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Solar Water Pumping System

Water-energy workshop, March 2nd and 3rd 2022

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Solar water pumping system configuration

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- **Complete Standalone solar pumping system**

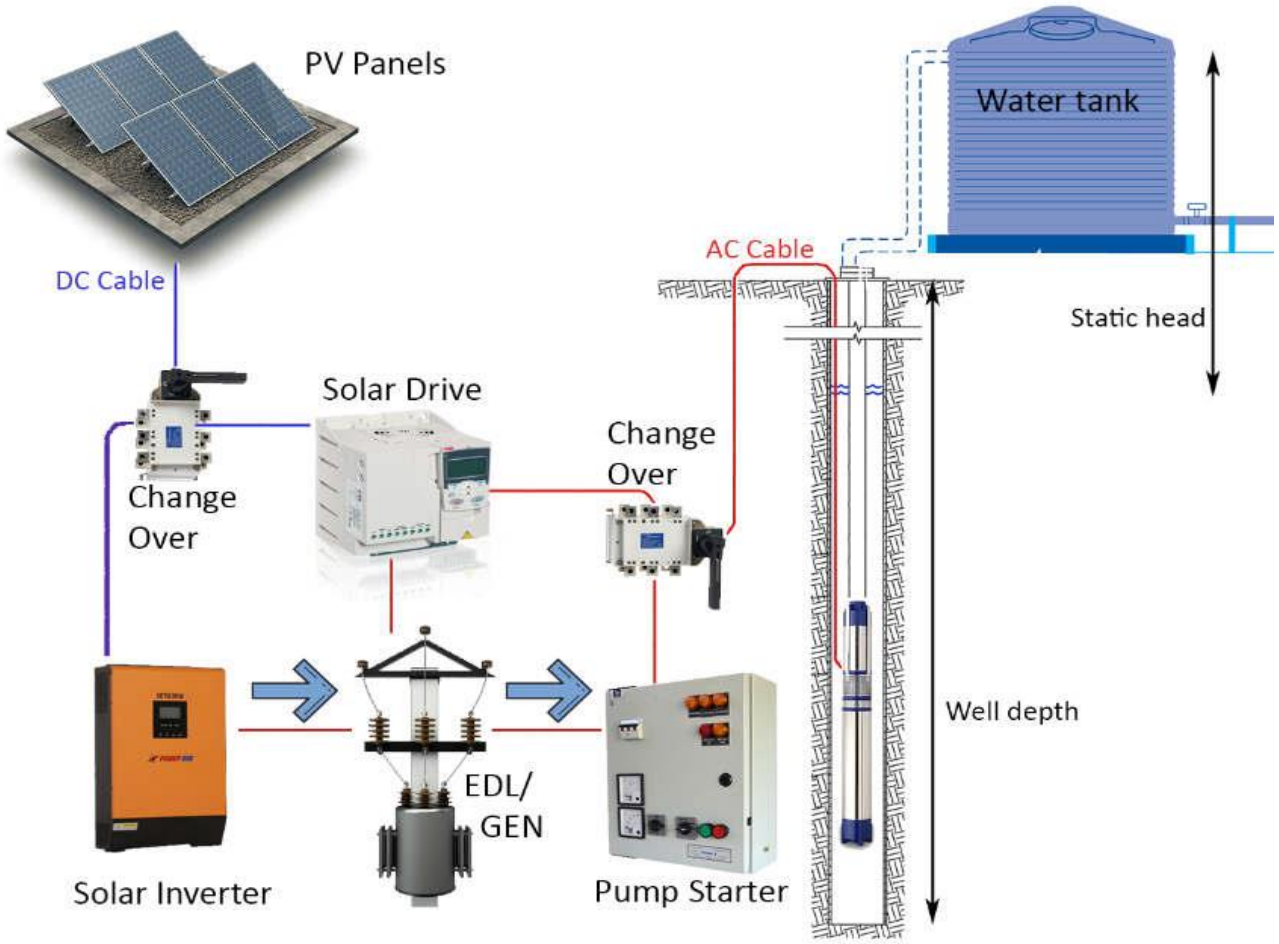
  Single power source from solar

- **Hybrid Pumping system** (example Haour Taal and Kfarzabad):

  100% on solar or 100% on AC(EDL/Generator

Hybrid PV-diesel/ Ongrid system with the Standalone solar pumping system: (example in Saghbine)

Combine DC and AC



The solar water pumping projects discussed in this presentation were implemented with the financial support of the European Union.

