AFRICAN BAMBOO

PROJECT
Biomass-Powered Thermal Processing of Ethiopian Bamboo

INNOVATION STAGE 4
Early Adoption/Distribution

CLEAN ENERGY SOURCE
Biomass

AGRICULTURAL FOCUS
Processing

PRODUCT SEGMENT
Agro-Forestry Products

COLLABORATOR(S)
Heartland Global (USA)

LOCATION APPLIED
Southern Nations, Nationalities, and Peoples' Region (SNNPR), Ethiopia

CLEAN ENERGY SOLUTION
African Bamboo's solution is an environmentally friendly bamboo thermal modification process called ThermoBoo, a modern value-added processing techniques that promises to increase the earning potential of farmers. Through ThermoBoo, a chemical-free process, decay factors such as rot and insects are virtually eliminated, and the thermally-modified bamboo fiber can be further processed into sturdy panels that can be marketed to a range of domestic and international buyers. The ThermoBoo process involves the combustion of biomass dust—a technological approach that is completely new to Ethiopia. Through the project’s successful implementation of a processing facility, African Bamboo envisions the improvement of the livelihood of the local community through job creation by forming new micro and small enterprises for bamboo forest harvesting and transportation, bamboo forest thinning, and micro charcoal production from low quality bamboo culms.

PROGRESS UPDATE
By the end of the Powering Agriculture Award in September 2017, African Bamboo had concluded the lease agreement at Hawassa Industrial Park for a facility of 16,500 m² for its factory space for the manufacture and export of its bamboo-based composite boards. It has also completed testing, pre-certification and pre-labelling of the boards and defined mechanical, electrical and utilities requirements to start production. African Bamboo also concluded long-term supply agreements for the bamboo raw materials and bulk purchase agreements for all inputs. It has signed various sales contracts, letters of intent for investment and identified 120 buyers in Europe and United States. At full-scale production, African Bamboo expects to produce 600,000 m² per year resulting in prospective annual earnings of Euro 2.5 million to 6,000 farmers. The abdication of the use of diesel fuel - which is the widespread practice in Ethiopia - and its replacement by biomass residues generated during the production process will reduce the greenhouse gas emissions by a certifiable amount of 16,700 tCO₂e per year.

www.african-bamboo.com
CAMCO

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOLUTION
Biomass

AGRICULTURAL FOCUS
Decentralized Power

PRODUCT SEGMENT
Agro-Forestry Products

COLLABORATOR(S)
Village Industrial Power (VIP) (USA)

LOCATION APPLIED
Oueme region in Benin, and the Kigoma and Mufindi regions in Tanzania

CLEAN ENERGY SOLUTION
CAMCO’s partner Village Industrial Power (VIP)’s solution is a small scale combined heat and power mobile steam plant powered through the combustion of biomass waste produced at local agricultural processing facilities to generate mechanical/electrical/thermal energy. VIP’s carbon neutral engine is fuel flexible, using waste such as maize cobs, coffee parchment, mango pits, and bagasse to generate energy that can be used for agricultural activities such as processing and drying; dairy pasteurization; pumping and purifying water. VIP’s mobile power plant unit is robust, reliable, and on demand, enabling farmers to process their own crops and participate directly in the value chain.

PROGRESS UPDATE
By the end of the Powering Agriculture Award in March 2016 CAMCO and VIP had installed five units in three locations. Three palm oil processing businesses in South Eastern Benin had tested the VIP unit in order to displace diesel consumption that is used in running the expeller press and the kernel and fiber separator. The VIP mini-grid in the village of Uchindile, Tanzania, electrified over 15 shops, homes, and a hospital while a rural clinic near Kigoma, Tanzania tested the VIP unit to power a submersible pump, provided hot water for the laundry and powered other equipment with the electricity produced by the unit. Training on the operation and maintenance of the units was provided at all sites.

Through a networking event organized by the Powering Agriculture, VIP met Factor(e) Ventures, an engineering and business incubator, and was helped by them to capture the lessons learned from the Powering Agriculture beta pilots and incorporate those into both the gen3c units, the business model and market entry strategies. In 2017, with funding from Shell Foundation, VIP ran 6 pilots in Kenya in the fruit and vegetable and maize drying sectors and was able to validate the value proposition, increasing farmers’ incomes by up to 7 times, and the business model for the farmers based on a lease to own model. Three VIP units are currently installed in Kenya with two under contract for sales. An additional 4 units have been shipped from India for designated customers. VIP has also moved manufacturing to India which has allowed for the reduction of the unit by half with further cost reductions to be realized at scale.

www.camcocleanenergy.com/africa
www.villageindustrialpower.com
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

CLEAN ENERGY SOLUTION
Earth Institute’s solution will enable a small group of farmers to use a central solar energy unit to power multiple alternate current (AC) pumps for irrigation. Farmers in Senegal typically use either labor or cost and energy intensive crop watering practices. The proposed solution takes advantage of the benefits of solar without the high costs associated with direct current (DC) powered pumps and battery storage. This power will be accessed by farmers with prepaid electricity cards issued by a micro-utility, and sold through local vendors who will benefit from a small commission. Recognizing that a major obstacle to technology adoption is financing, a tariff-based financing model will allow customers to cover their appliance loans in small payments added into their micro-utility bills. This innovation will allow farmers, even with small land holdings and/or little access to capital, to benefit from irrigation.

