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# RESEARCH SUMMARY

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## Energizing Alaska: Electricity Around the State

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This publication is mostly about electricity in Alaska: how it's generated, how much fuel is used to produce it, how fuel sources have shifted over time, and how prices vary. An inside foldout map shows how individual communities throughout the state generate electricity.

But besides looking in detail at electricity, it also reports more broadly on energy in Alaska. It includes our estimates of all the types of energy produced and consumed in Alaska, and summarizes changes over time in the prices and amounts of energy Alaskans use.

The information is from analyses we prepared for the Alaska Energy Authority (see back page). We've used the best and most recent data, but there's a two-year time lag before some types of data are available, and in other cases we made estimates, based on limited information.

About 57% of the electricity Alaskans use is generated by natural gas, another 22% by hydropower, 15% by diesel, and 6% by coal. Wind still produces a very small part of electricity statewide, but use of wind power is growing rapidly. Figure 1 previews the more detailed foldout map, showing how some communities around Alaska generate electricity. Many places use more than one power source.

Here we first highlight some findings and then provide more detail inside.

- *Utilities around Alaska used about 1.7 million barrels of diesel, 40 billion cubic feet of natural gas, and 410 thousand tons of coal to produce electricity in 2010 (Figure 1). But converting energy sources to electricity is a very inefficient process. In 2008, Alaska's electrical sector consumed about three times as much energy as it produced in electricity (Figure 4).*

- *Six times as much electricity was produced in Alaska in 2010 as in 1970, with an increasing share from natural gas and hydropower and a declining share from coal. Wind power was also introduced (Figure 2).*

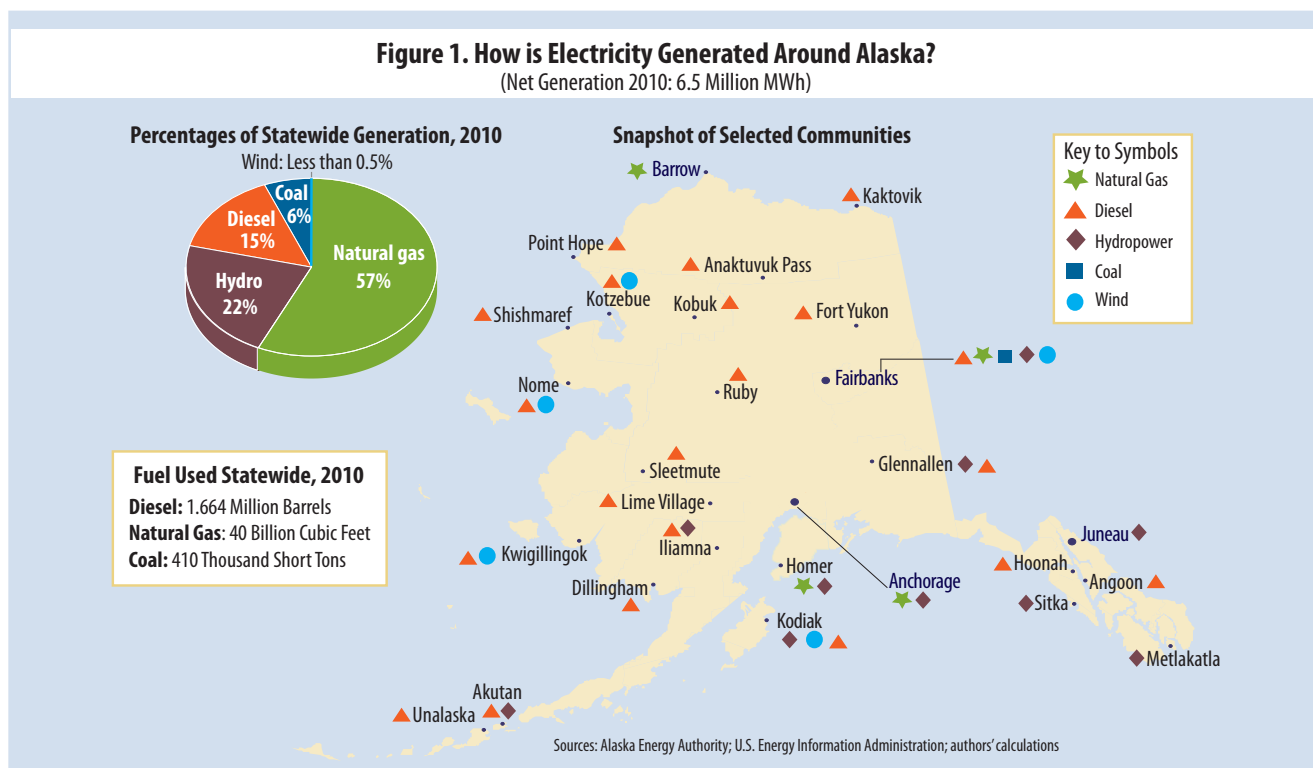
- *Use of electricity from hydropower increased more than 10% per capita in Alaska since 1975, even as the population more than tripled. A number of large and small hydroelectric projects were constructed over the past several decades, largely subsidized by federal and state money.*

