COMMUNITY ENERGY TECHNOLOGY IN THE MIDDLE EAST

COMET-H2O

Provision of Sustainable Water Services to off-grid Palestinian Communities in Area C

January 2017

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INTRODUCTION

Introduction

Water and energy are two urgent, and in many ways interdependent, needs facing rural Palestinian communities in the occupied Palestinian territories, in particular the off-grid rural communities in Area C of the West Bank. Since 2013, Comet-ME has developed and implemented its water program at the intersection of these two needs, building on our extensive experience in the renewable energy sector to provide comprehensive renewable-energy-based water services for communities struggling to survive in harsh climatic and political conditions.

Photo: Jon Persson

Defining the Problem

Access to water is one of the most acute issues facing impoverished off-grid rural communities worldwide. This is manifested, among other things, in insufficient water supply, inadequate delivery means, and poor water quality. In the rural Palestinian communities in Area C of the West Bank, this global problem set is colored by the specific reality of the Israeli Occupation, with its discriminatory planning and resource policy and denial of basic infrastructure to Palestinians—even as electricity and water lines run literally over people's heads, beneath their feet, and through their lands to connect illegal Israeli settlements to the grid.

The communities residing in the south Hebron hills, where Comet-ME has worked for the past decade, subsist primarily on herding and non-mechanized agriculture. They rely on rainwater harvesting and cistern storage for water supply, as do most Palestinian communities in Area C.

photo: Tomer Appelbaum

Families subsist on as little as 20 liters of water per capita per day—one fifth of the amount recommended by the World Health Organization. Neither connected to the water grid nor permitted to build new or access many existing cisterns for rainwater harvesting, families often exhaust their water supply early in the summer and need to purchase water in tanks and transport it to their dwellings, the price they pay reaching 8 to 10 times the tariff for grid-connected users. Rain runoff into the cisterns is contaminated with organic waste, impacting the quality of drinking water and the state of health in these communities, especially among children, the sick, and the elderly. And finally, because cisterns are not equipped with mechanized pumping capacity (due to the more general lack of electricity), water is drawn and carried manually. The burden of obtaining water for domestic use falls disproportionately on women and girls, who, global statistics show, can spend 15-17 hours per week collecting and carrying water. The time lost collecting water reduces income, reinforces poverty, disempowers women, and hinders education, while the lack of proper delivery means increases the risk of water-borne diseases, endangering community health.

photo: Ryan Brand

photo: Guy Butavia

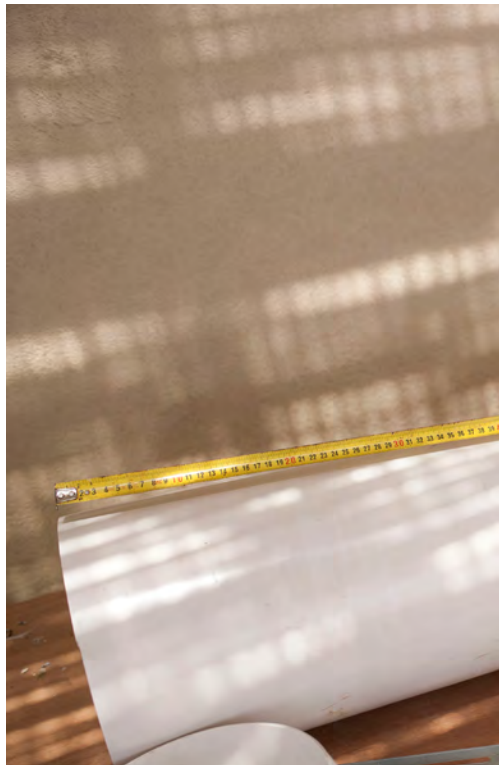
Technological Development

In 2013, after five years of designing, installing, and maintaining off-grid renewable-energy systems for communities in the south Hebron hills, Comet-ME entered the field of sustainable off-grid water solutions. Water supply in SHH is based on rainwater harvesting, and is managed on a household level, around the family cistern. Solutions would therefore need to be on a household level as well.

The two technical challenges we faced were: (1) filtration; and (2) integration of the pump into the community's energy micro-grid. Both of these challenges had to be met within the constraints of tiny scale and tiny price, while maintaining robustness and reliability.

The bio-sand filter

During the development phase, we tested and evaluated various hi-tech filtration technologies and methodologies—UV filtration, chlorination and de-chlorination, and others—before finally arriving at one of the simplest and most affordable of water filtration technologies, namely, bio-sand filtration. Using an open-source design from CAWST—The Centre for Affordable Water and Sanitation Technology—we adapted the design of the bio-sand filter to the local market and developed a PVC version of the filter container, which is now being produced for Comet-ME's H2O project by a local Palestinian manufacturer.



