Railbelt Decarbonization Pathways Study Public Comment Summary

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Technical Report
UAF/ACEP/TP-01-0001
June 2023

Suggested Citation:
P. Asmus, B. Rogers, P. Cicilio, S. Colt, F. Burtness-Adams, and J. Hansen, "Railbelt Decarbonization Pathways Study Public Comment Summary," Alaska Center for Energy and Power, University of Alaska, Fairbanks, 2023. UAF/ACEP/TP-01-0001.

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Cover Photo by Jeff Fisher.

Acknowledgments

The authors would also like to thank the following individuals from the Alaska Center for Energy and Power at the University of Alaska, Fairbanks for their helpful review and comments: Carolyn Loeffler, Savannah Crichton, and Emilia Hernandez.

Funding

This project is part of the Arctic Regional Collaboration for Technology Innovation and Commercialization (ARCTIC) 2 Program - Innovation Network, an initiative supported by the Office of Naval Research (ONR) Award #N00014-22-1-2049. This project is funded by the state of Alaska FY23 economic development capital funding.

Acronyms

ACEP Alaska Center for Energy and Power

BTM Behind-the-Meter

CCS Carbon Capture and Sequestration

CEA Chugach Electric Association

CI Commercial and Industrial

DER Distributed Energy Resources

DERMS Distributed Energy Resource Management Systems

EV Electric Vehicles

GVEA Golden Valley Electric Association

HEA Homer Electric Association

HVDC High Voltage Direct Current

IPP Independent Power Producer

IRA Inflation Reduction Act

MW Megawatt

PV Photovoltaic

REAP Renewable Energy Alaska Project

TAPS Trans-Alaska Pipeline System

TOU Time of Use

V2G Vehicle to Grid

VPP Virtual Power Plant

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1 Railbelt Decarbonization Pathways Study

The Alaska Center for Energy and Power (ACEP) is examining methods to reduce and ultimately eliminate net carbon emissions from Alaska's Railbelt electrical system. The Railbelt is the largest regional electric grid in Alaska, spanning about 700 miles from Fairbanks to Homer following the Alaska Railroad. This Railbelt serves about 70% of Alaska's population and about 75% of Alaska's electrical load. Currently, about 80% of the Railbelt's electricity generation comes from fossil fuels and 20% comes from renewable sources, mainly hydro.

