ANALYSIS OF THE DYNAMICS OF QUEENSLAND'S ELECTRICITY MARKET

GROUP 16

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PROBLEM SOLVING WITH DATA

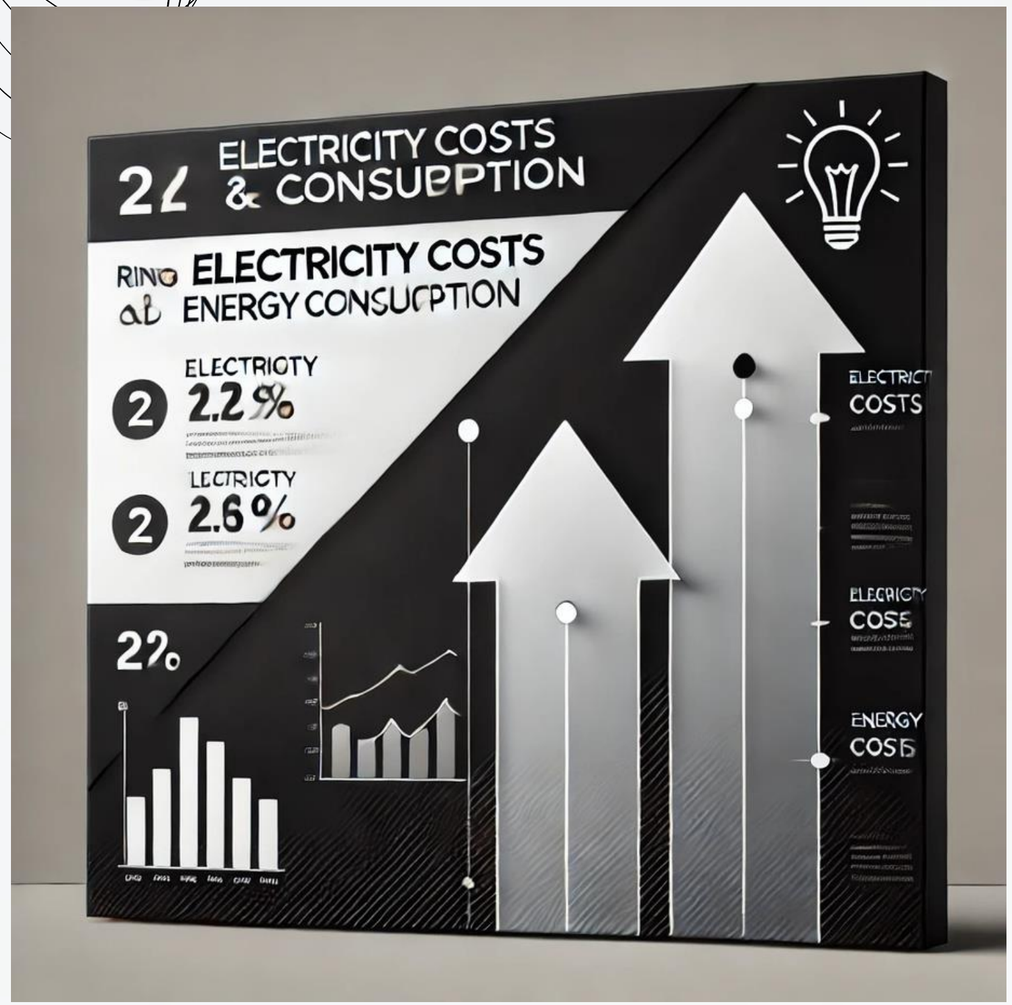
GETTING THE DATA I NEED

IS MY DATA FIT FOR USE

MAKING THE DATA CONFESS

STORYTELLING WITH DATA

BACKGROUND AND CONTEXT



Australia's energy demand is continually rising, driven by population growth and technological advancements.

Simultaneously, many consumers are increasingly concerned about the sharp rise in electricity prices, which are becoming unaffordable for both households and businesses.

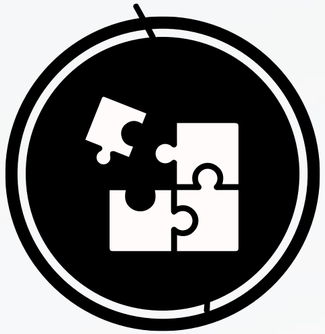
These challenges underscore the need for a more in-depth analysis of the factors influencing energy demand and pricing trends.

