Our problem is a 35 year old cable, if it fails it will be very expensive to replace.

- Built in 1983, expected life of 15-20 years
- If it fails today our only immediate alternative is diesel
- Diesel will more than double average cost of electricity to about 70¢/kWh
- Even with our current high subscriber rates we’ll run about $75,000 in debt each year. (revenue is only ~$120,000/yr)
We need to prepare for failure of the cable.

Have considered several alternatives - new cable, solar, wind, diesel, micro-turbines.

We chose to go with solar.

Solar has low capital costs, low maintenance, most economical

- We should be able to transition to solar without raising our rates
- Will build the solar project in two phases:
  - first — while cable is still operational,
  - second — when cable fails and we are truly ‘islanded’
Three issues we’ve had (so far)

1. **Early community buy-in**, not waiting until the problem was too big.

2. **Getting a large single phase inverter** slowed us down, a market not a technological problem.

3. **Managing a complicated renewable energy microgrid.**
   - Finding ways to use excess power produced every afternoon but in different amounts each season.
   - Balancing power distribution using battery and thermal energy storage.

This is and will be a continuing challenge

*Isle au Haut Electric Power Co.*
Every afternoon the solar array will produce excess power; but the amount of excess also varies with the season.

Consumption in kWh

Excess power in kWh (islanded with 400 kW of PV, 800 kWh of batteries)

Potential space heating demand in kWh

Will a small wind turbine help?

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Excess power is a problem that is a real opportunity

An efficient renewable system has to capture and store EXCESS POWER

• electrochemical storage (e.g., lithium-ion) is essential, but expensive,

• hot water stores energy at 10 to 15% of the cost of lithium.
THE OPPORTUNITY

Air to hot water heat pumps can be used for space heating. A large water tank is heated when there is excess solar power; the water is used later for space heating, replacing fossil fuels.

Currently the island spends about $100,000/yr. on fossil fuels.

10 heat pumps will reduce fossil fuel expenditures by about $40,000/yr., or 40% of current island expenditures. A special 16¢/kWh rate will generate $20,000 new revenue for the power company, and will reduce the heat cost for heat pump users by about $20,000.

Additionally, when we are islanded we will no longer spend about $33,000/yr for power from the mainland grid.

All these savings stay on the island and make the solar approach affordable - very important for a small year around community.
THE PROBLEM

(This where we could all get our annual dose of Nerdism.)

• System will have multiple sources of power, and changing loads
  • Solar, cable, batteries, diesel, heat pumps, line breaks, etc.
• It will have fluctuations, transients - the effect is magnified in a small system.
• Finding an efficient way to balance these different influences is the role of the microgrid controller.

Microgrid controller

• The controller Introspective Systems is developing is unique because it does this from the bottom up, kind of like a market.
• The controller will understand whether energy is abundant or scarce at any moment and will send out a signal, i.e., a virtual price.
• Heat pumps, batteries and other loads will react by deciding to turn on or off according to preferences of the owner.
• VERY DECENTRALIZED. No need for the ‘central controller’ to actually control.
We’ve had absolutely essential help from:

**Steven Strong** — Solar Design Assoc.,

**Kay Aikin** — Introspective Systems,

**Morgan Casella** — Dynamic Organics,

**Tom Gocze** — American Solar Technics, and

**Hans Albee** — ReVision Energy, and, of course,

**Island Institute** introduced us to the market.