Solar PV Solutions

Business Case Template

UNCT in [INSERT NAME OF DUTY STATION]

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This document was developed in close collaboration with UNDP, Office of Information Systems & Technology, Global ICT Advisory Unit.

1. Executive Summary

The UNCT in **[INSERT DUTY STATION]** has decided to work closely with UNDP OIST GIA in taking steps towards an energy solution which will effectively:

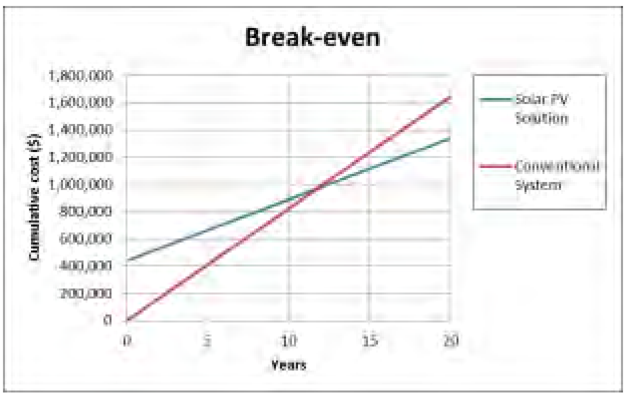
- **Reduce** costs of energy consumption
- **Gain** energy security
- **Comply** with the *UN Sustainable Development Goal #7*
- **Protect** the environment by reducing the carbon footprint and the demand for polluting fossil fuels.

The above mentioned perspectives are just a start; this business case serves to demonstrate the advantages of switching to solar PV solution, as well as its great potential for the well-being of the Agencies in **[INSERT DUTY STATION]**.

1.1 Current Situation

- The consolidated monthly electricity bill for the Agencies: US$**[INSERT AMOUNT]**/month
- Average of hours of power outage per month: **[INSERT AMOUNT]**hrs/month
- Percentage of working hours lost per month due to power outage: **[INSERT AMOUNT]**%
- Total amount of diesel generators: **[INSERT AMOUNT]**
- Average cost of 1 diesel generator per hour (fuel, average maintenance): US$**[INSERT DOLLAR AMOUNT]**/hour

1.2 Suggested Solution



- Initial investment: US$**[INSERT DOLLAR AMOUNT]**
- Expected lifespan: Approximately 21 years
- Yield: **[INSERT PERCENTAGE]** % of the total energy demand
- Anticipated Annual Savings: US$**[INSERT DOLLAR AMOUNT]**/Year
- Total Expected Savings: US$**[INSERT DOLLAR AMOUNT]**
- Return on Investment: After **[INSERT AMOUNT]** Years

1.3 Benefits

- Less expensive electricity; the office gets electricity at no cost – i.e. cost avoidance pays for the initial capital investment
- Low maintenance; unlike generators, the solar PV solution needs practically no maintenance
- Business Continuity; the office can run independently from the local power grid, and will not be impacted by fuel shortages and fluctuations in fuel prices (even higher business continuity is assured, if the solar PV solution includes batteries)
- Clean energy; the solar panels provide noiseless electricity and do not pollute the air

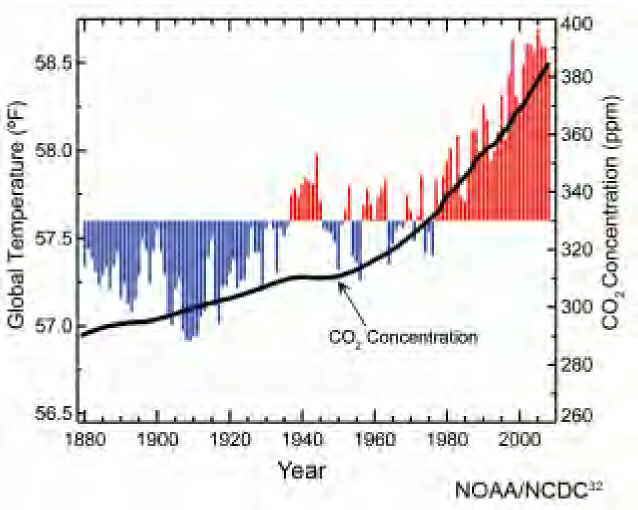
2. Introduction

While continuing efforts are being made to reduce the overall energy demand, the basic drivers for renewable energy solutions are quite clear today: the ways in which the world produces and consumes energy today is not sustainable and will have – if not changed rapidly – devastating consequences that will be felt all over the world. It is in this context that the United Nations have incorporated Environmental Sustainability as Millennium Development Goal #7 and will soon incorporate it into the Sustainable Development Goals.

With this business case for **[INSERT DUTY STATION]**, UNDP OIST GIA can make an initial assessment of the UNCT's potential to comply with the UN goal through an installation of solar panels.

This part serves as a basic introduction to the benefits of a solar photo voltaic (PV) installation and orients the reader to better understand the reason why the UNCT in **[INSERT DUTY STATION]** is choosing to implement a solar power solution.

2.1 Climate Change



A consensus has been reached that CO_2 emissions are a major contributor to global warming or climate change. Even a small rise of 2 degrees Centigrade in the average global temperature can have catastrophic consequences – the polar caps melt more and faster, causing higher water levels of our oceans and flooding islands. This trend is already evident in the Pacific Ocean.

Obtaining energy through the burning of fossil fuels like coal and oil is a major cause of CO_2 in our atmosphere. Implementing solar power solutions contribute to a seemingly small but important step towards reducing climate change – imagine if everyone did it!

2.2 Energy Security

The fossil fuels we are burning today are finite and subject to price fluctuations. Depending on these polluting energy sources adds insecurity to a UNCT's budget and business continuity.

