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Scaling Investment for Africa's Clean Energy Transformation:

A Case Study in Ethiopia

16 January 2020

IKI Mobilising Investment Project



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Managed by SouthSouthNorth to support 7 countries including Ethiopia, this project emanates from German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) for under the International Climate Initiative (IKI). The title of the project is Mobilising Investment (MI) for NDC Implementation. The project duration is approximately 3 years and runs from September 2017 to March 2020.

SouthSouthNorth SSN is supporting the Government of Ethiopia through the Ministry of Water, Irrigation and Energy to establish an investment-friendly environment to attract private capital in the renewable energy sector, broadly, and in the mini-grid sector, specifically. Veritas Consulting/Powerhive has been engaged by SSN to develop common/bankable productive uses that can be commercially scaled, a financial model, and to identify regulatory constraints and propose recommendations on regulatory amendments and private investment opportunities for mini-grid power generation in viable off-grid areas in Ethiopia.

Background – Activities Leading to this Engagement

SouthSouthNorth process and approach to this work...



New Regulations – Licensing



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In January 2019, Regulation No. 447/2019 was ratified that aims to govern the following:

- Licensing and certificate of competency of companies
- Generation, transmission, and distribution of energy
- Tariff rate structures
- Energy efficiency and conservation

The regulation licensing structure is segmented to power generation levels of

1. **> 10MW**
2. **< 10MW**

Draft directives are currently underway by EEA. Two are of particular relevance:

Rural electrification minimum design standards directive

- Design standards for the grid
- Prescribes a cost-effective **minimum standard**

Licensing requirements for off-grid directive

There are two tiers to this directive:

1. For **on-grid** systems > 50kw
2. For **off-grid** systems < 50kW, which is pertinent to **mini-grids**.

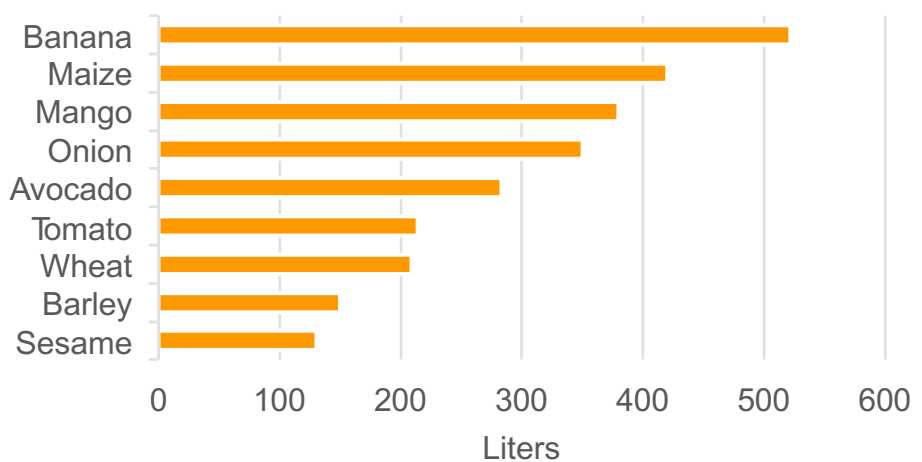


Irrigation for agriculture use

Background

- **Irrigation refers to both the pumping and distribution of water** for growing crops, including the use of water storage, where appropriate. The energy demand for irrigation purposes is the energy required to lift water by pumping from surface sources, such as ponds, streams, or canals; or from below-ground sources using open wells or boreholes AND distributing it across to the crops
- Water for irrigation agriculture is available, **with 122 billion cubic meters of surface water and 2.6 billion cubic meters of ground water**
- Conservative estimates show that shallow ground water resources distributed throughout Ethiopia has the **potential to irrigate 1.16 million hectares of land at the household level with resources at the depth of less than 30 meters (ATA)**

Water needs to grow one kg



Value chains that require irrigation

Fruit	• Banana • Mango • Avocado
Vegetables	• Tomato • Onion
Cereals	• Wheat • Maize • Barley

