TEAM T-RECS
SOLAR IRRIGATION SYSTEMS FUND

Solar Irrigation Systems Fund

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Line Cottier
Daniel Dieckmann
Felix Hatzold

Lagging agricultural productivity as a major barrier to food security in Sub-Saharan Africa

In Sub-Saharan Africa,

26% of households currently face food insecurity,

a figure only expected to grow as agricultural productivity lags behind demographic pressures.

This challenge is further exacerbated by climate shocks like droughts causing

climate-related crop losses of around 30%

in SSA.

Yet, less than

20% of required climate finance

for adaptation and mitigation in agriculture is currently being met.

Sources:
Global Green Growth Institute (October 2024). GGGI Technical Report No.39: Solar Powered Irrigation Systems (SPIS) Potential and Perspectives in sub-Saharan Africa
Lighting Global, The World Bank, & International Finance Corporation. (2019). The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa
World Bank. (2020). Accelerating Irrigation Expansion in Sub-Saharan Africa: Policy Lessons from the Global Revolution in Farmer-Led Smallholder Irrigation.

Productive use leveraging solar energy (PULSE) as a next frontier for fighting food insecurity and empowering farmers economically

Status Quo

- Currently, less than **5% of the cultivated land is irrigated**, corresponding to 6 mio. hectares in SSA

With Solar Irrigation, a key PULSE application

- Solar irrigation could **offset at least 30% of climate-driven crop losses**
- This leads to up to **5x higher and more stable yields**, in turn increasing farmer incomes
- Overall, investment in agriculture is **up to 11 times more effective in reducing extreme poverty** than investment in any other sector in Sub-Saharan Africa

The **market for solar powered irrigation systems in SSA** currently has a serviceable market volume of USD 913 million and a CAGR of 13%, **projected to reach USD 1.63 billion by 2030**.

Sources:
Lighting Global, The World Bank, & International Finance Corporation. (2019). The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa.
Accelerating Irrigation Expansion in Sub-Saharan Africa: Policy Lessons from the Global Revolution in Farmer-Led Smallholder Irrigation, World Bank, 2020
GGGI Technical Report No.39: Solar Powered Irrigation Systems (SPIS) Potential and Perspectives in sub-Saharan Africa October 2024

$1.6B potential solar irrigation market is stuck in a financing trap

What limits the adoption of Solar Irrigation Systems (SIS)?

Farmer's perspective

Too high upfront costs

- Upfront costs of around USD 600 for a solar pump, which is challenging for farmers due to lack of savings

Lacking access to financing

- Local FIs are hesitant to finance farmers due to credit risk and low margins

Developer's perspective

Liquidity gap

- Local FIs are hesitant to finance developers due to credit risk and low margins
- Foreign loans/investment expose them to significant FX risk

How can this problem be solved?

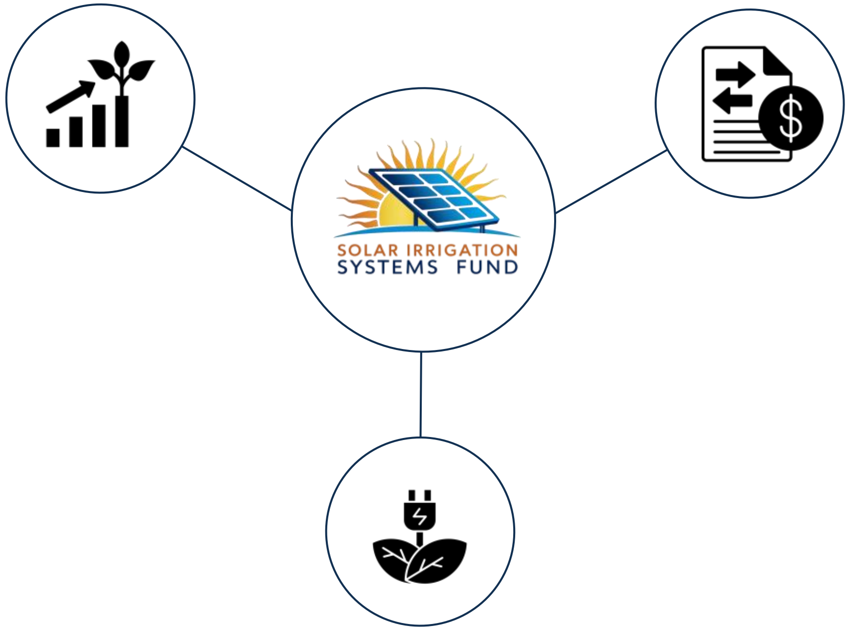
https://elicofoundation.org/solar-powered-irrigation-systems-transforming-smallholders-farming-practices-in-rural-tanzania/

The Solar Irrigation Systems Fund is a blended finance vehicle which finances receivables and uses RECs

The innovation of the SIS Fund is based on three pillars

Blended Finance vehicle

- *Definition:* **De-risk the investment** for commercial investors by including concessional capital
- *Goal*: Increase the fund size by **attracting private investors** despite high risk and marginal returns



