

Are Electric Vehicles a Solution for Arctic Isolated Microgrid Communities?

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Alaska Center for Energy and Power



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#2318385

NSF NNA Electric Vehicles in the Arctic (EVITA)





Our Mission: Develop and disseminate practical, cost-effective and innovative energy solutions for Alaska and beyond.

Our Vision: Alaska leading the way in innovative production, distribution, and management of energy.



Grid Edge

ACEP's Grid Edge research program seeks to explore a range of distributed energy resources to unlock local, sustainable, healthy and cost-effective energy resources available to all in Alaska and in other parts of the nation and world.

These resources include small- and mid-market solar and wind facilities, behind the meter resources, electrified loads and battery storage.

Our research focuses on cold regions and microgrid environments to:

- Improve our understanding of applications and approaches;
- Test, model and optimize controls to integrate variable energy sources;
- Investigate social, technical, economic and regulatory factors affecting grid edge technologies; and
- Engage and grow stakeholder relationships.

Public Resources

EV calculator

[Use the EV calculator](#)

Alaska Solar Manual

Alaska-specific solar energy design information in one easy volume.



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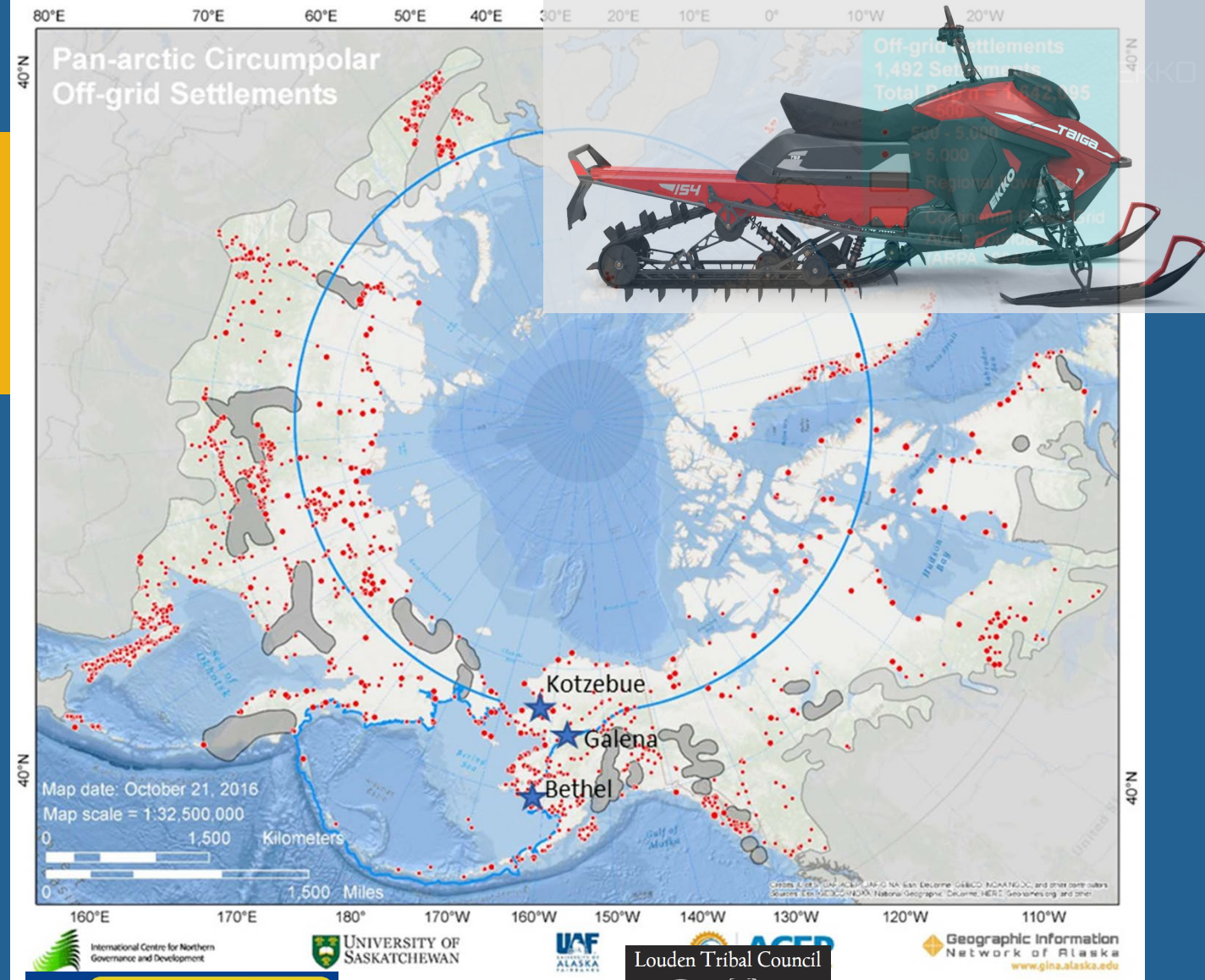
KOTZEBUE
ELECTRIC ASSOCIATION



Louden Tribal Council



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ALASKA
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Planning Phase: Community Workshops

Interviews and workshop in March 2023

- Interviewed between 8-10 organizations
- 8-14 participants in Bethel and Kotzebue, and Galena

