Kivalina

Kivaliniq

Native Village of Kivalina:
907-645-2153
City of Kivalina:
907-645-2137
AVEC:
907-561-1818

Demographics –
Native Village Status: Federally Recognized Tribal Council
Alaska Native Name: Kivaliniq
Population: 442
Avg. Household Size: 5.4
Median Household Income: $48,750

Access –
Barge Access: Seasonal
Runway Ownership: State
Runway Surface: Gravel
Runway 1: 3,000 ft x 60 ft
Runway 2: None

Climate –
Average Summer Temperature: 47 °F
Average Winter Temperature: 1 °F
Heating Degree Days: 19,579

Heat & Power Costs (2020) –
Cost of Diesel Fuel: $4.20 per gal
Cost of Gasoline: $4.61 per gal
Cost of Electricity: $0.57 per kWh
Cost of Electricity, after PCE: $0.24 per kWh

Tank Farm -
Ownership: Northwest Arctic Borough School District (NWABSD), Native Store, City of Kivalina, AVEC
Bulk Fuel Capacity:

Owner	Fuel	Capacity (gal)
City of Kivalina	Diesel	8,400
NWABSD	Diesel	50,000
Native Store	Gasoline	44,000
Native Store	Diesel	84,400
AVEC	Diesel	110,600

Condition: Deteriorating - Acceptable

Electric Utility –
Alaska Village Electric Cooperative (AVEC)

Power Demand (2020) –
Average Summer Load: 234 kW
Average Winter Load: 314 kW
Peak Summer Load: 250 kW
Peak Winter Load: 438 kW
Total Power Generated: 1,789,756 kWh

Power System (2020) –
Fuel Efficiency: 14.42 kWh/gal diesel
Line Loss: 2.6%
Number of Community Buildings on PCE: 9
Community PCE kWh Use of Total Allowed: 29% (106,590 kWh - used / 371,280 kWh - total allowed)

Power Generation Infrastructure –
Diesel Engines:

Manufacturer	Model	Capacity
Detroit Diesel	DDEC3-S60	229 kW
Caterpillar	D353	337 kW
Cummins	LTA 10	250 kW
Detroit Diesel	DDEC4-S60	363 kW

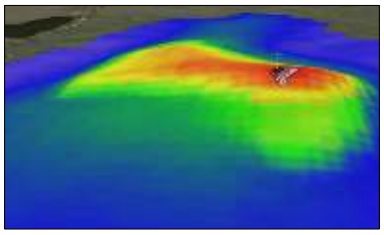
Wind Turbine(s): None
Solar PV: 10.53 kW installed for water plant, behind the meter
Battery Storage System: None

Heat Recovery –
Facilities Served: Washeteria and Raw Water Line
Opportunity to Expand Waste Heat: Yes

Water & Wastewater –
Ownership: City of Kivalina
Water System: Haul, Washeteria
Wastewater System: Honeybucket

Selected Projects –

Wind Turbine Feasibility and Design – *Expected 2023*



- Funding originally awarded for heat recovery expansion
- Opportunity to reallocate for wind turbine feasibility and design
  - Siting on Kisimigiuktuq Hill
- Village Improvement Fund
  - Funding awarded 2020
  - $443,242 awarded to ANTHC

Kisimigiuktuq Hill Electrical Intertie – *Completed 2021*

- Design and build intertie from existing power plant to K-Hill
- Village Improvement Fund
  - Funding awarded 2020 & expected 2022
  - $2.5 million & $1 million multi-year awards

LED Streetlight Retrofit Borough-Wide – *Completed 2015*

- Installed 18 LED streetlights in Kivalina
- 25-year community savings: ~$1.9M & ~750,000 gal diesel
- State of Alaska, Grants to Municipalities
  - Funding awarded 2014
  - $200,000 awarded to Northwest Arctic Borough

Water Plant Solar PV – *Completed 2016*

- 10.53 kW solar PV installed
- Average 10.7 kWh/day; still operational
- Coastal Impact Assistance Program (CIAP)
  - Funding awarded 2009
  - $84,078 awarded

