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Energy security in the residential sector: Rapid responses to heating emergencies Appendix: Non-governmental actions

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1. Introduction

Rapid rises in energy price or unexpected energy shortages can change the energy security of a jurisdiction, creating heating emergencies if there are insufficient energy supplies available to meet the heating needs of individuals and families. When the cost of heating becomes overwhelming or there are shortages in energy supply, it will be necessary for these individuals and families to have a means whereby they can be protected against the cold. This appendix presents actions that non-governmental groups (i.e., individuals, families, landlords, and communities) can take during a heating emergency (many of the actions could be applied to the commercial and institutional sectors). In most cases, the actions could be taken at short notice and produce immediate results. The actions are given in terms of increasing cost; where possible, the potential costs and benefits associated with each action are also given.

2. Rental properties

In most jurisdictions, a portion of the population leases their accommodation. Space heating in leased accommodations can often be a contentious issue; however, as energy prices rise, new pressures can develop:

- Tenants paying for heating may want the landlord to reduce the building's energy intensity[i] through building retrofits—something the landlord may refuse to do, seeing no benefit.
- To reduce operating costs, landlords paying for heating may want their tenants to reduce energy consumption. In extreme cases, the landlord may attempt to reduce heating supply in order reduce costs.
- Tenants not paying for heating have no incentive to reduce consumption and may waste energy unnecessarily.
- Jurisdictions that specify minimum temperatures for leased accommodations—for example, in Chicago where landlords must ensure that building temperatures do not fall below 68°F (daytime) and 66°F (nighttime) (CDHS, 2007)—assume that there is sufficient energy available for heating (if there are shortages, there is little the landlord can do to meet these requirements).

During a heating emergency, heating leased accommodation can become even more problematic as the tenant or the landlord, or both, may not be able to obtain the necessary energy to heat the tenant's accommodation. The actions discussed in the remainder of this section are applicable to homeowners as well as tenants.

3. Reducing the energy intensity of everyday activities

Reducing energy consumption can reduce the energy intensity of some activities and the savings applied to help offset the cost of heating fuels, as shown in Table 1.

Table 1: Potential savings associated with reducing energy consumption[ii, iii]

Activity	Action	Intensity savings	Savings at electricity rate		
			$0.07/kWh	$0.10/kWh	$0.13/kWh
Vampire appliances	Unplug all appliances not in use (assume 20W of vampire appliances)	0.48 kWh per day	$0.034	$0.048	$0.062
Bath	Avoid bathing for one day (120 litres at 45°C)	5.58 kWh per bath	$0.39	$0.56	$0.73
Shower	Avoid showering for one day (80 litres at 40°C)	3.26 kWh per shower	$0.23	$0.33	$0.42
Clothes washer	Switch from hot (50°C) to cold wash using high efficiency washer (86 litres per load)[iv]	2.25 kWh per load	$0.16	$0.23	$0.29
	Switch from hot (50°C) to cold wash using low efficiency washer (250 litres per load)[v]	6.54 kWh per load	$0.46	$0.65	$0.85

As an example of the possible cost savings associated with reducing energy consumption, consider the effect of washing clothes in cold water in a low-efficiency washer with electricity at $0.10/kWh. In this case, the savings would be about $0.65 per load. If multiple loads of laundry were washed each week, the savings could be significant. Additional savings can be made by increasing the load size thereby reducing the number of to be washed.

Further energy savings can be achieved by setting the maximum temperature of the hot water tank to no more than 50°C. Another compelling reason for reducing the temperature of the hot water tank is that hot water temperatures 50°C or higher can scald (Winnipeg, 2008).

Although much is said about the need to unplug vampire appliances unless they are in use, the fact is their savings pale when compared with reducing the consumption of hot water. This does not mean that appliances should not be unplugged; rather, that if significant cost savings are to be made, it is necessary to focus on those activities that are substantial consumers of energy.

Any cost savings obtained through these energy reduction measures can be applied to the heating fuel budget.

4. Reducing building (or household) fuel consumption[vi]

Broadly speaking, there are two ways in which the fuel consumption of a building or household can be reduced rapidly:

- Reducing the temperature at which the building operates, and
- Reducing the heated area within the building.

A building's energy consumption depends upon a number of factors, including its area and volume, whether it has a basement, its orientation, its permeability (i.e., the number of air changes per hour), the efficiency of its heating system, and its average temperature throughout the heating season. Lowering a building's average temperature is the quickest way to reduce energy consumption.

