

# BRILLIANT SOLAR INNOVATIONS IN THE ESTRIE REGION!

A concentration of expertise and technologies promoting the widespread implementation of solar technologies.



PRODUCTION OF ELECTRICITY THROUGH CPV



HEATING OF AIR WITH PASSIVE AND THERMAL SOLAR ENERGY



PRODUCTION OF HEAT, AIR-CONDITIONING, AND ELECTRICITY THROUGH CSP




SOLAR ENERGY STORAGE

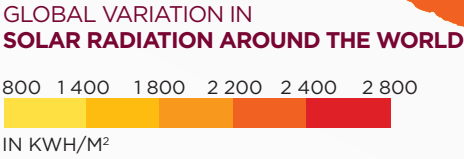


# THE REACH OF ESTRIE BUSINESSES AND RESEARCHERS IS WORLDWIDE!

The Estrie region has a Canadian-wide reputation for its comprehensive and extensive expertise in the development of **solar technologies for heating homes and industrial buildings, producing thermal energy for industrial processes, and generating renewable electricity**. This reputation is backed by sound skills in the **storage of thermal energy and electricity**. About a dozen businesses are involved in different solar projects and technologies **generating energy savings of thousands of kWh per year around the world**.

## WORLD MAP

-  Research partnerships and international collaboration
-  Estrie solar technologie installed outside of Québec



Source: DLR, from "Energy [r]evolution a sustainable world energy outlook," EREC/Greenpeace, 2006.

Solar radiation map:  
[www.creativhandz.co.za/images/solar\\_radiation.jpg](http://www.creativhandz.co.za/images/solar_radiation.jpg)

- CPV – Concentrated solar photovoltaics (see pp. 4-6)**
1. 3IT
  2. St-Georges
  3. Osemi
  4. S Automation
  5. Université de Sherbrooke

- Passive solar energy (see p. 7)**
1. LeVertendre
  2. UrbanÉco
  3. EkoHabitat
  4. Cimaïse
  5. Espace Vital
  6. Enerconcept
  7. MC² Énergie
  8. SyÉNERGIE

- CSP – Concentrated parabolic solar power (see p. 8)**
1. Rackam
  2. Cascades
  3. Laiterie Chagnon

- Solar energy storage (see p. 9)**
1. Lekla
  2. Sigma Energy Storage

- 3. Special projects, Cégep de Sherbrooke (see p. 9)**

- Industrial clusters (see p. 10)**
1. Sherbrooke Innopole — Cleantech key sector
- ACCORD clusters:
2. Bio-industries environnementales (CABIE – the region's environmental bio-industry cluster)
  3. Industrie des systèmes électroniques du Québec (CISEQ – Québec's cluster of excellence in the electronic system industry)

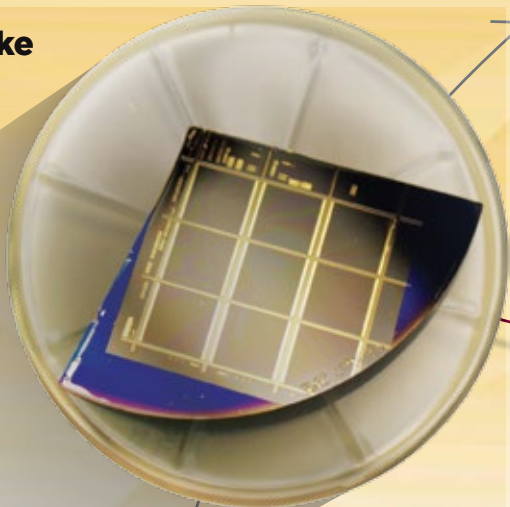




# CONCENTRATED SOLAR PHOTOVOLTAICS (CPV) MAKING BREAKTHROUGHS FOR INDUSTRY!

More than 30 researchers from the **Université de Sherbrooke** and the **Cégep de Sherbrooke** are working on different aspects of generating electricity using concentrated solar energy or CPV. They are developing technologies and expertise that are sought after around the world.

