# PROJECT IDENTIFICATION FORM (PIF) [1]

**PROJECT TYPE: Full-sized Project**
**TYPE OF TRUST FUND: GEF Trust Fund**

## PART I: PROJECT IDENTIFICATION

| | | | |
|---|---|---|---|
| Project Title: | Promoting Utility-Scale Power Generation from Wind Energy | | |
| Country(ies): | Republic of the Sudan | GEF Project ID:[2] | 4745 |
| GEF Agency(ies): | UNDP (select) (select) | GEF Agency Project ID: | 4726 |
| Other Executing Partner(s): | Ministry of Electricity and Dams | Submission Date:<br>Resubmission Date: | 04/12//2012<br>01/16/2012 |
| GEF Focal Area (s): | Climate Change | Project Duration (Months) | 60 |
| Name of parent program (if applicable):<br>• For SFM/REDD+ ☐ | | Agency Fee ($): | 335,955 |

## A. FOCAL AREA STRATEGY FRAMEWORK[3]:

| Focal Area Objectives | Expected FA Outcomes | Expected FA Outputs | Trust Fund | Indicative Grant Amount ($) | Indicative Co-financing ($) |
|---|---|---|---|---|---|
| CCM-3 (select) | Investment in renewable energy technologies increased | Volume of investment mobilised | GEFTF | 2,391,864 | 205,595,000 |
| CCM-3 (select) | Favorable policy and regulatory environment created for renewable energy investments | Renewable energy policy and regulation in place | GEFTF | 797,410 | 2,697,500 |
| CCM-3 (select) | GHG emissions avoided | Electricity and heat produced from renewable sources | GEFTF | 180,000 | 1,022,500 |
| | | Sub-Total | | 3,369,274 | 209,315,000 |
| | | Project Management Cost[4] | GEFTF | **167,090** | **4,385,000** |
| | | **Total Project Cost** | | 3,536,364 | 213,700,000 |

## B. PROJECT FRAMEWORK

| **Project Objective: To overcome barriers to the market development of utility-scale wind farms in Sudan** | | | | | | |
|---|---|---|---|---|---|---|
| **Project Component** | **Grant Type** | **Expected Outcomes** | **Expected Outputs** | **Trust Fund** | **Indicative Grant Amount ($)** | **Indicative Cofinancing ($)** |
| 1. Pilot wind farm implementation | Inv | Replicability plan for Red Sea wind farms completed after implementation of first utility-scale wind farm in Sudan (Dongola, 100MW) | 1.1 Completed design, installation and operation of interface electronics in Dongola wind farm such that islanding problems are avoided and grid stability is ensured<br><br>1.2 Completed and approved replication and investment plan for the construction of five additional wind farms in the Red Sea region prepared with the objective of catalyzing new investment:<br>• **Technical** component for the Red | GEFTF | 2,391,864 | 205,595,000 |

[1] It is very important to consult the PIF preparation guidelines when completing this template.
[2] Project ID number will be assigned by GEFSEC.
[3] Refer to the reference attached on the Focal Area Results Framework when filling up the table in item A.
[4] GEF will finance management cost that is solely linked to GEF financing of the project. PMC should be charged proportionately to focal areas based on focal area project grant amount.

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|---|---|---|---|---|---|---|
| | | | Sea wind farms to address interface electronics and grid stability, minimization of environmental impacts (e.g. soaring birds) and development of a prioritized list of practicable wind farm sites<br>• **Finance** component for the Red Sea wind farms to address business planning; banking proposal preparation; negotiation with investors; regional development and bottle-neck issues (e.g. logistical / accessibility constraints); detailed design of appropriate PPP vehicles; NAMA development for the Red Sea wind farms to catalyse climate financing | | | |
| 2. Policy, institutional and regulatory framework | TA | Increased wind power investment in Sudan facilitated by the approved and enforced enabling policy, institutional and regulatory frameworks | 2.1 Formulated long-term energy policy for Sudan, including analysis of the cost-effectiveness of financial policy instruments (portfolio standards, feed-in-tariffs, carbon finance, carbon taxation, removal of fossil fuel subsidies, reforms of existing tariffs, accelerated depreciation of turbines, tax credits, capital subsidies, time-of-use tariffs, etc.) for reducing GHG emissions and increasing the energy independence of Sudan<br><br>2.2 Developed and endorsed standardised Energy Purchase Agreement (EPA) for grid-connected renewable energy projects<br><br>2.3 Established and approved dynamic, geographically-zoned feed-in tariff for wind energy in Sudan<br><br>2.4 Adopted and approved secondary legislation relevant to wind energy developed for catalysing private sector investment in wind energy projects, including a Public-Private Partnership Act and an Independent Power Producers Act<br><br>2.5 Formulated and adopted grid code for the interconnection of intermittent renewable energy sources<br><br>2.6 Established and operational Inter-Ministerial Committee for Renewable Energy for providing cross-sectoral perspective and high-level political support for clean energy | GEFTF | 377,410 | 1,595,000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 2.7 Established and operational 'one-stop shop' (OSS) for wind energy investors and developers housed in the Renewable and Alternative Energy Directorate of the Ministry of Electricity and Dams | | | |
| 3. Strengthening the wind technology support and delivery system | TA | Enhanced stakeholders' technical and planning know-how and technological capacities for wind energy power initiatives | 3.1 Developed and approved wind atlas for the Republic of Sudan in a GIS system, with additional layers for geology, geomorphology, land ownership and type (e.g. protected areas / forests), settlements, and routes of migratory birds<br><br>3.2 Frequency and voltage stability of the national grid to the inter-connection of renewable energy sources of intermittent nature measured<br><br>3.3 Established and approved guidelines for new substations and transmission lines for the interconnection of additional wind farms to the national grid<br><br>3.4 Local experts, technicians and practitioners capacitated to prepare and conduct site study visits during construction, interconnection, operation and maintenance of the pilot wind farms<br><br>3.5 Approved RE-related curricula of specialized universities and the Energy Research Institute (ERI) | GEFTF | 420,000 | 1,102,500 |
| 4. Adaptive learning and replication plan | TA | Conditions enabled for leveraging significant additional investment and knowledge of best practices shared nationally and regionally | 4.1 Documented lessons learnt, experiences and best practices related to the development of the pilot wind farms compiled and disseminated for other wind farm projects in Sudan<br><br>4.2 Completed regional workshops for transferring knowledge and capacity to Sudan from relevant regional countries (e.g. Egypt, Morocco, Kenya) | GEFTF | 180,000 | 1,022,500 |
| | | | Sub-Total | | 3,369,274 | 209,315,000 |
| | | | Project Management Cost[5] | GEFTF | 167,090 | 4,385,000 |
| | | | **Total Project Costs** | | 3,536,364 | 213,700,000 |

## C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, ($)

| Sources of Co-financing | Name of Cofinancier | Type of Cofinancing | Amount ($) |
|---|---|---|---|
| National Government | Ministry of Electricity and Dams | Grant | 213,000,000 |

[5] Same as footnote #3.

| | | | |
|---|---|---|---|
| National Government | Ministry of Electricity and Dams | In-kind | 200,000 |
| National Government | Energy Directorate, Ministry of Petroleum | Grant | 200,000 |
| National Government | Energy Directorate, Ministry of Petroleum | In-kind | 50,000 |
| GEF Agency | UNDP | Grant | 250,000 |
| **Total Cofinancing** | | | 213,700,000 |

## D. GEF/LDCF/SCCF/NPIF RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]: N.A.

## PART II: PROJECT JUSTIFICATION

### A. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

A.1.1 the GEF focal area/LDCF/SCCF strategies /NPIF Initiative:

Within the GEF Focal Area of climate change (CC) mitigation, the proposed project supports Strategic Objective 3: "Promoting investment in renewable energy technologies".

The project aims to support the removal of barriers to the adoption of utility-scale wind energy tied to the national grid. Wind energy has been identified as a priority mitigation technology by the Government of Sudan, and, although it is a mature technology, it has not yet been adopted in Sudan. A systems approach is proposed to integrate energy policy analysis within the broader developmental objectives of Sudan. The proposed project will also establish regulatory frameworks for encouraging private investments in grid-connected wind energy and will support the development of six utility-scale wind farms in two geographical locations in the country.

In brief, the proposed project aims to create conditions for long-term and sustainable wind power development that is an environmental priority and to enable the development of a commercially-viable wind energy industry in Sudan. The project has been designed to play a catalytic role for the transformational scaling-up of renewable energies and other mitigation activities in Sudan.

