ALASKA NATIVE TRIBAL HEALTH CONSORTIUM

Stable Foundations – Active Cooling of Thermosiphons

LEO Network

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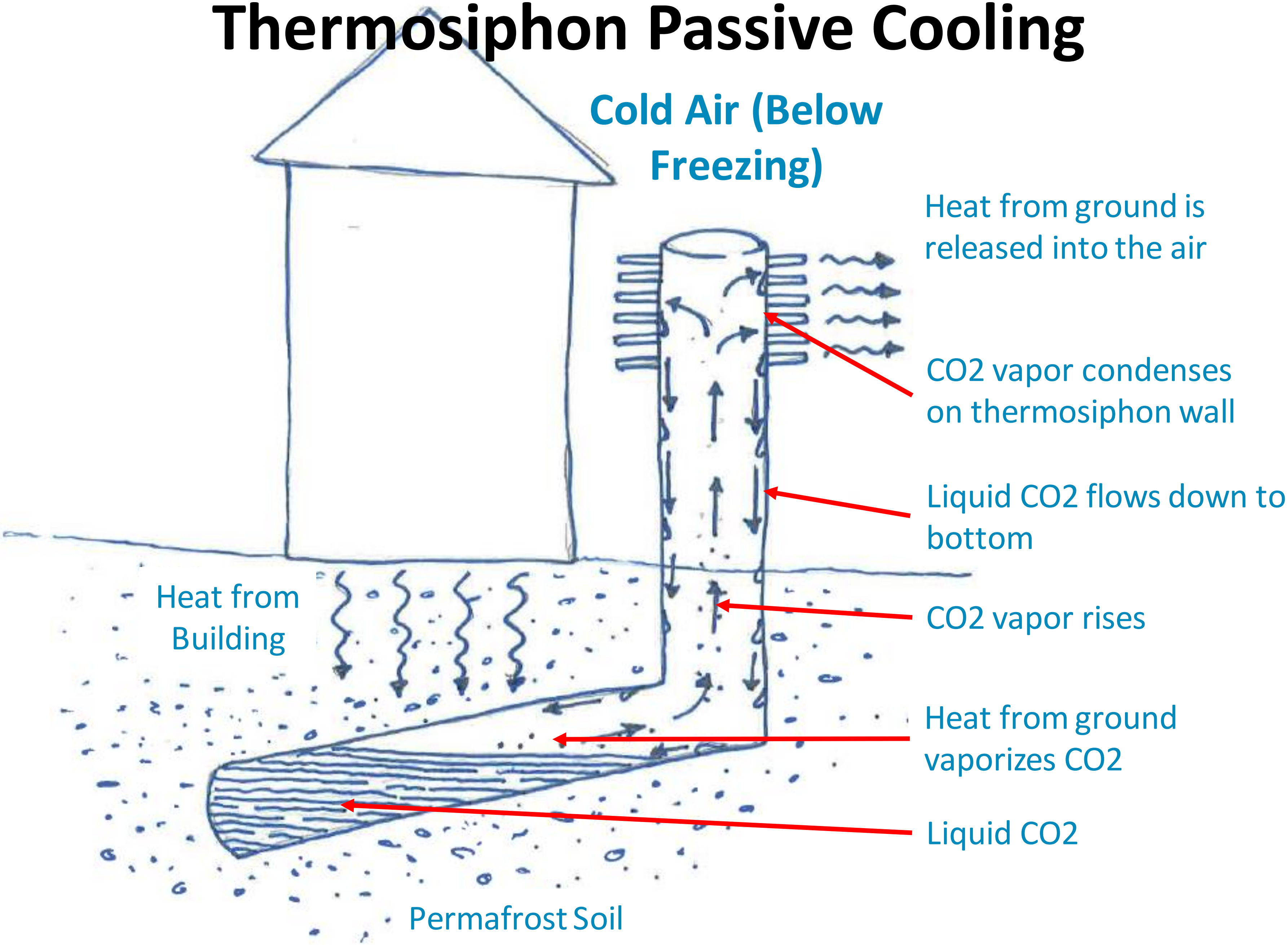
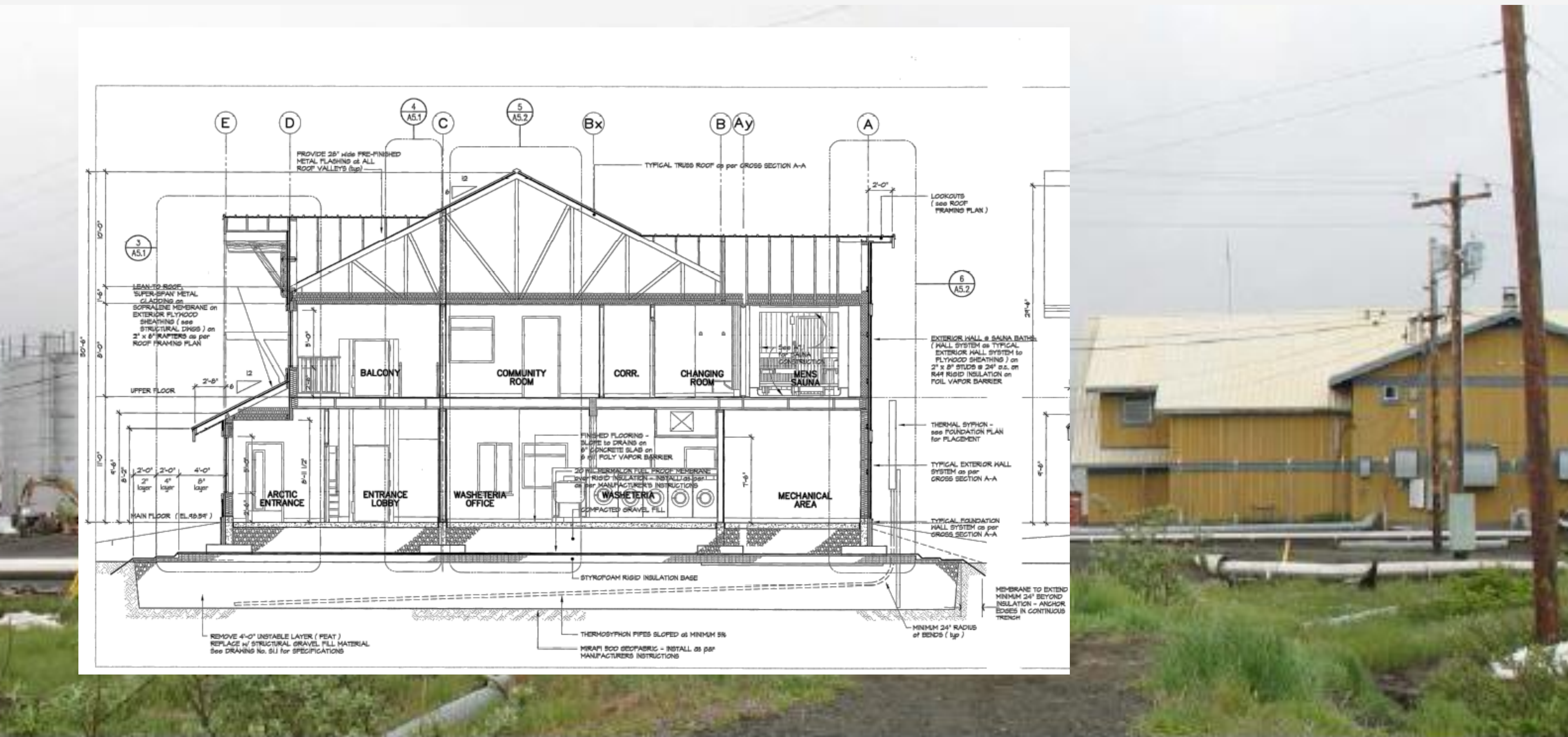
Thermosiphon Passive Cooling



