Challenges and Research Opportunities for EVs in Alaska

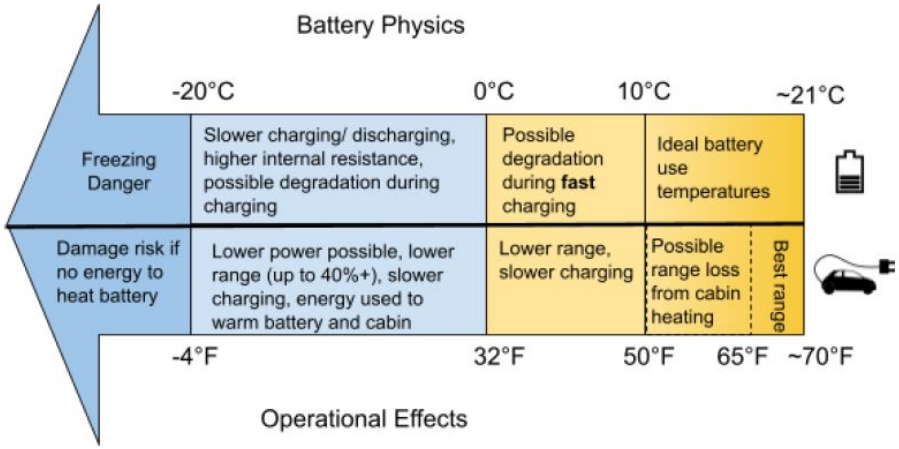
UAF University of Alaska Fairbanks

ACEP Alaska Center for Energy and Power

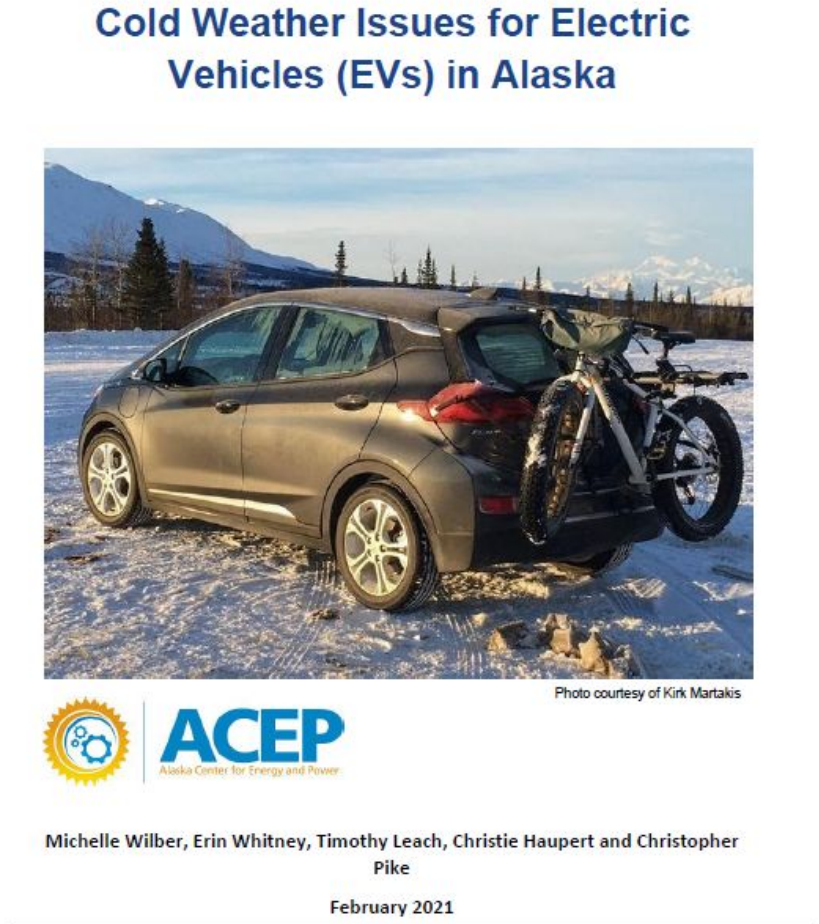
ACEP is an institute of the University of Alaska Fairbanks

