



ACEP
Alaska Center for Energy and Power



2024 Alaska Electricity Trends Report

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

Alaska Center for Energy and Power

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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

Alaska Center for Energy and Power. "2024 Alaska Energy Trends Report Web Book." Accessed {ojs} currentDate. <https://acep-uaf.github.io/aetr-web-book-2024>

```

//| echo: false

// set up today's date
date = new Date();
day = date.getDate();
month = date.toLocaleString('default', { month: 'long' });
year = date.getFullYear();
month_2digit = (date.getMonth() + 1).toString().padStart(2, "0");
day_2digit = date.getDate().toString().padStart(2, "0");

currentDate = `${month} ${day}, ${year}`

// build a button
button = (blob, filename = 'test.bib', displayname) => {
  const button = DOM.download(
    blob,
    filename,
    `${displayname}`
  );
  return button;
}
```

```

// BibLaTeX content
biblatexContent =
`@online{aetr_web_book_2024,
  author = {{Alaska Center for Energy and Power}},
  title = {{2024 Alaska Electricity Trends Report}},
  year = 2024,
  url = {https://acep-uaf.github.io/aetr-web-book-2024/},
  urldate = {{$year}}-{{$month_2digit}}-{{$day_2digit}}}
}`

risContent =
`TY - ELEC
AU - Alaska Center for Energy and Power
TI - 2024 Alaska Electricity Trends Report
PY - 2024
DA - {{$year}}-{{$month_2digit}}-{{$day_2digit}}}
UR - https://acep-uaf.github.io/aetr-web-book-2024/
N1 - Accessed on {{$currentDate}}
ER -`

// Create the blobs
biblatex_blob = new Blob([biblatexContent], { type: 'text/plain' });
ris_blob = new Blob([risContent], { type: 'text/plain' });

// Insert blobs into buttons
button(biblatex_blob, 'aetr_web_book_2024.bib', 'BibLaTeX');
button(ris_blob, 'aetr_web_book_2024.ris', 'RIS');

```

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.

Methods

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

2.1. 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.

2.1.1. Federal

- Energy Information Administration
 - [EIA-860](#)
 - [EIA-861](#)
 - [EIA-923](#)
- Federal Energy Regulatory Commission
 - [Form 1](#)

2.1.2. State

- Alaska Energy Authority
 - [Power Cost Equalization Program](#) Utility Monthly Reports
- Regulatory Authority of Alaska
 - [Annual filings](#)

2.1.3. Direct Communications

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

2.1.4. Commercial Sources

- [Intelligent Energy Systems](#)

2.1.5. 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 Electric 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](#).

2.2. 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 2.1 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.

```
// build a library
stdlib = require("@observablehq/stdlib")
d3 = require("d3@7")

L = require('leaflet@1.9.4')
html`<link href='${resolve('leaflet@1.2.0/dist/leaflet.css')} rel='stylesheet' />`

bootstrap=require("bootstrap")
css=html`<link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@5.2.0/dist/css/bootstrap.min.css" />`

aea_regions = FileAttachment("data/working/regions/aea_regions.geojson").json()
acep_regions = FileAttachment("data/working/regions/acep_regions.geojson").json()

coords_json = FileAttachment("data/working/regions/coordinates.geojson").json()

// coords_csv = FileAttachment("data/working/regions/coordinates_pce.csv").csv({typed: true})

aea_regions_input = L.geoJSON(aea_regions, {
  style: function(feature) {
    switch (feature.properties.NAME) {
      case 'Aleutians': return {color: "#FF5733"};
      case 'Bering Straits': return {color: "#FF1493"};
      case 'Bristol Bay': return {color: "#20B2AA"};
      case 'Copper River Chugach': return {color: "#7D3C98"};
```