Receivables Financing

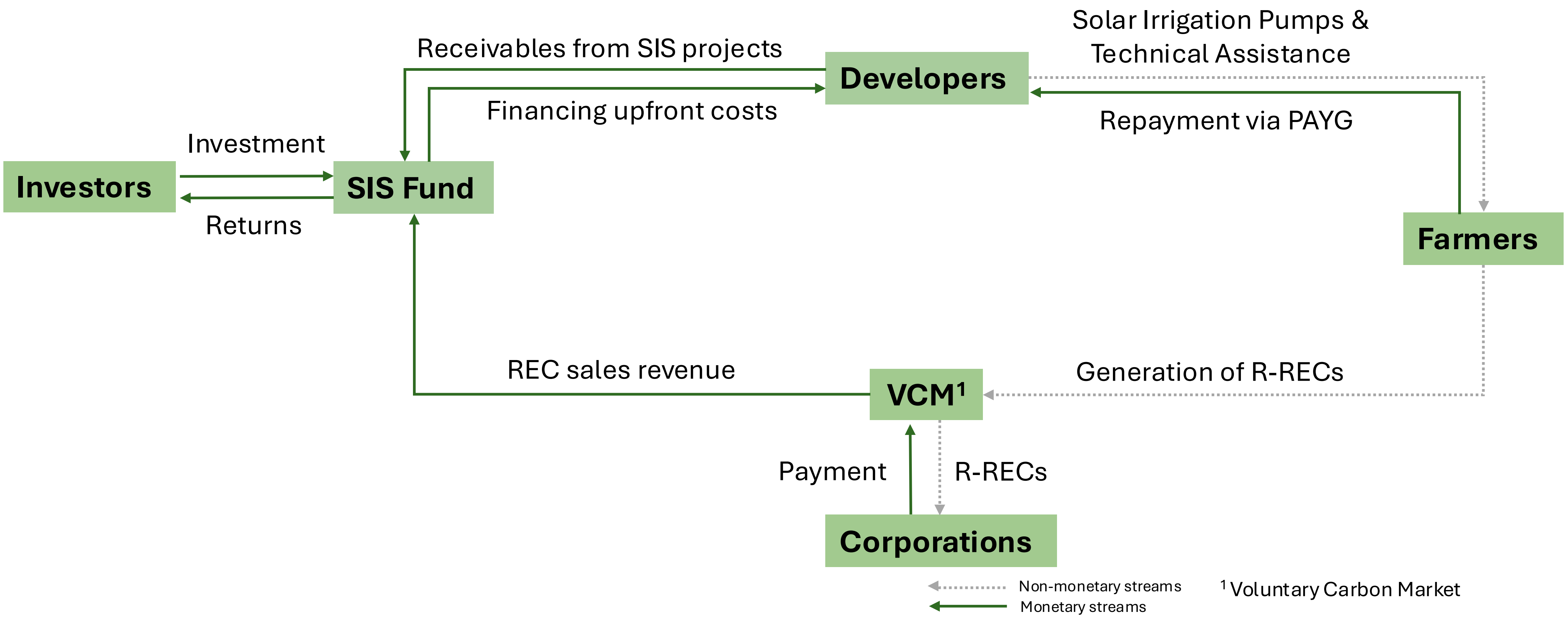
- *Definition*: **Financing upfront costs** to get payments back over multiple years
- *Goal*: **Enable developers to scale up operations** by overcoming liquidity gaps

Renewable Energy Certificates (RECs)

- *Definition:* Proof of 1 MWh of **renewable energy generation** at a specific site
- *Goal*: **generate an additional revenue stream** to make the investment more attractive and partially hedge the FX risk

