Hello Everyone,

My name is David Githiri Njoroge and it is my pleasure to be here with you today. I work with UNHCR in Uganda as the Technical Coordinator and appreciate this opportunity to share with you experiences of solar pumping technology in humanitarian setting.

The UN Refugee Agency is mandated to provide international protection and humanitarian assistance to people fleeing conflict and persecution threatening their lives. In most cases, asylum seekers and refugees, are received at locations usually at the margins of society where access to water services is poor or non-existence. Further, these areas are usually underdeveloped and marginalized making it extremely challenging to provide services, cost effectively and sustainably. Solar pumping technology has shown great potential in facilitating provision of portable water in these remote locations cost effectively and sustainably.

Context:

Currently, 174 pumped water schemes have been installed in the refugee hosting areas in Uganda out of which 164 units are either solar or solar/hybrids of varying capacities. The 174 produce on average 14,000m^3 daily (September data) of which 56% is attributed to solar, 5% national grid (hydro) and 39% is from the fuel component. It's worth noting that over 75% of the solar installation have been implemented in the last 3yrs and efforts/plans are underway to convert the remaining 5 fuel powered water schemes to solar/hybrids and grid connection where feasible. An additional 30 projects are at different stages of development and are either solar or solar hybrids.

What is driving the uptake of solar pumping technology?

Several divergent variables have converged and contributed to the exponential uptake of the solar pumping technology. For brevity, I have clustered the key drivers into 3:

- Life Cycle Cost
- Rapidly evolving solar pumping technology marketplace
- Environmental Consideration

Uganda Solar Water Pumping Report co-authored by the Africa Clean Energy Technical Assistance Facility and Open Capital Advisers, released in 2019, provides an overview of life time cost of solar pumps vs diesel pumps for varying outputs (m3/day). From the analysis, solar pumps have a clear advantage on lifetime costs as compared to diesel pumps. Further, the cost advantage is more for smaller output pumps as compared to the higher output installations. This plays favorably in humanitarian/rural/marginal settings where most installations are of less than 500m3/day.

In a separate analysis, Water Missions Uganda (WMU) used over 5yrs real time data collected from solar pumping installations in rural areas in Uganda (including refugee hosting districts) to arrive at interesting conclusions:

- CAPEX costs/Capita for fuel is on average less than that of solar only and definitely higher for solar/hybrids;
- As the size of installation increases as dictated by demand/number of people to be served, CAPEX costs/Capita reduces across the board;
- When Operation and Maintenance Costs are introduced total costs/capita/ year for solar only installations becomes cheaper in general although slightly cheaper for higher output installations;
- Overall, O&M cost as a percentage of total Life Cycle Costs is lowest for Solar only installations.

The solar pumping marketplace in Uganda has different players who work together to advance large scale adoption of the technology. In humanitarian settings in particular the enablers have been:

- Supportive policy and regulatory framework by the GoU which has facilitated key stakeholders to actively engage in this space including donors who finance the initiatives through grants. The MWE has developed and published Solar Powered water system design guidelines launched in September 2020, as an annex to water supply design manual. This was achieved with technical support from Engineers Without Borders (USA), a partner who works in the humanitarian/development space;
- Reliable and Efficient supply chains for solar pumping products, short turn around between design and implementation, as well as after sales service;
- Availability of technical capacity to design, implement and provide corrective and preventive maintenance to the solar installation.

The third driver is environmental considerations

With impacts of climate change being felt across the region, efforts to reduce carbon footprint have to be mainstreamed in provision of water particularly in the rural/marginal areas which more often lie in ecologically sensitive zones. A study undertaken by the Technical University of Denmark and Danish Refugee Council in Bidibidi refugee settlements in 2018 provides an overview with regard to CO2 Equivalent generated in an effort to provide water in refugee hosting areas. Of importance is:

- The correlation between CO2 equivalent generated against fuel or solar and solar/hybrid installations as well as installed capacity;
- The smaller the installation the lesser the contribution
- Essentially, at Zero O&M, Solar hybrids of higher capacities contribute higher CO2 equivalents, however, once O&M sets in, diesel only shoots up followed by solar/hybrids;
- Generally, solar only installations remain the least polluters when systems with equal output are compared;

Briefly, the solar powered pumping system chain in humanitarian setting starts with

- Solar Pumping System Software/Hardware Design: Grundfos & Lorentz software's are predominantly used as well as other proprietary softwares
- Financing/ Investment Options: Grants from donors and GoU investments
- Procurement/ Manufacturing and System Integration: Several companies although Grundfos & Lorentz pumps are mostly used.
- Implementation/ Installation: Contracting space is rich at the moment – some few dominant players in the market with a host of upcoming ones;
- Operation & Maintenance

Operation and maintenance is either handled by Utilities, District Local Governments, NGO partners or Community structures. Most of the solar installations have automatic sensors that sets in motion pumping once the solar irradiation is adequate to run the pump motor and then shuts off when irradiation goes down. Some installation have remote monitoring/IoT sensors that relay operational data to a central dashboard via satellite or GSM technology. Ordinarily, solar installations attendants are locally recruited from the community to provide security, switch on and off when necessary and ensure the solar array + compound is kept relatively free of bushes and shades/direct sunlight obstruction. They are also trained in cleaning the panels when dusty and logging performance data.

Data generated is analyzed to provide insights on efficiency and opportunities for optimization. You can observe from the graphs:
- Smaller pumps start earlier than larger pumps;
- Tendency to have significant energy losses (during peak hours) as pumps hit their max capacity;
- Correlation between wattage and capacity of pump, in relation to when the pump kicks in.

Overall, amidst the great promise potential risks exists which inadvertently present opportunities for growth

First one and most obvious, is elasticity in terms of solar irradiation: A spectrum of bright hot days versus cloundy wet/cold days. Ideally, this pattern fits perfectly with water demand curves. However, gaps in output during low irradiation days could be plugged with rainwater harvesting techniques;

Secondly, in rural settings attracting and retaining talent is not easy, leading to low technical capacity to monitor performance and provide timely trouble shooting skills. This can be mitigated by introducing remote sensing and IoT technologies to provide realtime operational profiles.

Thirdly, in practice instances of over design or under design of solar schemes are prevalent for various reasons. Data collected is rarely analyzed to inform optimization and normally resources to effect such are unavailable. There is need to incorporate agility on the Life Cycle of the water scheme to encourage analytics, design review and optimization of water schemes

Lastly, CAPEX costs for solar pumping is usually high and payback period at times deemed long. It advisable to consider system integration – potential applications relative to the context: taking advantage of excess power for lighting , charging, electronics.

The solar pumping space is dynamic and evolving rapidly, a lot to learn and opportunities to innovate are immense. An exciting time for the industry, lets keep the conversation going.

Thank you for listening