- *More than two dozen utilities will be using wind to generate part of their electricity by the end of 2012, up from 7 in 2008. A number of other communities plan to add wind systems. Most of the existing wind power is on Kodiak Island and in small communities in western Alaska (inside map).*

- *Alaska produces about five times more energy than it consumes, because of North Slope oil. The biggest use of energy in Alaska is for transportation and the smallest is for residential purposes (Figure 4).*

**Figure 1. How is Electricity Generated Around Alaska?**

(Net Generation 2010: 6.5 Million MWh)



## SOURCES AND PRICES OF ELECTRICITY

Natural gas discovered in Cook Inlet in the 1950s has been used to generate increasingly more electricity in Southcentral Alaska over the past several decades, as the region's population grew.

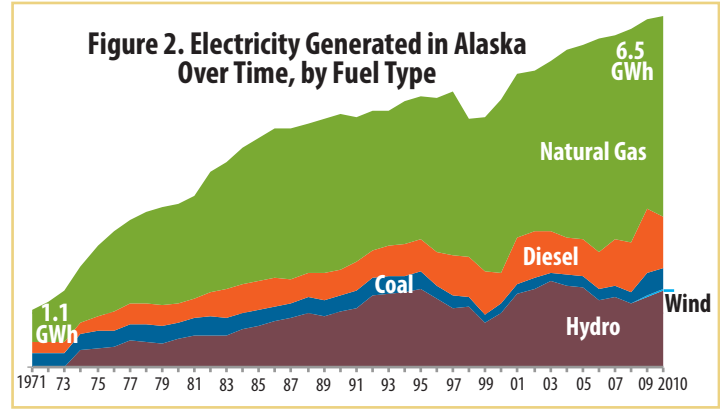
The electrical intertie linking utilities from the Kenai Peninsula to Fairbanks—the Railbelt—now gives most Railbelt communities some access to electricity from natural gas. But constraints on natural gas supplies, generation, and intertie capacity limit the amount of lower-priced electricity moved from Southcentral to Interior Alaska.

The Railbelt region also has some hydropower, and the largest communities in Southeast Alaska rely largely on hydropower. Some smaller communities in that region also benefit from hydropower, but others still have to rely entirely on diesel.

Diesel is used to generate electricity in most remote communities, although a growing number are supplementing diesel with wind and other renewable energy sources. Barrow and Nuiqsut on the North Slope have access to natural gas from local fields. Some of the electricity for Fairbanks and surrounding areas is generated with diesel and naphtha, as well as coal.

