Sea Water Heat Pump Performance Analysis and Overview of Heat Pumps in Alaska

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Data Collection & Analysis Program

Objective: *Collect, secure, and responsibly share high quality technical energy data and products from around the state.*

- Lead Alaska and the Arctic in effective and transparent data management practices.
- Organize ACEP data internally and externally, to be accessible and compatible with national databases.

Emerging Energy Technology Fund (EETF)

	Project	Project Lead
Round 1	Application of Composite Flywheels	Hatch
	Arctic Field Testing the Eocycle 25/12 Wind Turbine	Northwest Arctic Borough
	Arctic Thermal Shutters & Doors	Arctic Sun, LLC
	Biomass Reforestation for Boreal Forests	Alaska Division of Forestry
	BRI Cyclo-Turbine Hydrokinetic Demonstration	Boschma Research, Inc.
	Cold Climate Heat Pump Demonstration	Cold Climate Housing Research Center
	Enhanced Condensation for Organic Rankine Cycle	UAF – Inst. of Northern Engineering
	High Capacity Airborne Wind Turbine	Altaeros Energies, Inc.
	High Efficiency Diesel Electric Generator Set	Marsh Creek
	Oceana In-Stream Hydrokinetic Demonstration	Oceana Energy Company
	RivGen Power System Hydrokinetic Demonstration	Ocean Renewable Power Company
	Safe and Efficient Exhaust Thimble	UAF – Inst. of Northern Engineering
	Small Community Self-Regulating Grid	Intelligent Energy Systems
	Ultra-Efficient Generators and Diesel-Electric Propulsion	Genesis Machining & Fabrication
	Wind-Diesel Battery Hybrid for Kwigillingok	Intelligent Energy Systems
Round 2	Air Source Heat Pump Potential in Alaska	Cold Climate Housing Research Center
	Liquid Metal Battery Demonstration	UAF – Inst. of Northern Engineering
	Multi-Stage Energy Storage System	Chugach Electric Association
	St Paul Flywheel Demonstration	TDX Power
	Trans-Critical CO2 Heat Pump System	Alaska SeaLife Center

Alaska Sea Life Center
Trans-Critical CO_2 Heat Pump System

- Sea water source
- CO_2 refrigerant
- For medium temperature perimeter heating, large habitat observation desk snow melting, and cooling of boiler and central motor control rooms
- Installation and commissioning: September 2014 – March 2016
- Performance monitoring and ACEP data collection: April 2016 – April 2017

Tasks and Activities:

- Installation of four 20-ton Mayekawa CO_2 refrigerant heat pumps
- Installation of supporting infrastructure (heat exchangers, pumps, etc.)
- Commisioning of integrated monitoring and controls
- Reconfiguration of existing systems

Takeaways and Lessons
(April 1, 2016 – April 30, 2017)

- Heat pump system consumed 41% of the electricity used for heating and cooling while producing 38% of heating and cooling energy
- Net savings of $60, 716
- Average COP of 2.11
- 586,956 lbs CO_2 avoided

