School District Energy Costs in Alaska

Prepared for
Legislative Budget and Audit Committee

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Introduction

This brief presents analyses of school district energy costs in Alaska, as well as a discussion of the factors influencing these costs. By energy, we mean both electricity and heating costs.

Before delving deeper into the story, we highlight the major takeaways here:

- Energy costs in Alaska school districts are high. This is due to
  1) the generally high cost of energy for much of the state due remoteness and limited options for generating heat and electricity; and
  2) the cold climate.
- It is not possible to change the remoteness of communities or the weather, so investments in energy efficiency and renewable energy sources are the only solution to reducing these costs, with the understanding that the payoff from investing in renewables is a long-term, not immediate return.
- The lack of consistent data on how districts heat and power schools or which districts have made what energy efficiency improvements means it isn't possible at present to determine how much could be saved through these investments.

The context for understanding energy use in schools

A school needs a habitable environment for learning & teaching participants: a powered and heated environment. Energy is being used in schools to provide power and to provide a heated habitable environment.

Energy is Expensive in Alaska

Energy is expensive in Alaska, and Alaskans use a lot of it, both for power and heat. Per capita energy consumption in Alaska is the 4th-highest among the 50 states and DC because of the small population, harsh winters, and energy-intensive industries (US Energy Information Agency, 2019). The average price of electricity in Alaska is the 2nd highest in the nation, with only Hawaii paying more. Alaska's average cost of $.204 per kWh is almost twice the U.S. average of $.1039.

It is important to understand why energy is more expensive as well as by how much. The primary answer to "why" is remoteness. Our rural schools are mostly in communities that are islanded, reliant on diesel-powered microgrids for energy, and mostly reliant on diesel and oil for heat. Transportation of fuel to remote communities for energy is expensive as is maintenance, especially for those communities where there are not local people with the skills to maintain and repair energy systems.

Some districts are more fortunate than others to have reliable and more affordable sources of energy nearby. Districts located on the Railbelt have less expensive energy sources and more options. Districts with access to reliable hydro resources also may enjoy less expensive power. Still,

District costs for heating oil or diesel are subject to market forces but also, for remote communities that have limited windows for fuel delivery, are generally determined through annual contracts which are re-negotiated each year. This means that if the price of oil drops mid-year, the district will not enjoy savings because they have already set the price for the year. Conversely if the price of oil increases, the district will benefit from not having to pay a higher price for some time. If, however, a district underestimates fuel needed in a given year, their costs can become quite high, as they have to purchase on the spot market at whatever the cost is that day, and they often have to pay much higher costs for delivery of fuel. This can happen for many reasons, such as when another source of energy is lost, as when hydro was not an option in Southeast due to the drought, or when there is a leak in a storage tank or a flood wipes out a tank farm.

In 2012 Alaska Housing Finance Corporation (AHFC) conducted energy audits on 156 publics schools and the Cold Climate Housing Research Center (CCHRC) analyzed the results in 2013. It was found that on average schools could save approximately $33,300 per year on energy by implementing the cost-effective energy efficiency retrofits identified by the auditors for an upfront cost of approximately $125,000.[1] There is no comprehensive list showing which schools have implemented these upgrades.

Energy Sources in Alaska

Almost 50% of Alaska's electricity is generated from Natural Gas. However, this source of energy is limited to communities either on the Railbelt or with natural gas resources and facilities nearby (e.g., Utqiagvik). In 2018, hydroelectric power generated nearly 27% of the state's electricity, the highest on record. However, a prolonged drought in southeast Alaska in 2019 forced some communities to turn to diesel generators for electricity. With climate change increasing, threats to the reliability of hydropower are likely to continue.

The majority of communities that are off the road and not near hydropower sources are reliant on heating fuel/diesel for much of their heating. That said, there are several districts that have developed biomass plants for heating and there are also experiments around the state with heat pumps

Understanding and measuring energy use in schools

In schools, space heating consumes the largest amount of energy, upwards of 74% according to a 2014 Alaska Housing Finance Corporation study.[2] The remainder goes towards lighting, domestic hot water, ventilation and fans, refrigeration, cooking, and other electronics. The proportion of energy used for heat versus electricity, refrigeration, and other uses varies amongst schools and districts depending on a variety of factors.

