Energy 101: Overview of Clean Energy Use & Production in Alaska

7 October 2020

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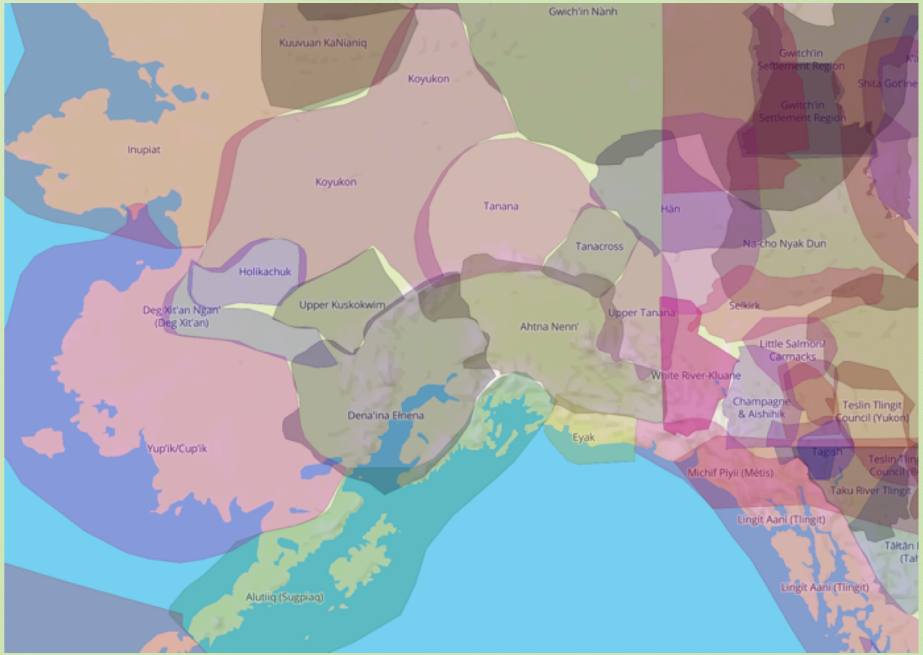
Energy Education Director

Land Acknowledgement

REAP staff live and work on the ancestral and current lands and territories of the Dena'ina Elnena, Ahtna Nenn', and Lingit Aani. We acknowledge the thousands of years of stewardship of these lands and waters and life, and the Indigenous knowledge and ways of life that continue to guide us today.



Screen shot from https://native-land.ca/

Who is REAP?

- Coalition of 70 dues-paying members
- Our mission is to advance clean energy in Alaska
- Learn more on our website AlaskaRenewableEnergy.org



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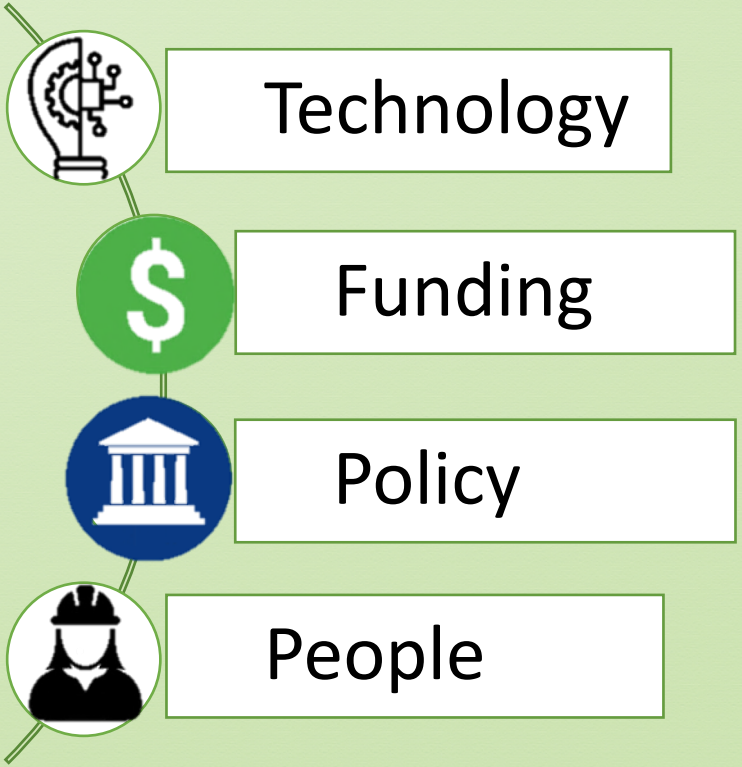
Four pillars for increasing clean energy



ENERGY.GOV

Energy Literacy Principles

1. Energy is a physical quantity that follows precise natural laws.
2. Physical processes on Earth are the result of energy flow through the Earth system
3. Biological Processes depend on energy flow through the Earth System
4. Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.
5. Energy decisions are influenced by economic, political, environmental, and social factors.
6. The amount of energy used by human society depends on many factors.
7. The quality of life of individuals and societies is affected by energy choices.

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Where does our energy come from?

Non-Renewable Sources

- Oil
- Natural Gas
- Coal

Renewable Sources

- Solar
- Wind
- Hydro
- Biomass
- Geothermal

How do we use energy?

Electricity

-the flow of electrons through a circuit

Heat

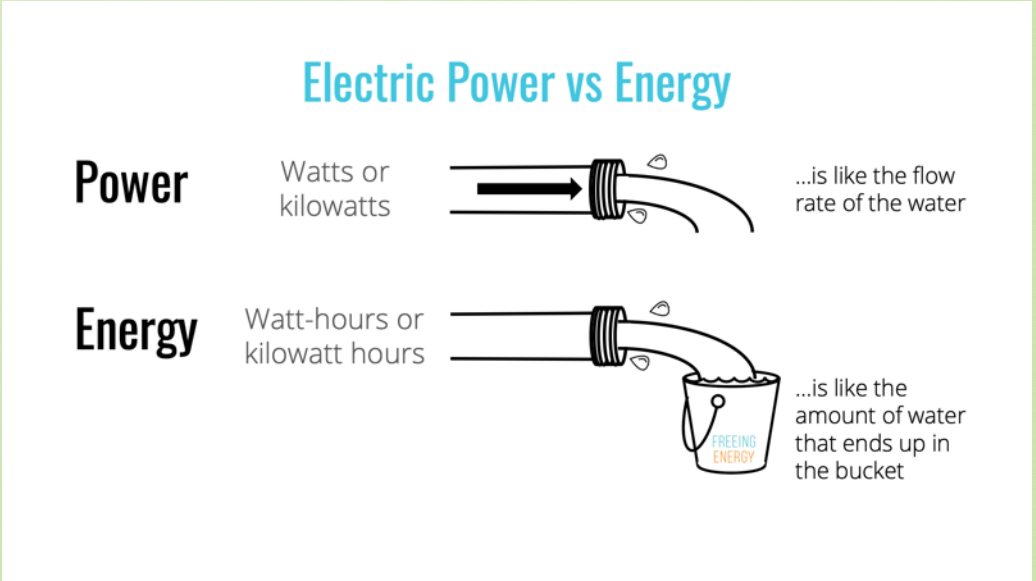
-the movement of atoms within or between objects/systems

