

# POWERING AGRICULTURE:

AN ENERGY GRAND CHALLENGE FOR DEVELOPMENT





## ABOUT POWERING AGRICULTURE

In 2012, the United States Agency for International Development (USAID), Sweden through the Swedish International Development Cooperation Agency (Sida), the Government of Germany (BMZ), Duke Energy Corporation, and the United States Overseas Private Investment Corporation (OPIC) (collectively, the “Founding Partners”) combined resources to create the Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) initiative. The objective of Powering Agriculture is to support the development and deployment of clean energy innovations that increase agriculture productivity and stimulate low carbon economic growth in the agriculture sector of developing countries to help end extreme poverty and extreme hunger.

Powering Agriculture utilizes the financial and technical resources of its Founding Partners to support its Innovator cohort’s implementation of clean energy technologies and business models for households, farms, villages, cooperatives, and industrial facilities in order to:

- Enhance agricultural yields/productivity; (ii) Decrease post-harvest loss; (iii) Improve farmer and agribusiness income generating opportunities and revenues; and/or
- Increase energy efficiency and associated savings within the operations of farms and agribusinesses.

For more information, visit [PoweringAg.org](http://PoweringAg.org)



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# Executive Summary

**Powering Agriculture: An Energy Grand Challenge for Development** (Powering Agriculture, or PAEGC) was a partnership of the United States Agency for International Development (USAID), the Government of Sweden through the Swedish International Development Cooperation Agency (Sida), the Government of Germany through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Duke Energy Corporation, and the Overseas Private Investment Corporation (OPIC)<sup>1</sup>. It was launched by the Founding Partners in 2012 to support the development and deployment of clean energy innovations that stimulate low-carbon economic growth in the agriculture sector of developing countries to help end extreme poverty and extreme hunger.

Powering Agriculture focused on the energy and agriculture sectors while providing technical, business acceleration, financing, and policy support to its stakeholders. The work for Powering Agriculture falls under four major program components described below and detailed each in each chapter with lessons learned.

## TECHNOLOGY AND BUSINESS MODEL INNOVATION

Powering Agriculture supported innovation within the clean energy-agriculture nexus that:

1. Enhanced agricultural yields/productivity;
2. Decreased post-harvest loss;
3. Improved farmer and agribusiness income-generating opportunities and revenues; or

4. Increased energy efficiency and associated savings within farms and agribusinesses, while stimulating low-carbon economic growth within the agriculture sectors of developing countries.

Powering Agriculture supported innovation in the clean energy-agriculture nexus through multiple avenues as described in Chapters 2 and 3:

1. Provided innovation grants (\$500,000–\$2,000,000) to 24 organizations, referred to as “awardees or innovators”, sourced through open calls for proposals to design, pilot, and deploy clean energy solutions at different points along the agricultural production cycle;

<sup>1</sup> The Overseas Private Investment Corporation has become the U.S. International Development Finance Corporation. To learn more, visit [dfc.gov](http://dfc.gov).

2. Leveraged private sector funds for direct debt and equity investments in firms through the Powering Agriculture Investment Alliance; and
3. Developed and funded ten pilot projects through GIZ's in-kind support to further research and testing of clean energy technologies.

### FINANCING FACILITY

Powering Agriculture partnered with AlphaMundi and FACTOR[e] to form the Powering Agriculture Investment Alliance (Investment Alliance) in 2018. The Investment Alliance will catalyze a minimum of \$25 million in private sector finance for ventures with the potential to achieve transformational development impact in the clean energy-agriculture nexus as described in Chapter 3. By PAEGC's end in December 2019, the Investment Alliance had catalyzed \$1.2 million in funds and had itself invested in two companies.

### KNOWLEDGE MANAGEMENT

Powering Agriculture served as a clean energy and agricultural information resource hub, sharing knowledge generated through its activities. This knowledge can be used by the clean energy-agriculture nexus community to stimulate further innovation and continue scaling. Powering Agriculture also documented its program-level activities, its challenges, and the lessons learned implementing the Grand Challenge that can be used for the design of future similar programs.

### MAINSTREAMING AND SCALING

Powering Agriculture worked to draw attention to the importance of the clean energy-agriculture nexus and the critical role it can

play in increasing agricultural productivity. To achieve that goal, the program utilized its website and social media to conduct outreach, present results at conferences and deliver technical trainings. Powering Agriculture established the East Africa Hub in Nairobi, Kenya managed by Founding Partner GIZ that helped catalyze the integration of clean energy within public-private partnerships, training programs, and other agricultural and energy programs. Powering Agriculture also further stimulated the uptake of clean energy-agricultural technologies through specific partnerships.

### POWERING AGRICULTURE'S RESULTS

Powering Agriculture's achievements were a product of the efforts of many entities including the Founding Partners, the innovators, the Investment Alliance Partners and implementing partners. These achievements included:



- **71 clean energy solutions** (technologies and/or business models) developed
- **6,236 kilowatts (kW)** of clean energy generation capacity installed
- **8,537 clean energy systems** deployed in Africa, Asia/Pacific, Latin America, and the Middle East
- **29,520 tonnes of carbon dioxide equivalent (tCO<sub>2</sub>e)** reduced as a result of innovators' field activities
- **\$13.5 million in energy costs saved** in the tea value chain, preventing 13.5 million trees from being cut down for firewood



- **234,100 beneficiaries** (e.g., farmers, households, agribusinesses) reached (including 22,740 women)
  - **18,230 people** (including 1,939 women) trained on the operations and maintenance of clean energy systems and their benefits
  - **54,440 people** (including 17,047 women) with increased knowledge of clean energy technologies due to attending demonstrations
  - **1,610 professionals** (including 406 women) provided services to clean energy system users mobilized by innovators in support of their clean energy solutions
- 



- **\$616,300 of technical assistance** and research and development (R&D) support given to 11 companies by the Investment Alliance
  - **\$1 million invested by in companies** identified, screened, selected and assisted by the Investment Alliance
  - **\$800,000 invested by AlphaMundi Group** in clean energy-agriculture nexus companies
  - **56 clean energy-agriculture nexus companies** identified and pre-screened as potential investments for the Investment Alliance
- 



- **16 individuals trained with 682 persons-hours recorded** as part of the Empowered Entrepreneur Training Program in Nairobi, Kenya.
  - **417 instances of technical assistance** provided on business acceleration needs spanning topics from business model development to product development to fundraising strategy
  - **288 referrals/linkages/partnerships/connections** made to investors, funders, donors, partners, stakeholders, mentors, educators, and potential hires
  - **3 in-person business acceleration workshops** delivered; November 2015 in Washington, D.C., United States; January 2018 in Kenya; October 2019 in San Francisco, United States
  - **5 multi-day embedded technical assistance engagements** provided to improve market research, organizational strategy, and market and distributor connections
- 



- **2 bid windows opened** under the 2019 Global LEAP+RBF program for solar water pump bulk procurement in seven countries
  - **2,714 solar water pump units approved** for incentives funded by Powering Agriculture totaling \$240,703
-



- **20 publications and studies** across five areas: agricultural markets, technology, financing, policy, and gender
- **100 published stories** highlighting the Powering Agriculture program or innovators
- **15,000 clean energy-agriculture nexus community members** following the program's communications and knowledge management platforms
- **19 conferences attended** to amplify Powering Agriculture's activities and results

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## LOOKING FORWARD

As Powering Agriculture ends its formal phase of implementation, a small number of activities remain in progress. Four innovators will continue deployment into 2020 and select innovators will continue to participate in the Empowered Entrepreneur Training Program to build business skills, leadership, and personal agency. Additionally, CLASP will continue implementing the 2019 Global LEAP+RBF for bulk procurement of solar water pumps and the Powering Agriculture Investment Alliance will continue to catalyze investment in the clean energy-agriculture nexus through 2021. Powering Agriculture Partner GIZ will continue its work on energy efficiency in tea processing and capacity-building on solar-powered irrigation systems.

The emergence of the new coronavirus, and the resulting pandemic, have suddenly and dramatically impacted Powering Agriculture companies and related activities. During the finalization of this report, many of these impacts are still playing out.



Several of the Powering Agriculture Partners are participating in a new Water and Energy for Food ("WE4F") Grand Challenge. WE4F is a partnership between USAID, Sida, BMZ and the Ministry of Foreign Affairs of the Kingdom of The Netherlands. This initiative will increase sustainable agricultural and food value-chains, food security, and climate resilience in developing countries and emerging markets - with a focus on the poor and women by investing in small enterprises that work in combinations of food, water, and energy. WE4F will capitalize on the resources and learnings from PAEGC and adopt its most promising innovations to grow and scale.



## ACKNOWLEDGEMENTS

This report was made possible through the support of the Powering Agriculture: An Energy Grand Challenge for Development Founding Partners, comprised of the United States Agency for International Development (USAID), the Swedish Government, the German Federal Ministry for Economic Cooperation and Development (BMZ), Duke Energy, and the Overseas Private Investment Corporation (OPIC). The contents of this report are the sole responsibility of **Tetra Tech ES, Inc.** and do not necessarily reflect the views of USAID or the United States Government.

The Powering Agriculture Founding Partners would like to thank the team from the Powering Agriculture Support Task Order, implemented by Tetra Tech ES, Inc. and their major subcontractor **VentureWell**, for their assistance in preparing this report.

# ACRONYMS AND ABBREVIATIONS

<b>AiIS</b>	Agriculture Innovation Investment Summit
<b>BMC</b>	Biogas Milk Chiller
<b>BMZ</b>	German Federal Ministry for Economic Cooperation and Development
<b>CES</b>	Clean energy solution
<b>DIY</b>	Do-It-Yourself
<b>EE</b>	Energy efficiency
<b>ETP</b>	Ethical Tea Partnership
<b>EETP</b>	Empowered Entrepreneur Training Program
<b>FY</b>	Fiscal or financial year
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>GCD</b>	Grand Challenge for Development
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
<b>GLOBEC</b>	Unit for Globally Sustainable Economic Development
<b>GLOBEN</b>	Unit for Global Cooperation on Environment
<b>HoA-REC&amp;N</b>	Horn of Africa Regional Environment Center and Network
<b>ICU</b>	Istituto per la Cooperazione Universitaria Onlus
<b>iDE</b>	International Development Enterprises
<b>KTDA</b>	Kenya Tea Development Agency
<b>M&amp;E</b>	Monitoring and evaluation
<b>MOU</b>	Memorandum of Understanding
<b>OPIC</b>	Overseas Private Investment Corporation
<b>PAEGC</b>	Powering Agriculture: An Energy Grand Challenge for Development
<b>PAIS</b>	Powering Agriculture Innovator Showcase
<b>PASTO</b>	Powering Agriculture Support Task Order
<b>PAX</b>	Powering Agriculture Xcelerator
<b>PAYG</b>	Pay-As-You-Go
<b>PPP</b>	Public-private partnership
<b>PV</b>	Photovoltaic
<b>PVR</b>	Photovoltaic refrigerator
<b>RBF</b>	Results-based financing
<b>RE</b>	Renewable energy
<b>R&amp;D</b>	Research and development
<b>SDG</b>	Sustainable Development Goal
<b>Sida</b>	Swedish International Development Cooperation Agency
<b>SME</b>	Small- and medium-sized enterprises
<b>SPIS</b>	Solar-powered irrigation system
<b>STPI</b>	Science and Technology Policy Institute
<b>UGARF</b>	University of Georgia Research Foundation
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>USAID</b>	United States Agency for International Development
<b>UVG</b>	Universidad del Valle de Guatemala
<b>VIA</b>	Village Infrastructure Angels
<b>WE4F</b>	Water and Energy for Food

# I. Introduction

**Powering Agriculture: An Energy Grand Challenge for Development** (Powering Agriculture, or PAEGC) was a partnership of the United States Agency for International Development (USAID), the Government of Sweden through the Swedish International Development Cooperation Agency (Sida), the Government of Germany through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Duke Energy Corporation, and the Overseas Private Investment Corporation (OPIC). It was launched by the Founding Partners in 2012 and began implementation in 2013 to support the development and deployment of clean energy innovations that stimulate low-carbon economic growth in the agriculture sectors of developing countries to help end extreme poverty and extreme hunger. December 2019 marked the conclusion of its formal phase of implementation.



Powering Agriculture followed the Grand Challenges for Development model, which focuses on defining problems, identifying constraints, and providing evidence-based analysis for a variety of development issues. This model is rooted in two fundamental beliefs about international development:

- Science and technology, when applied appropriately, can have transformational effects; and
- Engaging the world in the quest for solutions is critical to instigating breakthrough progress.

### 1.1 THE PROBLEM

Agriculture continues to be the primary livelihood for most households in developing countries. Continued population growth requires that farms and agribusiness produce, process, and transport increasing amounts of food. The Food and Agriculture Organization of the United Nations (FAO) estimates that by 2050, at least 60 percent more food will need to be produced on the same amount of agricultural land.<sup>2</sup> Clean energy technologies that help to intensify agricultural production will be crucial in meeting this demand.

Increasing access to clean energy and energy-efficient technologies will enable farmers to:

- Mechanize their operations;
- Add value to commodities through processing; and
- Store fresh produce in refrigerated containers to extend its shelf life.

Powering Agriculture contributes to the 2030 Agenda for Sustainable Development by supporting the following Sustainable Development Goals (SDGs):



SDG 1  
No Poverty



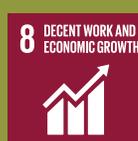
SDG 2  
Zero Hunger/  
Sustainable Agriculture



SDG 5  
Gender Equality



SDG 7  
Affordable and  
Clean Energy



SDG 8  
Economic Growth



SDG 9  
Innovation



SDG 13  
Climate action



SDG 17  
Partnerships for the  
Goals

<sup>2</sup> Niko Alexandratos and Jelle Bruinsma, World Agriculture Towards 2030/2050: The 2012 Revision, (Rome: Food and Agriculture Organization of the United Nations, June 2012), [www.fao.org/3/a-ap106e.pdf](http://www.fao.org/3/a-ap106e.pdf).

These advancements will lead to:

- More food in the market;
- Increased incomes for farmers and traders; and
- Decreased dependency of the agriculture sector on fossil fuels.

Significant barriers continue to hinder the integration of clean energy technology in agricultural development:

- Farmers are not aware of the variety of new technologies that may be appropriate for them;
- Because clean energy technologies are relatively new, farmers have limited access to distributors for their installation, parts, and service; and
- Farmers often do not have the means to cover the high capital costs associated with clean energy upgrades, and financing is seldom available.

Likewise, clean energy enterprises seeking to serve these farmers face a number of barriers:

- Limited access to debt and equity to support business development and growth;
- Low demand due to a lack of awareness by farmers and other customers of the economic and environmental benefits of the technologies;
- Remote, scattered, and often very poor client bases within agricultural communities; and
- Few successful business models that have been effective in delivering clean energy solutions to the agriculture sector in developing countries.

Strengthening the links between modern energy service providers and the agriculture sector will create positive feedback loops where clean energy technologies boost agricultural productivity, while increased agricultural incomes helps grow demand for these technologies.

## 1.2 THE SOLUTION

Energy is critical to almost every aspect of the agricultural value chain. Globally, the food sector consumes 30 percent of total energy supply and generates 20 percent of global emissions.<sup>3</sup>

To solve the challenges described above, Powering Agriculture has supported clean energy innovations across the agricultural value chain, including:

1. On-farm productivity;
2. Cold storage;
3. Transport;
4. Post-harvest agriculture processing; and
5. Agriculture waste for energy applications.



<sup>3</sup> Ralph Sims, Alessandro Flammini, Manas Puri, and Stefania Bracco, "Energy-Smart" Food for People and Climate, (Rome: Food and Agriculture Organization of the United Nations, June 2012), <http://www.fao.org/3/a-i2454e.pdf>.

### 1.3 THE WORK OF POWERING AGRICULTURE

Powering Agriculture focused concurrently on the energy and agriculture sectors while providing technical, business acceleration, financing, and policy support to its innovators and other stakeholders. The work for Powering Agriculture falls under four major program components:

 <h4>TECHNOLOGY &amp; BUSINESS MODEL INNOVATION (see Chapter 2)</h4> <p>Powering Agriculture provided innovation grants (\$500,000–\$2,000,000) to design, pilot, and deploy clean energy solutions at different points along the agricultural production cycle. On-demand tailored technical assistance and business acceleration support were provided through the <b>Powering Agriculture Support Task Order (PASTO)</b> implemented by <b>Tetra Tech</b> and its main subcontractor <b>VentureWell</b>.</p>	
 <h4>FINANCING FACILITY</h4> <p>To mobilize private sector equity and debt investments within the clean energy-agriculture nexus, Powering Agriculture established its Investment Alliance in 2018, partnering with venture development firms AlphaMundi and FACTOR[e]. The Alliance will continue through 2021. See Chapter 3.</p>	
 <h4>KNOWLEDGE MANAGEMENT</h4> <p>Powering Agriculture served as a clean energy and agricultural information resource hub by providing knowledge products with detailed data on the policy, economic, gender, and energy requirements to end extreme poverty and extreme hunger in developing countries. See Chapter 4.</p>	
 <h4>MAINSTREAMING AND SCALING</h4> <p>Powering Agriculture used communication tools, training workshops, conferences, and other events to draw attention to the importance of the clean energy-agriculture nexus and the critical role that it can play in increasing agricultural productivity. Powering Agriculture further stimulated the uptake of clean energy-agricultural technologies through specific partnerships under the East Africa Hub regional managed by GIZ and through collaborations with U.S. Government-led partnerships such as Power Africa and Feed the Future. See Chapter 5.</p>	

## 1.4 THE FOUNDING PARTNERS

The Founding Partners made financial and in-kind contributions to Powering Agriculture’s activities. USAID pooled and administered financial contributions on behalf of the Partners to implement core program activities. In addition, Partners committed technical assistance resources as in-kind contributions to support the goals of Powering Agriculture; they were managed by the individual Partners themselves.

TABLE 1 POWERING AGRICULTURE FOUNDING PARTNERS

Organization	Description
 <b>USAID</b> <small>FROM THE AMERICAN PEOPLE</small> <b>United States Agency for International Development</b>	<p>The American people, through USAID, have provided economic and humanitarian assistance worldwide for nearly 50 years. To learn more, visit <a href="https://www.usaid.gov">usaid.gov</a>.</p> <p>USAID’s support and implementation of Powering Agriculture was coordinated by the <b>Office of Energy and Infrastructure</b> in USAID’s <b>Bureau for Economic Growth, Education, and Environment</b>.</p> <p>USAID served as the administrator of Powering Agriculture, managing financial disbursements to innovators and supporting implementers and Investment Alliance partners.</p>
 <b>Sweden</b> <b>Sverige</b> <b>Government of Sweden</b>	<p>The Swedish International Development Cooperation Agency (Sida) is a government agency working on behalf of the Swedish Parliament and Government, with a mission to reduce poverty in the world. Through the Agency’s work and in cooperation with others, Sida contributes to the implementation of Sweden’s Policy for Global Development. To learn more, visit <a href="https://sida.se/english">sida.se/english</a>.</p> <p>Sida’s support to Powering Agriculture was coordinated from the Unit for Global Cooperation on Environment at the Department for International Policy Support.</p> <p>Sida’s support primarily consisted of providing financing for the program, including grants for Powering Agriculture innovators. Sida also financed a study on the analysis of gender perspectives and gender integration in Powering Agriculture, and developed a gender gap analysis as well as steps and tools for Powering Agriculture innovators’ gender integration in business strategies and plans.</p>
 <b>german cooperation</b> <small>DEUTSCHE ZUSAMMENARBEIT</small> <b>Government of Germany</b>	<p>The Federal Ministry for Economic Cooperation and Development (BMZ) develops the guidelines and fundamental concepts on which German development policy is based. BMZ devises long-term strategies for cooperation with the players concerned and defines the rules for implementing that cooperation. These are the foundations for developing shared projects with partner countries and international development organizations. All efforts are informed by the United Nations’ Sustainable Development Goals. To learn more, visit <a href="https://www.bmz.de/en">bmz.de/en</a>.</p> <p>The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH implemented the German contribution to Powering Agriculture on behalf of BMZ. The GIZ project <b>Sustainable Energy for Food—Powering Agriculture</b> not only contributed to the global initiative but reinforced PAEGC’s efforts via pilot projects, research, and capacity development. GIZ managed the Nairobi-based hub for East Africa to take advantage of the vast potential of the clean energy-agriculture nexus and to capitalize on the fact that most Powering Agriculture innovators implemented projects in that region. The Hub functioned as an accelerator for regional and supra-regional knowledge exchange, with a focus on the Powering Agriculture innovators located in the region.</p>
 <b>DUKE ENERGY</b> <b>Duke Energy</b>	<p>Duke Energy, one of the largest electric power companies in the United States, supplies services in a sustainable manner: affordable, reliable, and clean. Duke Energy’s support for Powering Agriculture was coordinated by Duke’s Federal Government Affairs unit. To learn more, visit <a href="https://www.duke-energy.com">duke-energy.com</a>.</p>
 <b>OPIC</b> <b>The Overseas Private Investment Corporation</b>	<p>OPIC was the U.S. Government’s development finance institution mobilizing private capital to help solve critical development challenges and in doing so, advancing United States foreign policy. The Overseas Private Investment Corporation has become the U.S. International Development Finance Corporation. To learn more, visit <a href="https://www.dfc.gov">dfc.gov</a></p> <p>OPIC examined Powering Agriculture Innovators from a lenders point of view and has provided follow-on financing to select innovators.</p>



## 2. Technology and Business Model Innovation

Powering Agriculture supported innovation in the clean energy-agriculture nexus through multiple avenues:

1. Provided grants to 24 organizations, referred to as “awardees or innovators”, sourced through open calls for proposals to design, pilot, and deploy clean energy solutions at different points along the agricultural production cycle;
2. Leveraged private sector funds for direct debt and equity investments in firms through the Powering Agriculture Investment Alliance as described in Chapter 3; and
3. Developed and funded ten pilot projects through GIZ’s in-kind support to further research and testing of clean energy technologies.



The clean energy technologies supported under Powering Agriculture can be classified based on the services that they provide in the agricultural value chain as described below.

1. **Farm Input:** Farm input innovators sell items—such as water, fertilizer, pesticides, other chemicals, grow lights, and seeds—that are required for growing agriculture or aquaculture products.
2. **Farm Production and Mechanization:** These innovators sell farm equipment that allows the farmer to reduce the manual labor required to plant, care for, and harvest a crop or that allows the farmer to conduct basic on-farm processing to increase crop value or reduce loss.
3. **Aggregation, Storage, and Logistics:** These innovators have developed processes that reduce the transportation costs or reduce crop losses during transportation to processing or the market.
4. **Value-Added Processing:** Value-added processing innovators have developed ways to incorporate renewable or energy efficiency into the industrial processing of agriculture or aquaculture products.
5. **Residential and Commercial Energy Production:** These innovators have developed electricity generation technologies —such as mini-grids, novel renewable energy generators, or behind-the-meter renewable energy generation— that are capable of powering machinery that fits into more than one other category.

Table 2.1 maps the innovators, firms and pilots supported by Powering Agriculture based on their service categories. This section provides an overview of the 24 innovators and their progress and details on the GIZ supported pilots. The Investment Alliance firms are discussed in Chapter 3.

TABLE 2.1 INNOVATORS, FIRMS, AND PILOTS SUPPORTED BY POWERING AGRICULTURE

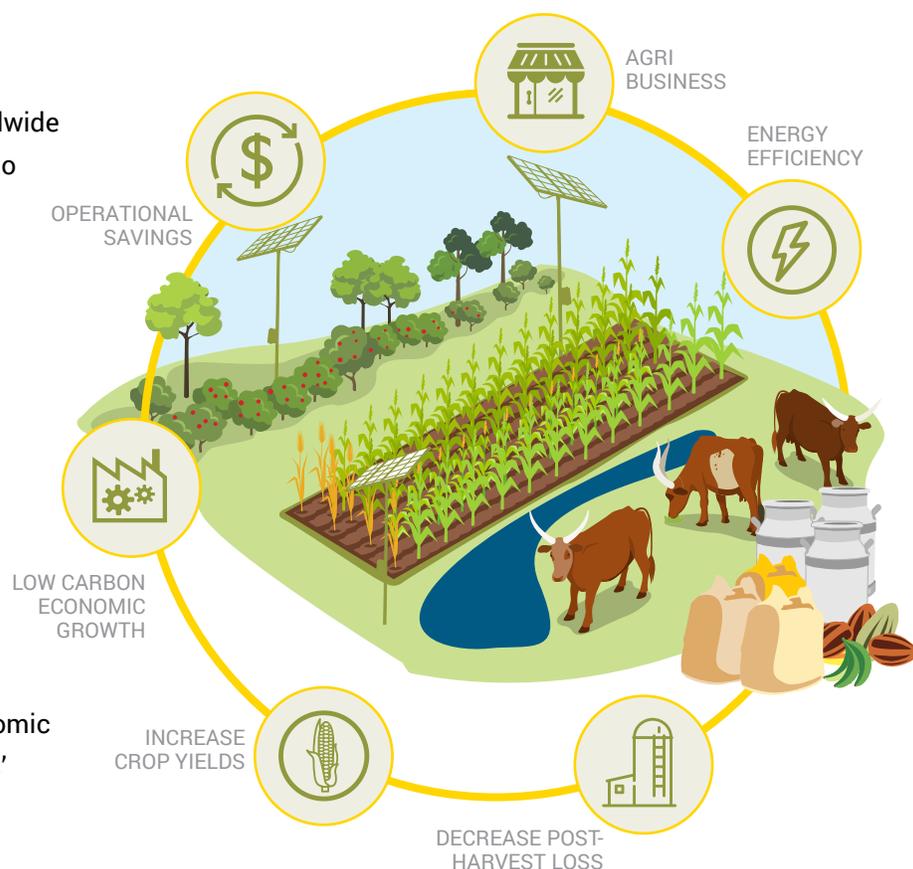
				
Farm Inputs	Farm Production & Mechanization	Aggregation, Storage, & Logistics	Value-Added Processing	Residential & Commercial Energy Production
ECO Consult	Motivo Engineering	Promethean Power Systems	Africa Bamboo	CAMCO Advisory Services
The Earth Institute at Columbia University	University of Georgia Research Foundation	InspiraFarms	Horn of Africa Regional Environmental Center and Network - Addis Ababa University	EarthSpark International
International Development Enterprises (iDE) Global	SunDanzer Refrigeration	ColdHubs	Coconut Holdings	iDE Bangladesh
Futurepump	Rebound Technologies		CorpoCampo	Universidad del Valle de Guatemala
KickStart International	SimGas Tanzania Ltd.		Improving Energy Efficiency in Tea Factories through Trainings and Audits	Ariya Finergy
Governing Council of University of Toronto	Village Infrastructure Angels			Husk Power Systems
Claro Energy	Amped Innovation			
SunCulture	Sistema.bio			
The Institute for University Cooperation	DIY Solar Cooling Systems and Solar Milk Cooling			
Sanergy	Solar Bubble Dryer			
SolarNow	Sesame Seed Oil Press			
Suni Solar	GrainSafe Dry Development			
Rent to Own				
Simusolar				
Fostering the Market Environment for Solar-powered Irrigation Systems in India				
RaSeed Solar-Powered Irrigation in Egypt				

INNOVATORS  
 INVESTMENT ALLIANCE FIRMS  
 GIZ PILOTS

## 2.1 INNOVATOR SELECTION

Powering Agriculture issued two worldwide calls for innovation in 2012 and 2014 to source solutions within the clean energy-agriculture nexus that:

1. Enhanced agricultural yields/productivity,
2. Decreased post-harvest loss,
3. Improved farmer and agribusiness income-generating opportunities and revenues, and/or
4. Increased energy efficiency and associated savings in farm or agribusiness operations while stimulating low-carbon economic growth within developing countries' agriculture sectors.



The first call was launched in December 2012 and resulted in 473 proposals from applicants representing 76 countries. The selection of 12 winners was announced in December 2013. The second was launched in November 2014 and resulted in the submission of 871 concept notes from applicants representing 99 countries. The selection of 13 winners was announced in November 2015.

## 2.2 INNOVATOR MANAGEMENT AND SUPPORT

The selected innovators were funded through award agreements issued by USAID, the administrator of Powering Agriculture's pooled funding. Powering Agriculture provided two types of assistance to innovators during the implementation of their award—implementation support and business acceleration support.

### 2.2.1 Implementation Support

Innovators received the following on-demand, individualized assistance provided under the **Powering Agriculture Support Task Order (PASTO)** by USAID contractor **Tetra Tech**:

- Assistance in complying with USAID policies and procedures in their award agreements, including guidance on monitoring and evaluation (M&E), environmental compliance, and gender integration;
- Guidelines to explain USAID regulations and provide best practices and templates for innovators' use;
- Technical feedback on how milestones can be improved; and
- Promotion of innovator progress on the website, on social media, and through traditional media.

### 2.2.2 Business Assistance

Structured but customized business acceleration assistance was provided through the Powering Agriculture Xcelerator (PAX) by **VentureWell** in collaboration with Tetra Tech. Each innovator was assigned a portfolio manager who regularly held check-in discussions with innovators, provided advice on the deployment of their clean energy technology and recommended actions to develop and validate their business model for bringing innovations to market. Portfolio managers also provide investor readiness coaching and referrals as requested. PAX's assistance to the innovator cohort included:

- Eight webinars on industry best practices for branding and communications, end-user financing, fundraising, gender integration, sales, engineering, and hiring and team building;
- 417 instances of technical assistance on business acceleration needs spanning topics from business model development to product development to fundraising strategy;

- 288 referrals/linkages/partnerships/connections to investors, funders, donors, partners, stakeholders, mentors, educators, and potential hires;
- Three in-person workshops to promote innovator interaction and idea cross-pollination: November 2015 in Washington, D.C., USA January 2018 in Nairobi, Kenya and October 2019 in San Francisco, USA; and
- Five multi-day embedded technical assistance engagements to provide market research, organizational strategy, and market and distributor connections.

The assistance sought to develop and sustain the innovations in the marketplace. Because the innovators were pursuing different business models in different regions and were at different points of the innovation life cycle, individual support was a critical component of the program's success. Over the life of the Grand Challenge, innovators received:



FIGURE 2.1 INSTANCES OF TECHNICAL ASSISTANCE

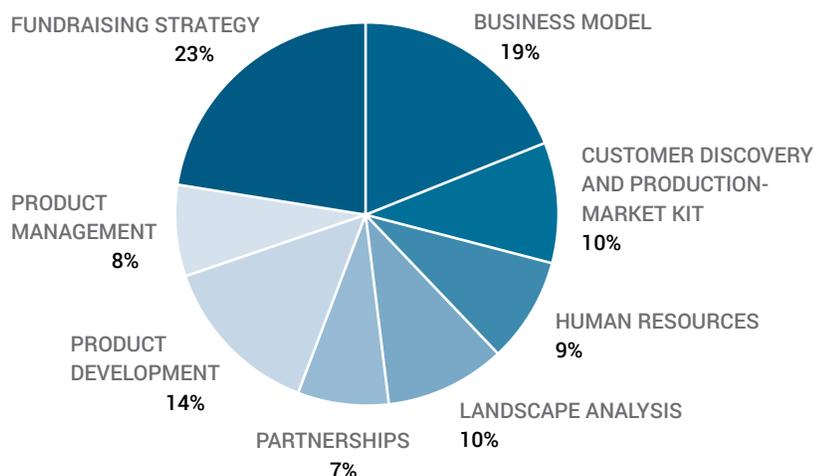
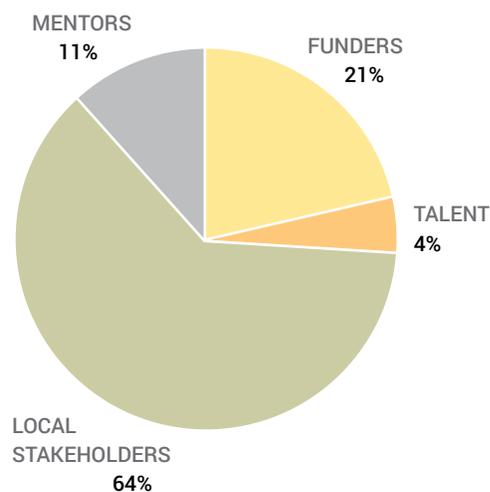


FIGURE 2.2 INTRODUCTIONS AND REFERRALS



**Feedback from innovators who received assistance from PAX includes:**

- “Great support on organizational strategy, fundraising, and approaching investors and partners. Investor deck review was also very helpful as well as fundraising overview.”
- “The PAX team provided valuable assistance whilst we were developing the business plan, company overview materials, and pitch deck.”
- “Understanding how the [Powering Agriculture] grants contribute to an ‘overall’ goal has been invaluable to devise the implementation strategy.”
- “I had insights into how many investors were in our space, how they viewed our company, and how we should structure our messaging.”
- “Overall the workshop was excellent and full of learning and new experiences. To be specific, the workshop facilitation, the showcases, the value chain mapping activities, and the panel discussion were exceptional for me.”
- “[Powering Agriculture] has had an incredible impact for our team and we credit a large part of our company’s success to this relationship.”
- “Extremely helpful and very supportive. Always felt that [Powering Agriculture] team went above and beyond to support [us], even as we transitioned to new leadership. The team’s genuine interest in our success is quite evident and extremely valuable. In regard to building our fundraising materials, connecting with investors, and increasing our exposure, etc., the acceleration support has been a significant help.”
- “Without this support, we would not exist as a business.”

### 2.2.3 Gender Integration Assistance

All recipients of Powering Agriculture grant funding were required to abide and support the principles of gender equality and ensure that their approaches did not reinforce harmful gender norms. Although, the first cohort of innovators detailed in their Powering Agriculture funding applications how the proposed interventions would lead to increased economic/social opportunities for women, they struggled with meaningfully applying abstract concept of gender equality to their day-to-day work. The second call for proposals made the requirement for gender equality more explicit asking innovators to demonstrate how their “clean energy solution will contribute to reducing gender disparities in access to, control over and benefit from clean energy resources, wealth, opportunities and services: economic, social, political, and cultural.”

Powering Agriculture Partner Sida contracted ILPI in 2016 to analyze the gender perspective and progress for gender integration made by challenge funds funded by Sida and provide recommendations. They found that though the innovators are concerned with gender issues but for most of them it was not a primary focus when developing and improving their innovations.

In order to support the innovators with strengthening their gender integration efforts, Powering Agriculture in 2016 funded a gender integration expert to strengthen gender integration in the overall Grand Challenge and to provide on-demand technical assistance to innovators. The gender integration expert initiated her efforts with a gender integration assessment based on review of innovator

project documents, a survey and a phone interview to gather additional information on gender-related planning and M&E, activities accomplished to date, challenges, and lessons learned. As a result of that assessment, the following activities targeted at the full cohort of innovators were implemented:

- Webinars to raise awareness of a) gender and the clean energy covering examples, issues, and strategies for technology access and adoption and b) the role of company culture with fair and equitable HR policies in recruiting and retaining female employees
- A series of six topical guides focused on integrating gender into the development and deployment of CES for the agricultural sector to assist innovators and better reach and serve women—a large, important, and often overlooked market segment. Each guide highlights a specific topic: CES deployment and product development, financial products, marketing, monitoring and evaluation, human resources and includes checklists or questionnaires to assist the reader in evaluating and improving the role of gender in their product design and deployment processes.
- *A How to Guide on Writing a Beneficiary Impact Story with a Gender Focus* to assist innovators with capturing the impacts of their innovations on gender equality and women’s empowerment
- Sessions on gender integration as part of the in-person business acceleration workshops
- Gender sections in the Powering Agriculture standardized reporting templates used for: work plans, M&E Plans and data collection, quarterly reports, annual reports and site visit reports.



The on-demand technical assistance was designed to respond to specific innovator requests and be delivered in an individualized manner through one-on-one support of the gender integration expert. The kinds of support to innovators included:

- Advice on integrating gender in implementation of specific activities.
- Assistance on recruiting female staff.
- Review and input into marketing strategies to target female clients.
- Introductions and referrals to in-country partners such women's NGOs to assist in the implementation of engendered activities.
- Assistance developing questions for use in baseline surveys and data collection tools to capture sex-disaggregated impact data.

Over the course of the program, innovators reported the following achievements in pursuing gender equality in their work, including but not limited to:

- CAMCO Advisory Services demonstrated that partner Village Industrial Power's units increased time savings for women due to a reduced need for firewood in boiler stoves.
- Claro Energy worked with several NGOs to organize separate trainings and demonstrations for women on solar irrigation.
- ECO Consult led a technology training on hydroponics for 24 women.
- Husk Power Systems hired at least one female operator per mini-grid plant in Tanzania.

- Institute for University Cooperation achieved a four percent increase in female participation at demonstration events when compared to the national average.
- iDE Bangladesh conducted awareness-generating meetings for women on baseline study, consultation, and safety awareness.
- KickStart International ensured that at least 30 percent of solar water pumps were adopted by single women or woman-led households.
- The Earth Institute at Columbia University connected a local women's group of 122 individuals to its system.
- Universidad del Valle de Guatemala has ensured active female participation in more than 50 percent of community meetings.
- The University of Georgia Research Foundation designed the EvaKuula milk chiller's functionality and weight to be easily used by both men and women. The team often engaged female leaders in local communities to demonstrate and spread knowledge about the product.
- Village Infrastructure Angels established the Market Linkage Program, which encourages women to make more sellable goods such as handicrafts and weavings that can be sold for cash or accepted in lieu of payment for milling services. This suggests that rural women's time can be 10 to 20 times more economically productive due to increased free time as compared to not having access to clean energy agro-processing.

In many cases, the innovators used the gender integration expert to assist in conceptualizing the activities described above.

Despite the activities listed above, gender equality was another grant requirement to be met and a lower priority than staying in business and completing award milestones. Perhaps additional attention to gender equality could have been generated if gender-related milestones with associated payments were expressly integrated into innovator award agreements. Additionally, it may have been useful to track gender integration with stand-alone impact metrics such as those drawn from the Global Impact Investor Network's (GIIN) IRIS+ impact accounting system that contains 130 metrics linked to gender equality.

Innovators also had a difficult time identifying opportunities for gender integration themselves. Though almost all understood the potential importance of their innovations for female end-users, they frequently did not know where to begin when it came to integrating gender into business operations. Opportunities were frequently identified during check-in calls where, in discussing upcoming plans and challenges, the award manager noted relevant opportunities. These innovators were then connected to the gender integration expert for a follow-up discussion. For Powering Agriculture's gender resources, see Chapter 4.

#### **2.2.4 Empowered Entrepreneur Training Program**

The experiences with on-demand technical assistance demonstrate that innovators appreciate practical, concrete interventions that support their basic business operations. To this end, Powering Agriculture introduced select innovators to the Empowered Entrepreneur Training (EETP) developed by Johns Hopkins University (JHU). This training, though

applicable to both men and women, has been shown to be particularly beneficial to female participants who, as documented by rigorous studies, demonstrate significant improvements in measures of empowerment, at home, professionally, and in their communities.

The EETP addresses a gap in typical entrepreneurship trainings that focus exclusively on the acquisition of business skills. Instead, EETP emphasizes the development of personal agency, a factor critical to overcoming inevitable business challenges, in addition to entrepreneurship. Controlled trials have shown that companies participating in this training have improved business outcomes such as increased sales and greater retention of sales staff.

JHU gave two 50-hour training programs to serve clean energy-agriculture nexus companies operating in East Africa and India. The training topics of business, leadership, and personal agency are delivered through a train-the-trainers (ToT) model, in which trainees from participating companies are certified to subsequently train their own staff or partners. This training was rolled out to approximately 49 trainees from 19 clean energy-agriculture companies, NGOs, and government organizations based in Africa and South Asia. Topics included the intersection of gender and business, goal setting, budgeting, and human-centered design. Many of these companies have already begun the process of rolling out this training to their sales staff and other personnel.

The strong uptake of this approach demonstrates innovators are eager for practical strategies to engage and support

women through their businesses. As engineers and business people, they need support in identifying practical strategies for integrating gender thoughtfully into their work. Though they might resist approaches perceived to be a drain on scarce resources, they will embrace gender integration efforts that can be aligned with and enhance their core business practices.



## 2.3 INNOVATOR OVERVIEW

The following tables and figures provide an overview of the 24 innovators that were sourced from open calls for proposals in 2013 and 2015 and received grant funding to design, pilot, and deploy clean energy solutions at different points along the agricultural production cycle. This is followed by detailed descriptions of the innovators and their technologies.