ACEP MISSION: Fostering development of practical, innovative, and cost-effective energy solutions for Alaska and beyond

Cold Weather Issues for EVs in Alaska



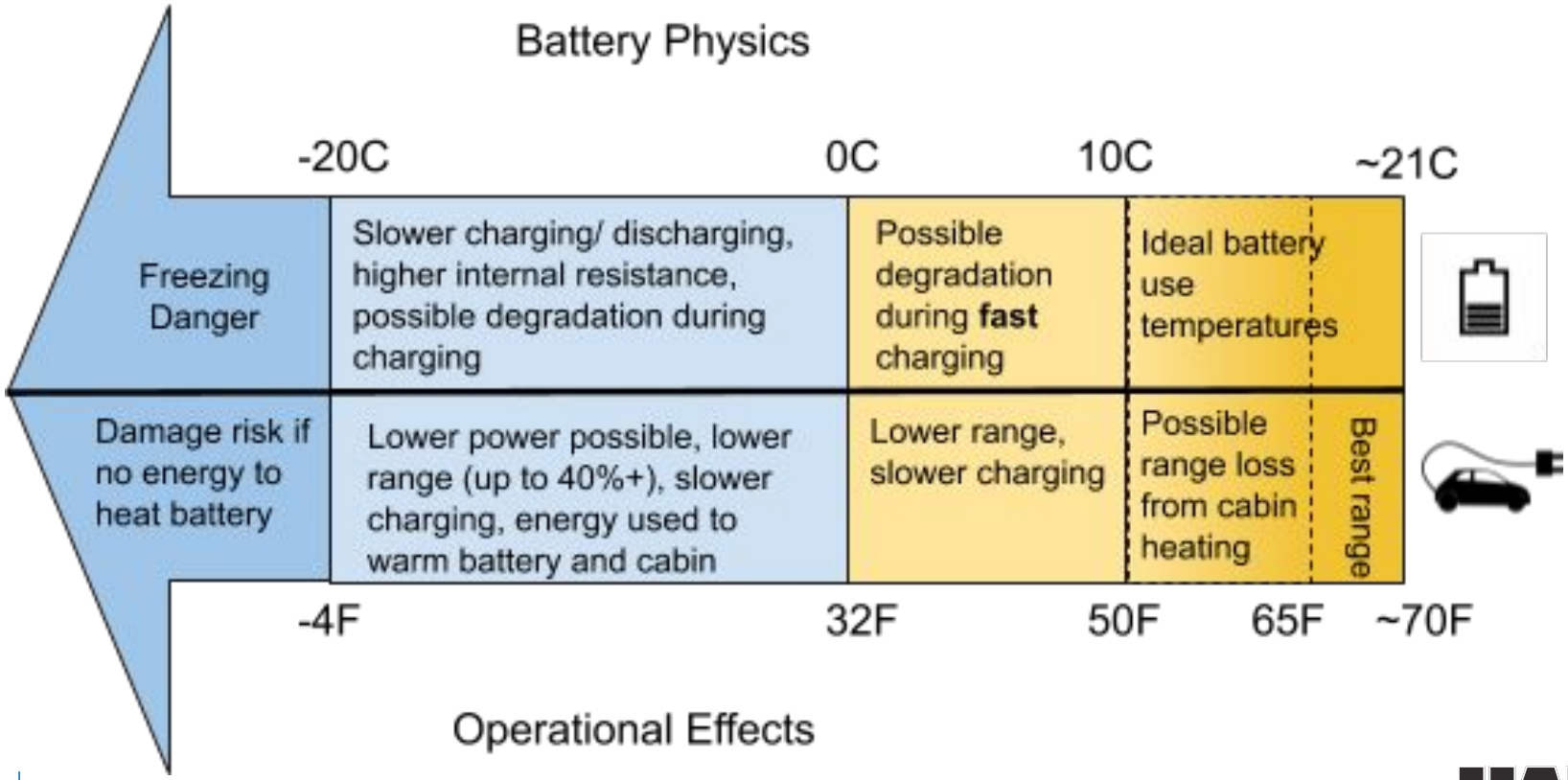
Report on expected cold weather impacts on EVs in Alaska based on literature review and experience of Alaska EV drivers.



