GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

Naoko Ishii
CEO and Chairperson

August 11, 2014

Dear Council Member:

UNDP as the Implementing Agency for the project entitled: ***Iraq: Catalysing the Use of Solar Photovoltaic Energy***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with UNDP procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by Council in November 2012 and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by UNDP satisfactorily details how Council's comments and those of the STAP have been addressed. I am, therefore, endorsing the project document.

We have today posted the proposed project document on the GEF website at www.TheGEF.org. If you do not have access to the Web, you may request the local field office of UNDP or the World Bank to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

Naoko Ishii

Attachment: GEFSEC Project Review Document
Copy to: Country Operational Focal Point, GEF Agencies, STAP, Trustee

1818 H Street, NW • Washington, DC 20433 • USA
Tel: +1 (202) 473 3202 - Fax: +1 (202) 522 3240
E-mail: gefceo@thegef.org
www.thegef.org

REQUEST FOR CEO APPROVAL
PROJECT TYPE: Full-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Catalysing the Use of Solar Photovoltaic Energy			
Country(ies):	Iraq	GEF Project ID:[1]	5063
GEF Agency(ies):	UNDP(select)(select)	GEF Agency Project ID:	5137
Other Executing Partner(s):	Ministry of Environment	Submission Date: Resubmission Date:	May 15, 2014 July 25, 2014
GEF Focal Area (s):	Climate Change	Project Duration(Months)	48 months
Name of Parent Program (if applicable): ➢ For SFM/REDD+ ☐ ➢ For SGP ☐ ➢ For PPP ☐	N/A	Project Agency Fee ($):	222,727

A. FOCAL AREA STRATEGY FRAMEWORK[2]

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Cofinancing ($)
CCM-3	Favorable policy and regulatory environment created for renewable energy investments, and solar PV in particular	Renewable energy policy and regulation in place	GEF TF	1,261,301	3,915,200
CCM-3	Investment in renewable energy technologies increased	Renewable energy capacity installed	GEF TF	965,972	29,050,000
(select)(select)			(select)		
(select)(select)			(select)		
(select)(select)			(select)		
(select)(select)			(select)		
		Total project costs		2,227,273	32,965,200

[1]Project ID number will be assigned by GEFSEC.
[2] Refer to the Focal Area Results Framework and LDCF/SCCF Framework when completing Table A.

B. PROJECT FRAMEWORK

Project Objective: To reduce GHG emissions in Iraq by demonstrating and catalysing the application of solar PV technology to meet the energy needs of offices, small businesses, residences and small town services (small-scale distributed solar PV power plants and utility scale plants, on- and off-grid).						
Project Component	**Grant type**	**Expected Outcomes**	**Expected Outputs**	**Trust Fund**	**Financing from relevant TF, ($)**	**Indicative co-financing, ($)**
			Outputs 1.1-1.3 relate to rooftop or building-mounted PV systems of a few kilowatts each. *Outputs 1.4-1.6 relate to ground-mounted, utility-scale PV plants.*			
1. Investment in solar photovoltaic power technologies for on-grid and off-grid distributed electricity generation for office, residential, small business and small town application.	INV	Concrete evidence of the utility, practicality and competitive advantage of rooftop solar PV and utility-scale ground-mounted systems.	1.1 Assessment of PV technology, for distributed solar rooftop units suitable for the Bytti project in Najaf, with total capacity of 5 MW. 1.2 Design, construction and operation of distributed small-scale rooftop solar PV power systems (total 5 MW) for town services in Bytti. 1.3 Monitoring data for operational aspects, including power production, distribution and domestic use of solar power supply, to allow performance evaluation. *Outputs 1.4-1.6 relate to ground-mounted, utility-scale PV plants.* 1.4 Selection of sites around Iraq for 2 on-grid and 12 off-grid utility-scale (ground-mounted) PV plants, as a model for IPPs and utility solar power. 1.5 Finalisation of tender documents and component	GEFTF	700,000	27,597,500

			specifications. 1.6 Monitoring data for operational aspects, power production, distribution and grid behaviour.			
2. Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and financial incentives.	TA	Enhanced private investment in, and uptake of, solar PV technologies (rooftop appliances and solar power plants).	2.1. Approved and enforced revised policies and regulations, and new financial incentives, to encourage solar power industry development (private sector) and consumer uptake. 2.2 Examination of inter-connections between distributed power producers and the grid, design of a feed-in tariff and net-metering options, and support to the Government to implement the feed-in tariff and/or net-metering scheme; evaluation of tendering schemes where appropriate. 2.3 Development of a renewable energy database (solar map) containing site-specific data on RE potential to facilitate investment decisions. 2.4 Development of a NAMA around the feed-in tariff, with corresponding baseline, MRV and institutional systems developed.	GEFTF	1,201,273	3,458,190
3. Facilitation of private sector capacity for technology development, innovation and servicing in the solar power	TA	Widespread awareness and increased private sector capacity for supply and	3.1 Solar power market demand/industry response strategy developed for Iraq. 3.2 Development and delivery of certified technical training on	GEFTF	220,000	261,250

industry.		servicing, and increased Government and private sector capacity for the design, construction and operation of small- and large-scale PV systems.	solar PV technologies (hybridisation, supply, service) for emerging private sector companies. 3.3 Development and delivery of dissemination sessions on future IPP involvement in the electricity supply network, including relationships with technology firms and Government agencies, feed-in tariffs, and net-metering options.			
Sub-total					**2,121,273**	**31,316,940**
Project management cost				GEFTF	106,000	1,648,260
Total project costs					**2,227, 273**	**32,965,200**

C. SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME ($)

Please include letters confirming co-financing for the project with this form

Sources of Co-financing	Name of Co-financier (source)	Type of Co-financing	Co-financing Amount ($)
National Government	Ministry of Electricity	Cash	20,000,000
Private Sector	Al Shafei Group	Cash	10,000,000
GEF Agency	UNDP	In-kind	50,000
GEF Agency	UNDP	Cash	165,200
National Government	Ministry of Science and Technology (MoST)	Cash	2,500,000
National Government	Ministry of Industry and Minerals (MoI&M)	Cash	50,000
National Government	Ministry of Environment (MoEN)	Cash	130,000
National Government	Ministry of Environment (MoEN)	In-kind	70,000
Total Co-financing			32,965,200

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in $)		
				Grant Amount (a)	Agency Fee (b)[2]	Total c=a+b
(select)	(select)	(select)				0
(select)	(select)	(select)				0
Total Grant Resources				0	0	0

[1] In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

[2]Indicate fees related to this project.

F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount($)	Cofinancing ($)	Project Total ($)
International Consultants	807,000	1,500,000	2,307,000
National/Local Consultants	300,000	800,000	1,100,000

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? No

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF[3]

Evolution of the project concept in light of GEF Secretariat, STAP and GEF Council guidance, and developments during the PPG Phase

In preparation of the CEO Endorsement Request and in response to GEF Secretariat, STAP and GEF Council guidance, the project team undertook the following:

1. A cost-benefit analysis for the proposed solar technologies.

2. An intensive workshop held in Amman, Jordan, from October 28-29, with key stakeholders from Iraq. Attendees represented the Ministries of Environment, Electricity, Science and Technology and Industry; Al Shafei, a private developer in Najaf Province; Anbar University Renewable Energy Research Centre; Al Mansour Co., a manufacturer of solar components; the Prime Minister's Advisory Council, and Najaf Province officials.

3. Analysis of literature and studies undertaken in recent years by various sources, such as the IEA, the Iraq Integrated National Energy Strategy, and the Iraq Electricity Master Plan.

Based on the above activities, the project team has learned the following:

4. There are two kinds of solar air-conditioning, solar PV air-conditioning and solar thermal air-conditioning. For solar-PV air-conditioning, PV panels are used to generate electricity which runs an AC unit. Solar thermal air-conditioners remove the need for a compressor by using a cooling fluid (such as an ammonia/water mixture) that cools upon mixing and can be separated by heating, rather than by using a compressor. Manufacturers claim such AC units consume as little as 7-20% of the power of comparable units during the daytime. As noted by the STAP reviewer, this technology is experimental and not well commercially established. We could not find evidence of large-scale adoption despite manufacturers' spectacular claims. Therefore, the pursuit of solar-thermal AC in Iraq is not well suited for the proposed project, although it may be promising for the future.

5. Solar PV AC technology is no different from solar PV technology. Once PV panels are installed on a building, the electricity consumption (i.e. the purpose to which the electricity is applied) is agnostic to the source. Therefore, no distinction is needed between the power going to supply AC units, light bulbs or appliances. For a grid-connected PV system, on a grid-connected building, all power-consuming devices are equivalent.

6. The use of a dedicated PV system to power an air-conditioner would indeed not be cost-effective. The typical AC would require some 3 kW of solar panels to operate. Even in a developed market, such as Europe, the cost of the solar PV power unit alone would be US$6,000 or greater, which is more than ten times the cost of the AC

[3] For questions A.1 – A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter "NA" after the respective question.

unit. In addition, the solar panels would only operate the AC unit during hours of strong sunlight. The combination of cost and limited operational hours makes air-conditioning by PV cost-prohibitive for the time being. There are ongoing trials at Anbar University on using solar thermal air-conditioning units with promising results. However, the work is not yet ready for large-scale commercial replication. On this basis, solar PV for air-conditioning units specifically has been ruled out. However, more than 50% of total electricity demand is due to air-conditioning. Therefore, by default, more than 50% of the PV-generated electricity facilitated by the project will provide power to air-conditioning. Rather than have dedicated PV units supplying only air-conditioning, it was found to be more cost-effective to supply the grid in general and thereby allow consumers to consume electricity based on their own priorities. This also fits better with the Government's current policy of increasing generation capacity to meet demand. Thus, it remains the case that the project will support air conditioning. However, it does so now by using limited GEF funds to support and enable ongoing initiatives within the Iraqi power system. This also serves to strengthen the long-term sustainability of the GEF project.

7. Solar hot water heaters cost approximately $700/unit for a 300 litre heater in Iraq, sufficient for a household of 4-5 persons. The intention was to replace electric water heaters with solar water heaters. Electric water heaters, when they are on, represent a significant portion of instantaneous electric load (a solar water heater may be 600-1,500W, depending on the model and type). Many households in Iraq do not pay for electricity, and those that do pay a few cents per kilowatt-hour (see baseline project description). The result is that payback periods for solar hot water heaters, assessed as part of the PPG, exceed the lifetime of the heaters (10 years). Thus, without a form of subsidy, solar water heaters are not cost-effective. Although end-users do pay higher prices for private diesel generation than for public electricity, work done during the PPG revealed that they pay for capacity (i.e. kW load) rather than electricity consumption. Therefore, they have no incentive to save on consumption. If their water heaters do cause them to exceed their load limits, they are typically turned off as this is easy to do and has a direct economic impact. There is no electric metering for private diesel generators; rather, they rely on rudimentary circuit-breaker switches which simply trip, disconnecting the power entirely when the paid-for load is reached. The generator operator then has to reset the switch. The result is that households are typically careful not to exceed their limits.

8. Based on interviews with stakeholders and the Ministry of Electricity, solar hot water heaters do not represent a priority. They are not thought to be a major component of demand, especially in times of high heat (mid-summer day), and therefore high electric load. Further, the heaters currently on the market can tolerate some power outage (a few hours) while still delivering hot water that has been stored in their insulated tanks. Even if power is lost for an extended period, lack of hot water is relatively well tolerated by consumers in contrast to the lack of electricity for other services. Unlike PV units, which can provide power and thus have a benefit other than strict economic savings, the only real benefit of solar water heaters to the user is to reduce cost. Given that they do not achieve this, their adoption is not likely. Therefore, based on STAP input and information gained during the PPG phase, solar water heaters have been excluded from the project design.
   From the perspective of the individual home-owner, who pays very little for electricity, neither hot-water heaters nor solar PV are cost-effective. The difference lies in three main points:

   - Utility: The only use of a hot water heater is to heat water, which is not of great value or urgency (one can easily live without a hot water heater for a few hours a day), especially in a hot climate such as Iraq. By contrast, PV panels generate electricity, which has a great many uses. It is much more difficult to live without electric power for a few hours per day in Iraq than it is to live without a hot water heater. Thus, a direct comparison on a purely economic basis is not justified as solar water heaters and PV generators satisfy different needs for the consumer.

   - Given the level of subsidies in Iraq, both solar water heaters and PV will require Government incentives (the exception is for industry, as noted below). Currently, there is a Government initiative on the promotion of solar technologies as they are seen to offer help in alleviating Iraq's power shortages. There is comparatively little being done to manage the demand-side with solar water heating. Thus, the deployment of the limited GEF funds to promote solar PV is significantly more cost-effective than deployment of GEF funds to promote solar hot water heaters because they impact the entire power

sector rather than one small component of demand (water heating), because they address a much stronger need (having electricity rather than hot water), and because they leverage existing Government support and finance for solar PV.

- Scale: while specific data are not available regarding the fraction of electricity demand that is attributable to electric water heaters, it was estimated during the PPG process to be less than a few percent of overall demand (given that AC is approximately half of demand, water heating is less than 10% of the remaining half, making it less than 5% of overall demand). It is also not a demand sector that can be expected to grow rapidly. Therefore, a focus on solar PV has the potential to have much greater impact.

From the perspective of an industrial consumer which pays US$0.10/kWh and suffers a loss of revenue because of power outages, solar power can be an attractive option today, given minimal regulatory encouragement and finance. Thus, industrial users are expected to be among the early adopters in the market and will help promote the sustainability of the market.

9. Solar PV remains costly from the perspective of the individual end-user compared with Government-subsidised electricity. However, solar PV can compete with the cost of private diesel generation. Consumers are already paying for private diesel generation. Specifics of the cost analysis are given in the following sections.

10. From the national perspective, solar PV generation costs are comparable with the cost of conventional generation technologies used in Iraq, when accounting for the opportunity cost to Iraq of burning oil and gas that could be sold on the international market.

11. There does not exist any regulatory framework to promote IPPs, and there is a marked lack of technical and regulatory knowledge concerning the development of renewable energies.

12. There is an absence of market players, which serves as an impediment to the implementation of projects.

13. There are several new initiatives within Iraq, notably those being led by the Ministry of Electricity, which seek to promote renewable energy, solar in particular, but which are stumbling for a lack of capacity and experience. In late 2012 (i.e. after PIF approval), the Ministry of Electricity created a Centre for Renewable Energy and Environment (CREE) with a mandate to promote renewable energy and a Regulatory Department with a mandate to develop new IPP legislation. CREE is staffed by two part-time personnel and the Regulatory Department by only one person. Neither has yet managed to progress on its mandate.

Based on the GEF Secretariat, STAP and GEF Council guidance, specifically to devote greater attention to policy and regulatory framework development, and informed by the findings of the project preparation phase, the project team has modified the project design to:

1. Focus solely on solar PV technology, instead of AC and water heating.

2. Give emphasis to the establishment of a regulatory environment with mechanisms – identified in the PIF – to promote investment in PV technology, such as a feed-in tariff, standard power purchase agreements, guidelines for grid connection, and a NAMA to enable the mobilisation of climate finance.

3. Develop 41.5 MW with committed financing partners, including both distributed rooftop PV and ground-mounted utility scale PV.

4. Create a capacity building programme to help support the supply-side of the market with competent solar professionals.

Original Proposal

1. Investment: Installation of 2,000 solar water heaters; design of a hybrid concept solar A/C/water heater; monitoring for one year; assessment of 5 MW PV plant, site selection and implementation of the 5 MW plant; one year of monitoring.

2. Technical Assistance: Approved and enforced revised policies and regulations, financial incentives; public dissemination of rooftop solar PV AC/water heater options; solar power market demand/industry response strategy for Iraq; technical training on solar PV technology; dissemination sessions on future IPP involvement.

3. Approximately $12.5 million total project budget.

4. Proposed $1.36 million GEF Grant for investment and $0.86 million GEF Grant for technical assistance.

Present Proposal

The project will focus only on PV solar technology to have the highest chance of achieving a sizable impact and to take advantage of nascent initiatives by the Iraqi Government and Provinces to promote solar PV technology.

The project will support the development of 5 MW of distributed solar rooftop PV within a 1,300-home housing community. The project will support PV integration into a mini-grid and connection to the national grid as a means of maximising and demonstrating the benefits of solar power. Private sector co-finance of $10 million has been mobilised for this goal from the Al Shafei Group, which will be spent on roof-top installations of PV at the Bytti housing community (Outputs 1.1-1.3 of Component 1).

The project will support MoE in the development of 36.5 MW of ground-mounted, utility-scale PV and its integration into the grid or as a stand-alone system to power off-grid communities (about 20% of the Iraqi population is not connected to the grid). Co-finance from MoE of $20 million has been mobilised for this goal: $19,050,000 will be spent directly on the development of the ground-mounted PV plants (Output 1.4-1.6 of Component 1); $850,000 will be directed towards policy and regulatory framework development (Component 2); and $50,000 will be directed towards capacity building, training and development of a sustainable market (Component 3).

The project will support the creation of a framework to promote solar PV in Iraq by:

- Supporting technical elements, such as the creation of a national solar resource map; creation of a technical grid code for connection to the national grid;
- Supporting regulatory elements: creation of an IPP law, power purchase agreements, and a feed-in tariff;
- Developing a NAMA around the feed-in tariff to help mobilise climate finance to support PV installation.

Co-finance of $3.6 million has been mobilised to support these goals from the Ministry of Electricity, the Ministry of Science and Technology, the Ministry of Environment, and UNDP.

Development of training and capacity building to help achieve the project goals (development of a total of 41.5 MW of solar PV) and to leave in place sufficient post-project solar experience to take advantage of the regulatory environment put in place by the project to develop further PV capacity.

All changes made to the project design are aligned with, and in response to, the specific review comments made by the GEF Secretariat, STAP and GEF Council. The impact on co-financing has been very significant: total co-financing at the time of CEO Endorsement is now $32,965,200, an increase of over 220% compared with the PIF co-financing estimate of $10.3 million.

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities.

In accordance with Objective 3 of the GEF Climate Change Focal Area Strategy for GEF-5, the project will promote investments in renewable energy.

A.3. The GEF Agency's comparative advantage:

The GEF Agency's comparative advantage is as detailed in the PIF. Having undertaken the PPG process, UNDP has further strengthened its ties and contacts with the relevant stakeholders.

A.4. The baseline project and the problem that it seeks to address:

The Project Document provides a detailed, illustrated and referenced description of the baseline. What follows is a summary of the content in the Project Document.

1. Approximately 80% of Iraqis are connected to the electricity grid, with over 80% of grid-supplied electricity coming from hydrocarbon-fueled power plants, almost 75% of which is crude-oil, heavy fuel oil or gasoil. A small amount, less than 20%, comes from hydropower. Iraqis have increased their demand for electricity (through population growth and increased electricity requirements in homes and offices), but the reliability of supply is inadequate and load-shedding is a common daily experience for Iraqis. Only in 2013 did the Iraqi power sector start to approach pre-1991 Gulf War supply levels, with 9,000 MW of available generation capacity. In the meantime, electricity demand has almost tripled, from some 5,100 MW in 1991 to almost 15,000 MW today. A workshop of Iraq stakeholders (UNDP-facilitated) revealed a widespread recognition that the reliability and capacity of Iraq's electricity supply have fallen in the past two decades, a finding confirmed by a recent Al Jazeera survey of Iraqis that found most experience several hours of grid outages each day. Iraq's present electricity shortages are estimated to cost it $40 billion a year, compared with Iraq's GDP of $210 billion for 2012.

2. The Iraqi power sector is owned and operated by the Iraqi Ministry of Electricity (MoE). There are three units within the Ministry of Electricity - Generation, Transmission and Distribution, responsible for generating electricity and delivering it to end-users.

3. About 50% of overall electricity demand is due to air conditioning. Iraq is one of the hottest countries in the world (with summer temperatures up to 45-50^{o}C), and summer temperatures are steadily increasing. People in Baghdad, especially, are desperate to buy, and hopefully have enough electricity to use, air conditioners, as noted frequently in media. Lack of electricity during the critical summer months affects national productivity and makes it difficult to work in the stifling heat.

4. As a result of the electricity shortages and demand for air conditioning, 90% of Iraqi households rely on some sort of diesel power generation operated by private independent operators. These independent operators erect ad-hoc distribution grids. There are an estimated 55,000 to 80,000 private diesel generators in Iraq, supplying an estimated 21 TWh, or 30% of the total electricity generated. The operators are often licensed by the local provincial council, but are otherwise poorly regulated. They contribute to chronic air and noise pollution problems, at great local health cost, but provide much-needed electricity. As a result primarily of private diesel generators, air pollution in Iraqi cities is well above World Health Organization and local guidelines. These pollutants have adverse effects on human respiratory, neurological and immune systems. In addition, as they settle or as they are spread by wind and rain, they cause acidification and pollution of water and soil.

5. The private diesel generators (who are, in effect, small-scale Independent Power Producers, IPPs), sell power to their customers based on a capacity charge ($/available kW) and not based on energy consumption ($/kWh). Figures collected during the project preparation phase indicate that prices vary widely across Iraq but tend to be in the range of $3-$8/kW per month to cover roughly a few hours of outage per day. The operating model, based on capacity charge and not usage, and a pricing structure that does not vary greatly with outage times, is reasonable for a market such as Iraq, which lacks technical tools and sophistication (e.g. use of meters) and in which fuel is often heavily subsidised, making the fuel operating cost for a diesel generator a relatively small

component of the overall cost, and making the capital expenditures for purchase, repair and overhaul proportionately more important.

6. With a high reliance on fossil fuel for power, and limited hydro resources, Iraq's average grid emission factor is 0.82 kg CO_2/kWh. With the pressure to meet electricity demand, the Government of Iraq plans to install 11 GW of simple-cycle gas turbines over the next five years. With approximately 75% of Iraq's present power generation fuel being heavy liquid fuels, and the efficiency of simple cycle gas turbines being relatively low (25-30%), the power sector contributes half of the nation's greenhouse gas emissions and 70% of the emissions from the Iraqi energy sector (i.e. GHG emissions from the power sector are more than double those from the oil sector).

7. With electricity shortages, significant unused land area, abundant solar resources, a large summer day-time peak load corresponding to the use of air-conditioning, and considerable losses in transmission and distribution, solar power appears ideally suited for Iraq. Iraq receives over 3,000 hours of bright sunshine per year, making it one of the sunniest places on Earth. Iraq also enjoys clear skies and relatively low degrees of cloud cover, making solar energy a predictable energy source with relatively low fluctuations compared with other regions. Iraq's average solar insolation of 5.1 kWh/m2/day is 70% higher than that of Germany, the present leader in solar installations. Moreover, the cost of solar energy equipment on international markets continues to fall rapidly. Solar modules today cost only a tenth of what they did in 1990. The price of oil, by contrast, has multiplied approximately six-fold, from $17/barrel in 1990 to $110/barrel today.

8. The modular nature of solar energy (solar power systems can be deployed from a few watts to several hundreds of megawatts), and the opportunity to develop distributed generation systems with minimal dependencies on existing infrastructure and institutional processes while having significant potential to feed back into the electricity grid during peak load periods, make solar a compelling electricity source in Iraq. In most power systems, the generation capacity needed is 50-100% more than the average load in order to cope with periods of peak demand. In the case of Iraq, where generation capacity is insufficient to meet peak demand, the reduction of peak demand provides immediate relief to the power system and helps the Government of Iraq more quickly address power outages. Solar power can in general be deployed much more quickly than conventional thermal plants, which take several years to construct. During times of peak demand, the transmission and distribution losses in Iraq are approximately one-third, meaning that for each kilowatt-hour of demand, 1.5 kilowatt-hours must be generated. By producing electricity near consumers (i.e. 'distributed generation'), solar power avoids much of the transmission and distribution losses, with the result that each kilowatt-hour of solar generated can relieve the generation and transmission system of having to generate and transmit 1.5 kilowatt-hours. In addition, there is significant opportunity for private-sector deployment in the solar power sector, especially given the expected increasing consumer demand for solar-powered appliances and given the construction of 'model' towns (for example, near Najaf, south of Baghdad), where the intention of developers is to remain non-reliant on the grid, ensure a reliable supply of electricity, and develop cost-recovery mechanisms that will support the initial investments (including selling electricity back to the grid).

9. The real cost of power generation in Iraq is calculated to be between $0.08/kWh for the most efficient Combined Cycle Gas Turbine (CCGT) power plants operating on natural gas and $0.22/kWh for gas or steam turbines running on gasoil or crude oil, and large diesel engines. At these prices, the use of solar energy can be cost-effective from a national perspective since the levelised costs of solar power are estimated to be in the range of US$0.10/kWh to US$0.16/kWh, depending on the initial cost and the cost of capital.

10. Part of the difficulty in the adoption of solar power remains the fact that Government subsidies suppress public electricity prices to artificially low levels. As a result, consumer electricity prices are rather low, ranging from 0.8 US cents/kWh for consumption up to 1,000 kWh/month, to 4 US cents/kWh for consumption over 4,000 kWh/month. Often, consumers do not pay any bills at all; after protests, Iraqis are now formally exempt from payment for the first 1,000 kWh per month of usage.

11. Compared with this diesel-based electricity price, solar power generation is competitive, provided a source of financing is available to offset the large initial cost of solar in comparison with a diesel engine. In addition, there are specific consumers, such as industrial consumers, for whom the official grid tariff is sufficiently high – US$0.10/kWh – and sufficiently enforced to make solar power price-competitive.

12. With the price of solar energy equipment having fallen considerably and the price of fossil fuels having continued to rise (in addition to specific incentives for solar power in certain countries), global solar capacity doubled every two years between 2004-2012, reaching over 100 GW today, and is set to double again by 2015. Despite Iraq's considerable solar resources and electricity shortfall, solar energy has not been adopted because of a set of barriers, specifically: Government subsidies for fossil fuels and electric power, lack of infrastructure and legislative framework to promote solar power, and lack of technical capacity. The GEF project is designed to address each of these barriers to catalyse the development of solar power in Iraq.

13. Iraq has made some initial ventures into solar power use. Baghdad, Basra, Fallujah, Kharma and Sakalaweyah installed some 1,500 street lights in 2007/2008. In addition, the Iraqi Ministry of Electricity (Modern Lighting Directorate) has installed some 5,000 solar-powered street lights in Baghdad.

14. Inquiries performed during project preparation have shown that, despite initial enthusiasm, the solar lighting programme was not the success that was initially hoped. Many of the batteries did not last, in part due to the extreme operating temperatures. The programme lacked coordination, follow-up and documentation to assess and demonstrate the benefits received from solar lighting, and as a result did not succeed in replicating installations throughout Iraq.

15. Iraq has also made forays into various other solar applications, though none has proved sustainable. The Ministry of Municipalities and Public Works (MoMPW) has installed 700 PV-powered water purification stations, of capacities between 1-5 m^3 per hour, in remote areas nationwide. The initiative has not proved sustainable, however, with the principal challenge encountered being a lack of expertise for installation, operation and maintenance, exacerbated by the remote locations of the stations. The Ministry of Water Resources (MoWR) has installed small (6-15 litres per second) solar-powered pumping units in remote areas of Iraq. From the perspective of MoWR, a significant limitation was the difficulty of scaling-up such solar-powered pumping to the large-scale pumps needed to supply large areas of irrigated land.

16. The pioneering Bytti Complex is a 50 hectare, 1,300 home 'New Town' development in the western Iraqi province of Najaf. The developer, Al Shafei, markets the use of solar power as one of the selling points of the project. Al Shafei intends to install a total of 5 MW of solar power, which will produce an estimated 7.5 million kilowatt-hours of electricity per year, or approximately one-quarter of Bytti's estimated annual consumption. A distributed installation of this size in a development such as Bytti offers significant opportunities to maximise the potential of the solar units through good engineering – for example, to reduce reliance on the grid, to feed into the grid if production exceeds consumption, and to use the solar units on each house to feed loads within the compound and allow exchange of energy between houses, such that the panels on an empty home with no load can be used to power another home that is consuming more than it is producing. The residential installations will also be designed to operate when the grid is not functioning and this is a key contribution of the UNDP-implemented, GEF-financed project. In the absence of the designs and technical assistance to be facilitated by the project, the solar units would not generate when the grid is not functioning and would therefore be of considerably less use. Under the baseline design, the Bytti community would be able to disconnect from the grid when the grid is not functioning and provide its own power through a diesel generator. The UNDP-implemented, GEF-financed project will allow rooftop PV power to continue to be generated on the complex's mini-grid, thereby facilitating a solar/diesel hybrid system. This is attractive to the Bytti developer as it reduces its reliance on diesel, and reduces air and noise pollution within the Bytti complex. It also increases the value of residents' properties.

17. Al Shafei has already installed groups of panels to test the solar output in order to select the most appropriate modules and better anticipate the output energy that will be achieved in practical operation under the prevalent conditions. Full installation of household PV systems is expected to commence in late 2014.

18. The Iraqi Government has had two major studies conducted relating to the energy and electricity sector: the Iraq National Energy Strategy (NES, 2012) by Booz and Co., and the Iraq Electricity Master Plan (EMP, 2010) by Parsons Brinkerhoff. The NES was initiated by the Prime Minister's Advisory Council (PMAC) and supervised by a project steering committee comprised of selected PMAC members as well as senior representatives from Iraq's Ministry of Oil, Ministry of Electricity, Ministry of Industry and Minerals, Ministry of Finance, Ministry of Planning, Ministry of Environment and Ministry of Water Resources. The EMP was financed by the US State Department and executed under the supervision of the US State Department's Iraq Transition Assistance Office. The project steering committee was comprised of representatives from Parsons Brinkerhoff, the Iraq Transition Assistance Office and the Iraq MoE. The NES and EMP together represent a concerted effort on the part of the Government to prepare a strategy and executable action plan with short-, medium- and long-term goals to address Iraq's energy needs and provide the resources and infrastructure needed for Iraq's social and economic development.

19. The EMP notes that:
    - Existing capacity is much less than installed nameplate capacity due to plant de-rating and high operating temperatures (which reduce plant output).
    - Not all capacity is available due to maintenance and forecast outages.
    - Hydro capacity is reduced due to water shortages and unit outages.
    - Pumped storage is not used at peak times as is it not worthwhile with the present generation shortages.

20. To address Iraq's electricity shortages, the EMP details Iraq's short-term target of installing 13 GW of power over five years with specific power generation additions.

21. The NES prescribes a national power system expansion to include renewable energy generation entering into the power generation mix in 2014, and contributing 5% of total capacity by 2030. It estimates that wind and solar can contribute 1.2 GW to Iraqi power generation by 2025.

22. The NES calls for a focus on developing Iraq's generation, transmission and distribution capacity in the short-term, reaching an acceptable level of supply reliability by 2016. Thereafter, Iraq will embark on a programme of tariff reform and demand-side management measures. These measures include: building and energy efficiency codes, load control, district cooling in high-density areas, replacing electricity with gas use (for example, in kitchens), and solar water heating.

23. Iraq's NES places particular emphasis on the development of solar power to supply Iraq's off-grid power requirements in the near-future as an alternative to diesel, and to help supply on-grid demand in the medium- and long-term. This is in contrast with the 2010 EMP, which does not mention renewable resources at all. The contrast illustrates the shift in thinking, and the developments taking place, within Iraq. Whereas four years ago renewable energy was not even considered as a component of the national energy strategy, it has now evolved into a significant element and one that has led MoE to establish an initiative to develop 16 on- and off-grid solar power plants distributed throughout Iraq, with a total capacity of 36.5 MW. Five of these plants are to be hybrid solar-wind plants.

24. MoE has also taken the important institutional step of creating a Centre for Renewable Energy and Environment (CREE), which will be responsible for the development of renewable energies in Iraq. The Centre is in its infancy with only two staff members, but already it has been responsible for MoE's initiative relating to the 16 solar plants. Moreover, the Regulatory Department has recently been established with the mandate to establish a regulatory framework to support private-sector power generation, through instruments such as power purchase agreements, feed-in tariffs and net-metering.

25. The Renewable Energy Research Centre (RERC) at the University of Anbar is the most active research institution in solar and renewable energy in Iraq. Several projects have been undertaken at RERC, including: design and analysis of intelligent fault-tolerant controllers for transmission line systems based on solar energy

injection; design and implementation of computerized solar cell testers; remote data acquisition from weather stations based on solar energy systems; and automatic irrigation systems using solar energy in remote areas. Of particular importance to the GEF project are RERC's efforts at developing a solar resource map for Iraq. To this end, RERC has installed a solar measurement station in the city of Ramadi capable of tracking the sun and measuring direct and diffuse solar radiation.

26. The Ministry of Science and Technology's (MoST) Renewable Energy Research Directorate has a number of initiatives underway to study solar equipment in Iraq. Amongst these, as examples, MoST has studied deep-cycle AGM batteries for solar street lighting, the use of mono- and poly-crystalline silicon cell efficiencies in Iraqi conditions, hybridization of solar and wind power, collaboration with RERC on the development of a solar atlas for Iraq, and development of a modular solar 'generator' unit of 1 kW, which can be deployed in remote locations. The Renewable Energy Research Directorate also investigates the use of solar energy for specific applications, for example for schools (which operate during the day, and hence can cover very large percentages of their power needs through solar energy). Other specific applications investigated include water pumping, street lighting, drip irrigation and remote off-grid power.

