



NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Annex 46 - Heat Pumps for DHW

Second Working Meeting

Belfast, September 2016

Roberto Sunyé, Martin Kegel, Justin Tamasauskas
NRCan - CanmetENERGY

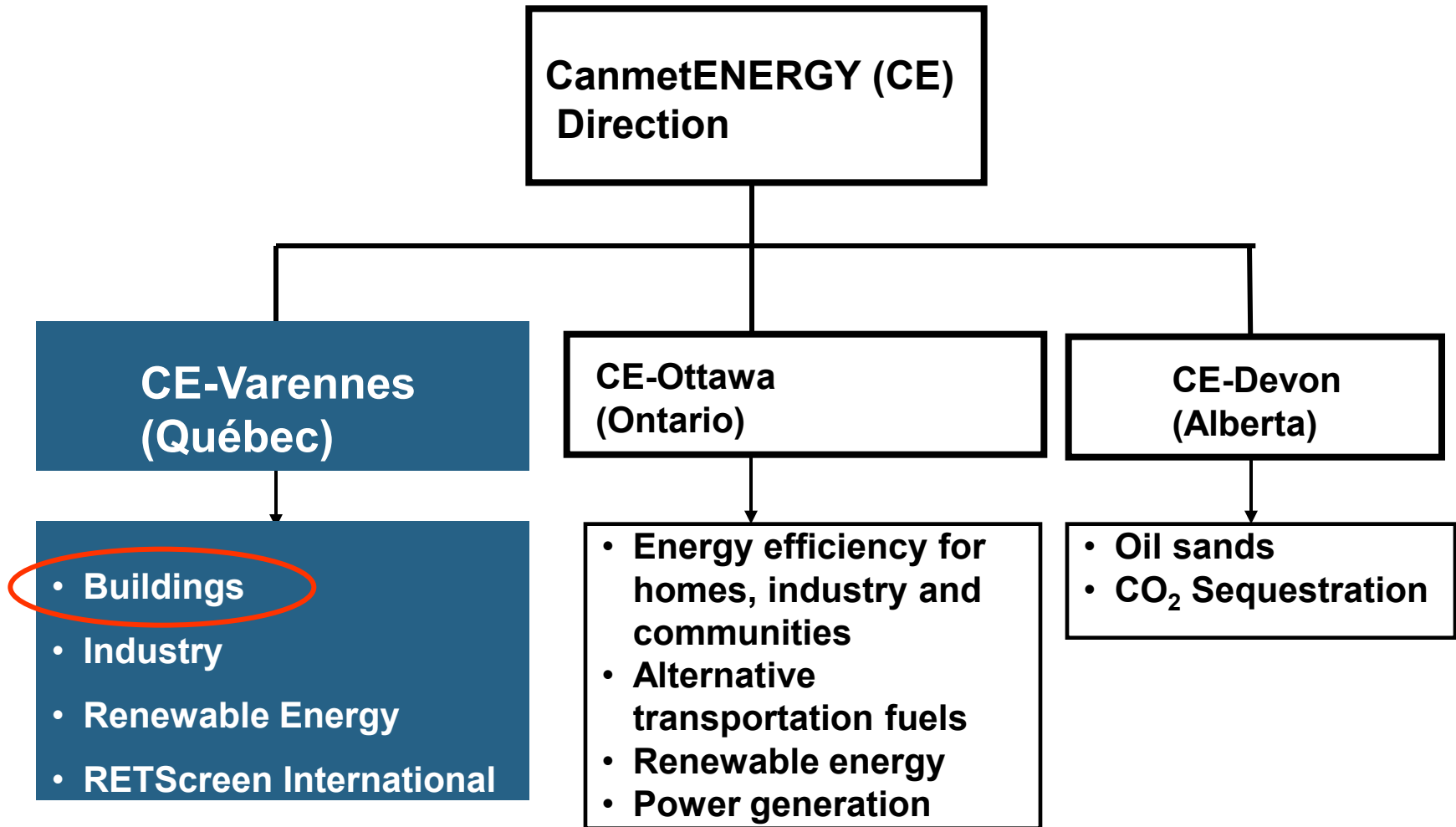


Natural Resources
Canada

Ressources naturelles
Canada

Canada

NRCan's Energy R&D Centres



Buildings Section

- Heating and Cooling Program
- Intelligent Buildings



Heating and Cooling Program - Target Sectors

Buildings



Industry



**Remote
Communities**



Canadian Context

- Canadian building sector
 - 31 % of secondary energy use
 - 28 % of GHG emissions

