Solar Drinking Water Supply Am Nabak, Chad

Subject	Am Nabak refugee camp	**Location**	Am Nabak, Chad
Application	Drinking and Sanitation Water	**Project Partner**	HELP - Hilfe zur Selbsthilfe e.V.
Size	Daily requirements of 42,000 USG of water	**Installation**	2013

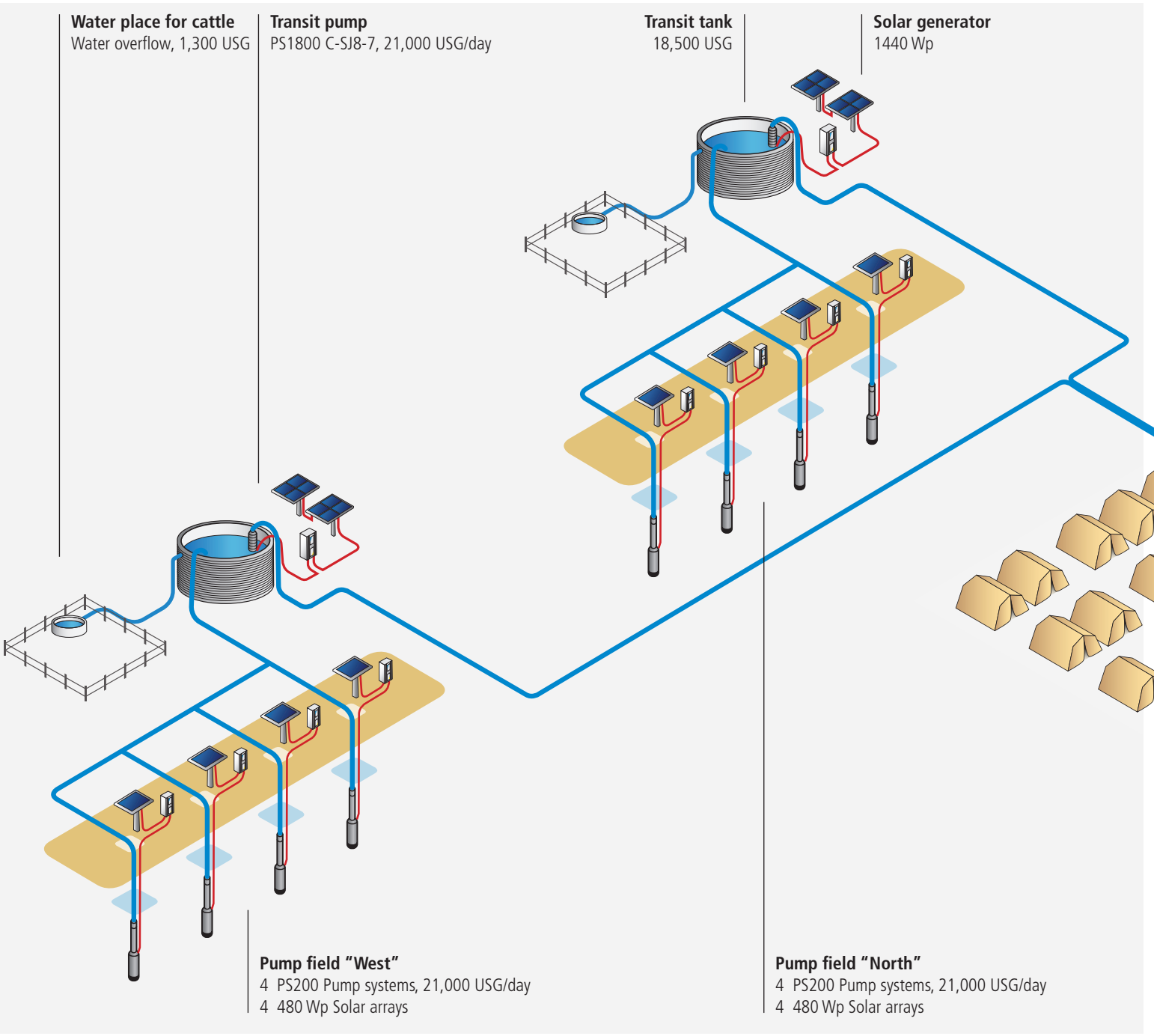
The refugee camp in Am Nabak helps more than 13,000 displaced people in an area with almost no natural resources. The camp was originally supported by trucking in 37,000 USG of water per day. The trucks had to carry the water 30 Km which proved to be expensive and was prone to external influences such as breakdown. A water supply system was first installed in 2009, the original pumping system proved difficult to operate because of the challenging ground and water conditions.

