Island Energy Plan
Energy Efficiency
Marc Rosenbaum

Introduction

The Commission has set goals for reductions in both GHG (greenhouse gas) emissions and fossil fuel use. Reducing the need for energy usage – implementing energy efficiency strategies – is almost always more cost effective than fuel switching or additional renewable energy strategy. In buildings, reducing energy needed for heating almost always increases comfort, indoor environmental quality, and durability. Also, lowering the heating load increases resilience during power outages – interior temperatures drop more slowly and spaces stay habitable longer.

Energy efficiency measures are also worthwhile in building systems including space conditioning, ventilation, water heating, lighting (interior and exterior), and pool heating. In commercial buildings, there are a host of efficiency measures for specialized energy uses such as refrigeration.

Energy efficiency in building enclosures

MV is a heating-dominated climate for most buildings, and space heating is usually the largest energy use in small, enclosure-dominated buildings such as houses and non-residential (mostly) wood-frame buildings. Heat loss is due to conduction through the walls, foundation, and roof, which is mitigated by insulation in these assemblies, and through air leakage in and out of the building. In many buildings, air leakage can be the largest single component of heat loss. Air leakage is quantified by depressurizing a building with a calibrated instrument called a blower door, and leakage spots are identified by using an infrared (IR) scanner (preferably during the heating season.) An experienced air sealing crew, guided by a blower door/IR scanner set-up, can make dramatic gains in just a day's work with inexpensive materials. Many common building problems, such as frozen pipes, ice dams, and pest infestations, are reduced or eliminated with targeted air sealing. Air sealing also reduces drafts and so makes buildings more comfortable.

When a building is receiving new siding, roofing, or new windows there are inexpensive opportunities to reduce air leakage. Installing a vapor permeable self-adhering membrane instead of conventional felt paper or housewrap before new cladding is an effective air sealing strategy, especially over board sheathing. If an old building is in need of additional bracing, a layer of structural sheathing with an integral weather barrier can be taped as an air barrier. Some of these products also incorporate a layer of rigid insulation as well. When windows are replaced there is an opportunity to air seal the rough opening gaps between the window and the wall framing.

Adding insulation to reduce conductive heat loss can be low cost (air sealing an attic, then blowing in insulation, or blowing insulation into empty walls cavities), intermediate (insulating a crawl space or basement), or high (adding exterior insulation to walls or roofs). Proper insulation of a crawl space or basement is rigid insulation on the walls rather than batt insulation in the first floor framing, as the latter makes the below grade space cooler and more mold-prone, almost guaranteeing the need for a dehumidifier (and its attendant energy use). Bare earth floors should be covered with a polyethylene vapor retarder to reduce moisture intrusion.

Energy efficiency in building systems

The most common heating and hot water systems on MV are fossil-fueled boilers, furnaces, and water heaters. Strategies for reducing fuel consumption (without fuel switching) include:

- Replacing outdated, inefficient, and over-sized boilers with state-of-the-art products, usually with sealed combustion equipment.

- It's always best to have the entire heating and cooling system inside the thermal enclosure of the building. Altering the thermal boundary can reduce heating and cooling energy substantially (for example, insulating the roof of an attic that has mechanical equipment installed, instead of the attic floor). It's equivalent to bring a heating system inside from outdoors!
- Sealing and insulating furnace/fan coil/cooling system ducts, especially when they are located outside the thermal boundary of the enclosure as mentioned above, especially in an attic or kneewall. Leaks in the return side ducts located in an attic are bringing outdoor air directly
- Fossil fuel systems use electricity to operate controls, burners, pumps, and blowers, and this usage can be significant, and worthy of effort to reduce. Changing control settings so that pumps and furnace/fan coil blowers don't run unless a thermostat is calling for heating or cooling can show significant savings of both energy and cost, especially in larger buildings where heating pumps may be set to run all summer!
- Adding reset controls to boilers and forced hot water heating systems lowers the temperature of the water circulating when it's not as cold out, which saves fuel by reducing unnecessary heat loss of the boiler and distribution system.

In buildings with large ventilation loads, adding energy recovery systems can save as much as 75-80% of the ventilation load and reduce the required heating and cooling system size appreciably (which also makes fuel switching to electric heat pumps less costly). An added benefit is that moisture is also recovered, leading to higher relative humidity (RH) in winter and lower summertime RH. Not only is the cooling system able to be downsized but its dehumidification ability is enhanced.

