$300 billion in oil revenues since the 1970s (Economist Intelligence Unit, 2009). With oil prices in excess of US$100 a barrel over the last few years, Nigeria was able to ameliorate its financial position. Consequently, the Nigerian federal government could conceivably commit the necessary resources to construct a nuclear power plant (Boyo, 2009; Adegbenro, 2009). It is the structure of the Nigerian electricity market that poses the greatest challenge to the viability of a civil nuclear industry.

The Nigerian energy sector has long been characterized by vertical integration and government control, which led to inefficiency. The industry is plagued by below-cost tariffs and poor revenue collection; an estimated 30-40 percent of the electricity supply is never billed, and theft and illegal power connections are endemic (Tallapragada and Adebusuyi, 2008). Attempts to privatize the sector and solicit private investment were initiated under the Obasanjo administration. A World Bank loan was issued to finance the necessary infrastructure to unbundle NEPA and facilitate an efficient wholesale power market (World Bank, 2001). Since NEPA was restructured in 2001, little progress has been made with regard to privatization of existing assets; most new investment has been undertaken by the federal government (Haider, 2009). Of the 23 independent power producers granted licences by the National Energy Regulation Commission (NERC) for developing 8,237 MW of generating capacity, only one had started work as of 2008 (Sambo, 2008), although there has since been limited progress (Guardian, 2009).

To complicate matters, Nigeria has a history of strong public reactions to government-initiated increases of energy prices. Rapid reform could be politically unpalatable as electricity tariffs are highly subsidized. Finally, reform has often been stymied by entrenched interests, such as those who control fuel imports and generator sales, which enjoy considerable political power in the country (Haider, 2009).

The high up-front costs of constructing a nuclear power plant cast doubt on private-sector involvement in Nigeria. Without real reform of the electricity sector and surrounding policy and infrastructure, the government will likely be the sole owner/operator of a nuclear plant. The government, however, has a chequered history of successfully managing large and complex projects. In the energy sector, limited progress on the Mambilla hydro-electric project is indicative of the government's poor management capacity. Nigeria's government-owned oil refineries suffer from chronic underproduction and poor maintenance. Government mismanagement extends beyond the energy sector: the Abeokuta Steel complex, despite billions of dollars of federal investment and numerous refurbishment projects, remains largely inoperative. Nigerian Railways, a public company which ran freight and passenger services, is no longer functional.

The government's reliance on oil revenues to fund a large percentage of its budget could make or break investment in nuclear energy. Falling oil revenues could extinguish government interest in large, complex and costly projects. Conversely, higher oil prices could stimulate investment in nuclear energy despite dubious long-term economic rationales.

Human Resources and Technical Capacity

Nigeria has had a nuclear research program in place since the NAEC was founded in 1976. Human resources and indigenous technical capacity remain significant limitations to the development of a domestic nuclear energy program, however: Nigeria does not have the domestic technical capacity to design, operate or manage a nuclear power plant. Consequently, any short- to medium-term development will likely take the form of turnkey projects purchased from a nuclear supplier country such a France, Russia or the United States (Boyo, 2009). Efforts to build the necessary human capital are ongoing. The University of Lagos and other federal universities have been asked to develop nuclear physics programs. Plans to upgrade the three nuclear research centres are underway, although serial neglect, especially of the NAEC research complex at Obafemi Awolowo University in Ife, means a great deal of work remains to be done. It will be a long time before Nigeria possesses the human resources and technological capacity to independently operate a nuclear power plant and its supporting infrastructure (Adegbenro, 2009).

Conclusion

Over the past six years, Nigeria has made limited progress in developing the supportive institutions and infrastructure required for a nuclear power program. A nuclear energy strategy has been put in place; studies have been carried out to assess the potential role of

nuclear energy as part of the power mix; and a regulatory agency has been established and staffed, and has adhered to most relevant international treaty obligations. The NAEC, the coordinating body for Nigeria's nuclear energy program, has been reconstituted with support at the highest level of government and has produced a roadmap that sets 2017 as a goal for the start of nuclear power generation – a goal Nigeria is unlikely to meet. Nigeria is thus in phase two of the IAEA three-phase assessment framework. It has adopted a policy decision to pursue nuclear power and is currently taking steps to implement the regulatory, technical and physical infrastructure necessary to invite bids for constructing a first nuclear power plant. Most capital expenditure is required during, and especially following, phase two. Consequently, accomplishments realized to date are not necessarily indicative of future commitments or progress.