Impact with energy

- Viable alternative to Ethiopia's **unpredictable rainfall patterns** by stabilizing production and increasing yields
- Farmers can produce several and diverse range of crops multiple times a year; **currently most farmers harvest 1x per year**
- Potentially **valuable component of climate adaptation strategies** as it increases resilience to cope with climate variability

Background

- Water pumps **move water from under the ground to above ground** for usage, particularly for troughs for livestock and water points for communities
- Ethiopia has the **fifth highest livestock population in the world**. And production is concentrated in the rural communities which are **still purely dependant on rainwater** but with the lowest rate of milk production per head in sub-Saharan Africa
- This has a **direct effect on the quantity and production of milk** – as milk is comprised of over 90% of water, as well as the production of feed and fodder
- ATA has **confirmed the substantial presence of shallow ground-water** at less than 30 meters in large parts of the country, and this is a viable source to tap in for both livestock input and for communities

Users of water lifting technologies

Livestock

- Dairy cows
- Poultry

Communities

- Households



Livestock	Quantity	Water consumption in lts
Egg	1 egg	196
Milk	1 x 250 ml	255
Cheese	1 kg	3,178
Chicken meat	1 Kg	4,325
Butter	1 kg	5,553
Beef	1 kg	15,415

Source UK institute of mechanical engineers

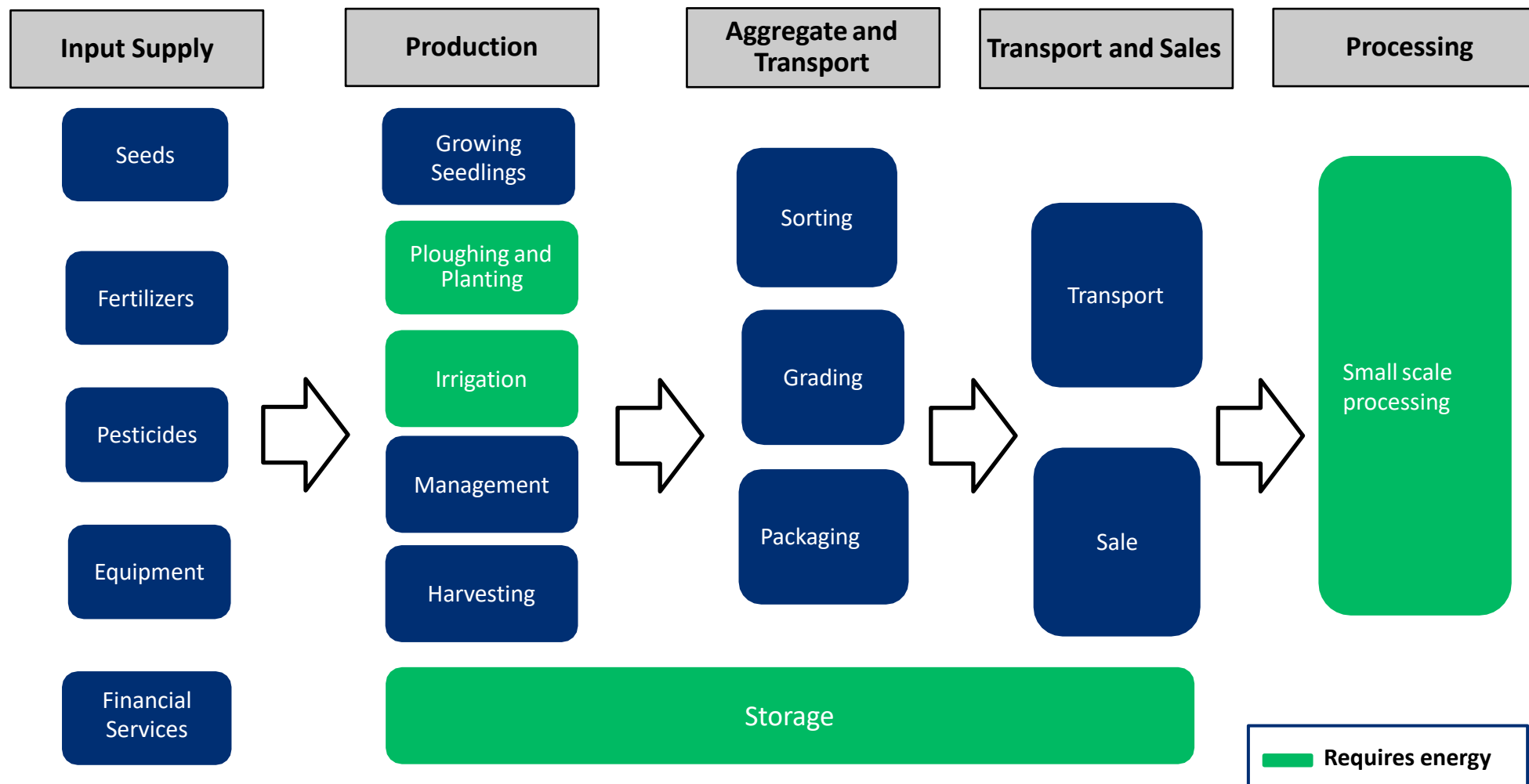
Impact with energy

- Dairy cows would now be able to drink year-round thus producing more milk and potentially more milk byproducts
- The water can also be used as an input to produce fodder for both cows and poultry which also contributes to increased production

