

SMALL HYDROPOWER DEVELOPMENT: ONE SOLUTION TO ACHIEVE MILLENNIUM DEVELOPMENT GOALS (MDGs)

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ABSTRACT

The provision of modern energy services is necessary for basic community services and equally dependent on existing energy or otherwise infrastructures. Modern lighting and telecommunications, reliable health care, water supply and irrigation, and local manufacturing would all be curtailed without modern energy services. Investment and income generation activities would never increase at the expected levels and the poverty would never be eradicated in the absence of adequate and sustainable modern energy services..

This paper looks at the small hydropower potential in Nigeria. The Federal government Policies on renewable electricity with particular reference to hydropower is highlighted. Development of small hydropower will enhance achieving National Economic Empowerment and Development Strategy (NEEDS) and the Millennium Development Goals (MDGs) goals. Nigerian's Hydro Potential is high

and hydropower currently accounts for about 32% of the total installed commercial electric power capacity. The overall large scale potential (exploitable) is in excess of 11,000MW.

1.0 Introduction

The Millennium Development Goals (MDGs) were adopted by all the world's Governments as a blueprint for building a better world in the 21st century. The MDGs represent a global partnership that has grown from the commitments and targets established at the World Summits of the 1990s. Responding to the world's main development challenges and to the calls of civil society, the MDGs promote poverty reduction, education, maternal health, gender equality, and aim at combating child mortality, AIDS and other diseases.

Set for the year 2015, the MDGs are an agreed set of goals that can be achieved if all stakeholders work together and play their

respective part. Poor countries have pledged to govern better, and invest in their people through health care and education. Rich countries have pledged to support them, through aid, debt relief, and fairer trade.

Nigeria has a population of over 140 million based on the result of the National Population Census of 2006. The country is blessed with abundant hydroelectric power resources. Nigeria's power demand is high but the available generation is well below the demand. As a result, the country experiences an energy supply crisis frequently and especially in March to August 2007. It has been argued that one solution to this crisis, in the short and long term, is further development of the country's small-hydro potential. Nigeria's rivers are characterized by high water discharges during the rainy season and very low discharges during the dry season.

The development of small hydropower around the world is on the increase. Small hydro offers a wide range of benefits especially for the rural areas in developing countries. Governments, financiers, and developers are finding new ways to fund and promote small hydropower development. Efforts are also being made

to improve the exchange of experience and technology related to small hydropower. Small hydropower stations throughout the world contribute more than 34,000 MW, representing about 5 percent of the installed hydropower capacity worldwide.

The Small Hydropower (SHP) technology is a renewable, sustainable, secure, clean and an efficient source. The fuel for hydropower is water, which is not consumed in the process of electricity generation. What separates hydropower from other sources of electric energy is that it leaves substantial positive legacies to future generations such as the structures of a hydropower plant. Small hydropower development meets the needs of the present without compromising the ability of the future generations to meet their own needs.

Hydro technology does not involve a process of combustion. Therefore, concerns over global climate change and health ramifications of pollutants are ended when using this free emission resource. Hydro can satisfy the increase of energy demand with no depletion of the resource and with little impact on the environment.

2.0 Millennium Development Goals

Access to electricity services is critical to achieving economic and social development targets outlined in the National Economic Empowerment and Development Strategy (NEEDS) and the Millennium Development Goals (MDGs). The Federal Government of Nigeria is committed to reaching these sustainable development targets through the full mobilization of the electricity sector. Renewable energy presents unique opportunities to scale up access to electricity services nationwide. In the pursuit of these objectives, the Federal Government seeks the implementation of the policy on renewable electricity in collaboration with other levels of government, communities and the private sector for the following specific reasons:

First and foremost, renewable energy represents an important tool in the Government's overall effort to expand access to electricity services nationwide. Improving access to electricity is consistent with NEEDS and MDG targets in stimulating economic growth, employment creation and poverty reduction. The policy enables the government to align and mainstream renewable energy development

in the country with these broader national development aspirations.

Second, rural electricity access in Nigeria is less than 20%. By their nature, renewable electricity technologies are generally modular and are ideal candidates for improving rural electricity access situations in the country. Grid power extensions over long distance to serve low load densities are usually technical and financial a costlier option than decentralized renewable electricity.