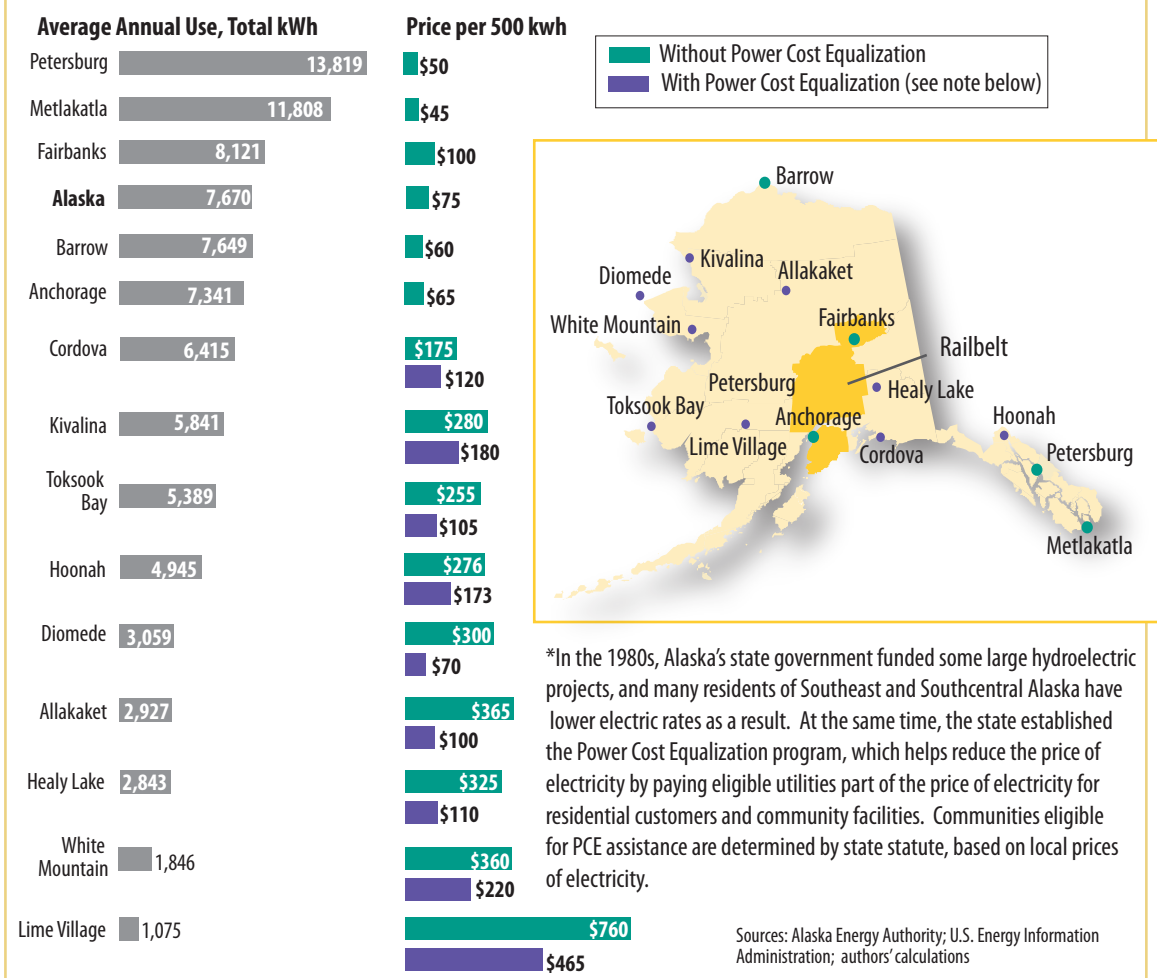
Figure 3 shows how sources of electricity affect prices and use.

- *Communities that get electricity mostly from hydropower have the lowest prices—because government subsidized costs of building hydropower facilities—and the highest use.* Petersburg and Metlakatla are examples.



- *Places that have access to natural gas, as well as some hydropower, have mid-range use and prices.* That includes Anchorage and Fairbanks.
- *Places that rely mostly on diesel have the highest prices and the lowest use.* That includes communities throughout Western, Interior, and Northern Alaska, as well as those in Southeast without hydropower. These places are generally eligible for payments under the Power Cost Equalization program, a state program that reduces prices of electricity for residential customers (see note on Figure 3).

**Figure 3. Average Annual Residential Use of Electricity and Price per 500 kWh, Selected Alaska Communities, 2010\***



## ENERGY PRODUCED AND CONSUMED IN ALASKA, 2008

Until now we've discussed generation and use of electricity. But Figure 4 looks at Alaska's total energy picture: it shows our estimates of all the energy produced and consumed in Alaska, as of 2008. We don't have complete data for more recent years. The figures are in trillion British Thermal Units (Btus), a standard measure of energy content that allows comparison across energy types. Figure 5 shows the equivalent of a trillion Btus, in barrels of oil and other common units.

