

New mines could consume some North Slope gas

Many Alaskans hope that a side benefit of the proposed multibillion-dollar LNG project would be to spark a new golden age for Alaska's historic mining industry.

It likely won't be that simple — nothing is for an industry beset by such challenges as numbing costs, remote sites, extreme climate and environmental landmines.

However, siphoning a small stream of gas from the 800-mile pipeline feeding the Alaska LNG project¹ could help mines improve their financial margins, shaving power costs in a place where energy can be extraordinarily expensive.

Mining is a small but important industry in Alaska. It creates wealth, produces jobs, pays well. Mining, with commercial fishing, once dominated the Alaska economy. It helped populate the territory and build the towns. It helped form the rugged, self-reliant, sourdough self-image many Alaskans continue to hold of themselves.

Today, mining contributes about 4 percent to the Alaska's gross state product, or about \$2.5 billion a year, according to U.S. Bureau of Economic Analysis data. It's long been eclipsed by the oil and gas industry and government spending, which together account for about half the economy.

Alaska's best mine prospects mostly are in far-flung locations, many expensive miles from reliable and affordable energy sources. These are the ones that some day might sip from the North

Slope gas flow. As such, they are eying the Alaska LNG project with interest.

The state's deal with its partners in Alaska LNG — North Slope producers ExxonMobil, BP and ConocoPhillips, and pipeline partner TransCanada — requires at least five points along the pipeline between Prudhoe Bay and Cook Inlet where mines, other industries and communities could get some of the gas. The state, not the companies, will decide the locations of the offtakes.

The remoteness of Alaska's mine prospects tells a story that often is not understood by those who never have visited the state. Most of Alaska lies off a road grid. In many ways it is like the 1850s' American West. It is wilderness. It is vastness. It is unsettled.

These traits put many mine prospects on the financial margins at the starting gate. But the industry understands high costs and remoteness — Alaska isn't the only remote place the mining industry operates in the world — and it knows that importing energy can be expensive.

To illustrate, take the case of the Nixon Fork mine.

Nixon Fork lies about 30 miles northeast of the village of McGrath in west-central Alaska. It is remote. Miners have worked the ground for about 100 years, mostly taking gold, silver and copper. The Nixon Fork underground gold and copper mine operated in gasps from 1995 to 1999, in 2007, and from 2011 to 2013.²

Diesel fueled Nixon Fork's power generators. For getting fuel to the site, the expensive option was the only option. Mystery Creek Resources, the mine operator, hauled in diesel aboard DC-6 and C-130 Hercules planes. The mine shut down in 2013 as the operator experienced financial problems.³ (Gold and copper prices fell in 2013.)

SIX BIG MINES

Six big mines dominate production in Alaska, although many, many small placer gold operations — several hundred of them — dot the summer landscape. (Rock, sand and gravel mining for construction sites is a different kind of business and not considered for this report.)

Besides gold, Alaska mines primarily produce coal, silver, lead and zinc, especially zinc.

The Red Dog zinc, lead and silver mine in remote Northwest Alaska, above the Arctic Circle, is one of the world's largest zinc producers. It started up in 1989, signaling a renaissance of an industry in Alaska that had limped along for decades, really since the start of World War II.

