Humanitarian Aid
and Civil Protection

Global Solar and
Water Initiative

Global Solar and Water Initiative

Visit Report to Assess feasibility for Solarisation of Existing Water Points in Asosa and Shire Refugee Camps in Ethiopia

14th to 21st December 2016

Table of Contents

List of Annexes

1. Executive Summary and Recommendations

A two week visit was done to two refugee locations in Ethiopia namely Shire and Asosa refugee camps in Ethiopia with 17 water points being visited. In shire 10 water points were visited spread out in 4 camps namely Shimelba, Hitsats, Mai-Aini and Adi Harush. In Asosa, 7 water points were visited which are spread out in 3 camps namely Bambasi, Tsore and Sherkole. The water points were a combination of deep wells, river pumping systems and collection chambers/boosting stations and are all motorized and running on diesel generator power.

The visit included collection of all relevant data necessary for a technical and economic analysis of the systems in order to determine feasibility for solar pumping**. Of note is that none of the water points visited were running on solar power hence the potential for solar power remains untapped. However the technical expertise of the implementing partners for solar pumping is absent and this seems to be the major challenge for adoption of solar power in Shire and Asosa.**

Implementing partners have faced several challenges -that in some cases led to water shortages- such as failure of generators, delay in fuel delivery due to flooding in the wet season, unavailability of service and repair kits for the generators with some repairable generators being abandoned and new expensive replacement sets being procured due to lack of parts. These among others are some of the issues that are making adoption of solar power for pumping to be a feasible alternative in both locations.

Following the visit, a technical and economic analysis of the water points was carried out for 26 water points (including 9 that were not visited but data for them was provided by UNHCR, 2 of which are supplying water to the host community).

The technical analysis took into consideration the water demand based on the population data provided by UNHCR as well as the safe yield of the boreholes in order to ensure over-abstraction does not occur. **A recommendation has been made to equip all of them with either stand alone solar power or hybrid solar-diesel power to jointly supply 2,938m3/day of water (69% from solar power and 31% from diesel generators) for 146,900 people in the least favourable month in terms of solar radiation.** Recommendations have been made to use stand-alone solar systems for 6 of the water schemesto meet the current water demand but it has been noted that if future demand increases beyond a certain level, diesel pumping should be incorporated. In cases where solar-diesel hybrid has been recommended to meet current demand, ifdemand increase in the future, this can be met by prolonged pumping on generator.

A technical audit of the systems was also done and recommendations made for appropriate generator sizes as it was noted that **nearly 90% of the systems have oversized generators**, the implication being that the cost of O&M is unnecessarily higher. Due to long distances and high elevations, a couple of camps are using double pumping in order to deliver water to the tanks and priority should be given to replacing the generators with appropriately sized generators in order to reduce on fuel costs.

The economic analysis over the life cycle of the systems was carried out by bringing all estimated costs to a present worth, using the average of last 5 years real interest rates published by the World Bank for Ethiopia (details of methodology in annex A). The economic analysis compares the proposed solar stand-alone system/hybrid system with generator stand-alone systems. The analysis shows an average ***breakeven point for solar investment of 2.2 years*** **and an average reduction of expenses in installation and O&M cost** ***of -59%.*** The initial capital cost of solarizing 26 water points is estimated at around 1.575 million USD (cost of equipment up to the support structure). Taking into account the short payback period and the reduction of costs over the life of the systems it is easy to see how beneficial it would be to move into solarization of these water systems at the earliest opportunity. Besides that, the recommendations if implemented would represent an ***annual carbon reduction of 66%.***

As it is unlikely that all solarizations could take place as recommended, a prioritisation exercise should take place, taken into account the shortest break-even points and higher savings as expressed in table of page 10.

Of particular attention is the possibility of fully solarize Shire camp (average payback period of 1.8 years) and convert it to the first-ever 100% solarized refugee camp in the East African Region (and probably in the world); a headline that would typically gather the attention of donors, government and WASH stakeholders easily.

