EU-AFD TECHNICAL ASSISTANCE PROGRAMME TO SUPPORT REFORMS IN THE WATER AND WASTEWATER SECTORS IN LEBANON

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SHORT NOTE

ON THE POTENTIAL OF SOLARIZATION OF WATER-RELATED INFRASTRUCTURES

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LIST OF ACRONYMS

AFD	Agence Française de Développement
BMLWE	Beirut and Mount Lebanon Water Establishment
BWE	Beqaa Water Establishment
CDR	Council for Development and Reconstruction
EDL	Électricité du Liban
EDZ	Électricité de Zahleh (in the Beqaa)
EDQ	Électricité de la Qadicha (in North Lebanon)
KW	Kilo watt \
KWh	Kilo watt hour
KWp	Kilo watt peak (solar peak power)
NLWE	North Lebanon Water Establishment
SLWE	South Lebanon Water Establishment
WE	Water Establishment

1 CONTEXT

With the outbreak of the financial crisis Lebanon is facing, and due to increasing shortages - not to say absence - of power supply from EDL (or EDZ in the Beqaa; EDQ in the North) coupled with soaring prices of oil for generators, photovoltaic energy emerged as the natural address to the situation, and a large number of individuals jumped into it headlong.

As for the WEs, they are no longer able to bare the operation cost of the water production/distribution sites or plants, the total number of which is around 1250 (identified as sites for which the WEs have an electricity subscription and therefore an electricity bill to pay). A number of sites are therefore operated intermittently, with long-lasting shutdowns, despite the assistance of organisations such as UNICEF and others who are donating fuel for generators.

Subsequently, a number of NGOs are taking the initiative to install photovoltaic systems on selected production sites (some 140, all over the national territory[1], as of Q1 2023), as a response to the present crisis and in a short-term vision, to provide some water to the concerned communities where there is no other source of energy available or affordable. In cases like these, it is useless to evaluate the relevance of installing a solar system because the other option is the absence of water. Whatever volume of water produced via a solar system is welcome, and any other argument is meaningless

But in fact, it is the long-term vision that should be the target, which is generating savings and bringing down the overall energy bill of the WEs, which is the real challenge for cost recovery and financial sustainability of the WEs. So in this long-term vision, it is worth evaluating the pertinence of installing solar systems: How much do we save? To which extent is the water demand covered? …

Out of the above mentioned 1250 sites, some 580 were covered by a survey conducted by the WASH Sector during end 2022 - beginning 2023 (still ongoing); following which the LTTA carried out a study in order to assess (i) to what extent are/can the installed photovoltaic plants cover the water needs, and (ii) how much are we presently saving on the energy cost and what is the ceiling of these savings.

The sites covered by this study are those sites

- For which the WE receives bills in the name of the WE for electricity consumption either from EDL, EDZ or EDQ, which is a proof that the WE owns the site.
- AND that are exclusively related to potable water production and/or distribution such as wells, water and wastewater pumping stations, springs, WTP, WWTP, and the like.

The present short note is a brief presentation of the outcome of this study.

[1] By Q1 2023 12 in NLWE, 10 in BMLWE, 78 in SLWE, and 39 in BWE

2 METHODOLOGY

2.1 GENERAL

The end target of this exercise is to evaluate the amount of demand coverage together with the amount of savings subsequent to the installation of solar plants in a given site.

By "savings" it is meant the ratio of the energy consumed from the solar system on the total energy required to operate the plant in a way to meet the water demand. Two scenarios must be considered: (i) the case where solar is the only source of power and (ii) the case where both solar and utility power are available and can be blended by the installed inverter.

To reach the end target it is assumed that the basic KWp of solar power to install in a given site is equal to the power (in KW) of all the machines running at the same time in this site, multiplied by the required mark-up factor to account for system performance

With this assumption, a model (actually four models, see sub-section 2.2.2aa below) was built to answer the above questions. This model is not site-related and provides answers in percentages, regardless the actual power consumed or the KWp installed.

2.2 KEY FACTORS USED FOR CALCULATION

2.2.1 Factors relating to the installed equipment

a. Installed power

This is the sum of the power (in KW) of all the machines installed on site and that would operate at the same time. For example stand-by machines are not accounted for here.
This was obtained directly from the WE.

b. Required daily operation

This is the number of hours per day that the machine must operate *in order to cover the water demand*. It is the key factor for the calculation of savings, as solar energy savings are calculated as the ratio of the number of hours during which the power required to operate the machine is available from solar, divided by the number of hours of operation required.
This was obtained directly from the WE.

