2024 Alaska Electricity Trends Report

Federal, state, and utility electricity data for Alaska, 2011-2021

ACEP Data Team

June 2024

University of Alaska Fairbanks

Technical Report
UAF/ACEP/number
June 2024

Suggested Citation:
J. Kaczmarski et al., "2024 Alaska Energy Trends Report," Alaska Center for Energy and Power, University of Alaska, Fairbanks, 2024. UAF/ACEP/number. DOI:number.

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Chapter 1.

Introduction

An Analysis of Electricity in Alaska, Data Years 2011-2021

Welcome

This interactive report summarizes electricity data gathered from federal, state, and utility sources and presented in the form of a web book. It provides an overview of electricity capacity, generation, consumption, and price trends from 2011 to 2021. A comprehensive report highlighting these trends has not been produced for the state of Alaska since 2013's *Alaska Energy Statistics Report.*

This web book is designed as 'best available' document for the 2011-2021 energy trends data and reports. This website will be updated when updates to the underlying 2011-2021 data or fixes become available. Future year trends reports will be tackled in a different context and reporting structure.

Please explore the data using the chapter navigation links in the left sidebar and the section navigation links in the right sidebar.

1.0.1. How to Cite

include _citations.qmd

Executive Summary

The objective of this work is to provide regulators, legislators, and other energy stakeholders with a holistic look at recent trends in electrical generation. The first impetus for this report is a lack of combined reporting on electricity generation across the state that extends to federally and non-federally regulated electric utilities (most of Alaska's electric utilities do not meet the minimum threshold for federal reporting requirements). The second impetus for this report is to aid in decision-making processes surrounding Alaska's energy future.

With uncertainty in natural gas sources on the Railbelt, technological advancements in generation technology, and improvements in the affordability of technologies, understanding trends in the state's capacity, generation, consumption, and prices is vital to more informed decision-making.

In this report, we present data collected from federal, state, and local sources supplemented by correspondence with utilities. We show trends for capacity, generation, consumption, and prices. The capacity and generation trends include data from 2011 to 2021, and the consumption and prices trends are data limited to 2019. More information on sources and methods are provided in the subsequent sections throughout the report. This report uses data visualizations as the primary mode for presenting the trends. To accommodate this presentation style, we present trends as simplified regions of the state as opposed to the Alaska Energy Authority energy regions.

We emphasize that this report is designed to provide factual information to the best of our ability without providing recommendations or in-depth analysis. However, context is provided for more impactful trends.

Key Takeaways

1.0.1. Capacity

- Generation capacity on average increased across all of Alaska from 2011 to 2021.
- The state saw large increases in renewable energy capacity, storage, and on-demand peaking units.

1.0.2. Generation

- Net generation has remained relatively stable
- The Coastal region generated more power from wind and hydro, but less from oil in 2021 than in 2011.
- The Railbelt region generated more power from wind, hydro, coal, and solar, but less from oil and gas in 2021 than in 2011.
- The Rural Remote region generated more power from wind and solar, but less from oil and hydro in 2021 than in 2011.
- We have seen significant increases in the usage of utility-scale battery storage.

1.0.3. Consumption

- Electricity consumption overall has fallen for all customer classes, with residential customers seeing the most reductions.
- The number of customer accounts have continued to increase throughout the state.
- Per capita consumption for the residential sector is highest in the Coastal region and lowest in the Rural Remote region.

1.0.4. Prices

- Residential electricity rates increased on average across Alaska after adjusting for inflation, the PCE subsidy, and population weighting.
- The region that experienced the least residential rate increase was the Coastal region with a 6% increase.
- The region experiencing the highest residential rate increase was the Railbelt with a 26% increase.
- Commercial and Other customers in the Coastal and Rural Remote regions saw rate decreases where Commercial customers in the Railbelt region saw price increases of about 15%.
- PCE subsidies continue to dampen residential prices in the Coastal and Rural Remote regions.

Chapter 2.

Acknowledgements and Roles

About the Team that Created the 2024 Alaska Electricity Trends Report

2.1. Acknowledgements

2.1.1. Funding

Funding support for this team was provided by leveraging support from multiple partners that include:

- Office of Naval Research's (ONR) Alaska Regional Collaboration for Technology Innovation and Commercialization (ARCTIC) program (award #N00014-19-1-2235)
- Denali Commission - Alaska Energy Project Partnerships (award #1659)
- State of Alaska

Note: Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funding supporters.

2.1.2. Partners

- Alaska Center for Energy and Power (ACEP) at the University of Alaska Fairbanks (UAF)
- Institute of Social and Economic Research (ISER) at the University of Alaska Anchorage (UAA)
- Alaska Energy Authority (AEA)
- DOWL Engineering (DOWL)

Data used in the energy workbooks comes from a variety of sources and partners, but special thanks to the Alaska Energy Authority for partnering with the team to make the base line power cost equalization datasets available. Without this openness, this report would not be possible. We would also like to thank the utilities who responded directly when we had questions. A full list of these organizations has been complied in Section 4.1.

2.2. Credits and Roles

The Alaska Electrical Trends web book has been produced by the Alaska Center for Energy and Power (ACEP) at the University of Alaska Fairbanks (UAF). It is a collaboration between data scientists, researchers, and policy experts. Roles here are described by Contributor Roles Taxonomy (CRediT).