Horticulture Value Chain



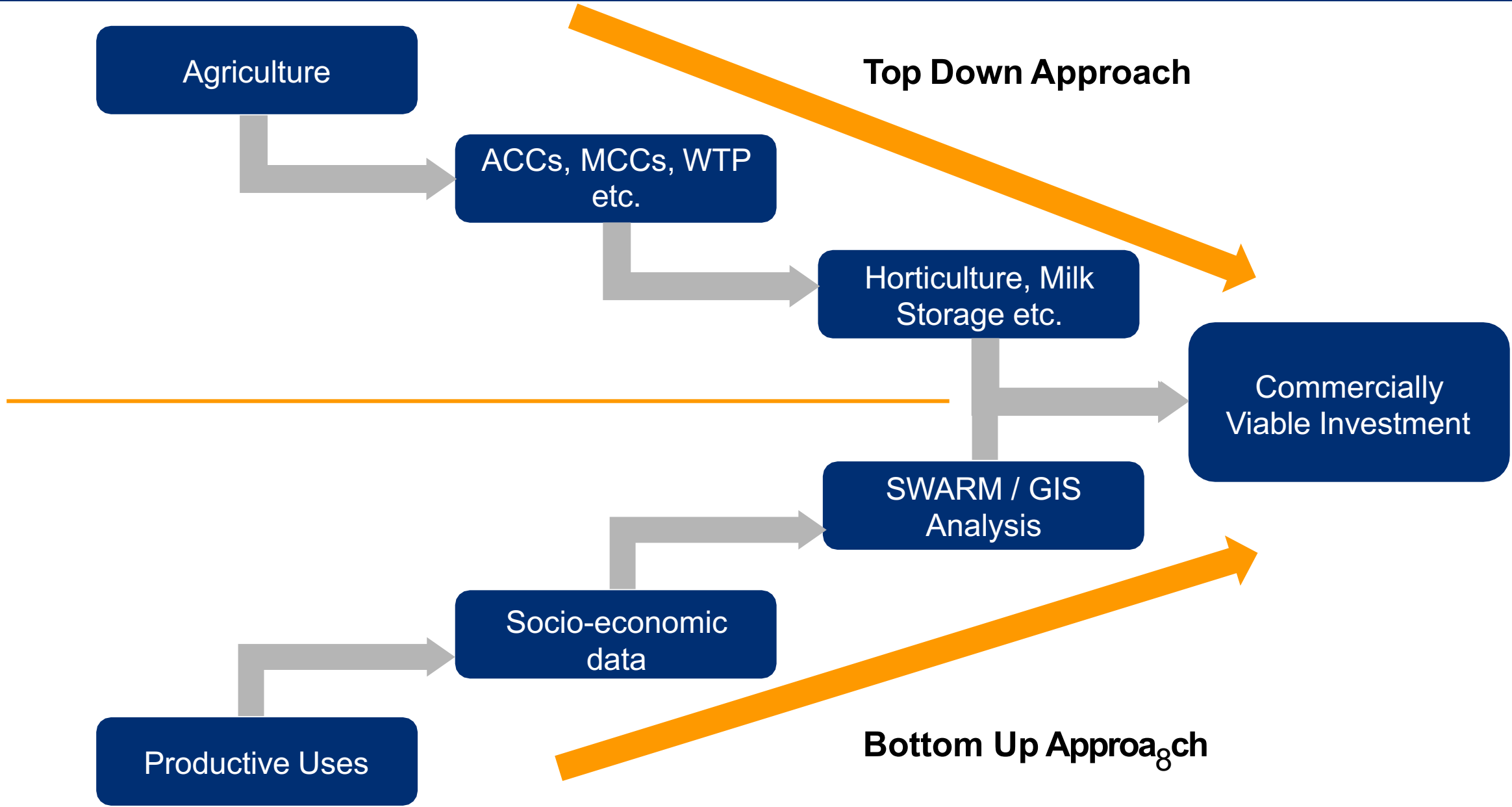
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