Nuclear power dangles the promise of a relatively stable and self-sufficient source of energy in a country crippled by its scarcity. Future economic growth will only increase the energy crisis that plagues Nigeria. A nuclear power program would reduce dependence on gas and oil – and the volatile Niger Delta region for its supply – as well as alleviate concerns about the long-term viability of hydroelectric power. In tandem with the exploitation of uranium deposits or a long-term contract with a uranium supplier, a successful nuclear power sector would contribute to the energy diversification essential for Nigeria's growth and development. Indeed, solving the energy crisis is imperative if Nigeria is to attain its development goal of becoming one of the 20 largest economies in the world by 2020.

Despite low levels of aggregate human development, Nigeria has pockets of well-educated elites, a large university system and a successful diaspora in the West. Furthermore, Nigeria enjoys a relatively stable fiscal position, a legacy of the recent oil windfall and thus the financial capacity to undertake large and costly projects. Thus, in some respects, Nigeria stands apart from other low-income countries regarding its capacity to pursue a nuclear energy program.

The problems that continue to plague Nigeria will undoubtedly affect its nuclear designs, however. Widespread corruption and decrepit infrastructure pose significant obstacles to the successful construction, operation and maintenance of a nuclear power plant. An aging electricity grid, the high political cost of reducing power subsidies, and the inability of the electricity sector to recoup costs are additional challenges. Security concerns remain prescient, despite the isolated nature of the Niger Delta and sectarian conflicts.

The oil export business has been efficiently developed by private-sector multinationals, whereas the public sector has failed to develop the necessary energy infrastructure for sustainable economic and social development. The same problems that have plagued public-sector investment in the past – corruption, mismanagement and neglect – continue to jeopardize the success of government projects. Without wholesale reforms of the electricity market, however, private-sector participation in a nuclear power plant is highly unlikely.

Given the lack of indigenous technical capacity, Nigeria's nuclear energy program, if implemented, would probably consist of purchased turnkey plants, with design, construction and possibly even operations and maintenance responsibilities outsourced to a foreign company. Recent agreements signed with Russia point in this direction. The construction of a turnkey plant will still have to coincide with significant upgrades to the national electricity grid, and even turnkey plants have to operate within a context of competent national governance structures and regulatory regimes that fully implement Nigeria's international safety, security and non-proliferation obligations.

It will take an enormous mobilization of resources to begin construction of Nigeria's first nuclear power plant. Without massive and effective investment in all areas of the power sector, Nigeria's nuclear development plans will remain an expensive dream. If reforms to the electricity sector and efforts to construct new generating capacity are successful over the next few years, the rationale for nuclear power will perhaps become clearer and the associated costs will decline. It is not certain, however, that nuclear energy will ever be the most efficient or cost-effective means of generating energy in Nigeria. Upgrading and securing inputs to existing plants and transmission infrastructure, as well as efficiency measures, are potentially more fiscally prudent strategies to meet short- and medium-term energy demands than large investments in nuclear power.

Although the timelines in the NAEC roadmap look unrealistic, Nigeria may yet develop a civil nuclear industry; the rationale for nuclear power is stronger as a long-term solution to energy stability if upgrades to other parts of the national energy system are successful. Current efforts to build regulatory and human capacity will facilitate faster construction of a plant when the larger infrastructure components are in place. While it may not be for a decade or more, Nigeria's potential to become a nuclear energy producer cannot be discounted.

Works Cited

Adegbenro, Wole (2009). Professor of Engineering, University of Lagos; Director, National Centre for Energy Efficiency and Conservation; Member, National Energy Commission of Nigeria. Interview with author, June 22.

Adeleke, Ademola (2009). Senior Lecturer, Department of History and Strategic Studies, University of Lagos. Interview with author, July 28.

