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Heat Pump for nZEB in Canada – System Assessment and Technology Developments

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The objective of this presentation is to describe the most significant activities developed by Canada on applications of heat pumps as core component of the HVAC system for Nearly or Net Zero energy buildings (NZEB), in the context of the IEA HPT Annex 40 "Heat Pump Concepts for Nearly Zero Energy Buildings".

In 2008, the Canadian total end use demand was of approximately 11 000 PJ, of which the residential sector, with more than 8 million detached residential houses, represented about 14%. Heating accounted for over 50% of this home annual energy consumption. In the province of Québec (Eastern Canada), more than 75% of new houses use electrical baseboards as heating systems. Because each of these houses consume in average 26 700 kWh per year, still a significant component of the total energy demand, reducing it presents a major challenge in the future. By using a variety of conventional and new technologies, future energy efficient houses must substantially reduce the space and hot water heating consumption.

During the past decades, the Canadian Government undertook several initiatives aimed at reducing the amount of home energy consumption. Some of these initiatives, as R2000 and *Energy Star* programs, aided by financial incentives, supported the development of high energy efficient technologies, as heat pumps and other heat recovery and/or renewable energy-based systems. As a result, new housing recently built is on average 13% more efficient in space and hot water heating than those built twenty years ago.

First, a techno-economic analysis of the most promising concepts able to be successfully implemented in the future in the Canadian Nearly Zero Energy Houses, will be presented. These systems have been optimized and improved at the level of the global system integration with renewable energies (geothermal, ambient air, solar), house waste heat recovery, and overall control sequences.

Second, a laboratory and in-field-scale heating and cooling system for Nearly Zero Energy Houses will be presented. It consists of a solar assisted HP system equipped with a cold storage for space heating, space cooling and domestic hot water production. In this study, the main thermodynamic parameters have been determined and the simultaneous performance factors in both heating and cooling modes, evaluated

Finally, a low-energy house built in eastern Canada (province of Québec) within the Equilibrium Housing Pilot Demonstration Project will be described. This project is a national initiative lead by Canada Mortgage and Housing Corporation (CMHC) that brought the private and public sectors together to develop homes producing as much energy as they consume on an annual basis. Monitoring results, including energy performances of the house and heat recovery devices, as well as a long-term (i.e. over four years) design validation of the 2 ground-source ground-coupled heat exchanger operating in the Canadian cold climate are also presented.