Not surprisingly, the energy reduction that can be achieved will vary from building to building. The graphs in Figure 1, obtained from HOT2000 simulations, show the reduction in energy consumption in two houses relative to an average temperature of 21°C; the first is a 2,000 ft^2 single-detached, two-storey, north-facing home with a basement, built in 1960, while the second is a 1,400 ft^2 single-detached, two-storey, west-facing home without a basement, built in the 1990s. By lowering the average temperature to 18°C, consumption is reduced by 23 and 27 percent in the first and second house, respectively. The lower the average temperature, the greater the reduction; a 50 percent reduction would require an average temperature of about 14°C in the first house and a temperature of 15°C in the second.

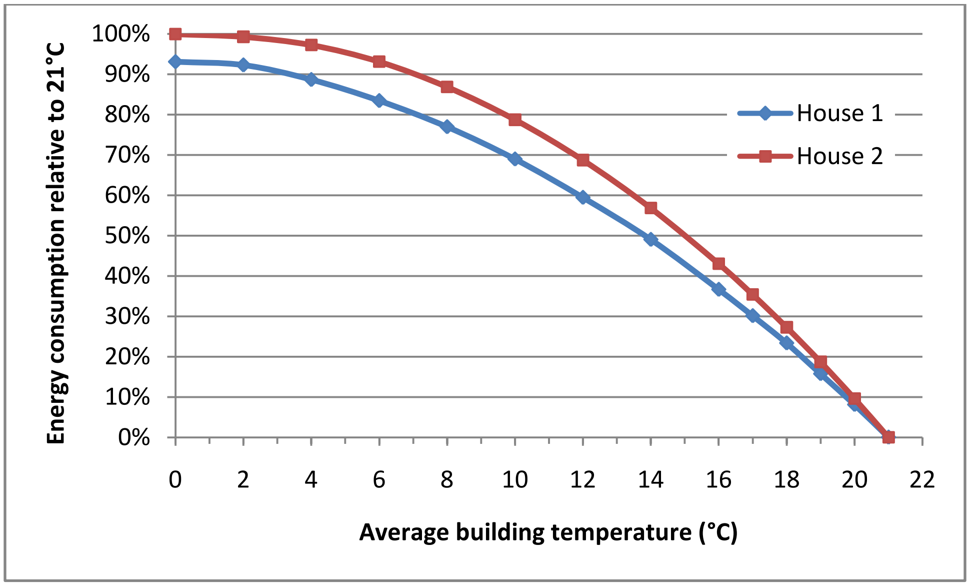

Figure 1: Temperature reduction and its effect on energy consumption

Maintaining the lower average temperature could be achieved by setting the building's thermostat to the specified temperature throughout the heating season. Alternatively, a programmable thermostat could be used, varying the temperature throughout the day, while maintaining the same, overall average temperature. Programmable thermostats are not inexpensive and in home with multiple heating zones, the cost of installing one thermostat per zone may be prohibitive.

Ideally, reducing the energy consumed to heat a building by lowering the average temperature would reduce the total heating cost; however, in a time of rising energy costs, the higher costs may offset the reduction in energy consumption.[vii]

5. Closing off rooms and reducing the heat to these rooms

Parts of a building that are not used during the heating season can be closed and their temperature lowered, thereby reducing the amount of energy needed to heat the building. If there is heat-loss between the warmer part of the building and the unused area, the overall temperature of the building may decline, causing the resident to increase the temperature in the warmer part of the building to offset this decline. Any such increase may reduce the expected savings. The heat-loss between the warmer and colder parts of the building can be reduced by separating the different areas with polyethylene barriers.

The potential benefits of reducing the building's average temperature are described in section 4.

6. Wearing warmer clothing

As temperatures drop, wearing several layers of loose, warm clothing is essential—this is true both outdoors and indoors. If indoor temperatures are lowered significantly, it is necessary to ensure that those susceptible to cold are properly clothed to withstand the cold.

7. Heating system maintenance

The amount of heating fuel a building consumes depends in part on the state of the heating system: the furnace (if one is used), the distribution system (duct-work or other piping), and the radiators. The overall efficiency of the heating system can be improved by several percent by having a furnace "tune-up", replacing air filters (on forced hot air systems), ensuring the distribution system is operating properly, and cleaning radiators. The benefits of the improvement will depend upon the state of the existing system.