Adenikinju, Adeola (2008). "Efficiency of the Energy Sector and its Impact on the Competitiveness of the Nigerian Economy," *IAEE Energy Forum* (4): 27-31.

Associated Press (2008). *Iran, Nigeria to share peaceful nuclear technology* (August 28). Available at: http://www.iht.com/articles/ap/2008/08/28/africa/AF-Nigeria-Iran-Nuclear.php.

Boyo, Henry. (2009). Professor of Physics, University of Lagos; Member, National Energy Commission of Nigeria. Interview with author, June 22.

BP (2008). *BP Statistical Review of World Energy*. June. Available at: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2008/STAGING/local_assets/downloads/pdf/statistical_review_of_world_energy_full_review_2008.pdf.

Centre for Non-Proliferation Studies (2009). *Inventory of International Nonproliferation Organizations and Regimes* (March). Available at: http://www.nti.org/e_research/official_docs/inventory/pdfs/anwfz.pdf.

Daily Trust (2009). *Nigeria: Agencies Partner On Nuclear Sites*. May 7. Available at: http://allafrica.com/stories/200905070912.html.

Economist Intelligence Unit (2009). *Country Profile 2009: Nigeria*. Available at: http://www.eiu.com.

Energy Information Administration (2007). *Country Analysis Briefs: Nigeria*. April. Available at: http://www.eia.doe.gov/emeu/cabs/Nigeria/pdf.pdf.

Guardian (2009). "Govt to Spend N323 Billion." March 15. Available at: http://www.ngrguardiannews.com/news/article02//indexn2_html?pdate=1500309&title=Govt%20To%20Spend%20N323%20Billion.

Haider, Waqar (2009). Senior Energy Specialist, World Bank Nigeria. Interview with author, July 2.

IAEA (2009a). *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. Registration No: 1729. January. Available at: http://www.iaea.org/Publications/Documents/Conventions/jointconv_status.pdf.

_____ (2009b). *Convention on Physical Protection of Nuclear Materials*. Registration No: 1533. April. Available at: http://www.iaea.org/Publications/Documents/Conventions/cppnm_status.pdf.

_____ (2009c). *Comprehensive Safeguards Agreement and Additional Protocol*. May. Available at: http://www.iaea.org/OurWork/SV/Safeguards/sir_table.pdf.

_____ (2008a). *Convention on Nuclear Safety*. Registration No. 1676. December. Available at: http://www.iaea.org/Publications/Documents/Conventions/nukesafety_status.pdf.

_____ (2008b). *Vienna Convention on Civil Liability for Nuclear Damage*. Registration No: 1277. December. Available at: http://www.iaea.org/Publications/Documents/Conventions/liability_status.pdf.

_____ (2008c). *Convention on Early notification of a Nuclear Accident*. Registration No: 1532. December. Available at: http://www.iaea.org/Publications/Documents/Conventions/cenna_status.pdf.

_____ (2008d) *1968 Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency*. Registration No. 1534. December. Available at: http://www.iaea.org/Publications/Documents/Conventions/cacnare_status.pdf.

_____ (2008e). *Convention on Supplementary Compensation for Nuclear Damage*. May 21. Available at: http://www.iaea.org/Publications/Documents/Conventions/supcomp_status.pdf.

_____ (2008f). *Evaluation of the Status of National Nuclear Infrastructure Development*. No. NG-T-3.2. Available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1358_web.pdf.

_____ (2007a). *Considerations to Launch a Nuclear Power Programme*. Available at: http://www.iaea.org/NuclearPower/Downloads/Launch_NPP/07-11471_Launch_NPP.pdf.

_____ (2007b). *Milestones in the Development of a National Infrastructure for Nuclear Power*. No. NG-G-3.1. Available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1305_web.pdf.

_____ (2007c). *Revised Supplementary Agreement Concerning Provision of Technical Assistance by the IAEA*. October. Available at: http://www.iaea.org/Publications/Documents/Conventions/rsa_status.pdf.