PROGRESS UPDATE
By the end of the Powering Agriculture Award in March 2016, Earth Institute had installed three shared battery-less solar PV pumping systems in Potou, Senegal. The three shared systems serve 21 farms, including a farm run by a women’s cooperative, and are now seeing maximum utilization. Farmers experienced a 29% average increase in agricultural production, and 24 tons of CO₂ equivalent emissions were avoided by not having to use diesel pumps. Eight persons have been trained on how to service the pumping systems. The project is now seeking partnerships for scaling up, adoption and local maintenance contracts.
EarthSpark's solution is a solar-diesel hybrid micro-grid system that will increase access to affordable, reliable electricity for value-added agricultural processing. By improving farmers’ ability to process agricultural goods, the value of their products is maximized and their livelihoods improved. By providing technical guidance and facilitating access to financing for local partners, EarthSpark is assisting agribusinesses in upgrading equipment to efficient electric mills for breadfruit processing and electric dekernelling for corn.

PROGRESS UPDATE
By the end of their Powering Agriculture Award in March 2017, EarthSpark had expanded the microgrid in Les Anglais from a pilot stage with 54 connections to a town-sized, solar-powered smart grid providing power to residents and commercial clients through a total of 452 connections. The project identified and supported acquisition of three agricultural processing technologies – a corn mill, a corn thresher, and a deep fryer. While these items haven't yet shown a significant economic benefit, the entrepreneur-owners continue to refine their business models to increase profitability.

In October 2016, Category 4 Hurricane Matthew made landfall in Les Anglais, inflicting serious damage on the town and affecting EarthSpark’s clients. The grid fared well, considering the intensity of the storm. It was estimated that 40% of the solar panels were damaged and the distribution grid needed to be nearly rebuilt but the power electronics and battery bank were left unscathed. EarthSpark is raising funds for the grid’s rehabilitation and plans to be fully functional once again by the end of 2017.
ECO Consult's solution is an integrated model of hydroponic and photovoltaic farming to compete with conventional greenhouse technology and drip irrigation systems in Jordan. For Farmers in one of the ten most water-scarce countries in the world, hydroponics offers an excellent opportunity for farmers to increase their income while reducing their water use. To make the technology attractive to large-scale commercial farms, ECO Consult will retrofit a multi-span greenhouse with advanced hydroponic technologies and photovoltaic panels to generate enough power to operate the lighting, pumping, and air moderation systems. The adoption of these new technologies will realize additional sources of income and new employment opportunities, including women and youth for rural households.

**PROGRESS UPDATE**
By the end of the Powering Agriculture Award in June 2017, ECO Consult had established the first community of practice/network for hydroponic farming in Jordan by focusing on expanding the knowledge and use of hydroponics by Jordanian farmers, private companies and suppliers. They reached more than 530 people through 19 field days, which provided attendees with hands-on training and a peer-to-peer educational experience, and trained more than 200 people through a series of 7 workshops. ECO Consult also established 22 demonstration sites—nearly quadrupling the target of six sites—with the majority of them located at households or community-based organizations. ECO Consult established a partnership with Wageningen University (WUR) in the Netherlands which included technical assistance from WUR, capacity building and ‘train the trainers’ sessions held in the Netherlands and in Jordan. The activities completed under the program have increased the visibility and awareness of hydroponic farming throughout Jordan; established a strong network of farmers, universities, government agencies, and international donors; and created an environment in which adoption of hydroponic farming should continue to expand.

ECO Consult will implement a second project that will target large farms with high-value crops for export markets and involve the Dutch private sector. The Dutch companies will provide hydroponic equipment and technical support (system monitoring and operation) for 2 to 3 years.
iDE and their partners’ solution is a clean irrigation system that will provide smallholder farmers across the developing world the opportunity to mechanize their farming with zero carbon emissions. Globally, there are more than 800 million smallholder farmers, many of whom manually lift and haul over four tons of water daily to irrigate their farmland. The system uses the Sunflower pump, an efficient, versatile, and cost-effective piston pump powered by a PV panel, which is coupled with iDE’s affordable, ultra-low pressure drip irrigation kit to maximize the agricultural output and value of each drop of water pumped for up to 1,500 square meters of arable land.

