INNOVATIVE FOOD PRODUCTION OF FISH AND VEGETABLES

HEALTHY ENVIRONMENTS FOR PEOPLE

FOOD IN CITIES

SSEC SWEDISH SURPLUS ENERGY COLLABORATION

Case

Urban Food from Residual Heat

Turning excess heat into local produce for greener cities

Project period	March 2017 – September 2018
Location	Malmö, Lund, Bjuv and Oskarshamn, all in Sweden
Theme	Urban Transitions
Lead contact	Bengt Persson, Project Manager at Swedish University of Agricultural Sciences
Stakeholders	Private and Public


HÄRODLAT FISK&GRÖNT

Case Overview

Malmö is growing. Looking at the biggest city in the southern part of Sweden – and number three nationally – it is hard to see that 25 years ago this was an ailing industrial hub with rising unemployment, a falling population and a general feeling of being caught in the economic slump of the early 1990's.

Since the turn of the century Malmö has seen an almost 25 % increase in population fueled in part by the opening of the bridge across the Oresund linking the city to neighboring country Denmark and its capital, Copenhagen. The university of Malmö was opened in 1998 and has contributed to making Malmö a young city with almost half of residents being under the age of 35. Today the city is as known for its biotech and startup scene as it is for its shipbuilding and industrial past.

Malmö's industrial past and high-tech present shows very clearly in municipality's plans for the harbor and port area. To the north is the industrial harbor that also is the core of the city's district heating and waste management facilities. To the south, a new development called Nyhamnen – New Harbor – aims to create 6,000 new homes and varied 13,000 workplaces over the coming decades.

Tying these two areas together is no small challenge. Therefore, the municipality of Malmö chose to make open innovation competition to explore the opportunities arising from the area. The purpose of the competition was to seeking new inspiration on how utilize the residual heat from the Northern part of the harbor with the district heating and waste management facilities for creating a local urban food production. Several Gigawatt hours are wasted each year. Using that energy to create local food production would tie the stories of the old and new Malmö together.

This is an opportunity Malmö share with the other three cities connected with the Open Innovation competition "Urban Food from Residual Heat" organized by a consortium of thirteen partners and supported by grants from Climate-KIC and the Swedish national innovation agency, Vinnova.

In nearby Lund, the construction of one of the largest research facilities in Europe, the European Spallation Source (ESS), is underway. Close to that, Max IV the world's strongest electron microscope has been built. Together the two facilities will be a global leading research facility, but also the center of an entire new part of town called Brunnshög. The high temperature excess heat from the research facilities will be utilized to heat the new homes and offices keeping up to 40,000 people warm, when Brunnshög is fully developed. But the low-temperature excess hear fraction is harder to utilize, and the city planners in Lund hope to use it to develop facilities for growing local produce. The ambition is, that it will add to the sustainable character of the new development, adding to the attractiveness of the area. But it will also act as a showcase for how to create a highly efficient production of

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Malin Norling, Malmö municipality

biological products making up for some of the farmland taken up by the expanding city.

Moving a bit north, to the medium sized town of Bjuv, highly efficient food production is at the center of towns economy. The town is located in the middle of the productive farm lands in south-western Sweden, and the agricultural focus in the business in and around Bjuv will be strengthened with the establishment of the Food Valley of Bjuv, a cluster of companies that work in food production and related activities. At the center of the Food Valley of Bjuv is the Foodhills Industrial Park, a large scale industrial food production site focused on sustainable climate-smart food production at industrial scale with highly efficient fish farms, greenhouses and cold storage facilities

To connect the town center to the new facility the municipality joined the Open Innovation competition looking for solutions on how to create a "Miniature Food Valley" in the city center, using excess heat from the towns district heating system to create facility combining food production with markets and exhibitions demonstrating the circular and sustainable nature of Food Valley.

Moving from south-west to the south-east coast of Sweden, the fourth challenge owner, the town of Oskarshamn shares both opportunities and challenges with several of the other challenge holders. The inner harbor district is to be developed as a new housing area, where urban food production is seen as a key element. The nearby closed down airfield is being developed as a new business area with a focus on sustainable food production and finally the

nuclear power plant OKG a bit further north along the coast generates huge amounts of excess heat. Each site contains specific opportunities and challenges that had to be addressed in the competition.