- Jesse Kaczmarski1
    - Roles: data curation, formal analysis, project administration, software, validation, visualization, writing – original draft

- Ian MacDougall1
  - Roles: data curation, formal analysis, software, validation, visualization, writing – original draft
- Steve Colt2
  - Roles: data curation, formal analysis, investigation, validation, writing – review & editing
- Elizabeth (Liz) Dobbins1
  - Roles: software, project administration, resources, supervision, writing – review & editing
- Neil McMahon3
  - Roles: data curation, investigation, validation
- Sara Fisher-Goad4
  - Roles: conceptualization, validation, writing – review & editing
- Brittany Smart2
  - Roles: project administration, writing – review & editing
- Dayne Broderson1
  - Roles: conceptualization, funding acquisition
- Gwen Holdmann2
  - Roles: conceptualization, funding acquisition
- Shivani Mathur2
  - Roles: validation, writing – review & editing
- Erika Boice2
  - Roles: writing – review & editing

2.2.1. Affiliations

ACEP's Data and Cyberinfrastructure Management (DCM) Team includes software developers, mathematicians, spatial analysts, economists, open science enthusiasts, and experts in information security and the deployment of computer infrastructure. ACEP's Energy Transition Initiative (ETI) is a group of experts that respond quickly to informational requests about Alaska energy. These teams together maintain a reliable pathway for data from collection to distribution.

Chapter 3.

Acronym Definitions

Acronyms Commonly used in the Report

3.1. Acronyms

These abbreviations are used throughout this report

- ACEP: Alaska Center for Energy and Power, UAF
- AEA: Alaska Energy Authority
- BUECI: Barrow Utilities & Electric Cooperative, Inc.
- DCM: the Data and Cyberinfrastructure Management team at ACEP, UAF
- PCE: Power Cost Equalization
- EIA: Energy Information Administration
- ETI: Energy Transitions Initiative, ACEP
- FERC: Federal Energy Regulatory Commission
- CAGR: Compound Annual Growth Rate
- kW: Kilowatt
- kWh: Kilowatt-hour
- MW: Megawatt
- MWh: Megawatt-hour
- GW: Gigawatts
- GWh: Gigawatt-hour
- UAF: University of Alaska Fairbanks

Chapter 4.

Methods

Data Sources, Region Definitions, and Description of the PCE Program

4.1. Data Sources

The data in this report was collected from a variety of sources that are listed below. Most electric utilities throughout the state are not required to submit annual reports to the federal government due to their size and/or number of customers. Therefore, our data sources encompass federal, state, commercial, and local filings as well as direct communications with utilities and state program managers. Each section of the report pulls data from a variety of these sources. The data was downloaded directly from the original sources and concatenated to develop a dataset for this report. In some cases, a single observation is derived from multiple sources due to reporting limitations.

Below are relevant sources of data for the report.

4.1.1. Federal

- Energy Information Administration
  - EIA-860
  - EIA-861
  - EIA-923
- Federal Energy Regulatory Commission
  - Form 1

4.1.2. State

- Alaska Energy Authority
  - Power Cost Equalization Program Utility Monthly Reports
- Regulatory Authority of Alaska
  - Annual filings

4.1.3. Direct Communications

- Alaska Energy Authority
  - Hydro/Wind Program Managers
  - Village and Powerhouse Assessments
- Electric Utilities

4.1.4. Commercial Sources

- Intelligent Energy Systems

4.1.5. Compilation

Neil McMahon, first at AEA and then at DOWL, an Alaska engineering firm, did the preliminary compilation of data and developed the Excel workbooks that support this report. This step involved careful cross-referencing of assets between the various data sources and error checking by domain experts. At this point, aggregate calculations were created to match the tables found in previous *Alaska Energy Statistics Reports*. Data in this report were derived from those workbooks exported to CSV files; the original workbooks are available via a GitHub repo ak-energy-statistics-2011_2021.

4.2. Regional Summaries

For the purpose of energy planning, AEA has defined eleven energy regions for the State of Alaska. Previous versions of the *Alaska Electric Energy Statistics* reports presented data summarized by those regions. In order to provide visualizations that are easier to understand, we have condensed these eleven regions into three major energy regions: Coastal, Railbelt, and Rural Remote. Figure 4.1 shows the diagrammatic relationship between these two classification systems and **?@fig-regions-map** displays this relationship cartographically.

We note that the Coastal and Rural Remote regions include mixtures of Power Cost Equalization (PCE) and non-PCE eligible communities. The Coastal region includes Copper River/Chugach and incorporates all communities served by Copper Valley Electric Association. PCE communities are largely dependent on diesel generation.

{{ include _regions_map.qmd }}

4.3. Power Cost Equalization (PCE)

Alaska is famous for wide expanses of rugged terrain. Towns are often extremely distant from one another, or are separated by inaccessible mountains and glaciers. The utility landscape of Alaska resembles a sea of islands, very different from the interconnected grids of the contiguous United States.

In total, Alaska contains over 100 separate utilities, many of which serve a single, small community. Most rely on diesel generators connected to huge fuel tanks, which receive a barge shipment of fuel in the summer that must last through the winter. If the town runs out of fuel during winter months, additional fuel has to be flown in at extreme expense. Predictably, electricity in these remote towns is extremely expensive.

Some rural towns pay 3 to 5 times the rates of urban Alaska. Urban Alaska has greatly benefited from large state-subsidized energy projects, such as the Bradley Lake Hydroelectric Project, the Four Dam Pool Projects, and the Alaska Intertie. In an effort to confer similar benefits to rural Alaska, the state of Alaska developed the Power Cost Equalization Program (PCE).

The PCE program reimburses rural utilities for credits that have been provided to eligible customers. Eligibility is limited to residential customers and community facilities. The subsidy applies to the first 750 kWh per month of residential consumption. Community facilities are subsidized up to the first 70 kWh per month per resident. The program is administered by the Regulatory Commission of Alaska (RCA) and the Alaska Energy Authority (AEA).