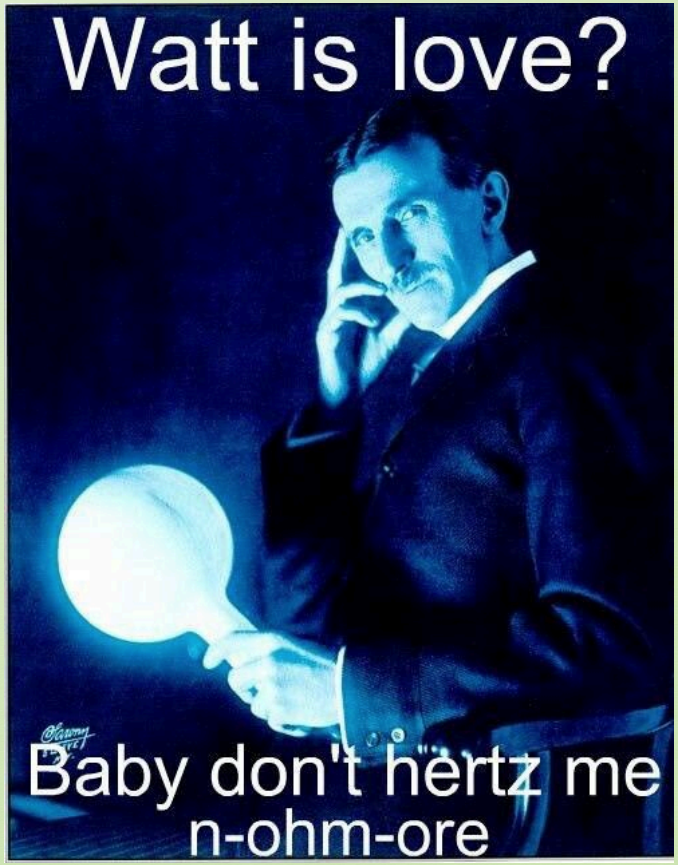
Transportation

-on road or off-road movement of people or supplies

Energy vs Power

- *ENERGY* = the ability to do *WORK*.
- *WORK* = when a *FORCE* moves an object.
  (Force x Distance = Work)
- *POWER* = the rate or speed of *WORK*.
  (Work / Time = Power)




