



**United Nations Development Programme**

**Country: Lebanon**

**PROJECT DOCUMENT<sup>1</sup>**

**Project Title: Small Decentralized Renewable Energy Power Generation**

**UNDAF Outcome(s):** By 2014, improved accessibility and management of natural resources and enhanced response to national and global environmental challenges

**UNDP Strategic Plan Environment and Sustainable Development Primary Outcome:** Increased effective response to climate change reflected in national programmes and external assistance programmes

**UNDP Strategic Plan Secondary Outcome:** Environmental considerations are mainstreamed in sector and local-level strategies and plans

**Expected CP Outcome(s):** Climate change considerations mainstreamed in national priorities

**Expected CPAP Output (s):** National sustainable energy strategy developed and its implementation promoted

**Executing Entity/Implementing Partner:** Ministry of Energy and Water

**Implementing Entity/Responsible Partners:** United Nations Development Programme

**Brief Description**

The project will catalyze the development of the small, decentralized, grid-connected renewable energy (RE) power generation market in Lebanon. The target is to facilitate the installation of at least 1.75 MW of new decentralized RE power generation capacity during the lifetime of the project, resulting in direct GHG reduction benefits of approximately 35,500 tonnes of CO<sub>2</sub>eq. Complementary indirect mitigation benefits are expected from the sustained market growth of decentralized RE power generation investments after the project and from paving the way for larger RE power plants – for example, by clarifying the technical and institutional aspects of connecting RE-based intermittent power generation sources into the grid and leveraging financing for RE investments from new sources such as carbon and climate financing. This indirect GHG reduction impact of the project has been estimated to range from 317,000 tonnes to over 1.7 million tonnes of CO<sub>2</sub>eq depending on the assumptions made.

Programme Period:	<u>2013-2017</u>
Atlas Award ID:	<u>00073116</u>
Project ID:	<u>00086064</u>
PIMS #	<u>4695</u>
Start date:	<u>Jun. 01, 2013</u>
End Date	<u>May 31, 2017</u>
Management Arrangements	NEX
PAC Meeting Date	_____

Total resources required	<u>US\$ 13,066,000</u>
Total allocated resources:	<u>US\$ 13,066,000</u>
• Regular UNDP (TRAC)	<u>US\$ 125,000</u>
• Other UNDP	<u>US\$ 6,257,000</u>
• Other:	
o GEF	<u>US\$ 1,450,000</u>
o Other Cash	<u>US\$ 4,734,000</u>
o Gov't in-kind	<u>US\$ 500,000</u>

<sup>1</sup> For UNDP supported GEF-funded projects, as this includes GEF-specific requirements

Agreed by (Government):

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Date/Month/Year

Agreed by (Executing Entity/Implementing Partner):

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Date/Month/Year

Agreed by (UNDP):

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Date/Month/Year

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## LIST OF ACRONYMS

<b>BoT</b>	Build, Operate and Transfer
<b>CEDRO</b>	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
<b>CO</b>	UNDP Country Office
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>CoM</b>	Council of Ministers
<b>CSP</b>	Concentrating Solar Power
<b>EE</b>	Energy Efficiency
<b>EENS</b>	Expected Energy Not Supplied
<b>EU</b>	European Union
<b>GDP</b>	Gross Domestic Product
<b>GEF</b>	Global Environment Facility
<b>GHG</b>	Greenhouse Gas
<b>HQ</b>	UNDP Headquarters
<b>IEA</b>	International Energy Agency
<b>ICT</b>	Information and Communication Technology
<b>LCEC</b>	Lebanese Center for Energy Conservation
<b>LGBC</b>	Lebanese Green Building Council
<b>LOLE</b>	Loss of Load Expectation
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MoEW</b>	Ministry of Energy and Water
<b>MRV</b>	Monitoring, Reporting and Verification
<b>NAMA</b>	Nationally Appropriate Mitigation Action
<b>NEEREA</b>	National Energy Efficiency and Renewable Energy Account
<b>NGO</b>	Non-Governmental Organisation
<b>ODS</b>	Ozone Depleting Substance
<b>O&amp;M</b>	Operation & Maintenance
<b>PIR</b>	Project Implementation Review
<b>PMU</b>	Project Management Unit
<b>PPG</b>	Project Preparation Grant
<b>PPP</b>	Purchasing Power Parity
<b>PSC</b>	Project Steering Committee
<b>PV</b>	Photovoltaic
<b>QPR</b>	Quarterly Progress Report
<b>RCU</b>	UNDP Regional Coordination Unit
<b>RE</b>	Renewable Energy
<b>RTA</b>	Regional Technical Advisor
<b>SWH</b>	Solar water heater
<b>TPR</b>	Tripartite Review
<b>TTR</b>	Terminal Tripartite Review
<b>TWh</b>	Terawatt hour
<b>WB</b>	World Bank
<b>UNDAF</b>	United Nations Development Assistance Framework
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change

## 1. SITUATION ANALYSIS

### 1.1. Context and Global Significance

1. The Lebanese Electric Power System (LEPS) has been suffering from technical and financial deficiencies for decades. It mirrors the problems encountered in many developing countries suffering from inadequate or no power systems planning, resulting in incomplete and poorly-operating infrastructure and enduring the consequences of political instability, significant debts, unavailability of financing for desired projects and inefficiency in operation.

2. The current energy supply of Lebanon relies almost entirely on imported fossil fuels, primarily oil products. Lebanon's greenhouse gas emissions in 2009 were estimated at 19.33 million tonnes (mega-tonnes, Mt) of CO<sub>2eq</sub>, equivalent to 4.52 tonnes per capita and 0.75 kg per USD<sub>2000</sub> of GDP. These can be compared with the OECD average of 9.83 tonnes per capita and 0.38 kg per USD<sub>2000</sub> of GDP<sup>2</sup>.

3. While the transport sector is the main source of urban air pollution, electricity generation is the largest source of Lebanon's greenhouse gas emissions<sup>3</sup>. Ageing power plants burn dirty heavy fuel oil and private back-up diesel generators also contribute significantly to local air pollution.

4. The LEPS is operated by a vertically-integrated, publicly-owned utility, Electricité du Liban (EdL). The results of an energy analysis prepared for the Electricity Sector Policy Paper in 2009<sup>3</sup> revealed that the Expected Energy Not Supplied (EENS) was 3,495 MWh, representing 25% of the estimated energy demand of 15 TWh; and the Loss of Load Expectation (LOLE) was 8,714 hours per year, indicating that the available generating capacity was only capable of meeting demand for few hours per year. Since then, the situation has deteriorated further. The Greater Beirut area is currently suffering from power cuts for about 3 hours per day on average and the rest of the country for about 10 hours per day (compared to 7 hours in 2011 and 6 hours in 2009).

5. The average power generation costs of EdL were estimated at 17.14 US cents per kWh in 2009, while the average consumer tariff is 9.58 US cents per kWh. Consequently, and complemented by the significant technical (15%) and non-technical (20%) losses in power transmission and distribution and uncollected bills (5%), EdL is suffering from chronic financial losses. With no indigenous fossil fuel resources, Lebanon is also exposed to fluctuating prices on the global market. All this has been estimated to produce additional public expenditures at approximately US\$ 1.5 billion per year to cover the deficit of EdL<sup>4</sup>.

6. On the demand-side, the frequent power cuts have forced the population to rely on expensive back-up arrangements, typically consisting of diesel generators. The Association of Lebanese Industrialists owns diesel generators amounting to a total power generation capacity of approximately 200 MW; hotels, schools, universities and hospitals together possess about 100 MW of diesel generating capacity; and residential buildings and districts about 600 MW<sup>5</sup>. It has been estimated<sup>5</sup> that more than one-third (33-38%) of Lebanon's total electricity demand is met by these privately-owned small diesel generators, with an average size of 200 kVA and typical power generation costs of around 30 US cents per kWh. A household survey conducted by the Central Administration of Statistics of the Government of Lebanon in 2007 revealed that, while close to 98% of Lebanese households are connected to the public grid, over 60% of them need to rely on private electricity networks as a secondary source of electricity. For the overall economy, the annual cost of energy not supplied was estimated by the Ministry of Energy and Water in 2009 to be over US\$ 2.5 billion at a minimum, which can be compared with the GDP of Lebanon of US\$ 34.7 billion during the same year<sup>6</sup>.

<sup>2</sup> IEA Key World Energy Statistics, 2011 ([http://www.iea.org/textbase/nppdf/free/2011/key\\_world\\_energy\\_stats.pdf](http://www.iea.org/textbase/nppdf/free/2011/key_world_energy_stats.pdf))

<sup>3</sup> Policy Paper for the Electricity Sector, Ministry of Energy and Water, Government of Lebanon, 2010

<sup>4</sup> Source: Ministry of Energy and Water

<sup>5</sup> Source: Republic of Lebanon Electricity Sector: Public Expenditure Review, Report no. 41421-LB. World Bank, 2008.

<sup>6</sup> Source: [www.imf.org](http://www.imf.org) (GDP 2009, USD current prices)

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

7. The current problems in the Lebanese electricity sector are having major technical and financial impacts on customers, the Government and the entire economy. To respond to these challenges and requirements, the Ministry of Energy and Water (MoEW) of Lebanon developed a comprehensive energy policy in 2009-2010 and secured the approval for this from the Council of Ministers (CoM) on June 21, 2010. This Policy Paper<sup>7</sup> represents a hitherto unprecedented effort in Lebanon to present a well-elaborated strategy and implementation programme to address the current power sector problems with concrete and quantified targets to be achieved in the short, medium and long term.

8. For overcoming the current power supply deficit, the bulk of the proposed capacity additions – i.e. 2,100-2,200 MW by 2014 and an additional 1,000 MW after that – rely on the construction of new thermal power plants using fossil fuels, primarily natural gas. This is to be complemented by rehabilitating and/or upgrading some existing thermal power plants (with 245 MW of estimated additional capacity) and also by increasing the role of renewable energy, with a target to have RE contributing 12% of total electricity and thermal energy generation in Lebanon by 2020, thereby reflecting the voluntary commitment made by the Government of Lebanon in 2009 in Copenhagen. The Policy Paper envisages 40 MW supplemental hydro-power in addition to the existing 290 MW (in 2012-2015), as well as new wind power (60-100 MW in 2011-2013) and waste to energy (15-25 MW in 2013-2014). No construction has yet begun on any of these renewable energy plants, however. A more detailed description of the current energy sector development plans of the Government of Lebanon can be found in Annex 7.5, while the status of and potential for renewable energy in Lebanon are discussed in further detail in Annex 7.6.

9. Other proposed measures in the Policy Paper that relate, in particular, to efforts to increase energy efficiency and the role of renewable energy include the establishment of a smart grid and the creation of the National Energy Efficiency and Renewable Energy Account (NEEREA) as a financing mechanism to support energy efficiency and renewable energy investments<sup>8</sup>. The Paper also encourages private sector involvement and the promotion of green buildings. Small, decentralized building-level RE applications for electricity generation were, however, not specifically emphasized in the Policy Paper.

10. The National Energy Efficiency Action Plan (NEEAP) was approved by the CoM in February 2012. The Plan describes 14 initiatives:

- Banning the import of incandescent lamps into Lebanon;
- Adoption of the draft Energy Conservation Law and institutionalization of the Lebanese Centre for Energy Conservation (LCEC);
- Promotion of decentralized PV and wind applications in the residential and commercial sectors;
- Solar water heaters (SWHs) for buildings and institutions;
- Design and implementation of a national strategy for efficient and economic public street lighting;
- Electricity generation from wind power;
- Electricity generation from solar energy (PV);
- Hydropower for electricity generation;
- Geothermal, waste to energy and other technologies;
- A new building code for Lebanon;
- Financing mechanisms and incentives;
- Awareness and capacity building;
- Paving the way for energy audits and ESCO business; and
- Promotion of energy efficient equipment.

<sup>7</sup> <http://lcecp.org.lb/policies.php?i=6>

<sup>8</sup> For further details about NEEEA, see section 1.6

11. Funding for EE and RE investments is expected to be provided mainly by the National Energy Efficiency and Renewable Energy Account (NEEREA), a joint cooperative initiative between BdL, UNDP, the EU, MOEW-LCEC, Lebanese banks and private investors. So far, the account has received €24 million from the EU and is expected to raise \$100 million locally to be invested in energy efficiency, renewable energy and green building projects. It is anticipated that many economic sectors and interest groups (SMEs in agriculture, industry and hospitals) will be competing for limited funds. A more detailed description of NEEREA and the other past and ongoing projects that relate to this GEF project can be found in chapter 1.5.

12. The Draft Energy Conservation Law, approved in early 2012 by the CoM and currently awaiting the approval of the Parliament, provides MoEW with a framework for mainstreaming EE and RE activities in Lebanon, and would institutionalize the Lebanese Centre for Energy Conservation (LCEC) as the lead energy entity in the country for the management of EE and RE activities. The draft Law proposes:

- Conducting obligatory and periodic energy audits for different types of buildings and energy consuming processes;
- Evaluating and assessing energy-intensive projects for the potential and options to improve their energy efficiency;
- Hiring the services of energy auditors or energy services firms to conduct energy audits;
- Energy labeling of products, machines, equipment and electrical appliances;
- Energy saving in both the private and public sector;
- Brokering agreements between LCEC and institutions that want to invest in energy conservation; and
- Providing tax exemptions for EE and RE equipment.

13. While the listed policy initiatives demonstrate a serious effort by the Government of Lebanon to address the current power sector problems by also taking into account the opportunities provided by renewable energy and energy efficiency, the construction of the planned capacity additions is running behind schedule. Therefore, the current power supply deficit and the need for complementary electricity generation by private diesel generators is likely to continue.

14. When considering alternative and complementary energy sources for bridging the gap between the current and projected future electricity demand and the available electricity supply in Lebanon, it is worth noting that the costs of different RE technologies suitable for small decentralized electricity generation and the costs of solar photovoltaic (PV), in particular, have decreased dramatically over the past 10 years as a result of new technology advances, a growing global market and competition. In Germany, for instance, the average costs of installed grid-connected rooftop PV systems fell during the first quarter of 2013 to around USD 2,200 per kWp (€1.684 per Wp), compared to about USD 7,000 per kWp in 2006<sup>9</sup>. The costs of large wind energy plants in locations with adequate wind resource have been successfully competing with the costs of new conventional power plants for some time already, while a number of micro-wind turbine manufacturers are offering cost-effective solutions for smaller applications. The power generation costs of RE technologies suitable for small decentralized power generation are discussed in further detail in chapter 1.3.

15. Besides the observed positive cost trend, a major advantage of small decentralized renewable energy units is their short construction time when compared to larger power plants. As such, they can also, time-wise, offer a feasible alternative for addressing the most acute power supply problems, while in the longer term becoming a sustainable part of the overall energy supply structure.

16. From the global perspective, it is essential that new markets can be opened up for sustaining the positive trend of PV and other small, decentralized RE applications. As concluded, among others, by the

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<sup>9</sup> Source: <http://www.solarwirtschaft.de/preisindex>.



recent review of the European Photovoltaic Industry Association<sup>10</sup>: “The balance of development will have to shift to new markets – both inside and outside of Europe.” A situation in which a few European countries account for over 70% of the global market growth of PV is unsustainable.

17. Renewable energy technologies typically face a range of barriers to achieving wide-scale deployment and maturity of the market. This also depends on the type of technology: utility-scale CSP, PV and wind power face different barriers than small, decentralized RE applications. The most common barrier for both types of systems, however, is the cost of the technology. It is also essential that for grid-connected systems, there are a “RE-friendly” grid code and power purchasing arrangements in place and that, for all systems, the performance and quality of the RE investments meet investor expectations. For the latter, there is a need to adopt an adequate quality control and certification scheme with associated testing standards and enforcement mechanisms, and build the capacity of the local supply-side and targeted end-users so as to prevent early market failure due to poor-quality hardware or installation. Finally, in many countries policy makers, potential investors and the general public are not yet sufficiently aware of the current costs and opportunities provided by new RE technologies. Therefore, complementary marketing and public awareness-raising activities are typically included in RE promotion activities.

18. Experience in a range of countries has demonstrated that, through appropriate policy design, countries can effectively catalyze the RE market by funding R&D and by providing incentives to overcome economic and financial barriers: as summarized in a recent IPCC report on Renewable Energy Sources and Climate Change Mitigation<sup>11</sup>, “Price-driven incentive frameworks, for example, were popularized after new Feed-In Tariffs (FiTs) boosted levels of PV deployment in Germany and Spain. Quota-driven frameworks, such as renewable portfolio standards and government bidding, are common in the USA and China, respectively. In addition, fiscal policies and financing mechanisms (e.g. tax credits, soft loans and grants) are often employed to support manufacturing and to increase consumer demand. Most successful RE policies have been those that have been tailored to the barriers imposed by specific applications and which have been sending clear, long-term and consistent signals to the market.”

19. In Lebanon, legislation is currently being considered to introduce feed-in tariffs (FiTs) for renewable energy supplied to the EdL grid, as one of the key measures to encourage private sector investment. The MoEW has also appointed a committee to study the required amendments of the Law # 462 (dated 02/09/2002). Private generation, which has previously been considered solely for self-supply, should be re-defined to also include grid-fed electricity. Hence, the Minister would be able to grant a licence to any party wanting to develop less than 1 MW of RE for personal use and sell the excess energy to the grid. The proposed amendments have already been sent to the Cabinet of Ministers for further discussion and, if approved, will be sent to the Parliament for final ratification.

20. Another measure for increasing small decentralized RE electricity generation is net metering (NM). Piloted in Lebanon in February 2012, net metering allows consumers to inject generated power from their premises into the EdL grid. By July 2012, the number of net metering participants in Lebanon reached 20, with 2 residential participants and 18 participants from municipalities. Unlike the proposed FiT, net metering involves the consumer being charged the net balance of electrical energy supplied and consumed. Neither a FiT nor NM can realize their full potential, however, unless electricity is on the grid 24 hours a day. When the grid is down, it cannot absorb any surplus electricity. As one option to address this problem, interconnected dual-mode RE generation with micro-storage was tested in the framework of the CEDRO project, which – together with demand side management strategies – can reduce the impact of black-outs, while also being capable of storing temporary surplus energy in a micro storage unit and injecting it to the grid at such time that the grid can safely absorb it<sup>12</sup>.

<sup>10</sup> Source: <http://files.epia.org/files/Global-Market-Outlook-2016.pdf>

<sup>11</sup> IPCC Special Report on Renewable Energy and Climate Change Mitigation, IPCC WG III, 2011. <http://srren.ipcc-wg3.de/>

<sup>12</sup> X.Vallvé, H. Haraji, E. Abou Jaoudeh, J.Obeid: Novel Example of PV and WTG Back Up Power Systems for Weak Rural Grids in Lebanon, April 2012.

### 1.3. Market Analysis and Current Status of Small Decentralized RE Applications in Lebanon

21. The market analysis of the small decentralized RE applications presented here builds on interviews with a number of stakeholders, including: three RE EPC/suppliers; the director of the LCEC; the director of CEDRO; energy consultants; energy advisors working in the Ministry of Energy and Water; university professors; and members of the Board of Directors of EdL.

22. The most active parties in promoting RE in Lebanon are CEDRO and the LCEC. Due to the funding received mainly from UNDP, the Government of Spain through the Lebanon Recovery Fund and the Lebanese Government, several demonstrations and pilot projects have been implemented. The market in Lebanon, however, is still in its early stages of development: the current installed total PV capacity in Lebanon is estimated to be around 700 kWp. Wind turbines for home applications have been installed by individuals, but the installed capacity is estimated to be less than 100kW. The largest single wind turbine installed in Lebanon is a refurbished model with a capacity of 300kW, but it has not been operational for a number of years due to shaft alignment problems. There are no micro-hydro installations in Lebanon and biomass initiatives are limited to a few projects for private use.

23. The environment needed to accelerate the penetration of RE into the market has not yet been instilled. The suggested amendments to the already mentioned Law # 462<sup>13</sup> have not yet been approved by the Cabinet of Ministers and it may take some time before they are ratified by the Parliament. The electricity tariff is still low and below the average EdL production cost of electricity. No feed-in tariff is in place that can stimulate the market and encourage investments in RE. The companies that provide RE services are numerous, but not all of them are experienced. Equipment suppliers import products of various quality levels. Since no systematic quality control mechanism yet exists, consumers face a high risk of acquiring systems that do not meet the expected performance. Energy standards for different type of products have been adopted, but the control on imports is not well organized. Taxes on imported RE products and systems have not yet been waived, but a plan to study and promote their reduction is expected in 2013. This will be coordinated between the MoEW /LCEC and the Ministry of Finance. Financial mechanisms such as NEEREA for supporting RE and EE investments have been introduced, but their full capacity is yet to be exploited.

24. The PV market in Lebanon has been largely triggered by projects developed through the CEDRO initiative<sup>14</sup>. Examples of installed systems are presented in Table T.8 of Annex 7.7. While the projects implemented under the ongoing CEDRO 3<sup>rd</sup> phase have been financed on a 100% grant basis, the projects to be implemented under the new CEDRO 4<sup>th</sup> phase are expected to increasingly leverage private sector co-financing by building, among others, on the early experiences and lessons learnt during the implementation of the proposed GEF project.

25. Following the evolution of international PV market prices, the pilot projects implemented in the framework of CEDRO have shown price reductions of complete autonomous PV systems (panels + balance of the system (BOS) with battery storage) from an initial price of US\$ 15,000 per kWp in 2009 to US\$ 5,500 per kWp in 2012. With typical solar conditions in Lebanon, this corresponds to average power generation costs (including O&M) of US\$ 22-65/kWh depending on the assumptions made (for further details, see figures 1.1 and 1.2 below). For grid-connected systems without battery storage, the Lebanese suppliers interviewed during the project preparation in 2012 indicated prices between USD 3,000 and 3,500 per kWp. The corresponding average annual power generation costs would be between US\$ 8-35/kWh depending, again, on the financing conditions. For micro-wind, no measured performance data from Lebanon yet exist, but with good siting and related wind conditions the power generation costs should typically be somewhat lower than those of PV.

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<sup>13</sup> See chapter 1.2

<sup>14</sup> For further details, see chapter 1.5

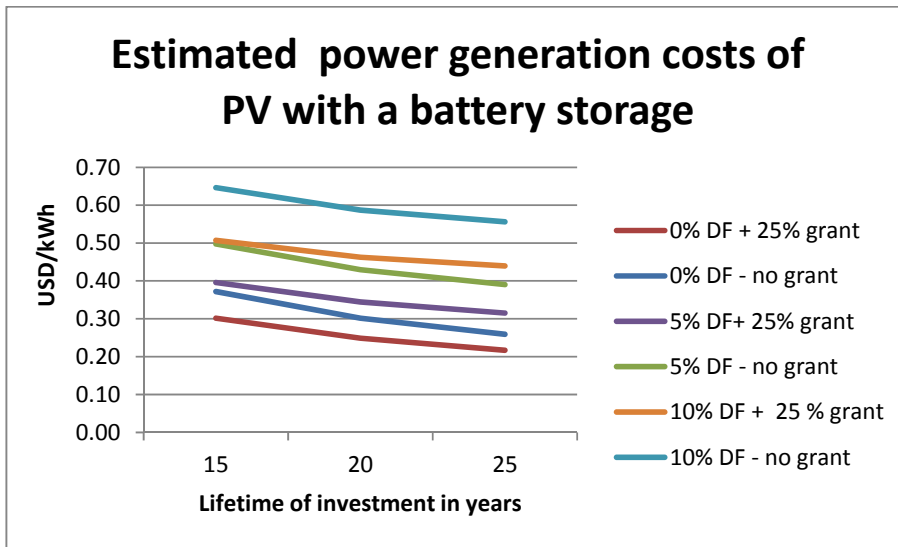


Figure 1.1 The power generation costs of off-grid (or grid-connected PV systems with battery storage) based on the current market prices of Lebanon with discount factors of 0%, 5% and 10% with and without a 25% grant<sup>15</sup>.

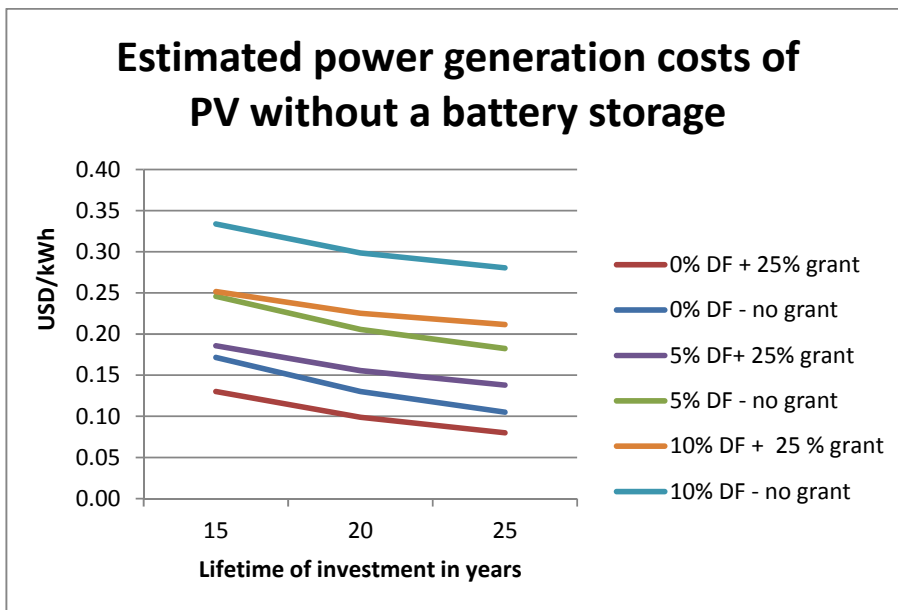


Figure 1.2 The power generation costs of grid-connected PV systems without battery storage based on the current market prices of Lebanon with discount factors of 0%, 5% and 10% with and without a 25% grant.