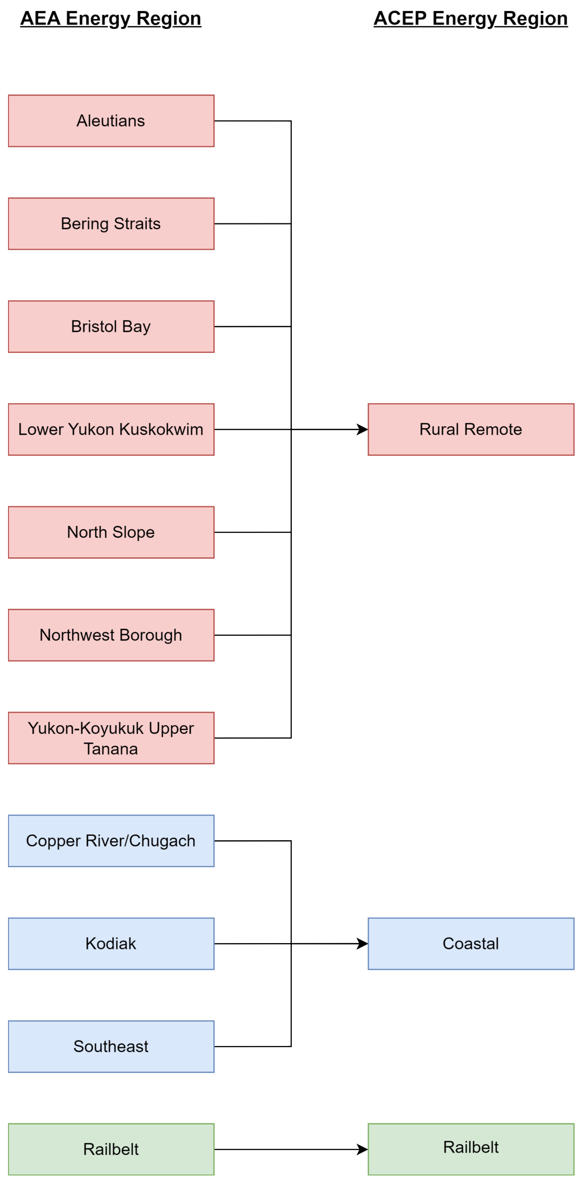


Figure 4.1.: Schematic Relationship between Energy Regions as defined by AEA and ACEP

Please visit the Alaska Energy Authority PCE webpage for more information about the Power Cost Equalization program.

4.4. Feedback Regarding Potential Errors

Since these data come from multiple sources, there is potential for errors in its compilation. An integral part of this effort is the creation of a high quality dataset that can constructively contribute to future work. Therefore, any discrepancies or noted errors should be reported using email or GitHub issues via the links in the right hand navigation menu of every page. Alternatively, direct contact information for members of the DCM team is listed in Section 2.2.

Chapter 5.

Price of Electricity

Residential, Commercial, and Industrial Customer Classes, 2011-2019

5.1. General Overview

Utilities in Alaska serve multiple customers, namely residential, commercial, industrial, government/municipal, and community customer classes. Each customer class experiences a different set of costs such as per kWh charge as well as monthly customer charges. In this section, we aim to highlight trends in electricity prices for the residential, commercial, and other customer classes across the Coastal, Railbelt, and Rural Remote regions. We again restrict the data years in this section to 2011 to 2019 due to concerns with data validity for 2020-21.

In rural areas, many communities are eligible to participate in the PCE program (described in Section 4.3). It is important to note that the prices presented here reflect the post-PCE adjustment and are annualized averages based on the calendar year. Yearly average effective rates listed here reflect the calendar year and not the fiscal year, which will make them different from those reported in the AEA's annual reports. We also note that for PCE communities, the rates are reported in the original data. For data sourced from the EIA, rates were calculated by dividing total revenue by total kWh sold in each customer class - this may overestimate the rate as this would include revenue from customer charges.

Note that all prices in this section have been adjusted for inflation over time to 2021 dollars using the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI) for all items in urban Alaska (BLS CUUSA427SA0). To our knowledge, there is no CPI that properly accounts for price changes over time in rural Alaska. However, the general trend shows that customer account-weighted prices have been relatively stagnant across all regions of the state.

5.1.1. Regional Overview

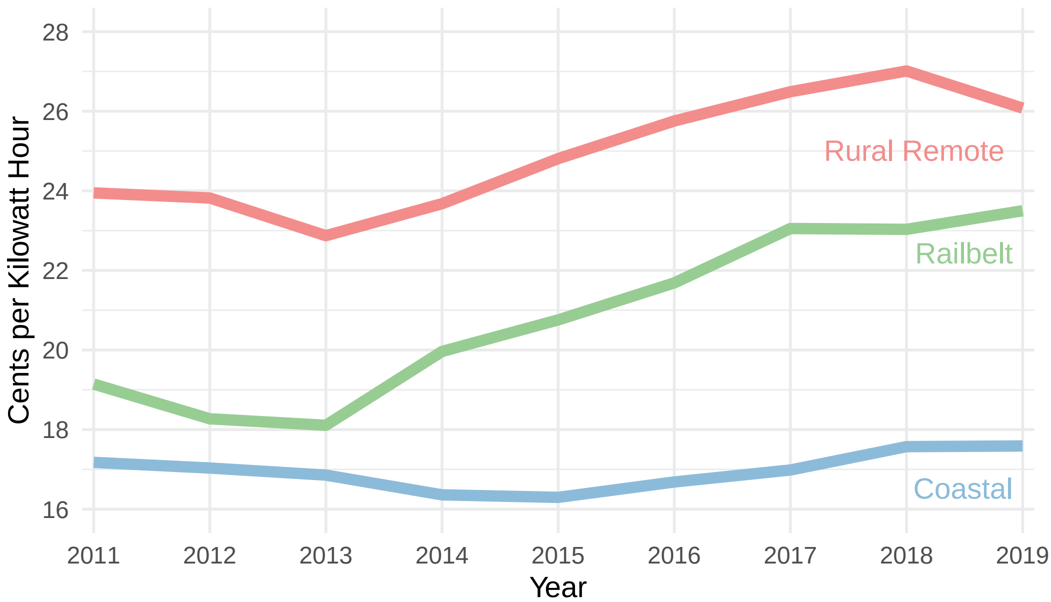
?@fig-price-regions-classes shows the distribution of prices across a selected customer class. The three classes used in this analysis can be selected from the dropdown menu. Hover your pointer over the dot to display utility information.