TABLE 2.2 2013 INNOVATOR COHORT INFORMATION

2013 Cohort	Innovator	Project Name	Country of Implementation	Start Date	End Date	Award Value
1	<b>African Bamboo</b> (COMPLETE)	Thermal treatment of agricultural goods based on a demand-driven and energy-efficient biomass combustion unit	Ethiopia	10/1/2013	9/30/2017	\$1,041,145
2	<b>Camco Advisory Services</b> (CANCELLED)	Biomass Mini-Grids for Palm-Oil Producing Communities in Benin and Tanzania	Benin, Tanzania	10/1/2013	6/30/2017	\$999,805
3	<b>The Earth Institute at Columbia University</b> (COMPLETE)	Micro-Solar Utilities for Small-Scale Irrigation in Senegal	Senegal	10/1/2013	3/31/2016	\$1,082,161.67
4	<b>EarthSpark International</b> (COMPLETE)	Smart Grid on Main Street: Powering Agricultural Processing with Sustainable Energy Services	Haiti	10/1/2013	3/31/2017	\$1,091,315
5	<b>ECO Consult</b> (COMPLETE)	Hydroponic Green Farming Initiative	Jordan	10/1/2013	6/30/2017	\$1,149,707
6	<b>iDE</b> (COMPLETE)	Clean Irrigation Solution (CIS) for Increased Agricultural Productivity	Honduras, Nepal, Zambia	10/1/2013	6/30/2017	\$1,499,831
7	<b>Motivo Engineering, LLC</b> (COMPLETE)	Hybrid Agriculture/Road Vehicle with Electricity Storage and Transformation (HARVEST)	India	10/1/2013	5/12/2017	\$861,158
8	<b>Promethean Power Systems</b> (COMPLETE)	Solar-powered Milk Chilling in Rural India	India	10/1/2013	6/30/2017	\$992,980
9	<b>Rebound Technologies</b> (COMPLETE)	Solar Cooling for Horticultural Preservation	Mozambique	10/1/2013	3/31/2016	\$1,375,853
10	<b>SunDanzer Refrigeration</b> (COMPLETE)	Sustainable Milk for Africa through Refrigeration Technology	Kenya	10/1/2013	5/31/2018	\$1,041,145
11	<b>University of Georgia Research Foundation</b> (COMPLETE)	Renewable Energy-Powered Evaporative Cooling for Smallholder Farmers	Uganda	1/3/2014	3/31/2018	\$1,000,000
12	<b>Experience International</b> (CANCELLED)	Solar Powered Cold Storage and Ice-Making Facilities for Fishing Communities in Eastern Indonesia	Indonesia	10/1/2013	04/20/2014	\$1,000,000

FIGURE 2.3 2013 INNOVATOR COHORT MAP

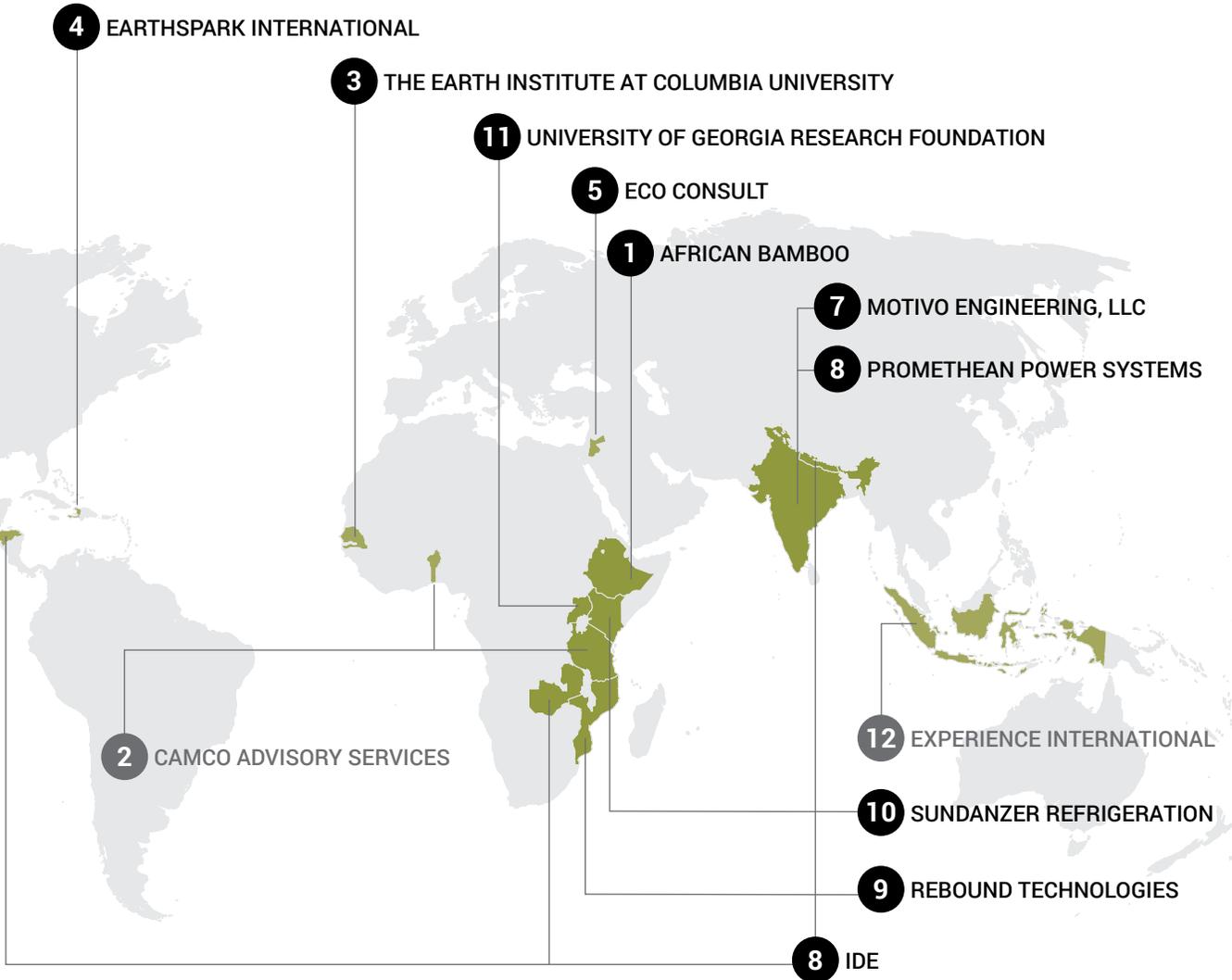


TABLE 2.3 2015 INNOVATOR COHORT INFORMATION

2015 Cohort	Innovator	Project Name	Country of Implementation	Start Date	End Date	Award Value
1	<b>Ariya Finergy</b>	Powering Agriculture with Renewable Energy	Kenya; Tanzania; Uganda	2/10/2016	6/30/2021	\$1,905,700
2	<b>Claro Energy</b> (COMPLETE)	Launch low-cost on-demand pay-as-you-go irrigation service using solar trolley systems to cut irrigation costs in half	India	12/3/2015	6/1/2019	\$500,000
3	<b>Futurepump (Kenya) Ltd</b>	Sunflower Pump - A working capital facility & after-sales investments to support a growing solar irrigation business in Kenya	Kenya	12/29/2015	7/31/2021	\$1,999,563
4	<b>Governing Council of the University of Toronto</b> (COMPLETE)	Field Evaluation of Passive Aeration System for Aquaculture	Bangladesh	1/18/2016	11/30/2019	\$500,000
5	<b>Horn of Africa Regional Environment Center and Network</b> (COMPLETE)	Improving coffee production and quality using Infra-red technology	Ethiopia	2/2/2016	2/2/2019	\$434,780
6	<b>Husk Power Systems</b>	Hybrid Solution- Biomass and Solar PV: Clean Energy Intervention in the food belts of Nigeria and Ghana	Ghana; Nigeria	1/21/2016	8/31/2020	\$1,282,418
7	<b>Institute for University Cooperation</b> (COMPLETE)	PV integrated irrigation systems in Jordan and Lebanon	Jordan; Lebanon	12/10/2015	3/31/2018	\$499,688
8	<b>iDE (Bangladesh)</b> (COMPLETE)	Renewable micro-grids for after-sales fish hatcheries and surrounding communities in Bangladesh	Bangladesh	12/14/2015	12/31/2018	\$499,748
9	<b>KickStart International</b> (COMPLETE)	To increase access to affordable, high-performance solar-powered irrigation technology among poor smallholder farmers in rural Kenya	Kenya	12/10/2015	3/31/2019	\$500,000
10	<b>SimGas Tanzania Ltd</b> (COMPLETE)	Biogas Milk Chilling to increase productivity and double the income of East African dairy farmers	Kenya; Rwanda; Tanzania	12/11/2015	6/30/2019	\$499,998

 Awards will continue

TABLE 2.3 2015 INNOVATOR COHORT INFORMATION (CONTINUED)

<b>11</b>	<b>SunCulture</b> (COMPLETE)	SunCulture: Scaling up distribution of smallholder tailored agro-solar irrigation kits across Africa	Kenya; Tanzania; Uganda; Zambia	12/11/2015	11/30/2019	\$2,000,000
<b>12</b>	<b>Universidad del Valle de Guatemala</b>	Private-Sector Financed Community Solar Power Grids (ComGrids) and Agricultural Accelerators in Off-Grid Communities in Guatemala	Guatemala	12/14/2015	9/30/2020	\$499,008
<b>13</b>	<b>Village Infrastructure Angels</b> (COMPLETE)	Solar Agro-processing Power Stations for 5000 Households	Indonesia; Papua New Guinea; Philippines; Vanuatu	12/11/2015	6/8/2019	\$1,762,400

FIGURE 2.4 2015 INNOVATOR COHORT MAP

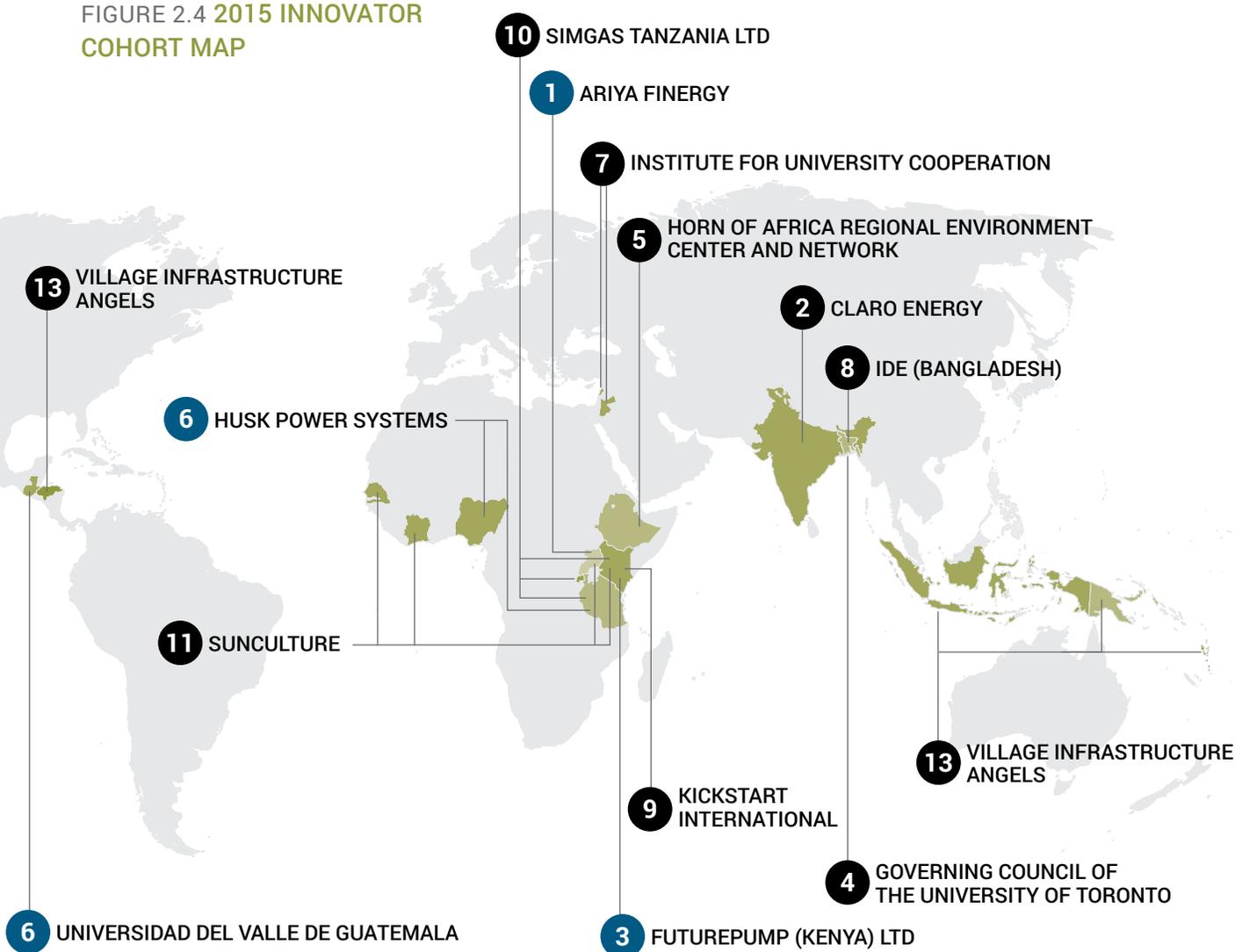


FIGURE 2.5 FOCUS OF INNOVATION

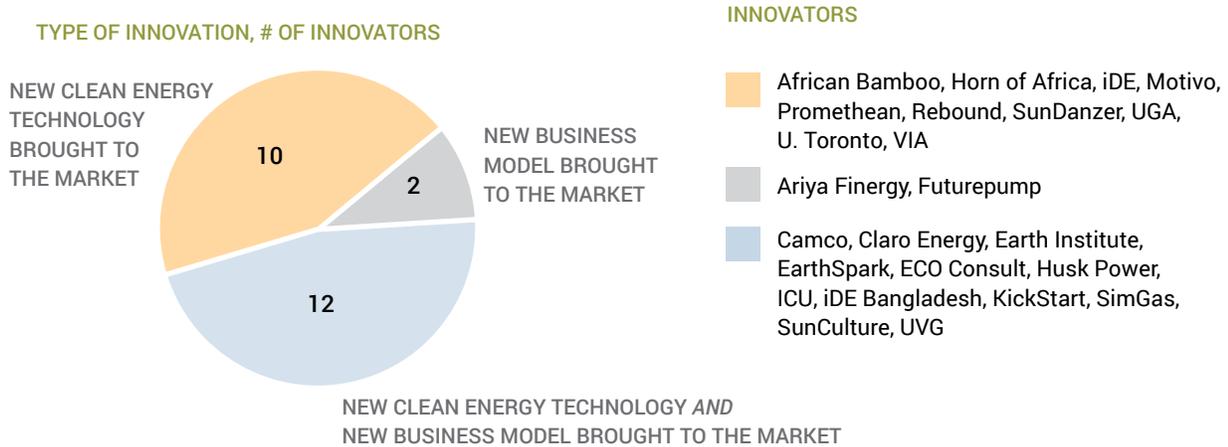
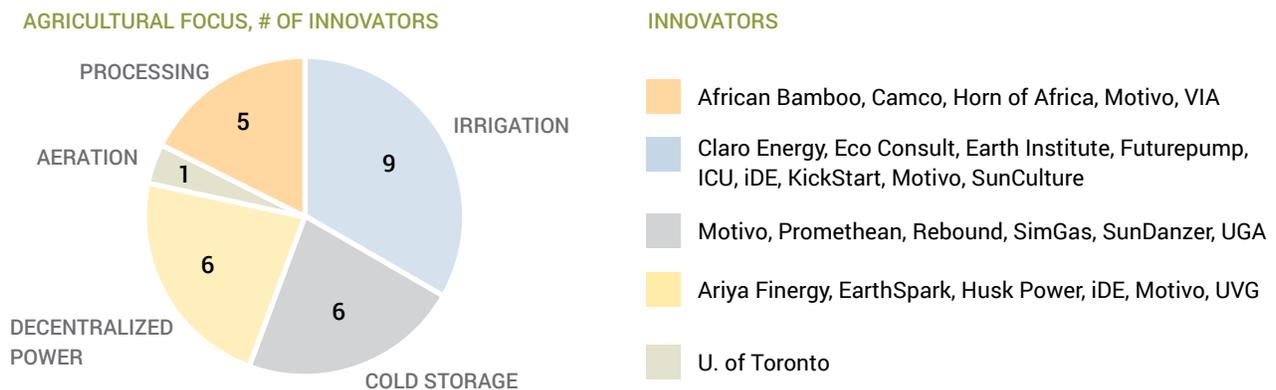


FIGURE 2.6 CLEAN ENERGY SOURCE USED FOR POWERING AGRICULTURE INNOVATIONS



FIGURE 2.7 AGRICULTURAL FOCUS OF POWERING AGRICULTURE INNOVATIONS



## 2.4 INNOVATOR PROGRESS

Powering Agriculture supported innovators that:

- Increased the visibility of clean energy solutions.
- Developed new clean energy product prototypes using technologies unavailable in developing markets or modified existing products in developed markets for use in developing markets.
- Increased access to clean energy asset financing.
- Pushed the boundaries on viable clean energy business model creation.

During the Grand Challenge, innovators frequently faced adverse markets or deteriorating/lacking enabling environments that delayed project implementation. Eighteen of the 24 innovators had to extend their grant period for reasons that include:

- Impacts of government policy on the deployment of their technologies particularly microgrids.
- Significant changes to innovator milestones to reflect market conditions and realities on the ground.
- Lower market traction than originally expected.

Despite these delays, innovators gained significant insight into the importance of value engineering, incorporating end-user feedback into designs, performance/price trade-offs, and the competitive landscape for their target customers.

In terms of commercial viability, Powering Agriculture supported a mix of nonprofit organizations, research institutions, and private for-profit companies. The latter ranged from newly incorporated start-ups to established companies with mature product lines such as SunCulture, Promethean Power Systems, and Husk Power Systems. One innovator reached hundreds of thousands of end users through a combination of successful product development, an established local presence, and its smart distribution strategy that allowed it to reach many end users through a centralized relationship with a small number of food processing companies. Other successful innovators introduced an established product and model to new countries and markets.

Generally, innovators who made significant progress toward becoming sustainable through the Grand Challenge had strong local partnerships and intimate knowledge of the local market, including customer willingness and ability to pay. Earlier-stage innovators sought to identify a sustainable path to growth for their innovation and cultivated these partnerships and market knowledge themselves during their award period. Early-stage innovators also continued to develop their technologies and strengthen their business operations, including developing a competent core leadership team and strong intellectual property portfolio. Throughout Powering Agriculture, innovators were lauded for their work, as demonstrated by the awards received and other successes described in this section.

Figure 2.8 shows the 2015 and 2013 innovators and their progress along the stages of innovation as of December 2019 and Figure 2.9 presents their final stages in aggregate. These stages are:

1. **Concept Development:** Articulation of the basic technical and financial feasibility of an approach and/or initial design of a product.
2. **Research and Development (R&D):** Basic research, applied R&D, testing and redesigning of an innovation, technology, or approach.
3. **Initial Piloting:** Small-scale, real-world, and experimental application of an innovation,

technology, or approach to evaluate feasibility, time, cost, adverse events, and other effects.

4. **Early Adoption:** Technical validation and early proof of adoption carried out, and product/approach has some customers/early adopters.
5. **Market Growth:** Innovator has proof of adoption/uptake in multiple markets, has acceleration partnerships established, and is moving toward a growing user/customer base.
6. **Wide-Scale Adoption:** Innovation has proven its ability to reach a large customer base.

FIGURE 2.8 INNOVATORS AND THEIR STAGES OF INNOVATION DECEMBER 2019

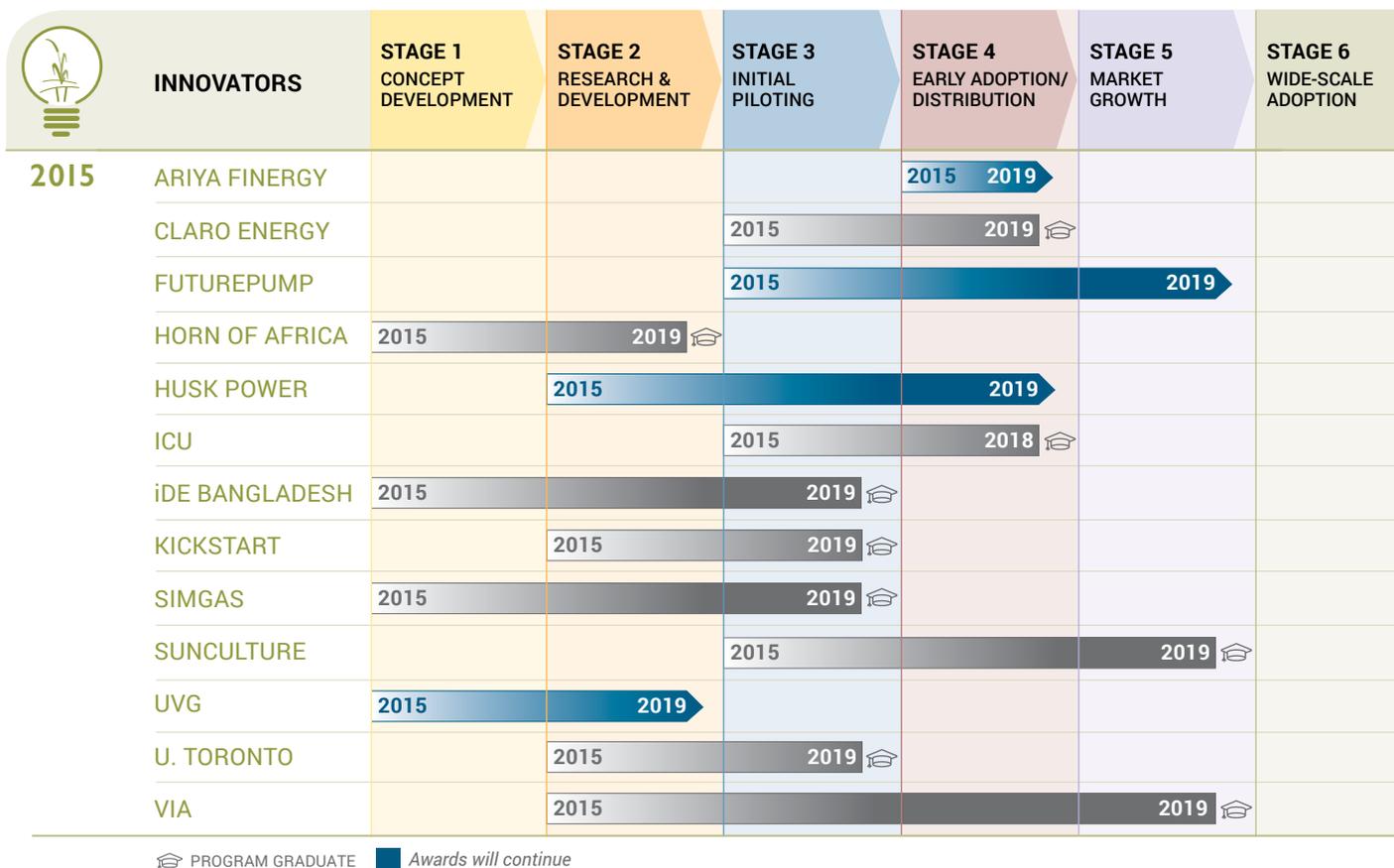


FIGURE 2.8 INNOVATORS AND THEIR STAGES OF INNOVATION DECEMBER 2019 (CONTINUED)

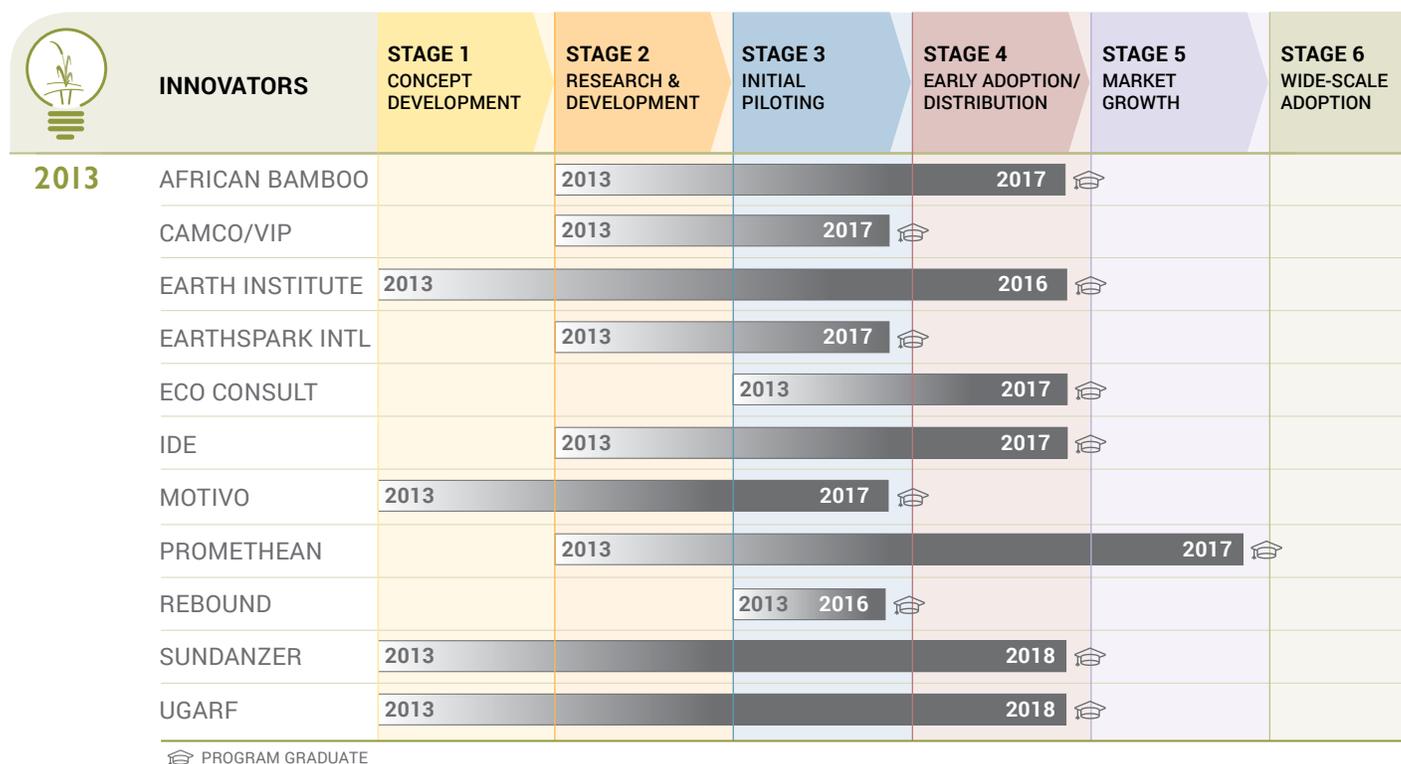
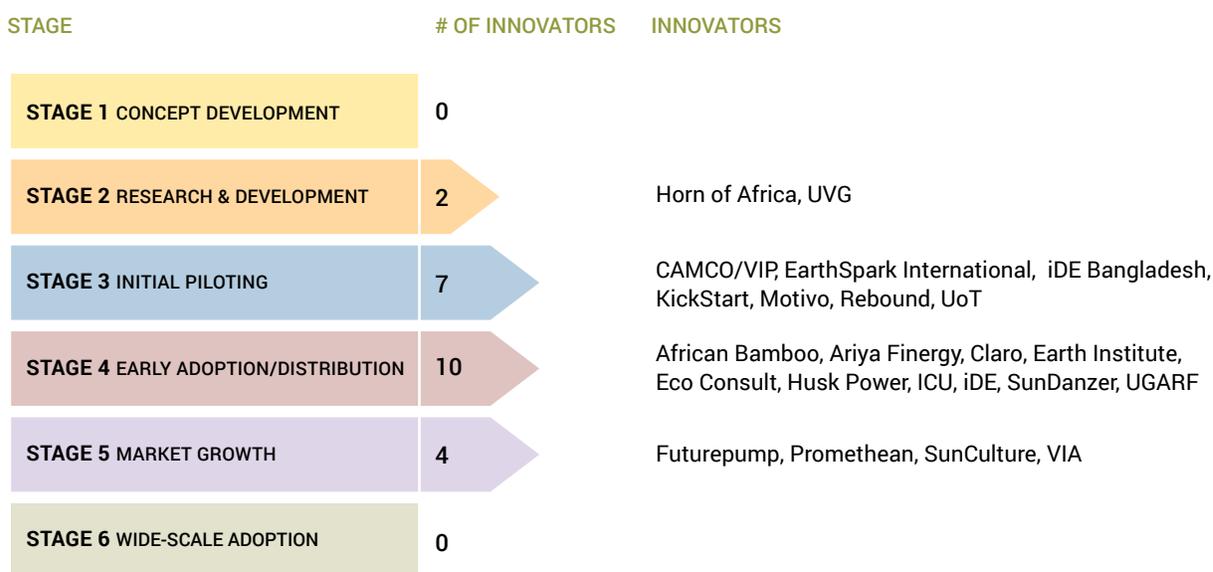


FIGURE 2.9 INNOVATION STAGES ACHIEVED



## Innovator Progress Based on VentureWell's Venture Development Framework

In an effort to capture innovator progress over the course of Powering Agriculture, the innovators were assessed in utilizing VentureWell's **Venture Development Framework**<sup>1</sup> in October and November 2019. The framework describes how science and technology-based innovators evolve at the earliest stages of commercialization. The assessment was conducted by a team from VentureWell given its experience providing business advisory services to the innovators under the Powering Agriculture Xcelerator.

The assessment was conducted for all 24 innovators at two points:

- The *pre-period* was considered to be the month and year the innovator received their award. The assessment was conducted retrospectively by reviewing the following documents: proposal, award agreement, first version of the work plan, and the intake survey (only available for the 2015 innovators). For context, analysts also reviewed the final milestone report, if available. Analysts used both a retrospective lens as well as the strength of evidence available in the initial documentation.
- The *post-period* was represented by either:  
1) the month and year at the time of the assessment (October 2019), if the innovator was still actively receiving business acceleration support or, if not, 2) the month and year their award ended. Analysts reviewed the final or most recent milestone

report, check-in call notes, trip reports, scorecards, and the latest fundraising deck if available.

Innovators were assessed on five of the six dimensions of the Venture Development Framework,<sup>2,3</sup> represented by the shaded areas of Figure 2.10 on the following page:

- **Team and Venture Structures:** The earliest stage indicates that a team is working casually on a project together, while the latest stage represents a team that has formally organized as a venture with employees, paid founders, and an active and engaged governance structure.
- **Technology Innovation:** The earliest stage represents a technology innovation that is at the fundamental research stage, prior to testing, while the latest stage represents a fully functional technology innovation that is being manufactured and sold to customers.
- **Market:** Innovators at the earliest stage have identified a market opportunity by naming a societal problem or technical challenge to solve, while innovators at the latest stage have developed a deep understanding of the market and its customers, and how to solve the named problems as evidenced by a repeatable, scalable, and/or recurring sales pipeline.
- **Business Model:** Innovators at the earliest stage have an interest in getting their innovation into the world but lack specifics on how to do so. Innovators at the latest stage have determined the path to market and have validated a self-sustaining

<sup>1</sup> The **Venture Development Framework** by VentureWell is licensed under [CC BY-NC-SA 4.0](https://creativecommons.org/licenses/by-nc-sa/4.0/).

<sup>2</sup> The Intellectual Property (IP) dimension was eliminated for three reasons: IP support was not a major component of the Powering Agriculture Grand Challenge, there was limited data on IP available in the documents reviewed, and the IP progression dimension was not applicable in its current format to non-U.S.-based ventures with varying IP policies

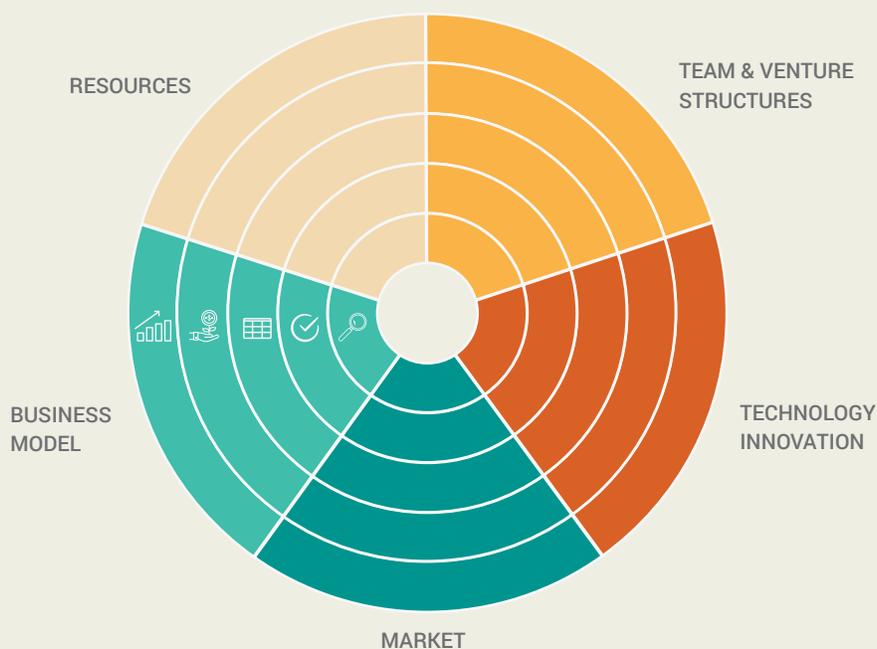
<sup>3</sup> It is important to note that progress is not only about moving outward (achieving a higher rating); it also includes the notion of learning and pivoting. Likewise, being at the "end" of the framework does not necessarily indicate that a company is fully developed and will no longer face challenges.

business model as evidenced by repeatable, scalable, and/or recurring sales pipeline.

- **Resources:** At the earliest stage, a team may have funds and advisors to support fundamental research and development, but

future support sources are unknown. Teams at the latest stage have secured funding and relationships required to sustain operations for the foreseeable future.

FIGURE 2.10 FIVE DIMENSIONS OF THE VENTURE DEVELOPMENT FRAMEWORK



Within each dimension, there are five stages of development (represented by the concentric circles of the figure, with the innermost circle indicating the least development and the outermost the most advanced stage). Each stage has an entry and exit point, for growth along a total of ten potential steps. Definitions of each step are provided in Appendix A. Teams can progress faster through certain dimensions, as venture development generally does not happen linearly.

Each innovator was evaluated based on their proposed project. In some cases, this meant the unit of analysis was the entity itself, as the entire organization was focused on building and commercializing the innovation. In other cases, the unit of analysis was a dedicated project team within a larger institution or across multiple organizations. For these innovators, analysts only considered the funded innovation (proposed in the work plan) along the technology, market, and business model dimensions, and considered the organization as a whole for the team and venture structures and resources dimensions. For innovators with a strategy that centered on partnership, analysts considered the maturity of the relationship with the partner in the team and venture structures dimension.

The assessment had four key findings:

**Finding 1: Innovators made the most progress on their technology innovation.** This makes sense, given that many innovators' awards focused on technology development. There was wide variation in the technological maturity of innovations when innovators began working with PAEGC, especially among the 2015 innovators. Five innovators did not progress at all over the course of the grant; four of them (all 2015 market expansion grantees) started at the highest step of technology development.

**Finding 2: Innovators developed their market and business models, but not necessarily alongside their technology.** Over the course of the program, an innovator's progress in the market and business model dimensions was typically made in tandem. Somewhat surprisingly, progress on the technology dimension was not correlated with progress on the market dimension and was only moderately correlated with progress on the business model dimension. In order to foster successful venture development, it is important to move a venture's technology, market, and business model forward in parallel. Working to develop a technology in the absence of movement on the other two can be a "road to nowhere," where the technology exists without a viable path to market. It is recommended that future programs craft milestones with this in mind. Innovators that engaged more deeply with the acceleration support tended to demonstrate greater increases in the business model dimension.

**Finding 3: Innovators made the least progress in their team and venture structures, in part because many started at the highest stage.** Most innovators entered the program at either a very high or very low stage of team and venture structure development: ten entered at the

Early Stage Growth (highest) stage and eight entered at the Market Discovery (lowest) stage. If working from a less developed starting place, it can be difficult to focus on building a highly functioning team and organization. In some cases, the funding allowed innovators to hire staff and build their teams, but when the awards ended, these changes were not sustained, thus leaving them at a low stage of development.

**Finding 4: Innovators made variable and sometimes limited progress in obtaining additional resources. Innovators entered the program at varying stages of the resources dimension.** Seven innovators did not progress at all and three progressed only one step. Innovators may have perceived obtaining additional, sustainable resources to be less urgent, given that they had secured funding at the beginning of the evaluation period. Advancing on the resources dimension often requires being able to prove a market and business model, and therefore may come after the other dimensions have advanced. Innovators that engaged more deeply with the business acceleration support tended to demonstrate greater increases in the resource dimension.

The following profiles provide a snapshot of each individual innovator's clean energy solution and their progress made throughout the Grand Challenge. Visit [www.poweringag.org/innovators](http://www.poweringag.org/innovators) for detailed profiles of all innovators, the most up-to-date information on their work, and an archive of news articles and videos.



# AFRICAN BAMBOO

## CLEAN ENERGY SOLUTION

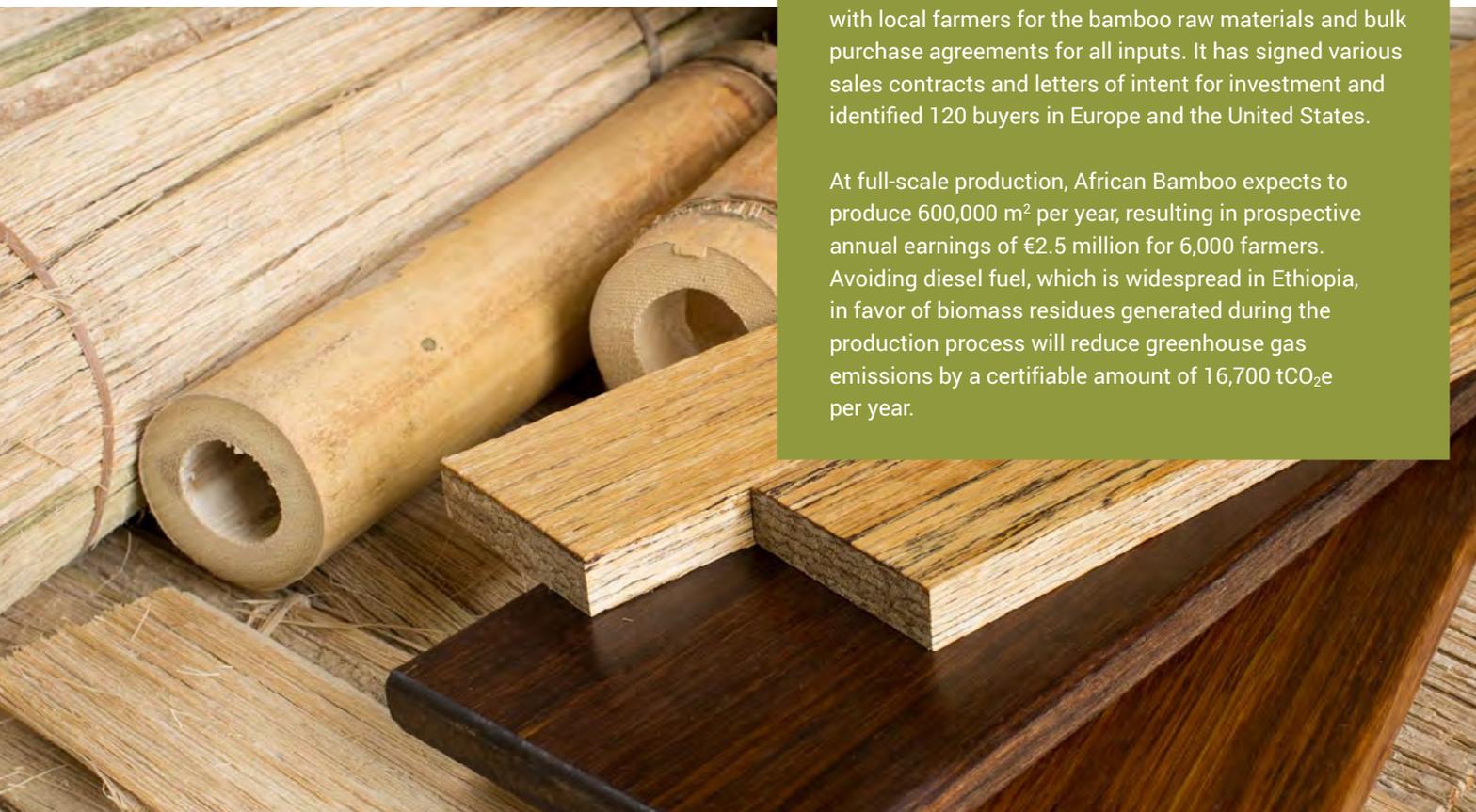
African Bamboo's solution is an environmentally friendly bamboo thermal modification process called ThermoBoo, a modern value-added processing technique that promises to increase farmers' earning potential. Through ThermoBoo, a chemical-free process, decay factors such as rot and insects are virtually 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 its successful establishment of a processing facility, African Bamboo envisions that job creation will improve local community livelihoods. Community members will be able to form new micro and small enterprises for bamboo forest harvesting and transportation, bamboo forest thinning, and micro charcoal production from low-quality bamboo culms.

