



ASIA CLEAN ENERGY FORUM 2026

Beyond Transition: Building Secure, Resilient, Inclusive, and Intelligent Energy Systems

8–11 June | ADB Headquarters, Metro Manila, Philippines



One Land, Triple Value : How AI- Enabled Agrivoltaics Create Sustainable Rural Income in Asia

Sung Yoon | CEO of Envelops Co., Ltd.

9 June 2026 | 2–3:30 p.m. (GMT+8)

In cooperation with



**KOREA ENERGY
AGENCY**

KOPIA
KOREA PLANT INDUSTRIES ASSOCIATION

An aerial photograph of a vast solar farm in a desert. The solar panels are arranged in neat, parallel rows that stretch towards the horizon. The surrounding landscape is arid and sandy, with a clear blue sky above. The text "One Land, One Value" is centered over the middle of the solar panel array.

One Land, One Value

One Land, One Value
Food Security at Crisis

One Land, Double Values Energy & Agriculture



VANILLA





Farm-Optimized Smart APV Structure

Optimal structural design considering machinery paths, work safety, and shading balance

[Learn More →](#)



SAMS Climate-Adaptive Operation

Real-time monitoring, automatic panel control, AI harvest prediction

[Learn More →](#)



Smart Farming Service

From seeding to harvest, permit maintenance, settlement reports

[Learn More →](#)

PROJECTS KLES & ENVELOPS Agrivoltaic References



FIJI



INDONESIA



VIETNAM



JAMAICA



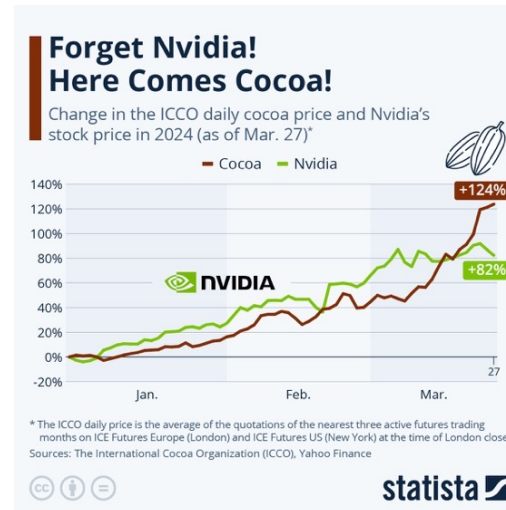
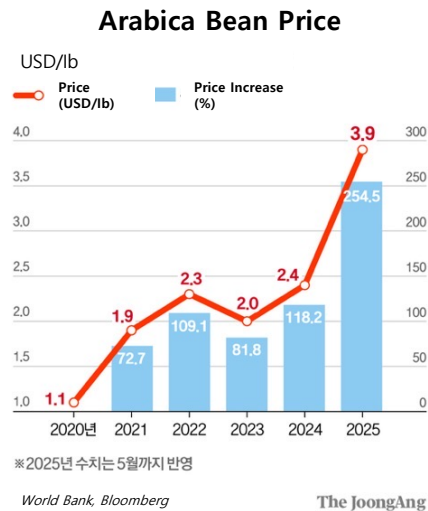
KOREA (21 sites, 2.2 MW)



PROBLEM Agriculture Crisis from Climate Change



More Price Increase than NVIDIA Stock?



Temperature
Heat Damage due to Climate Change



Water
Water Shortage for Agriculture Due to El Nino

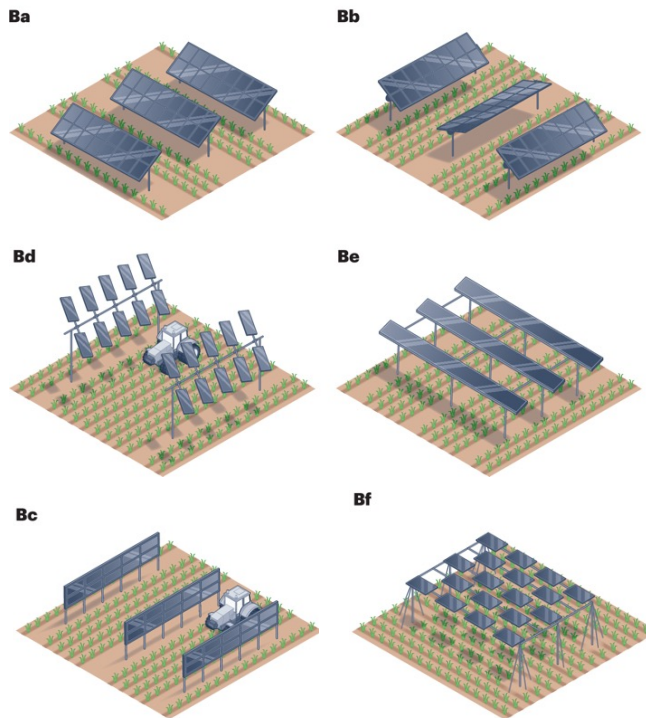


Energy
Heavily Depending on Fossil Fuel For Agro Activities (Pump, Processing)

Southeast Asia in particular is a powerhouse in the global coffee market, with Vietnam and Indonesia being the world's second and fourth **biggest coffee producers** respectively. In 2023, Vietnam produced **29.1 million** 60 kilogram bags of coffee while Indonesia contributed **11.85 million**. Other countries in the region such as Thailand, Laos and the Philippines are also increasing their output.

But rising temperatures, erratic rainfall and prolonged droughts are **taking a toll** on coffee crops. Coffee plants are **highly sensitive** to climatic changes and the increasing heat can impair their growth, reduce yields and lower the quality of the beans. Pests like the coffee berry borer, which thrive in warmer conditions, are further exacerbating the situation, leading to significant crop losses. By 2050, up to 50 per cent of land suitable for **coffee cultivation** may be lost due to climate change. *Eastasiaforum, 2024*