Quinhagak Community Buildings Settling

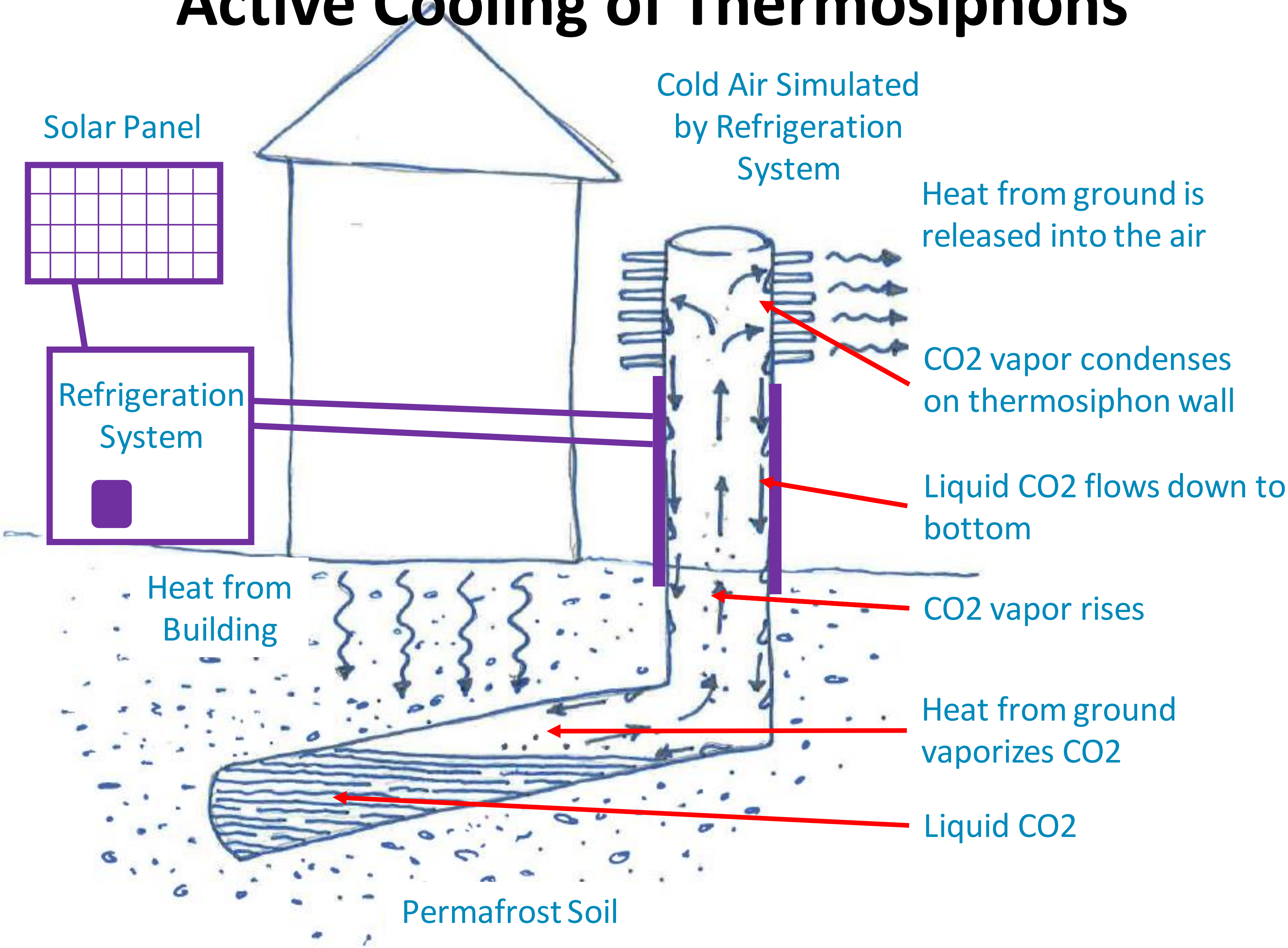


- Mechanical room warmer than expected
- Exhaust vent warming thermosiphon condenser fins
- Summers significantly longer than design assumption