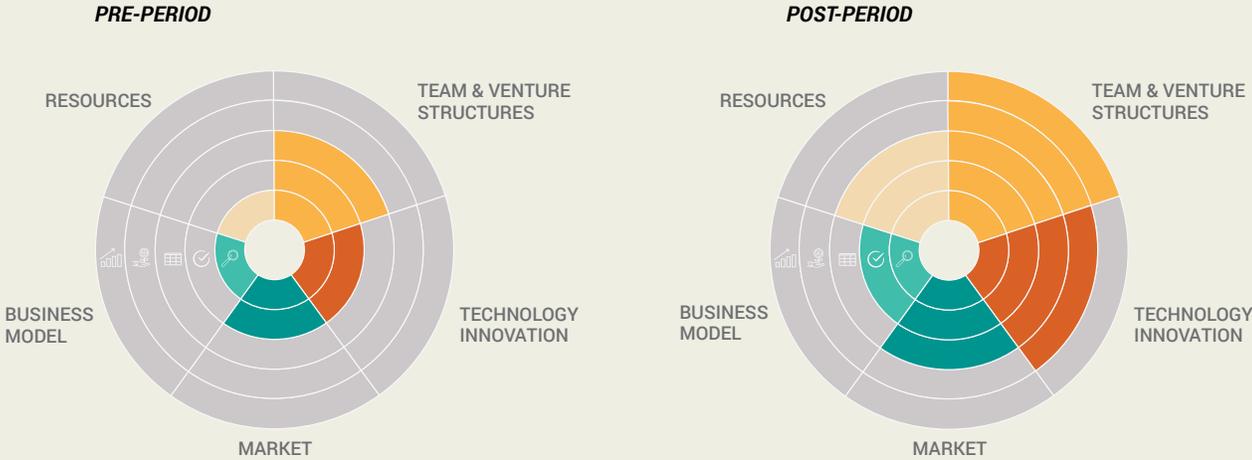
## PROGRESS UNDER POWERING AGRICULTURE:

By the end of the Powering Agriculture award in September 2017, African Bamboo had concluded the lease agreement for a facility of 16,500 m<sup>2</sup> at Hawassa Industrial Park for its factory space to manufacture and export bamboo-based composite boards. It had 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 with local farmers for the bamboo raw materials and bulk purchase agreements for all inputs. It has signed various sales contracts and letters of intent for investment and identified 120 buyers in Europe and the United States.

At full-scale production, African Bamboo expects to produce 600,000 m<sup>2</sup> per year, resulting in prospective annual earnings of €2.5 million for 6,000 farmers. Avoiding diesel fuel, which is widespread in Ethiopia, in favor of biomass residues generated during the production process will reduce greenhouse gas emissions by a certifiable amount of 16,700 tCO<sub>2e</sub> per year.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The company grew in sophistication as it hired personnel to perform key business activities in business development and marketing.
- **Technology Innovation:** The company produced proof-of-concept demo samples of the bamboo flooring product, sent several samples to potential customers as part of the market discovery process, and refined ideas for manufacturing.
- **Market:** African Bamboo’s collection of customer feedback is part of its efforts to understand the opportunity for its products in new markets and what the market segmentation will be. The next step is to define and address these customer segments.
- **Business Model:** The company continues to collect information from potential customers to generate market forecasting estimates and to understand how to engage and serve the market.
- **Resources:** The company began an investor discovery process and created investor archetypes to pursue as it seeks investment capital in 2020 to begin manufacturing and support scale-up.
- **Overall Impact:** PAEGC support was catalytic in allowing the team to demonstrate its technical capability and expertise, while simultaneously researching market opportunities for the company’s eventual product portfolio.

POWERING AGRICULTURE ASSISTANCE

- Supported the customer discovery process by introducing African Bamboo to stakeholders in the U.S. building materials and construction industry for interviews.
- Conducted market research from secondary sources and presented a high-level overview of the global manufactured building materials industry.
- Reviewed and edited a suite of marketing materials and external-facing documents the business development team uses in customer, investor, and industry partner meetings.

BY THE NUMBERS

<b>64</b>	<b>90%</b>	<b>100</b>	<b>1</b>	<b>\$3.25million</b>	<b>31</b>
test runs	high quality factor in fibers achieved	new bamboo cooperative members/suppliers engaged	new commercial facility established in 2017	of external funding leveraged	farmer cooperatives created with 2200+ farmers total



# CAMCO ADVISORY SERVICES/ VILLAGE INDUSTRIAL POWER

## CLEAN ENERGY SOLUTION

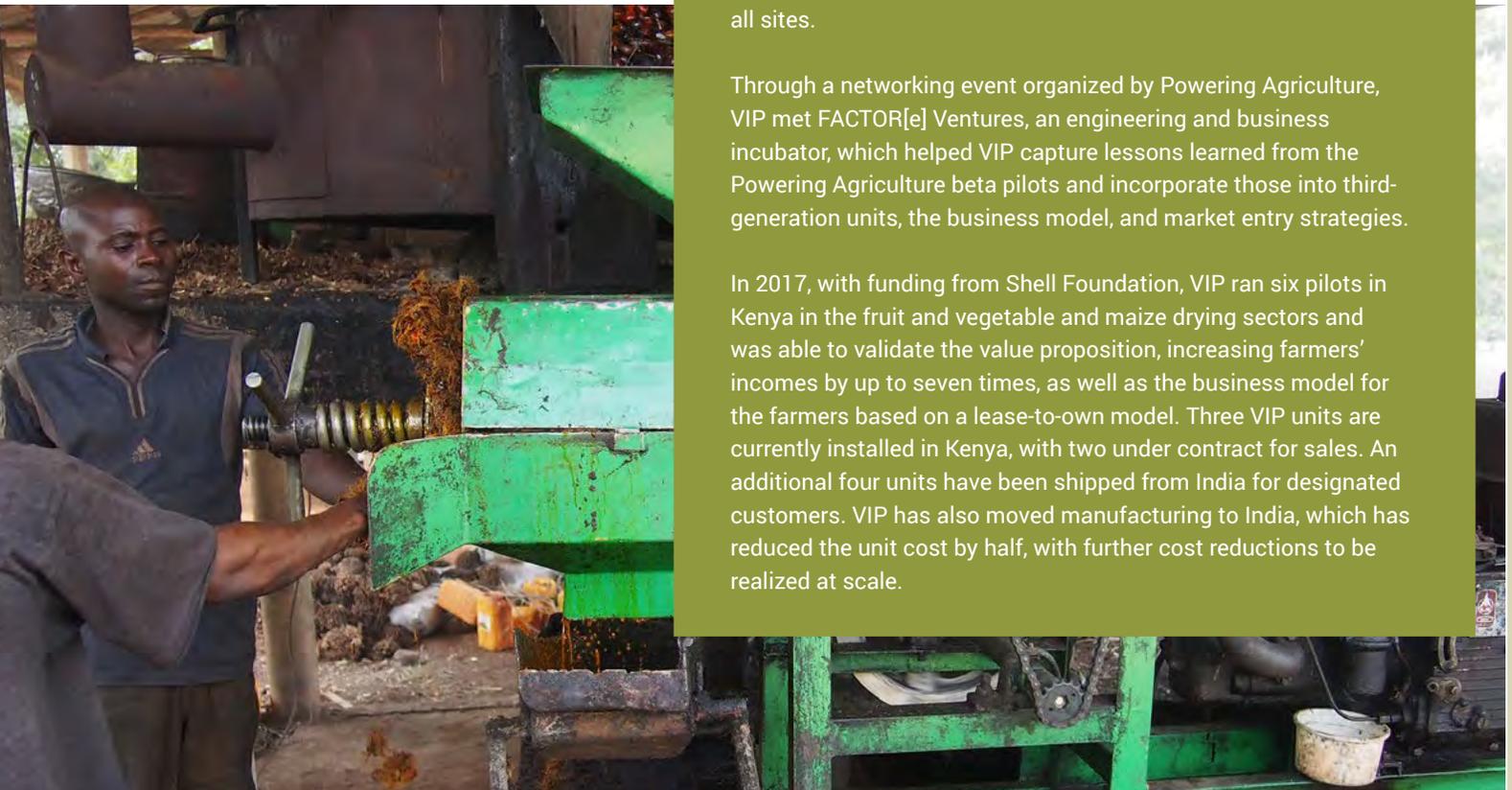
CAMCO's partner Village Industrial Power (VIP)'s solution is a small-scale, mobile combined heat and power plant powered by the combustion of biomass waste produced at local agricultural processing facilities to generate mechanical/electrical/thermal energy. VIP's carbon-neutral engine is fuel-flexible, 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, and 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 UNDER POWERING AGRICULTURE:

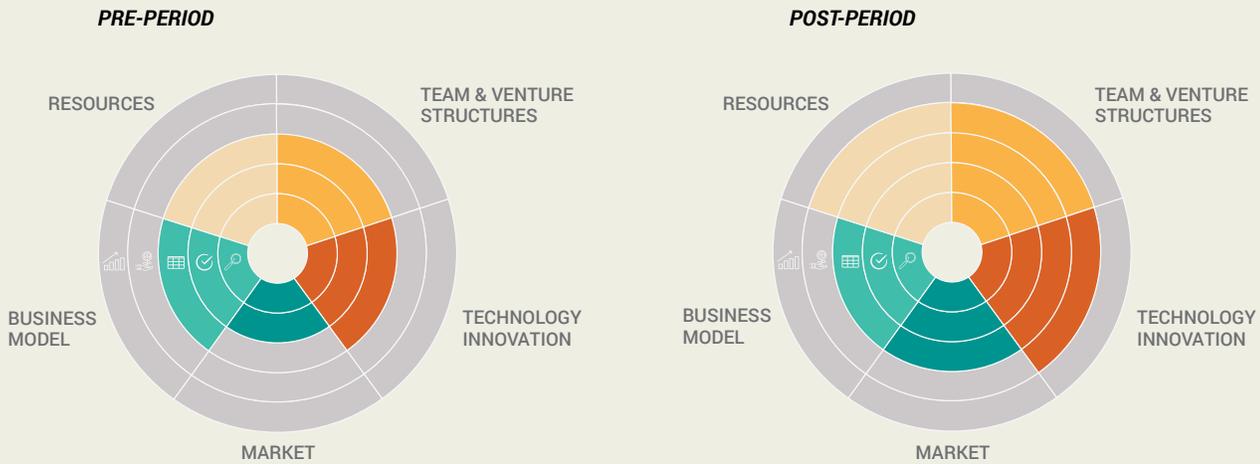
Though the award was terminated in 2016 after 1.5 years of implementation due to a breakdown in communication between CAMCO, the project implementer, and VIP, the technology vendor, VIP took over system maintenance in the communities where systems were installed and continued to improve the technology with the help of FACTOR[e] Ventures. 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 southeastern Benin had tested the VIP unit to displace diesel 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. 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 Powering Agriculture, VIP met FACTOR[e] Ventures, an engineering and business incubator, which helped VIP capture lessons learned from the Powering Agriculture beta pilots and incorporate those into third-generation units, the business model, and market entry strategies.

In 2017, with funding from Shell Foundation, VIP ran six 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 seven times, as well as 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 four units have been shipped from India for designated customers. VIP has also moved manufacturing to India, which has reduced the unit cost by half, with further cost reductions to be realized at scale.



ASSESSMENT OF PROGRESS



- Team and Venture Structures:** While CAMCO is a well-established company operating in East Africa since 1989, the project team and venture structure of VIP were most relevant to the award period. In that regard, the project team was able to successfully manage the technology pilots and validate incentives to move commercialization forward. VIP initially had some established processes for working with its original founders, but secured a new CEO during the course of the award.
- Technology Innovation:** VIP made significant progress on technology innovation with the development and installation of pilot units.
- Market:** CAMCO validated some of its initial hypotheses about palm oil processing in Benin, but discovered that palm oil processing was a small industry in Tanzania. As a result of this insight, the organization pivoted to focus on rural communities in Tanzania as a potential application for the VIP system.
- Business Model:** Through the pilots, CAMCO and VIP conducted numerous trainings and demonstrations at each site to raise awareness, promote the technology, and cultivate a pipeline of future sales leads. The next steps are to explore new geographies and markets, such as India, for commercialization. There is potential for VIP to leverage economies of scale to reduce manufacturing costs when production increases.
- Resources:** While the CAMCO award was cancelled, partner VIP secured additional resources or partnerships that it used for implementation outside of the award.
- Overall Impact:** Despite the incremental progress made in furthering its business model and resources, the program support allowed the VIP team to progress significantly in validating and demonstrating its technology in representative markets.

POWERING AGRICULTURE ASSISTANCE

No tailored assistance was provided to CAMCO.

BY THE NUMBERS

5

units developed as part of PAEGC grant in Benin and Tanzania

\$1.75 million

leveraged from the Shell Foundation for five pilot plans in Kenya

13

households provided with electricity

\$400,000

in private funds leveraged from FACTOR[e]



# EARTHSPARK INTERNATIONAL

## CLEAN ENERGY SOLUTION

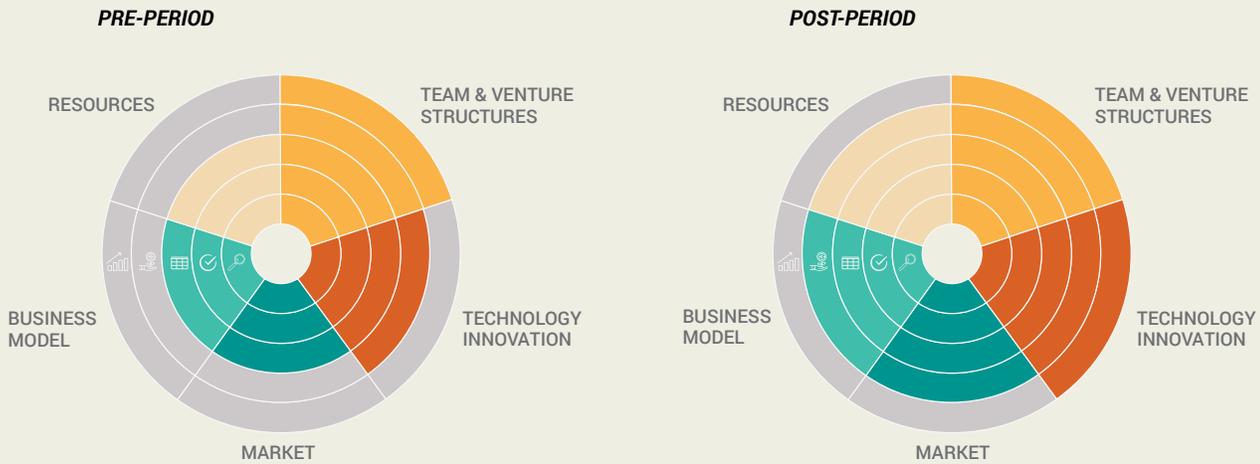
EarthSpark's solution is a solar-diesel hybrid microgrid system that will increase access to affordable, reliable electricity for value-added agricultural processing. By improving farmers' ability to process agricultural goods, the value of their products is maximized and their livelihoods improved. 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 corn dekerneling.

## PROGRESS UNDER POWERING AGRICULTURE:

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 have not yet shown a significant economic benefit, the entrepreneur-owners continue to refine their business model 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 percent 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 rebuilt the Les Anglais grid in 2017 and not only returned the grid to its former functionality but also improved its service. Currently, EarthSpark has more than 470 customers connected to the grid, with more on the Les Anglais waiting list.





- Team and Venture Structures:** Throughout the project, EarthSpark always had a strong team and vision around its venture structure. EarthSpark’s work led to the spinout of another company, SparkMeter, and the local microgrid operator, Enèji Pwòp, S.A.
- Technology Innovation:** During the funding period, the team worked to secure validation on the microgrid design and functionality as it accommodated a growing number of connections. EarthSpark updated the system design to meet performance specifications and was able to obtain valuable feedback from PASTO, further establishing credibility in technology innovation.
- Market:** The funding allowed for experimentation on EarthSpark’s value proposition and collection of information to validate the larger market opportunity for more microgrid installations in Haiti.
- Business Model:** EarthSpark was able to test the sustainability of the business model for the first microgrid and develop hypotheses for how future microgrid installations may operate. Importantly, EarthSpark was able to invalidate many hypotheses in the original business model draft, creating a stronger, more feasible set of ideas for future microgrid installations.
- Resources:** As EarthSpark has completed its award, the organization is in a position to secure additional resources for the scale-up of its work across Haiti and has clearly stated milestones and identified partner needs to do so.
- Overall Impact:** The funding provided by PAEGC allowed for critical progress in four of the five dimensions, putting the organization in a stronger position to secure additional funding for future microgrid installations in Haiti.

**POWERING AGRICULTURE ASSISTANCE**

- Provided input on EarthSpark’s follow-on funding strategy and made introductions to prospective funders based on this plan.

**BY THE NUMBERS**

**625**

individuals provided with electricity in the Les Anglais microgrid

**255**

women signed contracts for new connections

**\$480,000**

in donations leveraged for microgrid development

**24/7**

power provided through the first clean energy-powered microgrid in Haiti

**1**

Award: Clean Energy Education & Empowerment (C3E) International

# ECO CONSULT



## CLEAN ENERGY SOLUTION

ECO Consult's solution is an integrated model of hydroponic and photovoltaic (PV) 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 incomes while reducing 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 PV 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 for women and youth in rural households.

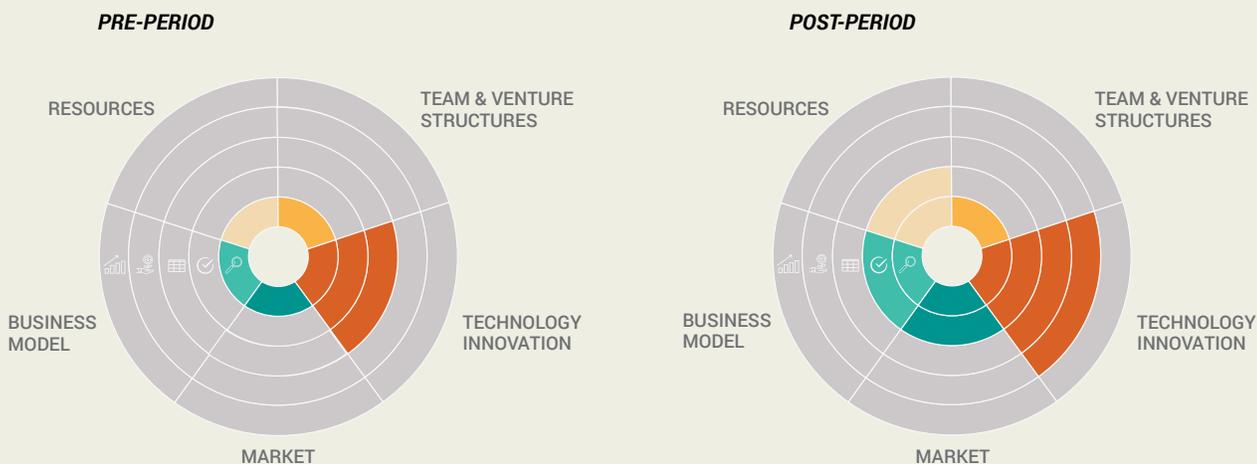
## PROGRESS UNDER POWERING AGRICULTURE:

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 seven workshops. ECO Consult also established 10 demonstration sites—nearly quadrupling the target of six sites—with the majority located at households or community-based organizations. ECO Consult established a partnership with Wageningen University in the Netherlands, which included technical assistance from the university, capacity-building, and 'train the trainers' sessions held in the Netherlands and Jordan.

Program activities 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 will involve the Dutch private sector. Dutch companies will provide hydroponic equipment and technical support (system monitoring and operation) for two to three years.





- Team and Venture Structures:** ECO Consult has been an established consulting firm in Jordan since 1995; however, the award focused on a project-based team. The team sought to promote awareness for hydroponic systems and provide specific technical assistance to farmers interested in adopting the innovative system. The team did not intend and therefore did not move forward in developing a dedicated entity to commercialize the innovation.
- Technology Innovation:** By identifying commercially available hydroponic farming and solar PV systems, the company was able to design and establish 10 demonstration sites across Jordan. Additionally, the team conducted six training sessions, four workshops, and 19 field days, which reached 530 people.
- Market:** Through engagement with key stakeholders, ECO Consult formed relationships that led to several farmers and NGOs approaching them for support and technical assistance in transitioning to the innovative new system.
- Business Model:** The team’s engagement with end users revealed that the initial high cost of the hydroponic system was a barrier to adoption for several farmers. This led them to identify ways to construct the system with local materials, which ultimately reduced cost and increased willingness to adopt.
- Resources:** PAEGC funding for demonstration sites allowed the company to secure resources to implement a follow-on project that targets large farms with high-value crops for export markets and will involve the Dutch private sector.
- Overall Impact:** The organization made the most progress in developing the technology, but also had the opportunity to further its understanding of what would be required for successful and sustainable commercialization.

**POWERING AGRICULTURE ASSISTANCE**

No tailored assistance was provided to ECO Consult.

**BY THE NUMBERS**

**60%**

of demonstration participants are willing to adopt hydroponics technology

**15%**

of demonstration participants took initial steps to adopt hydroponics technology



# IDE (INTERNATIONAL DEVELOPMENT ENTERPRISES)

## CLEAN ENERGY SOLUTION

iDE and their partners' solution is a solar 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 nearly four tonnes 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. Using the Sunflower pump allows farmers to increase their farm productivity, and thus their income.

## PROGRESS UNDER POWERING AGRICULTURE:

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 version of the pump, featuring a 40 percent reduction in weight and volume while retaining efficiency, was tested at sites in Kenya and began shipping to Nepal and Zambia. iDE installed 339 pumps for testing at 48 active field sites; 80 in Honduras, Zambia, and Nepal. An additional four pumps have been installed in the US, 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.



## ASSESSMENT OF PROGRESS

# IDE (INTERNATIONAL DEVELOPMENT ENTERPRISES)



- **Team and Venture Structures:** iDE is assessed as an established organization developing a new technology and experimenting with a business model for an internal program (i.e., “intrapreneurship”). As a venture, iDE was and remains well established as an organization with over 600 staff and a dedicated team continuing to work on this project.
- **Technology Innovation:** This team worked with partners including Futurepump and PRACTICA Foundation to reduce the cost of the Sunflower pump, improve its efficiency, and reach performance specifications necessary to be a commercially competitive product. The technology innovation is now commercially available through Futurepump and other partners around the globe.
- **Market:** The team was able to move from a general understanding of the market—such as key stakeholders, value chain nuances, and market size—in each target geography to obtaining a nuanced, well-documented understanding of each market and the opportunity within each one.
- **Business Model:** iDE’s goal was to validate a business model concept it was already employing in other parts of the world in Zambia, Nepal, and Honduras and to leverage its last-mile distribution network of Farm Business Advisors and local NGOs to expand the the product’s availability. This draft business model received further validation throughout the course of the award, especially in Nepal and Zambia, where 339 units were tested and an additional 80 were sold. The next step in validating the business model is to establish a recurring sales pipeline.
- **Resources:** The organization has sufficient resources to continue making progress in Nepal and Zambia through its local operations and will continue disseminating the product through partners like Futurepump.
- **Overall Impact:** iDE made significant progress in developing the technology and took important steps in furthering its understanding of key markets and the validation of a business model for dissemination of the clean energy service.

## POWERING AGRICULTURE ASSISTANCE

- Provided support gender integration support to guide data collection.
- Provided technical advice on integrating gender equality in strategic communications and in photographs for marketing.
- Suggested activities to reach more women and men as users, trainees, and employees and to promote gender equality.
- Identified potential Zambian strategic partners and stakeholders to connect NGOs, workers and customers to expand social inclusion offerings and work support that improve customers’ ability to pay and worker/entrepreneur productivity.

## BY THE NUMBERS

**5**

design iterations of the solar water pump system

**\$369,100**

in additional funds leveraged

**272**

beneficiaries, including

**131** women

**31%**

increase in agricultural production due to pumps, on average

# MOTIVO ENGINEERING, LLC



## CLEAN ENERGY SOLUTION

Motivo Engineering, LLC (Motivo) is developing a “Swiss-Army Knife” system—Hybrid Agriculture/Road Vehicles with Electricity Storage and Transformation (HARVEST)—that solves a wide range of agricultural mechanization and power-related problems by supplying 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 uses power from varied energy sources such as solar panels, wind turbines, micro-hydro turbines, or the grid to enable increased productivity all along the agricultural value chain. The entire system is operated at the community level, and mobile communication technology facilitates scheduling, billing, and payments.

HARVEST generates opportunity in agriculture by making huge gains in productivity available to entire communities, reducing 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.

## PROGRESS UNDER POWERING AGRICULTURE:

By the end of the Powering Agriculture award in May 2017, Motivo had shipped, assembled, and field-tested two HARVEST prototypes in India. The primary use of HARVEST during field testing was for field leveling, although the systems were also 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 reassess the feasibility of HARVEST solar charging. Motivo’s beneficiaries primarily see HARVEST as a mechanism to reduce expenses on light duty field preparation. Beneficiaries reported that they experience lower 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 that HARVEST would fully replace diesel tractors had not considered all the nuances of specific agricultural tasks. Motivo found that HARVEST was more appropriate for lighter-duty tasks.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** Motivo, an established engineering consulting firm in the US, explored the opportunity to establish a potential new start-up organization specifically to commercialize the technology developed in the project scope. Using this lens, the team was considering paths to market and thus was at the earliest stage of development for team and venture structures; they had clear goals for technology commercialization but were still considering potential paths to market. Over the period of the award, the team made progress and agreed on a commercialization path after exploring a variety of opportunities on the ground.
- **Technology Innovation:** The award enabled the team to develop, manufacture, and pilot two prototype units, moving them several stages forward in the validation of their technology innovation. These community trials allowed Motivo to validate design, product specifications, and functionality. The next steps in the technology innovation timeline would be to validate design for manufacturability and to develop a manufacturing plan.
- **Market:** Motivo started with a very basic understanding of the problem, and over the program period developed an initial value proposition for its target users.
- **Business Model:** Motivo determined that a licensing arrangement with a third party would be the best pathway to market. Motivo worked to identify partners with local expertise who could develop and pilot the business model.
- **Resources:** The overall progress helped Motivo obtain clarity on its needs for partners and funding for future pilots and business model development.
- **Overall Impact:** While Motivo's largest achievement was validating technology innovation, making stepwise progress in each of the other dimensions is a notable accomplishment and a good example of how progress in one dimension relates to progress in others in the establishment of a venture.

## POWERING AGRICULTURE ASSISTANCE

- Provided business model validation and fundraising strategy advisory assistance
- Provided technical advisory support and strategic advice on how both women and men should be targeted in field testing—as users, for outreach and communication, in surveying, etc.
- Provided technical advisory and strategic advice and resources on how to effectively hire, train, and develop women on staff, including provision of technical resources to support their efforts.

## BY THE NUMBERS

47

farmers, 2 businesses rented tractors, thus saving money

43

hectares of land impacted

1,880

hours of HARVEST use



# PROMETHEAN POWER SYSTEMS

## CLEAN ENERGY SOLUTION

Promethean Power Systems' (Promethean) refrigeration solution uses a thermal energy battery pack that charges on intermittent power sources such as solar power or a few hours of grid electricity. This provides cold storage around the clock in rural India, where a major obstacle to 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 solution with high operating costs and negative environmental impact. Promethean's refrigeration technology allows dairy processors to collect raw milk from remote dairy farmers and chill it in a rapid milk cooler, reducing the time that milk is not chilled 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, income for dairy farmers, and wealth creation through increase in herd size.

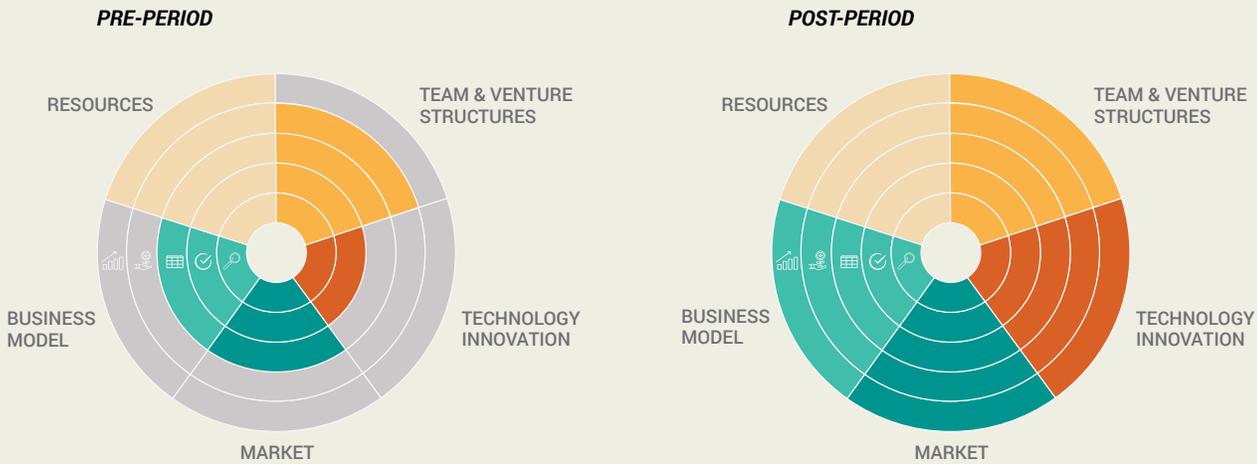
## PROGRESS UNDER POWERING AGRICULTURE:

By the end of the project in June 2017, Promethean sold 484 coupled milk chillers benefiting 25,300 dairy farmers, who can now chill their milk without the need for diesel generators. As deployment of the chillers continues, Promethean has been able to adapt the solar component design to address dairy partners' specific logistical needs, which has led to increased adoption.

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. This benefits the dairy processor, because they collect more quality milk and make more profits from value-added products that demand high quality milk. It benefits the environment, because there is no longer a need for pollution-causing diesel generators. It benefits consumers, because they are drinking healthier milk. Finally, it benefits farmers, because their livelihoods improve.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** During the period, the team secured a new CEO and COO/Managing Director India and actively worked with its board of directors to guide strategic decisions, such as expansion and fundraising.
- **Technology Innovation:** At the start of the award, Promethean was on the cusp of a functional prototype designed to meet customer-specified needs. By the end of the assessment period, Promethean had fully launched commercially with scaled manufacturing systems in place.
- **Market:** Initially, the innovator had a basic understanding of the customer and market opportunity, but has now developed a nuanced suite of products for a diverse sales pipeline.
- **Business Model:** Draft iterations of the business model were submitted with the innovator’s milestones, showing the continued progress and validation that Promethean obtained by having the resources necessary to pilot in-market. The company has now established a repeatable, scalable, and recurring sales pipeline with healthy underlying financials, indicating a functional business model.
- **Resources:** Promethean was in a unique position in that it had secured equity financing around the time the award was issued, putting it in a strong initial resource position that it has maintained with the closure of an equity financing round in mid-2019 led by Acumen Fund.
- **Overall Impact:** PAEGC support was catalytic in helping Promethean become an established venture with commercial validation, a vetted technology innovation, and a well-supported team.

POWERING AGRICULTURE ASSISTANCE

- Delivered technical assistance on strategic business development issues and leadership strategy through an in-person site visit in December 2019;
- Provided ongoing strategic advice on fundraising goals and leadership strategy in addition to investor connections.
- Provided gender integration assistance to create an M&E plan with strengthened collection of socio-economic data for marketing, hiring, customer expansion, and attracting impact investors.

BY THE NUMBERS

484

milk chillers deployed with patented thermal storage

25,298

dairy farmer beneficiaries

42,491

L/day of milk preserved



# REBOUND TECHNOLOGIES

## CLEAN ENERGY SOLUTION

SunChill™, a Rebound Technologies (Rebound) innovation, 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, which 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.

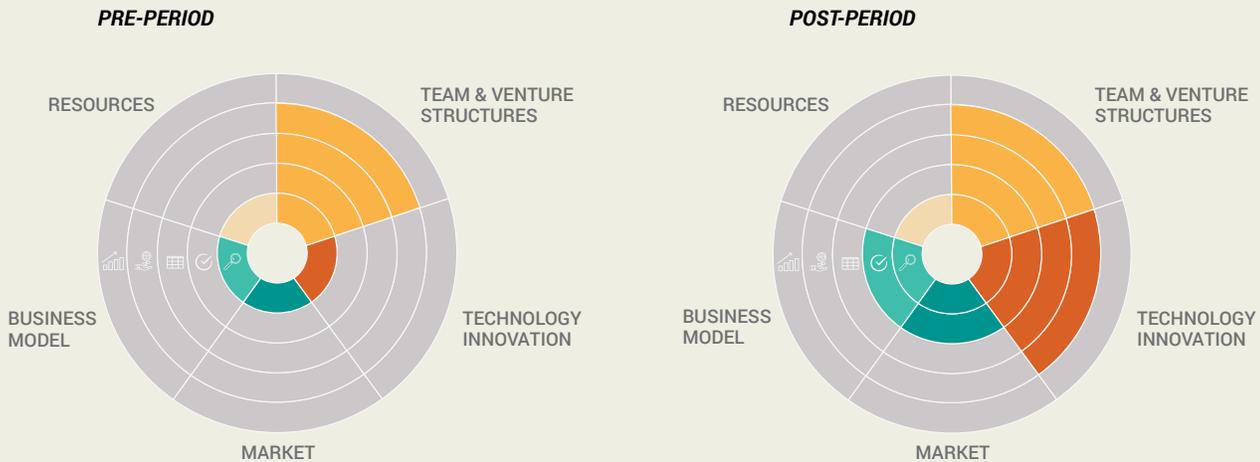
These characteristics enable production of a low-cost, low-maintenance technology that reduces spoilage and benefits smallholder farmer livelihoods. The low-cost system enables increased horticultural production for both domestic and export consumption, generating additional income for smallholder farmers and increased access to nutritional fruits and vegetables while creating manufacturing and service-based employment.

## PROGRESS UNDER POWERING AGRICULTURE:

Rebound finished the Powering Agriculture project in March 2016 by validating a SunChill™ field demonstration unit in Mozambique that cooled 43 kg of tomatoes during the pilot. This completed the engineering work that forms the technology foundation. The remaining task is the industrial design work necessary to move SunChill™ to a commercialized product available for deployment. Rebound has used some of the data and incorporated lessons learned from field testing SunChill™ into its latest IcePoint™ technology for the U.S. market.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** This for-profit company did not make significant changes in its venture related to this project, which was specifically designed to explore the commercial opportunity in Mozambique.
- **Technology Innovation:** At the beginning of the award, the team had an initial concept for the cooling system and had completed some preliminary modeling. The funding afforded the opportunity to design, engineer, and field-test the cooling system prototype and establish one demonstration system at a farm in Mozambique. The award also allowed for design iterations on the prototype's usability, functionality, and cost.
- **Market:** Initially, the team was early in its understanding of the market in Mozambique, but through the demonstration project was able to engage stakeholders and to identify and validate key differentiators of the technology compared to alternative solutions.
- **Business Model:** The team advanced its business model for SunChill™ technology by identifying its pathway to market as making the technology open-source upon completion of the project.
- **Resources:** Given that the team intends to make the technology open-source and not further pursue commercialization of the SunChill™, there is no indication that they have furthered their resources for this innovation
- **Overall Impact:** Overall, the team made the most significant progress on the development of the technology innovation, which created new product opportunities Rebound.

### POWERING AGRICULTURE ASSISTANCE

No tailored assistance was provided to Rebound Technologies.

### BY THE NUMBERS

# 10°C

operating temperature achieved

# \$10,761

cheaper than a comparably-sized, off-the-shelf solar-powered refrigerator

# 2

product iterations



# SUNDANZER REFRIGERATION

## CLEAN ENERGY SOLUTION

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. The PVR uses phase-change materials—substances capable of storing and releasing large amounts of energy—as thermal storage to maintain cold temperatures at night when solar power is not available.

SunDanzer also developed milk can blankets to retain the cold temperature as farmers transport milk to collection sites. 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.

## PROGRESS UNDER POWERING AGRICULTURE:

To date, SunDanzer has delivered and installed nearly 200 solar milk cooling refrigerators in Kenya and installed multiple units in Rwanda and Uganda. The second-generation units currently being installed are more cost-effective than the previous generation. Most units continue to be installed at dairy farms, with camel milk processors among the newest customers. SunDanzer and its partner Winrock International co-hosted a two-day Renewable Energy Cold Chain workshop and field visit in February 2017, with more than 70 attendees.

Users have stated that SunDanzer's PVR adds financial security to the household as well as food preservation. They also cite the ability to charge cell phones, which saves time and increases household income. Drawing on lessons learned while implementing the project, SunDanzer is developing multiple new technologies to increase the PVR affordability: a smaller 10 liter refrigerator designed for smallholder farmers, a large 500 liter refrigerator for milk collection centers, and a pay-as-you-go model.



ASSESSMENT OF PROGRESS



- Team and Venture Structures:** While SunDanzer is an established engineering consulting firm with over 20 years' experience in the industry, the assessment focused on the project team assigned to achieve the award's market expansion goals. The award was jointly implemented by SunDanzer, in charge of technology development, and Winrock, an NGO initially responsible for overseeing distribution in Kenya. The team was a temporary combination of third-party consultants and in-house personnel to manage logistics, install units, and obtain market data to inform the company's regional strategy. By the end of the award, the team had developed the business and market knowledge necessary to move the innovation to market, and can do so, if and when more favorable market conditions occur.
- Technology Innovation:** The team made significant progress on the technology innovation, including modifying a second generation of units in which a large external solar array needed for power was replaced with a smaller, less expensive roof-mounted option. This technical pivot led to a more cost-effective unit, better suited to the realities of the regional market.
- Market:** The team made progress in testing the market and generating customer feedback by having units installed and piloted in East Africa. Market testing found a need to lower unit costs, which led to modifications in the technical design.
- Business Model:** As part of piloting, unit economics, transit costs, and other key financial assumptions were validated and incorporated into the company's financial projections and strategic plans. Using these metrics to build an informed sales strategy that is repeatable and scalable would further move the innovation to market. Building this plan is a next step for the organization.
- Resources:** While SunDanzer as an organization has the resources to pursue product commercialization and the flexibility to pursue future opportunities (either in a different region or a different solution altogether), the project resources to bringing the small-scale cooler to market in East Africa expanded only slightly over the award period. The team understands the resources they need if they were to continue commercializing this product in the region, but as of award close, those relationships had not yet been fully secured.
- Overall Impact:** PAEGC funding and support was most critical in advancing the development of the technology innovation and in framing and testing market hypotheses needed to establish product-market fit.

POWERING AGRICULTURE ASSISTANCE

- Conducted an in-person technical assistance visit to Kenya in 2016 to identify potential customers, survey the technology's product-market fit, and make connections with stakeholders in the East African cold chain.
- Conducted policy research to gain clarity on potential clean-tech and solar value-added tax exemptions in Kenya.

BY THE NUMBERS

<b>80</b>	<b>91</b>	<b>3</b>	<b>3</b>
units deployed	tonnes of CO <sub>2</sub> abated	technology iterations developed	awards received: Global LEAP Awards, Overall Value Innovation Prize, Global LEAP Awards, Winner (Small Refrigerators), Global LEAP Awards, Winner (Large Refrigerators)



# THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

## CLEAN ENERGY SOLUTION

Earth Institute's solution enables 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.

Farmers will access this power 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 to their micro-utility bills. This innovation will allow farmers, even those with small landholdings or little access to capital, to benefit from irrigation.

## PROGRESS UNDER POWERING AGRICULTURE:

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 cooperative of 120 women, and are now seeing maximum utilization. Farmers experienced a 29 percent average increase in agricultural production, and 22 tonnes of CO<sub>2</sub> equivalent emissions were avoided by not using diesel pumps. Eight people have been trained on how to service the pumping systems. The project is now seeking partnerships for scaling up, adoption, and local maintenance contracts.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The team initially consisted of a single faculty principal investigator and his collaborators. The funding allowed a small group of graduate students to implement the project, although they did not stay with the project long enough to result in a lasting venture.
- **Technology Innovation:** PAEGC funding supported pilot validation studies and field use at three sites in Senegal. These studies confirmed that the system functioned to the point where users would pay for the cost of energy from the system (albeit subsidized).
- **Market:** The team made some progress understanding market dynamics and the larger industry value chain in Senegal. PAX supported this progress with an in-country landscape analysis in 2016.
- **Business Model:** In addition to the in-country landscape analysis, PAX support helped the team investigate possible pathways out of the university setting and into the market by translating a use case for specific customers and introducing business models that could be explored and instituted if the venture were to be ongoing and continue beyond the laboratory setting.
- **Resources:** With the right leadership in place, the venture could secure local partners and move forward in the market, as the team did make progress in developing relationships with potential strategic partners that could provide some of the resources necessary in the future for commercialization.
- **Overall Impact:** As anticipated through the milestones oriented to research and development, the PAEGC funding and support was most critical in advancing the development of the technology innovation.