However, it is worth noting that water production or distribution plants are seldom designed to operate only a few hours a day. Major plants operate 24 hours a day while wells and the like are sized in a way to cover the demand in 18 to 20 hours operation a day.

c. Consumed energy

This is the energy (in KWh) consumed by all the machines running at the same time in a given site, for a period of time (daily, yearly …).
This was calculated, for each site, from the EDL invoices coupled to the generators' fuel consumption; and crosschecked with the direct calculation based on the power installed and the daily operation hours.

2.2.2 Factors relating to solar data and solar requirements

a. Solar data

This is the data relating to the power and energy that can be provided by the installed panels. It includes solar irradiance and zenith and azimuth angles.

These were obtained from dedicated internet sites providing hourly and monthly values for each variable. Four sets of data were collected, one for Halba as average for the North, one in Beirut as average for Beirut and Mount Lebanon, one in Nabatiyeh as average for the South, and one for Baalbek as average for the Beqaa.

b. KWp oversizing factor.

As explained under sub-section 2.1 above, it is assumed that the basic KWp installed in a given site matches the power required by the site. However, this KWp is available only during sun radiance peak, which is when the sun is perpendicular to the solar panels. Depending on the season, this may not occur; or occurs during a very limited time during the day.

Thus the need to oversize the KWp in order to improve the performance of the solar system. The bigger this factor the better the demand coverage and the bigger the savings, but also the bigger the initial investment !

We adopted the value of 1.8

c. Required land.

This is the land required for the installation of the solar panels, the availability of which conditions, or limits, the possibility of installing solar panels. This information is used to assess if solarisation is feasible or not

3 POWER EXCLUSIVELY FROM SOLAR V/S HYBRID BLENDED SYSTEM

A. Power exclusively from solar

By *power exclusively from solar* it is meant that no other source of power is used at the same time as solar power.

In these cases, solar energy cannot be used unless the power (in KW) delivered by the solar system exceeds the power needs of the site. This, of course, is a limitation to the daily duration the plant can be operated from solar. The use of VFDs may appear as a get around to this issue, but VFDs have more constraining limitations as shown in sub-section 4 below.

B. Hybrid blended system

This is the case where (i) another source of power (EDL or generator) is available on site and (ii) the installed solar inverter allows for blending the two sources.

This, of course, is the most performing solution as the power available from the solar system is topped up by the utility so all the energy that the solar system can produce is consumed in full.

However, it is worth mentioning that in the case of generators (no EDL available) this system will generate no savings as the generator shall run anyway and savings on fuel consumption are not significant.

4 VFD DEVICES LIMITATION

4.1 GENERAL

Solar systems intended to operate water pumps are systematically equipped with VFDs, mainly for two reasons:

- To ensure a soft start of the pump because otherwise the solar system could not meet the start-up inrush current unless unrealistically oversized.
- To allow operating the pump when the solar irradiance (in KW) is somewhat lower than the power required for normal operation of the pump, either temporarily as in the case of a passing cloud, or for a longer periods of time such as mornings and afternoons, before and after near-peak hours.

The benefits of installing VFDs depend on the solar system installed :

- In case of power exclusively from solar, VFDs are required, if only for pump start-ups. Savings can be made by extending the time the pump is operated on solar. However, these savings are limited (and do significantly affect the delivered flow) as shown under sub-section 4.2 below
- In the case of a hybrid mixed system, VFDs may not be necessary as the start-up inrush current and solar energy variations are compensated by the utility. This assumes, of course, that the utility is available all the time, which currently is not the case.

4.2 HOW LOW CAN THE FREQUENCY BE BROUGHT DOWN

Gradually lowering the frequency of the power supply will gradually lower the rotational speed of the motor, which in turn gradually lowers the power delivered by the pump. The level at which the water must be raised (difference in elevation) being fixed, it is the flow rate and the generated loss of head which gradually decrease.

The behaviour of a pump in the face of frequency variations is governed by what are known as the three *Affinity Equations*, of which the second equation, that sets the relation between the frequency and the head delivered by the pump :

$$\left(\frac{f_1}{f_2}\right)^2 = \frac{P_1}{P_2} = \frac{H+h_1}{H+h_2}$$

where :

f_1 is the initial frequency (here 50 Hz)
f_2 is the lowered frequency
P_1 & P_2 are the respective heads delivered by the pump
H is the difference in elevation
h_1 & h_2 are the respective losses of head

As the head delivered by the pump is equal to the difference in elevation plus the loss of head.

