



# COSTS AND BENEFITS OF CLEAN ENERGY TECHNOLOGIES IN KENYA'S VEGETABLE VALUE CHAIN

Small-scale producers in the vegetable sector face many challenges. Overcoming them could help achieve a more constant level of production and income.

Both solar cold storage and small solar-powered water pumping technologies, assessed here as case studies, showed positive financial and economic returns.

Adoption of such clean energy technologies in the vegetable value chain can be facilitated by establishing guarantee schemes as well as specific micro-credit lines and support services for farmers and cooperatives; setting minimum performance standards for renewable energy (RE) equipment; educating and training practitioners on the benefits and effective use of solar technologies and raising awareness of technological and financing opportunities.



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## ENERGY TECHNOLOGIES IN THE KENYAN VEGETABLE VALUE CHAIN

Horticulture is the third leading agricultural subsector in Kenya (after dairy and tea), and it is a growing market. Vegetable production largely comes from smallholders, with the average farm less than two hectares. Farming is often the primary source of livelihood for rural households. There is little knowledge on appropriate post-harvest handling practices, packaging, labelling and grading, and storage. This leaves major opportunities for improvement in productivity and added value in the sector.

The main challenges for small-scale producers include erratic rainfall, high and volatile energy prices, low crop yields, post-harvest losses of perishable crops, seasonal variations in product prices, poor access to market information, weak transportation infrastructure, and lack of access to modern energy for productive uses. Accessible RE for cold storage in off-grid areas or areas with an unreliable electricity grid can significantly reduce the loss of perishable products such as tomatoes and beans. At the same time, pumping underground water for irrigation can

significantly increase vegetable productivity. Currently, only 6 percent of farmland is irrigated due to lack of awareness but also poor access to modern and affordable energy services on farms, especially electricity. Women are generally responsible for growing and selling surplus vegetables for subsistence needs, while men cultivate cash crops primarily for sale. This leads to a higher portion of agricultural income going to men. Male traders also dominate the more profitable wholesale segment of the value chain.

## CASE STUDIES

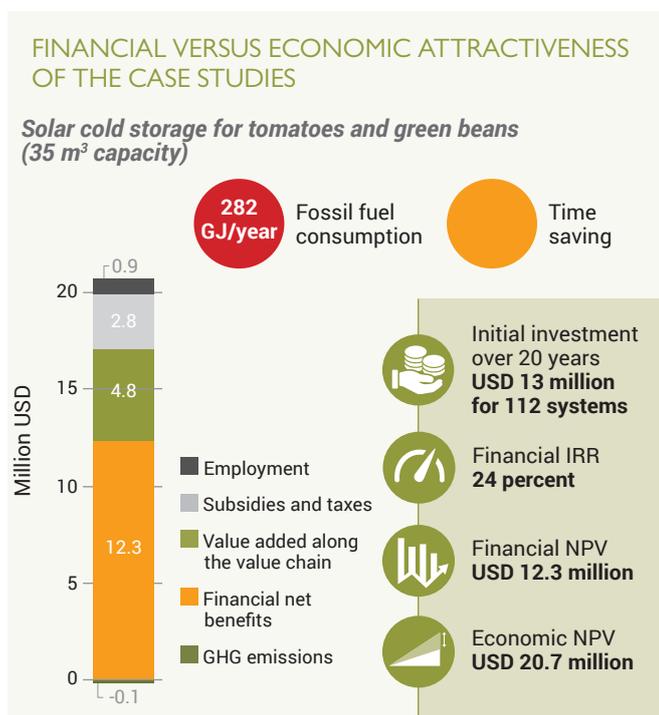
Solar cold storage and small solar-powered water pumping systems were chosen as examples of clean energy technologies that could be introduced in the Kenyan vegetable sector.