POWERING AGRICULTURE ASSISTANCE

- Conducted an in-person technical assistance visit to Senegal in 2016 to develop an understanding of the irrigation and agriculture landscape, meet with key stakeholders and develop a deep list of useful and important contacts, and develop an outline of potential activities and learning agendas that can be operationalized in a subsequent phase.
- Helped the team develop marketing collateral and overview documents used in presenting the solution to potential partners and stakeholders.
- Provided multiple referrals for follow-on grant funding opportunities to extend the operational runway of the project.

BY THE NUMBERS

**3**  
solar water pumping systems installed

**6**  
hectares irrigated

**34 kWh**  
generated daily



# UNIVERSITY OF GEORGIA RESEARCH FOUNDATION

## CLEAN ENERGY SOLUTION

The University of Georgia Research Foundation (UGARF) developed a two-component device (branded as “EvaKuula”) powered by biogas extracted from cow manure. The device delivers a mild heat treatment followed by a gentle evaporative cooling process that keeps the milk fresh overnight. This provides a refrigeration alternative to cold-chain facilities, as farmers have limited access to electricity, and kerosene and solar-powered options 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, extracting biogas from cow manure mitigates greenhouse gas emissions from fermenting cow manure.

## PROGRESS UNDER POWERING AGRICULTURE:

By the end of its project, UGARF had deployed 43 EvaKuula units, with 19 units sold to female-headed households. Smallholder Fortunes and Thermogenn, an NGO and social enterprise spun off of the project by Professor William Kisaalita, continue to adapt the EvaKuula to other uses. They are currently exploring its use as a bottled drinks chiller and are working with USAID’s Nutrition Lab and the University of Florida to develop an EvaKuula-based egg cooler in Burkina Faso. UGARF’s award ended in March 2018. To mark the end of the project, UGA hosted a press conference with the Ugandan Minister of Agriculture, Animal Industry and Fisheries to preside over the EvaKuula’s transition from a donor-funded project to a revenue-supported product.



ASSESSMENT OF PROGRESS



- Team and Venture Structures:** The team established a for-profit, fully independent university spin-out to handle commercial activities, which continue beyond the award period. This milestone marks a significant advancement in the life cycle of a university research project, as it shows the founder's commitment to moving the innovation from a lab and research environment to market. To support the new venture, a team has been formed to handle the manufacturing of the product, conduct sales and business development activities, and provide post-sale service and support.
- Technology Innovation:** The team was able to manufacture, install, and demonstrate the efficacy of its evaporative cooling units, further advancing the validation of the technology innovation. Early testing led to design modifications necessary to increase usability and improve safety features. These modifications increased the technology's appeal to female beneficiaries (who account for a significant percentage of the innovation's early adopters). The more user-friendly design was further value engineered to bring down price points and streamline manufacturing requirements, thus lowering the break-even price of the units for market.
- Market:** The team integrated its customer discovery findings into financial models, including bottom-up sales projections and a customer acquisition and demand generation strategy based on the target markets.
- Business Model:** The company conducted in-field customer discovery to refine its business model and segment customers based on their ability to finance the purchase of units as well as their likelihood to benefit from the technology.
- Resources:** To fulfil initial sales demand, the company will seek investment resources to fund inventory and begin batch production, which they will control as a division of their operations.
- Overall Impact:** The award funding was catalytic in allowing the team to improve product-market fit while simultaneously gaining market insights into customer behavior and customer adoption expectations.

POWERING AGRICULTURE ASSISTANCE

- Conducted an in-person technical assistance visit to Uganda and Kenya in 2019 to extract first-person testimonials from customers of pilot units, define customer archetypes, build sales capacity by defining internal customer relationship management protocols to be adopted by the business development team and make connections with stakeholders in the Ugandan dairy value chain.
- Provided multiple referrals for follow-on funding opportunities to expand R&D.

BY THE NUMBERS

**282,510**

liters of milk preserved

**\$12,962**

increase in consumer income due to EvaKuula operation

**3**

generations of product deployed

# ARIYA FINERGY



## CLEAN ENERGY SOLUTION

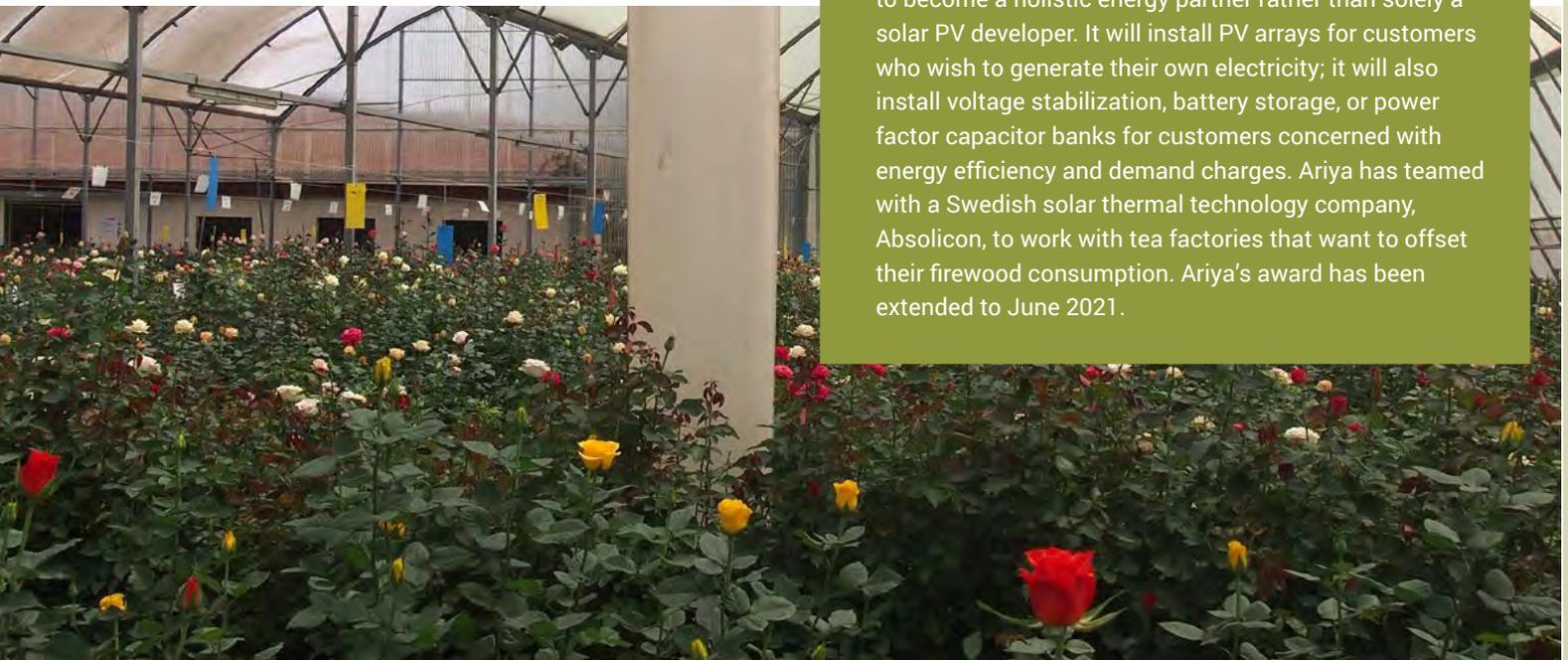
Ariya Finergy (Ariya) acts as the power partner for its clients, providing end-to-end cost-effective, low-risk renewable energy generation, storage, stabilization, and energy efficiency services to local flower and horticulture farms in East Africa with a focus on Kenya. Agriculture is a cornerstone of Kenya's economy: horticulture and the export of flowers are major sources of employment, with energy costs accounting for 15 percent of the input costs. Ariya's services are structured to minimize the upfront investment required by farmers. A mixed-technology approach, using various distributed renewable energy and energy efficiency solutions, allows flexibility in designing bespoke systems for each user. By helping East African horticulture exporters increase their bottom line, Ariya can help employees on their farms—ranging from 1,000 to 25,000 per farm and 50 percent women—and the associated local communities benefit from greater job security and improved living standards.

Other impacts include reduced carbon emissions, improved productivity, reduced water usage from farms using more sophisticated agriculture and horticulture techniques, and where legislation permits, the export of excess power to the grid or through microgrid designs that permit supply to other local businesses and communities.

## PROGRESS UNDER POWERING AGRICULTURE:

Ariya has commissioned eight systems as of October 2019, totaling over 680 kW. On average, the systems cover 37 percent of clients' energy consumption. All the installed systems are continuing to operate optimally, with regular operations and maintenance support and reports provided to the clients. The majority of Ariya's customers employ more than 50 percent women. The systems include remote monitoring and are used for power pumping, refrigeration, lighting, irrigation, and fertilizer dispersal.

While many farms have access to the national grid, Ariya's systems ensure consistent, reliable power for their operations. Ariya has expanded its business model to become a holistic energy partner rather than solely a solar PV developer. It will install PV arrays for customers who wish to generate their own electricity; it will also install voltage stabilization, battery storage, or power factor capacitor banks for customers concerned with energy efficiency and demand charges. Ariya has teamed with a Swedish solar thermal technology company, Absolicon, to work with tea factories that want to offset their firewood consumption. Ariya's award has been extended to June 2021.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** Ariya entered the program with a strong team and venture structure, which it maintained throughout the course of the program.
- **Technology Innovation:** Initially, Ariya had completed pre-feasibility assessments and energy audits to inform the parameters for the technology innovation. Throughout the award, Ariya worked through a number of design and manufacturing partners and options, and ultimately launched commercially with eight systems installed as of October 2019 and many more in the pipeline.
- **Market:** Ariya started with a broad value proposition and many potential customer segments. Through the efforts to build a pipeline of customers with feasibility studies, system design, and client prospecting, Ariya homed in on more specific customer segments and value propositions for them.
- **Business Model:** Ariya leveraged the funding to afford the time to convert pilot sites and prospective clients engaged in feasibility studies into paying customers. This careful work allowed the company to work through business model hypotheses and identify nuances in the key activities and partners required to successfully execute the business model.
- **Resources:** Ariya started out with a strong set of resources thanks to the initial capitalization from Ariya Capital Group, a holding company. The team focused its efforts primarily on business model validation. Therefore, Ariya can now articulate compelling funding milestones to prospective investors and lenders, which is the next step in progressing on resource acquisition.
- **Overall Impact:** Program funding afforded Ariya the time and opportunity to gain market and business model validation by developing of a strong sales pipeline, which will also help Ariya secure resources from investors and lenders going forward.

## POWERING AGRICULTURE ASSISTANCE

Through PAX's assistance, Ariya made significant progress in developing and validating a customer pipeline, which was an ongoing theme in all conversations with PAX to better position the organization for funders, including both equity investors and lenders. PAX provided several rounds of feedback on funder materials over the years, which included both strategic brainstorming and positioning along with feedback on the flow and content of the materials.

Powering Agriculture's gender integration specialist provided technical advisory assistance to help Ariya identify opportunities for partnerships with an NGO to support life improving services (health, financial literacy, gender-based violence) for technicians and field staff at clients' farms. The specialist helped identify who would find such services useful, what type of services would be appreciated, and one or two farms who might be amenable to such services (and where services would be feasible).

## BY THE NUMBERS

3,638

workers at farms powered by Ariya

\$7,833

saved in farm electricity bills from all customers in 2015-2018

\$1.37million

mobilized



# CLARO ENERGY

## CLEAN ENERGY SOLUTION

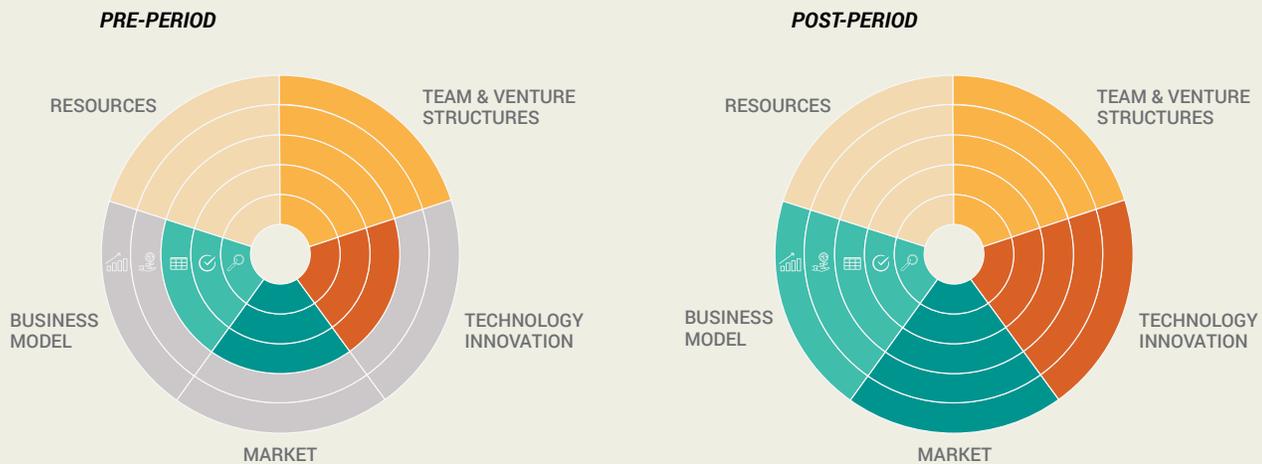
Claro Energy (Claro) is developing a pay-per-use irrigation service that uses a portable solar pump. The portable design will provide affordable, convenient, and on-demand irrigation. This will enable villages in India to irrigate independently of monsoon patterns or the availability of power to operate groundwater pumps. The service will meet the needs of farmers who do not own pumps, with no upfront capital costs incurred. Farmers will call a toll-free line, pre-pay, and schedule irrigation service at their fields. The project will increase farmers' productivity and income, while decreasing greenhouse gas emissions. Also, this service will create employment in rural agricultural communities, since villagers will have the opportunity to become local irrigation service providers.

## PROGRESS UNDER POWERING AGRICULTURE:

Claro Energy has installed five fixed solar systems, 50 trolleys, and 50 portable folding solar array-based solar pump systems. Claro is planning to develop an improved automation and remote monitoring module to reduce its current operation costs. More than 1,500 farmers are benefiting from the systems, with roughly 22 percent of those being women. Claro has a staff of 21 professionals available to provide technical assistance to users and continues to conduct trainings and demonstrations. Claro found that its trolleys were not mobile enough to reach borewells more than 50 meters from a road, so it developed a 2 kW portable folding solar array to power its pumps. This allowed its technicians to deploy pumps to new fields that they could not reach with the trolleys and oversee up to three solar pumps at a time. Claro's award ended in June 2019.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** Claro had a well-established team and venture structure selling solar irrigation pumps across India when it initially received the award, but aimed to develop a new product line to service new target markets and diversify revenue.
- **Technology Innovation:** Claro initially had a prototype with plans to improve its design and make iterations to meet performance specifications identified through customer discovery. This is where Claro made the most progress over the project term, working on at least five different models and iterations of the product and completing rollouts in three different communities.
- **Market:** Further customer discovery allowed the team to gain a working understanding of the specific market opportunity for irrigation trolleys, including the size of the opportunity, the logistics of the sale and implementation, and the dynamics of the value chain.
- **Business Model:** At the start of the award, Claro had completed initial customer discovery to develop a draft business model and value proposition for how the technology solution would solve a problem for the target customer base. Throughout the project, the community pilots translated to proof of customer interest through sales traction, securing further validation on both the business model and market opportunity.
- **Resources:** The organization has the resources required to continue with the commercialization of this product and is now seeking additional funding to scale up the opportunity.
- **Overall Impact:** The PAEGC funding allowed a strong organization to develop a new line of business for an underserved market based on a new technology innovation.

## POWERING AGRICULTURE ASSISTANCE

- Advisory support for corporate entity structuring and accompanying fundraising needs.
- Review and input into Claro Energy beneficiary impact story to strengthen gender integration storytelling.
- Review and input into Claro Energy baseline assessment tool and socio-economic survey.
- Work plan review and technical support for strategic planning on improving gender integration.

## BY THE NUMBERS

**\$4million**

external funds leveraged

**1,563**

customers served

**5**

product iterations

**2**

awards received: Amity Business School's Award for Excellence in Energy Industry (Kartik Wahi); Asian Entrepreneurship Award (First Place)



# FUTUREPUMP

## CLEAN ENERGY SOLUTION

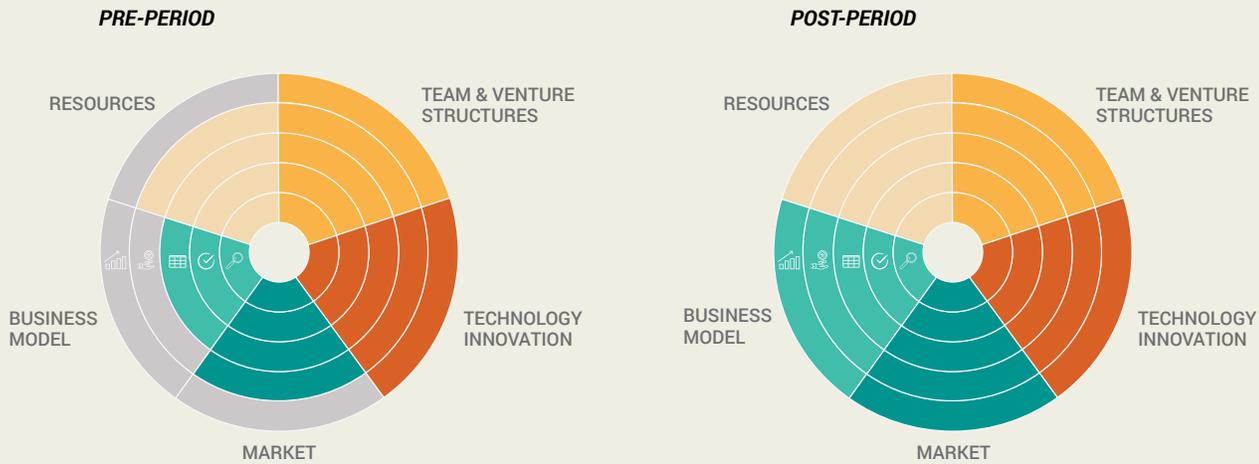
Futurepump solar pumps are easy-to-maintain solar irrigation pumps, built around a simple piston pump arrangement. Futurepump has gradually improved its product and is now able to provide every pump with a five-year warranty and remote monitoring as standard. The company will also offer the pump on finance through partners to lower the upfront barriers to solar technology. The project will have a particular impact for women and children, who take on much of the labor burden of manual irrigation or carrying fuel pumps. Farmers using solar irrigation can double productivity, and the growing season can be extended through the dry season, during which produce brings higher market prices.

## PROGRESS UNDER POWERING AGRICULTURE:

At the end of FY 2019, Futurepump had shipped over 2,200 solar pumps from its factory in India to Kenya. By shifting from direct sales to partnering with Davis and Shirliff in Kenya, Futurepump has seen a notable increase in the number of units deployed—now over 1,750. A small pay-as-you-go financing pilot was conducted through a partnership with Angaza and Green Light Planet. One of the conclusions, was that pay-as-you-go financing may not be the best way to provide productive assets. Futurepump continues to work with Equity Bank, SolarNow, and KuKuja Pamoja (formerly CoolCap) to offer product financing to customers. Women own 16 percent of the farms serviced by Futurepump systems, and they make up ten percent of the 86 maintenance professionals Futurepump employs. Futurepump's award has been extended until September 2020.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** From the start of the award, Futurepump had a fully functioning and resourced team in place with key leadership roles defined and filled.
- **Technology Innovation:** The company had a commercially available product with some limited sales traction, meaning that the technology innovation was already advanced.
- **Market:** By the end of the assessment period, the company had sold over 6,000 pumps across 15 countries—clear evidence of product-market fit and market acceptance.
- **Business Model:** Careful hypothesis testing enabled Futurepump to make key pivots in the business model, which ultimately allowed for repeatable sales momentum. The company established third-party distribution channels, demonstrated repeatable sales, and deepened sales partnerships that position it for scale-up. In the efforts to achieve this sales traction, the team worked with advisors, including the PAX team, to test business model hypotheses around marketing strategies, customer relationships, channels, and distribution strategies and relationships.
- **Resources:** The company moved from managing unpredictable income to a reliable set of revenue streams during the award period thanks to validated sales traction. Futurepump has also secured private investments to ensure its ongoing operations.
- **Overall Impact:** The PAEGC funding and support most significantly contributed to the identification of a viable business model, especially how the organization works with partners such as distributors and end-user finance providers.

POWERING AGRICULTURE ASSISTANCE

- Synthesized market feedback to refine Futurepump’s business model and home in on core competencies that the organization should prioritize.
- Advised on strengthening Futurepump’s marketing strategy with messages to targeting women and men.

BY THE NUMBERS

<b>1,516</b>	<b>902.5</b>	<b>213,257</b>	<b>\$1.86million</b>	<b>1</b>
customers engaged with financing	hectares irrigated	liters of petrol fuel avoided and reduced	private funds leveraged	award received: Global LEAP Awards, Finalist (Surface Pumps)



# HORN OF AFRICA REGIONAL ENVIRONMENT CENTER AND NETWORK – ADDIS ABABA UNIVERSITY

## CLEAN ENERGY SOLUTION

The Horn of Africa Regional Environment Center and Network's (HoA-REC&N) clean energy solution uses biogas digestion of coffee husk and pulp waste to fuel state-of-the-art coffee dryers to reduce coffee cherry drying time from several days to hours. In Ethiopia, where coffee accounts for 60 percent of export earnings, the quality of coffee harvested will be improved with this process by decreasing coffee's exposure to fungi and other undesirable elements. Reduced drying time minimizes the post-harvest loss that occurs during the conventional sun drying process. The time saved by farmers on coffee processing can be directed to other productive uses, which will help them generate additional income.

## PROGRESS UNDER POWERING AGRICULTURE:

HoA-REC&N found that neither biodigesters designed for coffee feedstock nor biogas-powered dryers are commercially available. In preparing to design and prototype these two technologies, HoA-REC&N assessed the coffee pulp feedstock availability, energy content of waste pump, and energy requirements for drying at several coffee plantations that HoA-REC&N has partnered with. With this data, HoA-REC&N was able to calculate biogas production rates and demonstrate theoretical technical feasibility. It is hoped that the technical feasibility, customer and market research, and an initial business plan will serve as the foundation of any subsequent efforts to design, build, and field-test a biogas-powered coffee cherry dryer.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The team assigned to the project had challenges managing the multi-dimensional international relationships initially proposed to develop the technology. In addition, the team faced high turnover, impacting continuity and sustained efforts.
- **Technology Innovation:** The infrared drying technology made no notable advancements in developing toward a pilotable appliance which could be demonstrated and tested in the market.
- **Market:** The team was able to expand on insights into Ethiopia's coffee value chain by conducting market research and writing various reports on market conditions. These insights were uncovered through desk research using secondary sources and through fieldwork with the aid of focus groups and customer discovery interviews. As a result of this research, the team can describe key partners and competitors in the market, understands the dynamics of the problem the technology could solve, and can articulate why the technology is superior to alternative methods (manual drying).
- **Business Model:** There was little progress in developing a business model.
- **Resources:** The organization made little progress in securing any additional resources or partnerships, which are needed to move the proof-of-concept activity forward.
- **Overall Impact:** The PAEGC funding and support covered operational expenses associated with efforts in conducting market research and customer discovery, which the team later translated into market landscaping reports. Due to both internal and external factors, the organization made little to no progress in advancing its venture during the assessment period.

### POWERING AGRICULTURE ASSISTANCE

- Supported the team in designing a customer discovery process to uncover key learnings and understand the market opportunity for increased drying capacity in Ethiopia's coffee industry.
- Reviewed and edited market research reports highlighting opportunities in Ethiopia's coffee value chain.
- Made suggestions on strengthening gender integration in the impact assessment methodology and data collection tools.
- Strengthened strategies for gender integration in technology roll-out to maximize positive benefits for employees and customers.

### BY THE NUMBERS

1

assessment report on coffee drying  
at seven farmer cooperatives

\$8,000

raised in co-financing



# HUSK POWER SYSTEMS

## CLEAN ENERGY SOLUTION

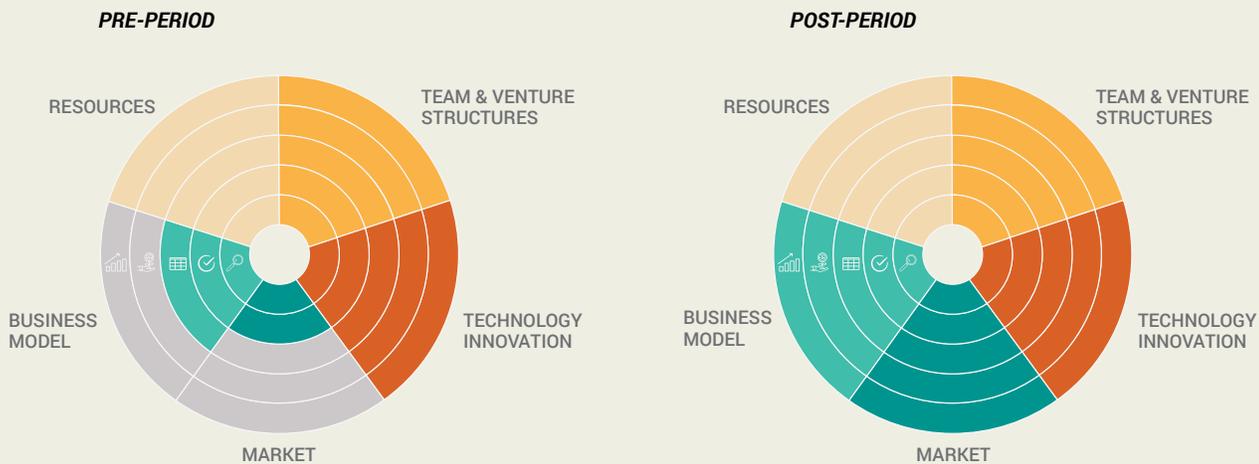
Husk Power Systems builds, owns, operates, and manages a hybrid solution that combines a biomass gasification system with a solar PV system. Husk Power Systems' solution allows access to electricity in rural, off-grid communities in Tanzania and Nigeria and extends the hours available for agricultural operations. The biomass plant uses a proprietary downdraft gasification technology that converts abundant agricultural residue, such as maize cobs, rice husks, coffee husks, and cotton stalks, into electricity. The system powers a mini-grid that produces electricity for residential, agricultural, commercial, institutional, and industrial needs. The electricity is distributed to rural households and micro-enterprises through a mini-grid system—providing a higher-quality, cheaper way to meet their needs for energy. Agricultural uses include irrigation pumps, agro-processing mills, and drying and heating processes. This solution allows agricultural operations to continue processing during nighttime hours, while also providing cost-effective power to customers during the daytime with solar PV and nighttime with the biomass gasification system.

## PROGRESS UNDER POWERING AGRICULTURE:

Husk Power Systems has installed four hybrid solar/biomass plants in Tanzania. Construction on the last three mini-grid sites in Tanzania started in November. They provide 24/7 power, with a discounted tariff for daytime usage to pass on the benefits of the lower cost of power generation from solar PV. At each site, three professionals are trained to operate the systems. Husk's systems currently use SparkMeter, a product developed as a spin-off of the work done by Powering Agriculture innovator EarthSpark International. Husk Power Systems has legally registered a Nigerian subsidiary so that it can develop three sites within Nigeria itself, undertaken an in-depth market study, and established a partnership with a Nigerian impact investor. Husk is concurrently scouting potential mini-grid site locations and plans to complete construction before November 2020. Procurement of major mini-grid components (solar panels, inverters, batteries, and gasifiers) has been completed for each of the project's ten sites.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The organization had an established team and a formalized venture in both India and Tanzania and was working to expand the team further within Tanzania and to launch a new venture in Nigeria.
- **Technology Innovation:** Husk entered the program with an established technology innovation in its hybrid biomass gasification/solar PV-powered microgrids, fully operational in India.
- **Market:** In the new target geographies, Husk initially had a general understanding of the size of the market opportunity but sought to better understand the nuances of the value chain through engagement with local stakeholders.
- **Business Model:** Husk aimed to translate its business model in India to markets where it did not already have a presence. By the end of the award, Husk had three systems installed in Tanzania, three more under construction, and plans for sites in Tanzania, indicating business model validation by securing a growing customer pipeline.
- **Resources:** During the course of the award, Husk secured \$25 million in financing from investors and is now seeking debt to continue scaling its operations and impact. To do so, Husk is leveraging the traction from validating an international business model and market opportunity.
- **Overall Impact:** PAEGC funding was most critical in supporting Husk’s transcontinental market expansion, which is typically very challenging for small and growing businesses.

POWERING AGRICULTURE ASSISTANCE

- Guidance and resources for translating the business model established in India to a new market context in sub-Saharan Africa, along with several investor introductions.
- Support to strengthen gender integration within Husk’s M&E plan, including disaggregating all indicators about people by sex and capturing impacts on gender equality to leverage for investment pitch purposes (e.g., about male and female engineer training, how hiring and training women changes dynamics within organizations and communities where they work, how men accept female engineers, how female engineers feel).
- Advice on utilizing existing sex-disaggregated data on technology use for making strategic marketing design and implementation plans based on different targeted customers.
- Strategic advice on how to hire more women in sales to better leverage outreach to female customers.

BY THE NUMBERS

**2,157**

individuals trained on mini-grid operations

**4**

mini-grids installed in Tanzania by 2020, resulting in 700 mtCO<sub>2</sub>e savings in electricity delivery

**\$20 million**

equity investment secured from Shell Technology Ventures LLC, Swedfund International and ENGIE Rassembleurs d’Energies in January 2018



# THE INSTITUTE FOR UNIVERSITY COOPERATION

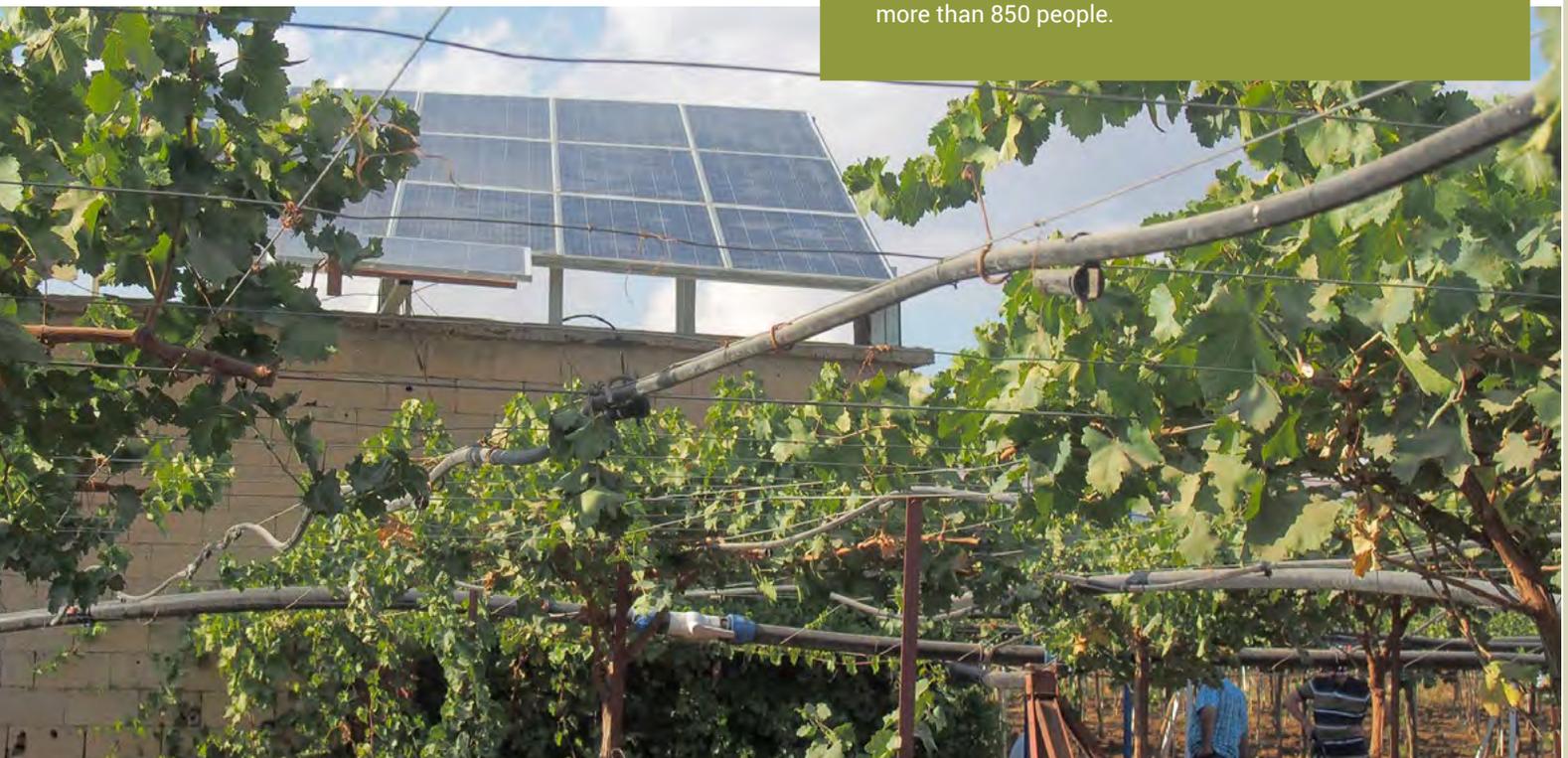
## CLEAN ENERGY SOLUTION

The Institute for University Cooperation (ICU) is installing drip irrigation systems powered by PV solar energy at pilot farms in Jordan and Lebanon. As one of the world's driest regions, Jordan and Lebanon have widespread use of inefficient irrigation methods, wasting large amounts of water. The system supports fertigation, which provides the possibility of fertilizer distribution through the irrigation system. ICU will support farmers with access to financing for the installation of the system. The solution will provide a complete package for purchase and installation, including training and access to knowledgeable extension agents and companies' staff.

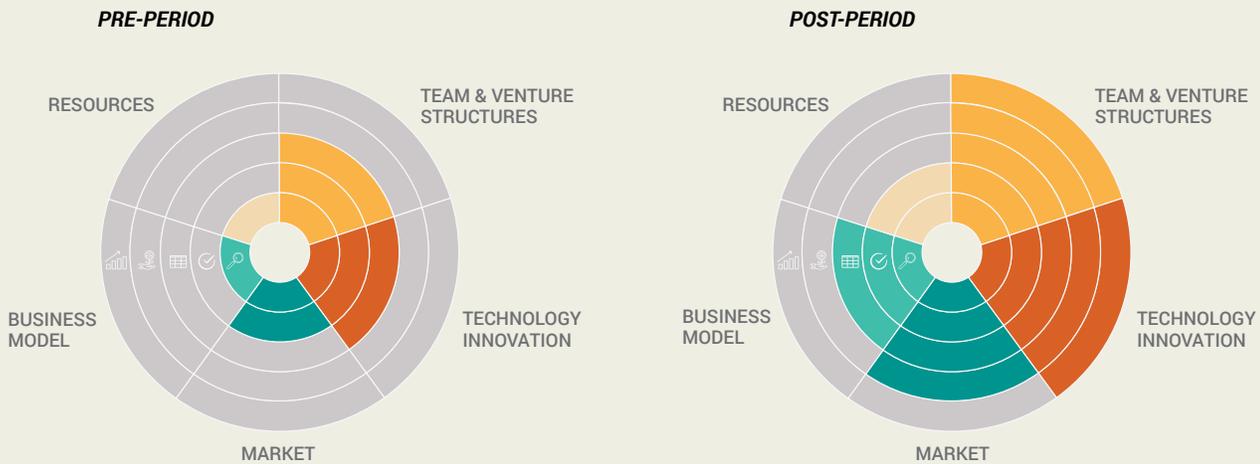
The PV-Drip Irrigation System will result in reduced CO<sub>2</sub> emissions and energy costs. In addition, the drip and fertigation system will reduce water and fertilizer use by up to 30 percent compared to traditional systems due to efficient and localized application.

## PROGRESS UNDER POWERING AGRICULTURE:

ICU is an NGO that engaged with two private sector partners: Nur Solar Systems (Jordan) and Solaris Green Power (Lebanon). The project installed six PV-Integrated Irrigation Systems in Lebanon and four in Jordan, for a total capacity of 87 kW. As a result of the Powering Agriculture project's visibility, ICU's partner in Lebanon has installed an additional 600 kW of solar-powered irrigation systems. Benefits from using the systems include farming previously unused land and extended growing seasons, both of which result in increased income. Fertigation also minimizes over-fertilization, which reduces costs. Through roadshows and other events, ICU demonstrated its clean energy solution to more than 850 people.



ASSESSMENT OF PROGRESS



- Team and Venture Structures:** This innovator was evaluated based on the project team. The team was successful in establishing key partnerships with local for-profit firms who could assume responsibility for the deployment of the technology and for taking it to market beyond the support period. These partners are continuing to add to installed capacity now that ICU's award has ended.
- Technology Innovation:** ICU promoted the drip irrigation solution through in-field pilot demonstrations and was able to showcase the impact of the technology to customers.
- Market:** The demonstrations improved the market opportunity by making customers and end users aware of how to adopt the technology for use on their own farms.
- Business Model:** As a nonprofit institution, the key business model innovations achieved were in helping partner organizations integrate the solar irrigation systems into their existing commercial product catalogs and offerings. As demonstrated by the ongoing commitment of partner organizations like Solaris, this effort was successful.
- Resources:** Additional resources are needed to scale dissemination of the technology: specifically, partner organizations' customers need end-user financing. Since these resources are provided outside of the efforts of ICU, they were not included in the assessment.
- Overall Impact:** The award funding was significant in allowing ICU to pilot clean energy technology in targeted ecosystems and to promote and transfer best practices in adopting the technology to increase agricultural outputs.

POWERING AGRICULTURE ASSISTANCE

- Shared referrals to available grants and additional research funding relevant to ICU's mission.
- Supported ICU's for-profit implementation project partners by providing referrals to financial organizations and credit agencies with an active presence in the Middle East and North Africa (MENA) region.

BY THE NUMBERS

10

solar PV drip irrigation systems demonstrated, sold, and installed

854

individuals trained or shown demonstrations

203

tonnes of CO<sub>2</sub> abated



# IDE (INTERNATIONAL DEVELOPMENT ENTERPRISES) BANGLADESH

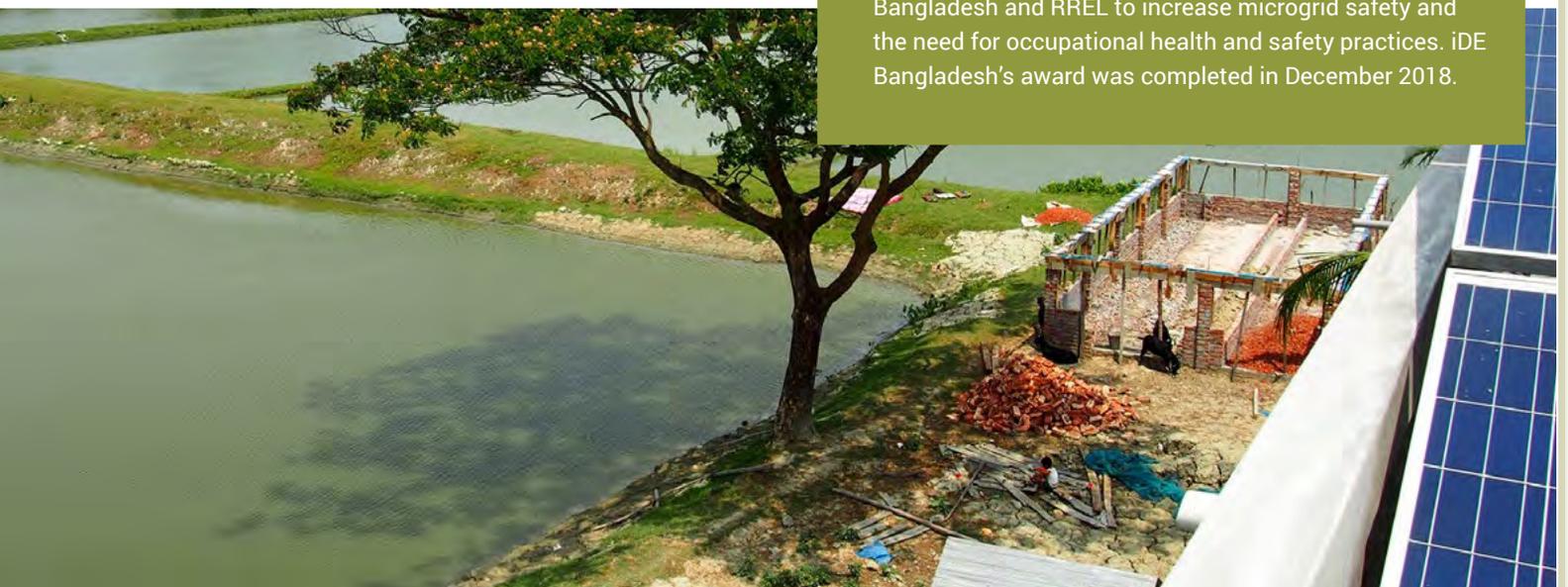
## CLEAN ENERGY SOLUTION

Off-grid fish hatcheries in Bangladesh and their surrounding communities rely extensively on diesel and kerosene—both costly and polluting—for electricity to pump water and provide light.