- Heating, cooling, and DHW
 - 82 % of energy use in residential sector
 - 61 % of energy use in commercial/institutional sector



Image: Phoenix Real Estate 2014

Our Vision for Energy Efficient Buildings

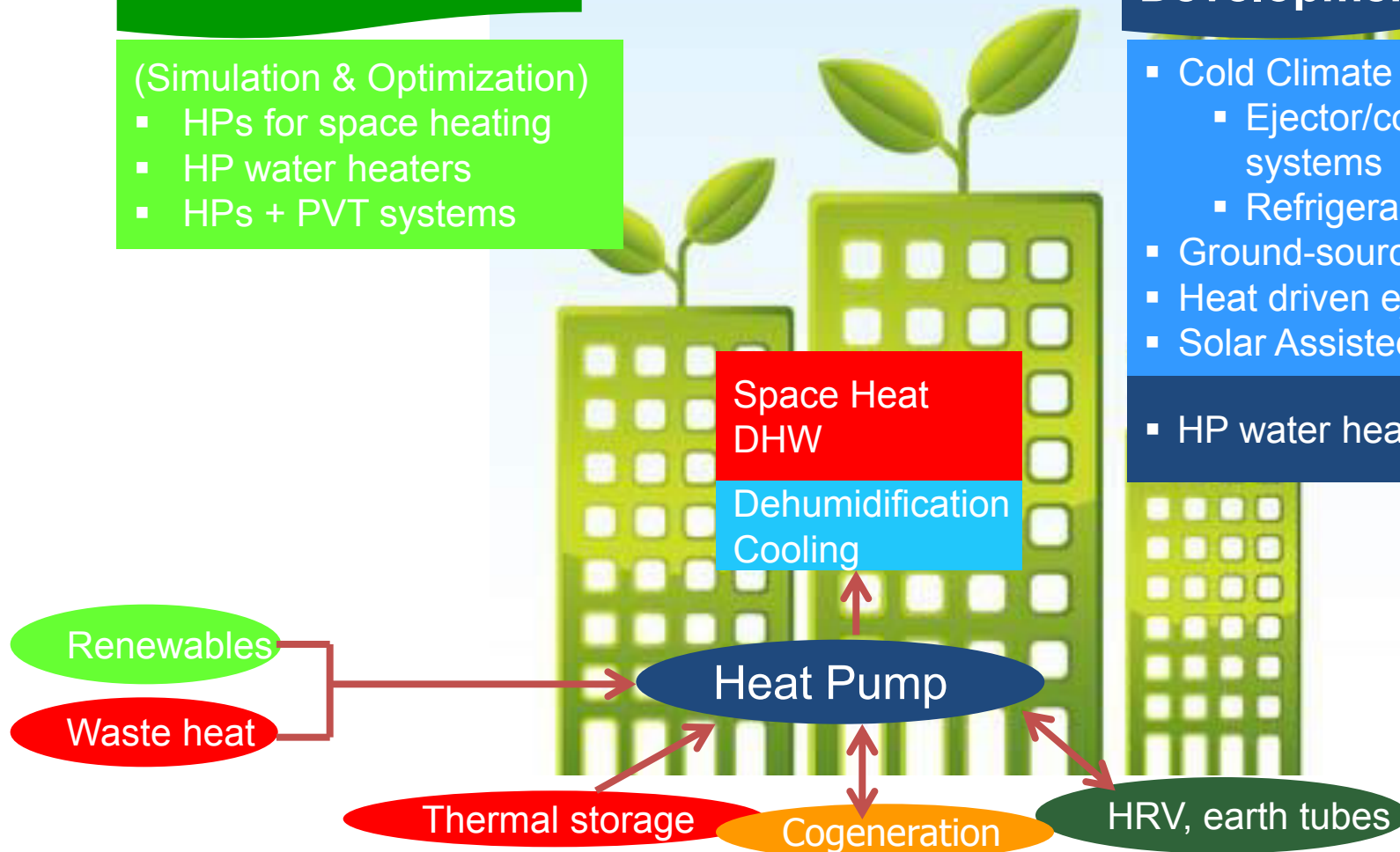
Optimal Integration

(Simulation & Optimization)