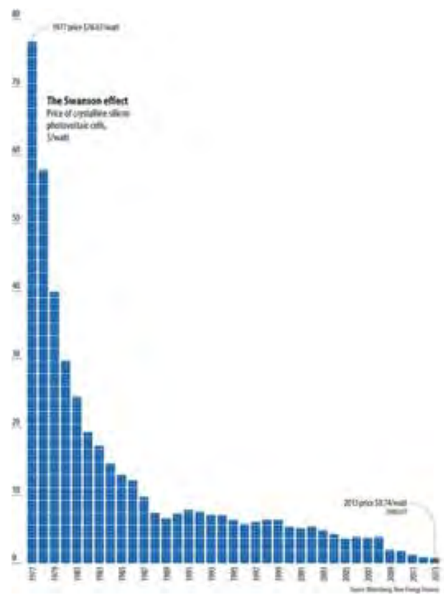
Solar panels, on the other hand, provide UNCTs with an energy source that is not affected by these price changes, and does not rely on the local energy infrastructure – which is a major benefit as UNCTs often need to operate in areas with an unstable power grid. Frequent outages disrupt the programme work of the agencies and frustrate staff, while crisis situations often cut off the UNCT from energy supply all together. Having a solar installation ensures the office to function continuously and especially when it is most needed and necessary.

2.3 Development

1.3 billion People live without electricity in our world today[1]. That is 18% of the world's population and a major obstacle in global development. Since fossil fuel resources are stretched already and cause significant changes in our climate, one crucial task is to expand electrification among the global population while achieving cost savings. One answer to this problem is the implementation of solar power. Every kilowatt-hour (kWh) generated through a solar PV installation relieves the power grids in developing countries and frees up power for other households. Taking this a step further, renewable energy generation dis-incentivizes the construction of the next fossil fuel power plant.

2.4 Dropping Prices

The overall cost of solar power systems has dropped by 75% since 2000[2] while the cost of battery storage has dropped by 60% since 2005; its consequences can be felt all over the world. The number of small-scale and off-grid solutions have significantly increased and are actually outcompeting their fossil fuel competitors which leads to further cost reductions. Today solar energy not only makes sense from an ecological standpoint but also economically.



[1] http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/#d.en.8609

[2] http://www.economist.com/news/international/21647975-plummeting-prices-are-boosting-renewables-even-subsidies-fall-not-toy

2.5 GIA's role

The UNDP Global ICT Advisory unit (GIA) first implemented solar solutions in the wake of the Ebola crisis. Country offices in Guinea, Sierra Leone and Liberia could not rely on local power grids for electricity and the fuel situation was critical. At the same time more and more energy was needed to support the crisis response and the additional staff which was why GIA partnered with a Danish vendor to install solar panels. While these projects were limited by the crisis situation, GIA found these solar power solutions proved to be valuable experiences.

3. [INSERT DUTY STATION NAME]`s Energy Situation

Based on information provided by the UNCT in **[INSERT DUTY STATION NAME]** through the ICT Registry Index, the following assessment of the current energy situations has been made:

Current Energy situation

- Expensive national grid
- Number of power shortages per month
- Fuel generator used as backup: polluting, expensive
- Impedes Business Continuity (% working hours loss/month)

Based on estimates provided by the GIA unit, the major benefits of implementing the solar power system are as follows;

The Solar solution

- ___$ saved per year
- ___Tonnes of CO_2 saved per year
- Improves stability and reliability
- Increases staff wellbeing
- Enhances Business Continuity

3.1 Cost and Access to National Electricity

Out of ^__^ countries, ^__^ **is ranked** ^_^th **for getting electricity**, according to the World Bank's Doing Business 2015 report

[INSERT DATA RELATED TO ACCESS TO AND AVAILABILITY OF ELECTRICITY, POWER OUTAGES, SUCH AS[3]:]

- World Bank's Doing Business - Getting Electricity
- data from World Bank>>
- from World Economic Forum>
- Any other relevant data from aid/development/governmental organizations

[3] www.doingbusiness.org is a good starting point

Figure 1: Average number of power outages per month, World Bank data

Figure 2: Access to Electricity, World Bank data 2015

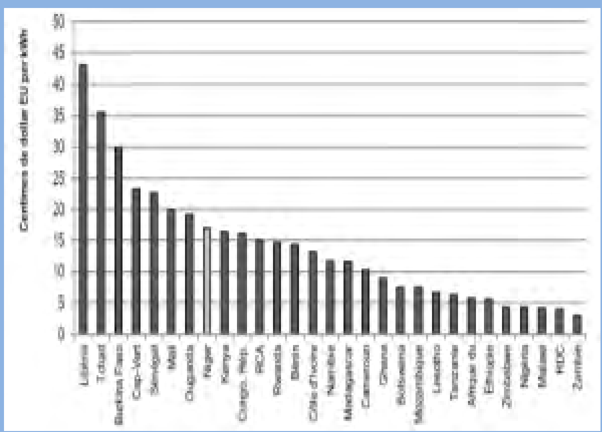


Table 2: Electricity prices in US Dollar per kWh, Africa infrastructure country diagnostic, World Bank data 2011

Pays	Coûts de la production d'électricité (dollars EU/kWh)	Prix du carburant (cents de dollar EU/litre)		
		2004	2006	2008
Burkina Faso	0,39	94	112	133
Mali	0,39	90	104	110
Niger	0,16	94	111	97
Nigeria	0,15	45	66	113
Ghana	0,12	43	84	90
Côte d'Ivoire	0,11	95	106	120

Figure 4: Production cost of electricity USD & fuel price, Africa infrastructure country diagnostic, World Bank data 2011

3.2 Current Situation

Local Grid Cost and Considerations

Prices for electricity supplied from local grids vary, and the sources of local electricity are many. Canada supplies grid-users with inexpensive and clean hydropower, whereas in Jamaica electricity is created by burning imported fuel, resulting in a rather unsustainable use of resources with heaps of incentives for the end-user to "go green". The feasibility of the solar energy investment depends on these individual variables.

In **[INSERT DUTY STATION NAME]** grid electricity is supplied by **[INSERT NAME OF POWER SUPPLIER]** and costs **[INSERT US$ COST/kWh]**, and a total of grid usage amounts to **[INSERT MONTHLY US$ COST FOR THE AGENCIES COMBINED]**. **[DESCRIBE THE ENERGY MIX AND RELIABILITY OF THE NATIONAL POWER GRID]**.

Local Grid Reliability

Office hours last from **[INSERT START TIME]** to **[INSERT END TIME]**, Monday to Friday. The total hours of a given working week is therefore **[INSERT AMOUNT]** hours. Additionally, electricity needs to be available outside office hours to facilitate overtime.