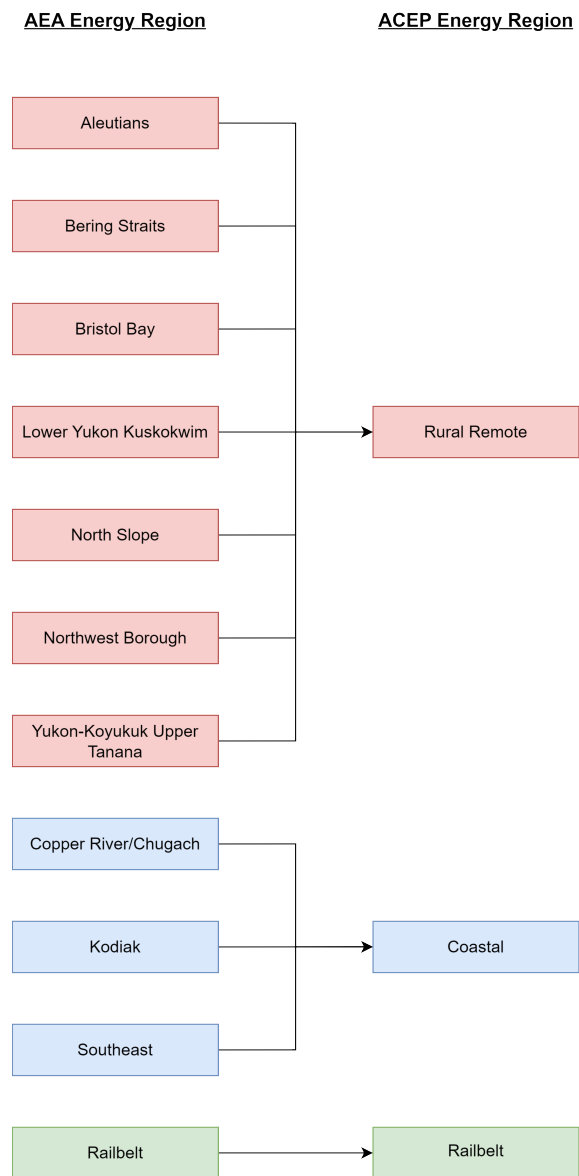


Figure 2.1.: Schematic Relationship between Energy Regions as defined by AEA and ACEP

```

        case 'Kodiak': return {color: "#C70039"};
        case 'Lower Yukon Kuskokwim': return {color: "#00B4D8"};
        case 'North Slope': return {color: "#4682B4"};
        case 'Northwest Arctic': return {color: "#6A5ACD"};
        case 'Railbelt': return {color: "#228B22"};
        case 'Southeast': return {color: "#FFC300"};
        case 'Yukon-Koyukuk Upper Tanana': return {color: "#FF8C00"};
    }
}
}).bindTooltip(function (layer) {
    return layer.feature.properties.NAME;
},
{
    sticky: true,
    offset: [10, 0],
    direction: "right",
    opacity: 0.75
});

acep_regions_input = L.geoJSON(acep_regions, {
    style: function(feature) {
        switch (feature.properties.NAME) {
            case 'Rural Remote': return {color: "#FF0000"};
            case 'Coastal': return {color: "#0000FF"};
            case 'Railbelt': return {color: "#228B22"};
        }
    }
}).bindTooltip(function (layer) {
    return layer.feature.properties.NAME;
},
{
    sticky: true,
    offset: [10, 0],
    direction: "right",
    opacity: 0.75
});

```

```

// Code below builds community location points
points = L.geoJSON(coords_json, {
    pointToLayer: function (feature, latlng) {
        return L.circleMarker(latlng,
            {radius: 5,
            fillColor: "#808080",
            color: "#000",
            weight: 1,
            opacity: 1,
            fillOpacity: 0.8
            });
    }
}).bindTooltip(function (layer) {
    return layer.feature.properties.name;
},
{
    sticky: true,
    offset: [10, 0],

```

```
        direction: "right",
        opacity: 0.75
    });
```

```
///| label: fig-regions-map
///| fig-cap: "Cartographic Relationship between Energy Regions as defined by AEA and ACEP"

viewof region_input = Inputs.select(new Map([
    ["AEA Regions", aea_regions_input],
    ["ACEP Regions", acep_regions_input]]),
    {value: aea_regions_input, label: "Display below:"}
);
```

```
// the order of the container calls is important, do first, don't mess with
map = {
    let container = DOM.element('div', { style: `width:${width}px;height:${width/1.2}px` });
    yield container;

    // create map object
    let map = L.map(container).setView([62.945279601222396, -155.5946697727831], 4);

    // add basemap
    var basemap = L.tileLayer('https://basemap.nationalmap.gov/arcgis/rest/services/USGSTopo/MapSe
        maxZoom: 20,
        attribution: 'Tiles courtesy of the <a href="https://usgs.gov/">U.S. Geological Survey</a>');
    basemap.addTo(map);

    // // add dropdown input selection
    region_input.addTo(map);

    // add community points
    points.addTo(map);
}
```

2.3. 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).

Please visit the Alaska Energy Authority [PCE webpage](#) for more information about the Power Cost Equalization program.

2.4. 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 [?@sec-contacts](#).

Chapter 3.

Price of Electricity

Electricity Prices for the Residential, Commercial, and Industrial Customer Classes, 2011-2019

3.1. 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 2.3). 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.