RESEARCH QUESTIONS

How does energy demand fluctuate over time?

What are the relationships between Queensland's electricity prices and weather conditions?

Are there significant correlations between Queensland's electricity prices and energy demand?



PROBLEM FORMULATION

WHO ARE THE STAKEHOLDERS

WHAT VALUES TO BRING

- Energy Producers: Optimize generation strategies
- Consumers: Make more informed decisions about their energy consumption
- Policymakers: Promote sustainability and energy efficiency

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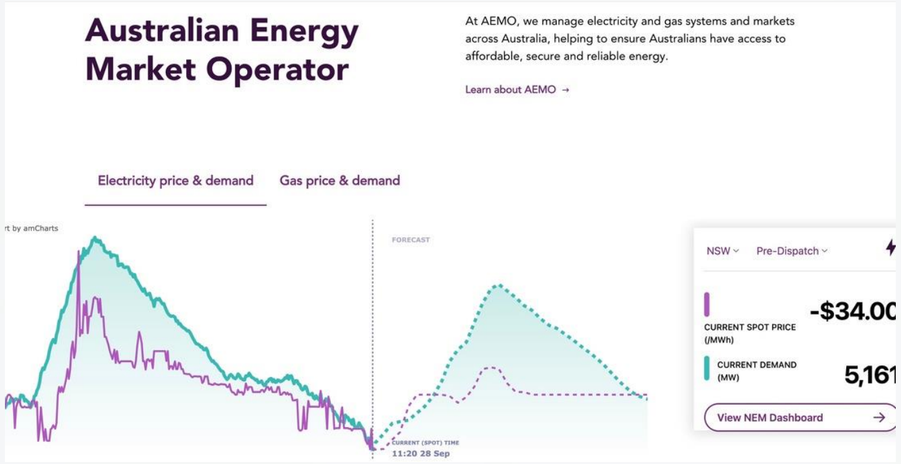
WHERE TO GET THE DATA

SOURCES



Our data comes from two main sources:

- Open-Meteo (weather data)
- AEMO (emission and price)

All of these data are sourced from official websites, ensuring their authenticity and accuracy for reliable analysis.

01

DATA SIZE

Price dataset:
- 60 files in total;
- Each file is about 400KB;
- 5 columns and
- Over 8,000 rows in each file

Weather dataset:
- 2.2MB in size;
- 32 columns and
- About 8,900 rows

02

DATA FORMAT

Numerical data covering energy prices, emissions, and weather conditions;

Easily imported into data analysis tools, such as Excel or Python

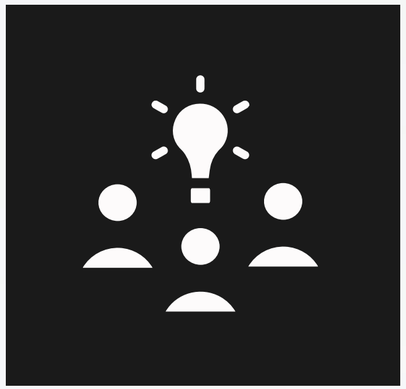
DATA DESCRIPTION

From columns：
The price and emission dataset: 4 energy and emissions attributes : energy(consumption), total emissions, intensity index and regional reference price
across five Australian states:

- New South Wales
- Queensland
- South Australia
- Tasmania
- Victoria

The weather dataset :
weather data, including variables:

- temperature
- wind speed
- humidity
- soil moisture



From rows：
Each row in the price and emission dataset corresponds to a 5-minute interval while each row in the weather dataset corresponds to a one-hour interval.

The data we collected spans from September 2023 to August 2024, providing a full year of records for analysis.

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DATA QUALITY: AEMO

AEMO is kept to a high accuracy standard by market participants

ACCURACY

There is no missing data, therefore methods of imputation will not need to be explored

MISSING DATA

data provided in real time accessed easily through website and api

FRESHNESS

DATA QUALITY: OPEN-METEO

Reformatted from the BOM, which is a trusted Australian government organisation

ACCURACY

One column contained 5.8% missing data, which was dropped as all remaining rows contained the same value, so no information was lost.

