WOP Energy Requirements:

Energy consumption here is a matrix. We use primarily hydro and propane. Our Airstreams run on a 12V battery cycle plugged into a 30amp power outlet. 4 of the 10 have substantial lithium and solar that primarily work when the power is out. The rest have deep cycle batteries that will give you around 8 hours in a power outtage. Any 12v power system can easily have solar and battery augmentation to run more off grid. Ideally we want to move towards more off grid power but our units are not really connected in one building and we are surrounded by 100 foot trees so an off-grid power source as a substantial alternative to hydro and propane other than power outage support is hard. Each unit could run when there is no power for up to 2 or 3 days with additional solar and battery power. The 4 that I added substantial battery and solar each have around 600amps of solar and 880Ah hours of battery backup and 2000 to 3000-watt automatic pure sine inverters. They are always topped up with the 30amp power and only are used when the power is off. Heat is the biggest draw. The propane furnaces in the Airstreams can continue to run as long as there is propane and battery power for the igniters. Without a propane furnace it is hard to provide heat with our off-grid inverted battery power. Plug in heaters draw 1500watts on their own plus all the other draws so a 2000 watt inverter would struggle and it would drain the batteries pretty fast.

We also have 4 x Jackery 3000 Explorer Solar Generators that each have a 100 watt to 200 watt solar panel that we can plug into them. We use them to run our Starlink and our electric macerating toilets during a power outage. They have a 30 amp plug that can plug directly into a trailers 30amp plugin.

The Restaurant and Motel would be the focus of increasing off grid or lowering the power consumption but the cost of conversion is substantial and the paybacks for solar with the inefficiencies makes if prohibitive. We did install 450lb Propane tanks for our Airstreams that are filled at a wholesale cost by Superior rather than filling them at the Hardware Store. That has lowered our cost substantially.

The Restaurant building is a largest single power user. The Garland cooktop, hot water heater and deep fryer run on propane. Heat is baseboard heaters that are not that efficient. When we are open and running the kitchen creates a lot of heat so we don't need much baseboard heat for at least 9 months a year. A heat pump combined with possibly a wood fireplace and solar and battery back up for both the Motel and the Restaurant would be good options. We already have a propane generator.

Overall Airstreams are pretty efficient power users. Most of the cooktops are propane and the furnace is propane. Outside the Hot Tubs are 15amp Soft Tubs heated at 104 degrees. The highest cost and least efficient is the propane fire pits and BBQs. Guests waste a lot of propane and our cost to refill is expensive. Guests also run too much heat and AC in the summer which makes no sense but that is the usual with hospitality guests. We don't allow the burning of logs for fire safety and smoke/pollution reasons.

Our costs are approximately $30,000 a year for BC Hydro and the same for Propane. The capital costs for installing solar in the restaurant would be around $75,000 and it would just reduce our grid power not run the restaurant. Reduction would be around $4,000 to $5,000 a year at the most so around a 18 year payback. We have a propane generator that runs off the main 1000lb Restaurant Propane tank. It automatically turns on in a power outage to run the freezers, coolers and the kitchen fan. It doesn't power the baseboard heat, water, pizza oven or the espresso machine but keeps the food from spoiling and the lights on.

Water here comes from two wells. We pay an annual fee to the Government now for well water usage. We use approximately 10,000 gallons a week during the 10 months we are open. The cost is just running our well pumps that is included in the $30K hydro cost. We have a water softner and purifier system that has an capital costs and a bit of maintenance cost for sand and filters but it isn't that substantial.

Category	Details
Primary Energy Sources	Hydro (BC Hydro), Propane, Solar (Limited), Battery Storage
Airstreams (10 units)	30-amp power outlet, propane heating & cooking
4 Airstreams (Solar + Battery)	600W solar, 880Ah battery, 2000-3000W inverters, runs for 2-3 days off-grid
6 Airstreams (Deep Cycle Battery)	Last ~8 hours in a power outage
Heating	Propane furnaces (battery required for igniters), Electric heaters (1500W, inefficient)
Hot Tubs	15-amp Soft Tubs, heated at 104°F
Backup Power (Airstreams)	4x Jackery 3000 Explorer Solar Generators (100W-200W solar panels, 30-amp plug)
Off-Grid Limitations	100-ft trees limit solar expansion
Restaurant (Largest Power User)	Propane: Garland cooktop, deep fryer, water heater; Baseboard heating (inefficient)
Backup Power (Restaurant)	Propane generator (1000 lb tank), runs freezers, coolers, kitchen fan, lights
Restaurant - Power Limitations	Generator does **not** run baseboard heat, water heater, pizza oven, espresso machine
Motel Energy Use	Target for off-grid expansion, possible solar + battery upgrade
Propane Usage	450 lb tanks for Airstreams (wholesale refill, cost savings), Fire pits & BBQs (wasteful)
Total Annual Propane Cost	~$30,000
Total Annual Hydro Cost	~$30,000
Water Usage	~10,000 gallons/week (10 months/year), well pumps included in hydro cost
Potential Energy Reductions	Limit propane fire pit/BBQ use, improve guest heating/AC habits