3.1.1. 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.

```
// active inputs

viewof dimension = Inputs.select(new Map([
    ["Residential", 'residential_price'],
    ["Commercial", 'commercial_price'],
    ["Other", 'other_price']]),
    {value: "Residential", label: "Customer Class:"}
);
```



```
// viewof flipCoords = Inputs.toggle({ label: 'Flip', value: false })

// Inputs.table(customers_pivot)
```

```
// hardcoded inputs here

// viewof thresholds = Inputs.select([10, 20, 60], { label: 'Bins', value: 60 })
thresholds = 40

// viewof seed = Inputs.range([1, 100], { step: 1, label: 'Raw Data Seed', value: 1 })
seed = 1

// viewof rawDataSize = Inputs.range([10, 100], { value: 40, step: 10, label: 'Raw Data Size (%)'
rawDataSize = 20

// viewof rawDataOffset = Inputs.range([0, 50], { value: 5, step: 5, label: 'Raw Data Offset (%)'
rawDataOffset = 5
```

```
///| label: fig-price-regions-classes
///| fig-cap: "Prices by Region and Customer Class"
///| class: raincloud-custom
Plot.plot(rainCloudX)
```

```
rainCloudX = ({
  grid: true,
  label: null,
  width: width,
  marks: [
    Plot.ruleX([0]),
    halfViolinX,
    rawDataX
  ],
  facet: {
    data: data,
    y: 'acep_energy_region',
    marginRight: 80
  },
  x: {
    label: "Cents per Kilowatt Hour"
  },
  y: {
    ticks: 0,
    tickFormat: d => d < 0 ? '' : d
  },
  color: {
    domain: ["Coastal", "Railbelt", "Rural Remote"],
    range: ["#8CBBDA", "#97CD93", "#F28D8C"]
  }
})
```

```
halfViolinX = Plot.areaY(
  data,
  Plot.binX(
    {
```

```

        y: 'count'
      },
      {
        x: dimension,
        fill: 'acep_energy_region',
        thresholds: thresholds,
        curve: 'basis'
      }
    )
  )
)

```

```

rawDataX = Plot.dot(
  data,
  {
    x: dimension,
    y: jitter(data, seed),
    fill: 'acep_energy_region',
    r: 1.5,
    channels: {Name: "reporting_name", Year: "year"},
    tip: {format: {fill: false,
                  fy: false,
                  y: false
                }}
  }
)

// tip = Plot.tip(
//   data, Plot.pointer(
//     {
//       x: dimension,
//       y: 'acep_energy_region',
//       format: {
//         year: true,
//         reporting_name: true,
//         dimension: true,
//         filter: (d) => d.reporting_name,
//         title: (d) => [d.reporting_name, d.year].join("\n\n"),
//         stroke: false
//       }
//     }
//   )
// )

```

```

//| echo: false
// appendix

jitter = (data, seed) => {
  const rng = seedrandom(seed);
  return data.map(() => -(rng() * rawDataSize + rawDataOffset) * maxTotal / 100);
}

maxTotal = d3.max(
  Array.from(
    d3
      .group(data, d => d.aea_energy_region)

```

```

    .values()
  )
  .flatMap(g => bins(g.map(d => d[dimension])))
  .map(bin => bin.length)
)

bins = d3
  .bin()
  .domain(d3.extent(data, d => d[dimension]))
  .thresholds(thresholds)

seedrandom = require('seedrandom')

```

```

prices_tidy = tidy(
  prices,
  rename({
    'residential_price_kwh_2021_dollars': 'residential_price',
    'commercial_price_kwh_2021_dollars': 'commercial_price',
    'other_price_kwh_2021_dollars': 'other_price',
  }),
  // pivotLonger({
  //   cols: ['residential', 'commercial', 'other'],
  //   namesTo: 'sector',
  //   valuesTo: 'price'
  // }),
  select([
    'year',
    'reporting_name',
    'acep_energy_region',
    'residential_price',
    'commercial_price',
    'other_price'
  ])
)

customers_pivot = tidy(
  prices,
  rename({
    'residential_price_kwh_2021_dollars': 'residential_price',
    'commercial_price_kwh_2021_dollars': 'commercial_price',
    'other_price_kwh_2021_dollars': 'other_price',
  }),
  rename({
    'residential_customers': 'residential',
    'commercial_customers': 'commercial',
    'other_customers': 'other',
  }),
  pivotLonger({
    cols: ['residential', 'commercial', 'other'],
    namesTo: 'sector',
    valuesTo: 'customers'
  }),
  select([
    'year',
    'reporting_name',