Bulk Fuel Storage Assessment – *Completed 2015*

- 2 tanks evaluated
- Condition ranges from deteriorating – acceptable
- Alaska Energy Authority (AEA)

Future Projects –

Village Relocation Energy Opportunities

- Evaluate opportunities for energy efficiency throughout village relocation process
    - Invest in energy efficiency now for long-term benefits
    - Home design and construction
        - Building envelope, heating, lighting, appliances
    - School design and construction
        - Make long-term plan for energy use required for desalination
- Secure funding for energy efficient infrastructure

Wind Turbine

- Finalize new village relocation site
- Site wind turbine on Kisimigiuktuq Hill with consideration of village location
- Reallocate Village Improvement Funds from heat recovery project to wind turbine project
- Design and construct wind turbine

Solar PV

- Conduct feasibility study for solar PV and battery installations
    - Evaluate siting with consideration of reduced line loss for location near new village site
    - Reduce diesel fuel consumption
    - Increase resiliency
- Secure funding for feasibility study

Energy Milestones –

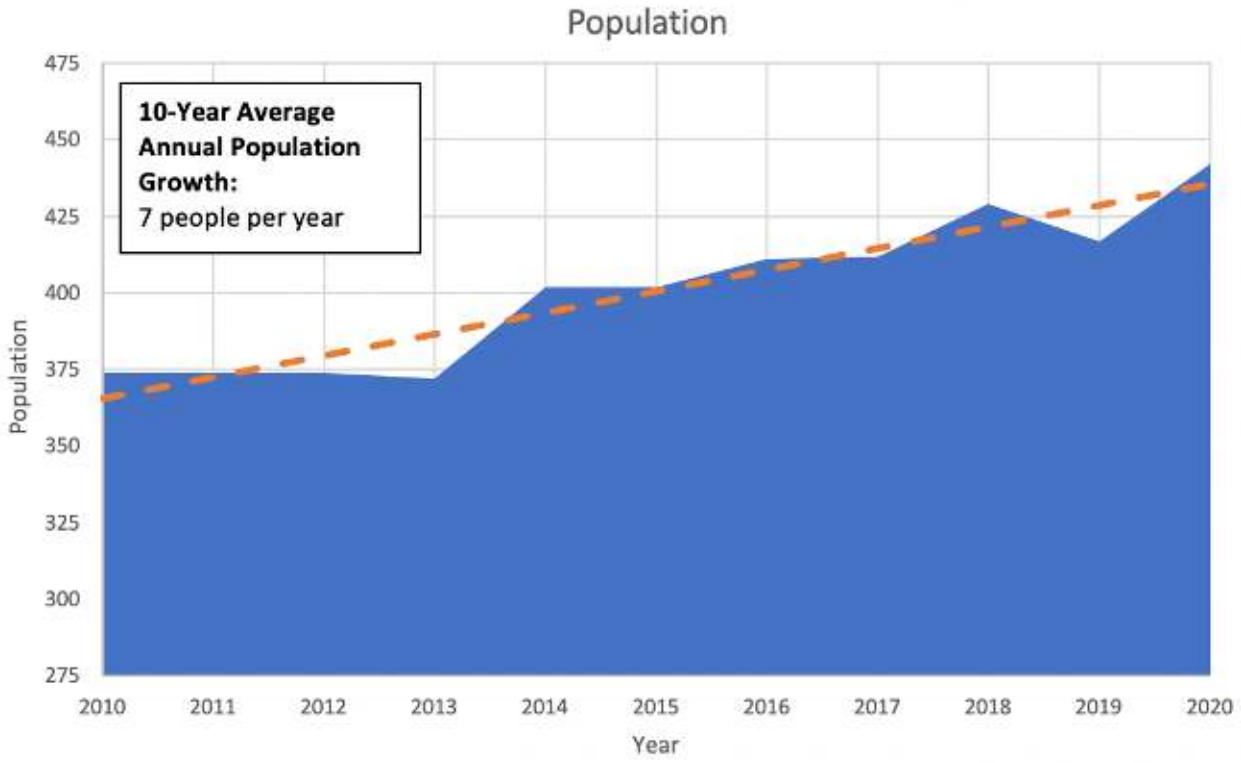
- Constructed intertie from Kivalina to Kisimigiuktuq Hill – *Completed 2021*
- Installed first solar PV in Kivalina – *Completed 2016*