MISSING DATA

data provided in real time accessed easily through website and api

FRESHNESS

DATA TRANSFORMATION

- 5 state price data sets
- 5 state emission data sets
- Joined on shared datetime column

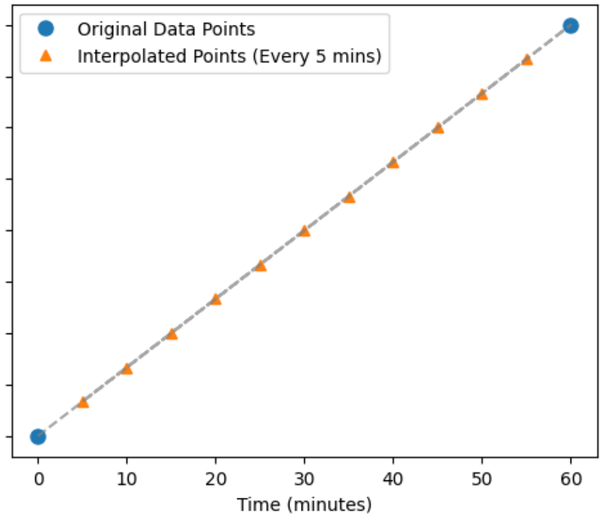
Resulting columns:
SETTLEMENTDATE, QLD_Energy, QLD_Total_Emissions, QLD_Intensity_Index, QLD_RRP, ...

- 4 columns per state
- 21 columns

DATA TRANSFORMATION

- Date column for weather data is hourly data

- Linear interpolation was applied to all the weather values, assuming that changes in weather over the span of an hour are approximately linear.



DATA TRANSFORMATION

- The interpolated weather data joined on the datetime column with the 5 states price and emission data

- 52 columns
- 105,000 rows
- 57.5 MB in csv format

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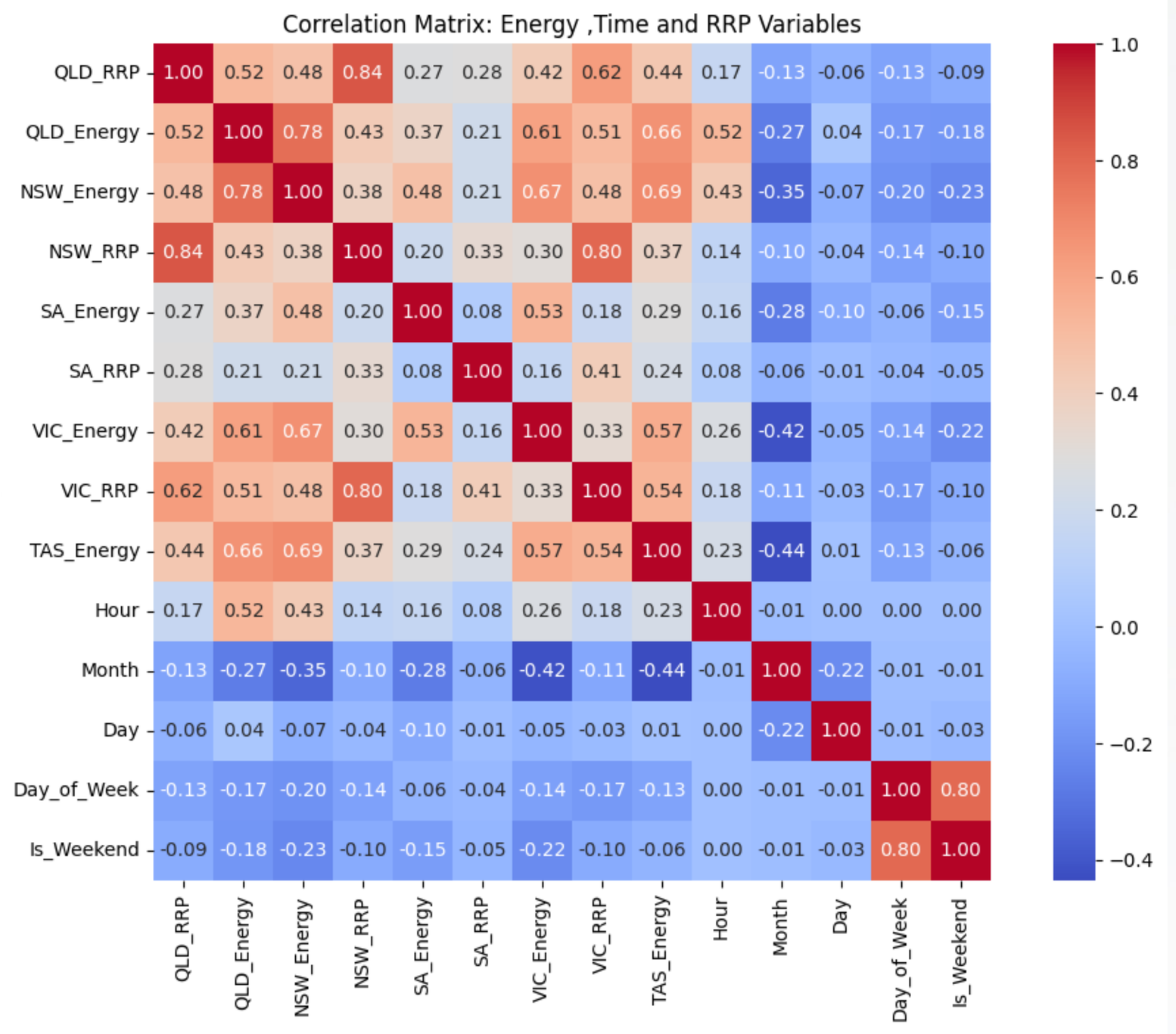
METHODOLOGY