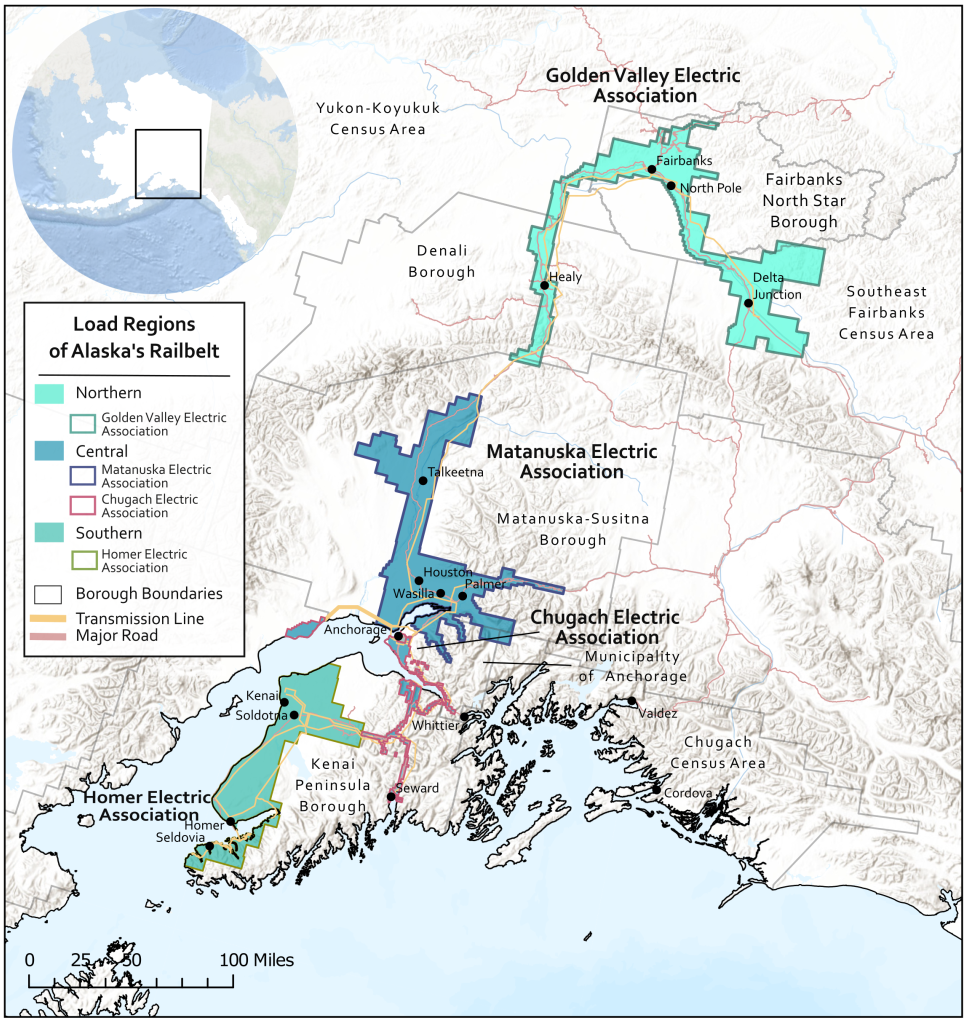


Figure 1. Alaska Railbelt transmission and electric utility territories.

The Alaska Center for Energy and Power (ACEP) is exploring and quantifying pathways toward reduced Railbelt electric grid carbon emissions while maintaining reliable and affordable electricity and promoting clean energy development. The purpose of this study is to inform future studies and decisions made by Alaska utilities, the State of Alaska, and the public with an independent, unbiased assessment that demonstrates to technical and non-technical audiences the opportunities and challenges facing isolated regional electric grids seeking to decarbonize.

The project is funded by the State of Alaska and the University of Alaska Fairbanks with support from the Office of Naval Research. It has the active technical assistance of the Alaska Energy Authority and the four Railbelt utilities: Homer Electric Association, Chugach Electric Association, Matanuska Electric Association, and Golden Valley Electric Association.

The project looks at a goal of zero net carbon emissions by 2050. Currently there are no state-wide carbon emission goals. The Railbelt electric co-ops have carbon reduction goals. The first phase of the project focuses on technical feasibility and economic impact, utilizing computer simulation models to understand the effects of various technologies and their locations on the existing grid. To highlight differences in approach, three basic scenarios are being examined:

1. Decentralized Energy Transition
2. Centralized Energy Transistion
3. Export Project Offtake

A public online survey was conducted by ACEP and Information Insights collecting feedback on the scenarios and opinions about technologies. The survey method is outlined in Section 2. The descriptions of the scenarios and the public feedback on those scenarios are provided in Sections 3-6. The actions taken to modify the scenarios in response to the public survey are outlined in Section 7.

2 Survey Method

The ACEP team, in collaboration with Information Insights, sought input from ratepayers, residents, organizations, and individuals on the study scenarios that could lead to decarbonization of the Alaska Railbelt electric grid. Answers were used to help improve ACEP's Phase 1 study.

A public, online survey was developed and open from October 19 - November 14, 2022 with extensive outreach happening before and during that period.

The survey was divided into three parts:

1. Identification: name, affiliation, and location.

2. Context and overview questions: importance of energy transition, preference on energy technologies, ranking on affordability, reliability, and sustainability.

3. Comments on the three decarbonization scenarios. Respondents were asked to provide comments related to completeness of the scenario, what needs to be added, what needs to be removed, and what, if anything, needs to be reconsidered.

A contact list was developed by Information Insights with the ACEP team and focusing was on representation from Alaska's organizations, individuals, and entities along the Railbelt.

The survey was distributed to an outreach list of environmental and conservation nonprofits and organizations, railbelt utilities and their ratepayers, state railbelt energy entities, commercial and independent power producers, ACEP staff and newsletter, telecommunications organizations, solar and other renewable energy service firms, oil, gas, and mining industry entities, tribal and Alaska Native associations, governments, corporations, economic development entities, unions, municipal governments, energy group members, and individuals who expressed interest in being kept in the loop about the study.

For some organizations, Information Insights requested they distribute the survey to their network. These organizations were given language for outreach as well as a social media kit to share widely.

