



ASIA CLEAN ENERGY FORUM 2026

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

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ENERGY EFFICIENCY SERVICES LIMITED
A JV of PSUs under the Ministry of Power

Solar-Powered Micro Cold Storage (SPMCS) with Net-Metering: A Distributed Energy Architecture for Food Security and Grid Resilience in Developing Economies enduring Climate Change

*(Thematic Track 2: Powering Through:
Environmental Vulnerability and Enhancing
the Resilience of Energy Systems)*

Anil Kumar Choudhary

**CGM, Head Operations & Head SPMCS, Projects, Q&I,
Sustainability & Clean Tech**



EESL Installed 5 MT SPMCS in Bajaura, Himachal Pradesh with support of ADB & CLASP



About Energy Efficiency Services Limited (EESL)



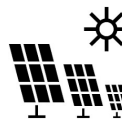
- **Energy Efficiency Service Limited**, established in 2009 by the Ministry of Power, Government of India, is a joint venture comprising four Central Public Sector Undertakings: NTPC Limited, Power Grid Corporation of India Limited (PGCIL), Power Finance Corporation Limited (PFC Limited), and Rural Electrification Corporation (REC).
- The primary goal of EESL is to spearhead market initiatives aimed at establishing and maintaining energy efficiency and sustainability markets in India. The larger picture is Net Zero much earlier than 2070.

Key Milestones



39.86 crore LED Bulbs

2.72 lakh solar lights



1.32 crore LED Street Lights

200 MW solar projects



12000+ retrofitting work

61.01 lakh solar lamps



3146 SE ACs sold

81180 agri pumps deployed



Agreement for IGEA with 25 states

1936 e-cars



Scaling Up Super ESCO-Led Cold Chain Solutions for Agriculture in India: A *distributed Agri-energy architecture for farmers, DISCOMs and policymaker*

Conventional cold storage: good for crops, hard on DISCOMs

- Large, grid-only cold stores create concentrated evening and summer peaks, forcing DISCOMs to procure expensive power and manage stressed agricultural feeders
- At the same time, most rural farmers, FPOs and mandis lack access to appropriately sized, reliable cold rooms near the farm-gate.

From the farmer's lens

- Forced Distress Sale Within 1-2 Days Of Harvest For Perishables.
- Limited Bargaining Power And Inability To Time The Market.
- High Transportation To Distant Cold Stores, If Space Is Available At All

From the DISCOM's lens

- New Cold Stores Add Multi-hundred Kw Loads On Weak Rural Feeders.
- Evening peaking coincides with residential demand and agri-pump use

Conventional Cold Room



Solar Cold Room



Net-metering basics for a cold storage prosumer

- Under net-metering, the farmer's bidirectional meter records both import and export; at the end of the billing period, DISCOM bills only the net imported units, and compensates surplus exports at a regulated rate.

KEY PARAMETERS

- Retail tariff for the consumer category (often ₹8–10/kWh for commercial / service loads).
- Average power purchase cost (APPPC) / feed-in tariff for solar exports (typically ₹3–4/kWh).
- Settlement period – usually monthly, sometimes annually.

WHY IT SUITS COLD STORAGE

- Cooling load is spread across the day and year, enabling high self-consumption of PV.
- Excess daytime generation can offset evening / seasonal grid imports.
- Regulations in many states now explicitly allow agricultural and C&I prosumers up to defined kW limits.

What does net-metering change in rupee terms?

- The table below adapts an illustrative rooftop solar example where retail tariff is ₹9/kWh and export compensation is ₹4/kWh (average pool power purchase cost).

Assumed pattern (per billing period)

- Cold storage consumption: 1,000 kWh.
- Solar generation from rooftop system: 1,000 kWh.
- Retail tariff: ₹9/kWh; export credit: ₹4/kWh

CASE A – GROSS METERING

- All 1,000 kWh of solar exported: credit = $1,000 \times ₹4 = ₹4,000$.
- All 1,000 kWh of load bought from grid: $1,000 \times ₹9 = ₹9,000$.
- Net energy bill = ₹5,000 for the period.

Case B – Net-metering

- 1,000 kWh solar directly meets 1,000 kWh load: net import = 0 kWh.
- No import energy charge: $0 \times ₹9 = ₹0$.
- No excess export in this simple case, so export credit = ₹0.
- Net energy bill = ₹0 (only fixed charges remain).