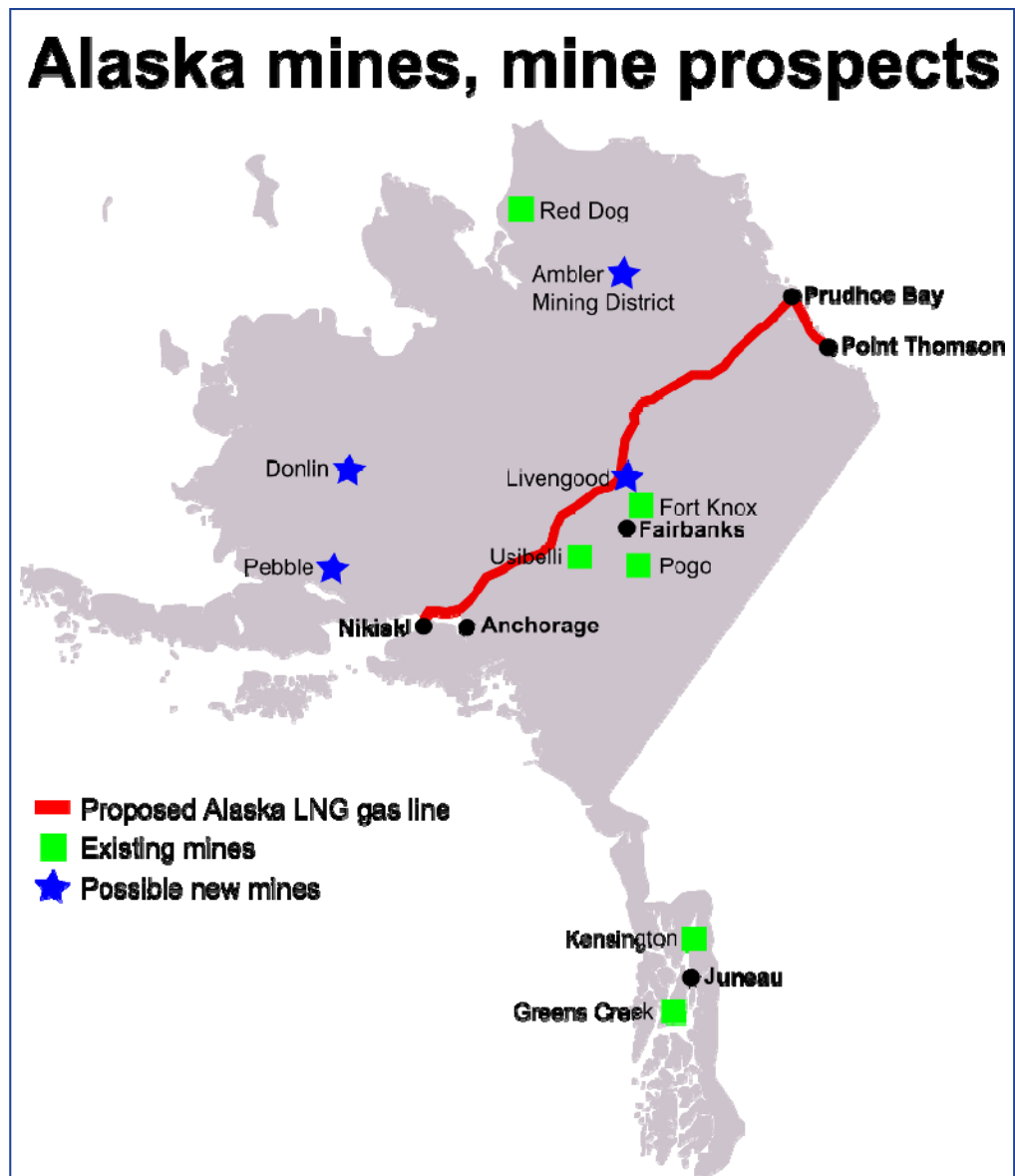
Until gold prices broke into the stratosphere in recent years, Red Dog's zinc production alone typically exceeded the collective production from all Alaska gold mining. Still, Red Dog accounts for perhaps

one-third the value of Alaska's mineral production. Canadian company Teck Resources operates Red Dog.

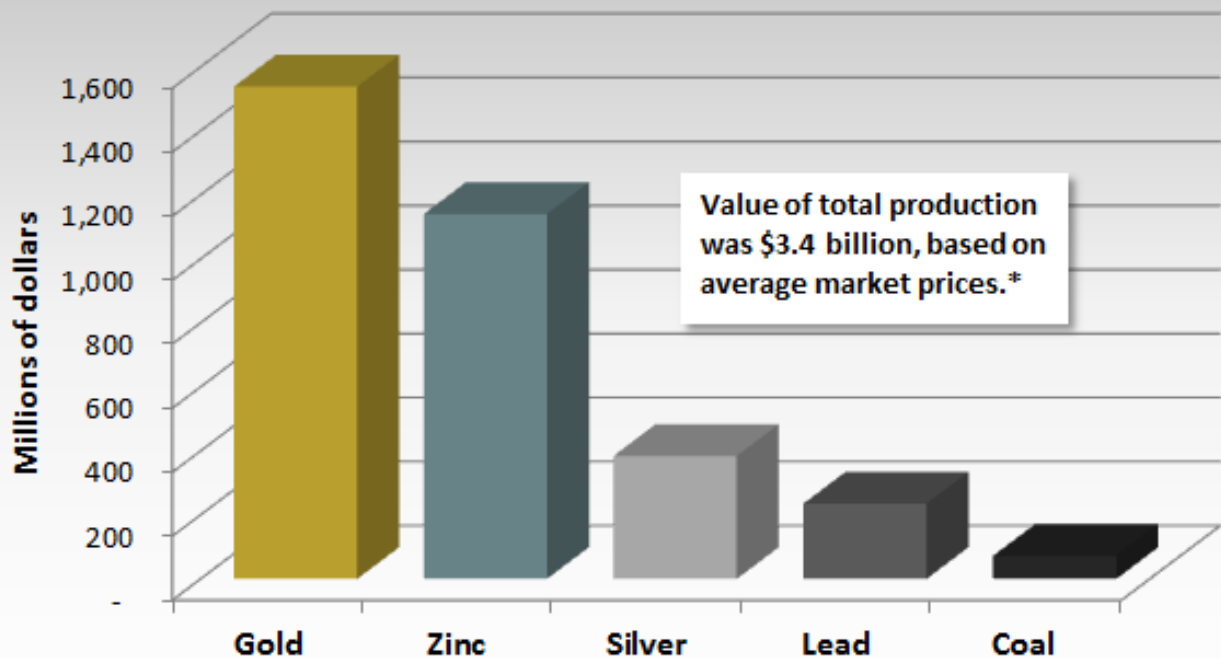
Another world-class resource is the Greens Creek Mine, which also started in 1989. Its money rock is silver, but it also produces lead, zinc and gold. Idaho-based Hecla Mining runs operations at the mine on Admiralty Island in Southeast Alaska.