```

```

        'acep_energy_region',
        'residential_price',
        'commercial_price',
        'other_price',
        'customers',
        'total_customers'
    ])
)

// prices_customers_long = tidy(
//   prices_pivot,
//   leftJoin(customers_pivot,
//     { by: ['year', 'aea_sales_reporting_id', 'reporting_name', 'sector'] }),
//   select([
//     'year',
//     'reporting_name',
//     'acep_energy_region',
//     'sector',
//     'price',
//     'customers',
//     'total_customers'
//   ])
// )

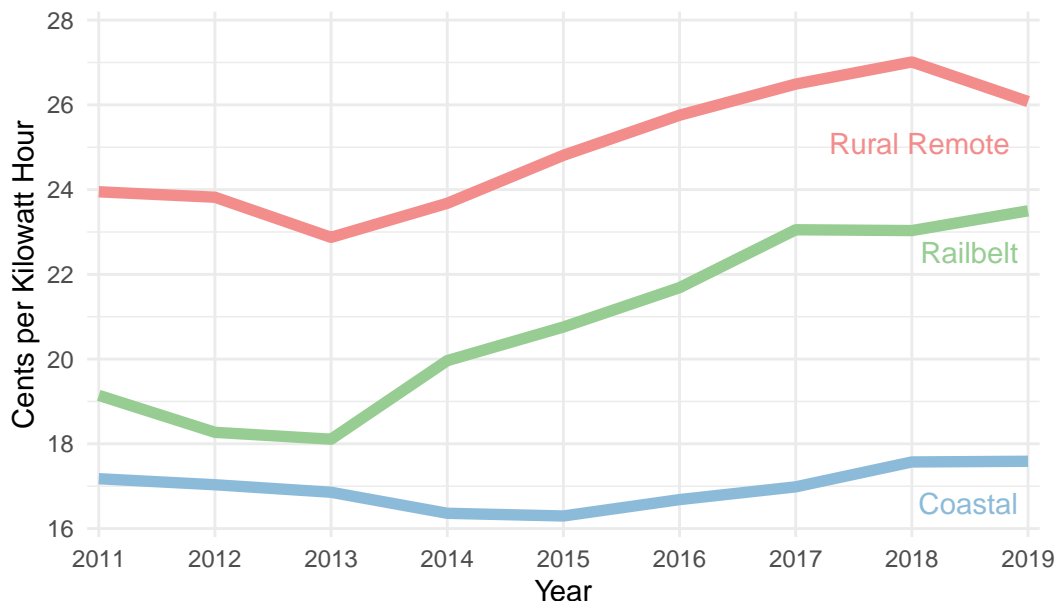
data = tidy(
  prices_tidy,
  mutate({
    residential_price: (d) => d.residential_price === 0 ? null : d.residential_price,
    commercial_price: (d) => d.commercial_price === 0 ? null : d.commercial_price,
    other_price: (d) => d.other_price === 0 ? null : d.other_price,
  }),
  filter((d) => d.year < 2020),
  filter((d) => d.reporting_name != "Lime Village"),
  filter((d) => d.reporting_name != "Healy Lake")
);