27. Al Mansour Company, owned by the Ministry of Industry (MoI), installs solar power systems and manufactures solar equipment but is focused mainly on manufacturing. It assembles solar modules from imported components and laminates solar cells with appropriate backing and wiring into modules. As a Government-owned company, Al Mansour's focus is on promoting and localising technology rather than generating immediate profit.

BAU cost-effectiveness compared with traditional approaches

28. Solar PV power is presently the most attractive form of renewable energy in Iraq, both because of the abundant solar resource and the modularity of solar PV technology. The cost of PV systems has come down, and the cost of fossil fuels has correspondingly increased to where the difference between the unsubsidised, levelised cost of electricity from the two is no longer as prohibitive as it once was. The table below presents the levelised cost of electricity from PV in Iraq for various assumptions of capital cost.

Levelised cost of electricity from PV over 25-year lifetime

Capital cost per installed kW ($/kW)	1,800	2,000	2,200	2,500	3,000
Levelised cost ($/kWh)	0.11	0.12	0.13	0.15	0.18

29. The figures in the table assume annual generation of 1,500 kWh/kWp installed, based on inputs from Anbar University and MoST. This translates as a capacity factor of 17%, which is very conservative. The calculation uses an interest rate of 6%, as published by the Iraqi Central Bank and as used by MoE for evaluation of its power generation investments and the value used in the Integrated National Energy Strategy. The levelised costs calculated above are consistent with those estimated by UNIDO[4] ($0.08-0.3/kWh), and competitive with the levelised costs of diesel and other generation technologies as provided by the IEA[5] ($0.08-0.22/kWh for diesel, $0.08-0.21/kWh for heavy fuel oil).

30. Compared with the real cost of electric power generation from other sources, in the region of $0.08-$0.22/kWh, solar PV is competitive. Once a nucleus of technological capability and appropriate regulation is created, solar technology can well be expected to be self-sustaining.

31. Industrial consumers presently pay a tariff of $0.10/kWh. This indicates that, with minimal incentives, they could be attracted to solar power. Private residents pay a fixed capacity charge of $3-$8/kW/month, roughly $0.05-$0.13/kWh. These tariffs indicate that the market is prepared to pay costs comparable to solar power generation costs, if the ease of access to solar energy is available.

[4] UNIDO (2012), *Global Assessment and Key Recommendations for Development of the Solar Energy Sector in Iraq.*
[5] IEA (2012), *Iraq Energy Outlook.*

32. Although PV may be close to competitive on the basis of levelised cost, it remains capital-intensive. Therefore, some means of financing will be required to make the adoption of solar power truly sustainable. In the early phases, the presently committed co-financiers (principally, Al Shafei and MoE) will provide the required capital for implementation of their systems. Nevertheless, on a life-cycle basis, solar is becoming competitive with diesel generation, in particular small diesel generation. This fact opens the door for private-sector financing by providing an attractive investment which needs capital to be mobilised. In the presence of an appropriate regulatory environment that serves to de-risk these investment opportunities, this will result in direct capital investment[6]. The provinces each have Investment Boards that are willing and capable of providing financing for proven project concepts, as evidenced by the Najaf Investment Board's support of the Al Shafei project.

A.5. 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) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

The incremental GEF Trust Fund activities (funding $2.227 million) will lead to over $32 million in direct co-financing from public and private entities, and will mobilise more in enabled projects.

The project, in conjunction with the Ministry of Electricity, the Ministry of Environment and Najaf Province, will enable the establishment 41.5 MW of solar PV installations.

Of the GEF financing for Outcome 1 (US$700,000), US$250,000 has been allocated to support the development of 5 MW of distributed solar PV within the grid-connected Bytti development. The GEF support will enable the project to develop an advanced power system which provides reliable power to its consumers, at minimum cost and with minimum CO_2 emissions. Outcome 1 will also support the MoE in its initiative to establish 16 PV power plants, ranging from 1.5 MW to 6 MW, around the country. These represent a total of 36.5 MW in aggregate, and a mobilisation of $200 million of co-finance against the GEF's $700,000 contribution. The $200 million co-finance represents a direct investment by the Government of Iraq in the development of solar energy. The $200 million had been allocated in the previous year's budget but could not be spent due a lack of technical capacity. The UNDP-implemented, GEF-financed project will provide the technical capacity to mobilise this Government investment and to put in place mechanisms to capture lessons-learned and replicate the projects. Only $20 million has been counted as co-finance so as to be (highly) conservative; additional financing will be reported as leveraged finance in the project's annual Project Implementation Reports (PIRs). Outcome 1 will enable the Ministry of Electricity to construct PV plants for which they presently have resources but lack expertise. Further, the GEF funding will help support the optimal design and operation of these plants, resulting in the highest electricity production achievable and, therefore, the greatest reduction in greenhouse gas emissions. In the absence of GEF support, it is likely that the plants will be considerably delayed, as they already have been. When constructed, it is likely that the plants would suffer sub-optimal performance, as there has not thus far been consideration of performance monitoring factors to inform future developments. Therefore, the relatively small GEF funding will catalyse a large deployment of renewable generation capacity and effective utilisation of that capacity, resulting in a very cost-effective reduction of greenhouse gas emissions.

The GEF financing for Outcome 2 consists of grants for technical assistance, which will support the further development of regulations, a solar map, technical requirements for grid connection, and development of a NAMA to support solar energy in Iraq. Together, these initiatives are expected to foster a regulatory environment for attracting investments for privately-owned, grid-connected renewable energy power generation and for facilitating effective monitoring, quality control and dissemination of the results of the RE investments made. The support for the activities of Outcome 2 creates an overall environment for development of solar power generation capacity. These activities mobilise $3.5 million against the GEF's investment of $1.2 million. The deployment of GEF funds is cost-effective because undertaking such work in Iraq is extremely difficult and costly. By mobilising and strengthening existing ideas and objectives within the Iraqi Government, the project makes it both more likely that the objectives will be achieved and that they will be achieved at a cost much lower than if they were initiated through other means.

[6] UNDP (2013), *De-Risking Renewable Energy Investment*. www.undp.org/drei

The GEF financing for Outcome 3 consists of technical assistance that will support the development of market capacity through training, workshops and dissemination of information. This is a critical component of the advancement of solar energy in Iraq and development of a functional marketplace. The creation of a cadre of personnel who are able to make a living out of solar energy, a regulatory environment that creates incentives for solar energy, and the declining prices of solar equipment will combine to create a sustainable market and sustainable source of supply. Organising existing efforts to function in concert, as is proposed, can only be achieved through the deployment of a national-level project such as the GEF-funded project. As with Outcome 2, the cost of achieving similar results through means that do not utilise existing structures would be considerably higher.

The proposed activities will: i) demonstrate the utility of PV systems, ii) put in place a regulatory framework that encourages the installation of PV systems; and iii) create a base of skilled PV workers capable of installing and servicing PV systems. These factors together will contribute to a sustainable home solar PV market. The demand for solar power exists, as evidenced by Al Shafei's initiative to install it in its Bytti housing development. By providing an appropriate national regulatory framework and enabling – through capacity building – the implementation of PV systems, the project will promote the diffusion of PV take-up after project completion.

In total, the activities of the UNDP-implemented, GEF-financed project combine to mobilise considerable co-financing and enable future investments that would be very difficult to achieve through a less comprehensive programme. The project builds on ambitious but sub-optimal baseline initiatives, augmenting them with GEF funds to provide enabling support and expertise and thereby making the use of GEF funds very cost-effective with regard to the reduction of greenhouse gas emissions.

A.6 Risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and measures that address these risks:

Risk	Level	Mitigation
Security Risk	Medium / High	Much of the work with counterparties will be conducted within the Green Zone, a secure area in Baghdad. Security convoys are available, though expensive, for travel outside of the Green Zone. The project will seek to maximise training for locals and use of local support for on-site activities. Despite the current situation in Iraq, the Government of Iraq is still fully functioning. The UNDP Country Office is communicating with the Ministries of Electricity, Science and Technology, and Environment on a daily basis. For example, the project team in the Country Office has been in discussions with MoST regarding the specification of solar PV panels. The NAMA Focal Point in the Ministry of Environment is preparing for the NAMA registration process (with the UNFCCC Secretariat NAMA Registry team). Al Mansour, the Government-owned PV module manufacturer, announced on July 4th that it is establishing a new PV assembly line. Najaf, the province in which the Bytti residential baseline project is located, is unaffected by the current security situation. Mr. Saad Alshafey, CEO of Alshafey Group, confirms that the situation in Najaf is stable and the business environment is unaffected. Najaf Airport continues to operate as usual. Thus, the indications are that, despite the current situation, most enterprises and Government facilities are proceeding with business as usual.
Political Risk	Medium	Policy reform and decision-making in Iraq can be slow. UNDP will rely on its close relations with MoEn, MoE and other counterparts built up through several past and ongoing joint projects. Through close participation, UNDP will aim to spur action. Iraq's urgent need for electric power means that policy-makers are under pressure to produce solutions to the electricity problem.
Iraqi private sector is slow to take up solar power business opportunities	Medium	The GEF project includes specific capacity building and market development components to help encourage participation in the market and minimise risk for market participants.

Risk	Level	Mitigation
Ministries of Electricity and Finance are slow to adapt policies and financial incentives to spur the solar power industry in Iraq	Medium	This may reflect the current, generally slow, pace of policy reform and decision-making in Iraq. It is believed that, as consumers and the private sector show increasing interest in solar PV technologies, growing pressure will spur policy reform. The involvement of several well-financed developers and the regional government of Najaf Province in the project, and their exposure to the opportunities presented by the project results, will also help significantly. Co-financing already committed guarantees a minimum level of activity in solar energy during the project years. Thereafter, the benefits of solar should be sufficiently well demonstrated to encourage Government action.
Low public awareness of solar power options regarding rooftop units	Low	The project includes significant capacity building and outreach components to help overcome this risk. The project will use the individuals trained to implement power installations and maintenance under the project, thereby providing immediate use for the knowledge they have acquired and providing them with immediate income opportunities.
Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures	Low	Close cooperation with the main participants in the local solar market and MoE to obtain the required data will be emphasised.
Limited engagement to date with the international climate change community	Low	With MoEN as the national counterpart for the project, a focus will be given to NAMA development. This is one area where the use of experienced consultants can make a significant impact without complete reliance on local resources and other complex factors (transport, security, etc.). MoEN is keen to proceed with NAMA development and has already instructed the UNFCCC Secretariat to upload the NAMA to be developed under the GEF project to the NAMA Registry.
Climate Risk	Low	Climate change is not expected to dramatically alter the output from solar installations. Ever-warmer summers are, however, expected to increase the demand for air conditioning (and hence electricity loads), emphasising the importance of deploying an energy source – solar – that is plentiful and whose supply corresponds closely with peak demand. In the design and installation of solar systems, adequate emphasis needs to be placed on the systems' ability to survive extreme weather conditions (such as temperature and dust storms) at a level that may have not been typically observed before. Such thinking will be incorporated into all stages of project design and implementation. Prediction of PV outputs under local conditions and selection of appropriate technologies are explicit activities within the project.

A.7. Coordination with other relevant GEF financed initiatives

Iraq has received one national GEF grant of $368,363 in the Biodiversity focal area. Iraq has also has had a PIF approved with GEF contribution of $1,230,360, in Biodiversity. Iraq is also the recipient of financing through a regional project in the focal area of Land Degradation. This is Iraq's first Climate Change GEF project.

There is no obvious coordination between the project and other GEF-financed initiatives unless the situation arises where one of the proposed solar projects will interact with land intended for one of the other GEF projects. This will be monitored during project implementation.

B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:

B.1 Describe how the stakeholders will be engaged in project implementation.

UNDP is the implementing agency for this project and will be accountable for the GEF grant. Other key stakeholders and co-financiers in the project are described below.

Key stakeholder	Role in the project:
Ministry of	The Ministry of Environment (MoEn) is the principal Government body concerned with greenhouse

Environment	gas mitigation and the reduction of other pollutants, such as particulate emissions from diesel generators. The Ministry of Environment is the Focal Point for the UNFCCC and is in the process of writing the Initial National Communication (supported by UNDP and UNEP). The Ministry has identified renewable energy as the focus for mitigation efforts. The Ministry will be the Focal Point for this project and will be responsible for collecting the monitoring data from the various project pilots and packaging that information for public dissemination. The Ministry will be involved in public awareness campaigns regarding the benefits of solar power. The Ministry will also help with discussions and coordination for the required policy and regulatory reforms to spur the development and growth of the solar power industry in Iraq. The Ministry of Environment will also lead the Nationally Appropriate Mitigation Action (NAMA) elements of the project.
Ministry of Electricity	Within MoE, there are two recently established entities: the Centre for Renewable Energy and Environment (CREE) and the Regulatory Office. Both entities were established in 2012 and form part of the institutional apparatus that MoE is currently assembling in preparation for a greater future role for both renewable energy and IPPs. Both institutions are currently small: CREE has two part-time employees and the Regulatory Office has one. CREE is tasked with the promotion of renewable energies, including supporting initiatives, such as feed-in tariffs, net-metering, tax exemptions, etc. The Regulatory Office is tasked with developing the regulatory framework required for the evolution of the power sector in Iraq, both renewable and conventional. This includes, for example, preparing regulations for private power generation, grid access, licensing, power purchase agreements and the format for price determination (whether public tender, fixed price, etc.). Together, CREE and the Regulatory Office represent a nascent platform for providing the incentives and regulations needed to promote renewable energy. They will be significant stakeholders in the GEF project and the recipients of significant technical assistance. As part of the GEF project, MoE will be directly involved in the development of 16 solar power plants, with a total capacity of 36.5 MW, with total budget of $200 million, including grid materials, upgrades, etc. Of this $200 million, $20 million has been included as co-finance, as a conservative estimate of the Ministry's support to the GEF project. These utility-scale PV plants, through operational monitoring, will also form the basis for lessons-learned and capacity development to be applied to future plants.
Ministry of Science and Technology	The Ministry of Science and Technology (MoST) is already engaged in a number of initiatives involving solar energy. In the context of the GEF project, MoST will be involved in the technology selection process and will therefore have the opportunity to contribute some of the experience it has acquired to date as well as further develop its capacity and that of other stakeholders. MoE has already requested MoST support for site selection and basic planning for three sites of the 16 that MoE intends to use for solar power development. Since 2006, MoST has been actively examining solar energy applications that suit Iraqi conditions (for example, experimentation with solar-tracking PV panels, and with various solar-powered applications). MoST has also examined a range of rooftop units to be used to generate power for household consumption, and also to feed to the grid. MoST is the Iraq focal point for the International Renewable Energy Agency, IRENA. Because of its previous work, MoST is one of the entities best positioned to advise on the practicalities of operating solar equipment in the heat and dust of Iraq.
Anbar University Renewable Energy Research Centre	Anbar University's Renewable Energy Research Centre (RERC) is the most active academic centre in the field of renewable energy in Iraq. There is a history of cooperation between RERC and MoST on various research projects. Anbar University's RERC was established as part of a cooperation project with UNDP in which the University provided space, facilities and personnel to support the Research Centre, and UNDP provided technical assistance and equipment (solar and wind testing equipment to date, as well as reference materials). A principal focus of effort at present is the development of a solar radiation atlas for Iraq, in cooperation with MoST. RERC is a recipient of technical assistance for solar mapping under the GEF project. It is also an important participant in the capacity building component of the GEF project to encourage replication throughout Iraq of the solar plants installed under the project.
Al Shafei Group, developer of the Bytti project	Al Shafei is a private-sector conglomerate that is developing the Bytti Complex, a 1,300 home community that will incorporate 5 MW of distributed (small-scale, roof-top), grid-connected PV solar power. As such, Bytti will become the first community in Iraq with solar power. Supported by Najaf Investment Board, Al Shafei is promoting the Bytti complex as part of its efforts to present housing there as both 'green' and as having reliable power free from the adverse effects of diesel generators

	that plague much of Iraq. Al Shafei is providing $10 million of co-finance to support the installation of 5 MW of PV capacity. The PV will be connected to the Bytti mini-grid through the aid of the GEF project and will be a demonstration for connection to the national grid, and will help establish the rules and regulations for such connection. The involvement of the Najaf Investment Board is an important element of replicating such projects elsewhere.
Ministry of Industry and Minerals	The Ministry of Industry and Minerals, through its wholly-owned Al Mansour Co., is working to promote localisation of manufacture of PV equipment and balance-of-plant materials. Al Mansour Co, already manufactures or assembles certain equipment or elements, but struggles as demand is very limited. The Ministry of Industry and Minerals will provide $50,000 of co-finance to support the use of some of Al Mansour's equipment, as a demonstration, on the Al Shafei project. With its success, Al Mansour will build a track record and knowledge, and will pave the way for localisation that will reduce costs and risks associated with PV systems.

B.2 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):

The project will aim to achieve the following socio-economic benefits:

1. Helping to provide reliable electricity: the implementation of renewable energy technologies will help to provide reliable electricity to enable development. The lack of reliable electricity is major impediument to the development of the Iraqi economy, costing it some $40 billion a year. Power outages of several hours a day are common in most provinces. By helping to provide reliable electricity, the project will enable various facets of civil life, including commerce, education and healthcare. Among the documented problems in Iraq associated with lack of electricity, for example, are patients not being able to receive medical treatment or access hospital floors because of lack of power to elevators.

2. Iraq is one of the hottest countries in the world and has a very unreliable electricity supply in many parts of the country (as noted previously). Even where air conditioners are installed, they may not be operable during the hottest times of the day due to load-shedding. This has a crippling effect on human productivity, especially for women and children who are disproportionately confined to their homes throughout the day. With improved access to air conditioning and reliable operation in only (conservatively) one million homes and small office buildings, with a multiplier of 4-5 persons for each unit, this would improve the comfort and productivity of about 20% of the Iraqi population, which would undoubtedly have a positive effect on the economy of the country.

3. Creation of green jobs: The project includes a capacity building component to help establish a cadre of professionals with solar PV experience and incentive to promote the technology. This will both catalyse the further adoption of renewable energy and provide these workers with new sources of livelihoods that are likely to be in significant demand and thus can contribute to an increase in their standard of living. The 41.5 MW to be installed by the project will require an estimated 700 personnel to build. They will also require ongoing maintenance from about 80 personnel. In total, it is expected that the project will directly train over 1,000 individuals in technical aspects, with an additional several hundred in market and regulatory aspects.

4. Creation of a local solar industry: While it is unlikely that panels will be competitively manufactured in Iraq, there are a significant number of components that can be manufactured locally, such as the mounting structures and cables (which together account for around some 20% of the total cost and 40% of the shipping costs if purchased from outside Iraq and imported). These will both help to reduce the cost and difficulty of obtaining solar equipment in Iraq as well as creating further jobs.

5. The diesel generators presently used in much of the country cause significant noise and air pollution. Pollutants associated with diesel, including particulates, sulphur and lead, are many multiples, sometimes ten times or more, the World Health Organisation guidelines. By reducing the reliance on diesel, living circumstnaces can be greatly improved. The reduced pollution will, in turn, lead to reduced health problems and greater productivity for the community.

6. The use of renewable energy should enable a reduction in the amount of funds diverted to subsidies, thereby freeing up Government funds for socio-economic development programmes. The equipment installed as a direct result of the project, over its lifetime, is expected to save some $200 million in subsidies and opportunity costs.[7]

B.3. Explain how cost-effectiveness is reflected in the project design:

The project aims to enable and encourage the development of solar energy in Iraq. The $2.2 million GEF investment will enable a further $32,965,200 in direct co-financing. The project will result in direct emissions reductions of 741,622 tonnes CO_2, resulting in a low cost of emission reduction of GEF$3/tonne CO_2 avoided.

The project also aims to reduce greenhouse gases:

Direct Emissions Reduction	741,622 tCO_2-eq
Indirect Emissions Reduction (top-down)	5.9 $MtCO_2$-eq
Indirect Emission Reductions (bottom-up)	2.966 $MtCO_2$-eq

A. Direct Emission Reductions
The direct emissions reductions are calculated based on the following formula and assumptions:

$CO_{2direct}$ = E * L * C; where

- C – CO_2 emission factor, i.e. 0.688 tCO_2-eq/MWh for grid electricity
- L – average useful lifetime of investments, i.e. 20 years; and
- E – annual energy production equal to the product of 20 years

The calculation is presented in three steps:

- Calculation of an emissions factor for electricity displaced by project electricity.
- Calculation of the electricity generated by the project, according to GEF Guidelines.
- Calculation of GHG emissions avoided.

At each step, the most conservative assumptions are used.

Step 1:
The present grid emission factor for Iraq is 0.82kgCO_2/kWh, (0.82 tonne CO_2/MWh).[8]

According to the Integrated National Energy Strategy, Iraq aims to generate 83% of its power from natural gas by 2030, and 5% from renewables.

Source	Fraction of Generation in 2030	Emission Factor (kg CO_2/kWh)	Weighted emissions factor
Natural Gas	0.83	0.499	0.41417
Oil	0.12	0.82	0.0984
Renewables	0.05	0	0

[7] The capacity installed by the project is expected to generate 1,454,000 MWh of electricity over the 20-year lifetime used by GEF for emission reduction calculations. According to the IEA, the real cost of generation for a megawatt-hour from petroleum-based fuels (the most common fuel in Iraq) is between US$200/MWh and US$220/MWh (Figure 7 in the UNDP Project Document). If US$200/MWh is used conservatively, multiplying the savings by the expected energy generation results in savings of US$290,832,000. This is conservatively stated as US$200 million, also to account for the fact that PV will not avoid all costs associated with generation, but will mostly avoid fuel and O&M costs, which are typically 70% of the total cost.
[8] Ecometrica (2011), *Electricity-Specific Emission Factors for Grid Electricity*, p.6.

Iraq Emission Factor 2030 ($kgCO_2/kWh$)	0.51257

2030 is the last year for which data are available. Given that most power generation by that time is expected to be from natural gas, there is no significant room for future reduction in the grid emission factor in the years 2030-2035. Therefore, the 2030 value has been used in the calculations for the period 2030-2035. Any lack of accuracy in these assumptions is more than compensated by the other conservative assumptions adopted, such as assuming no losses in the transmission grid, and applying the grid emission factor to all power generation, even though some will be off-grid with a much higher emission factor (0.82 $kgCO_2/kWh$).

If we assume Iraq progresses linearly from the present to its future (2030) emission factor, then the average emission factor over the project period is 0.67 kg CO_2/kWh.

According to UNFCCC Guidelines, emission factors for off-grid diesel generation range from 0.8 kg CO_2/kWh to 2.4 kg CO_2/kWh, depending on the size of the diesel generator and operating conditions.[9] In order to maintain conservativeness in the GHG emission reduction calculations, the on-grid emission factor has been used to calculate emissions reductions for all generation capacity.

Step 2:
Using a 20-year lifespan for PV equipment, in accordance with GEF guidelines, and a capacity factor of 20%, the 41.5 MW installed as a direct result of the GEF Project will produce 1.45 TWh.

Step 3:
Multiplying the average grid emission factor by the calculated energy generated from solar power as a result of the GEF project, the avoided greenhouse gas emissions are 741,622 tonnes CO_2.

Conservativeness of the approach:
The approach above is conservative as it does not account for any grid losses, which in Iraq amount to 30-50% of the generated electricity. It also assumes that all plants are displacing grid electricity, which has a lower emissions factor than off-grid diesel generation.

B. Direct Post-project Emission Reductions
Since no explicit mechanism is included in the project, the direct post-project emissions reductions are not included in the project emissions reduction calculations, as per GEF Guidelines.

C. Indirect Emission Reductions (bottom-up)
The GEF guidelines provide a formula for bottom-up emissions assessment as:

CO_2 indirect BU = CO2 direct * RF

where RF is a Replication Factor. The GEF guidelines estimate a default RF of 2 for solar PV projects. For the project at hand, we estimate a default replication factor of 4 for the following reasons:

1. The GEF guidelines for renewable energy are based on 2008 figures, when PV was far less competitive with alternatives. Today, solar installations are proliferating, in many cases without direct government intervention (or as a result of previous interventions). The price of solar energy today is less than a fifth of what it was in 2008 and further reductions can still be expected;

2. The solar resource in Iraq means that the same solar energy equipment installed in Iraq will produce considerably more energy that in Europe, for example.

[9] UNFCCC, Appendix B of the Simplified Modalities and Procedures for Small Scale (up to 15 MW) CDM Project Activities.

3. The power shortages in Iraq provide an additional incentive to seek alternative power sources.

For these reasons, a Replication Factor of 4 even seems conservative when taking into account this context.

With a replication factor of 4, the bottom-up indirect emissions are 2,966,488 tonnes CO_2 over the 10-year post-project period.

D. Indirect Emission Reductions (top-down)

The targeted potential for renewable energy in Iraq is 5% of generation capacity by 2030, generating some 2.9 TWh/year. Using the calculated average grid emission factor of 0.51 $kgCO_2/kWh$, taking into account the planned dynamic developments in the power generation system, the emissions reductions can be estimated at 14,790,000 tCO_2 in a ten-year period post-project, as per the GEF methodology.

Applying a conservative GEF Causality Factor of 40%, corresponding to Level 2 ("the GEF contribution is modest, and substation indirect emission reduction can be attributed to the baseline"), indirect emissions reduction by the project is 5.9 million tonnes CO_2 in the 10-year period post-project.

If a Level 3 Causality Factor ("the GEF contribution is substantial, but modest indirect emission reductions can be attributed to the baseline") is applied, then 60% of the indirect emissions can be attributed to the GEF project, or 8.9 million tonnes CO_2 in the 10-year period post-project.

To provide a more conservative estimate, the value of 5.9 million tonnes CO_2 has been reported in the GEF Tracking Tool.

C. DESCRIBE THE BUDGETED M &E PLAN:

The project will be directly implemented (DIM) by UNDP on behalf of the Government of Iraq. UNDP, in close cooperation with the Ministry of Environment, will take overall responsibility for the project implementation, and the timely and verifiable attainment of project objectives and outcomes. The Ministry of Environment will nominate a high-level official as a UNDP Focal Point, who will provide the Government oversight and guidance to project implementation. A Project Steering Committee will be established at the inception of the project to monitor project progress, to guide project implementation and to support the project in achieving its listed outputs and outcomes. It will be chaired by UNDP and will include the Ministry of Environment, the Ministry of Electricity, the Ministry of Finance, the Prime Minister's Advisory Committee (PMAC) and representatives from the main academic and private-sector stakeholders. As the UNFCCC, GEF and NAMA Focal Point, the Ministry of Environment will be the Government agency with overall responsibility for the project. Operationally, the Ministry of Environment will take the lead on development of the feed-in tariff and the associated NAMA; the Ministry of Electricity will take the lead on utility-scale PV investments; the Ministry of Science & Technology and the Ministry of Electricity will take the co-lead on activities relating to installation of PV systems in the Bytti residential complex.

The project will be monitored through the following M&E activities. The M&E budget is provided in the table below.

Project start:

A Project Inception Workshop will be held within the first 2 months of project start with those with assigned roles in the project organisation structure, UNDP Country Office and, where appropriate/feasible, regional technical policy and programme advisors as well as other stakeholders. The Inception Workshop is crucial to building ownership for the project results and to plan the first year annual work plan.

The Inception Workshop will address a number of key issues including:

- Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of UNDP CO and RCU staff vis-à-vis the project team. Discuss the roles, functions and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff will be discussed again as needed.

- Based on the project results framework and the relevant GEF Tracking Tool, finalise the first annual work plan. Review and agree on the indicators, targets and their means of verification, and recheck assumptions and risks.

- Provide a detailed overview of reporting, monitoring and evaluation (M&E) requirements. The Monitoring and Evaluation work plan and budget will be agreed and scheduled.

- Discuss financial reporting procedures and obligations, and arrangements for annual audit.

- Plan and schedule Project Steering Committee meetings. Roles and responsibilities of all project organisation structures will be clarified and meetings planned. The first Project Steering Committee meeting will be held within the first 12 months following the inception workshop.

- An Inception Workshop report is a key reference document and will be prepared and shared with participants to formalise various agreements and plans decided during the meeting.

Quarterly:
Progress made shall be monitored in the UNDP Enhanced Results-Based Managment Platform. Based on the initial risk analysis submitted, the risk log will be regularly updated in ATLAS. Risks become critical when the impact and probability are high. Based on the information recorded in Atlas, a Project Progress Reports (PPR) can be generated in the Executive Snapshot. Other ATLAS logs will be used to monitor issues, lessons-learned, etc. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.

Annually:
Annual Project Review/Project Implementation Reports (APR/PIR): This key report is prepared to monitor progress made since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and GEF reporting requirements.

The APR/PIR includes, but is not limited to, reporting on the following:

- Progress made toward project objective and project outcomes - each with indicators, baseline data and end-of-project targets (cumulative).
- Project outputs delivered per project outcome (annual).
- Lessons-learned/good practice.
- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR
- Portfolio-level indicators (i.e. GEF focal area tracking tools) are used by most focal areas on an annual basis as well.

Periodic monitoring through site visits:
The UNDP CO and the UNDP RCU will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first-hand project progress. Other members of the Project Steering Committee may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and UNDP RCU and will be circulated no less than one month after the visit to the project team and Project Steering Committee members.

Mid-term of project cycle:
The project will undergo an independent Mid-Term Review at the mid-point of project implementation. The Mid-Term Review will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organisation, terms of reference and timing of the Mid-Term Review will be decided

after consultation between the parties to the project document. The Terms of Reference for this Mid-Term Review will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit. The management response and the evaluation will be uploaded to UNDP corporate systems, in particular the UNDP Evaluation Office Evaluation Resource Center (ERC).

The GEF Focal Area Tracking Tool will also be completed during the mid-term evaluation cycle.

End of project:
An independent Terminal Evaluation will take place three months prior to the final Project Steering Committee meeting and will be undertaken in accordance with UNDP and GEF guidance. The final evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the mid-term evaluation, if any such correction took place). The final evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit.

The Final Terminal Evaluation will also provide recommendations for follow-up activities and requires a management response which should be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Center (ERC).

The GEF Focal Area Tracking Tool will also be completed during the final evaluation.

During the last three months, the project team will prepare the Project Terminal Report. This comprehensive report will summarise the results achieved (objectives, outcomes, outputs), lessons-learned, problems met and areas where results may not have been achieved. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the project's results.

M&E workplan and budget

Type of M&E activity	Responsible Parties	Budget US$ Excluding project team staff time	Time frame
Inception Workshop and Report	Project Manager UNDP CO, UNDP RTA	Indicative cost: 10,000	Within first two months of project start up
Measurement of Means of Verification of project results.	Project Manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members.	To be finalised in Inception Phase and Workshop.	Start, mid- and end of project (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on output and implementation	Oversight by Project Manager Project team	To be determined as part of the Annual Work Plan's preparation.	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	Project manager and team UNDP CO UNDP RTA	None	Annually
Periodic status/ progress reports	Project manager and team	None	Quarterly
Mid-term Evaluation	Project manager and team UNDP CO UNDP RCU External Consultants (i.e. evaluation team)	Indicative cost: 40,000	At the mid-point of project implementation.
Final Evaluation	Project manager and team, UNDP CO UNDP RCU External Consultants (i.e. evaluation team)	Indicative cost: 40,000	At least three months before the end of project implementation

Type of M&E activity	Responsible Parties	Budget US$ Excluding project team staff time	Time frame
Project Terminal Report	Project manager and team UNDP CO Local consultant	None	At least three months before the end of the project
Audit	UNDP CO Project manager and team	Indicative cost per year: 3,000	Yearly
Visits to field sites	UNDP CO UNDP RCU (as appropriate) Government representatives	For GEF-supported projects, paid from IA fees and operational budget	Yearly
TOTAL indicative COST Excluding project team staff time and UNDP staff and travel expenses		US$ 93,000 (+/- 5% of total budget)	

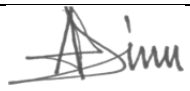
PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

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 form. For SGP, use this OFP endorsement letter).

NAME	POSITION	MINISTRY	DATE*(MM/dd/yyyy)*
Dr. Ali Al-Lami	GEF OFP	MINISTRY OF ENVIRONMENT	08/07/2012

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 CEO endorsement/approval of project.