Workshop in November 2022

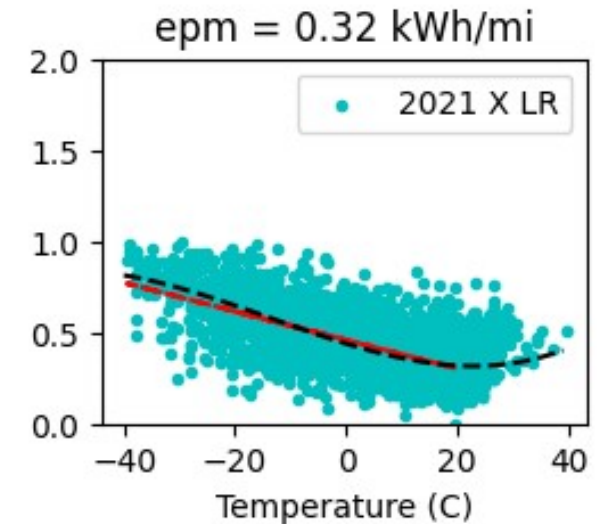
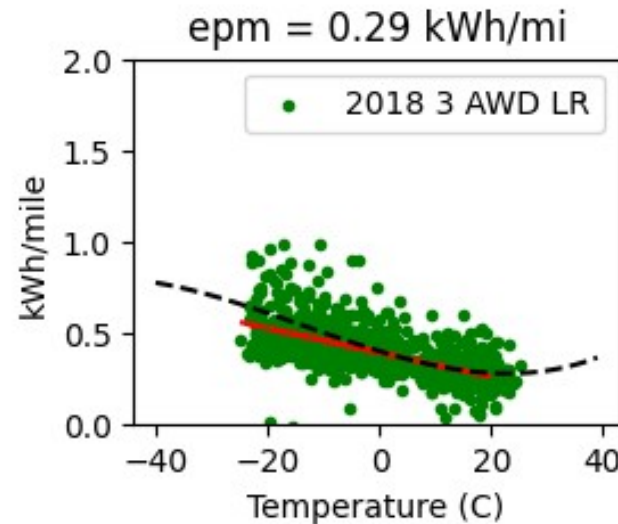
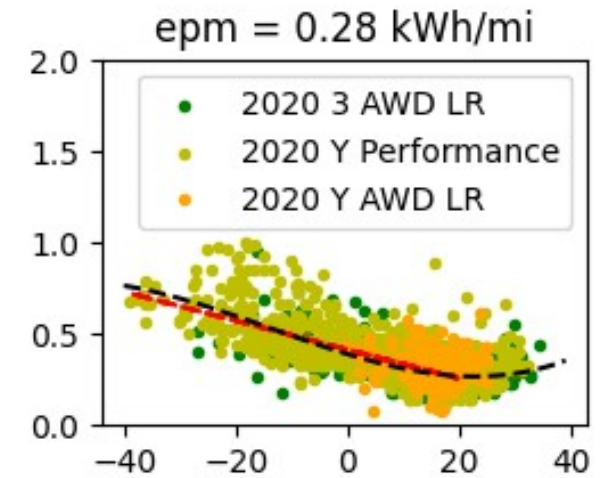
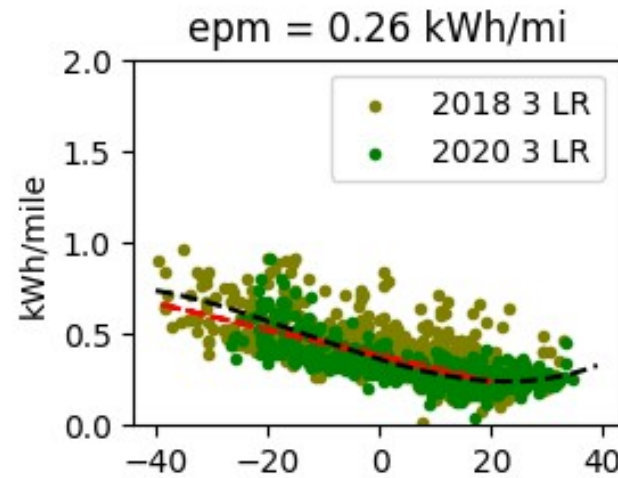
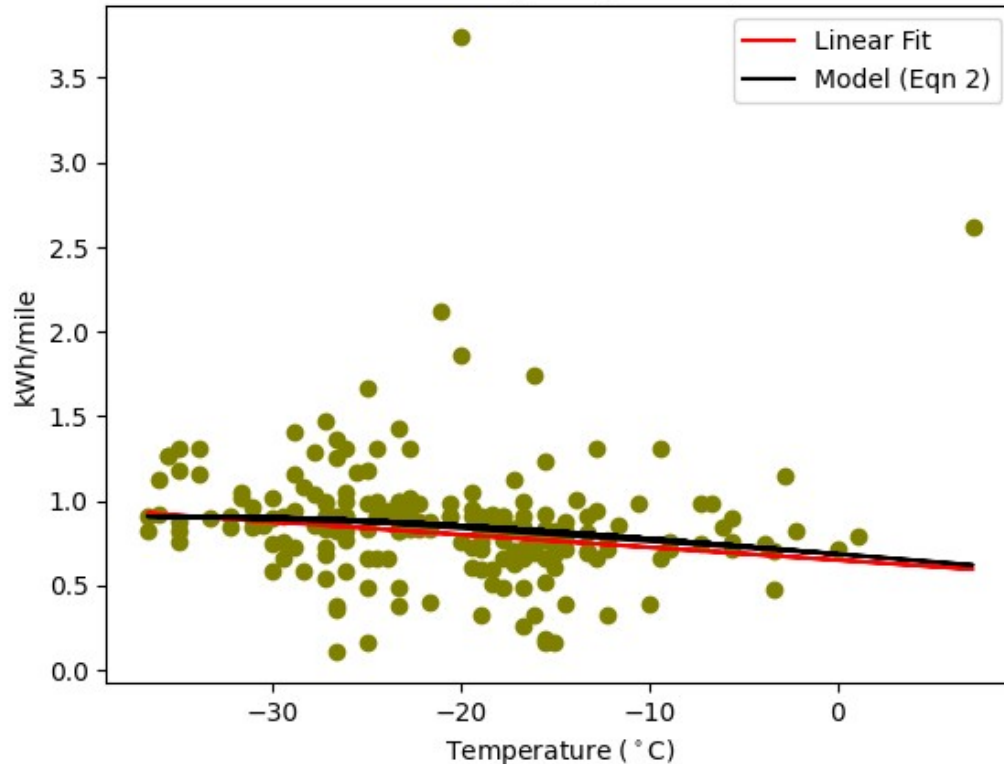
- 5-9 participants in Bethel, Kotzebue, and Galena