The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges. The MDGs are drawn from the actions and targets contained in the Millennium Declaration that was adopted by 189 nations-and signed by 147 heads of state and governments during the UN World Summit in Johannesburg, South Africa in September 2000.

The 8 MDGs break down into 18 quantifiable targets that are measured by 48 indicators. The broad goals of the MDGs are stated below.

Goal 1: Eradicate extreme poverty and hunger

Goal 2: Achieve universal primary education

Goal 3: Promote gender equality and empower women

Goal 4: Reduce child mortality

Goal 5: Improve maternal health

Goal 6: Combat HIV/AIDS, malaria and other diseases

Goal 7: Ensure environmental sustainability

Goal 8: Develop a Global Partnership for Development

Though improving access to modern energy is not one of the MDGs, it is one of the major catalysts of these goals as it is essential to have the support infrastructure needed to achieve the desires expressed in the MDGs. A prerequisite for achieving these goals is the need for improved productivity as this leads to employment

generation and rising incomes. The provision of substantial modern energy services is needed for productivity as well as providing high quality medical services. More rational modern energy system that integrates environmental concerns will provide higher quality energy for households and other demand sectors along with making the national, and hence regional and global environment better. Therefore, there is a positive correlation between high quality energy provision and achieving the MDGs. Further, the lack of such energy service provision will only worsen the conditions the MDGs are expected to solve. Table 1 gives the nexus between energy and the MDGs.

Table 1: ENERGY and the MDGs

1	Eradicate extreme poverty and hunger	Energy inputs such as electricity and fuels are essential to generate jobs, industrial activities, transportation, commerce, micro-enterprises and agriculture output. Most staple foods must be processed, conserved and cooked, requiring heat from various fuels. Provision of energy security especially in rural areas is critical to their survival as the level of poverty and lack of access to energy services is more significant in these areas.
2	Achieve universal primary education	To attract teachers to rural areas electricity is needed for homes and schools. After dusk study requires illumination. Many children, especially girls, do not attend primary schools in order to carry wood and water to meet family subsistence needs. The use of renewable energy (for example SHP systems) in areas far removed from the grid or awaiting grid connection provides an important source of electricity for study.
3	Promote gender equality and empower women	Lack of access to modern fuels and electricity constitutes to gender inequality. Women are responsible for most household cooking and water boiling activities and farming. This takes time away from other productive activities as well as from educational and social participation. Access to modern fuels and mechanised agricultural machinery and processes eases women's domestic and farming burden and allows them to pursue educational, economic and other opportunities.
4	Reduce child mortality	Diseases caused by unboiled water, and respiratory illness caused by the effects of indoor air pollution from traditional fuels and stoves, directly contribute to infant and child disease mortality. Also lack of modern energy such as electricity to maintain cold chains in local clinics of essential drugs further increases the incidence of child mortality

5	Improved maternal health	Women are disproportionately affected by indoor air pollution and water- and food-borne illnesses. Lack of electricity in health clinics, illumination of night time deliveries, and the daily drudgery and physical burden of fuel collection and transport all contribute to poor maternal health conditions, especially in rural areas.
6	Combat HIV/AIDS, malaria and other diseases	Electricity for communication such as radio and television can spread important public health information to combat deadly diseases. Health care facilities, doctors and nurses, all require electricity and the services that it provides (illumination, refrigeration, sterilization, etc) to deliver effective health services. Electricity also provides alternative entertainment after dusk other than sexual interactions through television and radio broadcast of light hearted programmes.
7	Ensure environmental sustainability	Energy production, distribution and consumption has many adverse effects on the local, regional and global environment including indoor, local and regional air pollution, local particulates, land degradation, acidification of land and water, and climate change. Cleaner energy systems are needed to mitigate all of these effects and to contribute to environmental sustainability.
8	Develop a global partnership for development	The World Summit for Sustainable Development called for partnerships between public entities, development agencies, civil society and the private sector to support sustainable development, including the delivery of affordable, reliable and environmentally sustainable energy services such as SHP.