Watt is love?
Baby don't hertz me
n-ohm-ore

Importance of Energy in Alaska

Alaska's energy use, access, and cost vary across communities

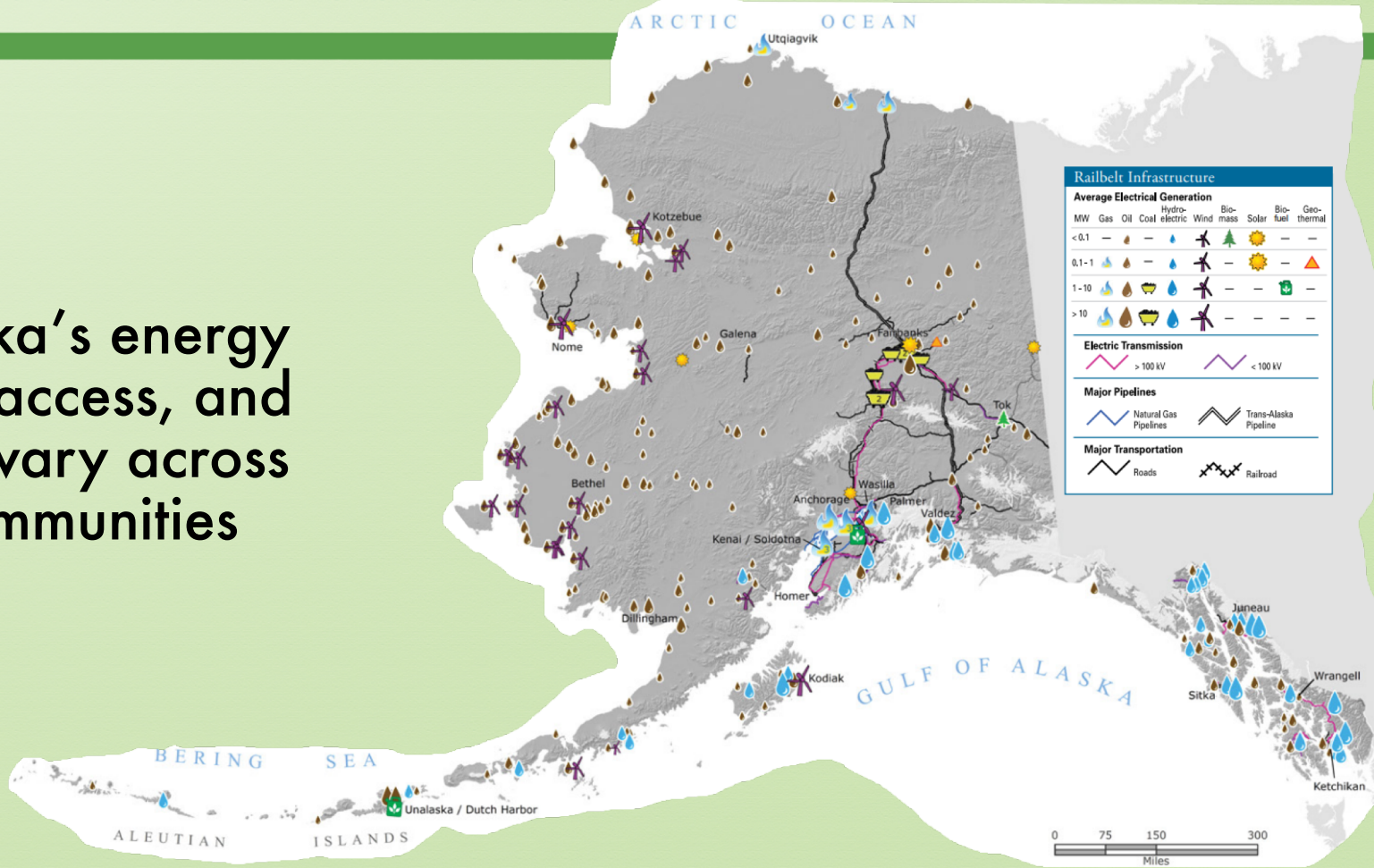


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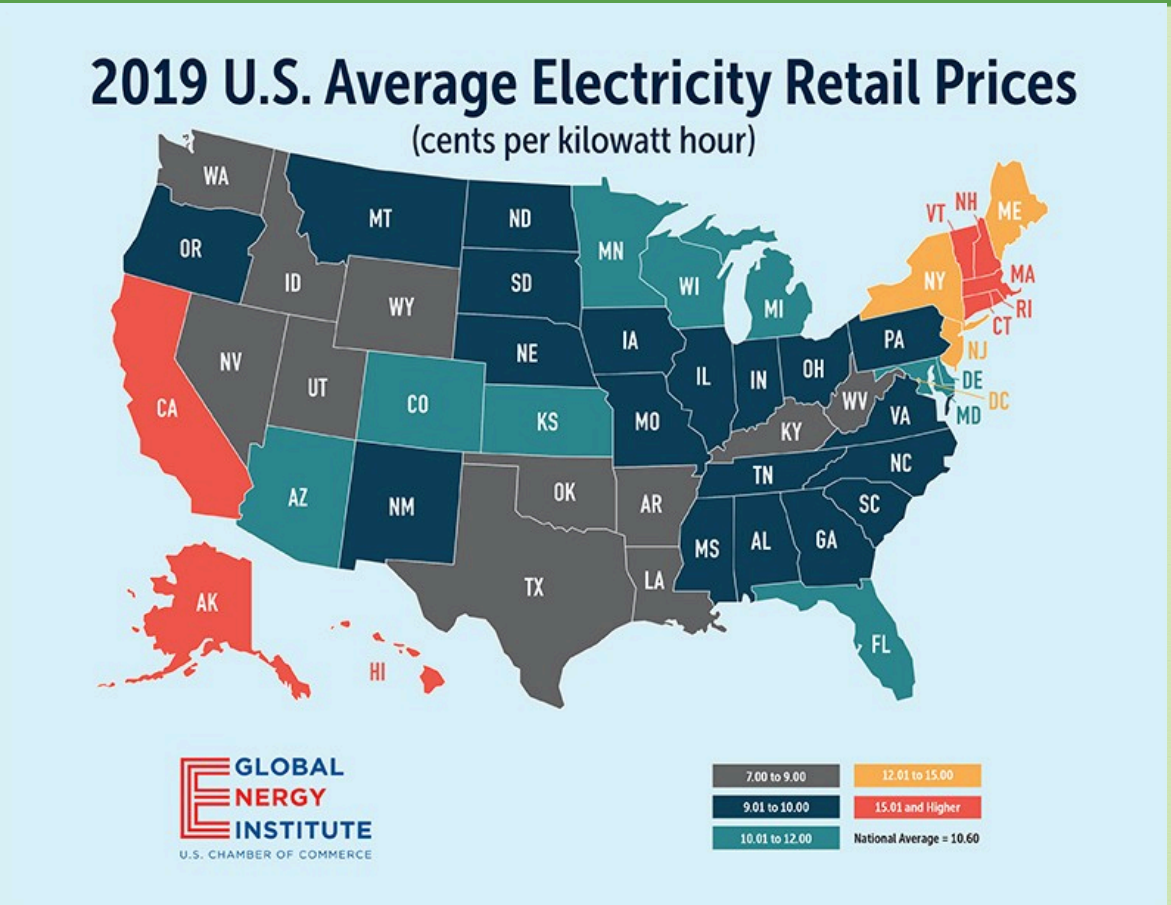
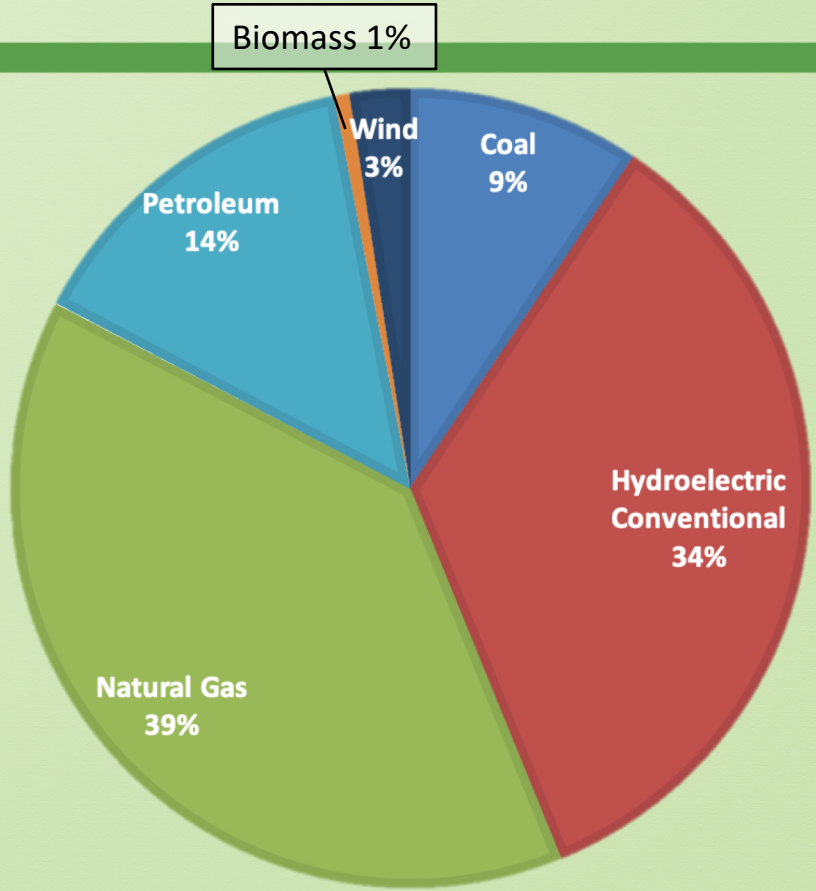
Image from Renewable Energy Atlas of Alaska, 2019 ed.



Alaska has the second-highest *average* cost of electricity in the US, but many rural communities have much higher electricity prices.

Alaska's electricity is mostly generated from fossil fuels and hydro

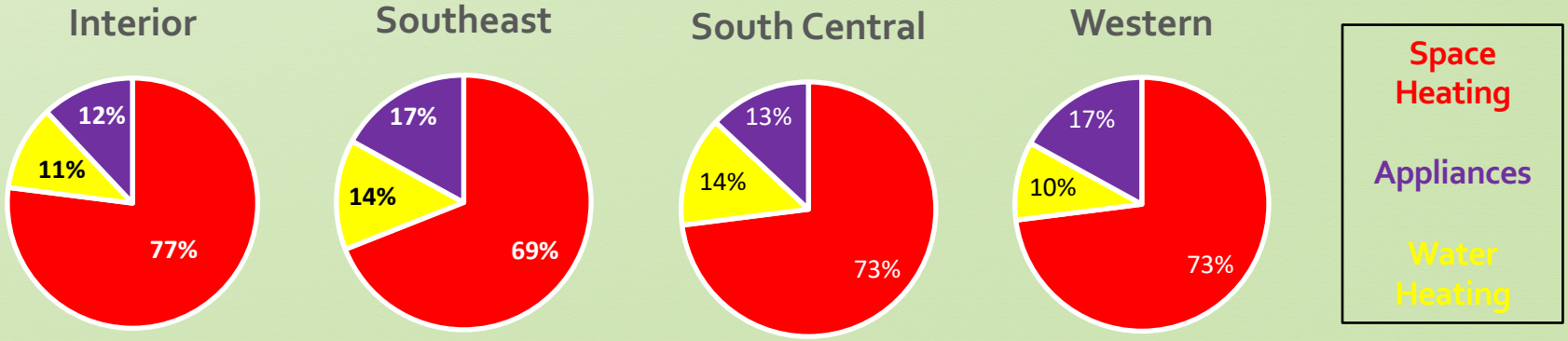


June 2020 AK Electricity Generation

Space heating is the largest use of energy everywhere in Alaska

Alaska Household Energy Costs $

(From AEA End Use Report)



End-use consumption by sector, excluding losses

574.6 trillion British thermal units
(percent of total for all sectors)

2018 Alaska data from EIA.gov

Commercial
41.8
(7.3%)

Industrial
326.3
(56.8%)

Residential
37.7
(6.6%)

Transportation
168.8
(29.4%)

The industrial sector (including all oil & gas operations) uses about half of the energy produced in the state

Food-Energy-Water nexus

- Many connections between Food, Energy and Water (FEW)
- Important for whole-community sustainability
- Example: Sustainable Southeast Partnership – Four pillars: Energy Independence, Fisheries & Forestry, Localized Economy, and Food Systems

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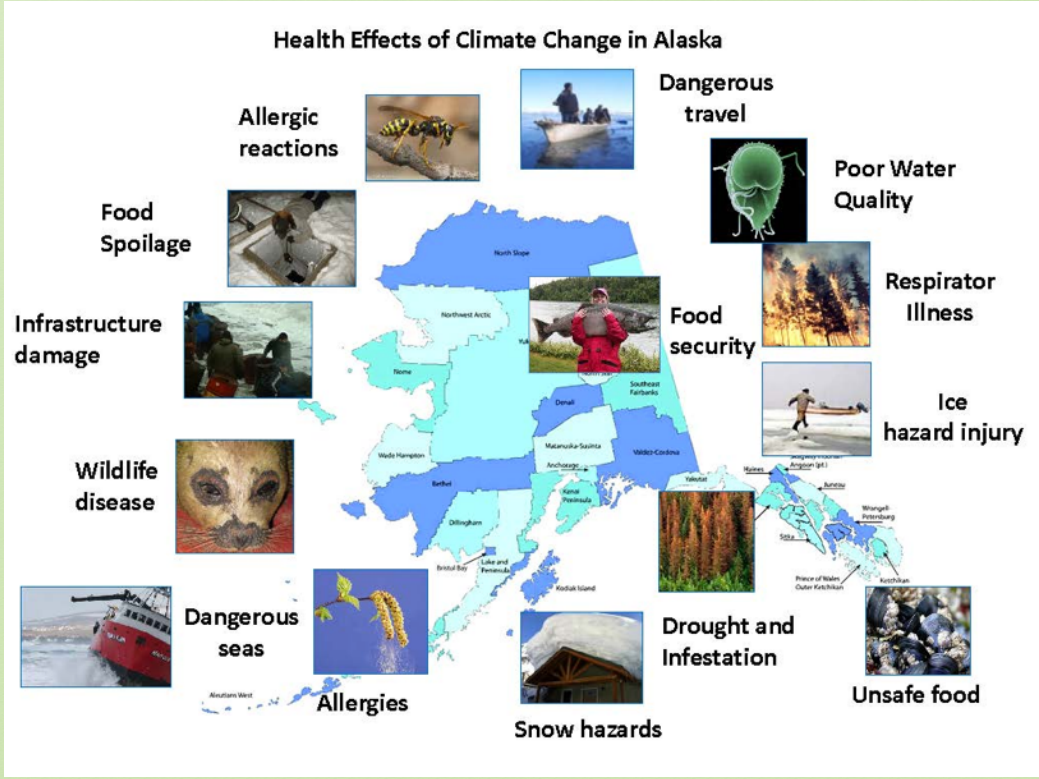
Graphic from MicroFEWs: http://ine.uaf.edu/microfews

Climate Change Impacts in Alaska

- Increased temperature
  - Permafrost
  - Beetle kill
  - Decreased sea ice
- Less predictable and more extreme weather
- Erosion
- Ocean acidification
- Air and water quality
- Food impacts
- And much more!