```

3.1.2. 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



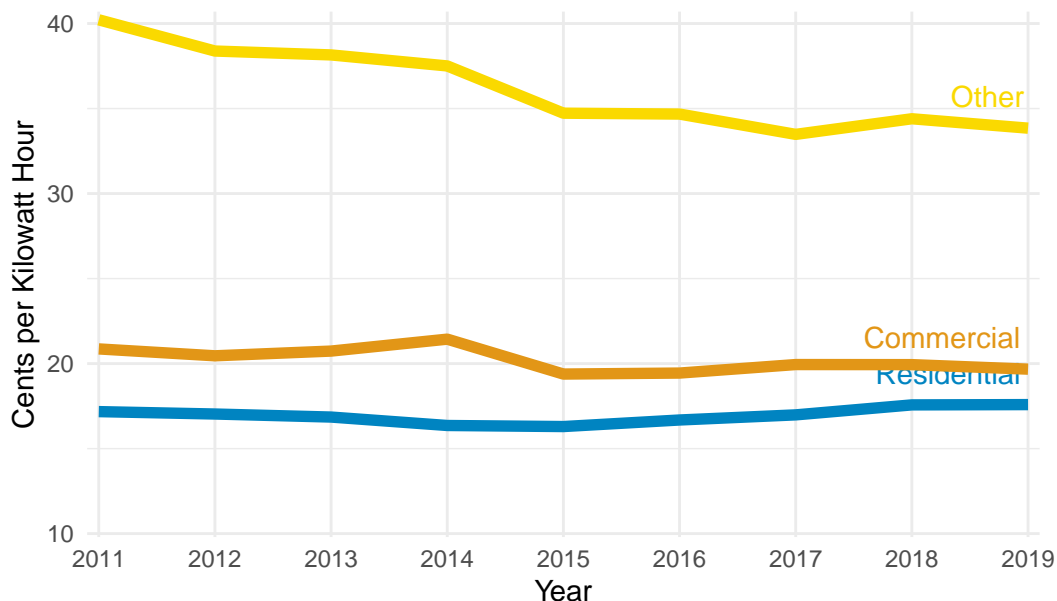
3.2. Coastal

?@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



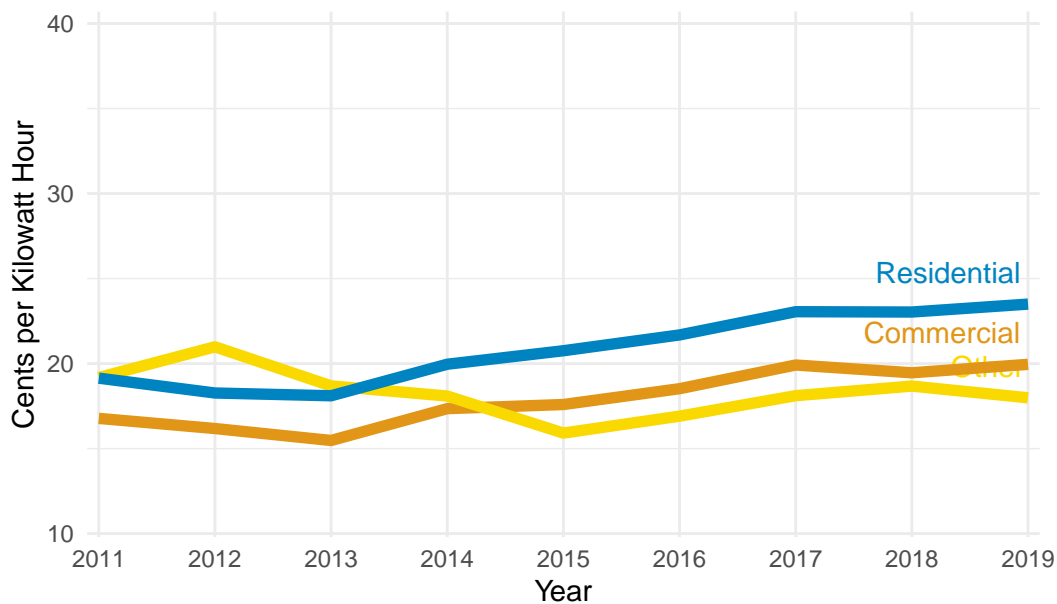
3.3. Railbelt

?@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.