The ARCTIC program is an initiative supported by the Office of Naval Research (ONR) Award # N00014-18-S-B001.

Cold Weather Impacts

Figure 1: Low temperature regimes for EVs



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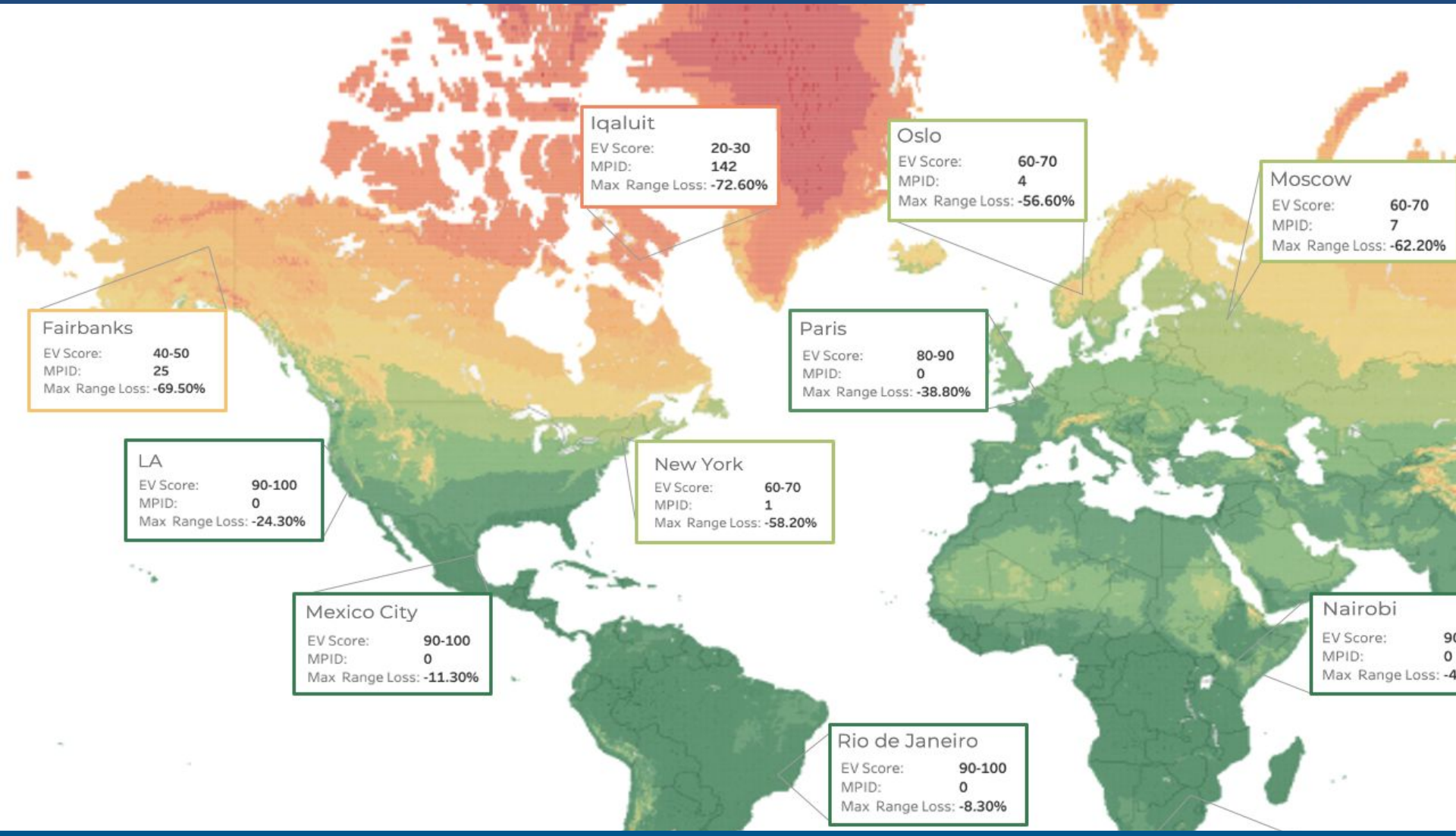
EV Temperature Map