Community Goals –

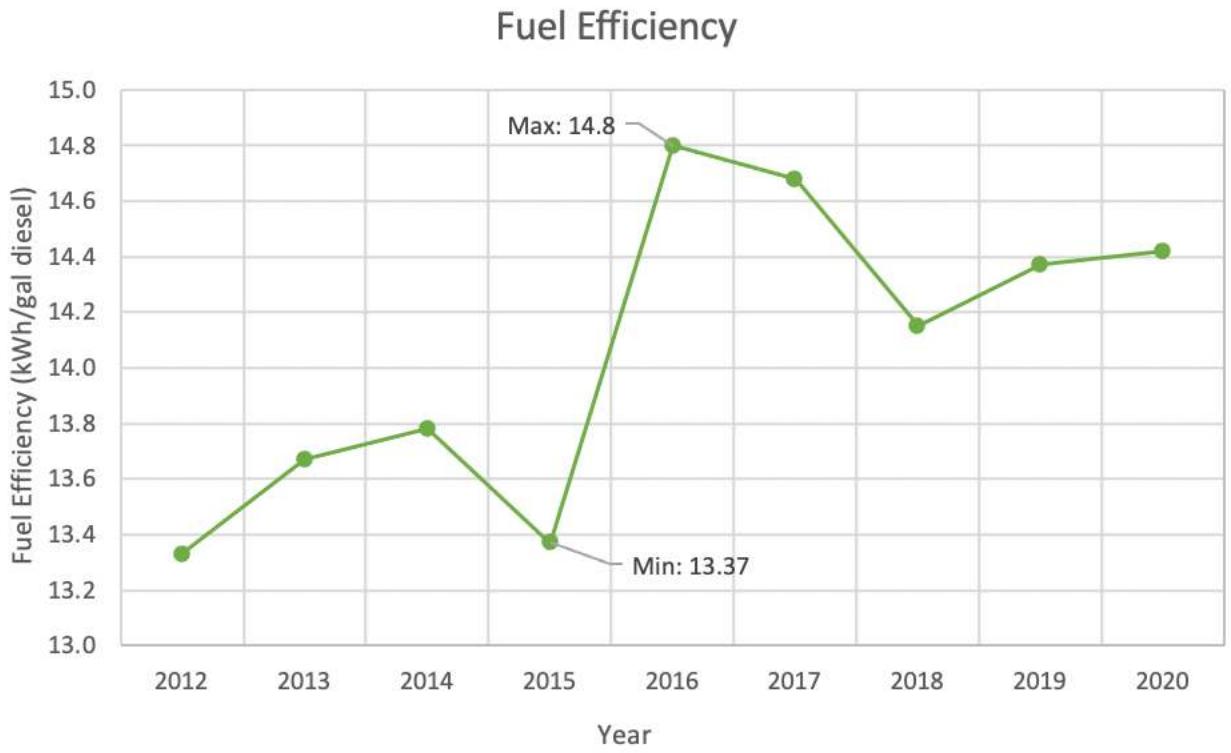
- Focus on village relocation process
    - Evaluate energy efficiency opportunities throughout relocation
    - Identify plan to support community members who choose not to relocate
- Reduce cost of residential space and water heating
    - Develop renewable energy microgrid
        - Facilitate reduced line loss by siting generation sources near village
    - Use energy efficient construction techniques for newly constructed homes
    - Install energy efficient residential heating appliances in newly constructed homes
        - Heat pumps – Upgrade of power plant infrastructure may be required
        - Wood stoves – Offer resiliency for residential heating systems
- Partner with Northwest Inupiat Housing Authority to implement policy changes to prioritize and invest in energy efficiency in newly constructed homes
    - Partnership led by Kivalina Housing Committee with support from NANA
- Upgrade distribution system to improve power quality
- Develop renewable energy microgrid
    - Wind turbine(s) and battery storage

