Building-Integrated Thermal Energy Systems (BITES)

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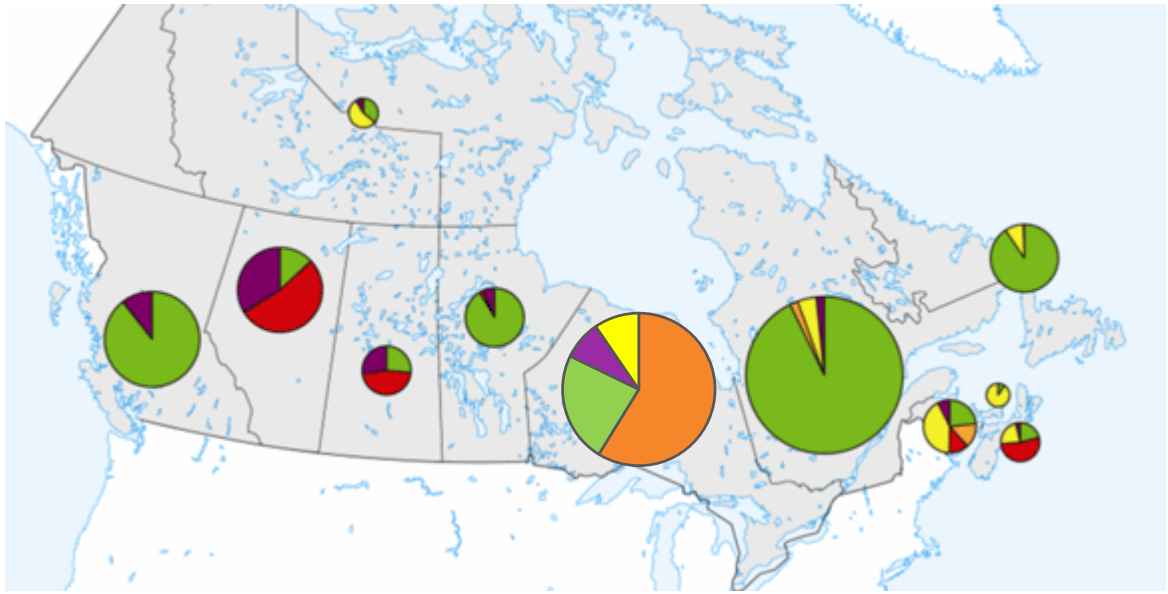
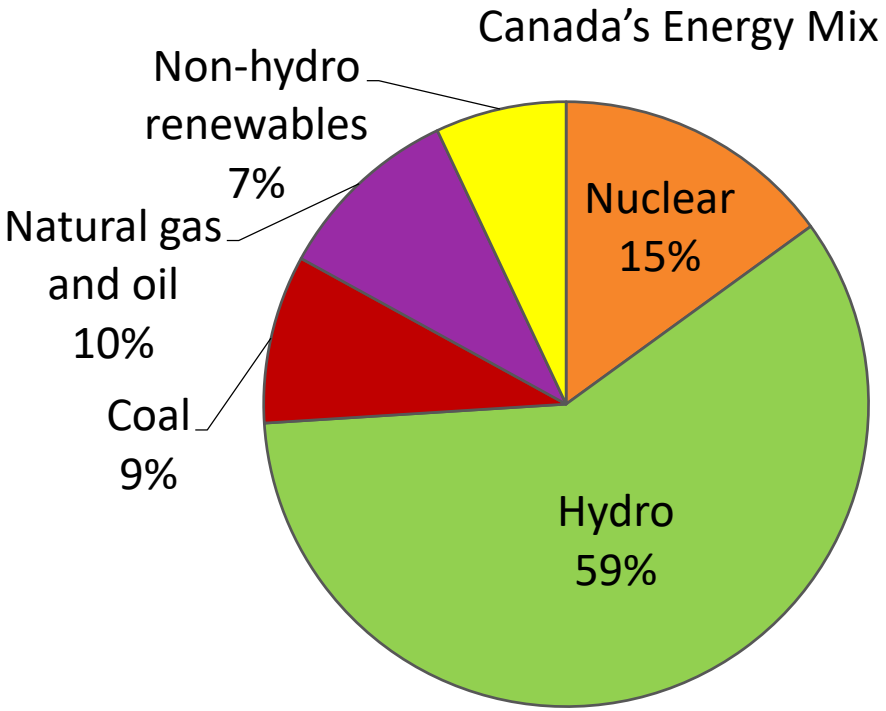
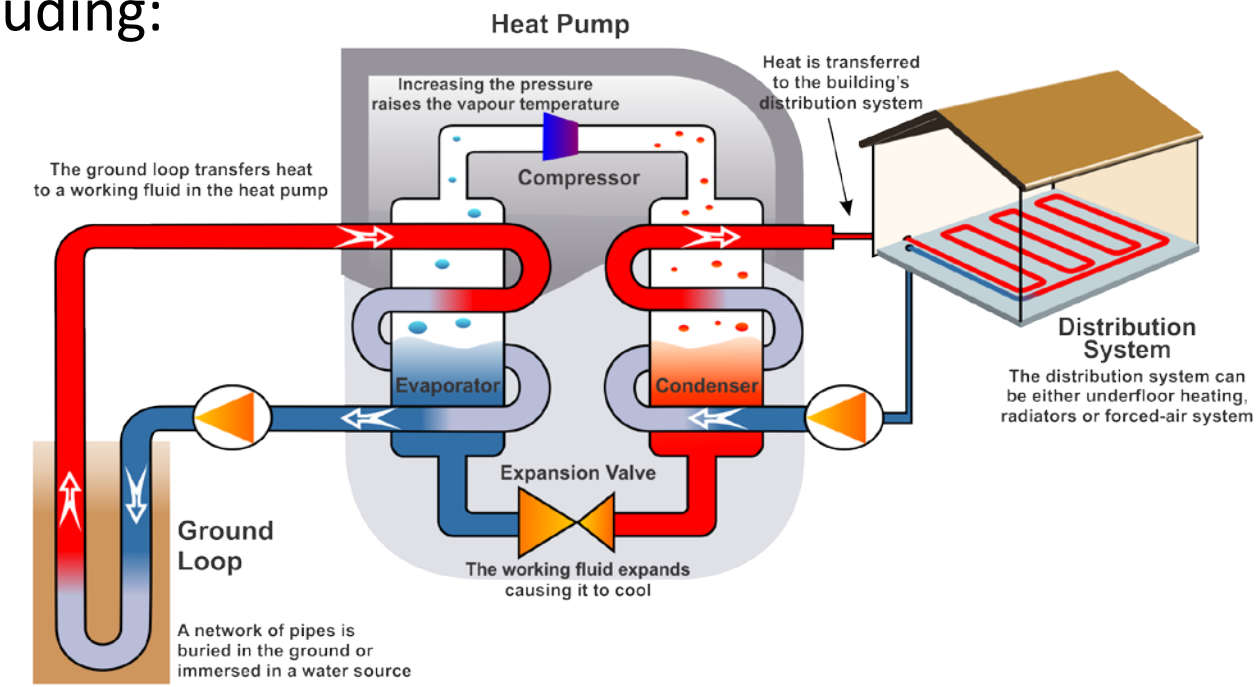


