Solar Buildings Research Network

A brief overview

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Concordia
www.concordia.ca

Natural Resources Canada
Ressources naturelles Canada

CMHC SCHL

Hydro Québec
Institut de recherche

SOLAR BUILDINGS RESEARCH NETWORK
RÉSEAU DE RECHERCHE SUR LES BÂTIMENTS SOLAIRES

VISION

Development of the **solar-optimized** building as an **integrated advanced technological system** that will approach on average the zero-energy target and be cost effective.

Advanced does not mean complex; it brings together **"low-tech" passive solar** technologies that appear simple but generally require careful design with **"high-tech" active envelope elements** such as motorized blinds and airflow windows with photovoltaics and smart predictive control systems.

Solar-optimization requires that the solar technologies are optimally integrated into the design and operation of the building.

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Unexploited potential of solar:

- A suitably-orientated façade or roof on a typical Canadian building receives enough solar energy over a year that exceeds by far its total energy consumption!
  - Photovoltaic (PV) panels mounted on the roof and façade typically convert 6-18% of the sun's energy into electricity,
  - 50-70% of the rest can be extracted as heated air from the PV panels while
  - 10-30% can be utilized for daylighting with semitransparent systems.
- Combined solar energy utilization efficiencies of up to about 80% can be achieved if proper integration strategies are implemented. Indeed, there is the potential for a building to achieve, on average, zero energy consumption.

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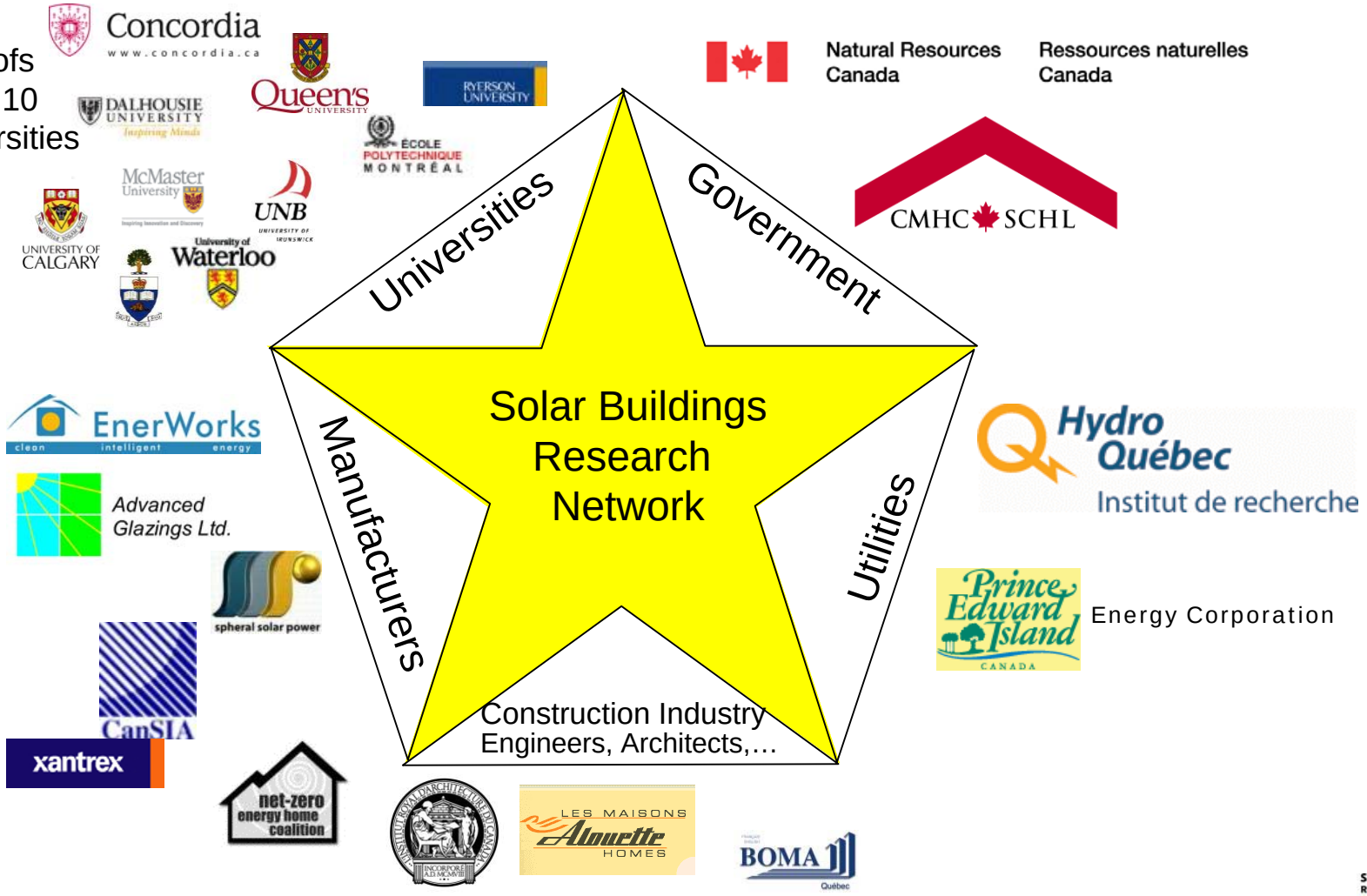
Partners and linkages…