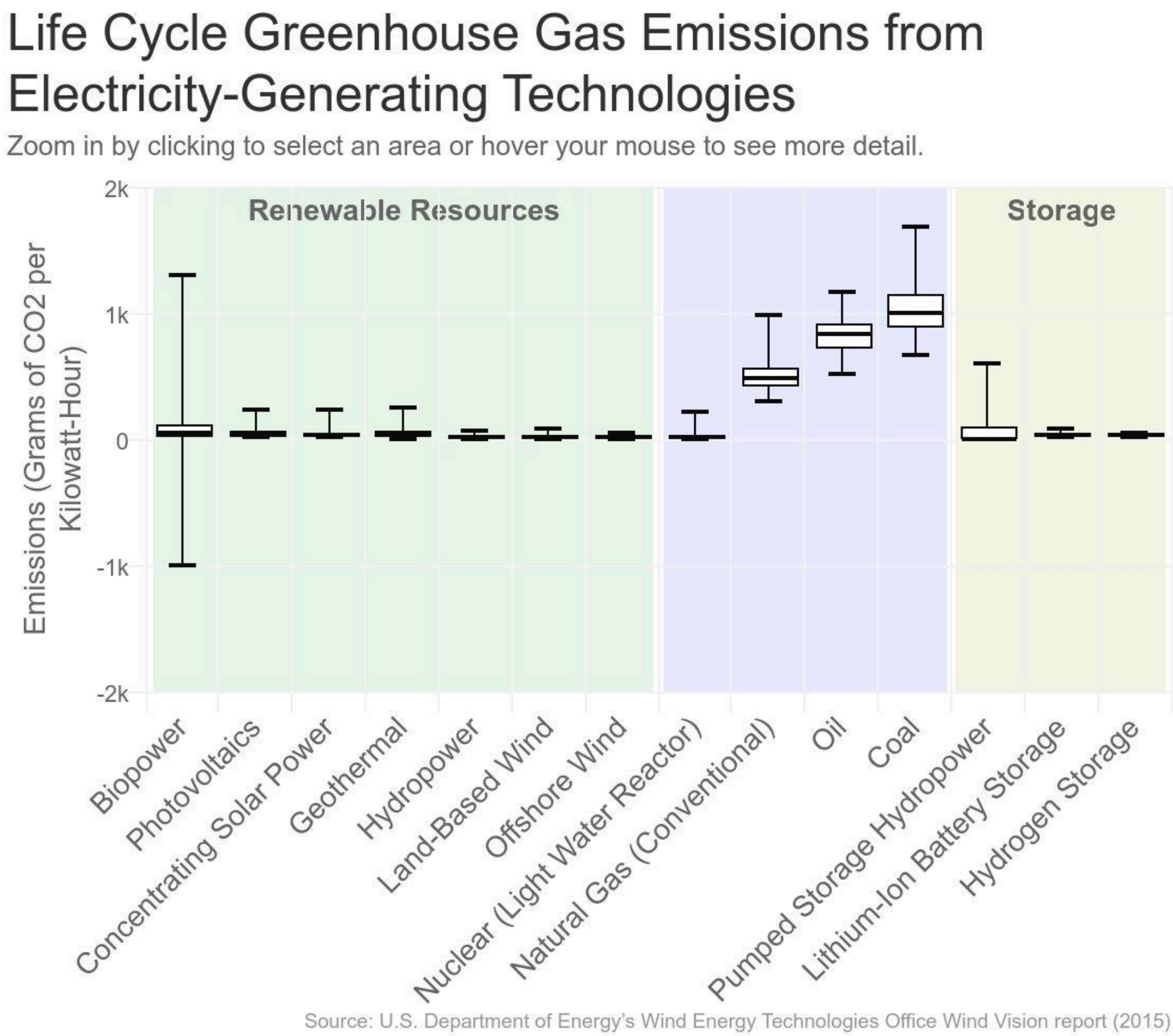
Possible Efficiency Upgrades	Heat pump, wood fireplace for restaurant/motel, expanded battery backup
Solar Feasibility (Restaurant)	Cost: ~$75,000, Savings: ~$4,000–$5,000/year, Payback: ~18 years (not cost-effective)