By the end of this project, iDE’s goal was to have a commercially available solar pump product for farmers irrigating up to 2,000 square meters of high-value dry season vegetables. Use of the Sunflower pump allows farmers to increase their farm productivity, and thus their income.

By the end of the Powering Agriculture Award in June 2017, iDE had pioneered a new product category of solar pump. iDE worked with its partners, Futurepump and the PRACTICA Foundation, on the development and refinement of the Sunflower pump—now branded as the SF1—a highly efficient piston pump powered by an 80-watt PV panel. This latest version of the pump, featuring a 40% reduction in weight and volume while retaining efficiency, was tested at sites in Kenya and began shipping to Nepal and Zambia. iDE installed 1,064 pumps for testing at 48 active field sites; 80 in Honduras, Zambia, Nepal. An additional 4 pumps have been installed in the USA, Bangladesh, Burkina Faso, and Cambodia, which shows iDE’s progress towards global distribution. As a result of these field tests, iDE and its partners have gone through five design iterations of the pump. In addition, 80 pumps have been sold to iDE’s private sector partners for sales to end users in Zambia and Nepal.
MOTIVO ENGINEERING

CLEAN ENERGY SOLUTION
Motivo is developing a “Swiss-Army Knife” system—the Hybrid Agriculture/Road Vehicles with Electricity Storage and Transformation (HARVEST)—that solves a wide range of agricultural mechanization and power-related problems. HARVEST brings a low cost, infrastructure-less electrification and mechanization for farmers. HARVEST is a multi-purpose platform that provides power for plowing, well-drilling, cold storage, and transporting crops to market. The system utilizes power from varied energy sources such as solar panels, wind turbines, micro-hydro turbines, or the grid to enable increased productivity all along the agriculture value chain. The entire system is operated at the community level, and facilitated by mobile communication technology for scheduling, billing, and payments. HARVEST democratizes opportunity in agriculture by making available to entire communities huge gains in productivity, reduce reliance on increasingly expensive imported diesel, and creating new skilled jobs for men and women in rural areas in deploying, managing, and maintaining the HARVEST equipment.

PROJECT
Hybrid Vehicles with Exportable Power for Community-Based Agriculture Mechanization

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Hybrid

AGRICULTURAL FOCUS
Cold Storage, Decentralized Power, Irrigation, Processing

PRODUCT SEGMENT
Aquaculture, Dairy, Horticulture, Staple Crops

COLLABORATOR(S)
The KVK Foundation (India), Feuerlabs (USA)

LOCATION APPLIED
Rangareddy, Telangana, India

PROGRESS UPDATE
By the end of the Powering Agriculture award in May 2017, Motivo Engineering had shipped, assembled, and field tested two HARVEST prototypes in India. The primary use of the HARVEST during field testing was for field leveling, with the systems also being used for hauling and to power lighting for village gatherings. During the initial testing, Motivo learned that HARVEST can accept solar power, but the solar array originally installed was not large enough to effectively recharge the tractor. Based on this information, they tripled the solar array to decrease charging time and re-assess the feasibility of solar charging of HARVEST. Motivo’s beneficiaries primarily see the HARVEST as a mechanism to reduce expenses on light duty field preparation. Beneficiaries reported that they experience a reduction in crop production expenses resulting in savings that are either used for additional crop production or paying for general household expenses including food and child education. Future plans may include a larger-scale pilot test using up to 50 units. One of the lessons learned was that the expectation of HARVEST to fully replace diesel tractors had not considered all the nuances of specific agricultural tasks. Motivo found that the HARVEST was more appropriate for lighter-duty tasks.
Promethean's refrigeration solution uses a thermal energy battery pack that charges on intermittent power sources such as solar power and/or a few hours of grid electricity. This provides cold storage around the clock despite inconsistent access to electricity in India. A major obstacle in setting up cold chain networks is the lack of reliable electricity to run refrigeration systems in villages and farming areas. Diesel generators are often used to provide electricity for milk chilling, a non-ideal solution with high operating costs and negative environmental impact. Promethean’s refrigeration addresses one of the main obstacles in setting up cold chains in villages and farming areas. Dairy processors can collect raw milk from remote dairy farmers and keep it cold in a rapid milk cooler, reducing the time that milk is unchilled by 75 percent. Increasing access to milk while decreasing bacteria and spoilage supports food security and consumer health in India, where 42 percent of children under the age of five are malnourished. Promethean’s clean energy solution improves access to forward markets, higher income for the dairy farmers, and wealth creation through increase in herd size.

