# Policy Brief

THE CENTER FOR INTERNATIONAL ENVIRONMENT & RESOURCE POLICY

CLIMATE POLICY LAB
THE FLETCHER SCHOOL OF LAW AND DIPLOMACY
TUFTS UNIVERSITY

# Scaling Up Solar Pumps for Irrigation and Domestic Water Use in Ethiopia: The Role of Blended Finance

**By Rishikesh Bhandary[a], Kyle Karber[b], Easwaran Narassimhan[a], and Bikash Pandey[b]** | *October 2020*

*This policy brief from the Climate Policy Lab highlights how blended finance can be used to scale up the deployment of solar water pumps and help ensure that they are well maintained and provide quality service to the water users.*

Solar pumps have the potential to help meet household and agriculture-related water needs in Ethiopia. With Ethiopia's electrification rate standing at only 45%, solar pumps would enable energy access and create multiple co-benefits.[1] Currently, diesel pumps are used in most rural agricultural applications. This oil-based infrastructure not only generates carbon dioxide emissions but also requires costly fuel imports, thereby depleting Ethiopia's limited foreign exchange reserves. The Ethiopian government has initiated publicly funded programs to provide solar pumps under a limited government procurement process that currently does not recover costs. To create a more sustainable program that can be widely scaled up, additional financing models will be needed for the largely unmet needs for water for both household and irrigation use across the nation.

## BACKGROUND

A large market for water pumping exists in Ethiopia. There are an estimated 10,000 community water supply systems using diesel pumps, many of which were provided via grants through federal and state authorities. The systems suffer from increasingly frequent breakdowns in equipment and high costs to access diesel fuel. The market for solar pumps in Africa is expected to grow by 20 percent between 2018 and 2024, with Ethiopia potentially serving as the second-largest market for solar pumps.[2] There are currently about 1,000 solar pumps in operation in Ethiopia. Only approximately 250,000 hectares of agricultural land out of a potential of 5 million are irrigated in Ethiopia at present. Many small farms grow tef and other rain-fed subsistence crops using manual labor and animals. As part of Ethiopia's ambition to become a middle-income country by 2030, improvement of efficiency in the agriculture sector is critical. Ethiopia is also a leading country in the global climate talks. Thus, the country has a strong interest in scaling up its solar water pumping sector.

## BLENDED FINANCE MODELS

Blended finance, that is, a combination of government and private sector infrastructure project funding, is required to bring solar pumps to scale. By lowering the capital costs, a blended finance model will help to gain the interest of investors and developers, while ensuring the beneficiaries are not charged exorbitant rates. Without public finance, solar pumps will be hard to deploy. For example, it is not commercially viable to install solar pumps for household use where the distribution infrastructure

a Climate Policy Lab, The Fletcher School, Tufts University

b Winrock International

1 https://www.iea.org/articles/ethiopia-energy-outlook

2 Research and Markets, Africa Solar Pump Market (2018–2024): Market Forecast for Power Rating by design type, by drive type, by countries and competitive landscape. https://www.researchandmarkets.com/reports/4604474/africa-solar-water-pump-market-2018-2024

*The findings outlined here are based on the site visits and analytical work conducted by a team from Tufts University's Climate Policy Lab (CPL) and Winrock International, which provided an economic feasibility study for the project. The team visited water-pumping sites in Leman, Awash Falte, and Dodiecha in Oromia and in Dangora in Amhara.*

is lacking. Similarly, community irrigation pumps that need bore wells need a grant element to attract private sector interest. Because so little of farmed land in Ethiopia is irrigated, there is a substantial need to not only replace existing pumps but install new ones. Private sector participation in solar water pumping could also bring superior results for preventative maintenance of equipment.

**Solar-powered community water supply pumps for domestic use are financially viable for private sector participation.** According to our calculations, the payback period is 2–3 years (5–year internal rate of return at 20–30%) for replacing diesel pumps with solar ones (with existing distribution infrastructure) in areas that have access to surface water sources. The ideal candidate communities for diesel pump replacement are the ones with pumps that are older than 10 years and face high diesel transportation costs. Public finance is needed in places where distribution infrastructure is not already installed. One blended finance option would be for the private sector to invest in the solar pumps, while public resources are invested in the water distribution systems. In such a model, the payback period for investors in solar pumps would be the same as replacing existing diesel pumps with traditional technology.

**While community solar irrigation systems that utilize surface water are economically viable, shallow and deep well extraction options are not.** Even though larger pumping systems are more cost-efficient than smaller ones, low water prices mean that revenues are lower for irrigation pumps for shallow and deep water wells on a per volume basis compared to household water supply. The commercial proposition of surface water pumps is substantially more favorable to deep wells. The payback period ranges from 1.8 to 5.9 years versus 38 to 127 years for shallow and deep wells respectively (depending on system capacity). Table 1 provides further details. Farmers are willing to pay a higher rate and their farm revenue would increase with regular water supply, but the headroom to increase the tariff is still quite low. Drip irrigation systems would reduce pumping system costs by 50 to 67 percent, but often come with higher irrigation hardware and maintenance costs.

