United Nations Development Programme
Global Environment Facility

Project Brief

PIMS number:	2129
Project title:	Development of On-grid Wind Electricity in Tunisia for the 10th Plan
Project number:	xxx
Country:	Tunisia
GEF focal area:	Climate change
GEF programming framework:	OP#6, promoting the adoption of renewable energy by removing barriers and reducing implementation costs
Eligibility:	Tunisia ratified the UNFCCC
Duration:	8 years
Estimated start date:	January 2004
Estimated end date:	January 2012
Implementing Agency:	UNDP
Executing Agency:	ANER – Agence Nationale des Energies Renouvelables under the Ministry of Industry and Energy

A. BRIEF DESCRIPTION: As of June 2003, Tunisia has only 20 MW of installed on-grid wind power capacity under ownership and management of STEG (Société Tunisienne d'Electricité et de Gaz), the public power utility. As a result of the renewable energy sector restructuring and promotional activities in recent years, the Government has announced that it will build a new 100 MW on-grid wind farm as part of the 10th plan's (2003-2007). Additionally, the Government expects to augment the country's wind energy development program significantly with another 200 MW capacity during the 11th plan period (2008-2011). It is expected that these 200MW will be built on a financially self-sustaining commercial basis. The Government has also made arrangements for the successful implementation of the proposed 100MW wind power plant to build toward the preparation of the forthcoming 200 MW wind electricity concession program. The proposed project will remove the existing barriers to wind energy commercialisation in Tunisia by: **(i)** supporting the *strengthening of the institutional, regulatory and operational capacities* of the key structures involved in wind energy sector development through technical assistance, namely, ANER (National Renewable Energy Agency), IPP Office (the country's Independent Power Production Office), STEG (the incumbent power Utility in charge of all network/power transmission operations), DGE (National Directorate of Energy), the Ministry of Energy; TA to ANER will also support improvement in the electricity regulatory framework to elicit further development of on-grid renewable electricity plants with a focus on establishing solid foundations for commercial wind electricity within the 11th plan; **(ii)** contributing to *a production-based "smart-subsidy" scheme* for the deployment and commercial operation of 100MW capacity; and **(iii)** implementing a TA component to ensure sizable (minimum target of 40%) *integration of the relevant local industry* (including electric equipment manufacturing, electronics, mechanical etc.).

BUDGET SUMMARY (US$):

Cost and Financing (in US$)		
GEF	Project:	10,250,000
	PDF-B:	275,000
	Subtotal GEF	10,525,000
Co-financing		
	Government (in cash and kind)	18,250,000
	IEPF and Partners:	503,000
	ANER:	232,000
	Private Sector (Unidentified)	75,750,000
	GTZ: (in Euro)	1,000,000
	Subtotal Co-financing	95,735,000
TOTAL PROJECT FINANCING:		**106,260,000**

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Government GEF Focal Point:
Dr. Dali NAJEH, Director
International Cooperation for Environment
Ministry of Agriculture, Environment and Water Resources
30, Rue Alain Savary – 1002, Tunis -TUNISIE
E-mail address: DCI@mineat.gov.tn and/or dali.najeh@inat.agrinet.tn
Tel: (216)-284-230; Fax: (216)-71-799-171

IA Contact:

Mathieu-C. KOUMOIN
GEF Climate Change Coordinator
Francophone North, West and Central Africa
Tel: (221)-849-1798/(221)-849-17-41
E-mail address: mathieu.koumoin@undp.org

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List of Acronyms and Abbreviations

ANER: National Renewable Energy Agency
STEG: Société Tunisienne d'Electricité et de Gas, National Power and Gas Utility
CSPIE: Higher Commission for Independent Power Production
IPP: Independent Power Producer
CIPIE: Inter-Departmental Commission of Independent Power Production
FDI: Foreign Direct Investment
UNDP: United Nations Development Programme
GEF: Global Environment Facility
LV: Low voltage
MV: Medium Voltage
HV: High Voltage
PBSS: Production-Based Smart Subsidy
MIE: Ministry of Industry and Energy

CURRENCY EQUIVALENTS

Currency Unit = Tunisian Dinar (DT)
1 $US = 1,28 DT (rate for May 1st through July 31st, 2003 from Bank of Canada)

UNITS OF MEASURE

1 A	=	Ampere		
1 GWh	=	Gigawatt-hour	=	1000 MWh
1 KV	=	Kilovolt	=	1000 volts (V)
1 KVA	=	Kilowatt-ampere	=	1000 VA
1 KW	=	Kilowatt	=	1000 watts (W)
1 KWh	=	Kilowatt-hour	=	1000 Wh
1 MVA	=	Mega-volt ampere	=	1000 KVA
1 MW	=	Megawatt	=	1000 KW
1 MWh	=	Megawatt hour	=	1000 kWh
1 TOE	=	Tonne Oil Equivalent		

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B. PROJECT DESCRIPTION

B1. Background and Project Context

1. In 2001, with support from the United Nations Development Programme (UNDP) and the Global Environmental Facility (GEF) together with complementary assistance from a number of donor partners including Institut d'Energie des Pays Francophones (IEPF), Tunisia was granted over 1 million US $ for the preparation of an on-grid wind electricity project. The above facility was aimed at jump-starting the development of commercial wind electricity through the removal of barriers and constraints to be identified during the preparation phase under the supervision of the country's National Renewable Energy Agency (Agence Nationale des Energies Renouvelables -- ANER).

2. During implementation of the preparatory assistance which included, among other activities, various wind measurements to ascertain the country's wind potential (launching of data collection to develop a wind map/Atlas), institutional, technical, financial and economic feasibility studies to support the intended commercial wind electricity capacity increase on the interconnected grid operated by STEG (Société Tunisienne d'Electricité et de Gaz -- National Power Utility), Tunisia's wind-energy sector ambitions were clarified in both quantitative and qualitative terms with the public announcement of the 10th plan.

3. With respect to the quantitative objectives set forth by the 10th plan, Tunisia has opted to install a 100MW additional wind power capacity by 2007. Furthermore, it was announced that the country's wind energy development program would be significantly strengthened by another 200 MW capacity to be deployed -- on a self-sustaining commercial basis and in successive stages -- within the 11th plan (2008-2011). As regards the government's preferred implementation process based on the general policy prescriptions of the 2003-2007 plan, wind-energy sector targets would be met by boosting private investments through the establishment of an increasingly competitive renewable energy business environment combined with various incentives to integrate the country's manufactures. This effort is principally geared at re-aligning the country's renewable energy sector performance with the overall competitiveness of the economy, using the proposed on-grid wind electricity program as an operational conduit to attract sizable Foreign Direct Investments (FDI). The country was awarded favourable ratings in the annual report on global competitiveness for 2002-2003 (World Economic Forum of Davos), ranking Tunisia ahead of Morocco, Portugal and Italy to mention but a few of its immediate neighbours in the Mediterranean Basin. Against the above backdrop, using Tunisia's ambitious wind energy program to accelerate the pace of energy sector structural reform, boost productivity, energize private sector activity, and create an environment more attractive to foreign investment appeared to be a sensible approach.

4. Within the above context, the UNDP-GEF Regional Coordination for Francophone Africa fielded a stock-taking/project preparation mission in Tunisia from February 24th through March 5th, 2003 to review progress made in the implementation of the preparatory assistance (jointly co-financed by GEF and the Tunisian Government). On the basis of the findings of the mission, and in collaboration with all local key players, the Tunisian government approach UNDP-GEF for the planning and execution of a project brief formulation mission that took place from July 24th through August 7th 2003 in Tunis. This brief builds upon the outcomes of the above field assessments and incorporates the recommendations made by all stakeholders. The proposed intervention falls under the purview of GEF Operational Programme Number 6 (OP#6- promoting the adoption of renewable energy by removing barriers and reducing implementation costs).

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B.2. National Policy

5. Until the mid 80s, Tunisia enjoyed a favourable energy situation characterized by a largely favourable energy balance. As a result, the energy sector played a significant role in the country's economic growth accounting for 13% of the country's GDP and 16% of national exports in 1980. By the end the 80s, the energy sector outlook declined presumably because of the following two major factors: (i) the decline in hydrocarbon fuels production owing to the depletion of the main oil reserve in El Borma; and, (ii) the rapid increase in domestic energy demand derived from the country's sustained economic growth and increasing urbanization. The energy balance went from a largely favourable situation of about 2,600,000 toe in excess in 1985 to a marginal deficit in 2001. Based on the analysis of the energy sector statistics, it is fair to suggest that since 1986, the contribution of the energy sector to economic growth has been constantly declining. To date, the energy sector accounts for less than 15% of the country's GDP. In fact, Tunisia is now meeting part of its energy requirements through imports.

6. On the face of the above situation, Tunisian public authorities rapidly developed a three-pronged strategy based on supply and demand actions together with a set of measures to gradually improve the energy sector regulatory framework. Major supply side actions included the following:

(i) setting-up of a regulatory and fiscal framework conducive to oil (and especially gas) exploration activities. This led to the discovery and further exploitation of new oil and gas reserves;

(ii) finalization and implementation of agreements signed with Algeria in connection with the exploitation of the Algero-Italian gas pipeline granting Tunisia a 5% volume share of all gas transits. This arrangement was further consolidated by the doubling of the capacity of the gas pipeline in 1995;

7. On the demand side, the principal action taken was:

(iii) development and implementation of a **volontariste** policy for the rational use of energy and the creation in 1985 of "Agence pour la Maîtrise de l'Energie" in charge of fostering renewable energy sector development;

8. Improvements in the regulatory framework included:

(iv) unbundling of the electricity production business from transmission and distribution activities, which remained vested with STEG, the Public Power Utility. As was the case in most emerging economies, opening electricity production to IPPs (Independent Power Producers) was one of the first measures of the sector re-structuring efforts to be fully backed-up by specific legislative and legal provisions as early as in 1996;

(v) establishment of new institutions and enactment of pro-active regulatory measures to promote renewable energies as substitutes to conventional energies.

B3. The electricity sub-sector

9. **National coverage:** Tunisia started quite early by setting itself very ambitious objectives for the electrification of the country including coverage of remote rural areas for which on-grid electricity access was not a realistic alternative in the foreseeable future. Achievements to date are quite remarkable. By late 2001, up to 2,3 million on-grid customers were recorded. Though the overall electrification rate had reached 100% in urban areas well before 1990, special emphasis was placed on rural electrification resulting in sizeable progress. This is best illustrated by the fact that with rural electrification rates around 66% in 1994, the country had achieved more than 95% rural electrification coverage by late 2002.

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10. **Electricity demand:** Electricity demand in 2002 reached 9,078 GWh, mostly from MV and LV customers who account for 48% and 42% of demand respectively. HV clients only account for 10% of total demand. The structure of demand is characterised by the important share of the industrial segment, which represents (47%) of customers, followed by the residential and tertiary sectors (25% and 22% respectively). National electricity demand has increased on average by 6.5% per year over the 1990-2000 decade. This rapid growth is basically due to LV consumers who are mostly residential subscribers. Average growth rate of demand in this category during the period was around 8.6% per annum.

11. **Electricity supply:** At the creation of STEG in 1962, the electricity capacity in Tunisia was 116 MW. To meet the increasing demand, STEG continued to increase its capacity, which stood at 2812 MW by the end of 2002 with a 10,340 GWh annual production. Peak demand was estimated at 1,890 MW in 2002. Over the last ten years, an average increase of over 6% per year was recorded.

12. However, a important factor in understanding the electricity sector dynamics in Tunisia today is the changing structure of power production by the STEG and the basic pattern underlying the above transformation in the last 20 years:

(i) by the early 80s, STEG decided to optimise the use of natural gas in electricity production. In 1994-95, the predominant share of natural gas in aggregate electricity production was particularly noticeable, with the doubling of the Algero-Italian gas pipeline and the actual exploitation of the MISKAR gas reserves.

(ii) in 1995, STEG deployed its first combined cycle gas-fired plant on the Sousse production site. Since then, combined cycle gas-fired technology has been STEG's choice for all new major power plants. The above choice has been justified on technical, efficiency and economic grounds. The first on-grid wind power plant was commissioned at Sidi Daoud in 2000. This 10.56 MW plant was built and operated directly by STEG. An additional 8.6 MW capacity was added and commissioned on a semi-industrial basis in June 2003.

13. Year 2001 witnessed the commissioning of the country's first independent power plant (RADES II) under the BOOT (Built, Own, Operate and Transfer) scheme. This combined-cycled plant has a capacity of 471 MW and has enabled public sector actors in the electricity business to acquire some valuable experience in accommodating a variety of public-private partnership arrangements. A dedicated Office, the IPP Bureau (Independent Power Production Bureau) acquainted itself with the intricacies of the tendering process and the subtleties of bid evaluation activities under a variety of binding constraints. At the same time, the single buyer, STEG, acquired some much valuable experience in the various procurements required and improved its operational capacity in connection with the company's dealings with private actors in purely commercial terms. This experience will be brought to bear during the implementation of the proposed 100MW wind concession contract.

14. In 2002, more than 97% of STEG's production capacity relied on thermal plants, hydro and wind capacity represented only 2.2% and 0.4% respectively. In view of the relatively poor water resource endowments of Tunisia, it is highly unlikely that the above trend will change unless the government's proposed large-scale wind electricity programme is implemented. The share of combined cycle gas-fired technology in the tune of some 29,7% of total installed thermal electricity is expected to be sustained – and even reinforced – in the years to come.

15. In view of the increase in electricity demand, the 10th development plan (2002-2006, at times indicated to run over 2003-2007) is expected to install an additional 770 MW. This trend would extend beyond the 10^{th} plan and total capacity should reach 4,400 MW by 2011.

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16. **Power Transportation and Distribution:** Tunisia now has a good power transmission network (HV). STEG certified data confirms that from 3,065 km in 1990, the transport network increased to 3,782 km in 2001 out of which 1,302 km are dedicated 225 kV lines; 1,518 km in 150kV and 962 km in 90kV. The entire network has 52 HV transformers scattered throughout the country.