On average the agencies suffer from **[INSERT AMOUNT]** hours of power outage per month, which accounts for **[INSERT AMOUNT]**% of the total working weeks in a month.

Generator Cost

Even though generators are relatively inexpensive in terms of procurement and are convenient in case of power outages, they are also quite expensive to operate as they run on expensive fuel. Other than the high price for the fuel itself, additional costs need to be taken into consideration for transporting and storing it. In terms of fuel, the average diesel generator will cost about $150 per 8-hour working day.

The agencies combined in **[INSERT DUTY STATION NAME]** run a total amount of **[INSERT AMOUNT]** generators, which consume a combined total of **[INSERT AMOUNT]** litres per working day, or a daily operating expense of US$**[INSERT DOLLAR AMOUNT]**.

In addition to the high operating cost, generators are often a nuisance to their surroundings as they produce noise and air pollution.

Put in a graphic figure or tables that shows how the variation is spread out.

Try to provide similar figures and graphs.

	1	2	3		4	5	7	6
	Country Office	**Annual Usage of Diesel (litre)**	**Annual Cost of Diesel (USD)**	**Annual Generator Output(kWh)**	**Annual Usage of Grid (kWh)**	**Annual Cost of Grid (USD)**	**Total electricity consumed (kWh)**	**Total Cost (USD)**
A								

Table 1: Energy consumption and costs 2014[4]

[4] *Grid documentation from 2014; 216 liters of diesel are consumed every day; Niger unit cost of Grid = 0.14 USD*

"There are long periods of shortages during the hot season (April to July), which can last from a week up to a month. Meanwhile, the generator cannot support continuously these electric loads, and needs to coll down for 1 to 2 hours every 5 working hours. During these down times, UNDP Niger operations are dramatically slowed down. Additionally, the energy budget is seriously affected as fuel prices remain very high".

Niandou Habibou, ICT Analyst, UNDP Niger

4. Technical solution

4.1 Proposed Configuration

- **[Insert a brief description of the types of Solar Power Configuration (scheme?)]**
- **[Highlight which configuration would apply for your duty station]**
  - **Amount of solar panels and size of each in square meters**
  - **Total capacity expressed in kilowatts peak (kWp)**
  - **Type of mounting (roof/ground/parking) and total amount of square meters the installation occupies**
  - **What kind of backup do you plan for the solar PV system? Batteries or generators or both?**
  - **Indicate battery/generator capacity in kilowatt hour (kWh)**
  - **Indicate the size of the battery storage/generator room in square meters**

Solar Panels

- ___panels each ___ sqm, peak power output ___Wp
- Total capacity is up to __kWp
- Total area ___m2 on <<type of mounting/surfaces>>

Batteries

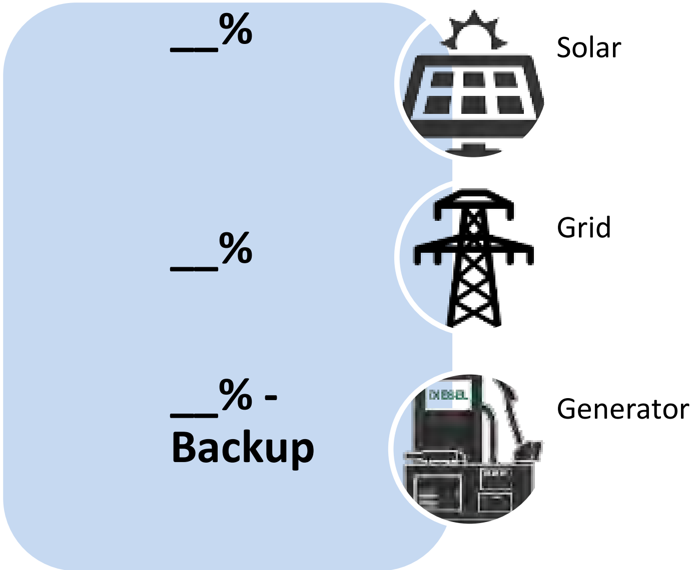
- ___ batteries, each __v/___Ah
- Total capacity of ___ kWh
- << Room size>>

Smart Power Management

- Reduce generator utilization to minimum, or
- Increase resiliency to maximum
- Adaptive charging cycle to prolonge baterie life (4 step)

4.2 Utilization Estimates

- **[Express solar coverage in both percentage (%) and kilowatt peak or kilowatt hour (kWp/kWh) of total energy needs]**
- **[Outline the benefits and backups of this system in case of outages]**



- **Capacity of Solar Panel: __Wp**
- **Total Capacity: __ kWp**
- **Batteries: ___kWh**
- **Total Daily Consumption: __kWh**

- **[Outline the expected energy consumption using the solar PV system in combination with the national grid, batteries and/or generators]**

	1	2	3	4	5
	Max solar output	**Generator production**	**Solar surplus**	**Uncovered grid kWh**	**% covered of grid**
A					

Table 2: Estimates of solar power output and percentage of solar reliance[5]

[5] Estimates are based on Photovoltaic Geographical Information System; http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?map=africa

5. Financial Aspects

- **[Include ONE table that compiles most important data + 2 graphs (payback/savings)]**

5.1 Return on Investment

	1	2	3	4
	Country Office	**Total cost of PV installation (USD)**	**Energy cost saved per year (USD)**	**RoI**
A				

Table 3: Return on Investment[6]

➔ During the investment period, there is a __**% return on the PV system.**

5.2 Break-Even Point

- **[Insert a Cost Analysis graph]**

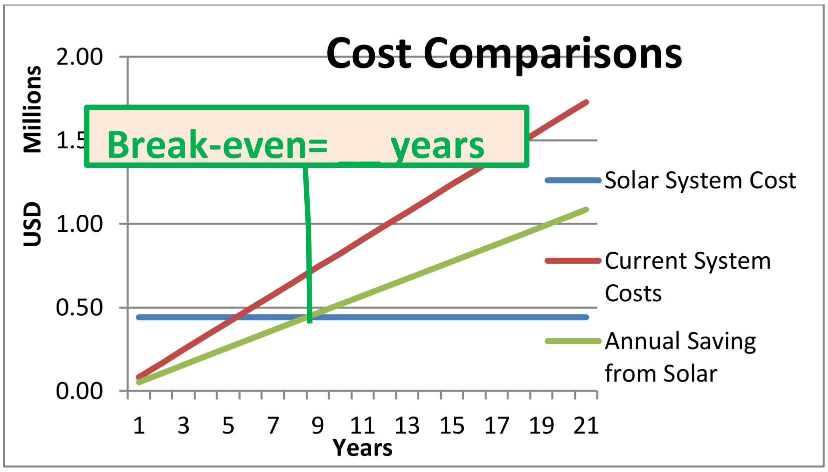


Figure 1: Total cost of ownership for DLO (fix and operating cost for the solar panel and grid/generator)

