TERRA
ENERGY CENTER

SECURE LONG-TERM ALASKA POWER

1/20/2025

FUEL AND SITE WORK

DECARBONIZED POWER PLANT

NEXT STEPS

COAL IS ALASKA'S FUEL

521Mt
Reserve/Resource
verified to date

100MW plant =
~22.5M tonnes
over 30 yrs

1GW plant =
~225M tonnes
over 30 yrs

PERMITTING

6 YRS DATA
NO RED FLAGS

MET STATION, FODAR, LIDAR, SURFACE WATER, GROUND WATER, SNOW SURVEYS, WETLAND SURVEY, COAL QUALITY, GEOLOGY, BIOTA, FISH, TRANSPORTATION ROUTES & IMPACTS

- State land
- Project qualifies to opt into FAST-41
- Presidential Executive Order to "expedite the permitting…of energy and natural resource projects in Alaska"

COAL POWER IS EPA PERMITTABLE

Image: Boundary Dam CCS Coal Plant successfully in operation with first generation CCS, for 10 years

ESG:
LOW IMPACT SURACE EXTRACTION

AND UNIQUELY CLEAN FUEL

EXCEPTIONALLY LOW CONTAMINANT

KEY TRACE ELEMENTS:

MOST WELL BELOW TYPICAL U.S. COAL RANGE

	Typical Content**	Project Coal
Sulphur (SOx)*	0.2 – 5.0 %	**0.13 %**
Nitrogen (NOx)*	0.5 – 3.0 %	**0.68 %**
	US Coal Typical Range ppm**	**Project Coal ppm**
Arsenic	14 – 15	**2.8**
Boron	50 – 102	**31.6**
Cadmium	1.3 – 2.5	**0.2**
Lead	16 – 35	**4.4**
Mercury	0.18 – 2.0	**0.036 (36 ppb)**
Molybdenum	3.0 – 7.5	**1.24**
Selenium	2.1 – 4.1	**0.11**

* Lower acid rain risk from Sox. Low NOx means low potential to form Nitrous Oxide (N2O), a greenhouse gas that can contribute to global warming.

** United States Energy Association and U.S. Department of Energy: https://usea.org/sites/default/files/092012_Trace%20element%20emissions%20from%20coal_ccc203.pdf and netl.doe.gov/research/Coal/energy-systems/gasification/gasifipedia/nitrogen-oxides

ESG: EMISSIONS

DISPELLING THE MYTH OF DIRTY COAL

- **ENVIRONMENTAL:**

  WITHOUT CCS: coal is cleaner than imported LNG

  https://doi.org/10.1002/ese3.1934 [2024]
  https://pubs.acs.org/doi/10.1021/acssuschemeng.1c01517 [case study 2021]

  WITH CCS: cleaner than wind with natural gas peakers

  UAF/EERC *Economic Feasibility Report,* Dec 2023 / March 2024

- **SOCIAL & GOVERNANCE:**

  Need for lower cost power in high-priced market

  National, Defense and State energy security objectives

  Economic development value – high-paying jobs, increased tax and royalty revenues, increased utility customer base

FUEL AND SITE WORK

DECARBONIZED POWER PLANT

NEXT STEPS

COULD SUPPLY ALL S.CENTRAL ALASKA ELECTRICITY, SAVING GAS FOR HEATING

3.22.2024 – Governor's announcement:

(S&P Global 22.3..2024)

S&P Global
https://www.spglobal.com › latest-news-headlines › alask...

Mar 22, 2024 — Mike **Dunleavy** said. Alaska is constructing roads into remote mining areas, and they will need **power**, **Dunleavy** told **S&P Global** Commodity Insights ...

Alaska governor says state considering 2 new, large coal power plants

Alaska may build the first large coal-fired plant in over a decade and is considering "probably two" equipped with carbon capture and storage technology, Gov. Mike Dunleavy said.

