ABOUT PAEGC

In 2012, The United States Agency for International Development (USAID), the Government of Sweden (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 PAEGC is to support new and sustainable approaches to accelerate the development and deployment of clean energy solutions for increasing agriculture productivity and/or value for farmers and agribusinesses in developing countries and emerging regions that lack access to reliable, affordable clean energy.

PAEGC utilizes the financial and technical resources of its Founding Partners to support its Innovator cohort’s implementation of clean energy technologies and business models that: (i) Enhance agricultural yields/productivity; (ii) Decrease post-harvest loss; (iii) Improve farmer and agribusiness income generating opportunities and revenues; and/or (iv) Increase energy efficiency and associated savings within the operations of farms and agribusinesses - while stimulating low carbon economic growth within the agriculture sector of developing countries and emerging regions.

For more information, visit PoweringAg.org
As Program Manager, I am pleased to share with you latest annual report for the Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) initiative.

Powering Agriculture plays a key role in expanding the Founding Partners’ collective efforts in support of energy and climate-smart agriculture in emerging regions. The activities undertaken by Powering Agriculture are designed to address global concerns about food insecurity and the prominent demand for fossil fuels within the energy-ag nexus.

It is my firm belief that the innovations in technology, business models, and community engagement strategies that Powering Agriculture is supporting will lead to the expansion of climate and clean energy solutions beyond the domain of think tanks and into the hands of the women’s groups, ordinary citizens, farmers, homemakers, and agribusinesses that need them.

I hope that this report excites you about the work of Powering Agriculture and encourages you to join in the collective efforts of the Founding Partners to provide reliable, affordable clean energy to farmers and agribusinesses in emerging regions.

Finally, I want to extend my sincere appreciation to all who worked so hard to support Powering Agriculture and to measure our progress. Behind every data verification call, communication outreach campaign, and site visit is a team of talented and dedicated professionals that are helping to ending extreme poverty and promote sustainable global growth.

Sincerely,

Dr. Ryan Shelby
Senior Energy Engineering Advisor
Program Manager, Powering Agriculture: An Energy Grand Challenge for Development
United States Agency for International Development (USAID)
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EXECUTIVE SUMMARY

This annual report describes the key activities of Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) implemented over the financial year period of October 2014 to September 2015.

Powering Agriculture: An Energy Grand Challenge for Development represents a partnership of the United States Agency for International Development with the Government of Sweden, the Government of Germany, Duke Energy Corporation, and the Overseas Private Investment Corporation. It was launched in 2012 with the goal to support new and sustainable approaches to accelerate the development and deployment of clean energy solutions for increasing agriculture productivity and/or value in developing countries. Powering Agriculture will:

• Support clean energy technology and business model innovations for agriculture.

• Ensure that financial intermediaries have the capital they need to help organizations scale their innovations and reach the farmers and farm-related businesses that need these technologies.

• Develop partnerships with public and private sector organizations that want to support the goals of the Powering Agriculture program.

• Serve as a clean energy and agricultural information resource for people around the world.

Some of the main activities that were implemented during the reporting year period include:

• The launch of the second global innovation call resulting in 871 concept note submissions from 99 countries and the selection of 13 winners who will work in 9 countries.

• Preparation of a report in conjunction with the Food and Agriculture Organization of the United Nations (FAO) focused on the energy needs, at all stages, along selected agri-food value chains. The report gives recommendations on how these value chains may become more energy smart by employing clean energy solutions.

• Ongoing public awareness raising activities, including the launch of a newly designed www.poweringag.org website, the increased dissemination of the quarterly e-newsletter, the Twitter presence, articles in leading publications, and sessions and exhibitions at several conferences.

• The launch of the Powering Agriculture Xcelerator (PAX) Program to provide Innovators with biz-tech development services, investment, and market partnership facilitation. The PAX Program is designed to help PAEGC Innovators advance their product or service more efficiently and effectively toward impact and scale.
In the next financial year (October 2015 to September 2016), Powering Agriculture expects to implement the following major items:

- Convene a week-long training acceleration workshop for its Innovators in November 2015, ending with the Powering Agriculture Innovators Showcase (PAIS) at which the 2015 Innovator Cohort will be formally announced.

- Launch an 8-week, free Massive Open Online Course over February 1 to March 27, 2016, to introduce challenges and solutions for sustainable energy use in the agriculture and food industry.

- Participate in various conferences such as the National Council for Science and the Environment’s 2016 Food-Energy-Water Nexus conference from January 19 to 21, 2016, in Arlington, Virginia, USA.

- Continue its work on “Opportunities for Agri-food Chains to become Energy-Smart” with a follow-up study to assess the specific financial and economic implications of the identified energy technologies in the agri-food sector, the technology suitability for a specific development context, the actual return on investment expected, as well as the enabling conditions and policies needed to trigger the much sought pro-poor investments in the sector with regard to clean energy solutions.

- Undertake site visits, document review, and follow-up phone calls to verify the performance indicator data submitted by 2013 Innovators in order to verify the impact of the clean energy solutions as their awards come to a close in FY2016.
# ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>BAA</td>
<td>Broad Agency Announcement</td>
</tr>
<tr>
<td>BMZ</td>
<td>German Federal Ministry for Economic Cooperation and Development</td>
</tr>
<tr>
<td>CIS</td>
<td>Clean Irrigation Solution</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>GCD</td>
<td>Grand Challenges for Development</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH</td>
</tr>
<tr>
<td>HARVEST</td>
<td>Hybrid Agriculture/Road Vehicles with Electricity Storage and Transformation</td>
</tr>
<tr>
<td>MOOC</td>
<td>Massive Open Online Course</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>OPIC</td>
<td>Overseas Private Investment Corporation</td>
</tr>
<tr>
<td>PAEGC</td>
<td>Powering Agriculture: An Energy Grand Challenge for Development</td>
</tr>
<tr>
<td>PAIS</td>
<td>Powering Agriculture Innovator Showcase</td>
</tr>
<tr>
<td>PARRB</td>
<td>Powering Agriculture Requests and Reminders Bulletin</td>
</tr>
<tr>
<td>PASTO</td>
<td>Powering Agriculture Support Task Order</td>
</tr>
<tr>
<td>PAX</td>
<td>Powering Agriculture Xcelerator</td>
</tr>
<tr>
<td>PV</td>
<td>Photovoltaic</td>
</tr>
<tr>
<td>PVR</td>
<td>Photovoltaic refrigerator</td>
</tr>
<tr>
<td>Sida</td>
<td>Swedish International Development Cooperation Agency</td>
</tr>
<tr>
<td>SNNPR</td>
<td>Southern Nations, Nationalities, and Peoples' Region</td>
</tr>
<tr>
<td>UGARF</td>
<td>University of Georgia Research Foundation</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>VIP</td>
<td>Village Industrial Power</td>
</tr>
<tr>
<td>WCA</td>
<td>West and Central Africa</td>
</tr>
</tbody>
</table>
INTRODUCTION

This annual report describes the key activities of Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) implemented over the period of October 2014 to September 2015.

The Powering Agriculture: An Energy Grand Challenge for Development initiative represents a partnership of the United States Agency for International Development (USAID) with the Government of Sweden, the Government of Germany, Duke Energy Corporation, and the Overseas Private Investment Corporation (OPIC); collectively known as the ‘Founding Partners’. The goal of Powering Agriculture is to support new and sustainable approaches to accelerate the development and deployment of clean energy solutions for increasing agriculture productivity and/or value in developing countries.

Powering Agriculture contributes to the 2030 Agenda for Sustainable Development by supporting the following goals: 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), and SDG 17 (Partnerships for the Goals).

Powering Agriculture follows the Grand Challenges for Development (GCD) model which focuses on defining problems, identifying constraints, and providing evidence-based analysis for a variety of development issues. The Grand Challenges for Development initiative is rooted

---

1 In the context of PAEGC, the term ‘clean energy’ is defined as: usable energy (i.e., electricity, illumination, heating/refrigeration, mechanization) that is derived from renewable sources and supports a reduction in fossil fuel use, increase in efficiency, and/or limitation of greenhouse gas emissions. Clean energy sources include solar, hydro, wind, geothermal, sustainably harvested biomass, and biogas. The term ‘clean energy solution’ is defined as: a combination of appropriate technology and business model that addresses the clean energy demands of a select market.
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
Throughout developing countries, agriculture remains the most prominent source of livelihood for most households. As our population expands, farms and agribusiness will need to produce, process, and transport an increasing amount of food. The Food and Agriculture Organization of the United Nations (FAO) estimates that at least 70% more food will need to be produced on the same amount of agricultural land. Identifying means by which clean energy technology can be used to intensify agricultural production will be crucial in meeting this demand.