<sup>15</sup> With the following assumptions for PV systems with battery storage: initial investment USD 5,500/kWp, annual yield 1300 kWh/kWp, O&M USD 0.09/kWh. For grid-connected systems without battery storage: initial investment USD 3,500/kWp, annual yield 1,400 kWh/kWp, O&M: USD 0.005/kWh. The lifetime of good-quality PV panels is typically over 25 years before the power generation rate starts to deteriorate

26. A pilot hybrid wind-solar project was implemented in 2010 by the Ministry of Public Works and Transport (MoPWT) for street lighting purposes on the Damascus Road in Dahr-Al-Baidar. The system consisted of 100 units, with wind turbine capacity of 300W each and mono-crystalline PV module capacity of 180W each. The total cost, including the battery, the charger, the transformer, the case and the low-pressure sodium lamp and taxes, was US\$2,750 per unit. The cost of the PV modules corresponded to a kW price of US\$2,440/kWp and the cost of the small wind turbine US\$2,000/kWp.

27. In addition, the Ministry of Public Works and Transportation installed 766 solar-powered streetlights on a 10km stretch of a highway in Hermel, North Lebanon, in 2012. The project cost was US\$1,072,000. Technical data about the PV systems are not available.

28. Other PV projects implemented or under development by the private sector are presented in Table T.9 of Annex 7.7.

29. The market analysis reveals that the factors affecting the RE – and particularly the small, decentralized RE application – market, can be summarized as follows:

- Competition does not yet work properly, as the market has low-quality products competing with high-quality ones without adequate quality control. As a result, all kind of products and systems may be brought into the market with an objective to make short-term profits and no consideration for market sustainability.
- Although many citizens and institutions support the development of RE, many of them do so without having adequate awareness and education about the characteristics of these products.
- Technicians and engineers dealing with RE and EE products need training to improve their skills.
- A new law to complement the net-metering scheme has to be worked out so as to allow the sale of any excess energy to the grid. As the scheme currently stands, users can benefit from bill reduction when injecting energy into the grid. However, if energy sales exceed the energy purchased from the grid, the customer cannot cash the balance.
- The current tariff for electricity is very low and does not represent even EdL's own production costs. Until the tariff is adjusted, it is very difficult envisaging private investments in RE unless supported by other factors. The projects currently taking place stem primarily from a desire to overcome electricity rationing and not from having a source of revenue from selling RE-generated electricity to the public grid.
- Until there is reliable electricity supply, net metering will continue to suffer from the inability to inject continuously into the grid (when rotating outages are in place); hence, to utilize the energy produced, storage batteries are necessary. Such storage considerably increases the cost of RE systems.
- Review and upgrade of the guidelines/standards for technical requirements for connecting small decentralized RE applications into the grid and their dissemination to, and training of, the beneficiaries is still pending.
- Besides the adjustment of the consumer tariff and legalising the sale of any excess electricity back to the grid, there would be a need to introduce a price premium – i.e. specific feed-in tariffs for the electricity produced by renewable energy – if wishing to increase the RE generation beyond just using it as back-up for power shortages.
- Revisiting the taxation of RE and EE products would encourage their market entry.
- The issue of developing suitable financing mechanisms via local banks remains crucial for the penetration of RE systems in the Lebanese market.

30. For solar water heating, the market analysis prepared under the UNDP/GEF-funded Solar Water Heating project was published in September 2012. Although not for decentralized power generation, the solar thermal market shares some common features with the decentralized RE power generation market and is therefore presented here. The study concluded that:

- The intent to purchase a solar thermal system has increased amongst the majority of end-users at an average growth rate of 60% compared to the results of a survey done 3 years ago. This demonstrates strong performance and great potential for SWH that needs to be taken into account in any planned development measures;
- The strong demand can be attributed to LCEC's initiatives (0% interest rate and \$200 subsidy scheme), greater awareness, occurrence of electricity shortages and high fuel costs;
- The residential sector has the highest growth rate – with an average of 55% – and the highest share of all installations (80%) due to cheaper unit prices for residential installations and the segment being able to benefit from LCEC initiatives directly;
- The above finding makes the residential segment the key area of focus for development and promotion of SWH;
- Suppliers/dealers have an essential part to play in the development of the market by influencing end-user choices through provision of extensive assistance and guidance;
- Mount Lebanon and Beirut are the most promising regions due to their population density, on-going constructions, high purchase power and awareness;
- Key business challenges are prevalent in the form of unfair competition, an unregulated market, high taxes, insufficient labour qualifications and availability, and difficulties in the supply sector;
- Primary initiatives to overcome gaps have been identified as increased awareness, provision of financial support and other forms of facilitation, reduction in taxation, quality control and improvement in qualifications;
- Some of these initiatives need to be taken into account by several supporting parties working cohesively, including municipal authorities, NGOs and system manufacturers / dealers / retailers.

#### **1.4. Institutional Framework and Stakeholder Analysis**

31. The Ministry of Energy and Water (MoEW) is the Government body responsible for energy sector development in Lebanon. It consists of 9 General Directorates, among which “Electricité du Liban” (EdL), the Directorate of Investment, the Directorate of Hydraulic & Electric Resources, and the Directorate of Oil are considered to be the main directorates in the energy sector.

32. The Lebanese Centre for Energy Conservation (LCEC), established as a result of the LCECP GEF project and supported by UNDP, has become a focal point for energy efficiency and renewable energy related initiatives in the country. Affiliated to the Lebanese Ministry of Energy and Water, the LCEC is directly supporting the Government of Lebanon to develop and implement national strategies that promote the development of efficient and rational uses of energy and the use of renewable energy at the consumer level. The LCEC has also been nominated by the Government (in November 2011) to be the national energy agency of Lebanon; it serves as the technical support unit for the implementation of NEEREA; and it is the Executive Secretariat of Lebanon's National Steering Committee for the Mediterranean Solar Plan. For the LCEC to become financially autonomous, however, legal texts have to be passed by Parliament, either in terms of a decree that designate the Centre as a Government agency or organization or through the passing of the Energy Efficiency Law, which includes a statement that would legalise the Centre as a stand-alone public entity.

33. The LCEC has been implementing and coordinating several projects funded by both the national budget as well as bilateral donors. Some of these projects include:

- Implementation of the GEF-funded Global Solar Water Heaters project under the management of UNDP, which will be completed by the end of 2013. This is a \$1 million project promoting the solar water heaters market in Lebanon.
- The LCEC is also coordinating the implementation of a \$2 million public solar street lighting project with grant funding from the Ministry of Energy and Water, implemented in co-operation with different Lebanese municipalities during 2012-2013.
- The LCEC has also been a key player in mobilising and supporting the NEEREA programme with the Central Bank of Lebanon. This includes a \$100 million loan programme from the EU to support renewable energy and energy efficiency projects.
- US\$9 million has been allocated to MoEW in the national budget of Lebanon for 2013 and beyond. This fund will be managed by the LCEC to execute a 1 MW PV farm (\$4 million), a 2 MW wind farm (\$ 4 million) and around 1,000 SWH systems (\$ 1 million). These investments are not yet fully secured, however.

34. The Ministry of Environment (MoE) was established after the 1992 Rio Earth Summit and its mandate and organizational structure were amended after the 2002 Johannesburg Summit to also include coordination of sustainable development issues in Lebanon. MoE's ability to fully exercise its mandate has been limited, however, due to understaffing and lack of resources.

35. The Ministry of Finance has a stake in elaborating any possible financial or fiscal incentives and funding schemes supported by the Government of Lebanon.

36. The Directorate General of Urban Planning within the Ministry of Public Works and Transport is the responsible Government body for the execution of the Building Law and for granting construction permits in Lebanon. In 2005, the Directorate General of Urban Planning, with the collaboration of UNDP in Lebanon, developed new Thermal Standards for Buildings, but their formal adoption as mandatory for all new buildings is still pending. The Directorate General is currently co-operating with the World Bank to upgrade the environmental performance of the Lebanese Building Code, with a link also to decentralized RE applications, as part of the "Green Building" scheme.

37. The LIBNOR (Lebanese Standards Institute) is a public organization responsible for the development of national standards in Lebanon and the issuance of the Lebanese Conformity Mark "Normes Lebanaise" (NL). LIBNOR is, therefore, expected to participate in, and contribute to, the development of any quality control schemes.

38. The IRI (Industrial Research Institute) is a semi-public institute responsible for quality control, equipment and goods compliance with the adopted norms, testing and certifications for all manufactured and imported goods. IRI has an essential role to regulate the Lebanese market for all imported energy efficiency and solar thermal equipment in close collaboration with LCEC. Thus far, only a SWH testing facility has been developed.

39. The Order of Engineers and Architects (OEA) is responsible for organizing architectural and engineering works in Lebanon and for building permits. Recently, the OEA partnered with UNDP to collaborate in the promotion of solar water heaters.

40. The Lebanese Solar Energy Society (LSES) is an NGO that includes renewable energy experts (consultants, manufacturers, traders, academics, etc.) with the main objective of promoting solar thermal systems in Lebanon through collaboration with other stakeholders. LSES has recently acquired a truck demonstration facility with a small wind turbine, SWH and PV systems, which is used for demonstration purposes at schools.



41. The Association Libanaise pour la Maitrise de l'Energie (ALME) is an NGO with experts in renewable energy (consultants, contractors, traders, academics, etc.). ALME has a principal objective of promoting renewable energy in Lebanon. ALME has been involved in several SWH projects as well as studies and research.

42. Universities in Lebanon can play an important role in promoting small RE applications by developing and hosting RE training courses as well as supporting research by engineers to gain theoretical experience in RE. The American University of Beirut has an active energy centre, a graduate programme in energy studies and advanced energy labs which can be developed to become testing labs for certification purposes.

43. Comprehensive lists of local suppliers in PV, wind and SWH technologies are given in Annexes 7.8 – 7.10.

### **1.5. Other Related Past and Ongoing Activities**

44. The UNDP Country Office in Lebanon currently manages a programme portfolio with an annual delivery target of over \$20 million, covering the thematic areas of Governance, Social and Local Development, Conflict Prevention and Recovery and Energy and Environment. The latter portfolio comprises US\$7 million of the total annual delivery, a large portion of which focuses on sustainable energy and combating climate change. UNDP's energy projects and climate change projects are coordinated by UNDP to ensure integration of energy policies in all sectors and between the different ministries involved. The programme works with different ministries on issues related to climate change, some of which are mentioned below.

45. With the Ministry of Environment, UNDP supported the First and Second National Communications to the UNFCCC and initiated the Third National Communication in mid-2012. UNDP has also partnered with UNEP Risoe Centre to complete the National Technology Needs Assessment (TNA), which is expected to be published imminently.

46. With funding from the European Union (EU) and the German Federal Environment Ministry (BMU), a globally-managed UNDP project – the 'Low Emission Capacity Building Programme', LECB – is underway. The project aims at promoting essential cooperation among relevant institutions, the private sector and industry in a concerted effort to address climate change consistent with Lebanon's development priorities. The project is expected to: (i) develop a national greenhouse gas (GHG) inventory management system, (ii) identify opportunities for nationally appropriate mitigation actions (NAMAs), (iii) design a low-emission development strategy (LEDS) in the context of national priorities; and (iv) design systems for measuring, reporting and verification (MRV) of proposed actions to reduce GHG emissions.

47. 'Parliamentary Action on Renewable Energy' (PARE) is a global project implemented by UNDP in collaboration with the NGO Climate Parliament. The project addresses the need to secure legal frameworks, policies and funding through support to parliamentarians who, as political actors, can advocate and influence the direction of national policies and procedures. The project will mainly provide technical support for a network of MPs, including Lebanese MPs, for building their capacity to advocate and implement laws and policies that promote access to renewable energy. Technical support will also be given in developing a national project.

48. In partnership with the Ministry of Energy and Water, UNDP is managing the 'Country Energy Efficiency and Renewable Energy Demonstration project for the Recovery of Lebanon' (CEDRO). The CEDRO project started in October 2007 with a budget of \$9.73 million funded by the Lebanon Recovery Fund by means of a donation from Spain. The current CEDRO 3 project has a mandate until October 2013, but is expected to be followed up by CEDRO 4 with an expected start in 2014. Until now, the project has facilitated the installation of PV systems in 26 public schools and community centres in

Akkar, Bekaa and the South of Lebanon, with capacities of 1.2-1.8 kWp each (recently extended to 2.7kWp). These systems have also been monitored for their performance, the results of which have been available for the preparation of this GEF project. The CEDRO project has also supported the finalization of a wind atlas for Lebanon and is currently undertaking more detailed feasibility and resource assessments for PV, micro-wind and hydro. The CEDRO project has also been instrumental in the December 2011 decision by EdL and the Government to allow net-metering in Lebanon.

49. The National Energy Efficiency and Renewable Energy Account (NEEREA) was established in 2010 as a joint initiative of the Central Bank of Lebanon (BdL), UNDP and the EU. In its current form, NEEREA can offer loans of up to 14 years' repayment period with 0% interest rate for eligible energy efficiency and renewable energy investments by using a risk guarantee and an interest rate subsidy funded by €2.1 and 11.9 million grant allocations, respectively, from the EU. The technical validation of the projects is done by UNDP's Lebanese Centre for Energy Conservation (LCEC). The target of NEEREA is to leverage funding for energy efficiency and renewable energy investments amounting to \$100 million until 2016. To date, NEEREA has supported LEED Gold, SWH and EE projects collectively worth \$17million.

50. The new EU-funded, UNDP-implemented 'MED-SOLAR' project, in the framework of the EU ENPI programme (Cross-Border Co-operation in the Mediterranean), is promoting the implementation of innovative technologies and transfer of know-how in the field of solar energy. The six project partners are Spain, France, the Palestinian Authority, Lebanon and Jordan. The main expected results of the project are: i) characterization of the weaknesses of the electrical grids; ii) analysis of the legal and regulatory frameworks, with related recommendations; iii) conceptual design of the new system architecture; iv) technical development of an energy management system; v) pilot projects in small and medium-size industries and public facilities; vi) tests and dissemination of results; and vii) creation of a cross-border network of stakeholders. The project will be implemented through the UNDP-CEDRO project over a period of 30 months and is expected to start in early 2013. The total budget of the project is about €3 million, of which more than €1 million will support activities complementing the proposed activities of the GEF project. For further details, see section 3.5.

51. 'Paving the Way to the Mediterranean Solar Plan' (PWMSP) is an EU-funded regional project assisting Mediterranean Partner Countries<sup>16</sup> to contribute to a significant increase in the deployment of sustainable energy systems based on renewable energy sources.

52. The project concentrates on four thematic lines of activities, all designed to facilitate concrete actions under the Mediterranean Solar Plan and to maximize their benefit for all parties involved:

- The first line of activities supports the Mediterranean Partner Countries in developing the appropriate harmonized regulatory framework for investments in the renewable energy sector;
- The second line facilitates the transfer of know-how and experience between the Mediterranean Partner Countries themselves and with the EU Member States, and promotes cooperation in Research, Development and Innovation (RDI) and the transfer of clean technologies;
- The third line of activities supports the Mediterranean Partner Countries to implement sustainable energy policies promoting the use of renewable energy sources in power generation and energy efficiency; and
- The fourth line provides assistance to improve the economic and financial framework for investments in the use of renewable energy for power generation, in particular in solar energy.

53. Interwoven in these four lines of activities are horizontal activities evaluating the Mediterranean grid and the European electrical backbone, as well as data and information collection for the implementation of the MSP.

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<sup>16</sup> Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine, Syria and Tunisia.



54. The project started on September 1, 2010 for a duration of 3 years, with a total budget of €4.6 million. Results achieved so far include the following:

- National Road Maps for legal and regulatory reform have been finalized and approved for all Mediterranean Partner Countries (Task 1)
- A Regional Road Map for legal and regulatory reform has been finalized and approved (Task 1)
- An assessment of needs for a programme on knowledge transfer and training has been developed (Task 2)
- A survey on research and development centres and activities has been conducted (Task 2)
- Benchmarking reports on sustainable energy policy have been developed (Task 3)
- Project reports on financing for the MSP have been developed (Task 4)
- Country reports on infrastructure needs for the MSP have been finalized (horizontal task)

55. The World Bank is working on a project to upgrade the environmental performance of the Lebanese Building Code. With the exception of Annex E of Article 14, which provides incentives for double walls and double glazing, the Lebanese Building Code contains no stipulations relating to energy efficiency in buildings. Green buildings are yet to gain a foothold in Lebanon. Several iconic buildings have been constructed in recent years according to international Green Building standards (LEED, BREEAM, etc.) but these buildings are primarily high-end luxury apartments and office buildings. In 2008, the Lebanon Green Building Council (LGBC) was founded with an aim to help revise construction standards in the country in collaboration with relevant agencies and research institutions. Through a partnership with the International Finance Corporation (IFC), the LGBC developed the ARZ green building rating system adapted for Lebanon and awarded its first ARZ rating to a commercial bank in 2012.

## **2. PROJECT STRATEGY**

### **2.1. Project Objective, Outcomes and Outputs**

56. The project strategy is presented by a logical framework approach. The essence of this approach is that outputs are clustered by outcomes, which together will achieve the project objective. These are discussed briefly below with further details in Section 3, “Project Results Framework”.

57. The objective of the project is to catalyze and remove barriers to the widespread application of decentralized renewable energy-based power generation in Lebanon, with a target to facilitate the installation of at least 1.75 MW of new, decentralized renewable energy power generation capacity during the implementation of the project as its direct impact. Complementary indirect mitigation benefits are expected from sustained market growth of decentralized RE generation after the project ends and from paving the way for larger RE power plants – for example, by clarifying the technical and institutional aspects of connecting RE-based intermittent power generation sources into the grid and leveraging financing for RE investments from new sources such as carbon finance and NAMAs.

58. The penetration of RE into the Lebanese energy mix first of all depends on its economic merits relative to those of alternative energy sources. At the consumer level, RE cannot yet compete with the costs of grid electricity, as the EdL consumer tariffs are controlled by the Government and do not even cover EdL’s own production costs. For the private back-up electricity supply, however, the situation is different. Despite the Government’s efforts to restore regular power supply, the need for private back-up generators for meeting demand and securing adequate operating reserve is still likely to continue for several years to come. Therefore, the initial focus of the project will be on promoting renewable energy as an alternative – or complementary – energy source to private diesel generators, which currently dominate the back-up power generation market. Once the regular power supply and grid stability are restored, and in the course of further developing the net-metering scheme and the related tariffs, the already-installed RE systems can continue to operate and the market can further develop on the basis of a fully grid-integrated approach.

59. The project is structured to deliver three outcomes as follows. For each outcome, the incrementality of the GEF project is discussed in the context of selected baseline projects, which consist of the past and ongoing projects that have been or will be working towards a similar goal.

#### **2.1.1. Outcome 1: Investments in decentralized renewable energy power generation increased**

60. The activities under this component focus on supporting actual investments and sustaining market growth. In co-operation with the key stakeholders such as MoEW, EdL, the Ministry of Finance and other donors, the GEF project will structure and leverage funding for attractive financing conditions for the RE investments under consideration.

61. The proposed pilot/demonstration projects aim to facilitate the development of decentralized RE systems using PV, wind, small hydro and/or biogas and any combination thereof. The first targeted investors will include private businesses and industrial complexes, universities, tourist resorts, bakeries, etc., all of which depend on continuous and reliable electricity supply. Representatives of these entities interviewed during the project preparatory phase indicated strong interest in new RE-based back-up electricity generation systems, should they be able to reduce the costs of current diesel-based systems.

62. While the costs of many RE technologies, and PV in particular, have fallen rapidly over the past several years, some complementary financial and/or fiscal incentives are typically still required to make the investment attractive enough for the targeted investors. This support can be provided through: i) direct capital grants, interest rate subsidies, tax concessions or premium feed-in tariffs supported by the state budget; ii) spreading the costs of premium feed-in tariffs for RE across the overall energy

production costs, for instance through minimum RE purchase obligations by the utilities; and/or iii) creating additional revenue streams for investors, for example through climate finance.

63. By starting with the implementation of selected pilot/demonstration projects supported jointly by the GEF and the project's co-financing resources, the activities will gradually move to leveraging more sustainable financing. The main co-financing source at the beginning will be the National Energy Efficiency and Renewable Energy Account (NEEREA), launched in 2010 by the Central Bank of Lebanon (BdL). This financing initiative is implemented by local commercial banks, while the Lebanese Centre for Energy Conservation (LCEC) serves as the technical arm evaluating the projects and providing other technical support. With financial resources leveraged from the Ministry of Finance and the EU, the commercial banks are able to offer loans for energy efficiency and renewable energy investments with a risk guarantee, 0% interest rate and loan maturity up to 14 years. To date, 12 projects have been approved through the NEEREA programme with an overall budget of \$17 million, and around 20 other projects are in the pipeline. All of these projects are related to energy conservation measures for a range of sectors, including new residential and hotel buildings, hospitals, orphanage centres, etc. No renewable energy projects have yet been financed with NEEREA loans.

64. In order to boost the decentralized RE market in Lebanon, the GEF financing in Outcome 1 will be used as complementary grant co-financing to leverage NEEREA and other funding for the early market development of small RE investments. While the ongoing EU-funded CEDRO 3 project has been financing public sector RE projects on a 100% grant basis, the proposed GEF project – complemented by the other new UNDP managed projects, MED-SOLAR and CEDRO 4 – will facilitate a gradual move from entirely grant-financed RE projects to a more sustainable financing model which also increasingly engages the private sector to finance these investments. With further market maturity, expected price reductions of RE systems and adjustment of electricity tariffs to reflect the true production and marginal costs of electricity generation, a gradual move entirely out of grants can eventually take place. This is still going to take some time, however. As such, the incrementality of the GEF funding derives from the fact that a NEEREA loan alone (although very soft) will likely still not attract significant investor interest; topped up by a complementary GEF grant, the investment will become sufficiently attractive.

65. The stakeholder consultations during the project preparatory phase with a number of prospective investors<sup>17</sup> who expressed interest in RE systems confirmed that a mix of 0% interest rate loans and grants up to 25% would be seen as feasible and attractive for them. The size of the projects could run up to 200 kWp – i.e. around \$1 million in investments for the biggest projects. As the projects granted with UNDP-GEF support will be selected on a competitive basis under a public tender, no further client-specific elaboration of the projects has been undertaken at this stage. The average costs of electricity produced with diesel generators were found to be around US 30 cents per kWh, for which PV, for example, can provide a competitive alternative or complementary energy source with the financing conditions discussed above.

66. The maximum share of the GEF grant will be limited to 25% of the total investment<sup>18</sup> and up to \$150,000 per project, so as to manage the risks and catalyse a sufficient number of demonstration projects for implementation. All electricity-generating small-scale RE technologies, including PV, wind, micro-hydro or biogas, are eligible for support. The ranking of projects will be done according to the “best value for money” approach, in which the projects requesting the smallest grant contribution per the projected kWh to be generated are prioritized for support. For the first round of proposals, specific quotas may also be introduced for different types of RE technologies so as to enhance the demonstration aspect. Should there be no qualified proposals for certain type of technology, however, the funds will be reallocated to other types of RE, for which the demand for support may be higher.

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<sup>17</sup> Including large industrial complexes, food processing plants and bakeries, hotels and private universities. See also Table T.10 in Annex 7.7

<sup>18</sup> In the case of hybrid projects such as PV-diesel or wind-diesel, this 25% is calculated on the basis of the RE investment component only: i.e. a maximum 25% of the total investment of the RE component.

67. Further guidance on the required technical specifications, quality assurance and calculation of the annual yield in a comparable manner is provided in the tender documents, which are to be finalized at the outset of project operations. Beside the financial evaluation, all the projects will be subject to technical due diligence and approval by the LCEC and verification of the proper installation and performance of the system during the commissioning stage before release of the grant. The investors receiving support are also expected to commit themselves to collect and share with the UNDP-GEF project team monthly performance data of the installed systems for the duration of the GEF project, which then can be used for further public awareness-raising and research activities.