Agency Coordinator, Agency Name	Signature	Date *(Month, day, year)*	Project Contact Person	Telephone	Email Address
Adriana Dinu, UNDP-GEF Executive Coordinator & Director a.i		July 25, 2014	Robert Kelly, UNDP-GEF Regional Technical Advisor	+421 915 725 069	robert.kelly@undp.org

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

This project will contribute to achieving the following Country Programme Outcome as defined in CPAP or CPD: The Government of Iraq has the institutional framework to develop and implement MDG-based, pro-poor, equitable and inclusive socio-economic and environmental policies and strategies.					
Country Programme Outcome Indicators: Capacities of national and sub-national authorities and communities for effective environmental governance, natural and renewable resources management and climate change strengthened.					
Primary applicable Key Environment and Sustainable Development Key Result Area: 1. Mainstreaming environment and energy OR **2. Catalysing environmental finance** OR 3. Promote climate change adaptation OR 4. Expanding access to environmental and energy services for the poor.					
Applicable GEF Focal Area Objective:GEF-5 FA Objective # 3 (CCM-3): "Promote Investment in Renewable Energy Technologies"					
	Indicator	**Baseline**	**Targets** **End of Project**	**Source of verification**	**Risks and Assumptions**
Project Objective To reduce GHG emissions in Iraq by demonstrating and catalyzing the application of distributed solar power to meet the energy needs of offices, small businesses, residences and small town services (small-scale distributed solar PV power plants and utility scale plants, on and off-grid).	Total electricity generation by the project (MWh).	0	Installations in place and operating to achieve direct reduction of 741,622 tonnes CO_2 over a 20-year lifetime from project start. Indirect: Mechanisms in place to support the further expansion of PV installations to result in indirect emissions reductions of 5.9 million tonnes CO_2.	Project monitoring reports and final evaluation. As applicable, post-project market monitoring and evaluations.	Security risk: the volatile situation in Iraq may delay implementation. Political risk: while MoE has committed to these plants, MoE has for years been struggling and continues to struggle with chronic shortages which strain its human and material resources.
Outcome 1 Investment in solar photovoltaic power technologies for distributed electricity generation for office, residential, small business and small town application.	Megawatts of solar PV installed.	0	Installation and operation of 5 MW of distributed, grid-connected PV at Bytti. Installation and operation of 16 utility-scale PV plants. Monitoring and recording operational data from all Bytti and the 16 plants to inform the development of future PV plants.	Project monitoring reports and final evaluation.	As above.
	Indicator	**Baseline**	**Targets**	**Source of**	**Risks and**

			End of Project	verification	Assumptions
Outcome 2 Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and financial incentives.	Existence of RE policies and laws encouraging deployment. Existence of a clear set of regulations, technical and regulatory requirements for connecting to the grid. Volume of investments mobilised for solar PV power.	There have been early-stage discussions between MoE and UNDP on net-metering. There have been no concrete steps or commitments.	Development and implementation of a grid code for distribution and transmission (for small-scale distributed generation and larger utility-scale generation). Design and implementation of a process for IPPs to engage in standardized PPAs with the Ministry of Electricity, to acquire generation licences and to inter-connect with the grid. Development of model contracts for power purchase agreements. Implementation of phased fiscal incentives for PV uptake, including partial removal of import taxes on solar panels. Design of a feed-in tariff for renewable energy IPPs with appropriate pricing calibration, geographical zoning and regression schedule, and packaged as a NAMA. Evaluation of net-metering options for industrial and residential applications. Evaluation of a range of policies for specific circumstances, such as tenders for large solar installations (suitable for	Existence of legislation on a FiT. Existence of standardised contracts (Power Purchase Agreements) which developers can sign to guarantee purchase of power from projects. Registration of the FiT NAMA in the UNFCCC NAMA Registry, or in bilateral agreement with a credit buyer.	The proposed legal and regulatory improvements passing swiftly through the Government approval process.

			Iraq's environment). Support to implementation of the feed-in tariff and/or net-metering scheme.		
Outcome 3 Facilitation of private sector capacity for technology development, innovation and servicing in the solar power industry, through technical capacity building and domestic market analysis.	Number of individuals and organisations capable of supporting activity in the Iraqi solar market. Records of market prices, participants, and installed capacity to track development of solar PV in Iraq.	No effective capacity building exists for the industry. There are few industry players. No significant market data exist.	Solar power market demand/industry response strategy developed for Iraq, informed by case studies from other countries with developed solar power industries, domestic market analysis, and clarification of Iraqi private sector opportunities for distributed solar PV power production. Iraq private sector and Government agencies exposed to all aspects of the industry (technology development, supply, servicing, financing). Development and delivery of certified technical training on solar PV technologies (hybridization, supply, service) for emerging private sector companies.	Project reports. Consumer surveys.	Lack of interest while the market opportunity is not yet clear to participants (this risk is minimal). Lack of reporting by market participants making collection of data difficult.

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

Responses to Comments from GEF Secretariat Review

a) *Please carefully respond to the issues about grid-integration and coordination among IPP, utility providers, and distributed generation. Policies for grid-inter-connection may be very important.*

As part of the GEF project, development of a grid code (technical guidelines and requirements for connection to the grid) will be developed. Also, draft Power Purchase Agreements will be developed which will include provisions for items such as the point of interconnection, metering, and similar aspects of grid connection. As part of the steps required to sign a Power Purchase Agreement, project developers (IPPs) must demonstrate that they have complied with the grid connection requirements and have obtained a licence for interconnection. The GEF project will work the Regulatory Department of the Ministry of Electricity to develop the licensing procedures and develop the Regulatory Department's capability to assess the requests for grid connection. The Centre for Renewable Energy and Environment will be responsible for supporting the Regulatory Department technically, ensuring that developers have submitted appropriate short-circuit, load flow, and voltage fluctuation studies.

As demonstrations, GEF investment will go primarily to support grid connection of the Bytti project and of MoE projects to ensure smooth operation of the grid and of the PV units and to maximise the benefit from the PV units.

b) *At CEO endorsement, we expect a presentation on the unit costs for Solar PV AC/water heater units.*

Solar AC and water heaters have been investigated thoroughly. The costs have been presented and, upon analysis, it was found that they are not cost-effective solutions in Iraq. The cost of solar-thermal AC is quite variable, but a household unit was found to be in the range of $1,500-$1,800, or approximately 2.5-3 times that of a conventional unit. The advantage of solar thermal AC units is that, during the day, they consume (according to manufacturers' claims) only 20% of the power requirements of a comparable unit. During night time, they require similar power. Given the low price of electricity, the additional cost of solar thermal AC units is not justified. The solar-thermal ACs are produced by relatively small manufacturers and have not yet managed to penetrate global markets at considerable scale. They are therefore considered under development and not suitable for the present project.

The use of solar PV units to power conventional AC units was found to be $6,000, or approximately ten times the cost of the AC unit. Again, given the low cost of electricity to consumers in Iraq, the additional capital cost for the PV generation cannot be justified, especially when it will provide power only during the day.

Therefore, the project has therefore been re-focused on the promotion of PV for power generation. This has the benefit of taking advantage of the efforts already put in place by the Government to promote PV technology, and discussed at length in this document. Although PV-generated electricity is still not cost-effective compared with subsidised baseline grid electricity, it is comparable with the cost of diesel generation paid by many Iraqis. It is also comparable with the true cost of generation paid by the MoE. PV has the advantage that it is generated near consumption, and thus avoids the transmission and distribution losses of some 25-33% that are characteristic of the Iraqi grid, making it more cost-effective than central generation, based on true costs.

When built as part of a mini-grid such as Bytti, and integrated into the national grid, PV can make a cost-effective contribution to the Iraqi power system.

c) Please include documentation in the CEO endorsement clarifying that this GEF project will not fund research and development, but will focus on demonstration and diffusion.

The GEF project will not fund research and development but will rather be a beneficiary of some of the research work already done at Anbar University (with UNDP support) and the Ministry of Science and Technology. All GEF funds are

allocated either to investments to support the PV projects being developed, technical assistance with policy and regulatory development, or capacity building for locals to support an ongoing PV industry.

d) Please document private sector co-financing opportunities and include all confirmed co-financing.

The project has confirmed co-financing of $32,965,200, including $10,000,000 of private sector co-finance from Al Shafei group, developers of the Bytti project. With a virtually non-existent PV market, raising private sector co-finance for PV projects is challenging.

Responses to Comments from STAP Review

a) *STAP commends the project for a very detailed presentation of the baseline project scenario, preliminary analysis of the technologies and explanation of the components, outputs and activities.*

b) *"With the exception of hydropower, deployment of renewable sources of energy is projected to remain below Iraq's potential. While Iraq has a large potential for non-hydro renewables, particularly solar, the costs of exploiting this for power generation remain high relative to alternative fossil fuel technologies. Due to this, and based on existing policies, there is only a small increase in non-hydro renewables, such as solar, over the Outlook period. The Ministry of Electricity has a number of off-grid solar research stations, with capacity of a few tens of megawatts (MW). Despite the strength of the resource, grid-connected solar electricity generation either through photovoltaics (PV) or concentrating solar power (CSP) will remain a very high-cost option, compared to fossil fuels. The Central Scenario assumes a small amount of solar PV capacity less than 50 MW is added by 2035. Outside the electricity sector, solar water heating is likely to be a highly attractive option for buildings if subsidies for fossil-fuel alternatives are phased out." [The above was quoted from the just-released IEA study Special Outlook Report on Iraq (http://www.iea.org/publications/freepublications/publication/WEO_2012_Iraq_Energy_OutlookFINAL-1.pdf)].*

The IEA study has been considered in the project design, as have many other documents obtained after a thorough literature review.

c) *The project's main focus is on the promotion of distributed solar power through rooftop solar power systems for AC and water heating as well as support for the distributed solar power plant of 5 MW. While a lot of information is presented on the status of these two technologies in Iraq, in light of the IEA report conclusions serious doubts remain that these two technologies will be cost-effective without strong financial incentives including support for domestic production of solar panel components. STAP recommends a preliminary cost-benefit analysis of solar power applications for different end users, in particular for air-conditioning. It is not clear if solar PV options would be a cost effective solution within a reasonable time frame for energy intensive end uses such as air-conditioning. STAP suggests that data is likely available, if not in Iraq from other countries in the region, that would provide an assessment of the cost effectiveness of utilizing SPV power for different end uses and in particular for air-conditioning. The cost of SPV electricity for air-conditioning applications is likely to be high. Although this is outside of STAP's area of expertise, the Panel would like to raise the issue of consumer ability to pay - and how consumers will be persuaded to adopt these technologies even with subsidies.*

Cost-benefit analyses for solar air-conditioning and solar water heating were undertaken. It was found that, from the perspective of the consumer, neither technology is cost-effective because of the high level of subsidies provided for electric power. The project has therefore been re-focused on supporting solar PV for power generation exclusively, while devoting a considerable amount of time and project resources to policy development. Solar PV technology is cost-effective from a national perspective because of the large opportunity cost Iraq incurs both by burning oil that it could sell on the international market and through the cost of power shortages to the economy, estimated at $40 billion/year. From the perspective of consumers, Government electricity is free or almost free, but unreliable. Consumers therefore pay for diesel power generation, which is comparable in cost to solar PV but comes with very significant health and environmental concerns. With the capital investment for 41.5 MW of PV supported by co-financiers, the GEF project is in an excellent position to demonstrate the cost-effectiveness and operational benefits of PV to enable widespread scale-up in Iraq.

It must be emphasised that for situations such as solar water heating, where alternatives exist (e.g. thermal water heating, or going without hot water for a short period), cost-effectiveness is of primary importance. However, for situations such as loss of electric power, direct economic comparisons with alternative sources become of lower importance as evidenced by consumers' willingness to pay high prices for diesel power compared with almost-free public utility power when the latter is not available. In economic terms, the demand elasticity for electric power is low. Therefore, if solar PV can demonstrate its effectiveness as an alternative power source, compared with diesel, it will find adoption. That the project has been able to secure $10 million in private co-finance is further demonstration that there is a willingness to pay for clean, reliable power, if it can be made available. The GEF project investments aim to create a nucleus around which solar power adoption can grow, and to create the regulatory environment to support such growth. It is ironic that solar PV power finds application in countries with the most subsidised electricity, not because of its economic value, but because countries with such heavy subsidies are not able to meet spiraling demand, leaving consumers to seek alternatives.

d) *Similarly, high investment costs related to the proposed solar power installations could be a major risk in large-scale promotion of this technology. It may be necessary, therefore, to consider options other than subsidising the solar power installations. The ambiguity of the cost-effectiveness consideration of the proposal for support technologies represents a large risk in this project, and puts its long-term sustainability and replication into question. STAP recommends mediating this risk at least partially by strengthening support to PV together with hydropower technologies at the national level through financial incentives, awareness raising, along with policy and institutional reforms. Integration of these potential RE sources into the grid on the one side and support for decentralised/distributed RE on the other should receive more emphasis in this project than that currently described in components 2 and 3 (for IPP facilitation). Given the critical importance of renewables in the future energy mix in Iraq, concomitant with the multiple barriers to widespread adoption compared to fossil fuel-based energy, the project should strengthen support for RE policy and institutional reform at the expense of site-specific technology demonstrations. In the longer term, the project aims to sell surplus electricity to the grid by establishing feed-in-tariff schemes. Under this scenario, the cost of feeding the power from a decentralised source to the grid and attractiveness of the price of electricity needs to be clearly established from the outset. Finally, while the project aims to promote solar power air-conditioner/ water heaters, the PIF is not clear whether water heating will be through thermal or PV means. Solar water heaters are likely to be very cost effective for water heating, as opposed to electric options.*

High investment costs required for PV technology are a risk. This risk has been mitigated by securing the investment for the PV units to be installed as part of the GEF project through co-finance. In line with STAP comments, the GEF project now includes a significant component on developing policies and regulations to support solar PV, including a feed-in tariff. The project also includes capacity building for individuals and institutions to support development of distributed and central utility-scale PV plants. Electricity from solar PV is cost-competitive today with the real cost of conventional power generation in Iraq. Therefore, from a national perspective, promotion of PV technology is cost-effective. By promoting both site-specific technology demonstrations, the funding for which has been allocated through co-finance, and building policy and institutional capacity, the project will help promote PV technology and put in place the regulatory and technical environment to support its replication. The central IEA scenario cited by STAP indicated the development of 50 MW of PV by 2035. The GEF project will develop 41.5 MW during the project period. Iraq's Integrated National Energy Strategy calls for subsidy reform starting in 2018. By putting in place the technical and regulatory environments at that time, the GEF project will set the stage for large-scale private replication once subsidies are reformed.

Canada’s Comments

Canada shares the STAP’s concerns regarding the cost-effectiveness of solar photovoltaic energy in Iraq. Please provide the necessary analysis to inform the CEO’s approval decision.

Please see response to STAP comments above.

Germany’s Comments

Germany sees a need for further elaboration of the economic viability of the solar technologies in comparison to other technologies with comparable level of service as examined by the cited previous studies in Iraq. This should include a risk assessment of shifts in financing terms (interest rates) that especially affect long-term financing activities like solar technologies. Further, regarding the evaluation of the emission reduction potential by solar technologies it is good practice to also include production related emissions into the overall emission reduction assessment (life-cycle assessment). Clarification is sought if these emissions are included or not. For allowing the evaluation of the requested GEF finance, it is necessary that the implementing entity provides a clearer quantification of the extent of measures in the final project document (e.g. number of trainings, dissemination sessions and addressed persons/ institutions).

Comparison of economic viability has been provided. It is worth noting that there are no other technologies which provide a comparable level of service. The only other alternatives are public utility power, which is highly unreliable, and diesel generation. Diesel generation causes significant air pollution and resultant health problems. It also causes considerable noise pollution. This is in addition to the fact that diesel is not always available and requires considerable ongoing maintenance. As a result, there is no directly comparable technology. Nevertheless, solar is economically viable in comparison with diesel power, and especially in comparison with the true, unsubsidised, cost of power generation.

While it is good practice to include life-cycle emissions, the calculation of emission reduction was performed according to GEF guidelines (Manual for Calculating GHG Benefits of GEF Projects: Energy Efficiency and Renewable Energy Projects, April 16, 2008), which do not include life-cycle assessment. Inclusion of a life-cycle assessment would have negligible impact on the result. A power plant (whether conventional or otherwise) generates much more energy over its lifetime than is consumed in making it.

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[10]

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF:			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF/NPIF Amount ($)***		
	Budgeted Amount	***Amount Spent To date***	***Amount Committed***
International Consultants	$48,000	$23,866.00	
Local Consultants	$22,000	$24,000.00	
Travel	$6,000	$5,942.17	
Miscellaneous	$4,000	$2,710.38	
Training, workshops & conferences	0	0	$22,565.80
Contribution / security	0	0	$203.48
Communication & Audio Visual Equip	0	0	$712.17
Total	**$80,000**	**$56,518.55**	**$23,481.45**

[10] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used**)**

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

N/A

United Nations Development Programme

Country: Iraq

PROJECT DOCUMENT[1]

Project Title: Catalysing the Use of Solar Photovoltaic Energy

UNDAF Outcome(s): People in Iraq have improved access to safe water, sanitation, electricity and municipal services; and the Iraqi state has institutionalized policy and operational framework for the sustainable management and conservation of natural resources.

UNDP Strategic Plan Primary Outcome: Countries have strengthened institutions to progressively deliver universal access to basic services.

UNDP Strategic Plan Secondary Outcome: Countries are able to reduce the likelihood of conflict, and lower the risk of natural disasters, including from climate change

Expected CP Outcome(s): Outcome 4: The Government of Iraq has the institutional framework to develop and implement MDG-based pro-poor, equitable and inclusive socio-economic and environmental policies and strategies.

Expected CPAP Output (s) Capacities of national and sub-national authorities and communities for effective governance, natural and renewable resources management and climate change.

Executing Entity/Implementing Partner: UNDP (Direct Execution Modality)

Implementing Entity/Responsible Partners:

Ministry of Environment

Ministry of Electricity

Ministry of Industry and Mining

Ministry of Science & Technology

AlShafei Group

Anbar University

[1] For UNDP supported GEF funded projects as this includes GEF-specific requirements

Brief Description

Iraq is highly dependent on fossil fuels to generate power which, despite recent improvements, does not meet peak demand. Private diesel power generation has grown significantly to meet the gap. Fuel used for domestic power generation denies Iraq the opportunity to export that fuel. The project will catalyse the adoption of solar power in Iraq, both on and off-grid, to: a) reduce Iraq's dependence on fossil fuel; b) result in direct GHG reductions of approximately 741,622 tonnes CO_2; and c) help provide reliable power to the Iraqi people to support development and a better standard of living.

The project targets residential-scale units (a few kilowatts) as well are utility-scale units (several megawatts). The project aims to facilitate the installation of 5 MW in aggregate of residential-scale PV generation capacity through the Bytti residential development in Najaf, Iraq. The project also aims to support the Iraqi Ministry of Electricity in the establishment of large, utility-scale PV plants, primarily by providing technical and investment support. The project supports the development of a regulatory framework, technical guidelines, capacity building, and institutional arrangements for the development of public and private (Independent Power Producer, IPP) solar power plants.

The project's National Focal Point is the Ministry of Environment. The project will receive close collaboration from the Ministry of Electricity, the Renewable Energy Research Centre of the Ministry of Science and Technology, and others. The project is expected to last 48 months.

Programme Period:	2014-2018
Atlas Award ID:	00079907
Project ID:	00089774
PIMS #	5137
Start date:	June 1, 2014
End Date:	June 1, 2018
Management Arrangements: DIM	
PAC Meeting Date	

Total resources required	US$ 35,192,473
Total allocated resources:	US$ 35,192,473
• Regular	US$ 165,200
• Other:	
o GEF	US$ 2,227,273
o Government	US$ 22,750,000
o In-kind	US$ 50,000
o Other	US$ 10,000,000

Agreed by UNDP

Date/Month/Year

Table of Contents

List of Acronyms

BOOT	Build, Own, Operate, Transfer
CO	UNDP Country Office
CO_2	Carbon dioxide
CSP	Concentrating Solar Power
EE	Energy Efficiency
EENS	Expected Energy Not Supplied
EMP	Electricity Master Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
IEA	International Energy Agency
IPP	Independent Power Producer
M&E	Monitoring and Evaluation
MoE	Ministry of Electricity
MoEn	Ministry of Environment
MoST	Ministry of Science and Technology
MRV	Monitoring, Reporting and Verification
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Action
NES	National Energy Strategy
NGO	Non-Governmental Organisation
O&M	Operation & Maintenance
PIR	Project Implementation Review
PMU	Project Management Unit
PPG	Project Preparation Grant
PPP	Purchasing Power Parity
PSC	Project Steering Committee
PV	Photovoltaic
QPR	Quarterly Progress Report
RCU	UNDP Regional Coordination Unit
RE	Renewable Energy
REEC	Renewable Energy and Environment Centre (under MoE)
RTA	Regional Technical Advisor
SWH	Solar water heater
TPR	Tripartite Review
TTR	Terminal Tripartite Review
TWh	Terawatt-hour (one thousand billion watt-hours)
WB	World Bank
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

List of Annexes

1. Situation analysis

1.1. Context and Global Significance

1. Approximately 80% of Iraqis are connected to the electricity grid, with over 80% of grid-supplied electricity coming from hydrocarbon-fueled power plants, almost 75% of which is crude-oil, heavy fuel oil or gasoil.[2] A small amount, less than 20%, comes from hydropower. Iraqis have increased their demand for electricity (through population growth and increased electricity requirements in homes and offices), but the reliability of supply is inadequate and load-shedding is a common daily experience for Iraqis (Figure 1). Only in 2013 did the Iraqi power sector start to approach pre-1991 Gulf War supply levels, with 9,000 MW of available generation capacity.[3] In the meantime, electricity demand has almost tripled, from some 5,100 MW in 1991 to almost 15,000 MW today.[4] A workshop of Iraq stakeholders (UNDP-facilitated, November 2011) revealed a widespread recognition that the reliability and capacity of Iraq's electricity supply have fallen in the past two decades, a finding confirmed by a recent Al Jazeera survey of Iraqis that found most experience several hours of grid outages each day.[5] Iraq's present electricity shortages are estimated to cost it $40 billion a year, compared with Iraq's GDP of $210 billion for 2012.[6,7]

2. The Iraqi power sector is owned and operated by the Iraqi Ministry of Electricity (MoE). There are three units within the Ministry of Electricity - Generation, Transmission and Distribution, responsible for generating electricity and delivering it to end-users.

3. About 50% of overall electricity demand is due to air conditioning. Iraq is one of the hottest countries in the world (with summer temperatures up to 45-50^{o}C), and summer temperatures are steadily increasing. People in Baghdad, especially, are desperate to buy, and hopefully have enough electricity to use, air conditioners, as noted frequently in media.[8,9,10] Lack of electricity during the critical summer months affects national productivity and makes it difficult to work in the stifling heat.

4. As a result of the electricity shortages and demand for air conditioning, 90% of Iraqi households rely on some sort of diesel power generation operated by private independent operators.[11,12] These

[2] Parsons Brinkerhoff (2010), *Iraq Electricity Master Plan*, p.11.
[3] Prior to the 1991 Gulf War, Iraq had 9,295 MW of generation capacity. It would not reach this level of functional generation capacity again until June 2012. See US Government Accountability Office, *Rebuilding Iraq*, May 2007, p. 15.
[4] IEA (2012), *Iraq Energy Outlook*.
[5] Al Jazeera (2013), *Iraq: Powering Up After a Decade Down*, March 20, 2013, http://www.aljazeera.com/indepth/interactive/2013/03/2013319131838173603.html.
[6] Parsons Brinkerhoff (2010), *Iraq Electricity Master Plan*, p. 3.
[7] World Bank Country Data – Iraq, http://data.worldbank.org/country/iraq.
[8] ABC News (2011), *Power Shortages Spark Anger in Iraq*, August 2011, http://abcnews.go.com/WNT/story?id=129521.
[9] National Public Radio (2010), *Iraq Minister Resigns Over Electricity Shortages*, June 22, 2010, http://www.npr.org/templates/story/story.php?storyId=128000162.
[10] National Turk (2010), *Iraq's Electricity Shortage Crisis Set to Continue*, 2010, http://www.nationalturk.com/en/iraq-electricity-shortage-crisis-set-to-continue-50120152.
[11] BBC News Online (2013), *Iraq Struggles to Solve Electricity Crisis*, 11 April, 2013, http://www.bbc.co.uk/news/world-middle-east-22093992
[12] Al Jazeera (2012), *Generator Man*, 19 June, 2012, http://www-ak.aljazeera.net/programmes/witness/2012/06/201261813243095357 2.html, accessed February 10, 2014

independent operators erect ad-hoc distribution grids as shown in Figure 2. There are an estimated 55,000 to 80,000 private diesel generators in Iraq, supplying an estimated 21 TWh, or 30% of the total electricity generated.[13] The operators are often licensed by the local provincial council, but are otherwise poorly regulated. They contribute to chronic air and noise pollution problems, at great local health cost, but provide much-needed electricity.[14] As a result primarily of private diesel generators, air pollution in Iraqi cities is well above World Health Organization and local guidelines (Figure 3. Air pollutant levels in Baghdad, well above local and World Health Organization limits.. These pollutants have adverse effects on human respiratory, neurological and immune systems. In addition, as they settle or as they are spread by wind and rain they cause acidification and pollution of water and soil. [15]

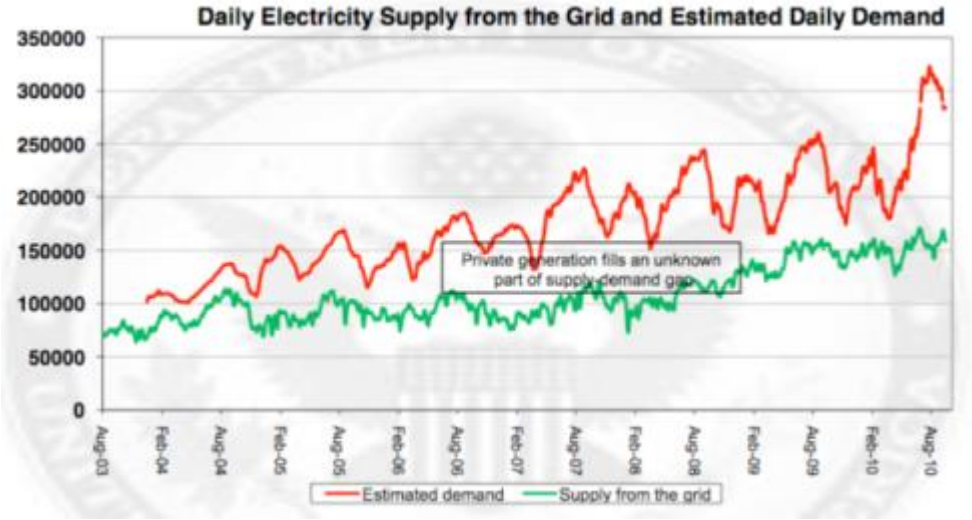
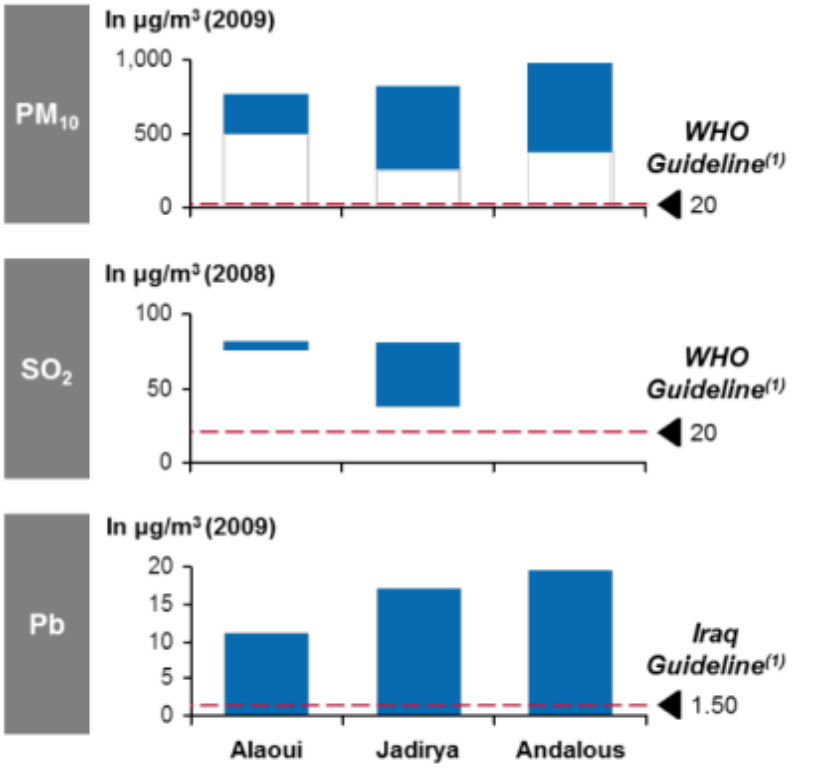


Figure 1. Daily supply and demand (kWh) in Iraq.[16]

Figure 2. Ad-hoc power distribution grids established by entrepreneurs who run diesel generators to feed demand when the grid is down.

[13] Booz & Co. (2012), *Integrated National Energy Strategy*, p. 45.
[14] IEA (2012), *Iraq Energy Outlook*.
[15] Booz & Co. (2012), *Integrated National Energy Strategy*, p. 70.
[16] US State Department, as reported in *Time* magazine, September 27, 2010.



1) WHO Air Quality Guideline is at 20 µg/m³ for annual mean of PM10 concentrations and 20 µg/m³ for 24-hour mean of SO2 concentrations; Lead emission standard is set for a rolling three-month average; standard for 24-hour average is set at 2 µg/m³; available measures from SoER (2010) are monthly averages

Source: *State of the Environment Report* 2008 and 2009, MoEnv; U.S. EPA; WHO Air Quality Guidelines; Booz & Company analysis

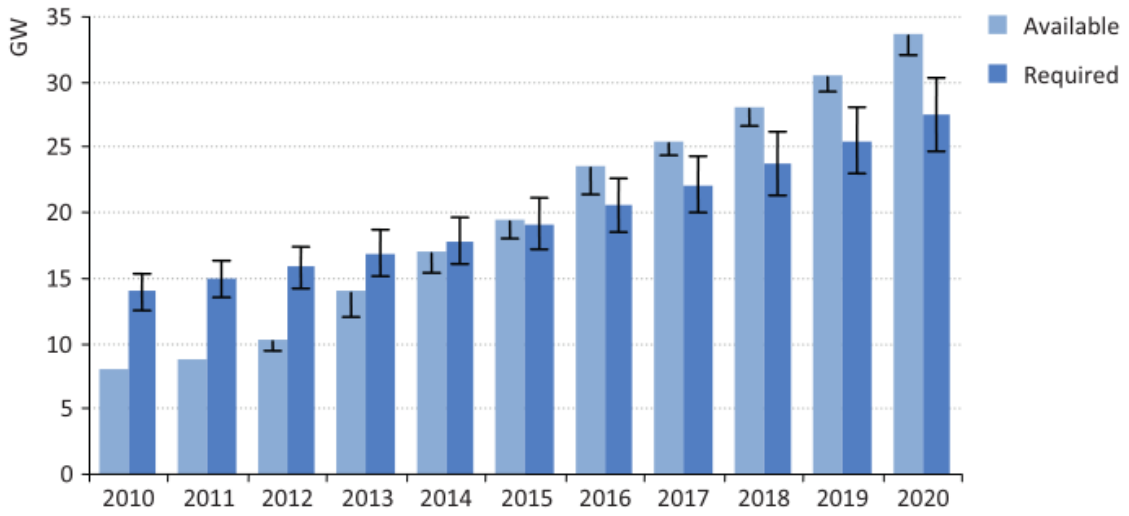
Figure 3. Air pollutant levels in Baghdad, well above local and World Health Organization limits.[17]

5. The private diesel generators (who are, in effect, small-scale Independent Power Producers, IPPs), sell power to their customers based on a capacity charge ($/available kW) and not based on energy consumption ($/kWh). Figures collected during the project preparation phase indicate that prices vary widely across Iraq but tend to be in the range of $3-$8/kW per month to cover roughly a few hours of outage per day[18]. The operating model, based on capacity charge and not usage, and a pricing structure that does not vary greatly with outage times, is reasonable for a market such as Iraq, which lacks technical tools and sophistication (e.g. use of meters) and in which fuel is often heavily subsidized, making the fuel operating cost for a diesel generator a relatively small component of the overall cost, and making the capital expenditures for purchase, repair and overhaul proportionately more important.

6. With a high reliance on fossil fuel for power, and limited hydro resources, Iraq's average grid emission factor is 0.82 kg CO_2/kWh[19]. With the pressure to meet electricity demand, the Government of Iraq plans to install 11 GW of simple-cycle gas turbines[20] over the next five years

[17] Booz & Co. (2012), *Integrated National Energy Strategy*, p. 70.
[18] Independent data collection by PPG team.
[19] Ecometrica (2011), *Electricity-Specific Emission Factors for Grid Electricity*, p.6.
[20] Simple cycle gas turbines discharge their hot exhaust directly to the atmosphere, and are thus considerably less efficient than combined cycle plants (so called because they combine a simple cycle gas turbine with a steam power cycle), which use the exhaust from a gas turbine in a heat recovery boiler to generate steam which is then used to

(Table 2).[21] With approximately 75% of Iraq's present power generation fuel being heavy liquid fuels, and the efficiency of simple cycle gas turbines being relatively low (25-30%), the power sector contributes half of the nation's greenhouse gas emissions and 70% of the emissions from the Iraqi energy sector (i.e. GHG emissions from the power sector are more than double those from the oil sector).[22]



Notes: Error bars for "Required" represent ±10% of Central Case demand. Error bars on "Available" assume half the new capacity added comes online after the summer peak.