### TABLE 1: FINANCIAL ANALYSIS OF COMMUNITY IRRIGATION SYSTEMS

| | Surface | | Shallow Well | | Deep Well | | |
|---|---|---|---|---|---|---|---|
| Total dynamic head | 5 | | 30 | | 150 | | m |
| Land area irrigated | 67 | | 67 | | 67 | | Ha |
| Annual gross revenue | 7538 | | 7538 | | 7538 | | USD |
| Annual O&M | 640 | | 640 | | 640 | | USD |
| System unit cost | 3.5 | | 3 | | 2.5 | | $/W |
| Daily water supply | **low** | **high** | **Low** | **high** | **low** | **high** | |
| | 7 | 24 | 7 | 24 | 7 | 24 | $m^3$/Ha/day |
| System size | 4 | 12 | 21 | 70 | 105 | 350 | kW |
| System total cost | 12,279 | 40,856 | 63,151 | 210,117 | 263,127 | 875,489 | USD |
| Water price | 0.043 | 0.013 | 0.043 | 0.013 | 0.043 | 0.013 | USD/$m^3$ |
| **Payback period** | **1.8** | **5.9** | **9.2** | **30** | **38** | **127** | **years** |

## KEY RECOMMENDATIONS

**The most salient policy barrier preventing private sector participation is the legal restriction barring private actors from pumping and selling water for community supply or irrigation.** A similar problem surfaced when the Electricity Regulatory Commission considered a petition to set a tariff for a mini-grid wind project. By allowing the private sector to sell water to recoup the cost of installation and provide regular service for community-based solar pumps, the government could unlock private investment where solar pumps are already financially feasible. We recommend the Ministry of Water, Irrigation and Electricity ensure private actors can install and operate solar pumps by authorizing third party sale of water and power via legal reform within the water and irrigation sector.

FOR ACADEMIC CITATION: Bhandary, R., Karber, K., Narassimhan, E., and Pandey, B., "Scaling Up Solar Pumps for Irrigation and Domestic Water Use in Ethiopia: The Role of Blended Finance," Policy Brief, Climate Policy Lab, Center for International Environment and Resource Policy, The Fletcher School, October 2020.

**More data is needed to craft a nation-wide solar pump plan rooted in sound economic analysis. We recommend the government commission a data gathering exercise to identify the exact specifications of the potential market.** Further research is needed to collect information on community water supply prices, including willingness to pay estimates, details of existing diesel irrigation systems (such as borehole depths), and groundwater tables and their recharge processes.

**Government needs to promote innovative business models that focus on energy access, water and sanitation, and agriculture. Government programs can tap multiple entry points for deploying private sector operated and maintained solar power pumps.** For example:

- Solar replacement projects can be combined with the government's rollout of a national mini-grid program to support energy access. Mini-grid operators would receive regular revenue that can then be used to pay for the solar pumps.
- Water, sanitation, and hygiene (WASH) projects are a potential source of investment for solar pumps. The One WASH – Consolidated WASH Account project, funded by the World Bank, aims to provide water supply to 3 million people through 8,260 rural water supply systems and 180 municipal utilities.
- Ethiopia's ambition to significantly expand agricultural production and increase farmer incomes through higher value-added farming such as refrigeration and storage and dairy farming provide another entry point for solar pumps.
- Innovative blended financing could link impact investors and commercial operators together with concessionary loans from the African Development Bank and other multinational lending sources.

There is also a clear need to continue learning from business models that are designed to work in Ethiopia's foreign exchange constrained setting.

**Grant finance needs to be targeted so that it does not distort the market and crowd out private actors.** Currently, the Agriculture Transformation Agency and the Green Climate Fund are supporting projects that give communities pumps on a pure grant basis. There is a possibility that such a financing model may depress demand and prevent the actual scaling up of solar pumps.

## CONCLUSION

The technology for solar pumping is widely available and can be commercialized in the Ethiopian setting. A next step would be for the Ethiopian government to undertake necessary sector reforms and seek investment into pilot projects to demonstrate proof of concept for replacing broken diesel pumps with solar pumps in existing community domestic water systems. These pilots will help to generate the evidence on what kinds of blended finance models work best in the Ethiopian context.

THE CENTER FOR INTERNATIONAL ENVIRONMENT & RESOURCE POLICY

Climate Policy Lab
Center for International Environment and Resource Policy (CIERP)

The Fletcher School
Tufts University
Cabot Intercultural Center, Suite 509
160 Packard Avenue, Medford, MA 02155
sites.tufts.edu/cierp

CLIMATE POLICY LAB