Figure 3: Sector Price Over Time, Railbelt Region

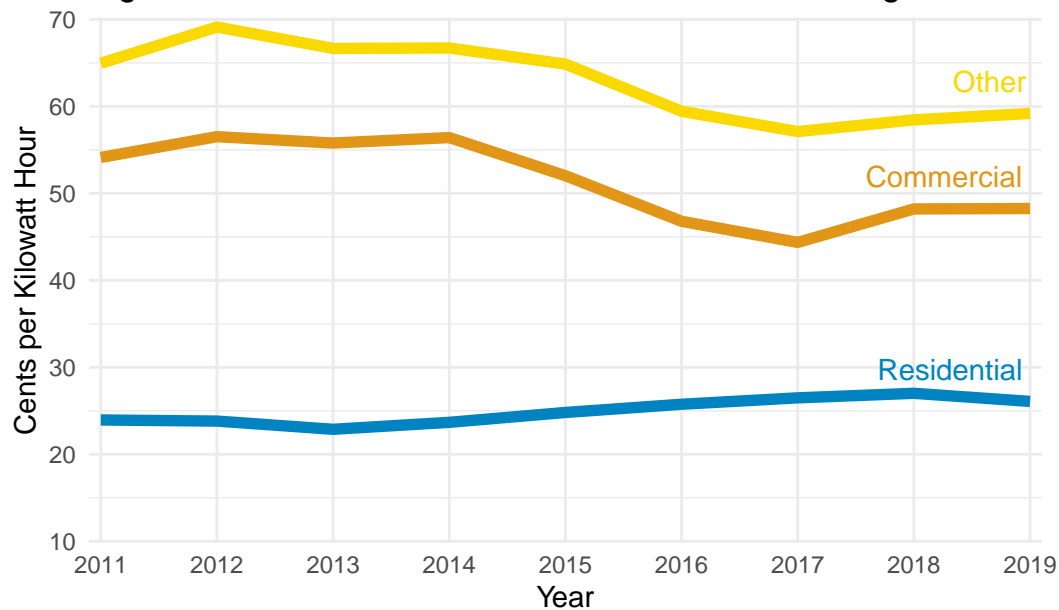


3.4. Rural Remote

?@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



```
// price extraction function

function extract_price(region, year, sector) {
  const filteredData = weighted_prices.filter(
    d => d.year === year &&
    d.sector === sector &&
    d.acep_energy_region === region);

  const extractedPrice = Math.round(filteredData.map(d => d.weighted_price));

  return extractedPrice;
};
```

```
// percentage function

function percent_change(region, start_year, end_year, sector){
  const start_price = extract_price(region, start_year, sector);
  const end_price = extract_price(region, end_year, sector);

  const rawPercent = (((start_price - end_price)/start_price) * 100);
  const percent = Math.abs(Math.round(rawPercent));

  return percent;
}
```

```
// starting prices

rural_res_2011 = extract_price("Rural Remote", 2011, 'residential');
railbelt_res_2011 = extract_price("Railbelt", 2011, 'residential');
coastal_res_2011 = extract_price("Coastal", 2011, 'residential');

rural_com_2011 = extract_price("Rural Remote", 2011, 'commercial');
railbelt_com_2011 = extract_price("Railbelt", 2011, 'commercial');
coastal_com_2011 = extract_price("Coastal", 2011, 'commercial');
```



```
rural_other_2011 = extract_price("Rural Remote", 2011, 'other');
railbelt_other_2011 = extract_price("Railbelt", 2011, 'other');
coastal_other_2011 = extract_price("Coastal", 2011, 'other');
```

```
// ending prices
```

```
rural_res_2019 = extract_price("Rural Remote", 2019, 'residential');
railbelt_res_2019 = extract_price("Railbelt", 2019, 'residential');
coastal_res_2019 = extract_price("Coastal", 2019, 'residential');
```

```
rural_com_2019 = extract_price("Rural Remote", 2019, 'commercial');
railbelt_com_2019 = extract_price("Railbelt", 2019, 'commercial');
coastal_com_2019 = extract_price("Coastal", 2019, 'commercial');
```

```
rural_other_2019 = extract_price("Rural Remote", 2019, 'other');
railbelt_other_2019 = extract_price("Railbelt", 2019, 'other');
coastal_other_2019 = extract_price("Coastal", 2019, 'other');
```

```
// percent changes
```

```
coastal_res_change = percent_change("Coastal", 2011, 2019, 'residential');
coastal_com_change = percent_change("Coastal", 2011, 2019, 'commercial');
coastal_other_change = percent_change("Coastal", 2011, 2019, 'other');
```

```
railbelt_res_change = percent_change("Railbelt", 2011, 2019, 'residential');
railbelt_com_change = percent_change("Railbelt", 2011, 2019, 'commercial');
railbelt_other_change = percent_change("Railbelt", 2011, 2019, 'other');
```

```
rural_res_change = percent_change("Rural Remote", 2011, 2019, 'residential');
rural_com_change = percent_change("Rural Remote", 2011, 2019, 'commercial');
rural_other_change = percent_change("Rural Remote", 2011, 2019, 'other');
```

```
// load libraries
```

```
stdlib = require("@observablehq/stdlib")
```

```
d3 = require("d3@7")
```

```
import {tidy, groupBy, rename, summarize, sum, mutate, select, n, nDistinct, mean, filter, pivotW
```

```
// load data
```

```
prices = FileAttachment("data/working/prices/prices.csv").csv({typed: true});
```

```
weighted_prices = FileAttachment("data/working/prices/weighted_prices.csv").csv({typed: true});
```

Chapter 4.

Conclusions

Description of Results and Conclusions

From 2011 to 2019/21, there have been significant developments in the electricity generation landscape in Alaska. In this report, we highlight trends across installed capacity, net/gross generation, consumption by customer class, and price per kWh. There are several key takeaways from each of these areas that we reiterate in this conclusion.

4.0.1. Capacity

There has been continued development in the installation and availability of electric generation capacity (**?@sec-capacity**) across the state. Throughout every region, installed capacity increased. Of particular note are the installation of peaking and/or backup engines, renewable energy facilities (hydro, wind, and solar expansions), and storage. If trends continue, we can expect to see further increases in resilience and reliability-focused capacity.

4.0.2. Generation

Net/gross generation (**?@sec-generation**) throughout the state remained relatively stable across observed years with each region having notable trends. In the Coastal region, we observed more hydroelectric and wind generation on average in 2021 than in 2011. This was coupled with reductions in generation from oil-based units. On the Railbelt, we observed more generation from wind, hydroelectric, coal, and solar resources in 2021 than in 2011. This was coupled with less oil and natural gas generation. Finally, in the Rural Remote region, we observed more generation from wind and solar resources in 2021 than in 2011. We also note the increase in use of utility-scale battery storage throughout the state.

4.0.3. Consumption

Electricity consumption (**?@sec-consumption**) throughout the state fell on average. The residential customer class saw the largest reductions, while the number of customer accounts increased across all categories. We also note that the Rural Remote region saw increases in consumption for the commercial and industrial customer classes. Finally, we observed that the Coastal region had the highest per capita consumption for residential customers, followed by the Railbelt and then the Rural Remote regions.