Bethel Weather

	Freezing Index	Thawing Index	Days of thaw
Hartman/Johnson	3500 °F-days	2500 °F-days	170
1997	3460 °F-days	3410 °F-days	195
1998	3470 °F-days	2700 °F-days	198
1999	4220 °F-days	2600 °F-days	164
2000	4000 °F-days	2580 °F-days	201
2001	2030 °F-days	2590 °F-days	168
2002	3750 °F-days	3300 °F-days	207
2003	2230 °F-days	3210 °F-days	212
2004	3350 °F-days	3630 °F-days	214

Active Cooling of Thermosiphons



Active Cooling Options

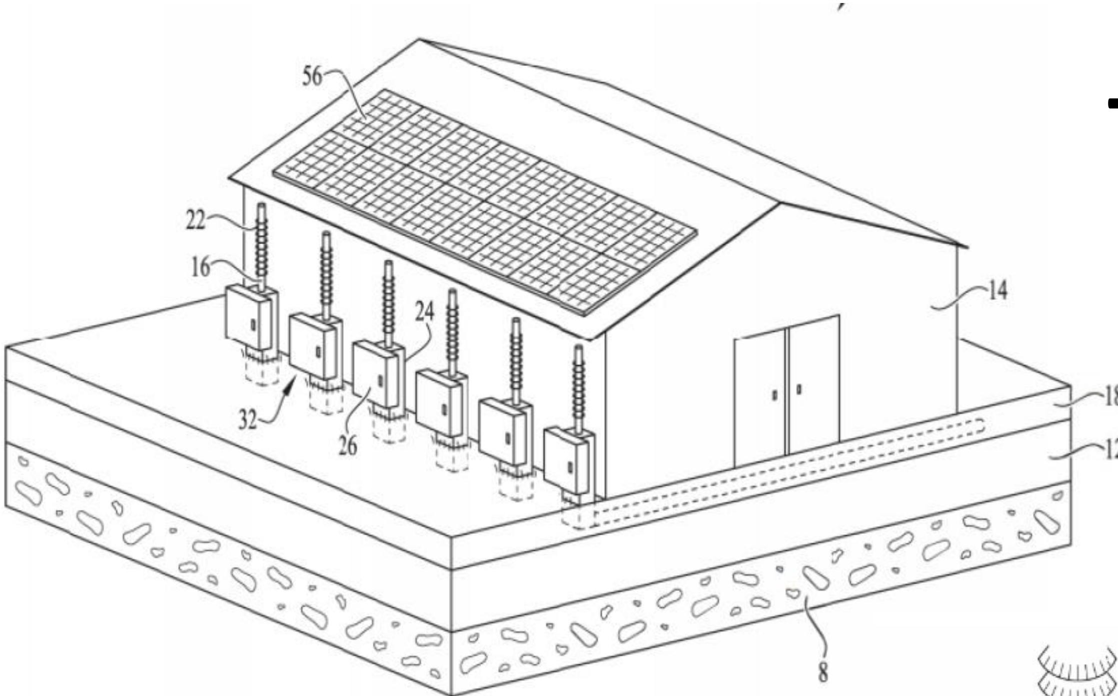
Centralized chiller/heat exchangers

- Off-the-shelf
- Power to central chiller unit
- Modification of thermosiphon
- Vulnerable refrigerant lines
- Require technician to service
- Larger, complex renewable system requirements
- $400,000-$500,000 installed (not including renewable energy system)

