Establishment and Analysis of Baseline Electrical Data for Thermalize Juneau 2021 Campaign

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Introduction

What is **Thermalize Juneau**?

- Clean-energy campaign consisting of 165 registered participants in Juneau, Alaska.
- Provides free heat pump assessments and energy audits, bulk discounts and simplified installation process, and energy efficiency retrofits.
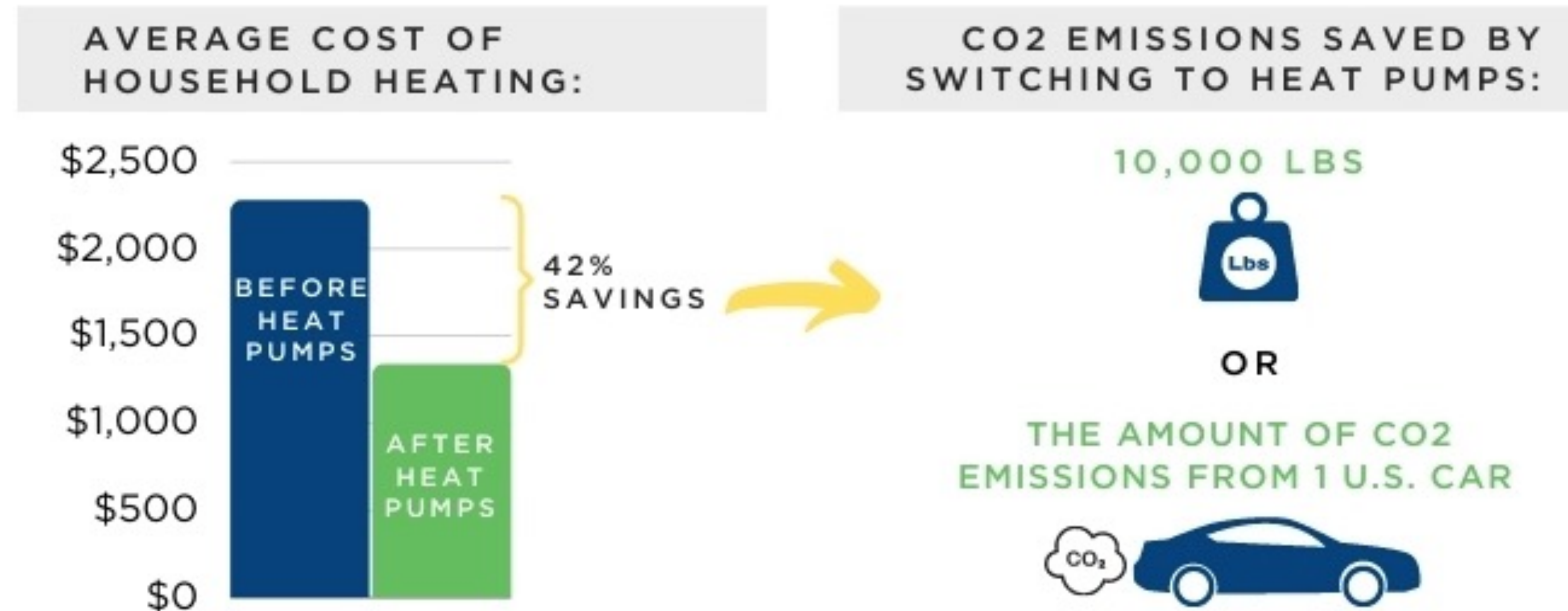

Figure 1: Decarbonization in Juneau Preliminary Findings. Image courtesy of (EESI, 2021)

What is an **air source heat pump (ASHP)**?