Three of the other big mines target gold:

- Fort Knox near Fairbanks, run by Kinross Gold, a Canada-based global operator. The first gold was poured in 1996.



What Alaska mines produced in 2012



* Excludes sand, gravel, rock, gemstones, small amount of copper

Source: Alaska Division of Geological & Geophysical Surveys

- Pogo, near Delta, about 100 miles southeast of Fairbanks, run by Japanese joint venture Sumitomo Metal Mining and Sumitomo Corp. Production started in 2006.
- Kensington near Juneau in Southeast, run by Idaho-based Coeur d'Alene Mines. Production began in 2010.

The sixth big mine is the granddaddy, dating its birth to 1943, as most of Alaska's other mines were shutting down. Usibelli Coal Mine near Healy, in Interior Alaska, was started by an Alaskan entrepreneur, Emil Usibelli, and remains Alaskan owned.

The five other big mines export their production, and Usibelli exports some of its coal, too. Its core market, however, is six Interior Alaska power plants.

None of the six has talked publicly about tapping into the gas stream if the Alaska LNG project goes

ahead. But the gas would be available to the electrical power grid that Fort Knox, Pogo and Usibelli already plug into.

HOPES FOR A BIG GOLD MINE

Alaskans talk about several large potential mines, but just one is in late gestation.

Work on Donlin Gold's environmental impact statement is underway.⁴ A decision on whether to build the \$7 billion project 277 miles west of Anchorage might come in 2017 or thereabouts.

Donlin would be massive. Its initial production of 1.5 million ounces of gold a year would rank it among the world's largest gold mines, as big as the biggest producers in Indonesia, South Africa, Peru, Uzbekistan and Nevada.

Figuring out how to power Donlin has vexed developers for well over a decade. Finally, they've landed on a two-pronged approach: diesel

delivered via a chain of hand-offs from ocean to river to a newly built 30-mile road, and natural gas via an approximately 315-mile pipeline that would be the longest single gas line in Alaska, at least until Alaska LNG project goes ahead.

The developers are Barrick Gold, a Canada-based global mining concern, and NovaGold Resources, a Canadian junior mining company whose main play is Donlin.

As conceived, Donlin would consume about 30 million to 35 million cubic feet of natural gas a day. The gas would fuel the mine's 227-megawatt power plant. Waste heat from the plant would heat the mine's buildings. Diesel would fuel the heavy-equipment and truck fleet, and be the power plant's back-up fuel.

The gas pipeline would cost \$1.1 billion, the developers estimate. It would start at Cook Inlet,

