TNO Decentralized Solar cooling system

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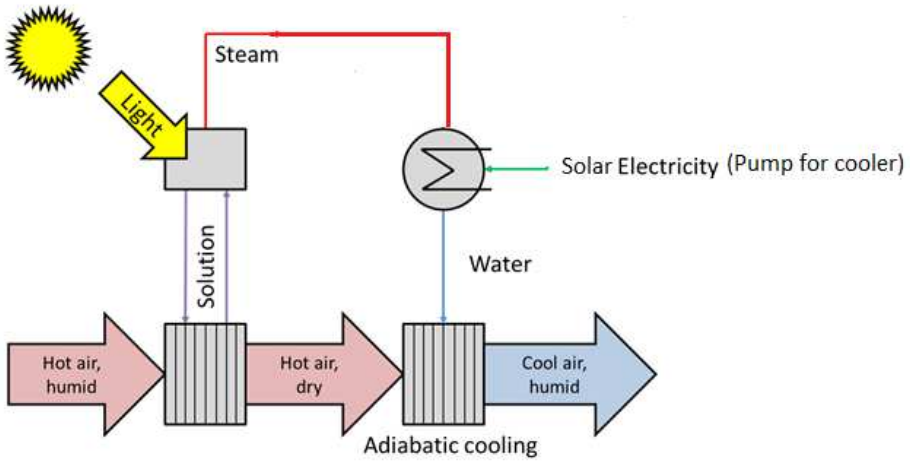
Introduction

TNO has developed an innovative cooling concept that can be used for different cooling applications such as smaller cooling houses (agriculture) or on trucks. Conventional cooling is being done by air-conditioning systems in isolated chambers. These are expensive in purchase and electricity costs, inefficient when the outside temperature is very high and (when connected to the grid) can go off-line during power cuts resulting in losses of for example stored product and cooling capacity.

Short Technology Description

In order to mitigate the problems of using air conditioners in cold chambers, we are developing an autonomous system for cooling that replaces the existing air-conditioning (see picture below). Cooling by night or in bad weather conditions is also possible by using a buffer for the solvent solution. The principle is shown below.



This system is a combination of techniques and works as follows;

- A (harmless) solvent removes the water from warm humid air,
- solar heat is used to release the water from the solvent,
- The solar heat generates water vapour,
- The water vapor is reintroduced in the dry warm air stream
- The released water is used for adiabatic cooling for generating cool air in the chamber.

System characteristics

The main benefit of the system is that it is a complete self-sustaining installation which delivers cooling capacity and water production (depending on the natural moisture content of the air) with very low costs during operations (only maintenance, electricity for the pump and no further consumables). It can be made very robust and durable to ensure long life (10-20 years). By using existing technologies (solar boilers) and cheap materials we expect low capital costs of approximately 500-1000 euros for the finished product.

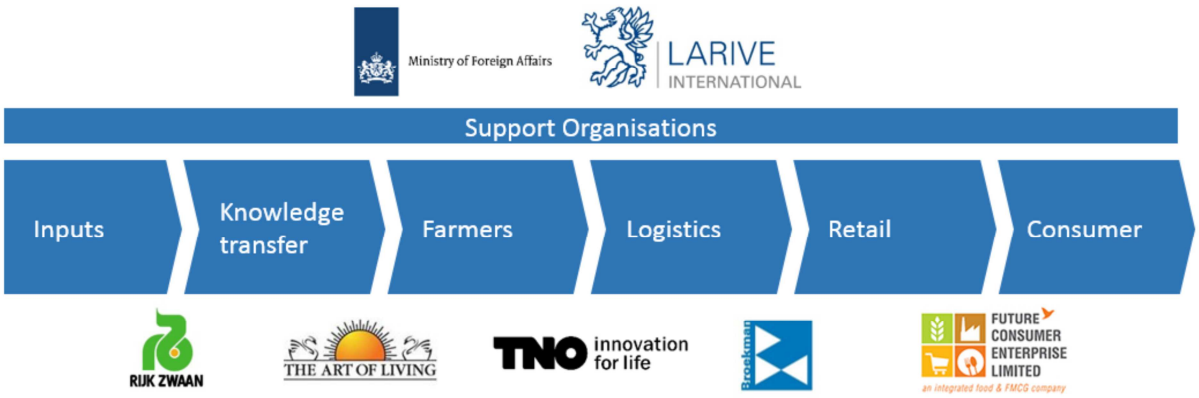
Business Case

A large portion of the world's energy is used for cooling (households, industrial, food, etc.). This system has the potential to deliver cheap cooling capacity and potentially water generation in countries with high solar radiation. Furthermore, the system can replace standard cooling systems as a stand-alone, energy efficient and environmentally friendly cooling application. The current business case is for application in decentralized rural cooling houses and transport trucks, to replace conventional cooling. For all applications we are looking at either starting a new business or incorporating the cooling products in existing companies for sale.

FoodTechIndia Project

Currently TNO, via the energy innovation for development program, is developing and piloting this technology in the Dutch government food program (FDOV) project FoodTechnIndia. This is a 6 million euro project which runs over 5 years to establish an efficient food transportation and processing chain from the source (rural greenhouses) to the consumers in Southern India. The consortium is all industry (Larive, Broekman Logistics, Rijk zwaan, Future group) with a Local NGO for farmer participation and TNO. TNO has a budget of 1 million euro and will develop and test the cooling technology for application in rural cooling houses and small trucks. Broekman logistics is interested in applying and commercializing the product on their 25.000 trucks in India during and after the project.

The project is set-up via the energy Innovation for Development program to enable This requires no enables cheap cooling without grid connection in rural area's to significantly decrease the losses of agricultural products, improving the livelihood of the local farmers as well as improving the food quality in the chain.



Beyond solar cooling

We are currently working on a proof of principle to which extends the use of the cooling technology to produce steam for use in biogas upgrading systems. A classic biogas upgrading systems removes CO2 to get the biogas to the specifications of natural gas. The solar cooling principle, when combined with Nano-particles to increase the heat release, can desorb the CO2 from an amine capture solvent with sunlight. This can potentially mean a very cheap upgrading system which requires no conventional energy source, only sunlight. An application for this is again in rural areas in emerging countries to produce compressed natural gas for transportation and bottling for cooking. First interest is in Pakistan and India via the EU Switch Asia program.