With the goal of trying to get as many different perspectives and as much participation as possible, Information Insights felt it important to try and make this process digestible by the average Alaskan. Therefore a two-page, graphic summary document about the scenario options was created to share on the ACEP website and through outreach, as well as a social media kit for organizations to share with their networks.

Contacts totaled approximately 275 and multiple rounds of emails and phone calls were made from October 27 to November 13, 2022. A total of 64 public comment surveys were completed.

3 Scenario One: Decentralized Energy Transition

This scenario is built on decentralized, customer-driven decarbonization and the maximum plausible use of distributed energy resources (DERs). Under this scenario:

- **Residential and small commercial (CI) customers** adopt the maximum plausible amount of behind-the-meter (BTM) resources and electrification: solar photovoltaics (PV), battery storage, electric vehicles (EVs), and heat pumps. These customers, as well as large commercial, industrial, and institutional customers, also exercise retail choice and/or direct procurement of renewable electricity from independent producers, from each other, or from specific low-carbon utility generation sources. The Railbelt electric load grows from electrification, somewhat modified by aggressive efficiency measures, such as building retrofits in combination with heat pumps.

- **Independent Power Producers (IPPs) and communities** play a major role to build both small-scale and larger scale solar, wind, and hydro projects. On-site energy storage provides some degree of dispatchable power from these variable resources. In other words, non-utility producers take some responsibility for "firming" their renewable power.

- **Distributed Energy Resource Management Systems (DERMs)** are utilized by utilities and/or non-utility actors to create, aggregate, control, and integrate DERs into the Railbelt Grid as dispatchable and/or controllable loads. EV batteries in particular play a major role in smoothing loads via managed charging and accommodating intermittent renewables supply via vehicle-to-grid power flows (V2G), displacing the need for fossil fuel peaking plants to crank up during peaks or to fill-in gaps when wind or solar resources dip.

- **New Market Structures** are implemented to facilitate the above adoptions of DERs. For example, "virtual power plants"(VPPs) are managed aggregations of small dispatchable DERs whose services can be bought and sold in real-time and which can help balance supply and demand across utility boundaries throughout the span of the Railbelt Grid.

- **Utility-scale renewable resources** are built by utilities or by independent producers, as necessary, from the same pool of potential resources considered for the Centralized Low-Carbon Generation scenario. However, less emphasis is placed on these larger renewable generation projects and more emphasis is placed on smaller, more distributed resources and on flexible loads aggregated into VPPs as resources.

- **Thermal Generation** is used as necessary to meet reliability and stability standards, such as preventing unserved load. Thermal generation includes zero-carbon or low-carbon fuels such as ammonia or hydrogen are blended into existing fuel supply networks and largely replace conventional fossil fuels by 2050. Carbon emissions from remaining fossil fuel combustion are dealt with using carbon capture and storage (CCS).

- **Transmission upgrades** are assumed to be in place by 2050 that are sufficient to allow substantial sharing and pooling of variable renewables and storage resources without exceeding line limits during normal operation.

3.1 Public Comment Summary

- The radical overhaul of market structures and the creation of an Independent System Operator was deemed perhaps unrealistic given the past stances and actions of Railbelt utilities.
- This is the scenario that takes the biggest advantage of the recent federal Inflation Reduction Act (IRA) legislation. The IRA is focused on the so-called "prosumer" approach to climate change mitigation, though it also includes provisions allowing co-ops and other non-profit entities to leverage tax incentives that in the past were only limited to those which had tax liabilities.
- A key question is which resources – owned by whom – would serve as the back-stop, "last resort" safety net resources to fulfill the traditional utility's "obligation to serve."
- The Railbelt grid is perhaps the only part of Alaska's energy system where concepts such as "community solar" supported by virtual net metering would be viable. This would allow renters and others to also become prosumers.
- What is the role of pumped hydro? This resource choice would seem to fall into Scenario 2. The comment highlights how many commenters voiced their concern that each of the three scenarios alone might need to be combined to really meet the end goal of decarbonization.
- A call for microgrids.
- Need for time-of-use (TOU) rates for a DER-centric scenario to succeed. (Evidence from other domestic and world markets reinforce this supposition.)
- Energy efficiency is the foundation upon which this scenario is built. (One could argue all 3 scenarios should be focused on energy efficiency as the first step.)
- Many voiced their skepticism about technologies such as ammonia, hydrogen, EVs and carbon sequestration. EVs are the most relevant to this DER scenario. EVs also bring up the issue of equity. Even with the IRA incentives, would underserved communities really take advantage of the IRA individually as prosumers?