Both climatological and hydro geological conditions in all areas visited were favourable, and in light of the aforementioned challenges and coupled with the high operation and maintenance costs of diesel systems, it is apparent that solar pumping should be adopted for all boreholes in both Shire and Asosa. In addition, decreasing trend of solar product prices, solar incentives provided by government (e.g. zero tax on imported solar panels), availability of technical expertise at private sector level in Addis Ababa, interest shown by donor community to solar solutions in Ethiopia make the context ideal to mainstream the use of solar pumping in the areas visited and beyond. In addition, it has to be considered that mismanagement of fuel supplies is a common issue in many operations; therefore, any option involving adoption of Solar technology will limit this problem, with cost-savings likely higher than the ones expressed in the analysis below. Finally other aspects beyond economic considerations (such as sustainability, reliability, possibility of running equipment regardless of access to area and environment) should be discussed in favor of the solar option.

Other issues

The single most important barrier towards a successful solarization of water points in the camps visited is the low solar technical expertise of WASH stakeholders involved in the refugee response, including UNHCR. Towards addressing this, a 2-day training was conducted in Addis Ababa with the presence of most of the major WASH actors in the country. Half day trainings were also conducted in the field locations at both Shire and Asosa. Tools, documents and contacts for remote support were provided during the training. However it would be important that all organizations and specially coordinating agencies build their own technical capacity and take a lead to organize refreshment trainings, taking advantage of the knowledge already present in Ethiopia and widening and adapting the scope of these trainings to address real problems encountered in the field.

Besides that, ***the use of good quality products with right quality certifications is strongly encouraged***, since solar technology makes more sense when thinking in the medium and long term. Costs can be reduced through bulk procurement and/ or signing of framework agreements to ***get large quantities of solar panels at once, as solar panels represents 35 to 50% of costs in any solar pumping scheme and they can be used in any water point*** (unlike pumps or inverters that are specific to each water point characteristics).

Depleting water levels and drying up of some boreholes is an issue of great importance in all areas visited and monitoring and interpretation of both water level and abstraction rates should be reinforced, as this was weak or absent in almost all boreholes assessed and it is the only way to anticipate drying up of boreholes. ***While solar technologies are not a solution for depleting aquifers, they offer the possibility to daily remotely monitor and record water levels*** in a very easy way. The use of remote monitoring is therefore recommended especially for critical and/or distant boreholes, till the moment when a sound understanding of the aquifer exploited is gained.

Finally, some partners have already introduced solar pumping at local community level. While technical solar pumping offers similar advantages as in camps, working at community level has an extra-layer of complexity related to the O&M of equipment. ***Contrary to the widespread idea that once installed, solar schemes will last long years on their own, after sale support is important especially from the first 18-24 months to ensure long lasting solar schemes***. A well thought approach, involving contribution from users and a good system to provide after sale support when needed (either government water office, NGOs, water utilities or private sector companies) is of paramount importance, as it is likely communities won't be able to solve certain problems on their own, even if trained. In this sense, coordinating approaches with government water offices should be a pre-requisite for these kinds of projects.

Recommendations:

For implementing organizations:

- Build technical capacity in order to know what designs, products and layouts are the best suited for every borehole. In addition build the technical capacity of technicians to be able to trouble shoot and repair solar systems
- Ensure after sale support service for the first 18-24 months after installation in a contract at the time of tendering or purchase. Favor 1-supplier policy to ensure warranties are kept in case of problems.
- Ensure regular monitoring of water levels, at least in the most critical boreholes, considering the possibility of using remote monitoring technologies. Additionally ensure chlorination of water in all solar schemes at refugee camp level (consideration should be made for automatic dozers which are more reliable, efficient and effective)
- Consider replacing the existing GI drop pipes with borehole PVC pipes especially in Shire where the water is aggressive making the pipes prone to corrosion with subsequent frequent replacement.