Figure 4. Iraq expected supply and demand trends[23]

7. With electricity shortages, significant unused land area, abundant solar resources, a large summer day-time peak load corresponding to the use of air-conditioning, and considerable losses in transmission and distribution (Figure 6. Calculated daily load curve showing peak demand between noon and 6 pm.
8. The upper curve is sent-out demand at the generation stations; the lower curve represents demand at the consumer level. The difference represents losses in the transmission and distribution system.), solar power appears ideally suited for Iraq.[24] Iraq receives over 3,000 hours of bright sunshine per year, making it one of the sunniest places on Earth.[25,26] Iraq also enjoys clear skies and relatively low degrees of cloud cover, making solar energy a predictable energy source with relatively low fluctuations compared with other regions.[27] Iraq's average solar insolation of 5.1 kWh/m^2/day is 70% higher than that of Germany, the present leader in solar installations, as can be seen from the map in

generate additional electricity. Typical efficiencies for a simple-cycle gas turbine power plant are 25% - 30%, while combined cycle plants have efficiencies of 55% - 60%. Simple cycle plants have the advantage of being less costly and quicker to build than combined cycle plants.

[21] Parsons Brinkerhoff (2010), *Iraq Electricity Master Plan*, p.13.

[22] Booz and Co. (2011), *Integrated National Energy Strategy* p. 69.

[23] Booz and Co. (2011), *Integrated National Energy Strategy*.

[24] Doyle P, and Jaafar, K. (2010), *Iraq Has an Opportunity to Become a Solar Leader*, DAI.

[25] Alasady, A. (2011), *Solar Energy: The Suitable Energy Alternative for Iraq Beyond Oil*, International Conference on Petroleum and Sustainable Development, Singapore, IPCBEE vol. 26.

[26] Rahoma, U. (2008), 'Utilization of Solar Radiation in High Energy Intensive Regions of the World by PV Systems', *American Journal of Environmental Sciences*, Vol. 4, 2008, pp 121-128.

[27] Abbas, M. and Elnest, M. (1974), 'Cloudiness and Estimation of Incoming Solar Radiation in Iraq', *Pure and Applied Geophysics*, Volume 112, p 234-239.

Figure 5.[28] Moreover, the cost of solar energy equipment on international markets continues to fall rapidly. Solar modules today cost only a tenth of what they did in 1990. The price of oil, by contrast, has multiplied approximately six-fold, from $17/barrel in 1990 to $110/barrel today.[29]

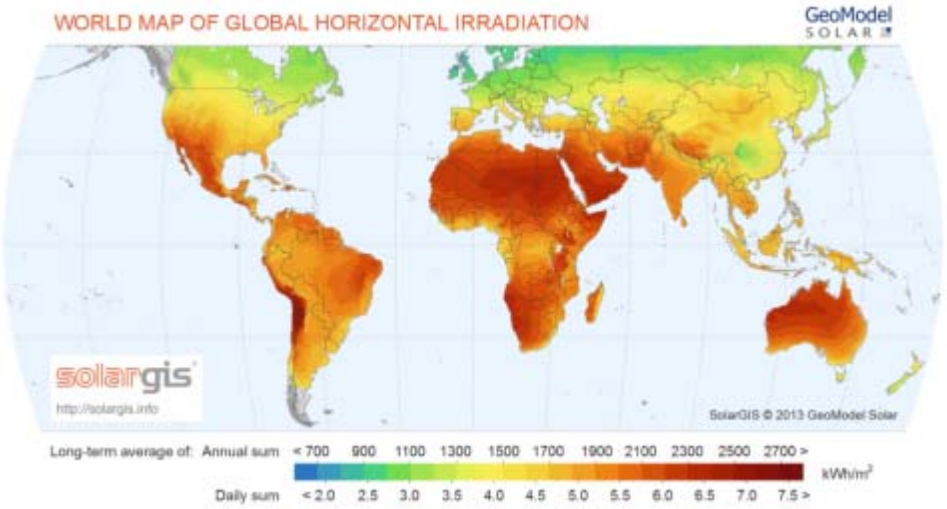


Figure 5. Global Hours of Bright Sunlight[30]

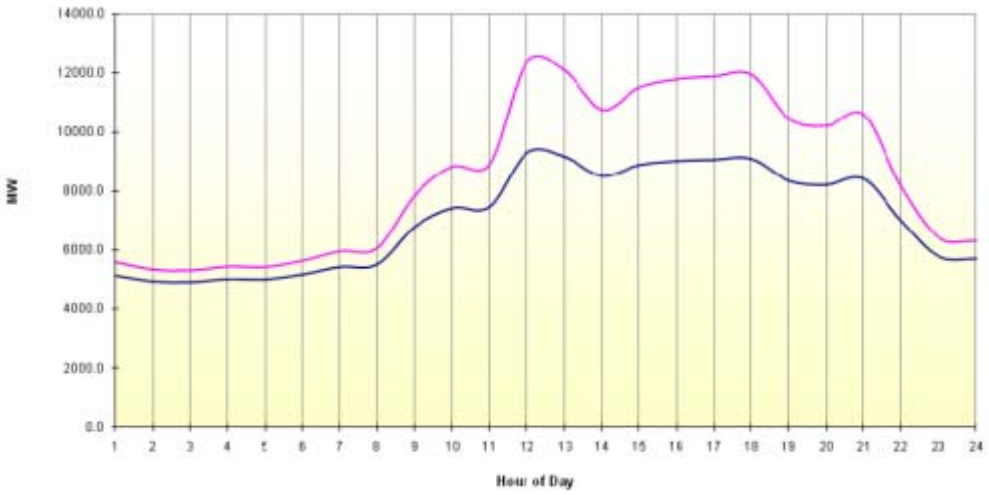


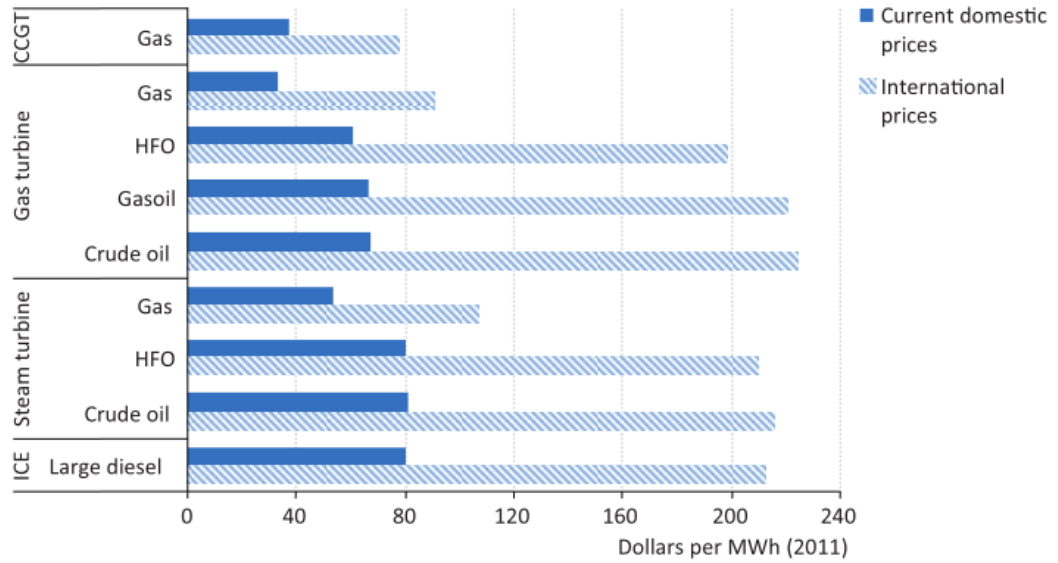
Figure 6. Calculated daily load curve showing peak demand between noon and 6 pm.
The upper curve is sent-out demand at the generation stations; the lower curve represents demand at the consumer level. The difference represents losses in the transmission and distribution system. Note that system losses are greatest between 11 am and 8 pm, when solar is expected to make the greatest contribution.[31]

9. The modular nature of solar energy (solar power systems can be deployed from a few watts to several hundreds of megawatts), and the opportunity to develop distributed generation systems with minimal dependencies on existing infrastructure and institutional processes while having

[28] Although the cooler temperatures in Germany mean that solar PV cells can operate more efficiently, the slight loss of efficiency is more than compensated by the increased solar irradiation in Iraq.
[29] Cleantechnica (2013), *Solar Power's Massive Price Drop*, http://cleantechnica.com/2013/05/24/solar-powers-massive-price-drop-graph/.
[30] SolarGIS: http://www.solargis.info
[31] Parsons Brinkerhoff (2010), *Iraq Electricity Master Plan*, p.6

significant potential to feed back into the electricity grid during peak load periods, make solar a compelling electricity source in Iraq. In addition, there is significant opportunity for private-sector deployment in the solar power sector, especially given the expected increasing consumer demand for solar-powered appliances and given the construction of 'model' towns (for example, near Najaf, south of Baghdad), where the intention of developers is to remain non-reliant on the grid, ensure a reliable supply of electricity, and develop cost-recovery mechanisms that will support the initial investments (including selling electricity back to the grid).

10. The real cost of power generation in Iraq is calculated to be between $0.08/kWh for the most efficient Combined Cycle Gas Turbine (CCGT) power plants operating on natural gas and $0.22/kWh for gas or steam turbines running on gasoil or crude oil, and large diesel engines (Figure 7). At these prices, the use of solar energy can be cost-effective from a national perspective since the levelised costs of solar power are estimated to be in the range of US$0.10/kWh to US$0.16/kWh (see Section 2.7 for further details), depending on the initial cost and the cost of capital.



Note: CCGT = combined-cycle gas turbine; ICE = internal combustion engine.

Figure 7. Levelised cost of electricity generation in Iraq[32]

11. Part of the difficulty in the adoption of solar power remains the fact that Government subsidies suppress public electricity prices to artificially low levels.[33] As a result, consumer electricity prices are rather low, ranging from 0.8 US cents/kWh for consumption up to 1,000 kWh/month, to 4 US cents/kWh for consumption over 4,000 kWh/month.[34,35] Often, consumers do not pay any bills at all; after protests, Iraqis are now formally exempt from payment for the first 1,000 kWh per month of usage.[36]

[32] IEA (2012), *Iraq Energy Outlook*.
[33] Iraq has the second-highest expenditure on energy subsidies as a percentage of GDP, at around 12%, in the Middle East and North Africa, surpassed only by Iran. See IMF (2013), *Energy Subsidies in the Middle East and North Africa: Lessons for Reform*.
[34] Iraq Ministry of Electricity, electricity prices, http://www.moelc.gov.iq/ar/index.php?name=Pages&op=page&pid=114.
[35] This is corroborated by UNDP interviews and field data collection during the PPG preparation.
[36] Reuters (2011), *Iraq Subsidises Power after Protests over Services*,

12. Compared with this diesel-based electricity price, solar power generation is competitive, provided a source of financing is available to offset the large initial cost of solar in comparison with a diesel engine. In addition, there are specific consumers, such as industrial consumers, for whom the official grid tariff is sufficiently high – US$0.10/kWh[37] – and sufficiently enforced to make solar power price-competitive.

13. With the price of solar energy equipment having fallen considerably and the price of fossil fuels having continued to rise (in addition to specific incentives for solar power in certain countries), global solar capacity doubled every two years between 2004-2012, reaching over 100 GW today, and is set to double again by 2015 (See Figure 8. Global installed solar capacity doubling every two years from 2004 - 2012, and again by 2015). Despite Iraq's considerable solar resources and electricity shortfall, solar energy has not been adopted because of a set of barriers, specifically: Government subsidies for fossil fuels and electric power, lack of infrastructure and legislative framework to promote solar power, and lack of technical capacity. The Project is designed to address each of these barriers to catalyse the development of solar power in Iraq.

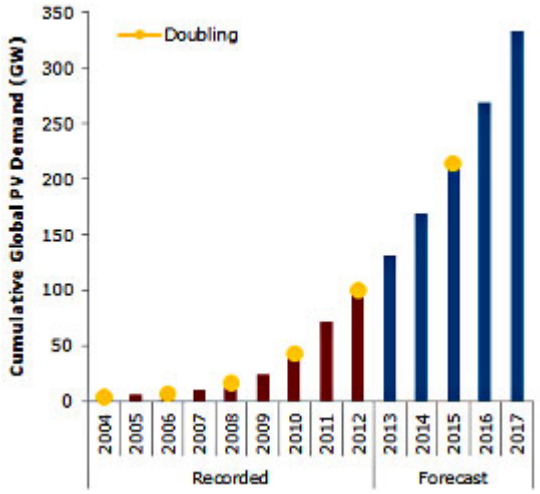


Figure 8. Global installed solar capacity doubling every two years from 2004 - 2012, and again by 2015[38]

1.2. Baseline, barriers and current Government policy to address the root causes and threats

14. Iraq has made some initial ventures into solar power use. Baghdad, Basra, Fallujah, Kharma and Sakalaweyah installed some 1,500 street lights in 2007/2008. In addition, the Iraqi Ministry of Electricity (Modern Lighting Directorate) has installed some 5,000 solar-powered street lights in Baghdad (Figure 9).

http://www.reuters.com/article/2011/02/12/iraq-electricity-bills-idAFRAS22447520110212.

[37] IEA (2012), *Iraq Energy Outlook*.

[38] 'Global solar photovoltaic capacities to reach over 200 GW by 2015', *Wind Energy and Electric Vehicle Revie*w, 2013 http://www.evwind.es/2013/03/26/global-solar-photovoltaic-capacities-to-reach-over-200-gw-by-2015/31199

Figure 9. Solar street lights installed in Baghdad.

15. Inquiries performed during project preparation have shown that, despite initial enthusiasm, the solar lighting programme was not the success that was initially hoped. Many of the batteries did not last, in part due to the extreme operating temperatures. The programme lacked coordination, follow-up and documentation to assess and demonstrate the benefits received from solar lighting, and as a result did not succeed in replicating installations throughout Iraq.

16. Iraq has also made forays into various other solar applications, though none has proved sustainable. The Ministry of Municipalities and Public Works (MoMPW) has installed 700 PV-powered water purification stations, of capacities between 1-5 m^3 per hour, in remote areas nationwide. The initiative has not proved sustainable, however, with the principal challenge encountered being a lack of expertise for installation, operation and maintenance, exacerbated by the remote locations of the stations. The Ministry of Water Resources (MoWR) has installed small (6-15 litres per second) solar-powered pumping units in remote areas of Iraq. From the perspective of MoWR, a significant limitation was the difficulty of scaling-up such solar-powered pumping to the large-scale pumps needed to supply large areas of irrigated land.

17. The pioneering Bytti Complex[39] is a 50 hectare, 1,300 home 'New Town' development in the western Iraqi province of Najaf. The developer, Al Shafei, markets the use of solar power as one of the selling points of the project, as shown in the project promotional material (Figure 10). Al Shafei intends to install a total of 5 MW of solar power, which will produce an estimated 7.5 million kilowatt-hours of electricity per year, or approximately one-quarter of Bytti's estimated annual consumption. A distributed installation of this size in a development such as Bytti offers significant opportunities to maximize the potential of the solar units through good engineering – for example, to reduce reliance on the grid, to feed into the grid if production exceeds consumption, and to use the solar units on each house to feed loads within the compound and allow exchange of energy between houses, such that the panels on an empty home with no load can be used to power another home that is consuming more than it is producing.

[39] Also translated into English as 'Baiti'.

18. Al Shafei has already installed groups of panels to test the solar output in order to select the most appropriate modules and better anticipate the output energy that will be achieved in practical operation under the prevalent conditions (Figure 11). Full installation of household PV systems is expected to commence in late 2014.

Figure 10. Bytti promotional image highlighting solar water heaters and PV panels on homes and solar street lighting. The Arabic text reads "Bytti residential compound - the address for good living".

Figure 11. Test solar module installation at the Bytti Complex showing dust accumulation and effects of uneven cleaning.

19. The Iraqi Government has had two major studies conducted relating to the energy and electricity sector: the Iraq National Energy Strategy (NES, 2012) by Booz and Co., and the Iraq Electricity Master Plan (EMP, 2010) by Parsons Brinkerhoff. The NES was initiated by the Prime Minister's Advisory Council (PMAC) and supervised by a project steering committee comprised of selected PMAC members as well as senior representatives from Iraq's Ministry of Oil, Ministry of Electricity, Ministry of Industry and Minerals, Ministry of Finance, Ministry of Planning, Ministry of Environment and Ministry of Water Resources. The EMP was financed by the US State Department and executed under the supervision of the US State Department's Iraq Transition Assistance Office. The project steering committee was comprised of representatives from Parsons Brinkerhoff, the

Iraq Transition Assistance Office and the Iraq MoE. The NES and EMP together represent a concerted effort on the part of the Government to prepare a strategy and executable action plan with short-, medium- and long-term goals to address Iraq's energy needs and provide the resources and infrastructure needed for Iraq's social and economic development.

20. The EMP shows existing plant capacities assuming no further capacity is developed, as shown in Table 1.

Table 1. Maximum capacity for existing plants 2009-2030, EMP (2010)

Maximum Capacity MW (45C) - All Plant Available					
	2009	2015	2020	2025	2030
GTs and Steam	6740	4284	1922	1084	1084
Interconnectors (Iran)	700	700	700	700	700
Hydro and Pumped Storage	1757	1757	1757	1757	1757
Total	**9197**	**6741**	**4379**	**3541**	**3541**

21. The EMP notes that:
    - Existing capacity is much less than installed nameplate capacity due to plant de-rating and high operating temperatures (which reduce plant output).
    - Not all capacity is available due to maintenance and forecast outages.
    - Hydro capacity is reduced due to water shortages and unit outages.
    - Pumped storage is not used at peak times as is it not worthwhile with the present generation shortages.

22. To address Iraq's electricity shortages, the EMP details Iraq's short-term target of installing 13 GW of power over five years with specific power generation additions (Table 2).

Table 2. Committed short-term generation rehabilitation and expansion over five years by GT, thermal (steam), hydro and diesel plants

		Sent-out	
Committed GTs in ME Short-term Plan	15C	45C	45C
ME Re-powering Project	600	507	
GE Fast Track	660	510	
GE MegaDeal	6500	5272	
Siemens MegaDeal	3190	2821	
Total	10950		9110
Diesels			
Hyundai Diesels	360		288
Committed Thermal			
Hartha 2 and 3 Rehab		376	
Hartha Extension		553	
Wassit		1216	
Yussifiyah		580	
Nasiriyah Extension		553	
Total			3278
Other Projects (642 MW)			
Sadr Sunior GTs		247	
Akkaz GTs		96	
Haditha Pielstick Diesels		200	
Huriyah Diesels		72	
Adhaim Hydro		27	
Total		642	642
New Interconnector		550	550
GRAND TOTAL			**13868**

23. The EMP shows the present mix of fuels used for Iraq's power generation. Heavy liquid fossil fuels (crude oil, heavy fuel oil, and gasoil) account for 74% of the overall fuel use, with natural gas accounting for just over one-quarter (26%) of power generation.

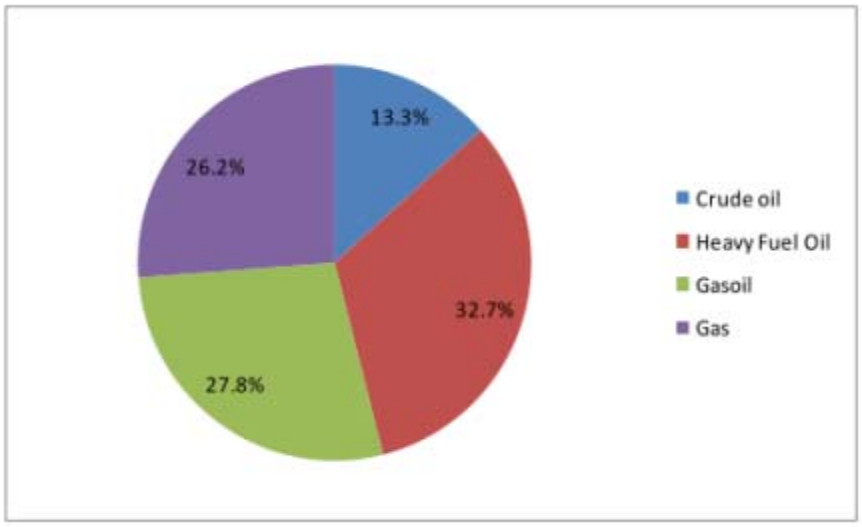


Figure 12. Fuel mix for electricity generation 2009[40]

[40] Parsons Brinkerhoff (2010), *Iraq Electricity Master Plan*.

24. The NES prescribes a national power system expansion to include renewable energy generation entering into the power generation mix in 2014, and contributing 5% of total capacity by 2030. It estimates that wind and solar can contribute 1.2 GW to Iraqi power generation by 2025.

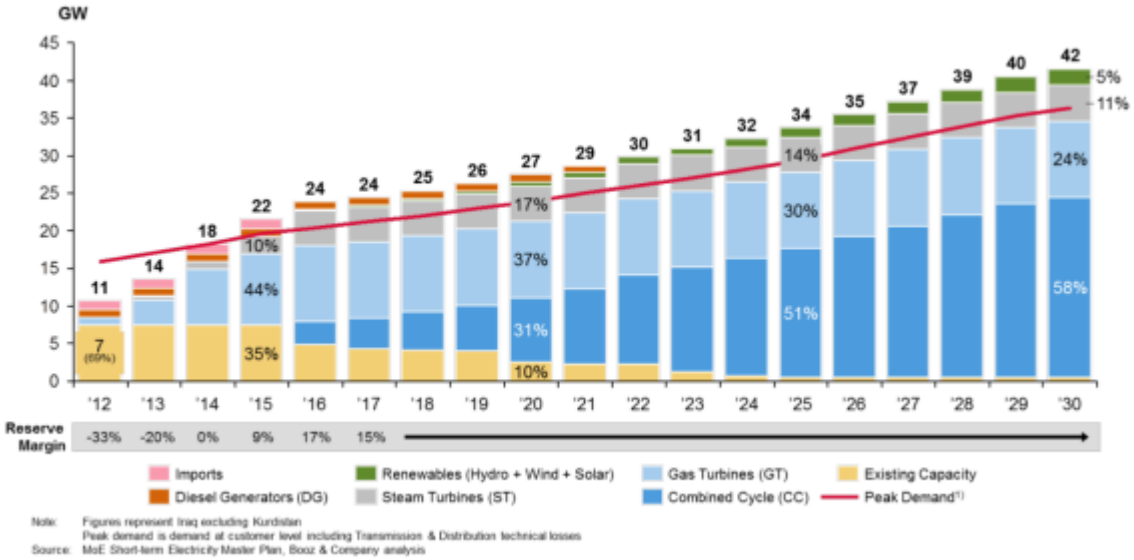


Figure 13. Planned expansion of Iraq's generation capacity by source[41]

25. The NES calls for a focus on developing Iraq's generation, transmission and distribution capacity in the short-term, reaching an acceptable level of supply reliability by 2016. Thereafter, Iraq will embark on a programme of tariff reform and demand-side management measures. These measures include: building and energy efficiency codes, load control, district cooling in high-density areas, replacing electricity with gas use (for example, in kitchens), and solar water heating.

26. Iraq's NES places particular emphasis on the development of solar power to supply Iraq's off-grid power requirements in the near-future as an alternative to diesel, and to help supply on-grid demand in the medium- and long-term. This is in contrast with the 2010 EMP, which does not mention renewable resources at all. The contrast illustrates the shift in thinking, and the developments taking place, within Iraq. Whereas four years ago renewable energy was not even considered as a component of the national energy strategy, it has now evolved into a significant element and one that has led MoE to establish an initiative to develop 16 on- and off-grid solar power plants distributed throughout Iraq, with a total capacity of 36.5 MW. Five of these plants are planned to be hybrid solar-wind plants. Thus far, the provisional selection has established the following sites:

- Al-Waleed (3.5 MW PV, hybrid)
- Treibeel (3.5 MW PV, hybrid)
- Al Nukheib (5 MW PV)
- Al-Salman (6 MW PV, hybrid)
- Al Ruffia (1 MW PV)
- Al Khairy (2 MW PV)

[41] Booz & Co., *Integrated National Energy Strategy*, 2012

- Al Khuasa (1 MW PV)
- Al Dawaia (1 MW PV)
- Shbaka (2 MW PV)
- Al-Sheeb (3 MW PV)
- Bazirgan (1 MW PV)
- Shalamcha (3 MW PV)
- Rahmania (3 MW PV, hybrid)
- Iskandarona (1.5 MW PV, hybrid)

27. Two sites are still to be nominated. MoE has asked the Ministry of Science & Technology (MoST) to study three sites, Al-Waleed, Treibeel, and Shalamcha, with an additional three sites to be selected for study in the near future.

28. MoE has also taken the important institutional step of creating a Centre for Renewable Energy and Environment (CREE), which will be responsible for the development of renewable energies in Iraq. The Centre is in its infancy with only two staff members, but already it has been responsible for MoE's initiative relating to the 16 solar plants. Moreover, the Regulatory Department has recently been established with the mandate to establish a regulatory framework to support private-sector power generation, through instruments such as power purchase agreements, feed-in tariffs and net-metering. Despite these initiatives, significant progress has not been made. Despite plans to begin construction on the 16 plants last year and available funding, none have started for lack of technical knowledge and an enabling environment. The project will provide MoE with the support needed to help it deploy the resources to achieve these projects.

29. The Renewable Energy Research Centre (RERC) at the University of Anbar is the most active research institution in solar and renewable energy in Iraq. Several projects have been undertaken at RERC, including: design and analysis of intelligent fault-tolerant controllers for transmission line systems based on solar energy injection; design and implementation of computerized solar cell testers; remote data acquisition from weather stations based on solar energy systems; and automatic irrigation systems using solar energy in remote areas. Of particular importance to the project are RERC's efforts at developing a solar resource map for Iraq. To this end, RERC has installed a solar measurement station in the city of Ramadi capable of tracking the sun and measuring direct and diffuse solar radiation.

30. The Ministry of Science and Technology's (MoST) Renewable Energy Research Directorate has a number of initiatives underway to study solar equipment in Iraq. Amongst these, as examples, MoST has studied deep-cycle AGM batteries for solar street lighting, the use of mono- and poly-crystalline silicon cell efficiencies in Iraqi conditions, hybridization of solar and wind power, collaboration with RERC on the development of a solar atlas for Iraq, and development of a modular solar 'generator' unit of 1 kW, which can be deployed in remote locations. The Renewable Energy Research Directorate also investigates the use of solar energy for specific applications, for example for schools (which operate during the day, and hence can cover very large percentages of their power needs through solar energy). Other specific applications investigated include water pumping, street lighting, drip irrigation and remote off-grid power.

31. Al Mansour Company, owned by the Ministry of Industry (MoI), installs solar power systems and manufactures solar equipment, including assembly of solar modules from imported components,

lamination of solar cells with appropriate backing, and wiring into modules. As a Government-owned company, Al Mansour's focus is on promoting and localizing technology rather than generating immediate profit.

1.3. Institutional framework and stakeholder analysis

32. A principal benefit of the project will lie in strengthening the institutional framework and inter-institutional cooperation on renewable energy, and specifically solar energy. Although there are a number of initiatives under development by a range of individual stakeholders, it became abundantly clear during project preparation that: (a) there is relatively little inter-institutional interaction at the current time, and (b) the various institutions would positively welcome such interaction.

33. The Ministry of Electricity (MoE) is the main body responsible for electricity supply in Iraq. It consists of four General Directorates: Generation, Transmission, Distribution, and Other (mainly relating to implementation of projects, testing and technical facilities). Each General Directorate consists of geographically-separate Directorates responsible for their respective scope of service within their geographical designation (Figure 14).

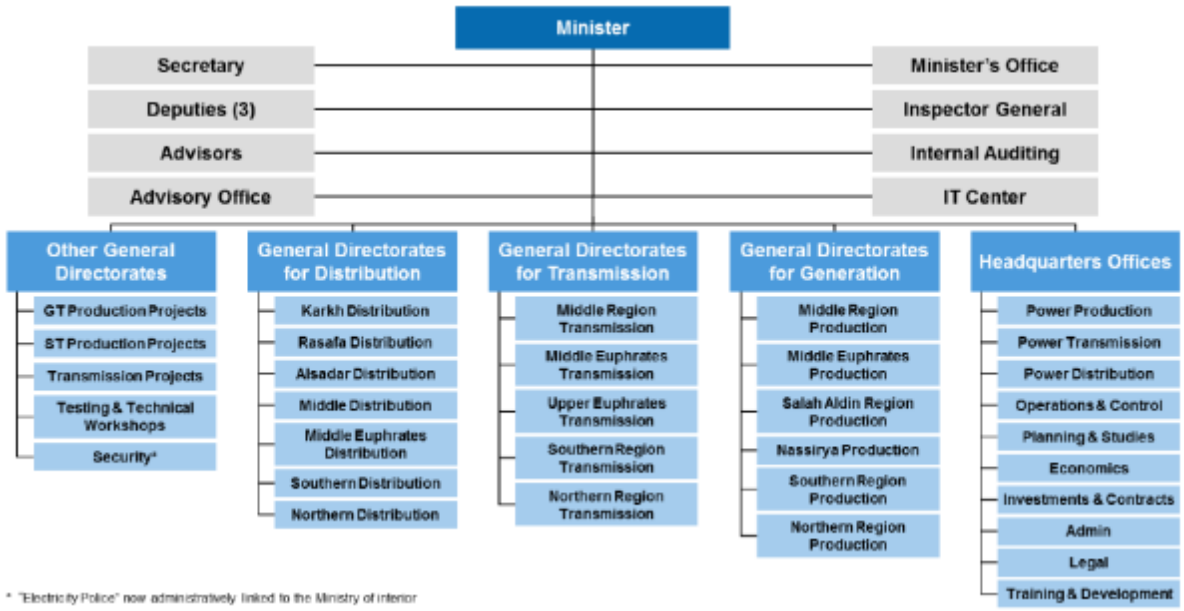


Figure 14. Ministry of Electricity organizational chart

34. Within MoE, there are two recently established entities: the Centre for Renewable Energy and Environment (CREE) and the Regulatory Office. Organizationally, they fall under Headquarters Offices in the chart shown in Figure 14. Both institutions were established in 2012 and form part of the institutional apparatus of the draft Electricity Law that MoE is currently preparing. Both institutions are currently small: CREE has two part-time employees and the Regulatory Department has one. CREE is tasked with the promotion of renewable energies, including supporting initiatives such as feed-in tariffs, net-metering, tax exemptions, etc. The Regulatory Office is tasked with developing the regulatory framework required for the evolution of the power sector in Iraq, both renewable and conventional. This includes, for example, preparing regulations for private power

generation, grid access, licensing, power purchase agreements and the format for price determination (whether public tender, fixed price, etc.). Together, CREE and the Regulatory Office represent a nascent platform for providing the incentives and regulations needed to promote renewable energy. They will be significant stakeholders in the project and the recipients of significant technical assistance. As part of the project, MoE will be directly involved in the development of 16 solar power plants, with a total capacity of 36.5 MW, with total co-finance of $200 million. These plants, through operational monitoring, will also form the basis for lessons-learned and capacity development to be applied to future plants.

35. The Ministry of Environment (MoEn) is the principal Government body concerned with greenhouse gas mitigation and the reduction of other pollutants, such as particulate emissions from diesel generators. The Ministry of Environment is the Focal Point for the UNFCCC and is in the process of writing the Initial National Communication (supported by UNDP and UNEP). The Ministry has identified renewable energy as the focus for mitigation efforts. The Ministry will be the Focal Point for this project and will be responsible for collecting the monitoring data from the various project pilots and packaging that information for public dissemination. The Ministry will be involved in public awareness campaigns regarding the benefits of solar power. The Ministry will also help with discussions and coordination for the required policy and regulatory reforms to spur the development and growth of the solar power industry in Iraq. The Ministry of Environment will also lead the Nationally Appropriate Mitigation Action (NAMA) elements of the project.

36. The Ministry of Science and Technology (MoST) is already engaged in a number of initiatives involving solar energy, as described in the previous section. In the context of the project, MoST will be involved in the technology selection process and will therefore have the opportunity to contribute some of the experience it has acquired to date as well as further develop its capacity and that of other stakeholders. MoE has already requested MoST support for site selection and basic planning for three sites of the 16 that MoE intends to use for solar power development. Since 2006, MoST has been actively examining solar energy applications that suit Iraqi conditions (for example, experimentation with solar-tracking PV panels, and with various solar-powered applications). MoST has also examined a range of rooftop units to be used to generate power for household consumption, and also to feed to the grid. MoST is the Iraq focal point for the International Renewable Energy Agency, IRENA. Because of its previous work, MoST is one of the entities best positioned to advise on the practicalities of operating solar equipment in the heat and dust of Iraq.