[6] Energy cost saved per year is based on the percentage of estimated PV electricity production; Calculated over a period of 20 year; Depreciation of the solar equipment is not comprised

6. Risks

- **[Include risks as well and hypothesis behind estimate (with worst case situation)]**

	A	B	C	D	F
	Risks	**Like-lihood**	**Impact**		**Mitigation**
1	**Improper Technical Installation** Wrong assembly and wiring at the site could fry the inverters and batteries making the system unusable	Low	High		1. Delivered as plug and play solution (power management part assembled and configured at vendor facilities) with few cables to be connected between the units; 2. Vendor engineer travel to the site for QA, installation oversight and commissioning;
2	**Unstable Grid** Unstable grid may cause an on-grid solar system to shut off and should do so on in some cases. However some inverters may not be able to handle grid conditions in developing countries	Low	High		3. Request capacity of inverters from contractor and get guarantees
3	**Damage from Natural Disasters** West Africa is prone to lightening. Seasonal storms may damage panels or reduce their efficiency from flying debris, requiring replacement.	Medium	High		4. Ensure redundant and best of breed **lightening protection**; 5. Implement a preventative maintenance plan; 6. Plan for 5% panel replacement per year;
4	**Weather Conditions** Weather conditions may change from day to day and year reducing the output.	Medium	Medium		7. Maintain a generator backup with sufficient fuel storage;
5	**Compromising Building Integrity** Roof needs to be able to hold the panels including the wind load.	Medium	High		8. **Site survey** and the building engineer must review site preparation and civil work plan; 9. Bracket of the panels must be solidly anchored to the roof while not compromising its integrity and causing water leaks;
6	**Faulty Utilization of System** The CO is forced by faulty utilization of the Solar system to discharge the battery below 50% of capacity, reducing the	Medium	Low		10. Add batteries to avoid discharging below 50%; 11. Replace batteries sooner than 10 years; 12. Implement proper monitoring and alarm systems;

	longevity of batteries which will increase the cost of the system.				
7	**Improper Space for Solar Panel** Lack of space with proper sun exposition.	Medium	High		13. Conduct a thorough **site survey**; 14. Accept lower performance;
8	**Improper Battery Room** Battery room too hot and subject to flooding and other environmental hazards.	Medium	High		15. Accept lower batteries performance; 16. Choose a dry and well ventilated room;
9	**Improper Power Load Assessment** Under estimate power load required for normal utilization and peaks.	Low	Medium		17. Conduct through **site survey** and evaluation of current electrical set-up and generator; 18. Use the grid or generator to fill the gap;
10	**Lack of Users Expertise** Regular maintenance not done properly and safety measures not implemented.	Medium	Medium		19. Training will be given to the CO staff; 20. **Local partner** will be on standby; 21. **Preventive plan and safety plan** will be maintained 22. Implement remote monitoring and alarm systems done by experts (vendors);

Table 4: Risk Assessment Matrix

Risk Reducing Strategies:

A. Completing the Preliminary Site Survey

B. Partnering with reliable local vendors

C. Set up sound preventive maintenance

D. Install lightening protection and safety measures

E. Implement a training plan and capacity building

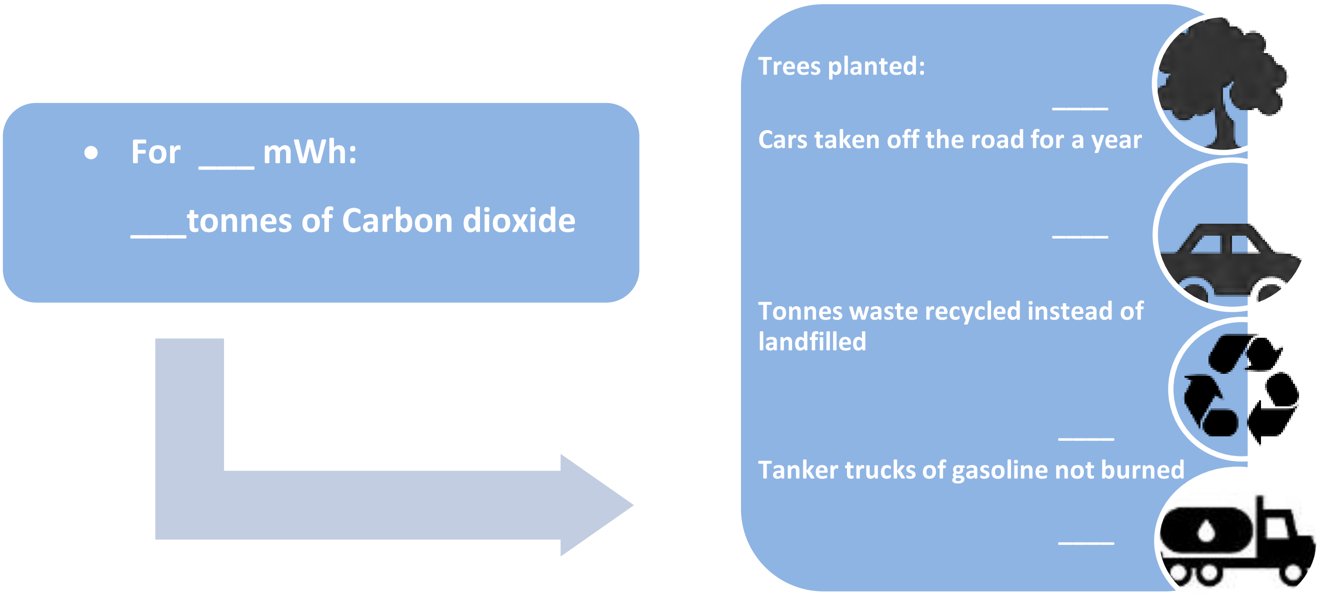
7. Additional Benefits

In addition to lower cost, there are the following benefits:

7.1 Sustainability

The proposed solar energy solution would cover **[INSERT AMOUNT]**% of **[INSERT DUTY STATION NAME]**'s offices, instead of using polluting sources such as generators or other fossil energy from the grid. Reflecting on the #7 MDG, below is a visual comparison of what this amount of saved energy;[7]

Equivalent annual reduction of emissions over 1 year



7.2 Business Continuity

Solar energy provides the UNCT with the security of an independent supply of electricity. In a crisis situation grid supply may be unsteady and fuel deliveries may be unreliable. Depending on external factors for energy security jeopardizes UNCT operations and puts staff at risk in case of a critical emergency.

7.3 Knowledge Sharing & Capacity Building

Solar PV systems are one of the most promising energy sources for the development of Africa, due to high sun exposure and an unstable conventional energy supply.[8] Kenya, for example, has been one of the pioneers of the solar power revolution; the initial projects generated great interest and ended up starting the development of a private solar market. The engineers

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[7] EPA CO_2 emission calculation tool (http://www2.epa.gov/sites/production/files/widgets/ghg_calc/calculator.html)

[8] http://www.economist.com/news/special-report/21639014-thanks-better-technology-and-improved-efficiency-energy-becoming-cleaner-and-more

of these large scale projects transferred knowledge to the locals they worked with, and now many of these locals have become solar system stakeholders in Kenya. The country is now projected to produce half of its energy through solar systems by 2016.[9] The case of Kenya serves as an example of how actual development happens as by result of implementation of solar energy systems. Other regions with high sun exposure can benefit from the same effects.

The Kenya example illustrates that investing in solar panels can be a solution to **[INSERT DUT STATION NAME]** 's numerous energy shortages for which the UNDP CO can become a leading example. In addition to sustainable green energy, the solar project can benefit the whole **[INSERT COUNTRY NAME]** economy if managed properly. UNDP can help raise awareness and co-create stakeholders, essential to diffuse knowledge and build capacity at local scale.

7.4 Other Benefits

[LIST ANY OTHER BENEFITS, IF ANY]

e.g. Reduction in costs to ICT equipment replacement.

8. Conclusion

The following logical steps have been taken to set up a solar PV system:

- First we defined the energy context and needs of the UNCT
- Secondly, we identified a suitable solution (i.e. solar PV configuration) in collaboration with UNDP GIA
- Lastly, we determined the one-time capital investment and put this into context of the expected benefits in terms of annual cost savings, return on investment, reduction of CO_2 emission

[9] http://www.theguardian.com/environment/2014/jan/17/kenya-solar-power-plants

Annex – Example Breakdown of One-time Capital Investment Costs

No	Item Description	Qty	Unit price	Total
1	Solar Panels for Niger (include controller)	650	$228.18	$148,317.00
2	Batteries 20 kW-hr	36	$432.08	$15,554.88
3	Inverters	13	$3,206.77	$41,688.01
4	Ancillaries, Cables, Monitoring Systems	1	$60,993.00	$60,993.00
5	Power Management Unit and Assembly	1	$2,847.00	$2,847.00
6	Site Survey and Design	1	$5,113.00	$5,113.00
7	Site Preparation, Civil Work and Installation	1	$139,048.00	$139,048.00
8	Internal Power Distribution Panel and internal building cabling	1	$3,910.00	$3,910.00
9	One year Monitoring, Maintenance and Support 1 year	1	$3,500.00	$3,500.00
10	Shipping and Insurance	1	$19,904.00	$19,904.00
	Total Cost, USD for Site XYZ			**$440,874.89**

Table 5: Cost Breakdown of One-time Capital Investment[10]

[10] Solar Panel Solution Scoping Costing and Bill of Material Tool

Annex – Example Monitoring Tool

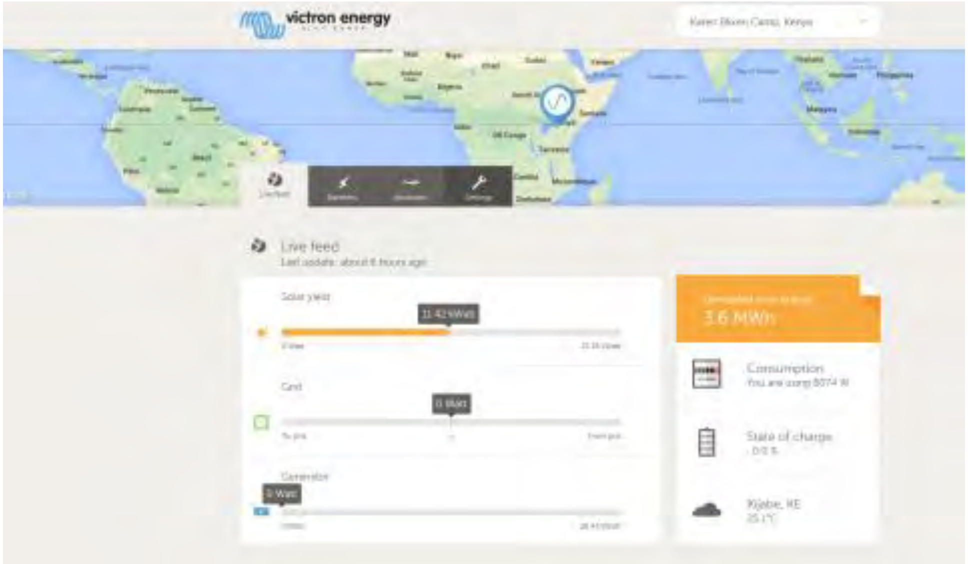


Figure 1: Victron **solar survey mobile application**.[11]

The Victron application for efficiency optimization and global remote monitoring. The app allows for remote monitoring so tech engineers can survey the solar system both on-site and on distance. It is a simple app that shows through live feeds the output of the solar system; solar yield, consumption, battery capacity and low battery loads. With knowledge of the solar system and local weather conditions it allows for simple assessment of the solar system and the need for a potential check-up.

