

Renewable Energy and Beneficial Electrification in the Arctic

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About Kotzebue Electric Association (KEA)

- Located above the Arctic Circle in Northwest Arctic Borough
- Hub community of 3,200 with 11 surrounding villages
- 1300 meters
- KEA operates a wind/PV-diesel hybrid power system
 - Average load – 2,500 kW; 3,500 kW maximum
 - 6 diesel gensets – 725 kW to 3,080 kW (~12MW total)
 - IMPORT ~1.2 million gallons diesel annually
 - ~2,400 kW of total **renewable** power generation
 - ~4 million kWh annual wind&PV production – 15 - 20% energy penetration
 - Average cost to members – ~\$0.39 kWh w/out PCE
 - Average cost to members – ~\$0.20 kWh with PCE



KEA Energy System

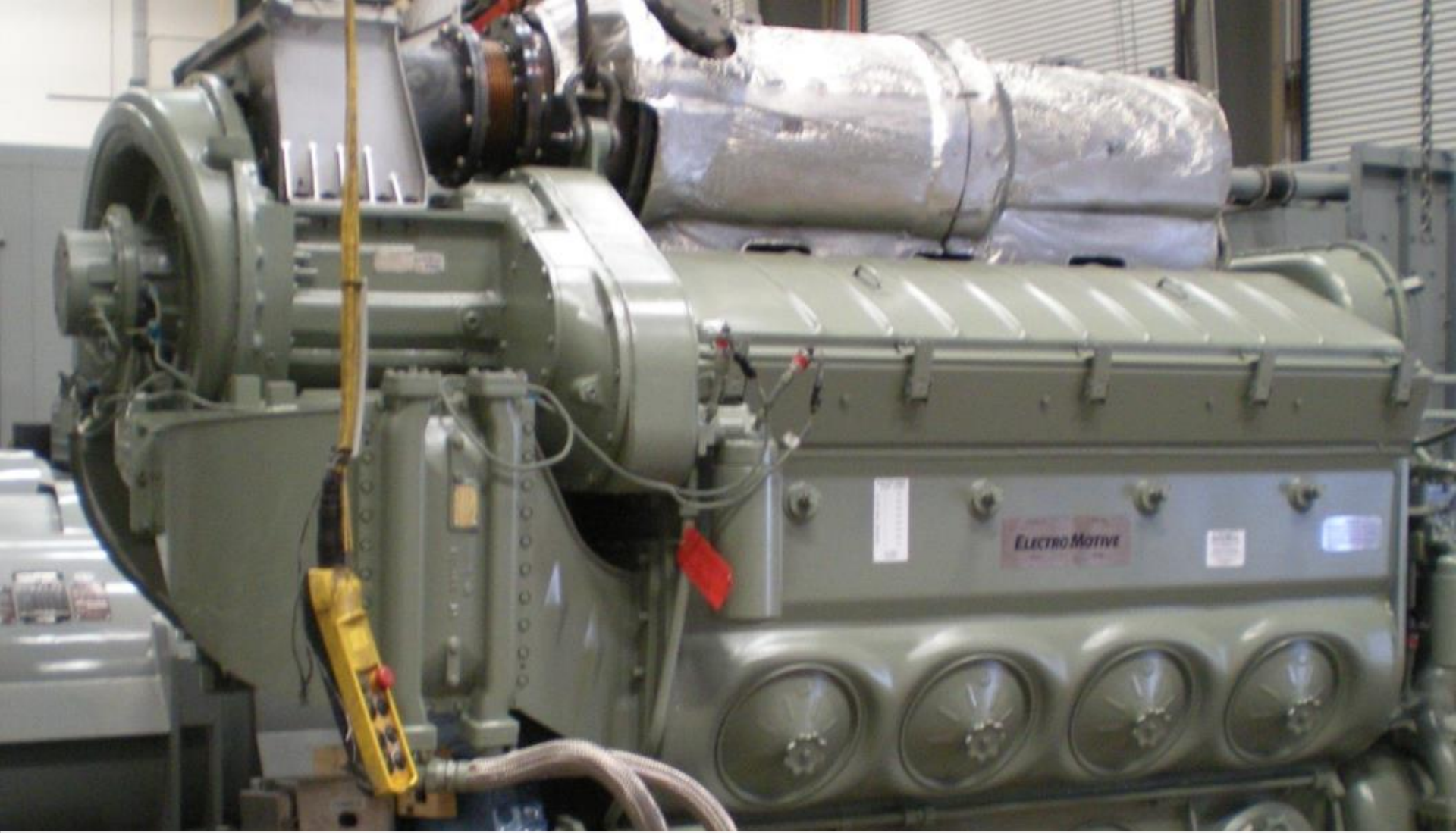
- 11 wind turbines (9 <100kW & 2 EWT 900kW)
- One 1.25MW/950kWh Li-ion battery (SAFT & ABB)
- Diesel genset automation and engine upgrades (EMD 8cyl 710 EFI is our “wind engine” and CAT C27 “fast start”)
- 450kW electric boiler at local hospital (hydronic heating w/ 30x 15kW steps)
- *532kW(AC) Solar PV array (commissioned July 2020)*
- 15-20% power gen fuel savings per year.
- Legacy PLC AMI system being replaced with EATON RF.