37. Anbar University’s Renewable Energy Research Centre (RERC) is the most active academic centre in the field of renewable energy in Iraq. There is a history of cooperation between RERC and MoST on various research projects. Anbar University's RERC was established as part of a cooperation project with UNDP in which the University provided space, facilities and personnel to support the Research Centre, and UNDP provided technical assistance and equipment (solar and wind testing equipment to date, as well as reference materials). A principal focus of effort at present is the development of a solar radiation atlas for Iraq, in cooperation with MoST. Other efforts are detailed under the previous section. RERC is a recipient of technical assistance for solar mapping under the project. It is also an important participant in the capacity building component of the project to encourage replication throughout Iraq of the solar plants installed under the project.

38. Al Shafei is a private-sector conglomerate that is developing the Bytti Complex, a 1,300 home community that will incorporate 5 MW of distributed (small-scale, roof-top), grid-connected PV solar power. As such, Bytti will become the first community in Iraq with solar power. Supported by

Najaf Investment Board, Al Shafei is promoting the Bytti complex having a solar energy component as part of its efforts to present housing there as both 'green' and as having reliable power free from the adverse effects of diesel generators that plague much of Iraq. (Though Bytti will have some back-up diesel generation, it will be located away from the homes in a well-maintained central plant and will feed the same Bytti mini-grid rather than creating its own ad-hoc grid of elevated cables so as to provide minimal disturbance to residents). The Najaf Investment Board supports the project as a new model for housing, which, if successful, can be replicated throughout Najaf province and the country.

39. There are a number of other small stakeholders involved in the development of solar projects – mainly off-grid – in Iraq, whether as Government-owned or private initiatives. Al Mansour Company, wholly owned by the Ministry of Industry (MoI), is the largest assembler of solar PV modules and components. It has also begun to invest in manufacturing capacity for several of the balance-of-plant (BoP) components, such as the steel frames on which the PV panels are installed. These are already manufactured in Iraq, as discussed in the previous section. Other Iraqi firms working in the field include Iraq Global Technologies, a supplier of solar power systems for on-grid and off-grid applications, and Faidh Al Wafa General Trading.

Table 3. Stakeholders and Co-Finance Contributions

Stakeholder	Role	Co-financing Amount ($)
MoE	Development of regulatory framework; development of 16 utility-scale plants, totalling 36.5 MW	20,000,000
Al Shafei	Developer of the Bytti complex, with 5 MW of rooftop solar PV.	10,000,000
MoST	Solar resource measurement and mapping; capacity building	2,500,000
University of Anbar RERC	Solar resource measurement and mapping; capacity building	-----
UNDP	Project implementing agency	215,200
MoEN	National Focal Point	200,000
MoI&M	Through Al Mansour Co. (owned by MoI&M), a manufacturer of solar equipment	50,000

2. Strategy

2.1. Project Objectives, Outcomes, and Outputs

40. The objective of the project is to reduce greenhouse gas emissions in Iraq by demonstrating and catalyzing the application of solar power to meet the energy needs of offices, small businesses, residences and town services through small-scale distributed solar PV installations and utility-scale plants, on- and off-grid.

41. The UNDP-implemented, GEF-financed project will advance the work done to date in Iraq with regard to solar power technologies and related baseline initiatives. It will facilitate the most practical and affordable range of solar power options that can meet the operational conditions in Iraq and address the most critical electricity demands. The project will build on the work completed to date by MoST and the Renewable Energy Research Centre of the Anbar University, will create the required policy and regulatory environment to catalyse the adoption of solar energy, will support the procurement and assembly of parts (or complete units), and will promote PV installations that allow monitoring for further effectiveness. The project will act at two distinct scales, in support of: (i) distributed, small-scale PV that can operate both on- and off-grid, providing particular technical and investment support to the innovative, first-of-its-kind 5 MW (in aggregate) Bytti development in Najaf; and (ii) to utility-scale PV plants for grid supply, providing particular support to MoE's ambitious solar plant construction programme.

42. The proposed project will advance the baseline project in four critical areas:

- By designing, piloting and monitoring selected solar photovoltaic technologies for distributed generation applications. In the case of Government-funded activities (e.g. the design assessment work led by the Ministry of Science and Technology), the project incrementality arises from the GEF's catalytic role in initiating and accelerating plans that have been 'on paper' for some time. In the case of private-sector involvement in installing 5 MW of distributed solar PV units in the Bytti project, the incrementality arises from the fact that the developer will face significant difficulty implementing its PV plans without the technical assistance provided by GEF involvement. Further, with GEF assistance the Bytti project will be enhanced from being merely a set of autonomous (unlinked) rooftop PV installations to being an integrated mini-grid that can distribute PV-generated electricity throughout the town (i.e. between residences) and that can supply the grid (i.e. as an Independent Power Producer). The project will also promote replicability by strengthening and supporting the involvement of Najaf Provincial Board and Investment Board.

- By supporting a first wave of utility-scale plants, to be developed by MoE, as demonstration plants to be later emulated by IPPs. By developing the initial wave of utility-scale plants, MoE will bear much of the initial risk, therefore reducing this risk for later IPPs through dissemination of monitoring data and experience gained in implementation.

- By stimulating investments in solar power technology and increasing consumer uptake of such technologies through new policies, tools and financial incentives.

- By facilitating private sector capacity for solar technology development and servicing, through awareness-raising, training and dissemination sessions on the IPP concept.

Based on interviews with stakeholders and the Ministry of Electricity, solar hot water heaters do not represent a priority and will not be addressed by the project. They are not thought to be a major component of demand, especially in times of high heat (mid-summer day), and therefore high electric load. Further, the heaters currently on the market can tolerate some power outage (a few hours) while still delivering hot water that has been stored in their insulated tanks. Even if power is lost for an extended period, lack of hot water is relatively well tolerated by consumers in contrast to the lack of electricity for other services. Unlike PV units, which can provide power and thus have a benefit other than strict economic savings, the only real benefit of solar water heaters to the user is to reduce cost. Given that they do not achieve this, their adoption is not likely. From the perspective of the individual home-owner, who pays very little for electricity, neither hot-water heaters nor solar PV are cost-effective. The difference lies in three main points:

- Utility: The only use of a hot water heater is to heat water, which is not of great value or urgency (one can easily live without a hot water heater for a few hours a day), especially in a hot climate such as Iraq. By contrast, PV panels generate electricity, which has a great many uses. It is much more difficult to live without electric power for a few hours per day in Iraq than it is to live without a hot water heater. Thus, a direct comparison on a purely economic basis is not justified as solar water heaters and PV generators satisfy different needs for the consumer.

- Given the level of subsidies in Iraq, both solar water heaters and PV will require Government incentives (the exception is for industry). Currently, there is a Government initiative on the promotion of solar technologies as they are seen to offer help in alleviating Iraq's power shortages. There is comparatively little being done to manage the demand-side with solar water heating. Thus, the deployment of the limited GEF funds to promote solar PV is significantly more cost-effective than deployment of GEF funds to promote solar hot water heaters because they impact the entire power sector rather than one small component of demand (water heating), because they address a much stronger need (having electricity rather than hot water), and because they leverage existing Government support and finance for solar PV.

- Scale: while specific data are not available regarding the fraction of electricity demand that is attributable to electric water heaters, it was estimated during the PPG process to be less than a few percent of overall demand (given that AC is approximately half of demand, water heating is less than 10% of the remaining half, making it less than 5% of overall demand). It is also not a demand sector that can be expected to grow rapidly. Therefore, a focus on solar PV has the potential to have much greater impact.

43. These four elements are expected to work in synergy, organizing and enhancing the baseline project so as to promote global environmental benefits (enhanced climate change mitigation) and making the transition from loosely-connected concepts and exploratory solar power technical and institutional initiatives to coherent and targeted investments, which in turn will encourage uptake and replication that will ultimately anchor solar power as a fundamental element of the national energy strategy in Iraq. Details for the four project components are provided below.

44. One of the ever-present risks when introducing new technologies to a market and developing accompanying capacity building is that the capacity building will not be synchronous with the market demand, resulting either in implementation difficulties because of a lack of capacity or loss of the built capacity because there is no immediate use for it. To help avoid this situation, the project intends to proceed in an integrated approach, whereby the initial implementations (41.5 MW) will guarantee initial demand for the skills and capacities that are built through the project. This allows a buffer whereby those trained under the project are well utilized in roles created directly by the project until the market begins to react to incentives and creates organic demand for the skills and capacities developed under the project.

Outcome 1: Investment in solar photovoltaic power technologies for on-grid and off-grid electricity generation for office, residential, small business and town application

45. The principal aims of this outcome of the project are:

- To enable the installation of 5 MW of distributed solar PV rooftop units by providing technical assistance and investment to support the implementation of the Bytti Model Town project and to maximize the benefits of the installed panels, and the replicability of the demonstrated model, through intelligent integration within the Bytti grid and with the national grid. The residential installations will be designed to operate when the grid is not functioning and this will be a key contribution of the UNDP-implemented, GEF-financed project. In the absence of the designs and technical assistance to be facilitated by the project, the solar units would not generate electricity when the grid is not functioning and would therefore be of considerably less use. Under the baseline design, the Bytti community would be able to disconnect from the grid when the grid is not functioning and provide its own power through a diesel generator. The UNDP-implemented, GEF-financed project will allow rooftop PV power to continue to be generated on the complex's mini-grid, thereby facilitating a solar/diesel hybrid system. This is attractive to the Al Shafei as it reduces its reliance on diesel, and reduces air and noise pollution within the Bytti complex. It also increases the value of residents' properties.

- To enable the implementation of 16 large-scale utility PV plants, on- and off-grid, by providing MoE with technical assistance, and to promote replication by recording and monitoring appropriate parameters from the plants. The monitoring will provide field-verified data on the energy output and availability of solar energy in prevalent Iraqi site conditions, therefore removing one of the risk elements in developing solar plants.

46. The project will help realise these aims specifically through three activities, to be performed with Al Shafei in support of its 5 MW of PV installations and with MoE in support of its 16 utility-scale installations. These three activities are:

- Assessment of appropriate system design for purpose, selection of components, and investment in unaccounted-for components for grid integration and control;

- Assistance, review and supervision of the design, tendering and implementation of the power installations/plants to ensure that implementation is according to design;

- Design of monitoring and evaluation schemes, monitoring and evaluation of the installations/plants under operation, investment in monitoring equipment, documentation of installation/plant operation and lessons from implementation to reduce the upfront risks for future projects.

47. These activities are to be replicated for Al Shafei's rooftop installations as well as for MoE's utility-scale ground installations, each with appropriate consideration for their circumstances.

48. Residential systems and utility-scale systems pose different challenges in implementation. Residential PV systems have largely developed in response to government incentives and feed-in tariffs in Europe, the US and – more recently – Japan. As a result, the technology for these systems has evolved to suit these particular markets. As an example, almost all grid-connected (so-called 'grid-tie') residential solar inverters are designed to 'synchronise' their power to the grid and disconnect the solar panels when the grid goes down. This is for safety, to avoid 'islanding'. From an economic perspective, operating the solar units is only reasonable when the grid is available and thus the owner can obtain the feed-in tariff or other incentive. Grid outages are sufficiently rare for PV system owners not to be concerned with what happens when the grid is out. By contrast, in Iraq there are significant benefits to having inverters that can disconnect from the grid when the grid is out and yet which continue to feed the loads of a house or community. In the case of Bytti, for example, where the community will have back-up diesel power, implementing an interface between the PV systems on individual homes with the Bytti mini-grid, the diesel power station and the national electricity grid presents a clear opportunity to maximize the use of the PV panels.

49. Inverter manufacturers are beginning to react to the emerging market in countries where the grid is unreliable by introducing models that can feed household loads even when the grid is out.[42,43] However, these models remain significantly more expensive than conventional grid-tie inverters. The Bytti project offers the opportunity to design an electric system on the scale of a sizeable mini-grid, whereby the scale of the project can be used such that the control and interface electronics are centralized. This will allow the use of conventional grid-tie inverters, along with diesel engines as backup, whilst avoiding the synchronisation deficiencies of such inverters in the Iraqi (unreliable grid) context. The result will be a replicable model of a community grid with high reliability, low cost and significantly reduced greenhouse gas emissions. These opportunities were not envisaged by the project developers in the baseline and would not occur in the absence of the UNDP-implemented, GEF-financed project. While the project will support general technology selection and implementation, it will also create a previously non-existent advantage of grid integration.

50. For utility-scale PV plants, the challenges are different. MoE had $200 million allocated in budget in 2013 for development of utility-scale plants, but was unable to deploy these financial resources because of a lack of human and technical capacity to launch appropriate planning, site selection, tendering, procurement and acceptance procedures. As a result, the funds were not spent and no solar capacity was built. By enabling such procedures through targeted technical assistance, the project will unlock the allocated funding resource and enable MoE to proceed with its plans for implementation.

[42] SMA (2013), *Grid Tied Inverters*, http://www.sma-america.com/en_US/products/grid-tied-inverters/sunny-boy/sunny-boy-3000tl-us-3800tl-us-4000tl-us-5000tl-us.html.
[43] Wilson, A., Aug. 7, 2013, *Beating the Achilles Heel of Grid-Tied Solar Electric Systems*, http://www2.buildinggreen.com/blogs/beating-achilles-heel-grid-tied-solar-electric-systems.

51. Both the distributed installations and utility-scale plants provide excellent opportunities for monitoring operational aspects of the selected units, while at the same time bringing benefits to thousands of consumers during the project period. An activity under this outcome is explicitly dedicated to monitoring of operational aspects with a view to developing concrete field data for optimization of modelling and operation of subsequent projects. Monitoring will provide several benefits. Chief among these is providing field-verified data on the energy yield and grid interaction of the solar plants. With the availability of this data, a considerable element of risk in future developments is removed, as energy yield is typically one of the least certain factors in a solar plant and one which developers spend a considerable amount of money studying to reduce their risk prior to investment.[44] The monitoring will help establish the electrical behaviour of the grid and the PV plants. This information (along with inputs from MoE and international experience) will be used, as part of the activities supporting this outcome, to establish a grid code setting the technical requirements for connecting solar PV to the national grid, both at utility scale and at residential scale.

52. With successful replication of installations over the next 10-15 years, most of the population of Iraq, about 33 million people, could benefit from solar power. Experience around the world indicates that ongoing technology development and refinements, and eventual mass marketing, inevitably lead to eventual reduction in unit costs, especially for items that are in high demand.[45] This is particularly true as a cadre of skilled installers develops, as well as a supply chain of importers, wholesalers and retailers with expertise in solar energy.

Outcome 1	Outputs	Activities
Investment in solar photovoltaic power technologies for on-grid and off-grid distributed electricity generation for office, residential, small business and small town application.	1.1 Assessment of PV technology, including cost-benefit analysis of a range of configurations, for distributed solar rooftop units suitable for the Bytti project in Najaf, with total capacity of 5 MW.	1.1.1 Evaluation of crystalline (mono and poly) and thin-film technology PV modules, and calculation of the most suitable performance ratios for each for small PV systems based on technical data and field measurements. 1.1.2 Evaluation of suitable inverters, taking into account grid characteristics, ability to provide power during outages, ability to handle frequent grid disturbances, and ability to integrate storage. 1.1.3 Establishing required grid connection equipment and isolators in the short-term absence of a grid code and reliable grid.

[44] To help define the likelihood of certain energy outputs, values such as P50, P70, and P90 are defined. They are the energy yield values that are likely to be achieved with 50%, 70%, and 90% certainty, respectively. These values are important indicators to plant financiers of the certainty that a plant will yield the energy it was designed to yield under site conditions.

[45] For example, see Naam (2011), *Smaller, Cheaper, Faster: Does Moore's Law Apply to Solar Cells?,* Scientific American blog, March 16, 2011, www.ScientificAmerican.com.

	1.2 Design, construction and operation of distributed small-scale rooftop solar PV power systems (total 5 MW) for town services in Bytti.	1.2.1 Design and sourcing of local mounting structures, security measures and cleaning procedures to avoid dust-related performance reduction procedures. 1.2.2 Design of electrical connections to integrate with home electrical systems and the grid, to form a mini-grid for the Bytti project, which can help support the Bytti project during power outages 1.2.3 Training of personnel on inverters, isolators and compliance with the grid code (developed with the assistance of the project) for appropriate operation and management of the rooftop PV systems and mini-grid.
	1.3 Monitoring data for operational aspects, including power production, distribution and domestic use of solar power supply, to allow performance evaluation.	1.3.1 Purchase and installation of equipment for monitoring of PV output. 1.3.2 Purchase and installation of equipment for monitoring grid behaviour. 1.3.3 Evaluation of recorded data in support of system performance evaluation and optimization of use of solar to supply mini-grid when power is out, and grid connection recommendations.
	1.4 Selection of sites around Iraq for 12 off-grid utility-scale PV plants, and 4 on-grid plants, as a model for IPPs and utility solar power.	1.4.1 Solar resource assessment for the proposed sites using ground-based and satellite data. 1.4.2 Feasibility studies for proposed sites, based on the above solar resource assessment and including predicted plant energy yields at P50, P70 and P90 levels, plant performance ratios, temperature, reflection, resistance and other losses.
	1.5 Finalization of tender documents and component specifications.	1.5.1 Assessment of commercial technologies for utility-scale PV power generation, taking into account available area, efficiency, costs and outputs as optimized for a larger ground mounted system. 1.5.2 Assessment of grid connection requirements, requirements for hybrid system support or storage for off-grid systems.

	1.6 Monitoring data for operational aspects, power production, distribution and grid behaviour.	1.6.1 Installation of monitoring equipment at plant location to monitor power plant performance and solar irradiation on-site. This will provide a level of data and analysis to assess operations, such as cleaning, at a level not typically expected. 1.6.2 Installation of grid power quality monitoring equipment to contribute to development of the grid code.

Outcome 2: Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and financial incentives

53. The principal aim of this Outcome is to catalyse private sector investments in solar PV power technology in Iraq, and, at the same time, to stimulate consumer demand for such technologies, to create an adequate and growing demand-side that will continue to encourage solar PV technology investment. The key 'marketing' principle here is to fill the electricity supply gap in areas not connected to the grid (spatial gaps) and to address the frequent blackouts (time gaps) in areas connected to the grid.

54. This Outcome includes four specific activities aimed at achieving the Outcome. They are:

- Development of a framework (set of rules and regulations, a grid code, model contracts, a procedure, financial incentives, etc.) to encourage Independent Power Producers to engage in solar power generation;

- Design of a feed-in tariff and net-metering scheme to provide incentives to solar energy in the most cost-effective manner for the Government of Iraq;

- Development of a solar atlas, showing the country's solar resource, which may vary due to geography, suspended matter, humidity, etc. The atlas will then be overlaid onto other geographical information (e.g. electric grid location, population, topography, etc.) in a Geographical Information System (GIS) to highlight areas that may benefit the most from solar power.

- Development of a NAMA around the feed-in tariff or net-metering scheme to help mobilize climate finance as support for the nascent solar energy sector.

55. The Government's current interest in the Independent Power Producer (IPP) concept (which is included in the Electricity Regulatory Law currently being drafted, and which will be further informed by this project) forms a strong context in which the necessary policy reforms and financial incentives can be defined to spur both consumer demand for, and private sector investment in, provision of solar PV technologies. Furthermore, there is a significant opportunity to develop distributed generation systems with minimal dependencies on existing infrastructure and institutional processes. At the same time, there is a significant opportunity for policy development

that will encourage IPPs to sell excess solar power back to the electricity grid (especially during peak load periods experienced in the daytime), which will in turn encourage further investment and address the pressing issue of load-shedding.

56. The current policy and regulatory environment does not specifically address the technology needs of solar power development. The project will analyse and clarify the 'pros and cons' of various policy and regulatory options, and will work with the Government to introduce, implement and enforce a sensible and clear policy/regulatory re-direction that will spur solar power technology development and servicing in Iraq. Specifically, the activities under this outcome will support the development of regulations for the generation and sale of power by private participants to the national grid. The project will define the legislative and technical aspects of connecting multiple independent generators and users to the grid. The legislative aspects will include issues such as point of interconnection, payment terms and calculation of imputed power. The technical aspects will include the requirements for interconnection, the response to voltage and frequency fluctuations on the grid, time response requirements for PV installations/plants, and required disconnect conditions. These aspects will be captured in the development of a standard Power Purchase Agreement (PPA) and a technical grid code. Demonstration of compliance with both will be required in order for an IPP to obtain a generation licence and grid interconnection approval.

57. The project will examine solar electricity policies and financial incentives (for private sector investment, as well as encouragement of consumer demand) in other jurisdictions in the region, notably in Lebanon, Jordan, Egypt and the Gulf Cooperation Council (GCC) states, as well as globally. The experiences of other countries will be used to help design an appropriate feed-in tariff, sensitive to geographical zoning and other variables as may be required. As part of the design of the feed-in tariff, detailed cost-benefit analyses of both utility-scale PV power plant design and distributed (rooftop) solar PV, for different volumes of installation and different scales of end-users, will be conducted to allow policy and financial incentive targeting that will reduce the cost aspect of developing these two PV applications. Consideration will also be given to developing various incremental (i.e. beyond the baseline) financing instruments, such as local bank loan schemes (low-interest loans and long payback periods) and tax breaks. Preliminary discussions with the Ministry of Finance and the Prime Minister's Advisory Council have indicated openness to such financial mechanisms provided that the overall benefit to Iraq can be demonstrated by showing that the benefit from reduced fuel consumption and savings on reduced subsidies outweighs the costs of the incentives.

58. Although net-metering is simpler to implement than a feed-in tariff, the electricity tariffs and collection rates in Iraq are such that net-metering does not offer any incentive to consumers. In limited circumstances, where industrial customers are paying US$0.10/kWh, net-metering may provide an incentive for the adoption of solar, perhaps coupled with other incentives such as insulation from some load-shedding. In order for net-metering to be effective, a comprehensive reform of the tariff structure and payment collection is necessary in Iraq. Such reform is very difficult to implement and will likely take several years. For this reason, a feed-in tariff is seen as a parallel route to promoting solar energy, without the need for immediate tariff and collection system reform.

59. Consideration will also be given to ancillary policies and instruments that can support investment in solar power technologies, such as streamlined planning permission for installing solar PV units on roofs. There will also be a requirement to establish quality control of the products and services that

will eventually be available on the market. Such quality control standards, requiring for example that installers be licensed and that equipment conforms to international standards, will be developed as part of the project. To support the effort to increase consumer demand for rooftop PV, there will be broad public dissemination of rooftop solar PV options (based on Outcome 1), as well as information about the associated costs and benefits.

60. A solar resource map will be developed in conjunction with Anbar University Renewable Energy Centre and MoST. Solar measurement stations will be deployed at five locations (or more, if resources allow) throughout Iraq to measure solar and meteorological parameters (direct normal irradiance, diffuse irradiance, temperature, humidity, wind speed and direction). The data collected will be integrated with satellite data (and coordinated with the International Renewable Energy Agency's ongoing solar data collation activities) so as to provide site-specific data on renewable energy potential, thereby gradually building up a resource that can facilitate private (and, indeed, public) sector investment decisions. The data will then be overlaid onto a GIS map containing topographic, demographic, infrastructure, water access (as a proxy for the need for pumping) and other 'layers' to highlight areas that are best-suited to solar development. As an example, if the target is to develop utility-scale on-grid plants, then the map can be used to search for suitable areas which may be within a specified distance from a transmission line but beyond a certain distance from population centres, for instance, to facilitate site identification. Alternatively, the map may be used to highlight areas where there is significant power demand (likely supplied by diesel generators) but which are too far from the national grid to be economically connected. These may be good candidates for off-grid solar power.

61. The Ministry of Environment, which serves as the UNFCCC Focal Point and the CDM Designated National Authority, will be provided with training support to enable it to become an effective NAMA National Designated Authority (NDA) for Iraq. Prior to being able to attract funding through dedicated climate funding mechanisms to support the implementation of NAMAs, the country must first demonstrate that a thorough and transparent methodological approach has been used to develop NAMAs. Building on proven CDM elements, such as the CDM grid emission factor tool, the tool to demonstrate additionality, baseline development and the MRV approaches adopted by CDM renewable energy methodologies, the project will adapt these carbon finance building blocks to serve as a robust NAMA approach that will be enforced by the NDA.

62. The feed-in tariff or net-metering scheme developed with project support will be developed as a NAMA, partly as a means of leveraging additional climate finance (subject to the status of international NAMA support options in the future – for instance, through the Green Climate Fund or bilateral/multilateral donors) and partly as a relatively straightforward learning-by-doing exercise for MoEn and MoE to engage in subsequent NAMA development.

Outcome 2	Outputs	Activities
2. Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and	2.1. Approved and enforced revised policies and regulations, and new financial incentives, to encourage solar power industry development (private sector) and consumer uptake, including removal of import tariffs on components;	2.1.1 Development of regulations and laws allowing generation and sale of power by IPPs. 2.1.2 Development and implementation of a grid code for distribution and transmission (for small-scale distributed generation and larger

financial incentives.	introduction of subsidies and tax credits to promote investment in, and installation of, solar units; and clarification of IPP policies, with inducements to accelerate solar PV power plant development throughout Iraq.	utility-scale generation). 2.1.3 Design and implementation of a process for IPPs to engage in standardized PPAs with the Ministry of Electricity, to acquire generation licences and to inter-connect with the grid. 2.1.4 Development of model contracts for power purchase agreements. 2.1.5 Implementation of phased fiscal incentives for PV uptake, including partial removal of import taxes on solar panels.
	2.2 Examination of inter-connections between distributed power producers and the grid, design of a feed-in tariff and net-metering options, and support to the Government to implement the feed-in tariff and/or net-metering scheme; evaluation of tendering schemes where appropriate.	2.2.1 Design of a feed-in tariff for renewable energy IPPs with appropriate pricing calibration, geographical zoning and regression schedule. 2.2.2 Evaluation of net-metering options for industrial and residential applications. 2.2.3 Evaluation of a range of policies for specific circumstances, such as tenders for large solar installations. (suitable for Iraq's environment) 2.2.4 Support to implementation of the feed-in tariff and/or net-metering scheme.
	2.3 Development of a renewable energy database (solar map) containing site-specific data on RE potential to facilitate investment decisions.	2.3.1 Installation of solar resource measurement stations distributed throughout Iraq, including side-by-side solar panels for the measurement of dust collection and cleaning efficacy techniques. 2.3.2 Modelling of the data collected, together with existing satellite and terrestrial data, to develop and evaluate a solar resource database and map to assist investment decisions and minimize the risk of plant underperformance.
	2.4 Development of the feed-in	2.4.1 Development of a set of guidelines

	tariff as a policy NAMA, with corresponding baseline, MRV and institutional systems developed.	to establish national NAMA eligibility and design criteria. 2.4.2 Strengthening the Iraqi DNA as the national coordinating institution and quality assurer for NAMAs. 2.4.3 Establishment of a baseline for calculating emission reductions from grid-connected renewable energy through development of a tool for annually updating the emission factor of the national electricity system. 2.4.4 Development and implementation of an MRV framework for the NAMA.

Outcome 3: Facilitation of private-sector capacity for technology development innovation and servicing in the solar industry through capacity building and domestic market analysis

63. The principal aim of this Outcome is to remove the current barriers to direct private-sector engagement in the solar power industry in Iraq through increasing private-sector actors' understanding of the sector and their capacity to engage with it. A key point to be emphasised is that there is significant 'pent-up' demand for solar PV in Iraq, especially in areas where new residential and office construction is planned or underway. Such areas are not currently well-served by the electricity grid. The owners/occupiers have the financial resources to afford the acquisition and operation of most required appliances, including solar-power options, but do not have sufficient knowledge of the most practical options, nor how to actually procure and install solar PV rooftop units. Developers are very willing to make the investments (and they expect reliable cost-recovery in the process): they simply need to know what is most suitable for Iraq's conditions and then procure accordingly.

64. Whereas Outcome 2 sets the stage for overall development of solar power technology in Iraq and consumer demand for it, through appropriate policy development and financial incentives, Outcome 3 focuses on technical capacity development and certification schemes to lever private business into the installation and servicing of rooftop solar PV units and the components for solar PV power plants. The overall approach for this outcome lies in the development of a solar power market demand/industry response strategy for Iraq, informed by case studies from other countries with developed solar power industries. The Iraqi private sector and relevant Government agencies will be exposed to all aspects of the industry (technology development, supply, servicing, financing), through technical assistance, exposure to specific industries in other countries (and subsequent mentoring in Iraq), and roundtable discussions of the most appropriate mechanisms for developing Iraqi capacity in this area. There will be an effort to match-up private-sector capability throughout Iraq with the expected demand in different parts of the country (which is expected to be variable because of varying population and varying connectivity and reliability of the grid). This effort will be supported by development and delivery of certified technical training on solar PV technologies

(hybridization, supply, service) for the firms that are appearing in the nascent solar sector. Mechanisms for monitoring the quality of both installations and servicing will be established, to give strength to eventual certifications and guarantees.

65. There will be a similar effort related to solar PV power plants, which will require a more sophisticated understanding of the techno-economic aspects of the industry. This will involve technology review and cost-benefit analysis of utility-scale – but initially relatively small (5 MW) – solar power plant options for Iraq (coming from Component 1).

66. Under this outcome, the project will develop a database of solar market participants in Iraq (installers, manufacturers, importers, etc.) to help provide targeted assistances and capacity building to these entities. A few of these already exist, as previously mentioned – specifically, Al Shafei, Al Mansour and others (notably Faidh Al Wafa General Trading[46] and Iraq Global Technologies[47]). Specialised private financiers also exist, such as Lukemani.[48]

67. A programme will be developed to help enable small local solar power IPPs to take advantage of regulations and other developments supported by the project. As part of the project's awareness-raising, study tours will be arranged to relevant countries with solar PV markets (e.g. UAE, South Africa). In addition, visits will be arranged to industry events, such as trade shows, and other points of interest, such as manufacturers or significant installations around the world. The objective is to create a group within Iraq that is well connected to the international solar industry and well aware of its developments such that this group can exploit these developments in the Iraqi context.

68. As part of the capacity building component of the project, a training programme will be developed providing both academic and vocational training and certification to create a cadre of competent solar professionals. The training will cover all aspects of the solar power life-cycle, from initial design to operation and maintenance. The training will be conveyed through national and regional networks of universities, teaching and training centres. Anbar University, as the most advanced academic institution in Iraq in solar energy research, will play a central role in this activity.

69. To develop widespread awareness of solar energy and encourage new participants in the marketplace, a set of awareness and knowledge materials will be developed that specifically target new market entrants and highlight the emerging market opportunities in solar PV in Iraq. A series of stakeholder workshops will be held in conjunction with the provincial councils and investment boards (such as Najaf Investment Board, which is supporting the Bytti project).

Outcome 3	Output	Activity
3. Facilitation of private sector capacity for technology development, innovation and servicing in the solar power	3.1 Solar power market demand/industry response strategy developed for Iraq, informed by case-studies from other countries with developed solar power industries, domestic market analysis, and clarification of	3.1.1 Development of a database of solar market participants (installers, manufacturers, importers, including Al Mansour Co., etc.) to help develop the solar marketplace and to target assistance and capacity building. 3.1.2 Development of a programme to support small, local, solar-powered IPPs to take advantage of new

[46] http://www.lorentz.de/en/references/middle-east__iraq_253.html
[47] www.iraqglobal.com
[48] www.lukemani.com

industry, through technical capacity building and domestic market analysis.	Iraqi private sector opportunities for distributed solar PV power production. Iraq private sector and Government agencies exposed to all aspects of the industry (technology development, supply, servicing, financing).	regulations and other developments. 3.1.3 Study tours for Government officials, the grid operator and IPPs to countries with relevant small-scale and utility-scale PV generation and manufacturing experience.
	3.2 Development and delivery of certified technical training on solar PV technologies (hybridization, supply, service) for emerging private sector companies.	3.2.1Development of training materials and twin-track academic and vocational certification schemes in conjunction with national institutions for modular solar energy training courses covering the full life-cycle of solar investment (site and equipment selection, financing, generation and inter-connection, operations and maintenance, etc.). 3.2.2 Organization of a national and regional network of venues and teaching institutions (including online courses) to deliver the modular training courses to students and relevant professionals, on a full-time and part-time basis, with existing facilities at Anbar University as the focal point of such activity.
	3.3 Development and delivery of dissemination sessions on future IPP involvement in the electricity supply network, including relationships with technology firms and Government agencies, feed-in tariffs and net-metering options.	3.3.1 A set of awareness and knowledge products developed that are specifically tailored to potential new entrants into the renewable power market (IPPs, farmers associations, industry) to inform them of the emerging legal/regulatory framework to be developed and the opportunities arising from solar energy, for both small- and large-scale installations. 3.3.2 A series of stakeholder workshops to be convened to update provincial councils on the emerging national IPP regulatory framework, to standardize provincial government engagement with the framework, to standardize regulations and licensing, and to assist provincial governments in developing locally-based investment incentive schemes for solar energy IPPs. 3.3.3 A mid-term and terminal evaluation to be conducted to assess progress towards achieving the project objective and propose correctional measures where relevant.

2.2. Key indicators, risks and assumptions

70. In accordance with the GEF's Focal Area Objective #3 to "Promote Investment in Renewable Energy Technologies" of the GEF-5 Climate Change Strategy, the key success indicators of the project are:

- Extent to which policies and regulations for decentralized RE are adopted and enforced;
- Volume of investment mobilized; and
- Tonnes of CO_2-equivalent avoided.