The SIS Fund uses receivables financing to enable solar irrigation projects

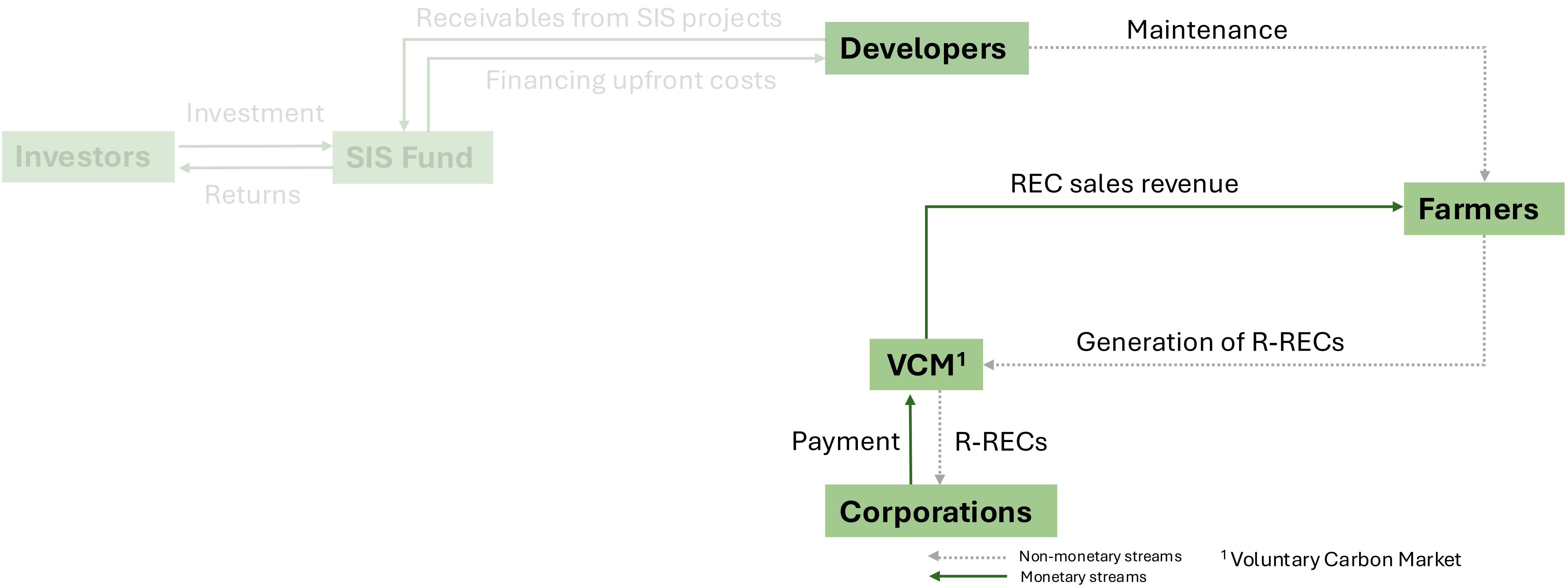
Structure of the SIS Fund



[1] Voluntary Carbon Market

After the end of SIS projects, farmers get continuous revenues from RECs

Revenue for farmers after SIS project payment ends



[1] Voluntary Carbon Market

Our blended finance approach enables the SIS projects by de-risking the investment for commercial investors

Development Banks

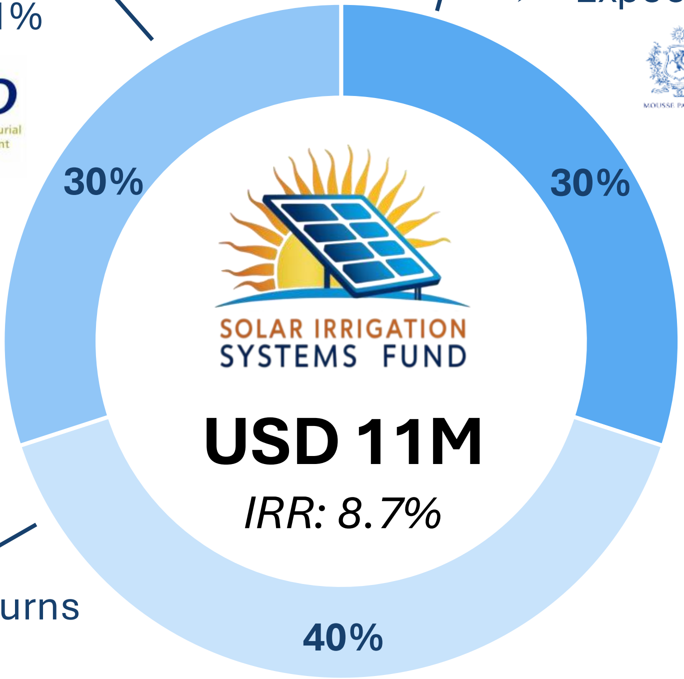
- Seeking impact
- Senior Debt
- Expected returns: 3.1%

WORLD BANK GROUP | AFRICAN DEVELOPMENT BANK GROUP | FMO Entrepreneurial Development Bank

Family Offices & HNWI

- Seeking returns
- Equity
- Expected returns: 15%

MOUSSE PARTNERS | SOROS Fund Management LLC



Impact investors

- Seeking impact & returns
- Mezzanine Debt
- Expected returns: 8.2%

Acumen | responsAbility

Developer 1

Number of Projects:	6’340
Investment:	USD 4.2M
Return from receivables:	USD 7.7M

Developer 2

Number of Projects:	5’450
Investment:	USD 3.6M
Return from receivables:	USD 6.6M

Developer 3

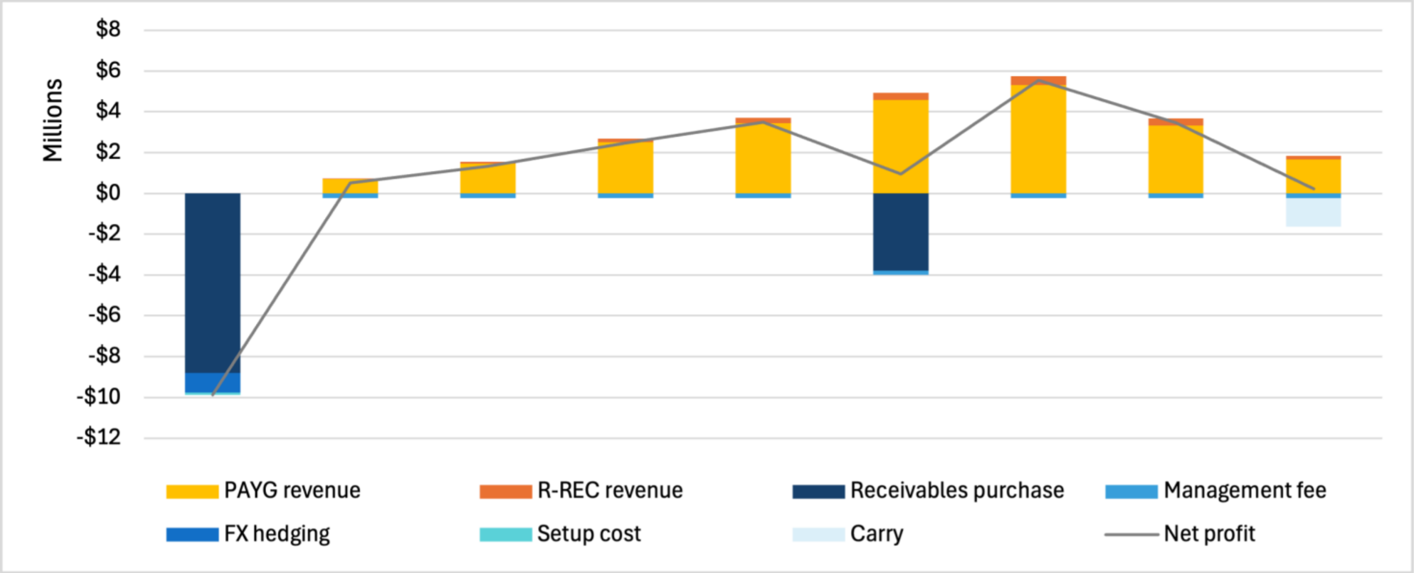
Number of Projects:	5’630
Investment:	USD 4.2M
Return from receivables:	USD 7.5M