68. By building on the visibility, demonstrated benefits and verified performance of the projects financed by the combined private sector funding, NEEREA loans and complementary GEF and other grant financing, the project will provide a basis for the establishment of a longer-term financing mechanism, which can sustain market growth after the project. For this, the project will approach new financing sources, including eventual complementary Government and donor grant funding, and facilitate the development of a proposal for an RE-based NAMA, in co-operation with the previously mentioned UNDP Low Emission Capacity Building (LECB) project funded by the EU and the German Federal Environment Ministry (BMU). While the GEF funding will contribute to the conceptualization and financial analysis of the RE technologies, policies and other supporting measures proposed for the NAMA, the LECB project will cover the costs of the development of the actual NAMA proposal, including in-depth baseline analysis, elaboration of the institutional arrangements for the implementation of the NAMA and development of the MRV (Monitoring, Reporting and Verification) plan (including integration with a national greenhouse gas inventory system). In addition, in the final year of GEF project implementation (2017), a comprehensive review of market-based financing options for renewable energy will be undertaken. It is expected that the transition away from pure grant-funding for renewable energy investments towards more sustainable business models will have been sufficiently accelerated by the GEF project by then to open up new market opportunities. Potential performance-related emission reduction payments in the context of the NAMA developed under the GEF project (and associated co-financiers) will also be explored. To help foster implementation of the identified viable market-based or performance-based instruments, the GEF project will organize discussions with the Government of Lebanon and potential financiers to identify ways in which such instruments can be implemented after the end of the project, with support from potential financiers to be identified during the implementation of the project.

### **2.1.2. Outcome 2: A supportive policy and regulatory environment enforced for attracting investments for privately-owned, grid-connected renewable energy power generation**

69. The activities under the project component that will deliver Outcome 2 will support the establishment of an enabling legal and regulatory framework to attract investment for privately-owned, grid-connected power generation by renewable energy sources. While the adopted Government strategy sets the overall targets for renewable energy, the topics to be addressed by more detailed laws and/or regulations and the related supporting documents include:

- Updated and harmonized technical guidelines for connecting different types of RE plants into the grid by private producers and for ensuring problem-free operation of these plants;
- The conditions for selling electricity to the grid by private producers, addressing issues such as required licences, purchase obligations of the utility, mechanisms for administering and setting feed-in tariffs at the national level and other possible financial and/or fiscal support mechanisms;
- Net/smart-metering and eventual changes required in the construction norms and other building regulations to facilitate better integration of renewable energy into buildings' energy supply;

- Quality control of the products and services available in the market (including installation and other after-sale services)
- Sample documents to guide the project developers and investors to apply for the required operation licences, financial/fiscal support, etc.

70. The project will support the required background analysis, consultations, awareness-raising and capacity building of the key stakeholders to allow the drafting of the new regulations and facilitate their effective adoption and implementation. It will build on and improve the initial analysis done in the framework of the CEDRO project and will also benefit from the results and conclusions of a number of international projects that have been doing research on the typical legal, regulatory and bureaucratic barriers to successful development of the small decentralized RE market. As examples of the work done in EU countries, the EU-supported PV LEGAL<sup>19</sup> and the new PV GRID<sup>20</sup> projects are noteworthy. For any legal and regulatory recommendations and the grid access studies in Lebanon, the project will also closely co-operate and co-ordinate its activities with the new EU MED-SOLAR project and the ongoing Mediterranean Solar Plan project.

71. For any policy work, the cost-efficiency analysis of different RE technologies requires regular updating as both RE costs and other framework conditions are evolving rapidly. Regularly updated market analysis to provide this information will be done as a part of the project's market monitoring activities under Outcome 3.

### **2.1.3. Outcome 3: Monitoring and quality control of RE-based decentralized power generation introduced and sustained**

72. The activities of this outcome will focus on: i) raising the awareness of the targeted stakeholders on what decentralized RE power generation systems can offer to them; ii) ensuring the quality of the products and installations through an effective quality control system, increased consumer awareness and supply-side capacity building; and iii) establishing an agreed market monitoring methodology and mechanism to keep track of the annual sales and installed capacity of PV and other small decentralized RE systems in Lebanon as well as of their costs and annual contribution to the overall electricity supply.

73. While some market monitoring activities have been, and are planned to be, implemented by the CEDRO project, this has not been done in a systematic way and has not yet been institutionalized to ensure its sustainability. For quality control, the GEF-funded solar water heating project has been developing a quality management scheme for solar thermal systems, but for other RE technologies no quality control schemes and mechanisms are currently under development. No quality control-related criteria are yet included in NEEREA either. All of these gaps will be addressed under Outcome 3 of this project.

74. The technology-specific requirements for the performance and durability of the targeted RE technologies and their installation to meet the required quality criteria will be developed at the outset of project operations together with a certification and market surveillance plan applicable for the Lebanese market. Some initial remarks and recommendations in this respect are that:

- Mandatory minimum energy performance and quality requirements for the entire market should rely on well-elaborated, technology-specific market surveillance plans, which are to be enforced by supporting legislation and adequately capacitated market surveillance authorities;
- A voluntary quality control scheme can be promoted: for instance, by embedding the agreed minimum performance and other quality requirements into the eligibility criteria of the available financial support schemes. The suppliers can prove their products meet the

<sup>19</sup> <http://www.pvlegal.eu>

<sup>20</sup> <http://www.epia.org/projects/ec-projects/pv-grid.html>

requirements by means of a certificate issued by an accredited authority either abroad or in Lebanon. For the quality control of installations, an in-country certification and inspection scheme will be required;

- A quality control scheme without associated training of the key stakeholders such as public authorities to implement that scheme and the local service providers such as installers to match the minimum quality requirements is useless. Therefore, an essential part of the activities under Outcome 3 will be to facilitate the training of the key stakeholders. For this, the project needs to co-operate closely with the local universities and professional and vocational schools to ensure that, for instance, sufficient numbers of trained and certified small RE system installers will be available in the market to provide their services.

75. The work on the quality control of electricity-generating small RE systems in Lebanon can build on the development of quality control schemes for solar water heating systems undertaken in the context of the ongoing UNDP-GEF solar water heating project and other related initiatives. Furthermore, it can build on the international work already done in this field, such as the development of the IEC<sup>21</sup> (International Electrotechnical Commission) standards 61215 and 61646 for Design Qualification and Type Approval of Crystalline Silicon and Thin-Film PV modules and the related certification schemes of the IEC<sup>22</sup>, IEC standard series 61400 for small wind turbines, Task 27 of the IEA wind energy programme on “Providing a standard consumer label for small wind turbines” and others. In developing a quality control scheme for installations, the project can take advantage of the research, training materials, manuals and expert networks developed under, among others, the EU-supported international Qualicert<sup>23</sup> scheme (implemented in 2009-2011) and the ongoing PVTRIN<sup>24</sup> project.

76. During project implementation, the experiences and lessons-learned from developing and implementing the quality control scheme for solar thermal systems under the GEF-supported solar thermal project in Lebanon will be closely monitored and taken into account, together with the experiences and lessons learned in other countries. The need to intensify efforts on quality control of both SWH systems and installation was one of the key recommendations that emerged from the Mid-Term Evaluation of the ongoing SWH project, thereby further highlighting the importance of this component to sustainable market development.

77. For enhancing the testing and related training opportunities, the project contains a small budget for the purchase of monitoring and testing equipment. In that context, a more detailed evaluation of testing facilities at Lebanese universities will also be carried out for finding synergies and opportunities for co-operation and for avoiding duplication of activities. The extension of the current SWH testing facility in the IRI to cover PV may also be considered, subject to the progress and results achieved with the SWH testing.

## 2.2. Project indicators, Risks and Assumptions

78. In accordance with the GEF’s Focal Area Objective #3 to “Promote Investment in Renewable Energy Technologies” of the GEF V 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<sub>2</sub> equivalent avoided.

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<sup>21</sup> <http://www.iec.ch/>

<sup>22</sup> [http://www.iec.ch/about/brochures/pdf/conformity\\_assessment/pv\\_certification.pdf](http://www.iec.ch/about/brochures/pdf/conformity_assessment/pv_certification.pdf)

<sup>23</sup> <http://www.qualicert-project.eu> “Common approach for certification and accreditation of installers of small-scale renewable energy systems”

<sup>24</sup> <http://www.pvtrin.eu/home/index.html> “Training of Photovoltaic Installers in Europe”

79. For further details about the related targets, see the project's results framework in Section 3.

80. The main identified risks to the successful implementation of the project include:

- **Political** – Government failure to adopt the required legal and regulatory changes, such as the required amendments to the Law 462, changes in the EdL tariffs and the financial/fiscal incentives to provide a basis for the proposed market promotion activities.
- **Political** – Sustainability of the adopted financial incentives and other supporting measures to maintain investors' confidence: i.e. the need to avoid damaging "stop-go-stop" dynamics.
- **Technology risk** – Technical failures either due to equipment failure or bad installation, leading to loss of trust by targeted customers on the performance of small, decentralized RE applications.
- **Financial Risks** – Government and/or other donors will not provide support and funds for new financing instruments; falling oil prices will negatively affect the cost-efficiency of RE versus fossil fuel-based power generation.
- **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.

81. Further details on these risks, with their probability and impact analysis and related mitigation measures, are presented in the "Offline Risk Log" in Annex 7-1.

82. 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. He/she should have an ability: i) to engage the key stakeholders in constructive discussion about future RE development needs in Lebanon; 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 the project implementation, the project manager also needs to be supported by qualified technical and legal experts.

83. A typical risk for different training and capacity building activities is that, after the completion of training, there will be no real demand for the services of the trained experts. The integrated approach adopted by the project is expected to mitigate this risk by combining the training with concrete possibilities to apply the new skills in practice for the planned demonstration projects and their envisaged replication.

### **2.3. Expected Global, National and Local Benefits**

84. The calculated global GHG reduction benefits of the project will consist of the combination of:

- Direct GHG emission reduction benefits from the pilot/demonstration 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.

85. 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.



86. The direct GHG reduction benefits of the project have been estimated at 35,500 tonnes of CO<sub>2eq</sub>, resulting from the installation of 1.75 MW of new decentralized renewable energy power generation capacity during the lifetime of the project and calculated over the 20-year default lifetime of the investments.

87. Additional indirect mitigation benefits can be expected from sustained market growth after the project, due to: (a) the project's work on creating enabling conditions for continued investments in small decentralized RE generation capacity. This is estimated to reach at least 17.5 MW by the end of 2026 (i.e. 10 years after the project end), corresponding to an indirect impact of 317,000 tonnes of CO<sub>2eq</sub> reduced over the estimated 20-year default lifetime of the investments made; and (b) utility-scale RE capacity through the project's work on capacity building, required changes in the legal and regulatory framework to improve grid access, and leveraging new sources of financing. The related indirect GHG reduction impact contributing to the utility-scale RE development in Lebanon could reach 1.7 million tonnes of CO<sub>2eq</sub> reduced by assuming the project contributes, with a causality factor of 0.1, to the Government's efforts to reach the target of meeting 12% of all the electricity and thermal energy needs in Lebanon from renewable energy sources by 2020. For further details about the assumptions and results of the project's GHG reduction analysis, see Annex 7-4.

88. The associated national and local benefits include reduced local pollution from the burning of fossil fuels and strengthened national energy security through reduced dependency on imported fuels.

89. The main socioeconomic benefits of the project stem from improving the electricity supply in areas that currently suffer from severe power shortages and black-outs. Furthermore, meeting the project market development objective can create new jobs in selling, installation and maintenance of the RE systems. The potential for this has been estimated at about 80 new jobs per installed MWp for PV and up to new 4,000 jobs in the entire RE sector, should the Government target to increase the share of renewable energy to 12% by 2020 be achieved<sup>25</sup>. This would constitute about 0.3% of the total Lebanese workforce.

90. Positive RE market development will also provide new work opportunities for women, who until now have remained relatively marginal actors in this sector. Improved electricity supply from renewables for different household appliances will also improve women's quality of life at home, especially in the rural areas where electricity supply is very intermittent. Accurate disaggregated gender data are not available from Lebanese renewable energy studies at the moment, but this will be further addressed during project implementation by identifying gender-sensitive factors and impacts that may affect the success of any particular activity or RE technology.

## **2.4. Project Rationale and GEF Policy Conformity**

91. 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 will expand beyond the creation of enabling policy and regulatory environment and will also invest in renewable energy projects that will lead to a step-change in the deployment and diffusion of reliable, least-cost renewable energy technologies. In addition, the GEF project will promote local SMEs to enhance their technical capacities to provide installation, operation and maintenance services for renewable energy technologies.

92. The specific outcomes of the GEF V climate change strategy that the project is addressing include:

- Favourable policy and regulatory environment created for renewable energy investments

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<sup>25</sup> Source: Green Jobs Assessment in Lebanon, ILO-UNDP, 2011.



- Investment in renewable energy technologies increased
- GHG emissions avoided

## **2.5. Country Ownership: Country Eligibility and Country Drivenness**

93. According to the Instrument for the Establishment of the Restructured Global Environment Facility, Lebanon 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.

94. The objective of the project is consistent with the voluntary commitment of the Government of Lebanon presented by the Lebanese Prime Minister in 2009 in Copenhagen to reach a target of meeting 12% of all electricity and thermal energy needs in Lebanon from renewable energy sources by 2020. It is further supported by the policy papers released after the 2009 commitment, such as the Policy Paper for Electricity Sector Development in 2010 and the National Energy Efficiency Action Plan in 2011.

95. The proposed project will contribute to the targets outlined in Lebanon's Second National Communication (SNC), submitted to the UNFCCC COP in February 2011, including the already-mentioned voluntary 12% RE commitment, which was followed up by a Ministerial Declaration and the Policy Paper for Electricity Sector Development in 2010 and the adoption of the NEEAP in 2011. Together with the Ministry of Environment's proposed policy to continue "greening" all production sectors, these provide the basis for expansion of clean energy production at all levels.

96. UNDP has a proven track record as being one of the leading agencies in Lebanon to promote the renewable energy and energy efficiency agenda. Successful implementation of the UNDP-GEF LCECP project and the institutional capacities created by that project have facilitated the incorporation of a number of energy efficiency and renewable energy measures into the current energy sector strategy of the Government of Lebanon.

97. The UNDAF and the UNDP Country Programme Action Plan (CPAP) both reflect the Government of Lebanon and UN Country Team's focus on responding to climate change at the national level as well as to meet Lebanon's need for increased energy supply. Output 5.2.1 of the UNDAF specifically targets the development and adoption of a national sustainable energy strategy to mitigate climate change. Given that UNDP is the lead agency on this output, the project will build towards meeting this target. Furthermore, Output 5.2.4 aims at increasing awareness about the effects of climate change among the general public; a component of the proposed project will directly contribute towards this Output.

98. Given the above, the proposed new GEF project to promote decentralized RE power generation can be seen as highly complementary to UNDP's ongoing activities and strategic priorities in Lebanon. Consisting mainly of TA-type activities and complemented by an already-established, external financing mechanism, the proposed project is also in full accordance with the type of activities where UNDP is seen to have a comparative advantage among the GEF implementing agencies.

99. The GEF Operational Focal Point of Lebanon, H.E. Mr Nazim El Khoury, Minister of Environment, endorsed the project with a letter signed on December 22, 2011.

## **2.6. Financial Modality and Cost-Effectiveness**

100. From the GEF financing for Outcome 1 (US\$900,000), US\$750,000 has been allocated for use as complementary grant co-financing to leverage NEEREA and other funding sources for the early market development phase of small RE investments. The GEF funds will not be mingled with the NEEREA resources, but they will be used as a complementary financial incentive (without expected pay-back) in accordance with the criteria that were elaborated in detail in chapter 2.1.1. The remaining US\$150,000

covers the costs of organizing the tender, evaluating the proposals received, supervising the construction and commissioning, and paving the way for longer-term financing mechanisms, including funding for a NAMA.

101. The GEF financing for Outcomes 2 and 3 will consist of grants for technical assistance, which will support the Government of Lebanon to further develop and implement a supportive policy and 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.

102. The combined direct and indirect global benefits of the project have been assessed at over 350,000 tonnes of CO<sub>2eq</sub>. With a GEF funding request of US\$ 1.45 million, this corresponds to an abatement cost of less than US\$ 4.5 per tonne of CO<sub>2</sub> reduced.

## **2.7. Sustainability (including Financial Sustainability)**

103. While the project seeks to promote all RE-based electricity generation that can be justified by feasible sites and positive cost-efficiency analysis, PV at the moment appears to have the largest longer-term market potential in Lebanon for small (i.e. less than 1 MW) decentralized RE applications. PV is less sensitive to site selection, it has demonstrated the largest cost reduction potential over the past several years, it has a lifetime of up 25-30 years with very small annual maintenance needs (if considering the PV panels only) and can be considered as a compact, easy to install RE package. As such, the following cost analysis is focused primarily on PV. It is to be noted, however, that at sites supporting wind, micro-hydro or biogas, they may be able to provide even more cost-effective solutions for local, small-scale electricity generation and thus will have their own market share. PV is likely to remain the most widespread small-scale RE power generation technology in Lebanon, however. The overall market potential for different RE technologies is discussed in further detail in Annex 7.6.

104. By building on the cost analysis presented in further detail in chapter 1.3 of this Project Document, the costs of electricity generated by a PV + storage system without any grant support, but with a 0% interest loan provided by NEEREA, would be in the range of 0.26-0.37 US\$ per kWh, depending primarily on the expected panel lifetime and time-frame of the analysis. For grid-connected systems without battery storage, the average power generation costs with the same financing conditions would range from US\$0.11 to US\$0.17 per kWh. With capital costs of 5% and 10%, these costs would be in the range of US\$ 0.18-0.25 per kWh and US\$ 0.28-0.33 per kWh, respectively.

105. The figures above are to be compared with the average 0.30 US\$/kWh electricity costs of small diesel generators typically used in Lebanon to cover the black-outs on the EdL grid, the estimated generation costs of EdL of 0.17-0.21 US\$/kWh, and the expected EdL consumer tariff increase from the current 0.10 to 0.14 US\$/kWh by 2015.

106. On the basis of the figures above, it is evident that some financial support is still required to make the purchase of PV systems sufficiently attractive for the targeted consumers. With expected further down-trend of international PV prices and the growing size of the local market and related supply chain development, the costs of electricity generated by PV will in the future, however, not be very different from the listed baseline options and will have a realistic chance to compete with more conventional energy sources even without any additional grant support. After demonstrating the feasibility of grid-connected PV together with net metering, it should also be in EdL's / Government of Lebanon's interest to further support this technology – for example, by adding a premium to the RE purchase price of any excess electricity supplied to the grid, which would reflect the difference between the prevailing consumer tariff and EdL's own generation costs.

107. While the main purpose of the available GEF and other donor support in the framework of this project is to gain more experience with the development of the small decentralized RE market in

Lebanon, strengthen the supply chain, clarify and remove the identified the technical, regulatory and institutional barriers and demonstrate that decentralized RE market will be a viable growth area in Lebanon even without 100% grant financed projects, it will also pave the way and leverage resources for longer-term financial support mechanisms to boost the small decentralized RE market through the required transition period.

108. Emphasis throughout project implementation will be placed on post-project sustainability – on building the capacity of the local supply-side to sell, install and maintain the systems, support the establishment of an adequate quality control scheme to ensure satisfactory consumer experience with the new technology, and a market monitoring mechanism to track progress and facilitate ongoing targeted support for the sector. When planning any new post-project financial or fiscal support mechanism, specific emphasis will be placed on the effort to avoid damaging “stop-and-go” dynamics, in which the financial and/or fiscal incentives emerge or are removed in an unpredictable manner or the support scheme suddenly runs out of resources at the point that the market has just started to grow.

## **2.8. Replicability**

109. Given the interest of several UNDP-GEF programme countries to develop and implement similar projects, the materials developed and the results and lessons learned in this project are expected to be of direct interest to other countries. Close monitoring and evaluation of project implementation and results will also in this respect be of primary importance.

110. The project seeks to facilitate continuing contacts and co-operation between the different stakeholder groups at the national and international level by organizing seminars, workshops and other public events, thereby bringing project proponents, policy makers and potential investors / other donors together. Co-operation with the new MED-SOLAR project for cross-border information exchange and knowledge transfer, in particular, will be sought in this respect.

### 3. PROJECT RESULTS FRAMEWORK

<b>This project will contribute to achieving the following Country Programme Outcome as defined in CPAP or CPD:</b>					
<b>Country Programme Outcome Indicators:</b>					
<b>Primary applicable Key Environment and Sustainable Development Key Result Area (same as that on the cover page, circle one):</b>					
1. Mainstreaming environment and energy OR					
2. <b>Catalyzing environmental finance</b> OR					
3. Promote climate change adaptation OR					
4. Expanding access to environmental and energy services for the poor.					
<b>Applicable GEF Focal Area Objective:</b> GEF-5 FA Objective # 3 (CCM-3): “Promote Investment in Renewable Energy Technologies”					
	<b>Indicator</b>	<b>Baseline</b>	<b>Targets End of Project</b>	<b>Source of verification</b>	<b>Risks and Assumptions</b>
<b>Project Objective</b> <sup>26</sup> Reducing greenhouse gas emissions by the removal of barriers to widespread application of decentralized renewable energy based power generation.	Amount of reduced CO <sub>2</sub> emissions by the investments facilitated by the project	0	Direct: 35,500 tonnes of CO <sub>2eq</sub> over the 20-year default lifetime of the investments made during project implementation.  Indirect: 317,000 tonnes of CO <sub>2eq</sub> over the 20-year default lifetime of the investments made within 10 years after the project end.	Project monitoring reports and final evaluation.  As applicable, post-project market monitoring and evaluations.	Adoption of a supportive regulatory framework for adequate feed-in tariffs, net metering, grid code and related financial incentives.
<b>Outcome 1</b> <sup>27</sup> Investments in decentralized renewable energy (RE) power generation	Volume of investments mobilized	0	US\$ 8.75 million	Project monitoring reports and final evaluation.	As above

<sup>26</sup> Objective (Atlas output) monitored quarterly ERBM and annually in APR/PIR

<sup>27</sup> All outcomes monitored annually in the APR/PIR. It is highly recommended not to have more than 4 outcomes.

increased					
	<b>Indicator</b>	<b>Baseline</b>	<b>Targets End of Project</b>	<b>Source of verification</b>	<b>Risks and Assumptions</b>
<b>Outcome 2</b> An enforced supportive policy and regulatory environment for attracting investments for privately owned, grid-connected power generation by RE sources	Extent to which RE policies and regulations are adopted and enforced	Regulations for feed-in tariffs and net metering under consideration	Net metering effectively implemented and complemented with other required regulations and/or guidance, including updated technical guidelines for grid connection as well as adopted standards and procedures for performance testing and quality control.  Mechanism and guidelines for the implementation of feed-in-tariffs developed.	Project monitoring reports and final evaluation	The proposed legal and regulatory improvements passing swiftly through the Government approval process.
<b>Outcome 3:</b> Monitoring and quality control for RE-based decentralized power generation established and operational	Availability of annual market data; Verified customer satisfaction with the RE technologies in use	No adequate market monitoring and quality control mechanisms in place	Availability of annual market data for new sales, total installed capacity and net production of all main RE applications sold in Lebanon by March/April each year.  Over 70% customers satisfaction on the RE installations made.	Project reports  Consumer surveys	Agreement reached with the key market players to regularly and timely submit the required data on time.  Adequate quality control and certification scheme in place supported by the required institutional arrangements and legal provisions.