4.0.4. Prices

Electricity prices (Section [3.1](#)) across the state were variable but trended upward. After adjusting for inflation, PCE subsidies, and including a population weight, the average residential electricity price across the state increased. The largest residential rate increases from 2011 to 2019 were observed in the Railbelt region (26%), and the smallest were observed in the Coastal region (6%). Throughout the Coastal and Rural Remote regions, commercial and other customer classes saw rate decreases. Rate decreases were also observed on the Railbelt for commercial customers. We also observed that PCE subsidies were paramount to mitigating the cost of electricity for residential and community customers in the Rural Remote and Coastal regions.

4.1. Future Plans

The results of this trends report highlight the direction that installed capacity, net/gross generation, consumption, and prices took from 2011-2019/21. We emphasize the importance of continuing to collate electricity data from federal, state, regional, and local sources so that it may be analyzed on a more consistent basis. Our hope is to continue producing trends reports with updated data to better inform the public and decision makers regarding Alaska's energy future.

Appendix A.

Historical Electric Power Statistics Reports

Links to Previous Reports, Data Years 1960-2012

A.1. Historical Electric Power Reports

For an overall description of previous reports that have examined electric power trends in Alaska, please see Section B.2. Below is an exhaustive list of links to these reports over time. Notably, we omit reports that include projections such as the State of Alaska Energy Reports/Plans.

Table A.1.: Links to Historical Reports

| Publication Year | Data Year | Type | Authoring Institution | Publication Title | Type | Persistent Links |
|------------------|-----------|----------|---|--|--------|--|
| 1969 | 1968 | Fiscal | United States Department of the Interior, Alaska Power Administration | First Annual Report | Report | First Annual Report |
| 1971 | 1960-1969 | Calendar | United States Department of the Interior, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1969 | Report | Alaska Electric Power Statistics 1960 - 1969 |
| 1972 | 1960-1970 | Calendar | United States Department of the Interior, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1970 | Report | Alaska Electric Power Statistics 1960 - 1970 |
| 1974 | 1960-1973 | Calendar | United States Department of the Interior, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1973 | Report | Alaska Electric Power Statistics 1960 - 1973 |
| 1976 | 1960-1975 | Calendar | United States Department of the Interior, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1975 | Report | Alaska Electric Power Statistics 1960 - 1975 |
| 1977 | 1960-1976 | Calendar | United States Department of the Interior, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1976 | Report | Alaska Electric Power Statistics 1960 - 1976 |
| 1981 | 1960-1980 | Calendar | United States Department of Energy, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1980 | Report | Alaska Electric Power Statistics 1960 - 1980 |

| Publication Year | Data Year | Type | Authoring Institution | Publication Title | Type | Persistent Links |
|------------------|-----------|----------|--|--|--------|--|
| 1983 | 1960-1982 | Calendar | United States Department of Energy, Alaska Power Administration | Alaska Electric Power Statistics 1960 - 1982 | Report | Alaska Electric Power Statistics 1960 - 1982 |
| 1984 | 1960-1983 | Calendar | State of Alaska, Alaska Power Authority | Alaska Electric Power Statistics 1960 - 1983 | Report | Alaska Electric Power Statistics 1960 - 1983 |
| 1985 | 1960-1984 | Calendar | State of Alaska, Alaska Power Authority | Alaska Electric Power Statistics 1960 - 1984 | Report | Alaska Electric Power Statistics 1960 - 1984 |
| 1986 | 1960-1985 | Calendar | State of Alaska, Alaska Power Authority | Alaska Electric Power Statistics 1960 - 1985 | Report | Alaska Electric Power Statistics 1960 - 1985 |
| 1987 | 1960-1986 | Calendar | State of Alaska, Alaska Power Authority | Alaska Electric Power Statistics 1960 - 1986 | Report | Alaska Electric Power Statistics 1960 - 1986 |
| 1988 | 1960-1987 | Calendar | State of Alaska, Alaska Power Authority | Alaska Electric Power Statistics 1960 - 1987 | Report | Alaska Electric Power Statistics 1960 - 1987 |
| 1989 | 1960-1988 | Calendar | State of Alaska, Alaska Energy Authority | Alaska Electric Power Statistics 1960 - 1988 | Report | Alaska Electric Power Statistics 1960 - 1988 |
| 1990 | 1960-1989 | Calendar | State of Alaska, Alaska Energy Authority | Alaska Electric Power Statistics 1960 - 1989 | Report | Alaska Electric Power Statistics 1960 - 1989 |
| 1991 | 1960-1990 | Calendar | State of Alaska, Alaska Energy Authority | Alaska Electric Power Statistics 1960 - 1990 | Report | Alaska Electric Power Statistics 1960 - 1990 |
| 1992 | 1960-1991 | Calendar | State of Alaska, Alaska Energy Authority | Alaska Electric Power Statistics 1960 - 1991 | Report | Alaska Electric Power Statistics 1960 - 1991 |
| 1993 | 1960-1992 | Calendar | Alaska Systems Coordinating Council; State of Alaska, Department of Community and Regional Affairs, Division of Energy | Alaska Electric Power Statistics 1960 - 1992 | Report | Alaska Electric Power Statistics 1960 - 1992 |
| 1994 | 1960-1993 | Calendar | Alaska Systems Coordinating Council; State of Alaska, Department of Community and Regional Affairs, Division of Energy | Alaska Electric Power Statistics 1960 - 1993 | Report | Alaska Electric Power Statistics 1960 - 1993 |