4 Scenario Two: Centralized Low-Carbon Generation

This scenario aims to provide electricity through utility-scale carbon-free energy resources such as hydro, wind, solar, geothermal, tidal, biomass, and nuclear. In 2050, no fossil fuel based thermal generation will be considered online, unless necessary to prevent unserved load. Zero- or low-carbon fuels will be blended to existing fuel supply networks and/or carbon capture and sequestration (CCS) will be used to remove carbon emissions. It includes utility-scale energy storage including batteries and pumped storage hydro. Three groupings are considered in this scenario:

- **All wind, solar and hydro** would include approximately 200 MW of solar and wind, and 833 MW of hydroelectric, including the Susitna-Watana hydro project. In this and the other two groupings, one solar farm would be built in each of the four utilities' service areas, roughly splitting the nameplate capacity between them. Wind facilities would be built in each of the four utilities' service areas as well with a greater concentration in GVEA where there are more significant wind resources.

- **A diverse mix** would increase the amount of solar and wind to the previous grouping. There would also be 50 MW of geothermal, 75 MW of tidal, 50 MW of biomass, and 215 MW of hydro, not including Susitna-Watana. New generation facilities would include geothermal at Mount Spurr, tidal at Cook Inlet, and a wood biomass plant in a location to be determined.

- **A diverse mix with nuclear** would substitute around 400 MW of nuclear generation for some of the wind and solar and 50 MW of biomass in the previous grouping. Two nuclear facilities would be included – one in Interior and one in Southcentral Alaska.

The groupings under this scenario also consider:

- **Transmission upgrades** are likely to be required for each of the groupings. Individual and combinations of transmission upgrades that will be considered include the planned Bradley Lake upgrade on the Kenai Peninsula, a Quartz Creek to University upgrade to 230kV, a new HVDC line from Bernice to Beluga or a new HVDC line from Bernice to Healy, Northern Intertie upgrades from Healy to Fairbanks and Teeland to Douglas, and an additional line from Teeland to Healy.

- **Energy storage** variations will be studied, including pumped storage hydro (2000 MW) and additional battery backup at GVEA, HEA and CEA (up to 800 MW). The planned battery additions in GVEA and CEA will also be included.

4.1 Public Comment Summary

- The focus should be on proven technologies first such as wind, solar and hydro.
- Some commenters saw challenges to large-scale hydro such as the Susitina-Watana project due to carbon emissions linked to cement and earth moving. Intense local opposition was also voiced to this same project due to probable negative impacts to local salmon populations.
- Similar opposition was voiced in terms of carbon reduction for biomass, though some commenters pointed out specific types of biomass projects that would be less carbon intensive. Nevertheless, the availability of sufficient biomass within the Railbelt grid regions was also brought up.
- It seems that the decarbonization value of both large-scale hydro and biomass needs to be quantified to be included in this scenario.
- Tidal power was also questioned, given its current nascent status.
- Emerging technologies such as tidal, and by inference technologies such as modular nuclear, could be incrementally integrated over time as they prove out, argued others.
- Commenters were especially skeptical of advanced nuclear technologies. As one noted, “the scale of nuclear being contemplated – 100 MW – does not yet exist.” This argument echoes a common theme throughout: to focus on “proven technologies.”
- Commenters such as the Renewable Energy Alaska Project (REAP) questioned the assumptions behind needed transmission upgrades, noting that absent other assumptions, such as unified dispatch protocol, the required cost of transmission upgrades might not be realistic. REAP stated: “Considering fixed transmission upgrades outside of the context of whether unified economic dispatch is occurring within the scenario appears to us to be unnecessarily arbitrary.”
- REAP also questioned the “stylistic” assumptions included in this scenario. “There are no good reasons to assume that “one solar farm would be built in each of the four utilities’ service areas”. Nor is there any reason to assume that a specifically named project, i.e., Susitna-Watana, would be built. At minimum, the rationale for these stylistic assumptions should be made explicit.”
- Initial steps for implementing this scenario would be to add renewables to “sweet spots” that do not require any transmission system upgrades.

