Sector: Energy

Sub-Sector/Technology Option: Wind Power (On & Off Grid)

Technology Application: Standalone wind farms to service Urban centers and supply the national grid.

Introduction

According to Wiser*et. al*(2011) wind energy has significant potential for near-term (2020) and long-term (2050) greenhouse gas (GHG) emissions reductions. While a number of wind energy technologies are available across a range of applications, of significance to climate change mitigation, is the generation of electricity from large, grid-connected wind turbines either on-shore or off-shore. On-shore wind energy applications have advanced over the years and are rapidly deployed for electricity production in a number of countries.

Guyana is heavily dependent on imported petroleum-based products to service its energy needs (GEA, 2010). The electricity generating power sector is the second largest consumer of imported petroleum-based products (29% in 2013) (GEA, 2014). The electricity generating sector accounted for approximately 36% consumption of total petroleum based products imported in 2014. Additionally, the industrial and residential sub-categories, accounted for 33% and 37% consumption in 2013 respectively, of electricity generated using fossil fuels (GEA 2015).

In this regard, Guyana is actively pursuing diverse energy sources for electricity generation and is considering the establishing wind farms to supply electricity to the national grid, as well as, off-grid applications at residential and commercial levels. A number of studies were conducted to assess potential sites to install wind power plants. It was concluded that the wind speeds at the sites measured in Hinterland areas were not favourable, resulting in low technology potential weighted against the high investment cost, but some sites along Guyana's coastline were found to be favourable. As a result of improved technology, further assessments were conducted by the GEA in recent years and, out of fifteen (15) sites, six (6) most favorable sites along Guyana's coast were identified to conduct wind measurement.

Technology Characteristics

Features	Onshore wind turbines are usually grouped together into wind power plants or wind farms. These plants are usually 5-300MW in capacity using either horizontal-axis or vertical-axis wind turbines. While vertical –axis turbines could be easily installed on roof-tops and near the base of buildings to avoid constructing high towers, over the years the horizontal-axis wind turbine dominated the market. A wind turbine consists of a supporting tower about 50-100m, with rotors that are often 50 to 100 m in diameter. Turbines, on average, operate with rotational speeds between 12 – 20 revolutions per minute (RPM). The three (3) blades rotor is connected to the hub, main shaft and the nacelle. It also contains a control system, emergency

	brake (to shut down the turbine in case of major technical issue) and other ancillary systems that maintain or monitor the turbine.
Capital Investment Cost[1]	The cost of wind power plants has declined over the years due to continued technology advances. However, the degrees of application locally depend on the economic performance of wind power compared to alternative power sources taking into consideration - annual energy production, investments costs, O&M costs, financing costs and the lifetime of the plant (Wiser *et al*, 2011). Wind power plants with grid connectivity are capital intensive where the initial investment costs could range from 75%-80% of total expenditure (Wiser *et al*, 2011). Investment costs include cost of the turbines, grid connection and other costs such as permits and assessment and monitoring equipment. The cost of the turbine accounts for more than 70% of the total investment costs (Wiser *et al*, 2011). Currently, a USD 50M wind farm project is proposed to be established at Hope Beach, East Coast Demerara for 25MW thereby costing an estimated USD 2M per megawatt in Guyana context (GEA, 2015[2]). According to IRENA (2015), the average levelised cost of electricity (LCOE) for onshore wind projects delivery of electricity is USD0.05kWh.
Operating Cost	Operating costs for wind power plants are about 20%-25% of the total expenditure of wind power plant (Wiser *et al*, 2011). Wind turbines meeting the International Electrotechnical Commission's (IEC) standard are designed for 20 year life but wind power plants, based on acceptable O&M costs, could exceed the life of the turbines. Initially, O&M costs of the wind power plant could be low due to coverage, to some extent, by the manufacture warranties for the turbine but can increase over the life of the plant as the turbine ages (Wiser *et al*, 2011).
Maturity	Wind energy is a mature renewable energy source thathas been successfully deployed in many countries. It is technically and economically capable of significant continued expansion and its further utilization is critical as GHG mitigation / reduction strategies.
Country Specific Applicability	
Status of technology in country	To date, more than 40kW of small isolated wind power installed capacity has been recorded in Guyana (GEA, 2014). Under the Sustainable Energy Programme for Guyana, after the measurements at four selected sites and selection of a

	suitable site, a 300kW grid-connected wind power system will be installed. While there are no current wind farms in Guyana, an investor had expressed interest to install a 25MW capacity wind power plant. A memorandum of understanding (MOU) was signed between the government and the private company to supply electricity to the national grid from this plant, proposed to be established at Hope Beach on the East Coast of Demerara. The MOU expired and the project became dormant for a few years. Currently, the government has commenced reengagement with the developer (GEA, 2014).
Market potential	The technology is commercially ready and cost effective to be deployed on large scale.
Scale of application and time horizon	25MW is currently being explored over the next five (5) years.
Institutional and Organisational requirements	The institutional and organizational requirements for establishing wind power plants are embodied in the mandates of the GEA, Environmental Protection Agency and the Ministry of Public Infrastructure.
Operation and maintenance	Extensive capacity building will be required to ensure skills locally available to maintain the interphases (software) and electronics and servicing of equipment.
Scale/size of beneficiary group	The direct beneficiaries are those connected to the national grid.
Acceptability to local stakeholders	This technology is widely accepted by local stakeholders.
Endorsement by experts	The use of wind energy to generate electricity on a large scale is widely accepted and endorsed by local (GEA) and international experts. GEA supports the implementation of wind farms to supply electricity to the national grid providing the supporting mechanisms such as pricing makes the investment competitive.
Barriers and Disadvantages	▪ The operation of wind turbines does not directly emit GHGs or air pollution. However, the construction and operation of wind power systems has a direct impact on biodiversity (bird and bat collision fatalities) and habitation and ecosystems disruptions. It should be noted that these impacts are site and species specific. ▪ Installation of wind powered systems could have aesthetic (visual) and landscape impacts and contribute to increased noise nuisance if sited close to residential areas. ▪ Visibility of wind power plants could result in reduced value of property in the local area.

	▪ The legal framework to allow for interconnection to the national grid through power purchase agreement. ▪ Variability in wind speed based on location limits the capacity at any one time to be delivered to the national grid. As a result, generation plants will be required to supplement power to the system due to changes in wind pattern which can impact the output of wind power plants.
Mitigation Benefits	
Greenhouse gases abatement potential	The generation of electricity from large, grid-connected wind turbines offers significant GHG emissions reductions through the displacement of fossil fuel-based electricity generation. Even though GHG emissions are produced during the manufacture, transport, installation, operation and decommissioning of wind turbines; these are small compared to the energy generated and emissions avoided over the lifetime of wind power systems.
Potential Development Benefits: Economic, Social, Environmental	
Economic benefits	▪ Increase energy security as a result of diverse sources of energy for electricity production. ▪ Reduce national expenditure on importation of petroleum-based products.
Social benefits	Increase employment opportunities.
Environmental benefits	The primary environmental benefit of the application of wind technology is the displacement of petroleum-based products for electricity generation.

References:

1. GoG, (2012): Second National Communication to the UNFCCC
2. Guyana Energy Agency (GEA), (2014): Strategic Plan 2014 – 2018
3. GEA (2014): Annual Report
4. GEA, (2010): Energy Development in Guyana
5. GEA, (2015): Statistical Data from GEA
6. International Renewable Energy Agency (IRENA), (2013): Renewable Power Generation Costs in 2012: An Overview.