A.1.2. For projects funded from LDCF/SCCF: the LDCF/SCCF eligibility criteria and priorities:
N/A

A.1.3 For projects funded from NPIF, relevant eligibility criteria and priorities of the Fund:
N/A

A.2. national strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NIPs, PRSPs, NPFE, etc.:

The proposed project is consistent with the priorities of Sudan. The following provide justification for the development of wind power in Sudan:

1. Renewable Energy Master Plan (REMP) 2005[6]: Approximately 27 million people in Sudan lack access to electricity and the country as a whole have a 36% electrification

[6] Sudan's Renewable Energy Masterplan Study (2005).

rate.[7] Sudan has set itself the target to increase electrification to 75-80% by 2020. The Master Plan, prepared under the UNDP-GEF 'Barrier Removal for PV Market Penetration in Semi-Urban Sudan' project, recognises that Sudan is endowed with diverse energy resources, ranging from biomass to hydro, solar, wind and geothermal, and calls for the use of these renewable energy sources to ensure the energy security of Sudan and to enhance access to electricity. In particular, REMP recommends the development of large-scale wind power over a near-term time horizon, highlighting the potential of the Red Sea coast in particular, based on the experience of wind farm installations on the Red Sea coast in neighbouring Egypt.

REMP makes a clear case for increasing the share of renewables in the electricity mix of Sudan.[8] The first, and perhaps most obvious, rationale for Sudan to diversify its electricity mix is the ample renewable energy resources found in the country. Sudan possesses large and abundant solar resources, considerable wind resources, large hydropower potential and significant geothermal and biomass resources. A second rationale for developing renewables in Sudan is the geographical distribution of renewable energy resources. In contrast to conventional energy sources, which are concentrated in particular locations, Sudan's renewables are generally better distributed throughout the country. This wide distribution implies a lower need for transmission and transportation, as it better reflects human settlement patterns.

2. National Strategic Vision 2001-2025: The Government of Sudan has formulated a 25-year strategic plan for the period 2001-2025, setting overall goals for economic development. The Vision is operationalised through rolling 5-year strategic plans, the latest of which is the National Strategic Plan (NSP) 2007-2011[9]. The Vision and NSP recognize the supportive role of the renewable energy sector in achieving the goals for economic development, both in terms of increasing the capacity of existing technologies (hydroelectricity and thermal) and through the addition of new renewables (e.g. wind, solar, geothermal and renewable biomass). Emphasis is placed on diversification of the electricity mix to ensure energy security and to enhance electricity access. The proposed GEF project falls squarely within the ambit of the Strategic Vision.

   The need to diversify Sudan's electricity mix has taken on added impetus since the secession of South Sudan in July 2011. Sudan's oil reserves were reduced by two-thirds following the secession and, moreover, South Sudan has recently announced plans to build its own refining capacity and is in discussions with Kenya regarding a 3,600 km pipeline from South Sudan to the Kenyan port of Lamu, with the objective of reducing its dependence for oil refining and export on (North) Sudan within a 3-year period.

3. Second National Communication (SNC): Sudan is currently finalizing its SNC with UNDP assistance. The SNC specifically identifies wind energy as being a high-potential climate change mitigation technology. Further, the SNC has identified several gaps in climate change mitigation in Sudan that the proposed project will be able to bridge through the use of an innovative dynamic modeling approach. In particular, the dynamic modeling tool will allow the analysis and assessment of mitigation options, planning and monitoring of mitigation programmes and projects, and the integration of climate change into national development planning.[10]

[7] http://www.eia.gov/cabs/Sudan/Full.html - accessed 15 November 2011.
[8] Sudan's Renewable Energy Masterplan Study (2005), pg12.
[9] National Council for Strategic Planning (2007) National Strategic Plan for Sudan: 2007-2011, pg. 28.
[10] Government of Sudan (2011) Chapter 5 – Other Information, in *Draft Second National Communication* (courtesy of Secretary General, Higher Council for Environment and Natural Resources).

4. National CDM Strategy 2011: The Higher Council for Environment and Natural Resources (HCENR), with UNDP assistance, has endorsed a national strategy to promote low-carbon projects through the CDM. This strategy states that wind energy is the most promising renewable energy option (over CSP and geothermal) in the short-term (i.e. within the next 5 years), a finding that is aligned with Sudan's current strategy to develop wind farms in Nyala (West Sudan), Dongola (North Sudan) and the Red Sea region.[11]

5. Nationally Appropriate Mitigation Actions (NAMAs): Sudan is among the countries that have not yet submitted its NAMAs following the provisions contained in the Copenhagen Accord emanating from COP-15. A project funded by the African Development Bank is currently being undertaken under the aegis of HCENR so that Sudan can submit its list of NAMAs in 2012. Large-scale wind energy has specifically been identified as a NAMA for Sudan.[12]

6. Technology Needs Assessment (TNA) for Sudan: GEF is currently funding a Technology Needs Assessment for climate change mitigation and adaptation in Sudan. Although the TNA is still in its infancy, preliminary communications with the host institution (HCENR) have revealed that there is a high likelihood that the renewable energy sector will be identified as a priority mitigation sector for Sudan. This will be confirmed and elaborated upon during the preparation phase of the project development.

7. Sudan's National Adaptation Programme of Action (NAPA, 2007) observes that disruptions to hydroelectric power generation - in terms of both the absolute quantity and reliability of electricity generation - will take place due to reduced precipitation arising from climate change, as well as increased variability in precipitation.[13] The diversification of the electricity mix using utility-scale wind energy is seen as a viable means of enhancing the energy security of Sudan. Further, diversifying the renewable electricity base of Sudan with wind energy will provide the added global environmental benefit of avoiding future adaptation costs in the power sector. High levels of sedimentation in Sudan's large dams due to upstream land degradation are a severe threat to hydro-electric power generation. A well-known example is at Roseires, which used to be Sudan's largest hydro power plant before Merowe dam was built, where sediments have reached the power intakes, affecting turbine operation and undermining electricity production.[14]

## B. PROJECT OVERVIEW:

B.1. Describe the baseline project and the problem that it seeks to address:

Background

To achieve its strategy of 75-80% electrification, the Government of Sudan plans to install 12,000 MW of additional generation up to 2020. With the commissioning of Merowe Dam 1.25GW hydro-power plant in 2008/09, hydro-electric power generation has become the dominant technology in power generation in Sudan, with a share of ~71% in the electricity mix in 2010. However, the total technically feasible potential for hydro-electric power generation totals 4,920 MW (or 24,132 GWh/year)[15], implying that, in the long-term, the bulk of expansion in generation capacity will come from thermal power plants. Indeed, the long-term development plan observes that 8,675 MW of additional thermal power plants will be needed up to 2030.[16] The technologies for thermal electricity

[11] Higher Council for Environment and Natural Resources (2011) National CDM Strategy for Sudan, pg. 33.
[12] Private communication with Eng. Mohamed Ali Hamid (Lead National Consultant developing list of NAMAs for Sudan).
[13] Ministry of Environment and Physical Development (2007) National Adaptation Programme of Action, pg18.
[14] UNEP (2007) Sudan post-conflict environmental assessment, Chapter 10 – Freshwater resources, pp225-226.
[15] National Electricity Corporation (2004) NEC Medium-Term Development Plan: 2005-2010, pg. 52.
[16] NEC Long-term Power System Planning Study (2006), pg.4.2.

generation have been identified as combined cycle gas turbines (CCGTs), low-sulphur diesel (LSD) generators, and coal-fired power plants. This will only exacerbate the country's energy security problems and lead to rising energy-related greenhouse gas emissions.

The medium-term development plan echoes the trend towards thermal power generation. In June 2011, the Sudan Ministry of Electricity and Dams released its Medium Term (2012- 2016) Power System Development Plan. It emphasizes least-cost energy solutions towards achieving the Government of Sudan's electricity access targets. These targets and objectives include, among others: (i) an increase in the available generation capacity from 2,232 MW in 2011 (with 2,532 MW installed capacity) to 4,161 MW (with 5,180 MW installed capacity), (ii) increasing the electrification rate from 27% to 45% in the medium term, (iii) raising per capita consumption from 233 kWh to 572 kWh, and (iv) extension of the national grid from 6,246 km to 9,100 km. The Medium Term Power System Development Plan also targets the addition of 551 MW of renewable electricity to the national mix over the medium-to-long terms.

Baseline Project (scenario without GEF financing)

The Ministry of Dams and Electricity (MED) is planning the installation and commissioning of seven utility-scale wind farms between 2012 and 2016, six of which form the baseline project[17]. This timeframe coincides with the implementation of the proposed GEF project. Table 1 below summarizes the details of the wind farms and their status in terms of both completion of feasibility studies and availability of secured financing to implement them.

The baseline project consists of the six wind farms: Dongola (for which implementation funding has been secured) and the five Red Sea sites (for which implementation funding has not yet been secured). Hence, the baseline project has a total installed capacity of 280 MW that is expected to produce 849,695 MWh of renewable electricity annually when all the sites are operational. The cost of the six farms is approximately US$523 million. Advanced negotiations are currently underway between the Ministry of Energy & Dams and private-sector contractors to implement the Dongola wind farm under an Engineering, Procurement and Construction (EPC) modality. The EPC approach has already been used successfully for the expansion of power generation to increase the electrification of Sudan.[18]

[17] The Dongola and six Red Sea wind farms form the baseline project for the purposes of this GEF project. The Nyala wind farm is excluded: it is relatively small, is due to commence after Dongola (and hence lacks Dongola's symbolic importance as Sudan's first utility-scale wind farm) and has few additional learning or replication benefits beyond those provided by the Dongola wind farm.