6.3.2024 – Host municipality votes to pursue coal power and seek State support

(communications 2.2024 MSB/AACEC, session 5.3.2024)

7.2.2024 – Gas distribution utility Enstar recommends coal-fired power generation to legislative Joint Resources Committee

(video, JRC hearing 7.2.2024)

STUDIES: LOWEST CAPEX FIRM POWER OPTION[1]

Firm Energy Supply Option	Capacity Evaluated (MW)	Capital Cost before tax credit	Capital Cost after tax credit
Proven Technology Readiness			
Coal + CCS[1]	400	$2.2B + $1.3B	$2.2B
Susitna-Watana Dam[2]	475	$9B	$6.3B
Not Proven Technology Readiness			
Small modular nuclear[2,3]	539	$12.6B	$8.8B
Tidal Power[2]	400	$10.1B	$7.1B

1. McGuire, T., et al, *Cook Inlet Region Clean Power Generation With Carbon Capture, Transport, and Storage Feasibility Study,* PCOR, UAF-Institute of Northern Engineering, February 2024. CCS cost includes CCS plant, pipeline and well.
2. Cicilio, P. et al, *Alaska's Railbelt Electric System: Decarbonization Scenarios for 2050*, UAF-Alaska Center for Energy and Power, January 2024
3. Nuclear was found to not be competitive unless gas was priced at a minimum of $25/MMBtu. 2023 CEA gas price presently $7.07 MMBtu, and is estimated to increase with imported LNG to between $19 - $24 MMBtu – see 1, Ibid.

[1] Various Alaska studies examining firm power alternatives to LNG import

STUDIES: LOWEST FUEL COST

Railbelt Power System Analysis

Institute of Northern Engineering
University of Alaska Fairbanks

- Coal is Lowest Cost Fuel ~ $4/MMBtu
  - $7 to $10/MMBtu natural gas now
  - $20 to $35/MMBtu diesel
  - Imported LNG $15 to $25 /MMBtu[1], similar price as diesel
- Coal Supply Local and Abundant.
  - The USA has 27% of the world's coal, with half of that in Alaska [2]
- LNG Import brings Price and Supply Risk, e.g.
  - Pakistan received only two-thirds of contracted LNG supply in recent years [3]
  - LNG tankers redirected to spot market
  - Rolling blackouts

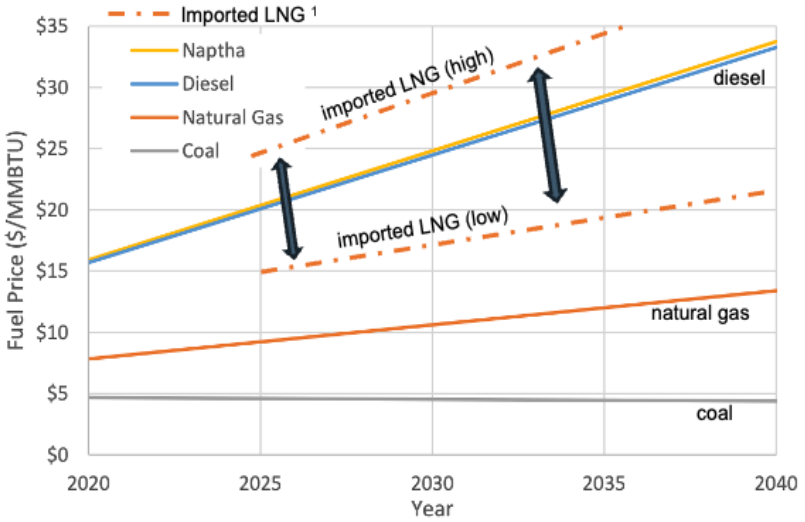

Figure 5. Assumed fuel price trajectories (2020$)

Fuel price forecasts from the Alaska Energy Authority, ref. *NREL Renewable Portfolio Standard Assessment for Alaska's Railbelt, 2022*, NREL/TP-5700-81698, https://www.nrel.gov/docs/fy22osti/81698.pdf

[1] Imported LNG price estimate from UAF study *"**Cook Inlet Region Low Carbon Power 2024**", Paskvan et. al.*
[2] www.usibelli.com/coal/abundance
[3] Bloomberg, Stephen Stapczynski and Faseeh Mangi, ***How Energy Traders Left a Country in the Cold***, December 14, 2023, https://www.bloomberg.com/features/2023-how-commodity-traders-switched-off-pakistan-energy/

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REGIONAL DEPLETING GAS SUPPLY

