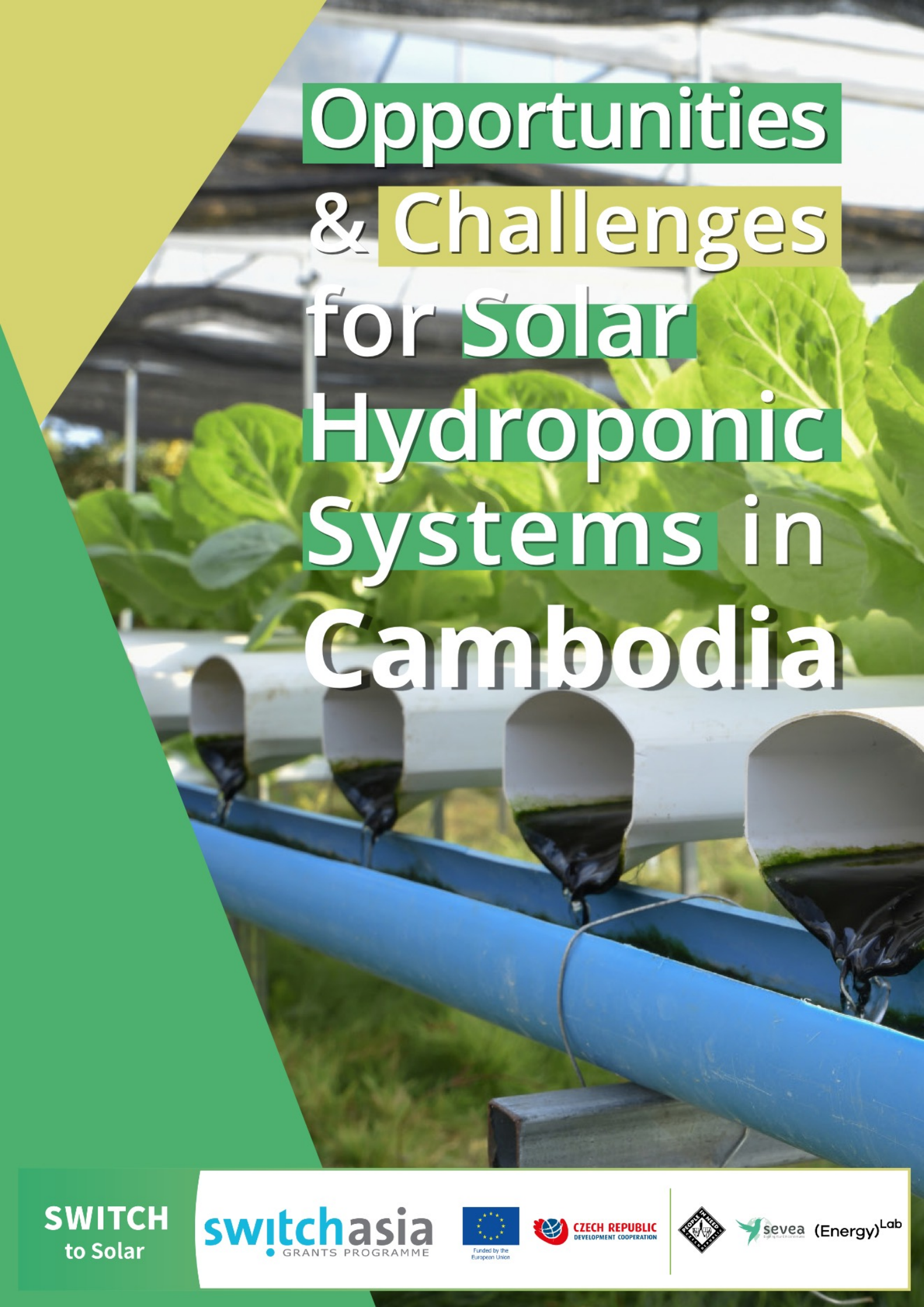


Opportunities & Challenges for Solar Hydroponic Systems in Cambodia

SWITCH to Solar

switchasia GRANTS PROGRAMME

Funded by the European Union

CZECH REPUBLIC DEVELOPMENT COOPERATION

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In recent years, Cambodia's electricity sector has been through outstanding improvements fuelled by the government's success in rapidly expanding access to grid electricity up to 81% of households at the end of 2020. Nonetheless, in light of the relatively high electricity costs, remoteness of farmers and overall low mechanisation of the agriculture sector, solar technologies for productive use have the potential to improve agri-fishery MSMEs competitiveness on the market while reducing their operational costs. This summary provides a short overview of the opportunities and challenges for the adoption of solar hydroponic systems in Cambodia.

Starting by looking at the use of hydroponic systems…

Hydroponic systems can be used for the production of horticultural products, mainly vegetables. The technology introduces a new production method, one where the plant is grown in a water-based, nutrient-rich solution. It does not require soil and is instead based on the constant addition of nutrients in the water solution; hence the main input needed is soluble nutrient and preferably organic (liquid fertilizer).