- HPs for space heating
- HP water heaters
- HPs + PVT systems

Technology Development

- Cold Climate Air-Source HP
 - Ejector/compressor systems
 - Refrigerant mixtures
 - Ground-source HPs
 - Heat driven ejector HPs
 - Solar Assisted HPs
- HP water heater testing



Heat Pump Water Heaters (HPWH)

Funded Projects (next 2 to 4 years)

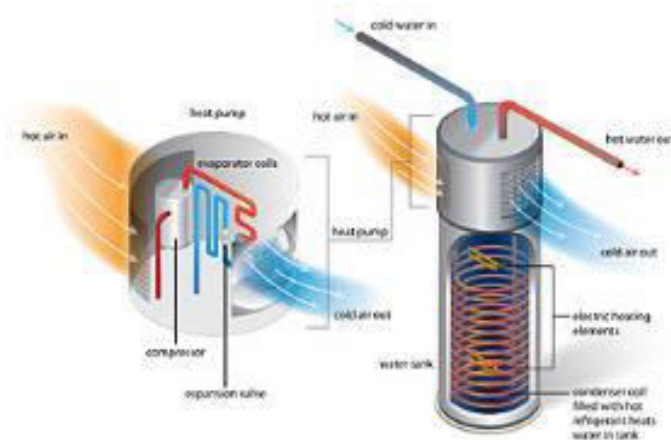
- Simulation based assessment of HPWHs in the Canadian residential sector.
- Testing of HPWHs for the Canadian residential sector and performance curve development for simulation tools
- Combined heating and cooling and domestic hot water using CO₂ DX GSHP



Simulation based assessment of HPWH

A systematic optimization of HPWH implementation:

- A typical Canadian house from 2000 in 6 climates in Canada
- A typical MURB in 6 climates in Canada
- Different locations in the house: garage, basement
- Indoor and outdoor energy source
- Evaluation of impact on energy, grid demand and cost reductions



Testing of HPWHs for the Canadian Residential Sector

- Two different market available HPWHs
 - a conventional HPWH (e.g. General Electric)
 - a system adapted to operate at low ambient temperatures (e.g. Noirot) or a system using CO₂ to provide DHW as well as space heating (e.g. ecoCUTE)
- HPWH Testing:
 - first HPWH will be tested at test rig developed Carleton University
 - second HPWH will be tested at a test rig to be developed by CanmetENERGY
- The knowledge acquired will lead to:
 - the development and validation of robust performance curves/algorithms for building simulation programs (e.g. TRNSYS)
 - supporting codes, standards and incentive programs
 - identifying technological and control improvements



Combined Heating and Cooling and DHW using CO₂ DX GSHP

- **Objective:** Theoretical and experimental performance analysis of CO₂ transcritical DX GSHP for heating, cooling and DHW
 - CO₂ is widely available with very reasonable cost
 - CO₂ has excellent heat transfer characteristics
 - No ground contamination in case of leakage
 - More compact and therefore less expensive ground heat exchanger
 - Low pressure drop in different components including boreholes (less compressor work needed)
 - Heat rejection takes place over a large temperature glide leading to high efficient heating, cooling and DHW production.



Contributions to Annex 46 – HP4DHW

- **Simulation based assessment of HPWHs in the Canadian residential sector**
 - results of the complete techno-economic analysis (simulations, optimization, best concepts)
- **Testing of HPWHs for the Canadian residential sector**
 - results of the tests
- **Combined heating and cooling and domestic hot water using CO₂ DX GSHP**
 - results of the technology development