Increasing the agricultural sector's access to clean energy and efficiency technologies will enable farmers to mechanize their operations, add value to commodities through processing, and store fresh produce in refrigerated containers to extend its shelflife.

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.

Unfortunately, significant barriers exist that hinder the integration of clean energy technology in agriculture development:

- Farmers are not aware of the variety of new technologies that may be appropriate for them.
- Clean energy technologies are relatively new, therefore farmers have limited access to distributors for installation, parts, and service.
- Farmers often do not have the means to cover 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.
- Farmers are not aware of the economic and environmental benefits of the technology, and therefore demand for clean energy technology is low.
- The client base of agricultural communities is remote, scattered, and often very poor;
- There are few examples of successful business models that have been effective in delivering clean energy solutions to the agriculture sector in developing countries.
These issues create an unproductive cycle in which suppliers and buyers are not connected, and farmers and agribusinesses are unable to leverage more cost-effective clean energy technologies. Strengthening the links between modern energy service providers and the agriculture sector will create positive feedback loops to increase productivity along major components of the agricultural supply chain: (1) on-farm productivity; (2) cold storage; (3) transport; (4) post-harvest agriculture processing; and (5) agriculture waste for energy applications.

1.2 The Solution
In order to solve the challenges described above in section 1.1, Powering Agriculture was launched in 2012 to:

- support clean energy technology and business model innovations for agriculture;
- ensure that financial intermediaries have the capital they need to help organizations scale their innovations and reach the farmers and farm-related businesses that need these technologies;
- develop partnerships with public and private sector organizations that want to support the goals of the Powering Agriculture program; and
- serve as a clean energy and agricultural information resource for people around the world.

The activities of Powering Agriculture will run through 2019.
1.3 The Work of Powering Agriculture
Powering Agriculture's programmatic interventions are grouped under the following four Technical Components (Figure 1-1):

- **Technology and Business Model Innovation Component**: Financial support primarily in the form of grant funding to private/non-profit/academic entities to design, pilot, and deploy innovative technologies and business models to further integrate clean energy solutions within agricultural supply chains in developing and emerging countries.

- **Commercial Financing Component**: Provision of grant funding, guarantees, and other incentives to financial intermediaries to encourage private sector equity and debt investments within the clean energy/ agriculture nexus.

- **Mainstreaming and Acceleration Component**: Catalyzing private-sector investment and associated technical assistance and training to bring proven clean energy solutions for enhancing agricultural productivity and/or value to commercial scale. Efforts are made through this Technical Component to pursue a ‘nexus’ approach to supporting PAEGC Partners’ ongoing/planned energy and agriculture programs.

- **Knowledge Management Component**: Collecting, analyzing, and disseminating knowledge gained through the implementation of PAEGC interventions and other activities within the clean energy/ agriculture nexus.

Figure 1.1. PAEGC’s Technical Components and Illustrative Activities
1.4 The Founding Partners
The Founding Partners have made financial and in-kind contributions to finance the activities of Powering Agriculture. In-kind contributions are technical assistance resources that individual Partners have committed to support the goal of Powering Agriculture but are managed by the individual Partners themselves. USAID serves as the administrator of Powering Agriculture managing the disbursements of the finances. Table 1-1 provides a description of each Founding Partner.

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Agency for International Development</td>
<td>The American people, through the USAID, have provided economic and humanitarian assistance worldwide for nearly 50 years. <a href="http://www.usaid.gov">www.usaid.gov</a></td>
</tr>
<tr>
<td>Government of Sweden</td>
<td>Sida, the Swedish International Development Cooperation Agency which is an authority under the jurisdiction of the Swedish Ministry for Foreign Affairs, focused on improving living conditions for developing nations around the world. <a href="http://www.sida.se/English/">www.sida.se/English/</a></td>
</tr>
<tr>
<td>Government of Germany</td>
<td>The BMZ, Federal Ministry for Economic Cooperation and Development, develops the guidelines and the fundamental concepts on which German development policy is based. It devises long-term strategies for cooperation with the various 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. <a href="http://www.bmz.de/en">www.bmz.de/en</a></td>
</tr>
<tr>
<td>Duke Energy</td>
<td>Duke Energy, one of the largest electric power companies in the United States, supplies services in a sustainable manner - affordable, reliable, and clean. <a href="http://www.duke-energy.com/">www.duke-energy.com</a></td>
</tr>
<tr>
<td>The Overseas Private Investment Corporation</td>
<td>OPIC is the U.S. Government’s development finance institution. It mobilizes private capital to help solve critical development challenges and in doing so, advances U.S. foreign policy. Because OPIC works with the U.S. private sector, it helps U.S. businesses gain footholds in emerging markets, catalyzing revenues, jobs and growth opportunities both at home and abroad. OPIC achieves its mission by providing investors with financing, guarantees, political risk insurance, and support for private equity investment funds. <a href="http://www.opic.gov/">www.opic.gov</a></td>
</tr>
</tbody>
</table>
The following are highlights of the main activities implemented under Powering Agriculture during the reporting period.

2.1. **Second Innovation Call**

Powering Agriculture launched its second global innovation call on November 13, 2014. The global call for proposals focused on creative solutions that address an identified development problem; that is, farmers and agribusinesses’ limited ability to sustainably maximize agricultural production and value due to limited access to modern energy services. Through the global innovation call, Powering Agriculture sought solutions within the clean energy/agricultural nexus that:

1. Enhance agricultural yields/productivity;

2. Decrease post-harvest loss;

3. Improve farmer and agribusiness income generating opportunities and revenues; or

4. Increase energy efficiency and associated savings within the operations of farms and agribusinesses – while stimulating low carbon economic growth within the agriculture sector of developing countries.
Based on the lessons learned from the first global innovation call, the Partners made some changes to the selection criteria and requirements for the second innovation global call, namely:

- A second funding window was included in order to support clean energy technologies and business models that have been successfully piloted in a developing country/emerging market on a small scale, and are now ready for market expansion and scaling-up/commercialization.

- The required cost share was increased for applicants of both funding windows.

- Gender was added as a selection criteria.

Powering Agriculture conducted an extensive global public outreach campaign to promote the innovation call, drive innovators/solvers to apply, while also secondarily raising awareness of issues at the nexus of clean energy and agriculture and the PAEGC Partners’ leadership in solving these issues through the Grand Challenge. The campaign was directed at three target audiences.

**Innovators/Solvers**: Entrepreneurs, businesses, and organizations around the globe which are capable of providing technical solutions that meet the PAEGC selection criteria.

**Thought Leaders**: Leaders in a variety of organizations and in the private sector who could leverage their professional networks to promote the call. The leaders also included bloggers and other media personnel, as well as project developers who regularly engage on this topic.

**Amplifiers**: Organizations that would help share the campaign’s material with their own specific audiences at no additional cost.

The campaign’s activities included:

- 3 email blasts to a mailing list of some 3,400 contacts;

- A factsheet summarizing the main points of the call was drafted and translated into four languages (French, Spanish, Portuguese, and Arabic) to increase the outreach, particularly in developing and emerging countries;

- A Twitter campaign with tweets three times a week and direct tweets to specific groups in the clean energy/ag nexus and amplifiers such as USAID Missions and national offices of the other Partners;

- A sponsored Facebook post that reached 17,920 and resulted in 923 actions, 859 likes, 4 comments, 11 shares;

- Individual LinkedIn posts to 82 LinkedIn members, reaching a combined LinkedIn audience potential of 565,444 per post;

- Outreach to 175 thought leaders, of which 52 thought leaders amplified the message and in turn reached an estimated number 140,850 persons;

- Outreach to 225 Amplifiers, of which 73 agreed to share information about the call for proposals via email lists, websites, social media (one significant amplifier utilized her LinkedIn profile), and conferences resulting in an estimated audience reach of 1,977,142;
A web banner campaign which ran from December 8 to 19, 2014, and January 5 to February 8, 2015, and resulted in a click through rate of 0.64% (number of clicks (102,854) over impressions (16,042,644)) compared to an average CTR = 0.10%. A click is the number of times the ad was clicked and an impression is the number of times the ad appeared. There was significant traffic from Southeast Asia and Asia Pacific regions and the top ten countries were: Indonesia, Egypt, India, Turkey, United States, Morocco, Ecuador, Pakistan, China, Bosnia and Herzegovina.