8. "Quick" retrofits

There are a number of simple retrofits that can be done rapidly to help reduce energy consumption, most attempt to limit heat loss from the building envelop. These actions include caulking (or sealing) windows and other openings in the envelope, covering windows with a plastic barrier or a heavy curtain (or blanket), or both, closing the damper on unused fireplaces, and adding insulation to the attic space. The effectiveness of such retrofits depends upon a variety of factors, including the age of the building, its structure, and its location. The savings made with the retrofits can be applied to the purchase of heating fuel.

9. Charitable organizations

Charitable organizations such as the Salvation Army often have heating funds that offer grants to help those in need meet some of their heating requirements (for example, see (Salvation Army, n.d.)). Such programs face at least two hurdles: first, donations are required to fund the program, and second, as fuel prices increase, the amount of fuel that can be purchased per grant decreases.

10.Switch heating fuels

Switching heating fuels at short notice to meet all or part of a building's heating requirements implies that the consumer has access to financial resources, an alternative heating fuel, and the associated infrastructure. In these cases, the consumer must consider supply, infrastructure, and health and safety.

10.1 Supply

Switching heating fuels implies that there is a viable alternative available to meet all or part of the consumer's heating requirements. The two most obvious fuels are electricity and biomass, because most buildings have access to the electrical grid and many residential structures have fireplaces or woodstoves.

Switching to electricity can be done quite easily by purchasing electric baseboard heaters that can be plugged into any outlet or simply turning on electric stoves and ovens. The problem is, if many consumers decide to make the switch to electricity, parts of the electrical grid may be overloaded, leading to brownouts or even blackouts.[viii] A blackout will affect more than those using electric heating, as some heating systems rely on electricity for the control of auxiliary devices such as pumps, blowers, or augers. Although energy suppliers often have agreements with large industrial loads for load shedding, repeated or lengthy periods of load shedding could be detrimental to industrial consumers and the economy of the jurisdiction.

The relationship between the cost of electricity and the cost of a litre of home heating fuel depends upon the efficiency of the oil-fired heating system, which can range from low-efficiency (60 percent), through medium-efficiency (78 percent), to high-efficiency (85 percent).

The graph in Figure 2 illustrates this relationship—the horizontal axis is the price of electricity, ranging from $0.09 to $0.14 per kilowatt-hour, while the vertical axis shows the price of home heating fuel, from $0.50 to $1.30 per litre. The three solid lines represent the three furnace efficiencies.

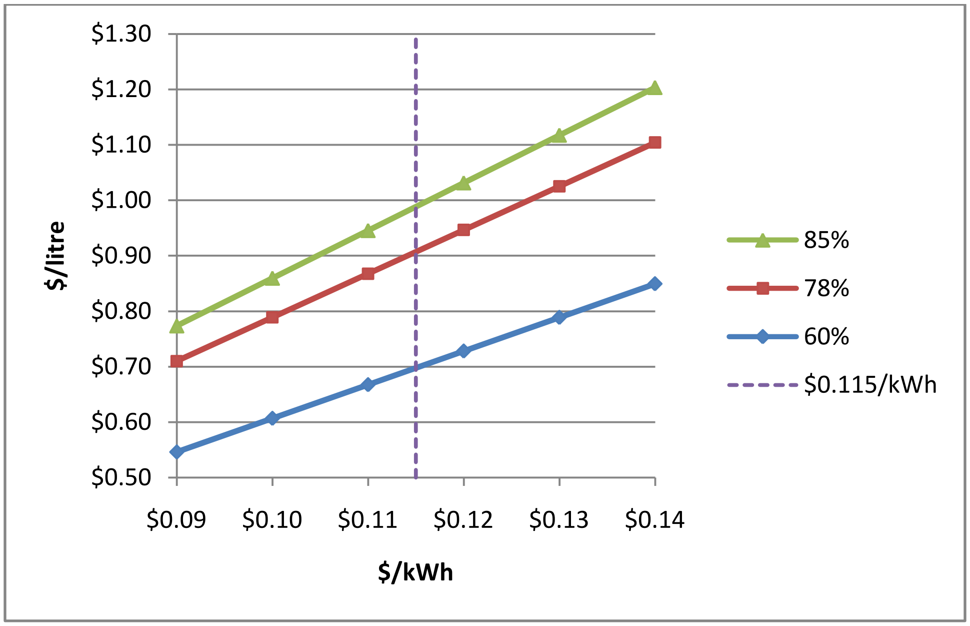

Figure 2: The relationship between electricity and home heating fuel costs

The dashed vertical line illustrates the equivalent cost of a litre of fuel oil if electricity were to cost $0.115/kWh. When oil prices are to the right of the line, electricity is less expensive, when oil prices are to the left of the line, electricity is more expensive; in this case, the cost of a litre of home heating fuel must be less than $0.70 if a 60 percent efficient furnace is used, whereas the cost of a litre of fuel can be as much as $0.99 or less in an 85 percent efficient furnace.