Alaska's six big mines

Red Dog — zinc, lead, silver

Started in 1989 north of Kotzebue in Northwest Alaska

Greens Creek — silver, gold, zinc, lead

Started in 1989 on island west of Juneau in Southeast Alaska

Fort Knox — gold

Started in 1996 near Fairbanks in Interior Alaska

Pogo — gold

Started in 2006 near Delta in Interior Alaska

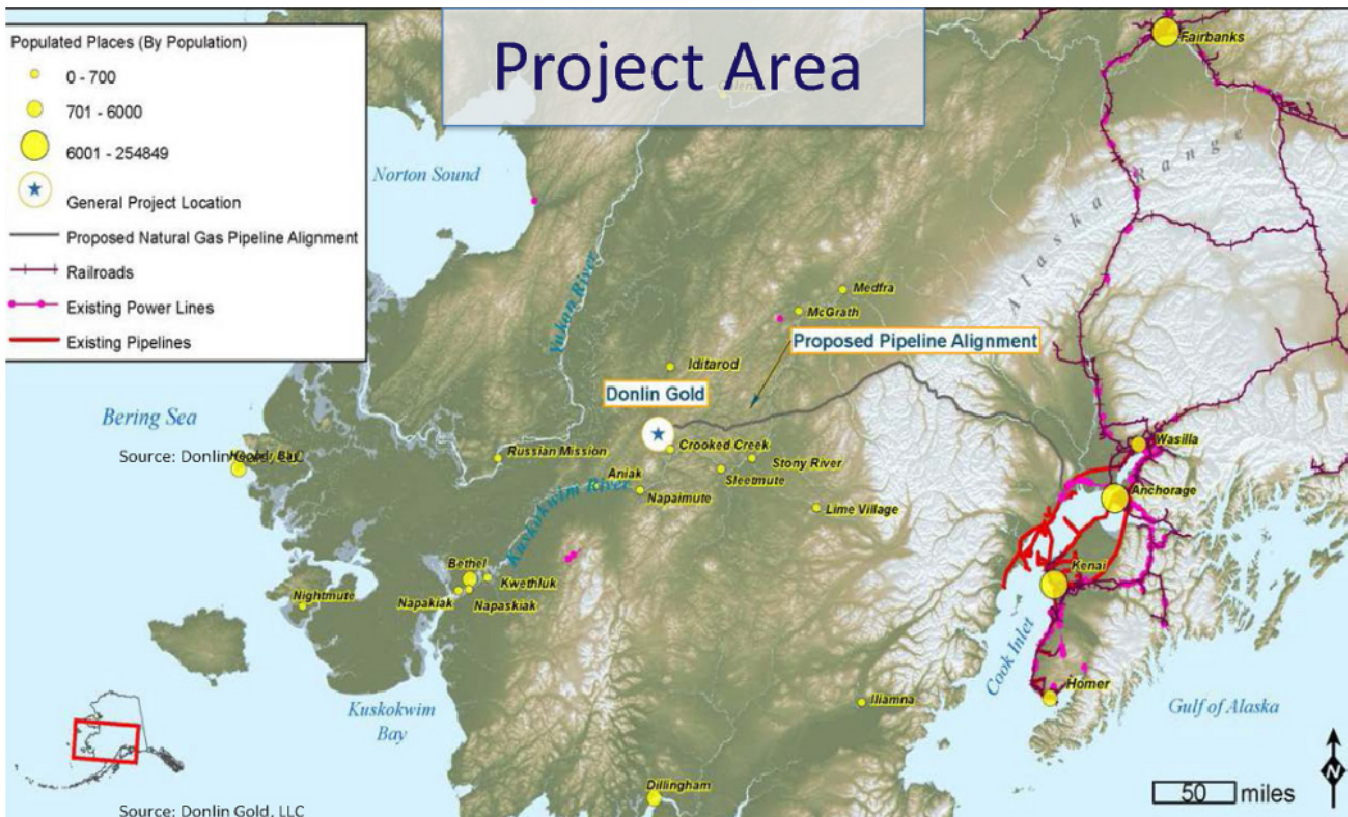
Kensington — gold

Started in 2010 north of Juneau in Southeast Alaska

Usibelli — coal

Started in 1943 near Healy in Interior Alaska

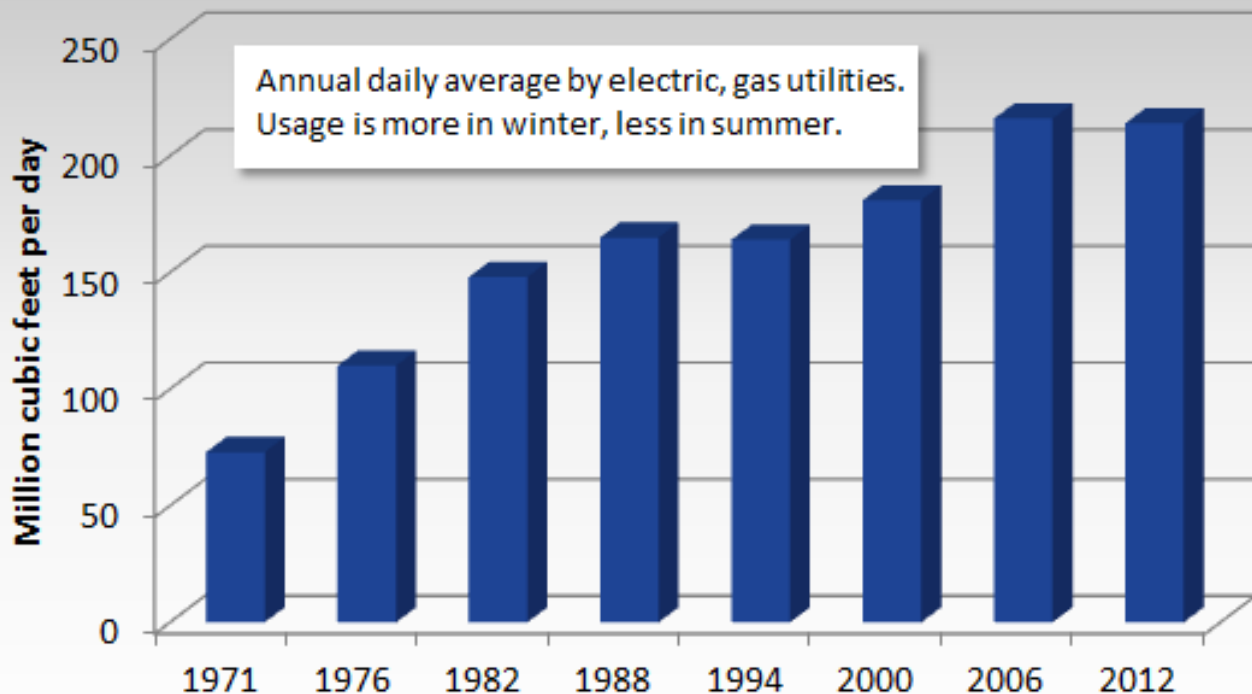
Donlin Gold prospect in Western Alaska



Source: URS

The proposed Donlin Gold Mine in Western Alaska would be a \$7 billion development that includes a \$1.1 billion, approximately 315-mile natural gas pipeline to the mine site.