SMALL HYDRO POWER (SHP) POTENTIALS IN NIGERIA

SHP potential sites exist in virtually all parts of Nigeria. There are over 278 unexploited

sites with total potentials of 734.3 MW. So far about eight (8) small hydropower station with aggregate capacity of 37.0 MW has been installed in Nigeria by private company and the government as shown in **TABLE 1.**

The technically exploitable small hydro capability in Nigeria is high and under utilized. The SHP development programme in the last five years has been able to assess potential sites for developments as shown in **TABLE 2**. Some river basins have actually undertaken pre-feasibility studies on some of these hydro potential sites. These are listed in **TABLE 3** with the corresponding estimated capacity.

Small hydropower (SHP) has a huge, as yet largely untapped, economic and technical potential, which will allow it to make a

significant contribution to future energy needs in this country. Some potential sites have been identified by relevant government ministries, parastatals and agencies. Currently the government is calling for private investor to participate in renewable energy generation to enhance the quality of life in small town and rural areas. This is back up with formulation of favourable policies to encourage private investor in achieving this objective. Some of the policies are stated in other sections in this paper.

TABLE 1: Existing Small Hydro Schemes in Nigeria

S/No.	River	State	Installed Capacity [mw]
1.	Bagel (I) (II)	Plateau	1.0 2.0
2.	Kurra	Plateau	8.0
3.	Lere (I) (II)	Plateau	4.0 4.0
4.	Bakalori	Sokoto	3.0
5.	Tiga	Kano	6.0
6.	Oyan	Ogun	9.0

TABLE 2: Small Hydro Potentials in 12 Surveyed States in Nigeria

S/No	State	River Basin	Total Sites	Potential Capacity (mw)
1.	Sokoto	Sokoto-Rima	22	30.6
2.	Katsina	Sokoto-Rima	11	8.0
3.	Niger	Niger	30	117.6
4.	Kaduna	Niger	19	59.2
5.	Kwara	Niger	12	38.8
6.	Kano	Hadeja-Jama'are	28	46.2
7.	Borno	Chad	29	20.8
8.	Bauchi	Upper-Benue	20	42.6
9.	Gongola	Upper-Benue	38	162.7
10.	Plateau	Lower-Benue	32	110.4
11.	Benue	Lower-Benue	19	69.2
12.	Cross River	Cross River	18	28.1

TABLE 3: RIVER BASINS IDENTIFIED HYDRO POTENTIAL

Organization	Potential site	Status	Capacity
Upper Benue River Basins Development Authority	• Jada Dam • Monkin Dam • Kiri Dam • Waya Dam • Dandinkowa Dam	Pre-feasibility level	5MW 500kW 1083kW 61.8kW 33kW
Owena Benin River Basin Development Authority	• River OWENA • Ele River • River Okhuanwan	Pre-feasibility level	1.3MW 0.30MW 600kW
Anambara–Imo River Development Authority	• River Igwu • Imo River • Ivo River	Identified	7.55 kW
Chad Basin Development Authority	• Biu site • Janga Dole Dam site • Majeekin Dam site	Identified	
Ogun-Oshun River Basin Development Authority	• Oyan River Dam • Ikere Gorge Dam • Lekan Are Dam • Oke-Odan • Eniosa • Ofiki I • Ofiki II • Sepeteri I • Sepeteri II • Okuku • Igbojaiye	Refurbishment Refurbishment Pre –feasibility	9MW 3MW

4.0 RENEWABLE ENERGY POLICY IN NIGERIA

The Policy Guidelines on Renewable Electricity (herein referred to as the Policy

Guidelines) is the Federal Government of Nigeria's overarching policy on all electricity derived from renewable energy sources. The Policy Guidelines sets out the Federal Government's vision, policies and

objectives for promoting renewable energy in the power sector. The Policy Guidelines is drawn primarily from the Constitution of the Federal Republic of Nigeria (1999) and the National Energy Policy (2003), the Electric Power Sector Reform Act 2005, the Renewable Energy Master Plan (2005) and the draft Rural Electrification Policy.

The Federal Government of Nigeria's vision of renewable energy in the power sector is the achievement of accelerated sustainable development through increased share of renewable electric power to the national electricity supply.

In the Policy Overview of the National Energy Policy, NEP, of August 2003, the overall thrust of the energy policy is stated as "optimal utilization of the nation's energy resources for sustainable development", while renewable energy resources among the nation's energy sources are hydropower, solar, biomass, wind, hydrogen, and other renewable such as ocean, tidal, wave and geothermal energy sources.