Substrate from which solar cells will be cut.  
Photo: Université de Sherbrooke



## RESEARCH PARTNERS AT THE UNIVERSITÉ DE SHERBROOKE'S 3IT\* [usherbrooke.ca/3it](http://usherbrooke.ca/3it)

With nearly 3000 m<sup>2</sup> of laboratory space, 3IT has one of the largest clean rooms in Canada and has a **team of 400 researchers and users**. It has numerous collaborators around the planet, including the following research centres:

### In **Canada**:

- The **SunLab** (University of Ottawa) is Canada's leading solar cell characterization research facility; it specializes in high performance devices;
- Integrated into 3IT, the **CNRS nanotechnologies and nanosystems laboratory "LN2"** (Unité Mixte Internationale) focuses on research and bilateral scientific and technological cooperation between Canada and France.

In **France**, through a group of **CNRS** (National Center for Scientific Research) **laboratories** including:

- The **PROMES** laboratory on processes, materials, and solar energy (Procédés, matériaux et énergie solaire), specialized in solar energy conversion processes and the development and characterization of materials in this context;
- The **CETHIL** (Center for Thermal Sciences of Lyon) laboratory, working in the areas of thermal and energy sciences, and, in particular, the conversion of solar energy to produce heat and/or electricity, and energy storage.

\*The Université de Sherbrooke's Interdisciplinary Institute for Technological Innovation: [usherbrooke.ca/3it](http://usherbrooke.ca/3it)



## THE MANUFACTURE, MODELING, AND CHARACTERIZATION OF SOLAR CELLS

Through international collaboration, the Université de Sherbrooke **enables the modeling and characterization of the complete value chain of CPV technology**.

Manufacturers from around the world are working with 3IT\* to optimize the performance of their multi-junction solar cell manufacturing processes.

**The highest-performing solar cells in Canada** are manufactured at 3IT.\*

A concentrated solar cell like this (actual size) produces as much electricity as 2 ft.<sup>2</sup> of standard solar paneling, equivalent to the size of these three pages!



The 1-MW solar oven at the **PROMES** laboratory located in Odeillo-Font Romeu, France.  
Photo: PROMES-CNRS, Jean-Michel Gineste (E. Guillot edition)



## MASTERING OPTICS AND THERMAL SCIENCE... TO CAPTURE THE POWER OF 4000 SUNS!

Designing concentrators requires a very high level of precision:

- adjustment to different climatic realities (cold, sand, etc.)
- research into and the incorporation of new ultra-high-performance materials
- optimal heat management.

This vital work is carried out by the *Canada Research Chair in Micro-fluidics and Power Microsystems on cooling of devices and bodies*.

Thanks to this expertise, solar cells will soon be able to receive solar concentration 8 times higher... the equivalent of as many as **4000 suns!**

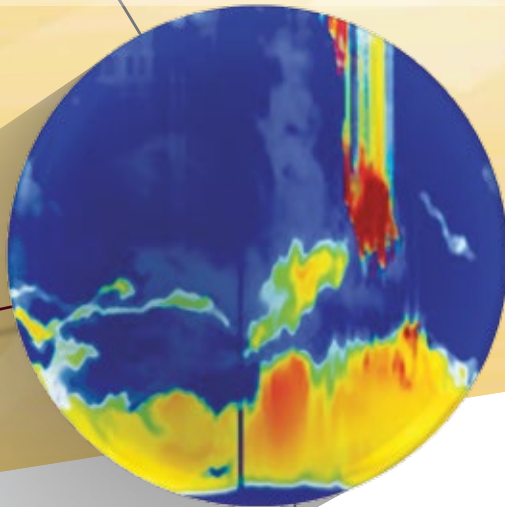


Located in the Université de Sherbrooke's Innovation Park, the research infrastructure at 3IT is unique in Canada in terms of the testing in a real environment of solar cells capable of attaining the power of as many as 1000 suns and in terms of the different CPV system components.