Indeed, when understanding energy utilization in school buildings, many factors come into play. The first is the size of the space to be heated. However, it is not as simple as it sounds even to measure that. Square footage, the most readily available measure of school spaces, is only a proxy for the total space. The height of spaces and how they are configured also matter. A wing of a building might have the same square footage as the gymnasium, but the gym will generally be two or three stories tall, so it includes much more airspace than the classrooms.

A second issue is building utilization. School facilities, such as gymnasiums or libraries, may be used for many more hours a day than regular classroom spaces. In most rural communities the gym is used for basketball after hours and on weekends. The doors also may be opened more often during recreation

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[1] Energy Efficiency of Public Buildings in Alaska: Schools, November 21, 2014 (https://www.ahfc.us/application/files/4114/1866/9804/Energy_Efficiency_of_Public_Buildings_in_Alaska_Schools.pdf)

[2] Energy Efficiency of Public Buildings in Alaska: Schools, November 21, 2014 (https://www.ahfc.us/application/files/4114/1866/9804/Energy_Efficiency_of_Public_Buildings_in_Alaska_Schools.pdf)

time to let players in and out and left open, even during cold winter months, to let air circulate when lots of people are using the space. In some communities, lights are left on outside school buildings for security reasons or to help community members who need to walk in the school area. All of these factors contribute to heating and electricity usage.

The number of people in a building may or may not be related to energy usage. We were asked to look at heating costs per student and did so in a prior memo. However, enrollment fluctuates year to year in a way that infrastructure does not. And spaces are not necessarily taken offline if there are fewer people. For example, in McGrath, the student population has dropped from well over 200 to under 50 over the past few years, due largely to state and federal agencies relocating their operations. However, the school buildings have not changed in size, and while individual classrooms may not be used, the district is still heating the whole building and likely having to turn at least some lights on for safety reasons.

Other issues include the age of the building, the quality of the construction, the condition of the building, and especially the maintenance of the building, from whether heating systems are regularly serviced to the condition of the physical structure, such as the insulation around windows and how the sealing around the door jams, and whether a building has been retrofitted for energy efficiency. The available data in Alaska does not address these issues sufficiently to inform the analyses in this brief.

National comparisons are difficult

The data on average energy expenditures and costs in schools in the lower 48 is mostly outdated. One more recent report estimated that districts spend 2-4% of their budgets on energy.[3] Another figure cited repeatedly, but again with no attribution, is that schools in the United States spend an average of 67 cents per square foot (ft^2) on electricity and 19 cents/ft^2 on natural gas annually.[4] However, even if these figures are underestimates, it does show that energy costs in some of Alaska's school districts are significantly higher than in the lower 48, though not in all. This is not surprising, given the extreme cold temperatures in the state's northern regions and the lack of access in most off the road communities to natural gas for heat. Appendices B and C show the percent of the budget school districts spent on energy in FY19. It runs from a high of 10% of the district budget to a low of 1.3%. However, **15 districts spent at least 6% of their budget on energy in FY19.**

SOURCES OF ENERGY FOR SCHOOLS IN ALASKA

At present, there is no complete list of the energy sources used by schools in Alaska. To get a better understanding of the sources of energy for heating and electricity in schools, we collaborated with the Alaska Association of School Business Officials to field a survey. The survey was sent to each district's ALASBO member. We did not specify who should complete this survey nor collect information on who completed it for each district. Sixteen districts responded. The responses for primary heat sources can be seen in Table 1 below, and the primary sources for electricity are in Table 2.

[3] https://esource.bizenergyadvisor.com/article/k-12-schools

[4] https://www.xcelenergy.com/staticfiles/xe/Marketing/Managing-Energy-Costs-Schools.pdf

Table 1: Survey responses by school districts regarding primary heat source in schools.

District	Natural Gas	Heating Fuel	Heat recovery	Electricity	Biomass	Other	Do not know
Alaska Gateway Schools		6			2		
Aleutian Region Schools		2					
Aleutians East Borough Schools		4					
Bering Strait Schools		15					
Copper River Schools		4				1	
Dillingham City Schools		2					
Haines Borough Schools		2					1
Juneau Borough Schools		15					
Kenai Peninsula Borough Schools	27	8		2		5	
Ketchikan Gateway Borough Schools		9					
Klawock City Schools		1					
Lake and Peninsula Borough Schools		4	6	2			
Lower Yukon Schools		11					
Nenana City Schools	1	1					
Saint Mary's Schools		1					
Valdez City Schools		4					

Table 2: Survey responses by school districts regarding primary electricity source in schools.