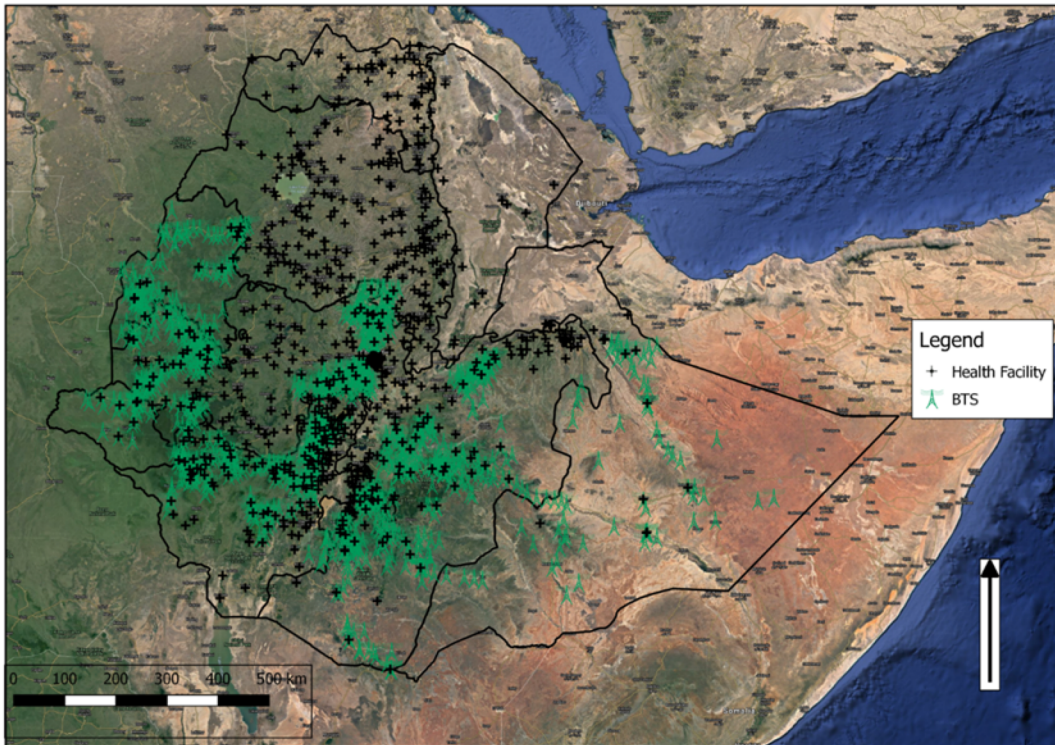
Pathways to Commercial Viability