Figures 2-1 through 2-3 provide details and analysis of campaign activities for the second global innovation call.
Figure 2.2. Weekly Page Views of Poweringag.com by Traffic Source

Figure 2.3. Quality vs. Quantity of Visitors from Traffic Sources

- **Height of a column** = average number of pages viewed by each visitor during their visit, or the “quality” of a visitor
- **Width of a column** = the relative number of visitors from that source compared to the other sources, or a “quantity” of visitors
- **Area of a column** = a relative amount of total site traffic generated by visitors through the respective traffic source

The “Paid Search” web banner campaign drove the largest quantity of visitors whereas the email blasts drove the highest quality visitors.

- **“Direct Visits”** are from people typing in a URL directly, or using a saved bookmark
- **“Other Email”** includes all other site traffic that originated from links shared by email
- **“Organic Search”** is traffic generated from (non-sponsored, or “organic”) links followed from search engines

Direct visits and organic search also includes visitors who would have originally learned about PAEGC from the other traffic sources.
The main conclusion is that while paid searches brought higher numbers to the PAEGC website, other outreach efforts brought a higher quality of visitors.

The campaign’s utilization of a variety of promotional activities resulted in an 84% increase over the number of applicants from the first round and a 30% increase in the number of countries from where applicants were based. The results were 871 concept note submissions from 99 countries as compared with 473 concept note submissions from 76 countries in the first round (Figure 2). The second call was more successful in reaching out to applicants from developing countries than the first call, due, amongst other reasons, to translated fact sheets and Partners’ particular campaign activities within their networks. Figures 2-4 through 2-7 provide a more detailed of breakdown of submissions.
Figure 2.5. Regional Breakdown of Innovators

- Africa: 15%
- North America: 23%
- Europe/Eurasia: 15%
- Asia: 15%
- Latin American Countries: 8%

Figure 2.6. Regions of Implementation

- Africa: 61%
- Asia: 17%
- Latin American Countries: 8%
- Middle East: 9%
- Oceania: 9%

Figure 2.7. Clean Energy Type

- Solar: 69%
- Biomass: 8%
- Hybrid: 15%
- Waste: 8%
- Solar: 69%
From the 871 concept note submissions, 13 winners were selected. The following describes the timeline and process for the selection of the 2015 Innovators that received ~$12.9 million USD in total funding over the next 3 years.

Table 2.1. Global Innovation Call Round 2 Process and Timeline

<table>
<thead>
<tr>
<th>DATES</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 13, 2014</td>
<td>The Broad Agency Announcement (BAA) solicitation was released on <a href="http://www.grants.gov">www.grants.gov</a> and <a href="http://www.fbo.gov">www.fbo.gov</a></td>
</tr>
<tr>
<td>December 1, 2014</td>
<td>This was the deadline for the submission of questions by email to <a href="mailto:poweringag@usaid.gov">poweringag@usaid.gov</a></td>
</tr>
<tr>
<td>December 8, 2014</td>
<td>The online application platform was open to applicants to submit concept notes.</td>
</tr>
<tr>
<td>February 12, 2015</td>
<td>This was the deadline for concept notes; 871 were received from 99 countries.</td>
</tr>
<tr>
<td>April 1, 2015</td>
<td>107 Semifinalist applicants from 32 countries were notified and requested to submit full proposals.</td>
</tr>
<tr>
<td>May 4, 2015</td>
<td>87 Semifinalists from 27 countries submitted full proposals and supporting documentation.</td>
</tr>
<tr>
<td>July 2015</td>
<td>21 Finalists from 11 countries were announced and were interviewed by the Innovator Evaluation Board.</td>
</tr>
<tr>
<td>September 2015</td>
<td>13 Innovators from 9 countries were selected to be issued PAEGC awards.</td>
</tr>
</tbody>
</table>

QUICK FACTS ABOUT THE 2015 INNOVATORS

- **Organizations in 9 countries:** 39% Africa, 23% North America, 15% Asia, 15% Europe/Eurasia, 8% Latin America (See Figure 2-8)
- **Clean energy type:** 69% Solar, 15% Hybrid, 8% Biomass, 8% Waste
- **Agriculture value chain focus:** 39% staple crops, 38% horticulture, 15% aquaculture, 8% dairy
- **Regions of implementation:** 61% Africa, 17% Asia, 9% Middle East, 9% Oceania, 4% Latin America
- **Funding type requested:** 62% applied under Funding Window 1 on the design of their clean energy solution, while 38% applied under Funding Window 2 to scale-up their clean energy solutions
Table 2.2. presents the 13 Innovators selected as the 2015 cohort.

<table>
<thead>
<tr>
<th>2015 COHORT</th>
<th>INNOVATOR</th>
<th>PROJECT NAME</th>
<th>COUNTRY OF IMPLEMENTATION</th>
<th>START DATE</th>
<th>END DATE</th>
<th>AWARD VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ariya Capital Group Ltd</td>
<td>Powering Agriculture with Renewable Energy</td>
<td>Kenya; Tanzania; Uganda</td>
<td>2/3/2016</td>
<td>12/31/2018</td>
<td>$1,905,700</td>
</tr>
<tr>
<td>2</td>
<td>Claro Energy</td>
<td>Launch low-cost on-demand pay-as-you-go irrigation service using solar trolley systems to cut irrigation costs in half.</td>
<td>India</td>
<td>12/10/2015</td>
<td>9/30/2018</td>
<td>$500,000</td>
</tr>
<tr>
<td>3</td>
<td>Futurepump (Kenya) Ltd</td>
<td>Sunflower Pump - A working capital facility &amp; after sales investments to support a growing solar irrigation business in Kenya</td>
<td>Kenya</td>
<td>12/29/2015</td>
<td>9/30/2018</td>
<td>$1,999,563</td>
</tr>
<tr>
<td>4</td>
<td>Governing Council of the University of Toronto</td>
<td>Field Evaluation of Passive Aeration System for Aquaculture</td>
<td>Bangladesh</td>
<td>1/18/2016</td>
<td>1/17/2019</td>
<td>$500,000</td>
</tr>
<tr>
<td>5</td>
<td>Horn of Africa Regional Environment Center and Network</td>
<td>Improving coffee production and quality using Infra-red technology</td>
<td>Ethiopia</td>
<td>2/2/2016</td>
<td>2/1/2019</td>
<td>$434,780</td>
</tr>
<tr>
<td>6</td>
<td>Husk Power Systems</td>
<td>Hybrid Solution- Biomass and Solar PV: Clean Energy Intervention in the food belts of Nigeria and Ghana</td>
<td>Ghana; Nigeria</td>
<td>1/21/2016</td>
<td>9/30/2018</td>
<td>$1,282,418</td>
</tr>
<tr>
<td>7</td>
<td>Istituto per la Cooperazione Universitaria Onlus (ICU)</td>
<td>PV integrated irrigation systems in Jordan and Lebanon</td>
<td>Jordan; Lebanon</td>
<td>12/14/2015</td>
<td>3/31/2018</td>
<td>$499,688</td>
</tr>
<tr>
<td>8</td>
<td>iDE (Bangladesh)</td>
<td>Renewable micro-grids for off-grid fish hatcheries and surrounding communities in Bangladesh</td>
<td>Bangladesh</td>
<td>12/14/2015</td>
<td>6/30/2018</td>
<td>$499,748</td>
</tr>
<tr>
<td>9</td>
<td>KickStart International</td>
<td>To increase access to affordable, high-performance solar-powered irrigation technology amongst poor smallholder farmers in rural Kenya</td>
<td>Kenya</td>
<td>12/10/2015</td>
<td>9/30/2018</td>
<td>$500,000</td>
</tr>
<tr>
<td>10</td>
<td>SimGas Tanzania Ltd.</td>
<td>Biogas Milk Chilling to increase productivity and double the income of East African dairy farmers</td>
<td>Kenya; Rwanda; Tanzania</td>
<td>12/11/2015</td>
<td>10/30/2018</td>
<td>$499,998</td>
</tr>
<tr>
<td>11</td>
<td>SunCulture</td>
<td>SunCulture: Scaling up distribution of smallholder tailored agro-solar irrigation kits across Africa</td>
<td>Kenya; Tanzania; Uganda; Zambia</td>
<td>2/11/2016</td>
<td>9/30/2018</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>12</td>
<td>Universidad del Valle de Guatemala</td>
<td>Private-Sector Financed Community Solar Power Grids (ComGrids) and Agricultural Accelerators in Off-Grid Communities in Guatemala</td>
<td>Guatemala</td>
<td>12/14/2015</td>
<td>12/13/2018</td>
<td>$499,008</td>
</tr>
<tr>
<td>13</td>
<td>Village Infrastructure Angels</td>
<td>Solar Agro-processing Power Stations for 5000 Households</td>
<td>Indonesia; Papua New Guinea; Philippines; Vanuatu</td>
<td>12/11/2015</td>
<td>9/30/2018</td>
<td>$1,762,400</td>
</tr>
</tbody>
</table>

**TOTAL** $12,883,303.00
2.2. **Innovator Progress**

The 2013 Innovator projects are generally focused on new clean energy technologies and business models that show promise of being viable in supporting the objectives of PAEGC, but have yet to demonstrate their proven applicability in a developing country context through extensive field tests. The activities of the projects are focused on the early stages of research and development and are using PAEGC funding to refine/improve the design of the technologies, establish proof of concept, pilot field tests, and adapt technologies/business models for new markets.