For coordinating organizations:

- Name/recruit a focal solar person at organizational level. Reinforce inter-agency collaboration among implementing/ operating partners, in order to build up internal technical capacity. Use expertise available at country level (experienced WASH partners and private sector) to organize workshops and trainings and raise technical expertise among relevant NGOs and government technical staff. Designate 2 water technicians to be invited to the advanced solar pumping training in Nairobi with the aim they become solar focal points for WASH partners in Ethiopia.
- Encourage the use of UNHCR Water Point Goggle Drive by all partners working in refugee camps –or organize a similar centralized data collection system-, in order to compile and manage information related to water points.
- Assess different modalities for buying solar panels in bulk (at country level or through regional offices)
- Consider pumping (using solar power) and treating surface water from Sorenta dam in Shire (cover picture) in order to supply water to the host communities and the freed up boreholes can be used to increase supply to the refugees
- Create an environment among WASH partners for serious consideration to be given to adoption of solar pumping from the initial stage of a project.

For Government/ Donors:

- Assess the possibility to support/ promote a solar training center at University level, as the one existing in Nairobi, that would serve as a reference for regular training of both government, NGO, UN technical staff as well as for private sector actors.
- Consider the possibility to include solar water technologies in their strategic documents. Favor solar pumping technology at camp level, including evaluation of actions and further building up of evidence on suitability of solar pumping for the given contexts.

- Consider the possibility to support the creation of a focal solar expert at country level to support all WASH actors in the mainstreaming of solar technologies in refugee camps and local communities.

2. Objectives of Mission and Team

Following discussions with UNHCR, it was agreed that the Global Solar and Water conducts field visits to assess and gauge the feasibility for using solar for pumping water in refugee camps in Ethiopia. Terms of reference were drawn and agreed in coordination with UNHCR Ethiopia team and are shown in Annex B.

The visit was conducted with the aim of achieving the following:-

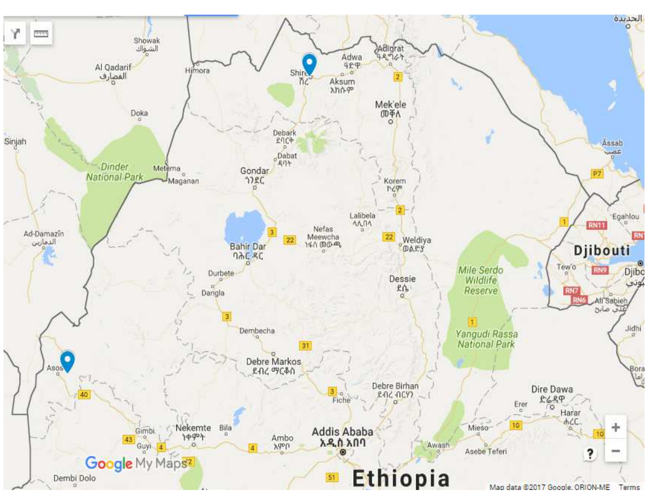
- Gauge the possibility to solarise water schemes in refugee camps of Asosa & Shire
- Raise awareness and technical expertise of field WASH teams to autonomously design solar schemes and evaluate economic viability in Asosa & Shire
- Brainstorm and decide together with UNHCR WASH coordinator and Country Management and UNICEF WASH counterparts on next steps to scale up use of solar water schemes in Ethiopia