Table at Cama-i festival in Bethel in March 2023 -
~80 visitors



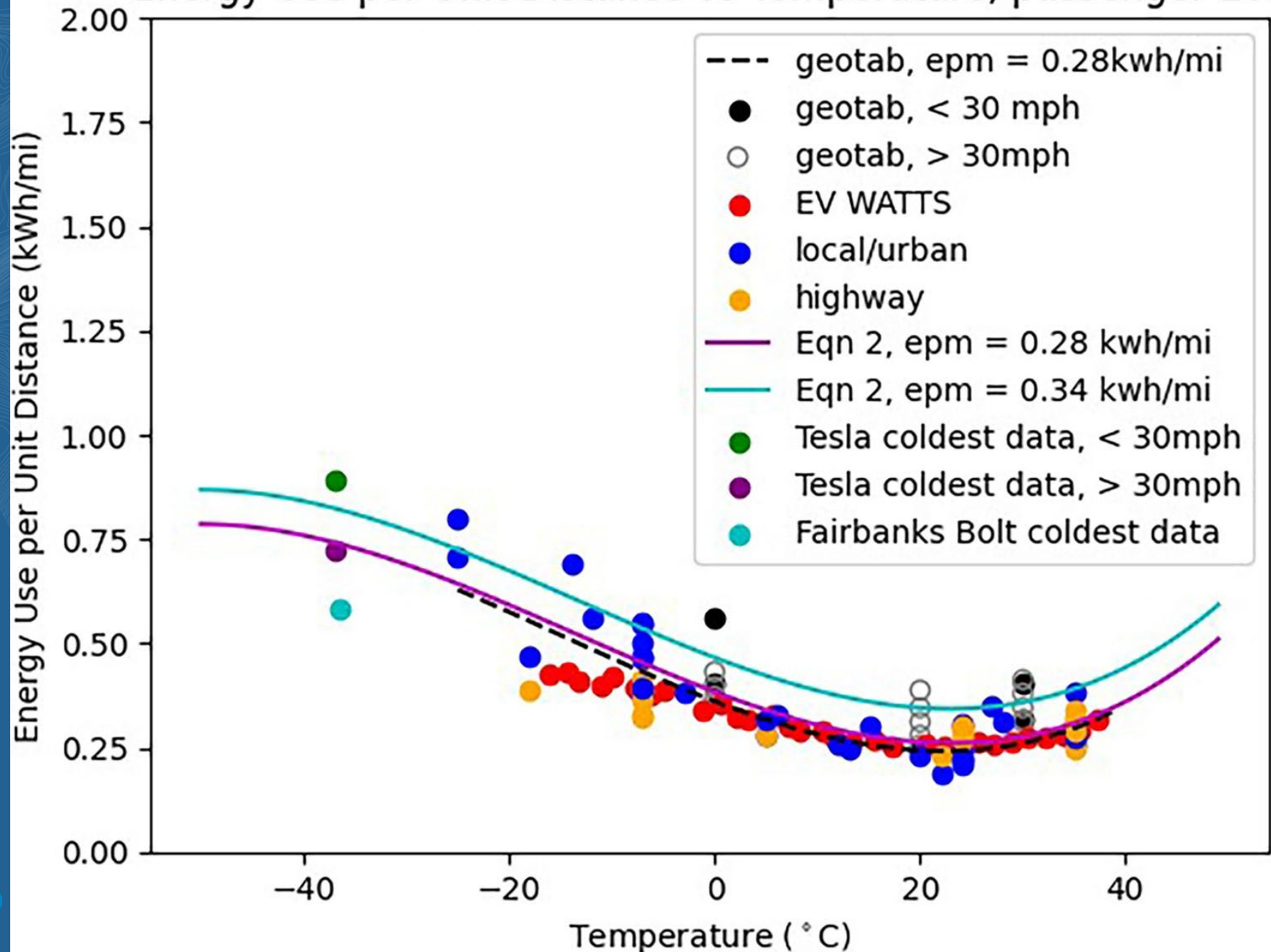
We've collected
crowdsourced data from EVs
in Alaska and used that to
make a calculator to compare
an EV to a gas vehicle