17. Power Distribution: By the end of 2001, the distribution grid totalled some 40,235 km of MV lines , 73,951 km of LV lines together with 33,262 MV/ LV transformers all owned by STEG. Additionally, there were 12,359 privately owned MV/ LV transformers. The distribution network has largely evolved during the first 10 years to meet the high rate of electrification of the country, in part because of the country's overly ambitious rural electrification programme launched by STEG during the 20 years past, and in part as a result of the adoption of the monophased (with an earthing system) distribution system in 1976. The above choice is widely credited to have contributed to increasing rural electrification rates. Total distribution grid (MV + LV) has shifted from 51,000 km in 1990 to 114,186 km in 2001.

18. **STEG electricity tariffs:** The Ministry of Industry and Energy fixes rates periodically based on tariff recommendations by STEG. The current levels of tariff are summarized below:

- High voltage (US$ cents per KWh)

Table 1: High voltage electricity tariff structure (US$ cents per KWh)

	Regular hours	Peaks	Evenings	Nights
4 load schedules	3.43	6.55	5.07	2.73
3 load schedules	3.74	6.39	-	2.73
Fall-back Tariffs	4.29	7.56	5.46	2.88

- **Low voltage:** Less than 2 KVA = 5.07 US$ cents / KWh and, over 2 KVA = 7.33 US$ cents per KWh

19. **Update on Power Sector Reform and Regulatory Arrangements:** In the framework of Bill n°62-8 of April 3rd 1962 creating STEG which was subsequently ratified by way of entry in force of Bill n°62-16 of May 24th 1962, STEG had monopoly rights for the production, transport and distribution of electricity. Under a number of circumstances -- all duly supported by documented approval of the Ministry of Industry and Energy -- STEG could produce electricity from renewable sources. The above monopoly right was terminated by a legislation voted in April 1st 1996 (Bill N°96-27) authorising the State to grant concessions to independent producers that would sell their output to STEG, the single buyer. Conditions and modalities of the concession are regulated by Decree n°9661125 of 20 June, 1996 specifying that:

(i) selection of the successful producer is done through a competitive tender process;

(ii) establishment of the Interdepartmental Commission for Independent Power Production (CIPIE) under the Ministry of Industry and Energy with a mandate to: **a)** suggest facilities to be granted to the selected Independent Producer; **b)** ascertain the various incentives to be granted by the state on a case-by-case basis; **c)** participate in bids opening and evaluation; together with, **d)** the responsibility to make recommendations to the Higher Commission described in item (iii) below with a view to formalizing the government's award decision.

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(iii) creation of a Higher Commission for Independent Electricity Production (CSPIE), as an interministerial body responsible for the selecting of the successful bidder for each independent power production contract;

(iv) CIPIE is also in charge of following-up negotiations with the independent producer up to the signing of conventions with the Ministry of Industry and Energy (MIE). The convention should specify among other things, key characteristics of the concession including its duration, advantages (if any) granted to the selected bidder as well as reporting requirements to the government as requested by MIE;

20. It should be noted that the mode of selection and specific criteria to apply, ranking schedules and bids specifications are set by CIPIE in compliance with the recommendations and guidance of the Higher Commission. The RADES II thermal power plant project was implemented using the process outlined above. It offered the local players a unique opportunity to gain some hands-on experience with private participation in electricity production in Tunisia. It resulted in a US$ 250 million investment contract awarded to an international Consortium on a 20-year BOOT-type contract for the installation of a 471MW combined cycled gas-fired plant.

B4. Greenhouse gas emissions in Tunisia in 2002

21. After a thorough inventory of greenhouse emissions conducted in 1994 and 1997, a decision was made to carry out another inventory of greenhouse emissions due to the energy sector in 2000. By and large, the 2000 inventory took into account the 1996 IPCC revised Guidelines as well as the IPCC recommendations available from the Guide of Good Practices for methodological options and emission factors. Results of the latter inventory of greenhouse emissions in 2000 indicate a clear prevalence of emissions due to energy combustion which account for 90% of total emissions in the energy sector (18.7 million TE-CO_2) against 10% (2 million TE-CO_2) due to fugitive emissions.

22. The pattern of emissions by source appears to have changed somehow as combustion-related emissions accounted for 92% of total emissions in 1994 compared with only 8% for fugitive emissions. The apparent relative increase in fugitive emissions is mainly due to the commissioning of the MISKAR gas reserve exploitation project and to the commensurate gas consumption increase throughout the country. Results of the inventory of emissions due to energy for the year 2000 also indicate a predominance of CO2 with 19 million tons or 91.7%, followed by CH4 with 1.5 TE-CO2, or 7.4% of emissions in the energy sector. The above figures have slightly declined as compared to the 1994 situation where CO2 levels of emissions stood at 93.5%

23. This decline is due in part to the relative increase in methane emissions (whose share in the sector was only 6% in 1994) following the increase of fugitive emissions from the newly exploited MISKAR natural gas reserve. Other factors could also account for this slight change, in particular the use of different emission factors in compliance with recommendations in the Guide of Good Practices.

B5. Status of renewable energies in Tunisia

24. The regulatory framework for renewable energy activity in Tunisia evolved over the last twenty years. Much of the change and progress has to do with the various fiscal incentives and entitlements granted by the government over the years. Though overall renewable energy sector business environment seems to have improved gradually, 2001 can be observed to be a unique milestone with the issuance of some 20 presidential decrees to support the government's renewed policy commitments to the sector. Government decisions made by way of the May 2001 decree can be outlined as follows:

(i) compulsory use of solar water heaters in new public buildings;

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(ii) emphasis on optimal use of photovoltaic energy in various sectors and government sponsored projects;

(iii) development of on-grid wind electricity;

(iv) announcement of a variety of incentives to produce energy from waste, geothermal sources, together with micro/mini-hydro power production to displace hydrocarbon fuel and oil use in conventional production.

25. In accordance with the above Presidential instructions, two commissions were created in March 2003 to prepare specific recommendations targeting both the strengthening of the institutional aspects of the renewable energy sector and the overall regulatory framework within which all key actors have been operating. The mandate of these commissions focussed primarily on wind, geothermal thermal and solar energy promotion. It should also be noted that since June 2001, mandatory use of solar water heaters in new public buildings has been enforced following a circular from the Prime Minister's Office.

B6. Status of wind energy in Tunisia

26. The Tunisian experience in wind electricity production is relatively recent and remains quite limited thus far. Earlier experimentations/trial projects date back to the beginning of the 80s with the commissioning of two 10 kW and 12 kW wind-turbines in Aquaria and Jabouza under the Société d'Energies Nouvelles (SEN). When SEN closed down in 1994, STEG took over its wind-turbine operations. The two aero generators are now out of service. The above units were not properly maintained and monitored to allow lessons to be drawn for future development of the sector; and the reason is simple. There was no long-term vision for the sector in the country at that time.

27. By the end of the 80s, there was a sense of an emerging worldwide interest in the prospects for wind energy technology both in terms of technical innovation and immediate economic viability. Within this context, the Tunisian authorities started exploring the possibility of tapping the country's wind resources for power production to boost on-grid electricity production in the country. By early 1990, a feasibility study for a pilot project was commissioned by STEG in the Cap Bon area. This led to the implementation of the initial 10.56 MW pilot on-grid wind plant in Sidi Daoud.

28. Following the above concrete and visible outcome, which served as a demonstration project, various Tunisian institutions gradually began to be interested and further involved themselves in the development of the wind energy sector in the country. The opportunity was also seized by STEG to strengthen its ownership of wind energy technology throughout the project implementation cycle and subsequent day-to-day operations management. Additionally, STEG was able to collect a set of useful wind data on a number of promising sites that could be put to further good use by future initiatives in the sector. These principally relate to:

- Jebel Sidi Abderrahmen, with an average wind speed exceeding 10m/s (at 45m height) and a load factor over 3,500 hours (i.e. 41%);

- Metline, with an average speed exceeding 9m/s (at 30m height) and a load factor over 3,500 hours (i.e. 41%).

29. As a result of the above demonstration phase that provided much needed initial learning, Tunisia decided to implement a pro-active policy with a view to developing its wind energy sector on a large-scale. Among the various efforts made, the following are noteworthy:

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(i) Presidential decision issued in 2001 for the promotion of on-grid wind electricity supply;

(ii) signing by Tunisia of the Kyoto Protocol in June 2002;

(iii) adoption of the 10th plan with a specific mandate to install 100 MW on-grid wind electricity by 2007 and deploy an additional 200 MW in the 11th over the 2008-2011 horizon;

(iv) launching in 2002 of a global project for capacity building in wind power. The project, jointly funded by ANER, UNDP, CIDA and IEPF, includes a component for capacity building for public organizations involved (ANER, STEG) and the private sector together with a partial wind power capacity assessment and an investigation of the sector's regulatory framework;

(v) creation in 2003 of a Commission for the development of wind energy in charge of preparing and supervising the implementation of a regulatory framework conducive to the development of on-grid wind power commercialisation; and,

(vi) extension of the Sidi Daoud unit by adding an additional 8.72 MW wind power capacity.

30. **Wind Energy potential in Tunisia:** The « On-shore » wind energy potential in Tunisia has been estimated by a number of preliminary studies to approximate 1,000 MW **nationwide**. Provisional estimates -- for the northern part of the country alone -- suggest a wind capacity in the tune of 250 MW based on explorations carried out in 15 specific sites of immediate interest (5 of which are located in the North and North-Eastern part of the country). In this region, annual average wind speed ranges between 7 and 10 m/s. However, data on these sites are still considered confidential. Table 2 below illustrates the state of knowledge of wind energy potential in the northern region for possible wind power plant deployment in the 10th plan. In fact ANER is currently carrying out additional wind measurement activities in other regions of Tunisia such the Centre-West and the South West to prepare for the implementation of the government's stated objectives in the 11th plan. A number of private firms are reported by ANER to be exploring the country's wind potential in other regions of the country as well.

Table 2 : Wind energy potential in Northern Regions of Tunisia

Site	Region	Developable output	Equivalent duration of operation (h)*	Producible (GWh / year)	Remarks
Jebel Abderrahmane	Cap Bon	120	4000	480	
Metline	Bizerte	30	3500	105	Data ownership:STEG-EnerCiel
Kechabta	Bizerte	35	3300	116	
Ben Aouf	Bizerte	25	3300	83	
Sidi Daoud 2	Cap Bon	40	2500	100	
TOTAL		**250**	**3535**	**884**	

- The duration required for the plant, operating full potential, to supply the energy actually produced over a year with variable regime.

31. **The Sidi Daoud project:** A Spanish company undertook this 9.36 US$ million project. The contract was signed in July 1998 and works started in May 1999. The 32 aero generators (10.56 MW total output) started operating in August 2000, i.e. about one year after the initial contract was awarded. Provisional reception took place in August 2001 and final reception in August 2003. In February 2002, STEG signed a contract with the same company for an extension project to include the supply of 22 additional aero generators adding-up a total capacity of 8.72 MW to the initial plant. Total cost for the extension project is estimated at 8.19 US$ million.

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Basic technical data

32. The Sidi DAOUD site is now known to have a relatively stable wind regime with characteristics that allow extraction of a good share of the existing wind power. Annual speed recorded over the years confirms an average 8.4 m/s (at 30 m height). Maximum speed recorded is 123 km/h, or some 34 m/s. In 2001, actual production was **24 GWh.** Despite this, there is a shared sense within and outside STEG that there is still ample scope for improvement after the initial learning curve. With transmission losses estimated this year at 10% of production, it was necessary to reinforce the MV line feeding the plant's output into the interconnected grid. For 2002, net production was 30 GWh or the equivalent of 2,800 hours of operation (i.e. an average capacity/load factor of 32%).

Sidi Daoud Project Costs and investment/financing arrangements

33. Capital cost incurred was 9.67 million US$. Wind turbines alone accounted for 70% of capital costs. The call for bids launched by STEG included a supplier credit clause. The Spanish company that was awarded the contract was able to mobilize credit/loan financing to cover 80% of capital costs; the balance was covered by STEG on equity co-financing. The terms of the loan financing were quite attractive:

- 50% funded on Spanish public credit (interest rate 1%, maturity 30 years with a 10-year grace period) ;
- 50% funded on manufacturer credit (interest rate 4.7%, maturity 7 years with a 2-year grace period)

Production output tariff settlements and environmental impact

34. The cost of a kWh unit is computed using the levelized cost method. It includes all project-costs incurred during the lifetime of the wind plant: capital costs, operational costs, financial costs etc. Under this project, the unit cost of kWh actualised over 20 years with a 8% discount rate is estimated by STEG to be round 2.65 US$ cents. The kWh cost includes basically equipment depreciation (70%). Maintenance costs stand on average at 21% and include costs for preventive maintenance and troubleshooting (5% and 16% respectively).

35. At the end of 2002, the project generated savings estimated between 14,000 and 16,000 toe. Under normal operation, the project saves some 7,000 to 9,000 toe of primary energy on an annual basis. From 2004 onwards, with the exploitation of the 2nd tranche, savings are expected to range between 13,000 and 16,000 toe. Over the project life, it is anticipated an aggregate saving of primary energy of some 140,000 to 170,000 toe for the first tranche. With the current extension process, now under semi-industrial phase (11 June to 11 September, 2003), the total saving of primary energy is estimated between 262,000 and 312,000 toe by 2023.

36. On the basis of the above, under peak operations, the current project (10.56 MW) avoids 22,000 $TECO_2$ annually. Including the newly commissioned second tranche yields 41,000 $TECO_2$ per annum. Over the lifetime of the project the amount of GHG avoided is estimated at 800,000 $TECO_2$, when project extension is factored into the calculation (10.56 MW + 8.72 MW).

37. According to STEG, the cost avoided by the wind project is estimated at 2.9 US$ cents per kWh, which reflects the cost of fuel displaced through the operation of the Sidi Daoud wind power plant. The financial gain can therefore be rounded-up to 0.3 US$ cents per kWh. Hence, the net annual financial gain to STEG is estimated at US$ 70,200 in 2001 and US$93,600 in 2002. Under normal operational conditions the project accrues savings to STEG estimated at some US$ 171,600 annually. In terms of indirect economic impact, five jobs have been created by exploitation activities in the site. Moreover, during the installation phase hundreds of employees had a full-time

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contract for about a year. The rate of local integration in terms of project equipment for Sidi Daoud was estimated at 20 or 25%: transformers, cables, electric equipment, etc. Civil works, engineering and development activities, which accounted for more than 8% of total capital cost could also be added. However the most important impact of the project was rather strategic. Indeed, the project was first used as a demonstration platform to dispel the apprehensions that the incumbent Power Utility (STEG) could have. Of special strategic interest to the Tunisian counterparts, was the transfer of "know-how" and ownership of the technology by STEG staff that carried out project implementation.