Buildings with chimneys and furnaces designed to burn biomass (for example, wood stoves, or dual-fuel furnaces) can potentially use biomass as the principal source of heat. Although biomass is typically far less expensive than “modern” fuels such as oil, natural gas, or electricity, it is usually more labour-intensive (logs must be stacked and carried) and dirtier. Furthermore, biomass, notably firewood, must be seasoned (i.e., its moisture content reduced) as unseasoned firewood offers little heating value.

One heating source that is free and is often overlooked is the sun. Opening the curtains on south-facing windows during sunny winter days can reduce the need for heating during the daytime (Wood & Hughes, 2008). Of course, the curtains must be closed overnight.

10.2 Infrastructure

Energy sources that require new infrastructure (for example, a fuel storage tank, a natural gas hookup, a wood-fired furnace, or a chimney) may not be readily available. In some cases, there may be a shortage of the necessary infrastructure, there may not be sufficient skilled technicians to install the infrastructure, there may be seasonal barriers to installing the infrastructure, or the installation cost may be prohibitive.

10.3 Health and Safety

Safety is another issue that must be considered when switching fuels, especially to one where the infrastructure may be of unknown quality. For example, reopening a sealed fireplace with a chimney that has not been properly inspected, or plugging additional electric heating baseboards into an improperly rated outlet, or having open fires, are all possible health and safety hazards. Old equipment or equipment that does not meet national standards should be avoided.

Air quality is another health and safety issue that must be considered, especially when burning biomass. Without adequate ventilation, gases from the combustion of wood can accumulate inside a building. On the other hand, widespread adoption of biomass combustion equipment can lead to localized atmospheric pollution in a neighbourhood.

There is considerable energy in post-consumer waste (for example, tires, paper, cardboard, Styrofoam, and plastics) and it can be used as a fuel source in fireplaces, wood stoves, and furnaces. Under the proper conditions, certain plastics can be combusted for energy; however, in addition to carbon and hydrogen molecules, many plastics include other chemical compounds, which when combusted can produce toxins such as dioxins (Nakao, Aozasa, Ohta, & Miyata, 2006). If such plastics were used for heating (for example, in fireplaces or woodstoves) in a heating emergency, the result could be localized atmospheric pollution.

11.Sharing accommodations

If one or more individuals or families are unable to meet their separate heating needs, they could pool their financial resources and share a common residence. The advantage of shared accommodation is that the fuel budget can be stretched further, potentially offsetting the increased cost of energy. In some jurisdictions, such actions are prohibited for those on income assistance; however, during a heating emergency, these prohibitions would need to be relaxed.

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Notes

[i] Energy intensity refers to the amount of energy required to perform a task. In the automotive sector, it is often expressed as litres-per-100 kilometres; while in the built environment, such as the housing sector, it is kWh-per-square metre or megajoules-per-square metre.

[ii] The following assumptions were made regarding this table. The water supply was assumed to be 5°C and the water tank heated water to 50°C; during the summer months, the water supply temperature would be higher. Cold water clothes washing took place in unheated water. When a washing machine used hot water, it was for the wash cycle only; it was assumed that half the water was for the wash cycle, the other half for rinsing. The volume of water used for bathing and showering varied greatly—these numbers are middle of the range (for a discussion of ranges, see (WSSC, n.d.)).

[iii] kWh an abbreviation for kilowatt-hour. A unit of electrical energy.

[iv] LG 4.0 cu. ft Washing Machine. Sears catalog number 263 625 672.

[v] Kenmore Elite 3.8 cu. ft Top Load Washer. Sears catalog number 263 628 032.

[vi] This section was written with the assistance of Mr. Tylor Wood, an MASc student in the Energy Research Group.

[vii] The total energy costs of any household that reduces consumption will always be less than what the household would pay had the reduction not been made.

[viii] A brownout is a temporary decline in system voltage, leading to, amongst other things, a dimming (browning) of lights.