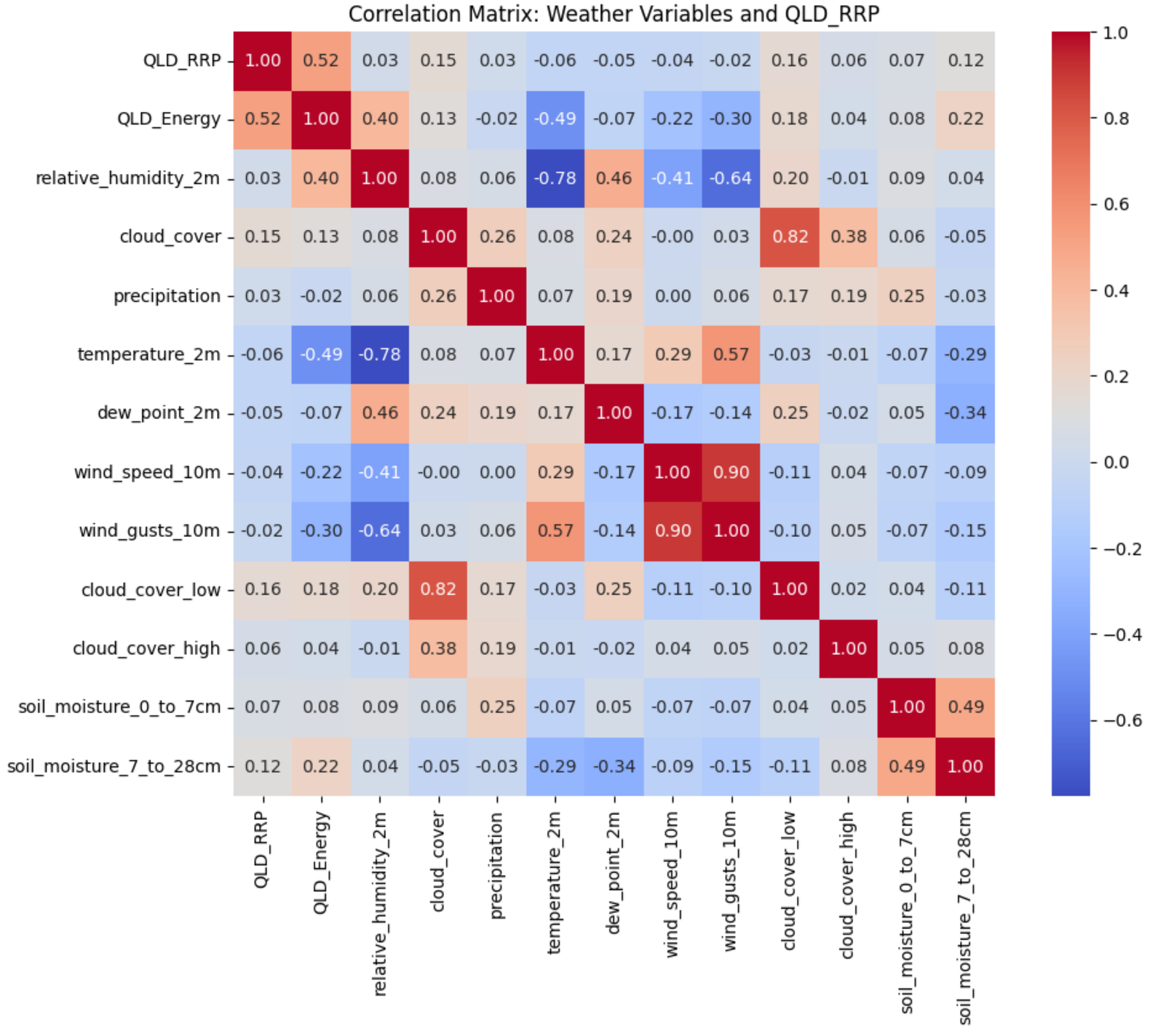
Correlation Heatmap

- Significant correlation between demand of neighbouring states