Individual refrigeration collars

- New – R&D still needed
- Power to each unit
- Modular - Can dismantle for easier transport
- Keep refrigerant lines contained
- Can be serviced by local operators
- Small enough to be powered by simple renewable systems
- $250,000 -$300,000 installed (10 units, not including renewable energy system)

Thermosiphon Refigeration Collars (TRC)



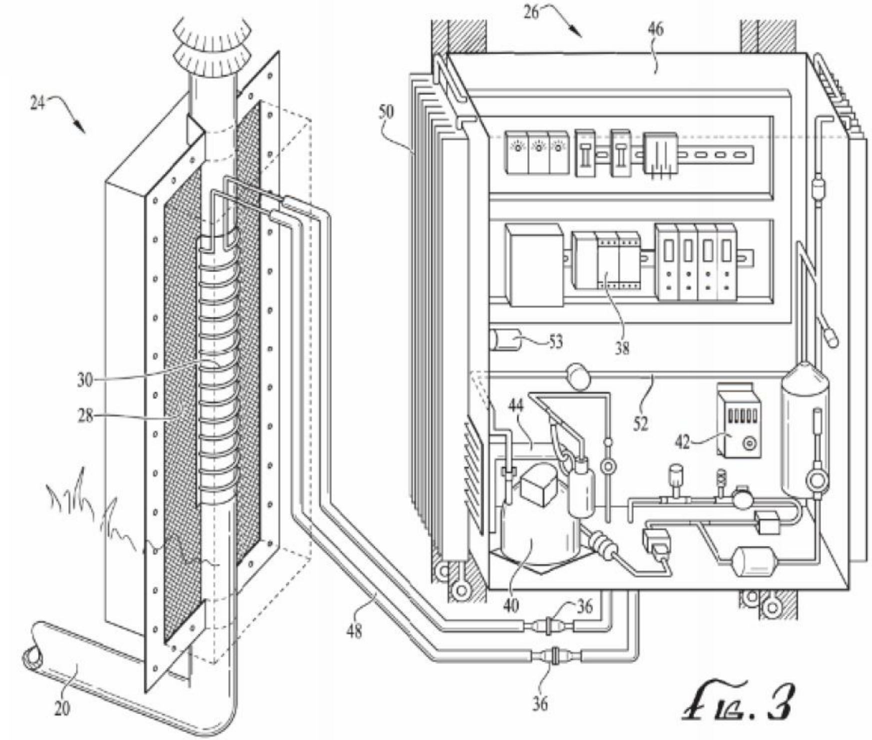


Fig. 3

COMPRESSOR OUTLET
1
2
SUCTION LINE
DISCHARGE LINE
CONDENSER FAN
AMBIENT (OUTSIDE) AIR IN
WARM AIR OUT
LIQUID LINE
WARM RETURN AIR IN
EVAPORATOR BLOWER
COOL SUPPLY AIR OUT
REFRIGERANT FLOW
METERING DEVICE
3
DRIER
4

Current Status

- First prototype installed at CCHRC in Fairbanks
- Logging ground and system temperature, pressure, power draw data
- Dialing in controls and operational setpoints
- Identifying vulnerabilities and opportunities for improvement

Next Steps

Phase 2: Finalize Design

- Apply lessons learned from version 1 to build an improved version.
- Optimize renewable integration.

