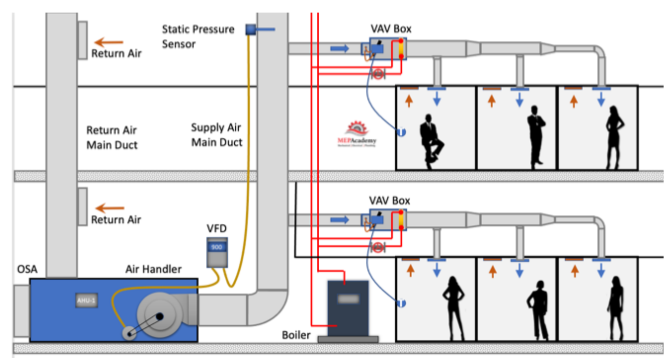
JohnQ | Public Impact

Energy Efficiency Commissioning for Fire Halls

System Category	Description of Energy Savings Method
Track energy use using template	☐ **Read your meters to track energy use**. Record date, time, energy readings and demand reading. Subtract the previous energy reading from the current reading and multiply the difference by the appropriate billing multipliers. The product is the total kilowatt hours of energy or the cubic metres of gas burned. Record average temperatures to relate energy use to weather. If gas usage increases significantly, it may be an equipment problem, something running too long, or a gas leak. If electrical consumption increases significantly, look for something left on, or something broken. If demand increases, check for new loads being added or increases in the size of loads.
Financial cost-benefit analysis	☐ **Consider calculating costs and benefits.** Methods include simple payback, net present value or constant dollar value. Energy efficiency projects generally show a direct benefit in reduced operating costs. Lower facility maintenance costs are another benefit.
Air leaks in the building envelope	☐ **Retrofit your air barrier first. Consider air leakage testing.** Leaks can be sealed with tapes, caulking or gaskets such as around electrical outlets. Materials like silicones, polysulphide, and urethanes are better suited than acoustic sealants. Leaks occur at joints between components, cracks in materials, and openings such as electrical boxes. When you find a leak in a wall or ceiling you will probably find there are several layers of construction. Find the layer that makes up part of the air barrier system. If you seal the wrong layer, you won't stop air leakage but only direct it through some other crack or opening. An effective air barrier layer has several components: • The air barrier membrane must be continuous throughout the whole building. • The air barrier must be fastened to the structure so it can resist high wind loads – inward and outward. Deflection of poly between studs must be kept to a minimum to avoid tearing.

	• The air barrier membrane must have the same life expectancy as the building, or else you have to be able to repair it. • The membrane should be sandwiched between solid materials on both faces to prevent movement and possible tearing. Polyethylene, a common vapour retarder, can be used in wood frame buildings where it can be stapled and held between the interior wallboard (drywall) and the insulation and studs. For other types of construction, it is best to use materials such as plywood, metal liner panels, or reinforced membranes. There are many membranes such as PermaBarrier by Grace, TFM by Tremco, and other manufacturers' products which can be used to make an air barrier system for many types of buildings. Liquid applied membranes and sealants are becoming more readily available.
Insulation	☐ **Consider increasing wall and/or roof insulation. Slab insulation can be added at time of construction.** Energy loss is inversely proportional to the R-value, which has implications regarding how much insulation is sufficient: For a wall with an insulation level of R-10, we can reduce heat loss by 50% by adding an additional R-10, for a total of R-20. Upgrading from R-20 to R-30 reduces heat loss by 16.7%; from R-30 to R-40 by 8.3%, and from R-40 to R-50 by 5%. In a building with bulky metal girts or beams coming through the walls and ceiling, you will not get full value for any extra insulation you install. The girts or beams will limit how much insulation is economical to put in the wall, or they may make it more effective (although also more expensive) to put insulation elsewhere on the inside or outside of the wall.
Space heating	☐ **Consider installing a heat pump for space heating.** A heat pump uses refrigerant circuits to move or "pump" heat from one location to another rather than using an electric heating element or burning fossil fuels. Ground source heat pumps have coefficient of performance (COP) ratings between 2.5–3.5, which translates to an 'efficiency' of 250%-350%. This means GSHP produce 2.5–3.5 kilowatts of heat energy for every kilowatt of electrical energy supplied to the unit. Heat pump units can provide a higher temperature heating source plus summer cooling. The savings must be weighed against the purchase price and maintenance costs. Ground source loops closed pipes can be buried in the soil under the parking lot, ball diamond, etc. next to the complex.