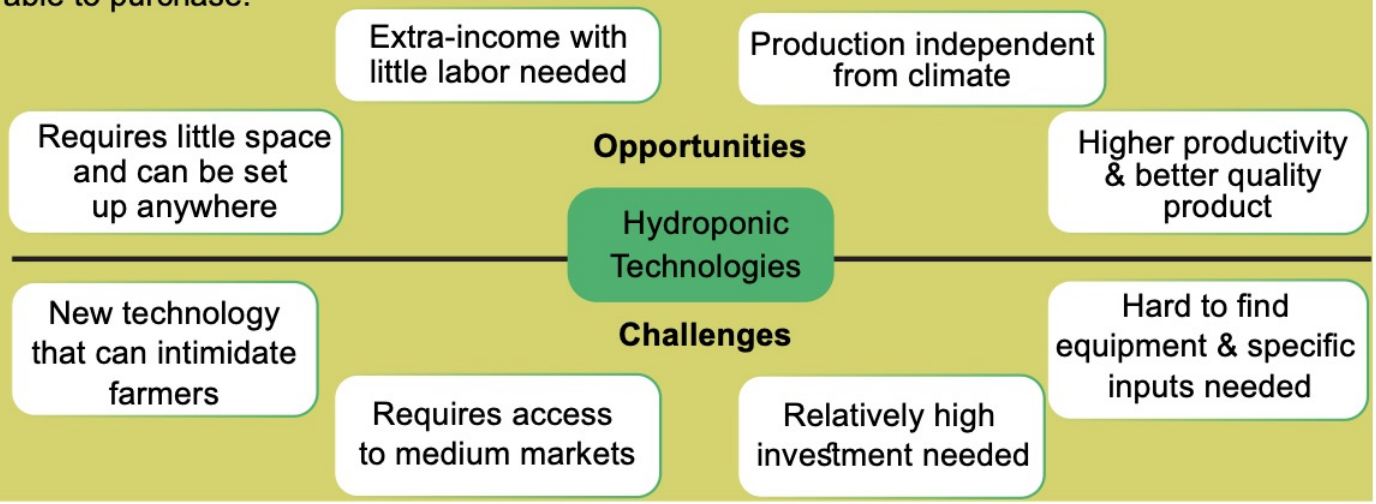
Hydroponic solutions facilitate the production of vegetables, especially leafy ones. Indeed, they hold many benefits that can positively influence their uptake:

- **Independence from climate and climate-resilience:** as they cultivate the plant away from the soil and often use a roof, hydroponic systems can be used to grow vegetables all year long, during both dry and rainy seasons, without spacing the cycles and independently from the climate
- **Higher productivity and product quality:** hydroponic techniques give farmers the control over environmental parameters leading to faster growth, increased productivity, cleaner and higher-quality outputs, which enables premium pricing.
- **Reduce labor:** as neither preparation and control of the soil is needed, nor manual irrigation and pest management if cultivated under greenhouse, hydroponic systems have the advantage of making the production less time- and labor-consuming compared to traditional farming, making them a particularly inclusive technology.