5.0 Hydropower Policies

(i) The nation shall fully harness the hydropower potential available in the country for electricity generation

(ii) The nation shall pay particular attention to the development of the mini and micro hydropower schemes

(ii) The exploitation of the hydro power resources shall be done in an environmentally friendly manner

(iii) Private sector and indigenous participation in hydropower development shall be actively promoted

5.1 Objectives of the Hydropower Policy

The objectives of the hydropower policy include but not limited to the following

(i) To increase the percentage contribution of hydro electricity to the total energy mix

(ii) To extend electricity to rural and remote areas, through the use of mini and micro hydro power schemes

(iii) To conserve non-renewable resources used in the generation of electricity

(iv) To diversify the energy resource base

(v) To ensure minimum damage to the ecosystem arising from hydropower development

(vi) To attract private investments into the hydropower sub-sector

5.2 Strategies

(i) Establishing and maintaining multilateral agreements to monitor and

regulate the use of water in international rivers flowing through the country

- (ii) Ensuring increased indigenous participation in the planning, design and construction of hydropower stations
- (iii) Providing basic engineering infrastructure for the production of hydropower plants, equipment and accessories
- (iv) Encouraging private sector, both indigenous and foreign, in the establishment and operation of hydropower plants
- (v) Encouraging private sector, both indigenous and foreign, for the local production of hydropower plants and accessories
- (vi) Ensuring that rural electricity boards incorporate small-scale hydropower plants in their development plans
- (vii) Promoting and supporting R&D activities for the local adaptation of hydropower plant technologies
- (viii) Initiating and updating data on the development of the hydro potential of our rivers and identifying all possible locations for dams

5.3 Renewable electricity promotion and regulatory policies

In growing the market for renewable electricity in Nigeria, the Federal

Government has the following policies and regulatory measures:

1. The Federal Government of Nigeria shall expand the market for renewable electricity to at least five percent of total electricity generating capacity and a minimum of 5TWh of electric power production, excluding large hydropower by 2016.
2. The Federal Government shall establish stable and long-term favorable pricing mechanisms and ensure unhindered access to the grid. Grid operators must guarantee the purchase and transmission of all available electricity from renewable electricity producers. While renewable electricity plant owners bear the cost of connection, grid operators must ensure the necessary system upgrade. All upgrade costs must be declared to ensure the necessary transparency.
3. The Federal Government supports the construction of independent renewable electricity systems in areas not covered by the electricity grid to provide power service for local economic activities and sustainable living.

The Federal Government will develop

4. innovative, cost-effective and practical measures to accelerate access to electricity services in rural areas through renewable sources.

5. The Federal Government establishes the Renewable Electricity Trust Fund. The Fund shall consist of budgetary allocations from the Federal Government, consumers of electricity and donor agencies.

6. The Federal Government is committed to a multi-stakeholder partnership in the delivery of renewable electricity to meet national development goals.

7. Nigeria is committed to broadening international cooperation in expanding the role of renewable electricity in meeting national development goals as well as contributing to global efforts in addressing climate change.

6.0 CONCLUSION

Electricity in particular is a key requirement for commercial activity. Where the supply of grid electricity is impractical, costly or delayed, alternative electricity supplies are required. Though improving access to modern energy is not one of the MDGs, it is one of the major catalysts of achieving the set goals as it is essential to have the support infrastructure needed to achieve the desires expressed in the MDGs. A prerequisite for achieving these goals is the need for improved productivity through SHP as this

leads to employment generation and rising incomes.

Modern energy services are an essential input for the development of rural commercial activities such as agriculture, business, social services etc

Moreover, hydropower has a major benefit to a water resource development project and can be integrated easily with projects like domestic and industrial water supply, flood protection, irrigation for food, discharge regulation downstream for navigation improvement and recreation.

Micro Hydro plants (up to 100 kW) and Mini-hydro in the 100 – 1000 kW range can be one of the most viable renewable energy options for rural energy access. They can usually produce electricity for rural communities using cost effective and environmentally benign methods. Most mini-hydro plants are operated as run-of-the-river plants that require small storage capability at the sites.

Local participation (co-operatives) should be encouraged in the financing, construction and operations of SHP projects as this can provide a sustainable source of energy for development of rural communities.

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