24 profs
From 10 universities



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Overview

- **24 profs from 10 universities plus govt sector** researchers collaborate to develop the projects and subprojects.
- $6 million over 5 years ($4.8 million from NSERC, $1.2 m from NRCan, CMHC and Hydro Quebec).
- About 100 graduate students will be trained. They will contribute to making Canada one of the leading countries in solar building technologies.
- Network started with workshop in Dec. 2005.
- First conference (joint with SESCI) at Concordia Aug. 20-24, 2006.

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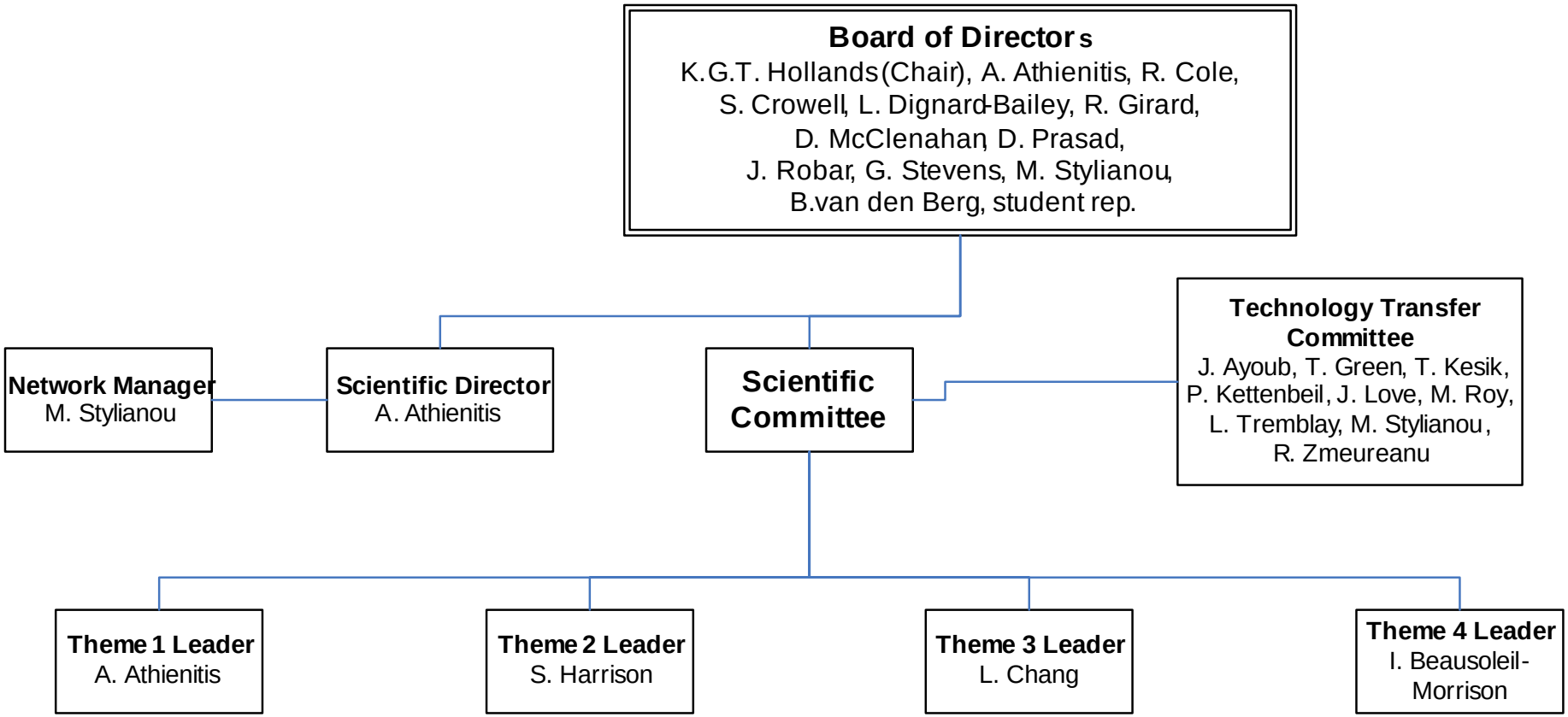
Network governance