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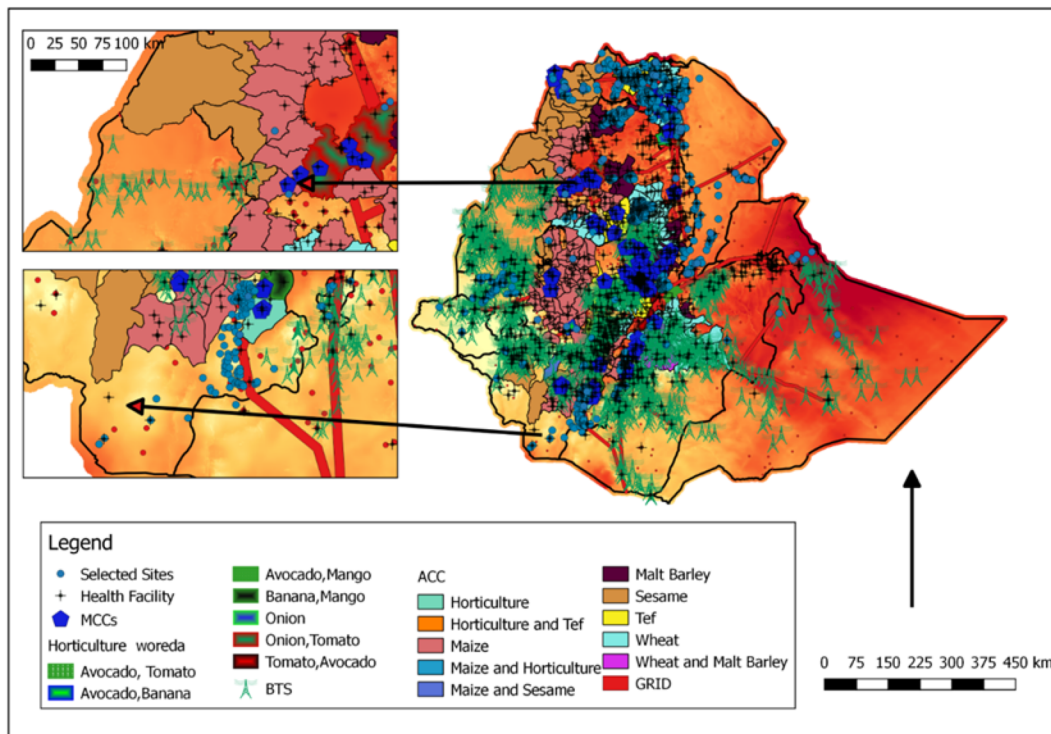


Basic socioeconomic data



- **BTS towers health facilities, and shallow ground water** were identified in this image.
- The data indicates that **BTS towers** and **health facilities** tend to overlap.
- However, there is very limited overlap between **shallow groundwater points**, and **health facilities** and **BTS towers**.

National level mapping



SWARM output

- SWARM, Powerhive's programming software, was then run to select sites with rooftops indicating at least 200 households (as indicated by rooftops) within a radius of 1 km. This was the initial filter.
- Thereafter, the software identified socioeconomic concentrations along the parameters identified in table 1 and figures 7 and 8.
- The process identified over 1,471 sites as potential areas for mini-grid development.

Site determination - Bottom Up or Top Down



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Two approaches were employed in identifying potential sites for minigrid investment.

Bottom-Up Approach

A plethora of data sources were utilized as input data for the selection process with over 1,500 potential sites identified.

Solar Irradiation Data

- Solar irradiation

Shallow Ground Water Data

- (From ATA)

Social Amenities

- Location of schools, clinics, etc

Base Transceiver Stations

- Telecom towers

National Grid Line

- Triangulated from BTS data, Black marble technology and other sources

Top-Down Approach

- What ideas are **scalable national projects** that we can leverage?
- Which initiatives do we engage? And how do we engage them?

ACCs

- Agriculture Commercialization Clusters by ATA and MoA

MCCs

- Milk Collection Centers – MoA / USAID Feed the Future

Agro Industrial Parks

- Agro Industrial Parks – PMO / MoTI

WTP

- Multi Sectoral Woreda Transformation –PMO / cross Ministerial.