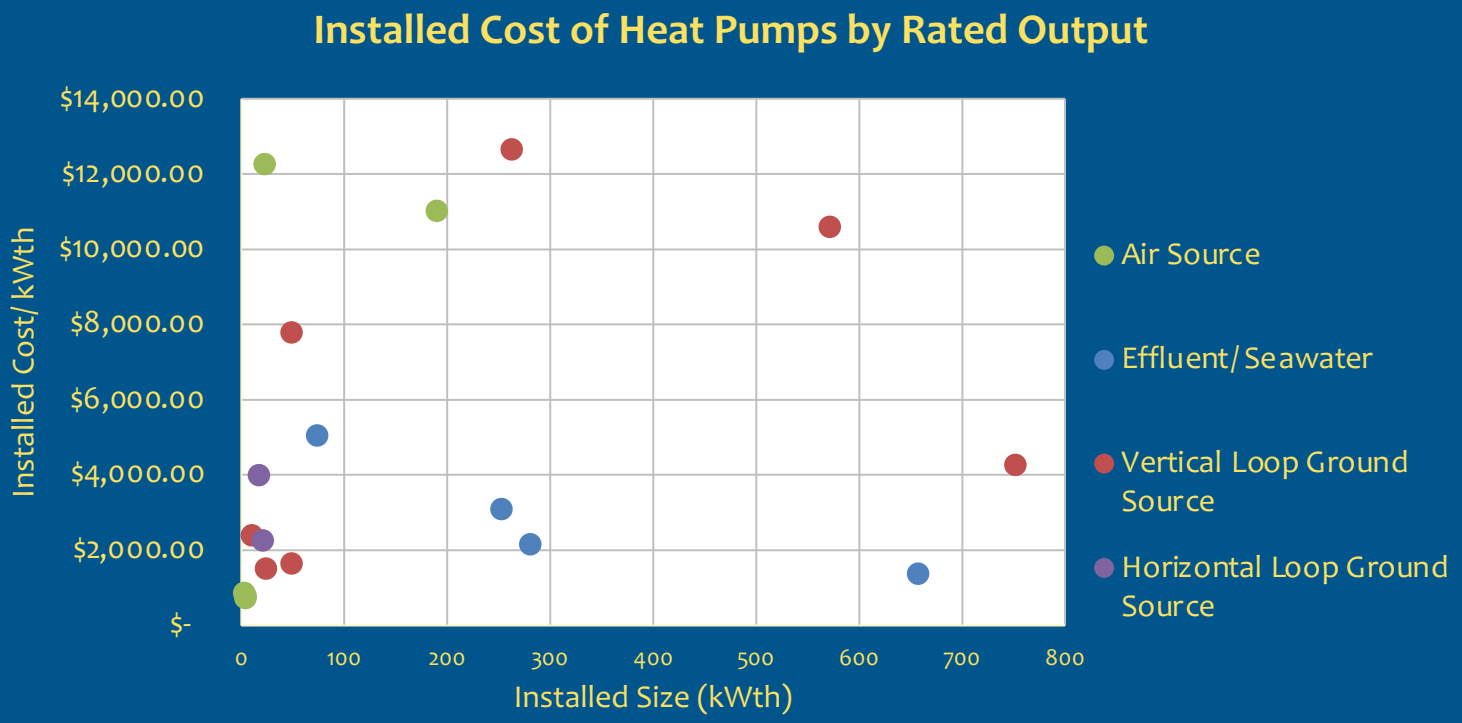
Heat Pump Technology: An Alaska Case Study

(Journal of Renewable and Sustainable Energy 9(6), 2017.

- Survey of 17 heat pumps (sea water, ground source, air source)
- Mostly large systems in public buildings (data availability)
- Estimates of effectiveness and installed costs

Heat Pump Technology: An Alaska Case Study

(Journal of Renewable and Sustainable Energy 9(6), 2017.



Heat Pump Type	Weighted Average of Installed Cost/kW_{th}
Effluent/Seawater	$2,096.91
Vertical Ground Loop	$7,613.90
Horizontal Ground Loop	$3,036.35
Air Source	$10,359.88

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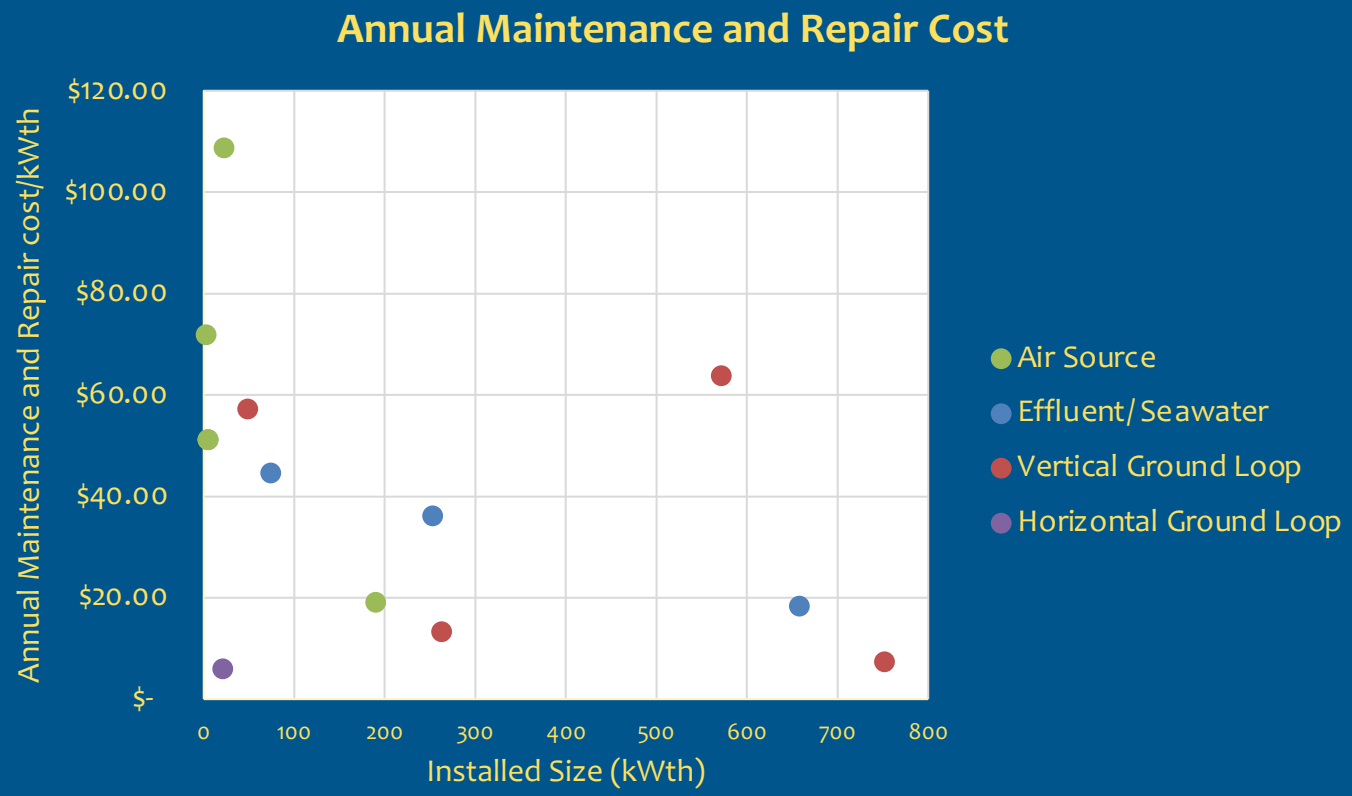