**EWT 900kW
on 75m
Tower
(winter
construction)**





SAFT 950 kWh Battery (ABB 1.2MW Inverter in Plant)



EMD 8-710 efi 1440kW "wind engine"



Hospital 450kW Electric Boiler (first B/E Project in 2016)



532kW PV Array (replaces eight 66kW wind turbines)



PV construction uses local talent... great for the local economy!

It's taken
KEA 25
years to
get to
where
we are...

- 1990s KEA Board and GM Brad Reeve leadership
- Significant grant funding along the way:
 - NRECA (initial wind study)
 - US DOE/NREL (AOCs, NW100, V15)
 - State of Alaska REF (EWTs, battery and electric boiler)
- USDA-RUS Loan for diesel plant switchgear upgrades
- Successes and failures along the way
- ***Wind technology and integration knowledge evolving***
- ***Energy storage is real and works!***
- ***Solar is real and works well in Arctic, Rural AK!***
- ***“Microgrids” are cool now...***



Why bother messing with wind and solar power?

- Primary: Power gen diesel displacement (largest annual expense)
- Secondary: ***B/E Heat generation from excess wind power (stove oil displacement for homes, businesses and community facilities)***
- Workforce opportunities (construction and O&M)
- Help the environment (check your air permit)
- Energy security and resilience
- Community pride
- Other or All of the above...?

KEA 2025 Vision...

- 50-60+% power generation diesel fuel displacement via:
 - More wind power! ~4MW tot. (add two EWT 1MW turbines)
 - More PV power! ~1.5 MW tot. (~540kW-AC in progress!)
 - Diesel-off/on automation w/ aux. plant heating system (electric and oil).
 - Medium term battery energy storage system with full-load, grid-forming inverter (~4MW/8MWh)
 - Move to an “Electric local economy” with significant **beneficial electrification**:

Community Scale B/E for Heating Oil Displacement

Energy poverty: Annual home heating oil cost is 3-4 times higher than electrical cost (State PCE)

Heating oil in Kotzebue is *\$8/gallon*.

Kotzebue average temperature is 26degF (no air conditioning needed in summer!)

Planned deployment (pilot project 2024):

- ~5-8 kW electric heating device installed in home heating systems (electric boiler, *Steffes, Inc.* GETS heater, electric duct heater, water heater boosting, etc.)
- **Eaton Yukon** and **Eaton RF Mesh** system devices will be used for dispatch, control and metering.

Kotzebue B/E Heating Program

Pricing of excess renewable electric heat will be ~50% (TBD) of the equivalent oil heat cost.

Cost of installation of the B/E heating device in the home is TBD (ideas?)

Planning the use of an energy sub-meter for the B/E heating device.

Eaton ***Demand Response Management System (DRMS)*** will be used to dispatch excess RE power.

Eaton DRMS Deployment

- Eaton DRMS components will be used to control the Kotzebue Community B/E system:
 - **“Advanced Load Management and Control”**: Dispatch strategy with **Load Control Switches** will be developed for **ADDING LOAD** to the system when excess renewable power is available.
 - **“Asset Availability & Management”**: KEA power plant operators can see what devices are working or not and respond accordingly.
 - **“Enterprise Integration Module”**: The KEA power system SCADA will be connected to DRMS to signal how much excess power is available for dispatch to B/E.

Kotzebue Community B/E Program Goals



Reduce home heating oil consumption with B/E by 50% (75+% reduction possible with home energy efficiency improvements and heat pumps).



Reduce energy poverty in community by reducing cost of heating.



B/E heating revenues stay in the community to support the cooperative.



Increase local jobs and improve local economy.

Thank you!

Next:

EVs in the Arctic!
First Nissan Leaf in
Kotzebue! Our Ford
Lightning is on
order...
(gasoline is \$7/gal)