Energy Efficiency Commissioning for Fire Halls

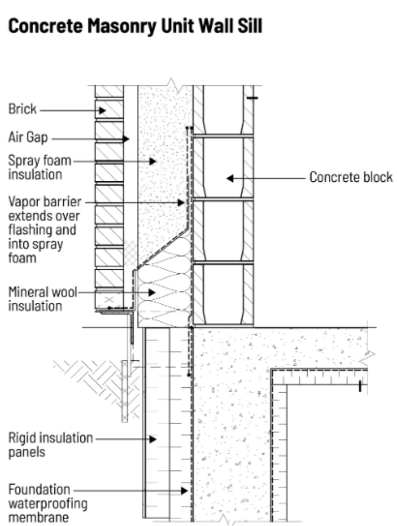
Ventilation	☐ **Consider installing a Heat Recovery Ventilator (HRV).** An HRV is an air-to-air heat recovery unit that removes heat from warm, stale air being exhausted from a building and uses it to heat incoming cold, fresh air. The recovery of heat saves energy by reducing the load on the heating system. Ensuring adequate fresh air from ventilation becomes increasingly important as the building envelope becomes increasingly airtight.
Water heating	☐ **Consider an air source heat pump hot water heater at time of replacement.** ☐ **Add insulation to storage tanks and pipes to hold the heat in the water and reduce stand-by loss (a lot of heat can be lost in distribution piping).** ☐ **Install an instantaneous gas-fired water heater which requires energy only when there is a demand for hot water. Since these units do not have a high storage capacity, stand-by losses are further reduced.** ☐ **Conserve hot water by ensuring ENERGY STAR rated appliances and low flow WaterSense water fixtures and fittings**
Temperature, Lighting and ventilation control	Consider the following methods to save energy based on differential occupancy or usage within the building: ☐ **Install air barriers between zones with different indoor temperature setpoints or keep the same indoor temperature** ☐ **Install variable air volume box to control ventilation rate of individual rooms.** ☐ **Install high-resolution occupancy sensors for heat (since irregular occupancy patters)** The VAV box regulates the flow (CFM) to a zone in relationship to the demand of the temperature sensor in the space.  *Variable Air Volume System with VAV Boxes*

	☐ **Ensure temperature and/or ventilation setbacks during unoccupied hours (e.g. recreational rooms or dorms).** ☐ **Install lighting occupancy sensors** Image from: How a Variable Air Volume VAV System Works - MEP Academy
Windows and Doors	☐ **Replace old, inefficient windows with double or triple-glazed low-e windows**
Maintenance	☐ **Reseal cracks and joints on the interior of the building every year, during summer or early fall.** ☐ **Maintenance for insulation is rarely required unless displacement or dampness is detected.** ☐ **Caulk unplanned cracks or openings in the exterior cladding with good quality exterior grade caulks. Don't seal planned openings, like weep holes through the wall.** ☐ **Increase staff awareness of energy efficiency**
Apparatus bay	☐ **Heat the truck itself and keep the heat in Apparatus Bays** ☐ **Reduce the heating temperature setpoint (e.g., 10 degrees Celsius) in the Apparatus Bays** ☐ **Install bi-folding doors that allow the trucks in and out.** These doors open two-and-three-quarter seconds faster than an overhead door goes up, which may sound miniscule, but when those doors are opening 4,000 times per year, that adds up to hours and hours that those doors are closed rather than open.

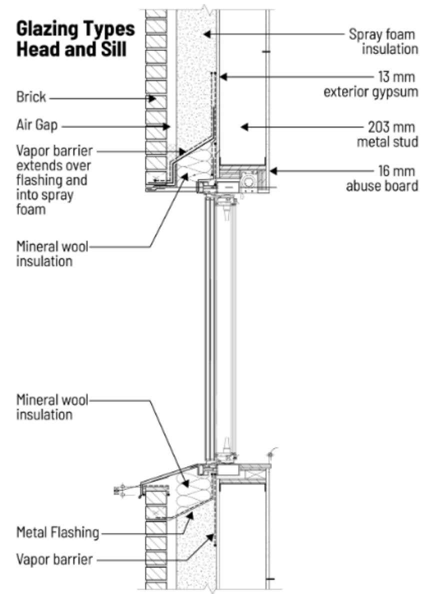
New construction

- ☐ **Consider reducing the ratio of window area to wall area**
- ☐ **Minimize thermal bridging in wall assembly (see below)**
- ☐ **Install solar panels (e.g. [Edmonton's Windermere fire station])**
- ☐ **Install a green roof for added insulation in summer (e.g. [Richmond Steveston Fire Hall No.2])**
- ☐ **Consider other aspects of passive house design (e.g. [Vancouver opened a zero-carbon fire hall], [Coldstream is a small hamlet in Middlesex Centre, northwest of the City of London])**

From Edmonton example:



A net-zero building requires a tight building envelope. In the case of the Windermere Fire Station, the wall included a 90mm brick veneer, a 45mm air space, 175mm of spray foam insulation and vapor barrier and a 190mm concrete block wall. It provides an excellent U-Value of 0.167 W/m2K.



The triple-glazed windows are set in walls made of 90mm brick veneer, a 45mm air space, 175mm of spray foam insulation and vapor barrier, 13mm exterior gypsum sheathing, 203mm metal stud framing and 16mm abuse board, giving an excellent solar heat-gain coefficient rating of 0.38.

Sources: *Energy Efficiency Guide for municipal recreation facilities*