Alaska Ford Lightning Driving Data



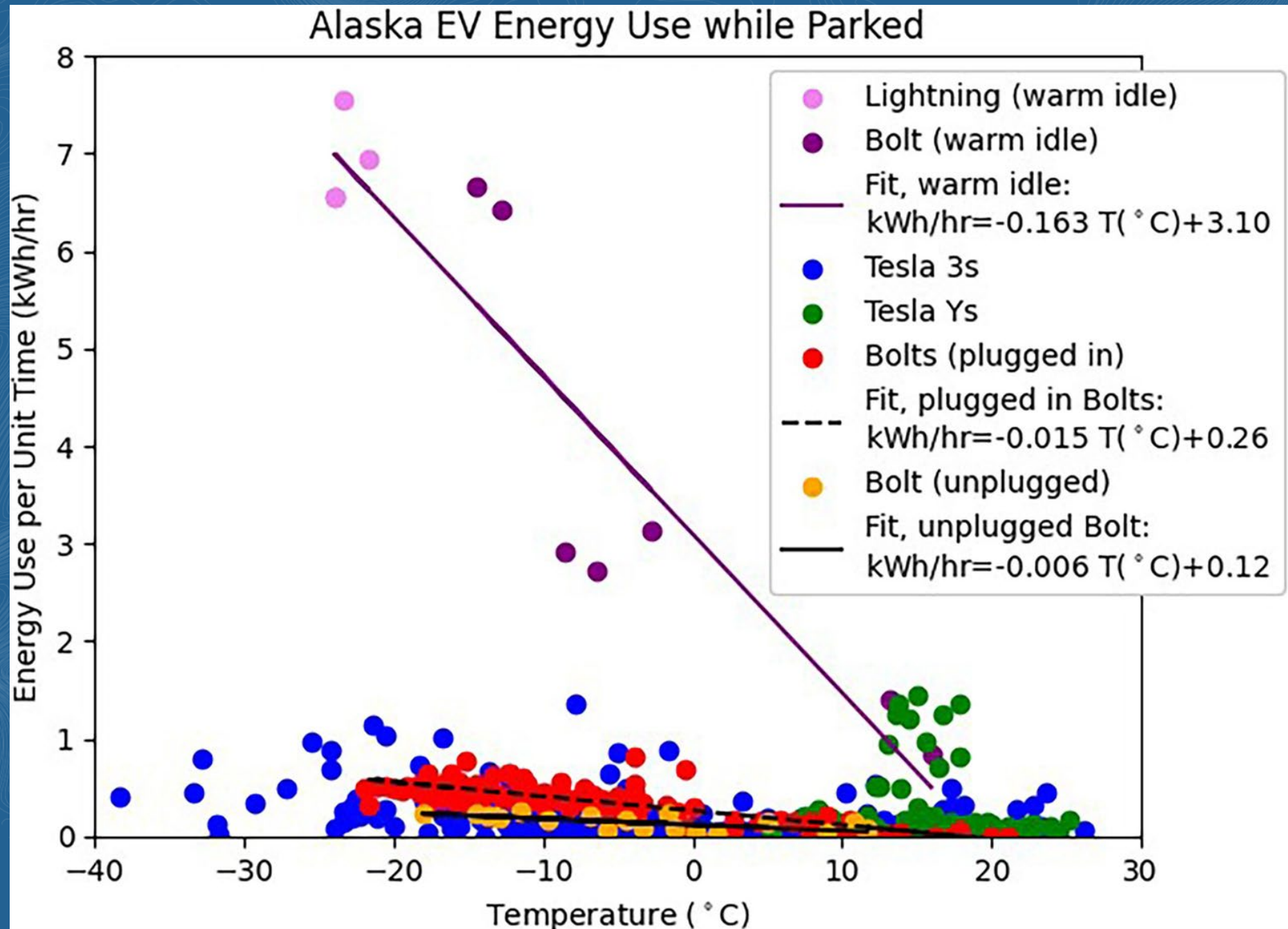
Crowdsourced data from 7 Alaska Teslas

Energy Use per Unit Distance vs Temperature, passenger EVs



Parked Energy Use

Data collection ongoing!
Needed from more vehicle
types in more temperatures.



User Input

- Community
- Vehicle type
- Daily mileage
- Price of gas

Advanced:

- Utility info (rate/emissions)
- Vehicle efficiency
- Home solar
- Block heater use and idling for gas vehicle
- Garage/temperature
- Weekend mileage

Alaska Electric Vehicle Calculator

This is a calculator to find out how much it would cost to charge an EV at home in Alaska, and what the carbon emissions would be.

A comparison is also made to an internal combustion engine (ICE) vehicle.

Select your community (start typing to jump down the list):

Anchorage

Select your vehicle type:

☒ Car

☐ Truck

How many miles do you drive each day, on average?



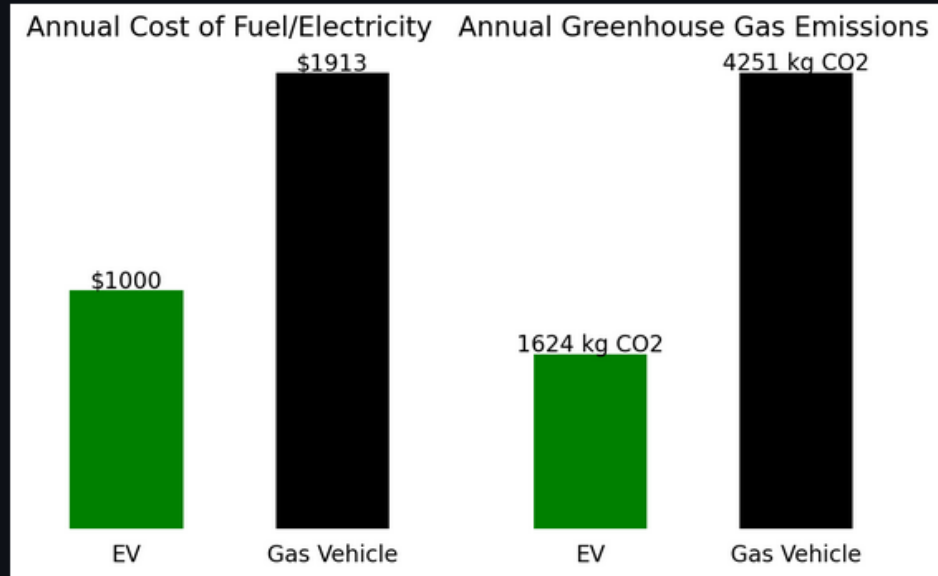
How many dollars do you pay per gallon of gas?



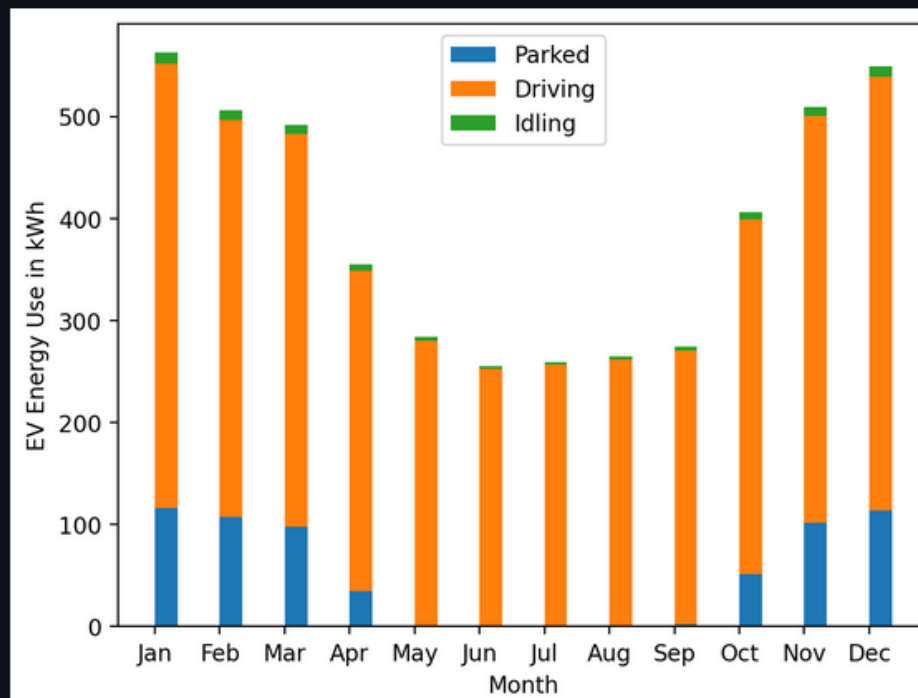
☐ I would like to check and adjust other factors in this calculation.