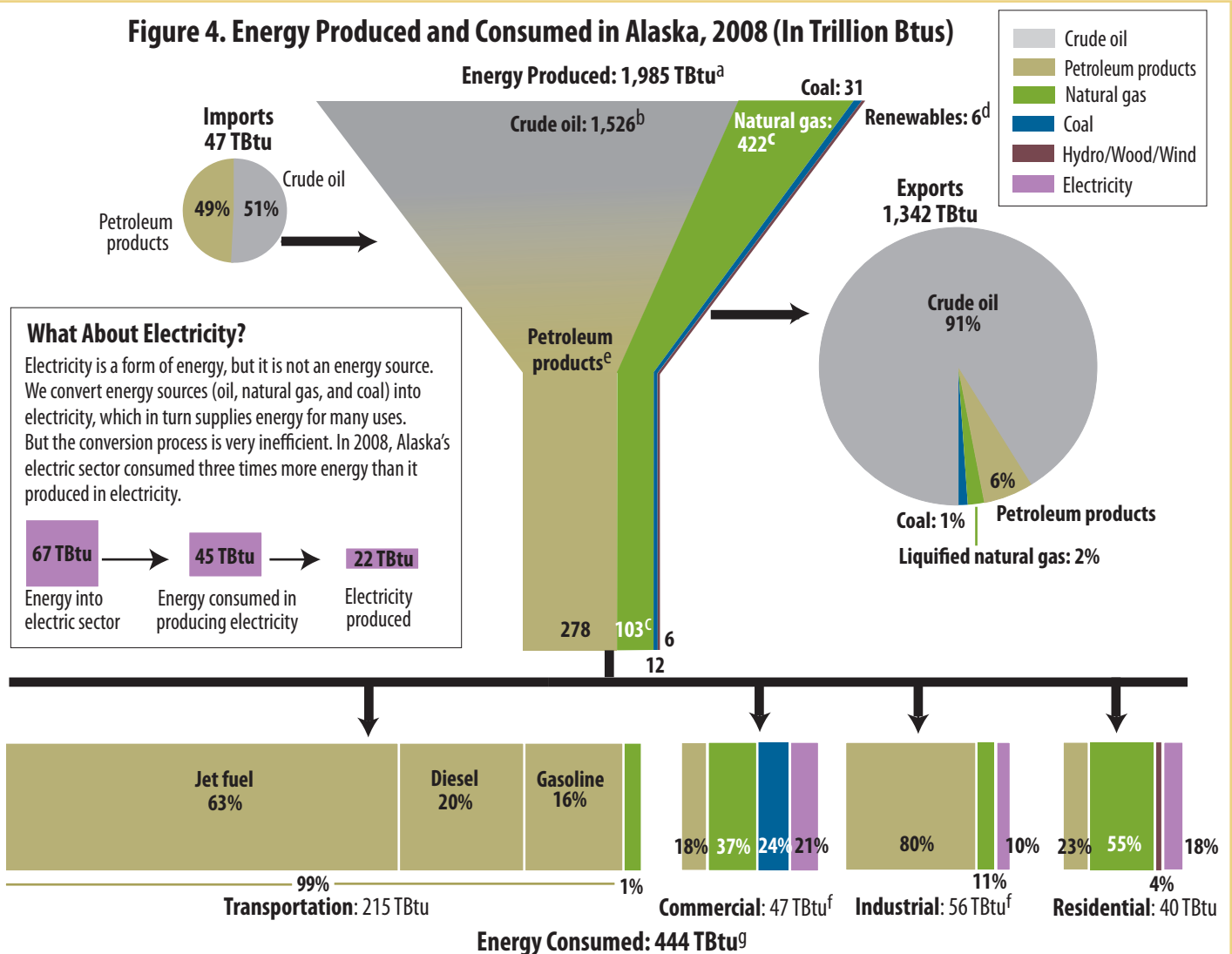
- *North Slope oil accounts for more than three-quarters of Alaska's energy production.* Most of that oil is exported, but some is refined into gasoline and other petroleum products used in Alaska.
- *Natural gas from Cook Inlet is used locally, mainly for residential and commercial uses, while most gas extracted on the North Slope is reinjected to boost oil production.* The oil producers use some for their North Slope operations, and two North Slope communities have access to natural gas.