- Hydro
- Nuclear
- Coal
- Natural gas and oil
- Non-hydro renewables



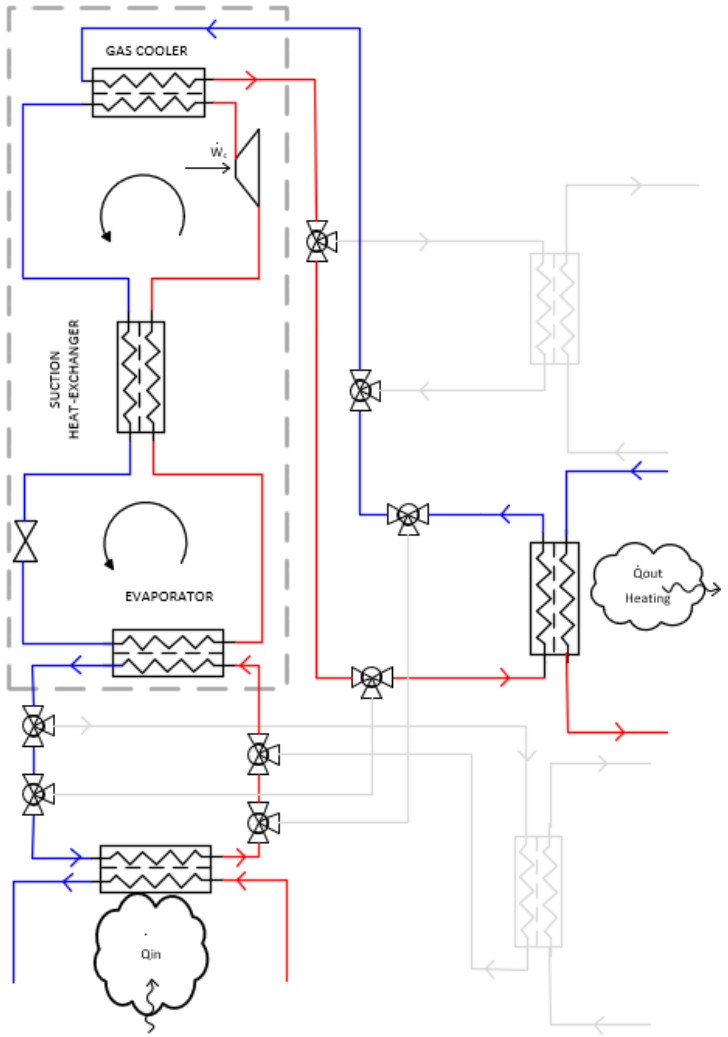
- Canada is the fifth largest energy producer in the world and the eighth largest consumer of energy
- Buildings account for 28% of secondary energy use in Canada and represent a large source of GHGs
- Approximately 80% of residential use is attributed to space heating and hot water demands
- Current strategies to reduce building loads typically consider heating, cooling and hot water needs separately

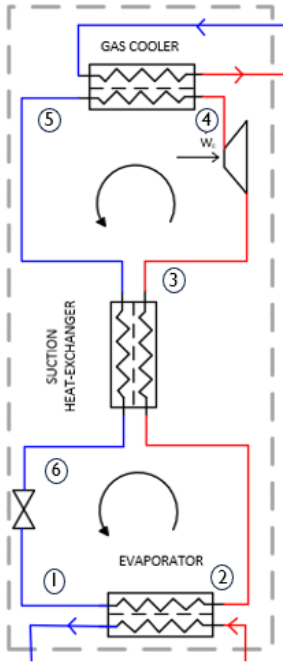
- Overall project focus is on an integrated approach for heating, cooling, ventilation, dehumidification, and domestic hot water heating for low-rise multi-unit residential buildings (MURBs)
- Design and optimization is required, including:
  - Passive solar architecture
  - High-performance envelope
  - Multi-function heat pumps
  - Heat recovery
  - Geothermal storage
  - Control strategies

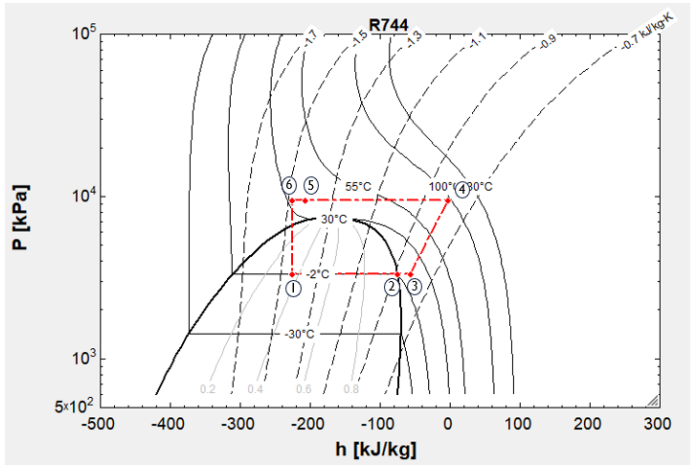


- Goal is to design a building integrated thermal energy system (BITES) that is replicable and delivers net-zero-energy-ready levels of performance