Agrivoltaics ▶ Climate Smart Agriculture





APV Relative Daytime
Temp. from Open Field
0.5~2 °C ▼

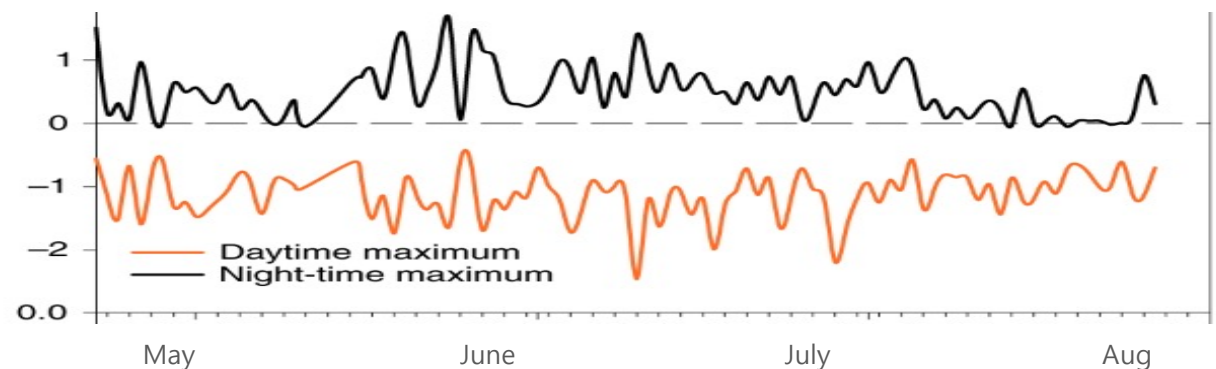
Heat Damage Decrease



APV Relative Nighttime
Temp. from Open Field
0~1.5 °C ▲

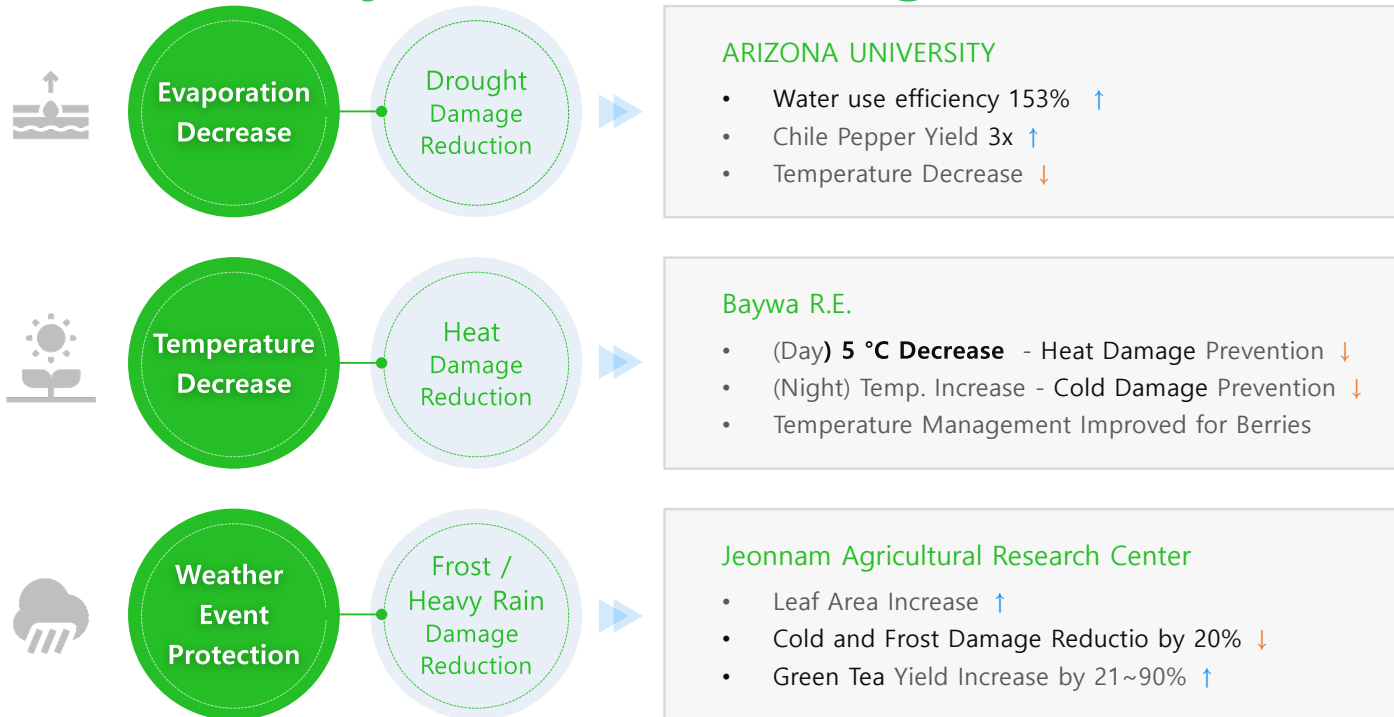
Cold Damage Decrease

Under APV Relative Temperature Compared to Open Field



Protecting Crops from Temperature Damage.

Case Study: Climate Damage Reduction



Effectively Reducing Temperature and Drought Damage

AGRIVOLTAICS



Jack's Solar Garden – Colorado, USA

- System Design: 1.6 hectares, 3,200 panels installed
- Target Crops: Carrots, tomatoes, lettuce, etc.



Agrivoltaic Park– Fontanellato, Italy

- System Design: 2 hectares, panels installed at a height of 5 m
- Target Crops: Tomatoes



Vignes Solaires – Bordeaux, France

- System Design: 2,000 sq. meter, panels installed at a height of 6 m
- Target Crops: Grapes for wine production

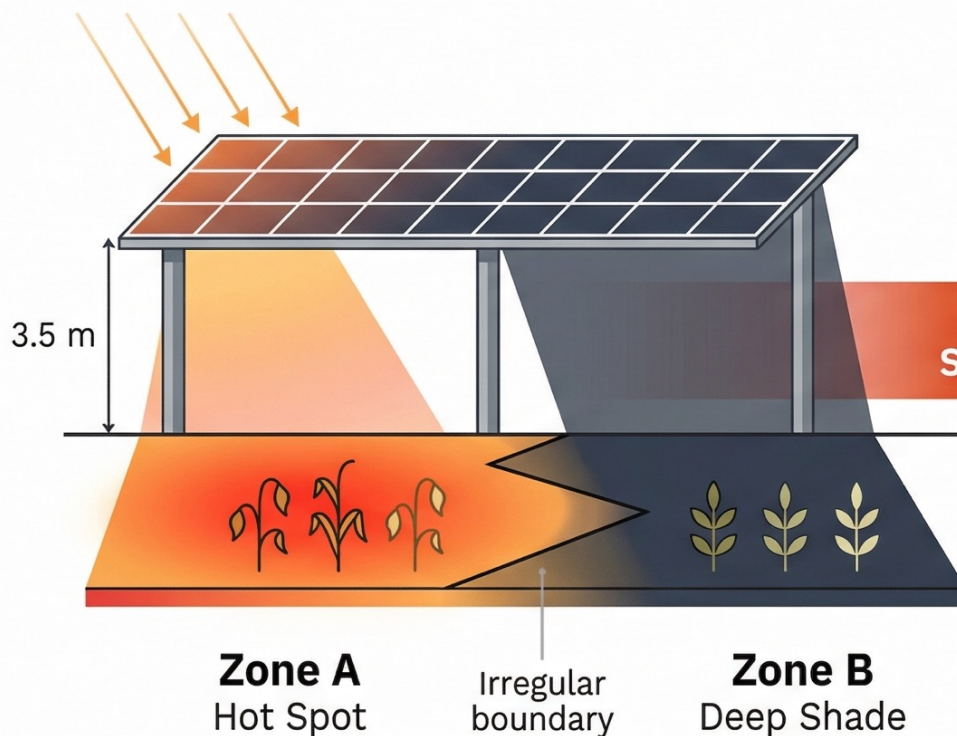


Goji Berry Solar Park – Ningxia, China

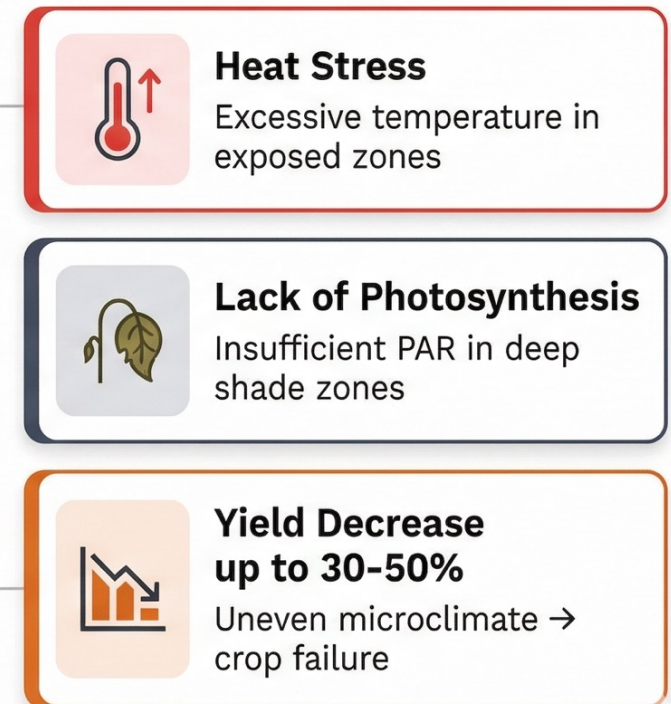
- System Design: 4,000 hectares site, panels installed at a height of 2.9 m
- Target Crops: Goji berry (Wolfberry)