Developer 4

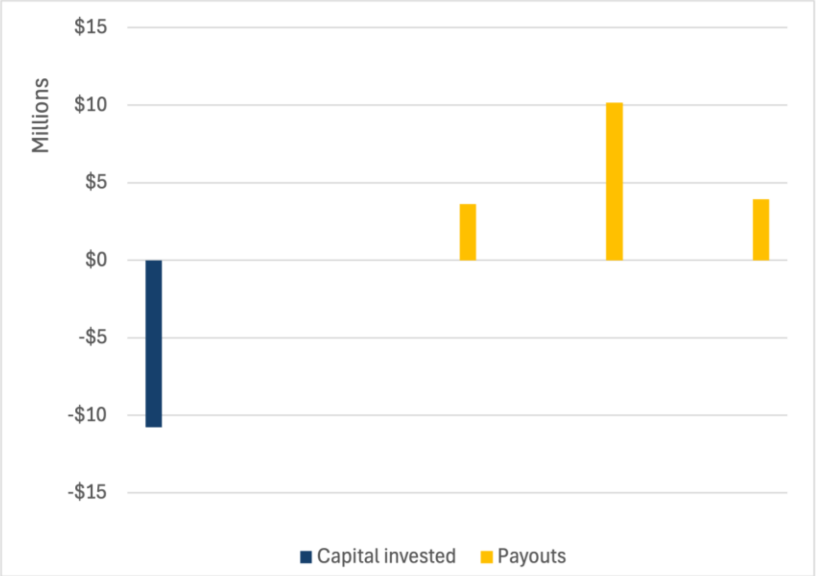
Number of Projects:	1’480
Investment:	USD 4.2M
Return from receivables::	USD 1.9M

Key metrics of fund performance and investor outcomes

Fund Cash Flows



Investor Cash Flows



Projects

Pumps installed:	**15k**
Irrigation area:	**22k acres**
Pump repayment:	**3 years**
Farmer monthly cost:	**~34 USD**
Farmer defaults:	**18-20%**

Fund terms

Fund lifetime:	**9 years**
Management fee:	**2%**
Fund setup cost:	**120K**
Carried interest:	**15%**
Hurdle rate:	**7.5% [IRR]**

Investor metrics

Investment:	**USD 11M**
Payouts:	**3**
Net profit:	**USD 6.95 M**
ROI:	**175%**
Overall IRR:	**8.7%**

We aim to select 3-6 companies out of our long list of 20+ potential investment targets

1. Screening

2. Due diligence

3. Selection

1. Longlist of 20+ potential partners

Ignite Energy Access · SOLARGEN · SunCulture · Balton Tanzania · MUSTLEAD · Simusolar · sprinktech Limited · ENERGY4IMPACT powered by Mercy Corps · Power Providers · SOLEKTRA · Weis Engineering · Balton Uganda · Futurepump · E Power · Open construction & Related services LTD · SunSweet Solar · SIRACO Irrigation · endev · Enagyl · Nexus Green · Vida Verde · Water & Pumps International

2. Shortlist of 8-10 companies which make it to the DD

3. Choice of 3-6 companies the SIS fund partners with

Scaling up from small pilot to SSA-wide receivables SPV

Three stages expansion plan

Phase 1: PILOT

- Fund Size: **$11M**
- Goal: **Validate repayment rates** in 2-3 countries in East Africa
- Capital stack:
    - 30% Senior Debt
    - 40% Mezzanine Debt
    - 30% Equity

Phase 2: SCALE

- Fund Size: **$50M+**
- Goal: **Expansion across SSA**
- Capital Stack:
    - 25% Senior Debt
    - 35% Mezzanine Debt
    - 40% Equity

Phase 3: MATURITY

- Goal: **Transition to local FIs**
- Structure:
    - Debt Funds by local commercial banks
    - Inclusion of Pan-African pension Funds

The SIS Fund faces credit risks, currency risks and cash outflow risks which need to be mitigated

Risk	**Credit risk** Farmers may not repay their receivables due to volatile income	**Currency risk** The local currency might depreciate, resulting in a loss when converting to USD	**Cash outflow risk** Local FIs might lack sufficient USD reserves to handle large-scale conversions
Mitigation Strategy	**Harvest-adjusted PAYG scheme** Farmers can repay their receivables over three years. External deactivation via SIM as a last resort.	**TCX Hedging** The SIS Fund hedges 70% of the receivables with cross-currency swaps from TCX	

Expected positive impacts include income increases for farmers of more than double compared to baseline