B7. Institutional framework of the wind energy sector

Public institutions

38. The development of wind power in Tunisia is undertaken within an institutional framework involving the following actors:

- **The Ministry of Industry and Energy:** The Directorate General of Energy, under the Ministry of Industry and Energy is in charge of implementing the country's energy policy, including planning of energy infrastructure, power plants included.

- **The Société Tunisienne de l'Electricité et du Gaz (STEG):** Created in 1962, STEG is a Public Law national company in charge of production, transport and distribution of electricity together with distribution of natural gas. Having the monopoly on power transport and distribution activities, STEG is one of the key actors in the development of wind energy activity in Tunisia. The dominant position of STEG in the on-going discussions for the implementation of the government's wind energy program is best illustrated by the fact that it is the only local structure with hands-on experience in planning and executing a wind-power plant project (Sidi Daoud) to date.

- **The National Agency for Renewable Energies (ANER):** The promotion of the wind energy sector in Tunisia is part of the responsibilities of ANER under its general mandate to implement State policy for the management of the energy sector through: (i) implementation of a development programme; (ii) design and implementation of institutional, regulatory and financial mechanisms for promotional activities; along with (iii) implementation of targeted demonstration projects. It is only of late that the wind energy sector started gaining importance in country. In that short period of time, ANER has established itself as a trusted local institution to provide impetus to wind energy development in terms of policy formulation. Nevertheless, the institution is quick to admit that it could use some improvement in specific wind-energy expertise and needs some technical assistance to be able to make the leap in a timely fashion.

39. Ad hoc Committees and Structures

- **The Commission Supérieure de la Production Indépendante d'Electricité (CSPIE):** Created by the decree n°96-115 on 20 June 1996, CSPIE makes decisions related to the applicable modalities and selection criteria of IPPs within the context of international competitive biddings (ICBs), ascertains the appropriate modalities for concession awards together with the specific firm/IPP selection criteria determining bids outcomes. CSPIE is also responsible for finalizing the recommendations in connection with fiscal incentives/tax breaks and the like to be granted by the government on a case-by-case basis.

- **The Commission Interdépartementale de la Production Indépendante d'Electricité (CIPIE):** Created by the same decree under MIE (Ministry of Industry and Energy), CIPIE is subordinated to CSPIE to which it provides input for the preparation of TORs, issuance of tender documents together with the evaluation of bids. CIPIE would usually make recommendations on specific facilities and entitlements to be granted to successful bidders provide its opinion on bids evaluation outcomes to be submitted to CSPIE for endorsement and/or review.

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- The Inter-Ministerial Council meetings of April 16th and 27th 2003 resulted in the formulation of a set of recommendations to provide impetus to the government program to promote rational and efficient use of energy in Tunisia. These recommendations were later operationalized by way of a set of follow-up Presidential instructions on efficient use of energy and renewable energy promotion promulgated on May 3rd 2003. Presidential instruction 19 specifically addresses on-grid wind electricity development. To guide implementation of the above instruction, an Ad Hoc ***National Wind Energy Development Committee*** was established to identify the legal and institutional barriers impeding the development of on-grid wind electricity with a view to suggesting viable options to correct the situation.

40. In the absence of an attractive wind energy market in Tunisia there are few or no organized economic operators in this sector. Nevertheless, the Tunisian authorities are aware that several private international investors have shown some genuine interest in concessions for independent wind electricity production contracts. And, a number of them have established wind measurement facilities in the northern region of the country. The absence of a specific regulatory framework favourable to the development of on-grid wind power supply appears to remains a major constraint to more active involvement of these potential investors.

41. Tunisia has a local industry that has the capacity to supply various components of a wind power projects. These include: towers, electrical wiring, civil works, site development etc. However, as mentioned early, local currency expenditures typically represent less than 30% of total financing needs. Major components such as rotor blades, turbines, alternators and regulation systems have to be imported. Finally, it should be noted that manufacturing of the "value-added" components parts such as aero generators (nacelle, rotor etc) is usually carried out offshore in high-tech and capital-intensive environments. The Tunisian market, even in a scenario of rapid development, is still realistically too narrow to justify full delocalisation of wind power industries to Tunisia. The core wind energy industry is more prone to pursue either sub-regional or regional markets and tends to have a market strategy that is worldwide in scope.

42. As regards local consultancy firms, specific skills in wind power development appear to be almost inexistent in the absence of a national market. Know-how for technical, legal and financial due diligence of wind-energy projects could probably be found with the few STEG staff that participated in the implementation of the Sidi Daoud Project but remains confined within STEG.

B8. Legal framework and incentives for wind power development

43. Renewable energy sector projects in Tunisia can take advantage of various fiscal and financial incentives, which are always difficult to estimate ex ante. These are outlines below:

- **Fiscal and customs tax holidays:** These are regulated by the application decree n°94-1191 dated May 30th 1994 that sets fiscal incentives under articles 37-42 of the Investment code under its special incentives provisions. Investment for the production and commercialisation of renewable energies benefit from the reduction of customs duties which can be lowered to the minimum rate of 10%, the waving of value-added tax (VAT) for capital goods and materials imported provided they are not manufactured locally together with the waving of the value-added tax on capital goods purchased locally. .

- **Other incentives offered by the Code of investment:** Articles 52 and 52 bis provide for the possibility for investors to be granted additional incentives such as: income tax holiday for a period not exceeding 5 years, participation of the State in infrastructure-acquisition expenses, investment bonuses not exceeding 5% of total investment. The investment bonus can be increased up to 20% of the overall investment package if there is reasonable evidence suggesting a sizable level of local integration. The above provision covers: a) all applicable investment operations until December 31st, 2004; b) custom duties and tax holidays on basic capital equipment. Article 52 bis

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foresees the possibility to give investors the land required for the settlement of important projects in terms of investment volume and job creation against payment of a symbolic Dinar. Medium to large-scale wind power projects fit in the above category. All of these incentives and entitlements are subject to the approval of the Commission Supérieure de la Production Indépendante d'Electricité (CSPIE) presented earlier.

B9. Barriers and Constraints to wind energy development in Tunisia

44. A number of barriers that were identified in the previous analysis are summarized below. They will have to be removed for the wind-energy sector to really take hold in Tunisia:

- **Lack of a regulatory framework specific to wind energy development:** Although the regulatory framework of the electricity sector has made some breakthroughs in recent years with the on-going restructuring, it does not address to the satisfaction of most IPPs, the modalities for on-grid wind electricity tariff settlements with STEG. These modalities are a crucial factor that will determine the level of attractiveness of Tunisia for private investors. Perhaps, it should be remembered that all countries which were successful in developing their wind energy sector have adopted tariff schemes that were relatively attractive to independent producers.

- **Inherent lack of competitivity as compared to conventional production for the next 5 or 8 years:** To the possible exception of limited wind resources of exceptional quality, the cost of kWh production of wind energy in the Tunisian context will remain quite higher for the 5 or 8 years to come, than the cost of producing conventional electricity. This is even more so because STEG power plants are mostly combined-cycle gas-fired plants with quite competitive kWh production costs. Although there appears to be compelling evidence and documented Wind industry analysis purporting to support a continued decline in wind electricity production cost, postponing sector investment and/or watering down the government's current ambition could be a costly bet. It could be costly in strategic terms and prove to be a liability when trying to fully take advantage of the forecasted price drops by the end of the current decade. Moreover, there is no such a thing as guaranteed available wind power capacity because of the seasonal and – at times – random/erratic nature of wind electricity production. This means that competitiveness of wind electricity has sensibly relied on the cost of fuel avoided as the most relevant yardstick.

- **The huge investment requirements:** First, wind electricity production is known to be highly capital- intensive with heavy investments required upfront and generally beyond the capacity of local investors (around 1 million US$/MW). The development of the sector will therefore depend on the capacity of Tunisia to attract major foreign investors.

- **Inadequacy of local expertise:** At the exception of STEG, expertise in the wind energy sector is still quite limited both for public entities (ANER, the Ministry of Industry and Energy) and the Private Sector (consultancy firms, etc.). All of the above actors will need to strengthen their institutional, regulatory and operational capacities as these relate to wind energy development.

B10. Relevant International experiences on removing barriers to the development of wind energy

45. The following paragraphs present a number of lessons drawn from experiences by some countries that developed their wind energy sector with various degrees of success.

- **Morocco:** Morocco depends on imports for more than 90% of its energy needs, and accordingly has developed a strategic plan to jump-start renewable energies. With more than 3,500 kilometres of coastline, and some of the best wind power development sites in the world, the country intends to utilize this resource. The national utility company, Office National de l'Electricité (ONE) plans to establish two major wind farms, one in the northern part of the country, and another in the south. The wind farms will have a total capacity of 200MW. Under a

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production concession scheme, ONE established a list of pre-qualified firms, and scheduled offers to be issued in early 2003. Construction is to begin in 2004, and wind power service will be provided in 2005. The wind farms will be developed by the concessionaire, and ONE committed that it would: a) grant 20 years of operation to the developer; and, b) offer a long-term PPA. At the end of this period, the facilities will be transferred to ONE. This process is designed to introduce competition into project development, and will help move ONE's electricity sector liberalization efforts forward.

- **Egypt**: Egypt has excellent wind resources in Suez Bay, and the government hopes to utilize wind resource concessions to develop the wind power there. As a first step, an eighty square kilometre parcel of land located north of Zafarana City has been designated for wind power development. Total capacity is estimated at 600 MW. The national public utility company has built a transmission line to the center of the area, and the areas will be divided into several blocks that will be issued for bidding. The first phase is proceeding with 2 projects under development, using bilateral funding from Denmark and Germany. As in the Moroccan case above, the situation in Egypt essentially represents a move towards introducing competition into wind power development in initial stages of small to medium size concessions in an iterative manner, rather than a full-scale programmatic wind resource concession as being envisaged by the Tunisian government in its 10^{th} and 11^{th} plans combined.

46. **Relevance of International/Experiences/Lessons** : Successful international experiences are all based on a system whereby kWh prices are guaranteed (with some kind of embedded flexibility to adjust tariff levels when necessary depending on the wind potential). Tariffs in all scenarios are set at levels appealing enough for private investors to venture their own capital. With respect to the wind energy industry, the core manufacturers are based in Spain, Denmark, Germany and increasingly in the United States of America. By adopting a wind program approach rather than a project approach, Tunisia is highly likely to appeal to the core wind energy manufacturer and appears quite likely to win its integration challenge.

B11. Government policy and strategy for wind energy development

Political orientations

47. The Tunisian government has taken two basic policy orientations for the development of its wind energy sector. First, it has established wind energy development as a major factor in its environmental policy within the 10^{th} and 11^{th} Plans to which quantitative and qualitative targets would be assigned. This move by the Tunisian authorities is a significant departure from past practices by shifting away from the usual project approach to a medium-term program approach. It is clear that the recent positive developments in the sector are driven by the strong political support that the government has committed. Therefore, the momentum that wind energy has been enjoying in Tunisia recently reflects -- in many ways -- the importance of national ownership of policies to ensure success of energy sector reform efforts, particularly given the barriers to be overcome when trying to mainstream renewable energy sources. Secondly, it appeared not only necessary to involve the private sector in the government's undertakings to increase the share of wind energy supply to the interconnected grid, but also indispensable to ensure that the process and the various public-private partnerships entailed would be forged in ways that boost productivity and create jobs for the local economy.

48. As regards the specific role to be played by private partners, the government has taken a medium to long-term perspective by making arrangements to ascertain that the implementation of the proposed 100MW wind power plant overlaps with -- and feeds into -- the preparation of the forthcoming 200 MW wind electricity concession program. In setting out to do so, it is anticipated that expected private sector commitments to the country's overall 300MW wind power program would materialize, and help improve the quality of the competition for the award of the announced concession contract in the 10th plan. This is in line with the government's aim to accelerate the

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pace of structural reform by boosting private investments through FDI principally. Limited public resources will complement the expected influx of FDI to implement the wind electricity targets in the 10th plan.

49. The above options/orientations, though similar to the trends observed in the recent evolution of the wind energy sector in Europe, the USA, Latin America and China is, in this instance, the Tunisian government's policy response to the need to: (i) widen the country's public –private partnership base; (ii) seize Foreign Direct Investment opportunities; and (iii) boost the creation of jobs on the basis of the job opportunities that can realistically be offered by the wind-energy sector in Tunisia.

Strategic Approach

50. To remove the barriers identified earlier, the government's strategy will focus on: (i) the launching of a significant wind resource concession program (300MW) for the 2003-2011 time horizon out of which 100MW will be deployed within the implementation of the current 10^{th} plan. The above program will be executed through international competitive biddings; in parallel to (ii) a number of activities intended to the strengthen the regulatory framework; while ensuring that (iii) various fiscal incentives are provided in ways that are commensurate with the intended rate of integration of local industries.

51. STEG, as a key local player still has considerable scope for improvement of its skills and operational capacity in connection with on-grid wind power absorption. Moreover, the launching of a one-time 100MW concession contract is expected to result in sizable economies of scale and to reduce transaction costs. The pro-active involvement of all structures interested, the sharing and large scale dissemination of information on the sector combined with targeted improvements in the regulatory framework are pre-requite institutional safeguards that the Tunisian government needs to invite the intended private sector participation. Finally, a long-term wind power purchase agreement combined with attractive wind-electricity tariffs as a whole, are likely to appeal to many private investors once all other conditions are met.

52. The Tunisian governments expects that the private sector will reciprocate when it grasps the depth and breath of the authorities commitments to developing the country's wind energy sector. Indeed, Tunisia has subscribed to the IMF Special Data Dissemination Standard, which reflects international best practice in the area of economic and financial statistics. Hence, the Tunisian government has been taking significant steps to raise the comfort level of private investors. And, with the anticipated co-financing of the Global Environment Facility, the government is determined to see to it that the forthcoming wind electricity concessions make the best of out the existing fiscal incentives and that integration of the local manufactures is maximized.