Agriculture Commercialization Clusters



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- NEP 2.0 has identified the ACCs as the key conduit for product use expansion in off-grid power expansion
- The ACCs integrates interventions prioritized within specific geographies targeting a limited number of high-value commodities
- This integration allows smallholders and value chain actors to benefit from access to coordinated interventions
- More developed communities with the ACC form into Farmer Production Clusters (FPCs) of up to 200 farmers, where the farmers consolidate purchases, farm as one unit, and market their products in bulk

Summary of ACCs

- Producing the same product
- 284 clusters
- 1.2m farmers
- 284 woredas

Cereals

- Wheat
- Maize
- Sesame
- Malt Barley

Horticulture

- Tomato
- Onion
- Banana
- Mango
- Avocado

Energy
within
the ACCs

Farmers can:

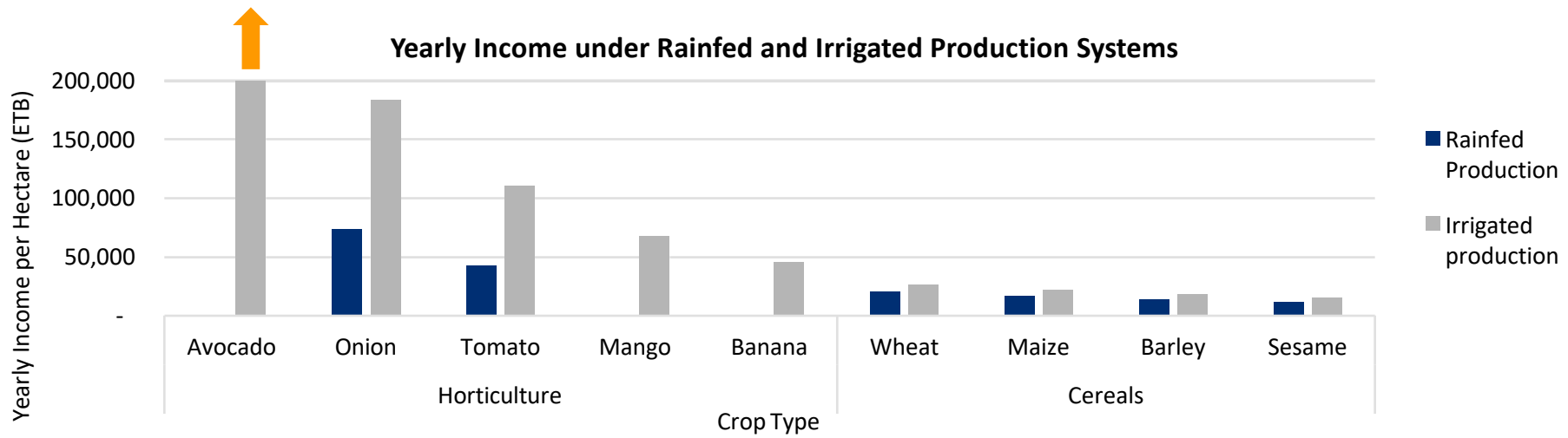
- ✓ Achieve economies of scale
- ✓ Maintain a proper post-harvest environment
- ✓ Collectively enter into contracts with service providers
- ✓ Engage in markets with greater strength
- ✓ Obtain better prices



The Case for Horticulture within ACCs

Five of the primary commodities in the ACC sites are horticulture crops. They have been chosen as focus crops over cereals due to the following reasons:

- **Income potential**
 - ✓ A horticulture farmer can earn up to 10x higher than cereal farmers under ideal circumstances
 - ✓ Farmers have much higher income to buy industrial level services, including electricity
- **Infrastructure**
 - ✓ Horticulture requires energy in pre-harvest, harvest and post-harvest seasons which means there is a high demand for energy
- **Sustainability**
 - ✓ The decision to grow perennial crops requires much higher levels of commitment and investment than it does for cereals
 - ✓ Once a farmer has planted a tree, it means s/he is in the business for 20 years, at least



