RePro Food

Innovations Findings Report

2016-09-30

The purpose of this document is to collect innovation information in the Vinnova project for public dissemination. Each innovation in the RePro Food project is detailed in a separate fact box below. As each innovation is completed, the summary will be published on the project web site news: www.reprofood.com.

1 Heat capture from challenging environments (Veolia)

Status: Completed 2015

The challenge: Heat recycling from waste water is a potentially valuable resource. In the RePro Food project, heat from waste water at Findus was identified as the primary heat source. Heat recycling form waste water is challenging because of solid materials in the waste water stream. In the Findus case, these were bits of food waste, rinsed out in the processing. Such solid material quickly clogs the heat exchangers used to capture the heat. Filtering the waste flows was not deemed to be viable, due to prohibitive operations costs. Veolia's task was to find a technical solution for a heat exchanger technology that could be used to capture the heat.

Solution: Veolia identified a heat exchanger system named SHARC developed by International Wastewater Systems in Canada: http://www.sewageheatrecovery.com/. SHARC is specifically designed for use on sewage flows. By automatically continually alternating the flow of wastewater through the heat exchanger, SHARC incorporates a continual back-flush into the heat exchanging process so that solid waste material is flushed out.

Unfortunately, because Findus announced the closure of their production plant on March 31, 2016, this innovation was never implemented in that environment. However, similar challenges are not unusual for low-grade heat recycling, and the solution will in all likelihood by applicable elsewhere.

2 Greenhouse glass (Royal Pride Sweden)

Status: Testing in progress

The challenge: Greenhouse output is fundamentally constrained by the amount of photosynthesis that takes place inside. To maximise the uptake of light to plants, the quality of the glass has been demonstrated to have a significant effect. Diffuse glass breaks up light and has been shown to increase light uptake in plants, but has not been tested for Nordic conditions. At the same time, heating costs are a substantial challenge for competitiveness and energy use for heat affects the environmental footprint of operations. The challenge is therefore to find a glass that optimises production.

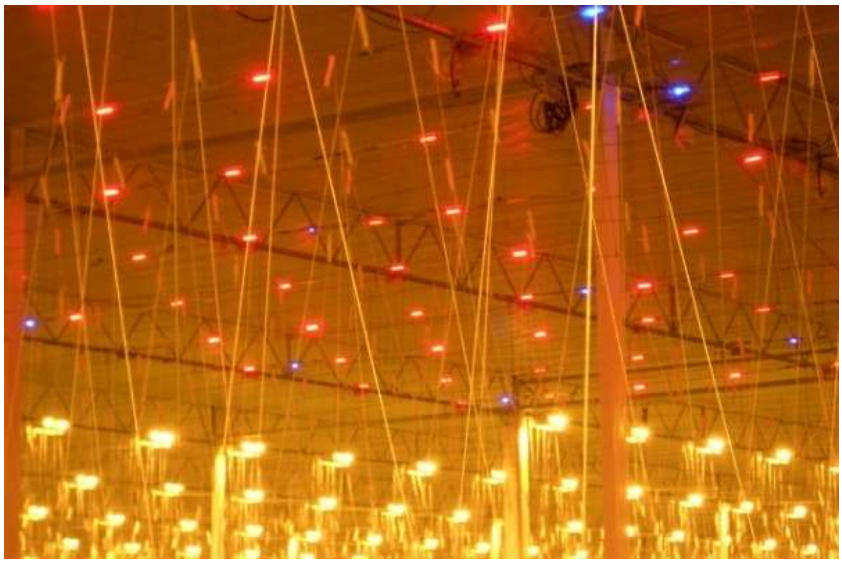
Progress: Tests are currently being conducted in Holland. A full-scale testing and demonstration facility is planned in Bjuv.

3 Hybrid greenhouse lighting (Royal Pride Sweden)

Status: Testing in progress

The challenge: Year-round production maximises the usefulness of the infrastructure and customer value and provides steady, secure employment for hundreds, but requires lighting. Conventional lighting technology using high-pressure sodium lamps (hps) and represents a significant cost for electricity use, as well as an indirect environmental impact. Experiments with LED (light emitting diode) lighting show that, for hitherto unexplained reasons, fruit growth is inhibited with LED light. A hybrid lighting system, comprised of both HPS and LED technology could provide cost savings and environmental benefits without loss of production.

Progress: Tests are currently being conducted in Holland. A full-scale testing and demonstration facility is planned in Bjuv.