[18] National Electricity Corporation (2004) NEC Medium-Term Development Plan: 2005-2010, pg. I.5.

**Table 1.** Status of wind farm projects that are planned between 2012-2016

| Wind farm project | Installed capacity (MW) | Electricity generated (MWh/yr) | Commissioning date | Status of feasibility study | Status of financing | Included as co-financing for the purposes of the GEF project?[19] |
|---|---|---|---|---|---|---|
| Dongola | 100 | 273,641 | Quarter 4, 2012 | Completed | In the process of finalisation (US$205,595,000) | Yes |
| Nyala (not part of the baseline project) | 20 | 64,006 | Mid-2013 | Completed | In the process of finalisation (US$56,556,000) | No |
| Red Sea (5 sites: 2 north of Port Sudan, 3 south of Port Sudan) | 180 | 576,054 | Beginning of 2014 for the South Port Sudan wind farms; beginning of 2016 for the North Port Sudan wind farms | Wind measurements commenced as precursor to feasibility study | Not yet secured (US$310 million capital cost anticipated) | No |
| **Total** | **300** | **913,701** | | | | **$213,000,000** |

To enumerate the added value (incremental reasoning) of the proposed GEF project, it is necessary to establish the rationale and orientation of the GEF project for the market development of wind energy in Sudan. As will be discussed below, the market development for wind energy faces significant barriers in Sudan. The baseline project provides a unique opportunity to start addressing these barriers with the view to favouring private investment in the market development of wind energy in the medium-to-long term. Some of these barriers, namely those related to the transfer of nationally-appropriate wind energy technologies, will be addressed directly within the baseline project. In order to generate market acceptance at a time when wind technology does not exist in Sudan, it is crucial to first demonstrate the technological viability of wind energy in the local context. Any technological failure at the early stages in wind energy development will only undermine the acceptance of the technology in Sudan, resulting in an unwanted increase in yet more market barriers. Using the favourable conditions generated by the imminent Dongola wind farm to promote wind energy, other – broader – barriers will be addressed by the GEF project in order to pave the way for the market development of the Red Sea wind farms and beyond.

A number of studies confirm that Sudan has considerable wind energy resources, with annual average wind speeds that exceed 5 $ms^{-1}$, particularly at the areas north of latitude 12 N and along the

[19] The financing for the Dongola wind farm is considered to be firm co-financing for the purposes of this GEF project. The Nyala wind farm is not considered to be part of the GEF project and therefore does not contribute to GEF co-financing. The Government of Sudan is currently in the process of sourcing the finance (primarily international loans) for the five Red Sea wind farms. The financing for the Red Sea wind farms is considered very likely to materialize, though there is of course an element of uncertainty over the precise amount, sources and terms. Consequently, as a conservative measure, this financing is not included as co-financing in this PIF. UNDP will assist the Government of Sudan in its efforts to mobilize the financing for the Red Sea wind farms; if successful, this financing will be presented as firm co-financing at the time of CEO Endorsement.

Nile valley. The wind density in the north part of Sudan, around Dongola, exceeds 400 W/m$^2$ while in Khartoum area it ranges from 285 to 380 W/m$^2$. Studies estimate wind speed in Eastern region to be as high as high > 5 ms$^{-1}$ and in Northern region to be as high as >4.5 ms$^{-1}$.[20] In total, there is a potential of 5,000 MW of utility-scale wind energy generation in Sudan related to sites with annual average wind speed above 4.5 ms$^{-1}$. [21] The main sites for wind energy are identified as: (1) the central Northern part of Sudan with Dongola as its centre; and (2) the Red Sea region, with Port Sudan as its major city.

Although wind energy is mature and technologically viable, there are currently no applications of wind turbines at any scale for the generation of electricity in Sudan. The experience of Sudan with wind turbine technology is limited to small-scale mechanical water pumping.

The key focus of the proposed GEF project is to help Sudan understand the planning and operational requirements of wind power, gain experience with installation and grid integration issues, and employ policy options that promote wind energy development within the broader context of low-carbon, climate-resilient development. GEF funding will thereby create the appropriate technological, institutional, policy and capacity environment that will enhance the probability of success of the baseline wind farms and establish the pre-conditions for replication elsewhere in Sudan.

The baseline wind farms currently face technological barriers, which have not been taken into consideration in their design. If not addressed decisively, these technological barriers will enhance the risk of failure of these demonstration wind farms, thereby decreasing the future acceptance of the technology. In particular, the national grid of Sudan is known to be relatively unstable, with variations in both frequency and voltage. The Ministry of Electricity and Dams has experience in synchronizing power generated from different conventional sources that provide base load. However, MED does not have experience in synchronizing the grid with power generated from an intermittent source like wind. Although the power system has improved in recent years, grid stability to accommodate power generated from an intermittent source such as wind is still inadequate. In the baseline situation, no special electronics are anticipated to interface (i.e. synchronize) the output of the wind farms and the sub-stations in order for the electricity generated by the wind farms to have the same characteristics as electricity in the national grid through real-time monitoring of the latter. The Ministry of Electricity and Dams confirms (January 5$^{th}$ 2012) that the issue of the interface electronics has not been considered (or budgeted for) for any of the baseline wind farms, and that the ongoing tender process for the Dongola wind farm reflects this omission. Further, MED specifically emphasizes (January 5$^{th}$ 2012) the need for GEF assistance in this area. In the absence of such interface electronics, it is highly probable that the grid will face islanding problems that will lead to load management problems and further grid instabilities.

A significant proportion (two-thirds) of the GEF funding (Outputs 1.1, 1.2) will be allocated as investment in the baseline wind farms in order to enhance their technical performance (particularly in terms of electricity output that has compatible properties with grid electricity) and to support the development of the Red Sea wind farms. It is known from preliminary wind mapping and the experience of Egypt and Eritrea that the Red Sea region offers the best wind energy resource potential in Sudan. Because of the significant barriers that wind energy market development faces today in Sudan, the proposed GEF project will remove additional barriers and pave the way for the higher-potential Red Sea region, replicating Egypt's success. Further, the proposed project will integrate an explicit learning component whereby Sudan can learn from the experiences of neighbouring country wind farm projects, including best practices, along the Red Sea coast. The

[20] Government of Sudan (2011) Renewable Energy sector related policies, in *Draft Second National Communication* (courtesy of Secretary General, Higher Council for Environment and Natural Resources).
[21] KEMA (2009) Strategic options for renewable energy in North and South Sudan.

intention for the GEF-supported replication plan (Output 1.2) is to provide a more comprehensive approach to the Red Sea wind farms than the baseline feasibility studies would provide, including help with: business planning; banking proposal preparation; negotiation with potential investors; regional development and bottle-neck issues, such as identification of labour force deficiencies, training needs and logistical/accessibility constraints; lessons-learned from the Dongola experience; and international lessons-learned from regional wind power sectors, such as those of Morocco and (particularly) Egypt.

The project will additionally seek to catalyse follow-on investment for the Red Sea wind farms by formulating a NAMA (with required baseline, institutional and MRV support); this NAMA will be submitted to the UNFCCC by the Government of Sudan and will act as a future channel for international funding for grid-connected wind energy. The NAMA to be developed under Output 1.2 is regarded as an investment vehicle (i.e. a platform to leverage climate finance investment during the project implementation period) and will be treated as such in the project. The financing that can be channelled through the NAMA will be a function of the funding environment (e.g. the operational status of the Green Climate Fund) in the future, but the intention is to design, operationalise and channel funding through a NAMA during the 5-year lifetime of the GEF project.

In summary, the GEF-supported replication plan for the Red Sea wind farms will represent a clear departure from the baseline scenario through (a) more rigorous inclusion of technical and environmental issues that would likely be omitted in baseline feasibility studies; and (b) broadening the approach to become more strategic and holistic, with a focus on catalysing private-sector engagement and investment and on learning the lessons from earlier experiences in Sudan and from the wind sector in other regional countries.

Analysis of the substantive barriers that wind energy faces in Sudan is provided in Table 2 below. In line with the rationale described earlier for the removal of barriers within and around the baseline project, Table 2 makes explicit links between the components of the proposed project and the barriers they will address, and also which barriers will be addressed at the level of the baseline wind farm projects themselves.