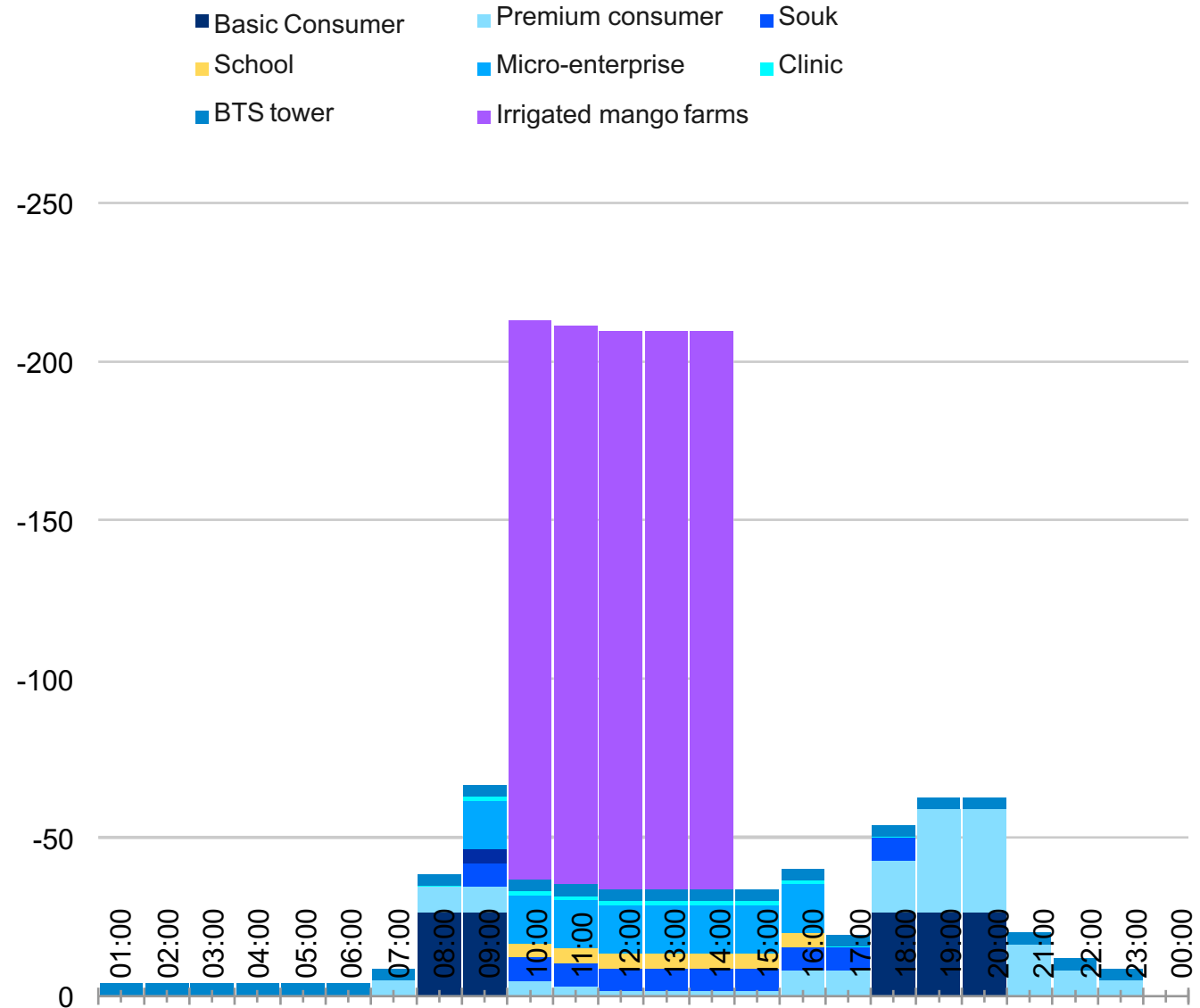
- Perennials and cereals have typically higher yields with irrigation. The yield increase has been assumed to be 30% for both in this case.
- Onions and Tomatoes have, in addition to 30% and 25% yield increase (respectively), multiple (2-3) harvests under irrigation.