Cook Inlet gas consumption*



* Excludes gas consumed in field operations or exported as LNG or fertilizer.

Sources: Alaska Division of Oil & Gas; U.S. Energy Information Administration

the source of the natural gas, cross a mountain range, eight major rivers and two active earthquake faults. The buried pipeline would need special engineering to traverse patches of discontinuous permafrost — to make sure it doesn't freeze unfrozen ground and thrust toward the surface, or thaw frozen soil and sag. Either scenario could cause the line to rupture.

Should Donlin get built and North Slope gas become available, the mine very well could consume some of the gas, taking a feed from the line near Cook Inlet. Another option for Donlin could be to buy gas from Cook Inlet fields. But gas production marketed from the inlet's aging fields — some of which date back 50 years — peaked in 2001 and has plunged since. Regional utilities are assured of supplies through at least 2019, and explorers are looking for and could find new supplies. Donlin's earliest start-up date might be 2020.

Regardless of the gas source, the Donlin EIS assumes gas from somewhere will come in via pipeline.

Over more than a decade, Donlin developers considered many alternatives instead of piping gas to the site for power generation.⁵ These included producing coal-bed methane nearby, combining diesel generators with wind turbines, small nuclear systems, and buying electricity someone else produces and stringing transmission lines across hundreds of miles of wilderness. The other options looked more expensive, less reliable or environmentally trickier — in some cases all three.

Two comparisons might help put the scale of Donlin's gas needs in perspective for those who can't easily grasp megawatts and cubic feet.

As one of the world's largest gold mines, Donlin's power needs would not be small. Its 227-megawatt power plant would give it the capacity

to produce a bit less electricity than Golden Valley Electric, which serves nearly 100,000 residents of the Fairbanks region. Donlin likely would produce much less power than its generating capacity, as is true for almost all electric utilities. Its average running load would be an estimated 153 megawatts.

The 30 million cubic feet a day of natural gas that Donlin would need for its power plant is roughly one-third the volume the rest of Alaska's electric utilities burn on a typical day. Add in utilities that pipe gas to home and business furnaces for heat demand, and Alaska burns about 200 million cubic feet of gas a day on average. So Donlin could raise Alaska demand by perhaps 15 percent or so.

But the Alaska LNG project is so big that even if Donlin got all of its gas from the North Slope, it would consume only about 1 percent of the daily flow that would leave Prudhoe Bay for market.

OTHER POSSIBLE MINES

The Alaska business community likes to talk about three other mining prospects that could tap the Alaska LNG gas stream: the Pebble copper-gold play, Livengood gold and the Ambler mining district.

All of these prospects are less certain of development than Donlin.

Pebble. Pebble would be to Donlin what a mountain is to a mesa. It would be bigger than even the Red Dog zinc and lead mine in Alaska's Northwest Arctic.

Where Donlin boasts an estimated 40 million ounces of gold in its reserves, Pebble hosts an estimated 107 million ounces of gold. And gold isn't Pebble's No. 1 prize. Copper is. An estimated 80 billion pounds of it. Pebble also holds molybdenum (used in making steel), rhenium (used in jet engines) and palladium (used in automobile emissions controls).

Pebble, if it's developed, would need a power plant perhaps twice the size of Donlin's — Pebble's

development plan is still a work in progress, so it's unclear at this point what the mine's specs would be. The developer — Canadian junior mining company Northern Dynasty Minerals — hopes to use natural gas at the mine site, whether from Cook Inlet or the North Slope. One early assessment, from 2011, estimated the mine would need 50 million cubic feet of gas per day.

Financing such a massive development is one high hurdle for Pebble. Two others are political and environmental. The deposit lies amid headwaters of two of the five river systems that comprise the Bristol Bay watershed — which supports the world's largest wild sockeye-salmon commercial fishery. The region also hosts subsistence fishing and high-end sports fishing lodges. Opposition to development is organized, entrenched and vocal.

Atop this, in 2014 the Environmental Protection Agency proposed to protect the Bristol Bay fisheries by restricting mining in the region under its Clean Water Act powers.⁶ A final decision is pending.

Livengood. The Livengood prospect has one advantage over all the others: location. It's on the Alaska road system, about 70 miles northwest of Fairbanks.

Although Alaska LNG's proposed 800-mile pipeline would pass Livengood, the mine's 2013 feasibility study doesn't envision tapping the gas stream directly.