Most of the Innovators spent the second year of implementation of their awards testing their solutions in the field and refining the design based on the results of these tests and as a result made progress along the innovation stage. Figure 2-9 shows the 2013 Innovators and their stages of innovation as of October 2015.
The following profiles provide a snapshot of each 2013 Innovator’s clean energy solution, their expected impacts, and their progress to date, as of October 2015.
2.2.1 AFRICAN BAMBOO

PROJECT
Biomass-Powered Thermal Processing of Ethiopian Bamboo

INNOVATION STAGE 4
Early Adoption/Distribution

CLEAN ENERGY SOURCE
Biomass

AGRICULTURAL FOCUS
Processing

PRODUCT SEGMENT
Agro-Forestry Products

COLLABORATOR(S)
Heartland Global (USA)

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

WEBSITE
www.african-bamboo.com
ORGANIZATION
African Bamboo is a forestry, wood, and bio-energy company located in Addis Ababa, Ethiopia, among Africa’s largest reserves of bamboo. African Bamboo develops innovative applications for bamboo, particularly for industrial and commercial uses. The company was established in 2012, as a subsidiary of Fortune Enterprise PLC which, since 1961, has been a manufacturer of wood and metal products in Addis Ababa.

PROBLEM/OPPORTUNITY
In Ethiopia, there are more than one million hectares of bamboo. Recognized as a fast-growing and largely sustainable raw material, there is an increasing global demand for bamboo as a wood substitute for a variety of construction and furnishing applications. However, bamboo resources are often poorly managed. Most in the industry have limited knowledge of modern value-added processing techniques, which limits their earning potential.

CLEAN ENERGY SOLUTION
African Bamboo is developing an environmentally friendly bamboo thermal modification process called ThermoBoo. Through this chemical-free process, decay factors such as rot and insects are virtually eliminated, and the thermally-modified bamboo fiber can be further processed into sturdy panels that can be marketed to a range of domestic and international buyers. The ThermoBoo process involves the combustion of biomass dust – a technological approach that is completely new to Ethiopia. Through the project’s successful implementation of a pilot processing facility, African Bamboo envisions developing a replicable model that can lead to prospective business opportunities throughout the region.

IMPACT
The success of this project will lead to new opportunities for export, employment, and manufacturing in Ethiopia. In addition to its socio-economic impact, bamboo cultivation of native species plays a significant role in reforestation by stabilizing soil. African Bamboo uses environmental impact assessments to ensure the continued promotion of bamboo’s environmental benefits, and the minimization of the company’s ecological footprint.

PROGRESS UPDATE
Over the past two years, African Bamboo has completed the system design and engineering for the thermal modification facility. Remote-sensing technology has been utilized to take stock of the bamboo resources available in the project area. Thirty farmer cooperatives (more than 2200 farmers) have been established in order to give small-scale farmers a voice. An additional 50 farmers have been added as bamboo suppliers. Construction of three factory halls began in July 2015, with completion scheduled for March 2016. The commercial factory will be operational in 2017. Five contracts were issued to undertake the final phase of testing and certification at a commercial scale.
### 2.2.2 CAMCO CLEAN ENERGY

**PROJECT**  
Building Markets for Efficient Biomass Power Provision in Africa

**INNOVATION STAGE 3**  
Initial Piloting

**CLEAN ENERGY SOURCE**  
Biomass

**AGRICULTURAL FOCUS**  
Decentralized Power

**PRODUCT SEGMENT**  
Agro-Forestry Products

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

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

**WEBSITE**  
www.camcocleanenergy.com/africa  
www.villageindustrialpower.com
**ORGANIZATION**
Camco Clean Energy is a sustainable energy development company with offices across Africa. It is experienced in providing rural electrification through solar, biomass, small hydro, and biofuel technologies, addressing traditional charcoal production and consumption. Camco will co-implement activities with Village Industrial Power (VIP) – a firm that specializes in the development of innovative biomass fueled co-generation plants.

**PROBLEM/ OPPORTUNITY**
In rural areas of sub-Saharan Africa, access to modern energy services is extremely limited. Without electricity, farming communities are slow in their adoption of modern agriculture practices – resulting in sparse irrigation, lagging food production, and few opportunities for value-added processing and refrigerated storage. Though some communities depend on fossil fuel-based technologies to meet their energy needs, perpetually escalating fuel costs - coupled with adverse environmental impacts - necessitate the exploration of more affordable and sustainable options.

**CLEAN ENERGY SOLUTION**
Village Industrial Power (VIP) steam plants are powered through the combustion of biomass waste produced at local agricultural processing facilities. The VIP Plants generate mechanical/electrical/thermal energy for use in a diverse range of agricultural activities - processing fruit, palm, rice, and cocoa; dairy pasteurization; purifying water; and powering irrigation pumps.

**IMPACT**
The project will result in the establishment of 25 agro-processing centers and village mini-grids capable of producing 10kW of electricity and 60kW of thermal energy for homes, social services, and businesses. It is anticipated that the VIP Plants will service more than 2,500 agrarian families. This clean energy solution will contribute agricultural development and low-carbon economic growth that improves food security, financial stability, environmental sustainability, and women's empowerment through new entrepreneurship opportunities.

**PROGRESS UPDATE**
To demonstrate the benefits of the VIP system, Camco and VIP have installed five 10-kW VIP units in three different applications. In the Village of Uchindile, Tanzania, Victoria Hongole has been chosen to be the operator of the VIP mini-grid. Three palm oil processing businesses in South Eastern Benin are using the VIP to displace diesel and wood consumption in the processing of oil palm. In this application all three forms of energy are used; mechanical energy is used in running the expeller press, electrical energy is used to power a submersible pump and electric motors, and thermal energy is used to supply hot water to the palm fruit cooking vats. A rural clinic near Kigoma, Tanzania, is using hot water from the VIP in their laundry and will be powering their submersible pump and other equipment with the electricity.
2.2.3 EARTH INSTITUTE – COLUMBIA UNIVERSITY

PROJECT
Micro-Solar Utilities for Small-Scale Irrigation in Senegal

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Solar Photovoltaic

AGRICULTURAL FOCUS
Irrigation

PRODUCT SEGMENT
Horticulture

COLLABORATOR(S)
The MDG Center West and Central Africa (Senegal)

LOCATION APPLIED
Potou, Senegal

WEBSITE
www.earth.columbia.edu
ORGANIZATION
The Earth Institute at Columbia University harnesses scientific research, education, and practical solutions to create a more sustainable world through innovation and critical thinking. Earth Institute has partnered with The MDG Center West and Central Africa (WCA) – an organization established to assist WCA countries to develop and implement operational strategies aimed at achieving the Millennium Development Goals.

PROBLEM/OPPORTUNITY
In Senegal, farmers currently use two practices for watering crops: the labor intensive method of flood irrigation with wells and buckets, or the cost- and energy-intensive method of using diesel-powered motor pumps. Neither of these options is ideal in a country with immense solar resources that can be harnessed and used to transform irrigation practices in the country and region.

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

IMPACT
This innovation will reduce the price of energy for irrigation significantly, while reducing the carbon intensity of irrigation and the labor expended on it. These benefits are particularly powerful when looking at the demographics of Senegal’s agricultural workforce, which is more than 85 percent women.

PROGRESS UPDATE
The Earth Institute has installed three pilot solar PV pumping systems, which will serve seven farmers each (21 total) from a single, centralized array. Farmers on the first system have been paying for the service since early 2015 with high satisfaction. The next two pilot systems have been installed in Senegal and are awaiting pump installations. These latter two systems have solar tracking systems designed to optimize pump usage by increasing the time period during a day which the solar panels are collecting the maximum amount of energy (normal to the sun’s rays).