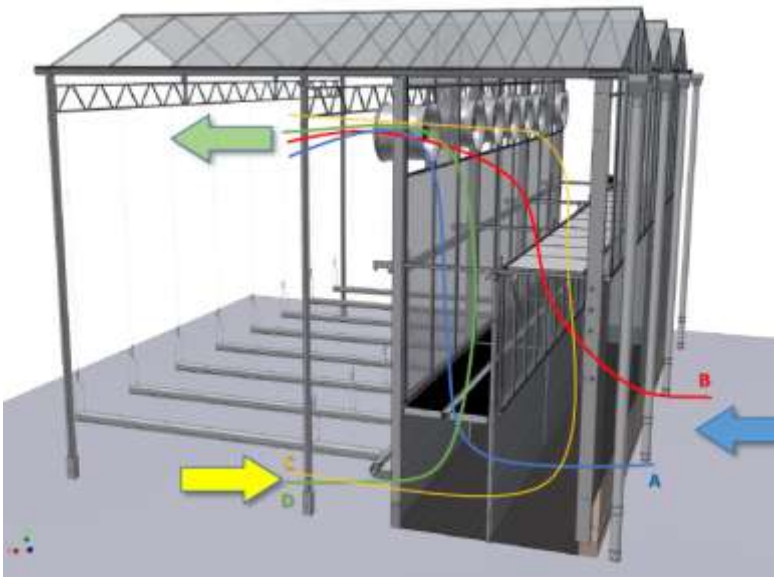


4 Low-temperature greenhouse heating (Royal Pride Sweden)

Status: Testing complete

The challenge: Using recycled heat to warm greenhouses allows greenhouse growing to be competitive in cool climates, but much waste heat is available at low temperatures. Being able to make use of this heat directly, without the expensive use of heat pumps, is therefore an important competitive advantage. Conventional heating systems for greenhouses use warm water to convey the heat, but with the low temperature difference the capacity for heat transfer through the piping may be insufficient on cold winter days.

Progress: A ventilation-based heating concept for greenhouses has been developed by partners and tested at a test facility at Royal Pride Holland, which is a full-scale greenhouse, but short of the industrial scale planned in RePro Food. A full-scale testing and demonstration facility is planned in Bjuv.



5 Nutrient Recycling (Vegafish)

Status: On-going

The challenge: Waste water emissions and related environmental issues are a major barrier to on-land fish farming. Even recirculation aquaculture systems (RAS) need to emit substantial water quantities continually including large concentrations of nutrients which otherwise would become toxic to the fish. The waste nutrients can be profitably used as fertiliser in greenhouse, but this requires coordination of the management of water and nutrient flows between the greenhouse and the fish farm and is dependent on the distribution systems for these at both facilities.

Progress: An investigation of how nutrients from the fish farm could be used in the planned greenhouse is underway. At the same time, alternatives are being considered, including integration with biogas production.

6 Integration of biogas production (Söderåsens Biogas)

Status: Optional

The challenge: Flows of nutrients and energy in RePro Food project may be useful for biogas production at the nearby plant of Söderåsens biogas. Possibilities include fish farm waste water, fish slaughter waste, tomato plant waste and also use of the biogas in the food production facilities.

7 Business and Financing Structure for Regenerative Industry Infrastructure (WA3RM)

Status: Complete

The challenge: To put in place the industrial-scale food production infrastructure that is the goal of the RePro Food project, the required investment is in the hundreds of millions of Swedish kroner, making it necessary to attract both loan financing and outside equity investment. In order to ensure that the cost of capital is affordable, the risks to investors must be managed and described carefully.

Progress: A business model for the infrastructure investments has been completed, and also shows the operations of the greenhouse and fish farm, clearly demonstrating excellent profitability and therefore low risk to investors. A legal framework to govern the relationships of the involved parties has been completed.

8 Financial Instruments for Regenerative Industry Infrastructure (WA3RM)

Status: Preliminary investigations

The challenge: International studies show that bank financing for large-scale greenhouses is limited to between 50 and 70 percent of the project total, meaning that that between 30 and 50 percent of the needed capital must be supplied by equity, unless a tier of financing in between can be identified, often called mezzanine financing. Although typically more expensive than bank loans, mezzanine financing would still have lower yield demands than equity, thereby improving the economic viability of the facility.

Progress: Two types of mezzanine financing have been explored in preliminary investigations, government programs to support sustainability investments and private issues of bonds, where so called green bonds and also resilience bonds are of interest.