The bio-sand filter (BSF) is an adaptation of the traditional slow-sand filter, which has been used for community drinking water treatment for 200 years. The filter container can be made of concrete or plastic. It is filled with layers of specially prepared sand and gravel, which remove pathogens and suspended solids from contaminated drinking water. A biological community of bacteria and other micro-organisms grows in the top 2 cm of sand. The micro-organisms in this "biolayer" eat many of the pathogens in the water, improving the water treatment. (source: www.cawst.org/services/topics/biosand-filter/more-information).

The smart controller

We worked with Orcon Technologies, Israel, to develop a controller that would operate the pumps automatically using surplus energy from the community's micro-grid. The resulting "smart" pump controller is installed in the users' homes and operates the pump by communicating with the electricity system over the existing electricity lines, with no need for extra cabling. Using excess energy from the micro-grids to pump water into elevated tanks, the smart controller helps store otherwise discarded energy.

Pilot Project

After the initial development phase we conducted two pilot projects, in January and May 2014, installing our household water systems in several households in Comet-ME's energy install base.

Community engagement in the pilot projects was crucial for the completion of the development process. A comprehensive needs survey and a series of community meetings were held in order to understand the needs and identify solutions suitable for the villages. Family members participated in the development process, providing constant input. As a result of the pilot testing and user feedback, we fine-tuned the system's design before wide-scale implementation.

Watch this video to learn more about the Comet-H2O pilot project.

photos: Tomer Appelbaum

Wide-Scale Implementation

In September 2014, we began the wide-scale installation of our water systems throughout our energy install base. To date, we have installed water pumping, distribution and filtration systems for over 150 households, serving nearly 2000 people in 20 different communities throughout our install base.

As part of our mission, Comet-ME also provides community institutions, such as schools and clinics, with our energy and water services. To date, 4 community elementary schools in the south Hebron hill receive electricity and clean drinking water from Comet-ME, serving 150 students and 30 staff members on a daily basis.

How Do The Systems Work?

Comet-ME's water pumping, distribution, and filtration systems provide a household-level water solution that builds upon and improves traditional family water-management practices in the south Hebron hills. The mechanical pumping and distribution of water to taps in and around the home provides convenient access to water and vastly reduces the amount of time and labor dedicated to household water management. Multi-stage filtration, culminating in a bio-sand filter (BSF) that is installed in the kitchen of each home, brings microbiologically contaminated water to first-world drinking standards.

photos: Comet-ME

1 *The electrical pump is operated automatically using excess energy from the community's renewable-energy grid.*

2 *Water is pumped from rainwater cisterns through a set of 55- and 20-micron pre-filters into a tank to remove physical debris from the water.*

IS WORK?

photo above: Comet-ME
photos below: Tomer Appelbaum

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3 *Then the water is distributed through pipes to taps placed in and around the home for human and herd consumption.*

4 *One tap in the home is equipped with a bio-sand filter to provide clean drinking water.*

▼

Water-Quality Monitoring

In order to ensure the high quality of drinking water coming out of our water systems, we have implemented a rigorous water-quality monitoring scheme. The scheme has several components:

• **Regular sampling and testing.** Comet-ME's water lab technician conducts regular sampling of drinking water following bio-sand filtration. He does this on a rotating basis between communities, visiting each community every 4-8 weeks. The water samples are then tested in Comet-ME's in-house microbiology lab, and a weekly internal report is produced, comparing the latest results with previous results in each community/household. This enables us to observe the adjustment of the BSFs to changes in water quality input (such as following rainfall) and to determine whether localized treatment of the water is necessary.