Figure 2.12. Earth Institute Solar PV Array Installation in Senegal
2.2.4 EARTHPARK INTERNATIONAL

**PROJECT**
Smart Grid on Main Street: Electricity and Value-added Processing for Agricultural Goods in Rural Haiti

**INNOVATION STAGE 4**
Early Adoption/Distribution

**CLEAN ENERGY SOURCE**
Solar Photovoltaic

**AGRICULTURAL FOCUS**
Decentralized Power

**PRODUCT SEGMENT**
Staple Crops

**COLLABORATOR(S)**
Enterprises La Foi (Haiti)

**LOCATION APPLIED**
Les Anglais, Haiti

**WEBSITE**
www.earthsparkinternational.org
ORGANIZATION
EarthSpark International is a U.S.-based, nonprofit organization with over six years’ experience working with communities, businesses, and government to bring energy access to Haiti’s unelectrified population. Through its local brand Enèji Pwòp, EarthSpark is an established and recognized brand in Haiti with the track record and infrastructure to scale up its clean energy and micro-grid activities. For this project, EarthSpark has partnered with the Haitian agro-processing company Entreprises La Foi. EarthSpark also spun-off the smart meter technology SparkMeter, Inc., which is now providing solutions to grid operators in other countries.

PROBLEM/OPPORTUNITY
Seventy-five percent of Haiti’s population lacks access to electricity, and farmers frequently lose value of their crops for want of infrastructure and processing equipment. Where processing facilities do exist, they are typically diesel-powered and expensive to operate. This imposes a severe limitation on farmers’ ability to process agricultural goods, maximize the value of their products, and improve their livelihoods.

CLEAN ENERGY SOLUTION
EarthSpark has developed a solar-diesel hybrid micro-grid system that will increase access to affordable, reliable electricity for value-added agricultural processing. By providing technical guidance and facilitating access to financing for local partners, EarthSpark is assisting agribusinesses in upgrading to efficient electric mills so the processing of rice, sorghum, coffee, and corn can be modernized. The project first focuses on breadfruit crops that typically rot due to lack of processing. Converting the fruit to flour or chips extends the shelf life by months and significantly increases its value and marketability.

IMPACT
By reducing food losses and enabling value-added processing, the project will boost agribusiness incomes as well as provide surrounding residents with access to electricity, through a pre-paid smart metering system. The project will demonstrate a sustainable business model for operating a local micro-grid, for agribusiness’ upgrading to efficient electric mills for breadfruit processing and electric de-kernelling for corn.

PROGRESS UPDATE
In May 2015, EarthSpark energized the grid, expanding service to 430 households and businesses in downtown Les Anglais; connecting these customers to grid electricity for the first time. The newly installed grid is powered by a state-of-the-art hybrid generation system including 90 kW of PV capacity, 400 kWh of battery capacity and a small diesel backup generator. EarthSpark has developed a town-scale distribution system which includes a medium-voltage line, standard electrical installation, and use of next-generation smart meters. In late September, an efficient, electric mill was installed in Les Anglais and started operation. In August, EarthSpark also helped a women-run cooperative in the area start a corn de-kernelling business that uses clean, microgrid electricity to de-kernel corn cobs in a region with ample corn production. EarthSpark recently began testing breadfruit chip production and recipes and is in discussions with local partners on expanding production.
2.2.5 ECO CONSULT

PROJECT
A Hydroponic Green Farming Initiative

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Solar Photovoltaic

AGRICULTURAL FOCUS
Irrigation

PRODUCT SEGMENT
Horticulture

COLLABORATOR(S)
El Wir Farm in Zarqa River and one large farm in the Highlands. The community households cluster will be identified during the feasibility study

LOCATION APPLIED
Jordan; Middle East and North Africa region

WEBSITE
www.ecoconsult.jo
ORGANIZATION
Established in Jordan in 1995, ECO Consult is a leading development firm with more than 15 years of experience working in Jordan and the Middle East. Past work includes projects in public sector reform, private sector development, local governance and development zones, energy, water, and environment.

PROBLEM/ OPPORTUNITY
Jordan is considered to be one of the ten most water-scarce countries in the world. As water becomes scarcer, its availability for agriculture is expected to decrease. Hydroponic technology, an intensive form of agriculture, uses much less water than conventional farming and offers an excellent opportunity for farmers to increase their income while reducing their water use. Although farmers have expressed their interest in this new technology, its application in Jordan is still limited.

CLEAN ENERGY SOLUTION
ECO Consult has developed an integrated model of hydroponic and photovoltaic farming to compete with conventional greenhouse technology and drip irrigation systems. To make the technology attractive to large-scale commercial farms, ECO Consult will retrofit a multi-span greenhouse with advanced hydroponic technologies and photovoltaic panels to generate enough power to operate the lighting, pumping, and air moderation systems.

IMPACT
ECO Consult’s beneficiaries include large commercial farms as well as small household farms. As more farms adopt these new technologies, the value of their agricultural produce will increase, while their use of scarce natural resources will decrease. Simultaneously, as more rural households adopt this technology at a small-scale, they will realize additional sources of income and new employment opportunities for women and youth.

PROGRESS UPDATE
ECO Consult organized a national advisory group in Jordan for hydroponic farming. As part of USAID’s Powering Agriculture program and Hydroponic Green Farming Initiative, they have designed indigenous hydroponic systems, incorporating materials readily available in Jordan. To date, ECO Consult has installed the hydroponic systems at four sites on a cost-share basis with the owners. A demonstration hydroponic pepper farming greenhouse was established to show systems that can be adopted for large and small-scale farming. Other crops being grown at the demonstration sites include thyme, lettuce, and other vegetables.
PROJECT
Solar-Powered Pumps for Improved Irrigation in Honduras, Nepal, and Zambia

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Solar Photovoltaic

AGRICULTURAL FOCUS
Irrigation

PRODUCT SEGMENT
Horticulture

COLLABORATOR(S)
PRACTICA Foundation (Netherlands), Futurepump Ltd (UK)

LOCATION APPLIED
Honduras; Nepal; and Zambia

WEBSITE
www.ideorg.org
ORGANIZATION
iDE has over 30 years’ experience creating business opportunities that spread transformative products and services through the developing world. In rural agriculture, iDE develops appropriate agricultural products and engages the private sector to supply these products to smallholder farmers, improving long-standing agricultural practices. iDE has reached over 23 million people across Africa, Asia, and Latin America. This project is implemented in partnership with PRACTICA Foundation – a Dutch organization that has a focus on the commercial application of technology in the field of water and energy, and Futurepump Ltd. – a UK manufacturer of efficient renewable irrigation pumps.

PROBLEM/ OPPORTUNITY
Globally, there are more than 800 million smallholder farmers, many of whom manually lift and haul over four tons of water daily to irrigate their farmland. These farmers can drastically decrease their labor and expand their irrigable area by employing motorized pumps. Currently, the most accessible and affordable pump solutions are small engine pumps powered by increasingly expensive fossil fuels. Consequently, many farmers are either unable to provide sufficient irrigation to their crops, and/or must allocate a sufficient portion of their income to environmentally-hazardous fossil fuels.

CLEAN ENERGY SOLUTION
To increase agricultural productivity, incomes, and livelihoods of smallholder farmers, iDE and its partners have developed a Clean Irrigation Solution that will provide smallholder farmers across the developing world the opportunity to mechanize their farming with zero carbon emissions. 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.

Technology development is only one component of bringing the Sunflower pump to scale. iDE has identified five key factors needed to bring a Clean Irrigation Solution to scale:

• Appropriate Technology – iDE is working with the PRACTICA Foundation to develop a low-cost solar pump called the Sunflower pump
• Viable Business Plan – iDE is partnering with Futurepump, a private company that will be responsible for the manufacturing and global distribution of the Sunflower pump
• Accompanying Finance Model – iDE is identifying finance models to bring down the high upfront costs that currently make the Sunflower pump cost-prohibitive to smallholder farmers.
• Established Supply Chain – iDE is identifying national and sub-national level retailers to bring the Sunflower pump to different markets. iDE is working through its last-mile distribution network to provide installation and repair services.
• Marketing and Educational Resources – iDE is developing training manuals for field technicians and using demonstration plots to convey the benefits of the Sunflower pump for smallholder farmers.
IMPACT
By the end of this project, iDE’s goal is to have a commercially available solar pump product for farmers irrigating up to 2,000 square meters of high-value dry season vegetables. Use of the Sunflower pump instead of a fossil fuel engine can reduce annual carbon emissions by 0.5 a ton. With a 10-year lifespan, each pump reduces CO2 emissions by 5 tons.