        - Understand impacts of noise and flicker on traditional whale hunting practices
    - Solar PV and battery storage
    - Develop Independent Power Producer agreement to sell power to AVEC
- Develop job shadow program for students to learn about energy system and operator position
- Work with AVEC to identify long-term plan for the continued ability of power plant to serve new village
    - Discuss pros and cons of power plant relocation from AVEC/community perspectives
- Enhance energy efficiency of water and sewer system

Energy System Trends –

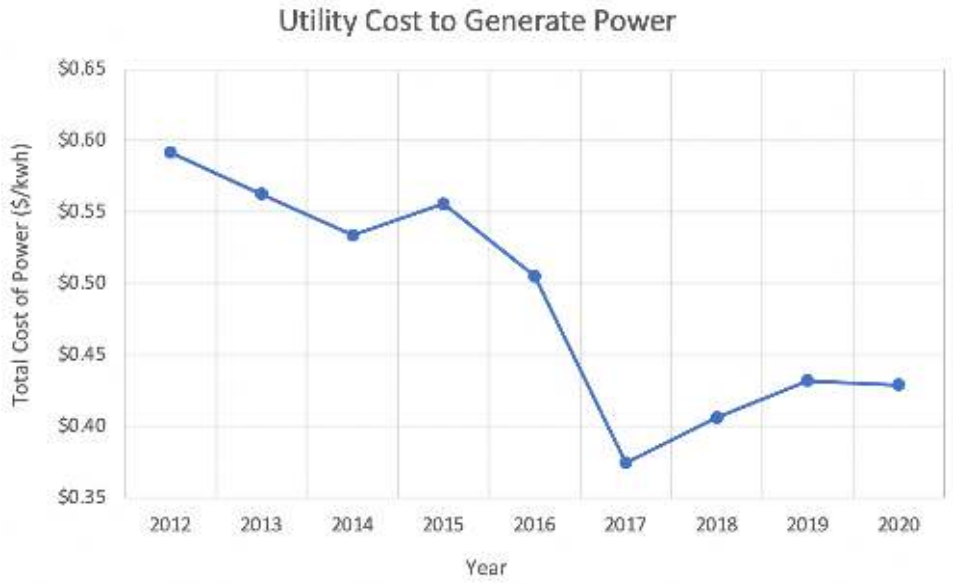


Dramatic changes in population impact the long-term community planning necessary to meet future power demand. The population in Kivalina is not changing dramatically. Over the last ten years the population has increased an average of 1.9% each year.