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

<p><b>Outcome 1:</b> Investments in decentralized renewable energy (RE) power generation increased.</p>	<p><b>Outcome 2:</b> An enforced supportive policy and regulatory environment for attracting investments for privately owned, grid-connected power generation by RE sources.</p>	<p><b>Outcome 3:</b> Monitoring and quality control for RE-based decentralized power generation established and operational</p>
<p><b>Output 1.1:</b> Approved and operational financing scheme tailored to support small, decentralized RE investments for power generation by building on the already-operational National Energy Efficiency and Renewable Energy Account (NEEREA), with completed implementation of selected pilot and demonstration projects.</p>	<p><b>Output 2.1:</b> Completed analysis of possible technical constraints associated with connecting new decentralized RE power generation units onto the grid.</p>	<p><b>Output 3.1:</b> Completed public awareness-raising campaigns, seminars, published and disseminated stakeholder group-specific technical guides, handbooks and other related training materials on the design, evaluation, financing, installation, operation and maintenance of the targeted RE technologies.</p>
<p><b>Output 1.2:</b> Developed complementary funding scheme that can continue to facilitate RE investments after the project ends, leveraging funding through climate finance (NAMAs, voluntary carbon market) and other sources.</p>	<p><b>Output 2.2:</b> Updated and harmonized technical guidelines for connecting small decentralized RE plants onto the grid and for ensuring their problem-free operation.</p>	<p><b>Output 3.2:</b> Adopted and operational quality control scheme with related market surveillance and enforcement mechanisms for both the targeted RE products and installations.</p>
	<p><b>Output 2.3:</b> Finalized proposal and draft legal/regulatory package to complement the already-initiated amendments to Law #462, which besides net-metering would allow small decentralized RE producers to sell any excess electricity to the grid, addressing issues such as required licences, purchase obligations of the utility, mechanisms for administering and setting national feed-in tariffs and other possible financial and/or fiscal support mechanisms.</p>	<p><b>Output 3.3:</b> Completed complementary training and other capacity development programmes for professional groups that are directly affected by the proposed quality control schemes.</p> <p><b>Output 3.4:</b> Agreed methodology and institutional arrangements for market monitoring.</p>
	<p><b>Output 2.4:</b> Enhanced knowledge of the cost efficiency of different RE and EE measures at the macroeconomic and final consumer level.</p>	<p><b>Output 3.5:</b> Annual market monitoring reports on the installed capacity and electricity produced by renewable energy and the institutional and financial arrangements in place to continue the market monitoring after the project.</p>
	<p><b>Output 2.5:</b> Amended construction and building management norms to promote increased application of different solar energy technologies in buildings' energy supply.</p>	<p><b>Output 3.6:</b> Regularly updated project website and interactive online training tool that can continue to operate after the project.</p>

### 3.2. Total Budget and Workplan

<b>Award ID:</b>	00073116	<b>Project ID(s):</b>	00086064
<b>Award Title:</b>	Lebanon - Small Decentralized Renewable Energy Power Generation		
<b>Business Unit:</b>	UNDP Lebanon CO		
<b>Project Title:</b>	Country Name Project Title: <b>Lebanon - Small Decentralized Renewable Energy Power Generation</b>		
<b>PIMS no.</b>	<b>4695</b>		
<b>Implementing Partner (Executing Agency)</b>	Ministry of Energy and Water		

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:				
<b>OUTCOME 1</b>	<b>MEW</b>	<b>62000</b>	<b>GEF</b>	71200	International Consultants	8 000	8 000	8 000	0	<b>24 000</b>	1				
				71300	Local Consultants	4 000	4 000	0	0	<b>8 000</b>	2				
				71400	Contr. services – indiv.	26 650	26 650	26 650	26 650	<b>106 600</b>	3				
				71600	Travel	1 500	1 500	1 500	500	<b>5 000</b>	4				
				72400	Grants		250 000	250 000	250 000	<b>750 000</b>	5				
				74200	Printing and publ. costs	500	500	500	500	<b>2 000</b>	6				
				74500	Miscellaneous	600	600	600	600	<b>2 400</b>					
				75700	Workshops and meetings	0	0	2000	0	<b>2 000</b>	7				
				<b>Sub-total GEF</b>						<b>41 250</b>	<b>291 250</b>	<b>289 250</b>	<b>278 250</b>	<b>900 000</b>	
				<b>Total Outcome 1</b>						<b>41 250</b>	<b>291 250</b>	<b>289 250</b>	<b>278 250</b>	<b>900 000</b>	
<b>OUTCOME 2</b>	<b>MEW</b>	<b>62000</b>	<b>GEF</b>	71200	International Consultants	8 000	8 000	0	0	<b>16 000</b>	1				
				71300	Local Consultants	12 000	8 000	8 000	4 000	<b>32 000</b>	2				
				71400	Contr. services – indiv.	39 212	39 212	39 213	39 213	<b>156 850</b>	3				
				71600	Travel	1 500	1 000	500	0	<b>3 000</b>	4				

				74200	Printing and publ. costs	500	500	500	500	2 000	6
				74500	Miscellaneous	500	500	500	150	1 650	
				75700	Workshops and meetings	0	2 000	500	0	2 500	7
				<b>Sub-total GEF</b>		<b>61 712</b>	<b>59 212</b>	<b>49 213</b>	<b>43 863</b>	<b>214 000</b>	
				<b>Total Outcome 2</b>		<b>61 712</b>	<b>59 212</b>	<b>49 213</b>	<b>43 863</b>	<b>214 000</b>	
<b>OUTCOME 3</b>	<b>MEW</b>	<b>62000</b>	<b>GEF</b>	71200	International Consultants	6 000	18 000	11 250	18 750	54 000	1
				71300	Local Consultants	8 000	10 000	6 000	2 000	26 000	2
				71400	Contr. services – indiv.	39 487	39 487	39 488	39 488	157 950	3
				71600	Travel	1 250	1 500	1 500	1 300	5 550	4
				72100	Contr. services - comp.	5 000	5 000	5 000	5 000	20 000	
				<b>Sub-total GEF</b>		<b>59 737</b>	<b>73 987</b>	<b>63 238</b>	<b>66 538</b>	<b>263 500</b>	
	<b>MEW</b>	<b>4000</b>	<b>UNDP</b>	72200	Equipment	0	5 000	10 000	10 000	25 000	8
				74200	Printing and publ. costs	0	1 000	2 000	2 000	5 000	6
				74500	Miscellaneous	600	600	600	200	2 000	
				75700	Workshops and meetings	0	2 000	1 000	0	3 000	7
				<b>Sub-total UNDP</b>		<b>600</b>	<b>8 600</b>	<b>13 600</b>	<b>12 200</b>	<b>35 000</b>	
<b>Total Outcome 3</b>				<b>60 337</b>	<b>82 557</b>	<b>76 838</b>	<b>78 738</b>	<b>298 500</b>			
<b>PROJECT MANAGEMENT</b> (This is not to appear as an Outcome in the Results Framework and should not exceed 10% of project budget)	<b>EED</b>	<b>4000</b>	<b>UNDP</b>	71400	Contr. services – indiv.	17 812	17 812	17 813	17 813	71 250	3
				71600	Travel	400	300	300	250	1 250	4
				<b>Sub-total GEF</b>		<b>18 212</b>	<b>18 112</b>	<b>18 113</b>	<b>18 063</b>	<b>72 500</b>	
				71400	Contr. services – indiv.	18 437	18 437	18 438	18 438	73 750	3
				72200	Equipment	3 000	1 000	1 000	0	5 000	9
				72400	Communication	1 000	1 000	1 000	1 000	4 000	
				72500	Office supplies	1 000	1 000	1 000	1 000	4 000	
				74500	Miscellaneous	850	800	800	800	3 250	
				<b>Sub-total UNDP</b>		<b>24 287</b>	<b>22 237</b>	<b>22 238</b>	<b>21 238</b>	<b>90 000</b>	
				<b>Total Management</b>		<b>42 499</b>	<b>40 349</b>	<b>40 351</b>	<b>39 301</b>	<b>162 500</b>	
<b>TOTAL GEF</b>						<b>180 911</b>	<b>442 561</b>	<b>419 814</b>	<b>406 714</b>	<b>1 450 000</b>	
<b>TOTAL UNDP</b>						<b>24 887</b>	<b>30 837</b>	<b>35 838</b>	<b>33 438</b>	<b>125 000</b>	
<b>GRAND TOTAL</b>						<b>205 798</b>	<b>473 398</b>	<b>455 652</b>	<b>440 152</b>	<b>1 575 000</b>	



### 3.3. Budget Notes

Number	Note
1	Consultancy fee, excluding mission (travel) costs
2	Local short-term consultants
3	Local long-term consultants / core project team consisting of the project manager, project engineer and administrative assistant
4	Travel costs of both international and local consultants
5	Cost sharing of RE investments
6	Including awareness-raising and training materials and those for ensuring visibility according to GEF-UNDP guidelines
7	Costs of training workshops and stakeholder consultations meetings
8	Measuring and other equipment for quality control
9	Office equipment

### 3.4. Summary of Funds:<sup>28</sup>

	Amount Year 1	Amount Year 2	Amount Year 3	Amount Year 4	Total
<b>GEF</b>	180 911	442 561	419 814	406 714	<b>1 450 000</b>
<b>NEEREA</b>		1 500 000	1 600 000	1 500 000	<b>4 600 000</b>
<b>Ministry of Energy and Water (in-kind + Transenergie)</b>	158 500	158 500	158 500	158 500	<b>634 000</b>
<b>UNDP (incl. CEDRO, MED-SOLAR, LECB, TRAC)</b>	1 882 000	1 500 000	1 500 000	1 500 000	<b>6 382 000</b>
<b>TOTAL</b>	<b>2 221 411</b>	<b>3 601 061</b>	<b>3 678 314</b>	<b>3 565 214</b>	<b>13 066 000</b>

<sup>28</sup> Summary table should include all financing of all kinds: GEF financing, co-financing, cash, in-kind, etc.

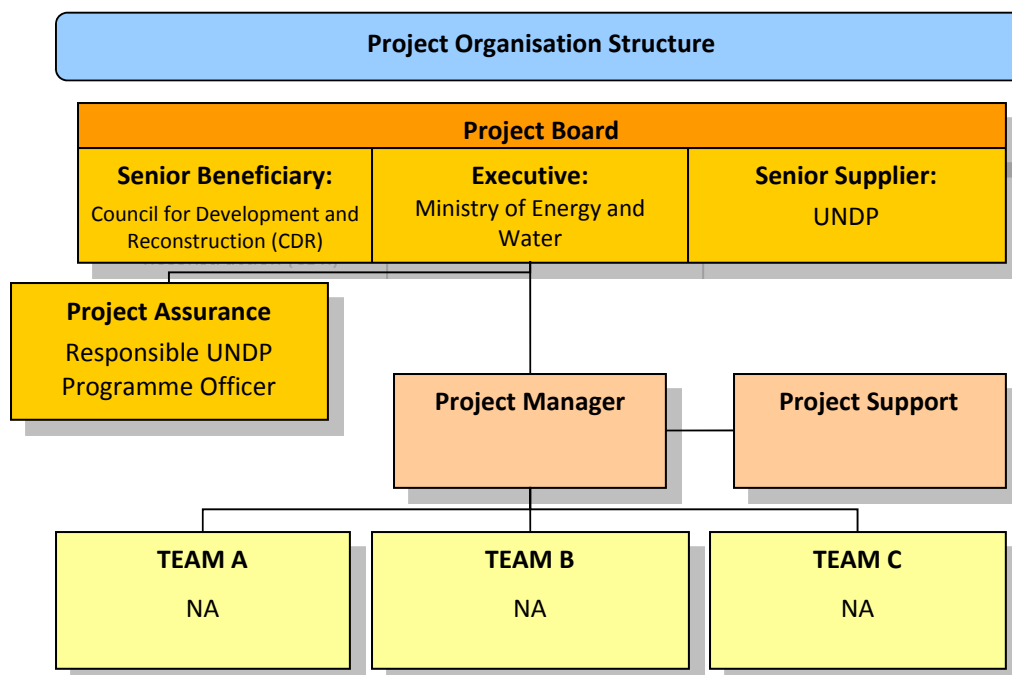
### 3.5. Summary of project co-financing (in USD)<sup>29</sup>

		NEEREA	Ministry of Energy and Water (MEW)		UNDP Lebanon					Total
			In-kind	Transenergie	CEDRO 3 and 4	MED-SOLAR	LECB	UNDP TRAC	Climate Change Co-ordination Unit	
<b>Outcome 1</b>	Cash	4,600,000			2,800,000	1,145,000	50,000		80,000	<b>8,675,000</b>
	In-kind		150,000							<b>150,000</b>
<b>Outcome 2</b>	Cash				770,000	100,000	110,000		50,000	<b>1,030,000</b>
	In-kind		150,000							<b>150,000</b>
<b>Outcome 3</b>	Cash			134,000	285,000	137,000	120,000	35,000	50,000	<b>761,000</b>
	In-kind		150,000							<b>150,000</b>
<b>Project management</b>	Cash				345,000	155,000	40,000	90,000	20,000	<b>650,000</b>
	In-kind		50,000							<b>50,000</b>
<b>TOTAL</b>	Cash	<b>4,600,000</b>		<b>134,000</b>	<b>4,200,000</b>	<b>1,537,000</b>	<b>320,000</b>	<b>125,000</b>	<b>200,000</b>	<b>11,116,000</b>
	In-kind		<b>500,000</b>							<b>500,000</b>
<b>Description</b>		<u>Outcome 1:</u> Zero-interest loans to eligible	<u>Outcome 1:</u> Admin. support for demo	<u>Outcome 3:</u> Practical training facility/	<u>Outcome 1:</u> Financing of demo projects <u>Outcome 2:</u>	<u>Outcome 1:</u> Financing of demo projects <u>Outcome 2:</u>	<u>Outcome 1:</u> NAMA development with related	<u>Outcome 2:</u> Regulatory and policy measures,	<u>Outcome 1:</u> NAMA development, elaboration of	

<sup>29</sup> All baseline activities and associated co-financing amounts presented in the table relate to the period after the approval of the PIF (or prodoc ?) . Baseline expenditures for activities already undertaken or which are expected to be undertaken after the end of the GEF project are not included in the PIF. Furthermore, the co-financing amounts stated in the table above are considered to be conservative estimates

	decentralized RE projects, providing baseline funding that will be topped-up by complementary grant financing by the GEF and other cofinancing sources	projects on siting, licencing, grid connection etc. <u>Outcome 2:</u> Setting up an enabling policy environment to promote private and public investments in renewable energy <u>Outcome 3:</u> Public awareness raising and market monitoring	platform for different RE technologies	Resource assessments and formulation of enabling policies, together with related background studies <u>Outcome 3:</u> Market monitoring in order to keep track of local RE market development	Grid and legal framework analysis <u>Outcome 3:</u> Monitoring, communication and training	capacity building	assistance with grid stability analysis, report containing updated analysis of the cost-efficiency of different RE and EE measures at the macroeconomic and final consumer levels; <u>Outcome 3:</u> Public awareness-raising campaigns, technical guides, handbooks and capacity development	possible fiscal incentives, overall coordination btw. the different ministries  <u>Outcome 2:</u> policy studies and measures to promote RE and EE  <u>Outcome 3:</u> public awareness raising campaigns, technical guidelines and capacity development	
<b>Co-Financing Letter #</b>	1	1	1	2	2	2	2	2	

#### 4. MANAGEMENT ARRANGEMENTS



111. The project will be nationally executed by the Ministry of Energy and Water of the Government of Lebanon and implemented by UNDP through support to the NIM modality. UNDP will be accountable for the disbursement of funds and the achievement of the project goals, according to the approved work plan. The executing agency will assign a senior officer as a National Focal Point to: i) coordinate the project activities with activities of other Government entities; and ii) certify the expenditures are in line with approved budgets and work-plans.

112. A Project Steering Committee (Project Board) 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 the UNDP and will include the National Focal Point from the Ministry of Energy and Water, the Council for Development and Reconstruction (CDR) and representatives from the main stakeholders, such as the Ministry of Finance and EdL. 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<sup>30</sup> 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.

113. 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 PMU will be established within the Ministry of Energy and Water and will coordinate its work with the Lebanese Center for Energy Conservation (LCEC) based in Beirut. The Project Manager will report to UNDP, the executing

<sup>30</sup> **Senior Supplier:** individual or group representing the interests of the parties concerned which provide funding for specific cost sharing projects and/or technical expertise to the project. **Senior Beneficiary:** individual or group of individuals representing the interests of those who will ultimately benefit from the project.

agency and the PSC. The Terms of Reference of the key project personnel 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.

114. 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.

115. UNDP Lebanon will maintain the oversight and management of the overall project budget. It will be responsible for monitoring project implementation, timely reporting of the progress to the UNDP Regional Co-ordination Center in Bratislava and the GEF as well as organizing mandatory and possible complementary reviews and evaluations on an as-needed basis. It will also support the executing agency in the procurement of the required expert services and other project inputs and administer the required contracts. Furthermore, it will support the co-ordination and networking with other related initiatives and institutions in the country.

116. 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.

117. In order to accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF 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.

118. The international experiences and lessons learned from catalyzing local renewable energy development, including those from the other GEF-funded energy efficiency and renewable energy projects in Lebanon, 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 utilized, 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 1.5 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.

## 5. MONITORING FRAMEWORK AND EVALUATION

119. The project will be monitored through the following M& E activities. The M&E budget is shown in section 5.9.

### 5.1. Project Start

120. 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, the 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.

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

122. 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.

123. Based on the project results framework and the relevant GEF Tracking Tool if appropriate, finalize the first annual work plan. Review and agree on the indicators, targets and their means of verification, and re-check assumptions and risks.

124. 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.

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

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

127. 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.

### 5.2. Quarterly

128. Progress made shall be monitored in the UNDP Enhanced Results Based Management Platform.

129. 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, microfinance 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).

130. Based on the information recorded in Atlas, Project Progress Reports (PPRs) can be generated in the Executive Snapshot.

131. 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.

### **5.3. Annually**

132. 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.

133. 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)
- Lesson learned/good practice
- AWP and other expenditure reports
- Risk and adaptive management
- ATLAS QPR

134. Portfolio-level indicators (e.g. GEF focal area tracking tools) are used by most focal areas on an annual basis as well.

### **5.4. Periodic Monitoring Through Site Visits**

135. 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 Board 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 Board members.

### **5.5. Mid-term of Project Cycle**

136. The project will undergo an independent Mid-Term Evaluation at the mid-point of project implementation (January 2015). The Mid-Term Evaluation will determine progress being made towards the achievement of outcomes and will identify course corrections 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 organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this mid-term evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF. 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 GEF Focal Area Tracking Tools will also be completed during the mid-term evaluation cycle.

### **5.6. End of Project**

138. An independent Final Evaluation will take place three months prior to the final Project Board 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 and UNDP-GEF.

139. The 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 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.

## **5.7. 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 in, as relevant and appropriate, 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.

## **5.8. 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 need 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](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](http://www.thegef.org/gef/sites/thegef.org/files/documents/C.40.08_Branding_the_GEF%20final_0.pdf).

147. 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.

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



## 5.9. M & E Workplan and Budget

Type of M&E activity	Responsible Parties	Budget US\$ <i>Excluding project team staff time</i>	Time frame
Inception Workshop and Report	Project Manager supported by an International Expert UNDP CO, UNDP GEF	Indicative cost: 10,000	Within first two months of project start up
Measurement of Means of Verification of project results.	UNDP GEF 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 UNDP EEG	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: 20,000	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 : 20,000	At least three months before the end of project implementation

Type of M&E activity	Responsible Parties	Budget US\$ <i>Excluding project team staff time</i>	Time frame
Project Terminal Report	Project manager and team UNDP CO local consultant	0	At least three months before the end of the project
Audit	UNDP CO Project manager and team	Indicative cost per year: 1,000	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
<b>TOTAL indicative COST</b> Excluding project team staff time and UNDP staff and travel expenses		US\$70,000 (+/- 5% of total budget)	

## 6. LEGAL CONTEXT

149. 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 and all CPAP provisions apply to this document.

150. 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.

151. The implementing partner shall:

- 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;
- assume all risks and liabilities related to the implementing partner's security, and the full implementation of the security plan.

152. 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.

153. 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.

154. Audit Clause: The Audit will be conducted in accordance with UNDP Financial Regulations and Rules and applicable audit policies on UNDP projects.

## 7. ANNEXES



### Annex 7.1. Offline Risk Log

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
1	Government failure to adopt the required legal and regulatory changes, such as the required amendments to the Law 462, tariff adjustments, grid code and financial /fiscal incentives, to provide a basis for the proposed market promotion activities.		Political	No policy basis and incentives to catalyze the RE market  p <sup>31</sup> = 3 I <sup>32</sup> = 5	The fragile political situation in Lebanon will remain as a risk to expediently passing the required legal and regulatory changes. On the other hand, the necessity of continuing electricity sector reform and moving the renewable and energy efficiency markets forward has been broadly recognized by Lebanese politicians of all parties, hence the prominent inclusion of RE in the widely-accepted "Policy Paper for Electricity Sector Development in Lebanon". The recent Government adoption of the National Energy Efficiency Action Plan (NEEAP, November 2011) reaffirms the Government's commitment to the 12% renewable energy target by 2020. Together with the continuing and strong commitment of the current	Project Board		N/A	N/A

<sup>31</sup> Probability from 1 (low) to 5 (high)

<sup>32</sup> Impact from 1 (low) to 5 (high)

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
					Minister of Energy and Water, the political risk is considered to be acceptable				
2	Technical failures leading to the loss of trust by targeted customers on the performance of small, decentralized RE applications.		Technology	Loss of consumer confidence affecting negatively the market  P = 2 I = 5	Small decentralized RE power generation systems such as PV, micro-wind and mini/micro-hydro can already be considered to be technically mature technologies, so the risk of their technical failure due to the early stage of their technical development is considered as low. This does not detract, however, from the importance of adequate quality control of both products and installations at all stages of market development.  The quality control aspects are addressed under Outcome 3, with one sub-component focusing on the development of a “quality control scheme with related market surveillance and enforcement mechanisms” and another component focusing on training to ensure that the equipment is correctly installed and maintained.	Project Board		N/A	N/A
3.	Government		Financial	Lack of capital to	Comprehensive economic and	Project		N/A	N/A

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
	and/or other donors will not provide support and funds for new financing instruments.			sustain the envisaged financial incentives and arrangements  P = 2 I = 4	financial analysis and early discussions with the Ministry of Finance, with the support of other relevant line ministries, will emphasise the macroeconomic benefits of the proposed financial and fiscal incentives, and will point to favourable experiences in – for example – Egypt, Tunisia and Jordan.  For international donors, the demonstrable commitment of the Government of Lebanon to establish and effectively manage similar funding mechanisms, most notably NEEREA, will serve as evidence of the Government’s commitment to the decentralized RE sector.  The project will serve to ‘prime’ alternative sources of funding that are either not tied to donors (e.g. carbon market) or are only indirectly tied to donors (e.g. through the development of a NAMA as a conduit for international financing).	Board			
4	Climate risk		Environmental	Lower than anticipated electricity output	According to the vulnerability assessment undertaken for Lebanon’s Second National	NA		N/A	N/A

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
				of the RE plants installed  P = 2 I = 3	Communication, climate change is not expected to dramatically alter the output from solar and wind installations. For hydro power plants, the uncertainties and risks are higher, which need to be taken into account in the design of the projects.  In the design and installation of RE systems, adequate emphasis also needs to be placed on the systems' ability to survive extreme weather conditions (such as 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.				
5	Lack of adequate and reliable market data to facilitate the monitoring of project impacts and planning of further policy measures.		Organizational	Reduced information from the reaction of the market on the measures implemented  P = 3 I = 4	Close cooperation with the local RE technology dealers and the local utility to obtain the required data will be emphasised.  Cross-checking of the reliability of the data by comparing the results from different sources (including other on-going projects) and approaches (e.g. top-down and bottom-up) will be undertaken.	National Project Manager (NPM).			

#	Description	Date identified	Type	Impact & Probability	Countermeasures / Mgt response	Owner	Submitted, updated by	Last Update	Status
					Monitoring methodologies can include a survey of retail stores and importers, a review of import and customs statistics, meter readings of EdL (after introduction of two-way metering), etc.				
6	Inadequate and/or non-capacitated human resources to successfully implement the project and support the mainstreaming of its results.		Operational	Project not meeting the stated targets  P = 2 I = 5	The project will be implemented within the management structure of the Lebanese Center for Energy Conservation, which has a proven track record of successfully managing similar initiatives.	National Project Manager (NPM)		N/A	N/A
7	Drop in oil prices and failure to adjust electricity tariff will create a negative context in which to promote renewables		Regulatory	Loss of consumer confidence negatively affecting the market  P = 2 I = 5	The fragile political situation in Lebanon will remain a risk to expediently passing the required legal and regulatory changes. However, the huge investments recently made by the Government to secure additional power supply will lead to an inevitable correction of electricity tariffs, which is expected to happen in the coming few years.	Project Board			



## Annex 7.2. Agreements

The co-financing letters are included below and as separate attachments.

### Letter #1: Ministry of Energy and Water

REPUBLIC OF LEBANON  
MINISTRY OF ENERGY & WATER  
THE MINISTER

7297/M  
15/3/2013

March 5, 2013

Ms. Adriana Dinu  
UNDP-GEF Officer In Charge  
304 East 45th Street, 9th Floor, New York, NY 10017 USA  
FAX: +1 212 906 6998

**Subject: Co-Financing for UNDP-GEF "Small Decentralized Renewable Energy Power Generation" Project**


On behalf of the Ministry of Energy and Water, I am pleased to express my full endorsement and support of the Global Environment Facility (GEF) project on "**Small Decentralized Renewable Energy Power Generation**" to be implemented with the Ministry of Energy and Water and the UNDP Country Office in Lebanon. The project is fully in line with the work programme of the Ministry and that of the Lebanese Centre for Energy Conservation (LCEC).


As mentioned in the National Energy Efficiency Action Plan of Lebanon and the National Electricity Policy Paper, the Government of Lebanon is promoting the implementation of renewable energy generation projects of different sizes. The Ministry will support the GEF project through the NEEREA Programme for Outcome 1 ("Investments in decentralized renewable energy power generation increased") with the provision of 4.6 USD million of investment cash by the private sector.