Photo: Université de Sherbrooke, Michel Caron



Photovoltaic solar panel

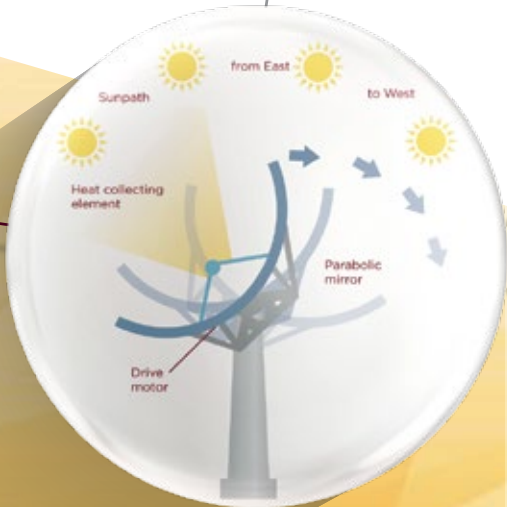


Height profile of aerosol concentration (red = high; blue = low) based on the wavelength (colour) of the light, which affects the performance of PV solar panels.  
Photo: Université de Sherbrooke

## STRUCTURE AND TRACKING OF THE SUN'S TRAJECTORY

A lightweight structure firmly connected to an automation system tracks the sun with an accuracy of 0.05 degrees and remarkable reliability. This accomplishment is the result of close company/research collaboration.

**St-Georges**, a structural and civil engineering company, developed 3IT's solar concentrator structure. [stg-ing.com](http://stg-ing.com)



Example of a motorized parabolic sun-tracking structure.

## ATMOSPHERIC CHARACTERIZATION

New methods guaranteeing the performance and profitability of solar energy parks must be developed to meet the demands of manufacturers, distributors, and energy producers. This will require the acquisition of more in-depth knowledge on atmospheric phenomena and solar radiation.

Spectrophotometers, solar simulators, and forecast models for atmospheric layers are being developed by researchers **at the Cégep de Sherbrooke** in collaboration with

*the Centre d'application et de recherche en télédétection (CARTEL - remote sensing research and application centre)*

at the Université de Sherbrooke, which has the following infrastructure:

- A spectroradiometry laboratory;
- The SIRENE station (Site interdisciplinaire de recherche en environnement extérieur): experimental site for interdisciplinary research on the outside environment (remote sensing, environment, and climatology).

*The Chaire de recherche Hydro-Québec/Réseau de transport et électricité de France* (Hydro-Québec research chair / France's power transmission network)

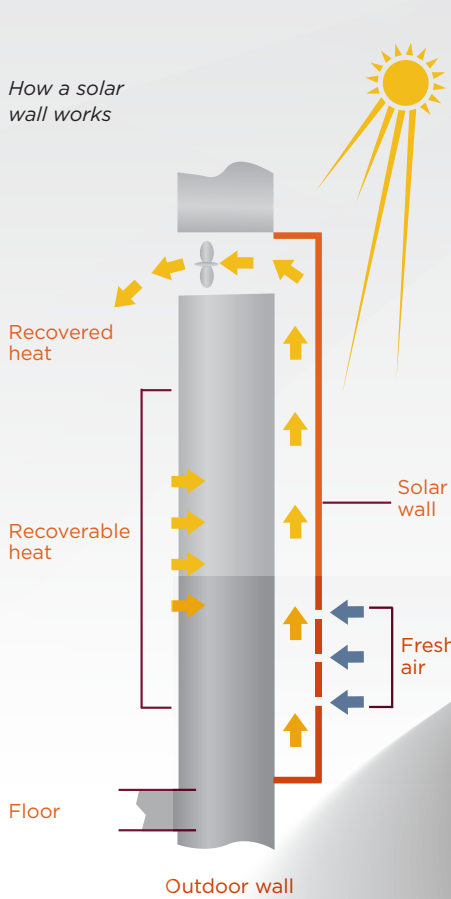
is working on the structures and mechanics of power transmission lines. Its expertise contributed to the design of 3IT's CPV infrastructure.