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STRATEGIC PLANNING

FOUR THEMES (OVERLAPPING) BASED ON THE VISION

- **1. Integration of solar energy systems** into buildings (BIPV/T air, water, daylighting systems, direct gain..) – residential and commercial. *(A. Athienitis)*
- **2. Solar thermal systems for heating and cooling** (DHW, combisystems, blinds…) *(S. Harrison)*
- **3. Solar Electricity** (Housing, commercial buildings, load management). (*L. Chang)*
- **4. Simulation tools for solar building analysis and design.** *(I.B. Morrison)*

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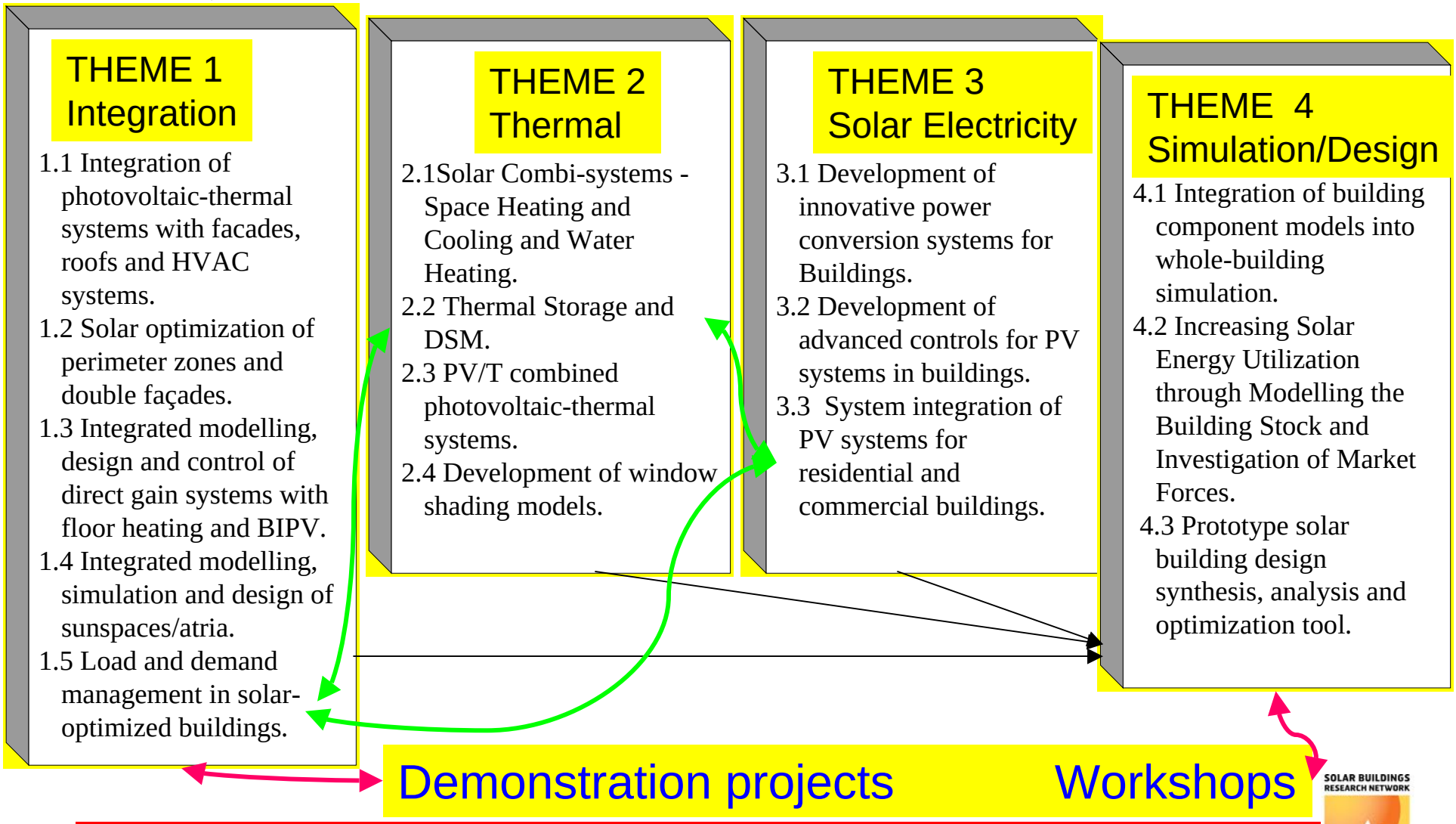
Projects and Linkages