For a cold storage prosumer with similar tariffs and matching generation-load over the billing cycle, net-metering can effectively convert the energy bill into only fixed charges, whereas gross metering still leaves a sizeable energy payment

Translating to micro cold storage economics

Per-kWh perspective

- Each kWh of solar that replaces grid consumption avoids paying retail tariff (≈₹8–10/kWh for many cold stores).
- Each surplus kWh exported only earns feed-in or APPPC rate (≈₹3–4/kWh).
- So, self-consumed solar can be worth roughly 2–3× more than exported solar, in pure energy-bill terms.

Implication for micro cold rooms

- Right-sizing PV so that most generation coincides with cold room load maximizes savings.
- Net-metering then allows seasonal surpluses (off-season, cloudy spells) to still earn credits instead of being curtailed.
- This improves benefit–cost ratios and shortens payback compared to off-grid or gross-metered designs.

In West Bengal, a 100 kWp solar plant on a cold store showed that using solar primarily for captive use was far more lucrative than exporting all units at a low feed-in tariff.

Why DISCOMs should care: Agri - feeders as clean, flexible loads

- Multiple state regulators now recognize that net-metered agricultural and rural C&I loads can help reduce average cost of supply while improving reliability on weak feeders.

Daytime peak shaving

Cooling and pre-cooling shifted to high-sun hours using PV plus CTES.

Reduces evening and late-night feeder loading.

Improved loss profile

Generation injected closer to the load reduces technical losses on long rural lines.

Aggregator/FPO-led models improve collection efficiency.

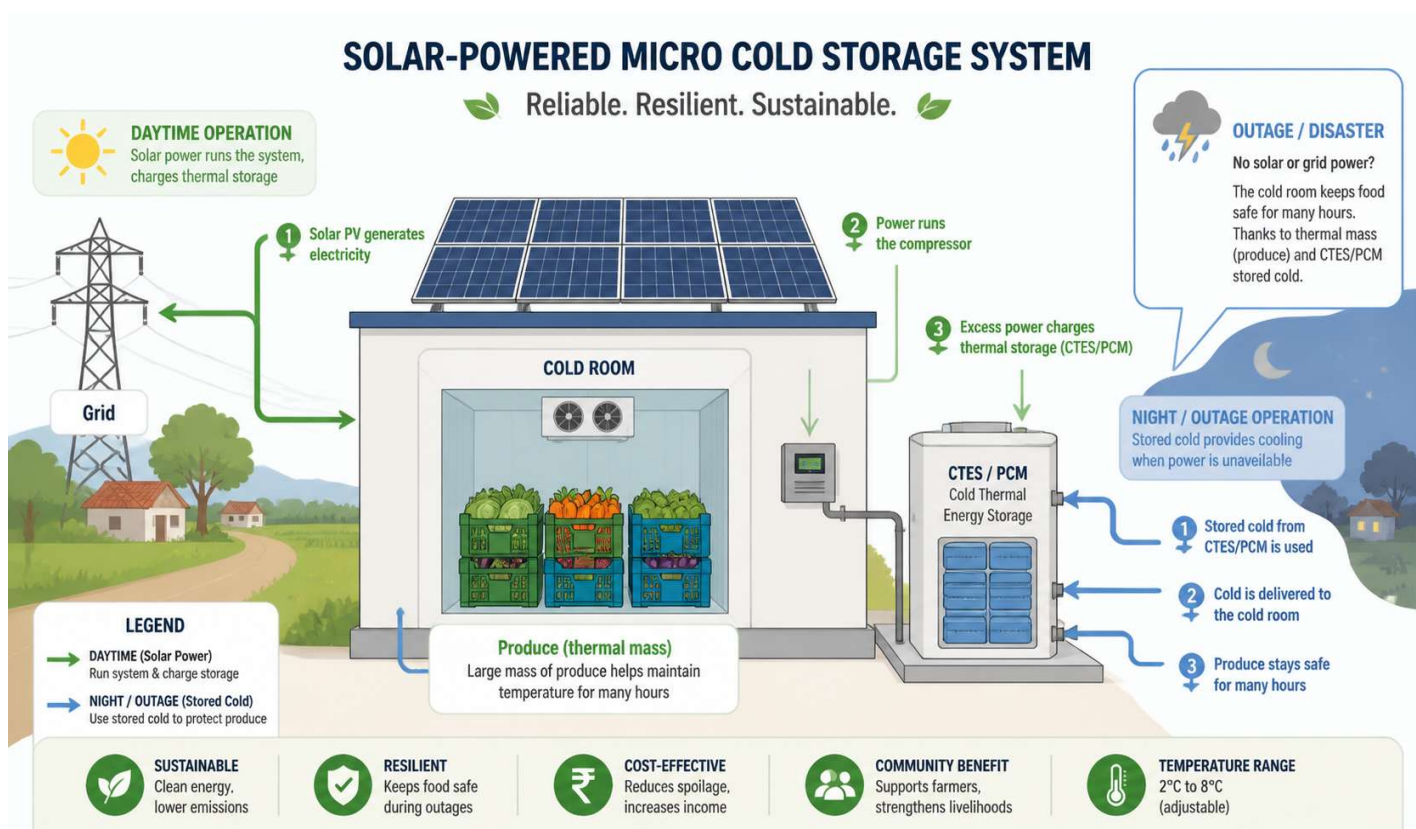
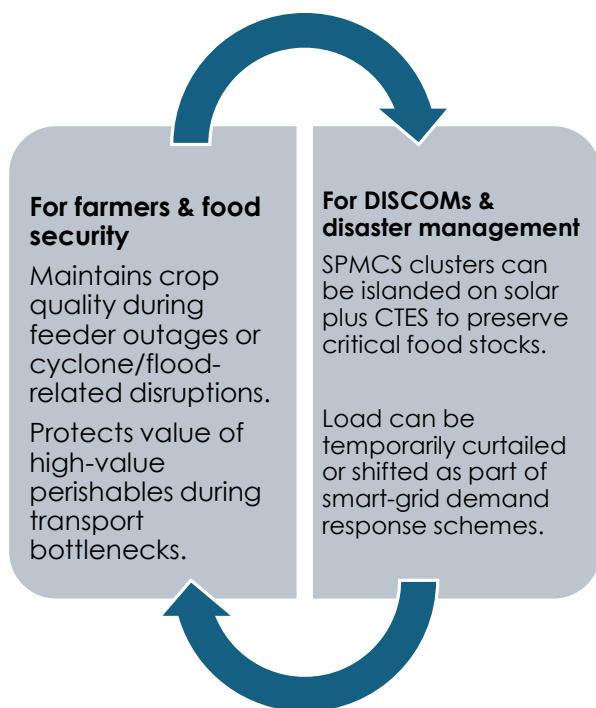
Planning-friendly assets