The sequencing of activities will also allow sufficient time to develop a partnership with the GEF-funded biodiversity project “Mainstreaming Conservation of Migratory Soaring Birds (MSBs) into the Key Productive Sectors Along the Rift Valley/Red Sea Flyway”, to ensure that globally threatened and significant populations of soaring birds that migrate along the Rift Valley/Red Sea flyway are effectively maintained. Of the baseline wind farms, Dongola is not located in the important Rift Valley/Red Sea flyway and the five Red Sea wind farms are. The Dongola wind farm is unlikely to pose a significant threat to migratory birds that are typically vulnerable to such developments; the Red Sea wind farms do, however, have significant potential to interfere with migratory species. Furthermore, impacts on resident bird species will also need to be considered. The current design of the baseline wind farms does not consider the impacts on MSBs or on resident birds: the recently-completed EIA for the Dongola wind farm, undertaken by a Sudanese firm and endorsed by the Higher Council for Environment and Natural Resources, devotes only cursory attention to migratory bird (or, incidentally, noise) impacts, and there is no reason to expect the Red Sea EIAs to be any different. As is evident from the example of the Dongola project, such omissions in the EIA are not a barrier to the EIA being officially endorsed. There is a clear need for the GEF project to rectify these baseline omissions. Such issues will be considered from the outset in the EIAs for the Red Sea wind farms constituting the baseline project.

**Table 2.** Analysis of barriers and how the project proposes to address them.

| Barriers | Options |
|---|---|
| | **Baseline project and activities** (i.e. without GEF intervention) |
| | **Proposed project-supported activities** (i.e. incremental reasoning) (the output numbers at the beginning of this section correspond with the Project Framework table in Section B - Part I) |
| **Lack of technical experience** | |
| The lack of in-country technical expertise to deal with the technological aspects of wind energy generation increase the risks that the first wind farms built in Sudan may not be technologically viable, thereby decreasing the market acceptance of subsequent wind power generation. This will jeopardize the prospects for the market development of wind energy in Sudan, regardless of how the remaining barriers discussed below are addressed. | **Baseline project:**<br>The feasibility study carried out by MED for the Dongola wind farm has overlooked some critical aspects of the wind farm design to suit the local context. These omissions can be attributed mainly to lack of in-country technical expertise. The principal omissions are: (1) synchronization of the intermittent electricity generated by the wind farms in the baseline projects to match the quality (frequency response and voltage fluctuations) of the relatively weak national grid has not been addressed; (2) impacts of the wind farms on migratory and resident birds have not been fully investigated; and (3) the possible impacts of low-frequency noise on neighbouring communities and wildlife have not been considered.<br><br>Moreover, no replication plan is proposed in the baseline for the Red Sea wind farms, leveraging the learning acquired from the implementation of the Dongola wind farm to catalyse investment activity.<br><br>**Baseline activities:** The baseline activities will constitute all the standard technical activities that take place during the setting up of a wind farm, including wind resource assessment, site selection and micro-siting of individual wind turbines, selection of wind technology, EIAs and SIAs, geotechnical and civil engineering, interconnection of wind farm at sub-station to grid, operation & maintenance. However, a number of these activities will be sub-standard or omitted entirely due to the lack of technical experience described above. |
| | **Incremental reasoning (i.e. with GEF intervention)**<br>***Component #1 - Outputs 1.1, 1.2 of the proposed project will effectively address all these shortcomings***<br><br>• Adequate interface electronics will be specified to synchronise wind farm electricity with the grid, based on the outcome of Outputs 2.5 and 3.2 (namely development of a grid code and mapping of the grid stability vis-a-vis increasing penetration of wind power and any other renewable energy of intermittent nature);<br>• Enhanced initial EIA and SIA for the Red Sea wind farms carried out to investigate the impacts on migratory and resident birds in collaboration with UNDP-GEF MSB project, and low-frequency noise on communities and wildlife. Remedial actions will be proposed and implemented;<br>• Siting of wind farms will take place based on enhanced EIA and SIA;<br>• Based on the experiences and lessons learned from the Dongola wind farm, a replication and sustainability investment plan will be formulated. This investment plan will help with feasibility studies, wind assessment, business planning, banking proposal preparation, regional development issues (e.g. relating to labour force capacities and infrastructure constraints), negotiation with potential investors and NAMA formulation to catalyse financing for the Red Sea wind farms. |
| **Legal and regulatory barriers** | |

| | |
|---|---|
| These conditions do not provide the visibility for investors to invest in renewable energies on the scale required to achieve ambitious goals of electrification of the country | **Baseline project:**<br>Sudan still uses a centralized model for electricity generation. Rather than simply continue to expand its centralized power systems, Sudan should begin to develop a complementary decentralized energy structure which would better match its current capital resources and management capability as well as position it well to adapt to environmentally-sound electricity generation technologies and systems. The first IPP licence was granted in 2004, but its use has remained marginal.<br><br>**Baseline activities:**<br>• Energy Purchase Agreement for wind farms carried out on an ad hoc basis and without transparency;<br>• Private investment carried out under existing Investment Law 2001, which has proved not to be favourable for private investment;<br>• Interconnection of wind farms will be carried out without concern for matching with the technical specifications of the grid. |
| | **Incremental reasoning (i.e. with GEF intervention)**<br>***Components #2 and #3 will address the above barriers.***<br><br>***Component #2 - Outputs 2.2, 2.4. 2.5 and 3.2***<br>• The project will develop a standardised Energy Purchase Agreement (EPA) on the basis of the financial and institutional arrangements that need to be put in place for the baseline wind farm projects;<br>• The project will create secondary laws for promoting IPPs and PPPs;<br>• A grid code will be developed that wind farms developed in Sudan must meet.<br><br>***Component #3 – Output 3.2***<br>• The stability of the national grid regarding injection of renewable electricity of intermittent sources will be mapped. This will allow the maximum potential for interconnectivity of these renewable energy sources to be known. |
| **Institutional and policy barriers** | |

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| In the absence of a coherent and integrated renewable energy policy, and supporting secondary legislation and policy instruments, there is no transparent and uniformly applicable system in place to place Sudan on a low-carbon development pathway. At best, renewable energy initiatives will remain ad hoc and piecemeal. Lack of an integrated and uniformly applicable decision-making framework does not permit the conditions needed for wind power development. | **Baseline Project:**<br>REMP 2005 made a strong case for institutional reforms in the power sector of Sudan, but adequate reforms have yet to be undertaken.[22] Overcoming these institutional barriers is in line with the Government's economic sector priority to increase the private sector's contribution to economic growth in Sudan.[23]<br><br>Climate change issues and MEAs are not well integrated in the national policy and planning systems that make the mainstreaming of mitigation actions at all levels and across all sectors ineffective. For instance, the draft Second National Communication notes that climate change and UNFCCC matters are not well integrated into national policy and planning systems. There have been limited efforts to foster awareness and understanding of climate change issues, since the structures and affiliations of Government institutions related to climate change are subject to frequent changes resulting from political instability.[24]<br><br>UNDP will leverage its worldwide experience (Kenya, Mauritius, Morocco and Namibia) in deploying a dynamic tool for integrated and cross-sectoral climate change policy planning that can provide the socio-economic and environmental evidence for investing in low-carbon development, including in wind energy development in Sudan.<br><br>**Baseline activities:**<br>• Wind energy development will not be integrated into cross-sctoral energy policy planning for low-carbon, climate-resilient development;<br>• Wind farms developed with coordination diffused between various institutions e.g. MED, Ministry of Environment, Forestry and Physical Development, HCENR, Ministry of Finance and National Economy, Ministry of National Investment, Energy Research Institute, local community associations, etc. |
| | **Incremental reasoning (i.e. with GEF intervention)**<br>***Component #2 – outputs 2.1, 2.6 and 2.7 will address the above barriers.***<br><br>• The project will deploy a dynamic methodology that will allow Sudan to carry out integrated, cross-sectoral energy policy and strategy planning. Importantly it will allow the cost of low-carbon development to be understood, as well as the impacts on key development indicators to be simulated;<br>• An Inter-Ministerial Committee for Renewable Energy will be set up to provide political support for renewables;<br>• A one-stop-shop will be set up within MED to provide timely and accurate information about wind energy in Sudan. |
| **Information/Awareness and Perception Barriers** | |

[22] Sudan's Renewable Energy Masterplan Study (2005), pg30.
[23] National Council for Strategic Planning (2007) National Strategic Plan for Sudan: 2007-2011, pg. 22.
[24] Government of Sudan (2011) Chapter 5 – Other Information, in *Draft Second National Communication* (courtesy of Secretary General, Higher Council for Environment and Natural Resources).