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https://www.commerce.alaska.gov/web/dcra/climatechange.aspx

What are the top 5 ways to reduce our global carbon footprint?

1. Onshore wind
2. Utility-scale solar photovoltaics
3. Reduced food waste
4. Plant-rich diets
5. Educating Girls & Family planning

*using Scenario 2 from Drawdown website, which stops Earth at 1.5 degrees C of warming

https://www.drawdown.org/solutions/table-of-solutions

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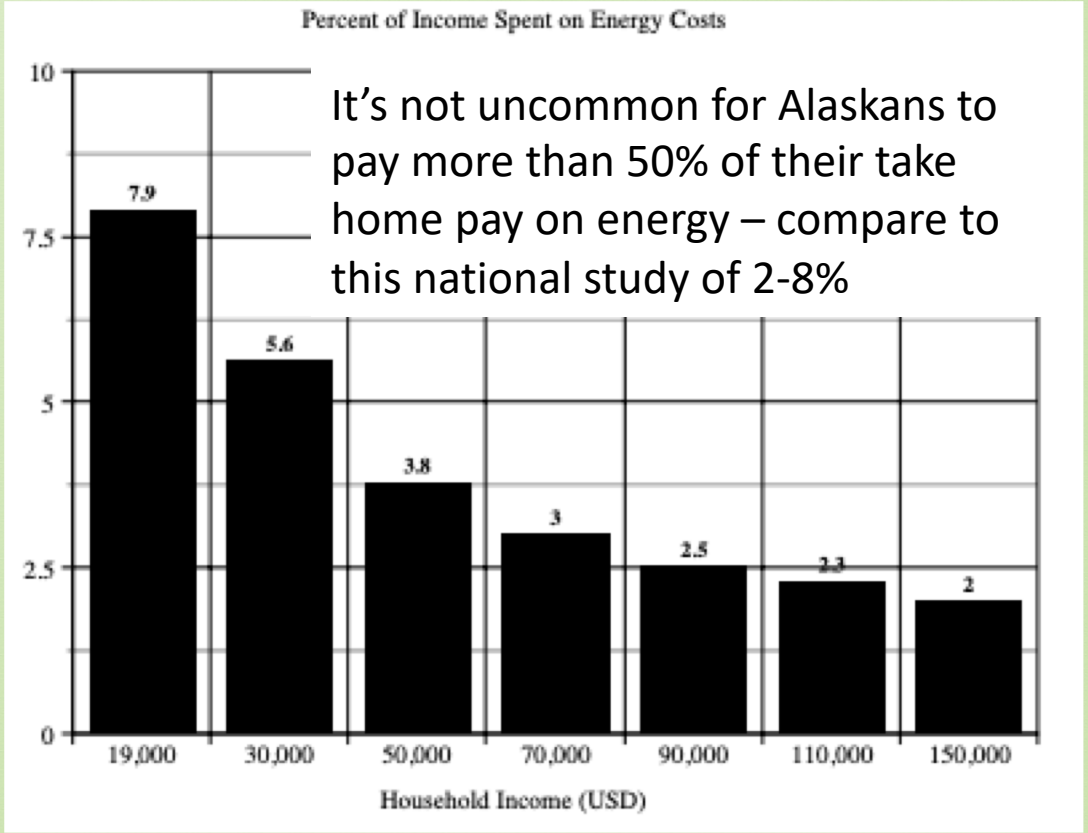
Equity

- High energy costs affect low income households more
- Of the 6 million people who live within 3 miles of a power plant, 39% are people of color
- The types of energy and energy jobs available in a community (or not) can have a profound impact



It's not uncommon for Alaskans to pay more than 50% of their take home pay on energy – compare to this national study of 2-8%

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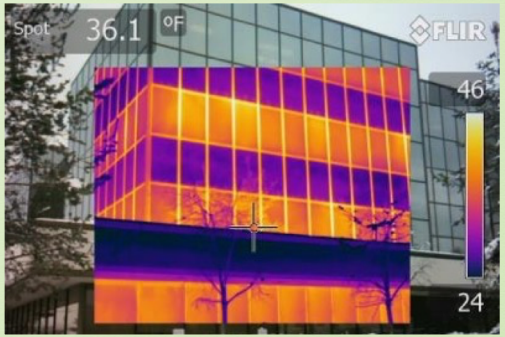
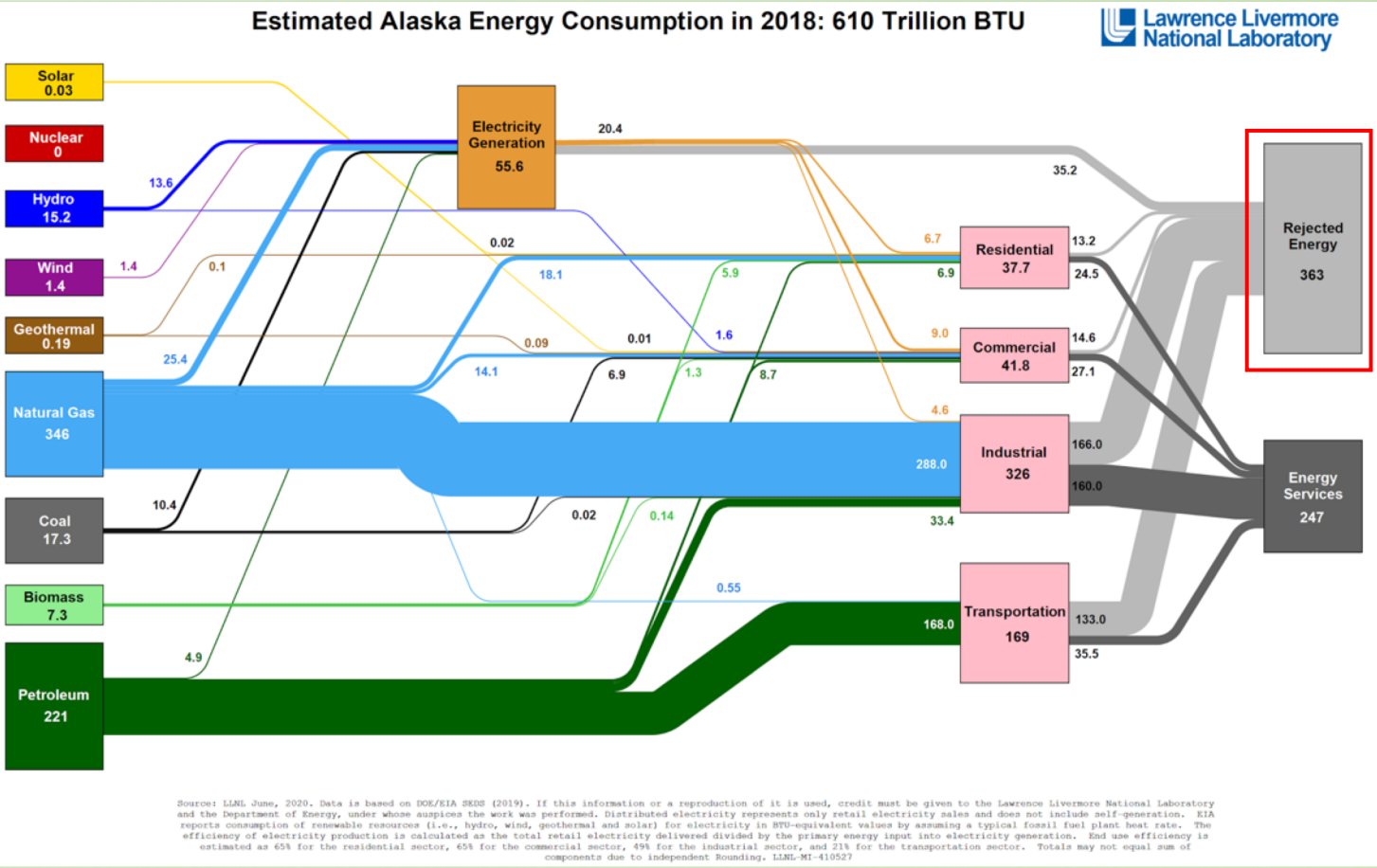