The original pumps have been replaced with LORENTZ helical rotor pumps which are performing very well. The camp now has a stable water supply and also supports the local population. The need to transport water by truck has now gone, making significant cost savings for the NGO responsible for water in Am Nabak.

The refugee camp in Am Nabak is one of several camps helping displaced people after decades of civil war in the neighboring Sudan. Water is a rare resource in the area which made the water supply of the refugee camp challenging. There were some historic tensions with the local community as they saw that the refugee camp inhabitants had a better water supply than they did.

Building a sufficient water supply system in Am Nabak is complicated, because water can only be pumped out of the nearby dry riverbed at low depths of approximately 50 ft. The water level continuously drops until it is refilled during the rainy season. Very fine sand blocks the wells' sole if too much water is pumped out in a short period of time. The initially installed pumps could not cope with this problem.

Am Nabak Water Supply System



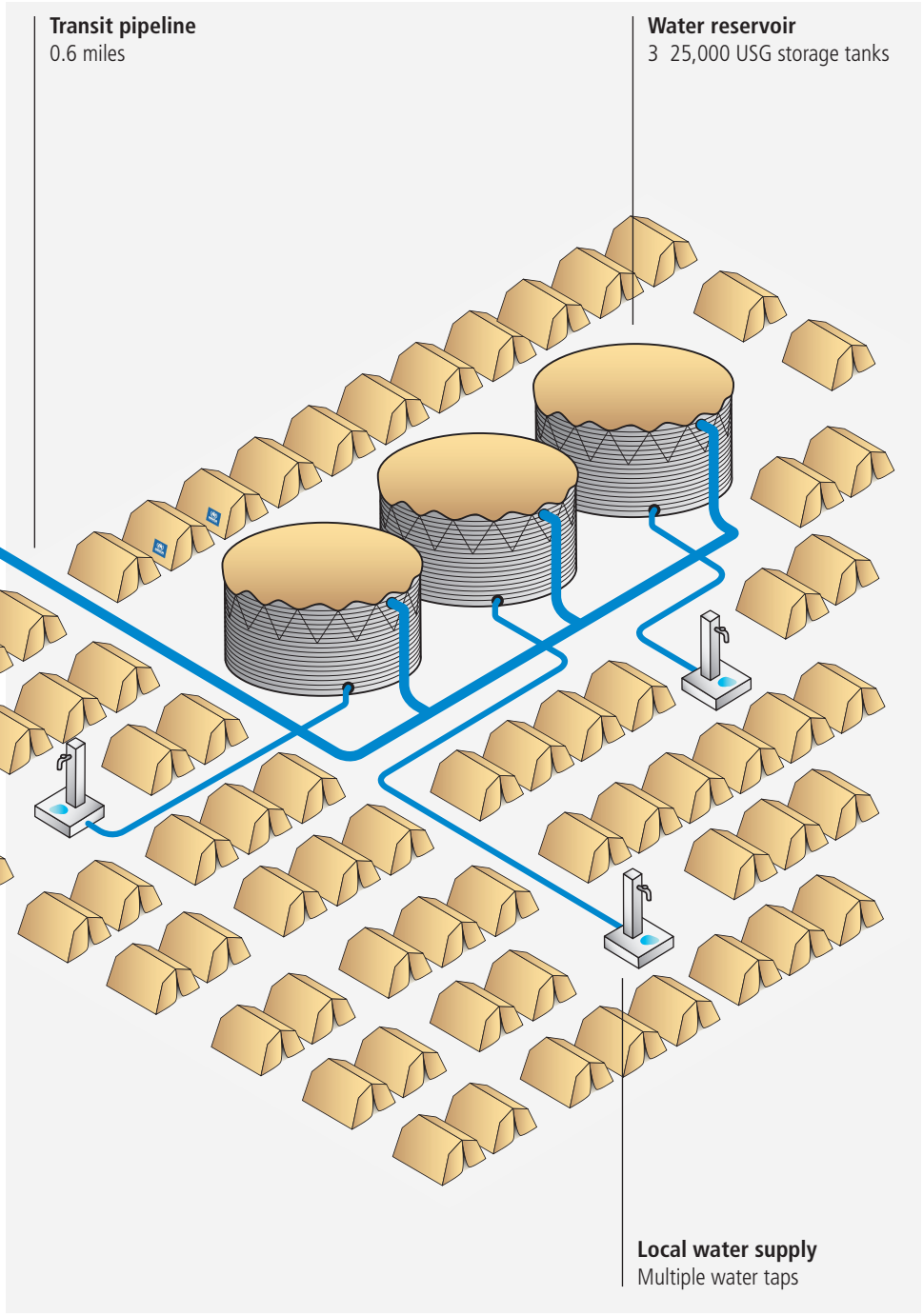
PROBLEM: Geological Conditions

Located in the south Saharan desert, water naturally is a scarce resource in Am Nabak. There is no general underground water level, as Am Nabak is situated on a solid granite plateau at 3.000 ft above sea level. The only known water reservoirs are found under dry rivers – wadis – that are refilled during the rainy season with a maximum rainfall of 12 in. The water reservoirs are at an average depth of 50 ft. For these reasons borehole wells are not an option.

The only alternative were traditional open wells. Initially, the camp was supplied by wells from up to 30 miles distance until more close reservoirs were discovered. The new wells in the wadis are 0.6 miles outside of Am Nabak.

Problems with Third-Party Pumps

Urban Britzius, HELP project manager in Chad, describes the problems with early pump installations: "Initially, the wells were equipped with different diesel and gasoline powered AC surface pumps of well-known brands. Due to relatively high flow volumes in interval mode very fine sands were constantly filtering into the wells. Some wells had to be freed of sand on a weekly basis. Therefore we also gave up on running



the submersible AC pumps of another European quality pump manufacturer, as the risk of sand entering and damaging the sensitive pumps was too high.

Only when we discovered the LORENTZ helical rotor pumps, this risk became manageable. The PS200 HR-14 pumps are designed to deliver a very constant low flow rate, solving the sand issues.

As the pumps run on DC current, installing a solar array to generate the power was only logical – even more so, being on the height of the 15th latitude."

Upscaling the solar array and installing additional more powerful LORENTZ PS1800 submersible pumps to feed the water into the local water distribution system then was the next logical step.