5 Scenario Three: Export Project Offtake

The third scenario for Railbelt decarbonization relies on a large-scale export project that produces sufficient carbon-neutral energy to provide a major portion of the Railbelt electrical needs. Possibilities in this scenario include three ammonia export opportunities that take advantage of Alaska's position on world shipping routes to export ammonia for Pacific marine transportation and energy production in the Asian markets. A fourth possibility would export electricity via HVDC to Canada.

- **Ammonia Delivered by existing TAPS Pipeline from North Slope** would utilize Alaska North Slope natural gas to produce ammonia ("blue ammonia") that would be sent by batch through the existing trans-Alaska pipeline to tidewater in Valdez. Carbon separated from the natural gas would be reinjected into North Slope gas fields, permanently sequestering it.

- **Ammonia Delivered by Ship** would use a carbon-free energy source to produce hydrogen from water by electrolysis and using that hydrogen to produce ammonia ("green ammonia"). Primary energy sources could include wind, geothermal, large-scale nuclear, or hydropower. Several possibilities would generate the ammonia in the Aleutians (wind, geothermal, nuclear). The ammonia would then be shipped to Nikiski with a HVDC line to Beluga or shipped to Point Mackenzie with generation at Beluga.

- **Natural Gas converted to Ammonia in Nikiski** would use a new Alaska North Slope gas pipeline to Nikiski. Under this scenario a blue ammonia plant would be built in Nikiski, with carbon sequestered in the Cook Inlet gas fields. From Nikiski, the ammonia would be moved by subsea pipeline to Beluga, with new electric generation facilities at Beluga and/or Nikiski, and new transmission connections from Nikiski to Beluga.

- **HVDC from North Slope for export to Canada** would use a blue ammonia plant constructed on the North Slope, with carbon sequestered in the North Slope oil and gas fields. A new generation plant utilizing ammonia would be built on the North Slope with an HVDC line constructed capable of exporting energy to Canada via a new transmission path that would likely exceed 1,300 miles if co-located with existing highway or proposed railroad alignments (1,100 miles from Delta Junction to Fort Nelson, B.C. plus 250 miles from Fort Nelson to the B.C. Hydro bulk power system at Peace Canyon.) This scenario would allow electricity to be taken from this HVDC line and be injected into the Northern Railbelt grid, most likely at Healy.

5.1 Public Comment Summary

This scenario seems to have solicited the most intense skepticism and opposition, as is evidenced by these comments highlighted below:

- "This scenario seems poised more as an industrial policy proposal for the Alaska economy and does not discuss in detail how generating ammonia for export would generate carbon-free energy for the Railbelt." And, "This scenario seems entirely unrelated and illogical to railbelt decarbonization and instead focused on repurposing Alaska's economic infrastructure to focus on exporting ammonia power. There's almost no description whatsoever of how that would lead to a decarbonized Railbelt grid."
- Not realistic, does not directly decarbonize the Railbelt grid, and has greatest risk of environmental catastrophe (with reference to Valdez oil spill) are some key themes.
- Commentors wondered if the carbon emissions from shipping and construction had been factored in (similar to skeptics of Scenario 2 on emissions from large dam cement and construction externalities being accounted for.)
- Ammonia is just one export opportunity. What about hydrogen or methanol? The analysis should prioritize a direct ammonia versus hydrogen export comparison, argued some.
- HVDC should perhaps examine a submarine cable that would allow the end-product fuels to be shipped either to the lower 48 or to remote Alaskan villages totally dependent upon diesel fuels.
- Blue ammonia is not fully carbon neutral. Has that fact been factored into this analysis?
- What about also looking at Aleutian geothermal to hydrogen or Cook Inlet tidal to green hydrogen scenarios?
- Echoing comments for Scenario 2 (and Scenario 1), skeptics abound when it comes to CCS and nuclear. In this scenario, some were equally opposed to any reliance upon natural gas as a decarbonization strategy.
- A broader critique of this and the other two major scenarios was this: Shouldn't all three scenarios address market structures and ownership? By doing so, they might be more directly comparable.
- Does this scenario consider changes inherent with accelerated climate change in Alaska: "Consider ice free arctic, sea level rise impacts, and take a broad look at the overall economics of export fuels with the understanding that all available climate science says we have to cut our inputs of CO2 into the atmosphere in an extremely rapid time frame or else we will suffer widespread feedback loops, increased storm frequency, flooding events that will decimate infrastructure and cause human and biological displacement at a scale never before experienced."
- And what about economics? "Basic laws of thermodynamics suggest all the multiple conversion steps to change energy states and products will never be economical, even if technically possible."
- Of the 3 sub-options included in this Scenario 3, perhaps the most optimistic assessment among the dissenters was this: "I would prefer option 2 described above, though I would imagine it might receive the least amount of political support since it does not involve the large oil and gas players currently operating in Alaska. Nevertheless, it would be the greenest option. Electrolysis could also be deployed locally in a more decentralized manner, aligning this export opportunity with the DER-centric scenario 1."