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| Lack of knowledge and negative perception of wind power still exist among decision-makers, the banking sector, the energy sector community and the general public. | **Baseline project:**<br>The current absence of wind power for electricity generation in Sudan, coupled with the fact that the main strategy for generating renewable electricity has been focused on hydro, means that investors, especially local ones, are risk-averse with regard to financing wind energy. Confidence in wind energy (compared with other technologies such as solar, hydro, geothermal and biomass) among policy makers is also low. This is further reinforced by the other barriers discussed here.<br><br>**Baseline activities:**<br>• Baseline wind farms developed as stand-alone projects with no concern to reducing awareness and perception barriers to wind farm development;<br>• No dedicated replicability plan for wind energy development in Sudan;<br>• No mechanisms will be in place for adaptive learning from experiences gained with baseline project and the MENA (Middle East and North Africa) region |
| | **Incremental reasoning (i.e. with GEF intervention)**<br>***Component #1, #2 and #4 will address the above barriers.***<br><br>***Component #1 - Output 1.2***<br>• A strategic replicability and sustainability investment plan for the Red Sea wind farms will be developed for Sudan.<br><br>***Component #2 - Outputs 2.6, 2.7***<br>• An Inter-Ministerial Committee for Renewable Energy will be set up to provide political support for renewables;<br>• A one-stop-shop will be set up within MED to provide timely and accurate information about wind energy in Sudan;<br>• A guidebook on wind energy will be created in collaboration with the private sector for investors and project developers;<br>• Awareness raising of decision makers from institutions and investing organizations will be provided to increase understanding and appreciation of wind power investments;<br><br>***Component #4 – Outputs 4.1, 4.2***<br>• The project will prepare and disseminate reports and other documents on lessons learned and successful application of wind energy in neighbouring countries;<br>• Regional workshops and field trips to disseminate best practices and to have hands-on experience with successful examples of commercially-viable wind farms will be carried out under the project. |
| **Capacity barriers** | |

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| There is a pressing need for trained professionals in relevant fields to ensure proper installation and reliable operation of the wind turbines. Relatively high project preparation costs stem in part from shortages of relevant skills. There is a lack of local capacity to prepare "bankable" feasibility studies, business plans and request for proposal documents to solicit bidders to implement wind farm projects. The lack of capacity extends also to site monitoring of installations and interconnections at sub-stations. | **Baseline project:**<br>The experience of Sudan with wind energy is restricted to mechanical water pumping. There is virtually no practical experience and technical education in the field of wind energy, which has resulted in a lack of trained professionals for the operation and maintenance of wind turbines. Another technical shortcoming is in the analysis of raw wind data to generate wind maps. Existing maps are mainly drawn from meteorological data measured at a height of 15m (unsuitable for the appraisal of wind farms), and there are sites of high wind potential, such as the Red Sea Region, that have not been mapped to date. Also, there is no methodology for developing layer maps using GIS technology that would ensure optimal siting of wind farms while taking into account their full social and environmental impacts. Fostering the development of human resources and encouraging their use is a valuable area for technical assistance, as it directly equips Sudan with tools for managing its resources on its own.[25] Bridging human capacity gaps is a key requirement for the sustainability of wind energy development in Sudan beyond the lifetime of the proposed GEF project.<br><br>Baseline activities:<br>• Reliance on foreign expertise to develop RFPs and for technical expertise to carry out wind energy resource assessments, construction, operation & maintenance of wind farms;<br>• Stand-alone commissioning of wind farms without catalyzing capacity building of local expertise. Any expertise gained will be marginal and confined to a few persons in institutions like MED;<br>• The socio-economic and environmental benefits of wind energy will not be made widely known. |
| | ***Incremental reasoning (i.e. with GEF intervention)***<br>***Component #3 – Outputs 3.3 – 3.5 will address the above barriers.***<br><br>• Develop a guideline for the MED to formulate RFPs for wind farms that will detail the exact technical standards that wind farms in Sudan must accomplish, as well as all the supporting conditions for technology transfer, capacity building of nationals and risk-sharing between different parties involved in the wind farm erection, operation and maintenance;<br>• Training for local specialists will be provided to enhance technical capacity to design installations, operate and maintain wind turbines.<br>• The project will provide necessary methodological support for local specialists to meet the measurement standards in the chosen sites as required for bankable proposals (including detailed wind speed measurements);<br>• The project will provide training, know-how transfer and awareness-raising for specialists from engineering and consulting firms to assist in the investment justification stage, financing scheme appraisals as well as in other logistical issues where expertise in the country is limited.<br>• Courses on wind energy engineering will be introduced in the vocational and higher education curricula, and will cover topics such as siting, design, installation (civil and electrical connections to the national grid), operation and maintenance;<br>• Development and publication of manuals, handbooks and brochures promoting wind power as one of RE sources with social, environmental and economic benefits. |
| **Financial and project implementation barriers** | |

[25] Sudan's Renewable Energy Masterplan Study (2005), pg 31.

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| There are strong financial barriers related to lack of reliable information on wind power potential and investment resources, risky investment climate and relatively high loan interest rates from local banks. There is also a lack of credible data concerning the best sites for installing wind farms. There is currently no vision or understanding of how emerging climate finance schemes such as sectoral crediting and development of NAMAs can assist wind farm development. | **Baseline project:**<br>The National Strategic Plan for Sudan 2007-2011 states that the "difficulty in obtaining, and high costs of, investment financing" is a weakness for Sudan's sustainable economic development.[26] Investment in wind energy technology is typified by high up-front cost, lack of easy and long-term financing, and high project development to investment ratio. Access to finance is often difficult because of lack of appropriate enabling conditions rather than lack of available capital. Providing secured feed-in-tariffs for a guaranteed length of time will provide private investors the visibility required to raise necessary capital and to better manage their financial cash flows. The project will examine different financial instruments that will provide project developers with the long-term visibility required to take risks and invest in wind energy projects.<br><br>**Baseline activities:**<br>• Feed-in-tariff (FiT), if any, will be set on an ad hoc basis during negotiation of EPA (also on an ad hoc basis as explained above) and it will not take into account the geographical variations of wind energy potential in Sudan;<br>• The use of additional policy instruments (i.e. over and above a FiT) to promote wind energy will not be considered in the baseline project;<br>• Novel climate financing will not be investigated;<br>• Development of a coherent country-wide wind atlas, which is needed to calculate differential or dynamic FiTs, will not form part of the baseline project. Wind resource assessment will be carried out along the Red Sea coast only, in collaboration with the Renewable Energy Directorate, Ministry of Petroleum. |
| | ***Incremental reasoning (i.e. with GEF intervention)***<br>***Components #2 and #3 will address the above barriers.***<br><br>***Component #2 - Outputs 2.1, 2.3***<br>• Scenario analysis of different financial policy instruments will be carried out to inform the best choice of instruments to lower financial barriers to invest in wind energy;<br>• Dynamic feed-in-tariffs for wind energy in Sudan will be developed based on geographical variations of wind energy profile;<br>• The project will catalyse novel financing architectures such as supported NAMAs and climate finance.<br><br>***Component #3 – Output 3.1***<br>• A wind atlas of Sudan will be developed. |

B. 2. incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund/NPIF) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

By using multiple levers to overcome barriers, the proposed GEF project will make a transformative impact in assisting Sudan to transform the market for, and investment in, grid-connected wind energy. Moreover, although the proposed project focuses on wind generation technology, it will have catalytic impacts on the market development of other renewable energy technologies.

It is acknowledged that the theoretical potential co-financing ($523m) associated with this project is considerable, in absolute terms and also relative to the amount of GEF funding (a co-

[26] National Council for Strategic Planning (2007) National Strategic Plan for Sudan: 2007-2011, pg. 11.

financing ratio of 1:149) and given that the project is based in an LDC. The bulk of the co-financing derives from the investment costs for the 6 wind farms. The investment cost per nameplate MW is estimated to be $2.1 million/MW for the Dongola wind farm and $1.7m for the Red Sea wind farms. These cost estimates are completely in line with wind farm costs elsewhere[27], and a high degree of confidence can be attached to these cost estimates. Nonetheless, there is, of course, a possibility that the Government of Sudan will not be successful in raising the needed finance for the Red Sea wind farms (though this is considered to be unlikely). Consequently, so as to adopt a conservative position on co-financing for the purposes of GEF Secretariat appraisal, the investment co-financing associated with the Red Sea wind farms has been excluded from the GEF co-financing estimate provided in this PIF. If the Red Sea financing is successfully mobilized before submission of the CEO Endorsement Request, it will be included as GEF-relevant co-financing in the Endorsement Request. In line with all GEF projects, the ultimate GEF approval of this project is contingent upon the amount of co-financing stated here in the PIF ($213.7 million) actually being leveraged by the time of submission of the CEO Endorsement Request. UNDP is confident that this co-financing will, indeed, be deployed in support of the GEF project.

To reiterate, the GEF funds will not be disbursed unless the co-financing specified in this PIF is mobilized. As for the co-financing uncertainites relating to the Red Sea wind farms, these will be resolved during the project preparation phase.

