How Do Higher Fuel Prices Affect Alaska’s Transportation System and Economy?

By Ginny Fay, Tobias Schwörer, Mouhcine Guettabi, and Jeffrey Armagost

Alaska needs a lot of energy to keep it running, and it relies much more on air and water transportation than the Lower 48 states do. So it’s especially vulnerable to spikes in fuel prices, which make transportation more expensive and add to the costs of producing everything from fish fillets to gasoline—and more expensive for households to keep their vehicles running and pay for transportation services. Alaska saw such fuel price spikes in recent years, particularly in mid-2008. But until now, no one has analyzed how higher fuel prices affect costs of transportation and ultimately work their way through the state economy.

Using the actual fuel price increases of more than 25% from 2009 to 2010, we estimated potential effects on businesses and households, if they continued to use fuel and transportation services at the same levels as they did in 2008 (Figure 1). But people and businesses facing higher prices often change their behavior, so we then compared economic data from 2008 and 2010—and found that transportation use was down. That drop was likely due to a number of things, including higher fuel prices—which encouraged more efficiency and reduced use—and the global recession, which started about the same time fuel prices spiked in 2008.

- **It would have cost Alaska industries about $500 million more a year to produce the same goods and services**, if they had continued to use transportation services and fuel at the same rate as before the price increases. That’s about 1% of the gross state product, which measures the value of goods and services industries produce annually, after their costs of production—including costs of transportation—are subtracted.

- **More than half the increased costs would have been concentrated in air transportation, oil refineries, commercial fishing, and water and pipeline transport.** That’s because those industries use more fuel in production, either for the process of creating something (like gasoline from crude oil) or for getting it to market—or both. But all industries would have seen some increase in costs.

- **Households would have paid about $150 million more a year for vehicle fuel and transportation services**, if they had kept the same levels of use as before the price increases. That would have boosted the share of household spending going to transportation from 5% to 6%. Some of that higher spending (we can’t quantify how much) reflects higher prices for groceries and other goods, because of higher transportation costs.

**Figure 1. Potential Effects of 2009-2010 Fuel Price Increases**

- 60% of higher costs would be in 5 industries
  - Air transportation $152 million
  - Oil refineries $62.5 million
  - Commercial fishing $39.4 million
  - Transport by water $38.8 million
  - Transport by pipeline $31.1 million

- Households: $150 Million More Annual Transportation Spending
  - Transportation services $431 million
  - Fuel for cars/snowmachines/other $404 million
  - Fuel for electricity and heat not included

*Table 1, page 3, shows how higher fuel prices translate into increased transportation costs.

1. Includes direct purchases of services (like plane trips), as well as spending for transportation costs incorporated in the final price of household goods (like groceries).

2. Mostly gasoline and diesel for household vehicles. Fuel for electricity and heat not included.

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At top: a Grumman Goose (now retired) delivers freight to Akutan, in the eastern Aleutian Islands, in 2006. Photo by Marie Lowe.
**Why This Research?**

Alaska’s distance from other states, strategic location, resource-based economy, long coastline, huge size, vast areas of rugged terrain—and its many small, isolated communities—make the transportation system different from that anywhere else in the country. Figure 2 shows how those characteristics make affordable transportation especially vital to Alaska.

This is the first analysis of how higher prices for refined petroleum products move through the Alaska economy, raising the costs of transporting people and freight and producing goods and services. Our analysis doesn’t include the effects of higher prices for fuel used to generate electricity or heat buildings—which also increase costs for businesses and households.

**What Happens When Fuel Prices Increase?**

Higher prices for refined petroleum products have a broad reach (Figure 3). All industries pay more for the fuel they need for transportation and production—and those that need the most fuel are the hardest hit. Households also immediately face higher costs, when prices of gasoline and other vehicle fuel go up.

Transportation industries paying more for fuel in turn charge more for carrying passengers and freight. But all industries also pay more for other things they need (besides fuel) for production—for whatever else they buy to create products. That’s because the industries they buy from incorporate higher fuel prices into their prices. For example, fish processors buy refrigeration units, which may get more expensive as a result of higher fuel prices.

Ultimately, all industries and households pay more for what they need, as industries pass on their higher transportation and production costs.

**How Much Fuel Do Alaska Transportation Industries Use?**

Alaska transportation industries used about 1 billion gallons of fuel in 2010, at a cost of $2.5 billion. Figure 4 estimates fuel use by industry that year. These estimates are based on limited data, but they give us a good idea of relative use and cost across industries.