The Ministry will also ensure co-financing through an in-kind contribution of around 634,000 USD (from the Ministry of Energy and Water and the French funded Transénergie project) for co-financing for Outcomes 2 and 3 as described in the project document ("A supportive policy and regulatory environment enforced for attracting investments for privately-owned, grid-connected renewable energy power generation" and "Monitoring and quality control of RE-based decentralized power generation introduced and sustained").

We thank you for your support and look forward to the approval of the project and to our fruitful future collaboration,

Sincerely,

  
Gibran Bassil  
Minister of Energy and Water



C.c.: Mr. Robert Watkins, Resident Representative, UNDP Lebanon

Letter #2: UNDP

United Nations Development Programme  
برنامج الأمم المتحدة الإنمائي



Pipeline  
Ref: 459/JSS/EC

19 February 2013

Dear Ms. Dinu,

**Subject: Co-Financing for UNDP-GEF "Small Decentralized Renewable Energy Power Generation" Project**

It is with pleasure that I confirm UNDP Lebanon's support for the GEF project "Small Decentralized Renewable Energy Power Generation", which was developed in close coordination with the Lebanese Ministry of Energy and Water. The project is in line with UNDP's work programme that targets mitigation to climate change and supports the Government of Lebanon to meet its 12% renewable energy target by 2020.

The UNDP Lebanon Country Office will be committing \$125,000 of dedicated cash co-financing towards this project from its own funding as well as \$6,257,000 of cash co-financing through UNDP-managed projects (CEDRO, LECB, CCCU, and Med-Solar), that directly contribute to the outcomes of the GEF project.

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

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Luca Renda', is positioned above the printed name and title.

Luca Renda  
Officer in Charge

Ms. Adriana Dinu  
Officer in Charge, UNDP-GEF  
Energy & Environment Group, BDP  
304 East 45th Street, 9th Floor  
New York, NY 10017 USA  
Fax: +1 212 906 6998

## **Annex 7.3. Terms of Reference**

### **Project Steering Committee (PSC) / Project Board**

#### **Duties and responsibilities:**

The Project Steering Committee (PSC) is the main body to supervise the project implementation in accordance with UNDP 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, as applicable, representatives of the project's other co-financing partners. A draft list of the permanent members of the Project Steering Committee is provided under section 4 of the Project Document: "Project Management and Implementation Arrangements". Other participants can be invited into the PSC meetings at the decision of the PSC.

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 organized provided that the executing agency, UNDP and at least 2/3 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.

### **National Focal Point**

As a representative of the Government and the project's executing agency, the National Focal Point has the main responsibility to ensure that the project is executed in accordance with the Project Document and the UNDP guidelines for nationally executed projects.

His/her main duties and responsibilities include:

- Coordinate and guide the work of the Project Manager with the work of the national implementing agency through meetings at regular intervals to receive project progress reports and provide guidance on policy issues;
- Certifying the annual and, as applicable, quarterly work plans, financial reports, and ensuring their accuracy and consistency with the project document and its agreed amendments;
- 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 (full-time)**

#### **Duties and responsibilities:**

Operational project management in accordance with the Project Document and the UNDP guidelines and procedures for nationally executed 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 as QPRs) to the PSC, Executing Agency and the 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 international renewable energy experiences, state-of-the-art approaches, and best practices in catalyzing the renewable energy market (by applying different policy measures, new financing mechanisms, etc.)
- 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 project's external relations at all levels; and
  - Fluent/good knowledge of Arabic, English and French languages
  - 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:

- Elaborating the technical criteria of the tender for small, decentralized RE applications seeking GEF cost-sharing;
- Technical due diligence of the RE investment proposals received;
- Quality control of RE products and installation of projects receiving GEF support, including the required inspections and tests at the commissioning stage;
- Supervising the monitoring of the annual performance of the RE investments supported by the GEF project and analyzing the results;
- In co-operation with an international grid analysis and management expert, drafting guidelines for and, as applicable, required new technical regulations, for connecting small, decentralized RE systems into the grid and operating them without distorting the grid balance;
- By building on the previous work both in Lebanon and abroad, elaborating a quality control and certification scheme applicable for Lebanese conditions for both products and installation, and

facilitating its adoption by initiating required stakeholder consultations, drafting of proposals and eventual new regulations or standards required for the implementation of the scheme;

- 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, implementation of the quality control and certification scheme, product maintenance during operation, product performance monitoring and testing, etc.
- Exploring opportunities for 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 grid management or related field;
- Familiarity with the key characteristics of small, decentralized RE applications and related hybrid systems and hands-on experience with their proper installation and operation in Lebanese conditions;
- 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; and
- Fluent/good knowledge of the Arabic and English languages. French is an asset.

#### **Project Assistant (full-time)**

##### **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. French is an asset
- Demonstrated experience and success of work in a similar position
- Good administration and interpersonal skills
- Ability to work effectively under pressure
- Good computer skills

## **INTERNATIONAL PROJECT EXPERTS (PART-TIME)**

### **NAMA and carbon finance expert**

- Further elaborating for the Lebanese RE market applicable financing and fiscal incentive schemes and developing proposals for applying financing for the related investments, including proposals for NAMA and eventual other carbon/climate financing;
- As part of the above, supporting the finalization of the baseline analysis and the monitoring, reporting and verification (MRV) plan;
- Liaising with and supporting the consultations with the international donors as well as with the Government of Lebanon and the Lebanese financing entities on the proposed incentives and other financial support mechanisms.

### **Electricity Grid Analysis and Management Expert**

- Supporting the finalization of the solicitation documents of the tender for the first demonstration projects by providing technical inputs and criteria for ensuring problem free grid-connection and operation;
- By building on the results and analysis done (or to be done) in the framework of other projects in Lebanon (including CEDRO and MED-SOLAR) and related international research on connecting intermittent renewable energy sources to the grid, identify technical, regulatory, institutional and operational barriers that hamper market growth, optimal system configuration and/or performance of small decentralized RE systems promoted by the project in Lebanon;
- Propose and draft technical solutions, eventual regulatory changes, new operational guidelines and procedures (e.g. for granting licences for small decentralized RE generation) to overcome the identified barriers in the most cost-effective manner;
- Lead 1-2 workshops to discuss the findings and proposed solutions with the key stakeholders;
- Finalize updated manual, technical guidelines/criteria and operational procedures for connecting small, decentralized RE units onto the grid and for operating them without disturbing the grid balance, while still obtaining the highest possible output for the generated power;

### **Quality control expert**

- Supporting the finalization of the solicitation documents of the tender for the first demonstration projects by providing technical inputs and criteria for ensuring adequate quality of both products and installation and for facilitating the monitoring of the performance of the systems installed;
- Elaborate, for the applicable Lebanese conditions, a more permanent quality control and certification scheme for small, decentralized RE applications (covering PV, wind and mini/micro hydro) for both products and installation;
- Lead 1-2 workshops to discuss the findings and proposed solutions with the key stakeholders and build their capacity on different aspects of quality control in general; and
- In co-operation with local experts and educational institutes, develop a training programme curriculum for installers of small, decentralized RE systems together with the certification scheme.



#### Annex 7.4. Greenhouse Gas Emission Reduction Analysis

The GHG emissions reduction analysis follows the standard GEF methodology<sup>33</sup> showing the results of the direct, direct post-project, indirect bottom-up and indirect top-down impact analysis and by using a causality factor for the latter.

The direct GHG reduction benefits of the project have been estimated at 35,500 tonnes of CO<sub>2eq</sub> resulting from the installation of at least 1.75 MWp of new small RE capacity during the lifetime of the project and calculated over the investments' default lifetime of 20 years<sup>34</sup>. Due to the continuing fall in international PV prices and the launching of some new projects such as MED-SOLAR and CEDRO 4 to co-operate with the GEF project in supporting RE investments in Lebanon, the earlier capacity target of 1 MWp of the PIF has been revised upwards by 75%. Of the new 1.75 MWp target, 1.25 MWp is assumed to consist of PV systems, while the rest is divided between small wind, micro hydro and biogas based electricity generation.

No direct post-project impact has been considered in the analysis since the GEF resources will be used as one-time capital grant support without expected pay-back: i.e. no new loan or loan guarantee mechanism will be created with the GEF funds.

For assessing the project's indirect impact based on a bottom-up analysis, it is assumed that, for the influencing period of 10 years after the project end, the project's market development activities together with the introduction of new financial and fiscal support mechanisms influenced by the project (e.g. under the NAMA window or other donor/GoL support) will facilitate the installation of new decentralized small RE capacity of at least 1.75 MWp per year: i.e. each year after the project, an amount similar to the estimated total capacity of the demonstration projects implemented during the project will be installed.

For the top-down analysis of the project's indirect impact, it can be assumed that, for meeting the Government commitment to have RE to contribute 12% of all electricity and thermal energy needs in the country by 2020, at least 5% (i.e. 5% of 12% = 0.6 %) of this target could be covered by small decentralized RE applications for power generation. This would correspond to about 90 GWh of energy produced<sup>35</sup> or 51 MWp of installed capacity based on an average capacity factor of 20%.

The project activities are also expected to contribute to larger-scale RE development in Lebanon through capacity building, leveraging new financial resources and work on removing those legal and regulatory barriers that are currently slowing down the development of both the large- and small-scale RE market in Lebanon. Consequently, the project's indirect impact could be multiplied. For maintaining consistency in the estimation approach, the indirect impact of the project on the basis of a top-down analysis has been estimated separately for small decentralized RE systems and for the development of the RE power generation market in general. For smaller plants, a causality factor of 0.6 is used, while for the development of the entire RE power generation market in Lebanon, a causality factor of 0.1 is suggested.

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<sup>33</sup> GEF/C.33/Inf.18, Manual for calculating GHG benefits of GEF projects: energy efficiency and renewable energy projects, April 2008.

<sup>34</sup> More discussion about the default lifetimes used in the calculations can be found later in this annex.

<sup>35</sup> Calculated on the basis of the 1,800 GWh RE share for the 12% contribution as estimated in the National Bioenergy Strategy for Lebanon, CEDRO 2012 <http://www.cedro-undp.org/en/news/details/?newsid=514>.

The key technology-specific assumptions used in the GHG analysis are summarized in table 7.1. For assessing the amount of RE capacity and investments that realistically can be supported with the available GEF and co-financing resources, the average capital cost of US\$ 5,000 per kWp has been used for all targeted RE technologies. While in reality there are obviously some differences<sup>36</sup>, for the purpose of this analysis this common figure is considered to provide adequately accurate results. The largest technology-specific differences in the GHG reduction analysis come from the estimated annual yield of each technology (see table 7.1).

For the default lifetime of the investments, the GEF manual gives for off-grid PV 10 years and for building integrated PV, wind and small-hydro 20 years. For good-quality PV panels, the guarantee provided by manufacturers is typically at least 20 years, with a real-life expectancy of around 25-30 years before the performance starts to significantly deteriorate. For the reasons above and considering the type of RE systems considered for this project, the use of a default lifetime of 20 years is justified. In the initial estimates of the PIF, a default lifetime of 15 years was used.

Table 7.1 Technology-specific assumptions used in the project's GHG reduction analysis

Assumptions Demo projects	Unit	PV with battery storage	Wind with battery storage	Mini/micro hydro	Biogas	Total
Capacity target	MWp	1.25	0.2	0.2	0.1	<b>1.75</b>
Estimated capital costs per kWp	US\$/kWp	5,000	5,000	5,000	5,000	<b>NA</b>
Total capital costs	US\$	6,250,000	1,000,000	1,000,000	500,000	<b>8,750,000</b>
Estimated annual net yield	kWh/kWp	1,300	1,800	4,000	5,000	<b>NA</b>
Total annual net amount of electricity generated	MWh	1,625	360	800	500	<b>3,285</b>
Average baseline emission factor over 20 year default lifetime of the investments	Tonnes CO <sub>2eq</sub> per MWh	0.541	0.541	0.541	0.541	<b>NA</b>
Direct GHG reduction impact over 20 year default lifetime of the investments	tonnes of CO <sub>2</sub>	17,585	3,896	8,657	5,411	<b>35,549</b>

<sup>36</sup> Based on the most recent bids received by the CEDRO project, the costs of a small 1,8 kWp PV systems with a more expensive dual-mode inverter and a battery storage have been in the range of US\$ 5,500-6,000 per kWp. The costs of the only micro-wind project implemented under the CEDRO project at the time of writing this report (with the capacity of 1 kWp and a similar dual-mode inverter and battery storage) were over US\$ 9,000, of which the costs of the wind-turbine itself, the tower and other direct accessories were approximately US\$ 2,500. For larger capacity systems and for systems without the need for a battery storage, the costs would obviously be considerably lower as the costs of inverters, for instance, do not increase in equal proportion to the increase of the capacity. As a part of a PV-diesel or wind-diesel hybrid system or for grid-connected systems without a battery storage, the costs per installed kW of both PV or wind would also be considerable lower.

For hydro power plants, the research undertaken by IRENA ([http://www.irena.org/DocumentDownloads/Publications/RE\\_Technologies\\_Cost\\_Analysis-HYDROPOWER.pdf](http://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-HYDROPOWER.pdf)) indicates typical investments costs of 1,000 – 4,000 US\$/kWp for large hydro, while for HPPs with capacity of less than 1 MW the investment costs can be considerable higher, i.e. 3,400 – 10,000 US\$/kWp depending on the site and the size of the plant. In the MEW Policy Paper, the capital cost of hydro of US\$ 5,800 per kWp was used for budgetary purposes.

Table 7.2 Summary of the GHG Reduction Analysis

	Lifetime direct	Lifetime post project	Lifetime indirect bottom-up	Lifetime indirect top-down for small RE	Lifetime indirect top-down for all RE
<b>New installed RE capacity (MW)</b>	1.75 MW	NA	10 x 1.75 MW = 17.5 MW	5% of the overall 12% RE target by 2020	12% RE target by 2020
<b>Timeframe for the analysis</b>	Investments made in 2013-2016 (project duration) GHG reduction impact calculated over 20 year default lifetime of the investments	NA	Investments made in 2017-2026 (during 10 years after project end) GHG reduction impact calculated over 20 year default lifetime of the investments	Investments made by 2020 GHG reduction impact calculated over 20 year default lifetime of the investments	Investments made by 2020 GHG reduction impact calculated over 20 year default lifetime of the investments
<b>Annual electricity generation (MWh)</b>	3,285	NA	32,850	90,000	1,800,000
<b>Total electricity generation over the default lifetime (MWh)</b>	65,700		657,000	1,800,000	36,000,000
<b>Average baseline emission factor (tonnes of CO<sub>2</sub>/MWh)</b>	0.541	NA	0.482	0.482	0.482
<b>Calculated GHG reduction (ktonnes of CO<sub>2eq</sub>)</b>	35.5	NA	285.3	867.6	17,352
<b>Causality factor</b>	NA	NA	NA	0.6	0.1
<b>Project impact (ktonnes of CO<sub>2</sub>)</b>	<b>35.5</b>		<b>316.7</b>	<b>520.6</b>	<b>1,735</b>

### Baseline Emission Factor

For calculating the baseline emission factor, there are significant uncertainties as it concerns the future development of the Lebanese power sector. While the Government policy outlined in 2009 targets the construction of 4,000 MW of new power generation capacity by 2014 and 5,000 MW after that, with a vision that there will be no need for private diesel electricity generation after such time, this is not expected to materialize within the originally envisaged schedule. Furthermore, it was assumed that from 2013 onwards natural gas will be available in Lebanon in sufficient quantities for all existing and new

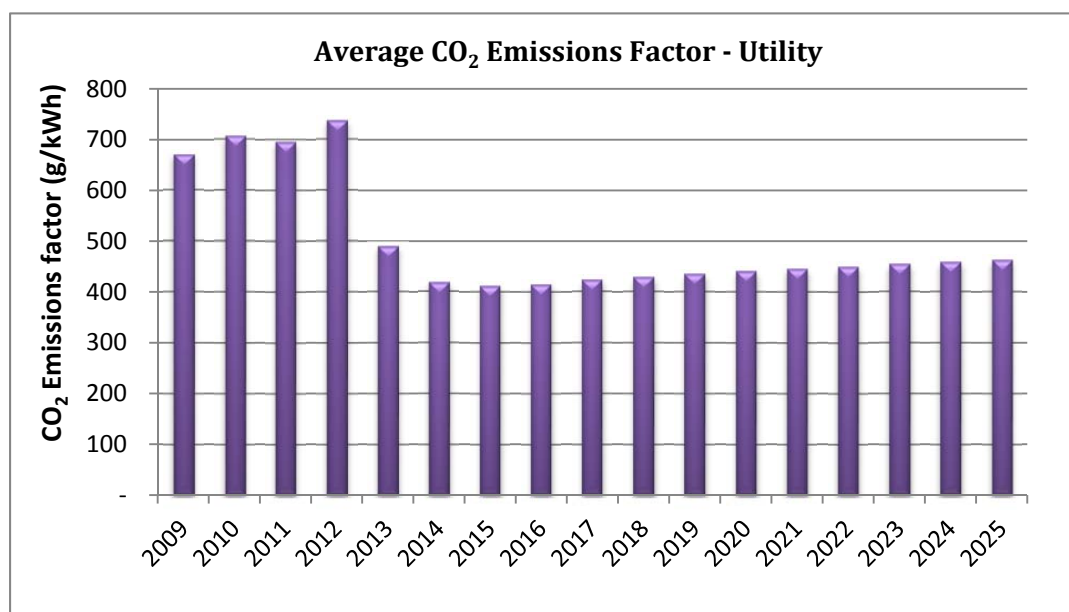
power plants to substitute the current use of oil. This is not likely to take place according to the projected schedule either.

Given the above, the options for defining the baseline emission factor are essentially as follows:

1) Assuming that the small, decentralized RE installations will primarily continue to substitute for private diesel generation. In this case, the reduction of GHG emissions will be about 0.7 kgCO<sub>2</sub> per kWh produced, reflecting the typical consumption of diesel generators of about 0.25 litres of diesel oil per kWh of electricity produced (corresponding to a conversion efficiency of about 38%).

2) Assuming that grid stability and 24/7 electricity supply is gradually achieved, in which case the need for private diesel generation should largely disappear<sup>37</sup>. Furthermore, and in line with Government energy policy, natural gas should replace the use of oil in both the existing and new thermal power plants, which would reduce the emissions of the electricity supplied to the national grid. Should all power plants in Lebanon run on natural gas and with new, more efficient power plants coming into use, the average emission factor of the electricity produced by thermal power plants should remain under 0.5 kgCO<sub>2</sub>/kWh (without accounting for any transmission or distribution losses), as compared to 0.77 kgCO<sub>2</sub>/kWh in 2009. For consumed electricity with transmission and distribution losses and hydro-power included, the average emission factor in 2009 was 0.83 kgCO<sub>2</sub>/kWh.<sup>38</sup>

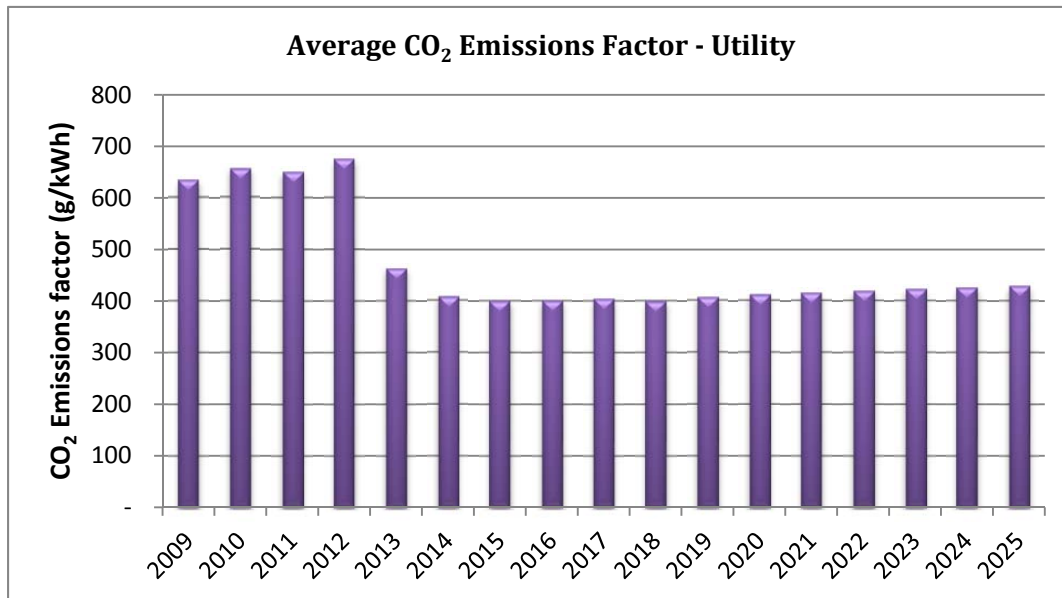
Figures 7.1 – 7.3 below illustrate the average emission factor of power generation including all plants supplying electricity to the national grid for different scenarios, as per the Government policy paper of 2009.



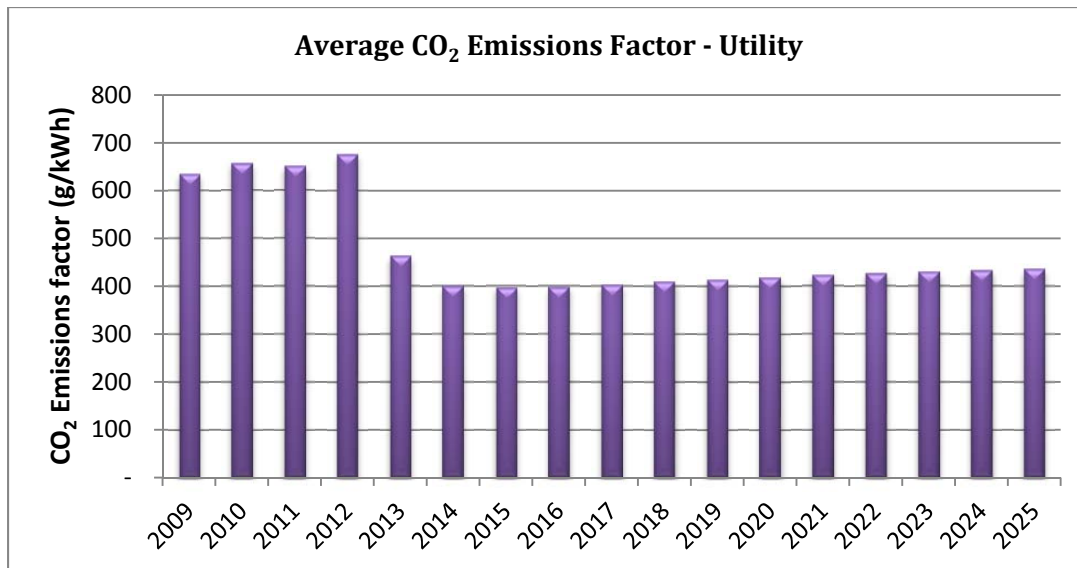
**Figure 7.1** Average CO<sub>2</sub> emission factor of power generation in the baseline scenario assuming no major new RE capacity and that natural gas will be supplied in sufficient quantities to Lebanese power plants from 2013 onwards.

<sup>37</sup> By being more expensive and considering the 98% grid connection rate among the population.

<sup>38</sup> Calculated based on the latest available IEA statistics of 2009.



**Figure 7.2** Average CO<sub>2</sub> emission factor associated with having natural gas as the primary fuel in all thermal power plants from 2013 onwards and increasing the hydro capacity by rehabilitating the existing plants from 190 MW to the originally installed 283 MW and adding 264 MW new run-of-river units in 3 consecutive years starting in 2015, as recommended by the Sogreah study<sup>39</sup>.

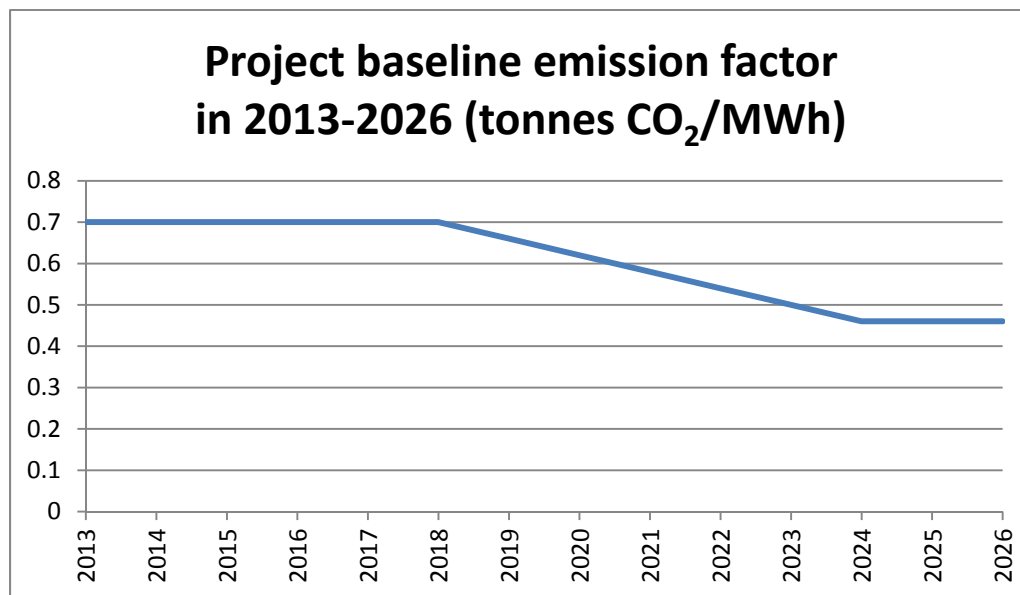


**Figure 7.3** Average CO<sub>2</sub> emission factor associated with having natural gas as the primary fuel in all thermal power plants from 2013 onwards and increasing the hydro capacity by rehabilitating the existing plants from 190 MW to the originally installed 283 MW, adding 77 MW of hydro capacity based on the Sogreah and CEDRO studies plus 100 MW of wind, 25 MW of waste-to-energy and 15 MW of PV.