- Partially renewable heating appliance, also known as ductless heat pumps (DHP), that gathers heat from outdoor air.
- Uses electricity to step up the heat from outdoor air and delivers it to indoor units.
- Since Juneau's electricity is generated by hydropower plants, ASHP are 100% renewable for this campaign.
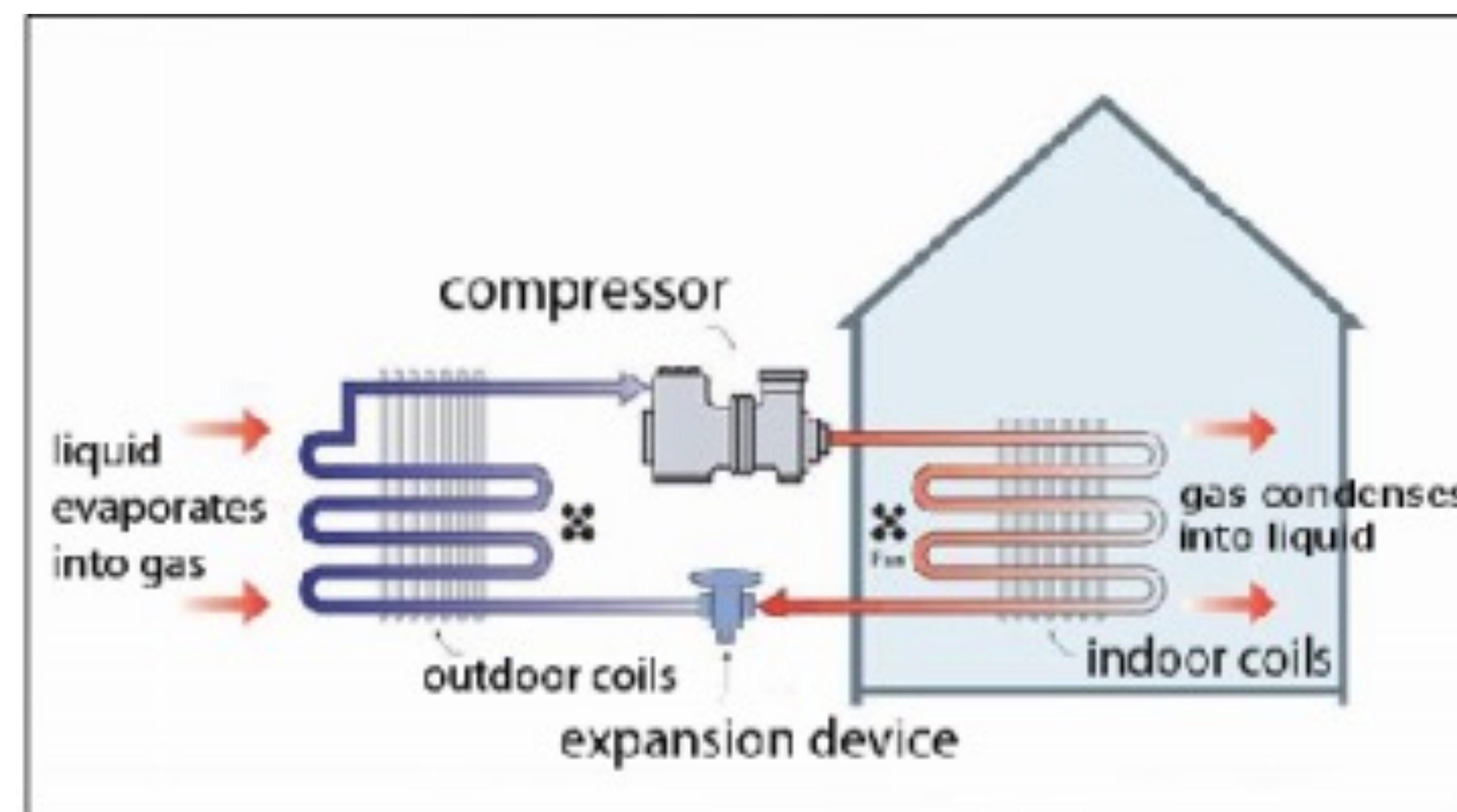

Figure 2: ASHP refrigeration cycle in heating mode. Image courtesy of (RETScreen, 2012)