Standardized 2–20 MT SPMCS nodes can be treated as distributed resources in planning tools.

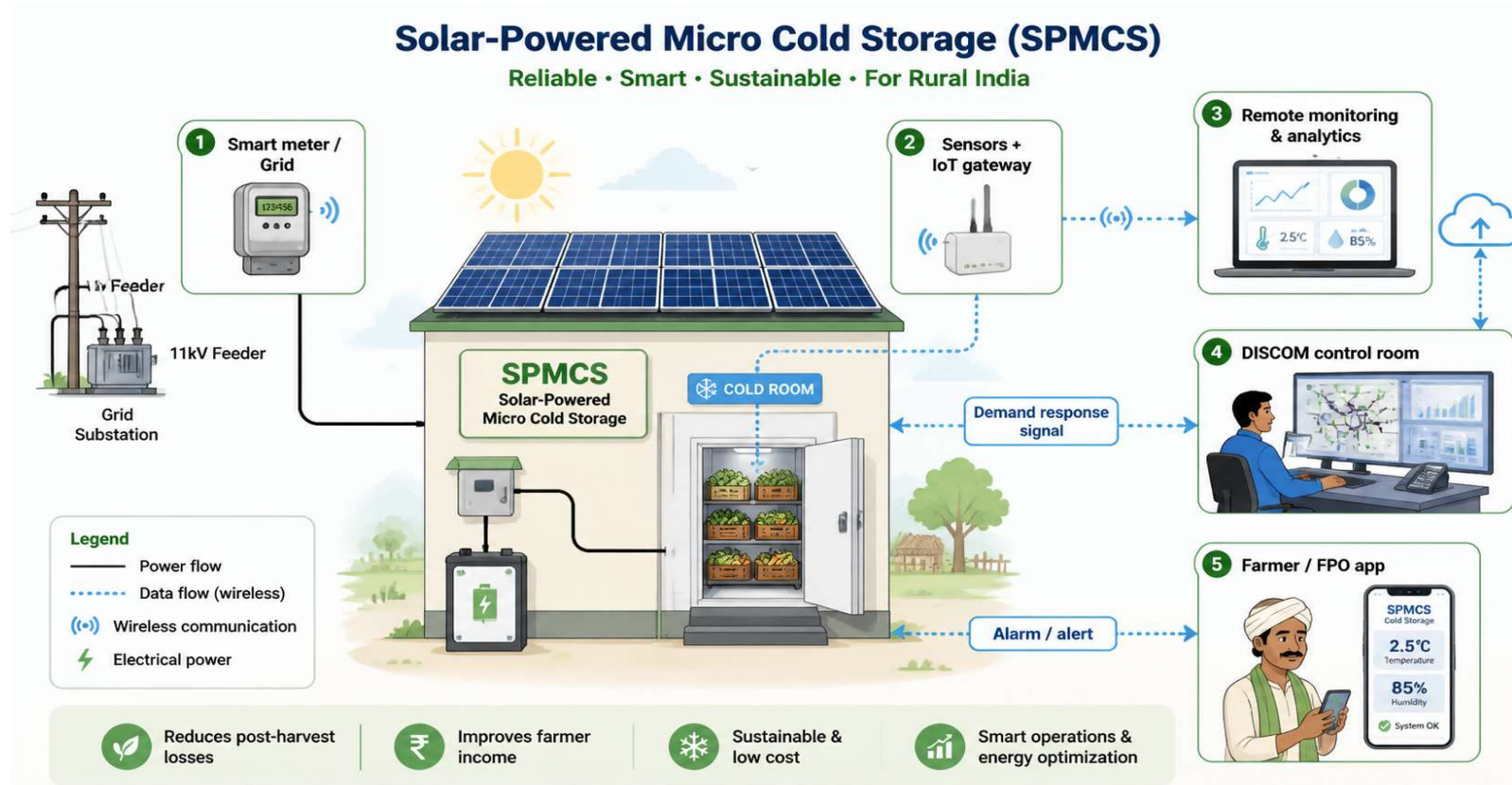
Digital monitoring enables

Thermal mass as virtual storage and disaster buffer

- Cold rooms with CTES and well-insulated envelopes can maintain safe temperatures for many hours even without grid supply, effectively acting as a “battery” for both food and the power system.



Making SPMCS “grid-interactive” with digitalization



IoT-based monitoring and cloud dashboards are increasingly used in Indian cold storages to track temperature, energy use, alarms and utilization in real time

Policy levers to unlock SPMCS at scale

AGRI-ENERGY INFRASTRUCTURE BONDS

- State/DFI-backed bonds to finance clusters of SPMCS on priority feeders.
- Repayment from storage fees and net-metering savings.

TARGETED NET-METERING FRAMEWORKS

- Explicit provisions for micro cold storage in Agri and C&I categories.
- Fair export compensation, while protecting DISCOM finances.

INTEGRATED AGRI-ENERGY POLICIES

- Coordinated use of MIDH, PMKSY, NHB and Agriculture Infrastructure Fund for SPMCS.
- Linking support to performance (utilization, loss reduction, digital reporting).