Most notably, the dramatic effects of the PCE subsidy can be seen by comparing the price distribution of the residential customer class against the price distribution of the commercial/other customer classes in the Rural Remote and Coastal regions.

5.1.2. Regional Averages

Due to the wide range of electricity prices in Alaska, it is difficult to accurately summarize the data. Because of this, we determined that averages were best calculated using a customer account weighted average. Population is roughly correlated to price, with small communities experiencing higher rates than larger communities. The average number of customer accounts for the year was used to calculate the weighted arithmetic mean price for each year and region. **?@fig-price-over-time** is a graph of residential customer prices over time after weighting for the number of customer accounts.

Figure 2: Residential Price Over Time




```
[1] "PDF code block active"
```

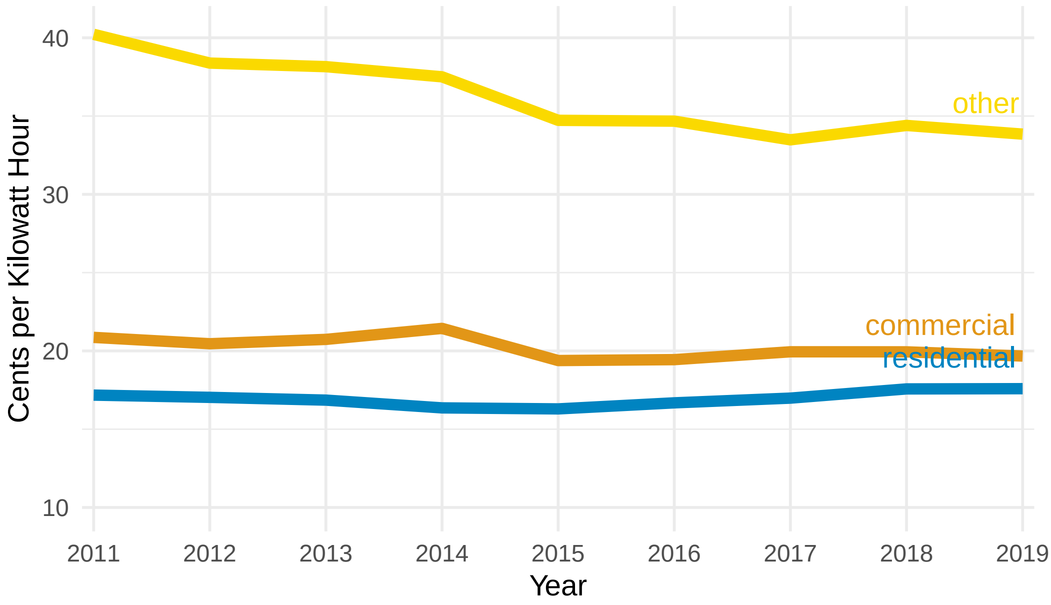
5.2. Coastal

?@fig-price-sector-coastal shows the average price of electricity in the Coastal region for each customer class and year. Between 2011 and 2019, the region experienced decreasing prices for Commercial and Other customers, while Residential customers have seen a slight increase in price.

The average real price (in 2021 dollars) of electricity for Residential customers in the Coastal region rose {ojs} coastal_res_change% from {ojs} coastal_res_2011 cents/kWh in 2011 to {ojs} coastal_res_2019 cents/kWh in 2019. The average price of electricity for Commercial customers in the Coastal region fell {ojs} coastal_com_change% from {ojs} coastal_com_2011 cents/kWh in 2011 to {ojs} coastal_com_2019 cents/kWh in 2019. Finally, the average price of electricity for Other customers in the Coastal region fell {ojs} coastal_other_change% from {ojs} coastal_other_2011 cents/kWh in 2011 to {ojs} coastal_other_2019 cents/kWh in 2019.

Residential customers in the Coastal region saw increases in the price of electricity while commercial and other customers saw decreases. However, the residential customer class continues to pay the lowest per kWh in the region due to a combination of low prices in high population areas and PCE subsidies in eligible communities.

Figure 3: Sector Price Over Time, Coastal Region

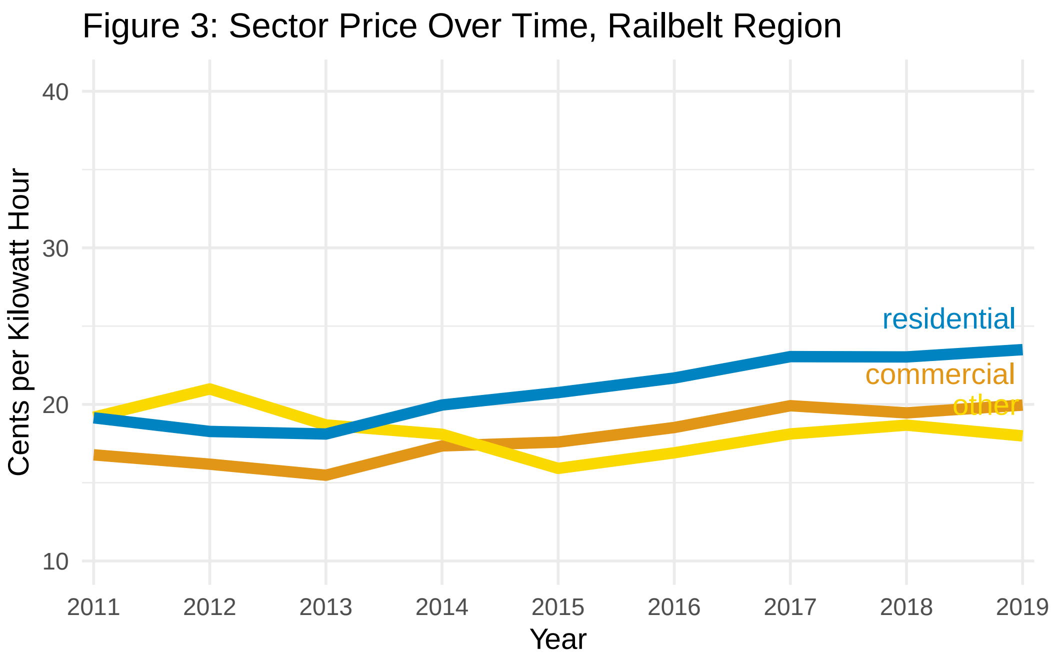


5.3. Railbelt

?@fig-price-sector-railbelt shows the average price of electricity in the Railbelt region for each customer class and each year of the report. Between 2011 and 2019, Other customers saw a large decrease in price, followed by a gradual increase. Residential and Commercial customers experienced slight decreases in price until 2013 when prices reversed and rose dramatically.