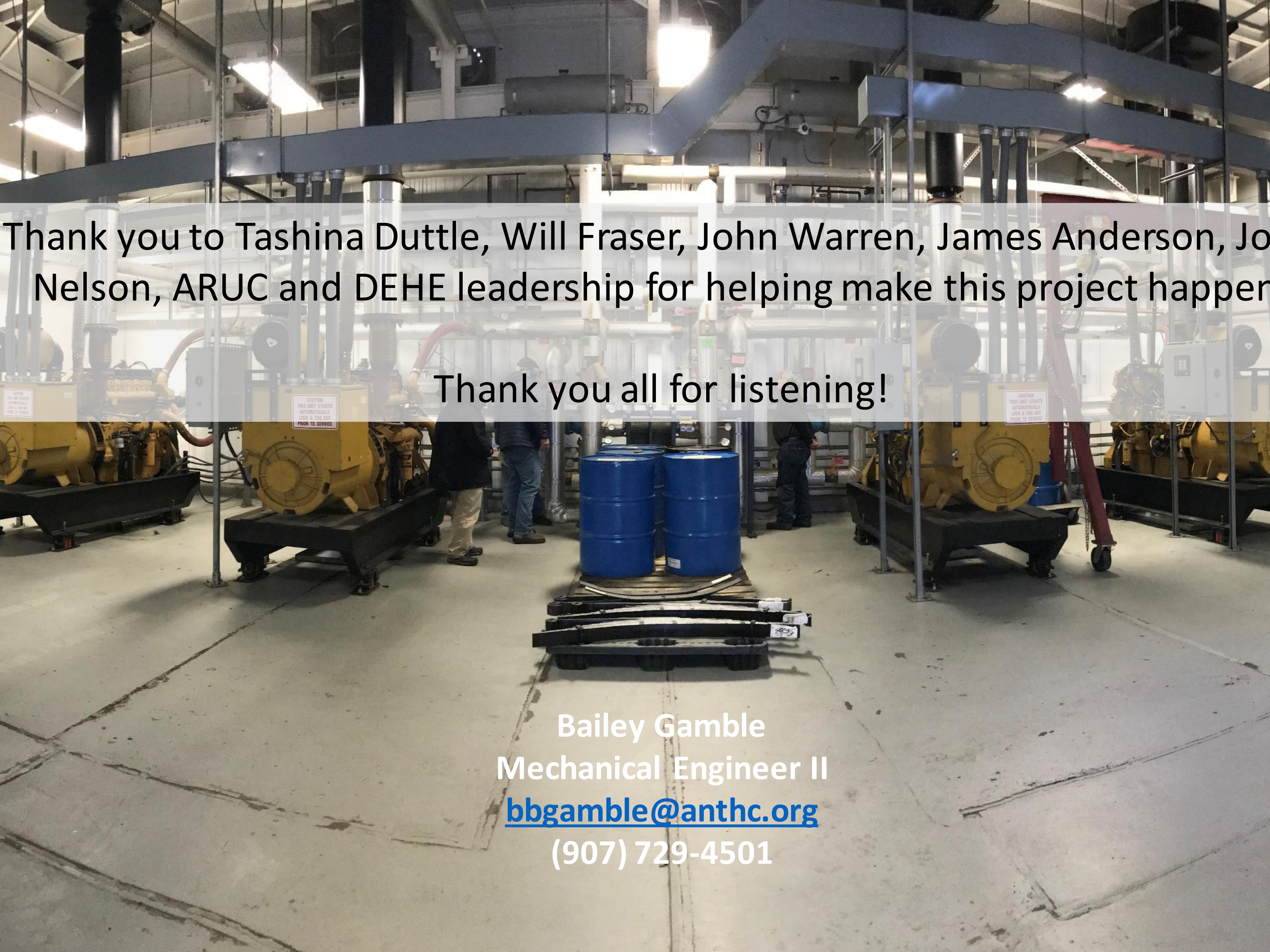
Phase 3: Field Deployment

- Fabricate batch of 10 units
- Install refrigeration collars and solar array in rural Alaska
- Monitor and evaluate performance

Questions

- In which locations will operating the TRC with renewables alone be enough to maintain frozen ground and protect infrastructure?

- What is the extent of the need?
  - Locations where thermosiphons are present and
    - Settling foundations are observed
    - Changes in permafrost conditions are observed
  - Important to catch buildings BEFORE foundations begin to thaw



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Thank you all for listening!

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