

Alaska Coal and Carbon Dioxide Emissions

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Ground Truth Trekking

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COAL SEAM IN ALASKA — Alaska has a rich coal resource — Get Photo (/photos/coal-seam-in-alaska/)

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Summary

Alaska has an enormous coal resource (/Issues/AlaskaCoal/HowMuchCoal.html), and if this resource were heavily exploited and Alaska became a “coal superpower”, Alaska’s coal would make a tremendous contribution to global greenhouse gas emissions, primarily in the form of carbon dioxide (CO2). If all of Alaska’s hypothetical coal resource were mined and burned, that alone might double the earth’s atmospheric carbon dioxide. However, this is not a present a realistic possibility.

At present, however, Alaska’s modest coal mining (/Issues/AlaskaCoal/UsibelliCoalMine.html) makes a tiny contribution to global CO2, producing less than 1/10,000th of annual global CO2 emissions. Signicant changes in Alaska’s globally minor coal production (such as doubling productiong to ~3-4 million tons/year, or reducing it to zero) would have a only a very small impact on worldwide CO2 emissions.

Although Alaska is disproportionately impacted (/Issues/ClimateChange.html) by global climate change driven primarily by man-made CO2 emissions and may face very large future costs related to climate change, this is largely decoupled from Alaska coal production and burning - as long as Alaska’s production and burning stays small in scale. Large expansions in Alaska coal mining, like developing the Chuitna and arctic coalfields, might begin to have measurable climate impacts.

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Alaska Coal's Current Global CO2 Contribution

Carbon dioxide is the primary driver of climate change, and coal is the single largest source (http://www.iea.org/publications/freepublications/publication/kwes.pdf) of this carbon. In the worldwide energy supply, coal is second (http://www.iea.org/publications/freepublications/publication/kwes.pdf) only to oil. In 2011, 7.8 billion metric tons of coal were mined and consumed globally (http://www.worldenergy.org/publications/2013/world-energy-resources-2013-survey/). In 2010, coal provided 27% of the world's energy production and contributed 43% of all human carbon dioxide emissions. If global coal use expands, Alaska could potentially become a coal superpower.

Alaska's contribution to the global coal market is currently miniscule, with only Usibelli Coal Mine (/Issues/AlaskaCoal/UsibelliCoalMine.html) operating. In 2010, Usibelli mined roughly 2 million tons, representing about 0.03% of total global production. Based on our calculations, Alaska's grade of coal produces roughly 1.7 tons of CO2 from each ton of coal, during burning. Alaska's 2010 mined coal volume produced about 3.4 million tons of carbon dioxide, or about 1/100th of 1% of global human CO2 emissions.

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The Future of Alaska Coal and Carbon Emissions

CO2 and Coal

How much CO2 is released per ton of coal? Burning coal, or any hydrocarbon, not only releases the elements that the original fuel contained, but also combines them with oxygen from the atmosphere. In coal, the important “fuel” elements are carbon and hydrogen. During combustion, the carbon in coal combines with oxygen from the atmosphere, producing carbon dioxide.

Each carbon atom from coal (atomic weight: 12) couples with two oxygen (atomic weight: 16 each) and is emitted into the air as a molecule of CO2 (atomic weight: 44). Thus, for each ton of carbon in coal, 3.667 tons of CO2 are released. Since coal does not consist entirely of carbon, but in fact includes hydrogen, sulfur, water, and ash, the mass of CO2 produced per ton of coal is actually much less than that figure. In the case of Usibelli coal, due to its particular carbon content, one ton of coal produces 1.7 tons of CO2.

A more representative output per ton of coal is 2.2 tons of CO2, calculated by averaging EPA emissions factors (http://www.epa.gov/cpd/pdf/brochure.pdf) for bituminous and subbituminous coal. The balance of weight in the coal is hydrogen, oxygen, and impurities, including water. As for the hydrogen in the coal, it bonds with more atmospheric oxygen and is emitted as water.

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Alaska coal's contribution to climate change depends on the amount of coal actually produced and burned. Alaska's coal resource is known to be vast compared to current mining activities, but it is little studied. It is unlikely to be mined heavily in the foreseeable future. This is due to a combination of logistical factors; geology and location of the beds; market forces; and the fact that it is understudied. In the near future, Alaska's global coal emissions could increase by 25 million (/Issues/AlaskaCoal/potential-co2-emissions-of-the-susitna-beluga-coalfield.html) tons per year if the Chuitna Coal Project (/Issues/AlaskaCoal/ChuitnaCoalMine.html) is developed.