The average real price of electricity for Residential customers in the Railbelt rose {ojs} railbelt_res_change% from {ojs} railbelt_res_2011 cents/kWh in 2011 to {ojs} railbelt_res_2019 cents/kWh in 2019. The average price of electricity for Commercial customers in the Railbelt rose {ojs} railbelt_com_change% from {ojs} railbelt_com_2011 cents/kWh in 2011 to {ojs} railbelt_com_2019 cents/kWh in 2019. Finally, the average price of electricity for Other customers in the Railbelt fell {ojs} railbelt_other_change% from {ojs} railbelt_other_2011 cents/kWh in 2011 to {ojs} railbelt_other_2019 cents/kWh in 2019.

This region differs significantly from the Coastal and Rural Remote regions in that residential customers pay more for electricity than the Commercial or Other customer classes.

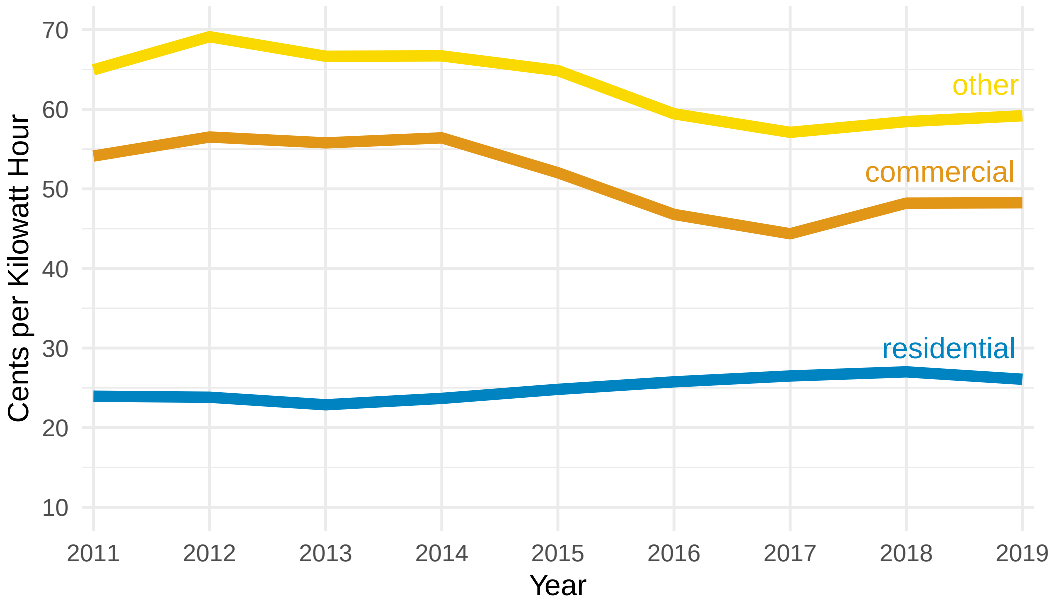


5.4. Rural Remote

?@fig-price-sector-rural shows the average price of electricity in the Rural Remote region for each customer class and year of the report. Between 2011 and 2019, Residential customers experienced a gradual increase in rates, while Commercial and Other customers experienced a gradual decrease in rates.

The average price of electricity for the Residential customers in the Rural Remote region rose {ojs} rural_res_change% from {ojs} rural_res_2011 cents/kWh in 2011 to {ojs} rural_res_2019 cents/kWh in 2019. The average price of electricity for Commercial customers in the Rural Remote region fell {ojs} rural_com_change% from {ojs} rural_com_2011 cents/kWh in 2011 to {ojs} rural_com_2019 cents/kWh in 2019. Finally, the average price of electricity for Other customers in the Rural Remote region fell {ojs} rural_other_change% from {ojs} rural_other_2011 cents/kWh in 2011 to {ojs} rural_other_2019 cents/kWh in 2019.

Figure 3: Sector Price Over Time, Rural Remote Region



Chapter 6.

Installed Capacity

Total Installed Capacity by Certified Utilities in Alaska, 2011-2021

6.1. General Overview

Generation capacity represents the maximum amount of electricity that can be generated at any given time dependent on certain conditions. The combination of generation sources is often referred to as the capacity mix. Changes in the capacity mix over time reflect decisions to build and retire generators. These decisions are a result of shifting costs, technological innovations, the normal aging of the generation fleet, and/or stakeholder policies. Due to data limitations, we show capacity levels for calendar years 2011-2013, 2018, and 2021. While we cannot observe year-to-year trends, there are enough years of data to visualize capacity trends from 2011 to 2021.

We begin this section by showcasing the increases in total capacity across the state. In 2011, it is estimated that the total statewide electricity generation capacity was 2,197 MW. We estimate that this has increased to approximately 3,163 MW in 2021 based on best available data. This represents an increase of 966 MW, or 44 percent increase since 2011. To illustrate this example, we show a stacked area chart in **?@fig-capacity-state** that showcases growth over time for various technologies.[1]

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[1]Prime movers are categorized as follows. Fossil turbines include combined cycle turbines, gas turbines, and steam turbines. Reciprocating engines include internal combustion engines. Hydro includes hydraulic turbines and hydrokinetics. Wind includes wind turbines. Utility solar includes utility-owned photovoltaic (PV), and Rooftop solar includes customer-sited, behind-the-meter PV. Storage refers to batteries and flywheels.