| Data | | Publication | | Type | Persistent Links |
|------------------|-----------|--|---|-------------------------|---|
| Publication Year | Data Year | Authoring Institution | Title | | |
| 1995 | 1960-1994 | Alaska Systems Coordinating Council; State of Alaska, Department of Community and Regional Affairs, Division of Energy | Alaska Electric Power Statistics 1960 - 1994 | Report | Alaska Electric Power Statistics 1960 - 1994 |
| 1996 | 1960-1995 | Alaska Systems Coordinating Council; State of Alaska, Department of Community and Regional Affairs, Division of Energy | Alaska Electric Power Statistics 1960 - 1995 | Report | Alaska Electric Power Statistics 1960 - 1995 |
| 2003 | 1960-2001 | University of Alaska Anchorage, Institute of Social and Economic Research | Alaska Electric Power Statistics (with Alaska Energy Balance) 1960 - 2001 | Report | Alaska Electric Power Statistics (with Alaska Energy Balance) 1960 - 2001 |
| 2011 | 1960-2008 | University of Alaska Anchorage, Institute of Social and Economic Research | Alaska Energy Statistics 1960 - 2008 | Report, Excel Work-book | Alaska Energy Statistics 1960 - 2008 |
| 2011 | 1960-2009 | University of Alaska Anchorage, Institute of Social and Economic Research | Alaska Energy Statistics 1960 - 2009 | Report, Excel Work-book | Alaska Energy Statistics 1960 - 2009 |
| 2012 | 1960-2010 | University of Alaska Anchorage, Institute of Social and Economic Research | Alaska Energy Statistics 1960 - 2010 Final Report | Report, Excel Work-book | Alaska Energy Statistics 1960 - 2010 Final Report |
| 2013 | 1960-2011 | University of Alaska Anchorage, Institute of Social and Economic Research | Alaska Energy Statistics 1960 - 2011 Final Report | Report, Excel Work-book | Alaska Energy Statistics 1960 - 2011 Final Report |
| 2015 | 2012 | State of Alaska, Alaska Energy Authority | 2012 Alaska Energy Statistics Final Report | Report | 2012 Alaska Energy Statistics Final Report |

Appendix B.

About this Report

Description of the 2024 Alaska Electricity Trends Report Web Book

B.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.

B.2. Historical Timeline of Prior Reports

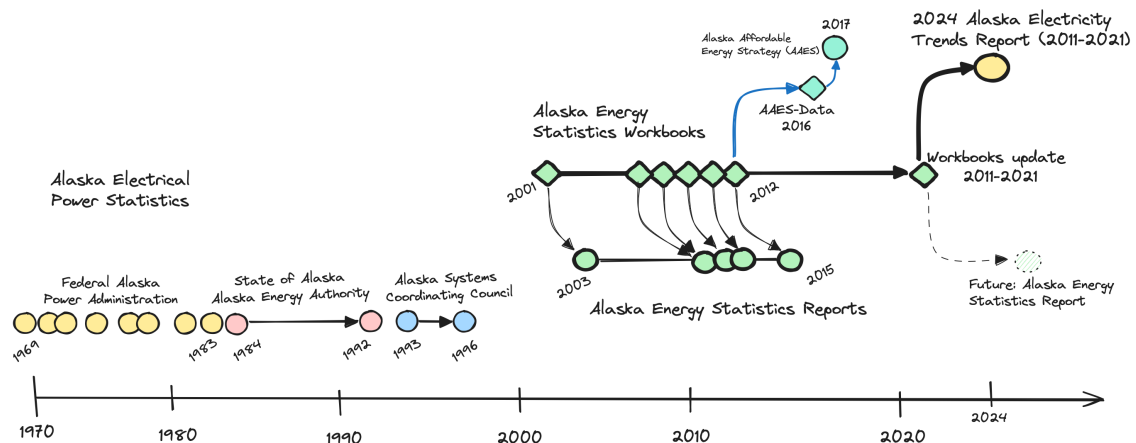


Figure B.1.: Timeline of Energy Reports

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 [B.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 B.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 Table [A.1](#).

B.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.