Volatile production volumes and high post-harvest losses underline an urgent need to improve cold chains. Unreliable electricity grids, and regions without electricity at all, make **solar cold storage** an interesting technology. The tomato and green beans value chains were analysed as they are two important perishable crops produced in Kenya, with growing markets. At the national level,

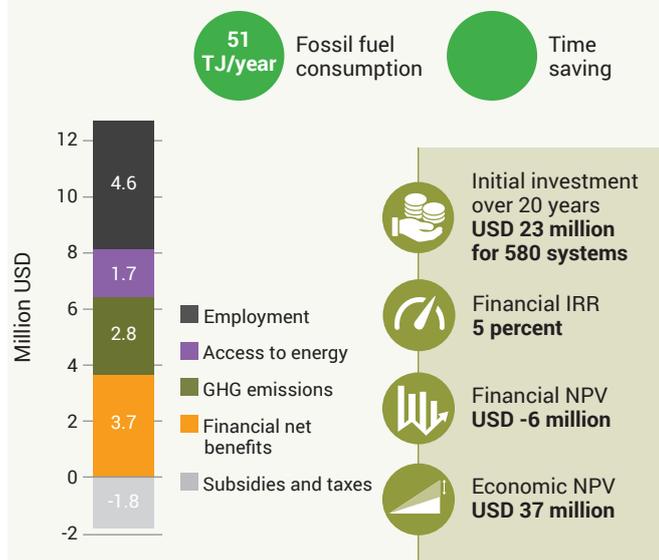
there is potential for about 112 grid-connected solar cold storage systems (35 m<sup>3</sup> capacity) for tomatoes and green beans that could be installed to serve farmer groups or associations at collection points.

About 11 000 off-grid farmers currently use petrol engine-powered water pumps in Western Kenya. These could all benefit from small portable **solar-powered water pumps** (with a maximum head of 8 m and up to 1 200 l of water per day capacity).

Both technologies show positive financial returns and valuable co-benefits. Solar cold storage creates added value in the vegetable sector by reducing food losses. If coupled with improved information between market demand and available supply, cold storage can reduce product loss and congestion in the market place, as well as provide a tool to deal with market price volatility.



*Solar-powered water pumping for vegetables replacing petrol-engine powered pumps (up to 1 200 l of water per day)*



Note: NPV: net present value; IRR: internal rate of return. Non-monetized impacts are depicted as circles (green: positive, orange: variable, red: negative impact) and quantified where possible.

Solar-powered pumps show good financial returns, reduce GHG emissions, improve access to energy, avoid fuel purchases, reduce time needed to supervise irrigation operations and create employment (including technical support services).

If early adopters were already irrigating their fields using traditional pumping systems, solar pumping does not bring an improvement in yields. Conversely, the co-benefits are significant if the solar-powered water pumping is adopted by farmers who rely on rainfed agriculture, but in this case the differential investment cost is higher.

### POSSIBLE SUPPORT INTERVENTIONS

Policy measures, financial instruments, knowledge providers and education schemes can facilitate the adoption of clean energy technologies in the Kenyan vegetable value chain. Policy-makers, private companies and financial actors might:

- support **guarantee schemes** and develop specific **micro-credit lines** coupled with support services for farmers and cooperatives wanting to adopt the clean energy technology, including instruments that hedge against production risk;
- complement the effort for **eradication of low efficiency and low quality equipment**, usually imported and sometimes counterfeit, by setting **minimum performance standards**;
- **clarify the rules** for import tax exemption of renewable energy equipment;
- **educate** practitioners about the benefits and effective use of the technology using public extension services, associations and local NGOs;
- provide **training** to farmers on the financial benefits of clean technologies and **raise awareness** of financing opportunities;
- **train retailers** so that they can complement their offer with support services; and
- organize **knowledge sharing** events on e-commerce and real-time information systems.



For more information on the INVESTA project and a description of the case studies please visit: [www.fao.org/energy/agrifood-chains/investa](http://www.fao.org/energy/agrifood-chains/investa)