53. Much of the confidence in future success and determination of the Tunisian government to implement its wind resource concession program has to do with the fact that many private sector expressions of interests were recorded by ANER over the years and various proposals submitted to the government by a number of private ventures. These private actors have recently intensified their data collection activities with the public announcement of the Wind electricity sector Presidential decisions in 2001. In December 1999, the Tunisian government was actually approached by a private firm offering to deploy a wind plant to supply 80 MW (2 * 40 MW) to the interconnected grid together with an additional 300 MW wind power development project to be launched in 2002 based on privately collected wind data. With an average annual electricity demand growth rate in the 7% to 8% range, a stable political regime and outlook which is expected to continue in the foreseeable future along with a BBB+ country rating, ANER and the government are confident that the anticipated private sector participation with the catalytic support of GEF is highly likely to materialize as the country deepens its ties with the European Union. In September 2003, the EU announced its decision to include on-grid electricity development in the selected 10 infrastructure sector project developments to boost the Union's economic growth. This suggests

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that the wind electricity market in the Mediterranean basin is prepared to respond favourably to the Tunisian proposal.

B12. Baseline Situation

54. The baseline scenario assumes that the expansion of Tunisia's electricity capacity would involve little or no successful commercial development of wind resources over the coming decade, and the growing demand for electricity would primarily be met by building new combined cycle natural gas-fired plants. The underlying reasons for this development scenario are based on an inefficient energy market that does not incorporate the diverse externalities, namely the ones associated with electric generation from both conventional and alternative energy sources and impact in terms of GHG emissions. Other factors contributing to this scenario include difficulties in technology adaptation, financial barriers, insufficient technical capacity and institutional failure. Other factors contributing to this scenario include difficulties in technology adaptation, financial barriers, insufficient technical capacity and institutional failure. Without a concerted national effort to remove fundamental market failures in the Tunisian energy market, the development scenario for on-grid wind power in Tunisia would most likely be limited to the continued operation and maintenance of the two existing wind power stations (10 and 8.6 MW).

C. GEF ALTERNATIVE COURSE OF ACTION

Project Design and Rational

55. The increased liberalization of the electricity sector and its re-alignment with the structural reforms being implemented in Tunisia have prompted the government to invite private participation through IPPs to join in its efforts to expand the country's Power production capacity.

56. In view of the current oil and natural gas production capacity of Tunisia (6.1 million tons in 2002 against 5.6 million in 2001, i.e 9% increase) with the El Borna, Ashtart and Sidi El Kilani reserves that supply 75% of the country's hydrocarbon needs, it is sensible to assume that conventional energy sources will continue to be more competitive than wind energy in the short and medium term. Additionally, hydrocarbon fuel production from 18 other oil/gas reserves (of a relatively modest sizes though), suggest that it will be overly difficult for Tunisia not to follow the baseline scenario described in paragraph 55 above unless there is a strong political commitment to revert the continued reliance on exhaustible oil/gas reserves given that the country is endowed with clean wind energy resources.

57. To fill the above policy void, the Tunisian authorities decided to mobilize the countries wind potential in a gradual but well articulated manner to displace hydrocarbon fuels consumption (by substitution effect) and improve the country's energy balance.

Project Area and Beneficiaries

58. The geographical boundary of the proposed project is Northern Tunisia where wind measurements and preliminary studies have ascertained wind energy potential in the tune of 250 MW. However, it is sensible to suggest that the project area extends to the entire geographical coverage of Tunisia for the simple reason that additional wind measurement activities will be carried through out the entire country to complement the wind map activities initiated during the project preparation phase. As explained in paragraph 30 (page10), investigation of the country's overall wind potential is already underway.

59. Major project beneficiaries include:

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(i) the Ministry of Industry and Energy, ANER, STEG, together with the IPP office which will benefit from the institutional and operational capacity strengthening activities under the TA component of the project;

(ii) local electric, electromechanic, electronic and metallurgical industries which will benefit from industrial integration clauses to be included in the tender documents. Out of an estimated the 5,300 Tunisian small businesses; some 700 companies (13 %) employ 9 or more workers on a full-time basis. These are mostly involved in the electric and electronic construction sectors.

(iii) the local private sector and the commercial banks to be involved in resource mobilization to co-finance the implementation of a 100MW plant;

Additional Benefits

60. Additional benefits of the project include improvements in localized air quality due to reductions in NOx, CO, VOC's and HC's, new investments and creation of jobs in the country, reduced dependence on fossil fuels and therefore less hydrocarbon fuels price fluctuations and improvements in the country's energy balance.

Strategic Context

61. The strategic context of the proposed intervention can be viewed from 3 complementary perspectives. First, the government's continued commitment to invite more private participation in Power production through IPPs.

62. Second, Tunisia's re-assuring macroeconomic performance with annual GDP growth rates ganging from 5 to 6% over the past decade or more, despite a difficult international situation and the recent set-backs to the country's tourism sector. The resiliency of the Tunsian economy on the face of the recurrent challenges not only attest to the country's successful economic reforms but also show a sure hand in macroeconomic management that was noticed by financial markets.

63. Third, Tunisia had already achieved a local integration rate of 33% with the construction of the first tranche of the Sidi Daoud plant by supplying MV and LV oil-immersed transformers, cables and the LV cells, assembly and civil works. For the proposed project, the government is targeting a higher integration rate with the partial or total manufacturing of towers and the assembling of nacelles within the overall context of its 300MW wind electricity program. The above strengths and the continued efforts underway on the regulatory front suggest that the expected catalytic support of the Global Environment Facility will help send a positive signal to the investment community and the market.

C1. Broad Development Goal

64. The development objective of the project is dual: (i) to reduce greenhouse gas emissions in the electricity sector through implementation of a 100 MW wind power plant to meet the objectives set forth in the 10th Plan; and, (ii) to lay the foundations for the deployment of an additional 200 MW capacity to be deployed in successive stages within the 11th plan (2008-2011), on a self-sustaining commercial basis.

C2. Global environmental objective

65. The global environmental objective of the project is to reduce greenhouse gas emissions associated with electrical generation by 183,960 tons of CO_2 per year through installation of a 100 MW wind power plant.

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C3. Specific objectives

66. The project will remove the existing barriers to wind energy commercialisation in Tunisia by:

(i) strengthening the institutional, regulatory and operational capacities of the various structures involved in wind energy sector development through technical assistance, namely, the Ministry of Industry and Energy (DGE, IPP task team), ANER (National Renewable Energy Agency), STEG (the incumbent Power Utility in charge of all network/power transmission operations), along with the private sector and sensitisation of the civil society. Improvement in the electricity regulatory framework seeks to elicit further development of on-grid renewable energy deployments with a focus on commercial wind electricity;

(ii) contributing to the establishment of the government's production-based **"smart-subsidy" scheme (PBSS)** to support the implementation/deployment and commercial operation of 100MW wind power capacity in the 10th plan through a trust referred to as ***"suggestion de compensation pour la production d'électricité propre de source éolienne;"*** and,

(iii) implementing a TA component intended to ensure sizable integration **of the relevant local industry** (including electric equipment manufactur ing, electronics, mechanical etc.).

C4. Project Description

67. ***COMPONENT A:*** **strengthening the institutional, regulatory and operational capacities** of the various structures involved in wind energy sector development through technical assistance, namely, the Ministry of Industry and Energy (DGE, IPP task team), ANER (National Renewable Energy Agency), STEG (the incumbent Power Utility in charge of all network/power transmission operations), along with the private sector and sensitisation of the civil society.

Technical Assistance to ANER

(***UNDP-GEF US$ 1,000,000 for 4 years,*** GTZ **600,000? for 2 years***)*

1. The proposed technical assistance will include:

(i) setting-up of a wind energy unit within ANER responsible for: a) planning of wind projects in Tunisia; b) management of the national wind energy development programme; c) implementation monitoring and evaluation activities to assess performance of the government's wind energy development program; d) assessment/review of fiscal, regulatory, legal and institutional factors impeding the development of the sector with a view to making corrective recommendations; e) organisation and execution of technical, financial and economic feasibility studies; f) wind energy kwh tariff estimation (avoided costs, externalities, avoided CO2 emissions, etc.); g) estimation of economic rates of returns associated with wind energy projects and environmental impacts of a wind plant (power outputs per annum, avoided CO2 etc.); h) certification; i) raising concessional bi/multilateral co-financing and, j) dissemination of the Tunisian wind energy sector experience; k) in collaboration with all other stakeholders, develop a project web-site to promote further the Tunisian wind energy program and disseminate relevant documentation to the public at large.

(ii) development of a database/meso-scale wind Atlas of Tunisia including: a) site identification; b) site evaluation; c) selection and purchase of measuring equipments; d) data collection, processing and analysis; selection of topographic maps and meteorological data required; e) definition and determination of the various parameters of sites selected (distribution of WEIBULL, rugosity, wind CISSAILLEMENT…°); f) computation/estimation of energy

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production in site selected; g) determination of optimal position of aero generators per site; h) selection and training on the use of various wind resources assessment softwares (WASP, WINDMAP, etc); and i) development of the wind Atlas on computer/digital form;

(iii) training on: a) all required software for accurate wind potential measurements (WASP, WINDMAP, etc.); b) estimation of potential wind energy form various selected sites; c) determination of optimal location of measurement devices and wind-turbines; d) size-setting of wind plants; e) technical, economic and financial feasibility studies ; f) preparation of monitoring and supervision guide to closely assess performance of the government's overall wind energy program; etc.

2. While the proposed wind measurement activities are important and expected to make a valuable contribution to the wind sector planning exercise, the required emphasis will be placed on the deployment of the anticipated wind plants to which the government has committed itself.

Technical Assistance to STEG

(***UNDP-GEF 300,000 .US$ for 2 years***)

3. Technical Assistance (TA) to STEG will include among others:

(i) training on technical connections of wind turbines to the national grid in order to: a) help optimise on site location as required by the manager of tenders; b) take into account feasibility studies of connections to the grid; and c) facilitate integration of control, monitoring and remote control/management of injection and the feed parameters into the interconnected grid;

(ii) Implementation of a technical study to ascertain the absorption capacity of the interconnected grid (see project terms of reference in annex 3) and ,

3.1. Connection of wind turbines to the interconnected national grid is quite likely to cause tremendous static and dynamic disturbances that STEG must anticipate, manage and resolve. Combination of targeted training with implementation of the recommemdations of the study on the technical absorption capacity will help prepare STEG to face up the above technical challenges.

Technical Assistance to the IPP Bureau/Task Team within the Ministry of Industry and Energy

(***UNDP-GEF 550,000 US$ for 3 years;*** GTZ ***300,000*** **? for 2 years**)

68. The IPP Bureau within the Ministry of Industry and Energy is responsible for preparing IPP tender documents issued by the government. The Bureau/IPP Task team is yet to acquire specific experience in the tendering and execution of wind energy procurements of goods, works and consulting services. The IPP Task team urgently needs the technical assistance of a reputable international Consulting firm with a solid tract record in the wind energy procurement and management.

69. The intended recruitment of the proposed commercial bank/consultancy firm will support the IPP team together with other sector structures (as needed) in the following specific tasks:

(i) preparation of TORs, technical specification and tenders
(ii) evaluation of bids (evaluation criteria, management of bidding procedures, frequency of tender issuance in the 11th Plan, power ceilings to be conceded etc.)
(iii) carrying out of economic and financial studies in connection with wind projects; optimal risks allocation in the deployment of the proposed 100MW wind plant as required by the 10th plan.
(iv) Negotiation of concession contracts and PPAs;

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COMPONENT B: **Production-Based Smart-Subsidy (PBSS) support to the development and implementation of the 10th plan's 100 MW plant:**

(UNDP-GEF **US$8,250,000 over 5 years,** Co-financing key with Government **US$1 from GEF for US$2 from Government**)

1. Assistance from the Global Environmental Facility will be in the form of a seed financing to a production-based smart-subsidy scheme referred to as "suggestion de compensation pour la production d'electricité propre de source éolienne", in the requested amount of US$8,250,000. The scheme will apply to the successful bidders requiring the least amount of subsidy for a period not to exceed the initial 5 years of operation of the wind plant.

2. The above is required to complement the government's own cash co-financing to offset the project's incremental cost for a full private sector based execution of the installation of the 10th plan's stated 100MW wind electricity farm. It will be carried out by way of a unique tranche concession award through a competitive bidding process. It is expected that the above arrangement will lead a to self-sustained commercial implementation of the 11th plan's targets.

3. **Structuring of the PBSS to meet the project's incremental cost:** As presented on figure 1 in Annex 5, the total incremental cost amounts to US$26,500,000 when translated into an investment grant/capital subsidy provided up-front at year 0 (based on assumptions presented in Table 6 with an electricity tariff settlement of 3.7 ¢ US representing the power utility's announced willingness to pay and a 35% capacity factor). The Power utility has announced that 3.7 ¢ US$ is its avoided cost and the above mentioned tariff level would sensibly be the starting point of tariff settlement negotiations once a successful IPP as been selected.

4. As the purpose of the intended PBSS is to induce the most efficient operation/management of the Wind Power plant as opposed to an investment subsidy, its use in the project is primarily justified by the fact that selection of the wind plant IPP based on pre-qualified bidders still carries a risk of having a financial offer (KWh purchase price required from STEG) by the selected IPP that is much higher than the price STEG and the government's price-setting bodies are willing to accept. To mitigate the above risk, the Ministry of Industry and Energy's IPP office (or IPP Task Team) together with the recruited International Technical Assistant/Consulting/commercial Bank will consider – as was the case in a number of recent successful international tenders in this sector – setting a ceiling price in the tender documents. The above should be thoroughly justified on the basis of the realities of the wind energy industry and the characteristics of the wind potential in Tunisia.

5. Converting the project's estimated total incremental cost in a "Production Based Smart Subsidy" (PBSS) through a model developed by the International Consulting firm selected by the government yields a PBSS requirement of **2.0 ¢ US /kWh** over the first five years of commercial operation (see figure 2 of annex 5 attached). Given an estimated production of 275,940 MWh for year 1 (equivalent to 306,600 MWh X 90% @ 35% load factor) and an annual production of 306,600 MWh for years 2 to 5, this PBSS represents a total amount of US $30,000,000 over 5 years (see figure 3 and sensitivity analysis in annex 5). Again, it should be emphasized that these numbers are based on assumptions presented in table 6 of annex 5; i.e. with an electricity selling price of 3.7 ¢ US and a 35 % capacity factor.

