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An innovative, efficient combined heat and power (CHP) plant

Background

There are 3400 inhabitants and 5000 cows in the municipality of Toholampi, Finland. In 2013, Toholampi Energy (TE) received the Finnish Energy and Material Efficiency organisation Motiva Oy's a 'Sustainable Public Procurer' award, for the innovative procurement of a combined heat and power (CHP) plant.

CHP is also known as cogeneration due to the simultaneous production of both heat and electricity. The process used within the plant is based on the Organic Rankine Cycle (ORC). The original plan was to create additional capacity within the old district heating plant. The Mayor of Toholampi, Jari Kangasvieri, however, learned of the benefits of the ORC process and this was chosen as a potential way forward instead, replacing the old district heating plant into a new CHP plant.


Image: Leie_kasto, Fotolia

Procurement objectives

The aim was to find the most suitable plant which also would boost the regional economy. The market analysis was included in a feasibility study done by a consultant. The outcome was a detailed analysis of the suitability of the technology, challenges and the viability of the solution. Toholampi received funding from the Finnish Technology and Innovation Fund (TEKES) for the further planning phase of the procurement using the negotiated procedure. A two-stage tender was used and seven companies were invited to submit offers. Three offers were subsequently received and these bidders went on to participate in a negotiation process. The initial offers differed considerably in terms of both the solutions proposed and the associated costs. A total of three rounds of negotiations were needed before the final tender documents and a draft contract were drawn up. An external consultant was facilitating the procurement procedure.

Criteria used

Subject matter of the contract: Procurement of a combined heat and power plant (CHP) for relatively small scale energy production using a process based on the Organic Rankine Cycle.

Technical specifications:

A negotiated procedure was used in order to try and stimulate innovation in the market. Therefore performance-based specifications were used in terms of the energy outputs of the CHP plant rather than conformance-based specifications, i.e. allowing the supplier to propose solutions rather than predetermining exactly how these requirements should be met.

Award criteria:

The efficiency and performance of the boilers were used as award criteria, along with price.

Contract performance clauses:

A two year warrantee for the functioning of the plant.

Results

Three out of the seven companies invited to tender actually placed a bid and then entered into the negotiation phase.

Overall Toholampi Energy was satisfied with the results. In traditional procurement procedures, conformance-based specifications are often used to define requirements. However, due to the fact that the organisation lacked experience with ORC technology, it would have

been very difficult to stipulate exact design specifications. The use of functional, performance-based specifications, coupled with the negotiated procedure used in this procurement, facilitated the development and proposal of innovative solutions. It is the first pilot of ORC technology for CHP units in Finland.

The investment in this technology has allowed for more efficient energy production and has supported the development of distributed electricity production. Efficiency of the heat production in the Toholampi ORC- power plant is currently estimated to be between 85% and 88%, and the efficiency of electricity production is around 20%. It is estimated that associated CO2 emissions will decrease by 2000 tons annually.

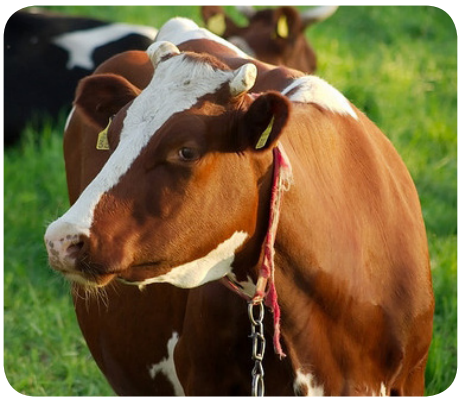
The ORC power plant produces enough heat for the needs of this small municipality. The fact that the new plant can replace the steam needed by the local food industry and oil and electricity needed by local plastic refiner is also of real benefit. Compared to conventional technologies the ORC-plant is seen to have more positive effects on regional economy and development.

Environmental impacts

Conventional power stations result in heat emission losses of up to 65%, whereas CHP systems use the heat generated in the production of electricity for other uses such as space heating, thus resulting in increased efficiency of the fuel source and therefore energy savings.

ORC power plants are able to take advantage of heat flows, which are not utilised as effectively by other techniques. Electricity and heat are therefore produced at comparably high levels of efficiency. The plant also emits less particulate matter and CO2 emissions than power plants using conventional technologies. Environmental benefits in this case also include the use of local wood fuel as biomass, a renewable energy source.

Cattle contribute significantly to the local food production industry, especially cheese production. These products are energy intensive and can be supported more sustainably by the new CHP plant.



Lessons learned

- There were relatively few solutions available because there has currently been little demand on the market for such technology. A further complexity was that suppliers do not always understand the needs and the system boundaries of a public authority, so this needs to be made clearer in future.
- The negotiated procedure was new to both the procuring entity as to the suppliers, which made it a learning process. External help for facilitating this new procedure was essential.
- It can be a great risk when a small municipality invests in a completely new technology, which in Finland has not been previously used. The contract had to be approved by the Municipal Council, as the investment required a loan guarantee from the Municipality. Eventually the choice was made in favour of efficiency gains for the region as a whole, which have proved to be successful.

For more information, please see technical background criteria and EU GPP criteria for Combined Heat and Power.

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