District	Natural Gas	Hydro	Gas-fired/ Diesel	Other	Do not know
Alaska Gateway Schools				8	
Aleutian Region Schools		1		1	
Aleutians East Borough Schools			4		
Bering Strait Schools				15	
Copper River Schools		4	1		
Denali Borough Schools					
Dillingham City Schools			2		
Haines Borough Schools		3			
Juneau Borough Schools		15			
Kenai Peninsula Borough Schools	42				
Ketchikan Gateway Borough Schools		9			
Klawock City Schools		1			
Lake and Peninsula Borough Schools		2		10	
Lower Yukon Schools			11		
Nenana City Schools				2	
Saint Mary's Schools				1	
Valdez City Schools		4			

The data from the survey is not generalizable to the state as a whole or to any district that did not respond. It should be noted the two largest districts in the state in terms of numbers of students and schools, Anchorage and Fairbanks, did not respond. Those districts are on the Railbelt; in Anchorage, electricity is generated by a combination of natural gas (76%), hydroelectric (21%), and wind (3%), and in Fairbanks electricity comes from coal (44%), oil (35%), gas (12%), wind (5%) and hydro (4%). Heat is primarily from natural gas in Anchorage.

Renewable Energy in Schools

There is no comprehensive list of schools that utilize renewable energy sources for heat or electricity. There are a number of communities that have wind turbines or hydropower for their primary source of electricity, so we can assume that in those communities, schools access at least some of their power from those sources. We also know which schools use biomass as a heat source. Table 3 below shows which school districts and communities have biomass boilers in schools. While there isn't good data at present on estimated cost savings from biomass, there is an estimate that these systems displace 351,000 gallons of heating fuel annually.

Table 3: School Districts with Biomass Boilers in Schools, by Community

• Alaska Gateway School District o Mentasta Lake o Tetlin o Tok • Copper River School District o Kenny Lake • Craig School District o Craig Elementary & Middle Schools and Aquatic Center • Delta Junction School District o Delta Junction	• Galena City School District o GILA in Galena • Southeast Island School District o Coffman Cove o Hollis o Kasaan o Naukati o Thorn Bay o Whale Pass • Tanana City School District[5] o Tanana

Trends in energy expenditures

To find general trends beyond a district-by-district analysis, the annual energy costs from fiscal year 2005 through 2019 were examined on a per square foot basis. The school districts were grouped by access to the road system as well as by climate zone.

The global climate zones were defined in the 2009 International Energy Conservations Codes, Chapter 3,[6] to match appropriate building energy efficiency codes with different climates. The Alaska Housing Finance Corporations (AHFC) released Alaska specific amendments[7] in 2011 to set standards for AHFC-funded residential mortgage loans and energy rebates, and energy retrofits of public buildings. The zones correspond roughly with Southeast Alaska (Zone 6), Southcentral Alaska including the Aleutians (Zone 7), and Western Alaska and the interior (Zone 8), and the North Slope (Zone 9). Since zone 9 only

[5] Woody biomass was readily available in Tanana during and shortly after the construction of the road. More recently, that supply has been depleted and the community has been unable to find an affordable alternative source, so their biomass boilers are not currently in use.

[6] https://codes.iccsafe.org/content/IECC2009PDF/chapter-3-climate-zones

[7] https://www.ahfc.us/application/files/7015/0169/1212/2012_IRC_Alaska_Specific_Amendments_Public_Hearing_05312017.pdf

has a single school district it did not make sense to separate it from other cold regions of the state for this project. The boroughs and Climate Zones are shown below in Figure 1.