*This corresponds to over **3.5 M flights** around the circumference of the world per year*

7 AFFORDABLE AND CLEAN ENERGY

Over **90,000 MwH** generated for over **120,000 livelihoods**, or **1.1 people per $100** invested

13 CLIMATE ACTION

Nearly **25 MtCO2e** avoided per year

2 ZERO HUNGER

More than **40,000 additional people fed** per year

8 DECENT WORK AND ECONOMIC GROWTH

Annual farmer incomes increased by more than 700 $

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

15,120 modern irrigation systems deployed

5 GENDER EQUALITY

Over **3,600 female farmers** bene-fitting (60% of farmers targeted)

Impact risks: Identifying both positive and negative spillovers is key

To be funded through targeted TA and grants (e.g. by the SDC or AFD)

SDG	Potential Risks	Our response
SDG 7: Affordable and Clean Energy	Decreasing incentives to expand access to electricity grid network to rural areas	Fund a Randomized Contol Trial studying extensive spillover effects
SDG 13: Climate Action	Water over-use and groundwater depletion	Most farmers use accessible surface water. Use smart meters to enforce usage limits.
SDG 2: Zero Hunger	Increased yield through irrigation does not guarantee storage facilities or market access.	Include comprehensive capacity building trainings going beyond system maintenance. Partner with solar storage providers.
SDG 8: Decent Work and Economic Growth	Exclusion of low-income farmers; repayment pressures creating temporary debt trap	Refine PAYG possibilities and grace periods considering harvesting cycles in repayment periods
SDG 9: Industry, Innovation, and Infrastructure	Remaining waste after pump is no longer usable	Collaborate with partners specializing in recycling of metal waste
SDG 5: Gender Equality	Intra-household bargaining tensions due to female empowerment; unsecured land rights for women	Provide community sensitization trainings in collaboration with specialized NGO

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SDG 2: Zero Hunger	Increased yield through irrigation does not guarantee storage facilities or market access.	Include comprehensive capacity building trainings going beyond system maintenance. Partner with solar storage providers.
SDG 8: Decent Work and Economic Growth	Debt trap due to interest rates	Offer complementary training in effective debt management; consider harvesting cycles in repayment periods
SDG 9: Industry, Innovation, and Infrastructure	Remaining waste after pump is no longer usable	Collaborate with partners specializing in recycling of metal waste
SDG 5: Gender Equality	Intra-household bargaining tensions due to female empowerment; unsecured land rights for women	Provide community sensitization trainings in collaboration with specialized NGO

Our team

Felix Hatzold
MSc Sustainable Management and Technology
EPFL, IMD & UNIL

Line Cottier
MSc Economic Policy for International Development,
London School of Economics and Political Science

Daniel Dieckmann
MSc Sustainable Management and Technology
EPFL, IMD & UNIL

TEAM T-RECS
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Be part of the solution.
Let's grow impact together.

Daniel Dieckmann   Line Cottier   Felix Hatzold

Questions?

TEAM T-RECS
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Solar Irrigation Systems Fund

Line Cottier: cottier.line@gmail.com

Daniel Dieckmann: dieckmann.daniel@gmx.de

Felix Hatzold: f.hatzold@gmx.ch

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Appendix

Financials for one Developer A

Developer A (Tanzania)										
Year	0	1	2	3	4	5	6	7	8	Total over fund lifetime
Projects										
Number of new pumps		480	630	900	1230	1550	1550	0	0	6,340.00
Numer of new pumps (non default)		384	504	720	984	1240	1240	0	0	5,072.00
Number of pumps running (after defaults)		384	888	1608	2208	2944	3464	2480	1240	
Cost for developer										
Cost for pumps		$ (268,800.00)	$ (352,800.00)	$ (504,000.00)	$ (688,800.00)	$ (868,000.00)	$ (868,000.00)	$ -	$ -	
Installation costs		$ (21,600.00)	$ (28,350.00)	$ (40,500.00)	$ (55,350.00)	$ (69,750.00)	$ (69,750.00)	$ -	$ -	
Maintenance for pumps		$ (9,600.00)	$ (22,200.00)	$ (40,200.00)	$ (55,200.00)	$ (73,600.00)	$ (86,600.00)	$ (62,000.00)	$ (31,000.00)	
Cost for training on pumps and farming (water use)										
Total cost (= cost receivables)		$ (300,000.00)	$ (403,350.00)	$ (584,700.00)	$ (799,350.00)	$ (1,011,350.00)	$ (1,024,350.00)	$ (62,000.00)	$ (31,000.00)	$ (4,216,100.00)
Revenue from farmers										
Revenue from upfront payment		$ 33,600.00	$ 44,100.00	$ 63,000.00	$ 86,100.00	$ 108,500.00	$ 108,500.00	$ -	$ -	$ 443,800.00
Monthly payments from farmers		$ 165,888.00	$ 383,616.00	$ 694,656.00	$ 953,856.00	$ 1,271,808.00	$ 1,496,448.00	$ 1,071,360.00	$ 535,680.00	$ 6,573,312.00
Income from pump repropriation		$ 35,481.60	$ 46,569.60	$ 66,528.00	$ 90,921.60	$ 114,576.00	$ 114,576.00	$ -	$ -	
Total revenue		$ 234,969.60	$ 474,285.60	$ 824,184.00	$ 1,130,877.60	$ 1,494,884.00	$ 1,719,524.00	$ 1,071,360.00	$ 535,680.00	$ 7,485,764.80
RECs										
Number of RECs generated		120.96	279.72	506.52	695.52	927.36	1091.16	781.2	390.6	
Revenue per REC		$ 33.00	$ 34.65	$ 36.38	$ 38.20	$ 40.11	$ 42.12	$ 44.22	$ 46.43	
Total revenue from RECS		$ 3,991.68	$ 9,692.30	$ 18,428.46	$ 26,569.99	$ 37,197.99	$ 45,956.70	$ 34,547.13	$ 18,137.24	
Net profit										
Profit		$ (61,038.72)	$ 80,627.90	$ 257,912.46	$ 358,097.59	$ 520,731.99	$ 741,130.70	$ 1,043,907.13	$ 522,817.24	$ 3,464,186.30
Summary										
Purchase of receivables	$ (2,951,270.00)					$ (1,264,830.00)				$ (4,216,100.00)
Cost of hedging	$ (314,402.12)									
Income from RECS	$ -	$ 3,991.68	$ 9,692.30	$ 18,428.46	$ 26,569.99	$ 37,197.99	$ 45,956.70	$ 34,547.13	$ 18,137.24	$ 194,521.50
Income from receivables	$ -	$ 234,969.60	$ 474,285.60	$ 824,184.00	$ 1,130,877.60	$ 1,494,884.00	$ 1,719,524.00	$ 1,071,360.00	$ 535,680.00	$ 7,485,764.80
Total income	$ -	$ 238,961.28	$ 483,977.90	$ 842,612.46	$ 1,157,447.59	$ 1,532,081.99	$ 1,765,480.70	$ 1,105,907.13	$ 553,817.24	$ 7,680,286.30
Net profit	$ (3,265,672.12)	$ 238,961.28	$ 483,977.90	$ 842,612.46	$ 1,157,447.59	$ 267,251.99	$ 1,765,480.70	$ 1,105,907.13	$ 553,817.24	$ 3,149,784.18
Project IRR										15.13%