6. The Tunisian government's requested GEF contribution in a total amount of US $8,250,000 over the first 5 year period of project commercial operation out of a total US$30,000,000 required within the proposed full PBSS scheme, represents a contribution of 27.5% of the required share to cover total incremental cost as the Government of Tunisia will have to cover the balance which is still substantial. The amount of US $8,250,000 from the GEF translates into **0.55¢ US /kWh** over the first five years of commercial operation within the proposed full PBSS scheme (again these

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numbers are based on assumptions presented in Table 6 of annex 5, given a 3.7¢ US electricity selling price and a 35 % capacity factor). Therefore, the proposed GEF contribution to the PBSS for US$1 would be matched by US$2.6 from the Tunisian government. However, the government intends to bring its PBSS contribution in the 2 to 1 proportion with respect to GEF contribution by discounting various fiscal incentives during the concession contract and PPA agreement negotiation.

7. While the above provides a satisfactory framework to launch the project on acceptable commercial terms by private sector standards, it should be noted that the exact contribution to be provided by the Government of Tunisia can be known only when the tender process is completed and the successful proposal selected. At that time and building on the expected GEF grant approval, it will be sensible to use a more realistic capacity factor based on additional observations. In any event, the Government of Tunisia is committed to and prepared to take the risk of covering the remaining incremental cost once GEF grant approval is secured. On the basis of the above and in view of the conservative cost parameters used, it appears that GEF grant approval would be timely for a fixed contribution totalling US $8,250,000 over the first 5 years of project operation in addition to the required technical assistance for components A and C. The above would represent less than 10% of total investment capital for the project, which seems quite acceptable if wind-energy development in Tunisia is to be given a chance.

8. An important element captured by the sensitivity analysis in annex 5 is the extent to which incremental cost of the proposed 100MW wind plant is responsive to load factor. Endogenous knowledge of the proven wind resource could be quite useful but not sufficiently re-assuring to foreign investors. Therefore, it appears that the level of PBSS resources requested from GEF reflects the need to reduce financing and contract negotiation failure risks, establish an initial investment comfort "zone" within which the proposed wind power project would be appealing enough to potential investors who would be – nevertheless – bearing a substantial share of the operational/technical/technological and construction risks. And, as it should be, the Tunisian government's commitment to bridge the financial gap to meet the project's estimated incremental cost is – in effect – commensurate with the political/process transparency risk it is willing to assume and a necessary comforting pledge to ensure tender/bidding process transparency in a country with an increasing competitive economy.

9. The project team will carefully monitor both the performance characteristics of the wind farm and the success of the PBSS in stimulating the investment in order to ascertain whether or not such a feature could usefully be used on a more systematic basis to stimulate a share of renewable energy generation in Tunisia's electric power system more generally. Such an approach might be made replicable or sustainable through the adoption of a surcharge on conventionally-generated power that is required to be devoted to paying future incremental, production subsidies or premiums. Or a slightly different approach would be to require, through a renewable portfolio standard, that the future generation mix contain a specific amount of renewably-generated power. In either event, the PBSS payment will provide an experiment with these approaches which can then be used to evaluate future options to make such future support to renewable power a permanent feature. If, as is explained elsewhere in this document, this initial 100MW facility enables future Tunisian installations to be undertaken at a cost that is both sustainable and replicable, then continuation of such a mechanism might not be necessary. However, in such a case, the question then becomes whether it would be useful to continue it in order to stimulate renewable energy from other forms.

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***COMPONENT C :* <u>Support for the integration of local industries</u>**

(UNDP-GEF ***US$ 150,000 for 2years ;*** GTZ **? 100,000 for 2 years**)

1. This component will essentially entail supplying all relevant information on the local industries and on integration activities required by the government to potential bidders. The government will see to it that the specific requirements are clearly spelled out in the tender documents including pertinent information on the local Tunisian industry.

2 Hence, a specific study will be carried out and relevant information on the Tunisian's industrial landscape together with the local industry's preparedness to manufacture part of the required equipment locally will be collected.

3. The output of the proposed investigation will be disseminated accordingly.

4. By targeting a minimum integration rate of 40% in the 10th plan, the government has placed the emphasis on local technology and build-up of local knowledge to sustain its wind electricity program. Under the assumption that up to 25% of total project cost could be incurred in local currency, this would sensibly amount to some US$26 million. It can be expected that the successful IPP will raise a sizable share of the above financing locally to mitigate the foreign exchange risks it would otherwise incur. As it was the case in the China Wind Resource Concession Program (WRC program), bundling local industrial integration with tendering for the procurement of works/equipment supply/installation and consultant services will have an interesting multiplier effect on the local economy.

D. <u>PROJECT SUSTAINABILITY AND RISKS</u>

D1. Sustainability

70. The approach adopted in this project seeks to reinforce the long-term sustainability of the Tunisian wind electricity market. By addressing systematically and simultaneously each of the barriers currently impeding the development of commercial wind electricity in Tunisia, the project will create a framework that is conducive to a sustainable market once the initial trigger conditions are met. Project activities will strengthen capacities and foster the establishment of a transparent environment within which all-key players and major stakeholders will have every reason to contribute their best efforts. The entire process will be supported by UNDP-GEF providing technical, financial and administrative assistance to the entire process as needed.

71. By making arrangements to ascertain that the successful implementation of the proposed 100MW wind power plant overlaps with – and feeds into – the preparation of the forthcoming 200 MW wind electricity concession program the government expects that private sector long-term commitments to the country's overall 300MW wind power program would materialize, and help improve the quality of the competition for the award of the announced concession contract in the 10th plan.

72. With respect to the sustainability of the proposed production-based "smart-subsidy" scheme co-financed by the government and GEF in the context of the current 10th plan, it is key to note that such a scheme will not be needed within the 11 plans for the following reasons:

(i) Tunisia would have acquired a sizable experience and will have strengthened its institutional and operational capacities tremendously. Through the implementation of the 100MW wind plant, STEG, ANER and the IPP Task team will collect concrete hands-on experience that will significantly establish the credibility of the local players.

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(ii) it is now well documented by expert forecasts that the wind energy market is expected to continue to grow and result in a significant decline in wind electricity kwh cost. Wind Energy Industry analyst predict that, over the 203-2007 period, the wind power market will register an annual growth rate above 11% while offering more reliable wind-turbines at more competitive costs.

(iii) While kwh wind electricity cost was approximately 1,500US$ in the 80s, it has dropped to about 1,000US$/KW nowadays; suggesting that an 18 to 25% reduction in wind electricity production cost by the year 2010 could be realistic.

73. Above and beyond the above preliminary forecasts, an investigation carried out with the Northern American wind industry indicated that a 17% cost reduction is expected between the 2001-2006 and 2007-2011 time periods. The implication for the present project being that with: (i) projected wind electricity costs around US$830/MW during the Tunisian government's 11th plan; (ii) the removal of institutional and regulatory barriers; (iii) the building of significant local capacity under this project combined with the confirmation of wind potential/network absorption capacity, all of the above circumstances are sensibly likely to ensure full implementation of the 11th plan's wind power targets on a self-sustaining commercial basis without a PBSS scheme.

D2. Risks

74. As described below, the project does involve a few risks. To circumvent/mitigate or curtail these risks, the project was designed and structured so as to involve major stakeholders and to take into account their needs and concerns. The following table summarises major risks and indicates mitigating measures.

Table 3: Mitigation of Project risks

Risks	Mitigating Measures
Inadequate commitment and lack of cooperation from public institutions involved	A national wind power Commission is requested to be put in place wit a specific mandate to help improve the sector's regulatory environment
Lack of interest from the private sector in the concession of the proposed 100 MW planned in the project	The project was designed for the private sector; some private operators have already shown interest. The private sector can only be deterred if the purchase price offered by STEG is too low or if fiscal and financial incentives by the government are deemed inadequate. This is unlikely to be the case as the government has pledged cash co-financing of incremental costs in addition to GEF's contribution to PBSS scheme described above.
The 100 MW plant not financed	If the production tariff settlement offered by STEG, along with government's various incentives together with GEF's contributions result in an acceptable IRR (around 14%) on equity as against a 9% interest rate on loan co-financing, the required equity financing expected from the international and local financial system can be realistically secured.

E. STAKEHOLDER PARTICIPATION AND IMPLEMENTATION MODALITIES

75. The project will be implemented by ANER through the directorate of renewable energies. ANER has been the executing agency for most UNDP-GEF funded projects. The Ministry of

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Industry and Energy will execute the tender and bids evaluation for the deployment of the 100MW wind plant.

76. The preparation of the project brought together all key actors during discussions of the Tunisia second Country-Cooperation Framework (CCF) for the period 2002-2006. The Tunisia CCF provided a forum for participatory involvement of the Tunisian counterparts in the proposed UNDP assistance strategy to the government's development priorities as spelled out in the 10th plan.

77. Environmental protection was identified by UNDP-Tunis and the government counterparts as the 3rd priority for action. Implementation of measures to combat desertification, conservation of fragile ecosystems along with development of on-grid wind energy to reduce GHG emissions in the country were specifically selected during the CCF discussions as priority sectors for UNDP support.

E1. Project costs

78. The total estimated investment costs of the project for an initial installation phase of 100 MW comes to approximately 103,250,000$US (based on a estimated construction cost of 1M$US/MW), and a 14% IRR on equity for the private sector developers, and a minimum required Technical Assistance component of 3,5M$US. The difference between the theoretical/hypothetical tariff settlement agreed with STEG (3.5 US$ cents in 2005 per Kwh) and the requested sale price by the successful IPP bidder (4.7 US$ cents in 2005 per Kwh) is – in effect – the incremental cost culminating in US$26,500,000. The above assumptions are presented in Table 6 of Annex 5 and it should be noted that these rely on a number of critical cost items are rather "aggressive" such as an investment cost of 1 US$ million / MW installed, an IPP equity contribution totalling 30% of the total investment capital, a required ROE of 14% (which is a minimum to make this project attractive for the private sector), a project life of 25 years, etc. It is also worthy mentioning that the Internal Rate of Return of the project would be only 8.3% without external aid which is clearly not enough to make this project attractive for investors. Hence, the project cannot stand on its own merits for the intended private sector participation without GEF and government contribution to the incremental cost. A total grant in the amount of US$10,250 million has been requested from GEF. It essentially covers all TA activities, capacity strengthening and regulatory improvement measures together with the series of promotional/business development activities intended to boost the integration rate of the project. These activities will require US$2,000,000 from GEF and will be co-financed by GTZ for ? 1,000,000.

79. Total GEF TA resources are allocated as follows: **US$1,000,000** to support **ANER**; US**$300,000** to cover the expenses to upgrade **STEG**'s capacity; **US$550,0000** for recruitment of a commercial Bank/Energy Consulting firm – on an international competitive basis – to assist with the coordination, preparation of TORs and tender documents, bids evaluation, PPA preparation along with contract negotiation to be executed by the **IPP Task Team** within the Ministry of Energy; **US$150,000** to ensure that the government's targeted integration rate for this 100MW concession is met through a series of activities and joint-venture promotion starting during the post contract award and the actual plant deployment phases. All of the above technical assistance activities will be co-financed by **GTZ** for **?1,000,000 or US$1,250,000**. Hence total TA for the project will reach approximately **US$3,250,000**.

80. The balance of the funds sought from GEF (**US$8,250,000**) will be applied as seed wind electricity production-based smart-subsidy ("*suggestion de compensation pour la production d'énergie propre de source éolienne*"). Therefore the financing gap in the amount of **US$18,250,000** will be met from direct co-financing by the Tunisian government as needed along with a number of applicable fiscal incentives.

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81. Based on a 25 year plant life time and the baseline assumptions suggesting an estimated 600 tons of CO2 per GWh produced, the proposed 100MW wind plant will result in a reduction of **4.6 million tons of CO2** at a unit cost of **2.23 US$** per ton of CO2 in terms of GEF resources

F. INDICATIVE PROJECT IMPLEMENTATION SCHEDULE

82. Project follow-up and evaluation will comply with UNDP rules for national projects although, for administration of the PBSS scheme, direct payment will be made to the IPP on approval from STEG once the KWh supplied by the Wind plant have been clearly accounted for. An appropriate and specific performance indicators will be develop before implementation so as to efficiently monitor progress and take the required management decisions. A quarterly review and periodic reports will be drafted along with an internal follow-up mechanism design by ANER and including the implementations of plans to secure the quality of financial and technical quarterly reports as well as annual reviews and reports.

Table 4: Indicative Project implementation schedule

Year	Tasks
2004	Request for Pre-qualifications
2004	Restricted consultation with pre-qualified candidates
2005 - 2006	Selection of the provisional successful bidder and contract negotiations
2006 - 2007	Development and implementation of a 100MW capacity

a. Project Monitoring and Evaluation Plan

83. In keeping with UNDP procedures, this project will be subject to annual financial audits. In addition, the normal UNDP process of annual review (consisting of APR's and TPR's) will be used to comply with the GEF annual reporting requirement (PIR). In addition, an independent mid-term and final evaluation will be undertaken, in accordance with both UNDP and GEF procedures.

84. The log-frame contained in Annex 1 summarizes the indicators of project progress and success that are considered appropriate at the present time. During the first quarter of project implementation, the Chief Technical Adviser or National Project Director will review these indicators with an eye toward fine-tuning them. He or she will then undertake an assessment of the baseline values for each of these indicators. These baseline values will then be considered as the points of comparison for progress being made under the project. Where appropriate, the indicators that are meaningful on an annual basis or a shorter period of time will be re-estimated each year in preparation for the APR, TPR, and PIR cycle. In addition, the performance of the remainder of the renewable-energy market will also be monitoring so that the contribution of this project can be kept in placed in its appropriate context.