3. Description of Areas Visited

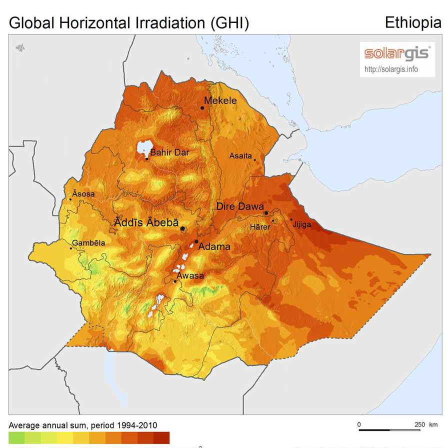
Shire Refugee camp is located to the North of Ethiopia. The camp has 4 camps (Shimelba, Hitsats, Mai-Aini and Adi Harush) with a total population of approximately 65,000 refugees. The WASH implementing partners is IRC and all the functional water points are running full time on diesel generators. The IP is also supplying water to the host communities. The camp has a total of 17 boreholes i.e. 15 serving the refugees and 2no serving the host community. 2 are not functional namely: Hitsats BH2 (high iron and manganese level) and Adi Harush BH 2 (failed pump). Treatment of water from Hitsats BH 2 is recommended prior to solarization for the system to be viable.

Asosa Refugee camp is located to the West of Ethiopia. The camp has 4 camps (Bambasi, Tsore, Sherkole and Tongo) with a total population of approximately 60,000 refugees. The WASH implementing partners are LWF and IRC and all the functional water points are running full time on diesel generators. The IPs are also supplying water to the host communities There are a total of 10 boreholes and one river system serving both the refugees and local community. Out of the 10 boreholes 2 were not operational at the time of the visit namely: Bambasi BH1 (as a result of flooding and retrieval has been challenging as the ground is very soft and sinks during installation) and Sherkole BH2 (lack of funds).

The two locations visited have good irradiation levels. Asosa has an average of 6.0 peak sun hours and Shire has 6.5 peak sun hours pointing to the feasibility for using solar power in both locations. The camps represent a typical example of a protracted refugee situation and further strengthens the idea of mainstreaming solar pumping in refugee camps.



Shire and Asosa Location



Average annual Solar Irradiation – 1994-2010

4. Water point and existing system: main characteristics

Existing motorized boreholes were assessed. Non-optimal sizing of systems (undersized delivery pipes and oversized generators) was the most common problem encountered. Cases of non-functioning water meters were encountered bringing to light the problem of lack of monitoring of system performance.

Yield from the boreholes in both locations have declined in the recent past, and the consequential over abstraction has led to mineralization of the water (example Hitsats BH2) with the borehole being abandoned. This has resulted in reports of frequent wearing out of pipes due to salinity and seasonal variation of water levels and output. Other problems encountered included seasonal failure of generators due to flooding. As expected, operating generators remains the biggest challenge due to fuel delivery problems especially during the rainy season and unavailability of service and repair kits with repairable generators being abandoned and new expensive replacement sets being procured due to lack of parts.

Manual chlorination was the most common method for chlorination and it is recommended that automatic in-line dosing of chlorine be adopted as it is more reliable, efficient and effective. Even though siltation was not a rampant problem (reported only in one borehole), due to the age of the boreholes it would be prudent to study the current borehole characteristics to determine whether cleaning would be necessary for all boreholes in order to avert future problems. It was noted that none of the sites visited were equipped with solar pointing to the untapped potential for use of solar power.

A table with the main characteristic and recommendations for the ***existing mechanized boreholes*** is shown below.