- **Fuel used for aviation dwarfs everything else**, accounting for about 90% of all fuel used by air, ship, barge, rail, and trucking industries in Alaska.
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- **Marine ships, state ferries, and tugboats towing barges** use less fuel than jets or airplanes, but more than trucks or the Alaska Railroad.

**Figure 2. What Shapes Alaska’s Transportation System?**

- Alaska is huge—at 3.75 million acres, it’s one-fifth the size of all the other states combined.
- Mountains, glaciers, and other obstacles make it very expensive to build roads in much of the state.
- Hundreds of small communities on coasts and rivers that freeze in the winter get seasonal fuel deliveries by barge but otherwise depend on airplanes to carry people and deliver most consumer goods. Areas without seasonal ice get fuel deliveries year-round, and more goods arrive by barge.
- The Aleutian Islands extend west more than 1,000 miles.
- The Alaska Railroad runs from Seward on the Kenai Peninsula to Fairbanks in the Interior, mostly hauling freight but also carrying passengers, especially summer tourists.
- Road distance from Alaska border to Lower 48 border is 2,000 miles. Most people come and go by air.

**Figure 3. What Happens When Fuel Prices Increase?**

<table>
<thead>
<tr>
<th>Other Industries</th>
<th>Transportation Industries</th>
<th>Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay more for transportation and other fuels they use for production</td>
<td>Pay more for plane, ship, truck, train fuels</td>
<td>Pay more for car, boat, snowmachine, plane fuels</td>
</tr>
<tr>
<td>Pay more for freight handling and transport services and for goods they buy to use in production</td>
<td>Raise prices for transport</td>
<td>Pay more for passenger tickets, freight shipping</td>
</tr>
<tr>
<td>Raise prices for final products</td>
<td><em>In the end: all industries and households pay more for the things they need</em></td>
<td></td>
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</table>

*Prices of refined petroleum products used for transportation and for producing goods or services.*
Long-haul trucks account for only a small share of total transportation fuel, because the road system here is more limited than in other states. The Alaska Railroad uses the least fuel, partly because it covers only about 500 miles in Southcentral Alaska—and it is also the most fuel-efficient.

**How Efficient Are Different Types of Transportation?**

Fuel efficiency in freight hauling is measured in ton-miles, defined as hauling one ton of freight one mile. Many things influence efficiency. Larger engines are better at converting fuel to energy, and diesel engines are more efficient than gas. Trains on tracks and ships in water face less resistance than trucks on roads. A tug towing several barges is more efficient than one towing a single barge. Trains and ships carrying large volumes are more efficient, but if they travel at less than capacity their efficiency drops.

Figure 5 reports fuel efficiency among Alaska freight haulers in ton-miles per gallon of fuel—that is, how many tons of freight Alaska carriers hauled on average per gallon of fuel used, from 2006 to 2010. The railroad uses fuel most efficiently, hauling an average 280 tons per gallon of fuel during the study period.

Water transportation (marine ships and barges towed by tugs) is the next most fuel-efficient, hauling an estimated 166 tons per gallon of fuel. (Studies in the Lower 48 have shown water transport to be most efficient, but efficiency in Alaska is likely reduced by long, less-than-full backhauls.) Trucks were considerably less efficient, transporting an estimated 48 tons of freight per gallon of fuel. But trucks are also the only mode of transportation that can reach all the towns on Alaska’s road system.

State ferries were least efficient (20 ton-miles per gallon), but several things reduce their efficiency. Many are old, they travel places where private barge service is not always economical, and they have set schedules, regardless of their loads.

Data on the fuel-efficiency of air cargo carriers are not publicly available. Carriers have become more fuel-efficient, but remain less so than other transportation modes. The air cargo industry is important to the state economy, as is the movement of freight and passengers to roadless communities—so the effects of higher fuel prices are particularly acute for Alaska.

We also looked at fuel-efficiency in carrying passengers. The railroad is most efficient, ferries the least, and aviation likely in between—but we don’t have the data to make an Alaska-specific estimate for aviation.

**Factoring Fuel Prices into Transportation Costs**

How higher fuel prices translate into higher costs for transportation industries depends on their fuel-intensity—that is, how much fuel an industry requires to produce $1 worth of output. Output is the entire value of the economy of what an industry produces, including both what it spends to create a product and the value of what it creates—the value-added—after production costs. Table 1 shows effects of the 2009-2010 price increases.