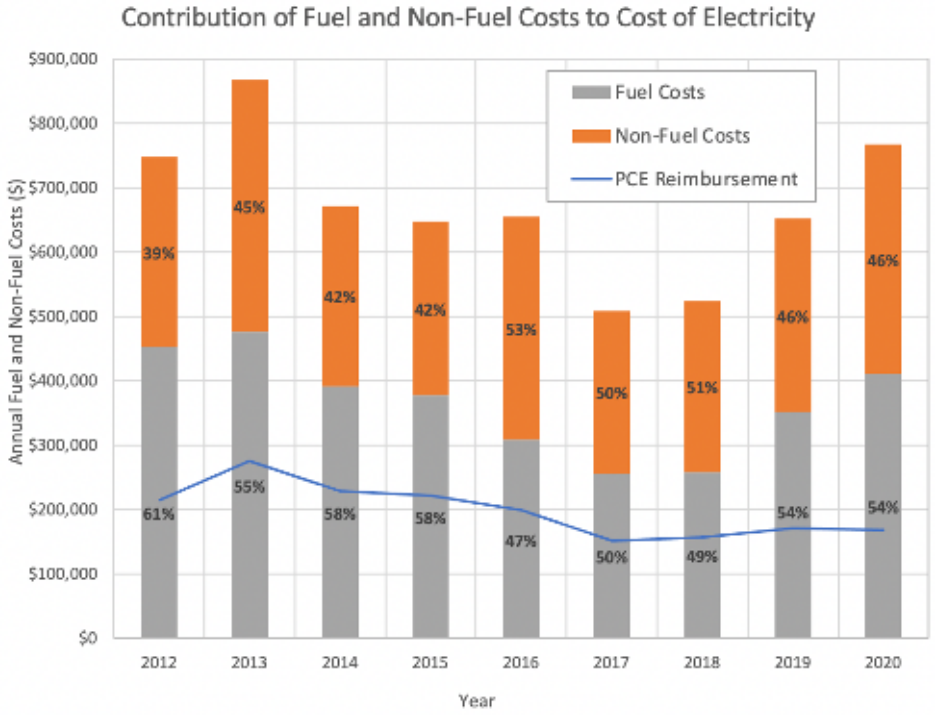


A higher fuel efficiency results in less diesel fuel use and a lower cost to generate power. A fuel efficiency below 12 kWh/gal is poor; a fuel efficiency above 14 kWh/gal is excellent. *The fuel efficiency in Kivalina historically has been good. Starting in 2016, there was a distinct improvement in efficiency to values consistently exceeding 14 kWh/gal of diesel. This improvement may correlate with generator upgrades.*

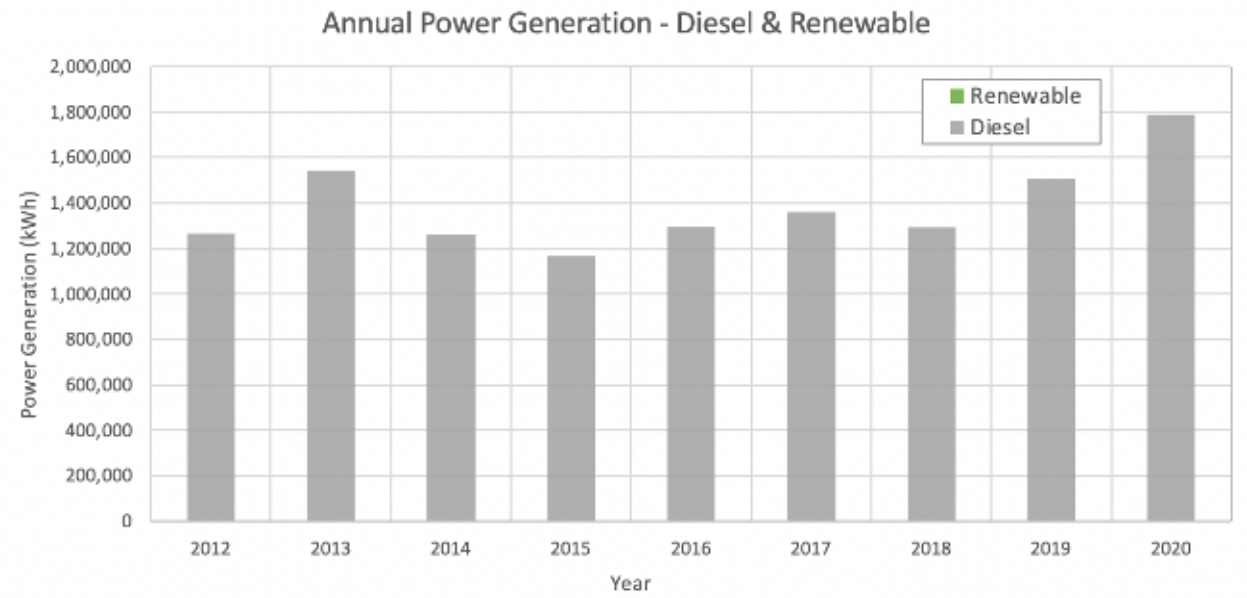
The maximum allowable line loss to maintain eligibility for PCE benefits is 12%. In Kivalina, the line loss is very low and has been very low for the past nine years, indicating the distribution system is in good condition and all power use is accounted for. As more of the village load moves to the new location, it is expected that some additional line loss will occur from the diesel power plant, but this may be offset by new renewable energy generation located closer to the new village loads.