Energy Efficiency & Conservation

With less than 5% of the world population, the US consumes about 18% of its energy



Alaska is wasting up to $1 billion for energy use every year

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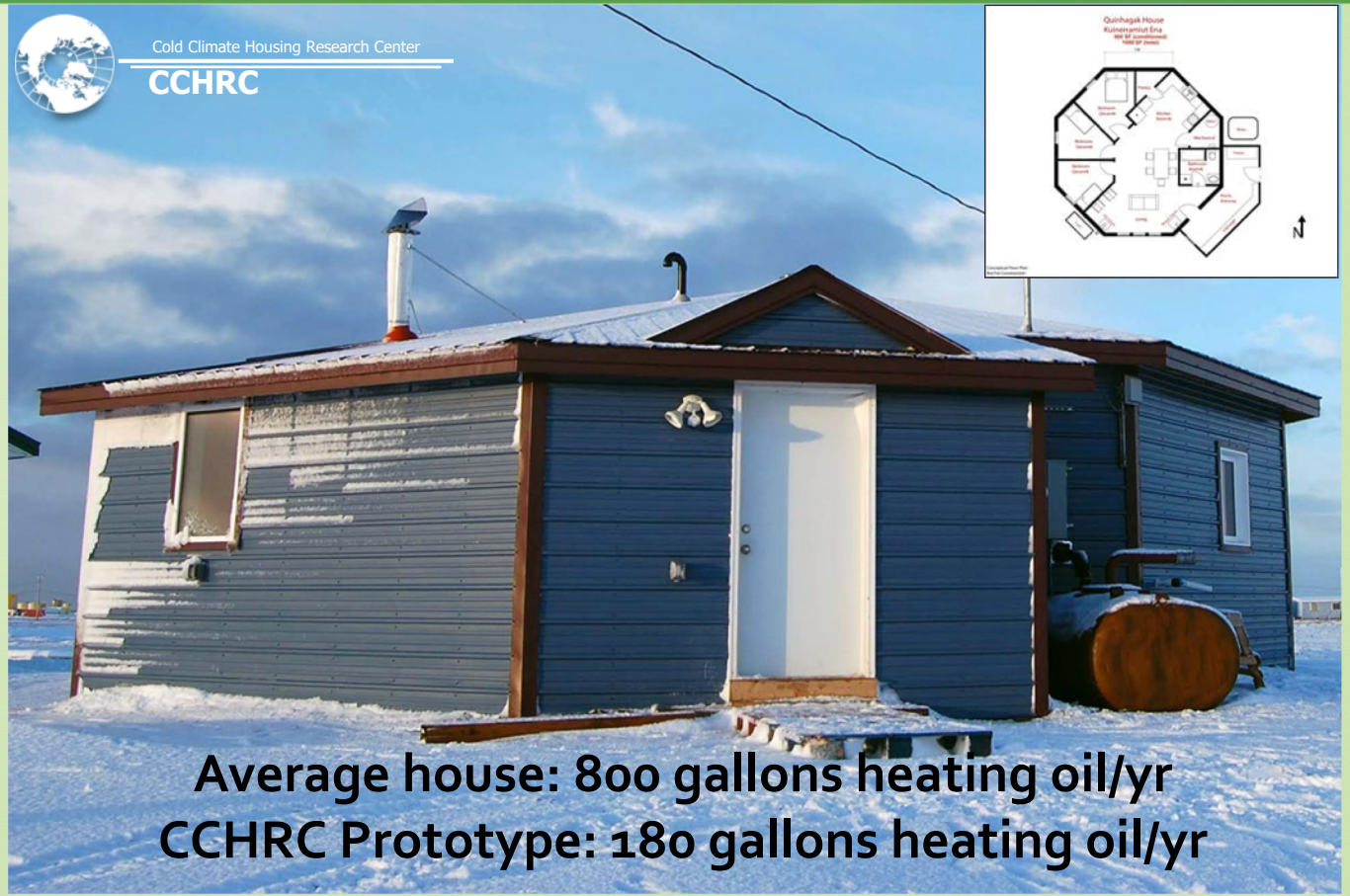
Over 45,000 homes participated in the home energy rebate and weatherization programs with an average savings of 30% per home. 671,600 barrels of oil equivalent continue to be saved *every year*

Photo courtesy of AHFC

Quinhagak

For more on building efficiency, listen to or watch “Building Science” presentation from March (podcast ep. 5)



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http://cchrc.org/quinhagak-prototype/

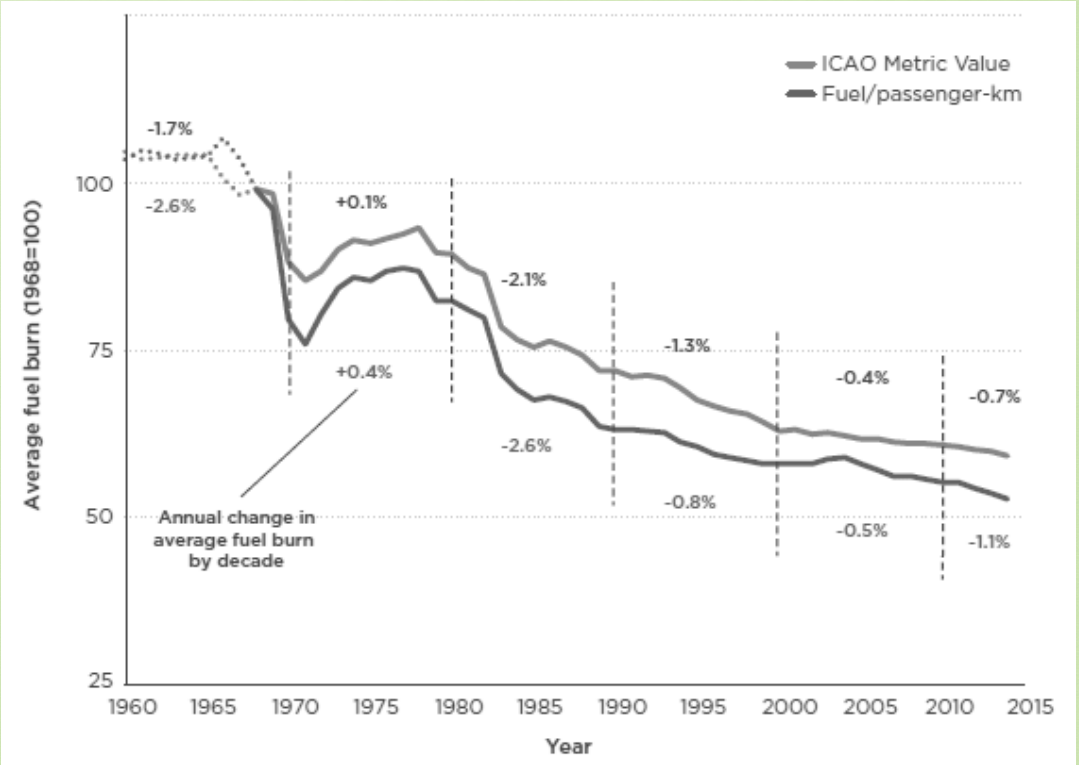
Natural Gas Power Plants

- New plants: combined heat and power
- 50%+ efficiency
- Coal and diesel plants 32-42% efficient