Yet, as this technology is relatively new, there are challenges that need to be considered as they might constrain its adoption:

- **Expensive and hard to find equipment & inputs:** as the availability of the technology is still limited in Cambodia and most equipment and inputs are imported, they stay expensive and can be hard to find. This is especially the case of the liquid fertilisers needed which are distributed by a small share of input supply stores only.
- **'Intimidating' technology:** hydroponic systems still appear as a novelty for a lot of farmers. Knowledge on their operation and benefits is not widespread. As such, it is likely that the technology will attract risk-takers and innovative profiles mostly
- **Access to premium markets:** Investing in hydroponics, since it raises the cost of production and quality of goods, also means targeting higher-value markets, mostly premium markets (locally or internationally), something that not all stakeholders are able to do.
- **Liquid fertilisers are not organic:** The currently available liquid fertilisers are not organic, which is a major drawback as it prevents farmers from selling their products as organic products, thus reducing the types of premium markets that farmers can target (in link with the above point).

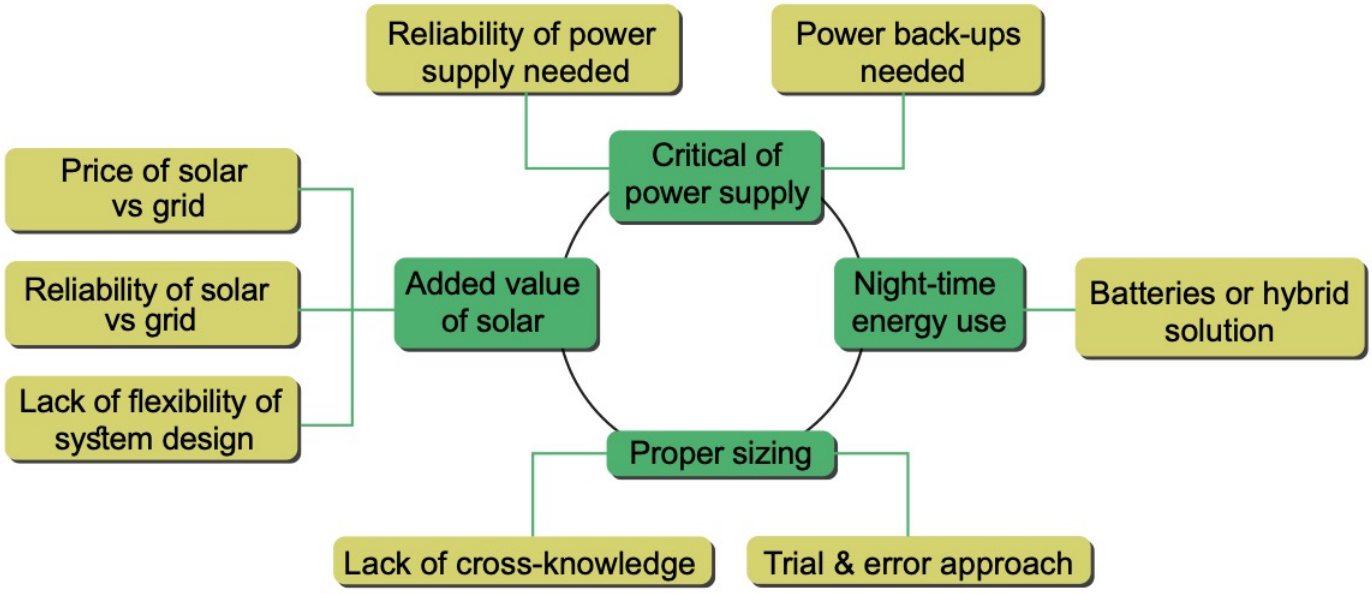
All in all, hydroponic systems can be relevant for both smallholder and commercial farmers. In spite of their low investment capacity, **smallholder farmers** can have an interest in hydroponic systems as a way of generating extra revenue without requiring a lot of extra labour.
Yet, hydroponic systems seem to present higher opportunities for **commercial farmers,** who have higher technical knowledge, better access to premium markets and investment capacity as well as potential willingness to experiment and take risks. Plus, hydroponic systems need to be **set up under a greenhouse**, which commercial farmers are more likely to already have or to be able to purchase.