Fresh perspectives

The great variety in the challenge sites was not the only challenge for the competitors. Their solutions had to be feasible not just technically but also socially and financially. It had to fit in and be a valued part of the urban scenery wherever it was to be placed, and it had to be able to generate enough revenue to pay for the investment and provide an income for the people it created jobs for. That meant that the competitors had to take both business plans and design into account also.

That called for outside inspiration, says climate strategist and project manager from Malmö municipality, Malin Norling:

"Our imagination only stretches this far, so we said: "let's see if someone else can think of something that we cannot think of," she says.

The municipality had already been part of one open innovation process for how to use the residual heat in the harbor, but the results were mixed. One idea – heated pavements at bus stops and other places for greater safety – is being implemented in another town, but for Malmö there was a smaller payoff. Only a handful of ideas looked realistic and – perhaps more importantly – they were not new.

"We thought there would be more new ideas. We had more or less thought of these ideas before, so we were not like: "Wow, surprised"", she explains.

But when Vinnova indicated that they would support a new and larger competition, now with 13 partners and access to Climate-KICs international network, they decided to go along. That changed the picture. While the new competition was longer – in three stages over 18 months – the focus was narrower – the residual heat had to be used for urban food production and associated activities. But the main factor was that the number of competitors rose – from 13 to 46 and international competitors now joined.

"It was a huge increase. I would say it came from the access to Climate-KICs international network," says Malin Norling.

The best ideas evolved

Bengt Persson, senior lecturer at Swedish University of Agricultural Sciences (SLU) was the initiator and project leader of both innovation challenges. He also noted the change in the breadth in the field of participants between the two challenges.

"I've been involved in quite a few competitions of different kinds. I know that it's very, very hard to get over 20 participants. I was very happy when we reached 46 from 21 different countries. The Climate-KIC network has been extremely important to spread the word and to find partners," he says.

Because the challenge was quite specific and complex – requiring both technical, financial and architectural competencies to work together – the participants entering the competition were given the choice of entering with either a full solution describing the entire setup or a partial solution focusing on one aspect of the challenge. All 46 proposals submitted were partial, so following the first phase, five teams were formed to continue the process. Teams were formed to give the ideas that passed the first phase as strong a base on which to develop. The first round of prize money was invested in the further development of the proposals towards stage two and three. At the end of phase two the five teams were narrowed down to the three finalists to enter the final stretch of development and refining. During the process the partial solutions were developed into full scale project plans. And that was tough work, notes Bengt Persson of SLU:

"It's such a pain to develop these kinds of solutions. The parts may exist and be on the shelf somewhere, but the system is not designed, there are so many steps. But we definitely saw some real rise in quality for some of the teams during the following process of stage two and especially stage three. It was the projects that developed the most that went on to the final round," says Bengt Person.

Patience pays off

On September 19th, 2018 during the Food and Cities festival in Malmö, the winner was announced. The winning consortium – see separate box – was the consortium Season5 presenting a modular installation combining fish farming, greenhouses and social function. The modular nature allows it to be designed and scaled to meet the needs and opportunities of the different challenge sites. The fish growing tank is not yet fully developed, but that is not a problem says Erik Borälv, program manager at Vinnova, the main funder, of the competition.

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Bengt Person, SLU

"We are patient in the sense, that we do not require the solutions to be ready off-the-shelf when the competition ends. We have a number of opportunities to support the development of the best ideas towards completion via our other programs, and that is perfectly expectable that the very innovative approaches that we aim for with an open innovation competition will not always be ready for deployment from day one," he says.

Vinnova has a specific program for developing and disseminating open innovation tools to wider use. One reason is the obvious successes from some open innovation platforms for example Apple's app store. Another is that the open innovation approach can provide other types of solutions that more traditional approaches.