To date, there is no know-how and hands-on experience in wind power generation at any scale. Without incremental investment in grid stability to support intermittent power output, proper policy (and policy instruments) and regulatory frameworks, institutional strengthening and capacity building activities, the baseline wind farm projects will incur high risks for Sudan with only one-off benefits: wind power development beyond the baseline projects will occur with only great difficulty. In the presence of the significant barriers discussed in Section B.1, it is quite likely that the Red Sea wind farms will be implemented sub-optimally and/or with significant delays. GEF funds will be used to support activities – i.e. incremental investment and removing barriers listed in Table 2 - that will not take place in the baseline projects and yet which will substantially enhance the prospects of the baseline projects and follow-on projects catalysed as a result. By the end of the project, it is expected that:

- The Government will develop and adopt a legal and regulatory framework of necessary legislation and regulations that will be conducive for grid-connected wind power development, including appropriate feed-in tariffs as well as other financial incentives and mechanisms, such as PPPs, to leverage private financing for investment;
- Local institutions, project developers and investors will have enhanced capacity to identify, develop and implement commercially-feasible, Sudan-adapted wind energy investment projects;
- Local institutions will have developed in-house skills to carry out dynamic, long-term integrated energy planning to inform the low-carbon development of Sudan; to compare the relative merits of various financial instruments to promote wind energy and other renewables; and to formulate NAMAs to channel international climate finance support for renewable energy in Sudan;
- The enabling conditions created by the project, as well as best practices drawn from neighbouring countries such as Egypt, and collaborations with regional projects such as the GEF-funded biodiversity project "Mainstreaming Conservation of Migratory Soaring Birds into the Key Productive Sectors Along the Rift Valley/Red Sea Flyway", will have led to the timely and optimal commissioning of the five wind farms in the Red Sea region.

[27] For example, see IPCC (2011), *Special Report on Renewable Energy Sources (SRREN)*, page 586. http://srren.ipcc-wg3.de/

The direct $CO_2$ emission reductions associated with the Dongola wind farm are estimated to be approximately 451,508 $tCO_2$ over the 5-year duration of the proposed project[28]. This translates into an abatement cost of approximately GEF US$7.8/$tCO_2$. Additional emission reductions will accrue from the GEF's support to the Red Sea wind farms. Assuming that the five Red Sea wind farms will be commissioned in two phases of 108 MW installed capacity at the beginning of 2014 and 72 MW at the beginning of 2016, the cumulative emission reductions are estimated at ~608kt$CO_2$ over the 5-year duration of the project (based on present estimates of the grid emission factor). This corresponds to approximately US$5.8/$tCO_2$ abated. Indirect mitigation benefits can be expected from the establishment of a supportive regulatory and institutional framework for renewable energy in Sudan and with the project's awareness-raising and capacity development activities. The global environment benefits of the project will be further estimated and refined as part of the project preparation activities.

B.3. Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF). As a background information, read Mainstreaming Gender at the GEF.":

The project will achieve a range of socio-economic benefits. The following lists the main benefits that will be further developed, where necessary, during the preparation phase.

(1) Creating new "green" jobs: The project will promote the development of the wind energy sector in the country, which will ultimately lead to the creation of new jobs for wind turbine construction and installation (C&I), and operation and maintenance (O&M). In the future, additional "green" jobs will be generated when parts of wind turbines are manufactured in Sudan. A preliminary assessment of "green" jobs for C&I and O&M has been carried out only for the years in which the wind farms listed in Table 1 are commissioned. A more detailed calculation of "green" jobs created over the lifetime of the wind farms can be carried out during the project preparation phase. The results are shown in Table 3.[29] It is assumed that Red Sea 1 will be commissioned over a 2-year period.

**Table 3.** Green jobs created in person-years in the year of commissioning wind farms.

| Wind farm | 2012 | | 2014 | | 2015 | | 2016 | |
|---|---|---|---|---|---|---|---|---|
| | C&I | O&M | C&I | O&M | C&I | O&M | C&I | O&M |
| Dongola | 963 | 164 | | | | | | |
| Red Sea | | | 839 | 143 | 826 | 141 | 452 | 77 |

(2) Poverty reduction: The Human Poverty Index (HPI) contains a component on '*material wellbeing*' that uses access to electricity as one of its determinants. The Dongola wind farm can be expected to have a positive impact of poverty in northern Sudan, where the poverty rate was 46.5% in 2009.[30] Grid extension in the Red Sea region associated with the construction of the wind farms will have a clear and positive impact on livelihoods: the fishery industry will improve through the availability of reliable refrigeration storage systems, and reliable grid electricity will obviate the need for diesel-powered desalination plants, which are inefficient

[28] The National CDM Strategy for Sudan, funded by UNDP in 2010/2011, calculated the national grid emission factor for 2010 to be 0.33t$CO_{2e}$/MWh.

[29] Multipliers used for calculating "green" jobs from onshore wind farms are courtesy of Dr Andrea Bassi, Millennium Institute. Data from two sources were used: (1) Wei M., S. Patadia, and M. Kammen (2010), 'Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US?' *Energy Policy* 38 (2010) 919-931; and (2) Greenpeace international (2009). 'Energy Sector Jobs to 2030: A Global Analysis'.

[30] Quoted in: Government of Sudan (2011) Chapter 1 – Sudan's National Circumstances, in *Draft Second National Communication* (courtesy of Secretary General, Higher Council for Environment and Natural Resources).

(water shortages are frequent in the region) and maintenance-intensive.

(3) Improving the country's energy security: Even before the secession of South Sudan and the loss of two-thirds of its oil reserves, Sudan imported heavy fuel oil to meet part of its electricity requirements. By promoting the use of local renewable energy sources, the project will contribute to improvement of the security of energy supply to the Sudanese population.

(4) Catalysing Public-Private Partnerships: The project will increase awareness among private companies operating in the country of the importance of tackling climate change and propose Public-Private Partnerships as a modality for private investment in the energy sector. Private investment in environmentally-sound technologies is seen as a requirement for transformational change towards low-carbon development.

(5) Differential feed-in-tariff: Access to finance to fund large capital expenditure projects is constrained in Sudan. The provision of attractive, long-term feed-in-tariffs for wind energy will provide the financial visibility and assurance to financiers to invest in wind technology, making it commercially attractive.

(6) Multi-stakeholder involvement: The existing level of communities' involvement in decision-making with regard to renewable energy technologies is relatively low in Sudan. The GEF Project will facilitate the dialogue between specialists, decision-makers and the general public through multi-stakeholder processes for sustainable development.[31] The affected communities will be involved in the decision-making process regarding wind farm site selection.

(7) Addressing the gender issue: In Sudan, poverty is correlated with gender, whereby female-headed households are found to be poorer than men-headed households; with sectors, where those employed in agriculture are poorer than those engaged in industry or services; and with education, where the illiterate are poorer than the educated. According to the 2009 National Baseline Survey (August 2010), inequality, as measured by the coefficient of variation (CV) of income-based dietary energy consumption, was similar for urban and rural populations (31.2% and 32.2% respectively); however, it was higher in female- than in male-headed households (35.1% and 29.6%, respectively).[32] It is expected that the proposed project will have a positive impact on gender-differentiated poverty in Sudan.

B.4 Indicate risks, including climate change risks that might prevent the project objectives from being achieved, and if possible, propose measures that address these risks to be further developed during the project design:

| Risk | Rating | Mitigation |
|---|---|---|
| Political Risks | High | Although there is currently a strong political will and commitment to tackle the electricity access challenges in Sudan and an objective to see the share of renewable energy in the national energy mix increased, political instability or a change of government could lead to potential policy reversals that may impact the energy policy and discourage private investment. However, energy security (i.e. utilization of domestic energy sources and reduced reliance on imports) is now a national priority following the loss of oil fields to South Sudan. The Government is showing growing interest in wind energy, and the GEF project will work closely with Government entities to enhance the enabling conditions for wind energy, with a |

[31] M. Hemmati, *Multi-Stakeholder Processes for Governance and Sustainability: Beyond Deadlock and Conflict* (Earthscan, London, 2002).
[32] Poverty in Sudan (2011) *The Sudan Institutional Capacity Program: Food Security Information for Action,* Policy Brief.