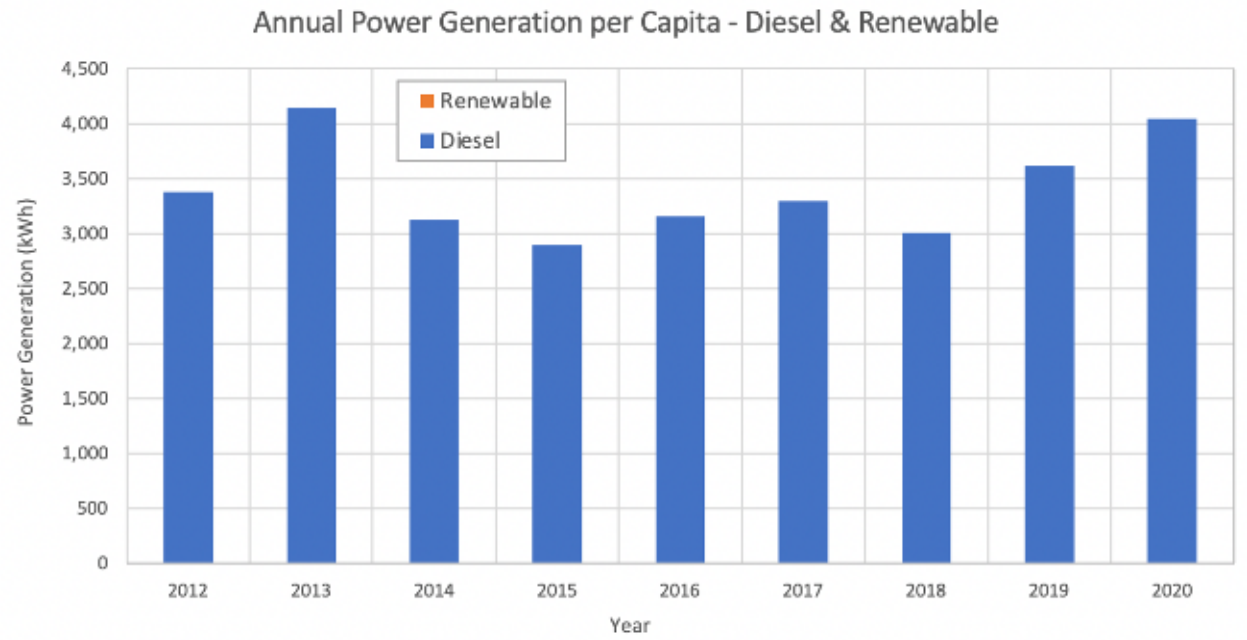
Over the long-term, a lower utility cost to generate power typically correlates with a lower cost of electricity for residents. The major factors that affect the cost to generate power are the cost of fuel, generator fuel efficiency, maintenance, and operations. Major system breakdowns may cause the cost to generate power to spike on a particular year, as will high fuel prices. In Kivalina the cost to generate power decreased significantly from 2012 to 2017, and then has increased about 5 cents/kWh from 2017-2020.



