



## THE HYBRID REFRIGERATOR – HARNESSING THE CANADIAN WINTER – Canada

### SUMMARY

**Project description:** Hybrid refrigerators are designed to use outside air for cooling when the temperature drops below 4 degrees Celsius. The design takes advantage of existing technologies, putting them to optimal use for refrigeration in a wilderness hostel setting.

**Project type:** Energy efficiency, Education in sustainability

**National Association:** Hostelling International Canada

**Project location:** HI-Rampart Creek

**Estimation of number of reduced tonnes of CO<sub>2</sub>:** The refrigerator(s) will result in an estimated annual reduction of 1,400 litres in propane consumption and the annual avoidance of an estimated 2 tonnes of CO<sub>2</sub>e emissions.

**Total funds requested:** £2,028

**Total project cost:** £2,535

**Annual £ saves and ROI (Return On Investment):** an estimated savings of £170 per year. From a financial perspective, the investment will be recovered in 15 years.

**Why this project should be funded ahead of others:** At HI-Rampart Creek, guests are able to enjoy a stunningly beautiful setting, challenging hiking trails, a warm stop-over on a cycling trip or an excellent base for ice or rock climbing. This hostel is already equipped with solar panels and a river run turbine generator that together generate enough power in the summer months. The addition of the innovative and practical design of the hybrid refrigerators will offer guests an excellent opportunity to experience a low emission wilderness experience. This proof-of-concept project, if successful, will allow us to manufacture and install at least **ten more** such units to our other off-grid Wilderness hostels, exponentially increasing the potential GHG reduction results (a possible avoidance of an additional 20 tonnes of GHG emissions). The concept, control unit engineering and manufacturing labour, to date has been a labour-of-love project of several dedicated employees and volunteers, but to move this ahead we require additional funding. This hostel, like other wilderness hostels in the Canadian Rockies, does not generate adequate revenues to recapitalize itself, relying on the much higher capacities and activity levels of our resort and urban properties. Nevertheless, HI-Rampart Creek provides a mountain hostelling experience like none other. It is these unique and memorable experiences that linger longest and most profoundly in the minds of those who make the journey.

These are the reasons for supporting this project and this hostel. Given HI-Rampart Creek's location in a wilderness location of a National Park, the hybrid refrigerators will offer inspirational examples of the values, educational and cultural experiences it is trying to promote to its guests – that of respecting, experiencing and gently impacting the environment in which it stands.





## DETAILED PROJECT INFORMATION

### Purpose/objectives of the project activity

The proposed hybrid refrigerators will provide an innovative and inspiring example in the use of existing technology to reduce this hostel's reliance on propane fuel in its operations. The objective is to replace the existing propane refrigerators (3) with three electrically powered models. During the summer months, of which there are only a few in the Rocky Mountains, these refrigerators will run on solar power (generated by existing panels on site) and a newly installed instream river turbine generator. In cold weather, which can be present from September through to May, the refrigerators' interior will be cooled via a device that will harness the naturally occurring cold temperatures and bring the chill of the outside into the refrigerators inside the cookhouse.

This initiative not only will reduce propane consumption by an estimated 1,400 litres of propane per year and result in an estimated annual avoidance of nearly **two** tonnes of CO<sub>2</sub>e. It will also offer an exceptional example of simplicity and ingenuity in harvesting elements from our natural surroundings without causing harm to the environment.

Finally, this original concept will provide another showcase in Rampart Creek Hostel, which is already a shining example of affordable, sustainable energy innovation in Banff National Park, with its solar power and instream-turbine micro-hydro power generation.

### Methodology (How) – project description

Essentially, the hybrid refrigerators are designed to use outside air for cooling when the temperature drops below 4 degrees Celsius. The design takes advantage of existing technologies, putting them to optimal use for refrigeration in a wilderness hostel setting. Here are a series of points outlining the central concept:

- In the summer, with plentiful solar power available from our photovoltaic generation bank and an instream turbine river generator, we have enough power to run electric fridges instead of propane ones. However, in winter there is nowhere near enough solar power to do so (and the river is frozen over, so no power comes from the river turbine). This device is being designed to allow us to use the cold winter air to provide fridge cooling at remarkably low power consumption levels.
- The units will be chest freezers converted into fridges by modifying the thermostats to maintain a 4°C temperature. Chest freezers have the advantage of a horizontal layout with a top door. This configuration takes advantage of the thermodynamic principle that cold air sinks. As a result, when someone opens one of these units, the cold air tends to remain in the fridge instead of spilling out, thus reducing cooling requirements and power consumption.
- The open configuration of the chest refrigerators will serve guests well since they will be able to better keep their food supplies separate using baskets or small crates that will just sit into a shelf in the repurposed freezer.