Southcentral Power Project photo from Power Magazine

Airplane efficiency

- Fuel efficiency has greatly improved in aircraft
- Get smaller and smaller improvements with more and more investment
- Airlines are looking for renewable options like biofuel



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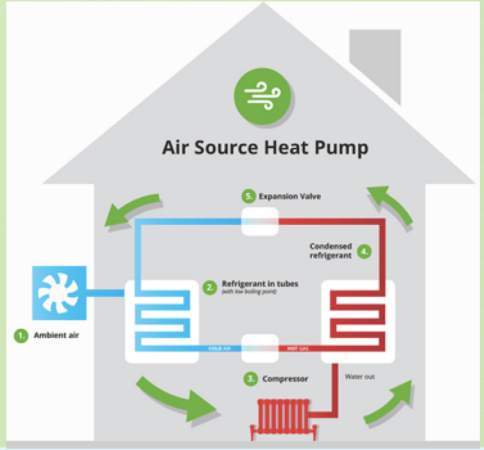
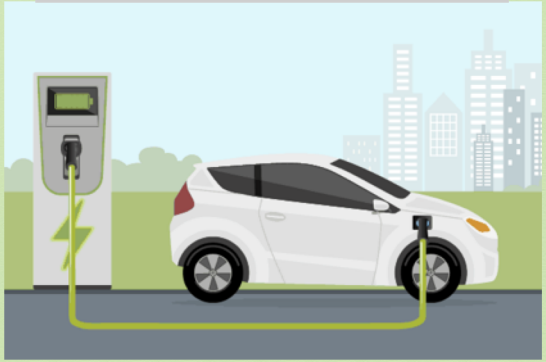
Beneficial Electrification

Beneficial Electrification includes the application of electricity to end-uses where doing so satisfies at least one of the following conditions, without adversely affecting the others:

- Saves consumers money over time;
- Benefits the environment and reduces greenhouse gas emissions;
- Improves product quality or consumer quality of life;
- Fosters a more robust and resilient grid

BeneficialElectrification.com





Electrify Alaska virtual conference: Nov 16-18

More on EVs in Alaska check out past Speaker Series presentation (podcast ep. 1)


DID YOU REMEMBER TO PLUG IN THE CAR?
STAHLER.
10:43

Alaska's Renewable Energy Resources

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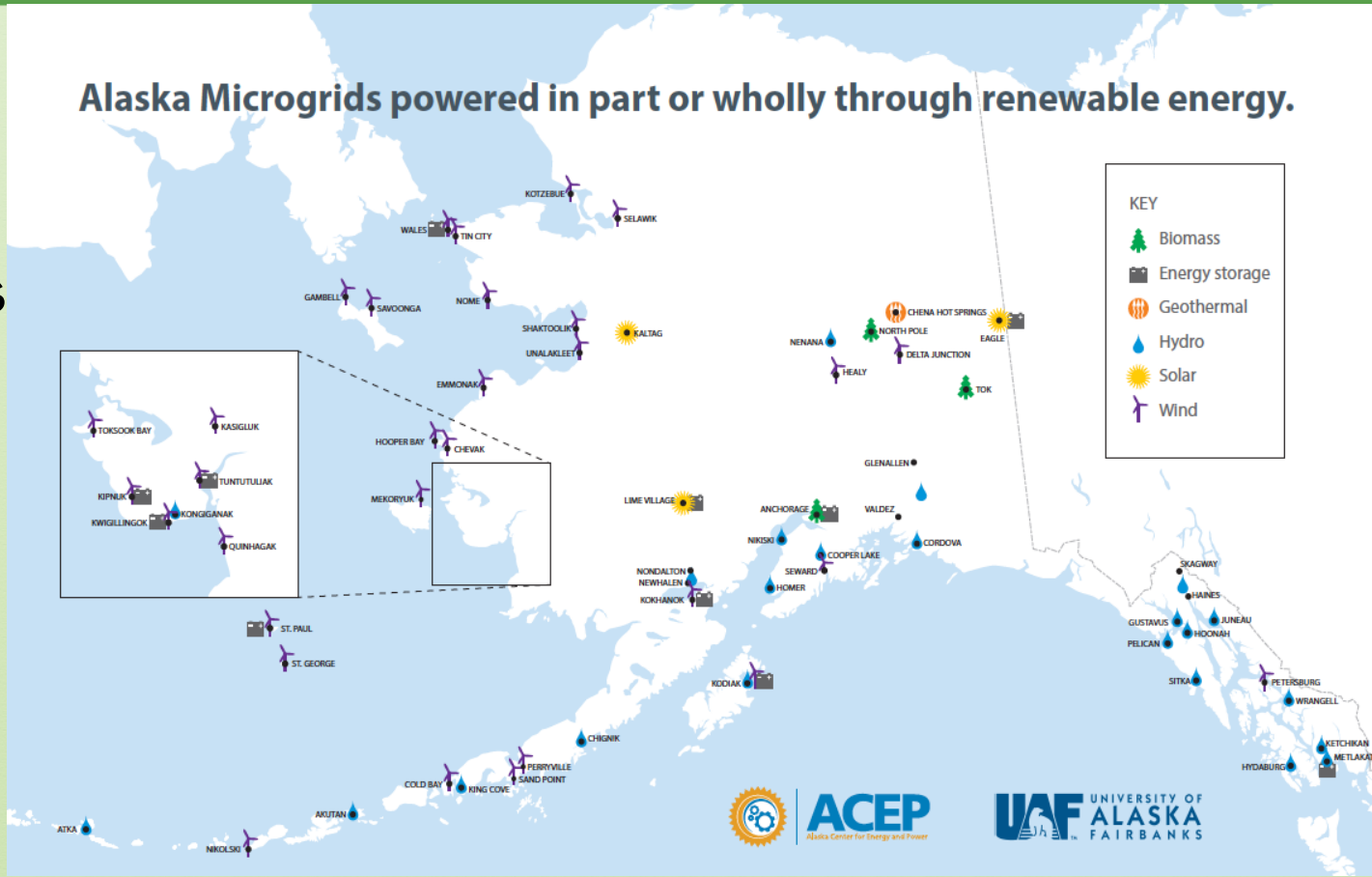
Benefits

- No worry about fuel supply availability
- Stabilize “fuel” costs
- Increases energy security
- Increase energy resilience
- Provide more local jobs
- Reduce carbon emissions
- No air/water pollution emissions at the site

Barriers

- Higher capital costs (but decreasing)
- Intermittent supply
- Unpredictable supply
- In Alaska and other small, isolated (particularly rural) grids:
  - Even higher capital costs
  - Grid stability
  - Cannot load follow
  - Lack of local expertise

80 microgrid communities in Alaska (of 200+) now have some renewable energy



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Renewable Energy Grant Fund

- Established in 2008
- $268 million awarded to date
- Over 90 operating projects have been built with REF contributions, collectively saving more than 30 million gallons of diesel each year