By gradually decreasing f_2 the flow gradually decreases and so the generated loss of head h_2 *… down to zero*.

Therefore solving the above equation for $h_2 = 0$ and $f_1 = 50$ Hz will give the minimum frequency, below which the pump will continue rotating but is no more capable of delivering flow because the power delivered by the motor is no longer sufficient to counter the difference in elevation.

$$f_{min} = \frac{50}{\sqrt{1 + \frac{h}{H}}}$$

where : **h** is the loss of head at 50 Hz
H is the height at which the water is pumped

Should the value of the electrical frequency be brought down to $\boldsymbol{f_{min}}$ and below, the pump's motor will continue rotating but cannot deliver the required power to lift up some water to the required ***H*** elevation.

The preponderant factor is the ratio **h/H**.

The generated loss of head is a function of the flow together with the physical characteristics of the pipeline, which are the material, length and diameter. Therefore calculation cannot be done but case by case.

To illustrate, let's consider two typical case studies :

1. <u>h/H is big, say 3</u>

   This is the typical case of pumping water on a long distance (therefore high loss of head) with small difference in elevation.

   Practically this would be the case of a pump delivering 20 l/s through a 7 000 m long DN 150 pipeline at a 20 m elevation. The loss of head is h = 60 m, thus h/H = 3

   In this case the frequency may be brought down to $\boldsymbol{f_{min}}$ **= 25 Hz** before the pump stops delivering flow.

2. <u>h/H is small, say 0.1</u>

   This is the typical case of pumping water at a high elevation with little loss of head.

   Practically this would be the case of a pump delivering 20 l/s through a 3 500 m long DN 150 pipeline at a 300 m elevation. The loss of head is h = 30 m, thus h/H = 0.1

   In this case the frequency cannot be brought down below $\boldsymbol{f_{min}}$ **= 47.6 Hz** otherwise the pump will stop delivering flow.

4.3 IMPACT ON THE DELIVERED FLOW

4.3.1 General

$$\left(\frac{50}{f_2}\right)^2 = \frac{H + h_1}{H + h_2}$$

Considering the two case studies above, h_1 being the loss of head generated by the 20 l/s flow (at 50 Hz), the flow delivered at the reduced frequency f_2 is the flow which will generate a loss of head equal to h_2.

This is calculated by iteration using the Colebrook formula

Figure 1 below shows the variation of the delivered flow for the two cases considered in the above paragraph.

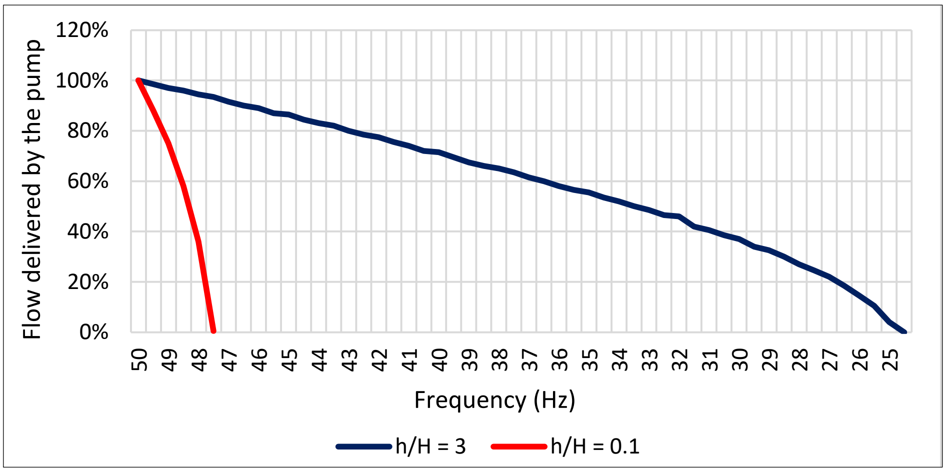

Figure 1 Flow delivered vs frequency variation, for the two case studies considered

The larger the ratio ***h/H***, the flatter the curve; which allows significant reduction in frequency while still having some flow delivered by the pump.

On the contrary, when the ratio ***h/H*** is small, the curve is so steep the delivered flow freefalls for minor variations in frequency.

4.3.2 The particular case of deep wells

The majority of the potable water production centres presently equipped with solar system are deep wells lifting up water at a high elevation (**H**). As such, the pipework is normally sized so as to have a low water velocity - around 1.2 to 1.4 m/s, which implies low losses of head (**h**) - in order to avoid destructive water hammers.