Wind Turbine System Details:

- 20 year life cycle
- Energy Generation Equation = $P = 0.5C_p\rho\pi R^2V^3$
    - Where P = Power Generated By Turbine
    - Cp = Coefficient of Performance (Efficiency Factor)
    - Rho = Air Density
    - R = Radius of Turbine
    - V = Wind Speed
- Two types of Turbines:
    - Horizontal Axis Wind Turbines (HAWT):
        - Regular Wind turbines
        - Range from 2.5m diameter for homes to 100+ for offshore
        - Max theoretical efficiency is 59%, but usually operate at 50% efficiency
        - Average annual wind speeds of 6.5m/s or greater at the height of 80m are generally considered commercially viable. [UMICH Air turbine info]
    - Vertical Axis Wind Turbines (VAWT);
        - More inefficient, thus not considered.
- Initial wind data from Saturna Island (Island Just North of North Pender Island was analysed from January 2024 - June 2024
    - **Average wind speed from Jan to Jun was 0.883 m/s, considerably lower than the 3m/s average wind speed cutoff point given to assess wind turbine viability.**
- This data was taken from Saturna island, and local vegetation, elevation, and topography can affect wind readings. An option to purchase higher-elevation land by WoP on Pender Island with higher wind speeds will be considered by WoP.
- Currently, wind power seems infeasible due to the Resorts location a the centre of the island, surrounded by tall vegetation.

Environmental Indicator Research

Greenhouse gas (GHG) emissions:

- https://www.energy.gov/eere/wind/articles/how-wind-can-help-us-breathe-easier#:~:text=In%20general%2C%20lifecycle%20greenhouse%20gas,2%2FkWh%20for%20natural%20gas.
- 11 gCO2e/kWh
- 

- Land-based Wind: ~12g CO2/kWh
- Offshore Wind: ~19g CO2/kWh
- https://www.sciencedirect.com/science/article/pii/S0959652620334302
- increasing the dimensions of wind machine would reduce the CO2-equ emissions
- https://www.ucsusa.org/resources/environmental-impacts-wind-power
- between 0.02 and 0.04 pounds of carbon dioxide equivalent per kilowatt-hour

Air and water pollution:

- https://renewablesassociation.ca/wind-energy/#:~:text=The%20production%20of%20electricity%20from,be%20deployed%20in%20different%20configurations.

- The production of energy from turbines causes no air or water pollution
- https://www.ucsusa.org/resources/environmental-impacts-wind-power
- There is impact on wildlife notably birds and bats
- Evidence of death from collisions with wind turbines and due to changes in air pressure when turbines are spinning
- However, impacts are relatively low and do not pose a threat to species populations
- No water use associated with operation of wind turbines
- Water is used to manufacture steel and cement

Land use:
- https://www.ucsusa.org/resources/environmental-impacts-wind-power
- Land use impact varies depending on the site
    - Wind turbines placed in flat areas use more land than those located in hilly areas
- If multiple are used they must be spaced apart
- use between 30 and 141 acres per megawatt of power output capacity
- less than 1 acre per megawatt is disturbed permanently and less than 3.5 acres per megawatt are disturbed temporarily during construction
- Offshore wind facilities require larger amounts of space because the turbines and blades are bigger than their land-based counterparts
- offshore installations may compete with a variety of other ocean activities, such as fishing, recreational activities, sand and gravel extraction, oil and gas extraction, navigation, and aquaculture

Resource sustainability:
- concrete, steel, iron, fibreglass, polymers, aluminium, copper, zinc
    - Mining and refining of many of these materials have geopolitic and ghg emissions impacts
    - Relatively abundant materials
- https://renewablesassociation.ca/wp-content/uploads/2025/01/CanREA-factsheet-Recycling-wind-turbine-components.pdf
- Most of the turbine is recyclable but the blades are not really
- 85-90% recyclable
- https://www.nytimes.com/2024/08/30/climate/wind-turbine-recycling-climate.html
- end of their life span of around 20 years
- expect more than 43 million tons of landfill waste will be generated by turbine blades globally by 2050