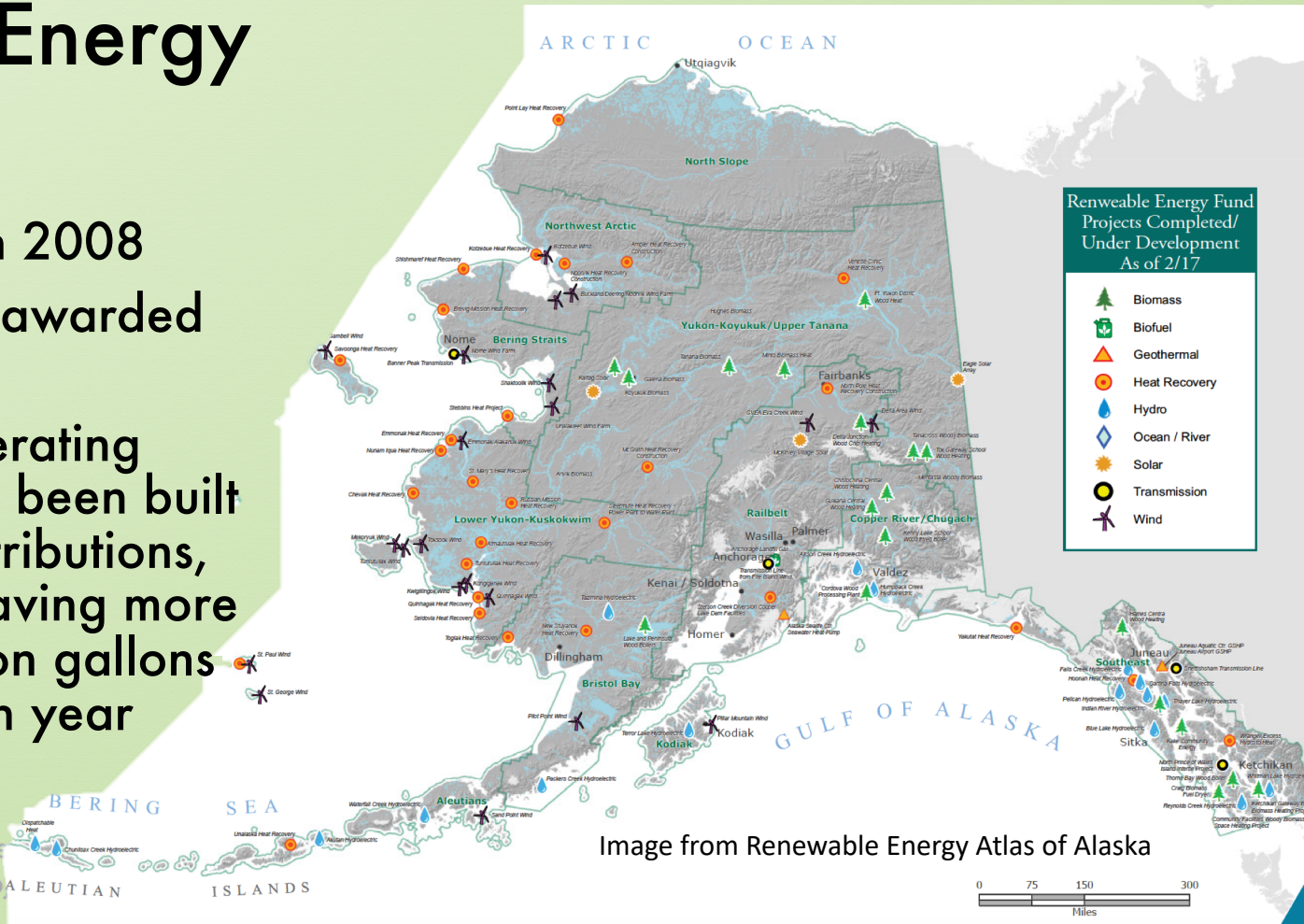


Image from Renewable Energy Atlas of Alaska

REAP Renewable Alaska Pro

Renewable Energy terms

- Dispatchable vs Non dispatchable: Can the energy be used on demand?
- Intermittent vs baseload: Is it available all the time?
- Capacity factor – How often is it available? It is the average expected output of a generator, usually over an annual period. Energy resource availability, economics, and maintenance can all affect capacity factor

Overview of renewable energy technology applications in Alaska

Renewable Type	Electric Power	Electric Heat Economical?	Direct Heat	Base load?
Hydropower	√	√		√
Biomass	√		√	√
Geothermal	√		√	√
Wind	√	µgrids only		
Solar thermal	√		√	
Solar photovoltaic	√	µgrids only		
Ocean tidal and tidal current	√			In theory; under research
Ocean wave	√			In theory; under research
Ocean thermal	√			In theory; under research
Hydrokinetic (river)	√			In theory; under research

Table from Daisy Huang, Alaskan Microgrids presentation

ACEP Alaska Center for Energy and Power

UAF University of Alaska Fairbanks

Hydroelectric

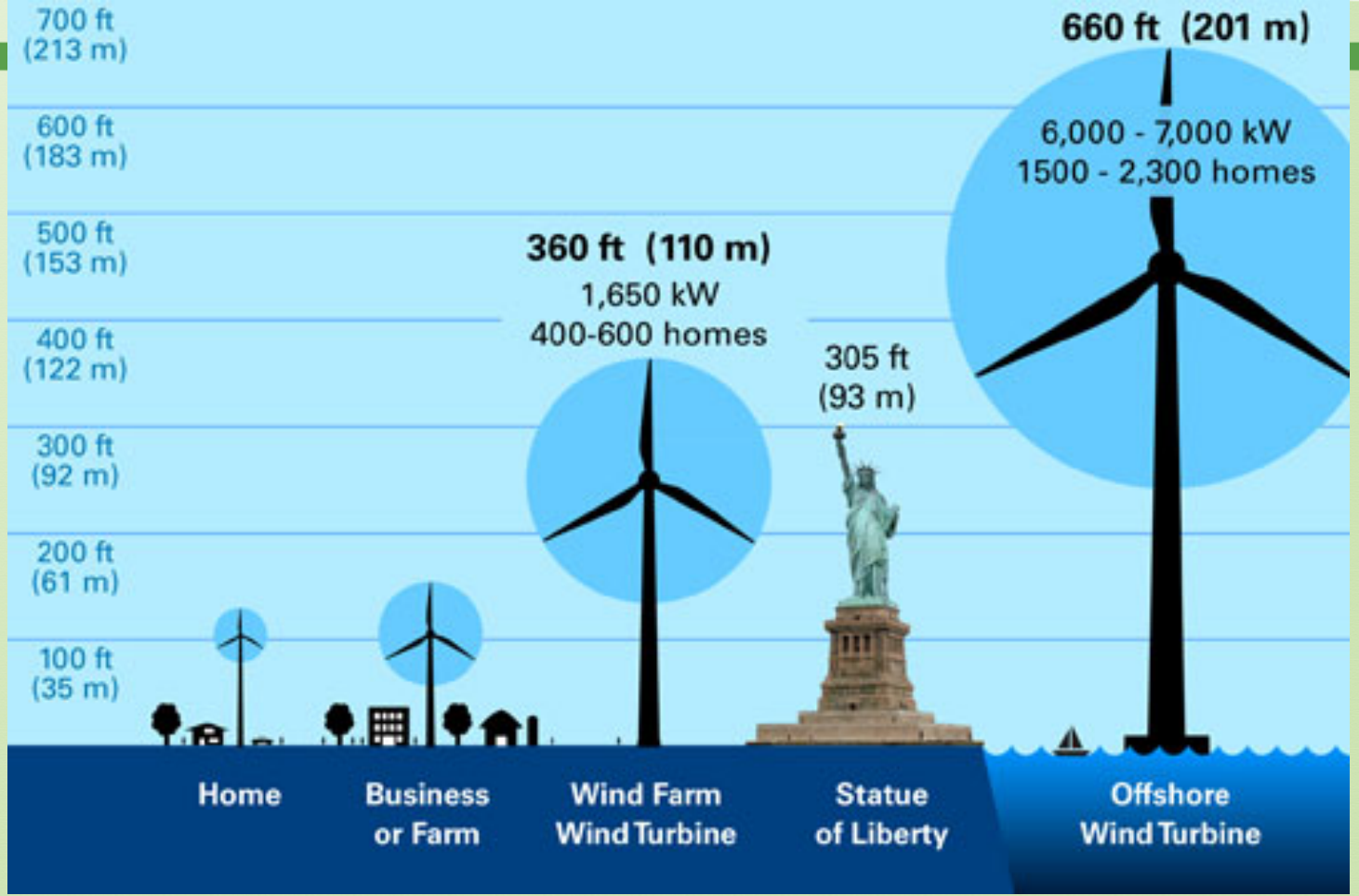
- Dispatchable baseload energy
- Cement curing releases a lot of carbon
- Energy storage
- 25-30% of state's electricity production
- Lake Tap Systems (Crater Lake, Juneau)
- Run of River
- 85-90% Efficient