PROGRESS UPDATE
iDE and its partners have established a manufacturing facility in India. Pumps for field testing have been installed in Nepal, Zambia, and Honduras. The feedback from these field tests informed future design iterations to the pump. The field testing sites have become demonstration sites, and iDE is laying the groundwork for sustainable sales and distribution of the pump in these three countries.
2.2.7 MOTIVO ENGINEERING

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

**INNOVATION STAGE 3**
Initial Piloting

**CLEAN ENERGY SOURCE**
Hybrid

**AGRICULTURAL FOCUS**
Cold Storage, Decentralized Power, Irrigation, Processing

**PRODUCT SEGMENT**
Aquaculture, Dairy, Horticulture, Staple Crops

**COLLABORATOR(S)**
The KVK Foundation (India); Feuerlabs (USA)

**LOCATION APPLIED**
Rangareddy, Telangana, India

**WEBSITE**
www.motivoengineering.com
**ORGANIZATION**
Motivo Engineering specializes in connected electro-mechanical systems to solve complex challenges across diverse market segments. Motivo’s partner, the KVK Foundation, will draw on their extensive rural development experience in India to introduce new technologies to rural villages.

**PROBLEM/ OPPORTUNITY**
Today, 2.6 billion people earn their livelihood from agriculture and there are 1.2 billion people who lack access to electricity. As our population expands, farms and agribusinesses need to produce, process and cold transport an increasing amount of food. The agricultural sector needs an easy way to access and use energy in order to increase farm productivity. Farmers across the world need low cost, infrastructure-less electrification and mechanization.

**CLEAN ENERGY SOLUTION**
Motivo is developing a “Swiss-Army Knife” system – the Hybrid Agriculture/Road Vehicles with Electricity Storage and Transformation (HARVEST) – that solves a wide range of agricultural mechanization and power-related problems. HARVEST is a multi-purpose platform that provides power for plowing, well-drilling, cold storage, and transporting crops to market. The system utilizes power from varied energy sources such as solar panels, wind turbines, micro-hydro turbines, or the grid to enable increased productivity all along the agriculture value chain. The entire system is operated at the community level, and facilitated by mobile communication technology for scheduling, billing, and payments.

**IMPACT**
HARVEST democratizes opportunity in agriculture by making available to entire communities huge gains in productivity that are enabled through mechanization and reliable power. Varied energy sources will reduce reliance on increasingly-expensive imported diesel, and the system itself will create new skilled jobs for men and women in rural areas in deploying, managing, and maintaining the HARVEST equipment.

**PROGRESS UPDATE**
Motivo’s HARVEST prototype is now functional and undergoing testing in California. The HARVEST prototype is being tested in small fields and nurseries. Motivo continues to work on upgrades to make the tractor more functional and is close to deploying HARVEST to Indian farmers.

Figure 2.16. Motivo’s HARVEST
Source: Motivo Engineering
2.2.8 PROMETHEAN POWER SYSTEMS

PROJECT
Reducing Milk Spoilage through Solar Powered Milk Chilling in Rural India

INNOVATION STAGE 4
Early Adoption/Distribution

CLEAN ENERGY SOURCE
Energy Efficiency, Solar Photovoltaic

AGRICULTURAL FOCUS
Cold Storage

PRODUCT SEGMENT
Dairy

COLLABORATOR(S)
Hatsun Agro (India), Orb Energy (India)

LOCATION APPLIED
India

WEBSITE
www.coolectrica.com/impact
ORGANIZATION
Promethean Power Systems designs and manufactures refrigeration systems coupled to their thermal batteries for agricultural commercial refrigeration applications in off-grid and partially electrified areas of developing countries. Promethean is working in partnership with the Hatsun Argo – India’s largest private dairy company, and Orb Energy – a leading solar energy system provider in India.

PROBLEM/ OPPORTUNITY
In India, $10 billion worth of perishable foods are wasted annually because of unreliable cold-chain supply networks. A major obstacle in setting up cold chain networks is the lack of reliable electricity to run refrigeration systems in villages and farming areas. Diesel generators are often used to provide electricity for milk chilling, a non-ideal solution with high operating costs and negative environmental impact.

CLEAN ENERGY SOLUTION
Promethean’s refrigeration solution uses a thermal energy battery pack that charges on intermittent power sources such as solar power and/or a few hours of grid electricity. This provides cold storage around the clock despite inconsistent access to electricity. Dairy processors can collect raw milk from remote dairy farmers and keep it cold in a rapid milk cooler, reducing the time that milk is unchilled by 75 percent. Promethean will design and deploy the refrigeration systems in collaboration with India’s largest private dairy and one of India’s largest solar installers.

IMPACT
India is the largest producer and consumer of milk in the world. 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. This project will improve access to forward markets, higher income for the dairy farmers, and wealth creation through increase in herd size.

PROGRESS UPDATE
Promethean has deployed and commissioned over 100 milk chillers coupled to its patented Thermal Battery. To date, none of the 100 Promethean chillers have required a diesel generator. Without Promethean’s Thermal Battery, a traditional milk chiller would have run diesel generators to chill milk in these villages. As deployment of the chillers continues, Promethean has been able to adapt the solar design to address specific logistical needs of dairy partners.
2.2.9 REBOUND TECHNOLOGIES

PROJECT
SunChill: Solar Cooling for Horticultural Preservation in Mozambique

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Solar Thermal

AGRICULTURAL FOCUS
Cold Storage

PRODUCT SEGMENT
Horticulture

COLLABORATOR(S)
Colorado State University; TechnoServe; Mozambique Organicos

LOCATION APPLIED
Inhambane Province, Mozambique

WEBSITE
www.rebound-tech.com
ORGANIZATION
Rebound Technologies develops tailored refrigeration technologies designed to meet global energy market dynamics while reducing fossil fuel dependence. To successfully design, build and deploy SunChill™ technology, Rebound will leverage critical partnerships. The Energy Institute’s (Colorado State University) product development experience will support R&D, TechnoServe’s business solutions focus will drive host nation outreach/support, and Mozambique Organicos research farm will provide the primary venue for SunChill™ deployment and in-field testing.

PROBLEM/ OPPORTUNITY
Post-harvest, physiological obstacles such as ethane production, respiration and microbial attack make getting high quality horticultural products to market a significant challenge. Removing field heat from these products can double shelf life and reduce spoilage rates that often exceed 40 percent in developing countries. Unfortunately, current off-grid cooling technologies are expensive, energy intensive, and difficult to maintain.

CLEAN ENERGY SOLUTION
SunChill™ is a novel, off-grid refrigeration solution enabling increased agricultural productivity by: (i) Removing field heat from crops immediately following harvest, and (ii) providing continued product cooling at local markets and/or central processing facilities. 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.

IMPACT
SunChill™ is one of the first developing world technologies that reliably removes field heat without a high-cost electrical supply. The low-cost system enables increased horticultural production both for domestic and export consumption, generating additional income for smallholder farmers and increased access to nutritional fruits and vegetables while generating both manufacturing and service based employment.

PROGRESS UPDATE
Rebound completed testing of the SunChill™ prototype April 2015. In June 2015, members of the Rebound team deployed to test technology in field conditions in Mozambique. The prototype is being assembled, using mostly locally available materials, at a for-profit farm, which also serves as an incubator to teach farming skills to local women. Feedback received during the demonstration will be incorporated into future designs.
2.2.10 SUNDANZER REFRIGERATION

PROJECT
Solar-Powered Refrigeration for Kenyan Dairy Farms

INNOVATION STAGE 3
Initial Piloting

CLEAN ENERGY SOURCE
Solar Photovoltaic

AGRICULTURAL FOCUS
Cold Storage

PRODUCT SEGMENT
Dairy

COLLABORATOR(S)
Winrock International (USA)

LOCATION APPLIED
Nakuru Region, Kenya

WEBSITE
www.sundanzer.com  www.winrock.com
ORGANIZATION
SunDanzer has 14 years of experience with off-grid refrigeration needs, including developing the world’s first battery-free solar powered refrigerator. Winrock International is a leader in agricultural development and has more than a quarter century of experience with renewable energy based rural electrification. It has supported the installation of more than 80,000 rural renewable energy systems around the globe and has three offices in Kenya.