Rather, the developer, International Tower Hill Mines, a junior Canadian mining company, sees the Fairbanks electric utility boosting its power supply, perhaps with a gas-fired turbine at a generating plant outside Fairbanks, while the mining company builds a 50-mile, 239-kilovolt transmission line to the mine site. All in all, a \$129 million project. The annual power bill would run about \$113 million, about one-third of the mine's operating costs.

International Tower Hill Mines estimates the Livengood gold resource at about 20 million ounces — "measured, indicated and inferred," in

the industry's language. That's about half the size of Donlin's, but sizable nonetheless.

Livengood would produce nearly 600,000 ounces of gold a year for 14 years, making it one of the world's more substantial gold mines.

But the project is stalled. The 2013 feasibility study concluded each ounce would cost \$1,474 to produce. Gold was last above that price in early 2013. It averaged about \$1,250 an ounce in the first nine months of 2014.

Management currently is "open to strategic alliance, while considering all appropriate financing options," according to a recent presentation.⁷

Ambler mining district. For several years, the state has discussed building a road to the Ambler district to jump-start mining there.

Ambler is remote, on the Brooks Range flanks in northern Alaska. It's just above the Arctic Circle. The coast is far away. The nearest road is far away.

To create access, the state has drawn plans to punch a spur from that nearest road — the Dalton Highway, a two-lane north-south supply artery to North Slope oil fields. A state agency, the Alaska Industrial Development and Export Authority, has taken plans for a \$500 million, 216-mile, one-lane toll road⁸ to Alaska Native groups and local communities in advance of pursuing federal permitting, including an environmental impact statement. Some groups support the plan; some oppose it.

The Ambler road is modeled after a late-1980s 52-mile toll road and port the state built to help the Red Dog mine. That road is widely regarded within Alaska as a smart use of state resources — it's even made money for the state.

What would be at the end of the 216-mile road to the Ambler district?

Geologists believe the area is rich in copper, zinc, gold and other minerals.

AIDEA officials like to talk about a variety of companies probing Ambler's prospects, but really

Potential Alaska mines

Donlin

Location	Western Alaska near Kuskokwim River, 277 miles west of Anchorage
Resource	Gold
Status	In permitting, environmental impact statement underway; development decision pending
Developers	Barrick Gold, NovaGold Resources
Website	donlingold.com

Pebble

Location	Southwest Alaska, 200 miles from Anchorage
Resources	Copper, gold, molybdenum
Status	Pre-development, pre-permitting
Developer	Northern Dynasty Minerals
Website	pebblepartnership.com

Livengood

Location	Interior Alaska, 70 miles northwest of Fairbanks
Resource	Gold
Status	Early feasibility, pre-development
Developer	International Tower Hill Mines
Website	ithmines.com

Ambler district

Location	Northern Alaska, about 300 miles northwest of Fairbanks and 200 miles west of Dalton Highway.
Resources	Copper, zinc, lead, gold, silver
Status	Exploration underway
Explorers	NovaCopper, among others
Website	novacopper.com

Source: Office of the Federal Coordinator research

only one is talking with a lot of bravado.

NovaCopper, a Canada-based junior mining company, has rights to a variety of public and

private mining claims in the large district and is focused on two — one called Arctic and the other called Bornite.

Its 2013 "preliminary economic assessment" outlines a \$718 million development that would mine copper, zinc, lead, silver and gold and make lots of money, according to the company's 2013 annual report. The estimate "includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves." Translation: A lot more exploration is needed to prove up the mineral reserves.

In August 2014, the company issued a press release noting it "expects to be a consumer of LNG" from a small-scale state-led project to truck LNG to Fairbanks from a small plant that would be built on the North Slope.⁹ That assumes the AIDEA toll road to Ambler gets built. The road also would be how the mine would get its production to market.

State officials have talked about the Sun and Smucker prospects in the Ambler district, too. A Canadian junior called Andover Mining Corp. has rights to those.

In early 2014, Andover went bankrupt after failing to work out a reorganization plan with its creditors.

A GOLDEN LEGACY

Commercial mining in Alaska dates almost to when the United States acquired the territory from Russia in 1867.

Far-north mining became a new pathway for American migration in the late 19th century as the east-west frontier ran out at the Pacific coast and a few of the most adventurous, avaricious and optimistic shifted their course northward. Mining was a key catalyst for industrial development during Alaska's first 70 years as a U.S. territory.

Into northland lore strode such miners as Joe Juneau (Southeast), Skookum Jim (Klondike), Felix Pedro (Fairbanks) and the three lucky Swedes (Nome).

The early decades involved mostly small-scale stuff, except for some larger gold discoveries near the state capital of Juneau.

The big event — the Klondike gold rush in 1898 — actually happened just across the border in Canada's Yukon. But aftershocks were felt across Alaska as hordes of dreamers the Klondike drew, and others, found gold elsewhere — in beach sands near Cape Nome on the Alaska's west coast, near Chena Slough in the territory's Interior, and so on.