_____ (2007d). *Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention*. Registration No: 1623. March 26. Available at: http://www.iaea.org/Publications/Documents/Conventions/jointprot_status.pdf.

_____ (2003). *Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage*. Registration No. 1759. July 4. Available at: http://www.iaea.org/Publications/Documents/Conventions/protamend_status.pdf.

Ikelegbe, Augustine (2005). "The Economy of Conflict in the Oil Rich Niger Delta Region of Nigeria," *Nordic Journal of African Studies*. Vol. 14, No. 2: 208–234.

Ikeme, Obas, J. and John Ebohon (2005). "Nigeria's electric power sector reform: what should form the key objectives?" *Energy Policy*. Vol. 33: 1213-1221.

Iwayemi, Akin (2008). "Nigeria's Dual Energy Problems: Policy Issues and Challenges." *IAEE Energy Forum* (4): 17-21.

Jonah, S.A. and G.I. Balogun (2005). *Current Status of the Nigeria MNSR (NIRR-1) and Feasibility for Conversion to LEU*. Centre for Energy Research and Training: Ahmadu Bello University. Available at: http://www.rertr.anl.gov/ RERTR27/PDF/S10-4_Jonah.pdf.

Mundu, M.A. and A. M. Umar (2004). "The Quest for Nuclear Technology and the Challenges of Knowledge Management in Nigeria." International Conference on Nuclear Knowledge Management (7 - 10 September) Saclay, France. IAEA-I1-CN-123. Available at: www.iaea.org/inisnkm/nkm/cnkm/abstracts/mundunigeria.pdf.

NAEC (2009). Website. Available at: http://www.nigatom.org.ng.

_____ (2008). "National Workshop on Education and Training to Support the Introduction of Nuclear Power in Nigeria." Communiqué of Four-Day Workshop. June 24-27. Available at: http://www.nigatom.org.ng/press/NAEC.COMMUNIQUE.National%20Workshop%20on%20Education.pdf

National Energy Commission (2007). *Draft National Energy Master Plan*. Federal Republic of Nigeria: Abuja. June.

_____ (2003). *National Energy Policy*. Federal Republic of Nigeria: Abuja. March. Available at: http://www.energy.gov.ng/index.php?option=com_docman&task=doc_download&gid=7.

NNRA (2009). Website. Available at: http://www.nnra-ng.org/.

_____ (2006). *Documents*, Website. Available at: http://www.nnra-ng.org/nnra/part2/Documents.php.

_____ (2003). *Nigeria Basic Ionizing Radiation Regulations 2003*. Available at: http://www.nnra-ng.org/nnra/Part2/pdf/regulations/Nigeria%20Basic%20Ionizing%20Radiation%20Regulations%202003.pdf.

Osaisai, F. Erepamo (2009a). "Introducing Nuclear Power: The Rational and Challenges." Presentation at Technical Session I of the International Ministerial Conference on Nuclear Energy in the 21st Century held in Beijing, China from April 20 to 22, 2009. Available at: http://www-pub.iaea.org/MTCD/Meetings/PDFplus/2009/cn169/Beijing_TS/TS1/3%20Osaisai.pdf.

_____ (2007). *Press Briefing at NAEC Secretariat*. July 26. Available at: http://www.nigatom.org.ng/press/Press%20briefing.NAEC%20HQ.Osaisai.pdf.

Quaker-Duboko, Charles (2000). "Nuclear Issues and Nigeria," *African Journal of International Affairs and Development*. Vol. 5, No.1: 83-104.

Sambo, A. S. (2008). "Matching Electricity Supply with Demand in Nigeria" *IAEE Energy Forum* (4): 32-36.

Sambo, A.S., O.C. Iloeje, J.O. Ojosu, J.S. Olayande and A. O. Yusuf (2006). *Nigeria's Experience on the Application of IAEA's Energy Model (MAED & WASP) for National Energy Planning*. National Energy Commission. Available at: http://www.energy.gov.ng/index.php?option=com_docman&task=doc_view&gid=4.pdf.