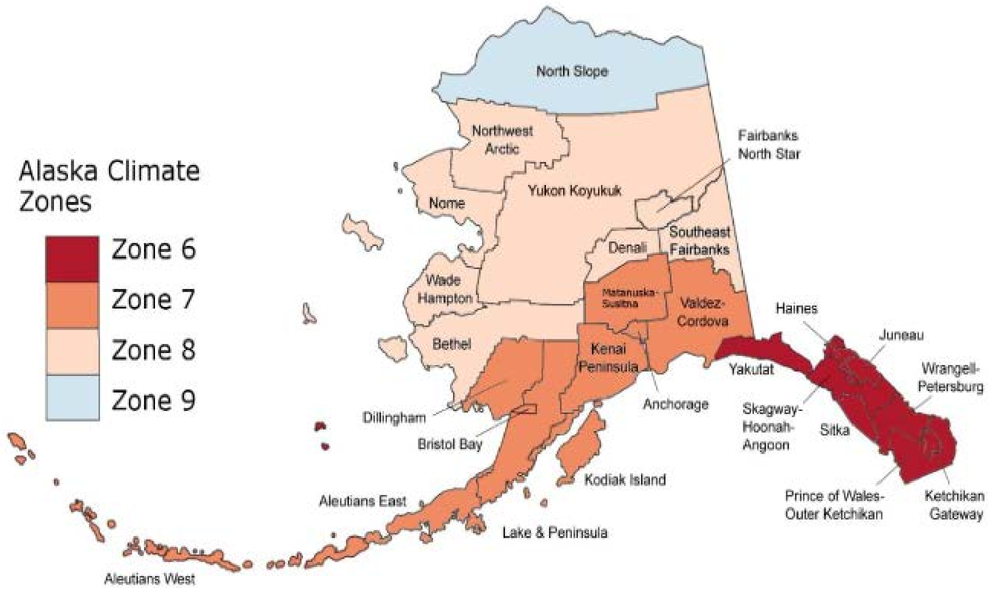
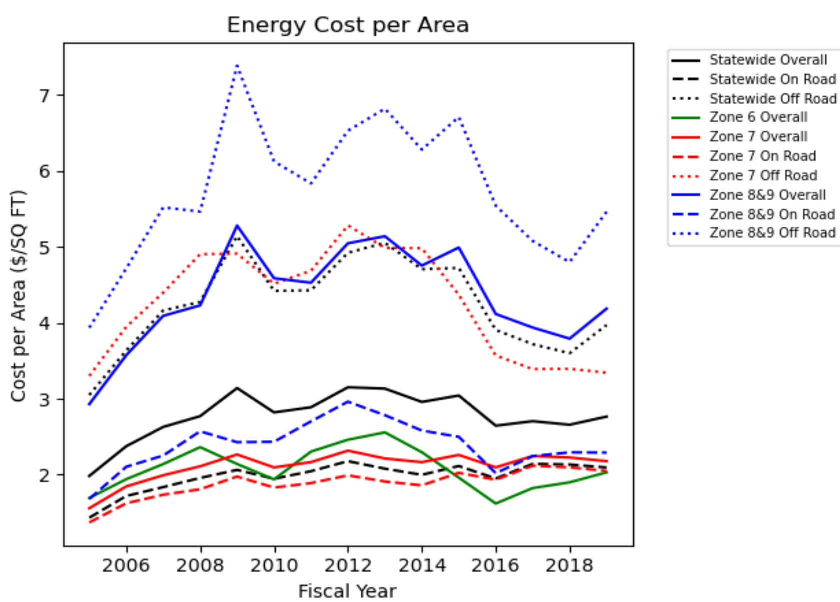


Figure 1: Map of Alaska Boroughs colored by Climate Zone. Source: CCHRC

Unsurprisingly, school districts primarily off the road system have much higher energy costs than those on the road system, as Figure 2 below demonstrates. Zone 6 is the exception, where it is entirely off the road system, but the milder climate likely leads to lower energy costs. Similarly, the harsher climate in zones 8 and 9 correspond with generally higher costs. The curves for zone 7 on the road system, zone 7 overall, and statewide on the road system are all similar. This is likely due to the economies of scale in Anchorage, where there are far more students than in any other district.

Figure 2: Summary of energy cost per area by climate zone and road system access from 2005-2019.

The solid lines represent the overall cost. The dashed lines represent the cost for school districts primarily on the road system. The dotted lines represent the cost for school districts primarily off the road system. The black lines represent costs across the state. The green line represents the cost of school districts in climate zone 6. The red lines represent the cost of school districts in climate zone 7. The blue lines represent the cost of school districts in climate zones 8 and 9.