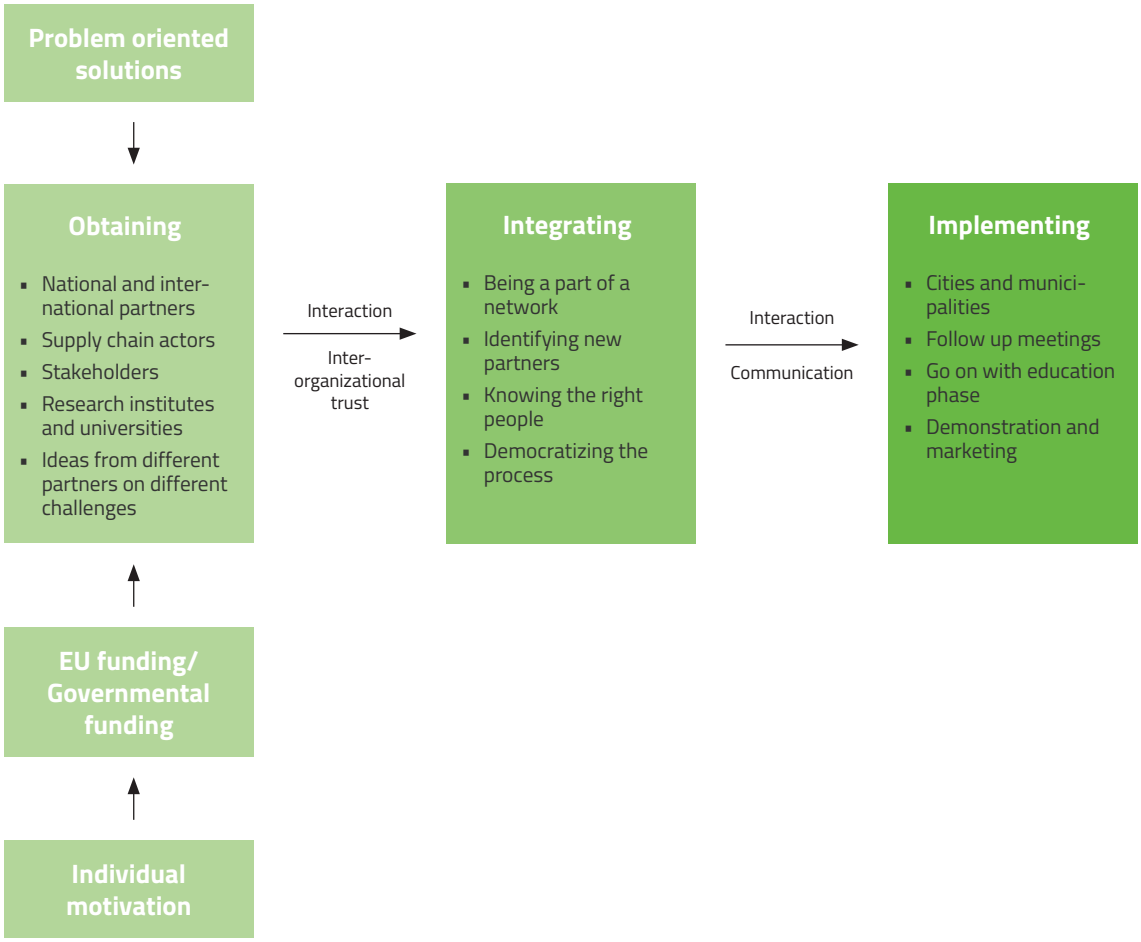
"Some problems, the grand societal challenges and other complex issues for example, benefits from an open innovation perspective. For us, it is about having more tools in our tool box. Even though the traditional open call will probably be our most used tool for a long time to come, open innovation in different forms is a very useful tool to have in our toolbox also," says Erik Borälv.

And in Malmö the municipality got the new ideas and inspiration they were hoping for, says Malin Norling.

"The upside of the open innovation competitions is that you get some "crazy" ideas, that – eventually – you realize, isn't that crazy after all. A few years later it's normal," she says.

Bengt Persson of SLU also looks back at a process that successfully attacked an opportunity – the enormous amounts of residual heat wasted today – and succeeded in bringing together ideas and talented people from several countries to do so.

"I think that the most remarkable is that we got this huge, international interest. I didn't really expect that. It was successful, a very beautiful result I'd say."



Modular fish farm and green house that can fit in everywhere

Season5's winning proposals is a modular construction partly based on reuse of old shipping containers. The containers contain a fish farm. A number of glulam greenhouse module can be added, and wooden containers for staff functions and social spaces from a café to a classroom or market stalls. All of it is clad on wood giving it a pleasant and distinct Nordic feel.