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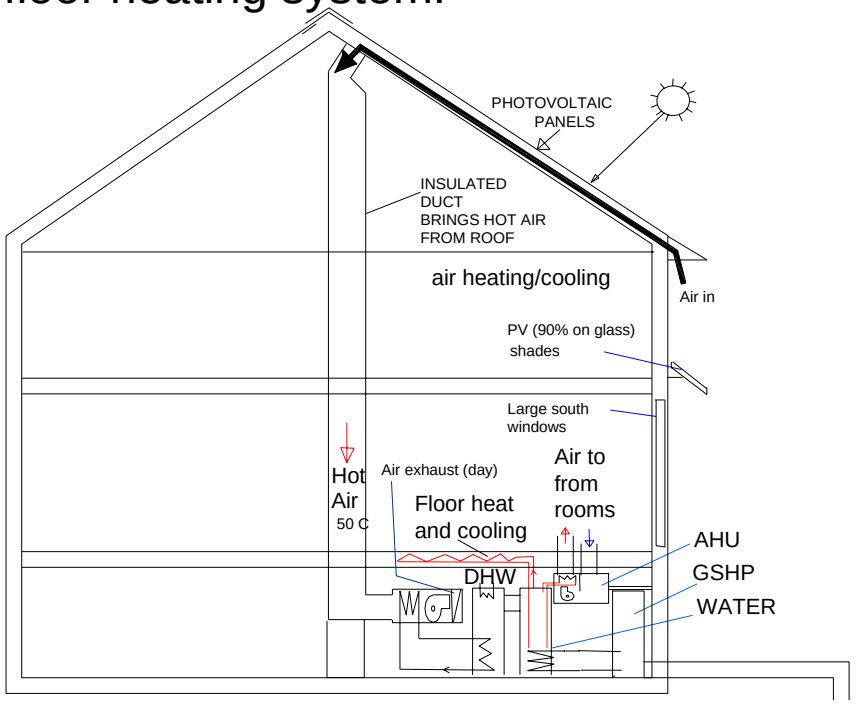
Example: Integrated modelling, design and control of direct gain with floor heating and BIPV

- Need for practical techniques for integrating direct gain passive solar design with floor heating design, taking into account anticipatory control of the space.
- Combination with a BIPV-thermal system (Project 1.1) and heat pump technologies may permit a house to achieve a net-zero energy target but with the comfort of a floor heating system.