Research Objectives

1. Process and establish baseline electrical consumption data
2. Study statistical time series analysis
3. Explore seasonal attributes and possible effects of Covid-19 shelter in place mandates

Materials and Methods

Data Processing:

- Converted electrical consumption from billing period to reflect calendar month for 2017-2021.
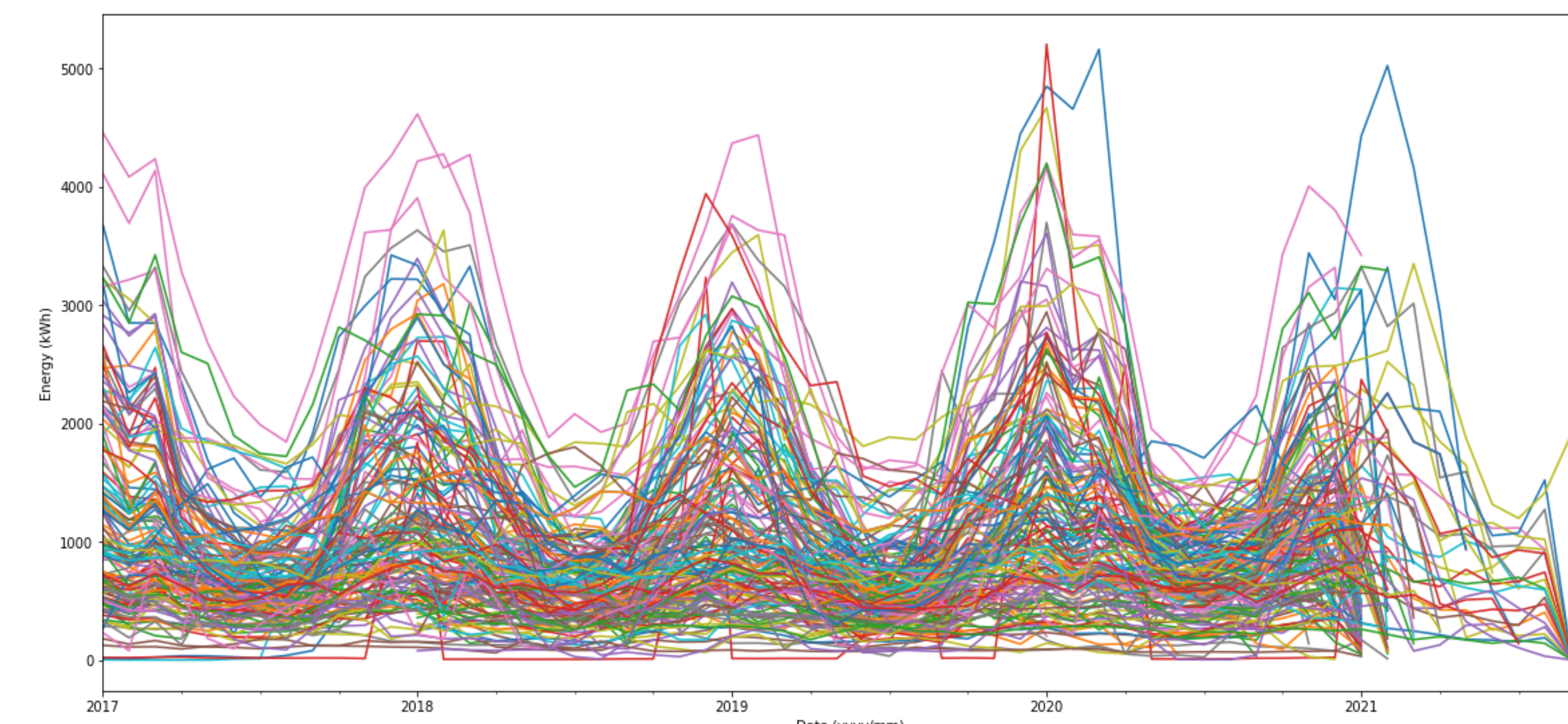- Mean and five-number summary detected outliers.