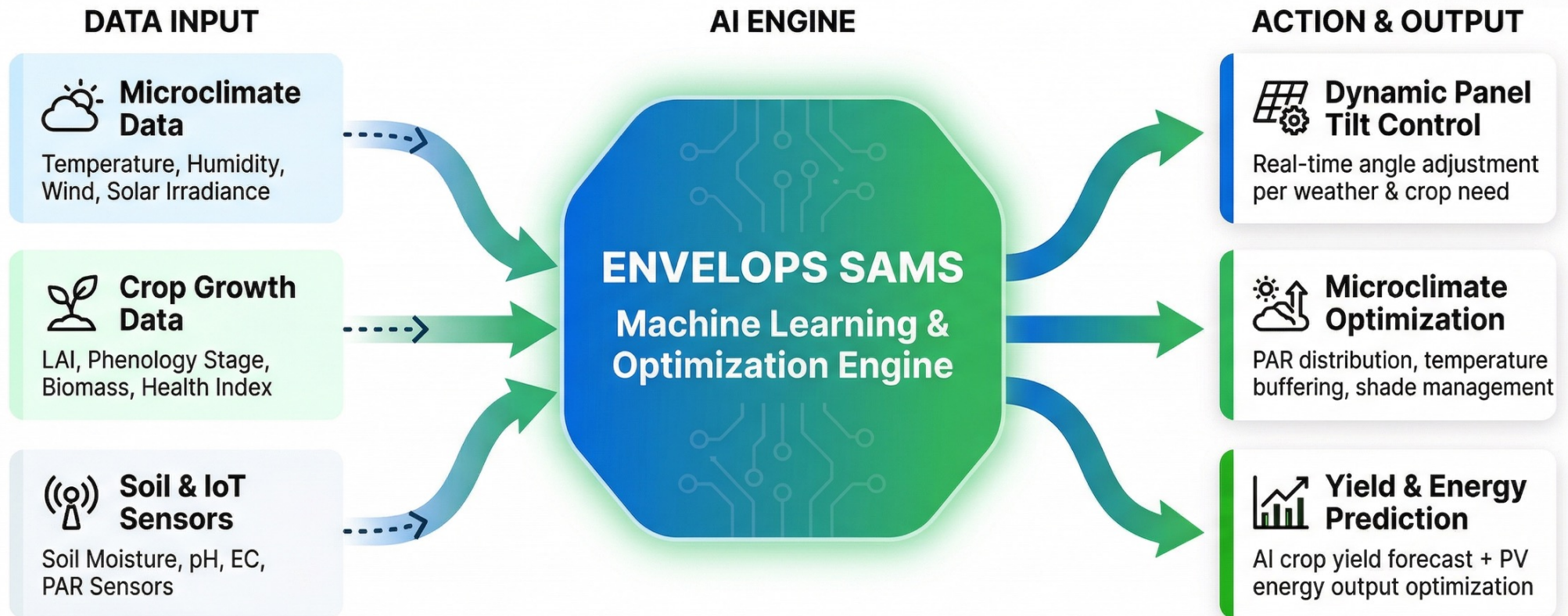
Static panels create irregular shading that damages crops

CAUSE: Static Panels



EFFECT: Crop Stress & Loss





From Data to Decision — Optimizing Both Energy and Agriculture on the Same Land



Indonesia APV Site



실시간 센서 정보

온도	습도	풍속
24.5°C	65%	3.2m/s
1시간 전 측정	1시간 전 측정	1시간 전 측정

기본 정보 태양광발전 작물 기상 토지/인프라

작물 정보

감자	운영중
불감자/수미	
파종일	수확 예정일
2024.03.15	2024.06.15

재배 이력

2023 하반기	감자
수확량 4.8톤	매출 2,880만원
2023 상반기	감자
수확량 5.2톤	매출 3,120만원
2022 하반기	감자
수확량 4.5톤	매출 2,700만원

생육 환경

토양 온도	토양 수분
18.5°C	65%
적정 범위	적정 범위
생육 적정 온도	18~22°C
적정 토양 산도	pH 6.0~6.5
병해충 위험도	낮음

수익성 분석

예상 수확량	예상 매출
5.0톤	3,000만원
+4% 전년 대비	+6% 전년 대비

비용 구조

종차/비료	480만원
인건비	620만원
기타 운영비	300만원
예상 순수익	1,600만원

Smart APV Sensing and Monitoring Technology



IPB University
— Bogor Indonesia —

First in Indonesia, IPB University Inaugurates Agrivoltaic Research Station



NEWS



KLES.  ENVELOPS

📅 November 28, 2024

IPB University has inaugurated the Agri-Photovoltaic Research Station at the Cikabayan Educational Farm, Dramaga Campus, Bogor (22/11). This unit is the first in Indonesia to integrate agriculture with solar panel-based energy.