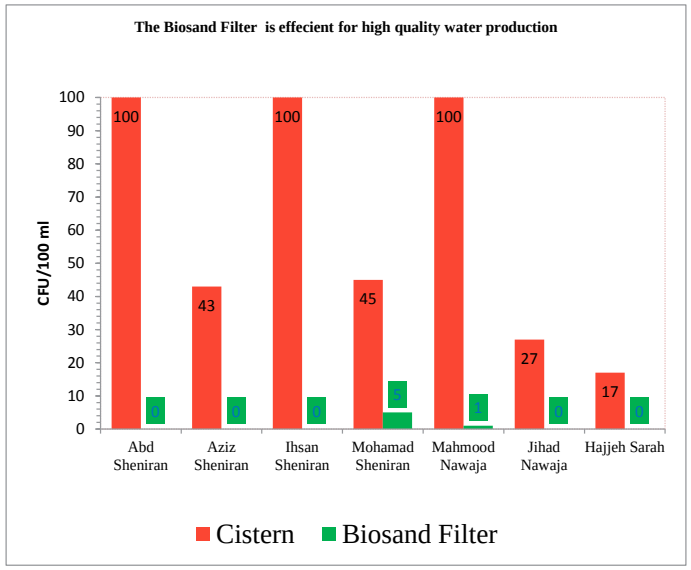
• **Localized treatment of drinking water.** In instances in which microbiological contamination is observed in the drinking water, we espouse an escalating treatment policy that keeps external input to a minimum. First we allow the BSF time to adjust on its own while charting the adjustment. If CFU levels are abnormally high, we provide chlorination tablets to be used in the water containers following filtration, thus ensuring that the family has good-quality drinking water as the BSF adjusts. Only rarely will we chlorinate at the source (cistern), as this kills off the biolayer in the BSF and then requires 3-4 weeks to become effective again.

photos: Comet-ME

Read this report on Comet-ME's water-quality monitoring work at the DelAgua Blog.

MONITORING

Photo: Jon Persson



Microbiological contamination is measured in units known as CFU (colony-forming units) per 100ml. CFU levels in cisterns in the south Hebron hills can regulary reach levels of 100 CFU/100ml or more, whereas potability standards in developing countries begin at 10 CFU/100ml and below, and WHO and developed nations standards are 0 CFU. The results of our testing have been overwhelmingly positive, consistently showing <10 CFU/100 ml post-filtration..

Community Capacity-Building

Training and capacity-building begins with the instruction of family members in the basic use of the system and upkeep of the mechanical filters and bio-sand filters (BSFs). We explain the risks of consuming water with high CFU levels and talk about the ways of reducing or eliminating these risks.

The bio-sand filter should perform well as long as it is operated daily and maintained. Therefore, we remind people of the importance of keeping water containers and tubes clean in order to maintain high water quality, as well as of cleaning the inside of the cistern every year, of cleaning well around it before the first rainfall of the winter, and of keeping animals away from the cistern that supplies the water for the family kitchen.

We work to raise awareness, especially among the women, of the importance of drinking water only from the BSF and instilling this habit in their children.

photo: Tomer Appelbaum

photo: Comet-ME

photo: Comet-ME

Having clean drinking water has a big health impact for children, the elderly, pregnant women, and people with chronic illnesses. For the Jabareen family in Shaab al-Buttum, the filter has become a regular fixture in the family's home and routine. 'Ablah, a mother of 11 and grandmother of 2, is very conscientious about explaining to her children and grandchildren the importance of drinking only from the filter and not directly from the cistern. Pictured is 18-month-old Dalal serving herself a cup of water from the filter.

photos: Tomer Appelbaum

About Comet-ME

Comet-ME is an Israeli-Palestinian organization providing basic energy and clean-water services to off-grid communities using environmentally and socially sustainable methods. We facilitate the social and economic empowerment of some of the poorest and most marginalized communities in the occupied Palestinian territories through the installation of renewable wind and solar energy systems, provision of clean water services, capacity building, and reliable maintenance.

Our work has developed out of a long-lasting relationship with and commitment to the marginalized Palestinian communities in the south Hebron hills. Initially a voluntary initiative, Comet-ME carried out its first installations in 2006 and formally incorporated in Israel as a public benefit company in September 2009. Today, we are a vertically integrated utility, providing basic energy services to 30 communities encompassing nearly 3,000 people.

In 2013 we entered the field of off-grid water pumping and filtration solutions, and since then have brought our clean-water services to households throughout our energy install base. Comet-ME is currently the leading provider of sustainable rural electrification services in the region, and an innovator in the field of off-grid water technologies.

photos: Tomer Appelbaum

Over nearly a decade of experience in the field, we have seen how the provision of basic energy and water services to the marginalized communities of the south Hebron hills has proven to be an effective means for community empowerment and economic development, allowing communities to choose their own paths and adapting our services to their evolving needs. Since the establishment of Comet-ME's Center for Appropriate Technologies in the south Hebron hills in 2012, Comet-ME has been a daily presence in the lives of the beneficiary communities, responding to any issue—technical or social—that arises, and in this way establishing ourselves as a reliable and trustworthy service provider in the region.

ET-ME

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