METHODOLOGY

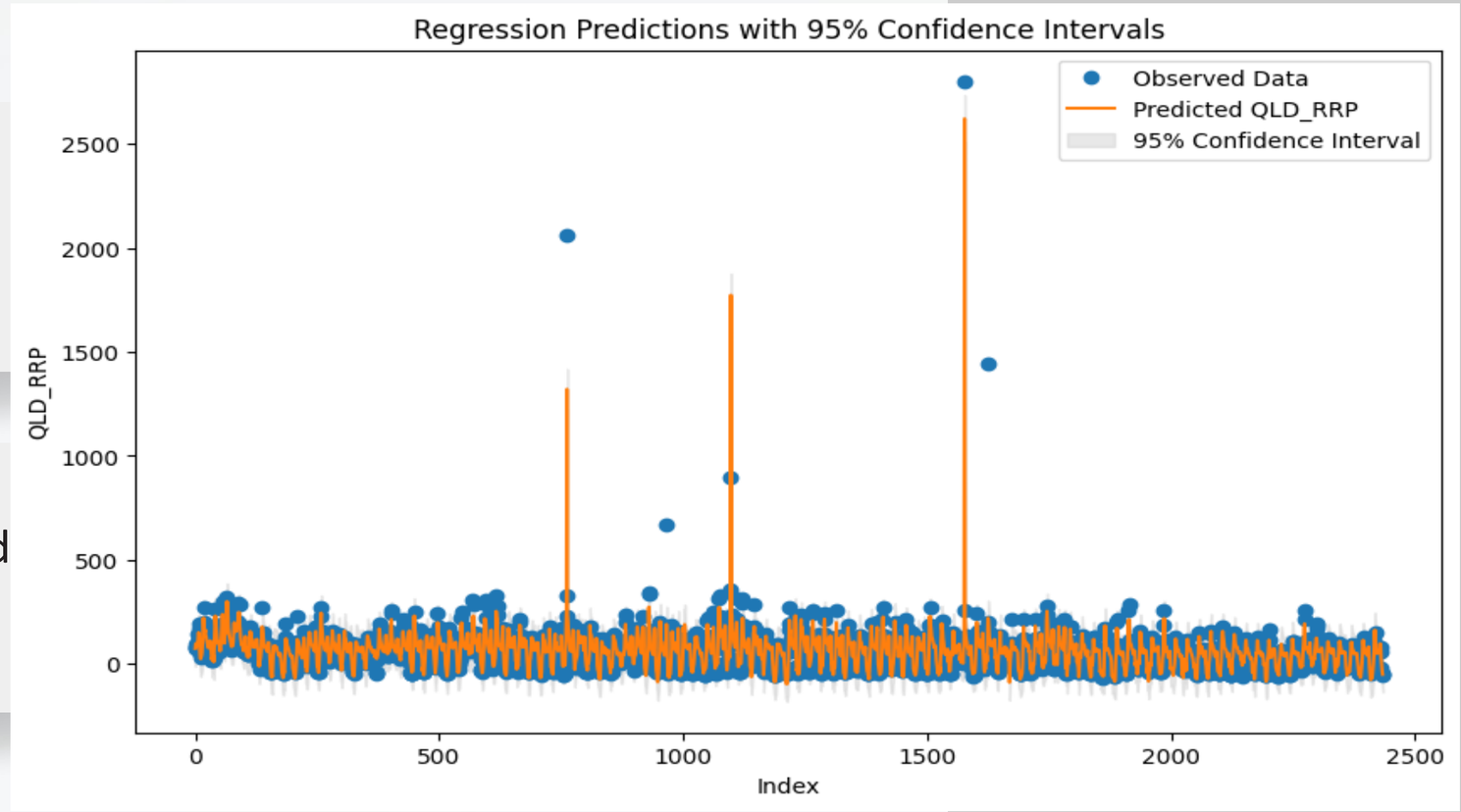
No significant correlation between Weather variables and energy cost