School District Costs by Zone

The cost per area of the individual districts in climate zone 6 can be seen in Figure 3. Figure 4 shows zone 7. Figure 5 shows zones 8 & 9. Each figure is split in two showing districts with higher costs per student in the upper half and lower cost per student districts in the lower half.

Figure 3: Energy cost per square foot in zone 6 school districts. Districts with higher cost per student are in the upper half.

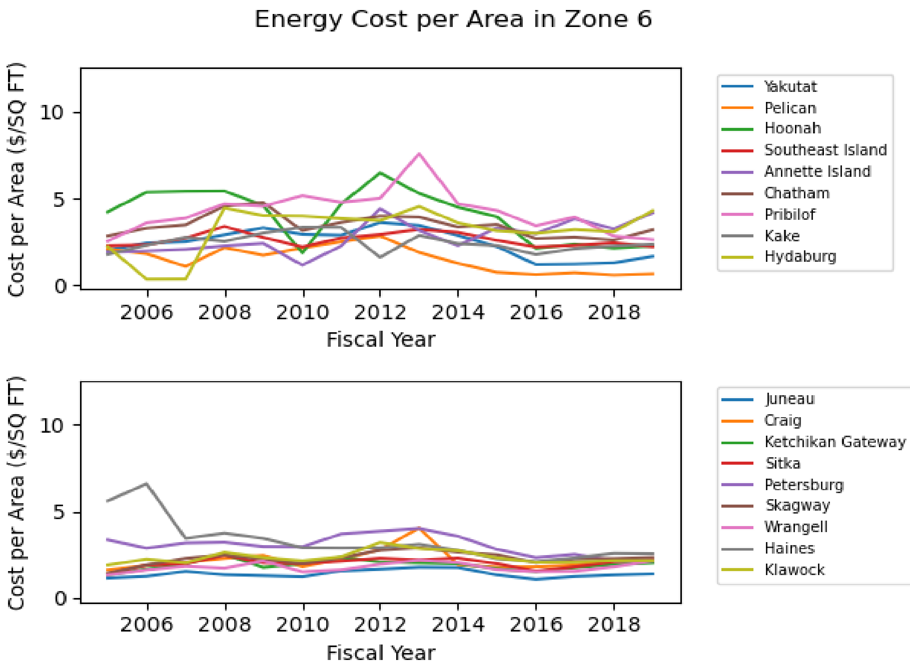


Figure 4 Energy cost per square foot in zone 7 school districts. Districts with higher cost per student are in the upper half.