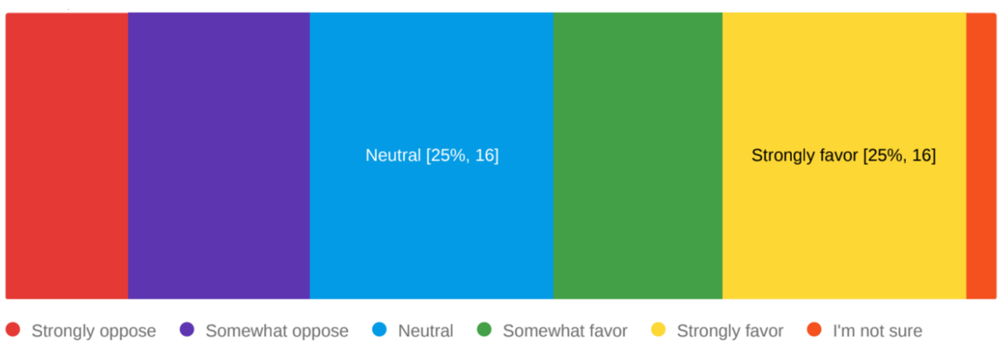
6 Survey Results on Each Prospective Decarbonization Technology and Priorities

The survey additionally sought opinions about specific low-carbon supply side resource options. The charts below show the range of responses for the following technologies:

- Advanced micronuclear
- Geothermal
- Large-scale hydro
- Large-scale solar PV
- Tidal turbines in the Cook Inlet
- Fossil thermal generation with hydrogen and/or ammonia
- Off-shore wind
- On-shore wind

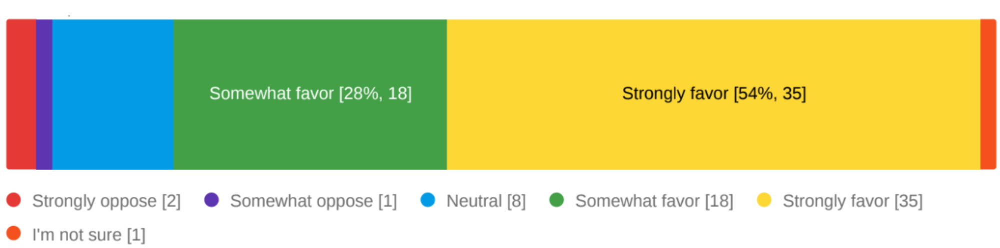
6.1 Advanced Micronuclear

The two most popular responses to this technology option were strongly in favor (25%) and neutral. It did feature, nevertheless, among the largest opposition of any technology surveyed.



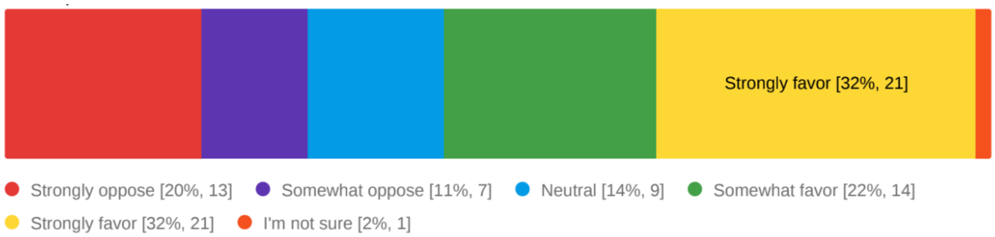
6.2 Geothermal

Despite its limited availability near population centers, including the Railbelt Grid, a majority of respondents strongly favored geothermal (54%). If one adds to this tally those who "somewhat favor" this technology, the overall favorably rating increases to 82%.