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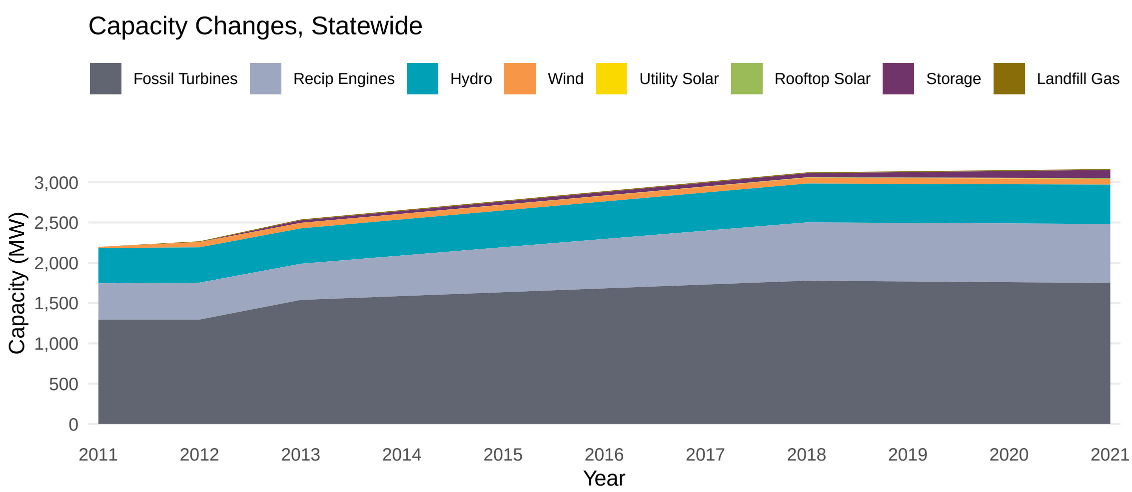

6.2. Coastal

For the coastal region, we observe a 121.2 MW increase in generation capacity (an increase of approximately 22.8 percent) between 2011 and 2021. **?@fig-capacity-coastal** shows the change in total installed capacity for each prime mover in the coastal region. This region saw additions of 38.9 MW of fossil turbines, and 28.9 MW of reciprocating engines. The remaining increases were renewable and storage capacity which we look at in more depth in **?@fig-capacity-coastal-renewable**.

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    }
})
```

Across the 53.45 MW of added renewable and storage capacity , hydropower accounted for the bulk of the capacity additions with 41.95 MW. Storage capacity increased by 7 MW and wind generation capacity increased by 4.5 MW. Between 2013 and 2018, significant hydropower additions were made in the Southeast (19.4 MW), Kodiak (11.3 MW), and the Copper-River/Chugach (6.5 MW) AEA energy regions.

```
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```

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```

6.3. Railbelt

For the Railbelt region, capacity additions were dominated by more-efficient fossil fuel generating units and new battery storage. These additions are visualized in **?@fig-capacity-railbelt**. There were 761.9 MW of capacity additions between 2011 and 2021. The Railbelt region saw 207.3 MW of reciprocating engine additions and 390.2 MW of fossil fuel turbines. The remaining capacity additions were renewables and storage and are shown in **?@fig-capacity-railbelt-renewable**.

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```

Total renewable and storage capacity in the Railbelt region increased by 164.41 MW. Notable additions included the commercial commissioning of the 18 MW Fire Island Wind site in September 2012 and the 25 MW Eva Creek Wind site in October 2012. Significant investments in storage capacity have also been made. Since 2011, 89.5 MW of storage, 43.49 MW of wind, 7.09 MW of hydro, 1.9 MW of utility solar, 10.93 MW of rooftop – also known as "behind-the-meter" – solar, and 11.5 MW of landfill gas have been added.

```
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  // Stacked area plot
  marks: [
    Plot.barY(cap_data.filter((d) => d.acep_region === "Railbelt" && d.capacity !== 0.0 && d.prime
      Plot.groupX(
        {
          y: "sum"
        },
        {
          x: "year",
          y: "capacity",
          fill: "Prime Mover",
          order: ["Hydro", "Wind","Utility Solar","Rooftop Solar","Storage","Landfill Gas"],
          tip: {format: {x: "d"}}
        }
      )
    ),
    Plot.ruleY([0])
  ],
  // Configure the color scheme
  color: {
        domain: ["Hydro", "Wind","Utility Solar","Rooftop Solar","Storage","Landfill Gas"],
        range: ["#00a1b7", "#F79646", "#fad900","#9BBB59","#71346a","#896D09"],
        legend: true
    }
})
```

6.4. Rural Remote

The rural remote region saw an increase of 83.1 MW in capacity (a 32.63% increase) (**?@fig-capacity-rural**). Most of the increases in capacity were fossil fuel turbines (25.4 MW added on the North Slope) and reciprocating engines (45.65 MW). Renewable capacity is explored in further detail in the **?@fig-capacity-rural-renewable**.

```
//| label: fig-capacity-rural
//| fig-cap: "Rural Remote Region Capacity"

Plot.plot({
  // Configure the x-axis
```

```
  x: {
    tickFormat: "d",
    type: "band",
    label: "Year"
  },
  // Configure the y-axis
  y: {
    grid: true,
    label: "Capacity (MW)"
  },
  // Configure the plot
  //title: "Rural Remote region capacity",
  insetLeft: 0,
  insetRight: 0,
  width: width,

  // Stacked area plot
  marks: [
    Plot.barY(cap_data.filter((d) => d.acep_region === "Rural Remote" && d.capacity !== 0.0),
      Plot.groupX(
        {
          y: "sum"
        },
        {
          x: "year",
          y: "capacity",
          fill: "Prime Mover",
          order: ["Fossil Turbines", "Recip Engines", "Hydro", "Wind","Utility Solar","Storage"],
          tip: {format: {x: "d"}}
        }
      )
    ),
    Plot.ruleY([0])
  ],
  // Configure the color scheme
  color: {
        domain: ["Fossil Turbines", "Recip Engines", "Hydro", "Wind","Utility Solar","Storage"],
        range: ["#606571", "#9da7bf", "#00a1b7", "#F79646", "#fad900","#71346a"],
        legend: true
    }
})
```