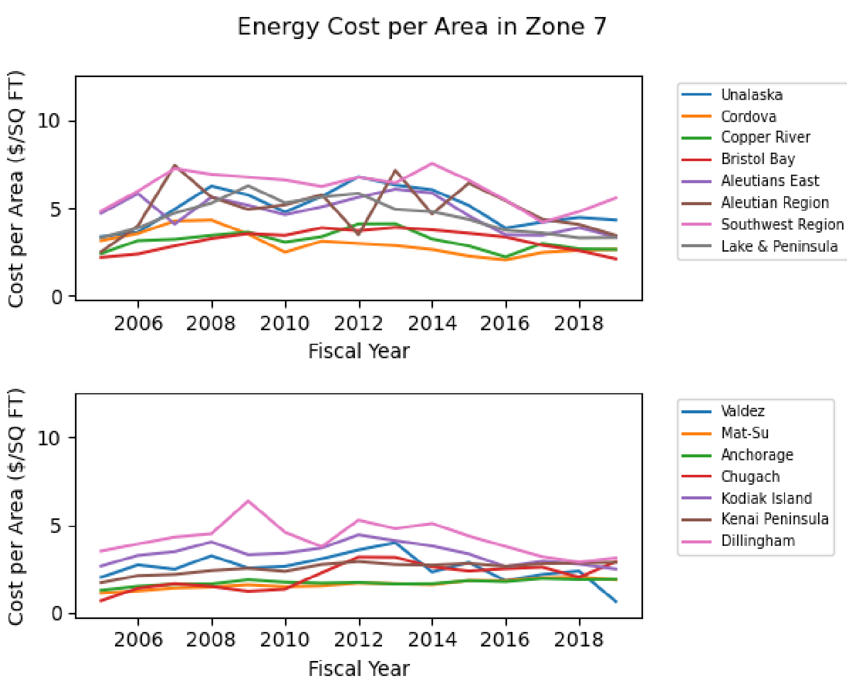
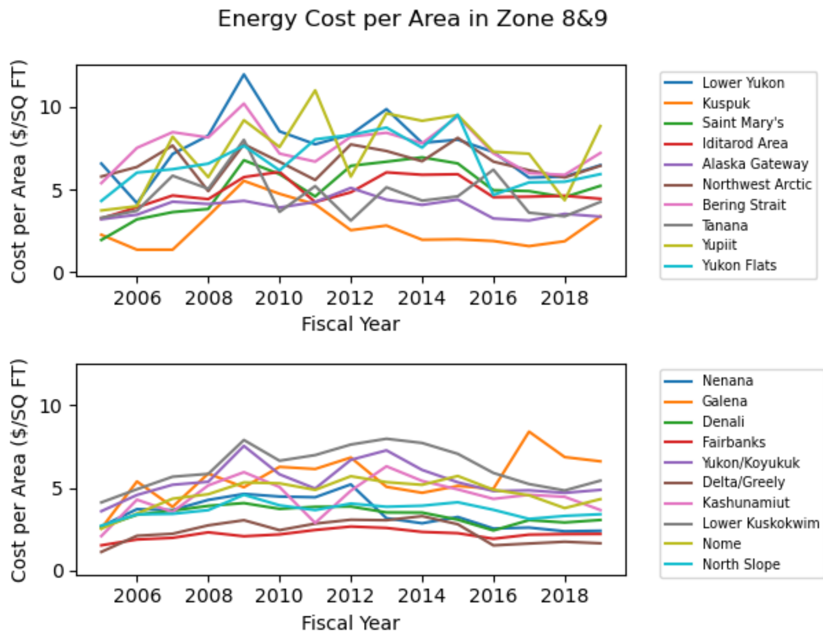


Figure 5 Energy cost per square foot in zone 8 & 9 school districts. Districts with higher cost per student are in the upper half.



Summary

What does the context mean for understanding the data?

As we look at the data presented here, it is important to remember what it can tell us, and what it doesn't tell us. Most importantly, we don't know where we have inefficiencies. There are efforts underway to install energy monitoring equipment in schools across Alaska so that we can understand better energy use and also hopefully engage young people in learning about energy. There is also data being collected by DEED for districts that are applying for retrofit funds. This data may not provide comparable data on energy costs, but it will help us understand energy use. But in order to tell the full picture of energy costs and usage, we need more data that is gathered in a consistent fashion.

As we noted earlier, Alaska's climate and remoteness are not something we can (or should) change. Rather, in order to address the high cost of energy, we need to address those factors that are within our control. There are several strategies to take. The first is to invest in energy efficiencies. In its 2014 report on the energy efficiency of school buildings the Alaska Housing Finance Corporation made a number of recommendations to increase energy efficiency and reduce energy costs. Among these were short term efforts such as energy audits for all buildings, implementing the cost-effective energy efficiency measures recommended by the auditors, creating district-wide energy policies, retro-commissioning buildings with high energy costs, and installing building monitoring systems. Long-term changes they recommended were focusing on space heating, incentivizing energy efficiency, standardizing equipment, and training for operations and maintenance staff.[8]

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[8] Energy Efficiency of Public Buildings in Alaska: Schools, November 21, 2014 (https://www.ahfc.us/application/files/4114/1866/9804/Energy_Efficiency_of_Public_Buildings_in_Alaska_Schools.pdf)

We are unaware of any follow up to see which districts have undertaking these actions or a systematic look at the savings generated. We know that some school districts have, and continue to increase energy efficiencies, from replacing all district lighting with energy efficient LED fixtures to upgrading windows, doors and insulation. But, we do not know the extent to which this has happened across the state. We imagine that some districts have conducted energy audits and implemented the energy efficiency upgrades recommended. But this process takes resources, and in a time of diminishing budgets, it can be hard to invest up front in these processes, even if they result in savings over the long run.