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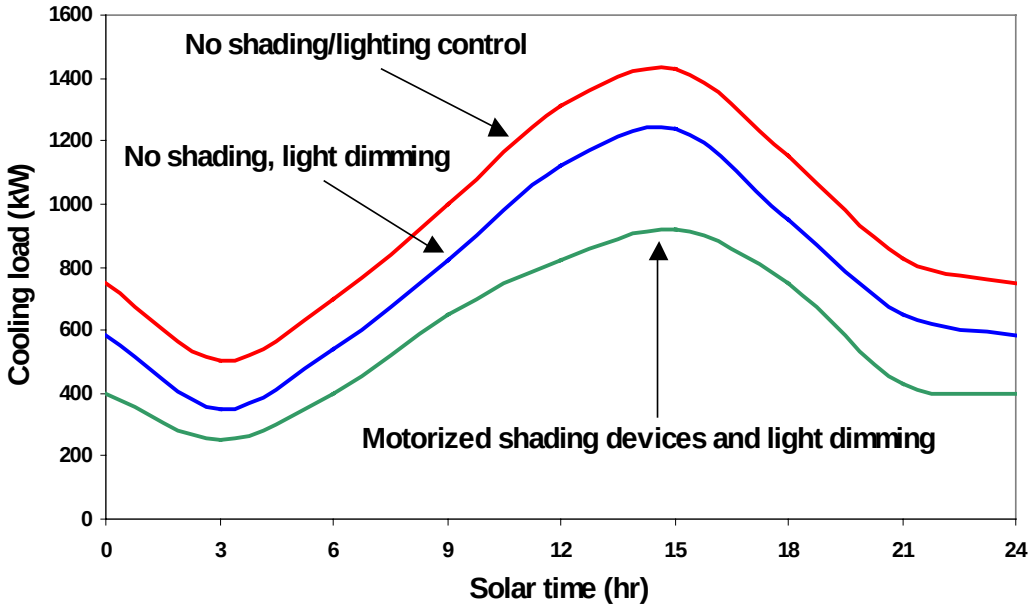
Example: Load and Demand Management in Solar-optimized buildings (Athienitis, Chang, Harrison, Beausoleil-Morrison)

- Dynamic building envelopes such as facades with building-integrated photovoltaics and motorized blinds offer significant potential to reduce peak cooling and heating loads.

Cooling load for typical perimeter office



To effectively utilize these technologies, control strategies will be developed for optimization of the utilization of solar energy for daylighting, heating and electricity needs while taking into account indoor environment requirements.

Links with 2.2 and 3.3

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Example outcomes

- Innovative façade and roof solar systems that integrate many functions (BIPV/T, daylighting, thermal control, storage)
- Techniques and models for integrated thermal + electric optimization of solar homes: direct gain plus PV/thermal, radiant heating, heat pumps
- Innovative combi systems integrating solar heating, cooling and hot water heating systems
- Integrated control and load management algorithms of electrical and thermal loads
- Conceptual design methodology and prototype software design tool.

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Technology transfer

- Transfer research outcomes to the end users (architects, engineers, construction, manufacturers and energy industries);

- Advance the adoption of new knowledge, tools, practices and technologies for cost effective construction of solar optimized buildings in Canada;

  - Workshops for end users in collaboration with CMHC, NRCan and end user associations; obtain feedback from end users for improvement of design tools (one research conference and one workshop per year).
  - Contribute to the development of government policies and programs aimed at adoption of solar technologies in buildings, **including ambitious demonstration projects with a research component** (e.g. solarbau in Germany).

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Benefits to Canada

- **Energy consumption reductions:** An average house equipped with a 4kW photovoltaic-thermal system may reduce its average energy consumption by 50%; a very efficient house with optimal combinations of passive solar, BIPV, heat pumps and smart control may approach net-zero energy.

- **Development of innovative solar energy utilization products** leading to more exports and jobs.

- **Greenhouse gas emission reductions.**

- **Improved indoor environment:** Lower costs for increased use of fresh air; improved access to natural daylight; increased productivity and well-being
- **Improved safety:** BIPV provides a back-up in the event of major blackouts such as an ice-storm!

- **Training of Highly Qualified Personnel** for: Construction industry, building materials sector, renewable energy sector.

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