Technical considerations

There are different architectures of hydroponic systems, usually consisting of a grow bed, a nutrient reservoir, a water pump, and a roof. Hydroponic systems are quite energy intensive due to constant water pumping and aeration, thus opening the opportunity to switch them to solar. If there are not many providers of solar hydroponic systems per say in Cambodia, hydroponic equipment and solar water pumps are both separately available.

Nonetheless, the needs of hydroponic systems associated to the own limitations of solar systems reveal 4 main technical constraints to the adoption of solar hydroponics, the main ones being the **criticality of the power supply** as the production is very sensitive to pump failure, and the **need for proper sizing of the systems.**



Capacity	 Electric	 Solar
Per grow bed (without greenhouse)	$400	$700

Another constraint to the adoption of solar hydroponics is their **upfront costs,** especially since the investment in a solar hydroponic system has to be combined with the investment in a greenhouse.
As such, they will be more affordable for stakeholders with higher investment capacity like commercial farmers, or farmers who already own greenhouses.

Yet, it is interesting to note that solar-powered hydroponic systems are quite competitive with grid-powered systems and both are economically viable. Under the assumptions used for the economic analysis, both types of systems would generate significant profits (~300USD/month) all year round and for a limited workload. For this reason, they can still be interesting for all types of stakeholders, and end-user financing mechanisms would be important to facilitate the uptake of the technology by stakeholders with smaller investment capacity.

Recommendations – How to be successful in distributing Solar Hydroponics?

Hydroponic systems hold great potential for farmers wishing to produce high quality vegetables as a main activity or as a way to generate extra revenues with little labour and time needed. In particular, hydroponic systems can be interesting income-generating technologies for women, elderlies or people with disabilities. Yet, there are challenges to overcome to be able to develop such a solar powered solution at scale. Here are a few recommendations to increase the adoption of solar hydroponic systems in Cambodia:

- In terms of distribution, two routes are recommended to scale up the market for hydroponics. First, it is recommended to target commercial farmers, who have better investment capacity and are more able and willing to take risks. As the technology needs to be used under a greenhouse, it can be interesting for technology providers to **partner with greenhouse distributors** to create bundles (greenhouse + hydroponic system) to sell to commercial farmers wanting to improve their yields and reduce risks linked to seasonality. The other route would be to leverage the inclusivity and climate-resilience of hydroponic systems to **create partnerships with development programs or NGOs**, and focus on community systems to help generate extra-income at the scale of the community (community systems also make more sense in terms of power supply).
- In both cases, in order to ensure the economic benefits of using the technology, it is key that end-users are able to sell their products at higher value than the traditional farming equivalent, thus requiring producers to **secure a premium market**. It is recommended to work with aggregators, who have access to such markets, and could be interested in models of contract farming.
- It is also important for end-users to optimise the use of the technology. The **provision of trainings** on hydroponic farming is thus key to ensure the added-value of the technology and ease its uptake.
- In all cases, it is important **to introduce end-user financing mechanisms** to mitigate the high upfront costs of the solutions. It can be done through partnerships with MFIs, simple financing mechanisms by technology providers themselves (payment terms), or more innovative models such as leasing or contract farming.



SWITCH to Solar For a Thriving Agri-Fisheries Market

This document is produced as part of the SWITCH to Solar Project, funded by the European Union and the Czech Republic, and implemented by three partner agencies: People in Need, EnergyLab and Sevea. The goal of this document is to present the results of the study led by Sevea on the opportunities and challenges for solar cricket incubators in Cambodia.
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