CADDET energy efficiency
IEA
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Weather forecasts control HVAC system

Local weather forecasts control building HVAC system

Summary

Combining local weather forecasts with new information technology saves more energy in a building than conventional control systems. Honeywell INUcontrol AB and SMHI (Swedish Meteorological and Hydrological Institute) have launched a new type of energy and management control system – a weather forecast control system – which saves energy and increases indoor comfort. The system has been tested in a number of buildings in Sweden, with good results.

An evaluation of the system assesses annual savings of 20 kWh/m² or 10% of the heating costs, as well as providing a better indoor climate.

Highlights

- **Saves 20 kWh/m² or 10% of heating costs annually**
- **Provides better indoor climate**
- **Costs are similar to a conventional system**

Building controlled by the weather forecast system.

Aim of the Project

Traditional indoor environment control systems use static techniques to control the indoor climate in a building. This means that they struggle to reach and maintain a certain indoor temperature whatever the outdoor climate. The indoor control system often regulates the HVAC equipment to heat the building at night, while the air-conditioning system cools the air during the daytime. An outdoor thermometer activates both these control systems.

Using local weather forecasts and information technology, this project aimed to evaluate and assess the possibilities to:

- obtain a more even indoor climate using advanced controls, prior to any change in the weather;
- reduce energy consumption and costs by utilising free solar energy for heating during spring and autumn;
- achieve more environmentally sound buildings through more efficient energy use and with less environmental impact (greenhouse effect);
- simplify the installation work, resulting in fewer investments and shorter payback periods.

The evaluation compares the project results to traditional control systems currently available.

The Principle

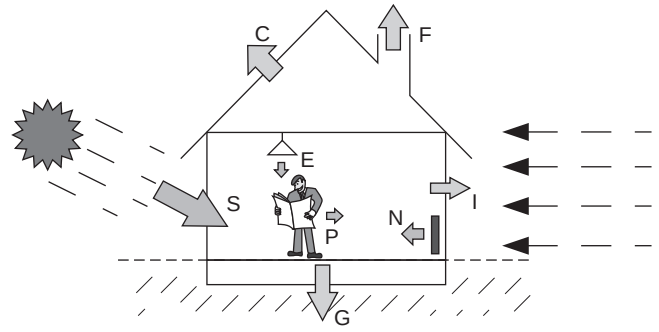
Using a weather forecast from SMHI the control unit knows how the weather and energy demand will develop from hour to hour over the following 3-5 days. The temperature used to operate the system is not the usual outdoor temperature but a so-called “equivalent temperature” (ET) developed by Professor Roger Taesler at SMHI in Norrköping, Sweden.

The ET takes into account how the outside air temperature, solar radiation and wind will affect the indoor temperature in relation to the orientation, performance and usage of the buildings. The ET also learns from previous experience with earlier weather situations. The weather forecasts are adjusted to account for local geographical effects on weather variables. If the weather forecast proves inaccurate, which is very rare, the HVAC system can still use its old outdoor thermometer to control the indoor climate.

The technology enables the HVAC system to be one step ahead of the weather, rather than regulating the energy supply after the event. The system uses the control functions in an intelligent and optimal way to assess the building’s heating and cooling requirements.

The Situation

Honeywell INUcontrol AB and SMHI evaluated the weather control system over a period of two years using two identical residential buildings in the Hestra area in Borås, Sweden. The first building was controlled in the traditional way and the second used the



Heat losses:

Conduction through walls and roof	C
Conduction through ground	G
Mechanical ventilation	F
Natural ventilation (infiltration/exfiltration)	I

Heat gains:

Passive solar gain	S
Electrical appliances	E
Occupants	P

Net required energy input N

$$N=k(T_i-T_e)$$

Forecast variable “Equivalent temperature” T_e

Figure 1: Assessing the ET (equivalent temperature)

weather forecast control system. SMHI sent the weather forecast by e-mail. The building using the weather forecast system resulted in 10% (or 20 kWh/m^2) less heating costs. However, neither building used a cooling system. For buildings with cooling systems, even higher potential savings are estimated if the system knows how the weather will develop 24 hours in advance. The cooling system can be shut down if a depression (cooler weather) is approaching, but when a high-pressure area stays, the night-time cooling is run more intensively, which means less cooling the during daytime.