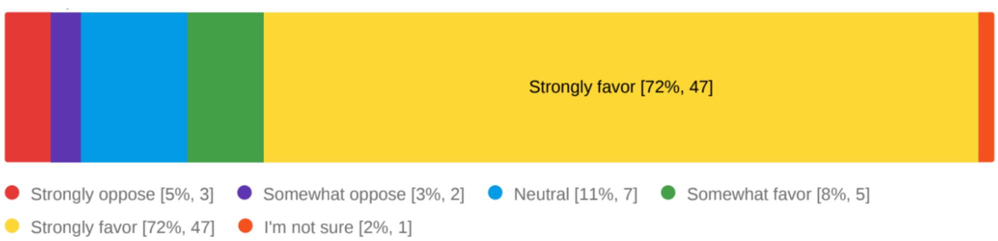
6.3 Large-Scale Hydro

A minority of respondents strongly favor this technology: 32%. An equal percentage either strongly oppose or somewhat oppose this option. Apparently, large-scale hydro is less popular among respondents than advanced nuclear.



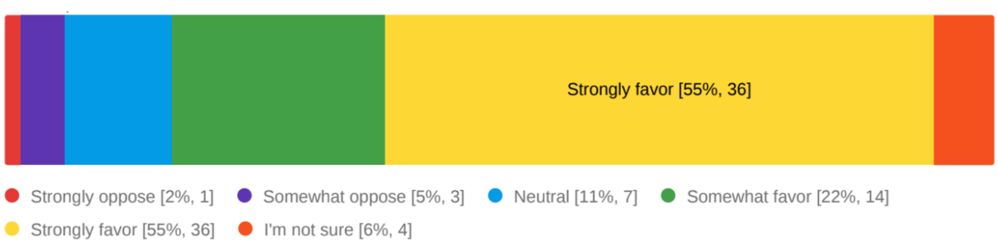
6.4 Large-Scale Solar PV

An impressive 72% of respondents were "strongly in favor" of this technology option, with only 5% strongly opposed. The "strongly favor" score ranked second among all technology options ranked by respondents.



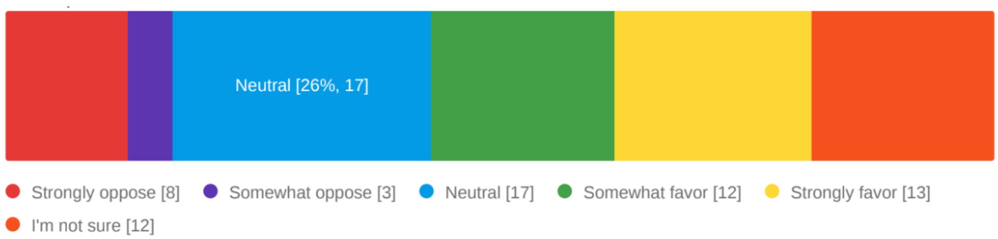
6.5 Cook Inlet Tidal

Given the nascent status of tidal turbine technology, it is revealing that 77% of respondents either strongly or somewhat favored this technology. In contrast, only 2% strongly opposed.



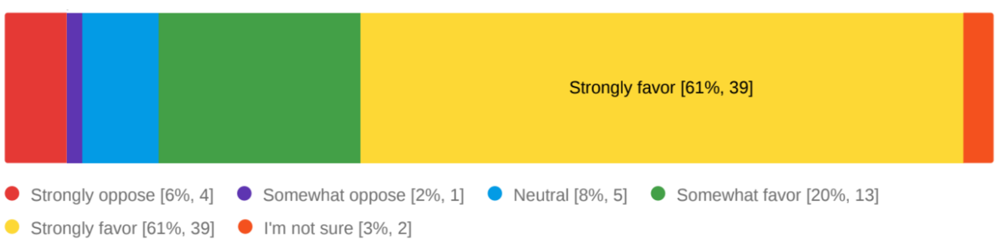
6.6 Thermal Generation with Hydrogen and/or Ammonia

The largest response category was "neutral," which likely reflects ambivalence about this technology. That said, only 8% strongly opposed, while 25 respondents were either strongly or somewhat in favor.