Similarly, we know there are districts investing in renewable energy sources for heating or electricity but, as noted earlier, there is not a comprehensive list of these efforts, nor of the extent to which renewable energy is offsetting the use of diesel or other non-renewable energy sources in schools and districts. Moving to renewable energy also can be costly, but there are likely to be new federal funding opportunities to support such efforts in the next few years. Hopefully Alaska schools and districts that are interested in adding renewable energy to their energy resource mix will be positioned to take advantage of them.

Appendixes

Appendix A: Data limitations

Above we have described several limitations in the data we have analyzed. In addition to the limitations around building footprints, use, and condition, we know that old schools and buildings have been replaced or taken off-line. However, we cannot tell from the data we have when buildings were simply taken offline and not replaced, as those structures are simply deleted from the database. Also, we cannot unpack the impact of new facilities on overall energy expenditures using the available data. For example, Clark Middle School in Anchorage was replaced within the timeframe of the data analysis, but we don’t know whether that saved significant energy costs or not. Gruening Middle School and Eagle River Elementary School have been closed since the November 2018 earthquake in Anchorage but we don’t know the extent to which that reduced energy use or not, given that other costs certainly were impacted by damage that may have made buildings less snug.

Appendix B: Percent of District Budget Spent on Energy, FY19, by District

School District	Total Expenditures	Energy costs	% spent on energy
Alaska Gateway	$10,208,343	$719,397	7.0%
Aleutian Region	1,773,583	39,976	2.3%
Aleutians East	8,175,626	457,724	5.6%
Anchorage	612,644,145	15,084,725	2.5%
Annette Island	8,410,962	446,307	5.3%
Bering Strait	54,212,422	3,818,793	7.0%
Bristol Bay	3,455,090	204,418	5.9%
Chatham	4,366,074	277,400	6.4%
Chugach	4,575,780	188,621	4.1%
Copper River	7,433,685	481,269	6.5%
Cordova	6,340,949	280,283	4.4%
Craig	6,368,728	209,813	3.3%
Delta/Greely	10,875,582	362,519	3.3%
Denali	10,084,082	369,645	3.7%
Dillingham	8,964,030	336,108	3.7%
Fairbanks	201,799,913	5,520,906	2.7%
Galena	26,760,564	1,213,277	4.5%
Haines	4,531,204	221,459	4.9%
Hoonah	2,833,229	138,865	4.9%
Hydaburg	2,237,355	211,665	9.5%
Iditarod Area	8,543,049	606,289	7.1%
Juneau	70,451,060	1,412,775	2.0%
Kake	2,990,797	196,330	6.6%
Kashunamiut	7,518,552	269,973	3.6%
Kenai Peninsula	139,471,259	5,827,455	4.2%
Ketchikan Gateway	39,814,484	1,013,204	2.5%
Klawock	3,293,500	118,675	3.6%
Kodiak Island	41,847,324	1,417,950	3.4%
Kuspuk	13,530,104	623,511	4.6%
Lake & Peninsula	13,765,844	803,629	5.8%
Lower Kuskokwim	128,693,866	4,867,781	3.8%
Lower Yukon	52,859,499	3,109,456	5.9%
Mat-Su	239,818,249	5,526,341	2.3%
Nenana	9,016,717	170,268	1.9%
Nome	11,438,330	961,515	8.4%
North Slope	68,448,152	2,664,143	3.9%
Northwest Arctic	62,806,910	3,854,077	6.1%
Pelican	580,948	13,838	2.4%
Petersburg	8,662,305	322,518	3.7%
Pribilof	1,817,123	122,914	6.8%
Saint Mary's	4,086,634	343,056	8.4%
Sitka	21,208,997	862,604	4.1%
Skagway	2,562,886	93,510	3.6%

Southeast Island	6,515,556	258,187	4.0%
Southwest Region	18,469,377	1,368,971	7.4%
Tanana	1,570,891	125,201	8.0%
Unalaska	7,943,345	344,705	4.3%
Valdez	13,371,469	173,768	1.3%
Wrangell	5,818,781	247,991	4.3%
Yakutat	1,917,358	98,204	5.1%
Yukon Flats	9,181,380	915,958	10.0%
Yukon/Koyukuk	18,498,201	818,566	4.4%
Yupiit	12,705,778	1,129,765	8.9%

Appendix C: Percent of District Budget Spent on Energy, FY19, High to Low

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