71. Specifically, the project aims to achieve the following:

- Installation of 5 MW of distributed rooftop PV in the Bytti development in Najaf
- Installation of 16 utility-scale solar PV plants
- Establishment of Government policies, regulations and financial incentives to promote investment in solar energy
- Completion of technical and regulatory standards needed for connection of private power generators to the grid
- Development of a solar resource map for Iraq
- Development of a feed-in tariff, packaged as a NAMA
- Development of human capacity in Government, the private sector and academia to support a solar energy market in Iraq

72. For further details about the related targets, see the project's Results Framework in Section 3.

73. The principal identified risks to the successful implementation of the project include:

- Security – The security situation in Iraq is unstable. Without general security, the ability of crews to travel, transport goods and work will be restricted. With renewable energy equipment, where the entire capital is procured and installed upfront, theft or damage can mean a complete loss of invested capital.[49] Nonetheless, despite the current situation in Iraq, the Government of Iraq is still fully functioning. The UNDP Country Office is communicating with the Ministries of Electricity, Science and Technology, and Environment on a daily basis. Al Mansour, the Government-owned PV module manufacturer, announced on July 4th 2014 that it is establishing a new PV assembly line. Najaf, the province in which the Bytti residential baseline project is located, is unaffected by the current security situation. Thus, the indications are that, despite the current situation, most enterprises and Government facilities are proceeding with business as usual.
- Political – The Government may fail to marshal the necessary resources or coordination amongst its entities to bring about the desired legislative and regulatory reform.
- Novelty and adoption risk – Private-sector entities in Iraq are slow to adopt new technology and take-up unfamiliar business models, in part because the overall 'ecosystem' of security, regulatory clarity, financing, technical capacity and awareness, does not encourage this.
- Technology risk – Technical failures, either due to equipment failure or poor installation, can lead to loss of trust by targeted customers on the performance of small, decentralized RE applications. The heat, dust and sand of Iraq represent a challenging environment for PV

[49] Al Ahram Weekly (2013), 19 December 2013, , http://weekly.ahram.org.eg/News/4957/19/Iraq-falling-apart.aspx

equipment, and thus a risk which will be mitigated through selection of equipment for these conditions.

- Financial Risks – The Government and private financial systems in Iraq are slow to adopt incentives to promote industries. This reflects in part the slow pace of policy reform and decision-making in Iraq. The cost of importing and installing PV units in Iraq will mean prices will be higher than on the international market, while alternatives (diesel and electricity) are heavily subsidized. Therefore, the long-term success of the PV market will depend on adoption of financial incentives by the Government.
- Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures.
- Inadequate and/or non-capacitated human resources to successfully implement the project and support the mainstreaming of its results.
- Limited engagement to date with the international climate change community. Iraq is presently working on its first National Communication to the UNFCCC (with UNDP support), has no registered CDM projects and has no NAMAs to date.

74. Further details on these risks, with their probability and impact analysis and related mitigation measures, are presented in the 'Offline Risk Log' in Annex 8-1.

75. For addressing the project management risks, a committed, full-time project manager with adequate outreach and networking skills is absolutely essential for the success of the activities. The project manager should have an ability: i) to engage the key stakeholders in constructive discussion about future solar development needs; ii) to guide and supervise the studies done and effectively co-operate with the international experts who are engaged to support this work; iii) to present their findings and recommendations in a convincing manner to key policy-makers and opinion leaders by taking into account the main macroeconomic and policy drivers for local energy sector development; and iv) to identify areas of future work. During project implementation, the project manager also needs to be supported by qualified technical and legal experts.

76. A typical risk for training and capacity building activities is that, after the completion of training, there is no real demand for the services of the trained experts. The integrated approach adopted by this project is expected to mitigate this risk by combining the training with concrete possibilities to apply the new skills in practice in the planned investment projects and their envisaged replication. The installations targeted as part of the project will help ensure that at least initial demand is available for the skills described.

2.3. Expected benefits, design principles and strategic considerations

77. The calculated greenhouse gas (GHG) reduction benefits of the project will consist of the combination of:
    - Direct GHG emission reduction benefits from the investment projects implemented in the framework of the project and supported by project funding;
    - Indirect GHG reduction benefits resulting from broader market transformation arising from project activities.

78. No post-project GHG emission reduction benefits arising from ongoing operation of financing mechanisms established or supported by the project have been accounted for in this project, as the

GEF cash contribution to capital investments represents a one-time capital grant without expected pay-back.

79. The direct CO_2 emission reductions attributed to the project are estimated to be 741,622 tCO_2 from the 41.5 MW installed PV power systems, resulting in a GEF cost of \$3/tonne CO_2 avoided. This is a conservative estimate of the project's mitigation impact as it considers only the 41.5 MW installed as a direct result of the project and using GEF funds or co-finance. It does not include any systems installed as an indirect result of the project – through the project's market-opening, awareness-raising and supply chain assistance activities, for example. It also considers the grid emission factor based only on generation characteristics and does not consider losses in transmission and distribution, which would increase the effective grid emission factor by an additional 33-50% (See Figure 15). For further details about the assumptions and results of the project's GHG reduction analysis, see Annex 8.3.

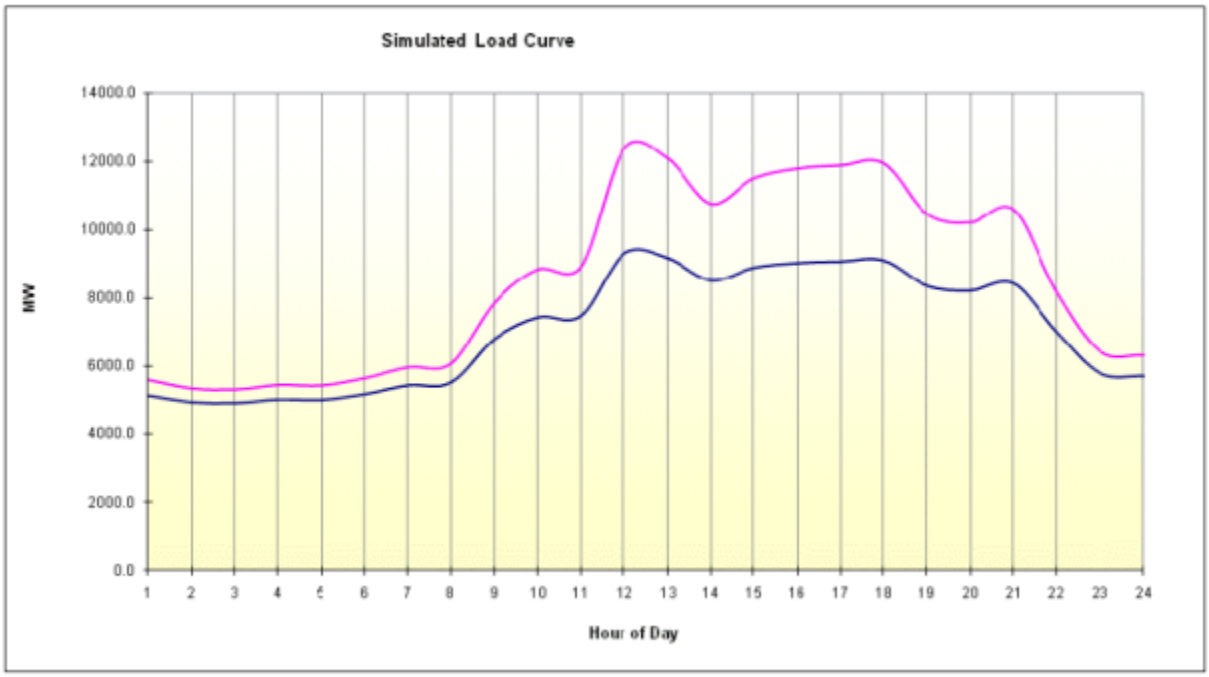


Figure 15. Calculated daily load curve, with upper curve showing sent-out demand and lower curve showing consumed demand.

The difference expresses the losses in the system. The losses of approximately one-quarter to one-third of generated electricity mean that the power plants must generate one-third to a half more electricity than is consumed. The effective emission factor, per kilowatt-hour consumed, is consequenty therefore one-third to a half higher than the generation emission factor. By producing electricity near where it is consumed, solar power reduces or eliminates many of the losses in the transmission and distribution system.

80. The associated national and local benefits include reduced local pollution from the burning of fossil fuels, increased national revenue through the availability of unburnt fossil fuel for export, and reduced energy losses from grid transmission and distribution. During times of peak demand, the transmission and distribution losses in Iraq are approximately one-third, meaning that for each kilowatt-hour of demand, 1.5 kilowatt-hours must be generated. By producing electricity near consumers (i.e. 'distributed generation'), solar power avoids much of the transmission and

distribution losses, with the result that each kilowatt-hour of solar generated can relieve the generation and transmission system of having to generate and transmit 1.5 kilowatt-hours.

81. These developments will catalyze the adoption of renewable energy technology and provide a foundation that allows the widespread use of renewable energy either in response to regulatory stimulus or simply to help realize systems where renewable energy may already be advantageous but are not utilized due to a lack of capacity or awareness.

82. The project will also achieve a range of socio-economic benefits. By helping to provide more reliable power, the project will greatly help Iraq's socio-economic development. As noted earlier, lack of reliable power costs Iraq approximately $40 billion/year. More than 50% of total electricity demand is due to air-conditioning. Therefore, by default, more than 50% of the PV-generated electricity facilitated by the project will provide power to air-conditioning, which will have a disproportionately beneficial impact on women and children, who spend considerable periods of time in their homes during the day. Rather than have dedicated PV units supplying only air-conditioning, it is more cost-effective to supply the grid in general and thereby allow consumers to consume electricity based on their own priorities. This also fits better with the Government's current policy of increasing generation capacity to meet demand.

83. Creating new 'green' jobs: The proposed project will create jobs at several levels. Field technicians and installers will be needed to install and trouble-shoot the PV units. These are expected to be mid-level technicians with basic electrical backgrounds. They will receive training as part of the project and will be able to generate new income by learning about PV technology that has potential application in Iraq. Significant job creation is also expected in the supply chain of PV units. Certain components can be readily manufactured locally, such as the steel and aluminium support structures, as well as other components. UNIDO estimates that, by 2030, the PV industry could provide 50,000-70,000 jobs in Iraq, if barriers to PV are appropriately eliminated.[50]

2.4. Project rationale and policy conformity

84. The project is contributing to GEF Climate Change Focal Area Objective #3, to "Promote Investment in Renewable Energy Technologies", recognizing that renewable energy plays an indispensable role not only in combating global climate change but also in addressing energy access, energy security, environmental pollution and sustainable development. In accordance with the adopted strategy, the GEF support under this Objective expands beyond the creation of enabling policy and regulatory environment and also encompasses solar energy projects that lead to a step-change in the deployment and diffusion of reliable, least-cost solar technologies.

85. The specific outcomes of the GEF-5 climate change strategy that the project is addressing include:
    - Favourable policy and regulatory environment created for renewable energy investments
    - Investment in renewable energy technologies increased
    - GHG emissions avoided

[50] UNIDO (2012), *Global Assessment and Key Recommendations for Development of the Solar Energy Sector in Iraq.*

86. The project aims to develop and accelerate the adoption of grid-integrated photovoltaic (PV) power generation through adoption by individual users and enterprises. The project also supports the development of solar PV on the utility scale, as a component of Iraq's electricity generation mix. Although Iraq is very rich in solar resource and is not able to meet its power demand, the present circumstances do not allow the development of widespread renewable power in general because of a lack of availability; lack of a framework to allow the sale of power to the grid; lack of technical know-how in the market; lack of technical solutions on the market; lack of user experience with the technology; and lack of user awareness of the possible solutions offered by today's PV technology.

87. The proposed project will achieve its objective by addressing impediments to the dissemination of PV power and by creating conditions for the autonomous long-term development of PV in the market. Specifically, the proposed project intends to achieve the project objective through the following:

- Supporting the establishment of a regulatory framework that allows the installation of grid-connected PV systems at a range of scales (kW-scale systems up to multiple-MW systems).
- Creating financial incentives – in the form of reduced import tariffs, a feed-in tariff and/or net-metering – to incentivize investment in solar generation capacity.
- Establishing a technical knowledge base and supply chain that help to reduce the cost of PV systems.

The project will play a critical role in creating a market that does not presently exist and supporting it through a nascent stage to the point where it is self-sustaining and able to respond to the needs of the populace. The project has the potential to drive a major transformation in the renewable energy landscape in Iraq, specifically by providing missing technical information and know-how and catalysing the installation of the first systems in Iraq that have thus far been stalled despite, in some cases, the availability of funds.

88. These developments will catalyze the adoption of renewable energy technology and provide a foundation that allows the widespread use of renewable energy either in response to regulatory stimulus or simply to help realize systems where renewable energy may already be advantageous but are not utilized due to a lack of capacity or awareness.

2.5. Country ownership: country eligibility and country drivenness

89. According to the Instrument for the Establishment of the Restructured Global Environment Facility, Iraq qualifies for GEF financing on the following grounds:
    - It has ratified the UN Framework Convention on Climate Change; and
    - It receives development assistance from UNDP's core resources.

90. The objective of the project is consistent with the efforts made by the Government of Iraq, as outlined in previous sections. It is also consistent with Iraq's NES, which envisions 4% of installed capacity being from solar and wind power by 2030.[51] It is further consistent with Iraq's targets of providing reliable electricity to the population and reducing fossil fuel use in power generation to

[51] Booz & Co., *Iraq National Energy Strategy*, pp.111

allow the country to recover more of the opportunity cost of using such fuel by exporting it at international market prices.

91. The project will provide the basis for Iraq to initiate the development of a NAMA to support renewable energy in Iraq. It will thus provide Iraq the chance to reinforce its engagement with the international climate change architecture, hitherto restricted to the country's Initial National Communication to the UNFCCC (currently under development).

92. UNDP has a proven track-record as being one of the leading agencies in Iraq to support the energy sector in Iraq. UNDP has supported the following projects in Iraq:

- Emergency Supply of Equipment to Electricity Sector in Iraq and Support to Essential Humanitarian Services (providing electricity to sensitive sectors: for example, hospitals).
- Support to the Iraqi Electricity and Health Sectors in the Emergency and Long-Term (with promotion of energy efficiency measures as one component).
- Al-Muthanna Governorate Electricity Network Reinforcement Programme.
- Electricity Sector Reconstruction Project in the Kurdistan Region.
- Review of Environmental Regulations, Standards and Processes Relating to Electricity Generation, Transmission and Distribution.
- Support to Establish a Renewable Energy Research Center in Anbar University.
- Assistance to Finalize the Energy Master Plans for Basra and Anbar Governorates.
- Preparatory Assistance for Formulating Comprehensive Strategies to Address Limitations in Iraq's Energy Sector.
- Roadmap for Energy Efficiency in Iraq.

93. The UNDAF and the UNDP Country Programme Action Plan (CPAP) both reflect the Government of Iraq's and UN Country Team's focus on responding to climate change at the national level as well as to meet Iraq's need for increased energy supply. UNDAF 2009-2014 Outcome 3.2 states "The Iraqi state is responsive to climate change issues in line with its commitments to ratified international agreements: 3.2.1 – A national policy on clean energy and reducing greenhouse gas emissions, 3.2.2 – Volume of CO_2-equivalent reduction through Energy Efficiency (EE), Renewable Energy (RE) or Clean Development Mechanism (CDM)".

94. The GEF Operational Focal Point for Iraq, Dr. Ali Al Lami, endorsed the project with a letter signed on August 7, 2012.

2.6. Cost-effectiveness

95. Of the GEF financing for Outcome 1 (US$700,000), US$250,000 has been allocated to support the development of 5 MW of distributed solar PV within the grid-connected Bytti development. The GEF support will enable the project to develop an advanced power system which provides reliable power to its consumers, at minimum cost and with minimum CO_2 emissions. Outcome 1 will also support the MoE in its initiative to establish 16 PV power plants, ranging from 1.5 MW to 6 MW, around the country. These represent a total of 36.5 MW in aggregate, and a mobilization of $200 million of co-finance against the GEF's $700,000 contribution.

96. The $700,000 allocation of GEF funds will enable the Ministry of Electricity to construct PV plants for which they presently have resources but lack expertise. Further, the GEF funding will help support the optimal design and operation of these plants, resulting in the highest electricity production achievable and, therefore, the greatest reduction in greenhouse gas emissions. In the absence of GEF support, it is likely that the plants will be considerably delayed, as they already have been. When constructed, it is likely that the plants would suffer sub-optimal performance, as there has not thus far been consideration of performance monitoring factors to inform future developments. Therefore, the relatively small GEF funding will catalyse a relatively large deployment of renewable generation capacity and effective utilisation of that capacity, resulting in a very cost-effective reduction of greenhouse gas emissions.

97. The GEF financing for Outcome 2 will consist of grants for technical assistance, which will support the further development of regulations, a solar map, technical requirements for grid connection, and development of a NAMA to support solar energy in Iraq. Together, these initiatives are expected to foster a regulatory environment for attracting investments for privately-owned, grid-connected renewable energy power generation and for facilitating effective monitoring, quality control and dissemination of the results of the RE investments made.

98. The support for the activities of Outcome 2 creates an overall environment for development of solar power generation capacity. These activities mobilise $3.5 million against GEF's investment of $1.2 million. The deployment of GEF funds is cost-effective because undertaking such work in Iraq is extremely difficult and costly. By mobilising and strengthening existing ideas and objectives within the Iraqi Government, the project makes it both more likely that the objectives will be achieved and that they will be achieved at a cost much lower than if they were initiated through other means.

99. The GEF financing for Outcome 3 will consist of technical assistance that will support the development of market capacity through training, workshops and dissemination of information. This is a critical component of the advancement of solar energy in Iraq and development of a functional marketplace.

100. Organising existing efforts to function in concert, as is proposed, can only be achieved through the deployment of a national-level project such as the GEF-funded project. As with Outcome 2, the cost of achieving similar results through means that do not utilise existing structures would be considerably higher.

101. In total, the activities of the UNDP-implemented, GEF-financed project combine to mobilise considerable co-financing and enable future investments that would be very difficult to achieve through a less comprehensive programme. The project builds on ambitious but sub-optimal baseline initiatives, augmenting them with GEF funds to provide enabling support and expertise and thereby making the use of GEF funds very cost-effective with regard to the reduction of greenhouse gas emissions.

2.7. Sustainability

102. Solar PV power is presently the most attractive form of renewable energy in Iraq, both because of the abundant solar resource and the modularity of solar PV technology. The cost of PV systems has come down, and the cost of fossil fuels has correspondingly increased to where the difference

between the unsubsidized, levelised cost of electricity from the two is no longer as prohibitive as it once was. The table below presents the levelised cost of electricity from PV in Iraq for various assumptions of capital cost.

Table 4. Levelised cost of electricity from PV over 25-year lifetime

Capital cost per installed kW ($/kW)	1,800	2,000	2,200	2,500	3,000
Levelised cost ($/kWh)	0.11	0.12	0.13	0.15	0.18

103. The figures in Table 4 assume annual generation of 1,500 kWh/kWp installed, based on inputs from Anbar University and MoST. This translates as a capacity factor of 17%, which is very conservative.[52] The calculation uses an interest rate of 6%, as published by the Iraqi Central Bank.[53] The levelised costs calculated above are consistent with those estimated by UNIDO[54], and competitive with the levelised costs of diesel and other generation technologies (see Figure 7).

104. Compared with the real cost of electric power generation from other sources, in the region of $0.08-$0.22/kWh (See Section 1.3), solar PV is competitive. Once a nucleus of technological capability and appropriate regulation is created, solar technology can well be expected to be self-sustaining.

105. Industrial consumers presently pay a tariff of $0.10/kWh. This indicates that, with minimal incentives, they could be attracted to solar power. Private residents pay a fixed capacity charge of $3-$8/kW/month, roughly $0.05-$0.13/kWh. These tariffs indicate that the market is prepared to pay costs comparable to solar power generation costs, if the ease of access to solar energy is available.

106. Although PV may be close to competitive on the basis of levelised cost, it remains capital-intensive. Therefore, some means of financing will be required to make the adoption of solar power truly sustainable. In the early phases, the presently committed co-financiers (principally, Al Shafei and MoE) will provide the required capital for implementation of their systems. Nevertheless, on a life-cycle basis, solar is becoming competitive with diesel generation, in particular small diesel generation.[55]

2.8. Replicability

107. A number of countries in the region are in various phases of developing renewable energy capacity. Given the interest of several GEF programme countries in developing and implementing similar projects, the materials developed and the results and lessons-learned in this project are expected to be of direct interest to other countries. An activity of Outcome 3 is specifically dedicated to condensing the lessons-learned in other countries in the region to help Iraq, and similarly to document the lessons from the project to help development throughout Iraq and in other countries.

[52] Al-Nimr, M., and Al-Shohani, W. (2013), 'Performance of photovoltaic modules for different sites in Iraq', , *Arabian Journal for Science and Engineering*, Vol. 28, p 277-283.
[53] Central Bank of Iraq, www.cbi.iq
[54] UNIDO (2012), *Global Assessment and Key Recommendations for Development of the Solar Energy Sector in Iraq.*
[55] UNIDO (2012), *Private Sector Development Report: Iraq*, *Final Report 2: Global Assessment and Key Recommendations for Development of the Solar Energy Sector.* p. 6.

108. The project includes funds for the general sharing of knowledge, including study-tours to various locations in the region that will help spread experiences and develop a network for cooperation between the various stakeholder groups at the national and international levels.

109. Iraq's National Energy Strategy anticipates 1.2 GW of solar and wind by 2025, and 2 GW by 2030 from solar, wind and hydro.[56] Average wind speeds at 50 metres above ground level in Iraq are relatively meagre – in the range of 5-6 m/s for a majority of the country, and 6-7 m/s in some isolated pockets. The potential for additional hydropower is similarly constrained because of limited rainfall and limited flows on the Tigris and Euphrates rivers.[57] The result is that solar is likely to make up the major share of renewable energy in Iraq and, within solar, PV is likely to be the dominant technology.

110. Assuming, conservatively, that half of Iraq's renewable energy capacity development is in PV, this implies the installation of 600 MW in the next ten years, and 1 GW in the next 15 years. Hence, there is a realistic potential for in-country replication 15-25 times the installed capacity of the project in the next 10-15 years. Iraq's relatively young population is also in need of new housing units, creating opportunities for the direct replication of projects such as Bytti.[58] There is presently no substantial solar power to speak of in Iraq.[59] The elements put in place by the project will enable the scale-up of solar power required to meet Iraq's targets.

[56] Booz & Co. (2012), *Iraq National Energy Strategy*.
[57] Janabi H. (Mar. 22, 2013), *Climate Change Impact on Iraqi Water and Agriculture Sectors,* Middle East Petroleum and Economic Publications
[58] UNIDO (2012), *Private Sector Development Report: Iraq*, *Final Report 2: Global Assessment and Key Recommendations for Development of the Solar Energy Sector.*
[59] No firm figures exist, though some sources estimate 5-10 MW distributed over the entire country, primarily in specialty remote applications, such as mobile phone towers. See UNIDO (2012), *Private Sector Development Report: Iraq*, *Final Report 2: Global Assessment and Key Recommendations for Development of the Solar Energy Sector.*

3. Project Results Framework

This project will contribute to achieving the following Country Programme Outcome as defined in CPAP or CPD: The Government of Iraq has the institutional framework to develop and implement MDG-based, pro-poor, equitable and inclusive socio-economic and environmental policies and strategies.					
Country Programme Outcome Indicators: Capacities of national and sub-national authorities and communities for effective environmental governance, natural and renewable resources management and climate change strengthened.					
Primary applicable Key Environment and Sustainable Development Key Result Area: 1. Mainstreaming environment and energy OR **2. Catalysing environmental finance** OR 3. Promote climate change adaptation OR 4. Expanding access to environmental and energy services for the poor.					
Applicable GEF Focal Area Objective:GEF-5 FA Objective # 3 (CCM-3): "Promote Investment in Renewable Energy Technologies"					
	Indicator	**Baseline**	**Targets** **End of Project**	**Source of verification**	**Risks and Assumptions**
Project Objective[60] To reduce GHG emissions in Iraq by demonstrating and catalyzing the application of distributed solar power to meet the energy needs of offices, small businesses, residences and small town services (small-scale distributed solar PV power plants and utility scale plants, on and off-grid).	Amount of reduced CO_2 emissions by the investments facilitated by the project. Total electricity generation by the project (MWh).	0	Installations in place and operating to achieve direct reduction of 741,622 tonnes CO_2 over a 20-year lifetime from project start. Indirect: Mechanisms in place to support the further expansion of PV installations to result in indirect emissions reductions of 5.9 million tonnes CO_2.	Project monitoring reports and final evaluation. As applicable, post-project market monitoring and evaluations.	Security risk: the volatile situation in Iraq may delay implementation. Political risk: while MoE has committed to these plants, MoE has for years been struggling and continues to struggle with chronic shortages which strain its human and material resources.
Outcome 1[61] Investment in solar photovoltaic power technologies for	Megawatts of solar PV installed.	0	Installation and operation of 5 MW of distributed, grid-connected PV at Bytti.	Project monitoring reports and final evaluation.	As above.

[60] *Objective (Atlas output) monitored quarterly ERBM and annually in APR/PIR*

[61] *All outcomes monitored annually in the APR/PIR. It is highly recommended not to have more than 4 outcomes.*

distributed electricity generation for office, residential, small business and small town application.			Installation and operation of 16 utility-scale PV plants. Monitoring and recording operational data from all Bytti and the 16 plants to inform the development of future PV plants.		
	Indicator	**Baseline**	**Targets** **End of Project**	**Source of verification**	**Risks and Assumptions**
Outcome 2 Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and financial incentives.	Existence of RE policies and laws encouraging deployment. Existence of a clear set of regulations and technical and regulatory requirements for connecting to the grid. Volume of investments mobilised for solar PV power.	There have been early-stage discussions between MoE and UNDP on net-metering. There have been no concrete steps or commitments.	Development and implementation of a grid code for distribution and transmission (for small-scale distributed generation and larger utility-scale generation). Design and implementation of a process for IPPs to engage in standardized PPAs with the Ministry of Electricity, to acquire generation licences and to inter-connect with the grid. Development of model contracts for power purchase agreements. Implementation of phased fiscal incentives for PV uptake, including partial removal of import taxes on solar panels. Design of a feed-in tariff for renewable energy IPPs with appropriate pricing calibration, geographical zoning and regression schedule, and packaged as a NAMA.	Existence of legislation on a FiT. Existence of standardised contracts (Power Purchase Agreements) which developers can sign to guarantee purchase of power from projects. Registration of the FiT NAMA in the UNFCCC NAMA Registry, or in bilateral agreement with a credit buyer.	The proposed legal and regulatory improvements passing swiftly through the Government approval process.

			Evaluation of net-metering options for industrial and residential applications. Evaluation of a range of policies for specific circumstances, such as tenders for large solar installations (suitable for Iraq's environment). Support to implementation of the feed-in tariff and/or net-metering scheme.		
Outcome 3 Facilitation of private sector capacity for technology development, innovation and servicing in the solar power industry, through technical capacity building and domestic market analysis.	Number of individuals and organisations capable of supporting activity in the Iraqi solar market. Records of PV market prices, participants and installed capacity to track development of solar PV in Iraq.	No effective capacity building exists for the industry. There are few industry players. No significant market data exist.	Solar power market demand/industry response strategy developed for Iraq, informed by case studies from other countries with developed solar power industries, domestic market analysis, and clarification of Iraqi private sector opportunities for distributed solar PV power production. Iraq private sector and Government agencies exposed to all aspects of the industry (technology development, supply, servicing, financing). Development and delivery of certified technical training on solar PV technologies (hybridization, supply, service) for emerging private sector companies.	Project reports. Consumer surveys.	Lack of interest while the market opportunity is not yet clear to participants (this risk is minimal). Lack of reporting by market participants making collection of data difficult.

Project Outputs and Related Target(s)/Sub-target(s), as applicable

Outcome 1: Investment in solar photovoltaic power technologies for on-grid and off-grid distributed electricity generation for office, residential, small business and small town application.	**Outcome 2:** Encouragement of investments in solar power technology in Iraq and consumer uptake of solar appliances through policy reform and financial incentives.	**Outcome 3:** Facilitation of private sector capacity for technology development, innovation and servicing in the solar power industry, through technical capacity building and domestic market analysis.
Output 1.1: Assessment of PV technology, including cost-benefit analysis of a range of configurations, for distributed solar rooftop units suitable for the Bytti project in Najaf, with total capacity of 5 MW.	**Output 2.1**: Approved and enforced revised policies and regulations, and new financial incentives, to encourage solar power industry development (private sector) and consumer uptake, including removal of import tariffs on components; introduction of subsidies and tax credits to promote investment in, and installation of, solar units; and clarification of IPP policies, with inducements to accelerate solar PV power plant development throughout Iraq.	**Output 3.1**: Solar power market demand/industry response strategy developed for Iraq, informed by case-studies from other countries with developed solar power industries, domestic market analysis, and clarification of Iraqi private sector opportunities for distributed solar PV power production. Iraq private sector and Government agencies exposed to all aspects of the industry (technology development, supply, servicing, financing).
Output 1.2: Design, construction and operation of distributed small-scale rooftop solar PV power systems (total 5 MW) for town services in Bytti.	**Output 2.2**: Examination of inter-connections between distributed power producers and the grid, design of a feed-in tariff and net-metering options, and support to the Government to implement the feed-in tariff and/or net-metering scheme; evaluation of tendering schemes where appropriate.	**Output 3.2**: Development and delivery of certified technical training on solar PV technologies (hybridization, supply, service) for emerging private sector companies.
Output 1.3: Monitoring data for operational aspects, including power production, distribution and domestic use of solar power supply, to allow performance evaluation.	**Output 2.3**: Development of a renewable energy database (solar map) containing site-specific data on RE potential to facilitate investment decisions.	**Output 3.3**: Development and delivery of dissemination sessions on future IPP involvement in the electricity supply network, including relationships with technology firms and Government agencies, feed-in tariffs, and net-metering options.
Output 1.4: Selection of sites around Iraq for on- and off-grid utility scale PV plants as a model for IPPs and utility solar power.	**Output 2.4**: Development of the feed-in tariff as a policy NAMA, with corresponding baseline, MRV and institutional systems.	
Output 1.5: Finalization of tender documents and component specifications.		
Output 1.6: Monitoring data for operational aspects, power production, distribution and grid behaviour.		