Site Details				Technical Design							Priority of recommendation
No.	Camp	BH ID	Managing Agency	Proposed Power Pump kW	Proposed Solar Power Size	Daily Water Demand (m3/day)	Daily Output Solar (m^3/day) in month with least output	Daily Output Generator (m^3/day)	Combined Daily Output (m3/day)	Comment /Recommendation	
1	Shimelba	BH#1	IRC	7.5	10,500	28.8	46.1	0.0	46.1	Change to 7.5kW pump stand alone solar to meet the current demand of approx.30m3/day. To cover future demand, generator can be used to supplement but should be reduced to 22.5kVA to reduce fuel cost	High
2	Shimelba	BH#2	IRC	5.5	9,500	25.9	41.5	0.0	41.5	Power existing pump with stand alone solar to cover current demand of approx. 26m3/day. To cover future demand, generator can be used to supplement but should be reduced to 16kVA to reduce fuel cost	High
3	Shimelba	BH#3	IRC	22.0	31,500	144.0	104.3	39.7	144.0	Power existing pump with solar power and run pump on hybrid solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 65kVA to reduce fuel cost	High
4	Maia-ini	BH#2	IRC	4.0	6,000	131.0	62.0	69.0	131.0	Change to 4kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 12kVA to reduce fuel cost	High
5	Maia-ini	BH#4	IRC	1.5	2,500	12.4	16.9	0.0	16.9	Change to 1.5kW pump stand alone solar to meet the current demand of approx.17m3/day. To cover future demand, generator can be used to supplement but should be reduced to 5kVA to reduce fuel cost	High
6	Maia-ini	BH#6	IRC	5.5	7,500	85.9	51.7	34.2	85.9	Change to 5.5kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 16kVA to reduce fuel cost	High
7	Maia-ini	BH#7	IRC	5.5	7,500	126.0	54.8	71.2	126.0	Power existing pump with solar power and run pump on hybrid solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 16kVA to reduce fuel cost	High
8	Maia-ini	BS1	IRC	18.5	30,000	175.0	114.0	61.0	175.0	Power existing pump with solar power and run pump on hybrid solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 55kVA to reduce fuel cost	High
9	Maia-ini	BS2	IRC	22.0	38,000	180.0	160.8	19.2	180.0	The existing pump is inefficient for the motor size. Change to a new 22kW pump and run on hybrid to meet the current boosting requirement of 180m3/day.	High
10	Adiharush	BH#1	IRC	4.0	7,000	45.4	33.1	12.3	45.4	Change to 4kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 12kVA to reduce fuel cost	High
11	Adiharush	BH#2	IRC	7.5	10,000	81.0	56.5	24.5	81.0	Power existing pump with solar power and run pump on hybrid solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 22.5kVA to reduce fuel cost	High
12	Adiharush	BH#7	IRC	7.5	13,500	64.8	45.1	19.7	64.8	Change to 7.5kW pump and run on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 22.5kVA to reduce fuel cost	High
13	Adiharush	BH#5	IRC	5.5	10,000	48.6	35.7	12.9	48.6	Change to 5.5kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to16kVA to reduce fuel cost	High
14	Adiharush	BH#6 (Host)	IRC	4.0	7,000	38.9	27.9	11.0	38.9	Change to 4kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to12kVA to reduce fuel cost	High
15	Adiharush	BH#9 (Host)	IRC	11.0	19,000	74.5	52.9	21.6	74.5	Change to 11kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 33kVA to reduce fuel cost	High
16	Hitsats	SBH#1	IRC	3.0	5,250	65.5	32.8	32.7	65.5	Change to 3kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset to 10kVA to reduce fuel cost	High
17	Hitsats	BH#1	IRC	5.5	9,000	79.6	36.3	43.3	79.6	Change to 5.5kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Appropriate genset	High
18	Hitsats	BH#2	IRC	5.5	9,000	115.2	82.3	32.9	115.2	Power existing pump with solar power and run pump on hybrid diesel-solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 16kVA to reduce fuel cost	High
19	Hitsats	BH#3	IRC	3.0	5,250	37.4	30.9	6.5	37.4	Change to 3kW pump and operate on hybrid solar-diesel to meet demand. Future demand can be met by longer pumping on genset. Change genset size to 10kVA	High
20	Hitsats	Collecting Chamber	IRC	15.0	25,000	300.0	156.0	144.0	300.0	Power existing pump with solar power and run pump on hybrid solar to meet demand. Future demand can be met by longer pumping on genset. Change genset to 45kVA to reduce fuel cost	Medium
21	Bambasi	BH#1	LWF	30.0	45,000	202.0	131.4	67.0	198.4	Change to 30kW pump for optimal performance and run on hybrid solar. Change the genset to 80kVA to reduce fuel cost	Medium
22	Bambasi	BH#3	LWF	18.5	28,000	126.0	76.5	49.0	125.5	Change to 18.5kW pump for optimal performance and run on hybrid solar.	High
23	Tsore	BH3	LWF	22.0	36,000	260.0	133.4	126.0	259.4	Retain the existing pump size and run on hybrid solar. Change the generator to 65kVA	High
24	Sherkole	Kibur Hamsa	LWF	18.5	28,500	79.1	100.7	0.0	100.7	Retain the existing pump and power with stand alone solar to meet demand of 80m3/day and get extra for an additional 1,300 people	Medium
25	Sherkole	BH#1	LWF	15.0	25,000	81.7	120.4	0.0	120.4	Retain the existing pump and power with stand alone solar to meet demand of 82m3/day and get extra for an additional 2,500 people	Medium
26	Sherkole	River System	LWF	15.0	25,000	139.2	235.8	0.0	235.8	Retain the existing pump and power with stand alone solar to meet demand of 139m3/day and get extra for an additional 6,400 people	Medium