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| | | particular focus on catalyzing private sector involvement.<br>Private sector investment in renewable energies on a large scale is limited in Sudan. Electricity generation is still largely centralized. Provisions for a less controlled environment (e.g. PPPs) will be a serious incentive for private sector investors to invest. Another critical issue is to create the enabling regulatory conditions for the establishment of IPPs for the implementation of wind farms. Adoption of appropriate policy and regulatory changes will be assured through involvement of the stakeholders concerned (including the key Government ministries) at all preparatory stages and through intensive involvement of project experts in conciliation processes. |
| Private investors do not find wind investments sufficiently attractive | Medium | The model that the project will serve to create is the harnessing of development and private banks to provide an appropriate financing mix, while the Government provides the basic regulatory framework regarding feed-in tariffs, incentives and concession/licensing terms and conditions. The project will help prepare high-quality feasibility studies, investment appraisal, business plans and bankable proposals that help decision-making by financial institutions. The project will assist site selection for the Red Sea wind farms. |
| Government finds it hard to commit to commercially attractive feed-in tariffs and/or other incentives | Medium | The project will bring in international experience (e.g. from European countries) to advise the Government on setting an appropriate legal and regulatory framework for wind development. The project will assist the Government to identify ways of raising funds to budget for feed-in-tariffs, and use dynamic modeling to identify the best combination of financial instruments (i.e. least socio-economic cost) to support wind farm development. |
| Climate Change Risks | Low | The risk that climate change will make it less likely that wind projects will be implemented is low due to the low climate sensitivity of wind power in Sudan. First, the NAPA (2007) observes that the occurrence of extreme weather events in the form of wind storms is rare.[33] Second, the impact of higher air temperature on changes in air density (leading to power loss) is insignificant.[34] Third, as climate change adversely affects hydro-power, Government and private sector attention will be drawn to the potential of wind power. |
| Environmental Risks | | |
| • Low-frequency noise | Low | Current wind turbine technology is advanced in terms of minimizing low-frequency noise. In order to make sure that this does not become a detrimental issue for communities and wildlife, the environmental and social impacts of low-frequency noise generated by wind turbines will be duly addressed in EIAs and SIAs. |
| • Migrating Soaring Birds and residents birds | Low | There is a real risk to bird life (migrating or resident birds) in Sudan. This risk will be mitigated by collaborating with the UNDP-GEF funded project entitled "Mainstreaming Conservation of Migratory Soaring Birds into the Key Productive Sectors Along the Rift Valley/Red Sea Flyway". Preliminary discussions with technical experts working on the MSB project has revealed that a protocol has |

[33] Ministry of Environment and Physical Development (2007) National Adaptation Programme of Action, pg18; Please also see Gastineau, G., and B. J. Soden (2009), 'Model projected changes of extreme wind events in response to global warming', Geophys. Res. Lett., 36, L10810, doi:10.1029/ 2009GL037500.

[34] For instance, a 1°C rise in temperature decreases air density and power generated by just one-third of one percent.

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| | | already been designed for the siting and designing of wind farms to reduce/eliminate risks to birds. |
| Lack of technical capacities | High | An integral aspect of the project is capacity building for the design, operation and maintenance of the wind farms. Vocational training will be provided to promote the availability of a qualified pool of technical staff in the country to support wind energy diffusion. Adaptive learning will be used to transfer knowledge and regional experience of wind energy technology in Sudan. Tendering processes will be designed to encourage the active participation of Sudanese equipment suppliers and supply agents. |
| Nationally-appropriate technology | Moderate | Although wind energy technology is mature, its reliability relies strictly on the local context of operation. For instance, issues related to dust ablation of wind turbines as well as the need for interface electronics to interface the output of wind-generated electricity to a relatively weak grid. These risks of technology failure will be mitigated by the direct intervention of the proposed project through investment in the necessary interface electronics. |

B.5. Identify key stakeholders involved in the project including the private sector, civil society organisations, local and indigenous communities, and their respective roles, as applicable:

| Stakeholder | Role |
|---|---|
| Ministry of Electricity and Dams (MED) | The principal role of MED is to formulate policies, strategies and action plans for the supply of electricity in Sudan, with a key focus on diversifying Sudan's electricity mix to include renewables. MED will be responsible for implementing the proposed project. |
| Renewable Energy Directorate, Ministry of Petroleum | The Renewable Energy Directorate is carrying out extensive wind energy resource mapping along the Red Sea coast that will provide input for the future development of wind farms in the Red Sea region. |
| Higher Council for Environment and Natural Resources (HCENR) | As the national focal point for climate change under the UNFCCC, HCENR is responsible for coordinating National Communications, the development of Climate Change Action Plans, NAPAs, Technology Needs Assessments and NAMAs. As the focal point for UNFCCC, HCENR is the official Government entity responsible for NAMAs. As mentioned under Section A.2., a study is being completed by AfDB with HCENR that recommends wind energy being developed as a NAMA. Accompanying the development of NAMAs, HCENR has a specific plan to develop a Low Emission Development Strategy for Sudan as an umbrella structure for the NAMAs: this Strategy will be developed in conjunction with the GEF project so as to maximize synergies and potentially open up a new channel of climate finance for the second wave of wind farm investments.<br><br>Further, HCENR is the Designated National Authority (DNA) and is central to carbon finance activities in Sudan. HCENR is also responsible for assessing EIAs and SIAs for wind farm developments in Sudan in accordance with the Environment Protection Act. |
| Energy Research Institute, ERI (under the Ministry of Science and Technology) | ERI is the primary institute at the national level for conducting research on renewables in Sudan, as well as pilot project implementation. ERI is also involved in all climate change-related studies that are completed under the UNFCCC. |
| Ministry of Finance and National Economy | Being responsible for budgeting and funding allocation to different line ministries, the Ministry of Finance and National Economy will be responsible for the formulation of secondary legislation such as the PPP Act, as well as directly involved in budgeting for feed-in-tariffs, and |

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| | other financial instruments to promote wind energy. |
| Ministry of National Investment | The Ministry of National Investment is responsible for formulating strategies, policies, goals and programs aimed at developing local and foreign investments in Sudan. It is concerned with: (1) executing strategies, policies and priorities of investment; (2) improving the investment climate and facilitating procedures; (3) work to attract national and foreign investments; and (4) aiming investment at the infrastructure sector, among others[35] – all of which will be required to scale-up the penetration of wind energy in Sudan. |
| Ministry of Environment, Forestry and Physical Development (MEFPD) | The Under-Secretary of MEFPD is the GEF Operational Focal Point. |
| Sudan Meteorological Authority | Provides weather information, including wind speeds, on a daily basis as part of the regional climate outlook forum of ICPAC - Climate Prediction and Application Centre. It produces agro-meteorological bulletins on a ten-day basis. |
| Communities living in proximity to proposed baseline wind farm projects | The site of the Dongola wind farm is already owned by the Ministry of Electricity and Dams. Dongola community representatives will be involved in the Local Project Appraisal Committee (LPAC) that will be chaired by MED. Local communities will also be involved in the project through EIA and SIA, and the exact definition of the communities in this context will take place during the stakeholder mapping exercise that is planned during the preparation phase. |
| Private sector | The wind turbines for the baseline wind farm projects will be supplied by the private sector – the precise source(s) is/are yet to be decided but, given the under-developed nature of the wind sector in Sudan, realistically can be expected to be an international manufacturer. The GEF project will work – through capacity development, awareness raising, stakeholder coordination and other means – to maximise the involvement of local companies in equipment supply, maintenance, logistics, construction and technical consultancy services. |

Coordination of key stakeholders

The coordination of the above stakeholders will be carried out by MED with the support of UNDP, commencing immediately from the onset of the project preparation phase and Project Document design and conceptualization. This coordination function will begin with the invitation and participation of the key stakeholders at the project development Inception Meeting. A Local Project Appraisal Committee (LPAC) will be established under the Chair of MED. The LPAC will meet on a regular basis during the Project Document design, conceptualization, formulation and validation process, and it will have the responsibility to coordinate and harmonize the actions of all the key stakeholders towards the development of a coherent project. Further, the Project Document will contain specific modalities for the coordination of the key stakeholders during the implementation stage of the proposed project.

B.6. Outline the coordination with other related initiatives:

The proposed project will avoid duplication and find synergy with other ongoing projects and programmes. In particular, the proposed project will ensure close coordination with:

Energy Directorate, Ministry of Petroleum: The proposed project will work closely with the

[35] Please see http://www.sudaninvest.org/English/About-Ministry.htm - accessed 18 November 2011.

project entitled '*Towards Sustainable Development of Wind Resource in Sudan'*, part of which is related to wind resource assessment on the Red Sea coast, training and capacity building in wind resources analysis.

The UNDP-GEF project, "Mainstreaming Conservation of Migratory Soaring Birds into the Key Productive Sectors Along the Rift Valley/Red Sea Flyway": Soaring birds migrate by spiraling upwards within areas of rising hot air and then gliding downwards to their next thermal. This method cannot be used over large water bodies or high mountains, and therefore concentrates birds into migratory corridors known as flyways, making soaring migrants highly vulnerable to localised threats such as utility-scale wind farms.[36] The proposed wind farm project will coordinate its activities closely with the 'Soaring Birds' project for site selection for Red Sea wind farms by ensuring that an overlay of wind maps and migration maps is done in such a way as to determine the best location for the wind farms.

Capacity Development for Pro-Poor Economic Policy Reform: UNDP is currently assisting the Ministry of Finance and National Economy to develop a project for pro-poor economic reform. One of the components of this project will be to build in-country capacity for dynamic modeling. The proposed GEF project will have strong synergies with the capacity building component of the Pro-Poor Economic Policy Reform project.

During project preparation, a stocktaking exercise will be carried out to identify all ongoing (and hard pipeline) projects that will have commonalities with the proposed wind farm project.