AI analysis on crop yield and power generation



Optimizing microclimate for crop by changing panel angle



ENVELOPS - INDONESIA



ENVELOPS INDONESIA AGRIVOLTAIC NEXUS



IPB University
Bogor Indonesia



한국에너지공단
KOREA ENERGY AGENCY

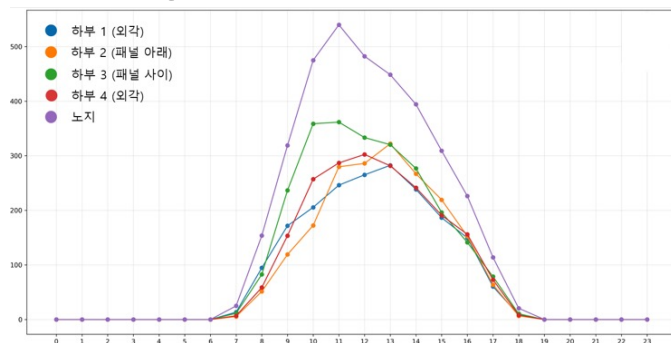


KLES

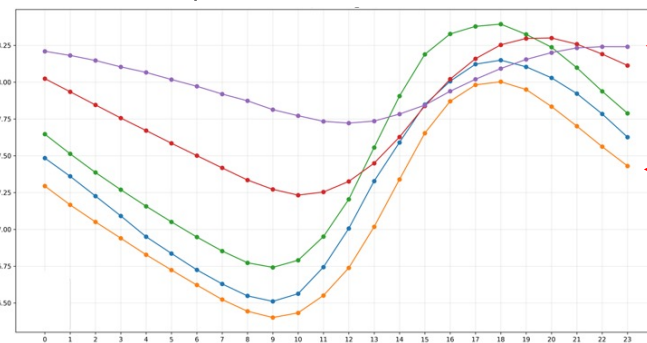


Max-Generation Mode for Non-farming Season, Max-Yield Mode for Farming Season

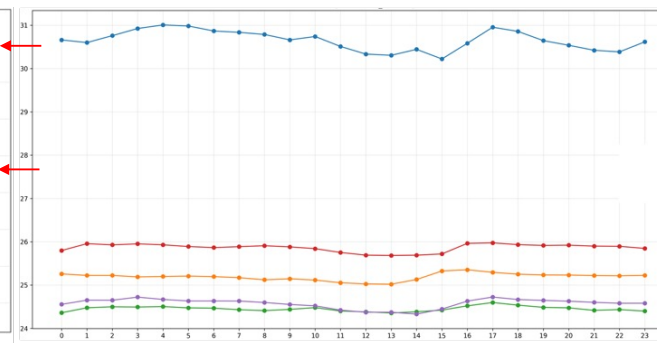
(A) Sunlight



(B) Soil temperature



(C) Soil moisture



Underneath APV



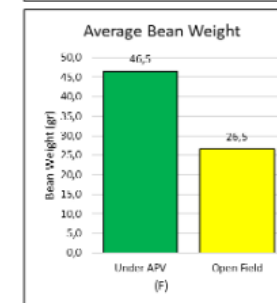
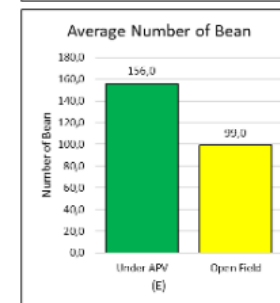
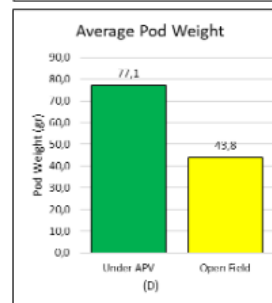
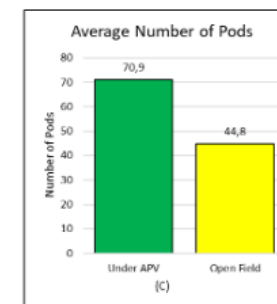
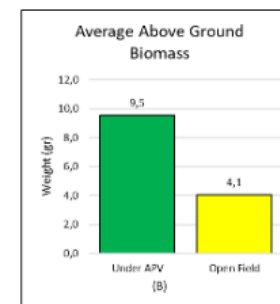
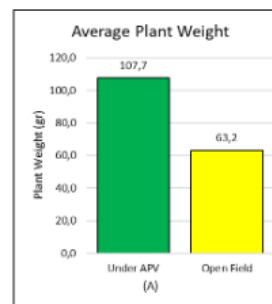
Open Field



Early
Stage



Recent



ENVELOPS CASE 2: Vietnam Agrivoltaic Pilot Project in Dalat



1 Economic Validation

High Efficiency Confirmed

- ✓ **99.98% Self-Consumption Rate** achieved over 10 months.
- ✓ **VND 61.2M** in calculated electricity cost savings.
- ✓ **941 kWh/kWp** Specific Energy Yield demonstrates robust PV performance.

2 Agricultural Success

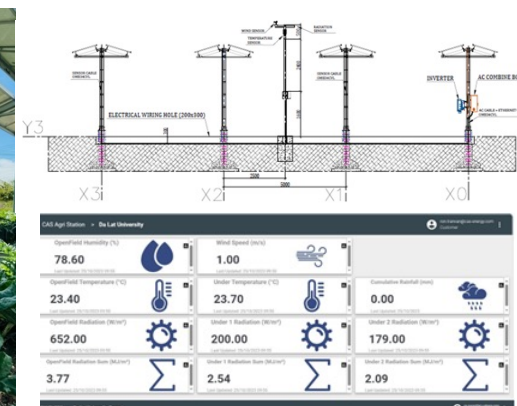
Optimized Yield & Microclimate

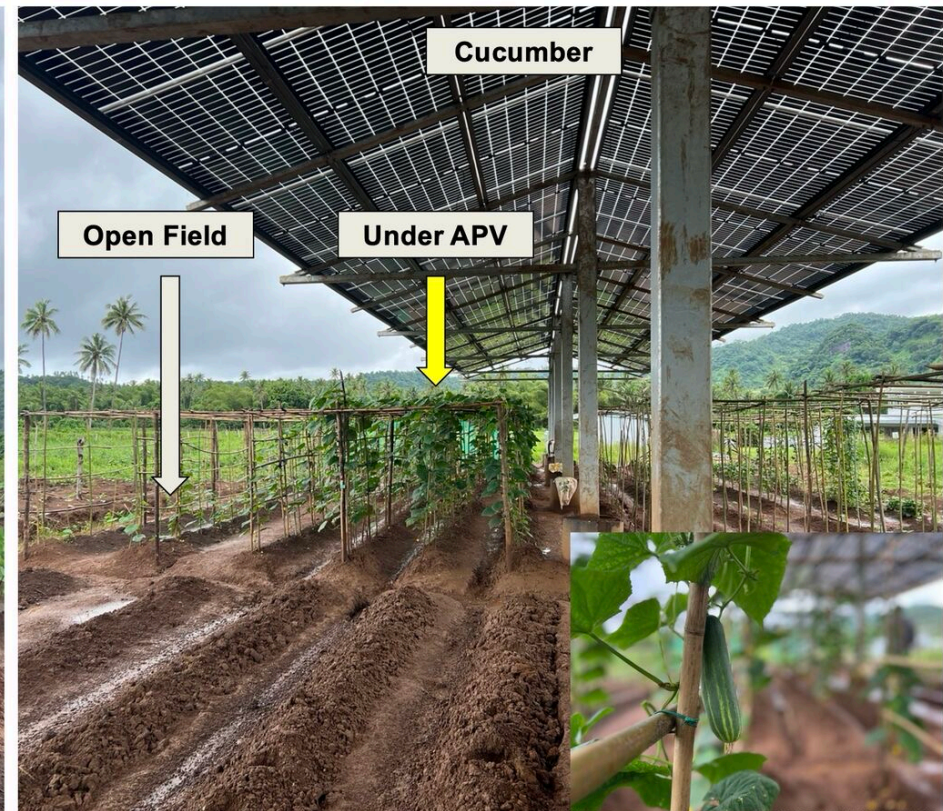
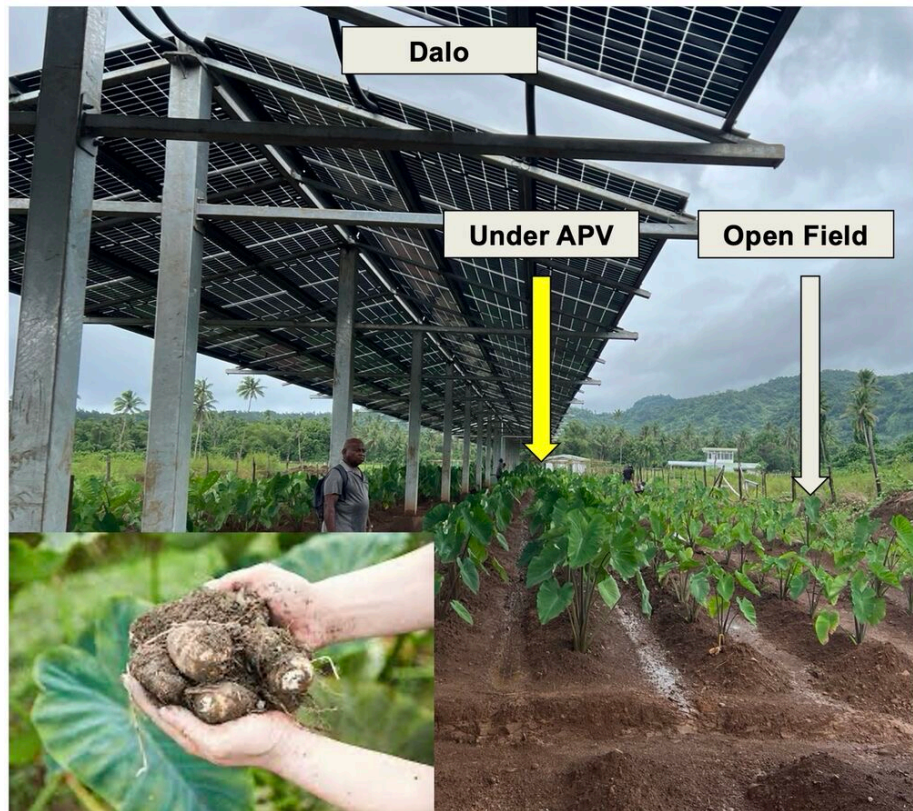
- ✓ **72.66% Survival Rate** for artichoke under APV, vs. 50% in the reference plot.
- ✓ **50-60% Radiation Reduction** created a highly beneficial, cooler microclimate.
- ✓ APV system produced **3.5X greater yield** than the unshaded reference plot.