METHODOLOGY

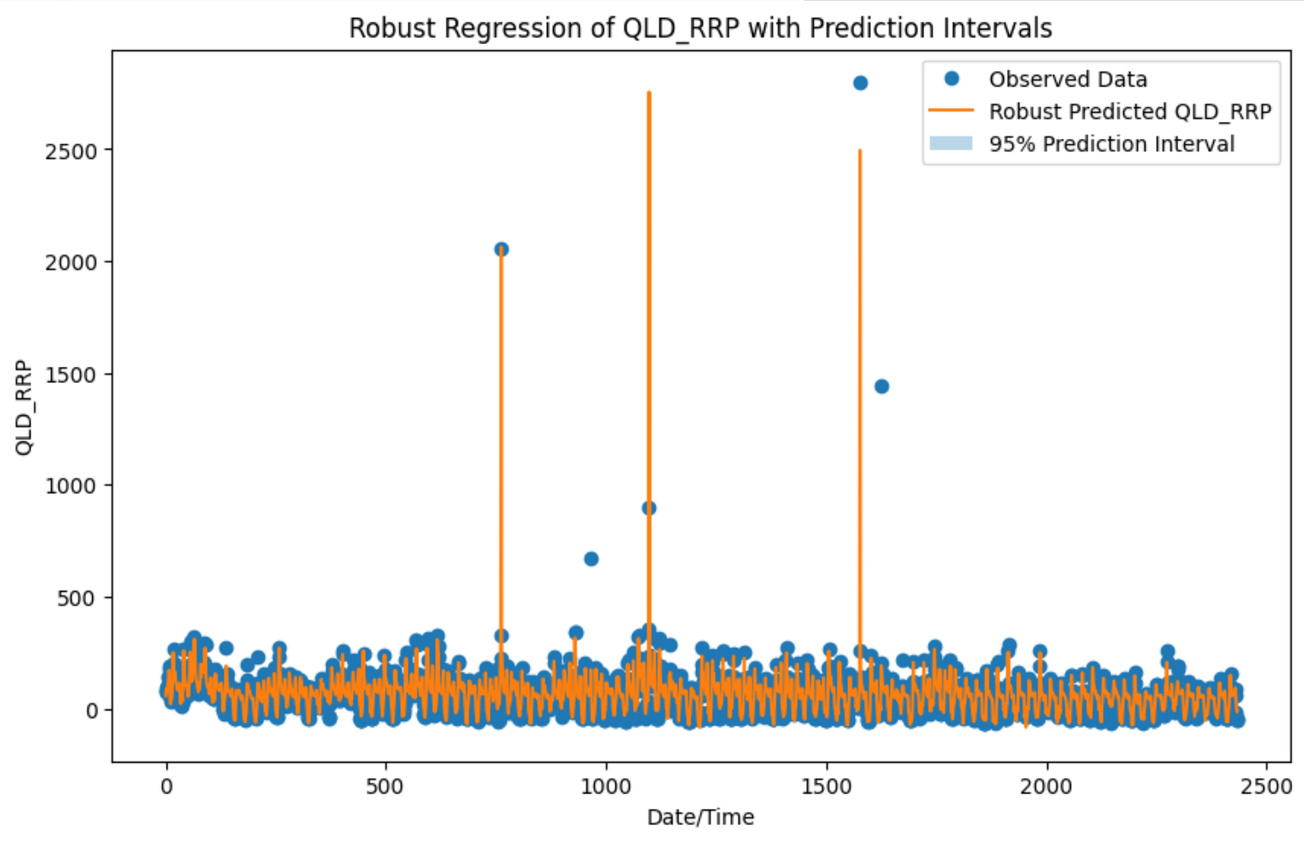
Regression predictions
With confidence intervals