The proposed solution is a microgrid powered by an economically viable renewable source to replace diesel consumption: solar energy. The solar microgrid reduces energy costs and increases productivity for hatcheries and Small and Medium Enterprises (SMEs) while also providing domestic energy access. The systems power hatchery water pumping activities while supplying households with renewable power through an innovative metering technology. A mobile metering and billing system allows users to pay for their electricity using mobile money. The innovative Build-Operate-Transfer business model ensures that hatcheries and surrounding households can afford the technical solution by bringing in private sector investment that otherwise would not be attracted to renewable grid development. The use of fish hatcheries as a hub for clean power generation provides a guaranteed, niche market with a higher level of sustainable and economic success.

## PROGRESS UNDER POWERING AGRICULTURE:

iDE Bangladesh has facilitated installation of microgrid systems by a private company, Rahimafrooz Renewable Energy Limited (RREL), at two fish hatcheries and surrounding communities in the Bhola and Patuakhali districts of coastal Bangladesh. As of September 2019, the systems are serving a total of 47 households, eight SMEs, and one community mosque. The electricity generated is used for water pumping at the hatcheries and to power household appliances such as lights, fans, televisions, and refrigerators in the communities. One female entrepreneur uses electricity generated by the microgrid to increase the capacity of her chicken farm from 375 to 900 chickens. In May 2018, iDE Bangladesh hired an occupational health and safety consultant, B-Advancy, to review the microgrids' layouts and operational protocols. B-Advancy worked with iDE Bangladesh and RREL to increase microgrid safety and the need for occupational health and safety practices. iDE Bangladesh's award was completed in December 2018.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** While iDE is an established organization, for this award the project team was evaluated separately from the nonprofit, as the goal was not to internalize the commercialization but to find a partner. In this respect, the team successfully managed complicated partnerships and multi-dimensional relationships that were required to construct, operate, and maintain two solar microgrids at fish hatcheries in rural Bangladesh.
- **Technology Innovation:** The technology innovation underwent value and safety engineering throughout the project. This effort eliminated early design flaws that weighed on output efficiency and had the potential for harm or personal injury.
- **Market:** The team developed an improved understanding of the market and has documented a compelling, clear, and accessible opportunity for its partners to operate and expand the technology's reach in Bangladesh.
- **Business Model:** iDE made progress in validating its Build-Operate-Transfer business model, which is innovative in making the technology affordable to the target ecosystem for deployment.
- **Resources:** In addition to managing the human resources necessary for the project, iDE Bangladesh facilitated private investment between two fish hatcheries and one national company
- **Overall Impact:** The award funding was instrumental in supporting iDE Bangladesh to deploy the technology, evaluate its impact, transfer the technology to local partners for future sustained operation, and generate awareness of the possibilities of clean energy solutions in the local operating environment. .

## POWERING AGRICULTURE ASSISTANCE

- Conducted a technical and occupational health and safety assessment of both microgrid sites in collaboration with iDE Bangladesh and RREL that revealed nine operational health and safety tasks to address.
- Presented techniques and best practices for incentivizing implementation partners to act in accordance with agreed-upon contracts and memoranda of understanding (MoUs).
- Facilitated cross-cohort conversations with a peer innovator in Powering Agriculture on "Opportunities For Non-Dairy Solutions" in the Bangladeshi market.
- Provided strategies to target women's groups and initiate stakeholder dialogues to overcoming gender barriers to clean energy solution adoption.

## BY THE NUMBERS

2

solar PV microgrids developed

56

beneficiaries reached, including Hatcheries, residencies, SMEs, and religious institutions

7.3

megawatt-hours generated by micro-grids

# KICKSTART INTERNATIONAL



## CLEAN ENERGY SOLUTION

KickStart and its partners are designing a clean energy solution with the farmer in mind—a high-performance yet easy-to-assemble, highly mobile, robust, and durable unit that requires minimal maintenance. KickStart will design a foldable, flat pack solar irrigation pump that is easy for farmers to install. KickStart’s clean energy solution will not only greatly reduce the cost of the irrigation hardware but, through the introduction of a pay-as-you-go mechanism, will also provide farmers with flexible financing options that will further promote affordability and demand.

On average, farmers who adopt one of KickStart’s best-selling human-powered irrigation pumps increase their household income by 400 percent, and over one million people have taken a major step out of poverty as a direct result of using these innovative tools.

## PROGRESS UNDER POWERING AGRICULTURE:

KickStart has completed its mechanical testing of the Encap-designed solar irrigation pump and its market testing of the Angaza-enabled pay-as-you-go solar irrigation pump. KickStart evaluated three different pay-as-you-go models based on charging users according to calendar time passed, pump runtime, or a hybrid model combining both calendar and pump runtime. Over the course of the project, 119 total systems were installed for field testing: 94 Angaza software-enabled pumps and 25 Encap pumps.

Across all demonstration sites and private farms, more than 200 adults are benefiting from the solution, 59 of whom are women. KickStart’s award ended in March 2019. Following the completion of its project, KickStart plans to continue developing its low-cost pay-as-you-go model. It also plans to explore Chinese manufacturing of its low-cost Encap pump.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** From the start of the award, KickStart had a fully functioning and resourced team in place with well-established leadership and deep expertise in the Kenyan market. By the end of the award there were six dedicated sales staff in place to support the commercialization of the product.
- **Technology Innovation:** Over the course of the award, the company piloted the products in the field multiple times and obtained first-hand feedback from customers to inform design. The product is close to being commercially ready for sale, since the cost of goods has been significantly lowered to meet the target sales price. The team has begun preparation of a manufacturing plan but will be reliant on additional resources to fully scale and produce at the price point the market demands.
- **Market:** The team enhanced its understanding of the market opportunity by identifying and engaging key stakeholders required for deployment and gathered information about willingness to pay to better segment the market opportunity. The team is working to validate the remaining hypothesis necessary to scale sales in a repeatable manner.
- **Business Model:** The business model allows the new technology to be integrated within the organization's core sales strategy. The team is working to validate additional hypotheses on partnership and distributor models, which will ultimately allow them to fully operationalize their business model. The team is preparing for large-scale manufacturing and moving toward a commercial trial run.
- **Resources:** As an enterprise, KickStart has demonstrated enough validation of the market opportunity to secure internal resources to take immediate steps toward commercialization. In the future, when the innovation is being commercialized at scale, the organization may require additional capital to offset manufacturing costs or inventory procurement, dependent on the business model they adopt.
- **Overall Impact:** The PAEGC funding allowed for critical pilots with both products, iterations, and extensive discovery and hypothesis testing on key assumptions around design, value proposition, value chain, and channels.

## POWERING AGRICULTURE ASSISTANCE

- Facilitated the mapping and translation of key venture activities into an accessible business model canvas that the team used internally during the award period.
- Consulted the team's CFO on concepts in debt restructuring and inventory financing.
- Provided links to scholarships and grant opportunities aligned with the team's mission.
- Advised on improving and strengthening gender integration within their customer and socio-economic survey and discussed identifying opportunities to strengthen gender integration.

## BY THE NUMBERS

229

beneficiaries reached

\$1.3million

external funds leveraged

100kW

of solar PV capacity installed

1

award received: Global LEAP Awards, Finalist (Submersible Pumps, Low Head, Low Flow Applications)

# SIMGAS TANZANIA LTD.



## CLEAN ENERGY SOLUTION

SimGas is developing the first off-grid, biogas-powered milk chiller at farm level to help milk supply meet demand: the SimGas Biogas Milk Chiller (BMC). The BMC sparked a revolution in the dairy industry; it is the first link towards a reliable milk cool chain from cow to dairy. SimGas offered a solution to provide milk chilling at micro-scale (for farmers with up to ten dairy cows) that ran independently from the power grid, and that complied with the international milk cooling standard. It helped small dairy farmers reduce milk losses and met quality standards required to access the formal sector. The BMC ran on biogas, produced with an on-farm biogas digester. The amount of manure produced by a cow created enough biogas to refrigerate her own milk, while leaving enough biogas to cook a meal for the household. The SimGas BMC aimed to empower small dairy farmers to guide their own development; the milk chiller was going to greatly improve the income of small dairy farmers, help supply meet demand, help farmers access the formal dairy market, and contribute to improved nutrition. In addition, the use of clean energy (biogas) for cooling and other purposes, such as cooking, would help reduce deforestation and carbon emissions.



## PROGRESS UNDER POWERING AGRICULTURE:

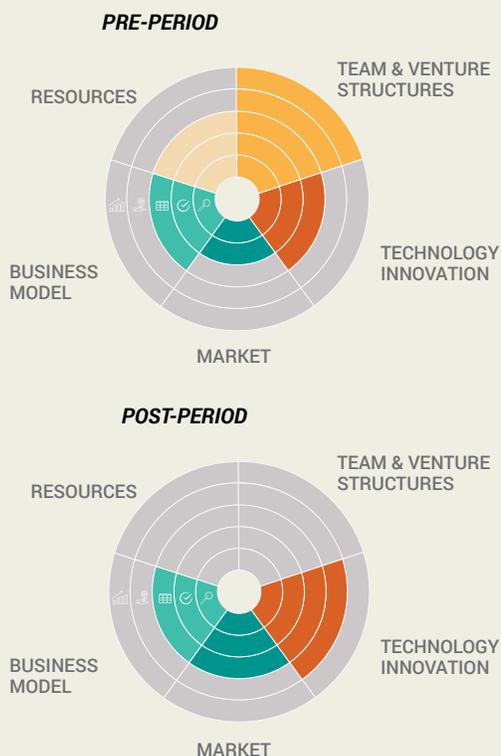
After ten years of operating, SimGas B.V. declared bankruptcy in November 2018 and was not able to help SimGas Tanzania and SimGas Kenya complete the project. The project ended with 75 percent of the milestones completed; only the manufacture and deployment of SimGas' final BMC prototype remained.

SimGas saw strong demand for its biogas products but struggled with having sufficient working capital to pay vendors and maintain stock levels. When the company began, it envisioned that local banks in Tanzania and Kenya would fulfill the role of short-term lenders to customers. Although agreements to deliver loans were signed, this fell through in the field as loan officers did not adhere to the agreement. Rather, banks were willing to lend to SimGas itself to support their other business operations.

Secondly, being strongly customer-focused and believing in providing high-quality designs to their customers based on extensive market research, SimGas over-engineered its products. Company founders noted that the BMC had a high number of components and was designed to meet European milk chilling standards at the behest of its international partners, but this did not meet local needs and ultimately led to an expensive product. SimGas then decided to fundamentally redesign the BMC. Despite making some progress toward developing a chilling solution at a more accessible price point, SimGas was ultimately unable to complete the field test of this technology due to insurmountable business challenges.

There are several lessons that can be gleaned from SimGas's experience. Company founders spoke of the primary challenge of navigating opaque policies and regulations in Tanzania—with border agents and tax and police authorities—while simultaneously gaining market traction. They also found that Kenya was a more suitable market than Tanzania when considering the higher purchasing power of target farmers and the more formalized structure of Savings and Credit

## ASSESSMENT OF PROGRESS



Cooperative Organizations (SACCOs) in Kenya. This led to the company's eventual departure from Tanzania. In reflecting on this, SimGas' founders stressed the need to be willing to abandon markets that can threaten the company's future sooner. They also emphasized the need for a strong team, especially a financial team that can focus on keeping the company's finances on track and can sound the alarm when indicators expose problems. Overall, the biogas cooking and milk chilling markets still hold potential for those that wish to address off-grid energy access, and SimGas is interested in sharing intellectual property with other companies still operating in this space.

- Team and Venture Structures:** SimGas entered the program with an established team and entity selling biogas systems to use agricultural waste to generate clean fuel for household cooking. Moving to a BMC was a natural product expansion as it leveraged many of the skills that SimGas had already secured on its team. Unfortunately, during the award, the company shut down due to insurmountable challenges with its core biodigester business.

- Technology Innovation:** Through extensive human-centered user design exploration, the team was able to showcase product specifications and functionality to meet user-specified needs. However, the team ran out of funding before being able to field-test its refined technology.
- Market:** Through its existing products, the team had an initial understanding of the customer base. Through this program, SimGas identified pilot partners and translated additional customer discovery into a well-articulated market opportunity.
- Business Model:** Despite its understanding of the market, SimGas was not able to establish a viable business model with healthy underlying financials.
- Resources:** The lack of a validated business model hindered SimGas' ability to secure the resources required, like working capital, to move forward with commercialization. As a result, the company ceased operations.
- Overall Impact:** Although SimGas ultimately ceased operations, it took important steps in moving forward a novel technology innovation that, with the right resources (including team and capital) and business model (including validated unit economics), could eventually solve an important problem for East African dairy farmers.

## POWERING AGRICULTURE ASSISTANCE

- Supported market assessments in Rwanda and discussions around product design.
- Reviewed and provided comments on the SimGas business plan and customer marketing materials to strengthen gender integration.

## BY THE NUMBERS

**83**

individuals trained

**15**

prototype units deployed

**3**

dairy cooperatives in Kenya and Tanzania engaged

**2**

awards received: Climate and Clean Air Award and ASME iShow Kenya Innovation Showcase

# SUNCULTURE



## CLEAN ENERGY SOLUTION

SunCulture began the grant process selling complete irrigation kits (including solar-powered pump, tank, and hoses) accompanied by in-person agronomic advice to increase production. Over the course of the award, SunCulture developed a series of lower-cost solar pumps as part of a new package offering. As a result of adopting solar-powered irrigation, smallholder farmers will realize significant benefits. Compared to rain-fed agriculture, farmers can generate higher yields, grow more cash crops, produce during the dry season, cultivate more land, and raise more livestock. Farmers switching from diesel-powered irrigation save on fuel and maintenance costs, while reducing emissions that are damaging to health and the environment. Of units sold in 2019, SunCulture farmers will prevent approximately 3,630 tonnes of annual CO2 emissions, adding about 31,750 tonnes in annual food production and an estimated \$7 million to smallholder gross domestic product (GDP).

## PROGRESS UNDER POWERING AGRICULTURE:

As part of its Powering Agriculture award, which ended in November 2019, SunCulture expanded its sales within Kenya and Uganda. It also conducted market exploration and established pilot programs in Senegal, Togo, and Côte D'Ivoire. The company developed its own enterprise software that automated and integrated many back-office operations, which increased productivity so that it could grow sales while managing operational expenses. SunCulture has rolled out its own in-house "Pay-As-You-Grow" program for consumer financing, which it continues to adjust.

SunCulture is committed to continual innovation. Over the course of its Powering Agriculture grant, SunCulture launched its new flagship system, the RainMaker2 with ClimateSmart Battery, a solar irrigation system that can pump water from up to 70 meters below ground level and that comes with energy storage to power lights, TV, and other appliances. The company also launched ClimateSmart Direct, an entry-level system optimized for battery-free operation. Both systems won the first-ever Global LEAP Awards for solar water pumps, recognized as best-in-class off-grid appliances.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** Upon receiving the award in 2015, SunCulture already had existing operations in Kenya with a well-established team and venture but continued to strengthen underlying operations management throughout the course of the award.
- **Technology Innovation:** SunCulture started with a well-validated concept from the outset and sought to improve this product and to expand to new markets. Despite the established stage of the product, it still benefited from improvements and additional iterations during the award period and the launch of the improved Rainmaker product.
- **Market:** SunCulture had an established market presence in Kenya and sought to explore how adjacent markets were different or similar. The team entered and explored new markets in East and West Africa by completing extensive interviews with stakeholders along the value chain as per the award milestones to test its market hypotheses. Through this effort, SunCulture pivoted to a partnership model working with third-party distributors for operations outside of Kenya. The model continues to operate successfully.
- **Business Model:** The funding received from PAEGC was most impactful in supporting SunCulture to validate its business model. SunCulture had a functional business model in Kenya that it used to envision a draft business model where it would establish ventures in each new country it expanded to. By working in each country, SunCulture validated its approach to identifying, selecting, and working with partners to establish a presence in each new geography.
- **Resources:** The organization was well-resourced at the outset thanks to private investors. SunCulture secured additional investors during the award period and will continue to leverage the validated market opportunity to scale.
- **Overall Impact:** The PAEGC funding came at a critical point for SunCulture as the young company developed its strategy for scale across additional countries in sub-Saharan Africa.

## POWERING AGRICULTURE ASSISTANCE

- Milestone planning and strategy development for the organization, including board and investor engagement.
- Support on strengthening gender integration in socio-economic surveys, and tools and review of strategy for prototyping products.

## BY THE NUMBERS

3

new markets entered as part of an international expansion

5,000+

individuals trained

1,300+

tonnes of CO<sub>2</sub> abated

3

awards received: Global LEAP Awards, Submersible Pumps, High Flow Applications and Submersible Pumps, Battery-Enabled (Winner), Global LEAP Awards, Submersible Pumps, Low Head, Low Flow Applications (Finalist) and FT/ITC Transformational Business Awards, Excellence in Transformational Business and Achievement in Sustainable Development, with a Focus on Food, Water, and Land



# GOVERNING COUNCIL OF THE UNIVERSITY OF TORONTO

## CLEAN ENERGY SOLUTION

In many low-income countries, aquaculture is a large industry. Improving the quality of aquaculture pond water has the potential to increase fish yields, raise incomes, and improve food security. The University of Toronto's proposed approach is a new aeration method that does not require electricity, has no moving parts, has low maintenance requirements, and is inexpensive to fabricate and deploy in low-income countries. The system uses heat captured through a solar thermal absorber and transferred to the bottom of the pond to heat the water. The heated water will rise and mix the pond, spreading oxygen-rich water from the top through the entire depth of the pond. The passive aeration system will increase ponds' dissolved oxygen levels to improve water quality and to allow for increased density of fish stock, higher fish yields, and larger fish with a higher market value and demand. At higher levels of dissolved oxygen, fish feed is also used more efficiently, which reduces operating costs.

## PROGRESS UNDER POWERING AGRICULTURE:

Using Powering Agriculture funding, the University of Toronto (UoT) developed four variants of its solar uplift aeration (SU<sub>P</sub>A) and spun off a start-up company to continue its commercialization. Over the past year, UoT ended its partnership with Brac Fisheries and started a new partnership with WorldFish. WorldFish has been responsible for continuing UoT's randomized control trials and developing a new field study that will give UoT more control over fish stocking levels and harvesting times. As part of its randomized control trials, UoT deployed a total of 51 devices. During FY 2019, UoT received recognition (and monetary awards) from two conferences for its project: the ASME iShow and the Aquaculture Innovation Challenge. The latter provided UoT with numerous global aquaculture industry contacts that can bring opportunities to commercialize SU<sub>P</sub>A technology, and it entitles WeTech (UoT's commercial spin-off) to participate in an aquaculture-focused business accelerator. The University of Toronto's award ended in November 2019.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The team initially consisted of academic collaborators for the purposes of research and evaluation. As the project developed, additional members were added to explore commercial channels and possible pathways to market. At the end of the evaluation period, the team is without a fully committed full-time commercial lead to transition the project from lab to market and lead a fully independent university spin-off.
- **Technology Innovation:** The team was able to design, build, and deploy initial pilot units to demonstrate and monitor the solution. Through the course of that deployment, initial design flaws were identified and later improved to produce a more durable next-generation product.
- **Market:** The pilot period was coupled with market research conducted in-person and through surveys in which farmers and other stakeholders were asked about their willingness to pay and product-market fit.
- **Business Model:** The team used this market research to improve the business model, in which business plans to form a for-profit university spin-off were framed and drafted.
- **Resources:** The team made progress in developing relationships with potential strategic partners who could provide some of the resources necessary for commercialization in the future.
- **Overall Impact:** PAEGC funding and support was critical in advancing the development of the technology, evaluating its efficacy in field applications, and providing a runway. The team used this runway for conducting market research and customer discovery, which they later translated into business plans and strategic frameworks for commercialization. With the right leadership in place, the spin-off venture would be in a position to secure local partners and move forward in the market.

## POWERING AGRICULTURE ASSISTANCE

- Conducted in-person technical assistance visit in 2019. The primary objective was to develop a comprehensive business plan to establish a for-profit spin-off to assume responsibility for transferring the technology from lab to market.
- Provided multiple referrals for follow-on funding opportunities to allow for commercialization and further technical iterations of R&D begun under Powering Agriculture.
- Facilitated cross-cohort collaboration on “best practices in commercializing university technologies” through an in-person roundtable discussion with university peer innovators in Powering Agriculture.
- Supported the team’s success in winning multiple business plan contests during the award period.
- Advised on bringing greater visibility to female operations among fish farmers, primarily through data collection and fieldwork. Provided written advice on strengthening data collection and survey methodology to collect data from women and men, hiring a female enumerator to conduct surveys and strengthening gender integration within surveys.

## BY THE NUMBERS

**54**

units deployed

**73.34kW**

of solar PV capacity installed

**2**

awards received: Aquaculture Innovation Challenge (First Place) and ASME iShow USA Innovation Showcase (Finalist)

# UNIVERSIDAD DEL VALLE DE GUATEMALA (UVG)



## CLEAN ENERGY SOLUTION

UVG uses an innovative approach to developing low-cost utility companies in agricultural communities in Guatemala that are not connected to the grid, called Comonsol Cellular Utilities. Each Comonsol Utility consists of a localized microgrid operated by a local service provider company that also provides agribusiness service. This “utility in a box” approach is designed so private sector financing can be used to fund the establishment of new utilities, making this clean energy solution scalable in low-income agricultural communities in Guatemala without additional donor funding. The project facilitated investment into one agricultural community in Guatemala to power agricultural production and processing equipment for coffee producing communities’ use.

## PROGRESS UNDER POWERING AGRICULTURE:

UVG’s primary technology partner, Development Ventures, completed the design of a complete plug-and-play microgrid solution for developing a ‘bankable’ microgrid. This solution includes all the operational, legal, and technical processes to establish a utility-scale power supply. UVG and its partner are currently finalizing the legal planning licenses from the Government of Guatemala to establish the first pilot project. Political violence and government shutdowns associated with the Guatemalan presidential election conducted between June and August 2019 prevented team access to the microgrid site and created significant project delays. UVG’s partner is applying to USAID’s Development Credit Authority for a credit guarantee to support the financing of the first site. Once the partner completes its fundraising, it will initiate construction of the microgrid. UVG’s award has been extended to September 2020.



## ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The project team was established to manage multiple local partners in the construction, assembly, and operation of the microgrid technology. Team members have a combination of business and technical skills to move project implementation along and a provisional lead on the ground.
- **Technology Innovation:** The technology innovation itself was not fully deployed during the assessment period of this report, as additional time lags such as receiving environmental assessments and other government approval on land use held up the construction process. To that point, construction has begun, and the team has been granted an extension through PAEGC that extends beyond the time period of this report.
- **Market:** The team can, based on market research and customer discovery work, articulate the size of the market segment and the value chain in which it is operating. The team has engaged heavily with customers and stakeholders through site assessments to verify and solidify its value proposition.
- **Business Model:** As a university, the project's business model is to transfer the technology to local operators who have a vested interest in its future success. Comonsol is the local entity that has been set up for commercialization efforts by sub-awardee Development Ventures. A draft business model exists, but due to lags in the system installation, it has not yet been vetted.
- **Resources:** The team completed significant investor discovery during the award period and has built relationships with potential funders who can provide additional financing as the project demands. The team is positioning itself towards an investment raise in the near future.
- **Overall Impact:** PAEGC funding has allowed the team to cement key partnerships needed to deploy its technology in Guatemala. The funding also allowed time for the team to overcome challenges in clearing legal hurdles and bureaucratic constraints. The team anticipates making significant milestone progress in the first half of 2020.

### POWERING AGRICULTURE ASSISTANCE

- Provided input and edits to pitch decks and executive summaries used in third-party conversations with funders and strategic partners.
- Facilitated a key introduction to a U.S.-based accelerator institution that can help in procuring future resources for development beyond the award period.
- Provided tools and resources to effectively measure data related to ownership and strengthening of gender integration within surveys.
- Provided tools and resources to strengthen gender integration within community agreements and public hearings and to increase possibilities for male engagement and foster male support for female community leaders in their community engagement processes.

### BY THE NUMBERS

54

individuals trained

32

communities assessed



# VILLAGE INFRASTRUCTURE ANGELS (VIA)

## CLEAN ENERGY SOLUTION

VIA is installing solar mills in villages in Indonesia, Papua New Guinea, Honduras, and Vanuatu. These mills will deliver services to up to 10,000 households. These small villages typically do not have access to electricity or a diesel mill for crop processing, and must rely on manual processing or travel long distances to use a mill. Small mills will be installed, with appropriate capacity for the village, through a microfinancing program. The mills will process staple crops such as rice, corn, and cassava, which require processing before eating, and which make up the majority of local diets. The time saved in manual labor can be redirected to other efforts that will increase income, particularly for women, who are the primary source of labor for agro-processing.

## PROGRESS UNDER POWERING AGRICULTURE:

VIA and its main partner, Project Support Services, have delivered over 800 solar mills to market, including 340 as cash sales and 270 on three-to-five-year lease agreements. VIA exceeded its target of mobilizing \$3 million in investment over the award period. VIA has also deployed 9,000 pay-as-you-go lighting kits alongside the solar mills, the first and largest deployment of pay-as-you-go solar in the Pacific region. VIA provides seven kinds of solar mills, each suited to a specific task such as a rice huller, corn sheller, flour grinder, or coconut/cassava grater. All seven solar mills have been warmly received by communities. The cassava grater is the most popular in Vanuatu, as it not only reduced the hours of manual processing for women, but has apparently improved the taste of national dishes laplap, tuluk and simboro. In FY 2018, VIA also began research and development for a solar PV rice cooker. VIA's award ended in September 2019.



ASSESSMENT OF PROGRESS



- **Team and Venture Structures:** The team, led by VIA’s founder and full-time CEO, used technical advisors, employees, and key partnerships in the deployment and sale of the technology during the award period.
- **Technology Innovation:** The technology innovation itself was developed prior to the assessment period, but VIA required additional resources to scale up and fully deploy it into the market. The PAEGC funding supported this next step in the technology’s trajectory.
- **Market:** The company offers its solar mill system as part of its overall business model and market presence, for which there is an established and strong sales pipeline. During the course of the award, the team was able to vet unit economics and prove customer demand through continued sales.
- **Business Model:** Initially a new product offering, the solar mill has been integrated into VIA’s global portfolio of solutions and is reliably earning revenue.
- **Resources:** The team exceeded the investment targets of its initial proposal by mobilizing additional resources during the award period.
- **Overall Impact:** The funding afforded VIA the necessary runway to validate key hypotheses in its business model and produce results on the feasibility and impact of the solar mill technology.

POWERING AGRICULTURE ASSISTANCE

- Provided multiple referrals for follow-on funding opportunities to allow for commercialization and further deployment of the technology beyond the scope of the award.
- Supported the founder in establishing a venture deal room and reviewing the necessary documents within it.
- Reviewed and offered advice on strengthening the baseline assessment survey to strengthen data collection related to gender equality impacts.
- Provided a standardized case study template that could be used in any country. The template directs users on the type of content or material they can be systematically collecting to highlight stories and vignettes on male and female beneficiaries specific to gender equality for use in future investment pitches and marketing.

BY THE NUMBERS

11

solar PV-powered processing appliances developed

24,218

direct and indirect beneficiaries reached

\$118,131

saved by farmers using mills

\$3.04 million

raised in financing

## 2.5 INNOVATOR RESULTS

The table below reflects the results that innovators have achieved over the six years of Powering Agriculture. The data presented is based on the innovators' self-reporting against the Powering Agriculture Partners' performance indicators.

TABLE 2.1 POWERING AGRICULTURE INNOVATOR RESULTS

IMPACT	FISCAL YEAR 2019	POWERING AGRICULTURE TOTAL
	<b>17</b> clean energy solutions developed (technologies and/or business models)	<b>59</b>
	<b>1,565 kW</b> of clean energy generation capacity installed	<b>3,664 kW</b>
	<b>3,848</b> clean energy systems deployed through Africa, Asia/Pacific, Latin America and Middle East	<b>8,449</b>
	<b>19,538</b> beneficiaries reached, such as farmers, households and agribusinesses, including <b>7,636</b> women	<b>65,116</b> <b>22,666</b> women
	<b>USD \$14.5 million</b> additional funding mobilized by innovators	<b>\$68.8</b> million
	<b>7,923 tCO<sub>2</sub>e</b> reduction, as a result of innovators field activities	<b>18,092 tCO<sub>2</sub>e</b>
	<b>7,805</b> people trained on operations and maintenance of clean energy systems and their benefits, including <b>255</b> women	<b>16,546</b> people <b>1,744</b> women
	<b>6,964</b> people increased their knowledge of clean energy technologies through attending demonstrations, as a result of Powering Agriculture support, including <b>2,462</b> women	<b>54,439</b> people <b>17,047</b> women
	<b>355</b> professionals provided services to clean energy system users, including <b>175</b> women	<b>1,542</b> professionals <b>400</b> women

## 2.6.1 EXEMPLIFYING GENDER EQUALITY IN THE ENERGY SECTOR: ARIYA FINERGY

For more than three years, Ariya Finergy has been supplying and financing clean energy and power storage and stabilization solutions to farmers in Kenya. The company has provided these life-changing services while exemplifying gender equality in a sector that continues to lag in progress towards gender equality despite its critical role in development. Ariya Finergy CEO Jenny Fletcher is a true female leader in a heavily male-dominated field: she has been nominated as the East African Power Industry Convention's Outstanding Woman in Power and named one of the Top 60 Most Influential Figures in East and West African Power by ESI Africa. She is also a founding member of Women Corporate Directors and sits on the board of its Kenya chapter. Jenny explains how her organization champions gender equality in the clean energy-agriculture nexus by institutionalizing it internally.

Jenny Fletcher spent the early days of her career in the finance industry, working in the entrepreneurial services division of a Big Four firm for several years until she was called to a different purpose. She took a job with CARE Australia, where she was introduced to humanitarian work and quickly discovered her passion for a job driven by the potential for impact. She then joined the International Rescue Committee (IRC), where her corporate experience brought her to New York to serve as their Director of International Finance. In this role, Jenny's portfolio included over 30 countries and a budget of around \$300 million and



solidified her interest in humanitarian projects and their design.

She completed her master's degree at the London School of Economics and rejoined the IRC as Deputy Director for their programs in Ethiopia, focusing on health systems, large village water programs, and work with refugees on health, HIV/AIDS, water, and sanitation. Jenny's hard work and success in the role resulted in a transfer to Kenya, where she was appointed Country Director.

True to form, Jenny soon found herself wanting to effect change at even greater levels. Marrying her experiences in finance and development, Jenny knew exactly which of the many ways to address poverty and promote economic growth she had to help facilitate: expanded, affordable energy access. In 2008, she entered the energy sector and brought a 60 megawatt (mW) wind park to financial close in Kenya, where she met

her now-business partner Herta von Stiegel and joined Ariya Capital. As a result of their collaboration, Ariya Finergy was born.

***“I have to say, being female had not really been on my horizon as an issue or a concern—until I joined the energy sector.”***

Jenny Fletcher  
CEO, Ariya Finergy

Though she had worked in the tough industry of finance, Jenny felt that gender did not impact her ability to do business and was surprised by the energy industry’s gendered dynamic. While starting out, it was evident that the government officials, parliament members, and ministerial counterparts with whom they met were used to dealing with men. Jenny saw this as an advantage, however, and did not let it change her course. Seeing male-led investment firms receive more funding despite weaker performance was motivating; she had read the literature that confirmed this bias, but she had also read the literature that evidenced female-led firms demonstrating higher success rates with any level of funding, be it more or less than their male-led counterparts received.

Drawn to the impact that energy can have on a community, her work to grow Ariya has given her an opportunity to affect the energy community in turn: “Really, where we can [have] impact is within our own organization,” says Jenny. To reinforce its commitment to affecting change, Ariya implements diversity and inclusion policies across its departments to move the needle on gender equality in the energy sector.

Ariya’s organizational belief is that a diversified environment is better for the bottom line, and their intentional efforts to foster a gender-balanced workforce have even resulted in periods wherein there were more female employees than male! Jenny and her team consciously recruited male employees, and now reap the benefits of a diverse team: “Men and women do think differently, and the combination is much more powerful than the individual.”

***“What really drew me was the impact energy can have. You give people power and GDP goes up. You give people cheaper, more reliable power, and industry is impacted.”***

Throughout her career, Jenny has consistently worked to create impact at a higher level and continues leading Ariya to do the same. Her philosophy of creating jobs and creating power to drive economic growth at local and national levels extends to Ariya’s operations, where the company seeks to not only create jobs that promote gender equality internally, but also to empower the companies they serve to improve and become more efficient. One day, these empowered companies will have the opportunity to undertake their own gender equality initiatives for a stronger energy sector and economy.

For more information on Ariya Finergy, click [here](#).

## 2.6.2 TECHNICAL DESIGN WITH WOMEN IN MIND: INCLUSIVE INNOVATION AT THE UNIVERSITY OF TORONTO

Dr. Amy Bilton leads the technical team developing the SUpA device, a passive solar updraft aeration device for smallholder fish farmers, at the University of Toronto's Water and Energy Research Lab. Fish farming is a large industry in many developing countries: in Bangladesh, where Amy and her team are testing their clean energy solution, fish farms account for five percent of GDP. The SUpA technology has the potential to increase yields and reduce operating costs for Bangladeshi fish farmers, contributing to the growth and prosperity of the country and its communities. Amy explains how her team took an inclusive design approach to ensure these opportunities for growth were made available to all Bangladeshis—men and women alike.

Dr. Amy Bilton has spent much of her life studying and working in the sciences, first completing her undergraduate and initial graduate work in the aerospace industry. Despite securing a job in the industry, Amy found the work uninspiring and returned to school to complete her Ph.D. at the Massachusetts Institute of Technology, which had just opened its Center for Clean Water and Clean Energy. The Center made a great home for her research on solar desalination and first introduced her to working with NGOs in the international space through field work in Central America. After completing her Ph.D. in 2013, Amy spent five months as a research scientist at the Commonwealth Science and Industrial Research Organization in Australia studying



aquaculture and some of the challenges faced by these farmers.

By January 2014, Amy accepted the offer of a faculty position with the University of Toronto, which has brought her to her current role as Director of UoT's Water and Energy Research Lab. By bringing together her childhood growing up on a farm, keen interest in the technical details and applications of solar energy, and unique experience with aquaculture and international development, Amy has led a diverse team in the development of innovative water and energy technologies using computer-based design methods, including the lab's Powering Agriculture-supported SUpA technology.

As a woman in a technical field, Amy has been intentional in considering gender while designing technologies: "When we were thinking about the SUpA technology program,

we wanted to make sure that we were being inclusive. There are women who do operate some fish farms within Bangladesh. It's not a huge number, but we did want to make sure that we were being inclusive in that process," says Amy. To facilitate gender inclusivity, the SUpA research team took a strategic approach, ensuring that at least one of the three field staff making direct contact with the farmers was a woman to ease communication with any female farmers they encountered.

Amy and her team at the Water and Energy Research Laboratory also want to provide opportunities for Bangladeshi women to contribute to the program, both those with technical backgrounds doing research for the program and those with farming backgrounds providing their gendered perspective and feedback on the technology. "The technology itself can be quite bulky and heavy, so we were trying to make it as easy to move around as possible. It's a bit of a challenge just because the nature of the technology requires part of it to be fairly large. That's one of the main things about the technical design we were thinking about that could promote gender equality [in its use]," says Amy.

The SUpA is no exception to Amy and her team's method of thinking about how to design the lab's programs and introduce the resulting technology into the field, especially in the context of systematic differences between gender roles across cultures and the growth opportunities afforded to them. They consider measures that can be put in place to help minimize women's barriers to equitable access to the technologies and the benefits that

come with them, including greater economic empowerment.

***"We couldn't make sure that women were getting the opportunity to be a farmer, but if there was a woman that was a farmer, we wanted to make sure that they had an opportunity to be able to improve their livelihoods."***

In parallel to her mission to promote equal access to empowering technologies and driven in part by her own experience with differential treatment based on gender in the technical and academic fields, Amy's hope is that the work being done by her team and the women around her will help mitigate pre-existing gender bias against women in science and technology.

***"I think being a woman in the research industry is definitely easier for me than it was for the women that came before me. So, I think things are changing, and the more women that work in this space and set that example, the easier it'll be for those in the future."***

For more information on the award-winning SUpA technology, click [here](#).

## 2.6 GIZ PILOT PROJECTS

GIZ piloted ten sustainable energy solutions in agricultural value chains in 17 countries, particularly in the areas of solar cooling, processing, and solar-powered irrigation. The pilot projects were not selected via calls. Rather, they complemented the calls approach by seizing opportunities for testing, providing short-term flexible support for innovation, and addressing local needs. The projects focused on supporting research and development of climate-smart innovations, giving researchers the opportunity to pilot and develop ideas with room to succeed or to fail.



### 2.6.1 Cooling



## DIY SOLAR COOLING SYSTEMS AND SOLAR MILK COOLING

**Clean Energy Solution:** GIZ partnered with the University of Hohenheim to pilot do-it-yourself (DIY) solar cooling systems and solar milk cooling technologies. Through this technical support, local companies and entrepreneurs in Kenya, Tunisia, Mali, and Colombia designed and produced small- and medium-scale solar cooling systems. This allows for reduction of the final price of the technology, while creating specialized jobs locally. By following this approach, high-tech components (such as the cooling units and electronic controls) were imported, while the manufacturing of the insulated box is carried out locally. This approach also granted entrepreneurs the possibility to adapt technology to the local market and offer distribution and maintenance under their own product brand.

Solar cooling systems and solar milk cooling technologies have proven reliable in testing:

1. The systems can efficiently make ice using minimal PV power,
2. Components experience minimal wear and tear, and
3. The systems are not highly dependent upon batteries.

Despite the benefits, the systems are not yet commercially viable due to high retail prices and unfavorable market conditions and policy regulations.

### **Progress Update**

- Developed cooling units suitable for different solar cooling applications (smart ice maker for milk/fish cooling, battery-free refrigerator or ice storage for cold rooms or chilled water).
- Organized technical trainings on solar cooling systems in Kenya and Mali.
- Developed an improved milk can and organizing technical trainings and field tests on milk cooling in Kenya and Tunisia.
- Conducted an initial technical training and promotion conference on the DIY solar cooling units in Nairobi, Kenya in March 2019. The workshop trained regional entrepreneurs, companies, and students to design, produce, and pilot small and medium-scale solar cooling systems. Over 150 participants from Kenya, Nigeria, Zambia, Somalia, Malawi, Tanzania, and Uganda attended the five-day event. [Learn more about the training here.](#)
- Produced a video on a dairy farmer's experience in Siaya County in Kenya. The video looks at the farmer's challenge not to sell spoiled milk and proposes the solution of solar milk cooling to preserve the milk.
- Delivered technical trainings on the DIY solar cooling units in Kenya, Germany and Mali for entrepreneurs, companies and students, which reflected the need for technologies that can be manufactured and adapted locally instead of being imported from overseas.
- Conducted a pilot project to study the technical feasibility and practical use of solar-powered cooling technologies in Zambia, in partnership with the Green Innovation Centre of GIZ and the Solar Academy of the Association of Building and Civil Engineering Contractors in Zambia. Locally available materials were tested for efficiency, environmental sustainability, and affordability. Association staff and students were trained to set up DIY solar cooling systems. It is envisioned that these systems will be used by dairy farmers in Zambia to increase productivity and income.
- Commissioned a market assessment study in Turkana County, Kenya to better understand the opportunities for solar cooling technologies in the fresh fish value chain there.

### **By the Numbers**

# 150

entrepreneurs trained on adapting and building solar cooling systems

## COLDHUBS

**Clean Energy Solution:** GIZ partnered with Institut für Luft – und Kältetechnik Dresden and The Smallholders Foundation to pilot **ColdHubs** in Nigeria. Cold room technology preserves vegetables on markets and improves shelf life to 21 days.