Bradley Lake Hydro, photo from Homer Electric

Wind

- Intermittent non-dispatchable
- State projects:
  - Wind-Diesel in rural Alaska
  - Fire Island (17.6 MW)
  - Banner Peak (1.8 MW)
  - Pillar Mountain (9 MW)
  - Eva Creek (24.6 MW)
  - Delta (2.4 MW)
- 30-45% efficient
- Electric to heat projects statewide

Fire Island Wind Project, photo from CIRI


700 ft
(213 m)
600 ft
(183 m)
500 ft
(153 m)
400 ft
(122 m)
300 ft
(92 m)
200 ft
(61 m)
100 ft
(35 m)
660 ft (201 m)
6,000 - 7,000 kW
1500 - 2,300 homes
360 ft (110 m)
1,650 kW
400-600 homes
305 ft
(93 m)
Home
Business
or Farm
Wind Farm
Wind Turbine
Statue
of Liberty
Offshore
Wind Turbine

Biomass

The biomass system and cordwood storage in Tanana, Alaska. Photo courtesy of Tanana Fire Department.

- Wood (logs, chips, pellets, etc.)
- Waste oil (AK Waste)
- Fish oil (Unalaska)
- Methane Landfill (Anchorage)
- Wide variety of efficiency

Solar

- Peak production is in the spring when you have ideal sun angle, colder temperatures, and snow reflection
- Intermittent non dispatchable
- Largest solar farm in Alaska: 1.2 MW in Willow
- Around 20% efficient (and still improving!)

Geothermal

- Alaska is 1 of 8 states in the US that uses Geothermal
- Chena Hot Springs: 40 kW
- Unalaska Geothermal?
- Dispatchable Baseload
- Around 35% efficient, but 99% capacity factor

Chena Hot Springs Geothermal power plant
Photo from AEA

Hydrokinetic

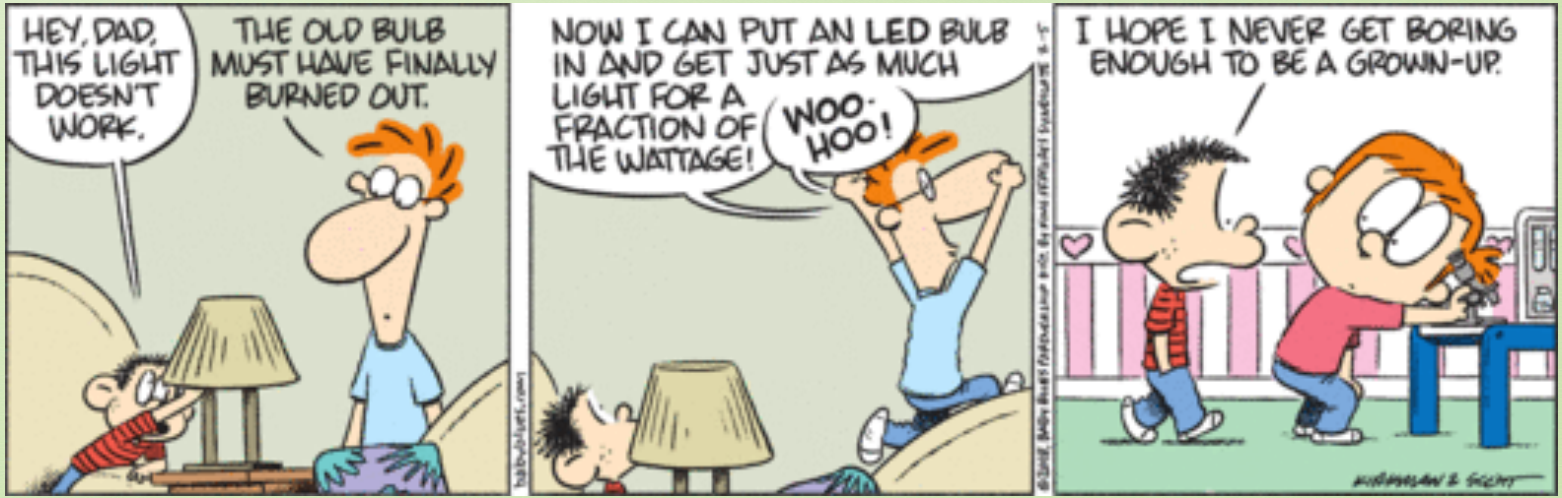
- Year-round in-river system in Igiugig
- First year-round in-river in US!
- 40 kW, Second one planned for 2021
- Potential for dispatchable baseload
- Could reduce diesel consumption by 90%

Photo: Ocean Renewable Power Company

Tidal/wave

- Cook Inlet: Largest tidal range in the US
- Commercial tidal not yet economically feasible in Alaska

A 2MW OpenHydro tidal turbine installed in Canada in July 2018 (Photo: Cape Sharp Tidal)


HEY, DAD, THIS LIGHT DOESN'T WORK.
THE OLD BULB MUST HAVE FINALLY BURNED OUT.
NOW I CAN PUT AN LED BULB IN AND GET JUST AS MUCH LIGHT FOR A FRACTION OF THE WATTAGE!
WOO-HOO!
I HOPE I NEVER GET BORING ENOUGH TO BE A GROWN-UP.

REAP K-12 Outreach

- AK EnergySmart: Free K-12 lessons on energy efficiency & conservation. Available at AKEnergySmart.org
- Wind for Schools: Renewable Energy education
- Lessons for K-12 students
- Kits for teachers, schools, libraries, etc
- KidWind Challenge – engineering design challenge
- Weather stations: lend to educators for place-based, student-led research

Get involved with REAP

- We are hiring an Alaska Microgrid Coordinator
- Join us for future webinars
- Follow us on social media – Facebook, Instagram, LinkedIn
- Subscribe to our newsletters
- Listen to our podcast "Renewable Radio" (on Apple, Spotify, etc)
- Become a member
- Donate

REAP Renewable Energy Alaska Project

Quyana	Tsín’ęę
Mahsi’	Basi
Gunalchéesh	Tsin’aen
Baasee’	Tsen’anh

Xasadigaghisidhoot

Igamsiqanaghhalek

Colleen Fisk

education@realaska.org

REAP Renewable Energy Alaska Project

REAP Renewable Energy Alaska Project

Fall Energy Speaker Series
October 7, 2020
Energy 101

Links From Live Chat

Land acknowledgement link: https://native-land.ca/

Renewable Energy Atlas: https://alaskarenewableenergy.org/initiatives/renewable-energy-atlas/

Arctic Research Consortium of the United States Climate Change Videos: https://www.youtube.com/watch?v=1enqXQ1AoM4&list=PLEfEOGoePNr3MGGsOKgoRdpe8dDSSfatU

Project Drawdown: https://drawdown.org/

Cold Climate Housing Research Center (awesome stuff!): http://cchrc.org/

Beneficial Electrification: https://beneficialelectrification.com

Electrify Alaska Conference: https://www.eventbrite.com/e/electrify-alaska-virtual-conference-tickets-122140097319?aff=erelexpmlt

Renewable Energy Grant Fund: http://www.akenergyauthority.org/What-We-Do/Grants-Loans/Renewable-Energy-Fund-REF-Grants

ACEP Seminars: https://www.uaa.alaska.edu/academics/college-of-engineering/community/professional-development-seminars/

https://www.youtube.com/watch?v=2IYzOzRjkt0&feature=youtu.be

Curriculum/Education Links: https://www.akenergysmart.org/
https://alaskarenewableenergy.org/initiatives/wind-for-schools/
https://alaskarenewableenergy.org/initiatives/weather-education-program/
https://www.need.org/
https://cleanet.org/index.html

NREL: https://www.nrel.gov/

ACEP's Daisy Huang Presentation:
https://www.youtube.com/watch?v=2IYzOzRjkt0&feature=youtu.be