**S Automation** co-developed the solar trajectory tracking system that is part of 3IT's infrastructure. This connects an astronomical clock to a fine tracking sensor, providing accuracy within less than 0.05 degrees and equipped with an inclinometer and a miniature weather station. [sautomation.ca](http://sautomation.ca)



# SOLAR ENERGY, TO EFFICIENTLY BUILD OUR CITIES

KEEPING WARM IN WINTER... **THANKS TO ESTRIE SOLAR WALLS AND TEMPERATURE SENSORS**



**A WORLD LEADER!**  
**Enerconcept**, a leader in the manufacturing and integration of solar walls for more than 15 years, offers the most efficient industrial solar collector on the market. This company has installed close to 75 000 m<sup>2</sup> of solar walls around the world (Canada, United States, Germany, China, France, Denmark) resulting in a **reduction in CO<sub>2</sub> emissions of 6500 tonnes per year!**  
[enerconcept.com](http://enerconcept.com)

The ORFIE house: 1<sup>st</sup> house with LEED Canada Platinum certification. [levertendre.com](http://levertendre.com)



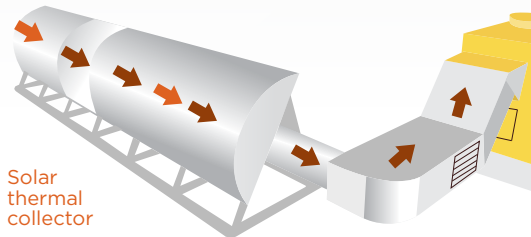
## PASSIVE SOLAR ENERGY ON THE RISE IN ESTRIE BUILDINGS!

The Estrie region is fortunate to have reputable architectural firms and independents with expert knowledge in the integration of active and passive solar energy and who are skilled in the multidisciplinary coordination required to produce building optimization.  
[cimaise.com](http://cimaise.com)  
[espacevital.com](http://espacevital.com)

The construction of homes with passive solar energy is gaining ground in the Estrie region, with companies incorporating the concepts of passive solar energy, thermal mass, geographic orientation, and minimizing impact on the environment.  
[levertendre.com](http://levertendre.com)  
[ekohabitat.com](http://ekohabitat.com)  
[urbanecoconstruction.ca](http://urbanecoconstruction.ca)

**EMERGING TECHNOLOGIES!**  
**MC<sup>2</sup> Énergie** is a new business that has developed the world's highest-performing residential glazed air heating solar collector, with more than 150 installations in Canada and the United States.  
[mc2energie.com](http://mc2energie.com)

**SyÉNERGIE**, a specialist in energy efficiency in industrial ventilation, has developed a solar thermal collector that is unique on the market. The SunDUI's mechanical characteristics and design were conceived to ensure the profitability of large-scale projects in the industrial and institutional sectors. [syenergy.ca](http://syenergy.ca)



Solar thermal collector



Zoobox lofts, 100% energy self-sufficient!  
[levertendre.com](http://levertendre.com)

# CONCENTRATED PARABOLIC SOLAR POWER (CSP): HEAT, COLD AIR, AND ELECTRICITY FOR INDUSTRY!



TECHNOLOGY SHOWCASES AND CUTTING-EDGE EXPERTISE ADDRESSING **MAJOR MANUFACTURERS' GOAL FOR A REDUCED CARBON FOOTPRINT**

The principle of CSP is to reflect the sun's radiation on mirrors that focus the light onto a tube within which flows a liquid that transports the accumulated heat.

Combined with other technologies and equipment, CSP is used to heat liquids to very high temperatures, to generate steam, to be transformed into electricity, and even to produce solar-based air conditioning!