Coal development could potentially provide (/Issues/AlaskaCoal/alaska-coal-resources-reserves-export-carbon-dioxide.html) economic development and tax revenue to Alaska. As oil resources on state land (currently the source of almost all government revenue) diminish, resources such as coal could potentially fill the gap.

In a scenario where coal development is a major economic boon to Alaska, coal revenues could help fund Alaskan efforts to adapt to climate change and provide greater net benefit than the marginal cost of its contribution to climate change. It is unclear whether coal development itself would be economically beneficial or harmful for Alaska. Coal is readily available in Alaska, and exists in great abundance. Unlike natural gas, coal transportation infrastucture already exists in Alaska, in the form of the Alaska railroad.

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In a bad scenario, however, environmental impacts and infrastructure costs of coal development could end up as a net loss for the state, due to insufficient coal revenues to offset these costs. The marginal cost of Alaska's global carbon contribution adds to the these costs indirectly (i.e., incremental increases in climate change produce incrementally higher costs for Alaska).

More directly, potential carbon taxes are a cause for concern in coal development. If carbon pricing or carbon taxes are eventually implemented at a national level, Alaska could be saddled with fossil fuel infrastructure that cannot pay off its costs. As the most carbon-intensive fossil fuel, the carbon footprint of coal makes it especially vulnerable to carbon taxes.

Alaska as a state has a very small current coal economy, great sensitivity to climate change, and yet the potential to become a coal superpower. In a classic Tragedy of the Commons (http://eesc.columbia.edu/courses/v1003/lectures/population/Tragedy%20of%20the%20Commons.pdf) dilemma, Alaska may benefit economically from development of its coal resource, even as the impacts of global climate change fall disproportionately on the state. The profit gained from a ton of coal mined and sold may be greater than the cost incurred by the state in climate-change impacts, per ton coal mined and burned, even though the total costs of climate change to the state may dwarf the state's coal economy. This is because Alaska will incurs costs for all global carbon emissions, not simply for the emissions of its own coal.

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Alaska Coal & Carbon Dioxide Emissions

Annual Coal Production

Coal Produced

(tons/year) | Could power the world for… | CO2 produced (tons/year) |

Fraction of
World Annual Energy (2011)

Alaska Production (2010) | ~2 million | < 30 minutes | 3.4 million** | < 1/100th of 1%
World Production (2010) | 7.8 billion | 14 weeks | 17 billion** | 27%
Coal Stocks | Coalfields
(metric tons) | Would power the world for… | CO2potential (metric tons) | Could raise global average temperature by:
Estimated Alaska Recoverable Resource* | 510 billion | 18 years | 1 trillion | 3° F
Estimated US Recoverable Resource | 1.6 trillion | 56 years | 3.5 trillion | 8° F
Total Alaska Resource | 5.1 trillion | 180 years | 11 trillion | 15° F
World Resource | 14 trillion | 500 years | 31 trillion | 25° F
*510 billion tons of recoverable resource is estimated at 10% of Alaska’s total estimated resource. This would give Alaska a reserve-to-resource ratio comparable to more explored coal

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regions. Alaska's currently identified recoverable reserves are only 5.3 billion tons, but this is not meaningful because most of the state's coal beds are not well-studied.
**Emissions per ton vary by coal grade and composition. Coal from Usibelli Coal Mine (Alaska's only mine) is a low-sulfur subbituminous coal that produces roughly 1.7 tons of carbon dioxide per ton of coal, due to its particular carbon, oxygen, hydrogen, water and impurities content. This table uses 1.7 as the factor for current Alaska mining and 2.2 as a more representative factor for world coal and for Alaska's statewide coal.

Conclusion

In conclusion, Alaska coal is at present a marginal contributor to CO2 emissions. Although Alaska has the potential to become a coal superpower and contribute dramatically to global emissions, this will not occur in the immediately foreseeable future. At present, the economics of Alaska's coal production are functionally decoupled from the economics of state climate change. While Alaska may make coal development choices which are economically significant to the state in the near future, such as the development of Chuitna (/Issues/AlaskaCoal/ChuitnaCoalMine.html), these choices are very modest on the stage of global carbon emissions and climate change.

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