- Year 1 (2018-19):
  - Analyze performance of BITES prototype (single-family residential scale) and identify opportunities for improving design
  - Size key components (heat pumps, thermal storage, hydronic floor, geothermal field, thermal mass, windows) using simplified models for low-rise MURB
- Year 2 (2019-20):
  - Design, develop and analyze new heat pump cycles for use in heating, cooling and domestic hot water applications
  - Develop heat transfer models of heat pump cycles in EES software
  - Evaluate system feasibility based on seasonal performance, energy and exergetic efficiencies, system economics, environmental analysis, safety, noise, originality, esthetic of design, practicality, etc.
  - Provide overall justification of design and performance, including assumptions and strategies

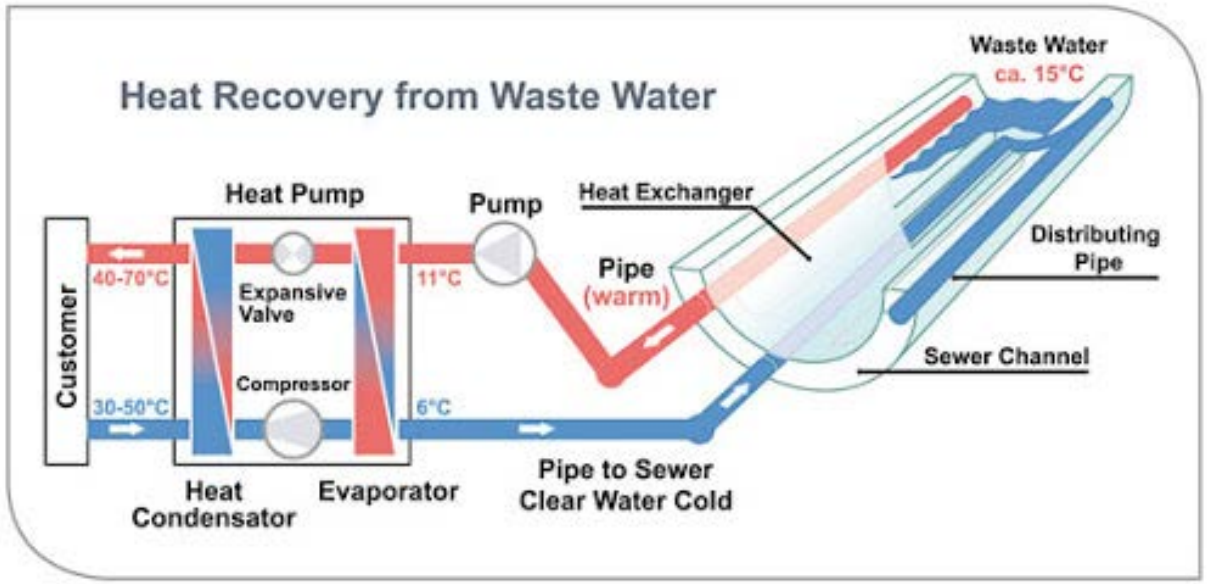






Group 2: Proposed CO_2 (R774) System and Operating Points

- Year 3 (2020-21):
  - Measure performance of a CO_2 heat pump prototype in laboratory setting
  - Optimize heat pump design based on preliminary results; optimize design to balance performance with cost
  - Investigate opportunities for effluent waste heat recovery in MURB utilizing current heat pump design
  - Develop detailed heat transfer model of waste heat recovery unit using energy simulation tool, and assess techno-economic benefits



Thank you for your interest in BITES!

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