Parabolic concentrating collectors.  
Photo: Rackam

## THE FIRST QUÉBEC SHOWCASE

The Laiterie Chagnon dairy, an agri-food processor, uses large quantities of heat in the form of steam for its pasteurizing and sterilizing processes. The 250 m<sup>2</sup> of CSP on the plant's roofs have resulted in savings of **25 000 m<sup>3</sup> per year of natural gas** and a six-year return on investment, before subsidies.  
[laiteriechagnon.com/environnement](http://laiteriechagnon.com/environnement)

## CASCADES CONTINUALLY INNOVATING!

The function of the 1490-m<sup>2</sup> concentrated solar power (CSP) system installed in the boiler room in Kingsey Falls (Cascades Inc.) in 2014 is to reduce natural gas consumption for heating a water loop that feeds Cascades' dryers as well as the Serres Francis Lemaire's greenhouses. The solar field will supply **3867 GJ (1075 MWh)** of energy, resulting in a reduction of **230 tonnes of CO<sub>2</sub>** emissions per year. [cascades.com](http://cascades.com)



Photos: Cascades



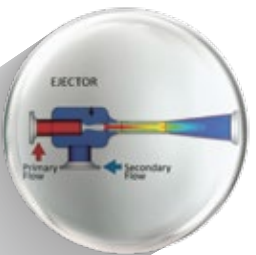
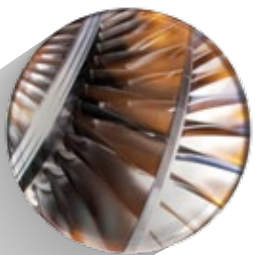
## CSP SOLAR ENERGY VARIATIONS

**CSP + STEAM TURBINE (ORC) = ELECTRICITY**  
Mechanical engineering students at the Université de Sherbrooke have developed a steam turbine that supplies electrical and thermal energy when combined with a parabolic solar concentrator (Apollon 2013 project).

**CSP + EJECTOR = AIR CONDITIONING**  
Thanks to CanmetENERGY\* and the Université de Sherbrooke, thermal solar energy can now be used to produce cold air and thus to air-condition countries with hot weather!

\* CanmetENERGY: Natural Resources Canada's research centre on energy technologies

**CSP + PHOTOVOLTAICS = HEAT AND ELECTRICITY COMBINED**  
A university/industry project involving collaboration between researchers from 3IT and from the **Rackam** company: Unique in Canada, Rackam's expertise in the design and optimization of CSP for industrial applications to produce process heat reaching 260°C is being coupled with that of 3IT researchers to develop hybrid solutions combining the production of heat and electricity through the same system. [rackam.com](http://rackam.com)



# SOLUTIONS TO VARIOUS ELECTRICAL AND THERMAL ENERGY STORAGE ISSUES

CLOSE TO A DOZEN RESEARCHERS FROM THE UNIVERSITÉ DE SHERBROOKE ARE WORKING ON **ELECTRICAL AND THERMAL ENERGY STORAGE SYSTEMS**

Mechanical engineering researchers at the Université de Sherbrooke are working with industrial partners on the thermal **storage of hot and cold air** using technologies involving phase change materials and ice slurry, thanks to an industrial energy efficiency grant from the NSERC (Natural Sciences and Engineering Research Council of Canada).

**Lekla** is developing a solar lighting system with extended duration: LED lighting technology powered by a photovoltaic panel combined with an innovative system for energy accumulation and management, resulting in greater autonomy.  
[eclairagesolairepivo.com](http://eclairagesolairepivo.com)

**SIGMA Energy Storage** is developing a new generation of electrical energy storage through high-pressure air compression and advanced thermal recovery using molten salts, which will allow for the autonomy and integration of solar and wind systems. Unit power of 500 kW lasting 4 to 10 hours.  
[sigmaenergystorage.com](http://sigmaenergystorage.com)



Senegalese woman standing in front of a well filled by a solar pump installed by students from the Cégep de Sherbrooke.  
Photo: Cégep de Sherbrooke, Pierre Masson



## SOLAR ENERGY INCORPORATED INTO THE APPLIED TRAINING OF OUR TECHNICIANS... TO OPTIMIZE FARMING OPERATIONS IN DEVELOPING COUNTRIES!