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Feasibility assessment form-technical

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No.	Site	Source of water	Name of the Source	Most vulnerable localities in Lebanon	Land: available of land for solar (yes , No)	Area of the land (m2) based on municipality info	GPS coordinates (Lat, Long Altitude)

Daily water Demand (m3/day)	No. of people served by borehole Lebanese	No. of people served by borehole Syrian	Total BH depth (m)	Casing dia [inch]	Safe yield	Design Discharge [m^3/h]	Pump test performed	Static water level [m]	Dynamic water level [m]	Type of Existing pump	Pump depth [m]

Pump motor power [kW]	Working point of pump (H,Q)	Pumping hours /day	Grid / Genset model, power (kVA)	Genset Fuel consumption [l/hr]	Water reservoir Size [m^3]	Total Dynamic Head, TDH (m)	Elevation [BH to tank inlet]	Chlorination system	Note

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Interview with community, municipality, BWE & MoEW

- Interview with community to check availability of water, level of water supply.
- Interview with municipalities to check availability of water, level of water supply.
- Interview with water establishment and MoEW.

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Selection criteria

- Land availability and ownership.
- Nb of beneficiaries/ people served by the borehole.
- Technical compliance and borehole situation.
- Need of water - increase water supply to citizen.
- Decrease financial Burden on water establishment and municipality.
- Prioritize borehole not connected to power source.
- Cost of the system.
- Safety and security.

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Example from the field; Kfarzabad

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Pre-SOLARIZATION

Water sources; Chamsine Station and the second being the Kfarzabad borehole.

The water network is connected directly to the village water network (not to the reservoir).
The water network is divided into 6 zones, two zones having water supply shortage due to elevation.
The water is available two days per week, depending on electricity…

<u>Borehole</u>
The borehole is not connected to electricity with no electrical generator in the pump station.
The borehole was connected to a 1000m3 reservoir.

<u>Coping Mechanism for the lack of water</u>
Paying around 25-50,000LBP per week in 2019 (cost of trucking 4000L was about 25,000LBP), currently the cost of trucking increased to reach 280,000LBP for 4000L.

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Post-SOLARIZATION

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81.6 kWp, total cost of 72,770 USD, estimation payback period 4.3 years (2019).

Starting May 2021, Kfarzabad benefited from the solar system to keep the borehole operational

In summer month, reached 10 Hours: 7.5 hours of full power/ nominal output flow of 29.35 (m3/h) and 2.5 hours of operations between 38 and 50 Hz with an average nominal flow of (19 m3/h). A total of 260 m3/day is pumped on the solar system.

The 1000 m3 water reservoir needs around 4 days of 10 hours operationality to be filled completely when empty.

During the fuel crisis and power shortages, the only water supply was from the borehole operating on solar system constructed.

The solar water pumping system increase the water supply to the community **by 36.4%.**

The online control and monitoring system will support the BWE to operate and monitor the system remotely and increase the reliability of the system

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Example from the field; Haour Taala

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Pre-SOLARIZATION

Old existing pump (100 HP rewinded several time, 36 m3/h, low efficiency).

required around **6.5 hours** of continuous operation on **AC (EDL)** to fill the **250,000-litter** water tank.

Before electricity crises; The power from EDL was only available **8-10 hours per 24 hours**. **Current situation**; around 1-2 hrs.

There is a generator, but it requires some maintenance.

Coping Mechanism for the lack of water; Purchase water from trucks.

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Post-SOLARIZATION

107.2 KWP, total cost 146,140 USD, pay back period 4.9 years (2019).

The pump operates around 8 hours per day on solar (variable frequency 40-50 Hz, reaching 50 Hz around 10:00am), **flow 55 m3/h.**

The tank is now filled in around **4.5 hours of full power operation** (50Hz).