### Progress Update

- Developed solar-powered cold rooms for conservation of vegetables.
- Developed training material for promoting cold storage.
- Tested the commercial viability of the system in Nigeria.

### By the Numbers

19

solar cold rooms installed in different markets

3

different business models tested for commercial viability

1

award received: Global LEAP Off-Grid Cold Chain Challenge (1st Place Award)



## 2.6.2 Processing

## GRAINSAFE™ DRY DEVELOPMENT

**Clean Energy Solution:** GIZ partnered with the International Rice Research Institute, Hohenheim University, and GrainPro, Inc. to pilot the GrainSafe™ Dry technology. This TechSheet, provides relevant information about the technology at one glance.

### Progress Update

- Developed and tested an improved drying system, combining in-store drying and hermetic storage.

### By the Numbers

50

percent reduction in drying and storage costs

1

commercial prototype under development

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## SOLAR BUBBLE DRYER

**Clean Energy Solution:** To ensure and maintain high product quality, drying is one of the most important post-harvest operations in Africa. Fluctuating weather conditions and contamination by insects and rodents are preeminent problems leading to quality deterioration and post-harvest losses. GIZ partnered with the International Rice Research Institute, Hohenheim University, and GrainPro, Inc. to pilot an Inflatable Solar Dryer for grain products like rice and maize suitable for SMEs, and a Modular Solar Box Dryer for high-value commodities suitable for smallholder farmers or cooperatives. The technology was developed in the Philippines and tested in Kenya, Burkina Faso, and Ghana.

In many African countries, traditional sun drying is still the most common practice during post-harvest handling. Not only small-scale farmers but also SMEs rely on it. Harvest season often coincides with unstable weather conditions and spontaneous rain events, which may result in improper drying, direct exposure to the environment, contamination by insects and animals, and health risks due to the development of mycotoxins within the grain. Improved solar drying technology remains of great interest.

The Inflatable Solar Dryer (ISD) consists of a transparent drying tunnel made of foil and an aeration unit. Electricity is supplied by 100 Watt peak (Wp) or 200 Wp PV panels depending on dryer size, together with a battery. Regular manual mixing of crops with a mixing roller or rake ensures an efficient and homogenous drying process. The ISD is suitable for grain products. Depending on the dryer size, the capacity is up to 1,000 kg. Using additional racks, the dryer can also be adapted to other commodities.

**Progress Update:** Despite the mobility and capacity, the existing ISD is expensive, hard to construct, and not suitable for high-value commodities like fruits, and the mixing of crops from different producers is often not desired. In order to address the shortcomings, the University of Hohenheim developed a Modular Solar Box Dryer prototype.

### By the Numbers

**2**

SMEs and 34 farmers in Kenya, Burkina Faso, and Ghana benefited from using the prototype ISDs

**0.15-0.20**

tonnes of CO<sub>2</sub>eq. avoided per year

**1**

commercialized version being sold by GrainPro

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## SESAME SEED OIL PRESS

**Clean Energy Solution:** Sesame is one of Burkina Faso's largest commodities. Most sesame grains are exported, because only a few sesame oil processing units exist in country due to lack of infrastructure and high energy cost. The aim of this project is to study the technical and economic viability of a solar-powered sesame oil production system at the cooperative level. The University of Hohenheim has developed the solar-powered system, and it has been undergoing testing in Germany since 2017. This TechSheet provides relevant information about the sesame seed oil press at one glance.

Sesame is a counter-seasonal cash crop, harsh weather-tolerant and requiring fewer inputs such as fertilizers and pesticides. In Burkina Faso, sesame grains are produced all over the country from organic to conventional. The main constraints of local sesame oil processing are capacity, equipment, skill, and above all, the cost of energy: the country's electricity costs are among the highest in the world. However, solar energy abundant. Therefore, a decentralized solar-powered oil production system at the cooperative level in rural areas has huge potential to address these challenges.

The system is based on a commercial mechanical oil press (KK20 F Universal, Kern Kraft oil press GmbH & Co. KG, Reut, Germany) with a nominal power of 2 kW and a maximum capacity of 20 kg/h.

**Progress Update:** Starting in March 2017, the solar system was tested at University of Hohenheim. Testers conducted a computational performance evaluation using a PV simulator to represent the real PV modules. The system's profitability is strongly related to the operation scenario, moisture content, price of sesame grains, weather condition, and oil quality. Increasing moisture content of the grains could improve the extraction efficiency to some extent.

An oil press has been successfully installed in a women's cooperative in Nouna, Burkina Faso. A training on how to operate the machine, along with some tests of on-grid oil production, has been conducted as a collaboration among the University of Hohenheim, GIZ, and local partners.

Implementation of the system in rural areas represents a huge potential of value-added creation, new local and international market opportunities, new job creation, and poverty reduction in rural areas. At the same time, the pilot also showed the need for improvement in the moisture content of sesame grains, a smart operation strategy, and oil quality preservation before large-scale oil export operations can commence.



## 2.6.3 Irrigation



# REALIZING THE POTENTIAL AND MANAGING THE RISKS OF SOLAR-POWERED IRRIGATION

**Clean Energy Solution:** GIZ partnered with the Food and Agriculture Organization of the United Nations to pilot a solar-powered irrigation toolbox. Solar-powered irrigation systems (SPIS) have been recognized as a powerful instrument to increase yields while mitigating emissions.

### Progress Update

- Published the “Global Report on The Benefits and Risks of Solar-Powered Irrigation—A Global Overview,” providing an overview and drawing lessons from the successes and failures of existing solar-powered irrigation systems.
- Developed the Toolbox on Solar-Powered Irrigation Systems to support decision-makers and advisors in planning, designing, and maintaining a solar pump in a farming system.
- Organized the International Forum on Solar Technologies for Small-scale Agriculture and Water Management.
- Established several pilot sites in Kenya using the SPIS Toolbox in order to prove its usefulness and robustness in designing, installing, and maintaining solar-powered irrigation systems.

### By the Numbers

**150**

participants at the Forum of Solar Technologies

**50,000**

clicks on the web-based Toolbox

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## FOSTERING THE MARKET ENVIRONMENT FOR SOLAR-POWERED IRRIGATION SYSTEMS IN INDIA

**Clean Energy Solution:** The market for SPIS in India faces two overarching weaknesses: (1) demand for the product is low due to lack of adequate awareness about the technology, and (2) the supply chain is weak as the primary focus is on government tenders. Applying an ecosystem-based approach, the Indo-German Energy Programme “Access to Energy in Rural Areas” of GIZ India with support from GIZ’s “Sustainable Energy for Food—Powering Agriculture” set out to improve the market conditions for SPIS.

The market for SPIS in India is primarily driven by government subsidy. Most SPIS companies prefer applying for government tenders in order to get access to the market. The government tender route saves them from having to invest in the human and financial resources to convert a potential farmer to a SPIS customer. Although such a business-to-government model is necessary to encourage private sector participation in the early stage of sector development, it has a negative impact on the overall market development in the long run, e.g., poor and delayed after-sale services because there is no accountability to the farmers; lack of innovation in product designing; and no customization of the technology.

The Indo-German Energy Programme “Access to Energy in Rural Areas” (IGEN), supported by GIZ Powering Agriculture, implemented activities in Bihar, Uttar Pradesh, Gujarat, and West Bengal, targeting different market weaknesses: facilitating demand creation, improving supply chain, and supporting the market ecosystem. See two [story sheets](#) that tells the story of the people using solar-powered water purification systems in India and how the innovations impact their lives positively.

**Progress Update:** IGEN designed a site selection tool after a series of feedback loops with key state and national stakeholders. The National Bank for Agriculture and Rural Development applied the matrix to shortlist the 100 districts with the highest potential for the deployment of SPIS. Further actors are interested in the matrix. To improve the supply chain, a market intelligence toolkit (software application) has been developed: a comprehensive database of key private sector players (manufacturers, distributors) involved in the SPIS market. An appropriate financial model for farmer groups was designed in West Bengal to demonstrate sprinkler and drip irrigation models, now implemented by Switch ON. Several bank loans for farmers’ groups were approved, and the project plans training for the farmers as well as a series of roundtables.

In cooperation with the Self Employed Women’s Association, the project designed financing products for small and marginal farmers. For these farmers, with less than two acres of land,

the high upfront cost of SPIS is a big hindrance. Financial products have been developed and analyzed to ensure a match between farmers' needs and repayment capacity. Six pumps have been used to pilot and assess three financial products: loan, lease, and sale on deferred credit. The beneficiary farmers are all female.

The project provided capacity-building to 171 officials of commercial and regional rural banks involved in undertaking the necessary due diligence for bank loans in the scope of the bank finance program by the Indian Government. Two bank loans for Joint Liability Groups have been awarded by two commercial banks in Bihar and West Bengal respectively. An MoU has been signed between a private sector bank and Switch ON to promote SPIS through a banking correspondence model.

#### By the Numbers

**171**

bankers trained

**237**

farmers benefited directly and indirectly from installed pumps

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## RASEED SOLAR-POWERED IRRIGATION IN EGYPT

**Clean Energy Solution:** About 54 percent of Egypt's working population is employed in the agricultural sector. However, agriculture is challenged by low rainfall, relatively low humidity, a hot climate, and the constantly decreasing water quality and volume of the Nile. RaSeed, a program by GIZ, introduced high-capacity solar-operated water pumps to the Egyptian agricultural sector.

Many rural areas in the Egyptian desert are too remote to be grid-connected and are thus entirely reliant on energy from diesel generators. However, prices of generators and parts have spiked in recent years due to their frequent use as backup systems in areas affected by blackouts and rapid agricultural expansion. Meanwhile, poor infrastructure in rural areas makes transportation of diesel fuel both expensive and risky.

Through BMZ's develoPPP.de program, which provides technical and financial assistance to private companies operating or seeking to operate in developing and emerging-market countries, RaSeed cooperated with the German company Aschoff Solar to promote the use of PV systems in irrigated agriculture to support cost-effective, sustainable desert farming in Egypt. The GIZ project "Sustainable Energy for Food—Powering Agriculture" supported the cooperation in dissemination and knowledge management. The project worked along four components:

- Establish a network for SPIS in agriculture.
- Support capacity-building.

- Develop technical guidelines and manuals.
- Implement pilot projects.

To address the lack of local suppliers with high-quality materials and necessary expertise, GIZ brought together European and Egyptian solar companies to increase information exchange and create partnerships.

**Progress Update:** A pilot project was installed on a farm near the Oasis of Bahariya, owned by SEKEM, an Egyptian organization supporting sustainable development in the desert. In cooperation with Aschoff Solar, one of the pumps was equipped with a solar system as well as an optimized and efficient irrigation system. The complete system will help to secure water availability and increase crop yields. The 55 kWp solar system (37 kW pump) is financed by Tamweel, a local leasing company.

The cooperation between farms, banks, and agribusiness showed great potential for the use of SPIS in Egypt. However, it also showed that guidance is required. Agribusinesses need help choosing adequate partners for projects. Solar companies need foreign expertise to develop local capacity and optimize solar system lifetimes under the local conditions.

A further gap to be filled is the documentation of the legal and administrative processes required to import a solar system. The first pilot project showed that imports can be subject to considerable delays and challenges.

GIZ also noted that the pilot exacerbated groundwater depletion in Egypt, underscoring the importance of sustainable water management when pumping water.

### By the Numbers

**1**

solar-powered irrigation system installed

**55 kWp**

of solar PV capacity installed

**21**

irrigation experts trained

**70**

participants in a technical workshop

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## MAXIMIZING THE USE OF SOLAR WATER PUMPS IN INDIA

**Clean Energy Solution:** Water pumps play a crucial role in the irrigation market. The widely used electric pumps, however, suffer from low power availability and low voltage. Diesel-powered water pumps are therefore widely deployed to compensate for the shortcomings of electric pumps but are expensive to run and polluting. Solar Water Pumps (SWP) can be a viable solution if the challenges of high purchase cost, financing and economic viability are addressed. Because the economic efficiency of a SWP is directly related to its utilization rate, adopting an inclusive ecosystem-based approach can be a promising solution to address the economic viability of SWPs.

The market adoption of SWPs in India is primarily determined by the cost-effectiveness of the service delivery (the cost of pumped water), which is determined by the initial capital requirements, the pump utilization rate, and available financing options. With a steady fall in production costs and additional government subsidies, the purchase cost for SWPs is decreasing and financing options are slowly becoming more widely available. Nevertheless, the use of SWPs remains low, as they are often not economically viable compared to diesel-powered pumps due to low pumping hours per year.

To address the challenge in an inclusive and sustainable way, GIZ India's Indo-German Energy Programme "Access to Energy in Rural Areas" (IGEN-Access), with support from "Sustainable Energy for Food—Powering Agriculture," implemented the following activities in the districts of Alipurduar and Coochbehar (West Bengal, India), targeting different market weaknesses:

- Facilitating demand creation: by sensitizing rural communities.
- Improving supply chains: by establishing linkages to local markets.
- Supporting the local market eco-system: by providing information to the participants, by encouraging new businesses, by providing inclusive financial support, and by providing real-life support to start and grow businesses.

**Progress Update:** In association with the NGO Tufanganj Anwasha Welfare Society, IGEN-Access selected three villages with existing SWPs to pilot improved asset utilization for unused energy. Capacity-building of the village Farmer Clubs and in-depth consultation with concerned stakeholders was carried out to collect business ideas for additional productive applications and to review them during a market development process.

Based on the selected productive applications, the SWPs in all three villages have been modified to provide otherwise unused electricity to machines. The pilot project uses different

technical specifications in each village to study the most effective option. The applications to be connected to the SWPs were:

- Water purification machines to sell drinking water
- Pulverizer machines
- Stitching machines<sup>4</sup>
- Modified pumps to provide otherwise unused electricity

The pilot also promoted an inclusive ecosystem-based approach to improve the economic viability of solar-powered irrigation systems in India. Further capacity-building has been conducted in the areas of agriculture, irrigation, water management, operations and maintenance, and repairs of the machines, business operation, and business development.

**By the Numbers**

**121**

people directly and indirectly benefiting from modified pumps

**150**

people provided skills development training

**18**

people provided business development training

**+6kW**

of new loads now powered by unused solar capacity



**2.6.4 Energy Efficiency**

# IMPROVING ENERGY EFFICIENCY IN TEA FACTORIES THROUGH TRAININGS AND AUDITS

**Clean Energy Solution:** Tea processing requires intensive energy input that is often costly and unsustainable. This presents an opportunity for significant energy saving. To tap this potential and in the framework of an integrated development partnership with the private sector, Powering Agriculture Partner GIZ joined forces with Kenya’s largest tea producer, the Kenya Tea Development Agency (KTDA), the Ethical Tea Partnership (ETP), Bettys and Taylors of Harrogate, and



<sup>4</sup> The first three machines run using solar power from the SWP during times when the water pump is not in operation.

Mars Drinks to build capacity in energy efficiency in East Africa. The partnership involved energy efficiency audits and trainings for KTDA tea factories. KTDA brings together 560,000 smallholder producers that are also shareholders of the tea factories, solidifying the fact that any changes in the factories directly affect the smallholders.

**Progress Update:** The partnership involved energy efficiency audits that included targeted energy use analysis and recommendations for improvements in tea factories, including but not limited to appliances, insulation and improvement of energy management systems. The audits provided insight into the most burning issues in energy consumption especially regarding patterns, thermal energy and economic recommendations. Further, the partnership provided training courses to technicians with the qualifications to carry out energy audits in tea factories. Other support included conducting international study tours, developing and implementing of plans to improve the energy efficiency of the 14 least performing factories, supporting the most energy-efficient factories to strive for operational excellence, installing energy management systems in two factories and creating a multi-stakeholder process to develop an ideal blueprint for an energy efficient KTDA tea factory.

As part of this activity, two videos were produced to showcase the work of the Hub in the Kenyan tea sector, which employs 2.5 million people in the country and is susceptible to climate change. The **first video**, produced by GIZ, discusses the technical trainings, employee exchange trips, and technologies used to increase energy efficiency in tea factories. The **second video**, produced by USAID, revisits factories to showcase energy efficiency measures being implemented, provides updated impact numbers, and highlights the continued need for energy efficient innovation for agricultural processing. **Six posters** were also created that highlighted energy efficiency measures in the different process of the Kenyan tea sector: heating, storing, withering, cutting, fermentation, and drying. The posters communicate the main behavioral changes needed throughout the supply chain.

### By the Numbers

**69**

tea factories supported

**1.35 million**

cut trees avoided

**10%**

reduction in firewood consumption

**\$13.5 million**

in energy cost savings achieved

**12,000**

tonnes of CO<sub>2</sub> abated

**11%**

reduction in electricity consumption

**1,002**

people including **136** women trained on energy efficiency topics

**2**

study tours to Rwanda and Finland conducted



## 2.7 LESSONS LEARNED

This section provides an overview of challenges to technology and business model innovation that were encountered during the program and lessons learned from overcoming them.

### 2.7.1. Award Sourcing

**The Call for Proposals:** The **PAEGC Mid-Term Innovators' Assessment** revealed challenges that the 2013 cohort faced when applying for their awards. It highlighted a lack of communication and clarity on the process, limited communication around the selection process, and long timelines for PAEGC to judge applications, award grants, and finalize contracts with the innovators. In response, the procurement of the 2015 cohort was changed to:

- Include more detailed and explicit descriptions of the application and selection process and timeline in the solicitation document;
- Simplify the first-stage application process, to require submission of a 600-word concept note that succinctly described the clean energy solution (CES) and why it is appropriate for PAEGC funding;

- Include external international experts and members of in-country missions and field offices to evaluate the technical and contextual aspects of the proposed submissions; and
- Reduce the procurement and award process from 12 months to 10 months.

During the management of the 2013 cohort, PAEGC noted that innovators frequently fell into one of two groups: 1) developing a new CES technology or 2) trying to scale a pre-existing CES technology. The project structure and the innovators' needs varied significantly depending on which of these two categories a project fell into. As a result, the Partners changed the selection criteria and requirements for the second innovation global call for the 2015 cohort.

- The 2015 call incorporated two funding windows to accommodate the different funding needs that the Partners observed in the 2013 cohort: 1) Clean Energy Solution – Design for up to \$500,000 and 2) Clean Energy Solution – Scaling up/Commercial Growth for up to \$2 million.

- A required cost share was added to both funding windows. The Clean Energy Solution – Design window required cost share of up to 15 percent of award value and Clean Energy Solution – Scaling Up/Commercial Growth required cost share of 35 percent of award value.

**Selection Criteria:** *Clear understanding the business case and the value proposition:*

Entrepreneurs and innovators who want to disseminate new products into underserved markets need to develop both the technology and a complementary business model to generate revenue from the distribution of the product. PAEGC found that few awardees began with a strong understanding of their target market. Though many awardees worked to overcome this during their award, those that failed to prioritize this were less successful in scaling their business. To better select applicants in light of this, probing questions around business model maturity and plans for business model development could better identify companies with the capacity to develop a strong understanding of the needs, preferences and willingness to pay of their customer base. This would help to select companies most likely to develop viable business models.

*In-country presence/partnerships:* In-country project partners provide insight into customer needs and market distribution channels. Without a local presence, entrepreneurs will struggle to sell products and collect revenue, stunting the development of a sustainable business model. Local partners typically provide distribution or after-sales service, which is critical for attracting customer interest. The selection process should vet the strength of the

local presence to winnow out applicants who will ultimately fail due to lack of presence in the target market.

*Gender Equality:* Gender equality components of a project are most successful when they are incorporated by the applicant at project inception. PAEGC encountered challenges when trying to introduce gender equality in the middle of the 2013 cohort's project implementation. As a result, PAEGC added gender equality as a selection criterion for the 2015 cohort and received proposals that more explicitly addressed how the clean energy solutions would impact women and men.

## 2.7.2. Award Management

### **Innovators Require Flexibility to Adapt to New Information and Changing Circumstances**

**on the Ground:** Developing a new technology and then distributing it throughout a market is an iterative process. Very few of PAEGC's innovators implemented their projects in the same timeframe that they originally envisioned, and multiple innovators chose to change either the technology they were developing or the market segment that they were pursuing. The grant award agreements should be structured to allow for flexibility and course corrections.

Almost all innovators required contract modifications to allow innovators to change the project to accommodate realities on the ground. This can be a time-consuming and complicated undertaking, especially for organizations new to working with USAID. The following support was provided to assist in the process:

- Contract modification templates for the innovators were provided to ensure that the necessary justifications were provided;

- PASTO staff assisted innovators in conceiving and structuring their modification requests and pre-screened the contract modification requests for common problems; and
- PAEGC program management staff engaged innovators at least quarterly on their progress and would pre-emptively ask about delays and barriers to implementation.

The early stages of product development are iterative and unpredictable; innovators can easily find themselves at a development dead end or that they have run out of cash in the middle of the development process. A large, multi-year grant award provides the innovator with the dual benefits of sufficient runway to weather technical setbacks and the time to focus on product development before having to raise more investment. One PAEGC innovator was able bounce back and develop a working milk chiller after experimenting with two different infeasible technologies. In effect, ensuring streamlined award processes including flexible reporting schedules – especially for innovators that are new to working with USAID – can support the unpredictable processes of product development and deployment.

**Management Consistency is Critical:** When a program is managing multiple contract awards and extracting impact data from multiple awardees, consistency is critical. At the beginning of the Grand Challenge, there were five different award managers and multiple changes due to internal reassignments. It is preferable to have a single award manager for all awardees from the beginning which allows for the identification of recurring issues and common problems across the cohort. When a single award manager is not possible and program management shifts between USAID staff, it is helpful to have consistency such as a standardized methodology for milestone review and innovator check-ins is essential. PAEGC has a single repository for awardee data and deliverables, and USAID and PASTO staff also an internal archive maintain to keep track of awardee-specific information and follow-up items. This allowed a consistent programmatic experience for awardees when there was turnover in both the funding partner staff and PASTO staff.

A support team can reduce the reporting and reviewing burden of the award manager so they can focus on high-level management tasks.

***“Compared to the administration in much lower-value grants, [Powering Agriculture] was for us a relatively low-admin project with modest reporting requirements. The fixed-value contract approach that meant financial reports were not required was easily the biggest advantage of the project design, allowing more time to be spent on real work instead of overly detailed accounting. Thanks for a great program run by great people—have experienced dozens of such programs, and this was certainly one of the best.”***

The support team provided via PASTO was useful in preparing standardized templates for use by the innovators, developing guidance documents on USAID award requirements, in coordinating regular check-ins and managing program data. However, for the support team to be of maximum value to the program, they need to be integrated from the start of the program and before any call for proposals. PASTO was contracted after the 2013 cohort selected and the support team was not fully utilized and integrated until the call for proposal in late 2014. The support team's role also needs to be clear to all involved entities. Some of the innovators were unclear as to how the support team was different from USAID as the Grand Challenge administrator.

**Supporting Gender Integration:** Social entrepreneurs run organizations on thin margins, and the success of their organizations depend on the innovators' ability to efficiently implement their projects. If the organization cannot maintain financial sustainability, then the innovator has no social impact, whether gender integration or the organization's original social mission. When faced with a decision to invest money in their own innovation or in gender integration efforts, PAEGC found that many innovators would make gender a secondary priority. Powering Agriculture staff learned two lessons from this experience:

1. Innovators will embrace gender interventions that support core business practices. The success of the Empowered Entrepreneurship Training Program (EETP), for instance, is due to the fact that it has provided innovators with a concrete approach to integrating gender while also supporting business outcomes such as increased sales and

staff retention. In structuring a grant-based program, it is beneficial to identify ways to integrate gender early-on, including milestones and support to innovators in this regard. Innovators should be paid to implement gender integration activities that only partially or hypothetically overlap with innovators' core business and should not be tacked on as a requirement post-fact.

2. Innovators may require outside expertise to identify opportunities to address gender equality. In a model piloted by the Investment Alliance, TA support is provided to companies to audit their business practices and suggest gender-related interventions. These practices were then adopted by the company, while results were monitored by the external experts. This enables companies to learn from gender experts, understand the impacts on their bottom line, while also staying principally occupied with their primary responsibility of managing a viable business.

### 2.7.3. Monitoring and Evaluation

There were a number of challenges associated with meaningful monitoring and evaluation (M&E) under PAEGC. The program established ten development indicators that innovators were to report annually, but many innovators were ill-equipped to collect this information. At the same time, many of the chosen indicators, such as number of beneficiaries and clean energy capacity installed, were poorly suited to measure progress of innovators working on small-scale pilots.

**Innovators Struggle to Collect High-Quality M&E Data:** Many awardees work with limited organizational budgets, and PAEGC saw

high turnover on implementing teams. This resulted in inconsistent interpretation of indicator definitions and hampered the ability of implementing teams to accurately and promptly report their M&E data.

- Organizations that do not typically interact with donor agencies underestimate the work required for M&E.
- Baseline studies were almost never conducted. Conducting a baseline study for initial M&E indicators should be a separate award milestone completed at the very beginning of the project.
- M&E work should be broken into deliverables with commensurate payments.
- The core business competencies of the innovators frequently did not include collection of more complicated M&E indicators, like increased incomes and yields resulting from product deployment.

Despite these challenges, PAEGC did find it effective to conduct at least one site visit per awardee. This enabled the program to validate innovator-reported M&E data and collect additional data that PAEGC technical experts could use to more fully understand the impacts of the innovation. PASTO developed a standardized format for conducting site visits, and the PASTO technical experts often learned insights the innovators did not know themselves. Future programs should consider hiring a dedicated data collection expert, instead of relying on innovator reporting. This would both alleviate a reporting burden many innovators deemed substantial, while at the same time insuring more efficient and consistent data collection practices.

### **Mismatch between Implementation and M&E**

**Indicators:** PAEGC was designed to promote the development of new clean energy technologies for the agriculture space through grants and technical assistance provision to organizations. When designing the M&E indicators for a similar program, it is necessary to include M&E indicators that track sales growth, innovator organizational development, and the social impact on customers. It is beneficial to utilize evidence-based business-standard metrics that innovators are already collecting as part of their standard business operations to minimize the reporting burden on innovators.

Donors should adjust their M&E indicators and targets to match the stages of the awardees participating in the program. Innovators that are scaling up market penetration will produce the largest social impact numbers, whereas awardees that are piloting their first working prototype will have low social impact numbers.

**Managing M&E Reporting:** Award managers should prepare for frequent retraining of awardees to submit required reports, such as M&E or annual reporting. Keep training short and concise. The program's M&E plan is a living document that should be updated periodically to reflect changes in the definitions of each metric and its calculations. This M&E plan can then be shared with innovators and partnering organizations to promote consistent data reporting between innovators.

#### **2.7.4. Provision of Technical Assistance**

A key component of the PAEGC program was technical assistance provided to innovators. This technical assistance was on-demand and ranged from help with award compliance to gender integration assistance to business acceleration support. There were some significant lessons learned with respect to the assistance provided to innovators.

**Market Research:** Market research and customer discovery is one of the most valuable forms of technical assistance an incubation program like PAEGC can provide to its awardees. A lack of market and customer understanding was one of the most common reasons for project delays and scope change. For innovators developing new products, this lack of market understanding typically took the form of products that only partially met customer expectations or fell outside customers' ability to pay. For innovators who were scaling up market penetration, this lack of market understanding typically took the form of uncertainty in which new market segment to enter or which distributors to approach.

**Business Model Development:** Providing business model development support and basic business operation training, if the innovator accepts it, will improve the success of the endeavor and increase its potential for investment. Many innovators are solely focused on developing a technology rather than bringing a product to market. As a result, their business model will inadequately address the target market, distribution plans, and unit cost.

**Fundraising Coaching:** Many innovators within both cohorts were first-time entrepreneurs and did not have experience raising money from

investors. PAEGC employed impact investing experts to coach innovators on how to create and implement investment strategies. Serial entrepreneurs and enterprises that had already raised multiple rounds of investment used this technical assistance less often. Nonetheless, fundraising coaching should be offered from the beginning of the award.

Program managers should be prepared for a small number of awardees to reject advice from the fundraising coaches yet still expect the coaches to identify and pair potential investors with them. If the awardee's fundraising strategy is unconventional or does not match the investment strategies of most impact investors, this puts the fundraising coaches in an untenable position. In addition, it is very difficult for fundraising coaches to overcome a negative reputation an innovator may have already established in the impact investing sphere.

#### **2.7.5. Enabling Policy Environment**

Many innovators faced similar policy and regulation environment challenges that PAEGC was not structured to address. These challenges often hindered innovator growth or entry into new markets, which also threatened completion of award milestones. Broadly, these included issues in the areas of business operations, market growth potential, product quality and access to government entities to solve issues.

Primary challenges encountered by innovators included unclear and non-transparent application of customs and tariffs, complicated foreign exchange processes, non-existent market awareness programs for clean energy-agriculture technologies, lackluster product quality recognition and labeling programs

and a lack of clear access points to engage with government agencies on policies and regulations. Follow-on programs should consider enabling environment components that address these common policy problems outside innovator control. While broadscale custom and tariff reforms may be unpalatable to host governments, there are a range of interventions that donors can support that may engender less resistance. These include:

- **Encourage consistent application of customs rules:** Several innovators experienced inconsistent application of importation duty regulations - for example, in one innovator's country of operations one government body used a Harmonized System (HS) code from 2012, whereas another used another from 2017. By supporting efforts to train customs staff to consistently and transparently apply tariffs, inform the private sector of tariff applications and provide access to accountability mechanisms for redress, donor governments can help address this issue.
- **Remove barriers to lending:** Innovators often encountered challenges in accessing loans and providing microloans to customers. For example, innovators experienced difficulties in accessing loans in Kenya due to the 14.5% interest rate cap set on commercial lending interest rates. Similarly, the 1% tax levied on mobile money payments in Uganda was noted to stymie the ability to provide PAYGO financing to customers. Donors can advocate for governments to review relevant financial regulations to ensure that they do not pose barriers to clean energy-agriculture companies.
- **Support market awareness programs:** Smallholder farmers are typically unfamiliar

with clean energy-agriculture technologies. Several innovators noted that public market awareness programs that disseminate knowledge on benefits of and create trust in such technologies would be very useful. In this regard, donors can implement or advocate for governments to fund public demonstrations, agricultural extension and other training programs.

- **Recognize quality products:** Innovators noted that recognition of high-quality clean energy-agriculture products can grant consumers the ability to assess cost versus quality and make informed purchasing decisions. This is especially useful in cases when cheaper, lower quality products without warranties or expected lifetimes are available to smallholder farmers. To address this, donors can support the creation of voluntary quality standards and award-based recognition programs that use robust lab and field testing.
- **Empower public-private engagements:** Clean energy-agriculture technology topics span different sectors and government ministries, like energy, water, agriculture and finance, which elucidates the need for a collaborative approach for clean channels of communications with innovators. Additionally, targeted public-private working groups that focus on clean energy-agriculture enabling environments would also be very useful. Therefore, donors can encourage and empower working groups that involve innovators and relevant government representatives to discuss policy and regulation pain points and solutions. Industry associations also play a pivotal role in these discussions.

# 3. Financing Facility

This section provides an overview of the Powering Agriculture Investment Alliance and details the Financing Facility activities under AlphaMundi and FACTOR[e].

alphamundi

**FACTOR[e]**  
VENTURES

## 3.1 OVERVIEW OF THE POWERING AGRICULTURE INVESTMENT ALLIANCE

Powering Agriculture partnered with AlphaMundi and FACTOR[e] to form the Powering Agriculture Investment Alliance (“Investment Alliance”). The Investment Alliance will catalyze a minimum of \$25 million in private sector finance for ventures with the potential to achieve transformational development impact in the clean energy-agriculture nexus.

AlphaMundi and FACTOR[e] have track records of making profitable investments in socially

and environmentally sustainable enterprises that generate substantial net benefits to society. Both organizations embrace Powering Agriculture’s goal of improving lives in the developing world by helping to scale clean energy solutions that increase agriculture productivity and/or value. Powering Agriculture funds are helping to subsidize on-the-ground activities that will enable FACTOR[e] and AlphaMundi to discover, vet, and engage with earlier-stage ventures—effectively helping build capacity to absorb more private sector capital.

### 3.1.1 AlphaMundi Profile

The AlphaMundi Foundation (“the Foundation”), through the Switzerland-based investment firm AlphaMundi Group, has been investing in clean energy and sustainable agriculture companies since 2009. AlphaMundi Foundation, the Washington, D.C.-based 501c3, was founded in 2016 to provide technical assistance and impact measurement support to these companies. In March 2018, AlphaMundi finalized a \$3 million partnership over three years to join the Investment Alliance. With both for-profit and nonprofit business models, AlphaMundi was uniquely positioned to collaborate with USAID on this effort.

Through the Investment Alliance, the AlphaMundi Foundation supports technical assistance and improved impact measurement for companies operating in the clean energy-agriculture nexus, while the AlphaMundi Group contributes private sector investment funds through direct debt and equity investments in

one of its managed impact investment funds. The Investment Alliance will continue to broaden the pipeline of investable companies for the AlphaMundi Group and other investors and therefore catalyze additional private sector funding to this space (or expedite the flow of private capital funds) in a manner that would not have been otherwise possible without the Investment Alliance.

The key program areas of AlphaMundi’s work include:

1. Pipeline development by providing support for accelerators and incubators operating in target countries for investment;
2. Pre- and post-investment technical assistance;
3. Impact measurement support;
4. R&D grants to support pilots and/or customer research for new products in the clean energy-agriculture nexus; and
5. Catalyzing private investment of \$15 million or more from AlphaMundi Group-managed funds and other private investment vehicles.



### 3.1.2 Alphamundi Technical Assistance Projects and Investments

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## SANERGY

sanergy.com

Sanergy converts organic waste streams—food, agricultural, and sanitation waste—into valuable agricultural inputs such as fuel and feed. Sanergy uses insect-based proteins from the Black Soldier Fly for animal feed.

The Foundation is supporting both:

1. A technical business model review to help scale up Sanergy's use of insect-based protein; and
2. A feasibility study to replace fossil fuels with renewable energy resources across the firm's operations.

**Country:** Kenya

*“Kenyan farmers and feed millers are in need of an affordable, consistent, safe, and high-quality protein rich animal feed. Through this project, Sanergy will be the first fully fledged organization in Kenya to serve this huge market that is rapidly growing.”*

– David Auerbach, Co-Founder

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## SUNCULTURE

sunculture.com

SunCulture provides affordable solar-powered irrigation solutions to smallholder farmers in Africa to improve crop yields and quality.

The Foundation supported an evaluation of SunCulture's consumer credit pilot and recommendations for their consumer credit model and strategy going forward. SunCulture engaged with local consulting firm Open Capital Advisors (OCA) to update the credit survey, scoring and overall credit framework; revise the consumer credit process, sales agreement contracts and sales agent training materials; and refine all-inclusive credit policy documentation in preparation of a roll out of its asset financing platform, Pay-As-You-Grow.

SunCulture is currently in the process of raising debt to fund its Pay-As-You-Grow portfolio, and the Foundation's supported work with OCA will be essential for SunCulture as it approaches potential debt providers and during the due diligence process.

**Country:** Kenya

*“The support Alpha Mundi provided for the Open Capital Advisors technical assistance has helped create a robust lending process which will enable us to better serve our customers. Our Pay-As-You-Grow financing platform is now more efficient, secure, and robust.”*

– Samir Ibrahim, Co-Founder/CEO

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## SISTEMA BIOBOLSA

sistema.bio

Sistema Biobolsa (Sistema.bio) is a Mexican certified B-Corporation that manufactures, distributes, sells, and installs biodigesters that transform livestock waste into organic fertilizer for crops and biogas for cooking, heat, and electricity. Sistema.bio provides an integrated product set by selling turnkey technology products and service packages, combined with interest-free financing and a ten-year warranty. Services include full operations trainings and manuals.

The Foundation is supporting both technical assistance and gender workshop grants with Sistema.bio and has played a role in catalyzing \$1.5 million in private sector investment.

- The technical assistance project supports the development of product suppliers, distribution partners, and service providers to meet the large demand for agricultural energy products in Kenya and build the capacity of Sistema.bio's team in Kenya to effectively manage the supply chain for such products.
- The Foundation is supporting the application of a gender lens to Sistema.bio's sales and loan repayment practices in Kenya. This will be the first gender pilot for an AlphaMundi portfolio company and will be implemented in partnership with leading boutique consultancy Value for Women.

**Country:** Kenya

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## CORPOCAMPO

corpocamp.com

CorpoCampo is the market leader in Colombia for producing "hearts of palm" and açai and has more than 90 percent market share in both products.

The Foundation is supporting a feasibility study that evaluates the financial, technical, design and social impact of transforming the current açai value chain to solar.

**Country:** Colombia

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## AMPED INNOVATION

[ampedinnovation.com](http://ampedinnovation.com)

Unlike other traditional solar companies, Amped Innovation (Amped) is vertically integrated and specializes in product innovation and manufacturing. The firm seeks to design each product using the fewest but highest quality components, which allows for savings without sacrificing quality. The result is that Amped's solar home systems (SHS) offer six times the power handling capacity of competing lighting systems at just one-third of the cost.

The Foundation is supporting an R&D grant to move Amped's solar-powered icemaker from product R&D to large-scale distribution. This will be the first mass-market approach to solar powered ice-making in East and West Africa.

**Country:** Kenya

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## SOLAR-NOW

[solarnow.edu](http://solarnow.edu)

SolarNow sells, distributes and provides financing for high-quality, modular solar home systems and accessories to make solar energy more accessible and affordable. SolarNow is a market leader in larger-scale SHS and is the only company currently offering a full range of solar-powered accessories, including TVs, a refrigerator, shaver, security lights, and flat iron.

The Foundation, in partnership with the AlphaMundi Group and peer investors, is supporting a broader strategy development and business restructuring process within SolarNow. Particular attention will be paid to increasing the profitability of SolarNow's agriproductive products and client base. This project will support SolarNow in its efforts to becoming a leading supplier of high-quality solar energy solutions for productive purposes in East Africa.

**Country:** Uganda

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## COCONUT HOLDINGS LIMITED

Coconut Holdings Limited (CHL) is a Kenyan coconut processing company that provides over 1,300 farmers with a consistent offtake market with stable prices throughout the year.

The Foundation is supporting a feasibility study to evaluate the viability of transforming coconut shells to briquettes as an RE source in their de-shelling process.

**Country:** Kenya

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## SUNISOLAR

[sunisolar.com](http://sunisolar.com)

SuniSolar is a Nicaraguan RE company that designs, sells, and installs solutions for the residential, commercial, and agricultural sectors. SuniSolar provides solar powered solutions to small- and medium-sized producers to help increase productivity and enhance farmer incomes.

The Foundation is supporting both:

1. A market study of irrigation systems in Nicaragua; and
2. A marketing plan to promote irrigation systems for the target end use of small- and medium-sized agricultural producers.

This support will be critical in demonstrating the viability of the distribution of SPIS to farmers in Nicaragua.

**Country:** Nicaragua

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## RENT TO OWN

[rtoafrica.com](http://rtoafrica.com)

Rent to Own is an asset financing company operating in rural Zambia, targeting productive use assets. They offer quality equipment, delivery, and installation, and uncollateralized financing to customers.

The Foundation is supporting the development of a three-year business plan that will:

1. Outline their path to one million customers;
2. Support fundraising efforts; and
3. Drive solutions for managing currency exposure, a key risk for securing working capital investment.

**Country:** Zambia

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## SIMUSOLAR

[simusolar.com](http://simusolar.com)

Simusolar provides and finances accessible, affordable, and energy-efficient equipment designed for off-grid businesses in sub-Saharan Africa. Simusolar provides productive equipment to smallholder farmers and fishers who use it to more than double their incomes in under a year. These turnkey packages include solar water pumps or fishing lights, solar panels, and pay-as-you-go (PAYGO) technology to secure them. The equipment is lease-to-own and financed over nine to 18 months.

The Foundation is supporting a technical assistance project to address Simusolar's operations, impact, and bankability by improving key areas of information systems development: inventory management system, loan management application, key performance indicator dashboard, and sales pipeline/lead management system. This targeted information systems development will allow the company to scale its off-grid agricultural productive equipment platform.

**Country:** Tanzania

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## INSPIRAFARMS

[inspirafarms.com](http://inspirafarms.com)

InspiraFarms provides agribusinesses and food distributors with turnkey, modular, energy-efficient cold rooms, packhouses, and automated ripening chambers. These significantly cut energy costs, come ready to meet international food safety certification standards, and allow for remote performance monitoring on- or off-grid. They also provide technical assistance and affordable asset financing terms that allow agribusinesses to leapfrog financial barriers to emerging technology and grow sustainably.