3 Future Imperatives

Key Areas for Next Phase R&D

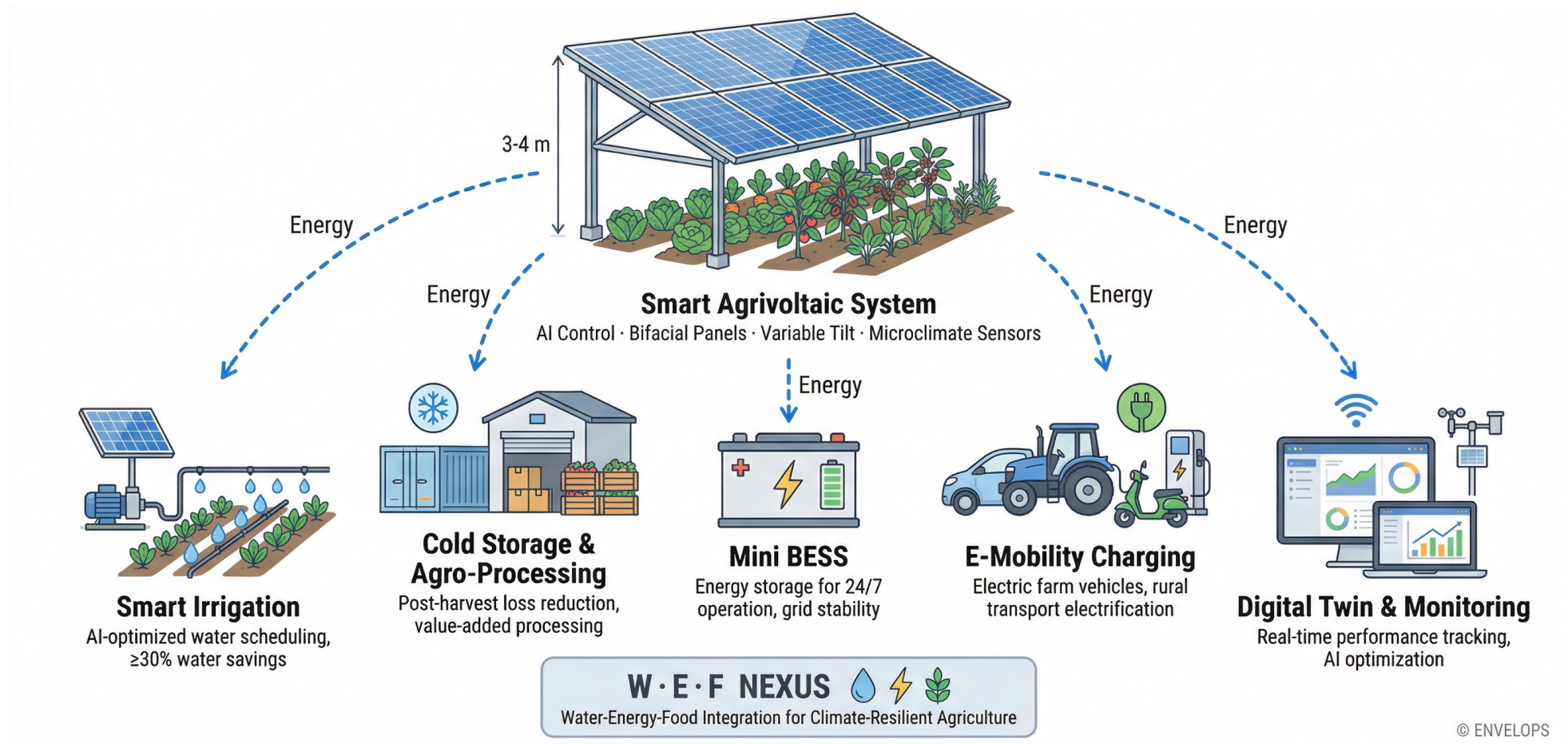
- > **Incorporate Humidity/Soil Sensors** to quantify water conservation benefits.
- > **Address Data Gaps** such as phenological inconsistencies for greater statistical confidence.
- > **Long-Term Monitoring** to track perennial crop yield stability over multiple seasons.





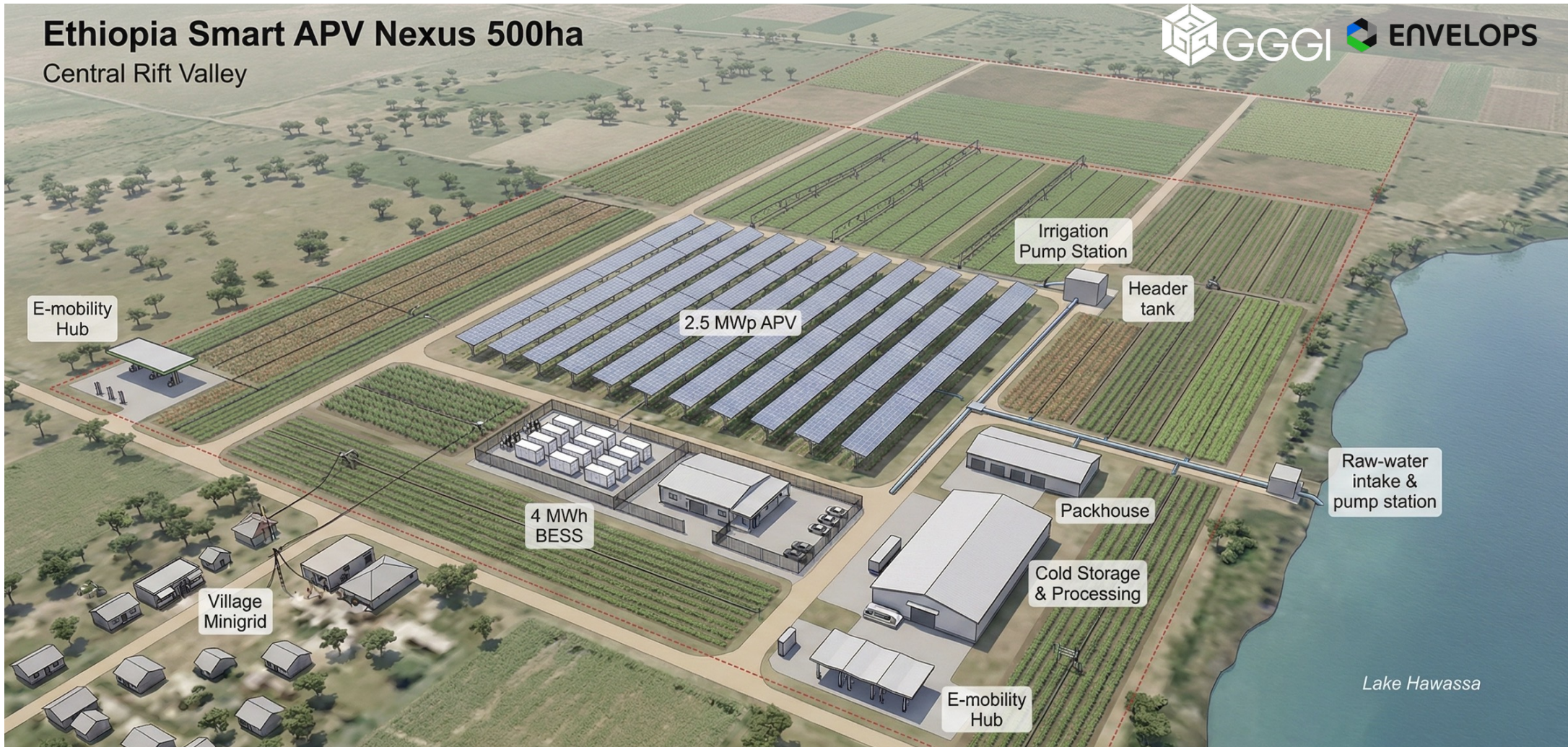
Tackling Multiple Problems with One Stone