For more details on any of the boreholes in the table, contact solarquery@iom.int

5. Economic analysis

An agreed methodology to compare costs over life cycle of different technology options was used, in order to better inform decisions when it comes to motorizing boreholes. Prices used for this analysis were averaged from real quotations shared by implementing agencies and estimations taken from existing reports on costs of repairs and maintenance of generators. Details of methodology can be found in Annex A.

An economic analysis was done comparing the existing diesel systems with solar stand-alone or hybrid ones (see table below), showing an *average breakeven point for solar investment of only 2.2 years* which is short, and so very favorable to Solar schemes. The *average reduction of expenses in installation and O&M cost was estimated at -59%.* The initial capital cost of solarizing 26 boreholes is estimated at around 1.575 million USD (cost of equipment up to the solar structure) and could supply 2,938m3/day (69% from solar power and 31% from diesel generators) of water for 146,900 people in the worst solar month.

Site Details							Economic/Life Cycle Analysis					
							Generator stand alone		Solar stand alone or Hybrid		Hybrid/Solar - Diesel Comparison	
No.	Camp	BH ID	Managing Agency	Daily Output Solar (m^3/day) in month with least output	Daily Output Generator (m^3/day)	Combined Daily Output (m3/day)	Initial cost (USD)	Cost over Life Cycle (USD)	Initial cost (USD)	Cost over Life Cycle (USD)	Reduction of expenses Hybrid/Solar vs Genset	Break-even point
1	Shimelba	BH#1	IRC	46.1	0.0	46.1	$28,322	$420,097	$33,698	$108,761	-74%	0.9 years
2	Shimelba	BH#2	IRC	41.5	0.0	41.5	$16,254	$483,525	$25,594	$100,509	-79%	1.4 years
3	Shimelba	BH#3	IRC	104.3	39.7	144.0	$25,471	$2,183,229	$97,539	$704,996	-68%	2.4 years
4	Maia-ini	BH#2	IRC	62.0	69.0	131.0	$24,587	$1,850,127	$22,700	$1,071,180	-42%	0.7 years
5	Maia-ini	BH#4	IRC	16.9	0.0	16.9	$11,469	$393,024	$13,832	$86,162	-78%	0.3 years
6	Maia-ini	BH#6	IRC	51.7	34.2	85.9	$26,711	$976,270	$43,148	$519,539	-47%	1.6 years
7	Maia-ini	BH#7	IRC	54.8	71.2	126.0	$16,254	$1,353,395	$37,634	$882,410	-35%	2.0 years
8	Maia-ini	BS1	IRC	114.0	61.0	175.0	$25,471	$2,331,288	$93,130	$1,325,478	-43%	3.0 years
9	Maia-ini	BS2	IRC	160.8	19.2	180.0	$43,906	$2,510,982	$120,508	$1,369,210	-45%	2.8 years
10	Adiharush	BH#1	IRC	33.1	12.3	45.4	$24,946	$782,559	$40,336	$310,877	-60%	1.8 years
11	Adiharush	BH#2	IRC	56.5	24.5	81.0	$16,886	$901,844	$43,188	$363,806	-60%	2.2 years
12	Adiharush	BH#7	IRC	45.1	19.7	64.8	$32,161	$1,248,271	$60,226	$482,450	-61%	1.7 years
13	Adiharush	BH#5	IRC	35.7	12.9	48.6	$29,638	$997,115	$50,911	$368,670	-63%	1.6 years
14	Adiharush	BH#6 (Host)	IRC	27.9	11.0	38.9	$24,452	$1,288,365	$39,842	$676,175	-48%	1.2 years
15	Adiharush	BH#9 (Host)	IRC	52.9	21.6	74.5	$38,902	$1,390,523	$77,676	$522,602	-62%	2.0 years