Gold wasn't the only treasure unearthed.¹⁰ A network of mines at Kennecott running from 1911 to 1938 produced a bonanza of copper. Coal mining began in 1917. Mercury mining near Sleetmute. Marble quarried on Prince of Wales Island. Tin on the Seward Peninsula. Platinum at the fabulously named site of Goodnews Bay.

Gold was Alaska mining's bedrock business, but World War II blasted that industry apart. A federal order shut down gold mines as not critical to the war effort. Most big operations never restarted. The industry hobbled forward on mostly small placer operations until the big Fort Knox open-pit mine started in the mid-1990s. Two large underground mines since have opened as well, cashing in on higher gold prices.

The copper, mercury, marble, tin and platinum mining are long gone.

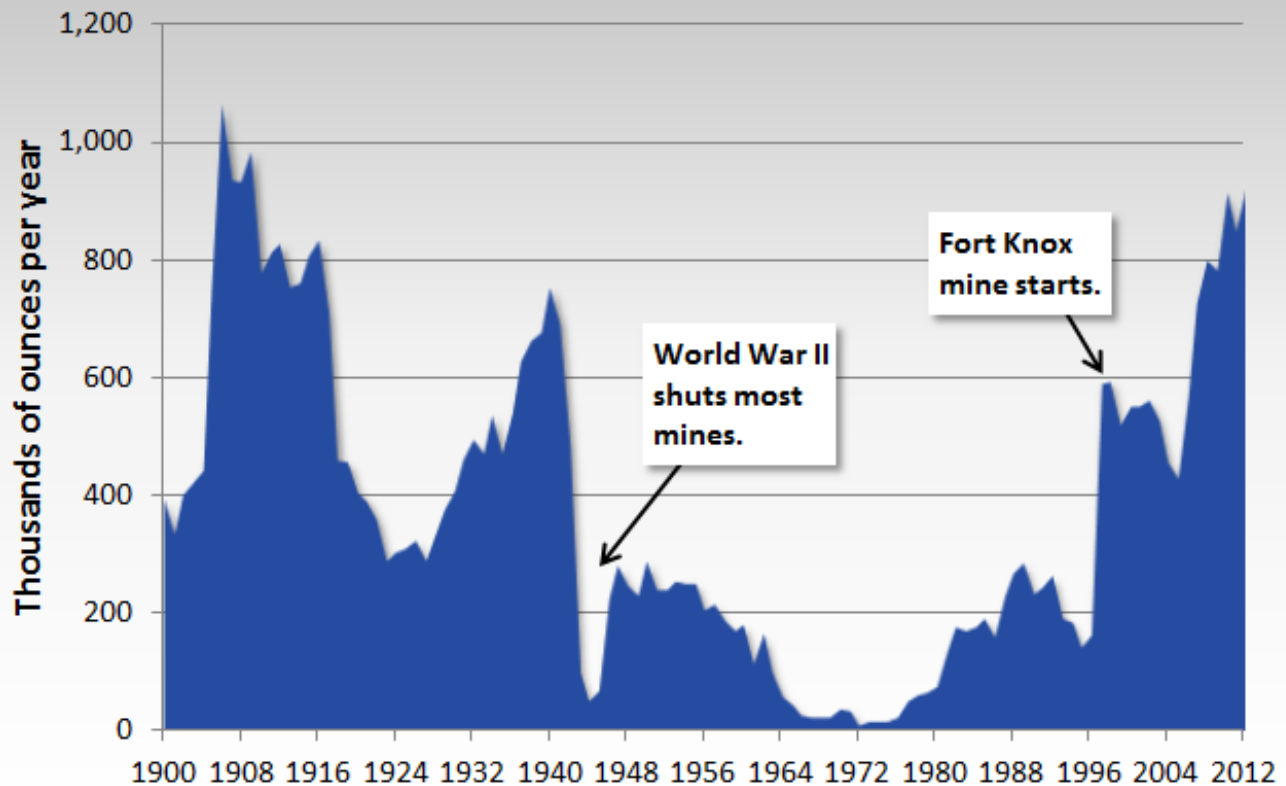
But mining's aura glows over Alaska like the aurora. Riding a sternwheeler on the Chena River in Fairbanks, the "Golden Heart City," visiting a gold dredge site and panning for gold remain popular draws for package tourists today.

LONG ANTICIPATED SIDE EFFECT

The Alaska mining industry's ether has vibrated through the years with the possibility that North Slope gas would flow to market.

In the 1970s, the thinking was that roads built for a gas pipeline project would break new ground for the mining industry.

Alaska gold production 1900-2012



Source: Alaska Division of Geological & Geophysical Surveys

"Mining could be expected to grow somewhat because of the increased access to mineral rich areas," said a 1976 environmental impact statement for two pipeline projects under consideration then.¹¹ Neither was built.