PROBLEM/ OPPORTUNITY
Due to limited electrification in rural areas, 85 percent of Kenya’s 800,000+ dairy farms do not have access to refrigerated storage and transportation. This deficiency in the distribution chain results in less than half of the milk produced reaching dairy processors. Of the milk that is processed, up to 30 percent of it may spoil without appropriate cold-storage options. Consequently, many dairy farmers and processors unnecessarily may lose significant earning potential from their operations.

CLEAN ENERGY SOLUTION
Recognizing the need for affordable cold-chain technologies, SunDanzer is developing a small-scale portable cooling system tailored for use in the Kenyan dairy market. The system comprises a photo-voltaic refrigerator (PVR) that uses solar energy to cool a chest refrigerator. This technology may use a battery for energy storage or phase-change materials – substances which are capable of storing and releasing large amounts of energy - or a combination of both. SunDanzer will evaluate freezing phase-change material into “milk packs”. The portable milk packs retain their cold temperature overnight, and in the morning, farmers use them to keep collected milk cold in sterilized aluminum milk containers as they transport it to dairy processing facilities.

IMPACT
This clean energy solution aims to increase dairy farm productivity and income by significantly decreasing milk spoilage. Effective cold-chain storage lowers bacteria count and improves milk quality for consumers. These improvements can play a major role in the livelihoods of approximately one million smallholder dairy farming families in Kenya.

PROGRESS UPDATE
SunDanzer has delivered and installed 40 solar milk cooling refrigerators in Kenya. Of these 40 refrigerators, 38 units were installed at dairy farmers whose product feeds two cooperatives; 1 was installed at Egerton University; and 1 was installed at the Mogotio milk cooperative.
2.2.11 UNIVERSITY OF GEORGIA RESEARCH FOUNDATION

Figure 2.20. Chilled milk heading to market

PROJECT
Biogas-Powered Evaporative Cooling for Uganda’s Dairy Industry

INNOVATION STAGE 2
Research & Development

CLEAN ENERGY SOURCE
Biogas

AGRICULTURAL FOCUS
Cold Storage

PRODUCT SEGMENT
Dairy

COLLABORATOR(S)
Smallholder Fortunes (Uganda)

LOCATION APPLIED
Wakiso District, Uganda

WEBSITE
www.ovpr.uga.edu/ugarf
ORGANIZATION
The University of Georgia Research Foundation (UGARF) is a nonprofit entity housed within the University of Georgia in the United States that enhances UGA’s excellence as a research and higher education institution. Smallholder Fortunes is a small scale demonstration dairy farm located in Wakiso District, Uganda.

PROBLEM/ OPPORTUNITY
Throughout sub-Saharan Africa, the dairy industry suffers from lack of proper refrigeration options. Large dairies cannot export milk to neighboring markets due to international standards requiring milk be cooled within four hours of production. Small farmers may lose 20-50 percent of milk to spoilage due to lack of cold-chain facilities. There is limited access to electricity for refrigeration units, and kerosene and solar-powered options have proved too expensive and difficult to operate.

CLEAN ENERGY SOLUTION
UGARF has developed a two-component device (branded as “EvaKuula”) powered by biogas – which is extracted from cow manure. The device delivers a mild heat treatment followed by gentle evaporative cooling process that keeps the milk fresh overnight. 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.

IMPACT
This project has numerous social, economic, and environmental benefits. The refrigeration device will benefit dairy farmers by decreasing milk spoilage and increasing production and profits. A fraction of the captured biogas can be used for lighting and cooking – saving income that would otherwise be spent on kerosene, and replacing the use of wood and charcoal for cooking. Also, by extracting biogas from cow manure, greenhouse gas emissions from fermenting cow manure is mitigated.

PROGRESS UPDATE
UGARF has completed a baseline study and identified smallholder farmer households to participate in their study. They have continued to perfect performance of the device and installed a demonstration unit at a partner site in Wakiso District. The initial stages have begun for the manufacture of 25 units that will be deployed among the participants. UGARF has also developed training materials that will be used to train participants before systems are installed on their farms.
2.3 Powering Agriculture Impact

Powering Agriculture has begun to have a positive impact as its Innovators undertake field testing of their clean energy solutions. The following are the results reported by the Innovators for FY2015:

- 9 of the 2013 Innovators began field testing their innovations in-country
- 661 beneficiaries have benefited from the clean energy solutions
- 34 technicians were trained to operate and maintain the clean energy solutions
- ~169 kW of clean energy generation capacity was installed
- 14 in-country persons attended trainings and demonstrations on the clean energy solution deployed
- More than USD $4.131 million in additional funding was mobilized from public investment and private investors as a result of Powering Agriculture
- More than 500 tons of CO2 equivalent has been reduced as a result of the field testing implemented

As a result of SunDanzer’s milk chilling technology, 46 dairy farmers in Ngorika and Mogotio, Kenya, have reduced the amount of evening milk that gets spoiled which has already led to a 20% increase in agricultural production.

Four vegetable farmers in Gabar, Senegal have been able to increase their agricultural production by 4.3% because of Earth Institute’s solar powered irrigation innovation.
2.3.1 Impact on Gender

- 35 women increased their knowledge of clean energy by attending trainings and demonstrations on the clean energy solutions deployed under Powering Agriculture.

- 85 women have benefited from the Powering Agriculture funded clean energy solutions.

In the upcoming year, Powering Agriculture will undertake site visits, document review and interviews to verify the performance indicator data submitted by 2013 Innovators in order to verify the impact of the clean energy solutions as their awards come to a close in FY2016.
2.4 Innovator Support
Powering Agriculture continued to provide various types of support to the 2013 Innovators during their second year of implementation mainly via Powering Agriculture Support Task Order (PASTO) which is implemented by USAID contractor, Tetra Tech. The support included:

- feedback on milestones
- advice on business models
- advice on referrals/linkages/partnerships/connections
- assistance with award modification
- assistance with compliance with USAID policies and procedures and the development of 6 templates/manuals/guides for Innovators’ use
- promotion of Innovator progress on the website, on Twitter, at conferences, and to the media

In August, the program launched the Powering Agriculture Requests and Reminders Bulletin (PARRB) as a direct way to update Innovators on Powering Agriculture developments, requests for information, and upcoming deadlines and events. The bulletin will go out every month and help streamline communication with the Innovators. The program also rolled out its online project monitoring platform called WebMo (http://poweringag.webmo.info/wiki) in September. This will streamline data reporting and milestone submission by the Innovators. The WebMo platform has credentialed access (user code/password) which ensures that the individual Innovators can only access their data.

Powering Agriculture is expanding acceleration support to its Innovators by retaining VentureWell, in association with Investors’ Circle through PASTO, to provide PAEGC Innovators with biz-tech development services, investment, and market partnership facilitation in a structured program called Powering Agriculture Xcelerator (PAX). The program will provide:

- Needs assessment, involving intake survey, scorecard, in-person strategy workshop and facilitator feedback
- Portfolio managers who will work through customized work plans and monthly calls on business model validation and market-partnership facilitation and draw on the PAX advisory board
- Peer mentoring through cohort groupings
- Investment facilitation focused on investor-readiness assessment, investor preparedness coaching, and investor linkages
- Powering Agriculture expanded its support to provide tailored gender support to its Innovators with recommendations on how to increase and improve gender integration and awareness in the projects.
2.5. Mainstreaming and Acceleration
Powering Agriculture undertook several activities to mainstream the renewable energy and agriculture nexus including using various communication tools, launching public private partnerships, and conducting trainings.

2.5.1 Raising the Public's Awareness
Powering Agriculture utilized multiple approaches to communicate the program objectives, activities, and results during the reporting period. These included various online platforms and communication tools detailed in Table 2-3 below, press stories and participation in conferences and workshops.

Powering Agriculture updated its communications strategy in July which redefined PAEGC’s audiences, messages, and tools that are used to convey these messages. In conjunction with this update, a newly-designed Powering Agriculture website was launched in September. The site now features a more visual design, easy to find news, and access on mobile devices.

Other outreach activities included the redesign of the program's two-page factsheet, the dissemination of five editions of the e-newsletter in October 2014, January 2015, April 2015,

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<tr>
<td>Powering Agriculture E-Newsletter</td>
<td>To raise awareness of Powering Agriculture, its activities, and the successes of its Innovators</td>
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</tr>
<tr>
<td>@Poweringag Twitter Account</td>
<td>To raise awareness of Powering Agriculture, its activities and the successes of its Innovators</td>
<td>News Event announcements</td>
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July 2015, and September 2015, and tweets at least 3 times a week of Innovator news and stories from across the nexus.