16	Hitsats	SBH#1	IRC	32.8	32.7	65.5	$22,984	$1,021,561	$34,863	$600,892	-41%	1.0 years
17	Hitsats	BH#1	IRC	36.3	43.3	79.6	$27,240	$1,719,427	$46,579	$1,004,596	-42%	1.2 years
18	Hitsats	BH#2	IRC	82.3	32.9	115.2	$16,254	$774,731	$40,794	$313,797	-59%	2.5 years
19	Hitsats	BH#3	IRC	30.9	6.5	37.4	$24,044	$719,471	$35,923	$220,976	-69%	1.5 years
20	Hitsats	Collecting Chamber	IRC	156.0	144.0	300.0	$23,191	$1,794,257	$88,594	$983,025	-45%	3.7 years
21	Bambasi	BH#1	LWF	131.4	67.0	198.4	$52,775	$1,459,939	$143,464	$392,051	-73%	3.6 years
22	Bambasi	BH#3	LWF	76.5	49.0	125.5	$45,739	$2,020,959	$102,688	$699,103	-65%	2.0 years
23	Tsore	BH3	LWF	133.4	126.0	259.4	$25,471	$2,120,345	$105,757	$1,049,165	-51%	3.3 years
24	Sherkole	Kibur Hamsa	LWF	100.7	0.0	100.7	$25,471	$708,144	$63,484	$143,925	-80%	3.5 years
25	Sherkole	BH#1	LWF	120.4	0.0	120.4	$23,191	$428,205	$56,371	$133,752	-69%	4.7 years
26	Sherkole	River System	LWF	235.8	0.0	235.8	$23,191	$528,452	$56,371	$133,752	-75%	3.9 years

Full economic analysis report for any of the systems in the above table is available upon request at solarquery@iom.int

6. Final technical observations

Low solar technical competence is the main obstacle towards a successful solarization of existing boreholes and organizations including UNHCR should discuss on options available at country level to close this gap.

Chlorination (especially in-line) should be standard in any mechanized borehole whether it is powered with solar or not. The size of the tanks for solar schemes (whether stand alone or hybrid) need attention, as normally solar schemes will require larger tanks in order to store as much water as possible during sun hours, even though the demand might be low at that time.

The solar initiative aim to support organizations willing to go solar and it that regard, a technical helpline is open and freely available up to April-2018 at solarquery@iom.int

7. Summary of next agreed steps

- Use of tools and documents provided during training to gauge solar opportunities for existing and future boreholes.
- Public debriefing to be organized during the next visit in the coming 3 months
- Internal discussion at organizational level for inclusion of Solar Pumping into country documents, country plans, strategic papers.
- Naming of 2 solar contact focal people in the country that will be invited by the Solar Initiative to get further training, bring it back to Ethiopia.
- Further 1-week training will be available at Energy Research Center in Strathmore University, Kenya. The solar team will share dates and details as they are made public.

8. List of Annexes

- Annex A – Economic analysis methodology and example
- Annex B – Terms of References
- Annex D – Example of tendering document and scoring table
- Annex E – Water point level: physical checklist, maintenance and recommended monitoring table