



Case project: Integration of wind power in district heating & combined heat and power systems in North-East China

The project 'System integration of wind power by use of the district heating (DH) & combined heat and power (CHP) systems in North-East China' has now been finalised. The project has focussed on analysing the energy system in Harbin with the purpose of detecting, investigating, and presenting possible institutional solutions, concepts and technologies for integration of the increasing share of fluctuating wind energy into the DH/CHP system. The project is one out of twelve projects which have received support from the joint Sino-Danish Renewable Energy Development programme.



Current framework and challenges for wind power integration

China is experiencing a big boom in wind power expansion which is having a positive impact in terms of reducing the use of coal and reducing CO₂ emissions and air pollution. This development has brought on increased challenges with regard to integration of the fluctuating electricity generation from wind power. New concepts and methods for balancing of the electricity system therefore have to be developed.

The current framework encourages CHP production, and does not take into account an overall optimisation of the whole electricity and district heating system. Furthermore, technical limitations regarding flexible use of the thermal power plants hinder the optimal use of wind power leading to curtailment of wind. In the Heilongjiang province, the curtailment rate is up to around 20 % per year.

In principle, according to the regulation in China's renewable energy law, all wind power generation should be accepted by the grid. But in practice this is not fully the case today.

The analyses in the project have focussed on how the curtailment rates which are happening today can be reduced by changed dispatch procedures and technical means, and how this can give benefit to the different stakeholders involved, including the wind developers and the heating companies.

It is important to emphasize that before curtailment problems are solved by technical means such as electric boilers, heat pumps and heat storages, the curtailment should be reduced as much as possible by making a coordinated power dispatch, taking also the generation from wind turbines into consideration.

Project shows great potential for wind power integration

The different means, both the coordinated dispatch as well as the technical means, have been analysed by using a system dispatch model which has been set up as part of the project. For each of the different technologies, the total benefit has been analysed in terms of e.g. reduced coal consumption in the system, reduced wind power curtailment, reduced CO₂ emissions and saved costs, as well as the possible economic consequences for different stakeholders.

The analyses show that there are potentials for improved wind power integration - even by using small parts of the total DH system. Practical realisation of the potentials requires action from the stakeholders involved or changes in the framework conditions.

It appears from the analyses that introducing coordinated dispatch as a first step significantly reduces the total system costs. This has the advantage that it is not associated with additional investment costs - it is only a matter of optimising the power dispatch taking also the contribution from wind turbines into consideration.

Furthermore, it appears from the results that among the technical measures, heat storage and electric boilers seem to be the most economical wind integration technologies as they result in the highest decrease for the total system costs when also considering the investment costs. Heat storages, however, are only relevant in CHP areas whereas electric boilers are also relevant in areas supplied exclusively by heat-only boilers.

Heat pumps also give benefit to the system but heat pumps have the disadvantage that the investment costs are very high and therefore the net economic system benefit is close to zero.

Specific pilot projects

For the specific pilot projects identified and analysed in the project, it was concluded that the relevant flexible DH measures in the heat area covered by the project, i.e. the heat area operated by Harbin Municipal Property DH Group, are electric boilers. One reason for this is that this particular heat area is mainly supplied by heat-only boilers.

The pilot projects can be used for either reducing curtailment from existing wind turbines in the Heilongjiang province, or mitigation of curtailment from new wind turbines in order to demonstrate that it is possible to build new wind turbines in the province without increasing the curtailment. In the project, both these two options are analysed and described in terms of technical setup, operational model, effect on the curtailment rate and how this result in saved coal consumption, saved CO₂, and saved costs in the system, and finally possible business models.

Dissemination

The preliminary projects results were presented and discussed during a stakeholder meeting in Harbin on 8 January 2014. In the first part of the meeting Chinese government officials and Danish politicians and officials participated including Liang Zhipeng, Deputy Director General of China's National Energy Administration, Martin Lidegaard, now former Danish Minister for Climate, Energy and Building, and a number of members from the Danish Parliament Committee for Climate, Energy and Building. The final project results will be presented on a final dissemination meeting.

The project has been carried out in a partnership between COWI in Denmark and China, Ea Energy Analyses, China Electric Power Research Institute, and State Grid Energy Research Institute together with a wider range of stakeholders consisting of Aarhus Municipality, Harbin Municipality, AffaldVarme Aarhus (WasteHeat in Aarhus), Harbin Municipal Property DH Group, Heilongjiang Huafu Power Investment Company, Heilongjiang Electric Power Company, Vestas Wind Systems and Suntien Green Energy.

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[Fact sheet on the project](#) , [Fact sheet on component 2 projects](#)

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