## C. DESCRIBE THE GEF AGENCY'S COMPARATIVE ADVANTAGE TO IMPLEMENT THIS PROJECT:

UNDP assists countries with establishing regulatory frameworks for identifying and mobilising resources. This includes public, private, multilateral and bilateral sources of finance. For more than 45 years, UNDP has worked in close partnership with the Sudanese Government. UNDP Sudan currently manages a programme portfolio of US$209 million.

The credibility of UNDP to implement the proposed project is backed up by real, practical, on-the-ground successes, as well as its strategic interventions that are forward-looking. The main examples are presented briefly below:

- National Communications under the UNFCCC: UNDP supported the preparation of the First National Communication on Climate Change and is also in the process of finalising the Second National Communication. UNDP also supported the National Capacity Assessment for implementation of environmental projects.

- Starting in 1998, the Government of Sudan, with UNDP technical assistance, implemented a 3-year project on Sustainable Rural Energy Development (SRED). The project was funded from UNDP core resources, and was carried out with the collaboration of the Energy Research Institute to enhance the dissemination of solar PV in North Kordofan state. The UNDP initiative was spread over 12 states, targeting 1.8 million people living in rural areas. UNDP's financing amounted to US$1.55 million. This project provided the evidence for the reliability and cost effectiveness of PV water pumps under Sudanese conditions compared to diesel pumps.

- Based on the successes of the SRED, UNDP implemented the GEF-funded project "Barrier Removal to Secure PV Market Penetration in Semi-Urban Sudan". The main accomplishments of this highly successful project through removal of barriers included:

[36] http://www.birdlife.org/news/news/2009/05/soaring_birds_launch.html - accessed 17 November 2011.

- ✓ PV systems installed in 400 schools, 800 health services, 250 social centers, 100 women's development centers, 54,000 households and other social services;
- ✓ Improvements in the areas of policy – e.g. formulation of REMP 2005; PV systems exempted from import duties and value added tax, making them 40% less expensive;
- ✓ Led to the setting up of a PV module assembly plant of 1MW capacity annually;
- ✓ A new Solar Energy Act was put forward by the National Energy Committee of the National Assembly and the project collaborated with the Sudanese Social Development and Savings Bank (SSDSB) to create a system of guarantees as a mechanism to encourage the issue of credit for solar systems, especially for home use;
- ✓ The Government now actively supports PV policies, ensuring the sustainability of PV in Sudan;

- UNDP's CDM Capacity Building Programme: In 2010, UNDP dedicated US$150,000 of TRAC (core) resources to promote low-carbon technologies through carbon finance. The main achievements to date are:
  - ✓ Formulation of a National CDM Strategy;
  - ✓ Calculation of the grid emission factor, for 2010;
  - ✓ Development of four Project Idea Notes (PINs), including one for the baseline project;
  - ✓ Institutional capacity building on the rules and modalities of the CDM.

- Capacity building on dynamic modeling to inform long-term, integrated development planning: In 2011, UNDP sponsored three people (Senior Economist, UNDP, and 2 Government officials, one from the National Council for Strategic Planning and another from the Ministry of Finance and National Economy) to attend a six-week course on the use of system dynamics modeling for integrated development planning at the University of Bergen, Norway. The Government of Sudan has indicated the need for organizing in-country training on system dynamics-based development planning for core planning and programming professionals selected from key line and central ministries and institutions such as the Ministry of Finance and National Economy and the National Council for Strategic Planning. UNDP is planning to incorporate this aspect into the "Capacity Development for Pro-poor Economic Policy Reform" project that is being prepared with the Ministry of Finance and National Economy.

C.1 Indicate the co-financing amount the GEF agency is bringing to the project:

UNDP's role, under its environment finance service line, is to assist countries to identify, combine, access and sequence funding to meet their environmental finance needs (this is also consistent with UNDP's mandate as the head of the UN Development Group). In this case, UNDP has worked with stakeholders to broker US$213.7 million in co-finance, a substantial co-financing ratio (1:60 of GEF to non-GEF resources) for a Least Developed Country. This includes US$100,000 in cash co-finance from UNDP TRAC (core funding) and US$150,000 grant financing from other projects that have synergies with the GEF project. Moreover, UNDP will provide in-kind support through its broader environment portfolio and through the range of technical staff working on energy and environment issues.

As discussed in Section C.2., renewable energy and climate change mitigation have, until recently, understandably not been a Government priority in Sudan given the principal focus on the implementation of the Comprehensive Peace Agreement. A new UNDAF, and consequently UNDP Country Programme, is currently being formulated for 2012-2016. UNDP Sudan's new

Country Programme Document places a priority on expanding its Energy and Environment portfolio, particularly to "promote effective partnership to secure resources and implement programmes to support sustainable clean energy, green economy and climate resilient development". Wind energy is specifically identified as an Output under this Outcome. In line with the Government's recent prioritization of renewable energy issues, UNDP Sudan has recently recruited an Energy Specialist (annual salary $65,000, paid from the UNDP Country Office's own resources) to enhance energy programming, in particular renewable energy. In addition to the wind energy project, the Energy Specialist will handle the Technology Transfer for Photovoltaic initiative; ongoing CDM initiatives for hydro-power, wind power and biomass energy (bagasse) in conjunction with HCENR; biomass energy synergies with the Country Office's UN-REDD activities; and joint UNDP-UNEP recovery and environmental recuperation activities. The UNDP TRAC co-financing for the GEF project represents a substantive 10% of UNDP's total TRAC allocation and a full one-third of the TRAC allocation to the Energy & Environment Unit. Please note that this UNDP co-financing is a conservative estimate, as it excludes staff time and other forms of in-kind co-financing. A full 50% of UNDP's TRAC co-financing will be allocated to investment towards accomplishment of Outcome 1. The remaining UNDP co-financing will be used for technical assistance activities such as capacity building, regulatory, institutional and policy framework development, and adaptive learning.

C.2. How does the project fit into the GEF agency's program (reflected in documents such as UNDAF, CAS, etc.) and staff capacity in the country to follow up project implementation:

The current UNDAF (2009-2012) was primarily driven by the security and political situation in the country, and was centered on supporting the implementation of the Comprehensive Peace Agreement (CPA) of 2005.[37] UNDP's Country Programme was therefore closely aligned with the UNDAF, and focused on: (1) poverty reduction and achievement of MDGs; (2) fostering and consolidating democratic governance; and (3) crisis prevention, conflict resolution and recovery. The current UNDAF expires in 2012 and discussions on the forthcoming UNDAF have commenced. Preliminary discussions with Government counterparties have revealed that the next UNDAF will have a clear focus on climate change mitigation and adaptation, clean energy and sustainable development paths.

In the post-partition development phase of Sudan, new priorities are emerging. During a recent consultative strategic visioning exercise with the Government, NGOs and UN agencies, climate change (mitigation and adaptation, and notably clean energy) came up, strikingly, as a high national priority. Consequently, UNDP is planning to expand its energy and environment portfolio. Environment and Energy will be one of the three major outcomes that will form the core of UNDP programmes during the next programming cycle (2012-2016). UNDP Sudan's new Country Programme Document (CPD, 2012-2016) places a priority on expanding its Energy and Environment portfolio to particularly "promote effective partnership to secure resources and implement programmes to support sustainable clean energy, green economy and climate resilient development". Wind energy is specifically identified as an Output under this Outcome.

UNDP Sudan has recently recruited an Energy Specialist to enhance energy programming, in particular renewable energy. The Energy Specialist will oversee project implementation on a daily basis, including quality assurance and monitoring and evaluation. An Environment Associate will assist with budget revisions, quarterly reporting, auditing and recruitment procedures. A Finance Analyst will review the project budgets and monitor project delivery status. The Head of Operations Unit will assure compliance with the overall fiduciary standards of UNDP. And the UNDP Country Director and Resident Representative will liaise with the

[37] United Nations Development Assistance Framework (UNDAF) 2009-2012.

Government and negotiate key policy and legislative changes proposed by the project. The project will also benefit from backstopping technical support from the UNDP Regional Technical Advisor, based in the Regional Centre in Bratislava.

## PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

### A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):

(Please attach the Operational Focal Point endorsement letter(s) with this template. For SGP, use this OFP endorsement letter).

| NAME | POSITION | MINISTRY | DATE *(MM/dd/yyyy)* |
|---|---|---|---|
| Babiker Abdalla Ibrahim | Under-Secretary, Ministry of Environment and GEF Operational Focal Point | **MINISTRY OF ENVIRONMENT, FORESTRY AND PHYSICAL DEVELOPMENT** | **12/20/2011** |

### B. GEF AGENCY(IES) CERTIFICATION

| **This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.** | | | | | |
|---|---|---|---|---|---|
| **Agency Coordinator, Agency name** | **Signature** | **DATE** *(MM/dd/yyyy)* | **Project Contact Person** | **Telephone** | **Email Address** |
| Adriana Dinu UNDP/ GEF Officer-in-Charge |  | 01/16/2013 | Robert Kelly Regional Technical Advisor Climate Change Mitigation | +263 4884 580 | robert.kelly@undp.org |