- The Smart Water-Energy-Food APV Nexus Model



Ethiopia Smart APV Nexus 500ha

Central Rift Valley

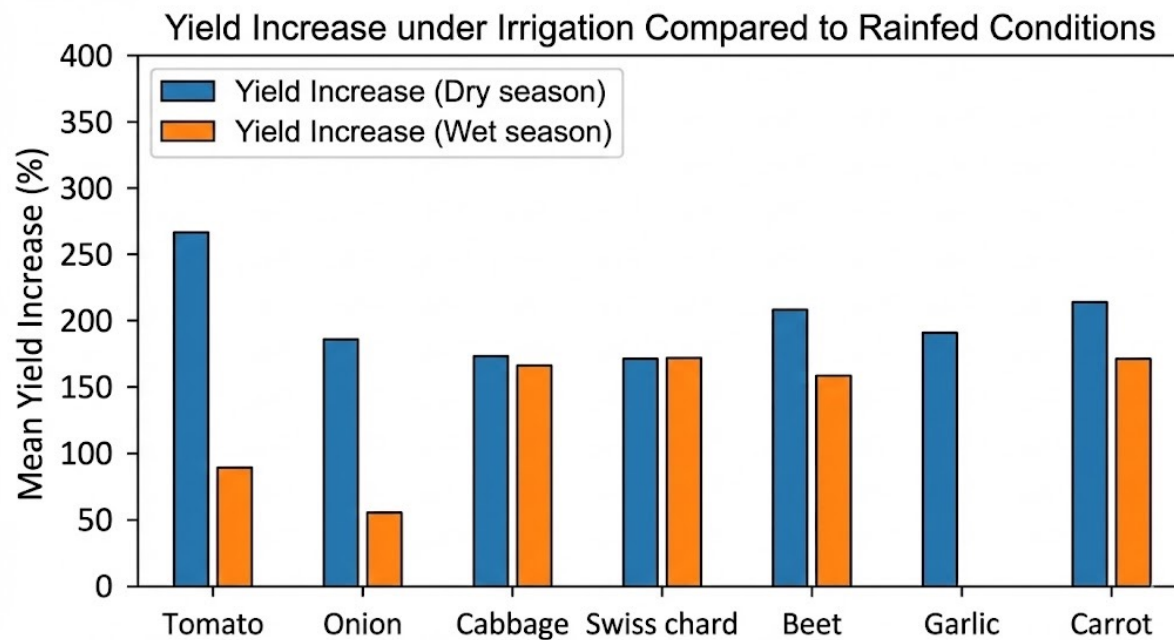


- ✓ 2.5 MWp fixed tilt APV plant
- ✓ 4 MWh Battery Energy Storage System (BESS)
- ✓ Irrigation system for ~500 ha command area

- ✓ Post harvest and value addition cluster
- ✓ Smart Nexus Operations

Irrigation Is Not Optional: A Prerequisite for Stable Agricultural Production

Across all seven crops, irrigation increases yields by 2.0–4.5 times, eliminates dry-season crop failure, and reduces inter-annual yield variability by more than 50%.



Outcome	Result under Irrigation
Mean yield	2.0–4.5× higher than rainfed
Dry-season yield	Fully restored to viable levels
Inter-annual variability	Reduced by >50%
Crop failure frequency	Reduced to near zero
Climate sensitivity	Strong buffering against rainfall variability and heat stress

Agrivoltaics as a Water-Efficiency Multiplier in Water-Limited Environments

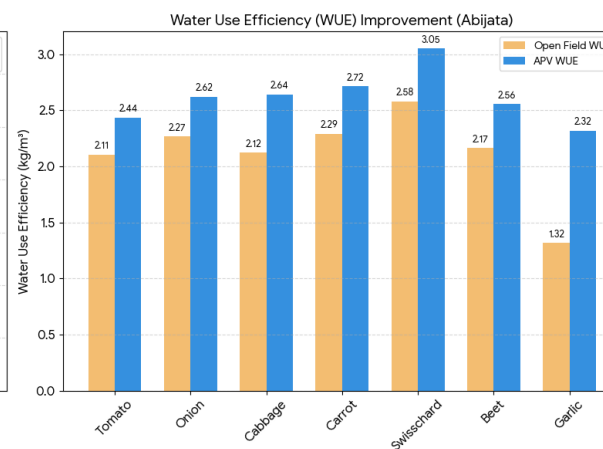
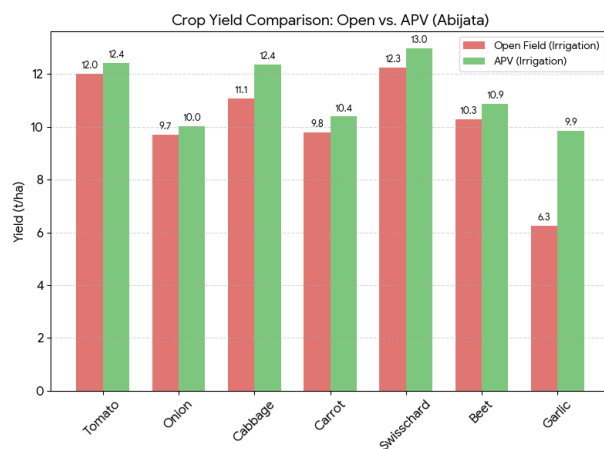
In Abijata, agrivoltaics functions primarily as a stability and water-efficiency enhancer rather than a yield-boosting technology.

1. Risk mitigation under severe water stress

- Rainfed conditions lead to **crop failure** due to low soil water retention (**TAW $\approx$ 12%**).
- Example (Tomato): Rainfed yield drops to **1.74 t/ha**, indicating non-viable production.
- Under irrigation, APV mitigates vapor pressure deficit (VPD) and reduces non-productive water losses, stabilizing crop performance.

2. Improved yield and water use efficiency in stress-sensitive crops

- APV increases yields in crops most vulnerable to heat and water stress: **(Cabbage) +11.5%** **(Garlic) +57.5%**
- Water Use Efficiency (WUE) improvement is particularly pronounced: **Garlic WUE increases from 1.32 $\rightarrow$ 2.32 kg m^{-3}**
- APV elevates water productivity to levels comparable with more resilient crops.