Thus, apart from very few, all the wells equipped with solar systems have a small ***h/H*** ratio and subsequently the delivered flow will be interrupted for very minor variations in the electric frequency.

Therefore, VFDs are necessary for a smooth start of the pump because otherwise the solar system could not meet the start-up inrush current unless unrealistically oversized; and also to avoid intermittent operation of the pump in cases such as a passing cloud. But it has to be known that the impact on the delivered flow is huge, and it is an illusion believing that the VFDs do generate additional savings by allowing taking advantage of every single sun ray.

Another issue is related to electromechanical constraints when operating a submersible pump inside a well : The motor is cooled by the surrounding water flow. In case the flow is interrupted while the motor is still rotating, there is a risk of overheating of the motor if this situation lasts long enough. It is therefore necessary to have alarm systems installed to monitor such cases and eventually disconnect the system.

5 ENERGY SAVINGS DUE TO SOLAR SYSTEM

To evaluate the energy savings generated by a solar system on a given site, the benchmark is the total energy normally necessary to cover the water demand related to this site. In other words it is the number of hours a pump is operated from solar vs the number of operating hours normally required to cover the demand.

A model - actually 4 models, for 4 representative zones in Lebanon : Halba, Beirut, Nabatiyeh, and Baalbek – was developed to assess the energy produced from solar system based on the sun's position each hour of the day and each month of the year; and in line with the methodology set forth under Sub-Section 2 above. Figure 2 below shows typical simulation output for the four representative zones, assuming 18 hours operation a day and a KWp oversizing of 1.8.

Yearly savings shown on Figure 2 below are summarized as follows :

Table 1 Compared yearly average saving by region
(assuming 18 hours operation a day and 1.8 KWp oversizing)

	Halba	Beirut	Nabatiyeh	Baalbek
Exclusively from solar	44 %	37 %	41 %	35.46 %
Hybrid blended system	54 %	46 %	53 %	45.21 %

It can be seen that the difference in latitude between the two extremes, Halba and Nabatiyeh, translates into less than 1% savings.

On the other hand, hybrid blended systems allows for an additional 10 % saving compared to an exclusive solar system.

Table 2 below shows a compared yearly average saving by required operation hours (typically for Beirut) assuming that :

- The calculation is based assuming that the installed KWp is oversized by 1.8 (i.e. 1.8 times the power of the machines to operate)
- The r*equired daily operation hours* is the number of daily hours the machine is operated under normal condition (i.e. in order to cover the demand)

Table 2 Compared yearly average saving by required operation hours

Required daily operation hours	24 h	20 h	18 h	16 h	12 h	8 h
Power exclusively from solar	28 %	33 %	37 %	41 %	55 %	80 %
Blended power solar / utility	35 %	42 %	46 %	52 %	70 %	96 %

Assessment of solar potential

(based on typical **HALBA** zenith and azimuth angles from Solar Topo)

Panels Tilt (optimun 29°) :	**29°**
Panels azimuth to south (optimun 0°) :	**0°**
Scheduled daily operation :	**18 Hrs**
kWp installed / Required kW :	**2.0**
Min acceptable frequency (VFD) :	**48 Hz**
Working power/installed power :	88%
CO_2/kWh from EDL :	**700 g**
CO_2/kWh from PV panels :	**40 g**

Per Year	
Total scheduled operation hours :	6 570
In case power exclusively from solar	
Total useful solar hours :	2 907
Actual hours used from solar :	2 907
Energy saving from solar :	44%
Total CO_2 reduction (Kg/kW) :	1920
In case of blended system Solar/EDL	
Total useful solar hours :	3 565
Energy saving from solar :	54%
Total CO_2 reduction (Kg/kW) :	2350

Monthly saving	
Jan : 33%	July : 55%
Feb : 33%	Aug ; 50%
March : 44%	Sep : 50%
April : 44%	Oct : 44%
May : 50%	Nov : 39%
June : 50%	Dec : 38%

Assessment of solar potential

(based on typical **BEIRUT** zenith and azimuth angles from Solar Topo)

Panels Tilt (optimum 28°) :	**28°**
Panels azimuth to south (γ) :	**0°**
Scheduled daily operation :	**18 Hrs**
kWp installed / Required kW :	**1.8**
Min acceptable frequency (VFD) :	**48 Hz**
Working power/installed power :	88%
CO_2/kWh from EDL :	**700 g**
CO_2/kWh from PV panels :	**40 g**