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LIST OF ANNEXES

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ANNEX 1 : PROJECT LOGICAL FRAMEWORK

UNDP-GEF Project- Development of a 100MW on-grid wind plant in Tunisia

Strategy	Objectively verifiable Indicators (OVI)	Means of verification (MoV)	Critical Assumptions and Risks
I. DEVELOPMENT OBJECTIVE			
Sectorial Objectives: • To reduce greenhouse gas emissions in the electricity sector through the deployment of a 100 MW wind plant to meet the sectorial objectives of the 10th Plan, and on the other hand, to lay the foundation for the implementation of the 11th Plan by the private sector.	• Wind plant generated output and sales at least 275,940 MWh during year 1.. • Wind plant generated and sales at least 306,600 MWh for year 2 to 7.	• Project follow-up report, statistical reports and official publications • Monitoring and evaluation report on avoided GHG emissions with respect to baseline	• Baseline is not superseded or rendered obsolete by early exhaustion of endogenous natural gas reserves • Support from the Tunisian Government throughout project life
II. IMMEDIATE OBJECTIVES			
Project Objectives: **A.** To strengthen the institutional, regulatory and operational structures in charge of the sector, namely ANER, STEG, Bureau IPP, DGE, the Ministry of Industry and Energy. **B.** To establish a production-based "smart-subsidy" scheme to support the deployment of 100MW wind plant in the 10th Plan. **C.** To support the integration of local Industries into the wind energy sector.	**a1.** Preparation for installing another 200MW during the 11th plan are advanced (at the stage of financial closure) by the end of the project for 10th plan. **b1.** Rate of **flaws in the connection of wind plants to the interconnected grid**, stability of the grid as measured by the stability of the frequency and regularity of the voltage level ; number of agents/engineers/technicians of STEG trained. **b2.** Acceptation of a wind KWH tariff by stakeholders, including consumers by year 2 after project start. **b3.** Number of economic studies conducted, number of tender documents prepared, acceptation by partners of project risk mitigation mechanisms. **b4.** 100% of wind energy generated, purchased by or sold to STEG **c1.** Amount of money spent on international wind companies/ experts reduced by 50% per kW installed capacity after year 4 of project start	**a.1.1.** Files from the ministry and other partners. • Supervision mission reports **b.1.1.** STEG report, Technical performance test report • Supervision mission reports **b.2.1.** Contract of purchase of wind KWh (PPA) • Supervision mission reports **b.3.1.** STEG Report **c.1.1.** Tender and contract files • Supervision mission reports	• Legal environment is conducive to enforcing agreements and contracts (PPA, O&M, performance guarantee, insurance etc.). • Overall incentive-based regulatory environment that reduces dispute resolution and promotes compliance • Bundling local industrial integration targets with tendering for plant concession to reduce cost rather than increasing it

Strategy	Objectively verifiable Indicators	Means of verification (MoV)	Critical Assumptions and Risks
III. OUTPUTS			
Project Outputs: **A1.** Capacities ANER strengthened **A2.** Capacities of STEG strengthened **A3.** Capacities of Bureau IPP strengthened **A4.** Regulatory framework strengthened and participation of the private sector to the wind energy development Programme within the 11th Plan promoted **B1.** 100MW-capacity wind energy plant deployed and operating in full commercial terms **B2.** PPA for 100MW-capacity wind energy plant contract/Plant shareholder covenant. **C1.** Capacities of local industries strengthened **C2.** Local Manufactures involved in wind plant deployment **C3.** Local industry sector information shared abroad	**a.1.1.** Number of ANER Staff trained **a.1.2.** Establishment of Wind Electricity Unit within ANER **a.2.1.** Number of STEG Staff trained **a.3.1.** Number of IPP Bureau Staff trained **a.4.1.** Government tariff policy for on-grid wind electricity clarified **b.1. 100 MW on-grid wind power capacity** installed with 67 wind turbines, all fully operational on a commercial basis ; plant generated output and sales at least 275,940 MWh during year 1 **b.2**. Wind plant generated and sales at least 306,600 MWh for year 2 to 3. **c.1.1.** Number of local manufactures participating in project construction increased by 50% in year 4 after project start as compared to baseline year 2003	• ANER annual Reports • STEG annual Reports • Ministry of Industry and Energy Reports • Supervision mission reports • Plant construction Reports • Plant performance test Reports • Tender and contract files • Project audit reports	Continued coordination among ANER, STEG, the IPP Task Team Completion of the country's Wind-Map/Wind Atlas Efficient/adequate structuring of the ownership of the 100MW Power plant This is not a risk external to the project as far as I understand Construction, design according to industry standards (costs, deadlines and performance) This is not external Foreign and local investors interested
Activities (per category)	**INPUTS/RESOURCES**		
Activities: (*These will be detailed with the government during project appraisal to include all required TA activities, detailed feasibility/IPP tender outlines, financing, construction and commercial; e.g. PPA principles*) • Study and development of terms de reference, organizational chart and assessments of skills need of the project unit and effective setting-up. • Development of terms of reference for the various studies required for the wind Atlas, recruitment of consultants, implementation of studies, development and dissemination of the Atlas • Definition of training modules on technical connections of wind turbines to the grid, recruitment of trainers, selection of bidders and training implementation	**Resources/Means** • Dissemination of studies, the organizational chart, decisions of creation. • Dissemination of the wind Atlas • Contracts with trainers and report on training sessions • Contracts with trainers and report on training sessions • Contracts with trainers and report on training sessions	**Costs** *(Will be specified after appraisal mission)*	• Confirmation of the country's wind energy potential following wind-map exercise • Agreement with all key partners on an acceptable ceiling price for the tender documents to be issued. • Proposed ceiling price to be able to sustain commercial operation of the wind plant.

Objectives	Objectively verifiable Indicators (OVI)	Means of verification (MoV)	Critical Assumptions and Risks
Activities (per category)	**INPUTS/RESOURCES**		
Activities:	**Resources/Means**	**Costs**	
• To evaluate the actual training needs for IPP in procurement procedures, to design corresponding training modules, to select competent training entities and training abroad.	• Dissemination of studies, the organizational chart, decisions of creation. • Dissemination of the wind Atlas		• Completion of the country's Wind-Map/Wind Atlas
• To jointly evaluate with STEG needs in wind project management, to decide on the most adequate form of assistance: training and/or training abroad and modalities of implementation: recruitment of a training entity or STAGE abroad..	• Contracts with trainers and report on training sessions • Contracts with trainers and report on training sessions • Contracts with trainers and report on training sessions		• Efficient/adequate structuring of the ownership of the 100MW Power plant • Wind energy in sufficient quantity
• To prepare a detailed feasibility study • To develop specification for private investors • To issue tenders • Funding • Construction • Commercial exploitation	• Capacity installed (MW) and number of wind turbines built and operating adequately • Tunisian government institutional actors • Consultant experts in wind power. • Independent electricity producer (IPP). • Investors and financial experts. Turbine and equipment specialists Turn-key manufacturer.		• Construction, design according to industry standards (costs, deadlines and performance) • Foreign and local investors interested

Pre-requisite: Government commitment to meeting the remaining gap of the project's incremental cost (after GEF support is accounted for) by a combination of all applicable fiscal incentives and direct government subsidy as needed.

Annex 2
INCREMENTAL COST ANALYSIS

BROAD DEVELOPMENT GOALS

1. The development objective of the project is dual: (i) to reduce greenhouse gas emissions in the electricity sector through implementation of a 100 MW wind power plant to meet the objectives set forth in the 10th Plan; and, (ii) to lay the foundations for the deployment of an additional 200 MW capacity to be deployed in successive stages within the 11th plan (2008-2011), on a self-sustaining commercial basis.

GLOBAL ENVIRONMENTAL OBJECTIVE

2. The global environmental objective of the project is to reduce greenhouse gas emissions associated with electrical generation by 183,960 tons per year through installation of a 100 MW wind power plant.

BASELINE

3. The baseline scenario assumes that the expansion of Tunisia's electricity capacity would involve little or no successful commercial development of wind resources over the coming decade, and the growing demand for electricity would primarily be met by building new combined cycle natural gas-fired plants. The underlying reasons for this development scenario are based on an inefficient energy market that does not incorporate the diverse externalities, namely the ones associated with electric generation from both conventional and alternative energy sources and impact in terms of GHG emissions. Other factors contributing to this scenario include difficulties in technology adaptation, financial barriers, insufficient technical capacity and institutional failure. Other factors contributing to this scenario include difficulties in technology adaptation, financial barriers, insufficient technical capacity and institutional failure. Without a concerted national effort to remove fundamental market failures in the Tunisian energy market, the development scenario for on-grid wind power in Tunisia would most likely be limited to the continued operation and maintenance of the two existing wind power stations (10 and 8.6 MW).

GEF PROJECT ALTERNATIVE

68. The project alternative project will remove the existing barriers to wind energy commercialisation in Tunisia by:

(i) strengthening the institutional, regulatory and operational capacities of the various structures involved in wind energy sector development through technical assistance, namely, the Ministry of Industry and Energy (DGE, IPP task team), ANER (National Renewable Energy Agency), STEG (the incumbent Power Utility in charge of all network/power transmission operations), along with the private sector and sensitisation of the civil society. Improvement in the electricity regulatory framework seeks to elicit further development of on-grid renewable energy deployments with a focus on commercial wind electricity;

(ii) contributing to the establishment of the government's production-based **"smart-subsidy" scheme** to support the implementation/deployment and commercial operation of 100MW wind power capacity in the 10th plan through a trust referred to as ***"suggestion de compensation pour la production d'électricité propre de source éolienne;"*** and,

(iii) implementing a TA component intended to ensure sizable integration **of the relevant local industry** (including electric equipment manufacturing, electronics, mechanical etc.).

SYSTEM BOUNDARY

5. The geographical boundary of the proposed project is Northern Tunisia where wind measurements and preliminary studies have ascertained wind energy potential in the tune of 250 MW. However, it is sensible to suggest that the project area extends to the entire geographical coverage of Tunisia for the simple reason that additional wind measurement activities will be carried through out the entire country to complement the wind map activities initiated during the project preparation phase.

ADDITIONAL BENEFITS

6. Additional benefits of the project include improvements in localized air quality due to reductions in NOx, CO, VOC's and HC's, new investments and creation of jobs in the country, reduced dependence on fossil fuels and therefore less hydrocarbon fuels price fluctuations and improvements in the country's energy balance.

COSTS

7. The total estimated investment costs of the project for an initial installation phase of 100 MW comes to approximately 103,250,000$US (based on a estimated construction cost of 1M$US/MW), and a 14% IRR on equity for the private sector developers, and a minimum required Technical Assistance component of 3,5M$US. The difference between the theoretical/hypothetical tariff settlement agreed with STEG (3.5 US$ cents in 2005 per Kwh) and the requested sale price by the successful IPP bidder (4.7 US$ cents in 2005 per Kwh) is – in effect – the incremental cost culminating in US$26,500,000. A total grant in the amount of US$10,250 million has been requested from GEF. It essentially covers all TA activities, capacity strengthening and regulatory improvement measures together with the series of promotional/business development activities intended to boost the integration rate of the project. These activities will require US$2,000,000 from GEF and will be co-financed by GTZ for ? 1,000,000.

8. Total GEF TA resources are allocated as follows: **US$1,000,000** to support **ANER**; US**$300,000** to cover the expenses to upgrade **STEG**'s capacity; **US$550,0000** for recruitment of a commercial Bank/Energy Consulting firm – on an international competitive basis – to assist with the coordination, preparation of TORs and tender documents, bids evaluation, PPA preparation along with contract negotiation to be executed by the **IPP Task Team** within the Ministry of Energy; **US$150,000** to ensure that the government's targeted integration rate for this 100MW concession is met through a series of activities and joint-venture promotion starting during the post contract award and the actual plant deployment phases. All of the above technical assistance activities will be co-financed by **GTZ** for **?1,000,000 or US$1,250,000**. Hence total TA for the project will reach approximately **US$3,250,000**.

9. The balance of the funds sought from GEF (**US$8,250,000**) will be applied as seed wind electricity production-based smart-subsidy ("*suggestion de compensation pour la production d'énergie propre de source éolienne*"). Therefore the financing gap in the amount of **US$18,250,000** will be met from direct co-financing by the Tunisian government as needed along with a number of applicable fiscal incentives.

10. Based on a 25 year plant life time and the baseline assumptions suggesting an estimated 600 tons of CO2 per GWh produced, the proposed 100MW wind plant will result in a reduction of **4.6 million tons of CO2** at a unit cost of **2.23 US$** per ton of CO2 in terms of GEF resources.

Annex 3

BASELINE AND EMISSION REDUCTIONS EVALUATION WITH RESPECT TO 100 MW WIND POWER PROJECT IN TUNISIA

Three main approaches can be applied to evaluate the baseline scenario. Participants shall select the one deemed most appropriate for the project activity. These approaches are:

* Existing actual or historical emissions, as applicable;

* Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

* Average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental, and technological circumstances; whose performance is among the top 20 per cent in their category.

As the table below shows, Carbon Dioxide emissions due to electricity generation is approximately 600 tCO_2/GWh during recent years, not considering the emissions of other GHG gases such as NO_x and CO.

Carbon Dioxide emissions due to electricity generation in Tunisia

	1994	1997
CO_2 Emission (1000 tonnes)[1]	3 845	4 243
Electricity (GWh)[2]	6 314	8 004
Emission Ratio (tCO_2/GWh)	609	530

Furthermore, the STEG has recently assessed the emission ratio as 580 tonnes of CO_2e/GWh, based on an average value of the emissions of their current operating power plants.

In fact, over 90 % of the electricity production from the STEG is currently generated by natural gas power plants, some using single stage natural gas turbines (the older plants), and the newer ones using the combined cycled type. The former model's emission ratio is assessed as being between 500 and 600 tonnes/GWh, while the latter model has a more significant emission level. The remaining 10 % of production is generated by plants using oil as a main fuel source, with quite significant emission levels.

Moreover, a baseline study of the Tunisian electricity sector was completed by Helimax Energy in early 2002. The study used the STEG predicted equipment programme over 2003-2020. According to this study, CO_2 emissions due to electricity generation in Tunisia will range between 550 and 600 tonnes CO_2/GWh over the next decade.

[1] Sources : « Inventaire des GES en Tunisie, 1994 – MEAT 2000 » et « Projection des émissions de GES dues à l'énergie dans le cadre d'une stratégie tunisienne d'atténuation – MEAT 2000 ».
[2] Source : IEA.

Consequently, GHG emissions due to energy generation can be assumed to be approximately 600 tonnes CO_2e/GWh (in term of CO_2 Equivalent).