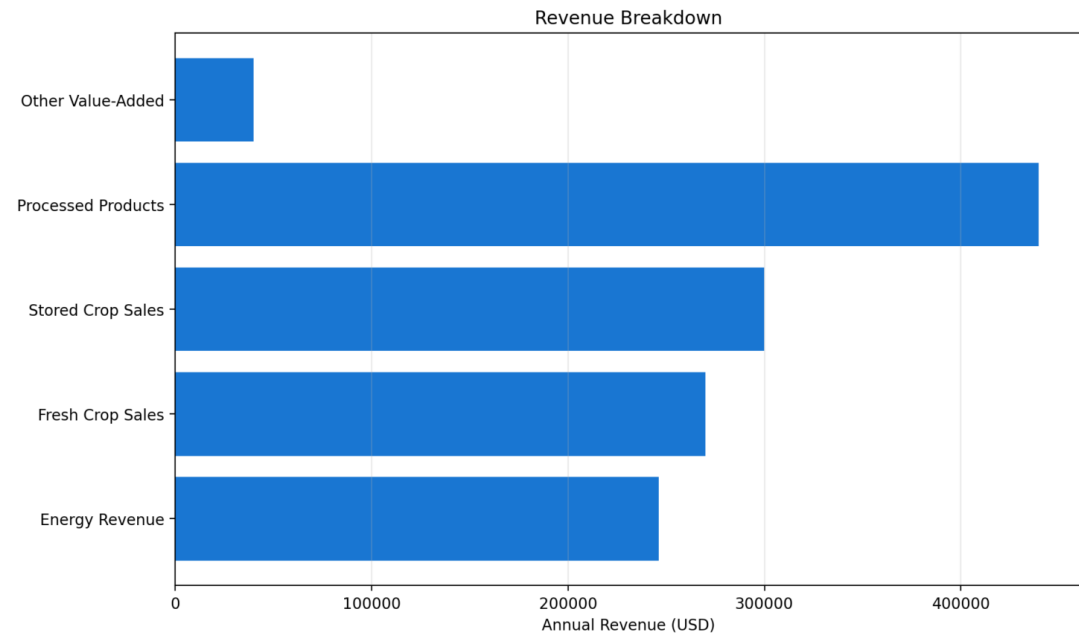


REVENUE STREAMS

Revenue category	Key modeling assumptions (central case)	Indicative annual revenue (USD/year, per site)
Energy services and surplus electricity sales	Average annual surplus electricity 2,461.3 MWh/year exported to surrounding communities and external e-mobility users at 0.10 USD/kWh . Internal APV-Nexus loads (irrigation, cold storage, processing, buildings, internal EVs) are treated as self-consumption cost savings.	≈246,000
Irrigated horticulture and value-added products (integrated SPC operation)	≈ 405 ha net cultivated area (within ~470 ha irrigated farmland). High-value vegetables and root crops under drip irrigation and APV microclimate; 2–3 cropping cycles per year. Marketing mix: 30 % fresh sales, 30 % cold-stored and sold off-season, 40 % processed on-site (tomato paste and other products). Blended net margin ≈2,200 USD/ha/year , inclusive of storage and processing value-addition benefits and associated OPEX.	≈890,000
Total annual revenue (per site, central case)	Steady-state operation after ramp-up; all values in real USD (no price escalation) over the 20-year evaluation period.	≈ 1,140,000 – 1,180,000

Analysis Mode: Real (constant prices) | Discount Rate: 10.0%

Project IRR (pre-financing)	Equity IRR (post-debt)	Payback Period	Total CAPEX
13.07%	28.05%	7 years	\$7.61M
Project NPV	Equity NPV	Min DSCR	Annual OPEX (Year 1)
\$1.56M	\$2.79M	1.51	\$360k





Aral Sea

Uzbekistan

Global Environmental Disaster

The Aral Sea Tragedy: From World's 4th Largest Lake to Desert

Once a thriving 68,000 km² ecosystem, the Aral Sea has lost 90% of its volume due to intensive cotton irrigation. This is Uzbekistan's greatest water security challenge.

90%

Volume Loss

54k

km² Dried Seabed

⇒ Toxic Salt Storms

Dried seabed dust affects health across the region



The Cost of Conventional Cotton

Linking irrigation practices to environmental collapse

Extreme Water Usage

~6,000 m³/ton

Direct Cause of Desiccation

Water diverted from Amu Darya river

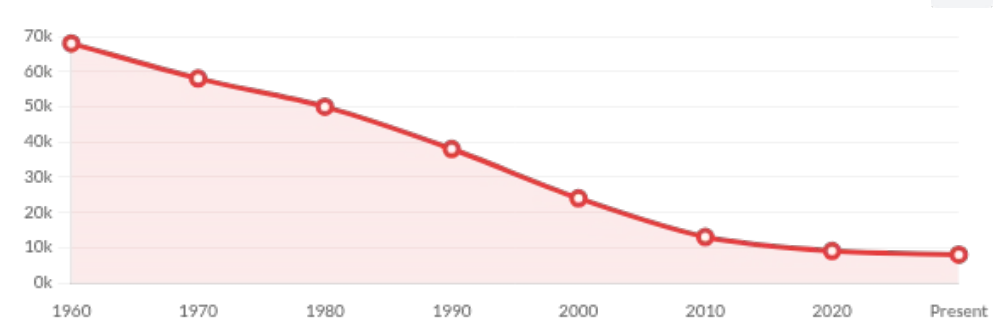
Economic Trap

Low Value

Raw Export Dependency

Exporting water-intensive commodities

Aral Sea Surface Area Decline (1960-Present)



☁ Scope 3 Emissions:
High

👕 Fashion Brands Demand
Change

Source: UN Environment Programme / World Bank
Data

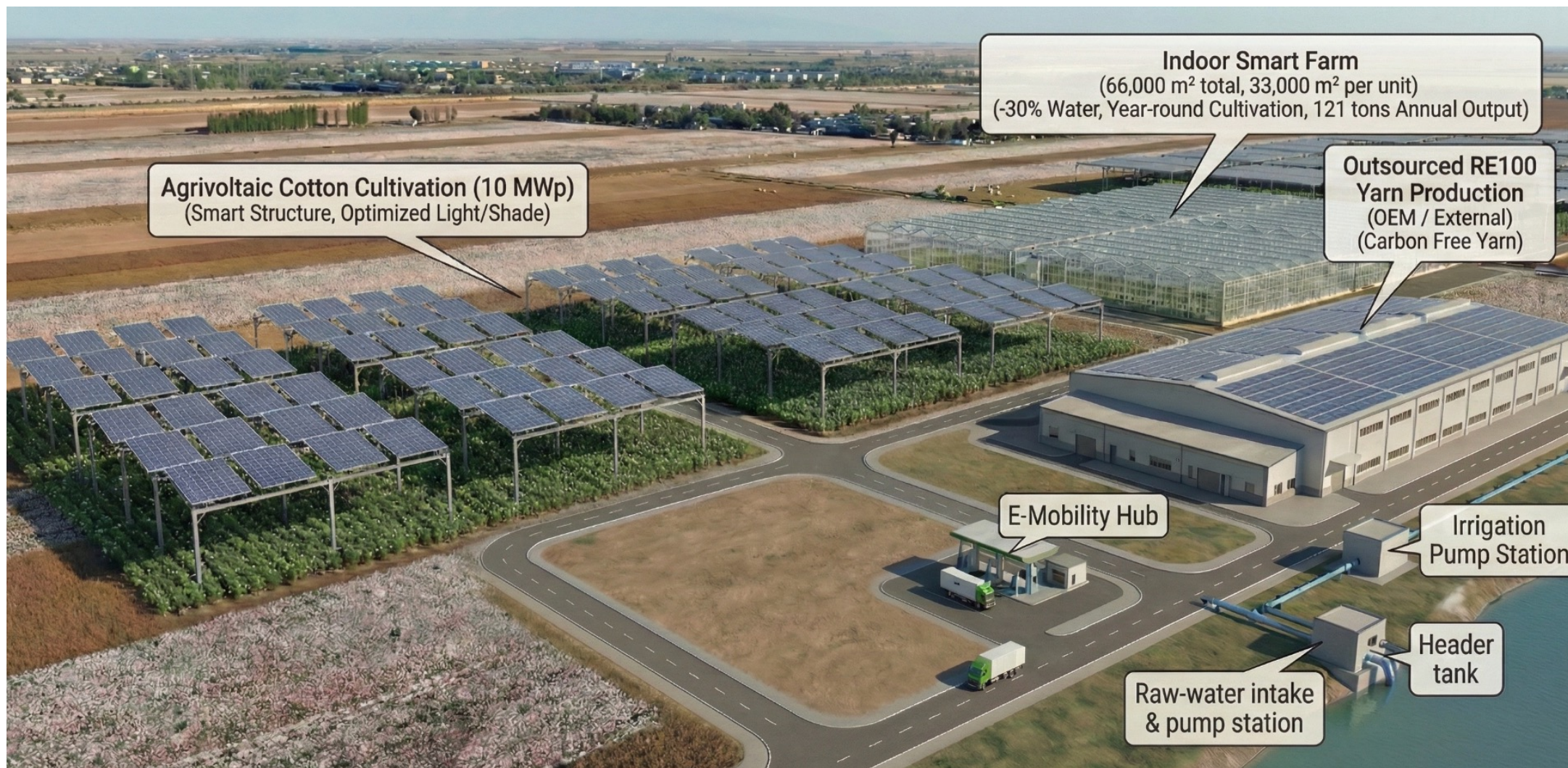


10 MWp | Carbon-Free Cotton

Expected Benefits of Agrivoltaics for Cotton Production

- Open field vs. smart irrigation vs. agrivoltaics: APV adds shade-based microclimate control and on-site power to smart farming