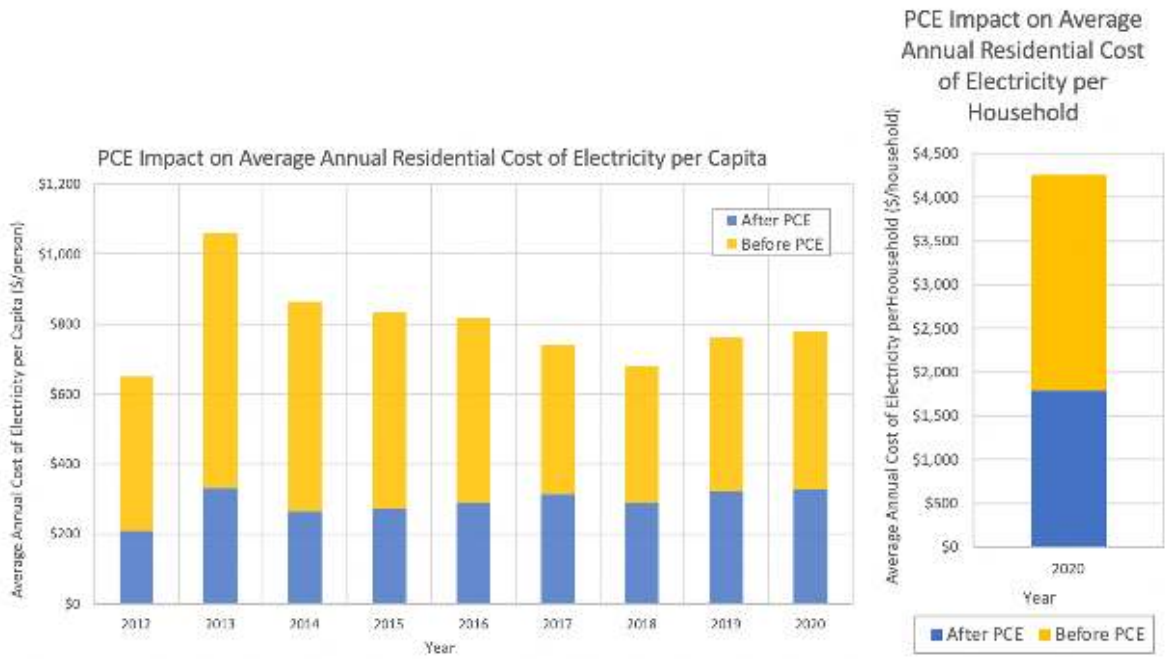
For many utilities, the non-fuel costs associated with generating power do not change dramatically each year. Fuel costs, on the other hand, are highly susceptible to annual fluctuations based on the global price of fuel, transportation costs, and the amount of power generated. PCE reimbursement is meant to offset the high fuel costs in rural Alaska. As the overall efficiency of the system increases, the PCE reimbursement offsets a larger portion of the total fuel costs. In Kivalina, the portion of the costs spent on fuel have varied over the last nine years, but are generally trending lower.



Renewable sources of power generation reduce diesel fuel use and can increase resiliency, in addition to offering many other benefits. The portion of power that is generated by renewable energy sources depends both on the capacity of the installed infrastructure as well as the performance of that infrastructure. In this way, the renewable energy generated may vary annually depending on the availability of the resource and availability of the equipment. There is no renewable power generation at the utility scale in Kivalina. All of the power is generated by diesel generators. The total power generated has fluctuated from a low of about 1.19 million kWh/year to a high of almost 1.80 million kWh/year over almost the last decade.



In general, people choose to power more electric devices each year, so the power generation per capita is expected to increase over time. When power generation per capita instead decreases over time, it is often correlated with reductions in power consumption as a result of energy efficiency upgrades. Power generation is also affected by the weather and corresponding heating needs each year. Power generation per capita in Kivalina has varied by similar proportions as the total power generation over the last nine years because the population has remained stable (see previous graph). From 2015 to 2020 the power generation per capita increased by 40%.



The PCE reimbursement reduces the residential cost of electricity by a different amount each year. In communities where the main factor that affects the cost of power is the price of fuel, the PCE reimbursement will tend to levelize the residential cost of electricity from one year to the next. In Kivalina, the residential cost of electricity per capita after PCE increased 56% from 2012 to 2020, from $210 per year to $328 per year.