- ***See a live system*** at https://vrm.victronenergy.com/user/login/invitekey/7dd9790bba0066342c08c2fce0a937e1
- Username:
- Password:

[11] https://vrm.victronenergy.com/user/login/invitekey/7dd9790bba0066342c08c2fce0a937e1

Annex – Example Bill of Material of a Potential Vendor

GSOL

UN reference number: UNDP/PSO GP600186
GSOL bid number: 3069

Niger location

Bill of Material as per section 1. Solar Panels in price schedule

Item		*Description*	*Qty.*	*Units*
1.1	Solar Panels	Victron BlueSolar MPPT 150/70 charge controller	19,00	pcs.
1.2	Solar Panels	Solar panels, 250W	300,00	pcs.
1.3	Solar Panels	Connector box, SOL	19,00	pcs.
1.4	Solar Panels	MC4 connectors	150,00	pcs.
1.5	Solar Panels	MC4 Y-connectors	38,00	pcs.
1.6	Solar Panels	Solar panels, 250W	350,00	pcs.

Bill of Material as per section 2. Batteries in price schedule

Item		*Description*	*Qty.*	*Units*
2.1	Batteries	Victron 12V/220Ah AGM Deep Cycle	36,00	pcs.
2.2	Batteries	Battery rack	2,00	pcs.

Bill of Material as per section 3. Inveters in price schedule

Item		*Description*	*Qty.*	*Units*
3.1	Inveters	Victron Quattro 10000 Quattro inverter / charger, 10 kVA	9,00	pcs.
3.2	Inveters	Fronius Symo 20 inverter	4,00	pcs.

Bill of Material as per section 4. Ancillaries, cables, monitoring systems in price schedule

Item		*Description*	*Qty.*	*Units*
4.1	Ancillaries, cables, monitoring systems	Combiner box for DC positive	1,00	pcs.
4.2	Ancillaries, cables, monitoring systems	Combiner box for DC negative	1,00	pcs.
4.3	Ancillaries, cables, monitoring systems	4 mm2 cable	1,500,00	mtr.
4.4	Ancillaries, cables, monitoring systems	16 mm2 cable Sol -> CC	1,900,00	mtr.
4.5	Ancillaries, cables, monitoring systems	16 mm2 cable for CC	380,00	mtr.
4.6	Ancillaries, cables, monitoring systems	Cable lugs for 16 mm2	38,00	pcs.
4.7	Ancillaries, cables, monitoring systems	35 mm2 cable for Inv	360,00	mtr.
4.8	Ancillaries, cables, monitoring systems	Cable lugs for 35mm2	72,00	pcs.
4.9	Ancillaries, cables, monitoring systems	50 mm2 battericable	198,00	mtr.
4.10	Ancillaries, cables, monitoring systems	Cable lugs for 50 mm2	108,00	pcs.
4.11	Ancillaries, cables, monitoring systems	AC cable, 50mm2	180,00	mtr.
4.12	Ancillaries, cables, monitoring systems	AC power-in cable	180,00	mtr.
4.13	Ancillaries, cables, monitoring systems	AC connection box	2,00	pcs.
4.14	Ancillaries, cables, monitoring systems	AC cable 4x95 mm2	20,00	mtr.
4.15	Ancillaries, cables, monitoring systems	6mm2 ground cable, DIN-rail, Cable lugs	1,00	pcs.
4.16	Ancillaries, cables, monitoring systems	Lightning protection, AC	1,00	pcs.
4.17	Ancillaries, cables, monitoring systems	Lightning protection, DC	19,00	pcs.
4.18	Ancillaries, cables, monitoring systems	Mounting and various (DIN)	2,00	pcs.
4.19	Ancillaries, cables, monitoring systems	4 mm2 solar cables	1,050,00	mtr.
4.20	Ancillaries, cables, monitoring systems	Connectors	2,00	Pcs.
4.21	Ancillaries, cables, monitoring systems	4x25 mm2 AC cable	200,00	mtr.

Bill of Material as per section 5. Power Management Unit and assembly in price schedule