Real World

- -27°F current temp
- Since last charge:
  - 51% Driving
  - 37% Climate settings
  - 12% Battery conditioning

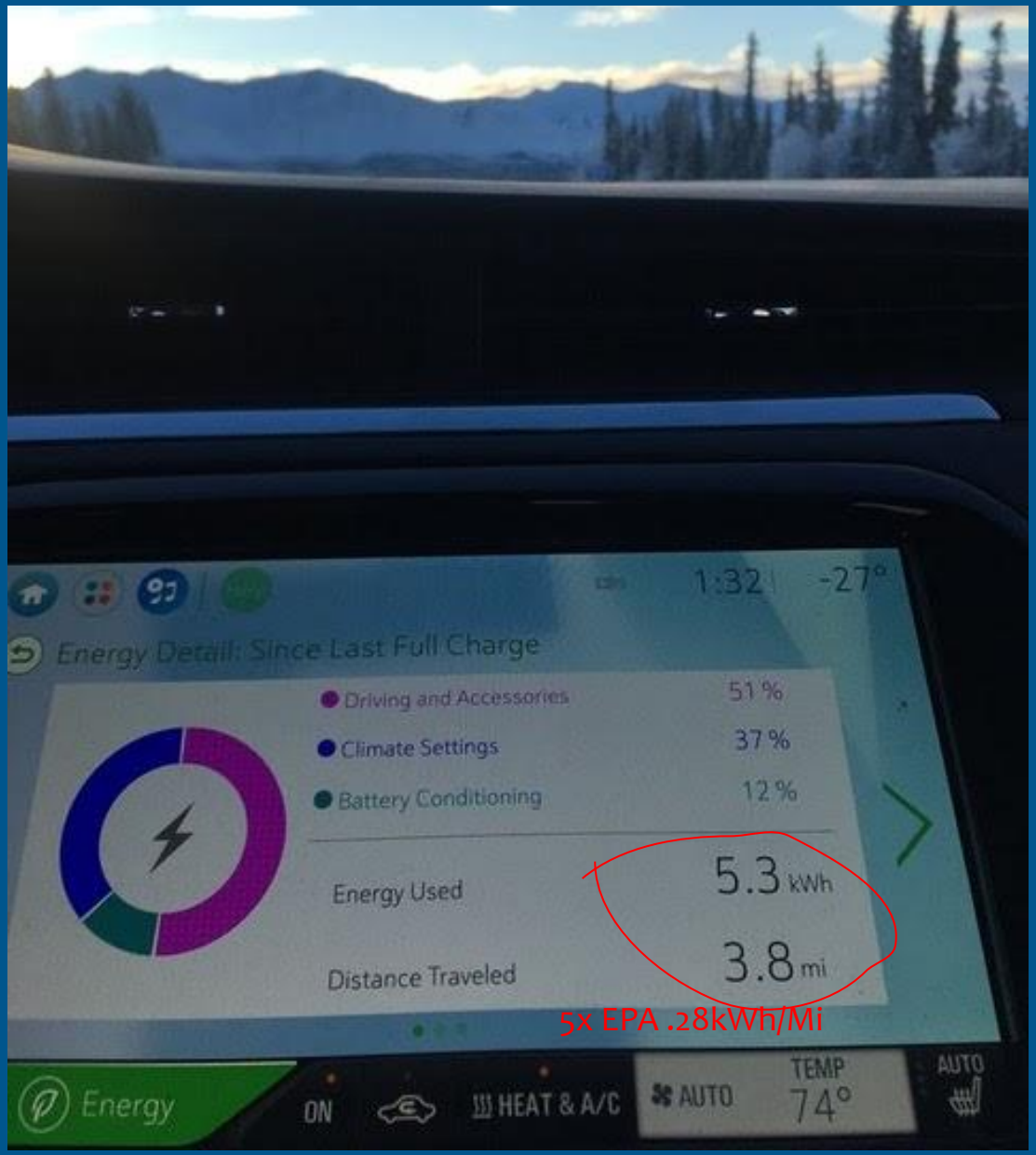
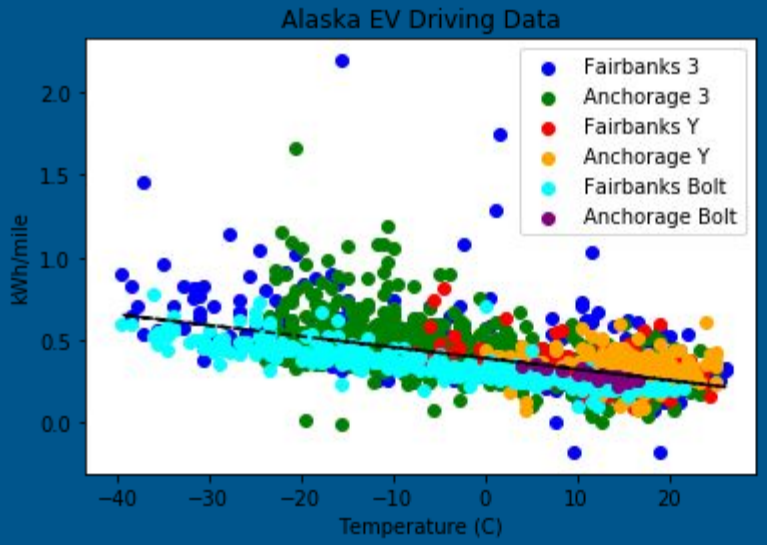
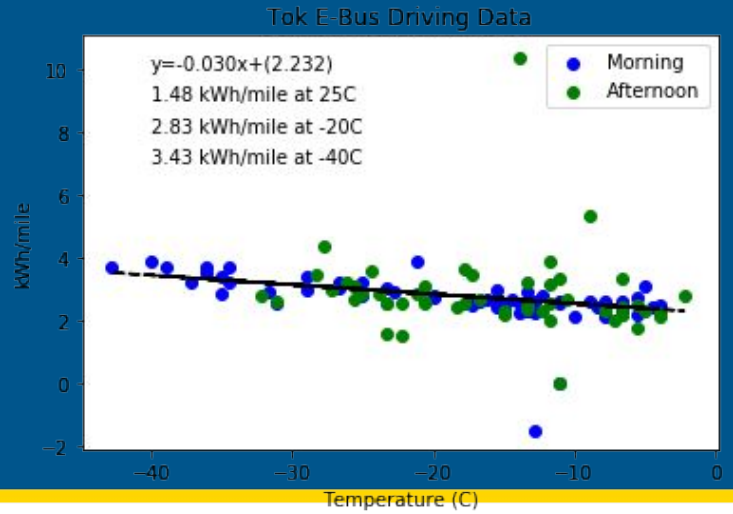