I would like to think that we won because we as architects could provide a holistic vision that kept it all together.

Fredrik Olson, Tailor Made Architects

Circling nutrients, heat and water turns the modules into a highly efficient food production facility that, along with associated teaching and commercial activities should generate enough income to pay back the initial investment in just over 5 years and create a few jobs on the side.

The jury noted the simplicity and flexibility of the solution and the ability to customize it to fit different competition sites.

The consortium behind the solutions was led by a number of architects, but the open innovation format had pushed them to develop a solution with a lot more attention to other aspects of the solution that pure architecture and building structure, said Fredrik Olson, architect with Tailor Made Architects and team leader for Season5 at the ceremony.

"It was tough to meet the demand for figures on how much fish and vegetables can be produced, building cost estimates, operating cost estimates and business model. Behind our illustrations we have large excel-sheets. I would like to think that we won because we as architects could provide a holistic vision that kept it all together," he said.

Case Study Summary

The challenge:

To utilize the vast amounts of energy wasted today as residual heat from e.g. energy production, waste management and research facilities. The energy is often bound in low temperature water that is hard to utilize. The emphasis on biological production was added to give focus to the competition as well as to address growing pressure on the global food production. The challenge was described in three questions:

- How can biological production units using low temperature residual heat – and possibly other residual flows for biological production – be organized so that they can be located in dense urban areas whilst also having the potential for side functions such as in-house shop, food processing area, opportunities for employment and spaces for community events and social meetings?

- How can the production process be organized to be space efficient whilst maintaining profitability?

- How can the technical challenges such as heat storage, heat distribution and cycles or residuals be solved alongside the project's ambition to create social value in the local community through the creation of employment, social meeting places and local distribution, sales, and processing?

Participants in the competition could choose to enter with a complete systems solution describing a fully operational plant or a partial solution addressing one of the key technical, social or financial aspects of the challenge.

The process:

The project was organized by a consortium on 13 partners. Main financial support came from Vinnova and Climate-KIC. It was set up as a global joint open innovation competition calling for innovative solutions to use the wasted heat energy in the production of food or other biological products within the urban environment. Prize money of 2 million SEK was made available in increments during all phases of the project.

The open innovation competition was structured in three phases spanning appr. 18 months:

Phase 1 – defining challenges and sourcing solutions. The challenge holders (municipalities of Malmö, Lund, Bjuv and Oskarshamn) defined and described the challenge and an international open call for solutions was put out via Climate-KICs network. 46 competitors from more 20 countries entered the competition. Phase 1 ended at a combined pitch and match-making event. Based on this, five consortia (or teams) were formed by combing competing teams for a fuller set of competencies to address both technical, social and financial aspects of the proposed solutions.

Phase 2 – developing teams and proposals. In phase 2 the newly formed teams worked together with professional guides from the partner organizations to develop their proposal to the next stage, Again, the phase ended with a pitch event in which the 5 remaining teams were reduced to 3.

Phase 3 – piecing it together. In the third phase, the teams develop their final proposal and pitch, incorporating feedback from the challenge

holders and the other partners in the competition consortium. The winner was decided by the competition panel based on the which proposal answered the competition question and criteria the best.

Criteria for selection

The proposed solutions to the challenge were judged on a number of criteria spanning technical, social and financial aspects:

Feasibility
- Technical feasibility
- Economic feasibility
- Replicability

Innovation and genius
- Level of creativeness
- Level of innovativeness

Use and function
- Functionality and attractiveness
- Form and design

Social sustainability
- Creating social cohesion
- Creating job opportunities

Results:

- 46 competition entries from more than 20 countries
- Technically and financially feasible solutions
- Competition teams now in dialogue with city planners

Challenges:

With the relatively long process (18 months) and the large consortium of 13 partners, it has proven a challenge to keep up momentum at times. It is suggested to design for a more condensed process.

Challenges	Solutions
Managing many different partner Managing many different partners with different ideas	Building managerial and organizational capabilities within ecosystems
Aligning expectations	Expanding communication channels
Time constraints	Constant communication with partners

Sustainable Development Goals addressed:

#7: Affordable and Clean Energy.
#9: Industry, Innovation and Infrastructure.
#11: Sustainable Cities and Communities.
#12: Responsible Consumption and Production
#13: Climate Action