- Air transportation faced the largest increase, because 31 cents of every dollar of its 2008 output was for fuel. Multiplying that by a 29% increase in fuel prices yields a 9% increase in costs for air transportation.
- Water transportation faced a 7.5% increase, applying a 28% increase in fuel prices to the 27 cents of every dollar of output going for fuel.
- Costs for truck and rail transportation both increased by about 4%. The trucking industry spent more for fuel—15 cents of every dollar of output in 2008, compared with 13 cents—but prices of train fuel increased more.

**How Much Did Transportation Use in Alaska Change by 2010?**

Industries and households used transportation services less by 2010—a drop likely due to both higher fuel prices and the global recession. For example, households may have booked fewer flights, directly reducing their use of air travel, or bought fewer new cars, indirectly reducing the demand for cargo ships bringing cars to Alaska.

Some transportation industries also became more fuel-efficient. The aviation industry reduced the amount of fuel used per $1 of output—from 31% in 2008 to 15% by 2010. But not all carriers are able to react quickly to higher fuel prices or a weaker economy. State ferries serving coastal communities can’t suddenly change their schedules, and the Alaska Railroad (a public corporation) also faces more constraints than private industry.

Figure 6 shows one measure of declining transportation use and increased fuel-efficiency—a drop in fuel used by air carriers and ships and barges. The aviation industry used 22% less fuel in 2010—it appears air carriers moved more passengers and freight per gallon of fuel used, and because of the recession, also made fewer flights.
**What About a Tax on CO2 Emissions?**

We also looked at the potential effects of a tax on carbon emissions. Congress has considered putting a price on greenhouse-gas emissions, possibly through a carbon tax. In general, such a tax would have a similar effect on transportation industries as higher fuel prices—because it would also increase their energy costs.

- The aviation industry produces about 90% of the carbon emissions from the transportation industries we analyzed (air, water, truck, and rail) and would pay the most in a carbon tax.
- Among industries other than transportation, petroleum refining and natural gas distribution have the highest carbon emissions and would pay more in a carbon tax.

**Mapping Imports and Exports by Water**

As part of our analysis, we also estimated flows of imports and exports by water, which are a major part of Alaska’s transportation picture (Figure 7).

- Almost all Alaska’s exports of goods are natural resources—crude oil that goes to the U.S. west coast; seafood that goes to U.S. and world markets; zinc and lead that go on world markets; and coal that goes mainly to Asia.
- Alaska imports most of what businesses and households need, largely from the U.S. west coast and Asia and largely through the port of Anchorage.

**A Final Word**

Information about much of Alaska’s transportation system is hard to come by. Government agencies don’t collect all the information we needed for this analysis, and many businesses keep information about their operations confidential—so we especially thank those agencies and businesses that did provide us with data. Also, lack of freight-cost data for all types of transportation, particularly air freight, is a nationwide problem. Such information has to be collected through surveys of freight companies, but market competition makes them reluctant to release proprietary information.

If more data become available in the future, we could undoubtedly improve our estimates of transportation fuel use and efficiency and of the economic effects of higher fuel prices. Also keep in mind that the estimated economic effects—as measured by higher costs for industries and households—are based on patterns of transportation and fuel use before the 2009-2010 fuel price spike.

We don’t have adequate data to sort out how much of the drop in use of transportation that occurred by 2010 was due to higher fuel prices and how much to the worldwide recession. Still, our estimates show the potential magnitude of the economic costs of higher fuel prices—and the importance to Alaska of affordable transportation.

This summary is based on *Analysis of Alaska Transportation Sector to Assess Energy Use and Impacts of Price Shocks and Climate Change Legislation*, Institute of Social and Economic Research, University of Alaska Anchorage, 2013, prepared for the Alaska University Transportation Center. It is by the same authors, and the findings are solely those of the authors.

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[www.iser.uaa.alaska.edu](http://www.iser.uaa.alaska.edu)

**Figure 7. Alaska Exports and Imports by Water, 2010** (In Thousands of Short Tons)

| ASIA | EUROPE | OTHER | WASHINGTON | CALIFORNIA | CANADA | HAWAI |
|------|--------|-------|------------|------------|-------|-------|------|
| 2,371 | 302    | 1,664 | 17,257     | 13,196     | 335   | 119   |

Note: Aggregate figures for imports and exports are based on the U.S. Army Corps of Engineers 2010 Waterborne Statistics, including the State Public Domain Data Base by Origin and Foreign Cargo Inbound and Outbound. Inter-waterway figures are based on author calculations using data from Waterborne Commerce of the United States (WCUS) 2010 and Foreign Cargo Inbound and Outbound data. These calculations remove double-counting intrastate traffic and reconcile differences in data. Discrepancies between inter-waterway figures and aggregate totals are attributable to the limitations on the number of ports reported and information published in WCUS.