- *About 40% of the small amount of coal produced in Alaska is exported, and the rest is used mainly for producing electricity in the Fairbanks area.*
- *Fuel for transportation makes up nearly half the energy consumed in Alaska, and jet fuel alone accounts for a third of total consumption.* But almost all that fuel is for flights into and out of the state's international airports—so it isn't "consumed" in Alaska the way other fuel is.
- *Producing electricity is very inefficient, with 67 TBtus from natural gas, water, oil, coal, and wind producing just 22 TBtus of electricity in 2008.*
- *The largest source of renewable energy in Alaska today is hydropower, which generates nearly a quarter of all electricity statewide.*

**Figure 5. How Much is a Trillion Btus?**

Crude oil: 172,414 barrels	Electricity: 293,083,236 kWh
Natural gas: 972,763 Mcf	Diesel: 7,210,300 gallons
Coal: 50,030 short tons	Gasoline: 7,995,431 gallons
Wood: 50,000 cords	

**Figure 4. Energy Produced and Consumed in Alaska, 2008 (In Trillion Btus)**



<sup>a</sup> Authors' estimates. A Btu (British thermal unit) is a standard measure of energy content (or heat value), roughly the amount of energy needed to heat one pound of water one degree Fahrenheit. <sup>b</sup> Includes 77 TBtu of natural gas liquids.  
<sup>c</sup> This figure excludes North Slope gas extracted but reinjected. It includes 259 TBtus North Slope oil producers used for their 2008 operations, 6 TBtus used in Barrow and Nuiqsut, and 157 TBtus from Cook Inlet. We were unable to specifically trace consumption of about 40 TBtus of that Cook Inlet gas that entered the Alaska market.  
<sup>d</sup> Renewables include mostly hydropower (4 TBtu), wind power (0.008 TBtu) and wood (2 TBtu).  
<sup>e</sup> Btus of crude oil remaining in the Alaska market do not equal Btus of petroleum products consumed, partly because of imprecise data on imports and exports, but also because we couldn't get data on energy used in the refining process.  
<sup>f</sup> The commercial sector includes businesses, government offices and facilities, and religious and other organizations. The industrial sector consists of industries that produce or process goods, including petroleum, commercial fishing and processing, agriculture, and mining. Not shown are wood, which generates less than 0.5% of energy for commercial and industrial uses, and coal, which generates less than 0.5% of the energy for industrial uses.  
<sup>g</sup> Includes 45 TBtus of energy used to produce electricity and 40 TBtus of natural gas that entered the market but couldn't specifically be traced.

## CHANGING PRICES AND USE OF ENERGY

We now look at how the amounts of energy Alaskans use, and the prices they pay for that energy, have changed over time.

- *Electricity is the only form of energy less expensive in 2008 than in 1970, when adjusted for inflation (Figure 6). The drop of nearly 15% is most likely due to the fact that the state and federal governments subsidized construction costs for a number of hydroelectric projects, so prices do not reflect the full costs of producing the hydropower.*
- *All other forms of energy were all considerably more expensive in 2008, but the biggest increases were for jet fuel and diesel fuel. Real—again, adjusted for inflation—prices for those fuels more than tripled.*
- *Real prices of gasoline and natural gas rose in the range of 60% to 80% between 1970 and 2008.*

Alaska's population tripled between 1960 and 2008. That fast population growth meant that Alaskans on the whole used a lot more energy in 2008. But to get a picture of how energy use changed independent of population growth, Figure 7 shows changing use per capita.

**Figure 6. Change in Alaska Energy Prices, 1970-2008**

	1970		2008		Real Percentage Change
	Nominal \$	2008\$			
Electricity (per kWh)	\$0.03	\$0.17	\$0.15		-14%
Natural gas (per Mcf)	\$0.69	\$3.82	\$6.88		80%
Distillate fuel (per gallon)	\$0.16	\$0.89	\$3.91		341%
Jet fuel (per gallon)	\$0.10	\$0.55	\$3.03		455%
Motor gasoline (per gallon)	\$0.40	\$2.21	\$3.65		65%

Sources: U.S. Energy Information Administration; authors' calculations

The largest change in energy use happened when discoveries of natural gas in Cook Inlet made relatively inexpensive gas available in Anchorage and adjacent areas. And despite sharp increases in prices, per capita use of gasoline and diesel also increased considerably.

