WORKSHOP Programme

Workshop title*: **IEA HPP Annex 41 – Cold Climate Heat Pumps**

Abstract:

• Background

The IEA Heat Pump Programme (IEA HPP) is a non-profit organisation with 15 member countries - Austria, Canada, Denmark, Finland, France, Italy, Germany, Japan, the Netherlands, Norway, South Korea, Sweden, Switzerland, United Kingdom and the United States http://www.heatpumpcentre.org/en/aboutHPP/Sidor/default.aspx. The Programme carries out a strategy to accelerate the use of heat pumps in all applications where they can reduce energy consumption for the benefit of the environment. It strives to achieve widespread deployment of appropriate high quality heat pumping technologies to obtain energy conservation and environmental benefits from these technologies. Under the management of an Executive Committee the member countries cooperate in projects (called Annexes) in the field of heat pumps and related heat pumping technologies such as air conditioning, refrigeration and working fluids (refrigerants). The IEA HPP established Annex 41 to investigate technology solutions to improve performance of heat pumps for cold climates. Four IEA HPP member countries are participating in the Annex – Austria, Canada, Japan, and the United States (U.S.).

The market adoption of heat pumps has been growing, particularly in temperate climate regions. However, heat pump sales in colder climate areas, especially for air-source heat pumps (ASHPs), have been more limited for several reasons. Some have to do with local market characteristics like competition from other heating systems, such as natural gas furnaces or boilers, where gas is widely available. For ASHPs, there is also the technical issue of the loss of heating capacity and efficiency at low outdoor temperatures. The capacity loss is especially significant since most ASHP systems rely on electric resistance back up heating when their heating capacity falls below the house heating demand, resulting in low seasonal efficiency (e.g. SPF_h). Ground source heat pump (GSHP) systems successfully overcome the capacity loss problem by using the warmer ground as a heat source and have achieved some market success in cold climate regions, but the need for installation of a ground heat exchanger (GHX) and its relatively high cost are issues impacting their wider acceptance. Availability of ASHP systems with improved low ambient performance would help bring about a much stronger heat pump market presence in cold areas that today rely predominantly on fossil fuel heating systems. Accordingly the principal focus of Annex 41 is on technical solutions to improve cold climate performance of ASHPs. Primary technical objectives of the Annex are to define pathways to limit heating capacity loss at -25°C to ≤25% vs. nominal rated capacity at 8.3°C and achieve an “in field” heating $SPF_h \geq 2.63$ W/W (HSPF ≥9.0 Btu/Wh).

Objective

The workshop objective is to share latest R&D results from Annex 41. Two presentations each are planned from Austria, Canada, Japan, and the United States.

Preliminary Workshop Agenda

Time		Title	Presenter
10	Minutes	Introduction to Annex 41	V. Baxter
5	Minutes	Welcome from host country	M. Katsuta
15	Minutes	Frosting phenomena between concavity and convexity plate under forced convection & Development of CO_2 thermo syphon for ground heat source assisted heat pump system	M. Katsuta
15	Minutes	Dynamics of heat pump system with frost formation process	K. Ohno
15	Minutes	A new method for preventing air-source heat pump water heaters from frosting	L. Zhang
20	Minutes	Investigation on icing effects of lab scale heat exchangers	T. Fleckl
20	Minutes	Field performance of cold climate heat pump	D. Giguère for B. Le Lostic
15	Minutes	Coffee break	
20	Minutes	Update on cold climate heat pump research at the Ray W. Herrick Laboratories at Purdue University	E. Groll
20	Minutes	Cold climate air-source heat pumps using refrigerant mixtures with thermal glide	D. Giguère
20	Minutes	Liquid Injection – a suitable solution for cold climate heat pumps?	R. Rieberer
20	Minutes	Tandem, single-speed	B. Shen

		compressor air-source heat pump system laboratory and preliminary field test results	
5	Minutes	Closing remarks - Annex 41 final report plan and schedule	V. Baxter
200	**minutes**		

Outputs from workshop

Attendees will have the opportunity to come away from the workshop with an understanding of potential technical solutions for improving the low outdoor temperature heating capacity and efficiency of ASHPs as well as ideas on how to apply these to their own country situations. It is hoped that new contacts will be made between attendees that could lead to future successful collaborations.

Participants*:

	Name	Chair/Speaker	Affiliation
Person 1	Mr. Van Baxter	Chair	Oak Ridge National Laboratory
Person 2	Dr. Masafumi Katsuta	Host & Speaker	Waseda University & President, JSRAE
Person 3	Dr. Keisuke Ohno	Speaker	Waseda University
Person 4	Dr. Li Zhang	Speaker	Central Research Institute of the Electric Power Industry of Japan
Person 5	Dr. Thomas Fleckl	Speaker	Austrian Institute of Technology (AIT)
Person 6	Dr. Brice Le Lostic	Speaker	Laboratoire des Technologies de l'Énergie Institut de Recherche (LTE), Hydro-Québec
Person 7	Dr. Eckhard Groll	Speaker	Herrick Labs, Purdue University
Person 8	Dr. Daniel Giguère	Speaker	CanmetEnergy, Natural Resources Canada
Person 9	Dr. René Rieberer	Speaker	Technical University of Graz (TU Graz)
Person 10	Dr. Bo Shen	Speaker	Oak Ridge National Laboratory