<sup>39</sup> For further details, see Annex 7.7

3) For grid electricity, there is a choice of using the average emission factor that incorporates all energy sources (including hydro and other RE) or to consider the electricity produced by those power plants only that new RE installations would primarily substitute. While the power generation structure in Lebanon also includes hydro-power and the Government of Lebanon has committed to increase the share of renewable energies up to 12% of the total electricity supply by 2020, it can be assumed that the output of all RE plants with practically no or very small operating costs will mostly be used to the maximum extent. With this assumption, the baseline emission factor would basically correspond to the average emission factor of the electricity produced by thermal power plants only.

As can be concluded from discussion above, the baseline emission factor largely depends on the projections and assumptions made, with variations up to  $\pm 50\%$ . Still, as a relatively conservative estimate, it was considered appropriate to use the emission factor of private diesel generation as the baseline emission factor for the RE investments directly facilitated by the project for the first 4-5 years of operation (i.e. for 2014 – 2018 by assuming that the commissioning of these RE systems starts at the beginning of 2014 and has been finalized by the end of 2014). After that, the increasing electricity supply and improved stability of the grid may gradually reduce the need for private diesel generation and, together with the natural gas entering Lebanese power plants as the primary fuel, the average baseline emission factor of thermal power generation starts to approach 0.5 kgCO<sub>2</sub> per kWh<sup>40</sup> and even lower. There are major uncertainties with these projections, however, especially with regard to the schedule of natural gas entry and the required new power plant investments. Therefore, the evolution of the Lebanese power sector will be closely monitored during the project implementation and the GHG analysis updated accordingly.



**Figure 7.4.** Baseline CO<sub>2</sub> emission factor used for the project’s GHG reduction analysis

<sup>40</sup> While the new combined gas cycle power plants running on natural gas have considerably higher efficiency and thus lower GHG emissions per kWh of electricity produced, 0.46 kgCO<sub>2</sub> per kWh is considered a representative value for a power generation structure containing both new and less efficient older power plants running on natural gas. This figure corresponds to an average conversion efficiency of 44%.

## Annex 7.5. Major Elements of the Current Energy Policy

The current energy policy of the Government of Lebanon elaborated in the 2010 MoEW Policy Paper covers 3 distinct strategic areas, with 10 specific initiatives, that are:

- **Infrastructure:** Generation; Transmission; and Distribution;
- **Supply and demand:** Fuel Sourcing; Renewable Energies; Demand Side Management/Energy Efficiency; and Tariffs; and
- **Legal framework:** Norms and Standards; Corporatization of EdL; and Legal Status.

The policy includes 42 action steps, with an implementation schedule phased according to a planning horizon based primarily on a short-term 2010-2012 and a medium-term 2012-2015.

The policy targets a gradual implementation of the projects according to a developed timeline with a cumulative budget of \$4.9 billion. The infrastructure alone accounts up to \$4.2 billion of the policy budget (87%) and the private sector will have the largest contribution in project financing, amounting up to \$2.3 billion.

### Infrastructure

The generation plan targets a total installed capacity of 4,000 MW by 2014 to meet a load forecast of 3,677 MW with around 8% reserve. The forecast peak for 2014 was estimated from the peak load of 2009 (2,450 MW) using an annual growth rate of 7%. In the immediate term, the generation plan considers the possibility of renting 250 MW (barges or small generators or imports) as a stop-gap solution and to provide the standby capacity needed for 4 years to rehabilitate old and deteriorated thermal units. The immediate term also considered commissioning new plants to rapidly increase the installed capacity by 600-700 MW using Combined Cycle Gas Turbine (CCGT) and Reciprocating Engines (400-500 MW for CCGT and 200-300 MW for reciprocating engines ). For the medium term, projects will increase the installed capacity by 1,500 MW in 2014 using the modality of Independent Power Producers (IPPs) in collaboration with the private sector, with a minimum share of 20% financed by international loans. Renewable energy has a significant role in the energy policy, and hydraulic power production will have a larger share through the maintenance, rehabilitation and/or replacement of existing hydro plants, in addition to facilitating the implementation of additional hydro capacity on a Build-Operate-Transfer (BOT) basis. The private sector will also be encouraged to build wind farms and adopt the technologies of waste-to-energy.

The transmission plan will focus on removing bottlenecks, reducing transmission losses, completing a control center to ensure adequate connection between power plants and load centers together with high reliability and stability at the lowest cost. The transmission plan aims at expanding the transmission system to increase evacuation capacity in accordance with the increase in generating capacity. Projects include building regional substations, expanding high-voltage and medium-voltage transmission networks, and completing the Lebanese Electricity National Control Center (LENCC).

The distribution plan is based on implementing a transitional programme with the participation of the private sector to improve planning and operation, including metering, billing and collection based on modern and smart systems. The major project in the distribution plan is the introduction of Service Providers (SPs), whose responsibility it is to provide distribution services and improve quality and adhere to performance benchmarks (KPIs) that would result in a progressive increase of revenues. In addition,



the SP project includes developing a center able to monitor automatic meter reading, perform remote connection/disconnection of supply, and demand management functions and its reduction.

## **Supply and Demand**

The fuel-sourcing plan is based on maximizing diversity and security whereby two-thirds of the fuel mix will be based on Natural Gas (NG) with multiple sources of supply, amongst which is a Liquefied Natural Gas (LNG) marine terminal. The remaining one-third will be based on other sources while selecting tri-fuel-compatible technologies capable of operating using NG, Heavy Fuel Oil (HFO) and Light Fuel Oil (LFO). All on-shore power plants will be connected by a gas pipeline running along the coast (on-shore and sub-sea where necessary) to feed all plants from Deir Ammar in the far north to Tyre in the far South.

The Government of Lebanon, through a Ministerial Declaration and through the Ministry of Energy and Water's Energy Policy for the Electricity Sector, has set the target of 12% of total energy supply to come from renewable energy sources by 2020. It also commits to the preparation and adoption of national programmes focusing on demand-side management as the basis of saving a minimum of 5% of total demand. This is to be achieved by adopting the Energy Conservation Law and launching a national plan for energy conservation; encouraging the use of Compact Fluorescent Lamps (CFLs), with the aim of banning energy-intensive devices in the future; increasing the penetration of solar water heaters; devising innovative financing schemes in collaboration with the banking sector to achieve the slogan "A solar heater for each household"; encouraging the use of energy-saving public lighting; and developing the ESCO (Energy Service Company) sector dealing with energy audit applications.

The supply and demand initiative will gradually restructure and increase the existing tariff as supply improves to eliminate the financial deficit in the electricity sector and establish a balanced budget for EdL. Even with the increased tariff, the financial burden on electricity consumers will decrease in line with their reduced reliance on private generators which are much more expensive.

## **Legal Framework**

The objective of the legal framework consists of setting norms and standards for the provision of electric services that are safe, equitable and fair with the best quality and lowest cost. The success of the policy necessitates the "revitalization" of EdL because it is the core entity of the sector. This entails providing EdL with the financial, administrative and human resource flexibility needed to cope with new situation that will prevail after the implementation of the proposed policy. To achieve this goal, the policy considers corporatization as the preferred solution.

The technical and financial problems of EdL were accentuated from 2011 until the present day due to delays in implementing capacity additions, institutional reforms, and the sharp increases in fuel prices. Due to this energy supply deficit, the greater Beirut area suffers from power cuts for 3 hours per day on average and the rest of the country for about 7 hours and 10 hours per day in 2011 and 2012 respectively.

With over 88% of its production from thermal power plants and no indigenous resources, Lebanon imports all of its fuel and is therefore prone to fluctuating prices of the world market. This, together with the capital amortization of former investments in the sector amounting to \$381 million, increased the deficit in 2009 to \$1.2 billion. The lack of elasticity of the tariff to oil prices makes the deficit a volatile parameter.



## **Annex 7.6. Potential for, and Current Status of, Renewable Energy Use and Planning in Lebanon**

Increasing the use of renewable energy sources is expected to bring significant advantages to Lebanon by improving, among others, energy security and energy independence beside the obvious environmental benefits. The spectrum of available technologies is broad, including wind, direct use of solar energy by CSP, PV and solar water heaters, biomass (including waste-to-energy), small hydro and geothermal. Many initiatives have already been implemented to catalyze the RE market, including those supported by CEDRO. These include the completion of Lebanon's first Wind Atlas (2011), a National Biomass Strategy (2012) and several pilot/demo projects, including PV, micro-wind, solar thermal and ground source heat pumps. Lebanon is also applying to become a member of the International Renewable Energy Agency (IRENA).

### **Hydro-Power**

Lebanon initially depended upon hydroelectric generation for electricity supply, and hydro-power still makes a contribution. Lebanon enjoys better access to water than neighbouring countries during a rainy season extending for 80-85 days/year, mainly between October and April. Rainfall varies considerably throughout the country; the western part is wetter and there is a substantial snowfall on the Mount Lebanon massif. Use of water for power generation is compromised by the requirements for domestic water and irrigation, with the latter frequently taking priority over hydro-power. A quarter of the hydro-power resources are being used, but they contribute only a small fraction (11.3% in 2009) of total power generation. Peak hydro-power generation occurs in March, which is when the electricity demand is lowest.

The Litani in the Bekaa is the most important river. The biggest hydro-power plant in Lebanon, comprising three plants on the Qaraoun Lake, is managed by the Litani River Authority: the dam confines a large 210 million m<sup>3</sup> reservoir and the turbines have a name plate capacity of 190 MW, but operate more usually between 80-170 MW according to the water flow<sup>41</sup>.

Two other concessions, Bared and Nahr Ibrahim, have an installed capacity of 17 and 33 MW, respectively. All of the hydro-power units are between 40 and 70 years old and all are in the need of renovation. The Master Plan for EdL, developed by Electricité de France (EdF) in 2008 with funding from the Government of France, proposes an additional 120 MW of hydropower generation, mainly coming from the extension of existing installations and some new run-of-river projects.

The installed capacity of all hydro-power plants is 283 MW, but the actual generation capacity is around 190 MW. The energy produced from the 190 MW of hydro plants (Litani, Nahr Ibrahim and Bared) constituted 11.3% of the total electricity production of 2009. Table T.2 in Annex 7.7 shows all the hydro-power units in Lebanon.

The MoEW Energy Policy outlined in 2010 aims to increase the share of hydraulic power production through maintenance, rehabilitation and/or replacement of existing hydro-power plants, facilitate the implementation of additional capacity on a Build-Operate-Transfer (BOT) basis, and invest in storage dams. However, there are several limitations facing hydro-power development, notably:

- Limited number of river streams.

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<sup>41</sup> Source: EdL

- High cost of dams for hydro-electric use due to limited water resources and the karst geology of the river streams.
- Environmental impact of hydro plants and protected zones.
- Increasing potable and irrigation water needs.
- Land ownership and occupancy; acquired rights on water.
- Multiplicity of actors: various water establishments: EdL, Litani Water Authority, La Kadisha, Al-Bared, various concessions, MoEW, Council for Development and Reconstruction (CDR), Higher Council of Privatization (HCP), etc.
- Obsolete legal framework, gaps and inefficiencies.
- Obsolete kWh tariffs among water establishments, concessions and EdL.
- Financial feasibility positive only in case dams are projected anyway for irrigation purposes.

Table T.3 in Annex 7.7 lists the existing sites that have been identified for rehabilitation/upgrades. Additionally, a study was completed by UNDP-CEDRO on the potential of micro-hydro in Lebanon. The study identified a number of streams for micro-hydro, as shown in Table T.4. of Annex 7.7. The MoEW also completed a Hydro Master Plan for Lebanon in collaboration with Sogreah for the sites shown in Table T.5. of Annex 7.7.

The above studies yielded the following conclusions:

- **Rehabilitation and Upgrade of Existing Hydro-Power Plants:** Such rehabilitation can increase hydro-generation capacity from at least 190 MW to 282 MW.
- **Installation of New Hydro-Power Plants – Master Plan:** 32 new sites have been identified and are expected to contribute an additional production capacity of:
  - Around 264 MW, at a cost of \$590 million, in run-of-river schemes
  - Around 338 MW, at a cost of \$695 million, in peak schemes<sup>42</sup>
- **Micro-Hydro:** 13 sites have been identified, with a production capacity around 5 MW. These include irrigation channels, wastewater treatment plant intakes and outfalls, electric power plant outfall channels and municipal water distribution networks.

Depending on the type of hydro/micro hydro plant, and consequently its capital expenditure (capex) requirements, the tariff ranges shown in Table T.6 of Annex 7.7 have been deduced as guidelines for the expected cost of generated energy.

## Wind Power

Lebanon has significant wind potential, especially in the North, with estimated average wind speeds of up to 6-9 m/sec at the 80 meter hub height<sup>43</sup>. The EdL Master Plan prepared by the EdF in 2008 predicted that 1% of the electrical power demand would come from wind in the year 2012, increasing

<sup>42</sup> Hydro power plants with water reservoirs that can also be used for peak management.

<sup>43</sup> The National Wind Atlas of Lebanon, CEDRO 2011 (<http://www.cedro-undp.org/en/research/details/?newsid=61>)

slowly thereafter. That would have represented a generation capacity of 30 MW in 2012, then 60 MW in 2018 (1.5% of demand). The assumed capacity factor is 23%, which will limit the contribution of wind energy to 120 GWh in 2018, or only 0.7% of total generation. A capital cost of \$1,950 per kW of wind power was used for budgetary purposes.

The forecast of the Master Plan did not materialize for 2012, as no significant wind energy production in Lebanon yet exists. Wind turbines for home applications have been installed by individuals and a few small wind turbines have been demonstrated in the South, Mount Lebanon and Bekaa, but the installed capacity is estimated to be less than 100kW. The largest single wind turbine installed in Lebanon is a refurbished model with a capacity of 300kW installed on Mount Lebanon, but it has not been operational for a number of years due to shaft alignment problems.

While the Government of Lebanon instigated the development of wind energy as early as 2008, when it signed several MOUs with local developers to develop wind farms, the political environment and the status of the Government at that time prevented the MoEW from going further into their development. However, with the realization of policy paper projects, it is hoped that the forecast for 2018 and beyond will prove realistic for wind energy development. The MoEW believes that the development of wind energy in Lebanon will play a crucial role in reaching the 12% renewable energy target.

In January 2011, CEDRO, a UNDP-MoEW project, finalized a wind atlas for Lebanon, which was funded by the government of Spain. The atlas showed large potentials for wind energy, especially in the North and East of Lebanon with an estimated total potential capacity of 1.5 GW. Meso-scale and micro-scale modeling was carried out for the entire Republic of Lebanon to produce a wind map with a resolution of 100 m. The work is summarized below:

- Both meso-scale and micro-scale wind flow modeling have been carried out to determine the wind speed variation at heights of 50 m and 80 m for Lebanon at a final resolution of 100 m. Measured data supplied by Météo Liban (ML) and for meteorological stations located in Syria were used in the production of these wind maps.
- The same wind flow modeling methodology was carried out to determine the wind speed variation at heights of 50 m and 80 m for the offshore region lying within 20 km of the Lebanese coastline. Consideration of all applicable offshore observations was undertaken in order to assess the applicability of the modeling results to the offshore region.
- The wind speed outputs were converted to power density estimates.

Considerable uncertainty was noted in all the displayed wind mapping results. This uncertainty arises from a number of sources such as:

- low resolution of monthly wind data provided;
- poor agreement between the hourly and monthly data provided for specific masts;
- absence of data coverage information for each month;
- lack of detailed information for each station;
- low height of the measurements;

- there being only one measurement height for the ML meteorological stations, preventing any measured estimate of wind shear within Lebanon over a large extrapolation distance from 10 m to heights of 50 m and 80 m and corresponding uncertainty in the modeled shear assumed;
- grid resolution (5 km and 100 m); and
- the inherent uncertainties in wind modeling over large distances.

Additional wind measurements at multiple heights approaching those of typical turbine hub heights were recommended in order to reduce the uncertainty in any future wind resource assessments carried out in Lebanon. The wind atlas concluded that there is great potential for wind power in North Lebanon.

The CEDRO project also initiated a guideline report for the ‘Environmental Impact Assessment (EIA) of wind farm projects’. Only after a proposed wind farm passes the EIA recommendation and/or modifies the project in accordance with the identified mitigation measures would a licence be granted. The report sets out the general principles and procedures to implement EIA for wind farm development in Lebanon. The report is aimed at providing environmental consultants and practitioners with introductory guidelines for conducting EIAs for wind power developments within the context of Lebanon. These guidelines outline the policy and legislative setting for EIAs in Lebanon; provide an overview of the EIA process in general, followed by an overview of EIAs specific to wind power installations.

## **Bioenergy / Biomass**

Lebanon has a relatively abundant availability of bioenergy resources, as approximately one-third of the country’s land is arable, with the most fertile areas being located along the coastal strip and in the Bekaa Valley. Traditional use of biomass in rural areas is intensive; however, the development of sustainable bioenergy is lagging behind the modest goals that have been formulated in the past.

Lebanon has little forest cover, but it has significant other sources of biomass, such as municipal solid waste and agricultural wastes. The Bekaa valley is the main agricultural region, with a wide range of crops – notably potatoes, cereals, tomatoes and sugar beet. South Lebanon is a wheat-growing region and the coastal zone grows mainly fruit, including citrus, bananas and vegetables. Cereals are largely produced in the north of Lebanon, especially in Akkar. Some of the residues from these crops are used for animal feed, but the majority are discarded. There may be some potential for energy-related products, but other applications, such as composting, are more likely to be cost-effective.

In the framework of the UNDP CEDRO project, a “National Bioenergy Strategy for Lebanon” was finalized in 2012.<sup>44</sup> The goal of the study was to define and develop all key elements to be considered in the formulation of the National Bioenergy Strategy for Lebanon in order to satisfy the Government’s commitment to make RE contribute to 12% of total energy needs by 2020. Four scenarios were studied to assess the contribution of bioenergy to electricity and heat generation, using all possible types of bioenergy: forestry, agriculture residues, energy crops, animal fat, municipal solid waste (MSW) and non-hazardous industrial waste.

- Scenario I: based on peace prevailing in the region accompanied by a rapidly-growing economy. The analysis of this scenario revealed the possibility of generating 934 GWh from around 119 MWe installed capacity.

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<sup>44</sup> <http://www.cedro-undp.org/en/news/details/?newsid=514>

- Scenario II: based on peace prevailing in the region accompanied by a slow-growing economy. This scenario yields 475 GWh of electricity from around 62 MWe installed capacity.
- Scenario III: based on the assumption that Lebanon is in political turmoil, which affects the economy with increasing socio-economic disparities across Lebanese regions. In such a scenario, 73 GWh of electricity can be generated from 9 MWe installed capacity.
- Scenario IV: There is a strong economy, with some regions remaining underdeveloped due to significant political and social unrest. Bioenergy is used to reduce energy deficits and imports.

The study recommends Scenario I as the best alternative to contribute to half of the electricity needed to reach the 12% target, requiring only a relatively small capacity of 119 MWe. The biomass fraction from MSW is found to be an important resource as it may contribute to the generation of 301 GWh of electricity, which could result in a total capacity of up to 38 MWe. The contribution of forestry is estimated at 930 GWh.

The MoEW and the Council for Development and Reconstruction (CDR) are also considering investing in energy produced from wastewater sludge through anaerobic digestion (AD). Currently, Lebanon has only a few operating wastewater treatment plants (WWTPs). The mentioned Bioenergy Strategy for Lebanon (2012) indicates that there is interesting energy potential for the ten largest WWTPs in the country.

The energy produced from the most interesting seven projects<sup>45</sup> out of the 10 WWTPs could represent 3-4% of the national bioenergy potential identified by the Bioenergy Strategy Plan.

### **Photovoltaic (PV)**

The Government policy paper of 2009 did not specifically include energy production from photovoltaic (PV) technology but it committed to start a pre-feasibility study on PV farms. The reason for the absence of a PV generation target in the policy paper may be due to the high perceived capital cost of PV, the perceived low efficiency of PV systems and the false belief that PV cannot make a contribution if widely implemented in decentralized mode for autonomous use or for connection to the grid via net-metering. In fact, with current market prices, PV-generated electricity is already close to competitive when compared with private generation that uses diesel oil. The CEDRO project has managed to complete – as of August 2012 – the installation of 126 kW of PV systems for schools, municipalities and community centers. It is expected that, by the end of 2012, CEDRO will complete the installation of an additional 104.4 kW, yielding a total of 230.4 kW. Such progress may trigger additional penetration of PV into the Lebanese market if supported by other initiatives.

No initiatives to promote Concentrated Solar Power (CSP) have been effectively started in Lebanon yet.

### **Geothermal**

A project contract to develop a geothermal atlas for Lebanon was recently awarded to a Swiss company, GEOWATT, for approximately €200,000. The study has just started and so no conclusions are yet available.