Tallapragada, P.V.S.N and B.S. Adebusuyi (2008). "Nigeria's Power Sector: Opportunities and Challenges." In P. Collier, C. Pattillo and C.C. Soludo (eds.) *Economic Policy Options for a Prosperous Nigeria*. New York: Palgrave Macmillan, 301 - 327.

The Punch (2009). "Power shortages: Minister proffers nuclear option." January 15. Available at: http://www.punchng.com/Articl.aspx?theartic=Art20090115283595.

This Day (2009). "FG Seeks India's Assistance on Power." January 18. Available at: http://www.thisdayonline.com/nview.php?id=133296.

_____ (2008) "Nigeria: NIPP Gulps N36bn So Far." January 30. Available at: http://allafrica.com/stories/200801300412.html.

Transparency International (2008). *Corruption Perception Index*. Available at: http://www.transparency.org/news_room/in_focus/2008/cpi2008.

UNDP (2008). *Human Development Report 2007/2008*. Available at: http://hdr.undp.org/statistics/.

US Library of Congress (2008). *Country Profile: Nigeria July 2008*. Available at: http://memory.loc.gov/frd/cs/profiles/Nigeria.pdf.

Watts, Michael (2007). "Petro-Insurgency or Criminal Syndicate? Conflict & Violence in the Niger Delta," *Review of African Political Economy*. Vol. 34, No. 114: 637- 660.

World Bank (2009). *Country Brief: Nigeria*. March. Available at: http://go.worldbank.org/FIIOT240K0.

_____ (2005). "Nigeria National Energy Development Project." Available at: http://web.worldbank.org/external/projects/main?pagePK=64312881&piPK=64302848&theSitePK=40941&Projectid=P090104.

_____ (2001). "Transmission Development Project: Project Appraisal Document." Available at: http://go.worldbank.org/CIS3CYNIE0.

World Nuclear Association (2008). *Emerging Nuclear Energy Countries*. August. Available at: http://www.world-nuclear.org/info/inf102.html.

World Nuclear News (2009). *Russia and Nigeria agree to cooperation*. March 19. Available at: http://www.world-nuclear-news.org/NP-Russia_and_Nigeria_agree_to_cooperation-1903094.html?jmid=8295&j=230983077&utm_source=JangoMail&utm_medium=Email&utm_campaign=WNN+Daily+19+March+2009+%28230983077%29&utm_content=Justin%5FAlger%40carleton%2Eca.

Who We Are

The Centre for International Governance Innovation is an independent, nonpartisan think tank that addresses international governance challenges. Led by a group of experienced practitioners and distinguished academics, CIGI supports research, forms networks, advances policy debate, builds capacity, and generates ideas for multilateral governance improvements. Conducting an active agenda of research, events, and publications, CIGI's interdisciplinary work includes collaboration with policy, business and academic communities around the world.

CIGI conducts in-depth research and engages experts and partners worldwide from its extensive networks to craft policy proposals and recommendations that promote change in international public policy. Current research interests focus on international economic and financial governance both for the long-term and in the wake of the 2008-2009 financial crisis; the role of the G20 and the newly emerging powers in the evolution of global diplomacy; Africa and climate change, and other issues related to food and human security.

CIGI was founded in 2002 by Jim Balsillie, co-CEO of RIM (Research In Motion) and collaborates with and gratefully acknowledges support from a number of strategic partners, in particular the Government of Canada and the Government of Ontario. CIGI gratefully acknowledges the contribution of the Government of Canada to its endowment fund.

Le CIGI a été fondé en 2002 par Jim Balsillie, co-chef de la direction de RIM (Research In Motion). Il collabore avec de nombreux partenaires stratégiques et exprime sa reconnaissance du soutien reçu de ceux-ci, notamment de l'appui reçu du gouvernement du Canada et de celui du gouvernement de l'Ontario. Le CIGI exprime sa reconnaissance envers le gouvernment du Canada pour sa contribution à son Fonds de dotation.

The Centre for International Governance Innovation

Centre pour l'innovation dans la gouvernance internationale

57 Erb Street West
Waterloo, Ontario, Canada N2L 6C2
tel +1.519.885.2444 fax +1.519.885.5450
www.cigionline.org