Photo: Kirk Martakis

Crowd-Sourced Data

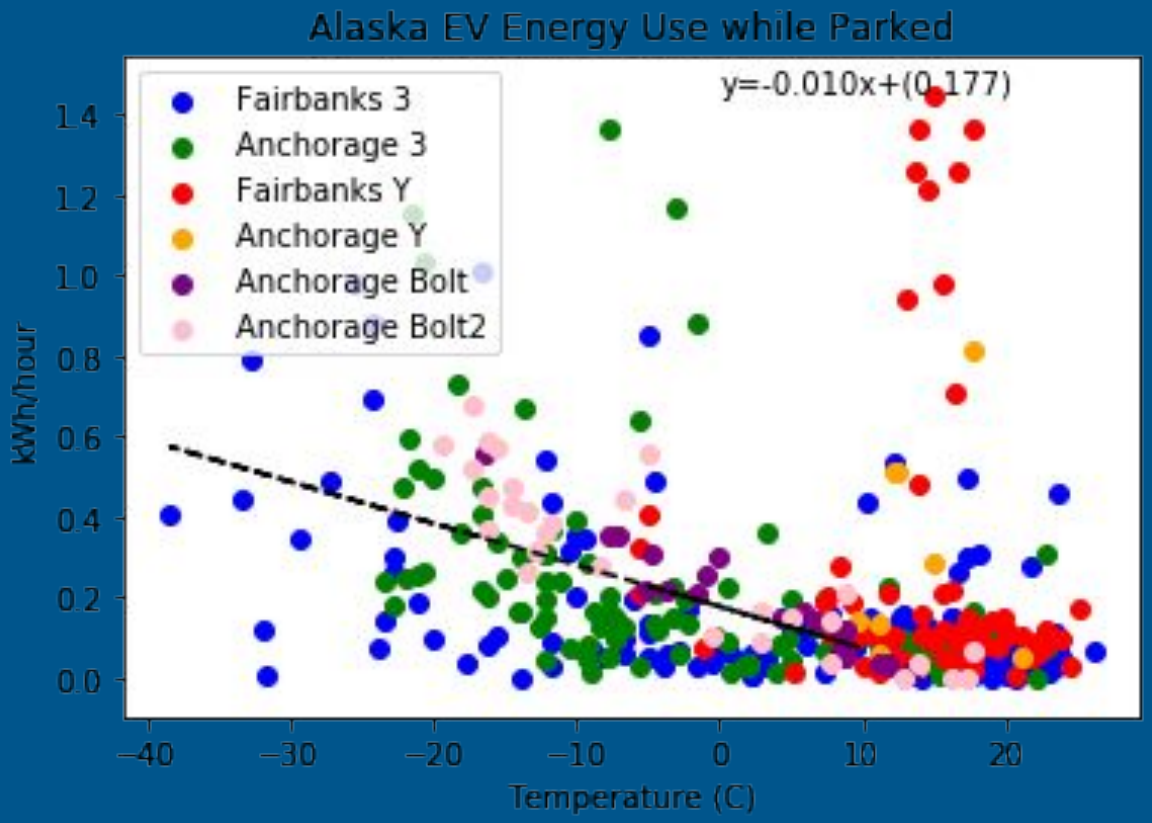
Gathering data from privately owned passenger EVs and Tok School bus to investigate energy use vs. Temperature