SOLUTION: LORENTZ Solar Pump System

The solution to the different geological problems was found in using LORENTZ helical rotor pumps. The existing field of four wells to the West of the camp was equipped with four LORENTZ PS200 HR-14 pumps, which are specifically designed for low water volumes. The pumps have an output of approximately 5,300 USG of water per day with all the benefits of smoothly operating LORENTZ DC pumps. The helical rotor positive displacement pump reduces the turbulence inside the well stopping the well from blocking and keeping sand out of the pump.

To generate the necessary amount of water, a second well field with four PS200 HR-14 pumps was built north of the camp. The eight LORENTZ PS200 HR-14 solar water pumps are each powered by PV modules with 480 Wp. Each field is connected to a 18,500 USG water storage tank.

One LORENTZ PS1800 C-SJ8-7 in each 18,500 USG tank feeds the stored water into the distributing system with three 25,000 USG tanks 0.6 miles away. The PS 1800 pumps are powered by PV modules with 1.440 Wp each.

The pumping volumes of the pumps follow a flow plan, as all pumps operate according to the sun cycle. The volumes pumped out of the 18,500 USG storage tanks by the PS 1800 pumps is set to a little less, than what the related fields of four PS200 each deliver. An overflow in the storage tanks then fills a basin used by cattle with the water surplus. This way, the water level in the transit tanks will always remain on the adjusted level as long as there is a minimum flow of water. The valuable water is used as effectively as possible.

Photos of the Project

From left to right: PV module installation, PV installation training, pump installation, water supply hub

RESULTS

The eight PS200 HR-14 pumps each deliver the designed 5,300 USG of water per day, providing about 42,000 USG of water for the camp and the local population. A partial installation was running since July 2012, with the complete system now online since February 2014. Sands and sediments in the water no longer are a problem and do not block the wells. The overflow system in the transit tanks also works as planned, providing drinking water for cattle on site as a very positive additional value of the installation.

The delivered output already exceeds 2,600,000 USG of water, equivalent to more than 250 tank truck transfers. Thousands of gallons of fuel were and will continue to be saved through the use of the solar powered water supply system. All system maintenance is done by trained locals.

Due to this project being a great sustainable success, the European Renewable Energy Council (EREC) awarded HELP with the German solar award 2013.

"The LORENTZ solar pumps were the optimal solution to the problems of Am Nabak." Berthold Engelmann of HELP says. "The wide portfolio of specialized pumps allowed us to build an efficient and lasting local water supply system, very specific to the difficult geological conditions.