Assumptions	
Market	
Installation costs new pump	45
Costs per pump per month	36
Down payment per pump	70
Default rate	20%
Recuperation percentage defaults	66%
Maintenance cost per pump per year	25
Cost per pump	560
Total cost per farmer	1366
RECS	
Watt per pump	300
Days with irrigation per year	210
Hours with irrigation per day	5
Price R-REC	33
Wh per R-REC	1000000
REC growth	5%
Fund	
Hedging cost as percentage	6.00%
Lifetime of the fund	9
Splitting of receivables (now/year 5)	70.00%
Carried interest	20.00%
Percentage of receivables hedged	70.00%

Overview fund returns

SIS Fund										
Year	0	1	2	3	4	5	6	7	8	
Total number of pumps	0	1112	1512	2112	2896	3744	3744	0	0	15,120.00
Total acres covered	0	1668								22,680.00
Total Revenue	$ -	$ 710,052.04	$ 1,485,686.17	$ 2,559,710.29	$ 3,520,545.85	$ 4,699,114.86	$ 5,449,097.68	$ 3,438,877.06	$ 1,728,933.64	$ 23,592,017.60
Cost										$ -
Costs for receivables	$ (8,801,441.25)	$ -	$ -	$ -	$ -	$ (3,772,046.25)	$ -	$ -	$ -	$ (12,573,487.50)
Cost for hedging	$ (966,383.46)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (966,383.46)
Setup fee	$ (120,000.00)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (120,000.00)
Total cost (without management fee)	$ (9,887,824.71)	$ -	$ -	$ -	$ -	$ (3,772,046.25)	$ -	$ -	$ -	$ (13,659,870.96)
Management fee		$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (1,760,000.00)
Total cost (with management fee)	$ (9,887,824.71)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (3,992,046.25)	$ (220,000.00)	$ (220,000.00)	$ (220,000.00)	$ (15,419,870.96)
Total required capital										$ 11,000,000.00
Net cash flows of SIS Fund (before carry)	$ (9,887,824.71)	$ 490,052.04	$ 1,265,686.17	$ 2,339,710.29	$ 3,300,545.85	$ 707,068.61	$ 5,229,097.68	$ 3,218,877.06	$ 1,508,933.64	$ 8,172,146.64
Cash flows investors										
Required capital	$ (10,767,824.71)	$ -	$ -	$ -	$ (4,652,046.25)	$ -	$ -	$ -	$ -	$ (15,419,870.96)
Capital calls		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (10,767,824.71)
Total revenue (V1)	$ -	$ -	$ -	$ -	$ 8,275,994.36	$ -	$ -	$ -	$ 15,316,023.24	$ 23,592,017.60
Total revenue (V2)	$ -	$ -	$ -	$ -	$ 8,275,994.36	$ -	$ 10,148,212.55	$ -	$ 5,167,810.69	$ 23,592,017.60
Investor cashflows (before carry)	$ (10,767,824.71)	$ -	$ -	$ -	$ 3,623,948.11	$ -	$ 10,148,212.55	$ -	$ 5,167,810.69	$ 8,172,146.64
Total revenue investors	$ -	$ -	$ -	$ -	$ 3,623,948.11	$ -	$ 10,148,212.55	$ -	$ 5,167,810.69	$ 18,939,971.35
Investor cashflows (for hurdle rate)	$ (10,767,824.71)	$ -	$ -	$ -	$ 3,623,948.11	$ -	$ 10,148,212.55	$ -	$ 2,636,981.33	$ 5,641,317.28
Excess return (above hurdle rate)									$ 2,530,829.36	$ 2,530,829.36
Carry 85/15 (with catch-up)									$ (1,225,822.00)	$ (1,225,822.00)
Net cashflows of SIS Fund (after carry)	$ (9,887,824.71)	$ 490,052.04	$ 1,265,686.17	$ 2,339,710.29	$ 3,300,545.85	$ 707,068.61	$ 5,229,097.68	$ 3,218,877.06	$ 283,111.64	$ 6,946,324.64
Cash flows for developers (after carry)	$ (10,767,824.71)	$ -	$ -	$ -	$ 3,623,948.11	$ -	$ 10,148,212.55	$ -	$ 3,941,988.70	$ 6,946,324.64