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<sup>45</sup> See table T.7 in Annex 7.7 for further details

## Annex 7.7. Tables

**Table T.1.** Levelized costs of current EdL generation.

Generating Unit	Cost per kWh
Hydro	\$0.04
Syria	\$0.14
Egypt	\$0.116
Zouk	\$0.134
Jieh	\$0.137
Deir Ammar	\$0.115
Zahrani	\$0.159
Tyre	\$0.248
Baalbeck	\$0.25

**Table T.2.** Existing hydro power plants in Lebanon.

River stream	Establishment	Plant name	Year	Installed capacity	MW	Remarks
Litani awali rivers	Litani water authority	Markabi	1961	1x17.9 MW + 1x19 MW	199	In service - will be affected by conveyor 800 project
		Awali	1964	3x37.76 MW		
		Joun	1967	2x24.65 MW		
Nahr Ibrahim river	Societe phoeniciene des forces de Nahr Ibrahim des eaux et electricite	Chouane	1961	2x7.5 MW	32	In service - needs rehabilitation
		Yahchouch	1955	2x4.984 MW + 1x2.464 MW		
Wadi kadisha	La kadisha - societe anonyme d'electricite du liban nord s.a.l. (EdL owned)	Bechare	1924	2x0.82 MW	21	In service - needs rehabilitation
		Mar licha	1957	3x1.04 MW		
		Blaouza ii	1961	3x2.8 MW		
		Abu-ali	1932	2x2.72 MW + 1x2.04 MW		
Sukar spring		Ouyoun al samak	1948	1x3 MW + 1x1 MW	4	
Al bared	Al bared concession (edl owned)	Al bared 1		3 x 4.5 MW	17	
		Al bared 2		1x1.2 MW + 1x2.5 MW		
Nahr el jouz		Kaftoun		3x5 MW	15	
Berdawni	Electricite de Zahle	Berdawni		1x1 MW	1	Out of service
Safa spring	Electricite du Liban	Richmaya – safa	1931	2x3.1 MW + 1x6.8 MW	13	In service - needs rehabilitation
Jeita spring	Water authority for Mount lebanon	Jeita - hrache	1930	1 x 0.312 mw + 2 x 0.8 mw	2	Out of service
<b>Total installed available capacity</b>					<b>282</b>	<b>MW</b>

**Table T.3.** Existing sites selected for rehabilitation/upgrades.

River Stream	Hydro Plant	Type of Upgrade
Nahr El Litani	Bardawni	Under Study
Nahr El Litani	Awali, Joun & Markabi	Peak Load
Nahr Ibrahim	Yahchouch, Moudiq	Peak Load
Nahr Ibrahim	Ibrahim 3	With the Flow / Peak Load
Nahr El Bared	Bared 1 , Bared 2	Under Study
Nahr El Damour	Safa	Rehab. / Replacement
Nahr Abou Ali	Mar Licha, Blaouza, Abou Ali	Rehab. / Replacement
Nahr Abou Ali	Bechare	With the Flow
Nahr Al Jouz	Al Jouz	Under Study
Nahr El Kelb	Hrache	Replacement

**Table T.4.** Streams for micro-hydro projects.

Stream	Capacity
Irrigation systems	756 kW
Nahr el bared lake	736 kW
Wadi el Hojier	20 kW
Water Distribution network	949 kW
Saida Water station	206 kW
Ain Leghwaibe	743 kW
Existing Power Plants	5260 kW
Water Discharge Zouk	2266 kW
Water Discharge Jieh	988 kW
Water Discharge Beddawi	1134 kW
Water Discharge Zahrani	872 kW
Water treatment plants	123 kW
Tripoli water treatment plant	123 kW

**Table T.5.** River streams and sites for the Hydro Master Plan.

River Stream	Site
Nahr Abou Moussa	Mechmech, Qarn, El Mara
Nahr Sukkar	Sir
Nahr Sir	Qattine, El Ouatie
Nahr Abou Ali	Kannoubin, Bchanin
Nahr El Jouz	Beit Chlala, Bustan
Nahr Ibrahim	Hdaine, Ibrahim 4
Nahr El Kelb	Mayrouba, Daraya, Chamra, Boqaata
Nahr Beirut	Baabdat, Dachouniye
Nahr Al Damour	Rechmaya, Mtaile, El Boum
Nahr El Awali	Bisri, Aval Joun
Nahr El Litani	Blat

**Table T.6.** Tariff ranges required for feasible investments in hydro power.

	Min Selling Tariff < 8.1 ¢\$	Min Selling Tariff 8.1 ¢\$ < tariff < 12 ¢\$	Min Selling Tariff > 12 ¢\$	Total
<b>Number of Sites</b>	13	12	4	29
<b>Power (MW)</b>	139	94	17	250
<b>CAPEX (M\$)</b>	273	287	78	638
<b>Production (GWh)</b>	713	413	68	1,194
<b>Average installation cost \$/Kw</b>	2,070	3,220	4,310	

**Table T.7.** Summary of study on electricity generation from wastewater sludge through anaerobic digestion.

Project	Primary Energy	Energy Production through CHP		Electric Power
	GWh/year	Electricity GWh/year	Heat GWh/year	MW
<b>Tripoli</b>	61.4	23.9	25.2	3
<b>South</b>	18.5	7.2	7.5	0.9
<b>Aabde</b>	28.2	11.01	11.6	1.38
<b>Sarafand</b>	30.5	11.9	12.5	1.49
<b>Saida</b>	34.9	13.6	14.3	1.7
<b>Magdal Anjar</b>	34.9	13.6	14.3	1.7
<b>Bekaa</b>	29.2	11.4	11.9	1.42
<b>Total</b>	<b>237.7</b>	<b>92.7</b>	<b>97.5</b>	<b>11.59</b>

**Table T.8.** Examples of PV projects implemented by CEDRO.

Project	Capacity (W)	Project	Capacity (W)
Rajem Issa public school	1,800.00	Meniara public school for girls	1,800.00
Mashta Hammoud public school	1,800.00	Jeb Jennine Municipality and Library	1,800.00
Kherbet Daoud public school	1,800.00	Mdoukha public school	1,800.00
El Tleile public school	1,800.00	Hosh El-Oumara community center	1,800.00
Hekr El Dahiri public school	1,800.00	Aana Intermediate public school	1,200.00
Ouyoun El-Samak public school	1,800.00	Tell Zounoub Intermediate public School	1,200.00
Kroum Arab public school	1,200.00	Ayteet public school	1,200.00
Habshit public school	1,200.00	Kherbet Selem first public school	1,800.00
Ain Yaakoub mixed public school	1,800.00	Kfarkela first public school	1,200.00
El-Hakoor mixed public school	1,200.00	Kfarshouba Intermediate public school	1,800.00
Baalbak first elementary public	1,800.00	Houla municipality	1,200.00
Chmestar community center	1,800.00	Ain Ebel municipality	1,200.00
Hosh el Harime intermediate school	1,800.00	<b>Total (Watts)</b>	<b>39,600.00</b>



**Table T.9. PV projects implemented or under development by the private sector.**

50kW PV system already installed in the Industrial Research Institute (IRI) by ASAKO for a total cost of U\$200,000.

300kW PV system for a hotel belonging to the church in Harissa. The project was implemented by SOMIRAL in 2010.

20 projects for banks with capacities ranging between (2-8) kW. Several residential and villa projects with capacities of 140kW, 120kW and 80kW are still under consideration for NEEREA financing. The developer is SOLARWIND ME s.a.r.l.

Olivetti started the installation of 40kW PV for its headquarters.

Earth Technologies applied for NEEREA funding for a 25kW PV for a school in ADMA and for 28kW PV for Khoury Hospital in Beirut. The same company has already installed PV systems in four factories, each of 30-35kW.

UNIFIL has installed an 80kW PV system in the south.

Renewable MED Energies has already installed 20kW and 25kW PV systems in the car parks of 2 villas.

ME Green Technologies has installed several small PV and wind systems in remote areas in the North, Bekaa and the South with finance from USAID. The total capacities of those systems is in the range of 50kW.

**Table T.10. Examples of PV projects under consideration by the private sector.**

**INDEVCO:** One of the largest industrial groups in Lebanon running its own diesel power plants. It has not only shown interest in RE projects, but has also expressed its willingness to commit to install PV systems to reduce its reliance on diesel generators, should there be interest-free loans, or a grant from GEF or EU, or both.

**Lebanese American University (LAU):** One of the most prestigious private universities in Lebanon, with two campuses in Beirut and Byblos. Interest in a hybrid PV-diesel project under the envisaged support scheme of 0% interest loan and a complementary GEF grant. The annual savings are estimated to amount about \$2 million per year.

**Le Royal Hotel:** A five-star hotel operating in a suburb of Beirut (Dbayeh) with about 230 rooms. Interest in PV-diesel systems.

**Malco Group:** A group of businesses that owns and operates bakeries and food processing plants in Lebanon. Interest in the installation of PV systems to support the operation of their diesel generators, subject to incentives such as interest-free loans and grants.

**Notre Dame University (NDU):** This is a well-established private university in Lebanon, with a plan to convert its campus into a green one. Has incorporated a PV project in its 2013 business plan based on the projection that it may benefit from a 15% EU grant to RE projects in Lebanon. NDU's intention is to install PV panels in the parking lot of the University with an estimated budget of around US\$ 1 million in order to reduce its dependency on diesel generators.

**Annex 7.8. List of Solar Thermal Companies (Solar Water Heaters) in Lebanon Compiled by the Lebanese Center for Energy Conservation (LCEC)**

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
1	AL BINA	Mohamad Tabbara	03 127721 01 863311	Beirut, Clemenceau, AXA ME bldg, 2nd Floor	albina@albinagroup.com	www.albinagroup.com
2	AL DIYAR FOR ENGINEERING & CONTRACTING & TRADE	Ali Awada	03 630449 01 545641	Bourj Al Barajina, Rweis, Abyad Street, Yakout Bldg, 2nd floor	awada1958@yahoo.com	
3	AL-RIDA	Mohsen Reda	03 086526 07 344526	Aqbiya, Street Main Street, Bldg. Layal company		
4	ALTERNATIVE ENERGY	Chamel Macaron	03 602936 01 481336	Sin el Fil, Metropolitan, St.Rita, Jatco center, 6th floor.	sales@altaka-albadila.com	www.altaka-albadila.com
5	AQUA SOLAR	Michel Khairallah	70 236271 01 921360	Elissar, Mazzaat Yachouh, Khalil Roukoz Street, Au Carrefour Bldg	michel_kh@hotmail.com	aqua.solar@hotmail.com
6	AQUAPRO	Tanios El Haibi	03 713797 04 925797	El Metn, Cornet Chehwan, Main street, Georges El Hasibi bldg	aquapro@terra.net.lb	
7	ASALEA TRADING AND CONTRACTING SARL	Elie Abou Sleiman	03 094542 05 470324	Caza Baabda, City Hadath, Street Antounieh, Bldg Khalil Azar	info@asalea.net	www.asalea.net
8	AVB – ENERGY & WATER SOLUTIONS	Bedros Avakian	03 302290	Jdeideh, Rue de la sagesse, Bldg Sigma 1 center, first floor	bedros@avbenergy.com	
9	AVS	Fahad Assafiri	03 394324 06 600194	El mina, Tripoli, Saeid Frayhat Street, Zailaa Bldg	fassafiri@gmail.com	
10	BLACK BOX	Marc Akar	03 302708	Beirut-Al Arz street-Acar bldg	mark@blackboxcontrol.com	www.blackboxcontrol.com
11	CENTURY TECH	Claudette Ashkar	03 224013 01 487779	Keserwan, Ajaltoun Main Road, Street- near St, Georges Hospital, Bldg.	centurytech.century@gmail.com	

Ref .	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
				Chemaly Labotory		
12	CHAFIC BOU YOUNES & Co. S.A.R.L	Antoiine Bou Younes	03 717144 09 478333	Nahr Ibrahim-Street industrial zone-Bldg Bou younes	info@bouyounes.com	
13	CLIMAPURE	Issam Al Amil	03 448226 01 489201	Beirut, Hersh Tabet, Bldg Aun	info@climapure.com	www.climapure.com
14	CONTRA INTERNATIONAL	Bassel baaklini	01 381381 03 949462	Qatar, UAE Sharjah SAIF Zone	basselb@contraintl.com	www.contraintl.com
15	DAWTEC	Wissam Daou	03 951460 01 288 688	Lebanon,Beirut, Furn El-Chebback Sagesse university street, Bldg.Lemec	dawtec@dawtec.com	www.dawtec.com
16	DECOFLAM	Nashaat Jomaa	03 770337 70 769032	Nabatieh,Kafaromman Street,Perla toys Bldg	jomaanashaat@gmail.com	
17	DK ENERGY SYSTEMS	Elie Dany	03 698880 04 916232	Mtayleb-main road-Bldg Noufaily-first floor	info@dkenergysystems.com	www.dkenergysystems.com
18	EARTH TECHNOLOGIES	Lara Fathallah	04 444 961 70 969 196	Antelias,Street of restaurants,behimd Sanyour Restaurant,CCL bldg,4th floor	info@earthtechnologies-me.com	www.earthtechnologies-me.com
19	ECOSUN	Roger Hitti	03 529804 01 285959	Dhour El Choueir Street , Dahr Echir Bldg. Hitti	eco-sun@hotmail.com	
20	ECOSYS	Elie Maalouf George Maalouf	01 682000 03 399074	460 Corniche Al Nahr	g.geha@itg.com.lb e.maalouf@ecosys.com.lb	www.ecosys.com.lb
21	ELECTRO MECHANIC Est	Rafic Ezzediine	03 566748 03 580579 07 381456	South Lebanon,Deir Kanoun el Naher	info@ecosys.com.lb ezzeddinefactory@hotmail.com	
22	ELEMENTS (SUN AND WIND)	Elias Abou Chedid	03 357599 01 492305	Horch Tabet,Beyrouth,Street Mkalles Hayek,Bldg GGF B enter Block A,8th floor		www.elementssw.com
23	EMARTS	Francois Farage Tony Zaatar	03 748 702 03 474 881	Zahle Street St. Elie Street Bldg. Jean Zaatar	ffarage@emarts.biz tzaatar@emarts.biz	www.emarts.biz

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
24	ENERCOM	Elie Aoun	01 687189 71 203080	Dikwaneh, Nafaa Str., Chalhoub Bldg	ener.com@hotmail.com	
25	EST. JOSEPH ZIADÉ POUR LE COMMERCE	Alain Ziade	03 669221 09 830702	Keserwan, Jounieh, old Harissa road, Bldg. Albert Naaman	ziadeh_co@hotmail.com ziade.alain@gmail.com	
26	EST. KHALIL SLEIMAN	Khalil Sleiman	03 458991 08 910172	Bednayel, Main street, versus Kard Al Hassan	eks@hotmail.ca	
27	FALCON WIN TRADING	Asaad Slaiby	03 694005 08 910521	Zahle, Autostrade, versus junction El rihab, Salkon Company.	f-w-t@hotmail.com	www.falconenergy-lb.com
28	FAYEZ ABOU EL SHEIKH	Khaled Fayez Aboul Sheikh	03 645406 07 755255	Saida, saint place street	gm@fasco-lb.com	
29	GENERAL ORGANIZATION FOR TRADE	Walid Bteddiny	05 501511	Kfarnabrakh, Chouf, Main Street, Walid Bteddiny Building	walidbteddinycenter@hotmail.com	
30	GEORGES KHOURY & CO	Joseph Elias	03 425963 01 901100	Bauchrieh El Metn, street 67; Khoury building	josephe@gkhoury.com	www.gkoury.com
31	GHADDAR COMMERCE AND CONSTRUCTION	Zouhour Ghaddar	03 422525 07 222656	Caza Saida, City Ghazieh, Street Saida, Tyr Main Road, Bldg Ghaddar	zouhourg@hotmail.com	
32	GHADDAR TRADE & INDUSTRY	Sahar Ghaddar	07 221956 07 220512	Saida, Tyre Road, Fouad Khalifeh, 1st Floor	redaghad@inco.com.lb	
33	GMG TABBOUCH SARL	Mikael Yazbek	03 277102 03 704227 06 442789	North Tripoli Al Raess Al chachid Rafic Hariri street, Bldg.	mikaelyazbek@hotmail.com	www.gmgolarenergy.com
34	GREEN ALTERNATIVE POWER SOURCES	Merwan Kiwani	09 233680 03 334555 05 507088	Nouhad Center Bakaata Alshouf, Behind Croix rouge, Dahr el Harik street, station Nasr Allah, Jamil Saad Deen Bldg, 3st	kmerwan@yahoo.com	

Ref .	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
35	GREEN ARMS LEBANON SAL	Toni Traboulsi	03 861051 01 696711	Floor.2Metn, Mkalles, Mansourieh Highway, Bldg. Factory Mall	info@greenarms.co.uk	www.greenarms.co.uk
36	GREEN ENERGY NTC EST	Mahmoud Naouchi	70 421640 06 390764	Tripoli,Malouli high way,Al shekh bldg	qtourch2@hotmail.com	
37	HADATEC	Samia Assaf	03 249103 01 878209	Metn-Jdeideh-Chalet Suisse-Aoun Center	hadatec@live.com	www.hadadec.com
38	HAGE GROUP	Joe El Hage	71 448121 01 329209	Beirut,Monot Street,Tabet Bldg	info@hagegroup.com	www.hagegroup.com
39	HIJAZI TRADE AND INDUSTRY	Abdul Hakim Eido	71 440804 07 220030	Lebanon,Saida,Ghazieh,Str eet main road,Bldg Hijazi Trade and Industry Show Room	aheido54@gmail.com	www.hijazitrade.com
40	HOUSSAM RIFAI AND PARTNERS CO FOR GENERAL TRADING	Houssam Rifai	71 193577 08 370876	Lebanon,Bekaa,Baalbeck,D ouris main street	hassanrifai2@gmail.com	
41	ISMAIL IBRAHIM SALLOUM	Ismail Salloum	03 707599	Caza Lebanon-Bekaa City Baalbeck Street Douris , Main Road Bldg. Rifai	salloum_general@hotmail.com	
42	ITANY COMPANY FOR TRADE & INDUSTRY	Khaled Itani	03 534797 05 481346	Mount Lebanon-Aley- Choueifat el omara-street tiro-bldg Itani.Boite Postale 13-6035	star20@inco.com.lb	www.schmellerwaterheaters.com
43	JF GROUP	Joseph Faddoul	03 177348 04 916533	Beirut-Ashrafyeh-Street Sassine-Bldg Trabolsy	jfgrp@hotmail.com	
44	KEVORK KOULADJIAN	Kevork Kouladjian	03 620744 01 485226	Sin el Fil-Beirut-Mar Elias,Dahdouh Bldg,versus Rosary Sisters School.	office@greentech.com.lb	www.greentech.com.lb
45	KHOUEIRY FOR TRADING AND CONTRACTING	Michel Khoueiry	03 723175 04 925349	Maten-Komet Chehwan- Main road-Bldg Joseph Abi Karam	solary_tc@live.com	
46	KHOURY & ABOU RJEILY	Naji Khoury	71 244904 01 893715	Baabda,Hadath,Baladiye Street from Kamil	Naji@synergy-greenliving.com	www.synergy-greenliving.com

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
	GROUP			Chamoun Boulevard, Ibrahim Mansour Bldg, Level		
47	KINAAN TRADING	Asaad Kinaan	03 303392 05 950607	Baabda, Hazmieh, Mar Takla street, Ali Nehme Bldg.	info@solarworld.com.lb	www.solarworld.com.lb
48	KODORAT	Rabih Shehayeb	03 515930	Aley, Main Street, Souk el Gharb chemlan.	rabih@kodorat.com	www.kodorat.com
49	LEBECO SAL	Oussama Fahd	03 637416 01 561494	103 Nahr street Georges Saba Building, ground Floor, Beirut	lebeco2000@hotmail.com	
50	LIBANCIEL S.A.R.L	Zahi Khawand	70 322633 05 922987	Jezzine, Roum main street, Abou zeid bldg, 1st floor	info@libanciel.co	www.libanciel.co
51	MAWARED & CONSTRUCTION CO	Hanna Akar	01 255755	Dora, Cebaco Building, Block A	info@kyrossolar.com	www.kyrossolar.com
52	MECATECH	Gaby Jalbout	03 634464 09 224967	Keserwan, Zouk Mosbeh, Street main road, Gebara/Katra bldg	mecatech@mecatechwater.com	
53	MECHA BASICS INDUSTRIES	Adel Zubaidi	76 766002 05 272074	Lebanon, Bchamoun, Zuhur Road, Juri Bldg	zadaco@gmail.com	www.mecha-basics.com
54	MEDITERRANEA N FOR ALTERNATIVE TECHNOLOGY AND COMMERCE (MEFALCO)	Abdul Karim Hajar	71 825101 70 183949	Tripoli, Mina, Azmi Street, Ghalayini Building	hec.company@yahoo.com	www.mefalco.com
55	MESMO ZREIK	Walid Zreik	70 109943 06 202566	Tripoli Street, meitein, Bldg. zamalek	zreikw@inco.com.lb	
56	METACS	Emile Azar	01 335929 01 200159	Beirut, Ashrafieh, Tabaris, 227 SELIM BUSTROS, AZAR bldg	metacs@metacs.com	www.metacs.com
57	MIDDLE EAST	Lara El	03 170788	Mount Lebanon, Sin el	lara.elkhoury@me-greenenergy.com	www.me-greenenergy.com

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
	GREEN ENERGY	Khoury	01 491446	fil,Beirut hall,Hibri bldg		
58	NAKKOZI	Mahmoud Nakkouzi	03 246456 07 721644	Saida, East Boulevard street	nakouzico@hotmail.com	
59	NATIONAL ENERGY CONSULTANTS (NEC)	Ronald Diab	07 730577 03 328010 01 219284	Beirut , Monot Str, Ashrafieh , Bldg Rebeiz	Ronald@nec-group.com	www.mec-group.com
60	NATUREENERGY	Gilbert Zabbal	05 457968	Babbda, Rihanieh, St Charles Hospital Str, Jawad Bldg	gilbert@skyenergies.com	www.skyenergies.com
61	PHOENIX GROUP	Simon Gerges	03 054976 09 855691	Kesrouan-City Safra-Street near Hawa chicken factory-Bldg Phoenix	energy@phoenixlb.com	www.phoenixlb.com
62	RAFALE TRADING	Elie Skaff	03 222693 08 930791	Industrial zone,Zahle,Saydi street.Mounir Skaff bldg	info@rafaletesting.com	
63	RENEWABLE MED ENERGIES	Ziad Doumit	03 302203 04 545230	Main street opposite-Hotel le Royal Dbayeh	ziad.doumit@rmenergies.com	www.renewablemed.com
64	RIVAGE SARL	Charbel Semaan	03 410795 06 668795	Mejdlaya-Zgharta	rivagesarl@gmail.com	
65	SAAB INTERNATIONAL	Roger Saab	71 750505 01 879589	Metn-Zalka-Biakout Main road-Jazra Bldg,versus Gallery Mobilia	roger.saab@saab-intl.com	www.saab-intl.com
66	SAAD EL-DEEN GENERAL TRADE ESTABLISHMENT	Ilyass Sadeddin	03 231258 06 250191	NORTH LEBANON – KFRCHLAN-MAIN ROAD DANNIYEH-Bldg Ahmad Osman	specialheat@hotmail.com	www.saad-el-deen.com
67	SABBAGH TRADING	Ibrahim Sabbagh	03 676470 08 544774	Zahle Chtaura-Steet Kab Elias intersection-Idriss Bldg,Boite Postal 44 Chtoura el Bekaa.	sabbagh-trade@freesun.com.lb	www.freesun.com.lb
68	SAWAN SOLAR SYSTEMS	Elie Sawan	03 472528 01 681421	Zgarta_Akbeh street. Tripoli Al Moutran street	sawan_est@hotmail.com	www.sawansolarsystems.com
69	SENSUS INTERNATIONAL	Marwan Chehab	03 283959 01 254726	Metn-Bauchrieh-Blvd sin el fil-Antaki Bldg	mchehab@antakigppk.com	www.haierlb.com
70	SERVICOM	Assad	03 669369	Sin-El-Fil street D-54	info@ecosol-lb.com	www.ecosol-lb.com

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
.	ECOSOL	Toubia	01 502111			
71	SKAFF	Bassam Skaff	03 846909 06 690122	Halba Main Street, Minyara way		
72	SOFAYA	Michael Mousa	70 466129 06 953110	Cosba,Koura, Arz Highway	michaelmoussa@hotmail.fr	
73	SOLAIR WATT S.A.R.L.	Magid Mahfoud Farid Rahme	03 369207 09 910307	Keserwan,Jounieh,Haret Sakher,Madeleine Khazen Bldg,2nd Floor.	info@solairwatt.com	www.solairwatt.com
74	SOLAR POWER	Rabih Hajj	03 250292 09 221449	Lebanon-Keserwan-Street Zouk Mosbeh-Bldg Elie Moukawam	rawadhaj@hotmail.com	
75	SOLAR SOLUTIONS	Jihad Ghorra	03 961516 08 802778	Zahle, Ksara, Al Daman Bldg	jihadghorra@hotmail.com	
76	SOLAR TECH BY AL SHAMS GROUP	Shamseddine Omary	71 284808	North Lebanon-Tripolis-Street tall-Fattal center	suneshine75@hotmail.com	www.solartech-lb.com
77	SOLARIS SUPER SOLAR WATER HEATER	Mohamad Al Jamal	03 640508 01 342701	Beirut, Abdulaziz street, Hamra Bldg Awad, 4th floor south	info@supersolarheater.com	www.supersolarheater.com
78	SOLARLEB	Leon kradjian	01 807772 03-473320 01-565449	GF , , bayramian bldg. , Armenia st. Bourj Hammoud	info@solarleb-lb.com	www.solarleb-lb.com
79	SOLARNET	Jean Paul Sfeir	03 309 885 04 532927	Metn, Mansourieh, Mansourieh old road, Yazbeck Bldg	info@solarnet-online.com	www.solarnet-online.com
80	SOLARTECH SARL	Joe Issa	04 532937 03 800057 09 223606	Keserwan-Adonis-Green Zone-St.Antonios Street.Bldg 13		www.solartecb.com
81	SOLEC ENERGY	Alain Azar	70 516251 01 482263	Freeway Center, 1st Floor, Beirut, Lebanon.	alain.azar@solec-energy.com	www.solec-energy.com
82	SOLTECH LEBANON	Kamel Sherkawi	03 606578 01 838012	Beirut-Safarat Street- Abdallah Bldg	soltech_lebanon@live.com	
83	STE. TECHNO SYSTEMS SARL	Hady Gemayel	09 220491 09 220492	Zouk Mosbeh Street Main Street, Bldg. Gebbara	sales@technosystems-lb.com	www.technosystems-lb.com
84	SUN ISLAND	Ziad Daou	03 580084	Dmit El Shouf	ziad_sunisland@hotmail.com	www. Sunisland.com.lb



Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
			05720473			
85	SUN POWER	Dani Akiki	03 123685 04 444204	Antelias, Bekfaya Highway, Abi Karam Bldg	sunpower_lebanon@hotmail.com dany@sunpowerlb.com	www.sunpowerlb.com
86	SUN SHINING COMPANY	Afif Fadel	03 875212 05 801314	Aley, Baabda, Bchemoon, Ita ny Bldg, behind Assaf Mill	afif_fadel@hotmail.com	
87	TABBARA GENERAL COMPANY	Ziad Tabbara	03 701386 01 704444	Beirut, Ahmad Takkiedine str, Colombia Center	ziad@tabbara-general.com	www.tabbara-general.com
88	TAKAT GENERAL TRADING EST	Deeb Youssef	03 750200 09 622574	Jbeil-Romane Street-Bldg Takat General Trading Est	deeb_youssef@hotmail.com	
89	TECHNICORP SAL	Amer Hafez	03 706543 01 884815	Meten, Dora, Beirut, street 75, Bldg pink	info@technicorp.net	
90	TECHNO MASS	Khaled Tohme	03 311953 04 920923	Metn, Beit al Chaar, Michel Abood Bldg, Fifth floor	info@techno-mass.com	www.techno-mass.com
91	TFAILY SOLAR ENERGY	Sami Tfaily	03 720129 07 530330	Dair Al Zazhrani Main Road	sunshine_solar@hotmail.com	
92	UNIVERSAL ENERGY	Omar El Hassan	03 801307 01 839030	Mount Lebanon, Hadath, Main Road, Center Cherfan	energy_universal@yahoo.com	
93	WADCO ESTABLISHMENT	Wadih Abi Yared	03 335113 71 742043	Maten, Antelias, Serhal hospital, 2nd Bldg, 3st floor	Optosolar@hotmail.com	
94	WEBCO	Walid El Baba	03 667492 01 850068	Beirut, Street, Zahia Salman Bldg. El Baba/ 2nd floor	webco@cyberia.net.lb	
95	WEHBE TECHNOLOGIES	Jean Wehbe	01 853711 03 670089 04 541140	Batroun, Royal Center, GF	jeanwehbe@gmail.com	
96	WHITE WATER	Gaby Mrad	03 660847 06 417847	Sammrieh, Barad El Chami, Yammouneh Bldg	whitewater660@gmail.com	
97	YOUNES GROUP	Naji Younes	70 109401 08 818177	Caza Hamra, City Zahle, Street national Zahle Baalbek, Bldg. Hamra Plaza	younes_group@hotmail.com	
98	HATOUM	Hassan Hatoum	03 354251 08 910774	Jnoub-Temnin El Tahta	chark_2011@hotmail.com	
99	ECO FRIENDLY	Patrick	70 570284	Ain el Remmeneh, Arid		www.ecofriendlyme.com.lb

Ref	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
	SARL	Ardahalian	01 292787	Street,Etoile Bldg,7th Floor		
100	AWATEF FOR GENERAL TRADING	Ayman Ghotme	08 661101	Lala -,West Bekaa , Lebanon	awatef13@hotmail.com	
101	NASSIF TRADING	Bachir Nassif	71 283868 09 943842	Mount Lebanon,Jbeil,Old Road Street,Joseph Howayek Bldg	bachir.nassif@gmail.com	
102	MONACO GLOBAL	Khalil Ibrahim	06 668441 03 979908	Zgharta,Houwara,St Elie Street	ontop_group@yahoo.com.au	www.monaco-global.com
103	GREEN ENERGY PROJECT SARL	Waid Al Dikah	01 551940 70 105100	Baabda,Chiah,Ariss Street,Awada Center,7th Floor	manager@greenprojectlb.com	www.greenprojectlb.com
104	ZEIN INTERNATIONAL	Ali Zein	03 740044 07 380300	Tyre,Abbassieh,Abassieh main street,Bldg Zein&Fawwaz	contact@zeinsolar.com	www.zeinsolar.com

N.B.: 1) The list includes contact details of the Lebanese companies working in the import, supply, installation, and maintenance of solar water heating in Lebanon. 2) The list includes all companies that have completed the LCEC questionnaire. 3) The companies shown in the above list are listed by alphabetical order. 4) All the data shown in the list is presented as given by the companies in the completed questionnaires. 5) Companies wishing to become listed can contact [energy@lcecp.org.lb](mailto:energy@lcecp.org.lb) 6) The list will be updated periodically (the current version is dated June 2012).