LNG IMPORT: PLANNED FOR HEATING AND A "BRIDGE SOLUTION" FOR POWER

Option	Estimated Fuel Supply Cost *
Coal Biomass	**~$4 /MMBtu**
Utilities Working Group BRG Report New Gas Supply Options (New Inlet Gas, Pipeline, Kenai LNG, Floating Regas Unit, Barge) with regasification costs	**$18 - $22 /MMBtu**
800 mile gas pipeline for Southcentral	**MIN $12.80 /MMBtu ASSUMING** • CAPEX IS $10B , WITH 25% EQUITY NEEDED - $2.5-3.5B • FEED GAS IS $1/MMBtu – LESS THAN HALF OF HENRY HUB RECENT PRICES, WHICH AVERAGED ~$2-$8 SINCE 2020 • ASSUMES ALL SOUTHCENTRAL & INTERIOR AK ELECTRICITY AND HEAT DEMAND INCL FAIRBANKS CONVERTING OIL/WOOD TO PIPELINE SOURCE, PLUS NIKISKI REFINERY RAMPUP, FOR THE 'BASELOAD' SCENARIO. *NO FUEL OR POWER DIVERSIFICATION.*
EIA Actual U.S. LNG import prices (2022-23)	**~$8-41 /MMBtu**
Enstar LNG	**"could be ~$20 - $30" /MMBtu ****

* Based on UAF/EERC *Economic Feasibility Report, Cook Inlet Region Low Carbon Power Generation with Carbon Capture, Transport, and Storage Feasibility Study,* Dec 2023 / March 2024 and *BRG Cook Inlet Supply Report,* July 2023 produced for AK Utilities Working Group. (Utility CEA has since released its own summary Black & Veatch Feb 2024); and *Economic viability assessment, Alaska LNG project Phase 1, Wood Mackenzie, Oct 2024*. ** RCA Jan 15, 2025 Enstar Presentation

WIND, SOLAR & GRID BATTERY STRATEGIES CARRY SUPPLY CHAIN RISKS

MATERIALS ARE IN 'CRITICAL' SHORT SUPPLY (DOE)

EXECUTIVE ORDER: PAUSES WIND LEASING AND PERMITTING

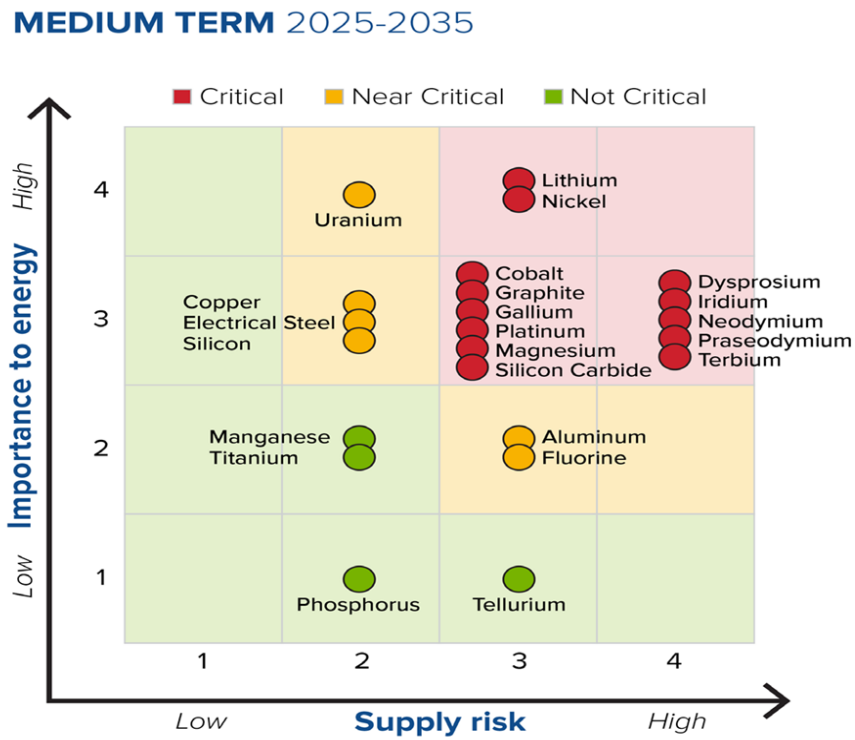


Figure ES.2. Medium-term (2025–2035) criticality matrix [edited for relevance; EV info excluded]:

- Rare earth materials (neodymium [Nd], praseodymium [Pr], dysprosium [Dy], and terbium [Tb]) used in **magnets in wind turbine generators** continue to be **critical**.
- Materials used in **batteries for stationary storage** are now considered to be **critical**. While cobalt (Co) was found to be critical in this and previous reports, lithium (Li) becomes critical in the medium term due to its broader use in **various battery chemistries** and the rampant growth of the EV industry. Natural graphite is a new addition in this assessment and is also found to be **critical**.
- Major materials like aluminum (Al), copper (Cu), nickel (Ni), and silicon (Si) move from noncritical in the short term to near critical in the medium term due to their importance in electrification.
- Electrical steel is near critical due to its use in transformers for the grid