Output

- Cost comparison
- Climate emissions comparison
- Monthly electricity use for EV



Note that costs and emissions for the Internal Combustion Engine vehicle include gas and any electricity used for block/oilpan/etc heating.





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Are Electric Vehicles a Solution for Arctic Isolated Microgrid Communities?

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Inputs

Community Data (Table 1)

Power plant
emissions per
kWh

Gasoline price

Electricity Prices
(subsidized and
unsubsidized)

Vehicle Data (Table 2)

Rated
efficiency
of EV

Rated fuel
efficiency of
ICE
comparison

Wattage of
ICE engine
block heater

ICE
gasoline
use at
warm idle

Co-produced Use Cases (Appendix A)

Type of vehicle

Daily
distance
driven

Warm 'idle'
duration

Block heater
use duration
for ICE

Alaska EV Calculator

model of energy use of vehicles
vs. temperature, uses database
of hourly temperature data for
Alaska Communities

Outputs

Comparison
of fueling
costs of EV vs
ICE

Comparison of
emissions of
EV vs ICE

Table 2. Model assumptions by vehicle type, expanded from Wilber and Schmidt, 2024.

Vehicle Type	EV	Internal Combustion Engine (ICE) Assumptions		
	Rated Efficiency, kWh/Mi	Rated Fuel Efficiency, Mi/Gallon	Engine Block Heater, W	Gasoline Used at Warm Idle, Gallons/Hour
Truck/SUV	0.50 ¹	20 ¹	600	0.2 ¹
Car	0.28 ¹	27 ¹	400	0.4 ¹
ATV	0.20 ⁴	15 ²	None	None
Snowmobile	0.37 ⁵	25 ³	None	None

Sources and notes: ¹ [3], ² [40], ³ Based on a 4-stroke engine model [41], ⁴ calculated from range and battery size of some available models [39], ⁵ Taiga Nomad reported to have 23 kWh battery, 62 mi standard range [40].

- What vehicles do you use?
- How many mi a day on average do you drive each of your vehicles?
- In winter, do you plug in your vehicles' block heaters and do you use an electric timer to control their energy use? If so, how many hours do you keep your block heaters turned on?
- How long is the vehicle idled each day when it is cold?

