TECHNOLOGY FACTSHEET

GRID-CONNECTED WIND POWER

1) **Sector:** Alternative energy sources

2) **Sub-sector:** Wind power plants

3) **Technology name:**

4) **Option name:** Grid-connected wind power

5) **Scale:** Large-scale

6) **Availability:** Available

7) **Technology to be included in prioritization?** Yes

8) **Background/notes**

Wind energy has great resources potential in the most of the territory of Republic of Azerbaijan.The average annual wind speed of Absheron peninsula which is considered the most windy area range 5,8–8,0 m/s. The numbers of windy days in these areas are 245-280 days. The average annual wind speed in Nakhchivan Autonomous Republic consist of 1,9-2,7 m/s. The increase in the annual course of wind regime is recorded in summer. The wind speed reaches to 3,4-5,5 m/s from June to September. The average annual wind speed is 0,8-2,3 m/s in the western regions of the Greater Caucasus, while 1,9-3,2 m/s in the eastern regions. Annual increase in wind speed is recognized in the western regions from December to April while in the eastern regions from November to March. The average annual wind speed consists of 1,8-2,4 m/s in the Lesser Caucasus. Annual slight increase in wind speed is observed as 2,8-3,2 m/s from April to December. The average annual wind speed is 1,8-2,4 m/s in the Central and lowland areas.

There are relevant governmental programs for the development of wind energy in the Republic. Azerbaijan has adopted State Program on utilization of alternative energy, including the wind energy sources (2005 – 2013). The objective of State Program is to promote the power generation from renewable and environmentally sound sources and to more efficiently utilize hydrocarbon energy sources. According to the program, Azerbaijan has taken target to have 20% share of renewable energy in electricity and 9,7% share of RE in total energy consumption by 2020. On 29 December 2011, President of Azerbaijan Republic issued an order on preparation of National Strategy on the use of Alternative energy for the periods of 2012-2020. The main

objectives of the strategy are to identify main directions of electricity from wind energy sources and legal framework for usage of wind energy sources.

- Institutional level was created.. The State Company on alternative energy was established recently by the Presidential degree.
- Development technical capacity for the wind techniques is going
- There is good cooperation with international industry companies on producing of wind techniques.
- The practices of wind turbines were gained. The 2 MW turbines were constructed recently by SOCAR and private companies.
- There is experience on preparation of national technical specialists.

9. Advantages of the technology:

- The technology can be used at regions located far from the industrial centers.
- Can be used for the electricity supplying of individual citizens or used with combined regime with electricity grid.
- The technology economy the grid electricity consumption and decreasing of the organic fuel using and environmental effects, due to emission reductions to soil, water and atmosphere air (CO_2, SO_2, NO_x etc.).
- Technological is ready to for industrial application.
- The modern wind turbines have a low speed (20-40 rotations per minute) and their air-dynamics is very rigorously projected, following the goal of reducing to minimum the noise level.

10. Disadvantages of the technology:

- Relatively high cost of the equipments.
- There are needs for financial support.
- Weak development of the national industry for production of wind techniques.
- Weak public awareness on wind energy advantages.
- As the some negative effects related with electromagnetic and phonic pollution, alienation of planted land and landscape change.
- Needs for the area for the environmentally friendly location.

11. Implementation assumptions (How the technology will be implemented and diffused across the subsector)

According to evaluation conducted by various experts Azerbaijan has 800-1500 MW annual wind energy resources. This reserve means 2.4 billion kW/h of electric power which in its turn can serve to 1 million tons of conditional fuel economy annually. As a result of investigations carried out based on the long-term observations it was determined that the most favorable wind conditions are in Absheron peninsula, Caspian Sea coastal zone and in its islands in the territory of the Republic of Azerbaijan.

- Installed capacity of the WPP with 3 MWt
- Air generator (AG) type deWind D6
- Yearly energy volume produced by the power station- 11,037 thousand kWh/year
- Actualized energy volume W_a produced in the entire period of the power stations life – 83,947 thousands of kWh
- Investment in the WPP, 4,117 Euro thousand
- Specific investment in the WPP – 1,37 Euro/ kW
- Price of the produced energy – 0,052 Euro/ kWh

12. Impact statements (How the options impact countries development priorities)

- Countries social development priorities
  - Create the work places. Usually a capacity of 1kW of wind energy creates work places for 15-19 persons.
  - The growth of the wind energy could considerable contribute to state energy security consolidation.
  - The implementation of the wind energy sources would also have a positive influence on the public opinion, which would realize the necessity to protect the environment and to consume rationally energy resources.
- Countries economic development priorities
  - External costs of electricity generated by wind energy were about 0,05-0,2 Euro cents/kWh. The production cost of grid electricity in Azerbaijan is 0.04 AZN/kWh
  - Development of the national wind energy industry will decrease the initial capital investment
- Countries environmental development priorities
  - Decreases the SO_2, NO_x emissions which have a negative impact on woods, crops, generally on vegetation and particularly on the endangered species by replacement of grid electricity conception.
  - This technology is zero-emissions of CO_2.
  - Can bring economic benefits due to its environmental friendly character.

- Reduction in GHG emission over 30 years

For 2030 year, total GHG emission reduction will be 3,96 mln ton $CO_{2.}$

13. Costs

a) Capital costs over 10 years

Based on rough calculation, there is a potential for producing 800 MW wind energy in Azerbaijan. If taking into account that for production of 3 Mw energy there is a need for 4.117.000 Euro investment, total capital costs will be around 1.097.000.000 Euro.

b) Operational & maintenance costs over 10 years

Amortization costs of the equipment may be considered as 10% of total cost per year.

c) Cost of GHG reduction

- Emission factor of the grid is 0,62 kg CO2 /kWh (in 2006)
- Price of the produced energy is 0,052 Euro/ kWh

So, cost effectiveness for mitigation is 0,052/0,62 Euro per kg(CO2) = 0,084 Euro per kg (CO2) or 1,25 x 0,084 USD per kg (CO2) = 0,105 USD per kg (CO2)

d) Other costs over 10 years

Additional costs may be needed to provided awareness raising activities among local population and commercial sector in order to promote application of wind energy