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Solar-Powered Cold Storage for Agricultural Produce

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INTRODUCTION

“Store Smart – Sell at the Right Time – Earn More”

Solar-powered cold storage is a modern post-harvest technology that uses solar energy to maintain suitable temperature and humidity for storing fruits, vegetables, flowers and other perishable agricultural products. Farmers often have to sell their produce immediately after harvesting because of inadequate storage facilities. During peak harvesting periods, excess supply may reduce market prices and lower farmers' income. Cold storage allows farmers to preserve produce for a longer period and sell it when market conditions are favourable.

Solar-powered cold storage is particularly useful in rural areas where electricity supply is unreliable or expensive. It combines solar panels, refrigeration equipment, insulated storage chambers and temperature-control systems to provide reliable cooling with lower dependence on conventional electricity.

2. How Does It Work?

The basic process is:

**Solar Panels → Controller/Inverter →
Battery/Power System → Refrigeration Unit →
Insulated Cold Room → Stored Produce**

Solar panels convert sunlight into electricity. The electricity operates the refrigeration system, while batteries can provide power when sunlight is unavailable. Good insulation helps maintain the desired temperature inside the chamber. Digital temperature and humidity monitoring can also be installed to maintain proper storage conditions.

3. Agricultural Produce Suitable for Storage

Solar cold storage can be used for:

- Fruits: Mango, apple, banana, guava, grapes and pomegranate
- Vegetables: Potato, tomato, onion, chilli, cauliflower, cabbage and carrot
- Other products: Flowers, mushrooms, dairy products, nursery plants and seed material

Different commodities require different temperature and humidity conditions, so storage settings should be adjusted according to the crop.

4. Major Benefits

1. Reduces post-harvest losses by slowing deterioration and maintaining quality.
2. Improves price realization by allowing farmers to delay sale during periods of low prices.
3. Reduces dependence on grid electricity and diesel generators.
4. Provides rural employment in collection, grading, packing, storage and marketing.
5. Supports FPOs, cooperatives and SHGs through shared storage facilities.
6. Promotes clean energy and reduces dependence on fossil fuels.
7. Strengthens the agricultural cold chain from farm to market.
8. Improves food quality and availability by making agricultural produce available beyond the harvesting season.

5. Government Subsidy and Support

Government programmes provide financial support for eligible cold-storage and post-harvest infrastructure. Under the Mission for Integrated Development of Horticulture (MIDH), assistance is available for eligible cold-storage facilities. Depending on the applicable component and area, assistance may be 35% of eligible project cost in general areas and 50% in specified North-Eastern, hilly and scheduled areas, subject to scheme norms and approval.

The National Horticulture Board (NHB) also operates schemes for construction, expansion and modernization of cold-storage facilities for horticultural produce. PM-KUSUM supports solar energy in agriculture through its applicable components, although it is not a universal direct subsidy specifically for cold-storage construction.

6. Investment and Profit Potential

The cost of a small solar cold-storage unit depends on capacity, refrigeration system, solar-panel size, battery system, insulation and automation. An illustrative small unit may require approximately ₹13–23 lakh, although actual costs vary considerably.

Income can be generated through storage rental, grading and packing services, aggregation and buy–store–sell activities. For example, if a 10-tonne facility charges an average of ₹2 per kg per month and operates for eight months, gross storage revenue could be around ₹1.60 lakh per year from storage alone. Additional services can increase revenue. Actual profit depends on utilization, operating expenses, financing costs and local market demand.

7. Establishment Requirements

Before establishing a solar cold-storage unit, the entrepreneur should select a location close to production areas, collection centres or markets. Adequate land, good road connectivity, drainage, proper insulation and reliable refrigeration equipment are important. The solar system should be designed according to the cooling requirement and storage capacity. Battery backup or an alternative power source may also be required.

Farmers should prepare a Detailed Project Report (DPR) covering investment, subsidy eligibility, expected income, operating expenses, market demand and repayment capacity before starting the project.

8. Suitable Business Model

Farmers/FPO → Collection → Grading → Solar Cold Storage → Market Information → Better Time of Sale → Market/Retailer → Higher Income
FPOs and farmer groups can establish or collectively use a cold-storage facility, reducing individual investment and improving bargaining power. Entrepreneurs can also provide paid services such as sorting, grading, packaging, transportation and market linkage.

9. Precautions

Produce should be properly graded before storage, and damaged or diseased commodities should be removed. Temperature and humidity should be monitored regularly. The refrigeration system, solar panels, batteries and electrical connections should receive periodic maintenance. Farmers should also calculate the expected storage demand and market price before storing produce for longer periods.

CONCLUSION

Solar-powered cold storage is a promising solution for reducing post-harvest losses, maintaining produce quality, and increasing farmers' flexibility in marketing. It combines renewable energy with cold-chain technology to extend shelf life and reduce distress sales. This technology can also promote rural entrepreneurship, employment generation, better market access, and higher farm income.

Solar Energy + Cold Storage + Better Marketing =
Less Wastage + Better Income