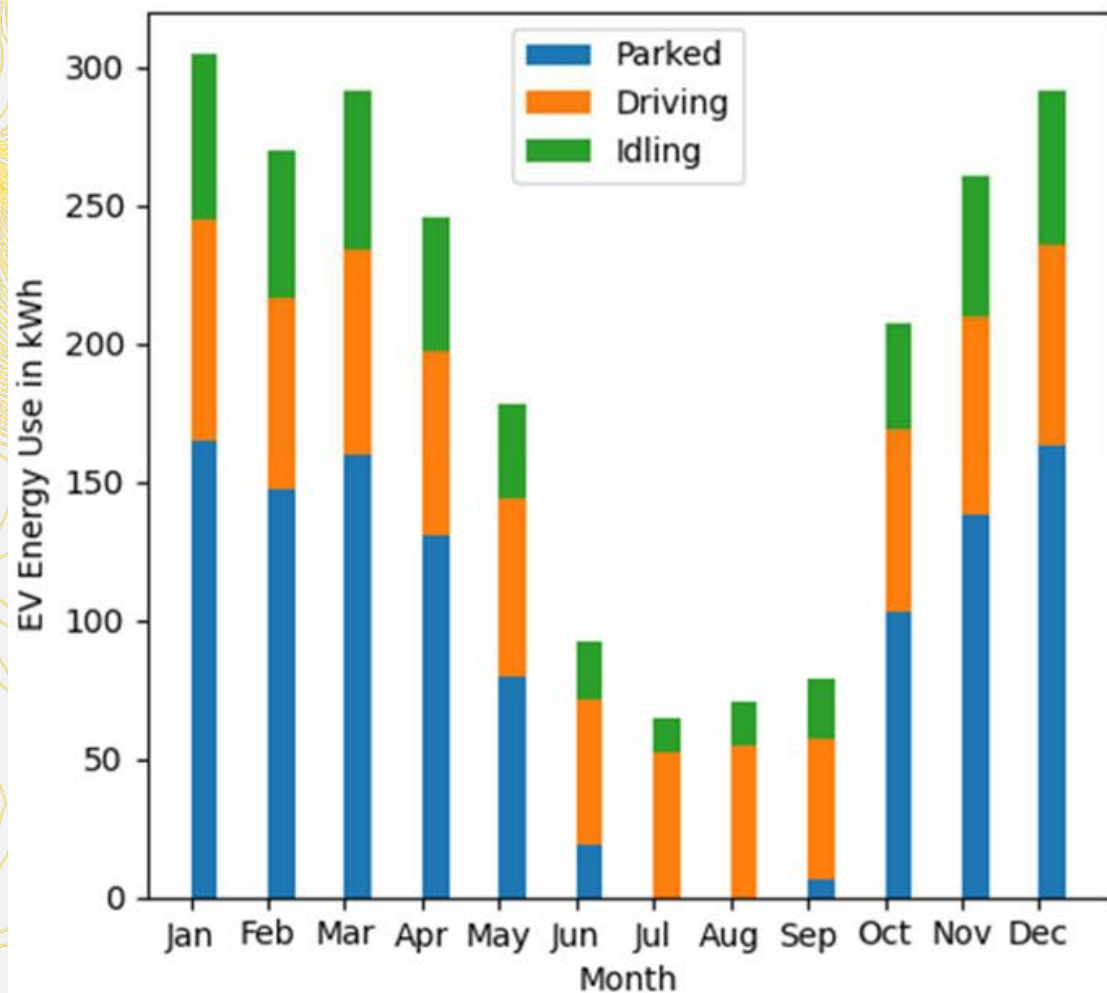
Inputs

Modeling Results

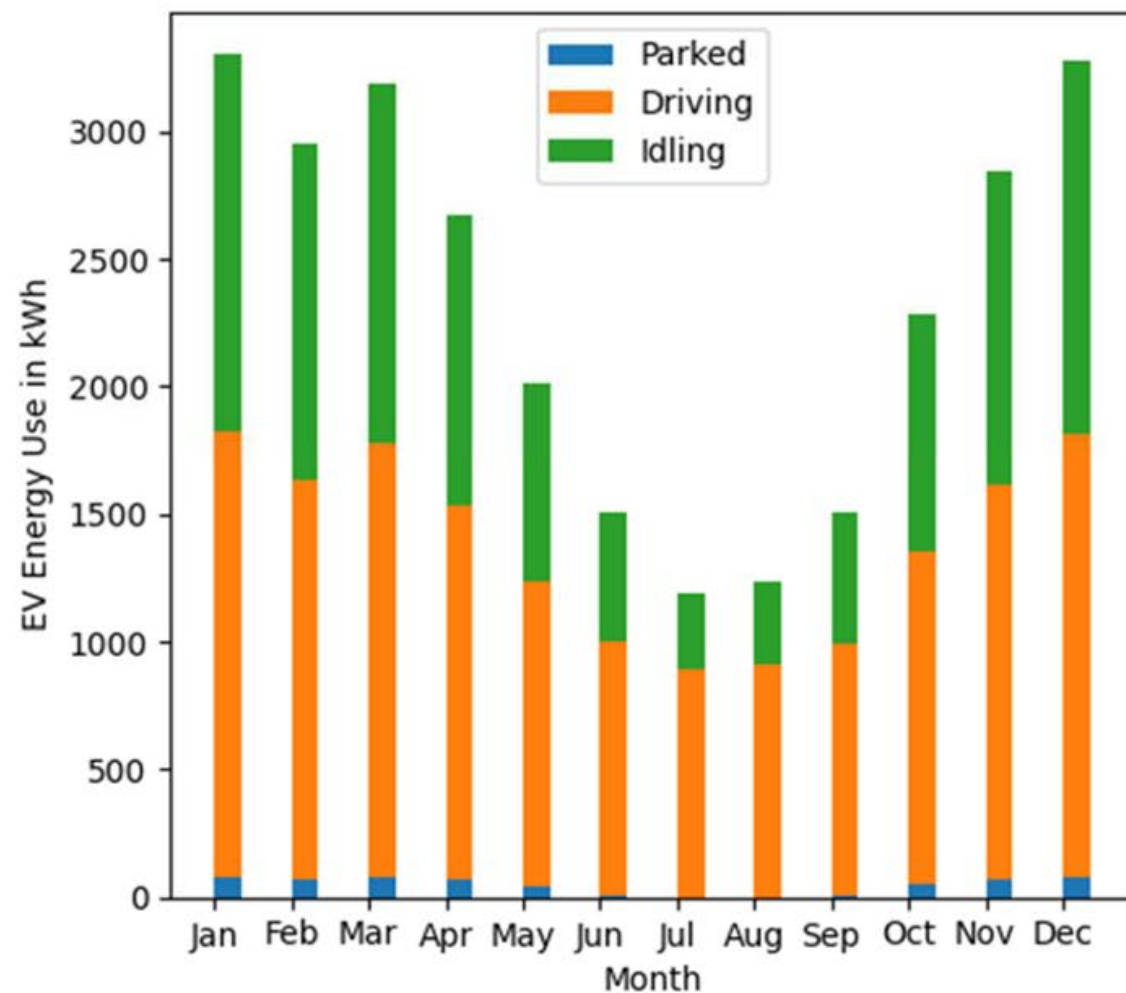
Case #	Vehicle and Daily Travel Distance	Block Heater Use—h/Day	Idling Time, Minutes	%Reduction Fuel Cost—Unsubsidized Electric Rates	%Reduction Fuel Costs, Subsidized Electric Rates	%Reduction Emissions
Kotzebue						
1	6 km (4 mi) weekdays truck ^{1, 2}	12	30	37%	62%	23%
2	6 km (4 mi) weekdays truck ^{1, 2}	2	20	3%	50%	-32%
3	21 km (13 mi) weekdays car ¹	4	20	25%	62%	-3%
4	160 km (100 mi) car (food delivery) ¹	0	540	42%	72%	18%
5	240 km (150 mi) truck (taxi) ¹	0	720	47%	74%	25%
6	45 km (28 mi) weekdays ATV ²	0	0	86%	93%	81%
7	45 km (28 mi) weekdays snowmobile ²	0	0	52%	77%	32%
Bethel						
8	6 km (4 mi) weekdays truck ^{1, 2}	5	0	-26%	31%	-30%
9	13 km (8 mi) day truck ^{1, 2}	12	60	25%	62%	22%
10	22 km (14 mi) weekdays truck ^{1, 2}	0	20	-8%	51%	-13%
11	19 km (12 mi) weekday, 24 km (15 mi) wkend car ¹	12	20	19%	60%	15%
12	480 km (300 mi) truck (Taxi) ¹	0	840	19%	64%	15%
13	6 km (4 mi) car ²	0	20	-48%	33%	-56%
Galena						
14	11 km (7 mi) weekdays truck ²	12	5	15%	37%	8%
15	13 km (8 mi) weekdays truck ²	12	240	34%	56%	26%
16	32 km (20 mi) weekdays truck ¹	12	5	14%	42%	6%
17	64 km (40 mi) weekdays truck ¹	12	240	25%	52%	16%
18	11 km (7 mi) weekday ATV ²	0	0	72%	83%	69%
19	11 km (7 mi) weekday car ²	12	5	7%	32%	0%
20	11 km (7 mi) weekday snowmobile ²	0	0	-27%	20%	-44%
21	10 km (6 mi) weekdays truck ^{1, 2, 3}	0	0	21%	57%	22%