- **Income from rainfed horticulture production is on average 3x that of cereals without irrigation, it becomes 4.3x that of cereals with irrigation.**



Load Profile – Demand Assessment

User Segment	# in site	kWh/user/day	Total kWh/day
Basic Consumer	880	0.15	132
Premium consumer	200	0.81	162
Souk	36	2.03	73
School	12	3.04	37
Micro-enterprise	24	5.07	122
Clinic	1	15.21	15
Religious center	5	0.67	3
BTS	1	84	84
Irrigated mango farms	400	2.2	891





Validations To Better Understand Load Profiles

MoWIE/EEU – EPC Validation (50)

- Site selection principally by **population density** and **distance from grid**.
- conduct site by site **geo-tagging** and assessment of consumer and commercial **user loads**.
- **33 are complete** and the balance will be complete within two weeks

Bottom Up (10)

- 6 sites identified by GIS mapping will be validated subsequently in addition to the 4 sites that have already been validated.

Top Down (10)

- Ten additional sites will be validated in December for potential private sector private investments**
- These will be in the **Agriculture Commercialization Clusters**.
 - The focus will be on **horticulture clusters** which are particularly aided by **irrigation**.
 - These are intended to aid the **development of specific investment cases** for each site.

By December, around seventy site validations will have been completed.

- Baseline data on:
 - ✓ Potential **willingness to pay**
 - ✓ Typical **load profiles** for various types of communities
 - ✓ Specific **user profiles** for communities with agriculture clusters
 - ✓ **Use case modalities** for **irrigation** centric communities

Well organized Pilots are a critical part of sector growth

Ten Potential top-down pilots are slated for 2020

Learnings

- As there is very little Ethiopia experience in private investments in the minigrid sector, conducting a pilot is important to inform broader investments. Information about rate structure, usage data across segments, logistics, stakeholder management will be important.

Close Coordination with GoE

- The participation of **GoE is crucial for win-win scalability** of any project in Ethiopia. Engaging government in a pilot will help set a trend for future cooperation in the sector.

Identify and Mitigate Challenges

- The pilot will also, in cooperation with GoE) help to identify and continue ongoing streamlining of investment in private minigrids in Ethiopia.

Demonstrate Viability

- The pilot can demonstrate that private minigrids are indeed viable and that a win-win situation can be ensured for both investors and communities.

Identify and Mitigate Challenges – Build on New Regs and Directives



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Identified Regulatory Challenges	Possible Resolutions	Potential Workarounds
Continued improvements in registration process	Streamline the consultative approach with community, EEA and regional EEU	International best practices / regional observations (Rwanda, etc.)
Exclusivity has to be defined	Parameters required by government articulated in licensing process	Parameters required by government articulated in licensing process
Offering assets such as pumps for irrigation would require a separate set of investment licenses	Regulatory solution through MoA or ATA	Engage MFIs as ‘middlemen’
Repatriation of capital and profits could be a challenge for mini-grid investors	Ensure that the ministry of finance guarantees repatriations on a timely basis (NBE, MoFEC)	Tap into insurance programs to de-risk investment
Substantial investment is required before rate structure is approved	Consultative approach with EEA	Consultative approach with EEA

Demonstrate Viability



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Initial pilots will prove the viability of private investments in the minigrid sector under the ABC model

Ascertaining win-win for investors and the community

The pilot will demonstrate that

- Investors will be profitable if they engage in this sector. It will also give an estimate of how much.
- All sections of the communities in which mini-grids are built will benefit from the investment.
 - ✓ **Anchor customers** will have a boost in productivity and income, as expected.
 - ✓ **Business customers** will provide better quality services and some businesses will potentially expand.
 - ✓ **Community (Household) customers** will have access to electricity paying par equity tariff with grid customers.

Socio-economic data collection and assessment

- During the pilot, socio-economic data will be collected. Assessments will be conducted that will provide concrete information for future investments concerning what major factors contribute to the viability of private investments.

Key Next Steps



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Program Definition

- Develop the program in terms of requirements, resources, bidding packages, regulatory requirements and exemptions, etc.

Technical Assistance

- Given lack of existing track record and expertise in Ethiopia, a TA package should be provided to selected operator(s)

Funding

- In order to de-risk the proposition in pilot phase, a significant amount of concessionary funding should be made available

Stakeholder Engagement

- The success of the pilot in terms of adaptation into country-wide program depends on close collaboration between developer(s), MoWIE, EEU, EEA, and ATA