Due to the shortage of electricity, the **borehole was operating on solar power**, quantity of water per person per day; **116L/p/d.**

Increase the water supply to the community **by 52%.**

The pump station equipped with online control and monitoring system

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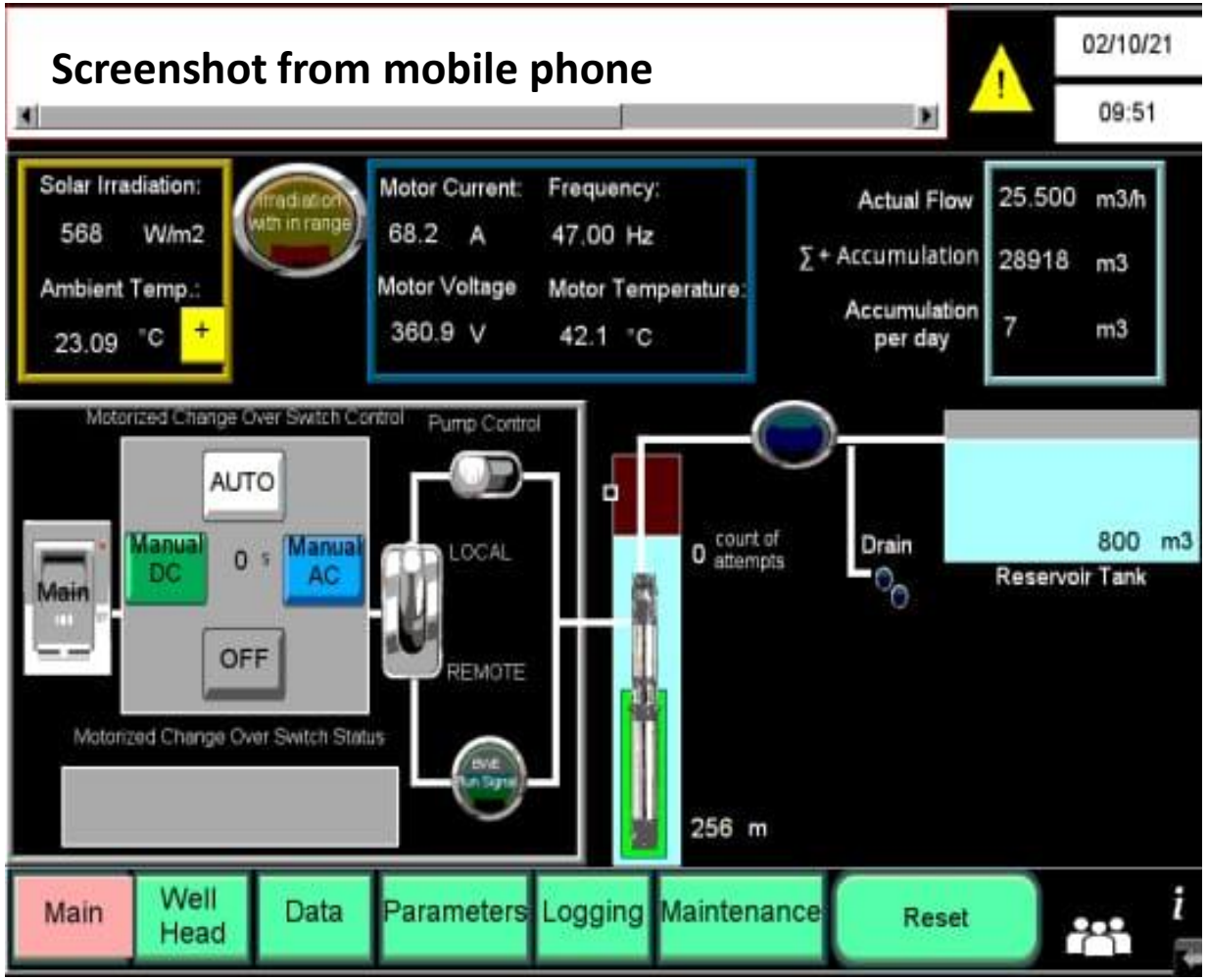
Control and monitoring system

Online



HMI graphics-Site

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Pictures from the field

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Gate sensor

Pressure *sensors*

Flow meter

CCTV camera and fence

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Advantages/Findings

- Water availability became independent from grid utility outages and Diesel availability.
- Increase the quantity of water.
- Reduce the high cost of the water trucking and decrease the added financial burden on residents.
- Decrease the financial burden on the BWE and municipality (cost of electricity and fuel).
- Easy to operate and no challenges recorded since one year.
- Online system, support BWE to proper control and monitoring of the water system.
- Environmental impact; reduce greenhouse gas emissions, particularly carbon dioxide (CO2).
- Municipality play an important role to facilitate the construction.
- Ensure coordination with BWE from the beginning of the project.
- Capacity building of Water Establishment team should be conducted during the intervention.
- Improve relations between people and the BWE.