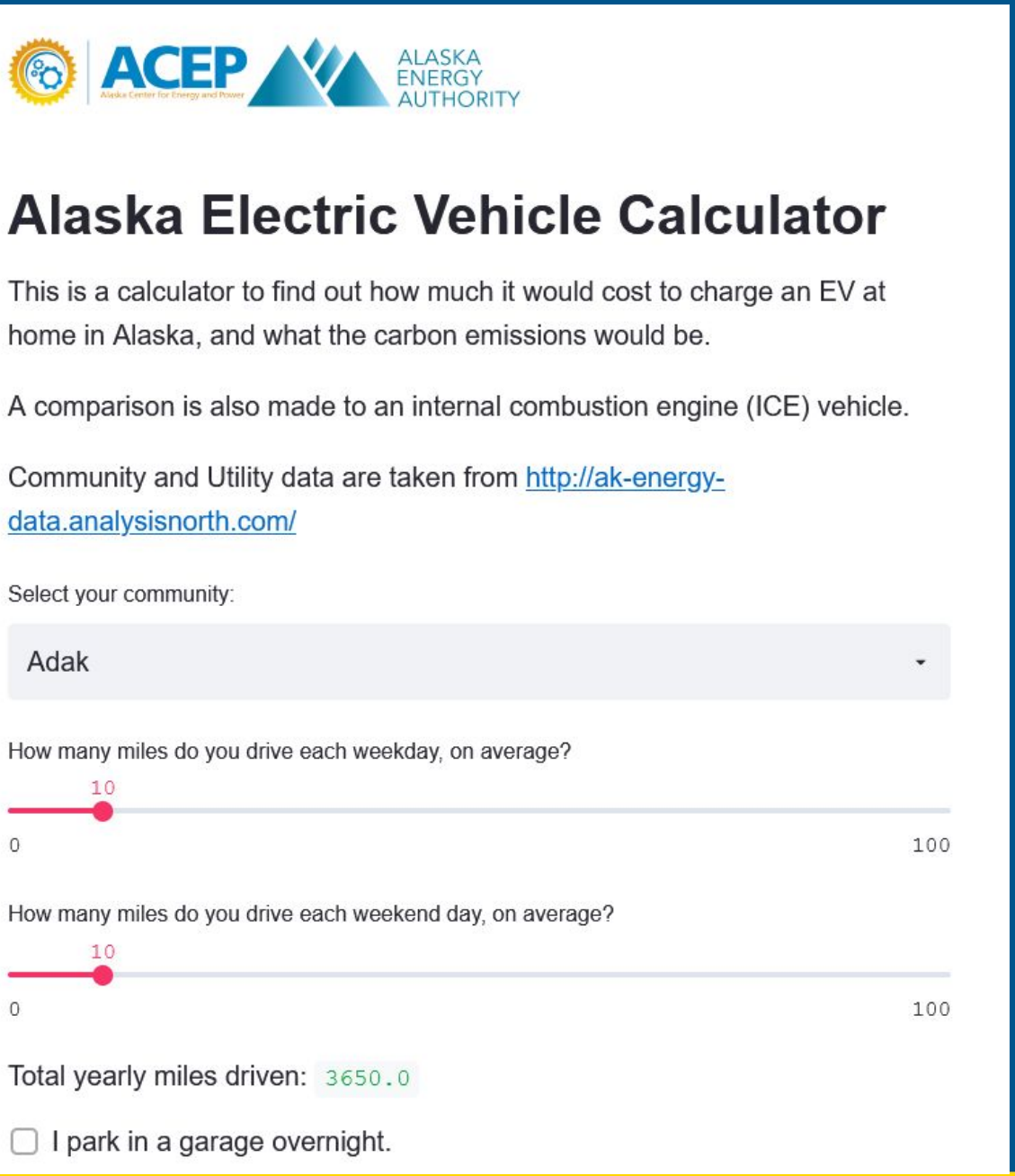


Crowd-Sourced Data

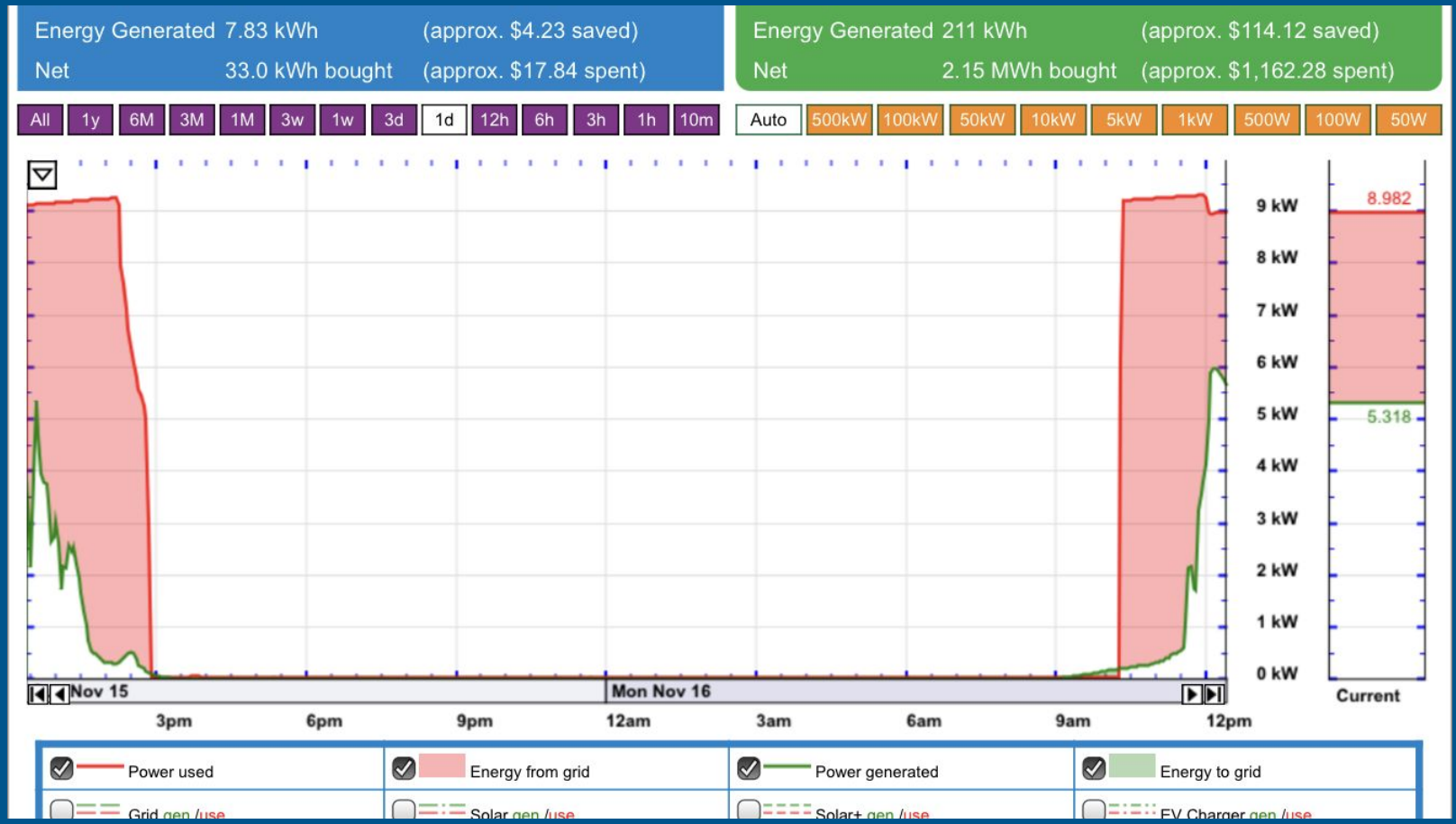
Energy use while Parked is also a big factor - but less clear relationship w/ T for all vehicles