Figure 3: Monthly electrical consumption of all 165 Thermalize Juneau registrants

Time Series Decomposition:

- Used monthly median values for unbiased analysis.
- Observed plot shows monthly median electricity consumption over time.
- Trend plot represents the overall direction and long-term movement of the data values.
- Seasonal plot represents yearly variations that are steady over time, direction, and magnitude.
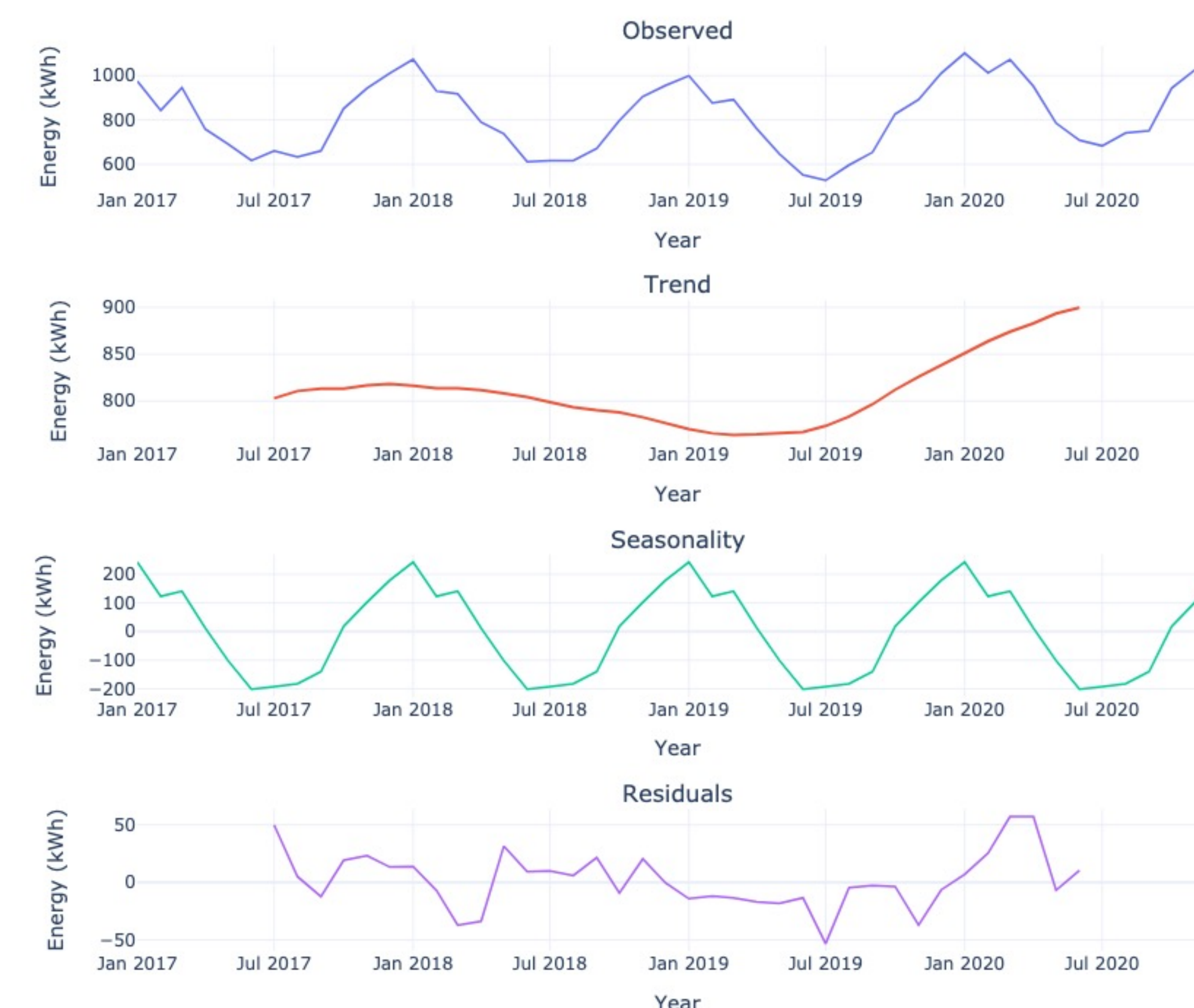- Residual plot represents random unexplainable parts of the data.