In the early 2000s, Alaska's governor formed a Natural Gas Policy Council to figure out how to get North Slope gas to market. A University of Alaska Fairbanks geological engineering professor testified about what a gas pipeline could do for the mining industry.

Alaska has 15 major "mineral occurrences" near the gas pipeline corridor through Interior Alaska, he said. The 50 percent probability gross value of these minerals is \$157 billion.

The new mines could employ as many as 20,000 people, the governor's council reported.¹² "The economic and employment impact of developing these mineral resources could exceed that of

Prudhoe Bay." Gas from the pipeline could help address the largest single cost of mining — energy, the council said.

In 2011, the project plan for a smaller-scale state-backed North Slope gas pipeline serving Alaska also cited the benefits for mining: "The project has the potential to stimulate existing industries and encourage new industrial activities, including mining."¹³

GUESSING GAS DEMAND

Alaska's current natural gas demand — outside of oil-field operations — averages about 200 million cubic feet a day for power generation and heat.

Looking at the mining prospects and counting cubic feet, the industry could boost that statewide total maybe 15 to 50 percent. Though 50 percent would mean everything goes well. And 0 percent is also a real possibility.

Donlin Gold, if the mine is developed, would need about 30 million cubic feet a day.

Pebble, if the mine is built, would need perhaps 50 million cubic feet a day, ideally from Cook Inlet, the North Slope or a combination of the two.

A gas-fired turbine to feed electricity to a Livengood gold mine, if it's developed, would burn about 8.5 million cubic feet a day, according to a 2013 report on Fairbanks-area gas demand.¹⁴

It's unclear how much gas Ambler mines would demand if any get developed.

Smaller mine prospects could gain as well. Many, particularly within reach of Alaska's roads, are in

various stages of exploration. These, too, could benefit from the availability of abundant gas if they get developed and the Alaska LNG project is built.

However much North Slope gas mines would consume, natural gas could be a cheaper, more environmentally friendly source of energy than diesel fuel. It could help shave one of the highest costs of doing business in cold, remote, rugged locations: the cost of heating buildings and powering the massive machinery of mining.



Notes

¹ "Alaska LNG project," <http://www.arcticgas.gov/alaska-lng-project>.

² Geologic Report NF-12-1, "Geologic Report NF-12-1, Technical Report on the Nixon Fork Mine Project," <http://www.firerivergold.com/i/pdf/NF-12EXE1-Form43Feb2012.pdf>.

³ Fire River Gold Corp. "Fire River Announces Waterton Takes Ownership of Nixon Fork Gold Mine," <http://www.firerivergold.com/i/pdf/FAU-pr-July-7-2014.pdf>.

⁴ U.S. Army Corps of Engineers, "Donlin Gold Project EIS Documents," <http://donlingoldeis.com/EISDocuments.aspx>.

⁵ Donlin Gold LLC, "Proposed Donlin Gold Project, Environmental Evaluation Document, Chapter 5, Alternatives Reviewed," http://donlingoldeis.com/Documents/Chapter_5_EED_FINAL_20130510_DONLIN.pdf.

⁶ U.S. Environmental Protection Agency, "Proposal to Protect the Bristol Bay Watershed," <http://www2.epa.gov/bristolbay>.

⁷ International Tower Hill Mines, LTD, "Corporate Presentation - September 2014," http://www.ithmines.com/_resources/presentations/ITH_Presentation.pdf.

⁸ Alaska Industrial Development and Export Authority, "Ambler Mining District, Industrial Access Road," <http://www.ambleraccess.org/projects/ambler/index.html>.

⁹ Interior Energy Project, <http://www.interiorenergyproject.com>.

¹⁰ Alaska Historical & Cultural Studies, "Alaska's Heritage, Chapter 4-15: Mining," <http://www.akhistorycourse.org/articles/article.php?artID=180>.

¹¹ U.S. Federal Power Commission, "Final Environmental Impact Statement for the Alaska Natural Gas Transportation Systems," http://www.arlis.org/docs/vol1/AlaskaGas/Report2/Report_FPC/Report_FPC_1976_FEISANGTS_v1.pdf.

¹² Alaska Highway Natural Gas Policy Council, "Report to the Governor, Volume 1, November 30, 2001," http://www.arlis.org/docs/vol1/AlaskaGas/Report/Report_GasPolicyCouncil_2001_RptGov_v1.pdf.

¹³ Alaska Gasline Development Corporation, "Alaska' Stand Alone Gas Pipeline/ ASAP Project Plan," http://www.arlis.org/docs/vol1/AlaskaGas/Report/Report_AGDC_2011_ASAP_ProjectPlan.pdf.

¹⁴ Northern Economics, "Memorandum Regarding Estimated Natural Gas Demand for the NS LNG Project," <http://www.interiorenergyproject.com/Resources%20and%20Documents/Estimated%20Natural%20Gas%20Demand.pdf>.

For more information, please visit our website: www.arcticgas.gov

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