By contrast, per capita use of electricity actually dropped somewhat. That's probably because appliances and light bulbs and other things that run on electricity became more efficient, and the price of diesel—which is used to produce electricity in some communities—increased considerably.

Alaska population  
1960: 226,000  
1975: 384,100  
2008: 681,977

**Figure 7. Changing Per Capita Use of Energy Among Alaskans**

Use of natural gas to generate electricity and heat homes in southcentral Alaska soared after the discovery of gas in Cook Inlet.

Most Alaskans outside the railbelt still generate most of their electricity and heat their homes with diesel, and per capita use increased 62% between 1960 and 2008.

Per capita use of gasoline was up 33% between 1960 and 2008.

Per capita use of coal dropped by half, with use of other energy sources growing faster. Also, almost 40% of the coal produced is exported.

Electricity from hydro produced per person increased about 88% between 1975 and 2008.

Per capita use of electricity from all sources increased 62% between 1975 and 2008.

### Natural gas (in thousand cubic feet)



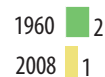
### Diesel (in gallons)



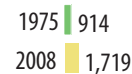
### Gasoline (in gallons)



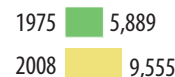
### Coal (in short tons)



### Electricity from hydro (in kilowatt-hours)



### Electricity from all sources (in kilowatt-hours)



Sources: U.S. Energy Information Administration; Alaska Department of Labor and Workforce Development; authors' calculations

Ginny Fay is an assistant professor of economics at ISER, and Alejandra Villalobos Melendez is an ISER research associate. This summary is based on energy statistics reports the authors prepared for the Alaska Energy Authority: *Alaska Energy Statistics 1960-2008*; *Alaska Energy Statistics 1960-2009*; and *Alaska Energy Statistics 1960-2010*.

The authors thank the staff of the Alaska Energy Authority and many others at utilities and businesses who provided information and valuable comments. We especially thank Amber Converse, an intern at AEA, who provided critical help collecting 2010 data.

Editor: Linda Leask • Graphics: Clemencia Merrill



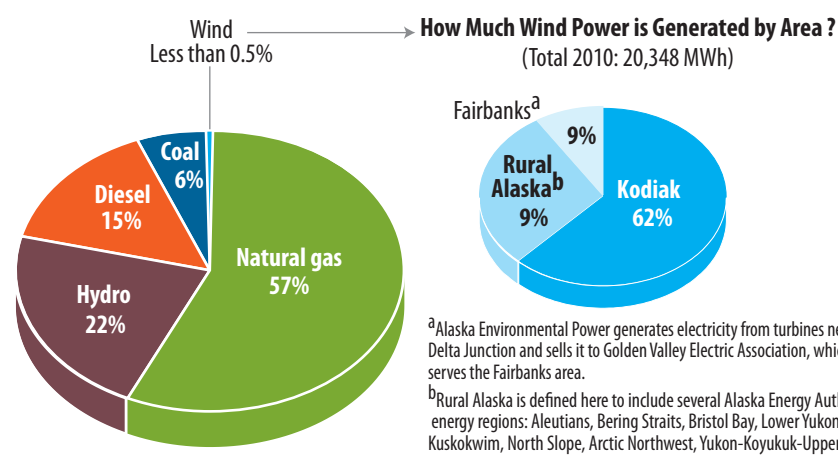
# How Electricity is Generated in Alaska, by Community, 2012\*

Communities in Blue: Eligible for Power Cost Equalization Program

Communities in Green: Not eligible for Power Cost Equalization Program

\*The map includes renewable energy projects that are complete as of mid-2012 and those scheduled to be completed by the end of 2012.