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Recommendations

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- Testing of borehole (pump test) is required, if data of borehole is not available & no pump test report.
- Set clear criteria for site selection; take into consideration, Land availability-improve water supply, reduce the cost for establishments, prioritize energy efficiency, return on investment for a shorter timeframe.
- Ensure ownership of the land and system for Water Establishment.
- The role of municipality should be clear from the beginning of the project.
- Coordination with water establishment should be clear from the beginning of the project, during the execution and hand over process.
- Ensure proper training for WE team on control and monitoring of the system.
- Increase the investment in solar water pumping systems (Water establishments and municipalities,...).
- Install control and monitoring system (SCADA) to the borehole and solar water pumping system.
- Install fence to protect the site (panel,…).
- Consider adding spare part for solar water pumping system (panel..)

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PREVENTIVE MAINTENANCE

1.Weekly or daily cleaning (according to level of dust…)

2. Prevention of shading

3. Inspection of the constituents

4. Safety

Checklist
https://www.oxfamwash.org/en/water/solar-pumping/Installation-Control-Checklist-vf-1.pdf

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MAINTENANCE OPERATIONS SCHEDULE

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MAINTENANCE OPERATIONS	Monthly	Quarterly	Biannually	Annually
Cleaning and visual inspection	x			
Functional verification			x	
Pump, pipes, and valves				
Visual check for the instruments and make sure it is running properly	x			
Visual check that no pipes or valves are leaking	x			
Check good condition of pipes, valves, pressure sensors, electrodes, switch flow, flowmeter, and all related components			x	
Control and monitoring system				
Visual check that no alarm is shown on the HMI screen	x			
Visual check sensors parameters on screen are within the expected values		x		
Check controller state: operation, displays, alarms, verification of modes of operation, etc		x		
Control and monitoring system- Evaluation level				
Download monitoring data, check raw data for eventual errors or inconsistencies		x		
Check that Operational performance parameters lie within design specifications				x
Analyze monitoring data and prepare evaluation reports (yearly and aggregate). Draw conclusions and recommendations on basic and operational parameters.		x		

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MAINTENANCE OPERATIONS SCHEDULE

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MAINTENANCE OPERATIONS	Monthly	Quarterly	Biannually	Annually
Main AC Panel Board / PLC Panel Boards (inside electrical room)				
Cleaning and visual inspection	x	x		
Functional verification (HMI display, operation, parameters…)			x	
Protection devices functionality (Fuses, SPDs)				x
VFD (inside electrical room)				
Cleaning and visual inspection		x		
Functional verification			x	
DC COMB A - C & TOTALIZER				
Cleaning and visual inspection	x			
Functional verification of protection (fuses, SPDs)		x		
DC & AC Cables				
Visual & Functional verification			x	
PV Modules				
Cleaning and visual inspection (shading)	x			
Functional verification (output power)				x
PV Support Structure				
Cleaning and visual inspection (vegetation growth)	x			
Functional verification (Check all nuts and bolts fixing)				
UPS / Grid-Tie Inverter				

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More details on solar water pumping system

- Solar Pumping for Water Supply-Full Book

https://www.oxfamwash.org/en/water/solar-pumping

- PHYSICAL INSTALLATION and MAINTENANCE CHECKLISTs

https://www.oxfamwash.org/en/water/solar-pumping/Installation-Control-Checklist-vf-1.pdf

- Criteria for Selection of Quality Solar Pumping Products & Services

https://www.oxfamwash.org/en/water/solar-pumping/Quality_Selection_of_Products.pdf

-O&M TOOLKIT FOR COMMUNITIES: SOLAR POWERED WATER SUPPLY SYSTEMS

https://www.oxfamwash.org/en/water/solar-pumping/O_M_Toolkit_for_Communities.pdf

- Template invitation to Tender

https://www.oxfamwash.org/en/water/solar-pumping/Bidding_Template.docx

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Thank you

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