KPIs	
IRR (yealry payout)	13.03%
IRR before carry	9.74%
Hurdle rate [IRR]	7.50%
IRR after carry	8.70%
ROI	176%
Managment fee	2.00%

Interview Partners

Name	Position	Organization
Tobias Ruckstuhl	CEO	Persistent Energy
Philipp Cottier	Senior manager	ex-responsAbility
Michael Aklin	Professor	EPFL
Shema Mitali	Professor	SKEMA Business School
Nick Selby	VP of Engineering	Renewvia
Alix Graham	Investment Manager	Cygnum Capital
Jan Martin Witte	COO	Cygnum Capital
Abdulmalik Abdulraheem	Controller	Vestas
Alain Harerimana	Managing Director	Solektra
Lucas Tschan	Senior Advisor	iGravity
Max Hyatt	Senior Associate	Orrick
Peter Page	Senior Investment Officer	responsAbility
Lauren Chin	Senior Consultant	Novatus Global

R-RECs are cost-efficient, easy to use with little technological knowledge and transparent

Definition REC: Certified generation of **1MWh of renewable energy**. They can be bought by corporations which can then claim to use renewable electricity although the electricity they use might not be from renewables. This systems allows for overall more funding which goes into renewable energies .

R-REC standard: There are multiple standards for the generation of RECs and the R-REC standard is one of them. It is based on the REC standard developed by the UN Convention on Climate Change.

Why does the Solar Irrigation Systems Fund work with the R-REC standard?

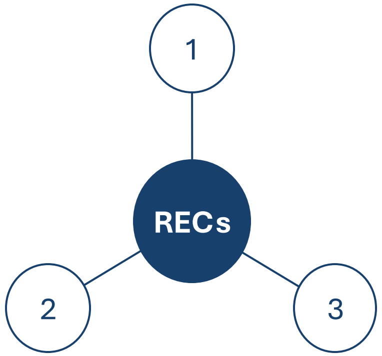
Costs	Ease of use	Transparency	Conversion
The R-REC standard involves **no onboarding costs** and takes a **fee of about 10%** of the generated RECs, which is below other standards.	R-RECs **are traded automatically** on a platform which is built by **Renewvia**. Farmers need only **access to mobile money** and receive the money generated from the R-REC sale.	The R-REC standard is built on a **blockchain** on which each R-REC can be traced back by anyone. This increases **trustworthiness** for clients in this scandal-plagued industry.	R-RECs can easily be **converted into carbon credits**, should this market develop in a more favorable direction. The conversion happens **automatically** on the **blockchain** and is traceable.

The demand for RECs is high, they are more reliable and easier to administrate than carbon credits

Why RECs and not Carbon Credits?

Demand

Many global sustainability frameworks (such as RE100 and the Carbon Disclosure Project) recognize and often require RECs for companies to substantiate claims about renewable energy use and Scope 2 emissions reduction



Easy implementation

Because RECs are easily accountable, they are simpler to manage and have lower transaction costs than carbon credits, which often require more complex and expensive validation, ongoing monitoring, and reporting, especially for small, distributed projects like solar irrigation

Reliability

RECs are verified *ex post* which means that they confirm renewable electricity has already been produced and delivered to the grid. This makes their environmental benefit concrete and easily auditable. Carbon credits often rely on *ex ante* projections of emissions avoided, which can introduce uncertainty and complexity in validation

A tax-efficient Mauritius-based legal structure w. country-specific SPVs common for Africa-focused investments

Over-arching fund

Holding Company (LP)

Established below the fund to house SPVs and isolate liabilities

Country A SPV | **Country B SPV** | **Country C SPV**

Each SPV is responsible for the deployment and operations in their respective jurisdiction

Limited Partners

Concessional and commercial lenders. Liability is limited to their investment amount.

General Partners

Fund managers are responsible for capital allocation, oversight, and compliance. Control the HoldCo, which in turn owns the country-specific SPVs.