DOE *Critical Minerals Assessment*, July 2023

CARBON CAPTURE TECHNOLOGY IS IN USE

- EPA:
  - CC is a proven technology, Best System of Emissions Reduction (BSER)
- Track record of CC success with coal plants; as yet unproven with gas plants
- Large CC technology global deployment (2022):
  - 41 in operation
  - 26 under construction
  - 325 under development

CO_2 USE AS AN ALTERNATIVE TO STORAGE:

FOOD SECURITY & PACKAGED CO_2

Alaska imports 95% of food

- CCS plant can provide HEAT and CO_2 for greenhouses at low cost
- DNR land adjacent to power plant
- National growers interested

Alaska imports 100% of CO2

- Essential for hospitals, beverage industry, industrial uses
- TEC can supply at lower cost than current

STAKEHOLDER AND POLICY SUPPORT

2024 – Carbon Storage and Class VI Permitting Primacy Legislation Passed

2024 DOE $9M with $2.2M State Matching – work under way for pipeline routing and CO2 storage verification

2024 – House votes unanimously (39-0) to prohibit LNG infrastructure costs being passed on to utility customers, signalling lack of support for long term LNG

2023 – Dittman Public Research Poll:
65% support coal with CCS
65% opposed to LNG import

G7 and EPA affirm decarbonized coal will not be phased out. Decarbonized coal fits COP28 goals

DOE HAS FUNDED MULTIPLE COAL CCS PROJECTS:

Project	In-Service	Capacity	Capex	Estimated Status
Petra Nova, TX	2016	1,400,000 (tCO2/yr)	$1,000M	**In Operation** **DOE-funded $195M** **Successful CCS Project**
Linde – City Water Light & Power Pilot Project, IL	2024	73,000		Under Construction **DOE-funded pilot $47M**
Basin Electric Dry Fork Pilot Project, WY	2024	54,800	$64M	FEED & Construction **DOE-funded (multiple), including pilot test & lg scale demo funding**
Dave Johnston Plant, WY		1,260,000	$850M	Planning **DOE pilot test**
Gerald Gentleman CC Program, NE		1,900,000	$438M	Planning & FEED **DOE FEED funding, CarbonSafe funding, Design/Costing funding**
Project Tundra, ND		4,000,000	$1,450M	FEED & Construction **DOE-funded FEED, Carbon Safe, and lg scale demo funding $350M**
Prairie State Gen Stn, IL		7,676,700	$2,044M	FEED Completed **DOE-funded FEED**

Source: BU Analytics Feb 2023, with updated information added Feb 2024

$400M DOE NOFO FOR CCS COAL PLANT ISSUED

OCED NEWS

OCED
Office of Clean Energy Demonstrations

December 17, 2024

OCED Announces $1.3 Billion in New Funding to Bolster Carbon Capture, Utilization, and Storage Technologies

The U.S. Department of Energy (DOE) Office of Clean Energy Demonstrations (OCED) today **opened applications** for up to $1.3 billion in funding to catalyze investments in transformative carbon capture, utilization, and storage (CCUS) technologies. This funding—provided by OCED's Carbon Capture Demonstration Projects Program and the Carbon Capture Large-Scale Pilot Projects Program—will help to catalyze the development and commercialization of carbon capture technologies with significant investments targeting the design, construction, and operation of large-scale point-source carbon capture projects. OCED aims to use this funding to enhance the confidence of commercial entities in adopting CCUS technologies, broaden the market for electricity generation and industrial emitters, and reduce costs to expand the feasibility of CCUS implementation across facilities. This funding aims to help create good-paying jobs, reduce pollution to deliver healthier communities, and ensure America's global leadership in developing cost-effective emissions reducing technologies for the nation's electricity generation and industrial sectors.

Commercial demonstration of advanced carbon capture technologies, integrated with reliable transportation and storage infrastructure, is necessary for the widespread deployment of carbon capture technologies.

For this opportunity, OCED plans to fund up to 11 projects across three main topic areas:

- **Topic Area 1 - Carbon Capture Demonstration Projects:** Up to $750 million for commercial-scale carbon capture demonstration projects integrated with carbon dioxide (CO_2) transportation and storage infrastructure at up to one coal-fired power plant and up to two industrial facilities that advance technical maturity, reduce uncertainty in cost and performance, and increase the potential for the technology to be replicated and deployed at additional facilities.