Per Year	
Total scheduled operation hours :	6 570
In case power exclusively from solar	
Total useful solar hours :	2 421
Actual hours used from solar :	2 421
Energy saving from solar :	37%
Total CO_2 reduction (Kg/kW) :	1600
In case of blended system Solar/EDL	
Total useful solar hours :	3 045
Energy saving from solar :	46%
Total CO_2 reduction (Kg/kW) :	2010

Monthly saving	
Jan : 22%	July : 39%
Feb : 22%	Aug ; 50%
March : 38%	Sep : 49%
April : 39%	Oct : 39%
May : 50%	Nov : 28%
June : 39%	Dec : 27%

Assessment of solar potential

(based on typical **NABATIYEH** zenith and azimuth angles from Solar Topo)

Panels Tilt (optimum 28°) :	**28°**
Panels azimuth to south (optimum 0°) :	**0°**
Scheduled daily operation :	**18 Hrs**
kWp installed / Required kW :	**1.8**
Min acceptable frequency (VFD) :	**48 Hz**
Working power/installed power :	88%
CO_2/kWh from EDL :	**700 g**
CO_2/kWh from PV panels :	**40 g**

Per Year	
Total scheduled operation hours :	6 570
In case power exclusively from solar	
Total useful solar hours :	2 672
Actual hours used from solar :	2 672
Energy saving from solar :	41%
Total CO_2 reduction (Kg/kW) :	1760
In case of blended system Solar/EDL	
Total useful solar hours :	3 466
Energy saving from solar :	53%
Total CO_2 reduction (Kg/kW) :	2290

Monthly saving	
Jan : 27%	July : 50%
Feb : 27%	Aug ; 50%
March : 39%	Sep : 50%
April : 39%	Oct : 39%
May : 50%	Nov : 39%
June : 50%	Dec : 28%

Assessment of solar potential

(based on typical **BAALBEK** zenith and azimuth angles from Solar Topo)

Panels Tilt (optimun 30°) :	**30°**
Panels azimuth to south (optimum 0°) :	**0°**
Scheduled daily operation :	**18 Hrs**
kWp installed / Required kW :	**1.8**
Min acceptable frequency (VFD) :	**48 Hz**
Working power/installed power :	88%
CO_2/kWh from EDL :	**700 g**
CO_2/kWh from PV panels :	**40 g**

Per Year	
Total scheduled operation hours :	6 570
In case power exclusively from solar	
Total useful solar hours :	2 579
Actual hours used from solar :	2 579
Energy saving from solar :	39.25%
Total CO_2 reduction (Kg/kW) :	1700
In case of blended system Solar/EDL	
Total useful solar hours :	3 420
Energy saving from solar :	52.05%
Total CO_2 reduction (Kg/kW) :	2260

Monthly saving	
Jan : 21%	July : 50%
Feb : 21%	Aug ; 50%
March : 39%	Sep : 50%
April : 39%	Oct : 39%
May : 50%	Nov : 33%
June : 50%	Dec : 27%

Figure 2 Typical example of general solar energy saving

6 SITE-RELATED SOLAR ENERGY SAVING.

As previously mentioned, all power-consuming sites (for which the WEs receive invoices from EDL, EDZ, or EDQ) were assessed by the LTTA and solar potential evaluated for sites where solar system is already installed or potentially feasible.

The total number of sites assessed is 1240, 248 sites in NLWE, 304 in BMLWE, 368 in SLWE, and 320 in BWE

The detailed outcome of the assessment is given in Table 3 below, for each WE..

It can be seen that despite the big number of sites already solarized or potentially feasible (more than 400 as of June 2023), and *assuming that the solarized sites are operated the normally required number of hours a day*, the savings on the overall energy bill of the WEs is still pretty much modest,.

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Table 3 Compared yearly average saving for the assessed sites in the four WEs

NLWE

Status of sites from Solar point of view	Nbr of sites	Required Energy (kWh/year)	Available from solar (kWh/year)	Savings on overall energy bill
A- Solar power NOT blended with EDL/generator				
Sites with no data available	175 (71%)	19 257 562	-	
Sites where solar is not feasible	18 (7%)	3 479 004	-	
Sites where solar is already installed	32 (13%)	18 148 226	643 244	4%
Sites potentially suitable	23 (9%)	12 243 829	977 281	8%
	248 (100%)	**53 128 621**	**1 620 525**	**3%**
To date, max saving on overall energy bill, pending updating of "No data" sites				↑
			CO2 saving :	1.1 Ton/y
B- Solar power blended with EDL/generator				
Sites with no data available	175 (71%)	19 257 562	-	
Sites where solar is not feasible	18 (7%)	3 479 004	-	
Sites where solar is already installed	32 (13%)	18 148 226	862 170	5%
Sites potentially suitable	23 (9%)	12 243 829	1 319 154	11%
	248 (100%)	**53 128 621**	**2 181 324**	**4%**
To date, max saving on overall energy bill, pending updating of "No data" sites				↑
			CO2 saving :	2.3 Ton/y