## Sources of Electrical Generation Statewide (Net Generation 2010: 6.5 Million MWh)



## Key to Symbols

- ★ Natural Gas
- ▲ Diesel
- ◆ Hydropower
- Coal
- Wind

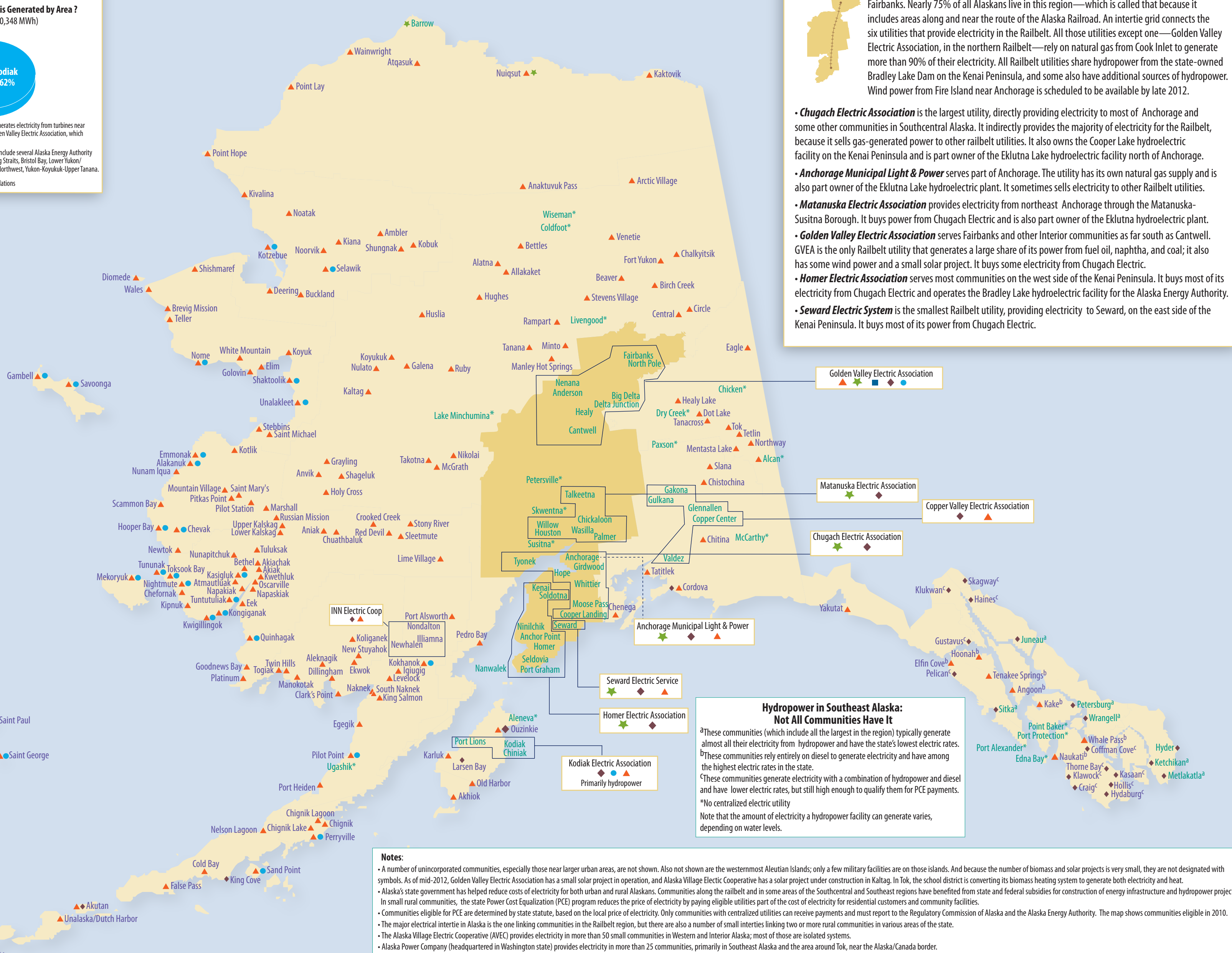
\*Communities with no centralized electric utility

## The Railbelt Intertie



Alaska's Railbelt region runs roughly 500 miles from the tip of the Kenai Peninsula north to Fairbanks. Nearly 75% of all Alaskans live in this region—which is called that because it includes areas along and near the route of the Alaska Railroad. An intertie grid connects the six utilities that provide electricity in the Railbelt. All those utilities except one—Golden Valley Electric Association, in the northern Railbelt—rely on natural gas from Cook Inlet to generate more than 90% of their electricity. All Railbelt utilities share hydropower from the state-owned Bradley Lake Dam on the Kenai Peninsula, and some also have additional sources of hydropower. Wind power from Fire Island near Anchorage is scheduled to be available by late 2012.