	Open Field	Smart Farm (sensor + drip)	Agrivoltaics (APV + smart irrigation)
Yield / productivity	Baseline index 100  100	+10–19% yield increase  110–119	+33% potential 3,750 → 5,002 kg/ha  133
Water effect	Baseline conventional irrigation	18–42% less irrigation water WUE +35–103%	20–47% WUE gain +14.4% water availability via rain harvesting
Heat stress mitigation	Exposed to high radiation & VPD	Better irrigation timing, limited shade	1–4°C lower air/soil temperature potential
Power & land value	External grid / diesel exposure	Sensors and pumps still need power	On-site PV for pumps + sensors Land efficiency +94%





GREEN COTTON AGRIVOLTAIC NEXUS — National Scaling Strategy

Korea-Uzbekistan Climate Cooperation under Paris Agreement Article 6

ODA Pre-Feasibility



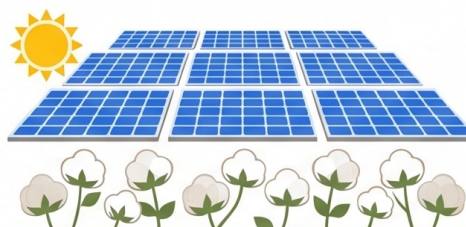
ODA Pre-Feasibility

2026-2027

MCEE Energy ODA
Technology & Economic Validation
Site: TSAU Campus, Tashkent

1 MW
Pilot Design

ITMO Commercial Project



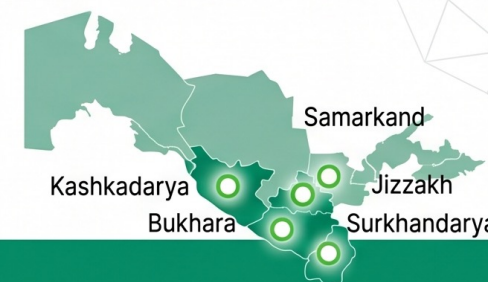
ITMO Commercial Project

2028-2031

Blended Finance: MDB + Private Equity
ITMO Transfer: Korea 80% / Uzbekistan 20%
Carbon Free Cotton: GOTS + RE100 + OEKO-TEX

10-20 MW	\$22-43M Investment	6,700-13,400 tCO ₂ /yr
--------------------	-------------------------------	---

Cotton Belt Replication



2031+

10 MW Standard Module × **5-10** Sites
Full Commercial Finance + Impact PE
Programme of Activities (PoA) Registration

50-100 MW	\$110-220M	Up to 67,000 tCO ₂ /yr
---------------------	-------------------	---

A photograph of a green corrugated metal building with a solar panel roof. Two large blue water tanks are positioned in front of the building. A green signpost stands in the foreground, displaying directions to various locations in Tuvalu. The background shows a tropical landscape with palm trees and the ocean under a cloudy sky.

But who owns it?

ODA PROJECT IN TUVALU



But who owns it?

ODA PROJECT IN TUVALU



Korea's Solar Income Village Model

한국농정

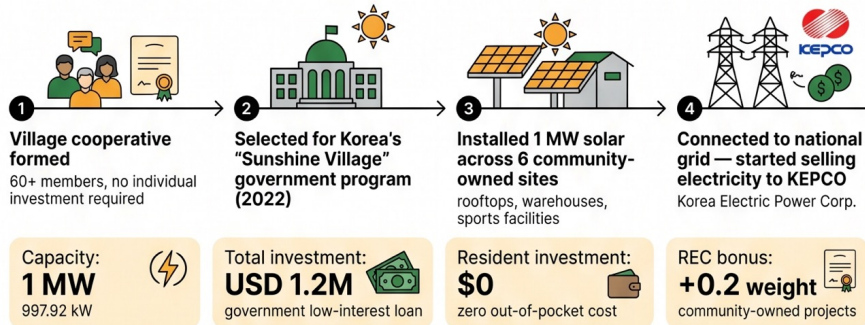
Project Sustainability Issue, Mostly from lack of Profit and Ownership – Solution : Solar Income Village Model

The Village That Cooks With Sunshine

70 households, 120 people — a community-owned solar power plant funding free meals and transport

📍 Gyangri, Yeosu City, Gyeonggi Province, South Korea

How a tiny village built its own power plant

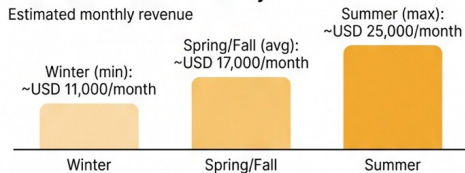


How the money flows

☀️ Sunlight → 🏠 6 Solar Sites → ⚡ Electricity → ⚡ Sold to Grid (KEPCO)

Revenue visualization monthly

Estimated monthly revenue



Annual gross revenue:
~USD 90,000

Loan repayment + insurance
+ maintenance:
~USD 8,000/month

Net profit:
~USD 7,500/month

Where the profits go

1. FREE DAILY LUNCH

Hot meals served every day at the village hall for all residents



2. FREE VILLAGE BUS

'Happiness Bus' runs daily routes to hospital, market, town center



3. VILLAGE MANAGER

Full-time staff hired to maintain facilities and coordinate services



NO individual cash dividends — 100% reinvested in community welfare

Even residents who initially opposed the project receive equal benefits



Welfare hub

Why Gyangri matters

100% community-owned

— No outside developer
The cooperative runs everything



Zero financial risk for residents

— Government loan, no personal investment needed



20+ year income stream

— Revenue continues for the full life of the solar installation



"We sell electricity to cook meals and run buses — that's our village business model."

Gyangri is now South Korea's flagship model for the national 'Sunshine Income Village' program targeting 2,500 villages by 2030.

Project Sustainability Issue, Mostly from lack of Profit – Solution : Solar Income Village Model

The Model

CONCEPT BOX



Community-Owned Solar Cooperatives

- Village installs solar PV on shared land (300 kW – 1 MW)
- Revenue flows into community welfare fund
- Residents receive 'Sunshine Pension' annually

HOW IT WORKS

HOW IT WORKS

Step 1



Village Consent

70%+ residents agree → form cooperative (10+ members)

Step 2



Government Financing

85% policy loan (low interest) + 15% community equity

Step 3



Generate & Earn

Sell electricity → Revenue to community fund & Sunshine Pension

National Scale



한국에너지공단
KOREA ENERGY AGENCY

DOMINANT VISUAL
HERO STAT

MASSIVE

2,500+

Sunshine Income Villages by 2030

From 500+ villages in 2026 → nationwide rollout across 38,000 rural communities

INVESTMENT CALLOUT

KRW 5.5 Trillion (USD 4 Billion)

Total Government Investment Commitment

KRW 4.5T in renewable energy financing – long-term, low-interest loans

TIMELINE 2026

2028

2030

500+ Villages Selected

Program Launch

1,500+ Villages

Mid-term Expansion

2,500+ Villages

National Coverage

Pan-government Task Force under Ministry of the Interior and Safety

SUCCESS CASE BOX

Proven Results



Gyang-ri, Yeosu

KRW 100M+ annual revenue
Funds community bus, meals, welfare



Sinan County

KRW 600K–1.8M per person/year
'Sunshine Pension' in local vouchers



One land, Three harvests. *Energy. Food. Sustainability.*



Phone: +82 2 6933 2004 / Home: www.en-velops.com

Email: info@en-velops.com

Address: #303, 48 Sungsuil-ro, Seongdong-gu, Seoul,
Republic of Korea (04768)

CEO: Yoon, Sung / syoon@en-velops.com

Bring Light, Bring Life - We harness the power of light to regenerate the planet