At the Cégep de Sherbrooke, students are encouraged to think down the line, towards projects focused on sustainable development, humanitarian aid, and international solidarity, while meeting current technical requirements. Two examples of students' projects in industrial maintenance and mechanical engineering techniques carried out in West Africa:

- Solar mill:** Replacing the manual grinding of millet, resulting in increased flour production and profit reinvestment in the community. This enables Senegalese women to devote the time thus freed up to more beneficial tasks (gardening, education, etc.).
  - Solar pump:** With the time freed up, the women devote themselves to gardening, which the solar pump makes much easier by enabling deep well water to be taken to fields.
- Pierre Masson**, teacher at the Cégep de Sherbrooke  
[pierre.masson@cegepshebrooke.qc.ca](mailto:pierre.masson@cegepshebrooke.qc.ca)



# INDUSTRIAL CLUSTERS SUPPORTED BY RESEARCH!



## The Université de Sherbrooke: The greenest university in Canada!

The Université de Sherbrooke ranks 1<sup>st</sup> in Canada and 6<sup>th</sup> in the world in the international classification of universities in terms of sustainable development (Universitas Indonesia Greenmetric World University Ranking 2013), out of a total of 215 universities. The university stands out in particular for its:

- **exemplary management of waste materials:** Customized sorting islands, on-campus composter and waste management centre, and the exclusive use of reusable or compostable dishes;
- **exceptional energy performance:** The only university at the Distinction level of Hydro-Québec's Energy-Savers' Circle, thanks to its energy efficiency strategies;
- **unique approach providing free access to public transit** for more than 10 years, in addition to being the first university to install **recharging terminals** as part as the Electric Circuit program.

## UNIVERSITÉ DE SHERBROOKE

Alain Webster  
819 821-8000, ext. 61286  
alain.webster@usherbrooke.ca

## 3IT - SOLAIRE

Vincent Aimez  
819 821-8000, poste 62137  
info3it@usherbrooke.ca  
[3it.ca](http://3it.ca)



## Acting together to be competitive

Based on specific recognized skills, the **ACCORD regional "clusters of excellence"** were introduced to develop a brand image for each region of Québec and to ensure that they receive wide exposure both nationally and internationally.

- **Créneau d'excellence Bio-industries environnementales (CABIE - the region's environmental bio-industry cluster):** This cluster groups together companies using biotechnologies, bioprocesses, or biomass to reduce or eliminate impacts on the environment.
- **Créneau d'excellence de l'industrie des systèmes électroniques du Québec (CISEQ - Québec's cluster of excellence in the electronic system industry):** This cluster is recognized for the significant presence of activities involving the manufacture of microelectronics components and the design of systems, especially in the micro electronics applications sector.

## CRÉNEAUX ACCORD

[economie.gouv.qc.ca/objectifs/informer/creneaux-dexcellence](http://economie.gouv.qc.ca/objectifs/informer/creneaux-dexcellence)

## CABIE

Anne Sophie Demers  
819 560-8403  
asdemers.accord@hsfqc.ca

## CISEQ

Réjean Dion  
450 534-8000, poste 1016  
rejean.dion@ciseq.ca



## Clean technologies in Sherbrooke - 100 companies and about 3000 jobs!

Sherbrooke Innopole's mandate is to contribute to the City of Sherbrooke's economic shift, focusing on innovation and the development of five key sectors, including that of **clean technologies**.

Sherbrooke, the major city in the Estrie region, is home to many Cleantech companies, making it a privileged area for this sector. Sherbrooke Innopole provides the following benefits:

- **Support** to companies during every phase of their development
- Access to **investment funds**
- Access to an **international business network**

## SHERBROOKE INNOPOLE

Myriam Belisle  
819 821-5577  
mbelisle@sherbrooke-innopole.com  
[sherbrooke-innopole.com](http://sherbrooke-innopole.com)