- In summer, each fridge unit will use our photovoltaic-generated and river turbine-generated electricity, operating on compressor mode, as does a normal refrigerator.
- In fall, winter and spring, when the air temperature drops below 4oC, the circuit control system will shut down the compressor and start a set of low-power fans that will draw cold outside air into the fridge (one blows air in and at the other end of the fridge one pulls out the existent interior air).
- The difference in power consumption will be remarkable. When using outside cold air to cool the fridges, our power consumption estimate is 200 watts / hours per fridge per day, or 13% that of a normal fridge. Even in summer, the top-door configuration will reduce cooling needs significantly.
  - Assembling and repurposing
- Previously used chest freezers are available on the re-sale market so the units will be repurposing a large appliance that might otherwise be directed to a landfill.
- Retrofitted 4" ducting, connected at each end of the unit, will bring air into and out of the refrigerator.
- Each unit will have one fan installed to push air in and another to draw air out. Air temperature sensors will control the temperature inside the fridge and for outside air temperature. A motorized air valve will be installed in each air pipe to seal off the flow of air when required.
- Prototype pieces have been designed in 3D CAD and have been produced using 3D printing technology. The circuit board has been designed and a prototype produced. All the relays will plug into the circuit board which controls the operation based on feedback from the temperature sensors.
- Inside the chest fridge will be a shelving layout designed to hold individual baskets/milk crates that guests can load their goods into and place in the fridge.
- See the diagrams in the attached pdf documents (listed below) for additional information and visual depictions of the project.
  - Control Box assembly
  - System Fabrication

### **Monitoring plan**

Monitoring will be a simple matter of comparing the annual propane consumption following installation to records from previous years.

### **Contribution of the project activity to sustainable development**

In addition to reducing the CO<sub>2</sub>e emissions from the operations of this hostel, the hybrid refrigerator(s) will provide an excellent educational opportunity for guests and employees to learn about this innovative design that takes advantage of the Canadian winter weather rather than resisting it. The hybrid refrigerators will offer an inspiring example of connecting with the natural environment. Employees and guests will gain a greater understanding of operating with an off-grid power system generated through a natural renewable energy source. Information posters will give information relative to the refrigerators' installation along with the fuel and emissions reductions.



### ➤ Environmental impacts

The hybrid refrigerator(s) will displace three propane fuelled models, each one consuming an estimated 450 litres of propane per year. Their replacement will result in the estimated annual avoidance of two tonnes of CO<sub>2e</sub>.

### **Estimation of number of reduced tonnes of CO<sub>2</sub>**

- The recipient will advance the clean growth economy by installing and operating an innovative technology perfectly suited to wilderness locations.
- The refrigerator(s) will result in an estimated annual reduction of 1,400 litres in propane consumption and the annual avoidance of an estimated 2 tonnes of CO<sub>2e</sub> emissions.
- The results of the installation will be reported as part of an informal education program to profile our efforts to minimize our environmental footprint and inspire others to do the same.

### **Saved Funds and ROI (Return On Investment)**

- The remote location of this hostel makes it difficult to calculate a traditional return on investment for this installation. More important in this situation will be the innovative design using existing technologies to productively and passively harness the natural weather and temperature patterns of the environment in which the hostel is located.
- The hybrid refrigerator(s) will displace three propane fuelled models, each one consuming an estimated 450 litres of propane per year. Their replacement will result in the estimated annual avoidance of nearly two tonnes of CO<sub>2e</sub> and an estimated savings of £170 per year. From a financial perspective, the investment will be recovered in fifteen years.
- Marketing appeal of a wilderness hostel environmental, already supported by solar power and an instream micro-hydro generator, will be further enhanced by the installation of the hybrid refrigerator design that uses the Canadian winter weather to replace propane fuelled models. This will provide inspiration to guests and increase overnight activity at this hostel.

### **Communication plan**

The hybrid refrigerator(s) will tell an inspiring story of ingenuity and vision that harmlessly connects the natural environment, in this case the cold Canadian winter temperatures, with an operational purpose and modern day expectation...that of keeping food cool and fresh inside.

This will be a central story told in our promotions through our many media channels. Hostelling International is active and expert in spreading the word via our existing web site and various social media channels. We will use these tools to reach guests and the community.

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