Water heaters can be replaced with more efficient units. Systems that recirculate hot water around the building continuously, such that all the piping is filled with hot water and therefore hot water is instantly available, have high heat loss off of the piping, and often use more energy to replace the piping heat loss than to actually heat the water. Controlling a recirculation system so that it only operates when people occupy the building can result in noticeable savings. There are also "smart pumps" that only activate when they sense that the water has cooled off, and demand-controlled recirculation systems that only operate the pump on demand when the user presses a switch at the end use location.

Lighting system load reductions may also have high potential. Replacing halogen lighting common in high end residences with LEDs can result in 80% load reduction, as well as decreasing cooling loads. In non-residential buildings, both lighting efficiency upgrades, and implementing lighting controls that keep lights off when spaces are unoccupied or daylight is adequate to light a space, can drop lighting energy significantly.

Appliances and office/entertainment/IT equipment have all undergone major efficiency improvements. The lowest cost reduction is assiduous use of the OFF switch when the equipment is not required!

Energy Efficiency in Transportation

In transportation systems, energy efficiency improvements are typically added into the vehicle/vessel by the manufacturer. Once acquired and deployed, there is relatively little the owner or user can do to affect the design of the vehicle. Instead, operators can improve energy efficiency by efficiency (1) in the way transportation is used, and (2) by reducing the frequency of use of transportation systems.

Operating Vehicles and Vessels More Efficiently

When operating a motor vehicle, driving patterns can optimize fuel efficiency. Minimizing accelerations and decelerations will improve mileage, as will accelerating gradually accelerating rather than quickly. Motor vehicles typically have an optimal speed for fuel efficiency which can be obtained from the manufacturer. Avoiding engine idling when a vehicle is stopped for more than a few seconds can make a big difference, particularly for users that make frequent, short stops. Maintaining a streamlined surface on the vehicle will also

improve fuel efficiency. Removing roof racks when not in use, or covering pick-up truck beds are common examples.

Similarly, the way boats are operated will greatly affect their fuel efficiency. Every boat model has a unique efficiency profile, depending on its weight, powerplant, hull design and use. Each boat will have an optimal efficient speed for cruising. Properly trimming the boat for the current weather and sea conditions also optimizes efficiency by reducing the drag on the hull. For boats with planing hulls, operating the vessel on plane raises part of the hull above the water and reduces drag. This much more efficient than operating at just below planing speed. When drifting, if safety conditions permit, turn off the engine.

Reducing Use of Transportation Systems

Reducing the use of transportation systems is analogous to undertaking a weight loss diet. The first step is to become aware of the usage in fossil fuels in all aspects of every-day life, and then consider tradeoffs with a reduction goal in mind. By carefully planning activities and the calendar, we can bundle errands into a single trip and avoid extra travel. By carpooling or ride-sharing, we can cut the use of fossil fuel for that activity by half, two-thirds, or more. Using mass transit systems multiplies this effect many more fold. Holding meetings via videoconference or teleconference eliminates the fuel consumption of traveling for that activity completely!

Human powered transportation not only eliminates fossil-fuel usage, but improves health. As a community, we should consider the case for expanding our network of bike paths and expanding some of them to multi-use paths for cycling and walking.

There is a hidden use of fossil fuels in many of the items we purchase. Considering the source of products that we buy, and the transportation required to bring them to market versus competitive or substitute products, can reduce fossil fuel usage in a subtle but important way.

Coupled with a growing and ultimately complete reliance on renewable energy, we may expect that energy efficiency in the transportation sector will make a major contribution to reduction in our carbon footprint.

Final thoughts and Recommendations

To accelerate the shift towards greater energy efficiency there are a set of key strategies to apply – some are in place already. Please note that the biggest gap is in education – for consumers, for installer and specifiers, for creating the tradespeople prepared to implement this transition.

- Readily available guidance documents, both print and web-based, for both consumers and installer/specifiers on building energy efficiency that show economic and other benefits.
- Free/low cost energy efficiency audits for residential and commercial/institutional buildings (Cape Light Compact)
- Trades education on assessing building energy usage and implementing prioritized energy efficiency measures
- Guidance documents for both consumers and builders about low cost energy efficiency upgrades available during re-siding, re-roofing, and window replacement projects
- A ban on fossil fuel used for heating, hot water, and pool heating in new construction and major additions/renovation
- Require energy use metering and submission of monthly energy use by fuel for all DRI projects, to build a database of actual performance