Implications

- **Main implication:** if an SPV defaults, creditors can only seize that SPV's assets (not the HoldCo or other SPVs).
- **Investor confidence:** LP's capital is not exposed to cross-jurisdictional risks.
- **GP liability protection:** The GP's personal/corporate assets are protected from business failures.
- **Regulatory compliance:** SPVs localize liabilities country-specific laws and FDI regulations (e.g., foreign ownership limits, tax treaties)

Detailed impact metrics calculations

SDG	Impact Target	Calculation
SDG 7: Affordable and Clean Energy	Over 90,000 MWh generated for over 120,000 livelihoods	MwH generated = No. of pumps installed * (1- default rate) * annual MwH generated per pump * use life of pump Livelihoods affected = No. of pumps installed * (1- default rate) * av. Household size in East Africa * multiplier effect
SDG 13: Climate Action	Around 500 million tCO2e avoided	(No. of pumps installed * (1−default rate) * share of fuel-based pumps *emissions per liter of fuel * annual fuel use per pump * use life of pump) + (no. of pumps installed * (1−default rate) * (1-share of fuel-based pumps) *emissions per liter of fuel * annual fuel use per pump * use life of pump) * REC-to-CO2e-factor
SDG 2: Zero Hunger	>40,000 additional people fed per year	((No. of pumps installed * (1-default rate) * share of farmers w/o pump before * area per pump (ha) * change in yield (t/ha) / maize consumption per person (t/year)) + ((no. of pumps installed * (1-default rate) * (1-share of farmers with fuel-based pump) * area per Pump (ha)* change in yield (t/ha) / maize consumption per person (t/year))
SDG 8: Decent Work and Economic Growth	Increase in annual farmer incomes of over 700$, doubling baseline incomes	(Share of farmers w/o pump before * change in yield (t/ha) * area per pump (ha) * (1 - share of post-harvest losses) * av. market price) + share of farmers with fuel-based pump * change in yield in t/ha * av. farm size in ha * (1- %post-harvest losses) * av. market price) + %fuelbased pump farmers * (fuel-based pump capital cost / uselife * (1+ maintenance costs ratio) + fuel used in L/year * av. price of fuel per liter - solar pump total cost/use life)
SDG 9: Industry, Innovation, and Infrastructure	Over 15,000 pumps in use	No. of pumps installed * (1−default rate)
SDG 5: Gender Equality	Over 3,600 women or >60% of farmers targeted	No. of pumps installed * (1−default rate) * gender quota

Conservative estimates for impact metrics assumptions

Measure	Assumption	Justification
Total USD invested	11000000	From our financial model
No. of installations	18900	From our financial model
Loss rate (from default and maintenance)	20%	Conservative AYG solar industry default averages aligning with what Cygnum and Solektra told us
Av. HH size in East Africa	5.5	UN World Household Survey 2022
Multiplier effect	1.5	from the GOGLA off-grid solar impact indicators
Share of fuel-based pumps replaced	0.2	We try to target farmers without any previous irrigation systems primarily, but expect a low share of farmers switching from diesel systems. Furthermore, note that standards like VERRA and Gold Standard now allow projects providing first-time electricity access to claim avoided emissions, assuming these households/businesses would have eventually used fossil fuels (e.g., diesel generators) without the intervention.
tCO_2e emitted per liter of fuel used	2.69	EPA data: Burning 1 gallon of diesel emits 10.18 kg of CO_2. Conversion to liters:10.18 kg CO 2 / 3.785liters/gallon = 2.69kg CO2/liter
Approximate use life per pump (in years)	20	Based on Giacomo Falchetta et al 2023 Environ. Res. Lett. 18 094044
REC-to-CO_2e Factor	0.7	varies by standard, this is the lower bound
Annual MwH generated per pump	0.3	From financial model
Annual hectares cultivated per farm	1	From financial model; aligns with typical smallholder plot size per pump in SSA according to FAO and other sources
Annual rainfed yield (t/ha)	1.68	Country-average yields of rainfed maize over the 2007–2016 period ranged from 1.68 to 1.99 t/ha in SSA (FAOSTAT, 2018)
Annual fuel-based irrigation yields (t/ha)	3.5	Using a diesel irrigation pump increases yields by a factor of around 2 (Wettstein et al., 2017, https://doi.org/10.3390/su9101772). End result aligns with other sources.
Annual solar irrigated yield (t/ha)	5	Solar irrigation typically increases yields by 2–5x (varies by crop/region); 2019 Lighting Global Report on PULSE potential
Annual maize consumption (t/person)	0.24	WHO: Daily protein needs: ~60g depending on body weight. Maize protein: ~9g per 100g. → 60g/9g/100g=667g maize/day → Annual: 667g×365=0.243t/year
Gender quota	60%	Women are responsible for approximately 50% of the agricultural labour on farms in Sub-Saharan Africa, but produce 60% to 80% of the continent's food. (AFDB/FAO report, 2015)
Post-harvest losses	15%	10-20% according to FAO, 2019a
East Africa fuel prices ($/L)	1.2	Q1 2024 East Africa average (GlobalPetrolPrices.com)
Fuel needed per pump per year	773.8	Diesel pump in SSA uses 0.4 L of fuel/hour × 5.3 hours/day × 365 days = 773.8 L/year (FAO: https://www.fao.org/4/w7314e/w7314e0o.htm)
Price per t of maize in $	210	ESA Maize Market brief: Uganda and Tanzania prices close to US$210 per ton of Maize
Baseline annual rainfed smallholder farmer income	464	$464/year (extrapolated from $116 per quarter acre named in Technoserve 2018 report "Smallholder Farmers Translating Produce to Profits" on Kenya)
Solar pump total cost, i.e. upfront cost + mainteance cost + monthly payments*12 ($)	1402	From financial model
Fuel pump av. Total capital cost	250	Capital cost for small fuel pump irrigating around 0.5-1 ha in Ghana (see Burney et al., 2013, doi: 10.1073)
Fuel-based pump maintenance and replacement factor	3.00	Xie et al., 2021, https://doi.org/10.1029/2020EF001611