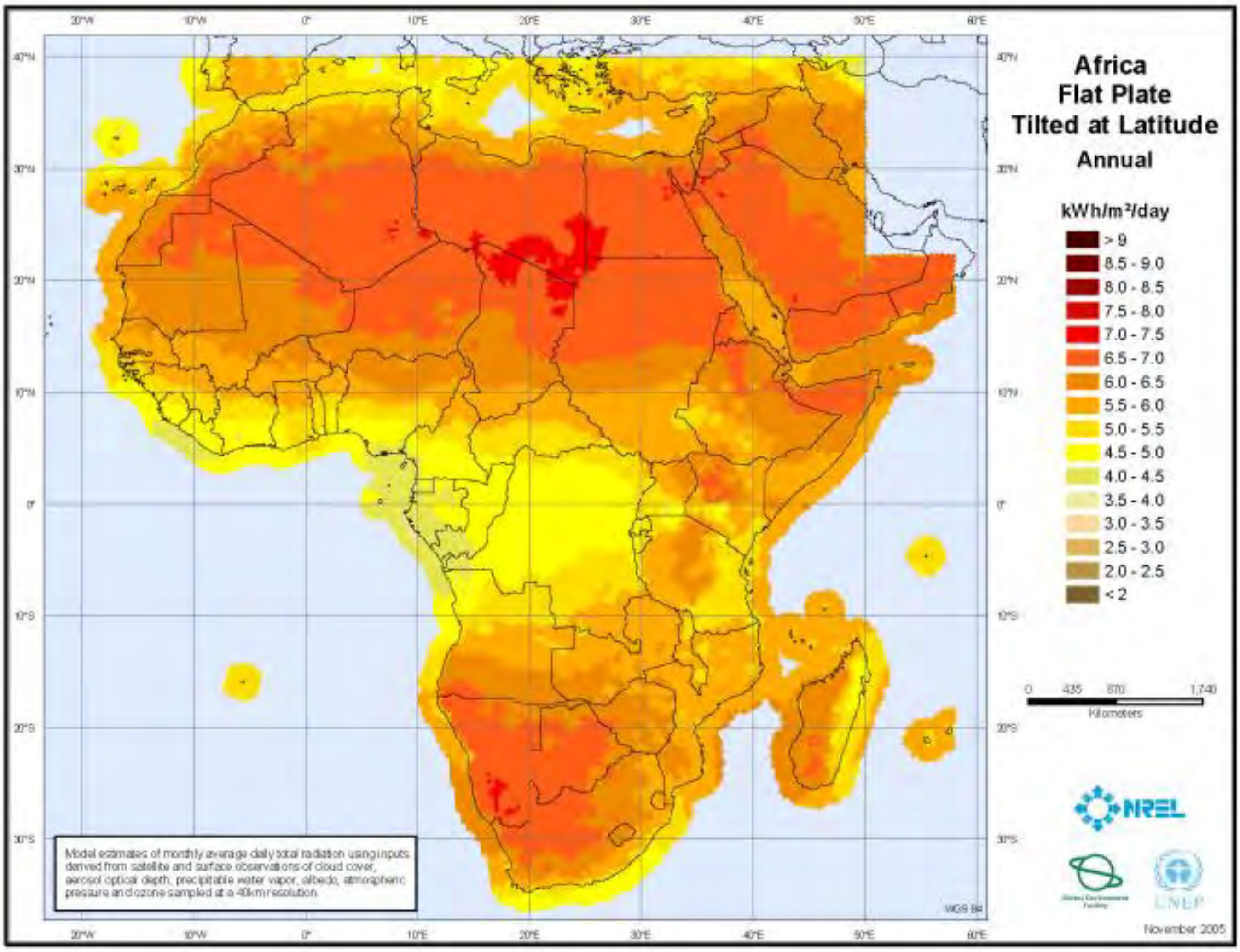
Item		*Description*	*Qty.*	*Units*
5.1	Power Management Unit and assembly	Generator autostart cable	100,00	mtr.
5.2	Power Management Unit and assembly	BMV 702 incl.temp sensor	1,00	pcs.
5.3	Power Management Unit and assembly	Color Control GX	1,00	pcs.
5.4	Power Management Unit and assembly	LAN cables	31,00	pcs.
5.5	Power Management Unit and assembly	Mounting and various	2,00	pcs.

Bill of Material as per section 7. Site preparation, civil work and installation in price schedule

Item		*Description*	*Qty.*	*Units*
7.1	Site preparation, civil work and installation	Mounting system, roof offgrid	75,00	pcs.
7.2	Site preparation, civil work and installation	Various (strips, screews, tape, exstra cable lugs etc.)	3,00	pcs.
7.3	Site preparation, civil work and installation	Mounting plate	3,00	pcs.
7.4	Site preparation, civil work and installation	Preassembly	3,00	pcs.
7.5	Site preparation, civil work and installation	Cable tray	26,10	mtr.
7.6	Site preparation, civil work and installation	Mounting parking system - on-gird	50,00	pcs.
7.7	Site preparation, civil work and installation	Concrete blocks	20,00	pcs.
7.8	Site preparation, civil work and installation	Mounting ground system	25,00	pcs.
7.9	Site preparation, civil work and installation	Mounting wall system	13,00	pcs.
7.10	Site preparation, civil work and installation	Local installation	1,00	pcs.