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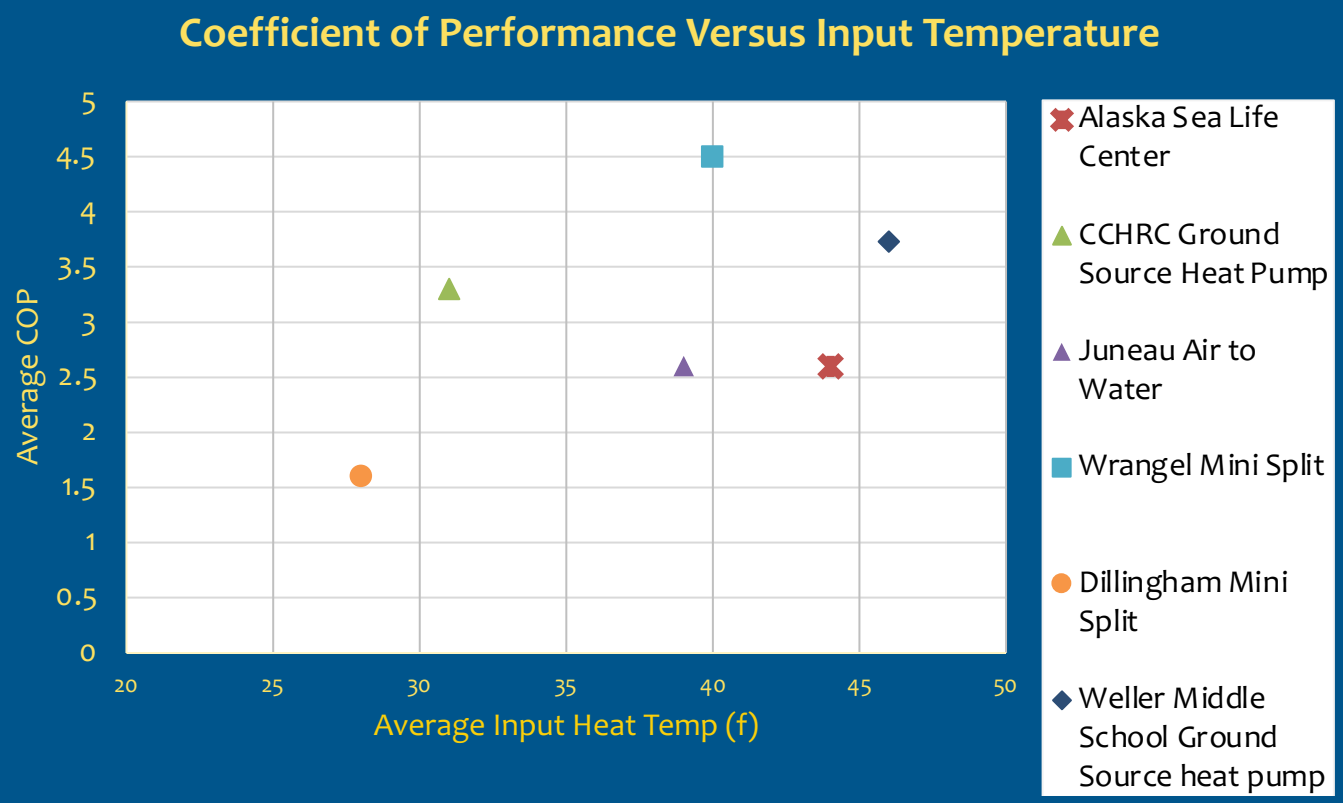

Thank You

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