This region saw an absolute increase of 12.05 MW of renewable capacity between 2011 to 2021. Over this time period, hydropower generation resources increased by 0.99 MW, wind increased by 6.51 MW, utility-scale solar increased by 1.31 MW and storage increased by 3.25 MW. Between 2018 and 2021, 2 MW of wind was retired in the Bering Straits energy region, 1.2 MW in Kotzebue, and 0.2 MW in the Aleutians, explaining the reduction in wind capacity between the calendar years.

```
//| label: fig-capacity-rural-renewable
//| fig-cap: "Rural Remote Region Renewable Capacity"
//|
Plot.plot({
  // Configure the x-axis
  x: {
    tickFormat: "d",
    type: "band",
```

```
    label: "Year"
  },
  // Configure the y-axis
  y: {
    grid: true,
    label: "Capacity (MW)"
  },
  // Configure the plot
  //title: "Rural Remote region renewable capacity",
  insetLeft: 0,
  insetRight: 0,
  width: width,

  // Stacked area plot
  marks: [
    Plot.barY(cap_data.filter((d) => d.acep_region === "Rural Remote" && d.capacity !== 0.0 && d.p
      Plot.groupX(
        {
          y: "sum"
        },
        {
          x: "year",
          y: "capacity",
          fill: "Prime Mover",
          order: ["Hydro", "Wind","Utility Solar","Storage"],
          tip: {format: {x: "d"}}
        }
      )
    ),
    Plot.ruleY([0])
  ],
  // Configure the color scheme
  color: {
        domain: ["Hydro", "Wind","Utility Solar","Storage"],
        range: ["#00a1b7", "#F79646", "#fad900","#71346a"],
        legend: true
    }
})
```

```
original_cap_data = FileAttachment("data/working/capacity/capacity_long.csv").csv({ typed: true })
cap_data = original_cap_data.map((d) => ({...d, "Prime Mover": d.prime_mover}))
```

Appendix A.

About this Report

Description of the 2024 Alaska Electricity Trends Report Web Book

A.1. General Overview

This Alaska Electrical Trends Report (AETR) Web Book has been produced by the Alaska Center for Energy and Power (ACEP) at the University of Alaska Fairbanks (UAF). It is designed to be interactive and dynamically updated when new data becomes available.

Throughout the years, several agencies have prepared and published reports and data compilations on energy use in Alaska. AETR is complementary to those prior reports, but is not presented in a comparable format.

A.2. Historical Timeline of Prior Reports

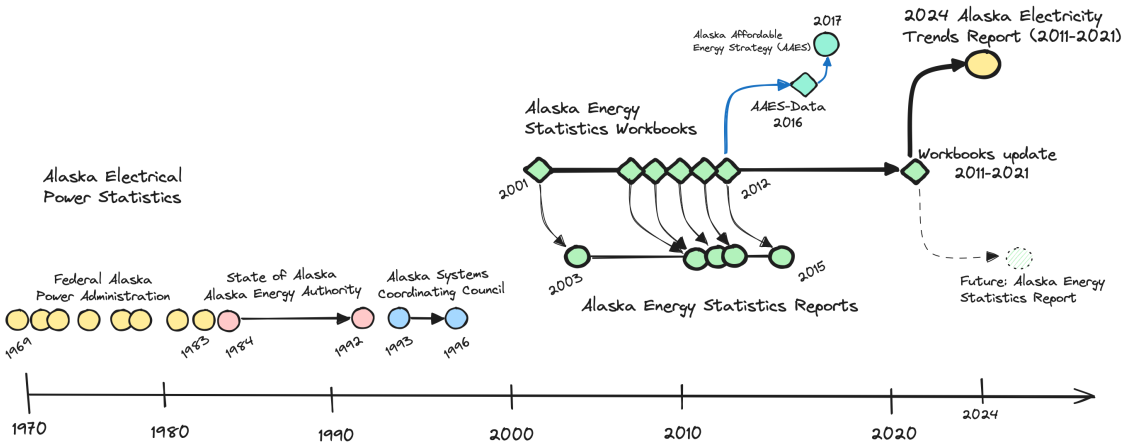


Figure A.1.: Timeline of Energy Reports

Starting in 1969, the first Electric Power Trends report was published by the Alaska Power Administration. During this time, the Alaska Power Administration was a federal agency housed within the U.S. Department of the Interior. Their first publication was known as the "First Annual Report" and covered data from the 1968 fiscal year. However, this became the "Alaska Electric Power Statistics Report" in 1971 and examined data from the 1960-1969 data years. The APA continued to produce intermittent reports until 1983 when the State of Alaska established the Alaska Power Authority (APA), which later became the Alaska Energy Authority (AEA).

Under state direction, the APA/AEA continued to publish intermittent reports on electric power statistics until their final publication in 1992 which covered data years 1960 to 1991. To address the reporting gap, the Alaska Systems Coordinating Council in collaboration with the State of Alaska, Department of Community and Regional Affairs, Division of Energy continued generating reports until 1996 with their final report covering data years 1960 to 1995. Finally, the University of Alaska Anchorage, Institute of Social and Economic Research produced several reports with their last covering 1960 to 2012. Since then, there have been no electric power statistical reports.

The Table A.1 provides a summary of this timeline. This report serves to supplement the reporting gap in electric power statistics for the State of Alaska.

Table A.1.: Historical Timeline of Reports

Year Published	Institution	Data Coverage
1971 to 1983	Alaska Power Administration	1960 to 1982
1984 to 1988	Alaska Power Authority	1960 to 1987
1989 to 1992	Alaska Energy Authority	1960 to 1991
1992 to 1996	Alaska Systems Coordinating Council; State of Alaska	1960 to 1995
2003, 2011 to 2015	University of Alaska Anchorage, Institute of Social and Economic Research	1960 to 2012

For a table of links to these historic reports, please refer to **?@tbl-historic-reports**.