- **Chugach Electric Association** is the largest utility, directly providing electricity to most of Anchorage and some other communities in Southcentral Alaska. It indirectly provides the majority of electricity for the Railbelt, because it sells gas-generated power to other railbelt utilities. It also owns the Cooper Lake hydroelectric facility on the Kenai Peninsula and is part owner of the Eklutna Lake hydroelectric facility north of Anchorage.
- **Anchorage Municipal Light & Power** serves part of Anchorage. The utility has its own natural gas supply and is also part owner of the Eklutna Lake hydroelectric plant. It sometimes sells electricity to other Railbelt utilities.
- **Matanuska Electric Association** provides electricity from northeast Anchorage through the Matanuska-Susitna Borough. It buys power from Chugach Electric and is also part owner of the Eklutna hydroelectric plant.
- **Golden Valley Electric Association** serves Fairbanks and other Interior communities as far south as Cantwell. GVEA is the only Railbelt utility that generates a large share of its power from fuel oil, naphtha, and coal; it also has some wind power and a small solar project. It buys some electricity from Chugach Electric.
- **Homer Electric Association** serves most communities on the west side of the Kenai Peninsula. It buys most of its electricity from Chugach Electric and operates the Bradley Lake hydroelectric facility for the Alaska Energy Authority.
- **Seward Electric System** is the smallest Railbelt utility, providing electricity to Seward, on the east side of the Kenai Peninsula. It buys most of its power from Chugach Electric.



## Hydropower in Southeast Alaska: Not All Communities Have It

- <sup>a</sup>These communities (which include all the largest in the region) typically generate almost all their electricity from hydropower and have the state's lowest electric rates.
  - <sup>b</sup>These communities rely entirely on diesel to generate electricity and have among the highest electric rates in the state.
  - <sup>c</sup>These communities generate electricity with a combination of hydropower and diesel and have lower electric rates, but still high enough to qualify them for PCE payments.
  - <sup>d</sup>No centralized electric utility
- Note that the amount of electricity a hydropower facility can generate varies, depending on water levels.

## Notes:

- A number of unincorporated communities, especially those near larger urban areas, are not shown. Also not shown are the westernmost Aleutian Islands; only a few military facilities are on those islands. And because the number of biomass and solar projects is very small, they are not designated with symbols. As of mid-2012, Golden Valley Electric Association has a small solar project in operation, and Alaska Village Electric Cooperative has a solar project under construction in Kaltag. In Tok, the school district is converting its biomass heating system to generate both electricity and heat.
- Alaska's state government has helped reduce costs of electricity for both urban and rural Alaskans. Communities along the railbelt and in some areas of the Southcentral and Southeast regions have benefited from state and federal subsidies for construction of energy infrastructure and hydropower projects. In small rural communities, the state Power Cost Equalization (PCE) program reduces the price of electricity by paying eligible utilities part of the cost of electricity for residential customers and community facilities.
- Communities eligible for PCE are determined by state statute, based on the local price of electricity. Only communities with centralized utilities can receive payments and must report to the Regulatory Commission of Alaska and the Alaska Energy Authority. The map shows communities eligible in 2010.
- The major electrical intertie in Alaska is the one linking communities in the Railbelt region, but there are also a number of small interties linking two or more rural communities in various areas of the state.
- The Alaska Village Electric Cooperative (AVEC) provides electricity in more than 50 small communities in Western and Interior Alaska; most of those are isolated systems.
- Alaska Power Company (headquartered in Washington state) provides electricity in more than 25 communities, primarily in Southeast Alaska and the area around Tok, near the Alaska/Canada border.
- About 85 communities around Alaska operate their own local electric utilities.