



Thermal Waste Reclamation for Small and Medium-Sized Industry

The Green Machine recovers heat from liquid or gaseous thermal waste ranging in temperature from 85°C to more than 125°C. The recovered heat is used to vaporize an organic fluid, which drives a turbine to generate up to 50 kW of electricity. About 10% of the recovered heat is used to generate electricity that can be consumed on-site or injected into the Hydro-Québec distribution grid.

Industrial manufacturing processes consume a lot of fossil fuels or electrical power and then discharge large quantities of energy into the environment in the form of liquid, steam or gas, with temperatures ranging from 15°C to more than 250°C. Scientists are very interested in this thermal waste because it contains enormous energy potential. Since 2009, a team at the Institut de recherche d'Hydro-Québec (IREQ) has been trying to find ways to reclaim this thermal waste to produce heat, electricity or cooling. The goal is to enable small and medium-sized industrial companies in Québec to reduce their energy consumption.

Two areas, five prototypes

This project targets two thermal energy reclamation areas and proposes technologies for each:

- > Waste with temperatures of 15°C to 45°C
- > Waste with temperatures of 85°C to more than 125 °C

The team is working to develop and adapt five prototypes: three high-temperature heat pumps, a thermal machine and a cooling machine. The five prototypes have been incorporated into a multifunctional test bench with two heat sources (electric boilers) and two air-cooling systems.

Stimulating industry interest

A team of researchers and technicians at the Laboratoire des technologies de l'énergie (LTE) is working to stimulate industry interest by proposing viable heat recovery technologies. The team is collaborating with EDF (France) and is also participating in an International Energy Agency project on industrial heat pumps. After the laboratory work, the team plans to launch industrial-scale pilot projects in 2013.

Hot water at lower cost

The LTE has designed and developed three high-temperature heat pumps that can absorb heat from liquid or gaseous thermal waste at temperatures of 15°C to 45°C. The pumps use this heat to heat water to temperatures of up to 85°C, with very little use of energy. For each kWh of electricity consumed, 3 to 5 kWh or more of thermal energy can be recovered. The resulting hot water can be used in industrial processes or for other purposes such as washing, particularly in the agri-food industry.

Generating electricity with the Green machine

The Green Machine is an apparatus manufactured in the U.S. Initially, the prototype had a rated generating capacity of 30 kW. In addition to evaluating its operation and energy performance, the LTE is working to fine-tune it. Almost all the recommended modifications and improvements have been incorporated into the new 50 kW preindustrial prototype. This generating capacity is considered the best adapted to the heat recovery market for small and medium-sized industry in Québec.

Heat for cooling

The LTE team is also testing a prototype cooling machine that uses thermal waste in the form of water at temperatures of 35°C to 45°C. The recovered heat is used to produce cooling of up to – 10°C, with practically no consumption of additional energy. This cooling can be used in various manufacturing processes or for food conservation.

For information

Research and development

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A forward-Looking project

IREQ has undertaken to develop efficient and reliable technical solutions to reclaim the large quantities of thermal waste produced by small and medium-sized industrial companies. In so doing, the research team hopes to:

- reduce the overall energy consumption of these companies
- lower power demand on the Hydro-Québec electrical system
- contribute to a sustainable future by decreasing greenhouse gas emissions from the use of fossil fuels