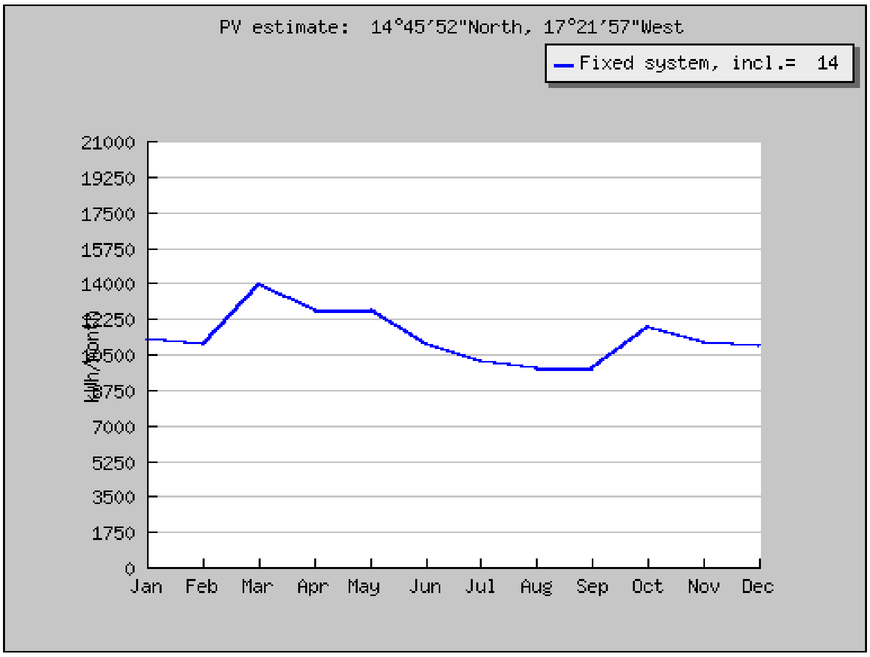
TOTAL MATERIEL - END Niger

Annex – Example Solar Irradiation

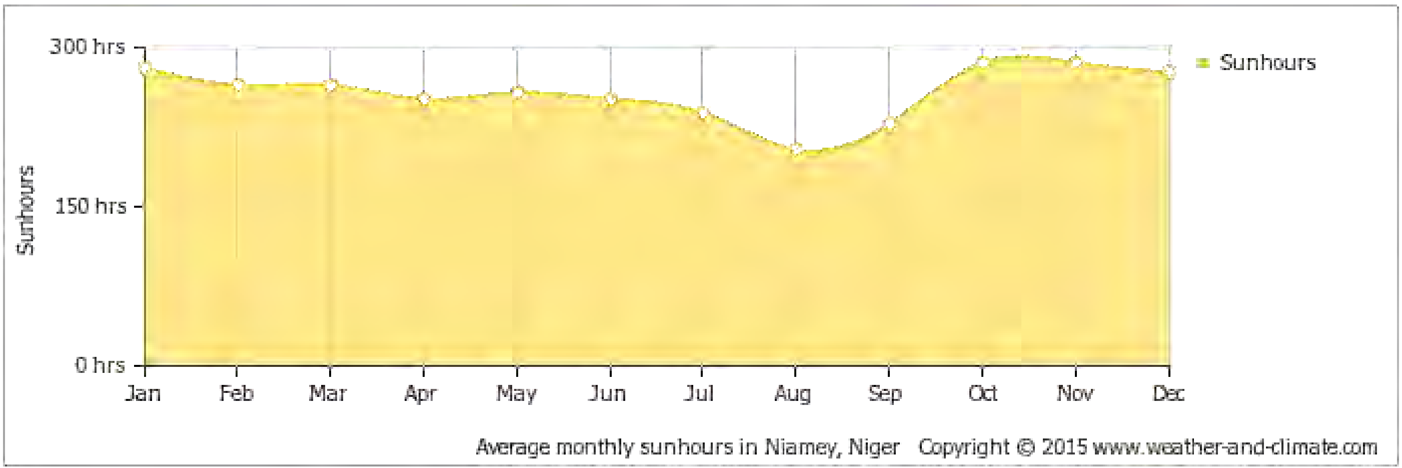


Annex – Example Performance Estimate of PV[12]

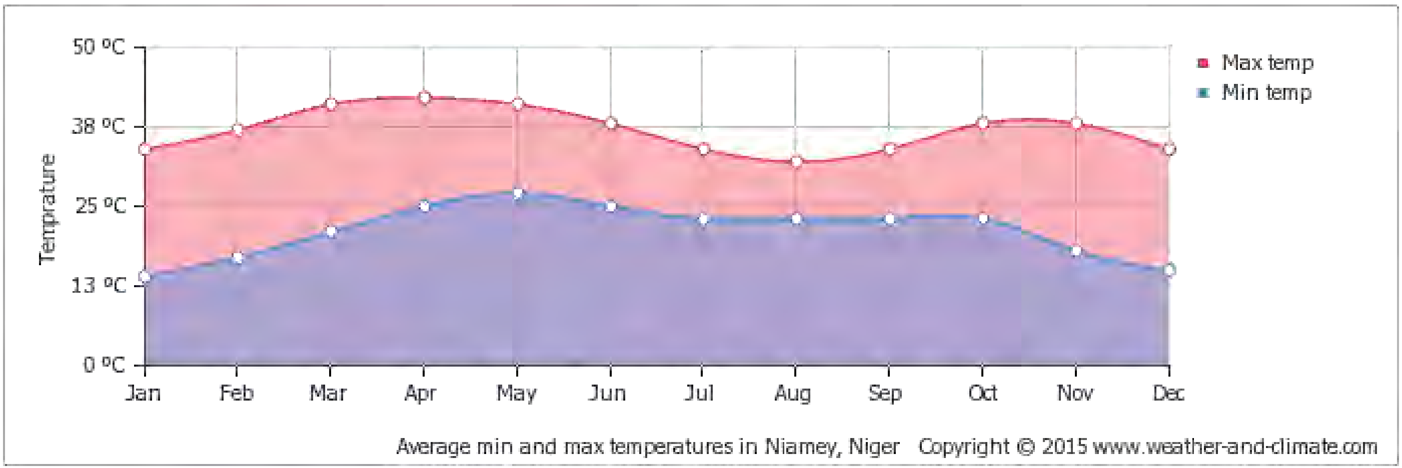
[12] PV Estimation, http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?map=africa#

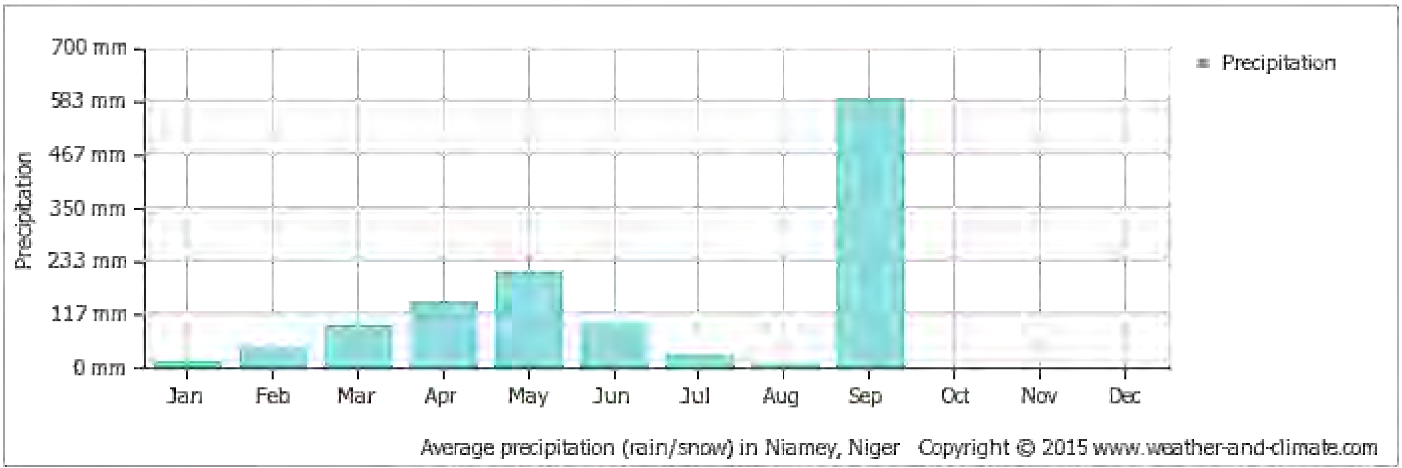


Annex – Weather and Climate Figures[13]



[13] http://www.weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Niamey,Niger


50 ºC
38 ºC
25 ºC
13 ºC
0 ºC
Temprature
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Max temp
Min temp
Average min and max temperatures in Niamey, Niger Copyright © 2015 www.weather-and-climate.com


700 mm
583 mm
467 mm
350 mm
233 mm
117 mm
0 mm
Precipitation
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Precipitation
Average precipitation (rain/snow) in Niamey, Niger Copyright © 2015 www.weather-and-climate.com