Assuming a Capacity Factor of 35 %, wind energy capacity of 100 MW will generate 306.6 GWh/year that would otherwise have been generated through conventional means while emitting 183 960 tonnes/Year (306.6 GWh/Year * 600 tonnes/GWh).

Therefore, operating a wind energy capacity of 100 MW could result in the saving of more than 180 000 tonnes of CO_2 per year.

Annex 4

Terms of Reference

Installation of on-grid wind power in Tunisia

Grid impact study to be carried out by STEG

I. OVERVIEW:

1.1. With a wind power generating potential exceeding 1,000 MW, Tunisia has embarked on deployment a 100 MW wind plant by the year 2006, within its 10th development plan. An additional 200 MW plant will be commissioned by 2011 representing almost 5% of the global generating capacity of STEG, for an aggregate 300 MW capacity within the 10th and 11th Plans combined. Total capacity installed to date stands at 20 MW entirely managed by STEG in the Sidi Daoud plant.

1.2. This study seeks to evaluate the stability of the on-grid power within the implementation of the 10 and 11th Plans sectoral objectives. This analysis should help,-if results are positive to determine the additional capacity that the private sector could deploy into the grid within the 11th Plan and beyond.

II. -STRUCTURE OF THE STUDY

2.1. All tasks making up this study will have to consider the two following phases of the project:

- 1st phase: from 2006 to 2007 in the 10th Plan
- 2nd phase: 2008-2011 in the 11th Plan at least 200 MW wind power will feed there production into the interconnected grid.

2.2. Implementation of the objectives in the 11th Plan will lead to a 5% penetration rate which is slightly below the Costa Rica rates (6% in 2001), which confirms that objectives set in the 10 and 11th Plans are technically feasible. However, it is important to evaluate the impact of clean energies on the national grid on purely technical terms (stability in transitory and permanent regimes) to reassure stakeholders and to meet the objectives assigned to the electricity sector . The study will be structured in two missions. .

Mission 1 : Evaluation/Study of the impact on grid generating requirements

2.3. Because of the intermittent nature of wind, special arrangements must be made to cater for the difference between the actual power production to be injected into the grid and expected production. To cope with this constraint, adequate power margins generated by conventional means must be foreseen. The objectives of mission 1 will be to:

- Evaluate the aggregate level of additional equipment required, due to the intermittent nature of wind power generation and to the deployment of such specialized equipment/devices.
- The estimated impacts on operating power margins, required notably during the off-peak hours of the day.

2.4. These analysis will take into account transit capacities on the grid as well as all export/import possibilities through existing interconnections and load modulation enabled by the use of pumping and generating stations. The consultant that will conduct the study will have to suggest a computer processing model establishing a link between the need to meet supply and demand for electricity within a grid, while taking into account the reliability aspect of wind parks and their impact on the grid .

Mission 2 : Evaluation/Analysis of the impact on the grid network operation

2.5. The objective of the study is to provide an evaluation of the highest level of wind power production that can be fed into the national grid, while respecting on one hand, the normalized limits in power fluctuation quality standards (flickers) and on the other hand, the conditions guaranteeing a stable grid operation in static and transient mode.

Tasks 2.1 : This study will provide a detailed overview of all technical specifications available for various types of wind turbines currently on the market, with an emphasis on voltage, frequency regulation, power compensation and protection associated with the conception of wind power systems. A detailed analysis of the various disturbances (Flickers, Harmonics, Voltage Fluctuations, etc.) likely to be generated by this form of energy production will have to be conducted, along with the imbedded regulation mechanisms and means that are provided to correct them.

A particular focus will be put on:

- Control and regulation mechanisms of wind turbines;
- Quality of wind generated electricity;

Distinctive features of high wind penetration grid systems and their associated management

Tasks 2.2 : Defining the criteria's and requirements to be used when connecting wind energy systems to the national grid.

Wind Turbines are known to generate harmonics and flicker currents that represent nuisances which are injected to the grid. These can harm electrical equipments and can interfere with the functioning of other circuits, in particular in the telecommunications. Hence, it is mandatory that they remain limited to standardized levels.

The methodology applied for studying these disturbances will consist in:

- The definition of standards and norms associated with the interconnection of wind parks into the grid.
- Evaluation of the disturbances at the grid connection level with the wind parks (wave shape, handling of grid during short circuits, etc.)
- Selecting the most appropriate methods and devices enabling predefined compatibility standards to be met.
- Evaluating the costs for the various solutions suggested

Task 2.3 : : Study of the continuous mode of operation

The fluctuations of the generated wind power can have an impact on the power flows and voltage levels within a grid system. By taking into account various modes of grid operations, the study will analyse the load sharing and voltage fluctuations for a variety of cases, normal, incidental etc…

The computations of short-circuits currents will be conducted through simulations of the most constraining operating conditions. The highest and lowest values of short-circuits currents will be computed right at the grid connection point of the wind parks.

Task 2.4 : Reactive power Analysis.

Since the wind power generation is prone to fluctuations due to wind gusts, it induces strong variations in the voltage profile which creates consequently some reactive power. To manage any sudden power release from significant amounts of wind turbines, a security margin for reactive power must be imbedded right at the wind turbine's level.

A detailed case study for these operations will be conducted in order to optimise the means of power rectifying alternatives that will have to be installed throughout the grid. A cost estimate for this additional equipment will be supplied

- **Task 2.5 :** Study of the grid's stability in static and transient mode of operation.

The grid stability study will have to be carried out using the software available within STEG (PSS/E, SPIRA, ERACLES) where an explicit methodology regarding the modeling of the wind turbines will have to be elaborated. The objective of the study will be to identify the major constraints affecting the dynamic behavior of the grid while fed with wind generated electricity. Appropriate solutions will be proposed in order to guarantee the stable operation of the interconnected grid network. This analysis will be carried out in the static mode operation and for various types of incidents with in particular the following defects:

- Mono- and Tri-phased short-circuits currents over a significant amount of power lines.
- The release of the most significant generating groups
- The release of the wind power production (with strong winds)

The analysis of the transient mode of operation will have to be conducted for sudden fluctuations of wind power generation due to high wind gusts.
The results of simulations will provide:

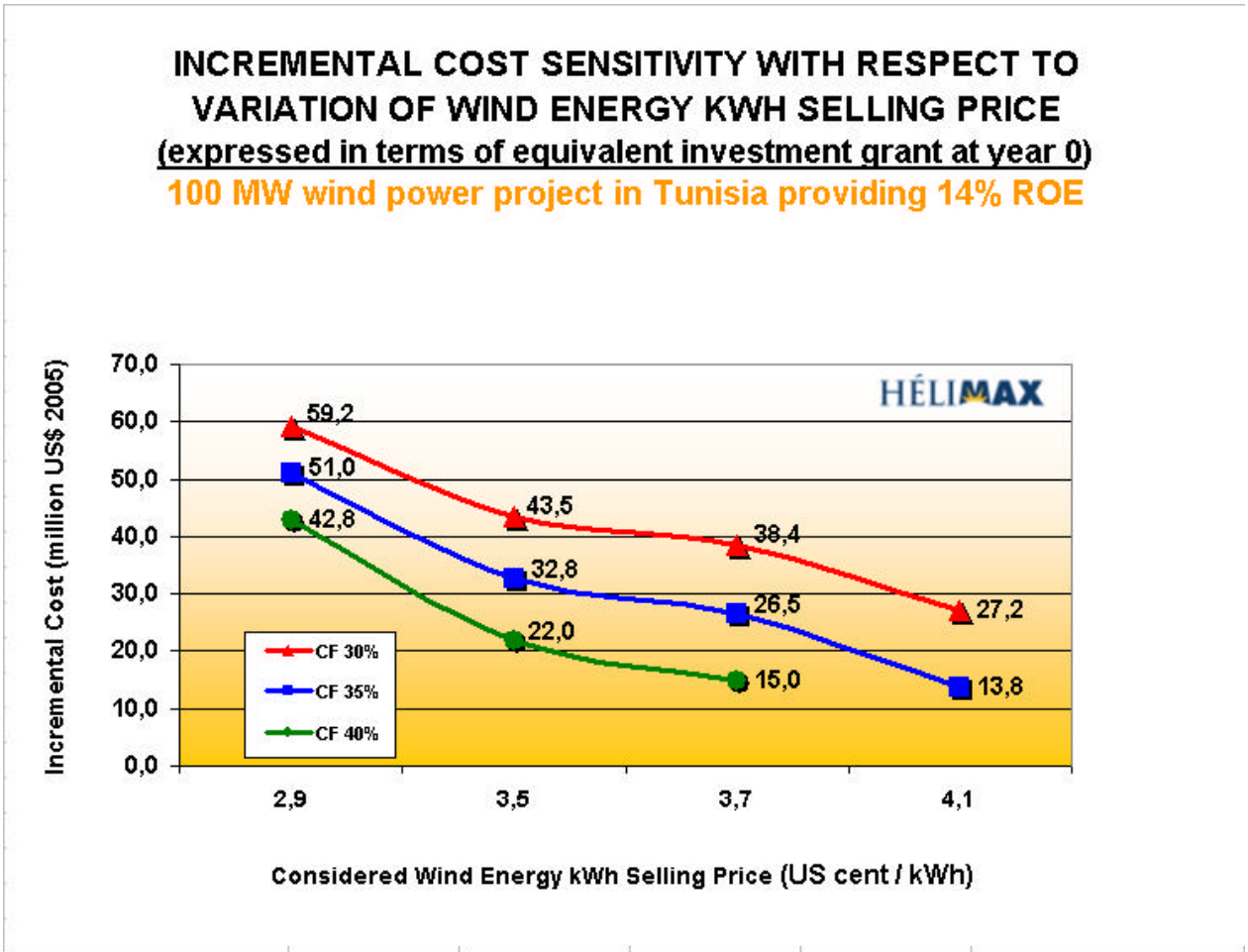
- An analysis of the grid fluctuations in transient mode and the reactions of the generating groups.
- The power distribution profile following the coming online of a significant amount of wind power units. A detailed attention will focus on the flows within the interconnection lines.
- The dynamic voltage variation levels.
- The evaluated impact on the critical time for eliminating short-circuits.
- A grid safety analysis

In the event other specific problems linked to the injection of wind power are detected, additional investigations will have to be conducted in order to guarantee the adequate operation of the grid. An estimate for these induced costs will be provided.

Annex 5

Project Financial Data and Sensitivity Analysis

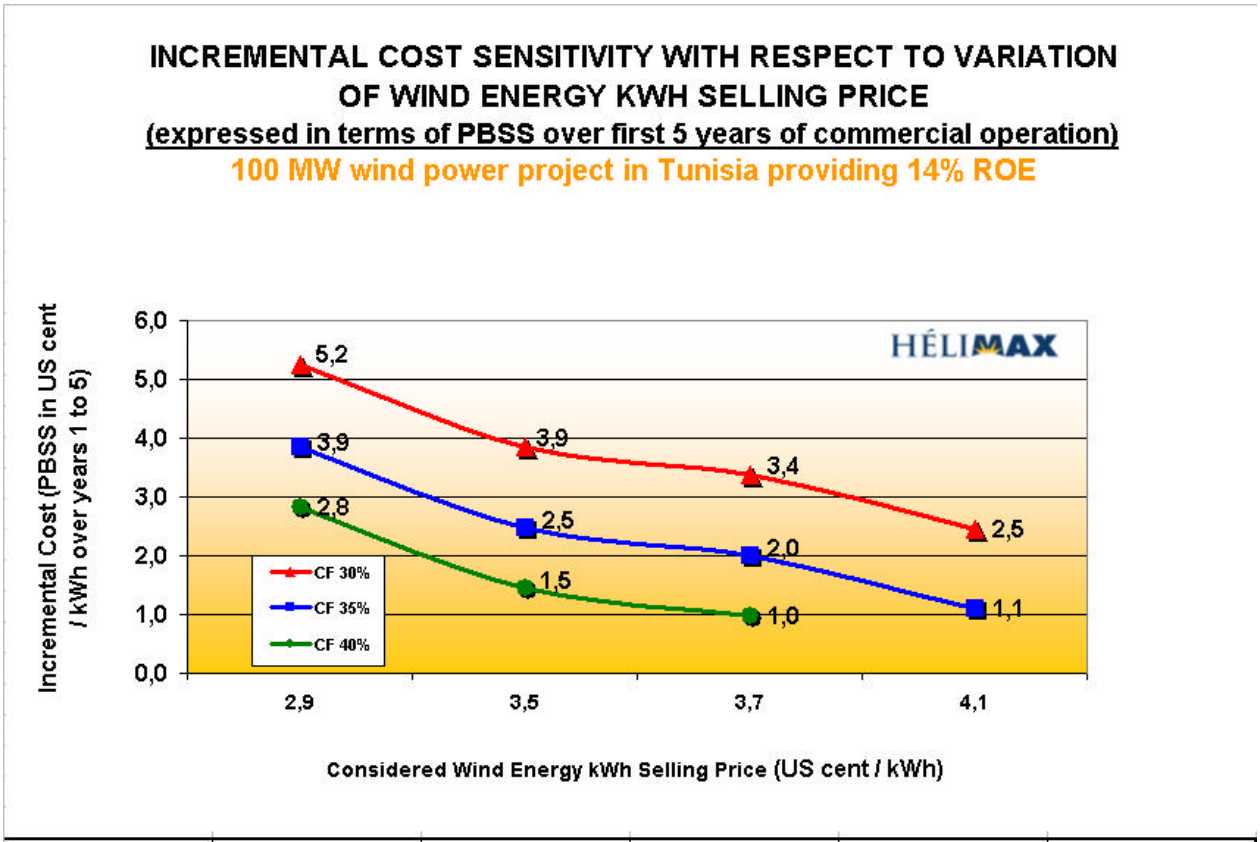
Figure 1 – Incremental Cost Sensitivity With Respect To Variation of Wind Energy kWh Selling Price (expressed in terms of investment grant at year 0)



Considered selling price	37	45	47	53	millimes DT / kWh
	2,9	3,5	3,7	4,1	US cent / kWh
Considered capacity factor (CF)	Coresponding Incremental Cost (expressed in terms of equivalent investment grant at year 0)				
CF 30%	59,2	43,5	38,4	27,2	million US$
CF 35%	51,0	32,8	26,5	13,8	million US$
CF 40%	42,8	22,0	15,0		million US$