Web based calculator - user selects community in Alaska and inputs driving information. Uses typical yearly temperature profile to calculate cost and emissions vs. ICE vehicle.



Tok School Bus – Solar charging!



Pilots in the State

Buses, garbage trucks, fleet cars, and many more!

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Electric Vehicles in the Arctic (EVITA)

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Goals

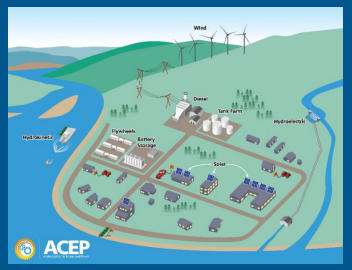
1. Identify perceived barriers to adoption, mechanisms for facilitating adoption, perceived
usefulness, and potential uses of EVs.

2. Examine potential trade-offs between conventional and electric for rural vehicle users across
specific use cases such as subsistence activities.

NSF
#2127171

Participating communities:
Galena
Kotzebue
Bethel

Grid Impacts



- **Impacts on the existing grid and the cost of service?**
  - How does penetration, clustering, battery size, charging rates impact **feeders**?
  - **generation** and **transmission**?
  - How do we site **DCFC** to minimize grid impacts, what are marginal costs? When does the incentive to charge in a "demand shadow" lead to efficient or inefficient outcomes for the grid as a whole?
  - Can utilities detect EV loads from **AMI meter data**?
- **How can we use EVs to promote beneficial electrification as opposed to detrimental electrification?**
  - Can impacts be minimized or grid assets optimized by **managed charging**? What technology is needed to shift EV charging loads?
  - How can EVs be used to increase penetration of non-firm **renewable energy** generators?
  - What are barriers to vehicle-to-grid (**V2G**)? From utilities? From vehicles and EVSE?
- **Policy? Regulation/ rate structures/ legislation/ etc.**

Some practical takeaways so far:

- Current EVs are often uneconomical and don't reduce carbon emissions in many areas/uses in Alaska - generally due to energy use in extreme cold. Need solutions:
  - Occupant comfort - insulation? other solutions to heat occupants? heat pumps not much help in extreme cold
  - Battery conditioning while parked can also use a lot of energy in low mileage vehicles - new chemistries or thermal management systems?

Thank You!

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This project is part of the ARCTIC Program, an initiative supported by the Office of Naval Research (ONR). Details at: thearcticprogram.net