4. Total budget and workplan

Award ID:	**00079907**	Project ID(s):	**00089774**
Award Title:	**Catalysing the Use of Solar Photovoltaic Energy**		
Business Unit:	**IRQ10**		
Project Title:	**Catalysing the Use of Solar Photovoltaic Energy**		
PIMS no.	**5137**		
Implementing Partner (Executing Agency)	**UNDP (Direct Implementation Modality)**		

GEF Outcome/Atlas Activity	Responsible Party/ Implementing Agent	Fund ID	Donor Name	Atlas Budgetary Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Amount Year 2 (USD)	Amount Year 3 (USD)	Amount Year 4 (USD)	Total (USD)	See Budget Note:
OUTCOME 1	**MoEn**	**62000**	**GEF**	71200	International Consultants	75,000	60,000	20,000	20,000	**175,000**	1
				71300	Local Consultants	20,000	20,000	20,000	20,000	**80,000**	2
				71400	Contr. services – indiv.	45,000	45,000	45,000	45,000	**180,000**	3
				71600	Travel	25,000	25,000	7,500	7,500	**65,000**	4
				72200	Equipment	100,000	100,000	0	0	**200,000**	5
				Sub-total GEF		**265,000**	**250,000**	**92,500**	**92,500**	**700,000**	
				Total Outcome 1		**265,000**	**250,000**	**92,500**	**92,500**	**700,000**	
OUTCOME 2	**MoEn**	**62000**	**GEF**	71200	International Consultants	150,000	150,000	120,000	100,000	**520,000**	6
				71300	Local Consultants	50,000	50,000	50,000	30,000	**180,000**	7
				71400	Contr. services – indiv.	80,000	80,000	80,000	80,000	**320,000**	8
				71600	Travel	35,000	35,000	35,000	35,000	**140,000**	4
				75700	Workshops and meetings	15,000	15,000	6,273	5,000	**41,273**	9
				Sub-total GEF		**330,000**	**330,000**	**291,273**	**250,000**	**1,201,273**	

				4000	**UNDP**	2,000	2,000	2,000	2,000	**8,000**	9
				71200	International Consultants	5,000	4,000	4,000	4,000	**17,000**	6
				71300	Local Consultants	2,500	2,500	2,500	2,500	**10,000**	7
				71400	Contr. services – indiv.	11,750	11,750	11,750	11,750	**47,000**	8
				Sub-total UNDP		**21,250**	**20,250**	**20,250**	**20,250**	**82,000**	
			UNDP	**Total Outcome 2**		**351,250**	**350,250**	**311,523**	**270,250**	**1,283,273**	
OUTCOME 3	**MoEn**	**62000**	**GEF**	71200	International Consultants	28,000	28,000	28,000	28,000	**112,000**	10
				71300	Local Consultants	10,000	10,000	10,000	10,000	**40,000**	11
				71400	Contr. services – indiv.	12,000	12,000	12,000	12,000	**48,000**	12
				71600	Travel	5,000	5,000	5,000	5,000	**20,000**	4
				Sub-total GEF		**55,000**	**55,000**	**55,000**	**55,000**	**220,000**	
	MoEn	**4000**	**UNDP**	71200	International Consultants	4,000	7,000	5,000	5,000	**21,000**	10
				71300	Local Consultants	2,000	2,000	2,000	2,000	**8,000**	11
				71600	Travel	4,000	7,000	7,000	7,000	**25,000**	4
				75700	Workshops and meetings	3,000	6,000	6,000	6,000	**21,000**	7
				Sub-total UNDP		**13,000**	**22,000**	**20,000**	**20,000**	**75,000**	
				Total Outcome 3		**68,000**	**77,000**	**75,000**	**75,000**	**295,000**	
Project Management	**MoEn**	**62000**	**GEF**	71400	Contr. services – indiv.	15,000	15,000	15,000	15,000	**60,000**	13
				71600	Travel	8,000	8,000	8,000	10,000	**34,000**	4
				72800	IT Equipment	7,000	3,000	1,000	1,000	**12,000**	14
				Sub-total GEF		**30,000**	**26,000**	**24,000**	**26,000**	**106,000**	
	MoEn	**4000**	**UNDP**	72800	IT Equipment	1,000	1,000	1,000	0	**3,000**	14
				72400	Communication	750	750	750	750	**3,000**	
				72500	Office supplies	700	500	500	500	**2,200**	
				Sub-total UNDP		**2,450**	**2,250**	**2,250**	**1,250**	**8,200**	

				Total Management	**32,450**	**28,250**	**26,250**	**27,250**	**114,200**	
				TOTAL GEF	**680,000**	**661,000**	**462,773**	**423,500**	**2,227,273**	
				TOTAL UNDP	**36,700**	**44,500**	**42,500**	**41,500**	**165,200**	
				GRAND TOTAL	**716,700**	**705,500**	**505,273**	**465,000**	**2,392,473**	

Summary of funds:[62]

All figures in USD	**Amount Year 1**	**Amount Year 2**	**Amount Year 3**	**Amount Year 4**	**Total**
GEF	680,000	661,000	462,773	423,500	**2,227,273**
MoE	2,000,000	6,000,000	6,000,000	6,000,000	**20,000,000**
Al Shafei	7,600,000	1,800,000	300,000	300,000	**10,000,000**
MoST	600,000	800,000	800,000	300,000	**2,500,000**
MoI&M	25,000	25,000	0	0	**50,000**
MoEN	50,000	50,000	50,000	50,000	**200,000**
UNDP	43,050	49,350	58,350	64,450	**215,200**
TOTAL	**10,998,050**	**9,385,350**	**7,671,123**	**7,137,950**	**35,192,473**

Budget Notes

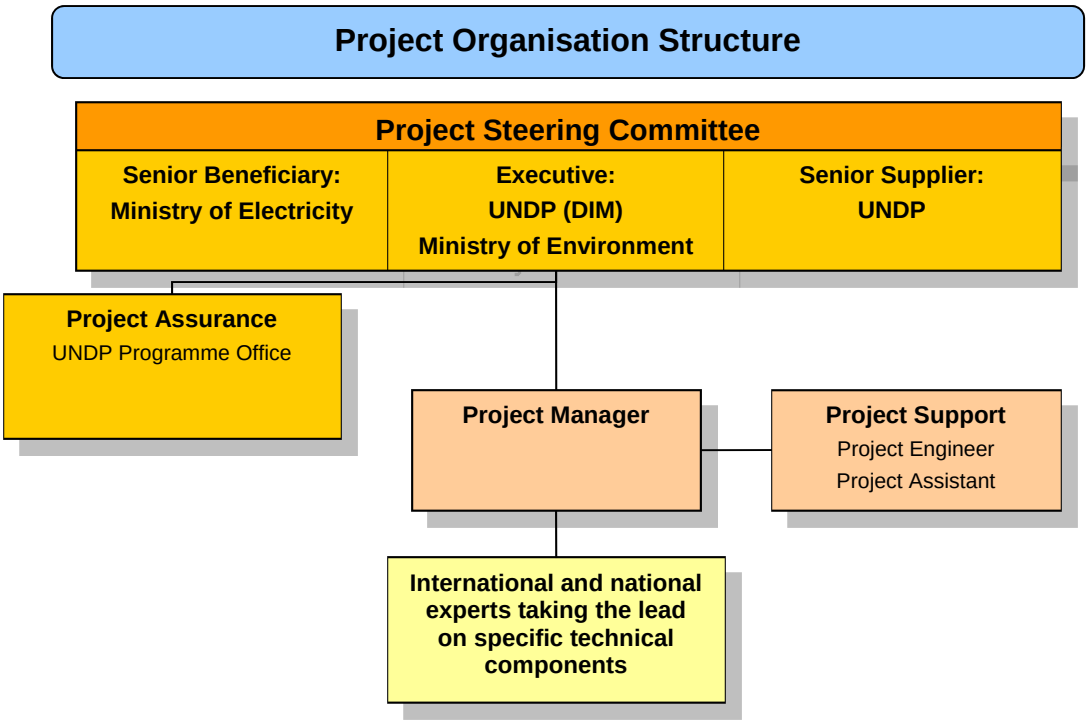
No.	**Note**
1	One power-grid integration expert, one hybrid solar-diesel mini-grid system expert, one PV technology expert to assist Bytti in selecting technology and integrating with the Bytti grid and national grid, one tender agent to support MoE.
2	Local consultants to support the international consultant with data-gathering and field work to the extent possible.
3	Local long-term consultants / core project team consisting of the project manager, project engineer and administrative assistant time allocation to Outcome 1, including M&E costs.
4	Travel costs of international and local consultants.
5	Power grid connection and monitoring equipment for Bytti and MoE.
6	International policy consultant; legal consultant for draft contracts; technical consultant for solar resource and grid issues; and climate finance consultant for NAMA.
7	Local consultants to support the international consultant with data-gathering and field work to the extent possible.
8	Local long-term consultants / core project team consisting of the project manager, project engineer and administrative assistant allocation to Outcome 2, including M&E

[62] *Summary table should include all financing of all kinds: GEF financing, cofinancing, cash, in-kind, etc...*

	costs.
9	Workshops and training to support policy reform; capacity building for contracts; capacity building for solar resource assessment and for climate finance (NAMA).
10	International consultants for capacity building in PV industry and for market analysis.
11	Local consultants to support the international consultant with capacity building and market analysis.
12	Local long-term consultants / core project team consisting of the project manager, project engineer and administrative assistant allocation to Outcome 3, including M&E costs.
13	Local long-term consultants / core project team consisting of the project manager, project engineer and administrative assistant - allocation to project management.
14	Software, computers and IT tools for the project team.

5. Management Arrangements

(SEE UNDP POPP FOR FURTHER DETAILS)



111. The project will be directly implemented (DIM) by UNDP on behalf of the Government of Iraq. UNDP, in close cooperation with the Ministry of Environment, will take overall responsibility for the project implementation, and the timely and verifiable attainment of project objectives and outcomes. The Ministry of Environment will nominate a high-level official as a UNDP Focal Point, who will provide the Government oversight and guidance to project implementation. The MoEn UNDP Focal Point will not be paid from the project funds but will, rather, represent a Government in-kind contribution to the project. As the UNFCCC, GEF and NAMA Focal Point, the Ministry of Environment will be the Government agency with overall responsibility for the project. Operationally, the Ministry of Environment will take the lead on development of the feed-in tariff and the associated NAMA; the Ministry of Electricity will take the lead on utility-scale PV investments; the Ministry of Science & Technology and the Ministry of Electricity will take the co-lead on activities relating to installation of PV systems in the Bytti residential complex.

112. UNDP will be accountable for the disbursement of funds and the achievement of the project goals, according to the approved work plan. Working closely with MoEn, the UNDP Country Office will be responsible for: (i) providing financial and audit services to the project, (ii) recruitment of project staff and contracting of consultants and service providers, (iii) overseeing financial expenditures against project budgets approved by the Project Steering Committee, (iv) appointment of independent financial auditors and evaluators; and (v) ensuring that all activities, including procurement and financial services, are carried out in strict compliance with UNDP-GEF procedures. A UNDP staff member will be assigned with the responsibility for the day-to-day management and control over project finances. The Direct Implementation Modality (DIM) is UNDP's standard working practice in Iraq. As a result, the UNDP Country Office places great emphasis on the

importance of Mid-Term Reviews and Terminal Evaluations, and will ensure that they are thorough and completely independent. In the context of this specific UNDP-implemented, GEF-financed project, the UNDP-GEF Regional Technical Advisor will provide an additional layer of oversight, and will participate in regular project team calls to monitor progress and advise on project implementation.

113. A Project Steering Committee will be established at the inception of the project to monitor project progress, to guide project implementation and to support the project in achieving its listed outputs and outcomes. It will be chaired by UNDP and will include the Focal Point from the Ministry of Environment, a member from the Ministry of Electricity, and representatives from the main stakeholders, such as the Ministry of Finance, or Prime Minister's Advisory Committee. Other members can be invited at the decision of the PSC on an as-needed basis, but taking due regard that the PSC remains sufficiently lean to be operationally effective. The final list of the PSC members will be completed at the outset of project operations and presented in the Inception Report by taking into account the envisaged role of different parties in the PSC. The Project Manager will participate as a non-voting member in the PSC meetings and will also be responsible for compiling a summary report of the discussions and conclusions of each meeting.

114. The Project Steering Committee is responsible for advising UNDP on management decisions for the project, in particular when guidance is required by the Project Manager. It ensures that required resources are committed and arbitrates on any conflicts within the project or negotiates a solution to any problems with external bodies. Based on the approved Annual WorkPlan, the Project Steering Committee can also consider and approve the quarterly plans (if applicable) and also approve any essential deviations from the original plans. In order to ensure UNDP's ultimate accountability for the project results, Project Steering Committee decisions will be made in accordance with standards that shall ensure management for development results, best value money, fairness, integrity, transparency and effective international competition. In case consensus cannot be reached within the PSC, the final decision shall rest with UNDP.

115. The day-to-day management of the project will be carried out by a Project Management Unit (PMU) under the overall guidance of the Project Steering Committee. The Project Manager will report to UNDP and the PSC. The Terms of Reference of the Project Manager are presented in Section IV, Part IV of this Project Document. The project personnel will be selected on a competitive basis in accordance with the relevant UNDP rules and procedures and in consultation with the UNDP-GEF Regional Technical Adviser.

116. The PM will produce Annual Work and Budget Plans (AWPs & ABPs) to be approved by the PSC at the beginning of each year. These plans will provide the basis for allocating resources to planned activities. Once the PSC approves the Annual Work Plan, it will be sent to the UNDP Regional Technical Advisor at the UNDP Regional Centre in Bratislava/Istanbul for revision and approval. Once the Annual Working Plan and Budget is approved by the Regional Centre, it will be sent to the UNDP-GEF Unit in New York for final approval and release of the funding. The PM will further produce quarterly operational reports and Annual Progress Reports (APRs) to the PSC, or any other reports at the request of the PSC. As in the case of the Annual Work Plans, these reports are sent for approval and clearance to the UNDP Regional Centre in Bratislava/Istanbul. These reports will summarise the progress made by the project versus the expected results, explain any significant variances, detail the necessary adjustments and be the main reporting mechanism for monitoring project activities.

117. The Project Manager will be supported by international and national experts taking the lead in the implementation of specific technical assistance components of the project. Contacts with experts and institutions in other countries that have already gained experience in developing and implementing renewable energy policies and financial support mechanisms are also to be established. Recruitment of all specialist services for the project will be done by the PM, in consultation with UNDP and the Government.

118. For successfully reaching the objective and outcomes of the project, it is essential that the progress of different project components will be closely monitored both by the key local stakeholders and authorities as well as by project's international experts, starting with the finalization of the detailed, component-specific work plans and implementation arrangements and continuing through the project's implementation phase. The purpose of this is to facilitate early identification of possible risks to successful completion of the project together with adaptive management and early corrective action, when needed.

119. In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant project publications, including any hardware purchased with GEF funds. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgement to GEF in accordance with the respective GEF guidelines.

120. The international experiences and lessons learned from catalysing local renewable energy development have been taken into account in the design of this new project. The applicable parts of the information collected and the work and contacts initiated during the previous projects will be fully utilised, thereby not losing or duplicating the work already done. The activities of the other donors and the foreseen synergies and opportunities for co-operation have been discussed in further detail in chapter 1 of this Project Document. During implementation, proper care will be taken to have adequate communication and co-ordination mechanisms in place to ensure that areas of common interest can be addressed in a cost-efficient way.

6. Monitoring Framework and Evaluation

121. The project will be monitored through the following M& E activities. The M& E budget is provided in the table below.

Project start:

122. A Project Inception Workshop will be held within the first 2 months of project start with those with assigned roles in the project organization structure, UNDP Country Office and, where appropriate/feasible, regional technical policy and programme advisors as well as other stakeholders. The Inception Workshop is crucial to building ownership for the project results and to plan the first year annual work plan.

The Inception Workshop should address a number of key issues including:

123. Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of UNDP CO and RCU staff vis-à-vis the project team. Discuss the roles, functions and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff will be discussed again as needed.

124. Based on the project results framework and the relevant SOF (GEF) Tracking Tool if appropriate, finalize the first annual work plan. Review and agree on the indicators, targets and their means of verification, and recheck assumptions and risks.

125. Provide a detailed overview of reporting, monitoring and evaluation (M&E) requirements. The Monitoring and Evaluation work plan and budget should be agreed and scheduled.

126. Discuss financial reporting procedures and obligations, and arrangements for annual audit.

127. Plan and schedule Project Steering Committee meetings. Roles and responsibilities of all project organisation structures should be clarified and meetings planned. The first Project Steering Committee meeting should be held within the first 12 months following the inception workshop.

128. An Inception Workshop report is a key reference document and must be prepared and shared with participants to formalize various agreements and plans decided during the meeting.

Quarterly:

129. Progress made shall be monitored in the UNDP Enhanced Results Based Managment Platform.

130. Based on the initial risk analysis submitted, the risk log shall be regularly updated in ATLAS. Risks become critical when the impact and probability are high. Note that for UNDP-GEF -projects, all financial risks associated with financial instruments such as revolving funds, micro-finance schemes, or capitalization of ESCOs are automatically classified as critical on the basis of their innovative nature (high impact and uncertainty due to no previous experience justifies classification as critical).

131. Based on the information recorded in Atlas, a Project Progress Reports (PPR) can be generated in the Executive Snapshot.

132. Other ATLAS logs can be used to monitor issues, lessons learned etc. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.

Annually:

133. Annual Project Review/Project Implementation Reports (APR/PIR): This key report is prepared to monitor progress made since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and SOF (e.g. GEF) reporting requirements.

134. The APR/PIR includes, but is not limited to, reporting on the following:

- Progress made toward project objective and project outcomes - each with indicators, baseline data and end-of-project targets (cumulative).
- Project outputs delivered per project outcome (annual).
- Lessons-learned/good practice.
- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR
- Portfolio-level indicators (i.e. GEF focal area tracking tools) are used by most focal areas on an annual basis as well.

Periodic monitoring through site visits:

135. UNDP CO and the UNDP RCU will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first-hand project progress. Other members of the Project Steering Committee may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and UNDP RCU and will be circulated no less than one month after the visit to the project team and Project Steering Committee members.

Mid-term of project cycle:

136. The project will undergo an independent Mid-Term Review at the mid-point of project implementation (approximately October 2016). The Mid-Term Review will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organisation, terms of reference and timing of the mid-term reveiw will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-Term Review will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit. The management response and the evaluation will be uploaded to UNDP corporate systems, in particular the UNDP Evaluation Office Evaluation Resource Center (ERC).

137. The relevant SOF (GEF) Focal Area Tracking Tools will also be completed during the mid-term evaluation cycle.

End of project:

138. An independent Terminal Evaluation will take place three months prior to the final Project Steering Committee meeting and will be undertaken in accordance with UNDP and SOF (GEF) guidance. The final evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the mid-term evaluation, if any such correction took place). The final evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit.

139. The Final Terminal Evaluation should also provide recommendations for follow-up activities and requires a management response which should be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Center (ERC).

140. The relevant SOF (GEF) Focal Area Tracking Tools will also be completed during the final evaluation.

141. During the last three months, the project team will prepare the Project Terminal Report. This comprehensive report will summarize the results achieved (objectives, outcomes, outputs), lessons-learned, problems met and areas where results may not have been achieved. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the project's results.

Learning and knowledge sharing:

142. Results from the project will be disseminated within and beyond the project intervention zone through existing information sharing networks and forums.

143. The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned. The project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects.

144. Finally, there will be a two-way flow of information between this project and other projects of a similar focus.

Communications and visibility requirements:

145. Full compliance is required with UNDP's Branding Guidelines. These can be accessed at http://intra.undp.org/coa/branding.shtml, and specific guidelines on UNDP logo use can be accessed at: http://intra.undp.org/branding/useOfLogo.html. Amongst other things, these guidelines describe when and how the UNDP logo needs to be used, as well as how the logos of donors to UNDP projects needs to be used. For the avoidance of any doubt, when logo use is required, the UNDP logo needs to be used alongside the GEF logo. The GEF logo can be accessed at:

http://www.thegef.org/gef/GEF_logo. The UNDP logo can be accessed at http://intra.undp.org/coa/branding.shtml.

146. Full compliance is also required with the GEF's Communication and Visibility Guidelines (the "GEF Guidelines"). The GEF Guidelines can be accessed at:

http://www.thegef.org/gef/sites/thegef.org/files/documents/C.40.08_Branding_the_GEF%20final_0.pdf.

Amongst other things, the GEF Guidelines describe when and how the GEF logo needs to be used in project publications, vehicles, supplies and other project equipment. The GEF Guidelines also describe other GEF promotional requirements regarding press releases, press conferences, press visits, visits by Government officials, productions and other promotional items.

147. Where other agencies and project partners have provided support through co-financing, their branding policies and requirements should be similarly applied.

M&E workplan and budget

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team staff time*	Time frame
Inception Workshop and Report	▪ Project Manager ▪ UNDP CO, UNDP CCA	Indicative cost: 10,000	Within first two months of project start up
Measurement of Means of Verification of project results.	▪ UNDP CCA RTA/Project Manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members.	To be finalized in Inception Phase and Workshop.	Start, mid- and end of project (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on output and implementation	▪ Oversight by Project Manager ▪ Project team	To be determined as part of the Annual Work Plan's preparation.	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	▪ Project manager and team ▪ UNDP CO ▪ UNDP RTA	None	Annually
Periodic status/ progress reports	▪ Project manager and team	None	Quarterly
Mid-term Review	▪ Project manager and team ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation team)	Indicative cost: 40,000	At the mid-point of project implementation.
Final Evaluation	▪ Project manager and team, ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation team)	Indicative cost : 40,000	At least three months before the end of project implementation

Type of M&E activity	Responsible Parties	Budget US$ *Excluding project team staff time*	Time frame
Project Terminal Report	▪ Project manager and team ▪ UNDP CO ▪ local consultant	None	At least three months before the end of the project
Audit	▪ UNDP CO ▪ Project manager and team	Indicative cost per year: 3,000	Yearly
Visits to field sites	▪ UNDP CO ▪ UNDP RCU (as appropriate) ▪ Government representatives	For GEF-supported projects, paid from IA fees and operational budget	Yearly
TOTAL indicative COST Excluding project team staff time and UNDP staff and travel expenses		US$ 93,000 (+/- 5% of total budget)	

7. Legal Context

This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement (SBAA) between the Government of Iraq and the United Nations Development Programme, signed by the parties on the 20th of October 1976. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government co-operating agency described in that Agreement. The UNDP Resident Representative in Iraq is authorized to effect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto with the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

a) Revision of, or addition to, any of the annexes to the Project Document;
b) Revisions which do not involve significant changes in the immediate objective, outcomes, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;
c) Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and
d) Inclusion of additional annexes and attachments only as set out here in this Project Document

This document, together with the CPAP signed by the Government and UNDP which is incorporated by reference, constitute together a Project Document as referred to in the SBAA [or other appropriate governing agreement] and all CPAP provisions apply to this document.

Consistent with the Article III of the Standard Basic Assistance Agreement, the responsibility for the safety and security of the implementing partner and its personnel and property, and of UNDP's property in the implementing partner's custody, rests with the implementing partner.

The implementing partner shall:
a) put in place an appropriate security plan and maintain the security plan, taking into account the security situation in the country where the project is being carried;
b) assume all risks and liabilities related to the implementing partner's security, and the full implementation of the security plan.

UNDP reserves the right to verify whether such a plan is in place, and to suggest modifications to the plan when necessary. Failure to maintain and implement an appropriate security plan as required hereunder shall be deemed a breach of this agreement.

The implementing partner agrees to undertake all reasonable efforts to ensure that none of the UNDP funds received pursuant to the Project Document are used to provide support to individuals or entities associated with terrorism and that the recipients of any amounts provided by UNDP hereunder do not appear on the list maintained by the Security Council Committee established pursuant to resolution 1267 (1999). The list can be accessed via:

http://www.un.org/Docs/sc/committees/1267/1267ListEng.htm.

This provision must be included in all sub-contracts or sub-agreements entered into under this Project Document.

This project will be audited in accordance with UNDP Financial Regulations and Rules and applicable audit policies.

8. Annexes

8.1 Risk Analysis

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
1	The security situation in Iraq is unstable. Without general security, the ability of crews to travel, transport goods and work will be restricted. With renewable energy equipment, where the entire capital is procured and installed upfront, theft or damage can mean a complete loss of invested capital		Political/ Operational	May prevent access to certain areas for implementation of projects P[63] = 3 I[64] = 4	Much of the work with counterparties will be conducted within the Green Zone, a secured area in Baghdad. Security convoys are available, though expensive, for travel outside of the Green Zone. The project will seek to maximise training for locals and use of local support for on-site activities. Despite the current situation in Iraq, the Government of Iraq is still fully functioning. The UNDP Country Office is communicating with the Ministries of Electricity, Science and Technology, and Environment on a daily basis. Al Mansour, the Government-owned PV module manufacturer, announced on July 4th 2014 that it is establishing a new PV assembly line. Najaf, the province in which the Bytti residential baseline project is located, is unaffected by the current security situation. Thus, the indications are that, despite the current situation, most enterprises and Government facilities are proceeding with	Project Steering Committee		N/A	N/A

[63] Probability from 1 (low) to 5 (high)

[64] Impact from 1 (low) to 5 (high)

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
					business as usual.				
2	The Government may fail to marshal the necessary resources or coordination amongst its entities to bring about the desired legislative and regulatory reform		Regulatory	Lack of policy basis to catalyse adoption of solar power P = 2 I = 5	Policy reform and decision making in Iraq can be slow. UNDP will rely on close relations with MoEn, MoE and other counterparts built through several past and ongoing joint projects. Through close participation, UNDP will aim to spur action. Iraq's urgent need for electric power also puts policy-makers under pressure to produce solutions to the electricity problem.	Govt		N/A	N/A
3.	Novelty and adoption risk – Private-sector entities in Iraq are slow to adopt new technology and take-up unfamiliar business models, in part because the overall 'ecosystem' of security, regulatory clarity, financing, technical capacity and awareness, does not encourage this		Organizational	Slow uptake of solar by market participants P = 2 I = 4	The proposed project includes specific capacity building and market development components to help encourage participation in the market and minimize risk for market participants.	Project Steering Committee		N/A	N/A
4	Technology risk – Technical failures, either due to		Technological	Lower than anticipated electricity output	Use of experience accumulated by MoST, MoI&M, Al Shafei, and Anbar University will ensure that	NA		N/A	N/A

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
	equipment failure or bad installation, can lead to loss of trust by targeted customers on the performance of small, decentralized RE applications. The heat, dust and sand of Iraq represent a challenging environment for PV equipment, and thus a risk which will be mitigated through selection of equipment for these conditions			of the RE plants installed P = 2 I = 3	technology selection and outputs are in line with expectations. Consultants hired for the project will be tasked with studying and emphasizing appropriate technology for the surrounding environment.				
5	Financial Risks – The Government and private financial systems in Iraq are slow to adopt incentives to promote industries. This reflects, in part, the slow pace of policy reform and decision-making in Iraq. The cost of importing and installing units in		Financial	Lack of financial incentives and heavy fossil fuel subsidies will mean limited incentive for the widespread use of solar power. P = 3 I = 4	Co-financing already committed guarantees a minimum level of activity in solar during the project years. Thereafter, the benefits of solar should be well demonstrated to encourage Government action.	Govt		N/A	N/A

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
	Iraq will mean PV prices will be higher than on the international market, while alternatives (diesel and electricity) are heavily subsidised. Therefore, the long-term success of the PV market will depend on adoption of financial incentives by the Government.								
6	Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures.		Operational	Limited information on the reaction of the market to the measures implemented P = 2 I = 2	Close cooperation with the main participants in the local solar market and MoE to obtain the required data will be emphasised.	National Project Manager (NPM)			
7	Inadequate and/or non-capacitated human resources to successfully implement the project and support the		Operational	Project not meeting the stated targets P = 2 I = 5	The project includes significant capacity building and outreach components to help overcome this risk. The project will use the individuals trained to implement power plants under the project, thereby providing immediate use for the knowledge they have	National Project Manager (NPM)		N/A	N/A

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
	mainstreaming of its results.				acquired and providing them with immediate income from it.				
8	Limited engagement to date with the international climate change community. Iraq has no registered CDM projects, is presently working on its first National Communication to the UNFCCC (with UNDP support), and has no NAMAs to date.		Operational	Inability to access climate finance P = 1 I = 2	With MoEN as the national counterpart for the project, a focus will be given to NAMA development. This is one area where the use of well-experienced consultants can make a significant impact without reliance and several other complex factors (transport, security, etc.).	Project Steering Committee		N/A	N/A

8.2 Terms of Reference for Project Personnel

Project Steering Committee (PSC)

Duties and responsibilities:
The Project Steering Committee (PSC) is the principal body supervising the project implementation in accordance with UNDP Direct Implementation Modality (DIM) rules and regulations and referring to the specific objectives and the outcomes of the project with their agreed performance indicators.
The main functions of the PSC are:

- General monitoring of project progress in meeting its objectives and outcomes and ensuring that they continue to be in line with national development objectives;
- Facilitating the co-operation between the different Government entities whose inputs are required for successful implementation of the project, ensuring access to the required information and resolving eventual conflict situations raising during the project implementation when trying to meet its outcomes and stated targets;
- Supporting the elaboration, processing and adoption of the required institutional, legal and regulatory changes to support the project objectives and overcoming of related barriers;
- Facilitating and supporting other measures to minimize the identified risks to project success, remove bottlenecks and resolve eventual conflicts;
- Approval of the annual work plans and progress reports, the first plan being prepared at the outset of project implementation;
- Approval of the project management arrangements; and
- Approval of any amendments to be made in the project strategy that may arise due to changing circumstances, after careful analysis and discussion of the ways to solve problems.

PSC Structure and Reimbursement of Costs
The PSC will be chaired by UNDP. The PSC will include representatives from the key Ministries and Agencies involved in the project and representatives of the project's other co-financing partners.
The costs of the PSC's work shall be considered as the Government's or other project partners' voluntary in-kind contribution to the project and shall not be paid separately by the project. Members of the PSC are also not eligible to receive any monetary compensation from their work as experts or advisers to the project.

Meetings
It is suggested that the PSC will meet at least once a year, including the annual Tripartite Review (TPR) meeting. A tentative schedule of the PSC meetings will be agreed as a part of the annual work plans, and all representatives of the PSC should be notified again in writing 14 days prior to the agreed date of the meeting. The meeting will be organised provided that UNDP and at least two-thirds of the other members of the PSC can confirm their attendance. The project manager shall distribute all materials associated with the meeting agenda at least 5 working days in prior to the meeting.

UNDP Focal Point
As a representative of the Government (Ministry of Environment), the UNDP Focal Point has the responsibility of liaising with UNDP and assisting UNDP's direct implementation of the project.
His/her main duties and responsibilities include:

- Coordinate with the work of the Project Manager through meetings at regular intervals to receive project progress reports and provide guidance on policy issues;
- Taking the lead in developing linkages with the relevant authorities at national, provincial and governmental level and supporting the project in resolving any institutional- or policy-related conflicts that may emerge during its implementation.

Project Manager

Duties and responsibilities:

Operational project management in accordance with the Project Document and the UNDP guidelines and procedures for directly-implemented (DIM) projects, including:

- General coordination, management and supervision of project implementation;
- Managing the procurement and the project budget under the supervision of UNDP to assure timely involvement of local and international experts, organisation of training and public outreach, purchase of required equipment etc. in accordance with UNDP rules and procedures;
- Submission of annual Project Implementation Reviews and other required progress reports (such QPRs) to the PSC and UNDP in accordance with the section "Monitoring and Evaluation" of the Project Document;
- Ensuring effective dissemination of, and access to, information on project activities and results, (including a regularly updated project website);
- Supervising and coordinating the contracts of the experts working for the project;
- As applicable, communicating with the project's international partners and attracting additional financing in order to fulfill the project objectives; and
- Ensuring otherwise successful completion of the project in accordance with the stated outcomes and performance indicators summarized in the project's log frame matrix and within the planned schedule and budget.

Expected Qualifications:

- Advanced university degree and at least 7 years of professional experience or university degree with 10 years of professional experience in the specific areas the project is dealing with, including solid knowledge of renewable energy (including specifically solar PV), state-of-the-art approaches, and best practices in catalysing the renewable energy market (by applying different policy measures and financing mechanisms such as feed-in tariffs, net-metering, grid codes and climate finance);
- Experience in managing projects of similar complexity and nature, including demonstrated capacity to actively explore new, innovative implementation and financing mechanisms to achieve the project objective;
- Demonstrated experience and success in the engagement of, and working with, the private sector and NGOs, creating partnerships and leveraging financing for activities of common interest;
- Good analytical and problem-solving skills and the related ability to adaptively manage with prompt action on the conclusion and recommendations coming out from the project's regular monitoring and self-assessment activities as well as from periodic external evaluations;
- Ability and demonstrated success to work in a team, to effectively organise it, and to motivate its members and other project counterparts to effectively work towards the project's objective and expected outcomes;

- Good communication skills and competence in handling the project's external relations at all levels;
- Fluent/good knowledge of Arabic and English;
- Experience in developing countries, preferably in the Middle East; and
- Familiarity and prior experience with UNDP and GEF requirements and procedures are considered as an asset.

Project Engineer

Duties and responsibilities:
The project engineer will contribute to and supervise the technical aspects of the project, including:

- Helping to select and interface with technical consultants on the project;
- Lending support to Al Shafei, MoE, and MoST in their work with consultants;
- Supervising the work of technical consultants and ensuring they meet the required ToRs for their work;
- Providing advice and support to project participants (primarily MoE, Al Shafei, MoST) on their implementation of project components to achieve outcomes;
- Local capacity building - preparation of training materials for and organizing/providing the actual training on the different technical aspects of the project, including RE system design, selection and installation, product maintenance during operation, product performance monitoring and testing, etc.
- Co-operation with local universities, professional and vocational schools and initiating and developing activities of common interest such as new courses and curricula for RE systems designers and installers and opportunities for practical training of the students.
- Supporting and contributing to the implementation of other technical aspects of the project, as requested by the project manager.

Expected Qualifications:
- Advanced university degree and at least 2 years of professional experience or graduate university degree with 4 years in electrical engineering, including solar PV work;
- Familiarity with the key characteristics of implementing solar PV installations, including grid-connected, off-grid, and hybrid installations with and without battery storage;
- Demonstrated experience and success in the engagement of, and working with, the private sector;
- Good analytical and problem-solving skills and the related ability to adaptively manage with prompt action on the conclusions and recommendations coming out of the project's regular monitoring and self-assessment activities as well as from periodical external evaluations;
- Ability and demonstrated success to work in a team, to effectively organize it, and to motivate its members and other project counterparts to effectively work towards the project's objective and expected outcomes;
- Good communication skills and competence in handling project's external relations at all levels;
- Fluent/good knowledge of the Arabic and English languages;
- Experience in developing countries, preferably in the Middle East.

Project Assistant

Duties and responsibilities:

Supporting the project manager in the implementation of the project, including:

- Responsibility for logistics and administrative support of project implementation, including administrative management of the project budget, required procurement support, etc.
- Maintaining up-to-date business and financial documentation, in accordance with UNDP and other project reporting requirements;
- Organizing meetings, business correspondence and other communications with the project partners;
- Supporting the project outreach and PR activities in general, including keeping the project web-site up to date;
- Managing the projects files and supporting the project manager in preparing the required financial and other reports required for monitoring and supervision of the project progress;
- Supporting the project manager in managing contracts, in organizing correspondence and in ensuring effective implementation of the project otherwise.