Currency exchange rate used: 1.00 US$ = 1.28 DT

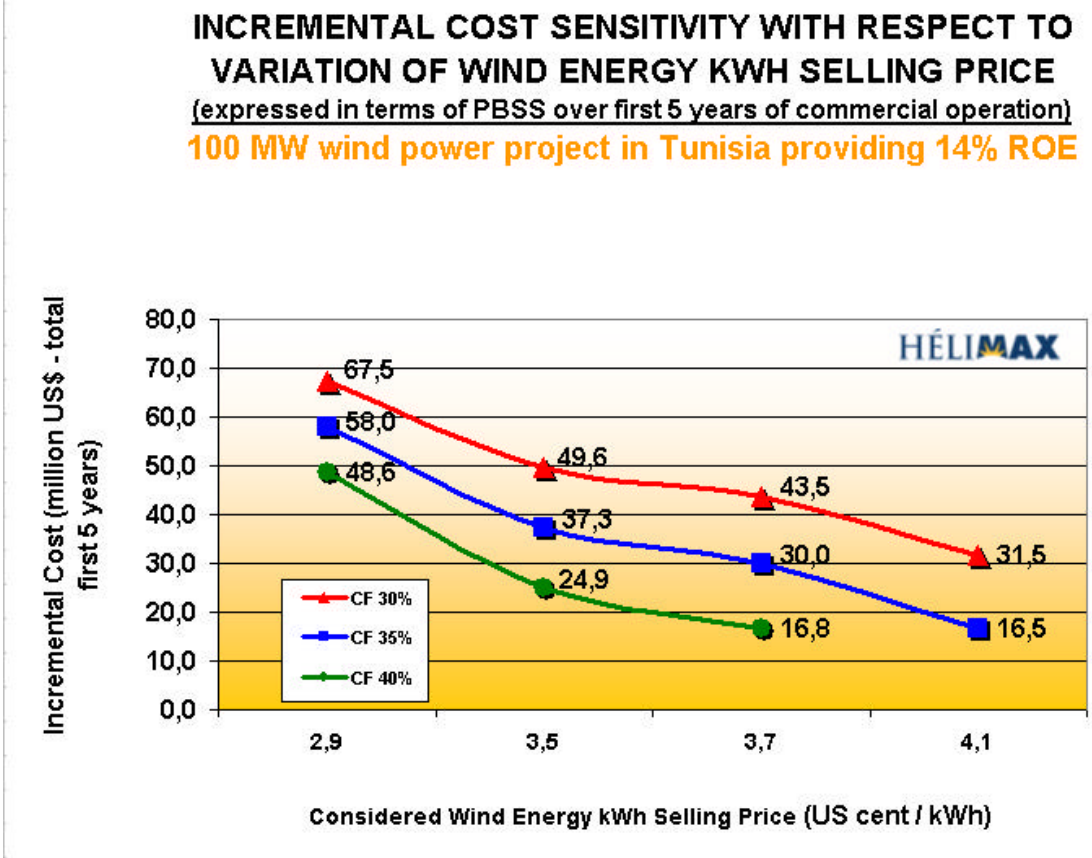
Figure 2 – Incremental Cost Sensitivity With Respect To Variation of Wind Energy kWh Selling Price (expressed in terms of PBSS per kWh over first 5 years of commercial operation)



Considered selling price	37	45	47	53	millimes DT / kWh
	2,9	3,5	3,7	4,1	US cent / kWh
Considered capacity factor (CF)	Coresponding Incremental Cost (expressed in terms of PBSS over first 5 years of commercial operation)				
CF 30%	5,2	3,9	3,4	2,5	million US$
CF 35%	3,9	2,5	2,0	1,1	million US$
CF 40%	2,8	1,5	1,0		million US$

Currency exchange rate used: 1.00 US$ = 1.28 DT

Figure 3 – Incremental Cost Sensitivity With Respect To Variation of Wind Energy kWh Selling Price (expressed in terms of total PBSS amount over first 5 years of commercial operation)



Considered selling price	37	45	47	53	millimes DT / kWh
	2,9	3,5	3,7	4,1	US cent / kWh
Considered capacity factor (CF)	Coresponding Incremental Cost (expressed in terms of PBSS over first 5 years of commercial operation)				
CF 30%	67,5	49,6	43,5	31,5	million US$
CF 35%	58,0	37,3	30,0	16,5	million US$
CF 40%	48,6	24,9	16,8		million US$

Currency exchange rate used: 1.00 US$ = 1.28 DT

Table 6 – Assumptions for Financial and Sensitivity Analysis

Project installed capacity	100	MW (rounded)
Number of wind turbines	**67**	**units**
Turbine rating	**1.5**	**MW**
Capacity Factor (CF)	**35**	**%**
Annual Production	**306,600**	**MWh**
Project life	**25**	**Years**
Start of commercial operation	Dec. 2005	
Adjustment factor- Year 1	**90**	**%**
Total project investment		
- **Amount**	**100,000,000**	**US$ 2005**
Equity		
- **Percentage of total project investment**	**30.0**	**%**
- **Amount**	**30,000,000**	**US$ 2005**
Debt		
- **Percentage of total project investment**	**37.2**	**%**
- **Amount**	**37,200,000**	**US$ 2005**
Grant		
- **Percentage of total project investment**	**32.8**	**%**
- **Amount**	**32,800,000**	**US$ 2005**
Debt		
- Interest rate	**9**	**%**
- Term	**12**	**years**
- Number of payments per year	**4**	
Operation and Maintenance (O & M) expenses	**1.0**	**¢ US 2005 / kWh**
Inflation rate on Operation and Maintenance (O & M) expenses	**2.0**	**%**
Indexation rate of electricity selling rate	**2.0**	**%**
Emission factor of marginal electricity generation	**600**	**tCO_2e/GWh**
Selling price of GHG emission reductions	**N/A**	**N/A**

Table 7 – FULL INVESTMENT GRANT SCENARIO - Assumptions in GEF format for a 100 MW wind power project in Tunisia based on 35% capacity factor and on an electricity selling price of 3.7 ¢ US / kWh (47 millimes DT)

Input data for the 100 MW wind power project in Tunisia	
Costs:	
Total investment in US$	100,000,000
Total O&M in US$/y	3,066,000
Annual increase of O&M cost in %	2%
Income calculation figures:	
Annual electricity generation in MWh/y	306,600
Contractual feed-in Price in DT/kWh	0,047
Contractual feed-in Price in US$/kWh	0,037
Saving of costs	
Fuel costs of EEA in US$/l	-
Fuel savings in 1000 l/y	-
CO_2e savings in t/y	183,960
Financing of investment	
Equity:	
Percentage of total investment	30,0%
Amount in US$	30,000,000
Loan 1:	
Percentage of total investment	43,5%
Amount in US$	43,500,000
Interest rate	9%
Payback free period	0
Number of payback years	12
Grant (GEF and other contributions)	
Percentage of total investment	26,5%
Amount in US$	26,500,000

Table 8 – FULL INVESTMENT GRANT SCENARIO – Cash-Flow Analysis for 100 MW Wind Power Project in Tunisia based on a 35% capacity factor and on an electricity selling price of 3.7 ¢ US / kWh (47 millimes DT)

100 MW Wind Power Project in Tunisia

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
All in thousand US$																									
Income in US$/year	10,210	11,571	11,803	12,039	12,279	12,525	12,775	13,031	13,292	13,557	13,828	14,105	14,387	14,675	14,968	15,268	15,573	15,885	16,202	16,526	16,857	17,194	17,538	17,889	18,246
Expenses																									
O&M in US$/y	3,068	3,127	3,190	3,254	3,319	3,385	3,453	3,522	3,592	3,664	3,737	3,812	3,888	3,966	4,046	4,126	4,209	4,293	4,379	4,467	4,556	4,647	4,740	4,835	4,931
Loan 1																									
Interest in US$/y	3,845	3,847	3,432	3,198	2,938	2,658	2,348	2,012	1,644	1,241	0,802	0,321													
Payback in US$/y	2,129	2,318	2,533	2,769	3,027	3,309	3,617	3,954	4,322	4,724	5,163	5,644													
Total Payback in US$	2,129	4,448	6,972	9,741	12,768	16,077	19,694	23,647	27,969	32,692	37,856	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500	43,500
Total Costs in US$	5,965	5,965	5,965	5,965	5,965	5,965	5,965	5,965	5,965	5,965	5,965	5,965													
Total Expenses in US$	9,031	9,092	9,155	9,219	9,284	9,350	9,418	9,487	9,557	9,629	9,703	9,777	3,888	3,966	4,046	4,126	4,209	4,293	4,379	4,467	4,556	4,647	4,740	4,835	4,931
Profit/Loss (-) in US$ before interest payment	5,023	6,126	6,079	6,016	5,934	5,831	5,706	5,556	5,378	5,169	4,928	4,649	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Profit/Loss (-) in US$ after interest payment	1,179	2,479	2,648	2,820	2,995	3,175	3,357	3,544	3,734	3,928	4,126	4,328	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Profit/Loss (-) in US$ after interest payment	1,179	2,479	2,648	2,820	2,995	3,175	3,357	3,544	3,734	3,928	4,126	4,328	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Sum of Profit/Loss in US$	1,179	3,657	6,305	9,125	12,120	15,295	18,652	22,196	25,930	29,858	33,984	38,312	48,811	59,520	70,442	81,584	92,948	104,539	116,363	128,423	140,724	153,271	166,068	179,122	192,437

ROE

Internal Interest Rate for NPV

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cost savings through fuel import red. per year in US$																									

NPV of cost savings in US$

NPV of expenses in US$, incl. investment payment in year 0

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Income in US$/year (Revenue generated)	10,210	11,571	11,803	12,039	12,279	12,525	12,775	13,031	13,292	13,557	13,828	14,105	14,387	14,675	14,968	15,268	15,573	15,885	16,202	16,526	16,857	17,194	17,538	17,889	18,246

NPV of Income (Revenue generated) in US$	142,726

Table 9 – FULL PBSS SCENARIO - Assumptions in GEF format for a 100 MW wind power project in Tunisia based on 35% capacity factor and on an electricity selling price of 3.7 ¢ US / kWh (47 millimes DT)

Input data for the 100 MW wind power project in Tunisia	
Costs:	
Total investment in US$	100,000,000
Total O&M in US$/y	3,066,000
Annual increase of O&M cost in %	2%
Income calculation figures:	
Annual electricity generation in MWh/y	306,600
Contractual feed-in Price in DT/kWh	0,047
Contractual feed-in Price in US$/kWh	0,037
Saving of costs	
Fuel costs of EEA in US$/l	-
Fuel savings in 1000 l/y	-
CO_2e savings in t/y	183,960
Financing of investment	
Equity:	
Percentage of total investment	30,0%
Amount in US$	30,000,000
Loan 1:	
Percentage of total investment	70,0%
Amount in US$	70,000,000
Interest rate	9%
Payback free period	0
Number of payback years	12
Grant (GEF and other contributions **on a full PBSS scheme)**	
PBSS (in US$/ kWh from year 1 to 5)	0,020
PBSS (total amount in US$)	30,000,000

Table 10 – FULL PBSS SCENARIO – Cash-Flow Analysis for 100 MW Wind Power Project in Tunisia based on a 35 % capacity factor and on an electricity selling price of 3.7 ¢ US / kWh (47 millimes DT)

100 MW Wind Power Project in Tunisia

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
All in thousand US$																									
Income in US$/year	15,729	17,703	17,936	18,171	18,411	12,526	12,776	13,031	13,292	13,557	13,828	14,105	14,387	14,675	14,968	15,268	15,573	15,885	16,202	16,526	16,857	17,194	17,538	17,889	18,246
Expenses:																									
O&M in US$/y	3,066	3,127	3,190	3,254	3,319	3,386	3,453	3,522	3,592	3,664	3,737	3,812	3,888	3,966	4,046	4,126	4,209	4,293	4,379	4,467	4,556	4,647	4,740	4,835	4,931
Loan 1																									
Interest in US$/y	6,187	5,869	5,522	5,143	4,728	4,274	3,779	3,237	2,645	1,998	1,290	0,517													
Payback in US$/y	3,412	3,730	4,077	4,456	4,871	5,325	5,820	6,362	6,954	7,601	8,309	9,082													
Total Payback in US$	3,412	7,142	11,219	15,675	20,546	25,871	31,691	38,053	45,007	52,608	60,918	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
Total Costs in US$	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599	9,599													
Total Expenses in US$	12,665	12,726	12,789	12,853	12,918	12,984	13,052	13,121	13,191	13,263	13,336	13,411	3,888	3,966	4,046	4,126	4,209	4,293	4,379	4,467	4,556	4,647	4,740	4,835	4,931
Profit/Loss (-) in US$ before interest payment	9,251	10,046	10,858	10,451	10,221	3,816	3,502	3,147	2,745	2,292	1,782	1,210	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Profit/Loss (-) in US$ after interest payment	3,064	4,977	5,146	5,318	5,494	-0,459	-0,276	-0,090	0,100	0,294	0,492	0,694	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Profit/Loss (-) in US$ after interest payment	3,064	4,977	5,146	5,318	6,490	-0,459	-0,276	-0,090	0,100	0,294	0,492	0,694	10,499	10,709	10,923	11,141	11,364	11,591	11,823	12,060	12,301	12,547	12,798	13,054	13,315
Sum of Profit/Loss in US$	3,064	8,040	13,186	18,504	23,997	23,538	23,262	23,171	23,272	23,566	24,059	24,752	35,250	45,959	56,882	68,023	79,388	90,979	102,802	114,862	127,163	139,710	152,508	165,562	178,877

ROE

Internal Interest Rate for NPV

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cost savings through fuel import red. per year in US$																									

NPV of cost savings in US$

NPV of expenses in US$, incl. investment payment in year 0

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Year from start	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Income in US$/year (Revenue generated)	15,729	17,703	17,936	18,171	18,411	12,526	12,776	13,031	13,292	13,557	13,828	14,105	14,387	14,675	14,968	15,268	15,573	15,885	16,202	16,526	16,857	17,194	17,538	17,889	18,246

NPV of Income (Revenue generated) in US$ 166,642