- **Topic Area 2 - Carbon Capture Large-Scale Pilot Projects:** Up to $450 million for large-scale carbon capture pilot projects that demonstrate transformative technologi

TIMING:

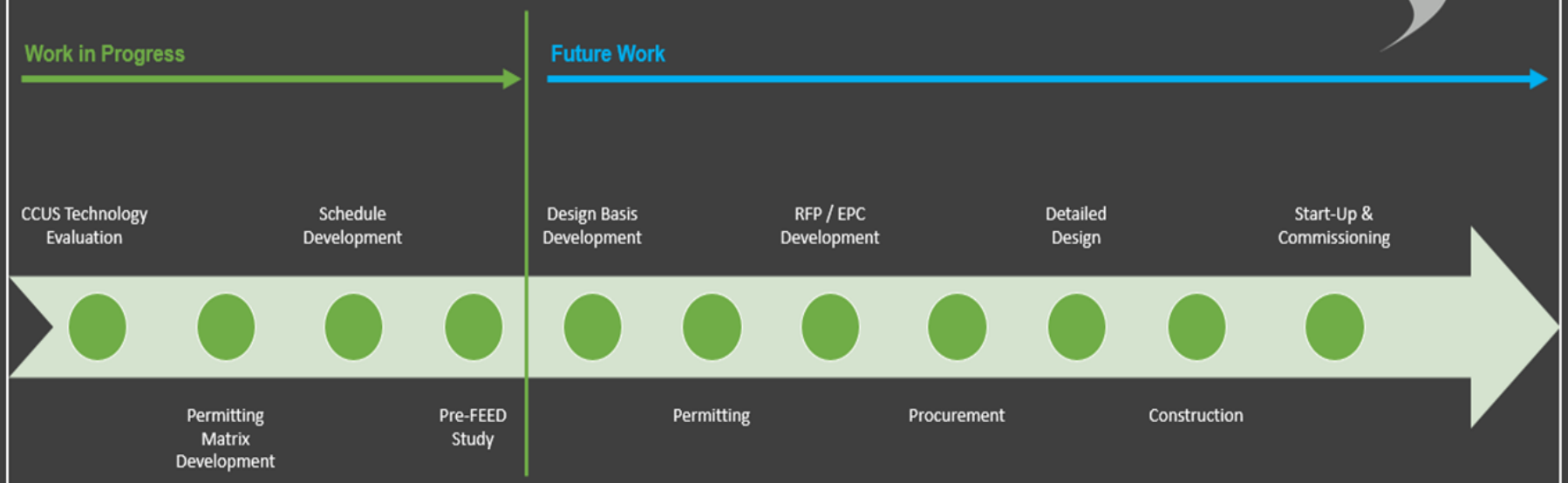
November ’24	NOFO ISSUED
Mar 1 ’25	CONCEPT PAPER
July ’25	APPLICATIONS
Winter ‘25-’26	SELECTIONS
	NEGOTIATION

FUEL AND SITE WORK

DECARBONIZED POWER PLANT

NEXT STEPS

WORK IN PROGRESS PreFeed Results Q1 2025



Authorized Work

CCUS Technology Evaluation

- Matrix Development for CCUS Vendors
- Technology Readiness Level (TRL)
- Known Installations

Permitting Matrix

- Identify Federal, Local, and State Permits/Requirements.

Schedule Development

- Permitting
- Major Equipment Procurement

Pre-FEED Study

- Process Design
- Basis of Design (BOD)
- PFDs & BFDs
- General Arrangement
- Heat & Material Balance
- Utility Summary
- Equipment Sizing
- Cost Estimate

Large Power Plant Procurement in Most Jurisdictions

CUSTOMARY PROCESS

TO MOVE TO FID

State entity or utility leads procurement process

- issues RFP with draft PPA
- sets out firm capacity need, term, guarantees, start date, interconnection, conditions

Developer prepares proposal and submits commitment letters from development team:

- Financing
- EPC
- Major equipment suppliers

State entity or utility conditionally contracts power plant developer

Elements similar to the successful Bradley Lake power plant financing

WHAT WE OFFER

Secure, long-term in-State fuel source providing power security for critical needs such as DoD expansion

Economic development – powering critical minerals and other mining sites

Scalable for data center customers – three potentials in discussion

New infrastructure power at cost competitive with existing gas-fired plants

Diversification from gas power averages down overall consumer utilities costs. Preserves remaining Cook Inlet reserves for heating needs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POWER ALASKA'S FUTURE NOW

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