A.3. Technical Details

The book is formatted using Quarto, an open-source scientific and technical publishing system. The template was developed by the Openscapes project, as part of their Quarto Website Tutorial.

The markdown files that make up the book reside in the aetr-web-book GitHub repository. The generation process is publicly accessible. Errors in the document can be flagged using GitHub issues where they can be tracked and addressed by the DCM team.

The book also integrates R code for data processing and figure generation. When data files are updated, manually triggering the Quarto render will update the figures automatically.

Appendix B.

Setup

Getting started with Quarto and conditional rendering

B.1. Welcome

Welcome to the technical setup page.

B.2. `renv` Package Management

Packages in this repo are managed by `renv`. The workflow takes a second to get used to, but doesn't have to be a big deal. Similar to `npm`, `renv` is globally installed on your system independent of the repo environment.

Once the repository has been cloned to your computer and `renv` is installed on your system, install the necessary R dependencies:
1. In a terminal window, navigate to the root directory of the repo
2. Start R by typing `R` and pressing Enter
3. In the resulting R console, run the following command

```
renv::restore() #installs packages in the `renv.lock` file
```

As you write code that needs additional packages, include them at the top of your scripts as `library("new-package")`. Then, before committing, run steps 1 through 3 above, but use `renv::snapshot()` in step 3. This will comb through the repo to look for packages not in the renv.lock file. When you are prompted for a selection, select option 2: `"Install the packages, then snapshot"` to bring the new packages into the fold.

Note: To get you started, the renv.lock file of this repo includes all `tidyverse` packages

B.3. Rendering a PDF

To render a PDF of this code, open a terminal, navigate to the root of the repo and run the following command. Make sure to change the output directory.

```
quarto render --to pdf --output-dir /path/to/output/dir
```

Please note that rendering to PDF requires a LaTeX distribution to be installed on your system. If you don't have one, you can install TinyTeX, a lightweight, portable, and easy-to-maintain LaTeX distribution. You can install it in R with `tinytex::install_tinytex()`.

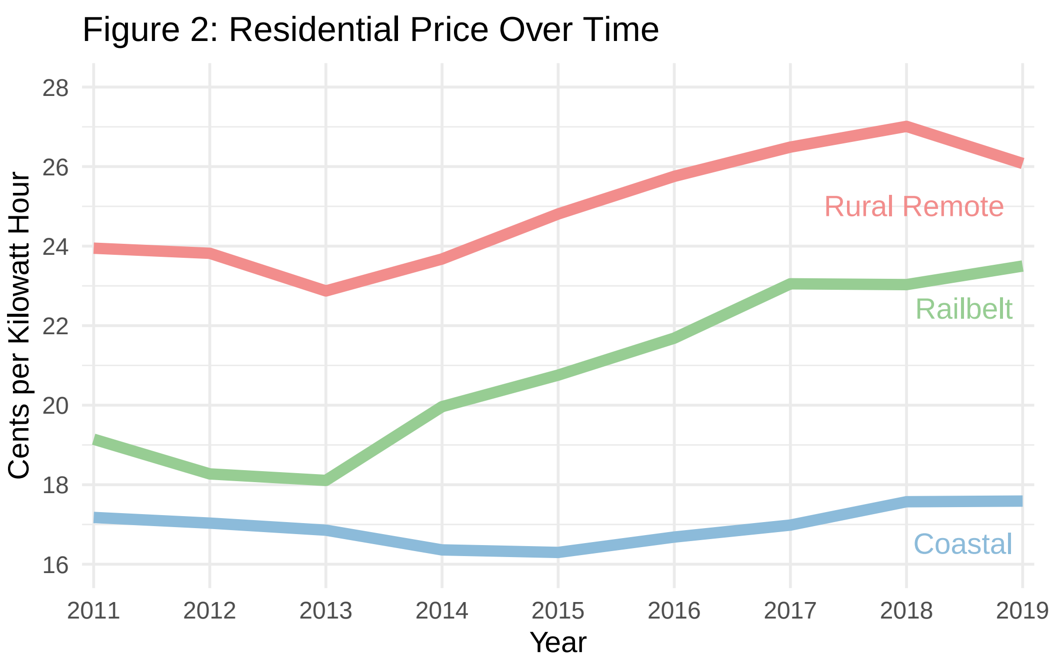
B.4. Conditional Rendering to HTML and PDF

Quarto bills itself as a "scientific and technical publishing system" and the system delivers. Code can be rendered into many formats, such as articles, presentations, dashboards, websites, blogs, and books.
The data team at ACEP has explored rendering to HTML and to PDF formats in order to build interactive websites and print publications.

Despite Quarto's powers, QMD files that generate Javascript and HTML won't render to PDF. In some cases, the render will throw an error. In order to maintain a code base that builds both an interactive website and a PDF document, we utilize seperate code blocks and conditional rendering. Effectively, code blocks are turned on or off depending on the target output. This is done in the chunk header.
If you'd like the chunk to run when building a website, use: `{r, eval=knitr::is_html_output()}`
If you'd like the chunk to run when building a PDF, use: `{r, eval=knitr::is_latex_output()}`

B.5. A tale of two chunks

Below is code to render two graphs using R. One code block is straight `ggplot`, the other contains an interactive tooltip from the `ggiraph` package. Since the interative tooltip builds out as HTML and Javascript, it will break if Quarto is rendering a PDF.
And so we have two chunks, one with interactivity that's destined for the web, and the other is static for the PDF report. By including them side-by-side, the flow of the document is preserved. By conditionally evaluating using the header code from above, we can build a website and static report from the same code base.
You will only see one graph no matter what the render format because the other is conditionally executed for the other format. Look below the graph to see either "HTML code block active" or "PDF code block active" depending on the format you are viewing.




```
[1] "PDF code block active"
```