BMLWE

Status of sites from Solar point of view	Nbr of sites	Required Energy (kWh/year)	Available from solar (kWh/year)	Savings on overall energy bill
A- Solar power NOT blended with EDL/generator				
Sites not assessed yet	107 (35%)	17 198 652	-	
Sites where solar is not feasible	78 (26%)	47 339 601	-	
Sites where solar is already installed	10 (3%)	1 185 744	254 985	21.5%
Sites potentially suitable	109 (36%)	76 658 718	5 939 609	8%
	304 (100%)	**142 382 715**	**6 194 594**	**4%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	4.1 Ton/y
B- Solar power blended with EDL/generator				
Sites with no data available	107 (35%)	17 198 652	-	
Sites where solar is not feasible	78 (26%)	47 339 601	-	
Sites where solar is already installed	10 (3%)	1 185 744	344 107	29%
Sites potentially suitable	109 (36%)	76 658 718	7 873 654	10%
	304 (100%)	**142 382 715**	**8 217 761**	**6%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	6.4 Ton/y

SLWE

Status of sites from Solar point of view	Nbr of sites	Required Energy (kWh/year)	Available from solar (kWh/year)	Savings
A- Solar power NOT blended with EDL/generator				
Sites with no data available	186 (51%)	43 849 239	-	
Sites where solar is not feasible	74 (20%)	82 019 918	-	
Sites where solar is already installed	78 (21%)	25 241 712	11 718 975	46%
Sites potentially suitable	30 (8%)	22 174 357	2 935 819	13%
	368 (100%)	**173 285 226**	**14 654 794**	**8%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	9.7 Ton/y
B- Solar power blended with EDL/generator				
Sites with no data available	186 (51%)	43 849 239	-	
Sites where solar is not feasible	74 (20%)	82 019 918	-	
Sites where solar is already installed	78 (21%)	25 241 712	15 751 028	62%
Sites potentially suitable	30 (8%)	22 174 357	4 234 379	19%
	368 (100%)	**173 285 226**	**19 985 407**	**12%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	13.2 Ton/y

BWE

Status of sites from Solar point of view	Nbr of sites	Required Energy (kWh/year)	Available from solar (kWh/year)	Savings on overall energy bill
A- Solar power NOT blended with EDL/generator				
Sites not assessed	148 (46%)	13 371 838	-	
Sites where solar is not feasible	51 (16%)	6 392 215	-	
Sites where solar is already installed	39 (12%)	8 602 571	3 910 578	45%
Sites potentially suitable	82 (26%)	11 114 765	5 842 653	53%
	320 (100%)	**39 481 388**	**9 753 231**	**25%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	6.4 Ton/y
B- Solar power blended with EDL/generator				
Sites not assessed	148 (46%)	13 371 838	-	
Sites where solar is not feasible	51 (16%)	6 392 215	-	
Sites where solar is already installed	39 (12%)	8 602 571	5 621 625	65%
Sites potentially suitable	82 (26%)	11 114 765	7 159 005	64%
	320 (100%)	**39 481 388**	**12 780 630**	**32%**
To date, max saving on overall energy bill, pending updating of "Not Assessed" sites				↑
			CO2 saving :	8.6 Ton/y

7 GENERAL GUIDE LINES

When envisaging installing a solar system on a given site, the following should be considered:

- Always install an inverter that allows for blending/synchronization between solar power and utility, even if there is no utility currently available on the site. It could well be available at a later stage.
- VFDs are required for pump's start-up, but minor decrease in the frequency will kill the delivered flow, especially on deep wells. Alarm systems must be provided to stop the pump if it is operating for a given time without delivering flow.
- When the available power (in Kw) from solar is less than the required power to operate the machines on the site, using generators to top-up energy is not a good idea as it generates no savings
- When selecting sites for the implementation of a solar system in a long-term vision, always give preference to sites with a dedicated EDL line because this allows maximum savings on the energy bill while allowing to operate the pump at normal speed, thus ensuring the required flow rate to cover the demand.