Figure 4: Time series decomposition of monthly median electricity consumption

Discussion and Conclusion

By filtering and manipulating raw data, we established baseline electrical consumption data for Thermalize Juneau registrants.

- Observed electricity consumption levels were higher in the beginning and end of the years and lower towards the middle.
- Noticed an overall consistent linear trend incline, suggesting minor effects of Covid-19 during 2020.
- Found consumption levels were significantly higher during winter and significantly lower during summer.
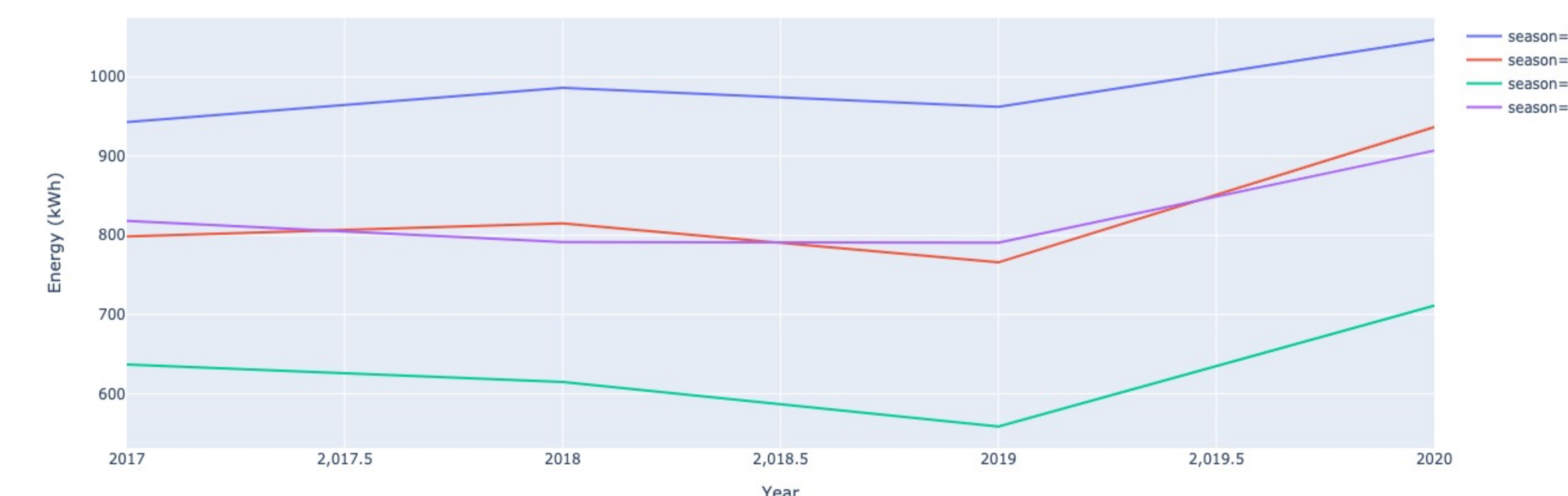- Fall and spring consumption levels stayed relatively in between the other two seasons.

Figure 4: Mean yearly electricity consumption average per season

Future Research

Though we did not find highly significant effects of Covid-19 shelter in place mandates for electrical consumption, we did not dismiss its possible effects for all energy usages. Future research involves cleaning and analyzing baseline Thermalize Juneau registrants' fuel oil and biomass data. We will then use this baseline data to get a more holistic analysis of energy usage from 2017-2020.

Afterwards, we will compare it to post-retrofit data of 2021-2022 and verify if DHP produce real-world energy savings.

Acknowledgements