The Foundation is supporting a two-part technical assistance project to help InspiraFarms improve the reach and efficiency of its business development activities. The project consists of two components, the first being a market survey of fresh fruit and vegetable production in Mexico and in East and Southern African countries. The survey will help InspiraFarms' business development team better target its sales activities and will also provide fine-tuned data on the market gap and opportunity for solar-powered and hybrid cold storage and packhouses. The second component is a technical analysis of competing cold chain and ripening solutions in areas of high fresh produce production to better understand why gaps in cold chains continue to exist. This is so that InspiraFarms' business development team can better target its efforts with growing agribusinesses and farmers.

**Country:** Kenya, Mexico, South Africa

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### 3.1.3 FACTOR[e] Profile

FACTOR[e] Ventures (FACTOR[e]) is a venture development firm with a mission to improve lives in the developing world through increased access to reliable and sustainable energy, improved incomes for smallholder farmers, and beneficial improvements in livelihoods in the areas of transportation, water, and sanitation. FACTOR[e] sources and invests in a rich pipeline of social ventures that aim to solve profound global problems. FACTOR[e]'s mandate is to find and invest in disruptive technologies have the potential to improve more than ten million livelihoods at scale.

FACTOR[e] was created in 2013, in part through funding from the Shell Foundation. FACTOR[e] makes equity investments in the range of \$200,000–\$700,000 for very early, seed-stage start-up companies operating in frontier and emerging economies. In addition to financial resources, FACTOR[e]'s philosophy is oriented around providing hands-on support to help grow these businesses. Especially in the areas of technology, FACTOR[e] has engineers,

technologists, and entrepreneurs on staff to provide guidance and mentorship to each of the investee companies. FACTOR[e] has made 18 investments to date and seeks to make approximately four to six investments per year.

FACTOR[e] sees itself as bridging the gap between donor/concessional capital and more commercially-oriented capital. FACTOR[e] invests at early stages of company development—with inherent technology risk—at a time when concessionary capital is still vital for growth. With an investment harvest cycle of eight to ten years, each of the portfolio companies will hopefully grow to a point where it can attract larger and more return-seeking capital. FACTOR[e] has been successful at leveraging its capital with other co-investors to stimulate further growth and capital flow to their investees. By successfully leveraging capital with co-investors, FACTOR[e] is helping to meet a main objective of the Investment Alliance: catalyzing additional investment in early-stage companies.





### 3.1.4 FACTOR[e] Investments

Under this program, FACTOR[e] has finalized one investment specifically focused on the clean energy-agriculture nexus.

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## SISTEMA BIOBOLSA

[sistema.bio](http://sistema.bio)

Sistema.bio (also called Sistema Biobolsa) is a Mexican certified B-Corporation that manufactures, distributes, sells, and installs biodigesters that transform livestock waste into organic fertilizer for crops and biogas for cooking, heat, and electricity. Sistema.bio has developed an anaerobic digestion technology that creates clean cooking fuel for households using animal waste. One of Sistema.bio's key innovations is the modular-yet-robust material of the digester itself. The simple installation process and maintenance-free operation make the Sistema.bio solution a valuable intervention for smallholder farmer customers with livestock.

FACTOR[e] provided a convertible note (with an intention to convert to equity) to support the development of new agricultural appliances in Kenya that run on biogas. These new appliances will replace traditional fossil fuel-powered energy products. Sistema.bio is also extending its reach into alternative waste-to-value products (including the use of human waste as a waste stream) that might benefit smallholder farmers and build new markets for Sistema.bio's team in East Africa.

FACTOR[e] will provide a training module for diversity, inclusion, and gender broadening, beginning with a self-examination of current practices. The training will focus on the benefits to Sistema.bio of implementing alternative methods for recruiting and team building.

FACTOR[e]'s investment will be focused on developing and using additional appliances for specific use with Sistema.bio's biogas output. The ability to use Sistema.bio's digester units with a broader range of appliances will expand the application potential of the technology and make it more accessible to a wider group of rural customers.

**Country:** Kenya



### 3.2 LESSONS LEARNED

The Powering Agriculture Investment Alliance is proving itself to be an effective method for catalyzing private investment in clean energy-agriculture companies. Though various programmatic and administrative hurdles delayed activities under this component of Powering Agriculture, the Investment Alliance has both identified new companies with high-impact solutions and successfully mobilized funding for existing Powering Agriculture innovators. While the effort has only just concluded the first full year of implementation, the following lessons are already emerging:

**Donor funds are effective in catalyzing private investment under the Powering Agriculture Investment Alliance.** Though clean energy solutions for the agriculture sector have high potential for development impact, many companies operating in this space remain high-risk and low-return from an investment perspective. Very often, the more a company strives to serve the base of the pyramid, the more difficult the business case becomes: marketing, distribution, and after-sales support

become more costly while risk tolerance and customers' ability to pay is decreased.

Deal sourcing is also costly for investors. Both AlphaMundi and FACTOR[e] have in-country and international investment teams dedicated to developing relationships, identifying deals, and conducting due diligence. Even once a deal is completed, companies frequently require support to continue to develop and grow as a business. This makes investments in these companies costly to administer, while the expectations for financial return remain moderate.



The Powering Agriculture Investment Alliance has overcome these challenges by subsidizing, in part, the high cost of investing in the clean energy-agriculture nexus. The results over the past year are preliminary, but promising. As noted above, the Investment Alliance has already catalyzed \$2.25 million in private investment, with \$1.39 million in donor funds spent to date on the program. We expect these results to improve over time as pipeline development efforts and seed investments result in new investments and follow-on funding rounds. The Investment Alliance is committed to mobilizing a minimum of \$25 million in private investment by 2023, with total donor funding of \$5 million.

**FACTOR[e] and AlphaMundi operate under different, but mutually complementary, models.**

FACTOR[e] and AlphaMundi are proving to be complementary partners for Powering Agriculture. FACTOR[e] prides itself on its technological expertise and typically invests in companies with an innovative technology at the core of its product or service offering. FACTOR[e] typically makes small (\$200,000–\$700,000) equity investments in companies that align with well-defined and heavily researched “theses” around market gaps and technologies with the potential to have transformative impacts.

AlphaMundi, on the other hand, has historically made debt available to social impact businesses in Africa and Latin America, although it has recently launched a mezzanine fund focused on Africa. While business expansion is of interest to AlphaMundi as it continues to reinvest in strong companies, its role as a debt provider encourages a strong focus on balance sheets and company sustainability. AlphaMundi also

carefully considers an investment’s potential social impact, rigorously tracking impact through the GIIRS rating system and an increasingly focusing on integration of gender equality into investment decision-making and support to companies.

These two models have demonstrated interesting overlaps with the existing Powering Agriculture portfolio of innovators. FACTOR[e], for instance, is working with Village Industrial Power (VIP), a company supported through a 2013 grant to CAMCO Clean Energy, to improve both VIP’s technology—a biomass-powered combined heat and power plant for off-grid agricultural processes—and its investability. FACTOR[e] supported VIP as it reduced manufacturing costs, established manufacturing relationships in India, improved engine efficiencies, and demonstrated attractive payback periods for small- and medium-sized agribusiness customers. AlphaMundi, on the other hand, is providing a loan to SunCulture to increase working capital as it expands solar water pump sales in Africa. This illustrates their mutual complementarity—VIP is likely still too early-stage for AlphaMundi debt capital, whereas SunCulture, with an established technology and having closed millions in recent investment rounds, is not a good fit for FACTOR[e]’s seed-size equity.

The investors’ involvement in the Powering Agriculture Investment Alliance has also led to new and compelling collaborations. For instance, AlphaMundi has provided a grant to Sistema.bio, a biodigester company that, with FACTOR[e]’s seed equity, is expanding its offerings of biogas-powered agriculture equipment.

The partnerships with AlphaMundi and FACTOR[e] are also demonstrating two different models for using donor funds to catalyze private investment. Under the Investment Alliance, AlphaMundi is deploying pre- and post-investment grants to support high-risk activities that investors will not yet stomach but improve investability, such as technical experimentation or market research. FACTOR[e]'s unique way of investing involves intense engagement with investees, where it works extensively to help develop the techno-economic case for the business and set up the structures and operations necessary to close follow-on rounds of funding. PAEGC funding to FACTOR[e] provides half of the funds necessary for each seed investment.

Though structured differently, at their core, both models use donor funds to buy down the high cost of transactions associated with investing in early-stage clean energy-agriculture businesses and subsidizing the hands-on support that businesses need to be successful. Beyond the value of the resources provided, it is clear that AlphaMundi and FACTOR[e] have been induced to be much more intentional about developing pipeline and deals in the clean energy-agriculture nexus.

**Capital must be patient.** The Investment Alliance is demonstrating the need for patient capital in the clean energy-agriculture nexus. This is capital that looks for sustainable growth and provides flexible terms structured around unique company needs. AlphaMundi has frequently noted that unrealistic investor expectations and the pursuit of hockey stick-shaped returns can backfire. One of AlphaMundi's portfolio companies, for instance, made a major push for rapid expansion to satisfy investors, but

ultimately it proved unsustainable. As the company closes branches and lays off staff, plummeting moral is making it challenging to turn things around. AlphaMundi and other investors are now faced with the challenge of either restructuring the terms of the loan or cutting their losses—an unfortunate situation for all involved, considering the company's previously solid business performance and its success serving base-of-the-pyramid customers. FACTOR[e] similarly understands that impact at scale does not come overnight. Though it ultimately seeks solutions that can improve the lives of millions, FACTOR[e] expects intense involvement with the portfolio for a minimum of two to three years after the initial investment. The organization often stays with its companies for multiple funding rounds and expects a return on investment in a seven-to-ten-year timeframe.

**The Investment Alliance is overcoming administrative barriers to identifying and supporting innovators.** Powering Agriculture experienced a number of challenges to identifying innovators and administering awards. The Investment Alliance is demonstrating a different way of operating that overcomes many of these barriers and may be applicable for future programs supporting technology innovation.

- **Flexibility in the procurement process:** There were two global calls under Powering Agriculture with grants made on the basis of written applications. Strict rules for fairness and competition made it difficult to learn about company teams through first-hand interactions, and the set application schedule meant there was no opportunity to engage other promising companies not identified through the two calls. The Investment

Alliance, on the other hand, has proven to be a great deal more flexible when it comes to engaging companies. Both Partners maintain a long list of potential pipeline companies that is updated on a continuous basis, and frequently maintain relationships with a company for extended time periods before investing. AlphaMundi and FACTOR[e] are able to freely interact with companies as they conduct due diligence, which allows them to more easily assess their management teams. While Powering Agriculture primarily assessed the innovation proposed during the global calls for innovation, FACTOR[e] and AlphaMundi looked more holistically at the business and the management team.

- **Flexibility in engagement:** The grants funded by Powering Agriculture have sometimes been hampered by inflexible award requirements. The majority of projects were structured as milestone-based grants, where grantees are paid on the basis of achieving predetermined accomplishments. This has sometimes caused difficulties as an innovator refines and updates its business model over the course of the project. In some cases, original milestones were no longer

deemed relevant and required a cumbersome modification process. FACTOR[e] and AlphaMundi are not burdened to the same extent by this structure. Grants provided by AlphaMundi can be more easily modified and redirected. Debt and equity investments at a company level can support company strategy as it evolves over time.

- **Incentives for engaging with business acceleration support:** Companies have a powerful motivation to engage with business acceleration support under the Investment Alliance. When the Powering Agriculture Xcelerator (PAX) team identified issues related to company strategy or team structure, the program could only make recommendations. Given the project nature of the awards, there was little to no leverage in the award agreement to require changes. However, the relationship established as an investor is different—companies are motivated to heed business advice to keep investors satisfied and secure follow-on funding. FACTOR[e] routinely and AlphaMundi occasionally take board seats, facilitating a direct say in company strategy and management.



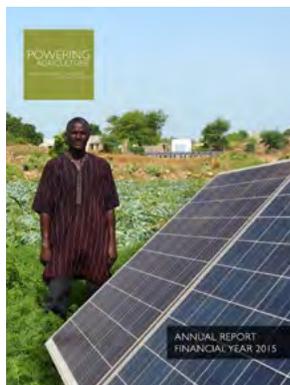
# 4. Knowledge Management

Powering Agriculture served as a clean energy and agricultural information resource hub, sharing knowledge generated through its activities. This knowledge can be used by the clean energy-agriculture nexus community to stimulate further innovation and continue scaling. Powering Agriculture also documented its program-level activities, its challenges, and the lessons learned implementing the Grand Challenge that can be used for the design of future similar programs.

## 4.1 DOCUMENTING PROGRAM RESULTS

Powering Agriculture produced the following reports, assessments, and videos as described below to document results and learnings from the implementation of the Grand Challenge.

**Powering Agriculture Annual Reports.** At the end of each fiscal year, Powering Agriculture produced a report summarizing the activities and accomplishments of the innovators and the Grand Challenge.



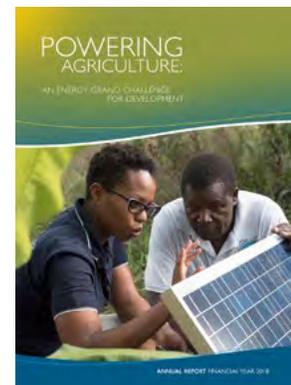
2015



2016

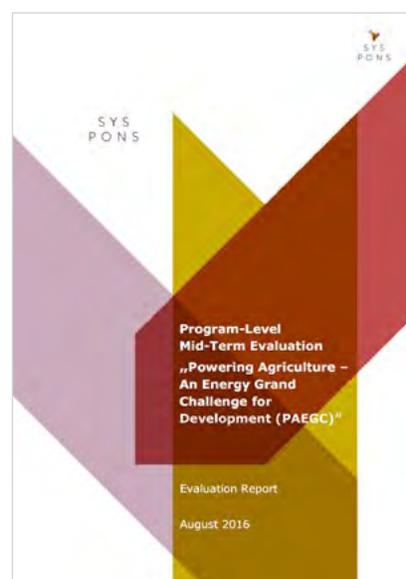


2017

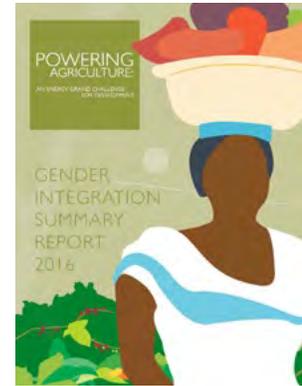


2018

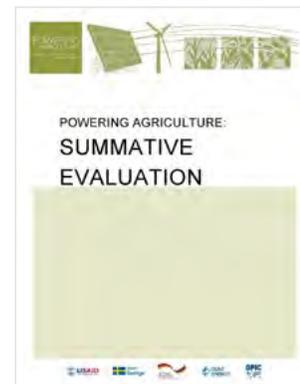
**Powering Agriculture Mid-Term Program-Level Evaluation and Innovators' Assessment.** In 2016, Powering Agriculture commissioned Syspons GmbH, an external evaluation team, to evaluate the program-level structures, processes, and impacts of the initiative. The evaluation team conducted an in-depth analysis of relevant documents and data, interviews, and an analysis of the results from a previous impact evaluation on the project level. The report includes key findings, conclusions, and recommendations, and was used to inform future decision-making by the Founding Partners. The report also includes an assessment of the progress of the 2013 innovators and the findings, conclusions, and recommendations that were used to make mid-course adjustments to improve the management of the innovators. Access the report [here](#).



**Gender Analysis and Lessons Learned Report.** In 2016, Powering Agriculture produced a report summarizing its innovators' progress thus far in integrating gender considerations into their projects. The report included an analysis of all 24 individual innovator plans, activities, challenges, and lessons learned related to gender integration in clean energy technology deployment. The report was used to strengthen the integration of gender at the program level and develop guidance for innovators. Access the report [here](#).



**Powering Agriculture Summative Evaluation.** Near the initiative's end, USAID tasked the Institute for Defense Analyses' Science and Technology Policy Institute (STPI) with conducting a summative evaluation of Powering Agriculture. This document presents the case studies for the benefit of PAEGC Partners and their governments. Because many of the interviewees shared sensitive or proprietary information with STPI staff during the interviews, these individual case studies have not been included in the public version of the evaluation. Access the assessment [here](#).



**Powering Agriculture Final Videos.** As part of the Grand Challenge ending, Powering Agriculture produced five final videos. In the Grand Challenge's innovator summary video, three innovators share the story of their clean energy solutions and the stories of the technology's impact on its intended beneficiaries. The three innovator vignettes are also available as standalone videos. In the program summary video, the four program components are introduced and explained by the Founding Partners and the Investment Alliance Partners. Watch the videos [here](#).



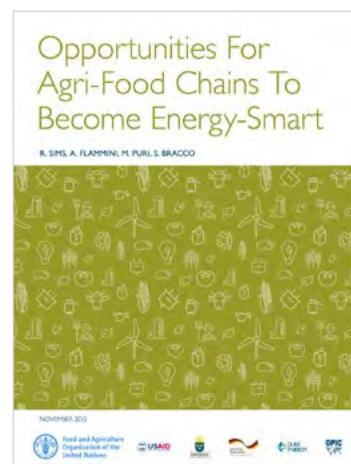
## 4.2 CLEAN ENERGY IN THE AGRICULTURAL VALUE CHAIN

Powering Agriculture has developed the following publications that present approaches to integrate clean energy technologies in the agricultural value chain. Powering Agriculture Partner GIZ, in partnership with the FAO, conducted extensive research to develop these foundational studies.

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### Opportunities for Agri-Food Chains to Become Energy-Smart.

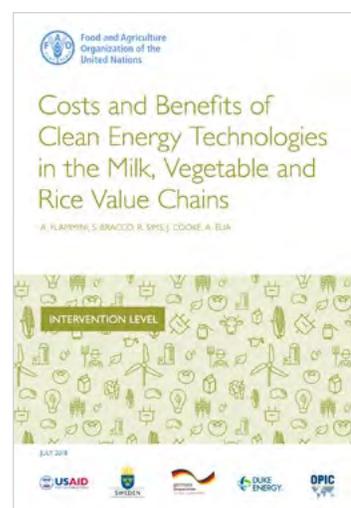
Published in 2015, this study highlights potential opportunities for reducing the demand for fossil fuels and reducing greenhouse gas (GHG) emissions in the value chains for milk, dairy, rice, and vegetables—all of them of central importance for human nutrition. The study addresses information needs through a detailed analysis of the energy demand and possible clean-energy solutions (more than 100 technologies and measures) along three selected value chains: milk, rice, and vegetables. It also gives an overview of tools for assessing the financial viability of clean energy solutions. Access the study [here](#).



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### Costs and Benefits of Clean Energy Technologies in the Milk, Vegetable and Rice Value Chains.

Published in 2018 this report presents a methodology to analyze the costs and benefits of some of the technologies that could supplement or replace fossil fuel use. It focuses on three food chains—rice, vegetables and milk and showcases six case studies of energy interventions in including biogas, a solar milk cooler, a solar-powered water pumping system, and others. It examines how clean energy solutions perform, discusses their suitability for specific development contexts, points out the enabling conditions necessary for their implementation, and suggests policies that should be in place in order to encourage investments that benefit both sustenance farmers and the environment. The report was developed under the project “Investing in Energy Sustainable Technologies in the Agri-food Sector” aimed at making agri-food chains more energy-smart by using RE and energy-efficiency measures. Access the report [here](#).

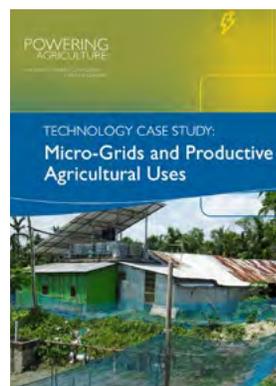


**Measuring Impacts and Enabling Investments in Energy-Smart Agri-food Chains.** Published in 2019, this study shows how to apply the methodological approach for a comprehensive cost-benefit analysis of energy technologies developed in the second study above to a country level, specifically Kenya, Tanzania, the Philippines, and Tunisia. The methodology provides guidelines for a sound and comprehensive cost-benefit analysis of clean energy interventions in agri-food value chains and compares the economic net benefits with a simple financial analysis to inform investors. Access the study [here](#).



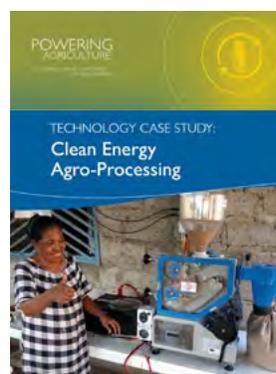
### 4.3 TECHNOLOGY

Powering Agriculture developed the following publications and videos that focus on the technology development aspect of integrating clean energy into the agriculture nexus:



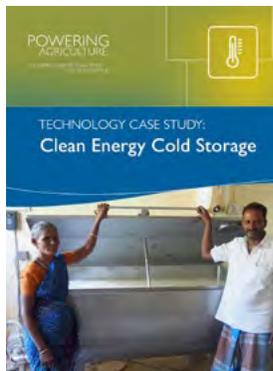
#### **Technology Case Study: Micro-Grids and Productive Agricultural Uses.**

This case study examines the mutually beneficial relationship between micro-grids and agricultural production, highlighting how the stimulation of productive agricultural electricity loads can increase micro-utility revenue and create a stronger financial argument for the deployment of micro-grids into unelectrified rural areas. It draws on lessons learned from Powering Agriculture innovators developing micro-grids around the world in addition to literature focusing on micro-grids' use of productive power. Access the case study [here](#).

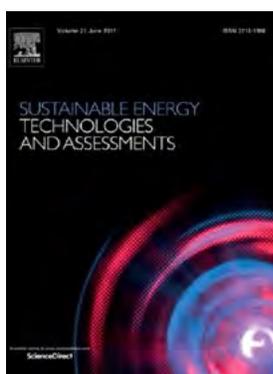


#### **Technology Case Study: Clean Energy Agro-Processing.**

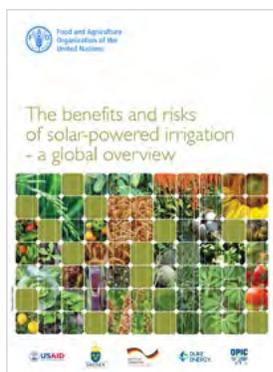
A significant portion of agricultural products undergo some degree of transformation between harvest and final use. Processes such as milling, grinding, grating, and drying help preserve agricultural products and add value to them. However, many smallholder farmers, who grow crops on less than two hectares, perform this work by hand, which is both time-intensive and produces products of lower quality than machine-processed products. Conventional large-scale processing technology powered by diesel, gasoline, or large AC motors is often too large for the small quantities of crops that smallholder farmers periodically bring for processing. This inefficient system presents a market opportunity for small-scale, decentralized, low-power agro-processing equipment. When powered by solar or other RE sources, processing machinery can operate in areas with poor or no access to grid power and provide cleaner, more environmentally friendly operations. This case study discusses both challenges and opportunities for small-scale, low-powered agro-processing, drawing on lessons learned from PAEGC innovators, and makes recommendations to serve these small markets. Access the case study [here](#).



**Technology Case Study: Cold Storage.** This case study presents how many technology providers are bringing clean energy-powered cold storage technologies to developing agricultural communities, the challenges faced by several PAEGC cold storage technology providers, and recommendations for donors and technology providers who wish to promote future deployment of cold storage technologies to these developing communities. Access the case study [here](#).



**Increasing Productivity through Irrigation: Problems and Solutions Implemented in Africa and Asia.** Powering Agriculture published this paper in the *Special Issue on Energy and Food Security in a Humanitarian Context, Journal of Sustainable Energy Technologies and Assessments*. The paper presents three major problems inhibiting the spread of irrigation in areas where agricultural productivity heavily depends on rainfall: lack of access to water, lack of access to energy, and lack of access to finance. It discusses how these problems are interconnected, complicating the use of technological solutions addressing them, and analyzes several solar irrigation approaches supported under Powering Agriculture that are tackling these problems in Asia and Africa. Access the abstract [here](#).



**The Benefits and Risks of Solar-Powered Irrigation – A Global Overview.** Powering Agriculture Partner GIZ and the FAO joined forces to analyze the evolution and current challenges of SPIS. To understand how different countries promote and manage SPIS, the study presents one North American state and six country profiles (California, India, Kenya, Mexico, Morocco, Nepal, and Senegal). It presents recommendations for further research and development, capacity-building, and structural support needed for greater uptake of solar irrigation worldwide. Access the study [here](#).

## 4.4 FINANCING

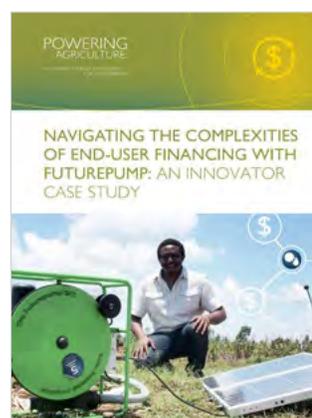
Powering Agriculture has released the following publications on the options for, experiences with, and challenges of financing clean energy-agriculture technologies:

**Access to Financing for Early-Stage Innovators in the Clean Energy-Agriculture Nexus.** This 35-page publication seeks to answer the following questions: What is preventing early-stage innovators from accessing private capital and follow-up funding, and what kind of support would prepare companies to obtain capital? Powering Agriculture drew upon existing literature and interviews with key clean energy-agriculture nexus stakeholders to identify the barriers early-stage innovators face in securing funding, understand the direct impact of those barriers to financing on their development, and provide recommendations to overcome them. Access the publication [here](#).



### **End-User Financing: Lessons Learned from Futurepump's Experience.**

Perhaps the most critical part of any company's success is having customers who not only want the services and products it offers but are also able to pay for them. Developed to accompany Powering Agriculture's *Access to Financing for Early-Stage Innovators in the Clean Energy-Agriculture Nexus* publication, it shares key lessons learned from the end-user financing experiences of innovator Futurepump, which may help future innovators seeking solutions for end-user financing of productive use assets in emerging markets. Access the case study [here](#).



**A Powering Agriculture Guide on Financing Types for Innovators.** Powering Agriculture created this handy financing guide for innovators. It presents an overview of the most common funding options, including grants, debt, and equity, along with a snapshot of emerging alternative forms of financing. The innovators supported by the Grand Challenge, and many others like them, are working on high-impact innovations that will require external capital to validate the technology, build and manufacture their product, reach customers, and ultimately scale before they can become self-sustaining. The type of external capital that a company can obtain depends on many factors including legal structure, mutual fit with the funder profile, stage of innovation, market opportunity, and return potential. The ability to navigate this complex landscape while maintaining a healthy capital structure is vital to the ultimate success of a venture. Access the guide [here](#).



## 4.5 POLICY

Powering Agriculture developed the following publications focused on the policy and regulatory challenges of innovating in the clean energy-agriculture nexus:

**Navigating Policy and Regulation in the Clean Energy-Agriculture Nexus.** This guide is designed to empower entrepreneurs and advocacy associations involved in clean energy-based water pumping, cold storage, and agricultural processing to start or continue a dialogue with policymakers and major donors to develop policies and programs that will enable the sector to grow and deliver transformative services to communities. The guide compiles experiences from innovators supported by PAEGC that deliver clean energy services for water pumping, cooling, and agro-processing, as well as from other companies working in this space. It is based on interviews with over 30 entrepreneurs, donors, and stakeholders based in sub-Saharan Africa, Latin America, and South Asia. Access the guide [here](#).



**Policy Briefs on Costs and Benefits of Clean Energy Technologies.** These six briefs on different value chains in Tanzania, Kenya, Tunisia, and the Philippines summarize policy recommendations from the GIZ and FAO study "Investing in Sustainable Energy Technologies for the Agri-food Sector." The briefs focus on the milk, vegetable, and rice value chains. Technologies analyzed range from milk chillers and coolers to biogas digesters for power generation, as well as solar cold storage and water pumping. Access the briefs [here](#).



## 4.6 GENDER

Originally published in June 2017, Powering Agriculture’s suite of six guides focuses on integrating gender into the development and deployment of clean energy solution for the agricultural sector to assist innovators and better reach and serve women—a large, important, and often overlooked market segment. Each guide highlights a specific topic and includes checklists or questionnaires to assist the reader in evaluating and improving the role of gender in their product design and deployment processes.

They were presented to a selection of USAID gender specialists in November 2017 and featured in a Power Africa blog on World Food Day. Following this, they were used by Power Africa transaction advisors in assisting off-grid energy companies. A full listing of the guides is provided below.

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### **Integrating Gender in the Deployment of Clean Energy Solutions**

**for Agriculture.** The insights contained in this document will help unlock the potential demand for a clean energy solution (CES) among women farmers in particular, who have been under-targeted and underserved. It will also provide best practices on how to integrate gender at all levels: individual, community, and within CES organizations. The guide includes a checklist that can help in developing a gender-responsive strategy to increase the sales of CES technology to both female and male clients. Access the guide [here](#).



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**Gender Responsive Product Development.** Ensuring that a clean energy solution’s product development process encompasses both male and female perspectives is good for business. There are five stages to the product development process; each stage has unique gender considerations. This guide describes these stages and points out gender consideration strategies that can be applied to each. It also includes a useful checklist that will help in the design of a gender-responsive product development process. Access the guide [here](#).



**Integrating Gender in the Financing of Clean Energy Solutions.** Women make up nearly half of the agricultural labor force in developing countries. However, access to financing continues to be a challenge for women. In most countries, the share of female smallholders who can access credit is five to ten percent lower than for male smallholders. Unlocking demand for a technology at relatively low risk can be accomplished by developing and facilitating access to gender-responsive financial products via partnerships with existing financial institutions or in-house programs. The guide also includes a checklist that can be helpful in developing a portfolio of appropriate financial products and services to increase the sales of CES technology to both female and male clients. Access the guide [here](#).



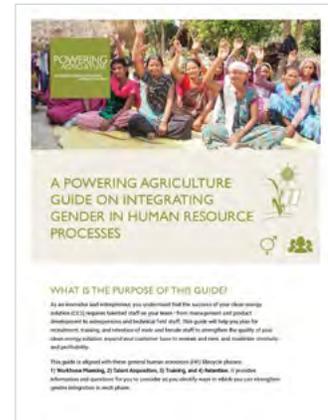
**Integrating Gender in the Marketing of Clean Energy Solutions to Agricultural Users.** This guide will help in developing a marketing approach that encompasses both female and male users and is based on international best practices in gender-responsive marketing. Gender analysis, communication, accessibility, and ease of use are all discussed. The guide includes a practical checklist that will help assess the extent to which marketing strategies effectively target and reach both male and female clients. Access the guide [here](#).



**Integrating Gender in Monitoring and Evaluation of Clean Energy Solutions.** This guide outlines why integrating gender into M&E makes good commercial sense, and the best practices for integrating gender into the M&E of a clean energy solution. Collecting good data is only the beginning—using data about how a CES technology is positively impacting the quality of life, well-being, incomes, and productivity for male and female farmers, as well as small- and medium-sized enterprises, can be powerful and profitable. The guide includes an illustrative list of gender-descriptive indicators to assess the impact of a CES on women and men. Access the guide [here](#).



**Integrating Gender in Human Resource Processes.** Women account for a large share of the global consumer market and drive many purchasing decisions within households—including in the agricultural sector in developing countries. To reach this crucial segment, women need to be included in product development, marketing, and sales, and on management and technical teams. This guide aligns with four general human resources life cycle phases—workforce planning, talent acquisition, training, and retention—and provides information and questions to be considered when identifying ways in which gender integration can be strengthened in each phase. Access the guide [here](#).



#### 4.7 LESSONS LEARNED

This section presents key takeaways observed during the development of knowledge products under Powering Agriculture.

##### **Conceptualize the types of knowledge products to be produced at the inception of the program.**

This allows for early identification of key messages to be conveyed, types of data to be collected, target audiences, and the formats of the knowledge products. Upfront planning ensures the development of each product is adequately scoped and resourced. Addition of new priorities mid-stream is difficult to manage, though a certain amount of flexibility should be expected to include emerging trends and insights.

##### **Experience has shown that different formats are necessary to reach various target groups.**

Studies, for example, have proven to be very informative; however, some audiences struggle with the academic language and an abundance of information. More comprehensive formats (such as infographics, videos, or fact sheets) are beneficial in transferring information in a more accessible and visually attractive manner.

**High-quality videos are a particularly effective instrument to reach audiences** online through social media platforms and program websites. Producing videos can be costly, so they must be well-conceived and budgeted for early.

##### **Each knowledge product needs to have a clear dissemination strategy and a mechanism to monitor each product's reach, use, and impact.**

Preparing a publication which sits on a website is insufficient, and should be accompanied by a plan for promotion through various platforms, including e-blasts, social media webinar presentations, et cetera.

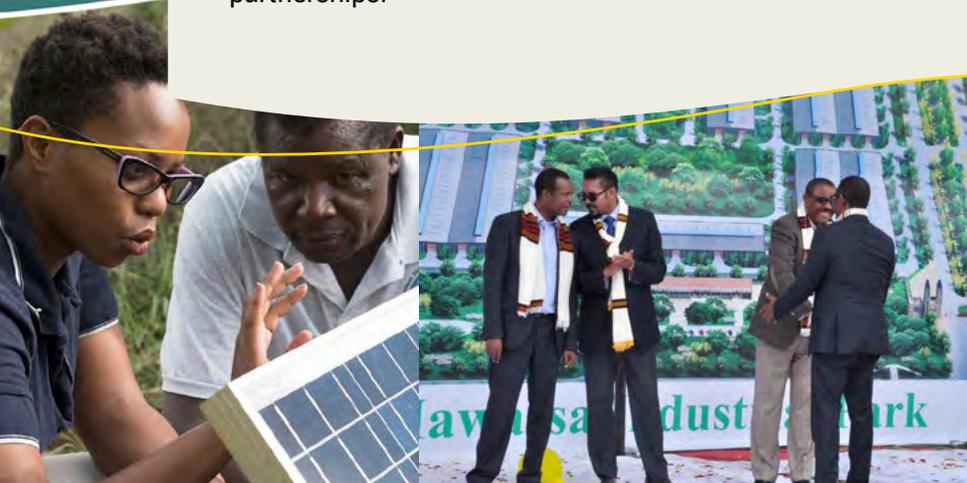
**Establish clear guidance on the branding and writing style** for all product types from the beginning of the production process to ensure a consistent look and feel.

**The data utilized in the knowledge products is only as good as the data collected** by the innovators and the Powering Agriculture Partners.

# POWERING AGRICULTURE

## 5. Mainstreaming and Scaling

One of Powering Agriculture’s goals was to draw attention to the importance of the clean energy-agriculture nexus and the critical role that it can play in increasing agricultural productivity. To achieve that goal, Powering Agriculture utilized its website and social media to conduct outreach, presented results at conferences, and delivered trainings. Powering Agriculture also further stimulated the uptake of clean energy-agricultural technologies through specific partnerships.



### 5.1 POWERING AGRICULTURE EAST AFRICA HUB

The Powering Agriculture East Africa Hub (the Hub) in Nairobi, Kenya was managed by Founding Partner GIZ to help catalyze the integration of clean energy within public-private partnerships, training programs, and other agricultural and energy programs. One of the Hub’s major activities focused on energy efficiency in the tea sector. In the framework of an integrated development partnership with

the private sector (a public-private partnership, or PPP), GIZ, the Ethical Tea Partnership (ETP), Bettys and Taylors of Harrogate, Mars Drinks, and Kenya’s largest tea producer—the Kenya Tea Development Agency (KTDA)—have been working together successfully since 2014. KTDA brings together 560,000 smallholder producers that are also shareholders of the tea factories. This means that any changes in the factories directly affect the smallholder producers. Other activities included the development and

implementation of plans to improve the energy efficiency of the 14 least performing factories, support to the most energy-efficient factories to strive for operational excellence, the installation of energy management systems in two factories, and a multi-stakeholder process to develop an ideal blueprint for an energy-efficient KTDA tea factory.

As part of this activity, two videos were produced to showcase the work of the Hub in the Kenyan tea sector, which employs 2.5 million people in the country and is susceptible to climate change. **The first video**, produced by Founding Partner GIZ, discusses the technical trainings, employee exchange trips, and technologies used to increase energy efficiency in tea factories. **The second video**, produced by Founding Partner USAID, revisits factories to showcase energy efficiency measures being implemented, provides updated impact numbers, and highlights the continued need for energy-efficient innovation for agricultural processing. **Six posters** were also created that highlighted energy efficiency measures in the different process of the Kenyan tea sector: heating, storing, withering, cutting, fermentation, and drying. The posters communicate the main behavioral changes needed throughout the supply chain.

The Hub also implemented several other activities to support the mainstreaming as described in Section 2.6 of Chapter 2, and the capacity building described in Section 5.3 below.

## 5.2 SCALING MARKETS FOR OFF-GRID AGRICULTURAL TECHNOLOGIES

To complement support given to individual innovators, in its final year Powering Agriculture explored ways to further stimulate the scale-up of markets for clean energy-agricultural technologies. A key challenge innovators face is overcoming the inertia inherent to early-stage markets. Because of low market awareness, technology developers must invest significant time and resources into educating both distributors and end users about the benefits of their technology. At the same time, both end users and distributors have low levels of trust for new technologies, and concerns about reliability and quality can impede uptake.

To address these barriers in the market for solar water pumps, Powering Agriculture provided support for the **2019 Global LEAP Awards + Results Based Financing** (Global LEAP+RBF) administered by CLASP, a leading international voice and resource for appliance energy efficiency policies and market acceleration initiatives. The group designs and facilitates RBF-based auctions across international markets with the goal of catalyzing the development of robust global markets for high-quality, efficient, and affordable appliances like solar water pumps and refrigeration units. To date, through its administration of two previous Global LEAP+RBF rounds, CLASP has supported the procurement of 12,000 off-grid fans and 240,492 off-grid refrigerators, television, and fan products in East Africa and Bangladesh.

The Powering Agriculture activity pre-qualifies solar water pumps via a rigorous testing process (the Global LEAP Awards) and enables distributors of these pumps to apply for bulk procurement incentives. The testing process

helps build confidence in pump performance and quality, while the bulk procurement incentives go toward reducing the higher costs distributors face when adding a new product to their line of offerings.

Three PAEGC solar water pumping innovators—Futurepump, KickStart International, and SunCulture—were pre-qualified through the 2019 Global Leap Awards for Solar Water Pumps and are eligible to receive support under the RBF mechanism. Additional information can be found in the Global LEAP Awards' [2019 Buyer's Guide for Solar Water Pumps](#).

Powering Agriculture contributed \$458,000 to the bulk procurement incentives for solar water pumps in Bangladesh, Kenya, Rwanda, Senegal, Tanzania, Uganda, and Zambia, leveraging an additional \$1.8 million from Energising Development (EnDev) for solar water pumps and off-grid refrigerators. Distributors in the aforementioned countries submit bids for incentive levels of up to 25 percent of the pump prices. This activity also leverages the SPIS Toolbox and consultants trained by GIZ under Powering Agriculture to educate distributors on potential environmental impacts related to water use, fertilizer, and land management.

As of December 31, 2019, through two bid windows issued by CLASP, Powering Agriculture has funded incentives allocated to 45 distributors to procure 2,714 solar water pump units approved for incentives funded by Powering Agriculture totaling \$240,703, which is nearly equal to the total number of pumps sold worldwide by GOGLA members in the first six months of 2019, as reported in GOGLA's most recent [Global Off-Grid Solar Market Report](#).

### 5.3 TRAINING

Powering Agriculture convened a variety of trainings to share technical knowledge and build competence among the clean energy-agriculture community.

**Training on the Toolbox on Solar-Powered Irrigation Systems.** The [Toolbox on Solar-Powered Irrigation Systems](#) (SPIS) gives advisors, service providers, and solar irrigation practitioners the tools they need to give broad, hands-on guidance to irrigation end-users, policymakers, and financiers. Available in English, Spanish, and French, the Toolbox includes modules with user-friendly calculations sheets, checklists, and guidelines as follows.

An [animated video](#) explains how to use the SPIS Toolbox to calculate a budget and to design, set up, and maintain a solar-powered irrigation system. And there are eleven [video tutorials](#) on SPIS financing, site selection, installation, sizing, operation, and maintenance of SPIS that guide any interested user through the tools and explain how they can be used based on a case study from Kenya. The clips visualize all aspects of SPIS with simple drawings and audio-visuals. To increase accessibility, selected clips are also available in Hindi and Bengali. In addition, three of the most commonly used tools are being turned into mobile applications, so that they can easily be accessed in the field.