Coverage of Powering Agriculture Innovators during the reporting year included the following:

- https://www.greentechmedia.com/articles/read/promethean-power-systems-thermal-energy-storage-a-cool-idea-for-indian-milk

Powering Agriculture hosted sessions and exhibited at several conferences as follows:


Powering Agriculture had a booth and the 2013 Innovators were in attendance where they delivered a brief TED-style talk on their clean energy solution. They also attended a program meeting with the PAEGC Partners.

- International Workshop on ‘The prospects for solar-powered irrigation systems in developing countries’ May 27-29, 2015, in Rome, Italy, organized by Powering Agriculture Partner BMZ/GIZ, in partnership with the FAO. 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.
Ag Innovation Showcase, September 14-16, 2015, St. Louis, Missouri, USA, the world’s premier forum on the convergence of agriculture and technology. 350 attendees from over 21 countries, including those who need 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 Earth Institute at Columbia University’s Dr. Vijay Modi, as shown in Figure 2-22. Mr. Jensen and Dr. Modi, along with Powering Agriculture Program Manager Dr. Ryan Shelby participated in a special content session focused on bringing agtech into new markets.

2.5.2 Training
Powering Agriculture is also tackling the need for training programs to convey the potential benefits of clean energy solutions and prompt the acceleration of their adoption by farmers and agribusinesses in development countries. Following the pilot call for training institutions in East Africa in 2014, implemented by Powering Agriculture Partner BMZ/GIZ, 4 training courses on sustainable energy use in agriculture and food production were tested in 3 countries, reaching 101 local stakeholders, 27 of them female. Further results were that following the successful pilot training, one of the winning training institutions integrated a developed course on energy efficiency in tea factories into its permanent course catalogue, and that additional cooperation for training activities is being discussed between some of the institutions and BMZ/GIZ.

2.6 Knowledge Management
Powering Agriculture collected, analyzed, and disseminated knowledge gained through the implementation of PAEGC interventions and other activities within the clean energy/agriculture nexus.

2.6.1 Research and Studies
Powering Agriculture collaborated with the FAO in preparing a report titled “Opportunities for Agri-food Chains to Become Energy Smart”. The study addresses the information needs regarding forms of energy and technologies currently in use in selected value chains. It also provides recommendations on practical alternative clean energy options to reduce or replace fossil fuel inputs.
The report concentrates on the high dependence of energy inputs, particularly fossil fuels, at all stages along the various agri-food value chains. Emphasis was given to agricultural food production systems and the subsequent processing of raw food products into consumer products for the fresh, local and export markets. Direct energy inputs considered include petroleum fuels for tractors, harvesters, trucks, and irrigation plants; electricity for motor drives, product conveyance, lighting, refrigeration, water pumping; and natural gas for water heating, steam raising, and process heat. Indirect energy inputs include those used for the manufacture and delivery of fertilizers and agri-chemicals. Indirect energy embedded in farm buildings and processing factories, machinery, equipment and fencing, as well as transport, food retailing, cooking, and waste disposal, were largely excluded from the analysis.

Three food chains – milk, rice, and vegetables – were selected as examples to demonstrate the potential opportunities for economizing energy use, reducing the demand for fossil fuels and, reducing greenhouse gas (GHG) emissions. The vegetable food chain was restricted to tomatoes (including greenhouse production), beans, and carrots, with various markets for each including fresh, canned, paste and frozen products. The report presents various case studies, including several PAEGC Innovators.

The study is intended to assist farm businesses, farmer associations, practitioners, training institutions, food processing companies, policy makers, and other stakeholders in the agri-food industry to reduce their dependence on fossil fuels, reduce related GHG emissions, and become more resilient to possible future climate change impacts. The PAEGC initiative itself can use the valuable insights to inform further activities (e.g. focus of future calls, input for the planned massive open online course (MOOC), information for Innovators).

2.7 Partners Meeting

The Partners held their annual Partners Meeting at the Sida offices in Sweden over June 15 to 18, 2015. USAID, BMZ, and Sida were in attendance. The key decisions coming out of the meeting were as follows:

- Partners identified 21 Finalists applicants that they would like to invite for Stage 3 interviews.
- Partners agreed to extend the governing memorandum of understanding to the calendar end of 2019 as well as update the main points of contact for the Powering Agriculture.
- Partners agreed to review and update overall PAEGC M&E plan with additional indicators/evaluations as needed.
- Partners agreed to expand gender support to the first and second cohorts of Innovators.
- Partners agreed to utilize WebMo as its main information sharing & project management platform.
- Partners will create a strategic plan for knowledge management.
- Partners agreed to further investigate the implementation of the PPP.
- Partners agreed to create management options white paper for discussion amongst their institutions.
- Partners agreed to consider options for overall PAEGC program evaluation.
- Partners agreed to create a streamlined communication strategy and action plan.
The following financial information on PAEGC’s budget, contributions, and disbursements is confidential and limited for distribution only to the Powering Agriculture Partners.
Powering Agriculture plans to implement the following activities over the next financial year of October 2015 to September 2016.

- Powering Agriculture Xcelerator (PAX) Training: Innovators will attend a 4-day in person workshop in November 2015 to introduce the Xcelerator Program. The program is designed to help Innovators advance their products or services more efficiently and effectively toward impact and scale.

- Powering Agriculture Innovators Showcase (PAIS), November 20, 2015: PAIS will be the culmination of the week-long PAX workshop. The showcase will provide an opportunity for PAEGC Innovators to introduce their clean energy solutions to potential investors, media, and other donors.

- Powering Agriculture will participate and exhibit at the National Council for Science and the Environment’s 2016 Food-Energy-Water Nexus conference from January 19 to 21, 2016, in Arlington, Virginia, USA. The conference will have participants in science, technology, government, business, civil society, and education discussing strategies and initiatives that move policy into practice and transform ideas into action with regards to integrating food, energy, and water systems to achieving solutions to the most pressing issues facing the planet. On January 21, Powering Agriculture’s Program Manager, Dr. Ryan Shelby, will participate in a World Café session discussing integrated food-energy systems.
• Powering Agriculture will undertake site visits, document review, and phone interviews to verify the performance indicator data submitted by 2013 Innovators in order to verify the impact of the clean energy solutions as their awards come to a close in FY2016.

• Powering Agriculture is launching a free Massive Open Online Course (MOOC) in cooperation with TH Köln - University of Applied Sciences. The MOOC aims to:
  – Sensitize a large audience to the importance of the energy-food nexus for future development and strengthen PAEGC’s role as a leading player in the sector;
  – Disseminate up-to-date and innovative technical knowledge and business models around clean energy solutions;
  – Build and consolidate a network with participating organizations, participants, and partners;
  – Facilitate joint learning and stimulate discussion/exchange on innovative nexus solutions.

The 8-week course, which will run from February 1 to March 27, 2016, will introduce challenges and solutions for sustainable energy use in the agriculture and food industry. This will help to address the challenges of capacity building at the interface of energy and agriculture. The MOOC will introduce participants to the Energy-Agriculture Nexus and introduce approaches for sustainably providing energy throughout all stages of agricultural value chains. Challenges but also solutions will be analyzed, concrete technologies will be examined focusing on their utility to promote access to clean energy. Participants will further be familiarized with relevant external influences such as market conditions, politics, and financing schemes of “powering agricultural” projects. Learning materials, developed by well-known experts, will be available as texts as well as videos on a week-by-week basis and are accompanied by assignments that will require the application of the newly learned skills.

• Powering Agriculture in cooperation with FAO will continue its work on "Opportunities for Agri-food Chains to become Energy-Smart" with a follow-up study to assess the specific financial and economic implications of the identified energy technologies in the agri-food sector, the technology suitability for a specific development context, the actual return on investment expected, as well as the enabling conditions and policies needed to trigger the much sought pro-poor investments in the sector with regard to clean energy solutions. The final report is planned for April 2016. The study part will also feed into a stakeholder dialogue in countries that provide case study materials. In addition the results will be shared amongst interested stakeholders from diverse sectors and financial institutions across world regions.

• To complement numerous efforts by Powering Agriculture Innovators in making Solar Powered Irrigation Systems a success in increasing agricultural productivity, Powering Agriculture intends to publish a Manual + Tools for the Implementation of Solar Powered Irrigation Systems – SPIS. Before these knowledge products will be made available to support extension staff and credit officers, a draft version will be field tested until mid-2016.