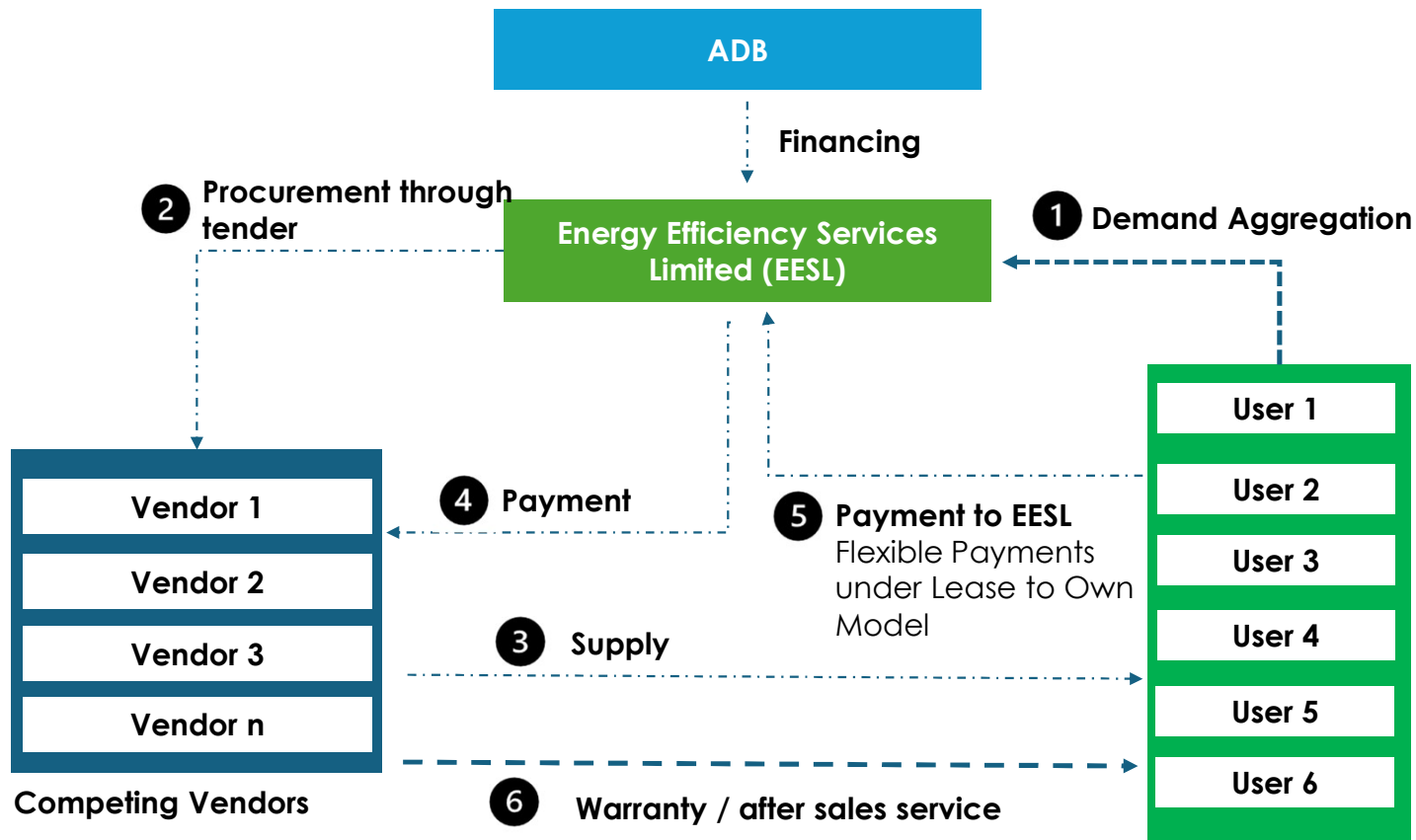
Existing cold-chain and horticulture schemes already support infrastructure, but mostly for larger, centralized facilities; new instruments can target distributed, solar-powered micro assets.

Implementation Approach (1/2)



Collaborative Effort to Unlock Solar Cold Storages: CLASP, EESL, ADB & Rural livelihood organizations

Financing Model



EESL - Led Demand Aggregation Halved the Cost of Solar Micro Cold Storages

Pilot Projects by EESL



Further progress:

- EESL has recently and successfully completed the tender process for 150 units of SMPCS and has identified potential vendors.
- Six pilot projects have been implemented in different climatic regions with support from ADB funding.
- Regarding aggregation, EESL has been collaborating with state horticulture departments to aggregate potential units in rural areas and at farm gate locations. Scale up would cater need of 2,50,000 SPMCS in India.

Thank You



Let's turn every village into a smart Agri-energy node

Solar-powered micro cold storages with net-metering are not just appliances – they are the building blocks of a new distributed infrastructure for food security, farmer prosperity and grid resilience.

CGM, Head Operations & Head SPMCS ,
Projects, Q&I , Sustainability & Clean
Tech.

Email id- achoudhary@eesl.co.in
head-agdsm@eesl.co.in
mcs@eesl.co.in