### Annex 7.9 List of Solar Photovoltaic Companies in Lebanon Compiled by the Lebanese Center for Energy Conservation (LCEC)

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
1	AL DIYAR FOR ENGINEERING & CONTRACTING & TRADE	Ali Awada	03 630449 01 545641	Chiah, Beirut, Bir Al Abed, Bldg. Diab	awada1958@yahoo.com	
2	AL SHAMS GROUP	Shamseddine Omary	71 284808	Tripolis, Street tall, Fattal center	Suneshine75@hotmail.com	
3	ALTERNATIVE ENERGY DPC/LEBANON sarl	Chamel Macaron	03 602936 01 481336	Metn, Sin el fil , greater Beirut, jisser el bacha, Bldg. facing arc en ciel	sales@altaka-albadila.com	www.altaka-albadila.com
4	AMACK SOLAR	Sleiman Khattar	03 325263 05 450278	Baabda, Fayadieh, Ste therese st(15) sector 8, Bldg. La Lainiere Nationale	info@amacksolar.com	www.amacksolar.com
5	ASACO	Ramzi AbuSaid	01 310649 01 700548	Beirut, Almazraa, Almmama St, Hassania bldg, 4th flr	asaco@cyberia.net.lb	www.asacogtc.com
6	AVS	Fahad Assafiri	03 975097 03 394324 06 600194	El mina, Tripoli, Saeid Farhat Street, Zailaa Bldg	fassafiri@gmail.com	
7	AWATEF FOR GENERAL TRADING	Ayman Ghotme	71 189630 08 661108	Lala, West Bekaa	Awatef13@hotmail.com	
8	BLACK BOX	Mark Acar	03 302708 01 443773	Beirut, Al arz street, Acar bldg	mark@blackboxcontrol.com	www.blackboxcontrol.com
9	CONTRA INTERNATIONAL	Bassel Baaklini	03 949462 01 381381	Caza Beirut, City Badaro, Street Sami Solh Avenue, Bldg Cemat	basselb@constraintl.com	www.constraintl.com
10	DAWTEC	Wissam Daou	03 951 460 01 288 688	Lebanon, Beirut, Furn El-Chebback Sagesse university street, Bldg. LEMEC	dawtec@dawtec.com	www.dawtec.com
11	DERVICHE HADDAD	Victoria El Khoury	01 447956 01 563663	Beirut, Street Medawar, Pasteur street, Bldg	vickyk11@hotmail.com	derhad@cyberia.net.lb

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
				S.Dagher, 6th Floor		
12	DK ENERGY SYSTEMS	Elie Dany	03 698880 04 916232	Mtayleb,main road,bldg Noufaily	info@dkenergysystems.com	www.dkenergysystems.com
13	ECOFRIENDLY SARL	Patrick Ardahalian	70 570284 01 292787	Ain el Remmeneh,Arid Street.Centre Etoile.7th Floor		www.ecofriendly.com.lb
14	ECOSYS	Elie Maalouf George Maalouf	01 682000 03 399074	460 Corniche Al Nahr	g.geha@itg.com.lb e.maalouf@ecosys.com.lb	www.ecosys.com.lb
15	FALCON WIN TRADING	Asaad Slaiby	03 566748 03 694005 08 910521	Zahle, Main Street	info@ecosys.com.lb t@hotmail.com	f-w- www.falconenergy-lb.com
16	FUTURE POWER	Toni Tannouri	03 872646 07 359030	Tyre, Bldg. Centre Ivoir, 1st floor Bekaa	info@fp-lebanon.net	www.fp-lebanon.net
17	GREEN ALTERNATIVE POWER SOURCES	Merwan Kiwan	03 334555 05 507088	Bakaata Alshouf,Jamil Saad Deen Bldg	kmerwan@yahoo.com	
18	GREEN ARMS LEBANON SAL	Toni Traboulsi	03 861051 01 696711	Metn, Mkalles, Mansourieh highway, bldg. Factory Mall	info@greenarms.co.uk	www.greenarms.co.uk
19	GREEN ENERGY NTC EST	Mahmoud Naouchi	70 421640	Tripolis,Malouhi highway,Al cheikh bldg	qtourch2@hotmail.com	
20	GREEN ENERGY PROJECT SARL	Wail El Dikah	01 551940 70 105100	Baabda,Chiah,Ariss Street,Awada Center Bldg,7th Floor	manager@greenprojectlb.com	www.greenprojectlb.com
21	JF GROUP	Joseph Faddoul	03 177348 04 916533	Ashrafyeh,Trabolsy bldg,	jfgrp@hotmail.com	
22	KATRANJI	Amir Katranji	01 820020 03 217318	Beirut, Adel Hakim Str, Grand Hill Bldg	sales@ekt2.com	www.ekt2.com
23	LIBANCIEL	Zahi Khawand	70 322633 05 922987	Jezzine,Roum Street,AbouZeid Bldg	info@libanciel.co	www.libanciel.co
24	MAWARED CONSTRUCTION CO &	Hanna Akar	01 255755	Dora, Cebaco Building, Block A	info@kyrossolar.com	www.kyrossolar.com
25	MEFALCO	Abdul Karim Hajar	71 825101 06 205571	El mina,Tripoli,Al Azmi Street,Ghalayini Bldg		www.mefalco.com

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
26	METACS	Emile Azar	01 335929 01 200159	Beirut, Ashrafieh, Tabaris, 227 SELIM BUSTROS, AZAR bldg	metacs@metacs.com	www.metacs.com
27	MIDDLE EAST GREEN ENERGY	Philippe El Houry	03 444961 01 491446	Mount Lebanon, Sin El Fil, Beirut Hall, Hibri bldg	philippe.elkhoury@me- greenenergy.com	www.me-greenenergy.com
28	MIRNA TECHNOLOGY	Mirna Lahout	71 932688 06 542545	North, Chekka al Sahel Street, Bldg Asaad Lahout	mirnatechnology@gmail.com	
29	NATIONAL ENERGY CONSULTANTS (NEC)	Ronald Diab	03 328010 01 219284/5	Beirut, Monot Str, Ashrafieh, Bldg Rebeiz	Ronald@nec-group.com	www.nec-group.com
30	NEO CONSULT SAL	Sima Hafez	03 399 988 04 410590	Metn, Antelias, Road 61 Bldg. Doumit	sima.hafez@neo-consultlb.com	www.neo-consultlb.com
31	PANORAMIC SOLAR	Sami Madi	04 520050 03 147219 05 951710	Baabda, City Hazmieh, Street Mar Takla square, Bldg. Madi	info@panoramic.ws	www.panoramic.ws
32	RENEWABLE MED ENERGY	Ziad Doumit	05 952338 03 302203 04 542230	Dbayeh, Main street opposite, hotel le royal Dbayeh.	ziad.doumit@rmenergies.com	www.renewablemed.com
33	SERVICOM ECOSOL	Assad Toubia	03 669369 03 502 111	Beirut, Street D-54, Bldg. Moretti building	assad.toubia@ecosol-lb.com	www.ecosol-lb.com
34	SIOLAR SOLUTIONS	Jihad Ghorra	03 961516 09 802778	Zahle, Ksara, Al Daman bldg	jihadghorra@hotmail.com	
35	SKY ENERGIES	Gilbert Zabbal	05 457968	Babbda, Rihanieh, St Charles Hospital Str, Jawad Bldg	gilbert@skyenergies.com	www.skyenergies.com
36	SOLAIR WATT S.A.R.L	Magid Mahfoud	03 369207 09 910307	Keserwan, Jounieh, Haret Sakher High way, Bldg Abdul Sater	info@solairwatt.com	www.solairwatt.com
37	SOLAR LIGHT TECHNOLOGY	Elias Abou jaoude	70 414191 70 414191	Bekennaya - jal el dib; Mar takla, Bldg. Rachid Abou jaoude	solarlighttechnology@hotmail.com	
38	SOIARLEB	Leon kradjian	03 473320 01 565449	Geitawi, Achrafieh, Rmeil, Beirut, Saint Louis	info@solarleb-lb.com	www.solarleb-lb.com

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
39	SOLARNET	Jean Paul Sfeir	03 309 885 04 532927	Street, Kechichian Bldg Metn, Mansourieh, Mansourieh old road, Yazbeck Bldg	info@solarnet-online.com	www.solarnet-online.com
40	SOLARTECH	Joe Issa	04 532937 09 236851 03 800057	Keserwen Zouk Mosbeh, Adonis, Green zone ST. Antonios street, Bldg.Number 13	joeissa@solartecb.com	www.solartecb.com
41	SOLARWINDME SARL	Hyam Samia	03 306633 04 871975	North, Metn, Ain Saade City, Green Vallery Street, Himo Bldg	solarwindme@solarwindme.com	www.solarwindme.com
42	SOLEC ENERGY	Alain Azar	70 516251 01 482263	Freeway Center, 1st Floor, POBox: 90-1634, Beirut, Lebanon.	alain.azar@solec-energy.com	www.solec-energy.com
43	WEBCO	Walid El Baba	03 667492 01 850068	Beirut, Street, Zahia Salman Bldg. El Baba/ 2nd floor	webco@cyberia.net.lb	

N.B.: 1) The list includes contact details of the Lebanese companies working in the import, supply, installation, and maintenance of solar PV in Lebanon. 2) The list includes all companies that have completed the LCEC questionnaire. 3) The companies shown in the above list are listed by alphabetical order. 4) All the data shown in the list is presented as given by the companies in the completed questionnaires. 5) Companies wishing to become listed can contact [energy@lcecp.org.lb](mailto:energy@lcecp.org.lb). 6) The list will be updated periodically (the current version is dated June 2012).

### Annex 7.10. List of Wind Energy Companies in Lebanon Compiled by the Lebanese Center for Energy Conservation (LCEC)

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
1	ALTERNATIVE ENERGY DPC/LEBANON sarl	Chamel Macaron	03 602936 01 481336	Metn,Sin el fil ,greater Beirut,jisser el bacha,Bldg. facing arc en ciel	sales@altaka-albadila.com	www.altaka-albadila.com
2	AMACK SOLAR	Sleiman Khattar	03 325263 05 450278	Baabda, Fayadieh, Ste therese st(15) sector 8, Bldg. La Lainiere Nationale	info@amacksolar.com	www.amacksolar.com
3	ASACO GENERAL TRADE AND CONTRACTING	Ramzi AbuSaid	01 310649 01 700548	Beirut, Almazraa, Almmama St, Hassania bldg, 4th flr	asaco@cyberia.net.lb	www.asacogtc.com
4	DAWTEC	Wissam Daou	03 975097 03 951 460 01 288 688	Lebanon,Beirut, Furn El-Chebbak Sagesse university street, Bldg.LEMEC	dawtec@dawtec.com	www.dawtec.com
5	DK ENERGY SYSTEMS	Elie Dany	03 698880 04 916232	Mtayleb,main road,bldg Noufaily	info@dkenergysystems.com	www.dkenergysystems.com
6	ECOFRIENDLY SARL	Patrick Ardahalian	70 570284 01 292787	Ein El Remmenneh,Arid Street,Centre Etoile,7th Floor		www.ecofriendlyme.com.lb
7	FALCON WIN TRADING	Asaad Slaiby	03 694005 08 910521	Zahle, Main Street	f-w-t@hotmail.com	www.falconenergy-lb.com
8	FUTURE POWER	Toni Tannouri	07 359030	1st floor Tyre Bldg. Centre Ivoir	info@fp-lebanon.net	www.fp-lebanon.net
9	GREEN ENERGY NTC EST	Mahmoud Naouchi	70 421640	Tripolis,Malouhi high way,Al cheikh bldg	qtouch2@hotmail.com	
10	GREEN ENERGY PROJECT SARL	Walid El Dikah	01 551940 70 105100	Baabda,Chiah City,Ariss Street,Awada Center Bldg,7th Floor	manager@greenprojectlb.com	www.greenprojectlb.com
11	JF GROUP	Joseph Faddoul	03 177348 04 916533	Ashrafyeh,Trabolsy bldg,	jfgrp@hotmail.com	
12	KATRANJI	Amir Katranji	01 820020 03 217318	Beirut, Adel Hakim Str, Grand Hill Bldg	sales@ekt2.com	www.ekt2.com
13	MEFALCO	Abdul Karim Hajar	06 205571 71 825101	Tripoli,Mina,Azmi Street,Ghalayini Bldg		www.mefalco.com
14	METACS	Emile Azar	01 335929	Beirut, Ashrafieh, Tabaris, 227	metacs@metacs.com	www.metacs.com

Ref.	Company name	Contact Person	Phone/ Fax	Full Address	Email	Website
			01 200159	SELIM BUSTROS, AZAR bldg		
15	MIDDLE EAST GREEN ENERGY	Lara El Khoury	03 170788 01 491446	Mount Lebanon, Sin el fil, Beirut hall, Hibri bldg	lara.elkhoury@me-greenenergy.com	www.me-greenenergy.com
16	MIDWARE DATA SYSTEMS	Elie Maalouf Fady Tabet	01 582000 01 562430	460 Corniche Al Nahr	e.maalouf@middleware.com.lb info@middleware.com.lb	www.middleware.com.lb
17	NATIONAL ENERGY CONSULTANTS (NEC)	Ronald Diab	03 566748 03 328010 01 219284/5	Beirut , Monot Str, Ashrafieh , Bldg Rebeiz	Ronald@nec-group.com	www.nec-group.com
18	RENEWABLE MED ENERGY	Ziad Doumit	03 302203 04 542230	Dbayeh, Main street opposite, hotel le royal Dbayeh.	ziad.doumit@rmenergies.com	www.renewablemed.com
19	SERVICOMM-ECOSOL	Assad Toubia	03 669369 01 502 111	Beirut, Street D-54, Bldg. Moretti Building	info@ecosol-lb.com	www.ecosol-lb.com
20	SOLAIR WATT S.A.R.L	Magid Mahdoud	03 369207 09 910307	Keserwan, Jounieh, Haret Sakher High way, Bldg Abdul Sater	info@solariwatt.com	www.solairwatt.com
21	SOLAR LIGHT TECHNOLOGY	Elias Abou jaoude	70 414191	Bekennaya - jal el dib Street Mar takla, Bldg. Rachid Abou jaoude	solarlighttechnology@hotmail.com	
22	SOLARNET	Jean Paul Sfeir	03 309 885 04 532927	Metn, Mansourieh, Mansourieh old road, Yazbeck Bldg	info@solarnet-online.com	www.solarnet-online.com
23	SOLARWINDME Sarl	Hyam Samia	04 532937 03 306633 04 871975	North, Metn, Ain Saade City, Green Valey Street, Himon Bldg	solarwindme@solarwindme.com	www.solarwindme.com
24	TECHNOWIND	Rabih Assaker	06 237224	3400 Ave D'orleans # 12, Montreal, QC, Canada	info@upaps.com	www.upaps.com

N.B.: 1) The list includes contact details of the Lebanese companies working in the import, supply, installation, and maintenance of wind energy in Lebanon. 2) The list includes all companies that have completed the LCEC questionnaire. 3) The companies shown in the above list are listed by alphabetical order. 4) All the data shown in the list is presented as given by the companies in the completed questionnaires. 5) Companies wishing to become listed can contact [energy@lcecp.org.lb](mailto:energy@lcecp.org.lb). 6) The list will be updated periodically (the current version is dated June 2012).



## Annex 8. Environment & Social Safeguards

### 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 FAC, 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?	

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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 FAC.

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 <b>global-level</b> strategies, policies, plans, and programmes. <i>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.</i>	No
2. Support for the elaboration or revision of <b>regional-level</b> strategies, policies and plans, and programmes. <i>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.).</i>	No
3. Support for the elaboration or revision of <b>national-level</b> strategies, policies, plans and programmes. <i>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.</i>	Yes
4. Support for the elaboration or revision of <b>sub-national/local-level</b> strategies, policies, plans and programmes. <i>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.</i>	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 indicate 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.

1. Biodiversity and Natural Resources	Answer (Yes/No/ Not Applicable)
<b>1.1</b> Would the proposed project result in the conversion or degradation of modified habitat, natural habitat or critical habitat?	No
<b>1.2</b> Are any development activities proposed within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity?	No
<b>1.3</b> Would the proposed project pose a risk of introducing invasive alien species?	No
<b>1.4</b> 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
<b>1.5</b> 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
<b>1.6</b> Does the project involve significant extraction, diversion or containment of surface or ground water?	No

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TABLE 4.3: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT		
<i>For example, construction of dams, reservoirs, river basin developments, groundwater extraction.</i>		
1.7	Does the project pose a risk of degrading soils?	No
2.	<b>Pollution</b>	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 proposed project involve the manufacture, trade, release, and/or use of chemicals and hazardous materials subject to international action bans or phase-outs? <i>For example, DDT, PCBs and other chemicals listed in international conventions such as the Stockholm Convention on Persistent Organic Pollutants, or the Montreal Protocol.</i>	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.	<b>Climate Change</b>	
3.1	Will the proposed project result in significant <sup>1</sup> greenhouse gas emissions? <i>Annex E provides additional guidance for answering this question.</i>	No
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. <i>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.</i>	No
4.	<b>Social Equity and Equality</b>	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
4.2	Is the project likely to significantly impact gender equality and women's empowerment <sup>2</sup> ?	No

<sup>1</sup> Significant corresponds to CO<sub>2</sub> 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<sub>2</sub> emissions.

<sup>2</sup> 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.

<b>TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT</b>		
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?	No
4.6	Will the project have specific human rights implications for vulnerable groups?	No
<b>5. Demographics</b>		
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? <i>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.</i>	No
5.3	Would the proposed project lead to significant population density increase which could affect the environmental and social sustainability of the project? <i>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).</i>	No
<b>1. Culture</b>		
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? <i>For example, through the construction of a road, powerline, or dam that divides a community.</i>	No
<b>2. Health and Safety</b>		
7.1	Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence, landslides, erosion, flooding or extreme climatic conditions? <i>For example, development projects located within a floodplain or landslide prone area.</i>	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
<b>3. Socio-Economics</b>		
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? <i>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-</i>	No

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TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT	
	<i>being?</i>
<b>8.2</b>	Is the proposed project likely to significantly affect land tenure arrangements and/or traditional cultural ownership patterns? <b>No</b>
<b>8.3</b>	Is the proposed project likely to negatively affect the income levels or employment opportunities of vulnerable groups? <b>No</b>
<b>9.</b>	<b>Cumulative and/or Secondary impacts</b> <b>Answer (Yes/No/Not Applicable)</b>
<b>9.1</b>	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? <i>For example, future plans for urban growth, industrial development, transportation infrastructure, etc.</i> <b>No</b>
<b>9.2</b>	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? <i>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.</i> <b>No</b>



ANNEX A.2: ENVIRONMENTAL AND SOCIAL SCREENING SUMMARY

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

**Name of Proposed Project:** Decentralised renewable energy applications

**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 consists of the installation of renewable energy technologies in pilot project sites, mostly on the rooftops of companies, hotels, households and similar facilities. These installations are not expected to impact biodiversity or areas of natural resources such as protected areas, natural forests or involve significant impacts on surface of groundwater. Most of the pilot sites will be located in urban areas or in remote rural areas. The technology that will be used will not result in the release of pollutants to the environment in the form of air pollution or greenhouse gas emissions. Actually, the project is expected to reduce carbon emissions and air pollution due to the expected decrease in the use of electricity that is produced by fossil fuels and the reduction in the use of diesel power generators.

The systems will, however, include large battery systems that would need to be recycled after they expire. Their lifetime is up to 5 years and the recycling of these lead batteries is feasible in Lebanon.

Social impacts are expected to be minimal given that the project will not significantly impact communities at large.



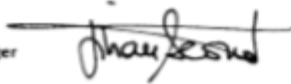
**C. Next Steps** (for projects requiring further environmental and social review and management):

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.

The project does not have significant environment and social risks. The environmental opportunities are considerable given that there will be a decrease in the use of electricity and diesel generators which cause air pollution and contribute to the increase in greenhouse gas emissions. Recycling options for lead batteries will be explored in detail during project implementation.

**D. Sign Off**

Project Manager



Date 27 Feb 2013

PAC

Date

Programme Manager

Date

## SIGNATURE PAGE

**UNDAF Outcome(s)/Indicator(s):** By 2014, improved accessibility and management of natural resources and enhanced response to national and global environmental challenges

**CP Outcome(s):** Climate change considerations mainstreamed in national priorities

**CPAP Outcome(s)/Indicator(s):** National sustainable energy strategy developed and its implementation promoted

**Executing Entity/Implementing Partner:** Ministry of Energy and Water

**Implementing entity/Responsible Partner:** United Nations Development Programme

**Country:** Lebanon

Programme Period:	<u>2013-2016</u>
Atlas Award ID:	<u>00073116</u>
Project ID:	<u>00086064</u>
PIMS #	<u>4695</u>
Start date:	<u>Jan. 01, 2013</u>
End Date	<u>Dec. 31, 2016</u>
Management Arrangements	NEX
PAC Meeting Date	_____

Total resources required	<u>US\$ 13,066,000</u>
Total allocated resources:	<u>US\$ 13,066,000</u>
• Regular UNDP (TRAC)	<u>US\$ 125,000</u>
• Other UNDP	<u>US\$ 6,257,000</u>
• Other:	
o GEF	<u>US\$ 1,450,000</u>
o Other Cash	<u>US\$ 4,734,000</u>
o Gov't in-kind	<u>US\$ 500,000</u>

Agreed by (Government): \_\_\_\_\_

Date/Month/Year

Agreed by (Executing Entity/Implementing Partner): \_\_\_\_\_

Date/Month/Year

Agreed by (UNDP): \_\_\_\_\_

Date/Month/Year