Progress Update

By the end of the project in June 2017, Promethean sold over 600 units, of which they have deployed and commissioned over 460 milk chillers coupled to its patented Thermal Battery. Today this technology is enabling over 25,000 dairy farmers to chill their milk without diesel generators to get their milk to the market safely. None of the 250 Promethean chillers in the field have required a diesel generator. As deployment of the chillers continues, Promethean has been able to adapt the solar component design to address specific logistical needs of dairy partners and has seen increased adoption of the chilling solution as a result. Promethean’s solution gives farmers a larger time window to bring their milk to the village center so they can be more productive with crops and other income-generating tasks. It’s a win for the dairy processor because they collect more quality milk and they make more profits as value-added products demand high quality milk. It’s a win for the environment as there is no longer a need for pollution-causing diesel generators. It’s a win for the consumers because they are drinking healthier milk. And it’s a win for the farmers because their livelihoods improve.
SunChill™ is a novel, off-grid refrigeration solution enabling increased agricultural productivity by: (i) removing field heat from crops immediately following harvest, and (ii) providing continued product cooling at local markets and/or central processing facilities. Removing field heat from horticultural products can double shelf life and reduce spoilage rates that often exceed 40 percent in developing countries. This clean energy solution transforms 50°C solar thermal energy into 10°C refrigeration using solid refrigerants and local, non-precision components. These characteristics enable production of a low cost, low-maintenance technology that reduces spoilage and benefits smallholder farmer livelihoods. The low-cost system enables increased horticultural production both for domestic and export consumption, generating additional income for smallholder farmers and increased access to nutritional fruits and vegetables while generating both manufacturing and service based employment.

Rebound completed the Powering Agriculture project in March 2016 by validating a SunChill™ field demonstration unit in Mozambique which cooled 43 kg of tomatoes during the pilot. The total project effort resulted in the completion of the engineering work that forms the technology foundation. Remaining is the industrial design work necessary to move SunChill™ to a commercialized product available for deployment. Rebound has utilized some of the data and incorporated lessons learned from field testing SunChill™ into its latest IcePoint™ technology for the US market.
Recognizing the need for affordable cold-chain technologies, SunDanzer has developed a small-scale portable cooling system tailored for use in the Kenyan dairy market. In rural areas, 85 percent of Kenya’s 800,000+ dairy farms do not have access to refrigerated storage and transportation, resulting in less than half of the milk produced reaching dairy processors. The system comprises a photovoltaic refrigerator (PVR) that uses solar energy to cool a chest refrigerator. This uses phase-change materials—substances which are capable of storing and releasing large amounts of energy—as energy storage. SunDanzer also developed milk can blankets to retain the cold temperature as farmers transport the milk to the collection site. With effective cold-chain storage, this clean energy solution aims to increase dairy farm productivity and income by significantly decreasing milk spoilage. This can play a major role in the livelihoods of approximately one million smallholder dairy farming families in Kenya.

To date, SunDanzer has delivered and installed nearly 70 solar milk cooling refrigerators in Kenya, and installed two units in Rwanda. The second generation units currently being installed are roof-mounted, a more cost-effective option than the previous generation, which were pole-mounted. Most units continue to be installed at dairy farms, with camel milk processors being among the newest customers. SunDanzer and their partner Winrock International co-hosted a 2-day Renewable Energy Cold Chain workshop and field visit in February 2017, with over 70 attendees. In their third phase of deployment, SunDanzer expects to install an additional 25 units in Kenya and 75 units in other countries by early 2018. SunDanzer’s project has been extended to May 2018. Users have stated that the solution has provided benefits that include adding financial security to the household, cell phone charging which saved time and added income to the household, as well as food preservation.
UGARF has developed a two-component device (branded as “EvaKuula”) powered by biogas which is extracted from cow manure. The device delivers a mild heat treatment followed by gentle evaporative cooling process that keeps the milk fresh overnight. This provides a refrigeration alternative to cold-chain facilities, as there is limited access to electricity, and kerosene and solar-powered options thus far have proved too expensive and difficult to operate in the local context. Partnered with Smallholder Fortunes, UGARF is refining the design of the refrigeration device, and testing it with farmers in Uganda. UGARF is working with local manufacturers to field-test the device and will secure financing and bring production of the units to commercial scale. The EvaKuula brings numerous benefits to smallholder dairy farmers such as decreased milk spoilage, increased production and profits, and biogas for lighting and cooking. Also, by extracting biogas from cow manure, greenhouse gas emissions from fermenting cow manure is mitigated.

PROGRESS UPDATE
As of September 2017, UGARF had deployed 34 EvaKuula units, with 5 additional units to be installed in the coming months. Half of the beneficiaries using the product are women, who have been successful users and provided important word-of-mouth marketing for the technology. User input has been an important piece of the product design process, with input from women ensuring that the product incorporates factors that are female-friendly. UGARF hopes to expand into Rwanda in the future. Next steps include conducting value engineering to lower the manufacturing cost well below the price point for the units. UGARF’s award has been extended to March 2018.