Evaluation has shown that the indoor temperature in the building is more stable using the weather forecast control system. This means that the system provides a better indoor climate as well as saving energy.

Approximately 200 systems have been installed to date. Using the technology to its full advantage requires highly accurate installation as well as an optimally functioning heating system.

The Company

Honeywell INUcontrol AB, a subsidiary of Honeywell AB, specialises in building automation. Customers include companies within the construction sector as well as property owners and building management firms.

The company employs 155 staff and achieved a turnover of SEK 158 million in 1999.

The Swedish Meteorological and Hydrological Institute (SMHI), is an authority with extensive service and business operations. SMHI offers comprehensive experience within the areas of meteorology, hydrology and oceanography. The institute employs 550 staff and had a turnover of SEK 175 million in 1999.

Economics

Weather forecasts are purchased on an annual subscription basis. The fee is SEK 3/m^2 floor area (SEK 1 = USD 9.71). The forecasts are sent via the Internet to a computer in the building.

Investment costs are approximately the same as when installing a conventional

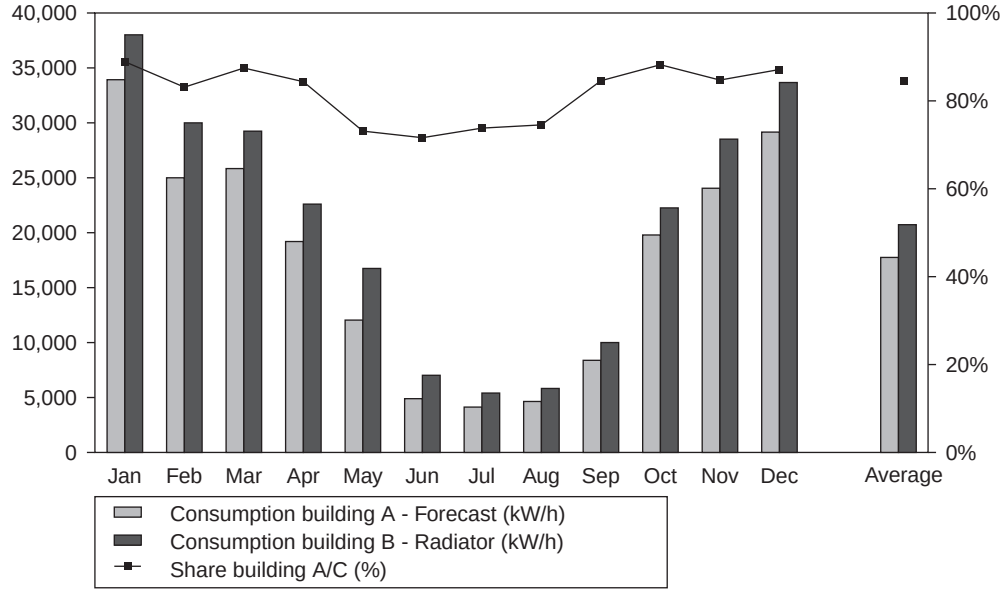


Figure 2: Two identical buildings were compared. Building (A) uses the weather forecast system and building (C) contains a traditional control system.

energy management control system. However, the forecast control system saves at least 20 kWh/m^2 in Sweden. Each kWh costs SEK 0.4 excl. VAT, resulting in an energy saving of SEK 8/m^2. Together with costs of SEK 3/m^2 this gives a final profit of SEK 5/m^2.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the 24 IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources, new energy technology, and research and development (R&D).

This is achieved, in part, through a programme of energy technology and R&D collaboration currently within the framework of 40 Implementing Agreements, containing a total of over 70 separate collaboration projects.

The Scheme

CADDET functions as the IEA Centre for Analysis and Dissemination of Demonstrated Energy Technologies. Currently, the Energy Efficiency programme is active in 11 member countries and the European Commission.

This project can now be repeated in CADDET Energy Efficiency member countries. Parties interested in adopting this process can contact their National Team or CADDET Energy Efficiency.

Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET Energy Efficiency 'Demo' or 'Result' respectively, for ongoing and finalised projects.

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