With the translation of the Toolbox and the development of additional country case studies, the demand for trainings on the SPIS Toolbox has been growing. In 2019, five trainings were organized with the direct involvement of Powering Agriculture, either as an activity of other GIZ projects or in collaboration with the FAO. Other projects and organizations also

<a href="#">GET INFORMED</a>
<a href="#">PROMOTE &amp; INITIATE</a> <a href="#">SPIS Rapid Assessment Tool</a> <a href="#">Impact Assessment Tool</a>
<a href="#">SAFEGUARD WATER</a> <a href="#">Water Requirement Tool</a> <a href="#">Water Resource Management Checklist</a>
<a href="#">MARKET</a> <a href="#">Market Assessment Tool</a>
<a href="#">INVEST</a> <a href="#">Farm Analysis Tool</a> <a href="#">Payback Tool</a>
<a href="#">FINANCE</a> <a href="#">Finance Deployment Tool</a>
<a href="#">DESIGN</a> <a href="#">Site Data Collection Tool</a> <a href="#">SPIS Suitability Checklist</a> <a href="#">Pump Sizing Tool</a>
<a href="#">SET UP</a> <a href="#">PVP Acceptance Test</a> <a href="#">Workmanship Quality Checklist</a>
<a href="#">IRRIGATE</a> <a href="#">Soil Tool</a>
<a href="#">MAINTAIN</a> <a href="#">Maintenance Checklist</a> <a href="#">Water Application Uniformity Guide</a>

hosted trainings in consultation with Powering Agriculture such as the Regional Meeting of Green Innovation Centers in Malawi, the Water-Energy-Food Nexus project in Egypt, and the Institut National Agronomique de Tunisie.

The training modules have also been anchored in the continuous curricula of different training institutions and their courses (University of Ostfalia, Strathmore University), which demonstrates the demand for capacity development at the intersection of energy and agriculture. The modules' adoption by various training institutions is key to disseminating their contents in a sustainable manner.

In 2019, SPIS Toolbox trainings were delivered in four countries to 93 individuals:

Country	Men	Women
		
Kenya	29	4
Ghana	32	3
Tunisia	12	3
Uganda	22	10

In addition, four week-long Training of Trainer (ToT) courses were held with the aim of building up a pool of trainers:

Country	Men	Women
		
Kenya	5	7
Tunisia	11	6 (in French)
Mali	23	2 (in French)
Italy	9	3



All in all, more than 550 people were trained on solar-powered irrigation.

To gain practical experience, these trainers are later invited to co-lead a training on the SPIS Toolbox. If done satisfactorily, they can then be recruited as consulting trainers, helping Powering Agriculture to respond to the growing demand for trainings as well as to ensure continuity of trainings after the end of the project. For this purpose, the *Trainers Community on Solar Irrigation* was set up as an online platform, where information on upcoming trainings, training materials, and contact details can be shared. During the ToT workshop, participants are guided through the Toolbox, using practical exercises and site visits. They are also introduced to interactive training and communication methods.

In order to disseminate the Toolbox even further, the Powering Agriculture supported the development of an **online e-learning course** by University of Ostfalia and Margraf Publishers, that explained the planning, designing, and maintaining of SPIS to more than 150 participants from around the globe in both English and French.

**DIY Solar Cooling.** In Kenya, Germany, and Mali, technical trainings on the Do-It-Yourself (DIY) solar cooling units have been delivered to regional entrepreneurs, companies, and students. They received training on the design, production, and piloting of small- and medium-scale solar cooling systems. Nearly 150 people have been trained on the DIY approach. The interest reflects the need for technologies that can be manufactured and adapted locally instead of being imported from overseas.

**Powering Agriculture-Sustainable Energy for Food Massive Open Online Course (MOOC).** Powering Agriculture concluded a successful

massive open online course (MOOC) in Spring 2016. The contents were developed with the TH Köln–University of Applied Sciences (TH Köln), the FAO, the World Bank, the Center for Development Research at the University of Bonn, and Tetra Tech through PASTO. Nearly 1,700 participants from around the globe took part in the course and learned about the sustainable use of energy throughout agricultural value chains. With the large participant turnout, lively discussions, and thousands of comments, the MOOC achieved its main goals: creating awareness and providing knowledge on the clean energy-agriculture nexus.

The **MOOC platform**, including all materials and links, remains a publicly available resource. The **companion reader** for the MOOC is an online publication that covers climate change, energy input in agriculture value chains, RE sources and technologies, energy efficiency, policies and regulations, and business models for projects in the nexus.

**Scaling up the MOOC training to the Caribbean→ CaribOOC.** The strong interest in the Spring 2016 MOOC proved both the relevance of the topic and the power of massive open online learning. Based on the success of the inaugural course, the MOOC materials and case studies were modified for the Caribbean region. The course, named CaribOOC, was piloted in Spring 2017 with 40 participants. CaribOOC was conducted in partnership with the GIZ REETA (Renewable Energy and Energy Efficiency Technical Assistance) project, the GIZ Academy for International Cooperation, and the Inter-American Institute for Cooperation on Agriculture, with support from TH Köln and Universidad ISA in Santiago.

**Trainings on RE and Energy Efficiency in Agriculture.** GIZ, in cooperation with the Green Innovation Centres for the Agriculture and Food Sector (GIAE) under the One World - No Hunger initiative, developed and piloted an online introductory training, titled “Renewable Energy and Energy Efficiency in Agricultural Value Chains.” The training was part of a postgraduate course held at the Weihenstephan-Triesdorf University of Applied Sciences in Germany. Trainings on the same topic were held in English and French with GIAE in Feldafing, Germany. Nearly 70 participants have been trained on this topic.

**Powering Agriculture Hub Energy Efficiency Trainings and Audit Efforts.** A key activity of the Powering Agriculture Hub in Kenya implemented by GIZ concentrated on improving energy efficiency in the tea sector. Tea processing requires intensive energy input that is often costly and unsustainable. This presents an opportunity for significant energy saving. To tap this potential, GIZ joined forces with KTDA, ETP, Bettys and Taylors of Harrogate, and Mars Drinks to build capacity in energy efficiency in East Africa.

The focus of the partnership was on energy efficiency trainings for factory workers, engineers, and managers in 69 KTDA tea factories:



Specialized trainings on energy efficiency in the tea sector (electrical, mechanical, and operational aspects)



1,002 people (136 women)

*As a result of the energy efficiency training measures, there have been average reductions of 11 percent in electricity and ten percent in firewood consumption in each factory. Throughout the project term, savings have been roughly \$13.5 million in energy costs. These measures have also avoided the cutting of 1.35 million trees. Overall, nearly 12,000 tCO<sub>2</sub>e have been saved.*





### Study tour to Rwanda



11 men, no women

*During this study tour, KTDA staff learned about innovative technologies and operative approaches to optimize energy use in the factories.*

### Study tour to Finland



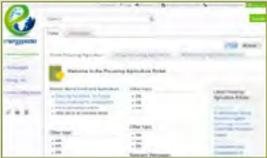
3 men, no women

*This study tour served to better understand which boiler technologies and fuelwood management practices are the most energy-efficient. While many of these technologies are more expensive, they will lead to significant energy cost savings in the long run.*

Additionally, energy efficiency activities are being implemented together with ETP in Sri Lanka and Indonesia. Based on the experiences in Kenya, training material was developed and rolled out in Indonesia to 43 men and two women participants from two factories.



TABLE 5.1 POWERING AGRICULTURE COMMUNICATION ACTIVITIES

Screenshot	Platform	Purpose	Contents	Reach
	Powering Agriculture website	Powering Agriculture's primary public website; communications and outreach for information dissemination about the program	Official documents; calls for proposals; outreach information (press releases, news articles, videos, event information); resources	239,932 total sessions 176,616 total users 482,996 total page views
	Powering Agriculture Portal on energypedia.info	Networking with experts; research; mutual knowledge exchange	Thematic pages; articles and reports; studies; event announcements	129,628 visits
	Powering Agriculture E-Newsletter	To raise awareness of Powering Agriculture, its activities and the successes of its innovators	News; success stories; event announcements	4,928 total contacts 16 total editions 31.24% average open rate <sup>4</sup> 14.91% average click-through rate <sup>5</sup>
	@PoweringAg Twitter account	To raise awareness of Powering Agriculture, its activities, and the successes of its innovators	News; event announcements	2,560 total tweets 3,462 total followers
	Powering Agriculture Facebook account	To raise awareness of Powering Agriculture, its activities and the successes of its innovators	News; event announcements; innovator promotion	410 total posts 3,178 total followers
	Powering Agriculture Dashboard	To inform senior management of the Founding Partners of programmatic and innovator updates	News; event announcements; resources	
	Powering Agriculture YouTube account	To raise awareness of Powering Agriculture, its activities and the successes of its innovators	Videos	57 total uploads 92 total subscribers

<sup>4</sup> As of December 2019, the Constant Contact overall average open rate was 13.94%. [https://knowledgebase.constantcontact.com/articles/KnowledgeBase/5409-average-industry-rates?lang=en\\_US](https://knowledgebase.constantcontact.com/articles/KnowledgeBase/5409-average-industry-rates?lang=en_US)

<sup>5</sup> As of December 2019, the Constant Contact overall average click-through rate was 6.86%. Ibid.

Powering Agriculture conducted media outreach during the first three years of the Grand Challenge resulting in over one hundred published stories highlighting the Powering Agriculture program or innovators. See below for a selection of these stories.



Credit: Gillian Willman/National Geographic

### **These Short Videos May Give You Hope About Climate Change**

**National Geographic**

EarthSpark International is featured in a group of six short and sweet stories about innovators—each recipients of funding from National Geographic's Great Energy Challenge—who are making a difference. Read the full story [here](#).



### **A Conversation With Praveen Penmetsa, CEO/Founder of Motivo Engineering**

**Forbes**

Praveen Penmetsa, CEO of Motivo Engineering, explains the transformational potential of Motivo's innovative solar-powered Harvest tractor in a recent Forbes interview. Farmers in remote areas will use this machine not only to work the fields, but to store and use power anywhere. Read the full story [here](#).



Credit: Financial Times

### **Kenyan Farmers Use SunCulture Solar Power to Help Water Dry Land**

**Financial Times**

SunCulture, a Powering Agriculture Innovator, was featured in the Financial Times recently! The story highlights Alice Migwi, a farmer who's seen her revenues grow ten percent in the three years she's used SunCulture's solar irrigation system. This has enabled her to expand and diversify her business. Read the full story [here](#).



Credit: Tim McDonnell for National Geographic

### **Could Climate Change Build Big Business in Kenya?**

**National Geographic**

Startups in Kenya offer tools like solar-powered irrigation pumps and all-natural pesticides, while nonprofits and banks improve access to such products with microloans and weather-based insurance. It's all part of a movement to equip Kenyan farmers with the tools they need to face global warming. Read the full story [here](#).



Photo: ETCIO.com

### **How Promethean Power Systems is revitalizing dairy farming industry**

**Economic Times of India**

Word is spreading about the transformative impact of Promethean's milk chiller technology. The company has sold over 500 milk chilling units to its dairy partners in India, Sri Lanka and Bangladesh. Retailers are also using Promethean's system for refrigerating produce. Read the full story [here](#).



Photo: ETCIO.com

### **Multi-Billion Dollar Africa-India Partnership Aims to Eradicate Energy Poverty**

**Thomson Reuters**

The area most ripe for immediate collaboration is solar irrigation, which is already scaling rapidly in India. Husk Power Systems, Futurepump and Claro Energy are building commercial bridges between the two regions. Read the full story [here](#).



Credit: Kariki

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### **Ecoligo launches new solar project on crowdfunding platform**

**PV Magazine**

Ariya Leasing, a subsidiary of Ariya Capital, Ltd., provides financing for solar power systems to businesses, with a special focus on the agricultural sector. Access to solar power will allow Bondet Farm to save on energy costs, and to operate with a reduced environmental impact. Read the full story [here](#).



Credit: Prism

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### **Disruptive Development**

**PV Magazine**

USAID is seeking out early-stage innovations that could be nurtured into self-sustaining ventures that improve the lives of millions. The agency is using science and technology in a robust way, engaging the world's brightest minds in the effort to solve our most pressing challenges. Read the full story [here](#).

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## **5.4 CONFERENCES**

Powering Agriculture hosted sessions and exhibited at the following conferences:

**Symposium Sustainable Food for Energy.** In order to develop an expert network together, Powering Agriculture, in cooperation with the German Development Institute, hosted a symposium on “Sustainable Energy for Food” on June 12, 2014 in Bonn with more than 90 participants from science, the private sector, civil society, and the development community.

**Global Forum for Innovations in Agriculture.** Powering Agriculture had a booth at this international showcase of innovations in sustainable agriculture held in Abu Dhabi, United Arab Emirates on March 9 and 10, 2015. The 2013 innovators each delivered a brief TED-style talk on their clean energy solution to the global audience in attendance.

**International Workshop on the Prospects for Solar-Powered Irrigation Systems in Developing Countries.** The overall goal of the workshop was to take stock of experiences and existing

tools and practices for the use of solar power for irrigation and to identify key challenges and constraints for the development of solar-powered water technologies in developing countries. The workshop was held on May 27-29, 2015 in Rome, Italy. It was organized by Powering Agriculture Partner GLZ, in partnership with the FAO.

**Ag Innovation Showcase.** Powering Agriculture was represented at the world's premier forum on the convergence of agriculture and technology held on September 14-16, 2015, St. Louis, Missouri, USA. 350 attendees from over 21 countries were in attendance including those seeking funding and markets for their technologies and those with money to invest in technologies that have the potential to address and improve the world's food system. Powering Agriculture was represented by SunDanzer's Mr. Brian Jensen and the Earth Institute at Columbia University's Dr. Vijay Modi who, along with then Powering Agriculture Program Manager Dr. Ryan Shelby, participated in a special content session focused on bringing agricultural technologies into new markets.



**Powering Agriculture Innovator Showcase (PAIS).** This half-day event was held on November 20, 2015 in Washington, D.C., USA, and was attended by 130 people. During the event, the 13 finalists comprising the Powering Agriculture 2015 innovator cohort were announced, followed by pitches and exhibits by Powering Agriculture’s 23 innovators, as well as speeches by Powering Agriculture Partners and a keynote speech from Jehiel Oliver, CEO of Hello Tractor. The showcase also served as the official launch of “Opportunities for Agri-food Chains to Become Energy-Smart,” a report co-authored by Powering Agriculture and the FAO. Dr. Alessandro Flammini, Natural Resources Officer for the FAO and one of the report’s primary authors, delivered remarks about the report and distributed copies to attendees. A **highlight video**, featuring interviews with Founding Partner organization representatives, innovators, and guest speakers discussing the Grand Challenge’s important role in supporting innovation, was produced.

**Agriculture Innovation Investment Summit.** On June 1 and 2, 2016, Powering Agriculture, along with the Securing Water for Food Grand Challenge and USAID’s Feed the Future Partnering for Innovation program, hosted the

first-ever Agriculture Innovation Investment Summit. The Summit, held in Washington, D.C., brought together nearly 60 innovators—including 14 representing Powering Agriculture, along with representatives from the investment community and development organizations. The two-day program included an Innovator Marketplace, a pitch competition, and TED-style talks from innovators, along with remarks from USAID Administrator Gayle Smith, BMZ’s One World – No Hunger Initiative Dr. Stefan Schmitz, One Acre Fund’s Tony Kalm, and the White House Office of Science and Technology’s Tom Kalil. Innovators who participated in the TED-style talks and pitch competition received support and feedback on the development of their presentations.



**The 16th National Conference of the National Council for Science and the Environment: “The Water-Energy-Food Nexus.”** Powering Agriculture was part of the Opportunities and Challenges in Integrated Food-Energy Systems panel and manned a booth that was visited by about 150 individuals over January 19–21, 2016 in Arlington, VA.

**Sustainable Energy for All Technical Workshop: “The Water-Energy-Food Nexus.”** The members of the Nexus High Impact Opportunity convened in Vienna Austria on February 22, 2016 and explored opportunities to operationalize the water-energy-food nexus in the context of the SDGs. Powering Agriculture shared its implementation experience within the clean energy-agriculture nexus.

**Intersolar.** The world’s leading exhibition for the solar industry held on June 22–26, 2016 in Munich, Germany attracted more than 1,077 expositors and about 43,000 visitors. Powering Agriculture presented the SPIS stocktaking study, manual, and toolkit, while 2015 Powering Agriculture innovator Village Infrastructure Angels presented their clean energy solution.

**Biogas Africa Forum.** This was a convening held in Nairobi, Kenya over July 11–13, 2016 for key stakeholders in the biogas value chain to discuss and exchange on “industrial size” biogas activities of private developers, policymakers, and development partners in sub-Saharan Africa. Powering Agriculture presented on its program, and Powering Agriculture innovator SimGas presented its clean energy solution and activities in East Africa.

**International Off-Grid Renewable Energy Conference.** At this global platform for sharing experiences and best practices about renewables held in Nairobi, Kenya over September 30–October 1, 2016. Powering Agriculture co-organized two side events with the International Renewable Energy Agency. The Powering Agriculture studies “Opportunities for Agri-Food Chains to become Energy-Smart”

and “Solar-Powered Irrigation Systems–Manual and Tools” were received with great interest by the audience. Powering Agriculture innovators SunCulture and Futurepump contributed to a panel discussing ecosystem requirements.

**VentureWell OPEN.** Powering Agriculture convened a panel titled “Lessons Learned by Early-Stage Clean Tech Innovators in Developing Countries.” The panel, which took place on March 24, 2017, was comprised of representatives from iDE, KickStart International, SunDanzer, and Powering Agriculture, and was moderated by Powering Agriculture’s Program Manager. Panelists shared insights and lessons learned in response to common challenges identified in the Powering Agriculture mid-term assessment of the 2013 innovators’ progress to date.

**Solar Milk Cooling Award for University Hohenheim at Intersolar.** In May 2017, GIZ, along with the University of Hohenheim and Phaesun, won an award at the annual Intersolar Conference held in Munich, Germany, in the category of outstanding solar projects. Phaesun specializes in the sale, installation, and operation of off-grid photovoltaics and wind energy systems. The award-winning system uses solar energy for cooling milk in Kenya and Tunisia. The concept maintains the cold chain for storage and transport of milk, which is particularly critical in off-grid regions. The project’s potential positive effects on society and the economy, as well as the favorable business case, won over the panel of judges.

**Solar Forum.** Can solar technologies help in the fight against hunger, climate change, and poverty all at once? Participants of the International Forum on Solar Technologies for Small-Scale Agriculture and Water Management discussed this and many other questions in Rome on April 12–13, 2018. 50 participants from governments, international organizations, NGOs, research institutes, financial institutions, and private companies from the water, energy, and agriculture sectors came together during the Solar Forum for a rewarding exchange. The event was jointly organized by the FAO and Powering Agriculture in collaboration with the International Fund for Agricultural Development, the International Water Management Institute, and the Research Program on Water, Land and Ecosystems. The Forum’s high-level opening session featured the official launch of the SPIS Toolbox and a study on “The Benefits and Risks of Solar-Powered Irrigation—A Global Overview,” jointly developed by GIZ and the FAO.

**Powering Agriculture Innovator Showcase.** During the showcase held on January 18, 2018 in Nairobi, Kenya, 21 Powering Agriculture innovators demonstrated their technologies to representatives of the government, donors, other programs, universities, and the general East African innovation community. Attendees received three million “venture shillings” upon arrival to invest in their favorite innovations. The three innovators with the most venture shillings received the chance to pitch to the whole audience on stage. The event also included a panel titled “The Importance of the Agriculture-Energy Nexus,” featuring four experts with diverse perspectives. A [highlight video](#) provides an overview of the event including the innovators explaining their innovations, experts

explaining the importance of the nexus, and remarks by the Partners.



**UNFCCC Climate Change Conference.** Powering Agriculture contributed to three Technical Expert Meetings at the United Nations Framework Convention on Climate Change (UNFCCC) Climate Change Conference in Bonn in 2019 with a focus on “Off-grid and decentralized energy solutions for smart energy and water use in the agri-food chain.” These sessions contributed to setting the agenda for the nexus as well as for the relevance of agriculture to climate change (mitigation and adaptation) by sharing sound practical experiences, concepts, and approaches, and sharing key information the delegates.

**Powering Agriculture Policy Round Table.** In September 2019, Powering Agriculture, in partnership with [GOGLA](#), convened the Powering Agriculture Policy Round Table in Nairobi, Kenya. The one-day event convened more than 30 representatives from private companies, various government agencies, donors, and

stakeholder organizations including regional RE associations, GOGLA, and **CLASP**. Participants engaged in an action-oriented discussion on policy and regulation challenges and solutions related to scaling the deployment of solar water pumping, cold storage, and agricultural processing technologies in East Africa.



**Social Capital Markets Conference.** In October 2019, Powering Agriculture held a series of activities at the annual Social Capital Markets Conference (**SOCAP**) in San Francisco, CA to mark the formal end of the Grand Challenge. One of the highlights was Powering Agriculture’s organization of the SOCAP 2019 Agri-business track along with ACDI/VOCA, AV Ventures (an ACDI/VOCA affiliate), Feed the Future Partnering for Innovation (implemented by Fintrac), Mercy Corps Social Venture Fund, and Village Capital. The track, titled “Unlocking The Investment Potential of Companies That Will Feed the Future” and featured Powering Agriculture innovators and implementing partners on various panels.



Dr. Augusta Abrahamse, USAID Program Manager for Powering Agriculture, delivers remarks during the SOCAP Sustainable Ag Track Networking Reception.

### **Evening Network Reception**

The Sustainable Ag Track Networking Reception was an opportunity to connect innovators, investors, entrepreneurs and partners in a relaxed environment.



Christina Tamer of VentureWell (L) and Jiten Ghelani of Promethean Power Systems (R) at the Powering Agriculture booth.

### **Powering Agriculture Booth**

As a Pitch Partner-level sponsor, Powering Agriculture hosted a booth in the main networking space at the conference. This offered program staff the opportunity to showcase the work of the Powering Agriculture innovators and offered a gathering place for innovators and partners to connect with one another.

**The 5th Global Science Conference on Climate-Smart Agriculture.** In October 2019 Powering Agriculture, together with the International Water Management Institute and CGIAR, organized a session on scaling solar based irrigation. The session's objectives were:

- Understanding technical innovations and financial instruments designed to ensure inclusive and equitable access to solar-powered irrigation;
- Understanding technical or institutional innovations to safeguard water resources while scaling solar-based irrigation;
- Exchanging challenges and opportunities resulting from scaling of integrated solar-based innovations in different contexts and across sectors; and
- Identifying key next research questions related to integrated on-off grid solar solutions to support agricultural transformation.

## 5.5 LESSONS LEARNED

This section details the lessons learned from mainstreaming and scaling efforts during the implementation of the Grand Challenge.

**As technologies mature, broader, less innovator-specific interventions may become more relevant.**

In the solar water pumping space, for instance, multiple Powering Agriculture innovators (as well as other entities) have grown from small-scale pilots to legitimate commercial entities. Approaches to support this growth and scale have also evolved. The work of the Hub on the SPIS Toolbox and related training of agriculture extension agents is creating important market awareness around solar water pumping. Powering Agriculture's support to Global LEAP+RBF is also proving to be an effective way to provide support to a range of market participants,

thereby catalyzing growth of the larger solar water pump market.

**The Hub's regional approach provided a counterpart** to the global focus of Powering Agriculture. It allowed for additional relationship-building with the innovators and in-country stakeholders.

**ToT workshops have proved to be a very effective approach to multiplying the impact** that a single workshop can have. Through hosting several training events, Powering Agriculture developed a cadre of trainers in Africa that built local capacity and understanding of solar-powered irrigation. The EETP has also used a ToT model to train select personnel of PAEGC innovators, who then deliver the training to their sales, vendor, and distributor networks.

**It is difficult to attract women for technical trainings** due to an underrepresentation of women in technical professions. An opportunity exists to improve gender integration by making a special effort to identify women working in the nexus and create a community similar to the **Women in African Power** group to target capacity-building efforts.

**Assessing the impact of trainings is challenging.** While it is important to understand how trainees use their learning or how they have incorporated it into their professional lives, collecting this data is difficult. Training implementers should develop a systematic approach to evaluate the impact of training before the training is provided. Johns Hopkins University is tracking the attendees of the EET and their activities for at least six months after the training to measure its effectiveness.

**Conference participation was very opportunistic** and spearheaded by different Powering Agriculture Partners. An integrated annual plan that identified events to be attended with desired outcomes, potential presenters and attendees, suggested materials to be distributed, and a defined follow-

up strategy would have allowed for better coordination among the Partners and increased the linkages between trainings on technical topics and PAEGC's knowledge products. This could have improved the exposure of Powering Agriculture and its activities.



# 6. Grand Challenge Governance

This section provides an overview of the Memorandum of Understanding through which the Grand Challenge was managed and financial information on Powering Agriculture's budget, contributions, and disbursements. Note that this chapter is confidential and limited for distribution only to the Powering Agriculture Partners.



## 6.1 GOVERNANCE OVERVIEW

The Partners signed a Memorandum of Understanding (MoU) in November 2013 that outlined their commitment to pool resources and the governance structure, the process for award selection and management, the approach to media, marketing and intellectual property, rules on confidentiality, non-disclosure, procurement, and technical evaluation committee member conflicts of interest. The MoU also detailed individual Partner

contributions and designated authorized points of contact.

The Founding Partners managed Powering Agriculture and its activities through a Steering Committee, consisting of a primary representative from each Founding Partner organization and chaired by USAID as the program administrator. The Steering Committee met in-person on an annual basis and quarterly via teleconference.

**TABLE 6.1 POWERING AGRICULTURE ANNUAL MEETINGS**

Date and Location	Key Outcomes
June 11 and 12, 2014 at the GIZ headquarters in Germany	Decisions on the structure of the second innovation call and support to awardees. Decisions on leadership roles for the different components of the Grand Challenge.
June 15 to 18, 2015 at the Sida headquarters in Sweden	The selection of the 21 finalists of the second innovation call for proposals. See the <a href="#">2015 Powering Agriculture Annual Report</a> for more detail.
June 1 to 3, 2016 at the USAID headquarters in the District of Columbia, USA	Expansion of business acceleration and gender integration technical assistance to all PAEGC innovators. See the <a href="#">2016 Powering Agriculture Annual Report</a> for more detail.
March 28 and 29, 2017 at the GIZ headquarters in Germany	The establishment of a financing facility via USAID’s GDA Annual Program Statement process which invites prospective partners to work side-by-side with USAID and other interested organizations to build transformational partnerships that foster and leverage market-based approaches to solve critical business and development challenges. See the <a href="#">2017 Powering Agriculture Annual Report</a> for more detail.
April 24-25, 2018 at the Sida headquarters in Sweden	Powering Agriculture will develop a final evaluation that focuses on outcomes and impacts. It will take a bottom-up perspective, understanding how the portfolio of innovators have achieved program-level results. See the <a href="#">2018 Powering Agriculture Annual Report</a> for more detail.
October 24 and 25, 2019 at the SOCAP Conference in California, USA	The gift agreement/MoU with the Partners concluded in December 2019, however there will be administrative extension for the remaining Powering Agriculture activities detailed in Chapter Seven.



# 7. Looking Forward

As Powering Agriculture ends its formal phase of implementation, a small number of innovator activities remain in progress. Four innovators will continue deployment into 2020 and select innovators will continue to participate in the Empowered Entrepreneur Training Program to build business skills, leadership, and personal agency using a train-the-trainers model. Additionally, CLASP will continue implementing the 2019 Global LEAP+RBF for bulk procurement of solar water pumps and the Powering Agriculture Investment Alliance will continue to catalyze investment in the clean energy-agriculture nexus through 2021. Powering Agriculture Partner GIZ will continue its work on energy efficiency in tea processing and capacity-building on solar-powered irrigation systems.

The emergence of the new coronavirus and resulting pandemic have suddenly and dramatically impacted Powering Agriculture companies and related activities. As of the writing of this report many of these impacts are still playing out, but some anticipated changes to ongoing activities are detailed below.



## 7.1 ONGOING INNOVATOR DEPLOYMENT

Four innovators are continuing project implementation into 2021 (due, in part, to delays related to the coronavirus-related):

Ariya Finergy, Futurepump, Husk Power Systems, and Universidad del Valle de Guatemala.

- Ariya Finergy has a project extension to June 30, 2021 to complete the following tasks:
  - Install another ten sites totaling 1.7 MW of installed solar capacity;
  - Staff training at 13 solar sites;
  - Completion of a revised business plan; and
  - Host a stakeholder workshop to gauge customer satisfaction.
- Futurepump has a project extension to July 31, 2021 to complete the following tasks:
  - Work plan for start-up after the coronavirus-related shutdown; and
  - Ship 2,200 solar water pumps to Kenya and make available for sale via a finance mechanism.
- Universidad del Valle de Guatemala has a project extension to September 30, 2020 to complete the following tasks:
  - Raise private investment for their first mini-grid site;
  - Build out solar array, remote integrated grid sub-station and balance-of-system components, distribution system, and home wiring;
  - Set up the payment process; and
  - Develop investment proposals for the second site.

- Husk Power Systems has a project extension to August 31, 2020 to complete the following tasks:
  - Construct and commission four mini-grid sites in Tanzania;
  - Conduct capacity training for staff and capacity-building for community members at four mini-grids in Tanzania;
  - Establish a legal subsidiary in Nigeria;
  - Build three mini-grid sites in Nigeria;
  - Conduct capacity training for staff and capacity-building for community members at three mini-grids in Nigeria; and
  - Conduct impact assessments for all ten sites in Tanzania and Nigeria.

## 7.2 FINANCING FACILITY INVESTMENT ACTIVITIES

Both AlphaMundi and FACTOR[e] will continue PAEGC Financing Facility activities into 2021. They are also seeking to adapt their strategies to support companies in their portfolio in overcoming challenges associated with the coronavirus-related pandemic.

- AlphaMundi will continue implementing its project until the end of its award with USAID on September 30, 2021. AlphaMundi will be working to deploy an additional \$430,000 in technical assistance and cash flow resilience grants in response to the coronavirus-related pandemic. It will mobilize an additional \$5 million in private investment by the end of the award and an additional \$13 million by 2023.
- FACTOR[e] will continue implementing its project until the end of its award with USAID on December 31, 2021. FACTOR[e] will be working to invest \$2.4 million of FACTOR[e] capital and mobilizing an additional \$3 million of non-FACTOR[e] investment in clean energy-agriculture nexus companies.

### **7.3 SCALING MARKETS FOR OFF-GRID AGRICULTURAL TECHNOLOGIES**

CLASP will continue implementing the 2019 Global LEAP+RBF for bulk procurement of solar water pumps with PAEGC's support. Though the contract currently ends on November 30, 2020, this may be extended due to the impact of the coronavirus-related pandemic. Three bid windows have already been opened to select distributors. These distributors will continue to pursue sales in seven countries: Bangladesh, Kenya, Rwanda, Senegal, Tanzania, Uganda, and Zambia. However, because of lockdowns and delays due to the coronavirus-related pandemic, many of these distributors are currently seeing major declines in sales. To help with these companies' immediate cash flow needs, PAEGC support will be shifted to provide funding immediately. CLASP will continue to verify orders, inventory, and end-user sales.

### **7.4 EMPOWERED ENTREPRENEUR TRAINING PROGRAM**

JHU will continue to implement the EETP for PAEGC innovators and other clean energy-agriculture companies. However, the timeline will likely be extended beyond the current activity end date of November 30, 2020 due to delays resulting from the coronavirus-related pandemic. Following its training for organizations based in East Africa in October 2019, JHU held a second training workshop for India-based organizations in February 2020 and is now supporting companies to complete their training certifications and roll out the trainings internally. Due to the coronavirus-related pandemic, most participating companies are delayed in undertaking these rollouts. The JHU team will work with these companies to conduct virtual refresher trainings and adapt the material to be responsive to the coronavirus-related pandemic, both in format and in content.



## 7.5 ETHICAL TEA PARTNERSHIP

Besides Kenya, where GIZ has been supporting activities to improve energy efficiency in tea processing for several years, Indonesia and Sri Lanka are globally important tea producers. In cooperation with ETP, GIZ will support energy audits in Indonesian tea factories. In Sri Lanka, a landscape plan and data gathering framework will be elaborated as basis for a comprehensive Carbon Neutral Tea strategy. GIZ and ETP will also support the development of a blueprint for a carbon neutral and energy-efficient tea factory, implement a high-impact communication strategy, and raise awareness of energy efficiency issues and solutions.

## 7.6 SOLAR-POWERED IRRIGATION SYSTEMS

In order to further strengthen the advisory capacity on SPIS, GIZ will continue working on the existing capacity building program. Face-to-face training will partly be transformed to webinars. A systematic approach on training and learning evaluation will allow GIZ to better track and evaluate the long-term impact of capacity building measures. A digital learning module on mobile devices will be piloted in Kenya in order to reach out to farmers interested in solar pumping. The development of further SPIS Toolbox apps will increase access to helpful tools.



## WATER AND ENERGY FOR FOOD

As Powering Agriculture ends its formal phase, several of the Powering Agriculture Partners are participating in a new Water and Energy for Food (“WE4F”) Grand Challenge. WE4F is a joint international initiative of BMZ, the Foreign Ministry of the Netherlands, Sida, and the U.S. Agency for International Development (USAID). WE4F aims to: increase food production along the value chain through a more sustainable and efficient usage of water and/or energy; increase income for base of the pyramid women and men in both rural and urban areas; sustainably scale innovators’ solutions to meet the challenges in the WE4F nexus; and promote climate and environmental resilience and biodiversity through the sustainable, holistic management of natural resources and ecosystems. The WE4F program will capitalize on lessons learned from PAEGC and incorporate PAEGC’s Regional Innovation Hub (RIH) model. WE4F will also work with promising innovations that were identified and nurtured during the PAEGC to support their next level of scaling. At the same time, the program will open up new calls for innovations within the water-agriculture-food nexus.

# Appendix A.

## FRAMEWORK USED TO ASSESS POWERING AGRICULTURE INNOVATOR PROGRESS

The following is an extract from the **Venture Development Framework** that describes the development of science- and technology-based ventures at the very earliest stages of commercialization. It is focused primarily on a trajectory for for-profit ventures that will likely seek equity investments. It describes venture development along six dimensions.

Dimension of the Venture Development Framework	Key Questions	Definitions of Steps
<b>Team and Venture Structures</b>	<p>To what extent is there clear / formal team leadership?</p> <p>To what extent is there a team with the necessary knowledge/skills and processes for working together?</p> <p>How “formal” is the venture (incorporated entity, founders’ agreement, cap table, paid employees, board of directors)?</p>	<p><b>Step 1:</b> There are one or two people working to solve a problem they are passionate about or a grant-backed research project. Nothing to signal this is a “venture.”</p> <p><b>Step 2:</b> Team can clearly articulate their goals for their technology and has begun considering paths to market.</p> <p><b>Step 3:</b> Team is clearly interested in pursuing business/entrepreneurship as a means to getting their technology into the world.</p> <p><b>Step 4:</b> Team has agreed on the path to commercialization. Team has identified knowledge/skill gaps and thought about team dynamics issues. Team has informal ways of working together.</p> <p><b>Step 5:</b> Team has provisional team lead. Team members spend necessary time on venture. Team has technical and business skills. Team has implemented a few formalized processes for working together.</p> <p><b>Step 6:</b> Team has team leader in full-time capacity. Team can clearly articulate to third party why they are moving ahead.</p> <p><b>Step 7:</b> Venture has been incorporated. Full time CEO. Team has clear, formalized processes for working together (e.g., a project management system, written expectations for communication, and processes for making decisions). Team has founders’ agreement and document specifying roles.</p> <p><b>Step 8:</b> Team has cap table.</p> <p><b>Step 9:</b> Team has begun to hire initial employees. Team has identified potential board of directors.</p> <p><b>Step 10:</b> Team has several employees. Founders draw salary. Team has active and functioning board of directors.</p>

Dimension of the Venture Development Framework	Key Questions	Definitions of Steps
<b>Market</b>	<p>How well does the team understand the market? How deeply have they engaged with customers and stakeholders?</p> <p>How strong is the team's value proposition?</p> <p>To what extent does the team have proof of customer interest (e.g., letters of intent, pilot partner, sales)?</p>	<p><b>Step 1:</b> Team is team is aware of a societal or technical problem/ challenge that its technology may address.</p> <p><b>Step 2:</b> Team has identified use cases for the technology, grouped customers into market segments, and begun to analyze alternative markets.</p> <p><b>Step 3:</b> Team can describe key partners and competitors in the market, understands the dynamics of the problem its technology will solve, and can articulate why its technology is superior to alternative products (problem-solution fit).</p> <p><b>Step 4:</b> Team can identify the specific market (who and how the technology will be used) and articulate a clear business thesis and an initial value proposition.</p> <p><b>Step 5:</b> Team can articulate the size of the market segment and the value chain in which it is operating. Team has engaged with customers/ stakeholders to verify and iterate upon value proposition.</p> <p><b>Step 6:</b> Team has completed market testing with multiple customers/ stakeholder groups in the value chain to validate the technology's basic market assumptions.</p> <p><b>Step 7:</b> Team has a deep understanding of its chosen market sector. Team has proof of customer interest (e.g., potential customers have provided letters of intent or shared resources or validating the technology).</p> <p><b>Step 8:</b> Team has documented a compelling, clear, and accessible market opportunity.</p> <p><b>Step 9:</b> Team has tested and vetted all of the business model assumptions. Lessons learned are reflected in financial model and sales strategy. There is proof of customer interest, such as early sales, contracts, or commitments.</p> <p><b>Step 10:</b> There is a repeatable, scalable, and/or recurring sales pipeline. Team has validated its business model and growth strategy through earning revenue and demonstrating a path to profitability.</p>

Dimension of the Venture Development Framework	Key Questions	Definitions of Steps
<p><b>Business Model</b></p>	<p>To what extent has the team identified a path to market?</p> <p>To what extent has the team developed and tested the business model?</p> <p>To what extent does the team have proof of customer interest (e.g., sales, commitments, sales pipeline)?</p>	<p><b>Step 1:</b> Team has a desire to move the technology into the world but no/limited sense of how to do it or what options exist.</p> <p><b>Step 2:</b> Team has considered various pathways to market and the needs and perspective of potential customers.</p> <p><b>Step 3:</b> Team has identified a pathway to market and has a sense of the pros and cons involved with pursuing the chosen pathway.</p> <p><b>Step 4:</b> Team can describe possible revenue streams, how its competitive position impacts its goals for development of the technology, and potential alignment with a market opportunity.</p> <p><b>Step 5:</b> Team can describe the customer base willing to pay to solve the problem they have identified (conceptual product-market fit).</p> <p><b>Step 6:</b> Team has developed a draft business model.</p> <p><b>Step 7:</b> Team has conducted a cost of “goods sold” analysis and vetted unit economics, value chain economics, and other key financial assumptions.</p> <p><b>Step 8:</b> Team has validated components of the business model. Team has built an initial financial model and financial packet, including bottom-up sales projections and a customer acquisition/demand generation strategy.</p> <p><b>Step 9:</b> Team has tested and vetted all the business model assumptions. Lessons learned are reflected in the financial model and sales strategy. There is proof of customer interest, such as early sales, contracts, or commitments.</p> <p><b>Step 10:</b> There is a repeatable, scalable, and/or recurring sales pipeline. Team has validated its business model and growth strategy through earning revenue and demonstrating a path to profitability.</p>

Dimension of the Venture Development Framework	Key Questions	Definitions of Steps
<p><b>Resources</b></p>	<p>To what extent has the team developed all of the necessary relationships (e.g., mentors/advisors, technical experts, suppliers, funders, regulatory experts)?</p> <p>How much and from what sources (grants, angel/seed) has the team secured financial resources?</p> <p>To what extent does the team company have a clear fundraising strategy? To what extent do they have the necessary financial resources to move the venture forward?</p>	<p><b>Stage 1:</b> Team is self-funded/volunteer-based or funded through academic/fundamental research grant. Grant-backed teams may have advisors or partners.</p> <p><b>Step 2:</b> Team understands the resources needed to bring a technology to market and has generated ideas for where it might find financial, infrastructural, or intellectual/expert support.</p> <p><b>Step 3:</b> Team may be funded through academic research grants, pitch competition awards, and/or friends and family. The team has secured initial advisors.</p> <p><b>Step 4:</b> Team can identify the type(s) of funding/resources needed for its desired pathway to market. Team can articulate the types of experts/strategic partners it needs and has begun to develop key relationships.</p> <p><b>Step 5:</b> The team is likely supported by grants. Team has a basic understanding of the types of funders that can support the venture. Team has secured the necessary relationships to support the development of the technology, including institutional support for product development and a technical/medical advisory board.</p> <p><b>Step 6:</b> Team has strengthened external relationships and understands key concepts (potential suppliers, regulatory requirements for financing, milestones funders expect, processes for engaging funders) that can help secure funding and other resources.</p> <p><b>Step 7:</b> Team has secured at least some outside, non-dilutive funding. The team intends to pursue equity funding within the next 6-12 months.</p> <p><b>Step 8:</b> Team has a well-developed fundraising strategy with milestones and has completed key deliverables needed to raise funding. Team has a financial plan, which includes a cash flow forecast, a high-level income statement. and a balance sheet.</p> <p><b>Step 9:</b> Team has secured an initial round of angel or seed funding and is launched into early commercial phase.</p> <p><b>Step 10:</b> Team has secured the funding needed (from whatever sources) for a year's worth of operations.</p>

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