This not only helped to ease the tense atmosphere between refugees and locals by guaranteeing a sufficient supply to all, it also freed an enormous amount of resources for other HELP projects."

Calculation of the Energy Cost and Financial Analysis

Table 1 compares the cost of water transport to the cost of installation and operation of the solar powered pump system and to the hypothetical cost of a diesel powered alternative.

Supplying the camp with water transported over large distances was necessary while no local sources were available. With local water sources found in the wadis, the transport from distance became extremely inefficient. The cost for acquiring and installing the solar water pump system was only 20% of the regular water transport cost per year. Even though local people were trained by HELP to maintain the system, regular maintenance for the solar system only means cleaning the panels.

On a five year scale, cost savings amount to more than 3,000,000 USD that can now be used for other humanitarian support projects.

Table 1: Cost savings over time
For daily water requirements of 42,000 USG

Energy source	Water transport	PV	Diesel
Well building	0 USD	49,000 USD	49,000 USD
Pumps and installation	0 USD	27,500 USD	10,000 USD
Additional infrastructure	0 USD	27,500 USD	27,500 USD
PV modules	0 USD	16,500 USD	0 USD
Diesel generator	0 USD	0 USD	14,000 USD
Initial system cost	**0 USD**	**120,500 USD**	**100,500 USD**
Energy required per day	-	29 kWh	29 kWh
Tanktruck cost per year	438,000 USD	0 USD	5,000 USD[2]
Diesel cost per year	197,600 USD	0 USD	6,112 USD
Maintenance/servicing	0 USD	500 USD	3,500 USD
Yearly Operational cost	635,600 USD	500 USD	14,612 USD
1 year cost	635,600 USD	121,500 USD	115,112 USD
5 year cost (no cost increase)	**3,178,000 USD**	**123,000 USD**	**173,560 USD**
5 year cost (cost increase)[1]	**3,531,769 USD**	**123,155 USD**	**182,939 USD**

[1]Assuming an annual general cost increase of 3% and an annual 10% increase on fuel

What about a diesel powered system instead?

Comparing the installed solar water pumping system to a hypothetical diesel system shows diesel is no alternative for a number of reasons.

Because wells and infrastructure would have had to be built for both systems, the initial installation cost for diesel would only have been slightly lower compared to a solar system. The savings in lower costs for AC pumps and diesel generators are outweighed by higher maintenance cost after just two years in operation.

The diesel generator needs more intensive regular servicing and parts replacement which also requires more skilled labor. Additionally, the generators either need regular refueling or fuel storage tanks on site. Assuming regular tank sizes for appropriate generators, refueling would have to be done about 35 times per year. Installing alternative fuel tanks would force a need for guarding the site, also resulting in higher costs.

Talking into account a moderate increase of general costs by 3% and a realistic annual increase of fuel prices by 10%, a diesel system would be almost 50% more expensive than a LORENTZ solar water pumping solution on a five year scale.

Hilfe zur Selbsthilfe e.V.

About HELP - Hilfe zur Selbsthilfe e.V.

Help – Hilfe zur Selbsthilfe e.V. is a German non-governmental relief organization duly registered with the courts of law in Bonn.

In the wake of the war in Afghanistan and the ensuing refugee crises, members of Parliament of all parties represented in the German Parliament and other distinguished personalities founded Help in July 1981. Help started its work by providing humanitarian assistance for Afghan refugees having fled to Pakistan. After the very first years of its existence, Help started to continuously expand its humanitarian work to other countries. Aid is given regardless of race, creed or nationality of the recipients and without adverse distinction of any kind. Aid priorities are considered solely on the basis of need.

Working with refugees throughout the world is a particular responsibility of Help's humanitarian work. Thereby Help never loses track of the overall policy: "help to self-help". The persons concerned are empowered to improve their environment self-propelling. Therefore Help is always cooperating with local partner organizations, because locals know their people, their culture and therefore the needs of the people better than any foreign expert.

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LORENTZ

LORENTZ is a market leader in solar powered water pumping solutions.

Founded in Germany during 1993 LORENTZ has pioneered, innovated and excelled in the engineering and manufacturing of solar powered water pumping.
Today LORENTZ is active in over 120 countries through a dedicated network of professional partners. LORENTZ technology uses the power of the sun to pump water, sustaining and enhancing the life of millions of people, their livestock and crops.

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