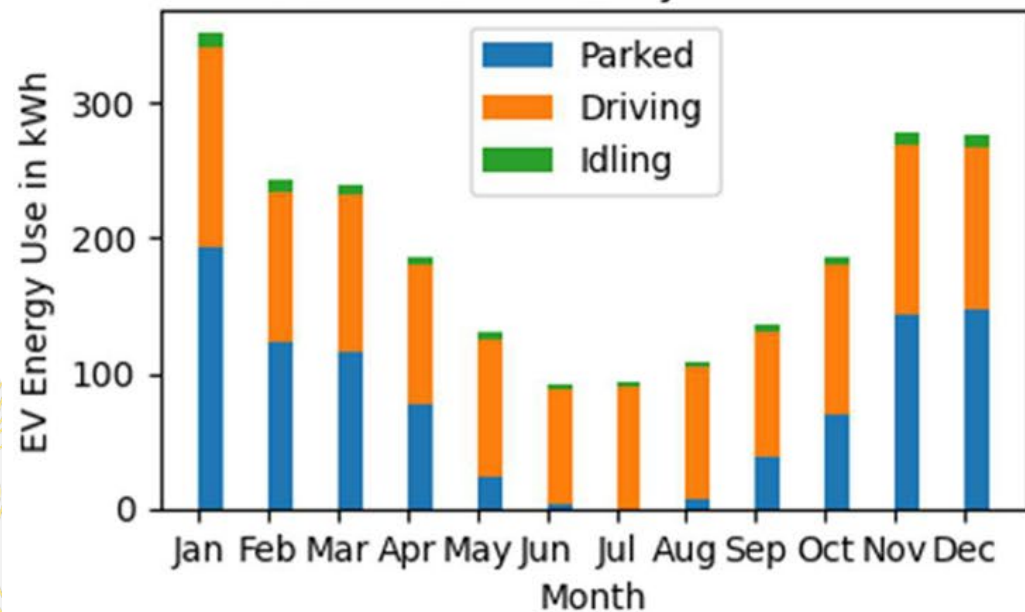
(a) Truck commuting 6km (4mi)/day, 30min idle in cold



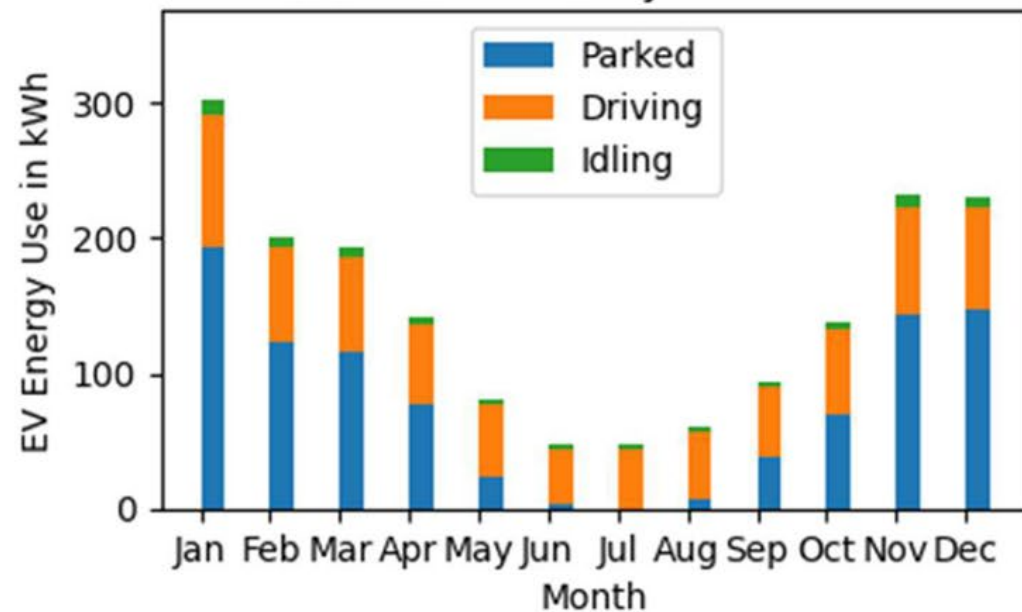
(b) Delivery car driving 160km (100mi)/day, 9 hr idle in the cold



