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Overview of emerging gas technologies for heating commercial buildings

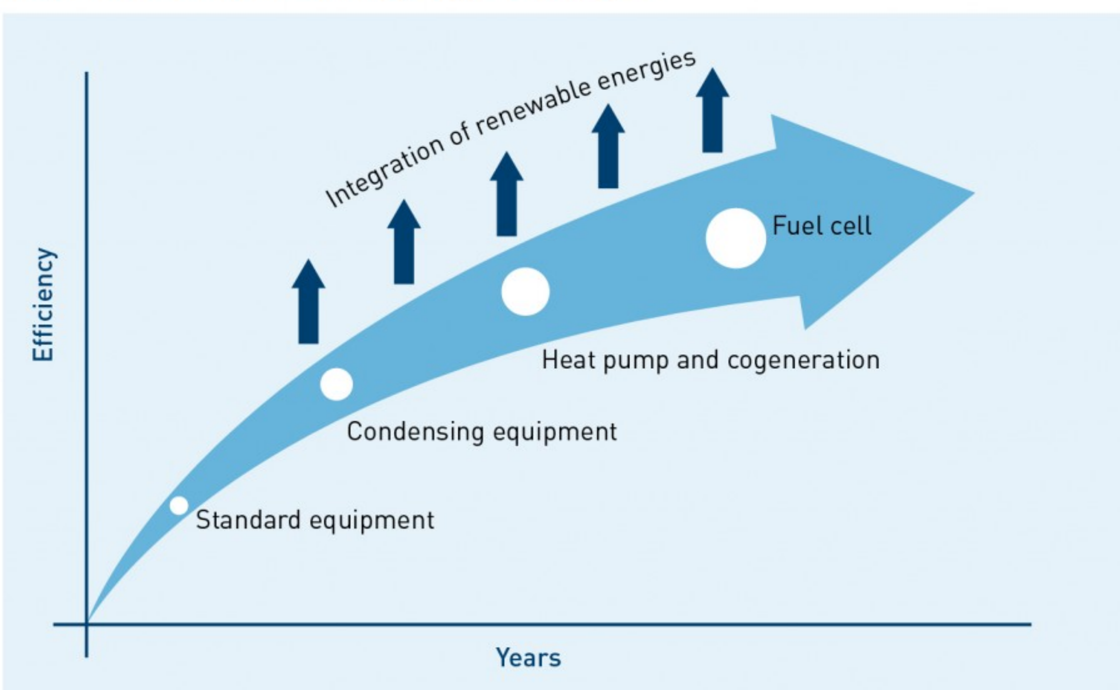
While the energy intensity of commercial buildings has been declining for a number of years, there is a considerable need for space heating, which represents approximately 49%[1] of all energy used by a building. Improving its energy performance is an important element.

In 2011, the International Energy Agency published technology roadmaps, including one on the role of heating and cooling equipment in improving the energy efficiency of buildings.[2] The long-term potential for improving their performance is based on four commercially available technologies, whose development is not yet mature:

- Active solar thermal
- Combined heat and power (CHP)
- Heat pumps (gas, electricity)
- Thermal storage

The efficiency of gas technologies has progressed in recent decades thanks to the improvement in equipment, the development of new concepts and the integration of secondary energy sources, as per the following graph:

Graph 1: Evolution in the efficiency of gas technologies



Manufacturers of HVAC products strive to develop high-performance products. In this regard, significant work has been carried out, is still under way, or is about to be completed. The following is an overview of some emerging technologies.

Make-up air units and high-efficiency rooftop units

Conventional air heaters installed today have a typical efficiency of 80%, while condensing equipment has an energy efficiency potential of 90%. Given the size of this market, the potential for energy savings is an interesting prospect for all.

One of the technologies identified by manufacturers for improved efficiency is the Dedicated Outdoor Air system – DOAS, which should be more efficient given the ever-increasing need for fresh air. Whether to satisfy the regulatory requirements of ASHRAE Standard 62.1—the installation of variable refrigerant flow (VRF) systems that do not heat outdoor air—or to raise awareness for better indoor air quality in existing buildings, heating fresh air is a considerable energy expense.

There are a number of design issues at play here: for example, the need to avoid increasing static pressure through the addition of an overly large exchanger, which would increase the electricity bill; and the need to remove or easily dispose of the condensate without risk of freezing. Some manufacturers now offer condensing systems and have developed ways to mitigate these problems for the most part.

Modine, Reznor, EngA, Heatco, Sterling and soon Bousquet have make-up air systems capable of attaining or even exceeding 90% thermal efficiency.

Another equipment identified by manufacturers is the rooftop unit, arguably one of the systems most often installed. Technological developments are similar to those for outdoor air units. Innovations also include controls (exclusive use of natural gas during unoccupied periods) or heat recovery from compressor order to preheat water for conservation applications, for example (Rheem).

Microcogeneration (mCHP)

Electricity costs being what they are—mainly outside Québec, where there is even more of a competitive disadvantage for this energy source—significant work is being carried out to develop combined heat and power devices. With a capacity ranging from 1 to 50 kW, microcogeneration gives rise to considerable interest among many industry players. While we are seeing greater efforts in Japan and Europe, several companies on this side of the Atlantic are also working in this regard. Reducing costs per kilowatt is a priority for the Gas Technology Institute (GTI) and manufacturers who are developing this type of equipment. Based on a scaled-up deployment of their technology, they are aiming for $1,500 to $4,000/kW and a return on investment in less than six years. This technology also offers further benefits, such as the production of electricity in the event of a network outage that will improve profitability, and the sole consideration of additional costs between an emergency generator and a microcogeneration system that will reduce the initial cost of purchase.

Among the challenges faced in developing this type of equipment is the need for better efficiency in electricity production, which varies from 15–45% according to the principles used. The proposed principles are based on the Stirling cycle, organic Rankine cycle, internal combustion engine, fuel cell, micro-turbine or thermo acoustic effect. The latter is very different since it converts heat into acoustic waves, which are subsequently converted into electric power. Seven manufacturers are already offering their products in the United States, five are planning to do so, while another five are in the development phase with plans to market their products. Initially designed for residential use, this equipment now has a capacity of 35 kWe and can be installed in series. Commercial building owners who want to manage peak demand for electricity may therefore consider this type of technology.

Table 1: Manufacturers of mCHP (<35 kWe)

Company	Electricity capacity
Yanmar	5, 10 and 35 kWe
Capstone	30 kWe
EC Power	19 kWe
M-Trigen PowerAire	6 kWe
Marathon ecopower	4.7 kWe
Qnergy Stirling/ITC	3 to 6.5 kWe

Gaz Métro is working in close collaboration to identify and develop the new gas technologies described in this article. This way, Gaz Métro will be in a position to increase the technological offer and better meet market needs.

Marc Francoeur, P. Eng, CEM, LEED AP
DATECH Chief Adviser, Technologies & Innovation, Gaz Métro

1 Natural Resources Canada (on line), National Energy Use Database, Commercial/Institutional Sector, Table 2: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=com&juris=qc&rn=2&page=0

2 International Energy Agency. Technology Roadmaps, Energy-efficient Buildings: Heating and Cooling Equipment (on line), 2011: https://www.iea.org/publications/freepublications/publication/buildings_roadmap.pdf

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