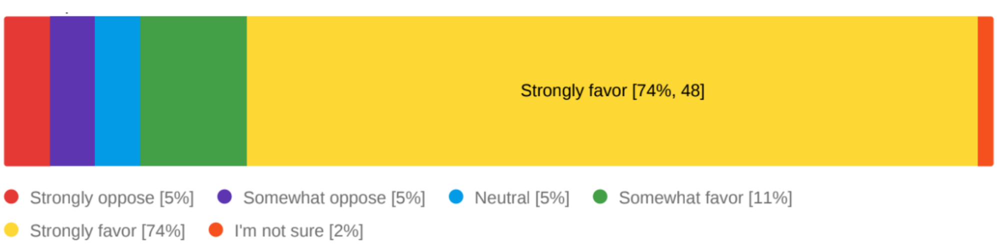
6.7 Off-Shore Wind

Alaska has yet to deploy wind turbines off-shire, but a clear majority of respondents either strongly favor (61%) or somewhat favor this technology option (20%).



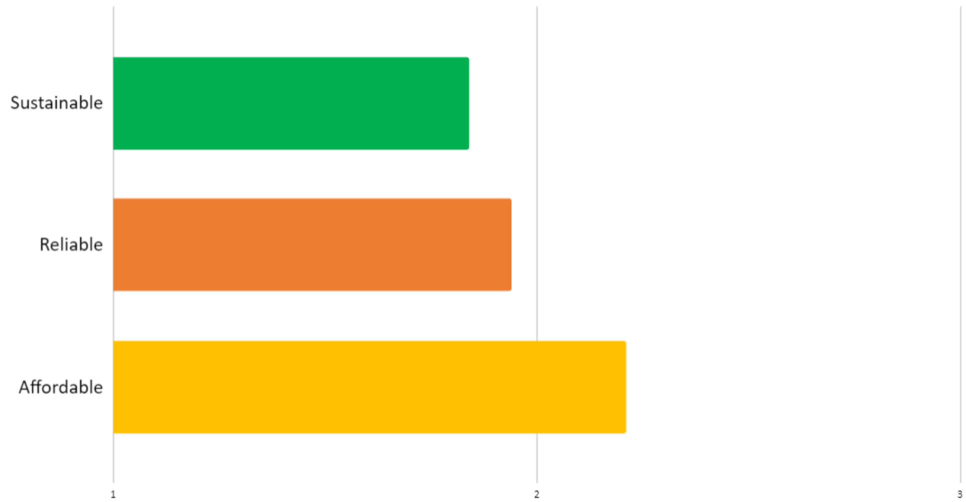
6.8 On-Shore Wind

The most popular of all low or no carbon technology options is on-shore wind, a mainstay of Alaska's renewable energy options in microgrids. Almost three-quarters of respondents - 74% - are strongly in favor. Only 10% - 5% strongly - oppose the use of on-shore wind to decarbonize the Railbelt Grid.



6.9 Priorities

Respondents were asked to rank the following priorities from 1 to 3 for the Railbelt grid: sustainability, reliability, and affordability.



7 Conclusion

The actions taken in response to the public comment so far are summarized below.

- Energy efficiency is considered in the baseline load forecast.
- All technologies remain in the scenarios for this current project, and some may be dropped from further consideration in future projects. This project aims to be technology agnostic with the goal of decarbonization.
- The energy export scenario will not be analyzed and modeled further in this project.
- The scenarios are reframed to the following:
  - High Electrification Focus: New Wind, Solar, Tidal with High Electrification
  - New Hydro Focus: New Hydro, Wind, Solar with Moderate Electrification
  - Diverse Mix Focus: New Wind, Solar, Tidal with Moderate Electrification
  - Nuclear Focus: New Nuclear, Wind, Solar with Moderate Electrification
  - In all decarbonization scenarios:
    - Transmission upgrades and energy storage (battery and/or pumped storage hydro) will be included as needed for reliability and stability purposes.
    - Carbon capture and sequestration and/or carbon neutral fuels (hydrogen) will be considered if thermal generation is needed to maintain reliability and stability.
  - Business as Usual: No new renewable generation, no electrification, planned transmission upgrades
- The following items are outside of the scope of this project and may be considered in future projects: policy, heating sector, transportation sector, rail decarbonization, electricity market structures, and implementation schedules.

Further actions and adjustments may be included during the remainder of this ongoing project. All responses and comments will be saved for future reference in this project and future projects.