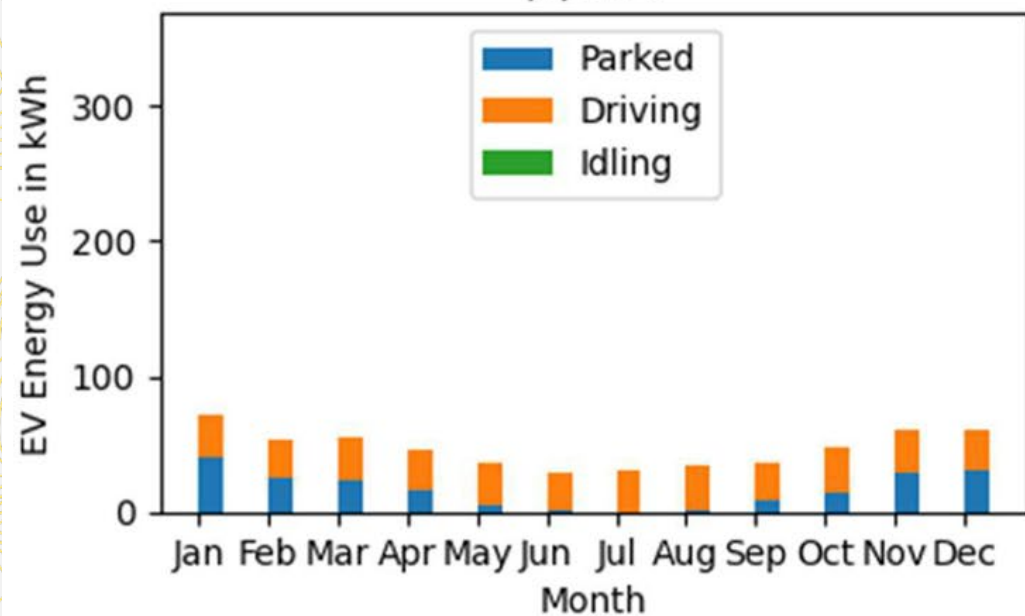
(a) Truck, 5 min/day idle in cold



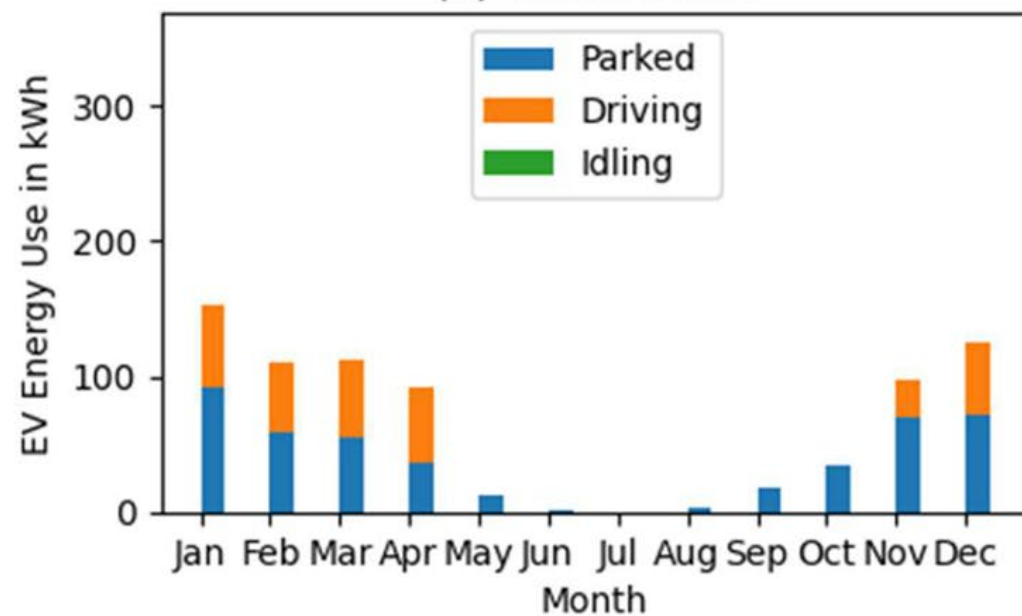
(b) Car, 5 min/day idle in cold



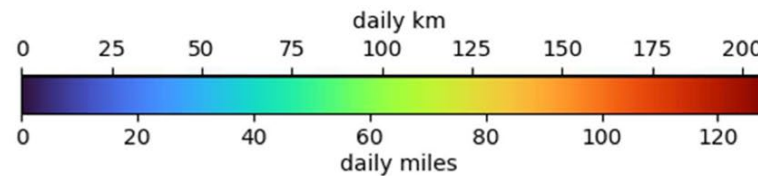
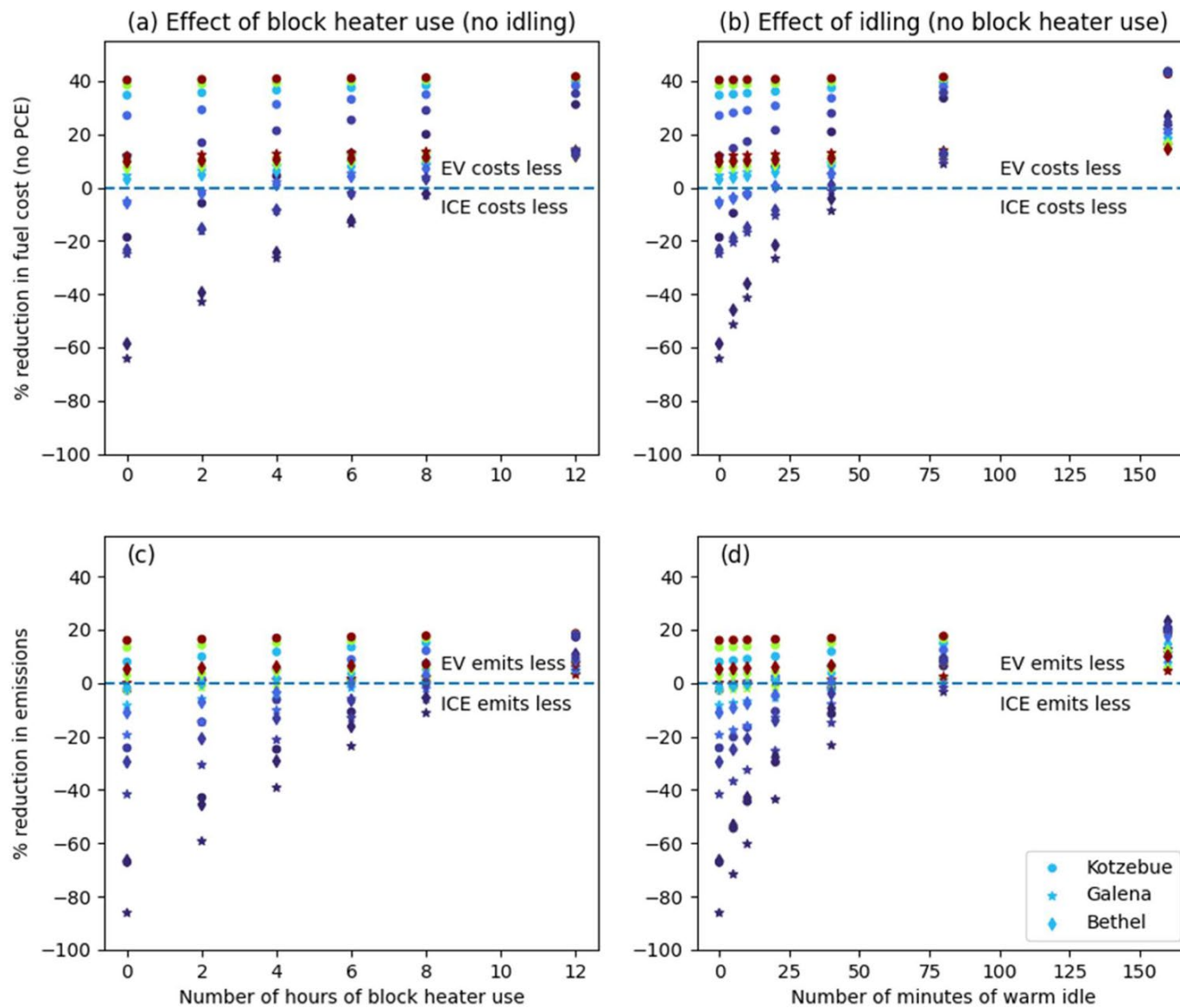
(c) ATV



(d) Snowmobile



% reductions in net cost at non-subsidized electric rate



Questions?

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