Expected Qualifications:

- Fluent/good knowledge of Arabic, English.
- Demonstrated experience and success of work in a similar position
- Experience working in developing countries, preferably the Middle East
- Good administration and interpersonal skills
- Ability to work effectively under pressure
- Good computer skills
- Understanding of UNDP and/or GEF work practices would be advantageous

8.3 Greenhouse Gas Emission Reduction Calculations

Direct GHG Emissions Reductions

The calculation is presented in three steps:

1- Calculation of an emissions factor for electricity displaced by project electricity
2- Calculation of the electricity generated by the project, according to GEF Guidelines
3- Calculation of GHG emissions avoided

At each step, the most conservative assumptions are used.

Step 1:

The present grid emission factor for Iraq is 0.82kgCO_2/kWh, (0.82 tonne CO_2/MWh).[65]

According to the Integrated National Energy Strategy, Iraq aims to generate 83% of its power from natural gas by 2030, and 5% from renewables.[66]

Source	Fraction of Generation	Emission Factor (kg CO_2/kWh)	Weighted emissions factor
Natural Gas	0.83	0.499[67]	0.41417
Oil	0.12	0.82	0.0984
Renewables	0.05	0	0
Iraq Emission Factor 2030 (kgCO_2/kWh)[68]			0.51257

If we assume Iraq progresses linearly from the present to its future emission factor, then the average emission factor over the project period is 0.67 kg CO_2/kWh.

According to UNFCCC Guidelines, emission factors for off-grid diesel generation range from 0.8 kg CO_2/kWh to 2.4 kg CO_2/kWh, depending on the size of the diesel generator and operating conditions.[69] In order to maintain conservativeness in in the GHG emission reduction calculations, the on-grid emission factor has been used to calculate emissions reductions for all generation capacity.

Step 2:

Using a 20-year lifespan for PV equipment, in accordance with GEF guidelines, and a capacity factor of 20%[70], the 41.5 MW installed as a direct result of the project will produce 1.45 TWh.

Step 3:

[65] Ecometrica (2011), *Electricity-Specific Emission Factors for Grid Electricity*, p.6.
[66] Booz & Co. (2012), *Integrated National Energy Strategy*, p. 17, 170.
[67] World Nuclear Association (2011), *Comparison of Lifecycle GHG Emissions from Various Electricity Generation Sources.*
[68] 2030 is the last year for which data are available. Given that most power generation at the time is expected to be by natural gas, there is not significant room for future reduction in the years 2030 - 2035. Therefore, the 2030 value has been used in calculation. Any lack of accuracy in these assumptions is more than compensated by the other conservative assumptions, such as assuming no losses in the transmission grid, and applying the grid emission factor to all power generation, even though some will be off-grid with a much higher emission factor (0.82 kg CO_2/kWh).
[69] UNFCCC, Appendix B of the simplified modalities and procedures for small scale (up to 15 MW) CDM project activities.
[70] Booz & Co., *A New Source of Power – The Potential for Renewable Energy in the MENA Region*, p. 17.

Multiplying the average grid emission factor by the calculated energy generated from solar power as a result of the project, the avoided greenhouse gas emissions are 741,622 tonnes CO_2.

Conservativeness of the approach:
The approach above is conservative as it does not account for any grid losses, which in Iraq amount to 30-50% of the generated electricity (See Figure 15). It also assumes all plants are displacing grid electricity, which has a lower emissions factor than diesel generation. The UNFCCC guidelines present emission factors from diesel generators of 0.8 to 2.4 kg CO_2/kWh, depending on size and operational load.[71]

Indirect GHG Emissions Reductions

Top down analysis:

The targeted potential for renewable energy in Iraq is 5% of generation capacity by 2030, generating some 2.9 TWh/year.[72] Using the calculated average grid emission factor of 0.51kgCO_2/kWh, taking into account planned dynamic developments in the power generation system, the emissions reductions in can be estimated at 14,790,000 tCO_2 in a ten-year period post-project, as per the GEF methodology.[73]

Applying a conservative GEF Causality Factor of 40%, corresponding to Level 2 ("the GEF contribution is modest, and substation indirect emission reduction can be attributed to the baseline"), indirect emissions reduction by the project are 5.9 million tonnes CO_2 in the 10-year period post-project.

If a Level 3 Causality Factor ("the GEF contribution is substantial, but modest indirect emission reductions can be attributed to the baseline") is applied, then 60% of the indirect emissions can be attributed to the project , or 8.9 million tonnes CO_2 in the 10-year period post-project.

To provide a more conservative estimate, the value of 5.9 million tonnes CO_2 has been reported in the GEF Tracking Tool.

Bottom up analysis:

The GEF guidelines provide a formula for bottom-up emissions assessment as:

$CO_{2\ \text{indirect BU}} = CO_{2\ \text{direct}} * RF$

where RF is a Replication Factor. The GEF guidelines estimate a default RF of 2 for solar PV projects. For the project at hand, we estimate a default replication factor of 4 for the following reasons:

1) The GEF guidelines for renewable energy are based on 2008 figures, when solar energy was far less competitive with alternatives. Today, solar installations are proliferating, in many cases without direct

[71] UNFCCC (2013), *Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories*.
[72] Booz & Co. (2012), *Integrated National Energy Strategy*, p 48
[73] GEF (2008), *Manual for Calculating GHG Benefits of Projects: Energy Efficiency and Renewable Energy Projects.*

government intervention (or as a result of previous interventions). The price of solar energy today is less than a fifth of what it was in 2008 and further reductions can still be expected;[74]

2) The solar resource in Iraq means that the same solar energy equipment installed in Iraq will produce considerably more energy that in Europe, for example.

3) The power shortages in Iraq provide an additional incentive to seek alternative power sources.

For these reasons, a Replication Factor of 4 even seems conservative when taking into account this context.

With a replication factor of 4, the bottom-up indirect emissions are 2,966,488 tonnes CO_2 over the 10-year post-project period.

[74] Cleantechnica, Solar Module Prices have Fallen 80% Since 2008, Wind 29%, http://cleantechnica.com/2013/05/06/solar-pv-module-prices-have-fallen-80-since-2008-wind-turbines-29/

8.4 Letters of Co-finance

REPUBLIC OF IRAQ
MINISTRYOF ELECTRICITY
Planning & Studies Office

No. : 29
Date : 5 / 1 / 2014

جمهورية العراق
وزارة الكهرباء
دائرة التخطيط والدراسات

العدد :
التاريخ : / / ٢٠١٤

Adriana Dinu,
Office in Charge and Deputy Executive Coordinator,
UNDP-GEF,
304 East 45th Street, 9th Floor, New York, NY 10017, USA.

Subject: UNDP-GEF project, "Catalysing the Use of Solar Photovoltaic Energy"

On behalf of the Ministry of Electricity of the Republic of Iraq, I am pleased to express my full support and endorsement of the Global Environment Facility (GEF) project, "Catalysing the use of solar photovoltaic energy". The project is aligned with, and supportive of, the work of the Ministry, notably in the areas of promotion of renewable energy, development of a regulatory framework for independent power production, and promoting technical understanding of solar power issues.

The Ministry of Electricity intends to spend US$20,000,000 for Ministry activities in renewable energy, such as on- and off-grid photovoltaic power plants and design and development of laws and regulations to promote renewable energy and independent power production.

The Ministry of Electricity thanks the Global Environment Facility for its support to this project and looks forward to the commencement of the project and our future collaboration.

Sincerely,

Mr. Laith H. Hassan
DG of Planning and Studies
Ministry of electricity
Baghdad - Iraq

UNDP-d.m

مجموعة الشافعي
للتجارة والصناعة والمقاولات العامة
Al Shafiy Group
AL SHAFIY GROUP
مجمع BYTTI Bytti complex

No: 110
Date: 28/12/2013

Adriana Dinu,
Office in Charge and Deputy Executive Coordinator,
UNDP-GEF,
304 East 45th Street, 9th Floor, New York, NY 10017, USA.

Subject: Co-Financing for UNDP-GEF project, "Catalysing the Use of Solar Photovoltaic Energy"

On behalf of Al Shafei Company, I am pleased to express my full support and endorsement of the Global Environment Facility (GEF) project, "Catalysing the use of solar photovoltaic energy". The project will assist Al Shafei to demonstrate the potential of solar photovoltaic energy in Iraq to provide reliable power to communities while reducing the use of diesel and fuel oil.

Al Shafei Company will support the GEF project through grant co-financing of US$10,000,000, primarily for Component 1 in the context of the installation and operation of a photovoltaic systems for the Baiti new town development being undertaken in conjunction with Najaf Investment Board.

Al Shafei Company extends its thanks to the United Nations Development Programme and the Global Environment Facility for their support to this project.

Managing Director
Saad Jaddou Al-Shafei

MOB : +964 7711993341
+964 7811115836
www.myhome-iq.com
E-mail:sh@myhome-iq.com
العراق - النجف الاشرف

Republic of Iraq
Ministry Of Industry & Minerals
Al-Mansour State Company

جمهورية العراق
وزارة الصناعة و المعادن
شركة المنصور العامة
قسم الشؤون التجارية

No. : // 3955
Date : 18 / 12 /2013

العدد : // ٣٩٥٥
التاريخ : ١٨/١٢/٢٠١٣

To: United Nations Development Program

Subject: Co-Financing for UNDP-GEF project, "Catalyzing the Use of Solar Photovoltaic Energy"

Dear Sir

On behalf of the Ministry of Industry of the Republic of Iraq, I am pleased to express my full support and endorsement of the Global Environment Facility (GEF) project, "Catalyzing the use of solar photovoltaic energy", implemented by the Ministry of Environment and the United Nations Development Program. The project is aligned with, and supportive of,the work of the Ministry in promoting investment in the renewable energy sector, specifically solar energy, and in building the technical capacities of Iraqi stakeholders to manufacture, install, operate and maintain PV systems.

The Ministry of Industrywill support the GEF project through grant co-financing of US$50,000, primarily for Component 1 (support for PV rooftop and mini-grid systems).

The Ministry of Industryextends its thanks to the Global Environment Facility for its support to this project and looks forward to the commencement of the project.

Best regards

Rajaa Ismaiel
Senior Eng.

Hussein S. Ali
Expert Eng.

Ghazi K.Abbas
General manager

Address : Baghdad – Kadhmia – Tajiat

العنوان : بغداد / الكاظمية / التاجيات

Wireless 07270003999 , Mobile : 07712184751
P.O.Box (55053)

هاتف : ٠٧٢٧٠٠٠٣٩٩٩ ، ٠٧٧١٢١٨٤٧٥١
صندوق بريد : (٥٥٠٥٣) مكتب بريد بغداد المركزي / الصالحية

Website : www. Msc.industry.gov.iq

E-mail : info@msc.industry.gov.iq

اصدار ١ نيسان /٢٠١١

REPUBLIC OF IRAQ

MINISTRY OF SCIENCE & TECHNOLOGY

RENEWABLE ENERGY DIRECTORATE

وزارة العلوم و التكنولوجيا
Ministry Of Science & Technology

جمهورية العراق

وزارة العلوم والتكنولوجيا

دائرة الطاقات المتجددة

العدد: ط م 2123

التأريخ: 11 / 12 /2013

Subject: Co-Financing for UNDP-GEF project, "Catalysing the Use of Solar Photovoltaic Energy"

On behalf of the Ministry of Science and Technology of the Republic of Iraq, I am pleased to express my endorsement of the Global Environment Facility (GEF) project, "Catalysing the use of solar photovoltaic energy". The project is aligned with, and supportive of,the work of the Ministry, notably in the context of solar resource assessment and mapping, and the development of solar equipment tailored to the specific conditions of Iraq.

The Ministry of Science and Technology will support the GEF project through grant co-financing of US$2,500,000 for solar resource measurement and mapping under Component 2 and capacity building under Component 3.

The Ministry of Science and Technology thanks the Global Environment Facility and the United Nations Development Programme for their support to this project and looks forward to the commencement of the project and our future collaboration.

Sincerely,

kamal

Dr.Kamal H.Latif
General Director
11 / 12/ 2013

وزارة العلوم والتكنولوجيا
دائرة بحوث
وتكنولوجيا
الطاقات المتجددة

REPUBLIC OF IRAQ
MINISTRY OF ENVIRONMENT
MINISTERS OFFICE
Climate Change Center

جمهورية العراق
وزارة البيئة
مكتب الوزير
مركز التغيرات المناخية

NO :MO/CCC / 1568
DATE : 23/12/2013

العدد : م و / م ت م / ١٥٦٨
التاريخ ٢٣ / ١٢ / ٢٠١٣

Adriana Dinu,
Office in Charge and Deputy Executive Coordinator,
UNDP-GEF,
304 East 45th Street, 9th Floor, New York, NY 10017, USA.

Subject: Co-Financing for UNDP-GEF project, "Catalysing the Use of Solar Photovoltaic Energy"

On behalf of the Ministry of Environment of the Republic of Iraq, I am pleased to express my support and endorsement of the Global Environment Facility (GEF) project, "Catalysing the use of solar photovoltaic energy", which will be implemented by the Ministry. The project is aligned with the work of the Ministry and complements the Ministry's activities in climate change mitigation, low-carbon development and Nationally Appropriate Mitigation Actions.

The Ministry of Environment will support the GEF project through total co-financing of US$200,000, consisting of: US$130,000 of grant co-finance through Ministry-managed strategy projects for the period 2014-2017 that directly contribute to the outcomes of the GEF project; and US$70,000 of in-kind co-finance, in the form of Ministry resources including staff time.

This co-financing will be used to support a range of project activities, notably under Component 2 (CDM, NAMAs, MRV, institutional strengthening and increase public awareness).

The Ministry of Environment thanks the Global Environment Facility for its support to this project and looks forward to the commencement of the project.

Eng. Sargon Lazar Slewa
Minister of Environment
23 /12/2013

Ministry Of Environment

نسخة منه الى:
- مكتب الوزير/ للتفضل بالإطلاع... مع التقدير.
- مركز التغيرات المناخية/ للمتابعة مع الأوليات رجاءً.
- التوثيق.

E-mail:iraqccc@gmail .com
Tel: (7177828 - 7173721)

رقم الهاتف : (٧١٧٧٨٢٨ - ٧١٧٣٧٢١)

بـــرنـــامج الأمـــم المتحـــدة الإنمـــــائي

United Nations Development Programme

18 February 2014

Subject: Co-Financing for UNDP-GEF project, "Catalysing the Use of Solar Photovoltaic Energy"

On behalf of the United Nations Development Programme in Iraq, I am pleased to express UNDP's support for the Global Environment Facility (GEF) project, "Catalysing the use of solar photovoltaic energy", which will be implemented under the National Implementation Modality by the Ministry of Environment with UNDP's support. The project supports the efforts of the Government of Iraq to promote the adoption of renewable energy and is aligned with relevant energy-sector policies and strategies, and with the United Nations Development Assistance Framework (UNDAF) for Iraq.

UNDP Iraq will support the GEF project through total co-financing of US$215,200. Grant (cash) co-finance of US$165,200 will be sourced from core TRAC sources of $50,000 and relevant UNDP projects of $115,200 that directly contribute to the outcomes of the GEF project, primarily in support of Components 2 and 3 (pro-renewable energy investment policy reform and facilitation of private sector capacity). Additionally, UNDP Iraq will provide $50,000 of in-kind co-finance, in the form of Country Office resources including staff time.

We hope this project is approved and we look forward to commencing the work.

Yours Sincerely,

Adam Abdelmoula
Country Director

Ms. Adriana Dinu,
Executive Coordinator and Director a.i.,
UNDP-GEF,
304 East 45th Street, 9th Floor, New York, NY 10017, USA.

8.5 Letter of Endorsement from GEF Operational Focal Point

REPUBLIC OF IRAQ
MINISTRY OF ENVIRONMENT

CHANCELLOR'S OFFICE

جمهورية العراق
وزارة البيئة

مكتب المستشار

No : 616
Date : 7 /8 /2012

العـــدد : م ش /
التاريخ : / / ٢٠١

To: Mr Yannick Glemarec
United Nations Development Programme
304 E 45th Street, New York, NY 10017, USA

Subject: Endorsement for GEF project: Catalysing the Use of Solar Photovoltaic Energy in Iraq

In my capacity as GEF Operational Focal Point for Iraq, I confirm that the above project proposal (a) is in accordance with my government's national priorities including Iraq integrated climate change framework programme prepared by the Ministry of Environment and our commitment to the relevant global environmental conventions; and (b) was discussed with relevant stakeholders, including the global environmental convention focal points.

I am pleased to endorse the preparation of the above project proposal with the support of the GEF Agency(ies) listed below. If approved, the proposal will be prepared and implemented by the Ministry of Environment. I request the GEF Agency(ies) to provide a copy of the project document before it is submitted to the GEF Secretariat for CEO endorsement.

The total financing (from GEFTF, LDCF, SCCF and/or NPIF) being requested for this project is US$2,538,000, inclusive of project preparation grant (PPG), if any, and Agency fees for project cycle management services associated with the total GEF grant. The financing requested for Iraq is detailed in the table below.

Source of Funds	GEF Agency	Focal Area	Amount (in US$)			
			Project Preparation	Project	Fee	Total
GEFTF	UNDP	CC	80,000	2,227,273	230,727	2,538,000
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)	(select)				0
Total GEF Resources			80,000	2,227,273	230,727	2,538,000

[WHERE THE SOURCE OF FUNDING IS GEF TRUST FUND ONLY (I.E. EXCLUDING LDCF AND/OR SCCF) AND THE FOCAL AREA FALLS UNDER THE STAR MODEL, INCLUDE THE FOLLOWING:

I consent to the utilization of Iraq's allocations in GEF-5 as defined in the System for Transparent Allocation of Resources (STAR).

Sincerely,

Dr. Ali Al- Lami/ GEF OFP
Ministry Advisor
7 August 2012

E-mail:aaz959@yahoo.com
Tel: (7173721 - 7177828)

GEF Operational Focal Point Endorsement Template, November 2011

رقم الهاتف : (٧١٧٣٧٢١ - ٧١٧٧٨٢٨)

8.6 Environmental and Social Safeguards Screening

UNDP Environmental and Social Screening Template (December 2012)

QUESTION 1:

Has a combined environmental and social assessment/review that covers the proposed project already been completed by implementing partners or donor(s)?

Select answer below and follow instructions:

☒ →NO: Continue to Question 2 (do not fill out Table 1.1)

☐→YES: No further environmental and social review is required if the existing documentation meets UNDP's quality assurance standards, and environmental and social management recommendations are integrated into the project. Therefore, you should undertake the following steps to complete the screening process:

1. Use Table 1.1 below to assess existing documentation. (It is recommended that this assessment be undertaken jointly by the Project Developer and other relevant Focal Points in the office or Bureau).
2. Ensure that the Project Document incorporates the recommendations made in the implementing partner's environmental and social review.
3. Summarize the relevant information contained in the implementing partner's environmental and social review in Annex A.2 of this Screening Template, selecting Category 1.
4. Submit Annex A to the PAC, along with other relevant documentation.

Note: Further guidance on the use of national systems for environmental and social assessment can be found in the UNDP ESSP Annex B.

TABLE 1.1: CHECKLIST FOR APPRAISING QUALITY ASSURANCE OF EXISTING ENVIRONMENTAL AND SOCIAL ASSESSMENT	**Yes/No**
1. Does the assessment/review meet its terms of reference, both procedurally and substantively?	
2. Does the assessment/review provide a satisfactory assessment of the proposed project?	
3. Does the assessment/review contain the information required for decision-making?	
4. Does the assessment/review describe specific environmental and social management measures (e.g. mitigation, monitoring, advocacy, and capacity development measures)?	
5. Does the assessment/review identify capacity needs of the institutions responsible for implementing environmental and social management issues?	
6. Was the assessment/review developed through a consultative process with strong stakeholder engagement, including the view of men and women?	
7. Does the assessment/review assess the adequacy of the cost of and financing arrangements for environmental and social management issues?	

Table 1.1 (continued) For any "no" answers, describe below how the issue has been or will be resolved (e.g. amendments made or supplemental review conducted).

QUESTION 2:

Do all outputs and activities described in the Project Document fall within the following categories?

- ☐ Procurement (in which case UNDP's Procurement Ethics and Environmental Procurement Guide need to be complied with)
- ☐ Report preparation
- ☒ Training
- ☐ Event/workshop/meeting/conference (refer to Green Meeting Guide)
- ☐ Communication and dissemination of results

Select answer below and follow instructions:

- ☒ NO → Continue to Question 3
- ☐ YES → No further environmental and social review required. Complete Annex A.2, selecting Category 1, and submit the completed template (Annex A) to the PAC.

QUESTION 3:

Does the proposed project include activities and outputs that support *upstream* planning processes that potentially pose environmental and social impacts or are vulnerable to environmental and social change (refer to Table 3.1 for examples)? (Note that *upstream* planning processes can occur at global, regional, national, local and sectoral levels)

Select the appropriate answer and follow instructions:

☐ NO → Continue to Question 4.

☒ YES →Conduct the following steps to complete the screening process:

1. Adjust the project design as needed to incorporate UNDP support to the country(ies), to ensure that environmental and social issues are appropriately considered during the upstream planning process. Refer to Section 7 of this Guidance for elaboration of environmental and social mainstreaming services, tools, guidance and approaches that may be used.
2. Summarize environmental and social mainstreaming support in Annex A.2, Section C of the Screening Template and select "Category 2".
3. If the proposed project ONLY includes upstream planning processes then screening is complete, and you should submit the completed Environmental and Social Screening Template (Annex A) to the PAC. If downstream implementation activities are also included in the project then continue to Question 4.

TABLE 3. 1 EXAMPLES OF UPSTREAM PLANNING PROCESSES WITH POTENTIAL DOWNSTREAM ENVIRONMENTAL AND SOCIAL IMPACTS	Check appropriate box(es) below
1. Support for the elaboration or revision of **global- level** strategies, policies, plans, and programmes. *For example, capacity development and support related to international negotiations and agreements. Other examples might include a global water governance project or a global MDG project.*	No
2. Support for the elaboration or revision of **regional-level** strategies, policies and plans, and programmes. *For example, capacity development and support related to transboundary programmes and planning (river basin management, migration, international waters, energy development and access, climate change adaptation etc.).*	No
3. Support for the elaboration or revision of **national-level** strategies, policies, plans and programmes. *For example, capacity development and support related to national development policies, plans, strategies and budgets, MDG-based plans and strategies (e.g. PRS/PRSPs, NAMAs), sector plans.*	Yes
4. Support for the elaboration or revision of **sub-national/local-level** strategies, polices, plans and programmes. *For example, capacity development and support for district and local level development plans and regulatory frameworks, urban plans, land use development plans, sector plans, provincial development plans, provision of services, investment funds, technical guidelines and methods, stakeholder engagement.*	Yes

QUESTION 4:

Does the proposed project include the implementation of *downstream* activities that potentially pose environmental and social impacts or are vulnerable to environmental and social change?

To answer this question, you should first complete Table 4.1 by selecting appropriate answers. If you answer "No" or "Not Applicable" to all questions in Table 4.1 then the answer to Question 4 is "NO." If you answer "Yes" to any questions in Table 4.1 (even one "Yes" can indicated a significant issue that needs to be addressed through further review and management) then the answer to Question 4 is "YES":

☐ **NO** → No further environmental and social review and management required for downstream activities. Complete Annex A.2 by selecting "Category 1", and submit the Environmental and Social Screening Template to the PAC.

☒ **YES** → Conduct the following steps to complete the screening process:

1. Consult Section 8 of this Guidance, to determine the extent of further environmental and social review and management that might be required for the project.
2. Revise the Project Document to incorporate environmental and social management measures. Where further environmental and social review and management activity cannot be undertaken prior to the PAC, a plan for undertaking such review and management activity within an acceptable period of time, post-PAC approval (e.g. as the first phase of the project) should be outlined in Annex A.2.
3. Select "Category 3" in Annex A.2, and submit the completed Environmental and Social Screening Template (Annex A) and relevant documentation to the PAC.

TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT		
1.	**Biodiversity and Natural Resources**	**Answer (Yes/No/ Not Applicable)**
1.1	Would the proposed project result in the conversion or degradation of modified habitat, natural habitat or critical habitat?	Unlikely - but solar plant siting may have impacts that will need to be assessed on a site-by-site basis
1.2	Are any development activities proposed within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	No
1.3	Would the proposed project pose a risk of introducing invasive alien species?	No
1.4	Does the project involve natural forest harvesting or plantation development without an independent forest certification system for sustainable forest management (*e.g. PEFC, the Forest Stewardship Council certification systems, or processes established or accepted by the relevant National Environmental Authority*)?	No
1.5	Does the project involve the production and harvesting of fish populations or other aquatic species without an accepted system of independent certification to ensure sustainability (*e.g. the Marine Stewardship Council certification system, or certifications, standards, or processes established or accepted by the relevant National Environmental Authority*)?	No

TABLE 4.1:	ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT	
1.6	Does the project involve significant extraction, diversion or containment of surface or ground water? *For example, construction of dams, reservoirs, river basin developments, groundwater extraction.*	No
1.7	Does the project pose a risk of degrading soils?	No
2.	**Pollution**	**Answer (Yes/No/ Not Applicable)**
2.1	Would the proposed project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional, and transboundary impacts?	No
2.2	Would the proposed project result in the generation of waste that cannot be recovered, reused, or disposed of in an environmentally and socially sound manner?	No
2.3	Will the propose project involve the manufacture, trade, release, and/or use of chemicals and hazardous materials subject to international action bans or phase-outs? *For example, DDT, PCBs and other chemicals listed in international conventions such as the Stockholm Convention on Persistent Organic Pollutants, or the Montreal Protocol.*	No
2.4	Is there a potential for the release, in the environment, of hazardous materials resulting from their production, transportation, handling, storage and use for project activities?	No
2.5	Will the proposed project involve the application of pesticides that have a known negative effect on the environment or human health?	No
3.	**Climate Change**	
3.1	Will the proposed project result in significant[1] greenhouse gas emissions? *Annex E provides additional guidance for answering this question.*	No (the reverse: the project will result in significant emission reductions)
3.2	Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)? You can refer to the additional guidance in Annex C to help you answer this question. *For example, a project that would involve indirectly removing mangroves from coastal zones or encouraging land use plans that would suggest building houses on floodplains could increase the surrounding population's vulnerability to climate change, specifically flooding.*	No
4.	**Social Equity and Equality**	**Answer (Yes/No/ Not Applicable)**
4.1	Would the proposed project have environmental and social impacts that could affect indigenous people or other vulnerable groups?	No

[1] Significant corresponds to CO_2 emissions greater than 100,000 tons per year (from both direct and indirect sources). Annex E provides additional guidance on calculating potential amounts of CO_2 emissions.

TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT	
4.2 Is the project likely to significantly impact gender equality and women's empowerment[2]?	**No**
4.3 Is the proposed project likely to directly or indirectly increase social inequalities now or in the future?	**No**
4.4 Will the proposed project have variable impacts on women and men, different ethnic groups, social classes?	**No**
4.5 Have there been challenges in engaging women and other certain key groups of stakeholders in the project design process?	**Not applicable**
4.6 Will the project have specific human rights implications for vulnerable groups?	**No**
5. Demographics	
5.1 Is the project likely to result in a substantial influx of people into the affected community(ies)?	**No**
5.2 Would the proposed project result in substantial voluntary or involuntary resettlement of populations? *For example, projects with environmental and social benefits (e.g. protected areas, climate change adaptation) that impact human settlements, and certain disadvantaged groups within these settlements in particular.*	**No**
5.3 Would the proposed project lead to significant population density increase which could affect the environmental and social sustainability of the project? *For example, a project aiming at financing tourism infrastructure in a specific area (e.g. coastal zone, mountain) could lead to significant population density increase which could have serious environmental and social impacts (e.g. destruction of the area's ecology, noise pollution, waste management problems, greater work burden on women).*	**No**
1. Culture	
6.1 Is the project likely to significantly affect the cultural traditions of affected communities, including gender-based roles?	**No**
6.2 Will the proposed project result in physical interventions (during construction or implementation) that would affect areas that have known physical or cultural significance to indigenous groups and other communities with settled recognized cultural claims?	**No**
6.3 Would the proposed project produce a physical "splintering" of a community? *For example, through the construction of a road, powerline, or dam that divides a community.*	**No**
2. Health and Safety	
7.1 Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence, landslides, erosion, flooding or extreme climatic conditions? *For example, development projects located within a floodplain or landslide prone area.*	**No**
7.2 Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection?	**No**
7.3 Will the proposed project require additional health services including testing?	**No**

[2] Women are often more vulnerable than men to environmental degradation and resource scarcity. They typically have weaker and insecure rights to the resources they manage (especially land), and spend longer hours on collection of water, firewood, etc. (OECD, 2006). Women are also more often excluded from other social, economic, and political development processes.

TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT		
3.	**Socio-Economics**	
8.1	Is the proposed project likely to have impacts that could affect women's and men's ability to use, develop and protect natural resources and other natural capital assets? *For example, activities that could lead to natural resources degradation or depletion in communities who depend on these resources for their development, livelihoods, and well-being?*	**No**
8.2	Is the proposed project likely to significantly affect land tenure arrangements and/or traditional cultural ownership patterns?	**No**
8.3	Is the proposed project likely to negatively affect the income levels or employment opportunities of vulnerable groups?	**No**
9.	**Cumulative and/or Secondary Impacts**	**Answer** (Yes/No/ Not Applicable)
9.1	Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project? *For example, future plans for urban growth, industrial development, transportation infrastructure, etc.*	To be determined during project implementation as the Ministry of Electricity selects PV plant sites (16 in total).
9.2	Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area? *For example, a new road through forested land will generate direct environmental and social impacts through the cutting of forest and earthworks associated with construction and potential relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts. (Sometimes these are termed "secondary" or "consequential" impacts). Or if there are similar developments planned in the same forested area then cumulative impacts need to be considered.*	**No**

ANNEX A.2: ENVIRONMENTAL AND SOCIAL SCREENING SUMMARY

(to be filled in after Annex A.1 has been completed)

Name of Proposed Project: Catalysing the Use of Solar Photovoltaic Energy in Iraq

A. Environmental and Social Screening Outcome

Select from the following:

☐ Category 1. No further action is needed

☐ Category 2. Further review and management is needed. There are possible environmental and social benefits, impacts, and/or risks associated with the project (or specific project component), but these are predominantly indirect or very long-term and so extremely difficult or impossible to directly identify and assess.

☒ Category 3. Further review and management is needed, and it is possible to identify these with a reasonable degree of certainty. If Category 3, select one or more of the following sub-categories:

☐ Category 3a: Impacts and risks are limited in scale and can be identified with a reasonable degree of certainty and can often be handled through application of standard best practice, but require some minimal or targeted further review and assessment to identify and evaluate whether there is a need for a full environmental and social assessment (in which case the project would move to Category 3b).

☒ Category 3b: Impacts and risks may well be significant, and so full environmental and social assessment is required. In these cases, a scoping exercise will need to be conducted to identify the level and approach of assessment that is most appropriate.

B. Environmental and Social Issues (for projects requiring further environmental and social review and management)

In this section, you should list the key potential environmental and social issues raised by this project. This might include both environmental and social opportunities that could be seized on to strengthen the project, as well as risks that need to be managed. You should use the answers you provided in Table 4.1 as the basis for this summary, as well as any further review and management that is conducted.

The project involves promotion of solar PV technology in Iraq. Although mostly environmentally beneficial, there are specific issues that may be relevant for some large-scale implementations. Roof-top PV implementation are not likely to require any futher environemntal analysis. Large-scale, ground-mounted PV plants will require environmental and social impact assessments to identify issues such as land use, social impact, impact of bird-life and wildlife, and impact on aviation. PV technology does not inherently pose any environmental or social threats. On the contrary, PV power provides both local and global environmental benefits, reducing the pollutants emitted by diesel generators and other power sources, and reducing global pollutants, such as CO2. However, where large installations are concerned, there may be impacts related to th scale of the PV plant or the scale of construction. Such impacts may include transporation of equipment and personnel, housing for labour,and other construction-related activities, or the above-mentioned environmental impacts.

C. Next Steps (for projects requiring further environmental and social review and management):

In this section, you should summarize actions that will be taken to deal with the above-listed issues. If your project has Category 2 or 3 components, then appropriate next steps will likely involve further environmental and social review and management, and the outcomes of this work should also be summarized here. Relevant guidance should be obtained from Section 7 for Category 2, and Section 8 for Category 3.

For large-scale, ground-mounted PV plants, environment and social impact assessments should be carried out. In many cases, where installations are remote or not within areas of significant biodiversity, an initial assessment may be sufficient to rule out significant adverse impacts. This will depend on the size of the project and project location and will be considered on a case-by-case basis. In all cases, relevant national planning and environment legislation will be respected. All the solar plants (expected to number 16 in total) supported by the GEF project will be owned and operated by the Ministry of Electricity (MoE). In such cases that detailed environment and social impact assessments are required, MoE will undertake EIAs/SIAs at its own cost (as co-financing) with GEF technical support as required.

D. Sign Off

Project Manager	**Shigeru Handa**		**Date 18/03/2014**
PAC			**Date**
Programme Manager			**Date**