Outliers should be handled



METHODOLOGY

Robust Regression with prediction intervals



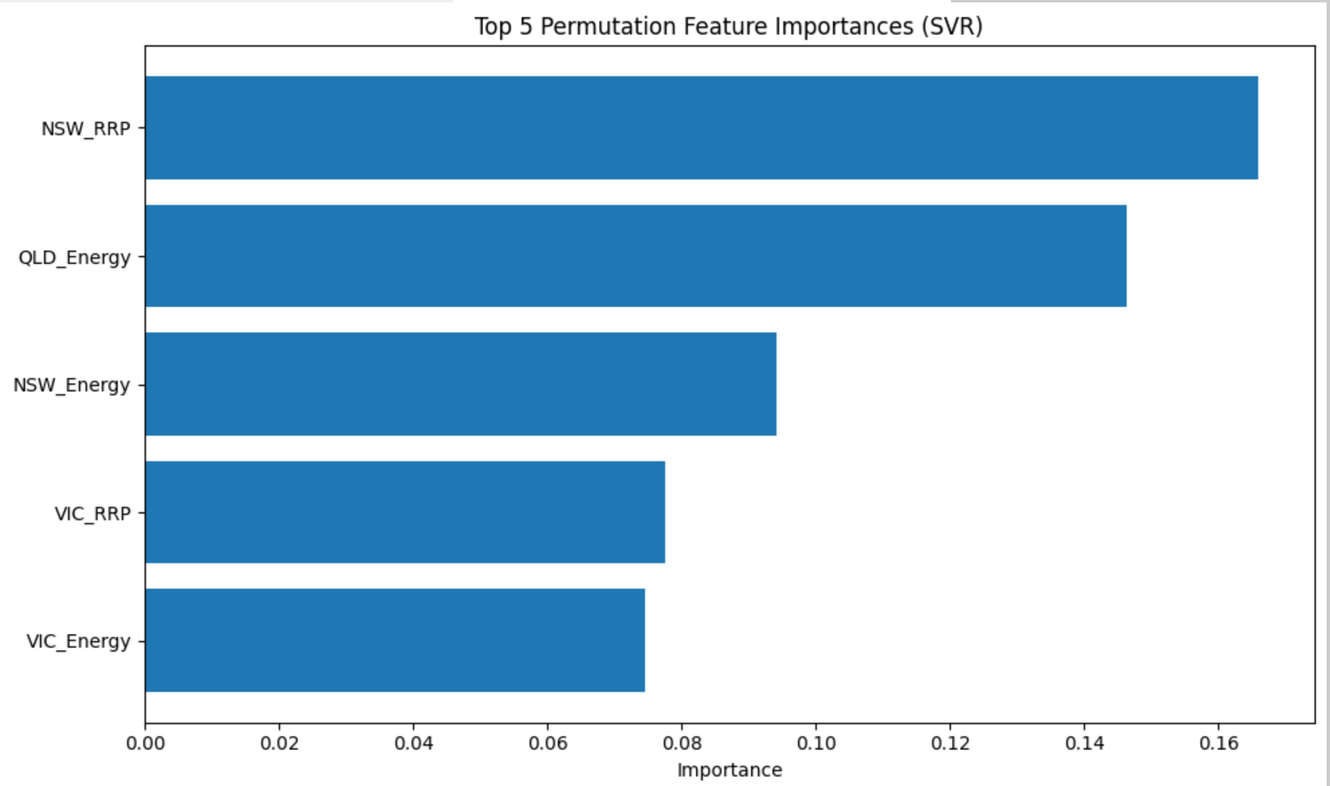
METHODOLOGY

SVR was implemented for Feature importance

• NSW_RRP had the most significant influence

	MSE	R2
Polynomial Degree 1	125139.555117	0.055994
Polynomial Degree 2	123371.634426	0.069331
Polynomial Degree 3	120103.180765	0.093987
Polynomial Degree 4	118414.165237	0.106728
Polynomial Degree 5	118509.197210	0.106011
Decision Tree	246567.174080	-0.860010
Gradient Boosting	124526.935947	0.060616

The best model is: Polynomial Degree 4



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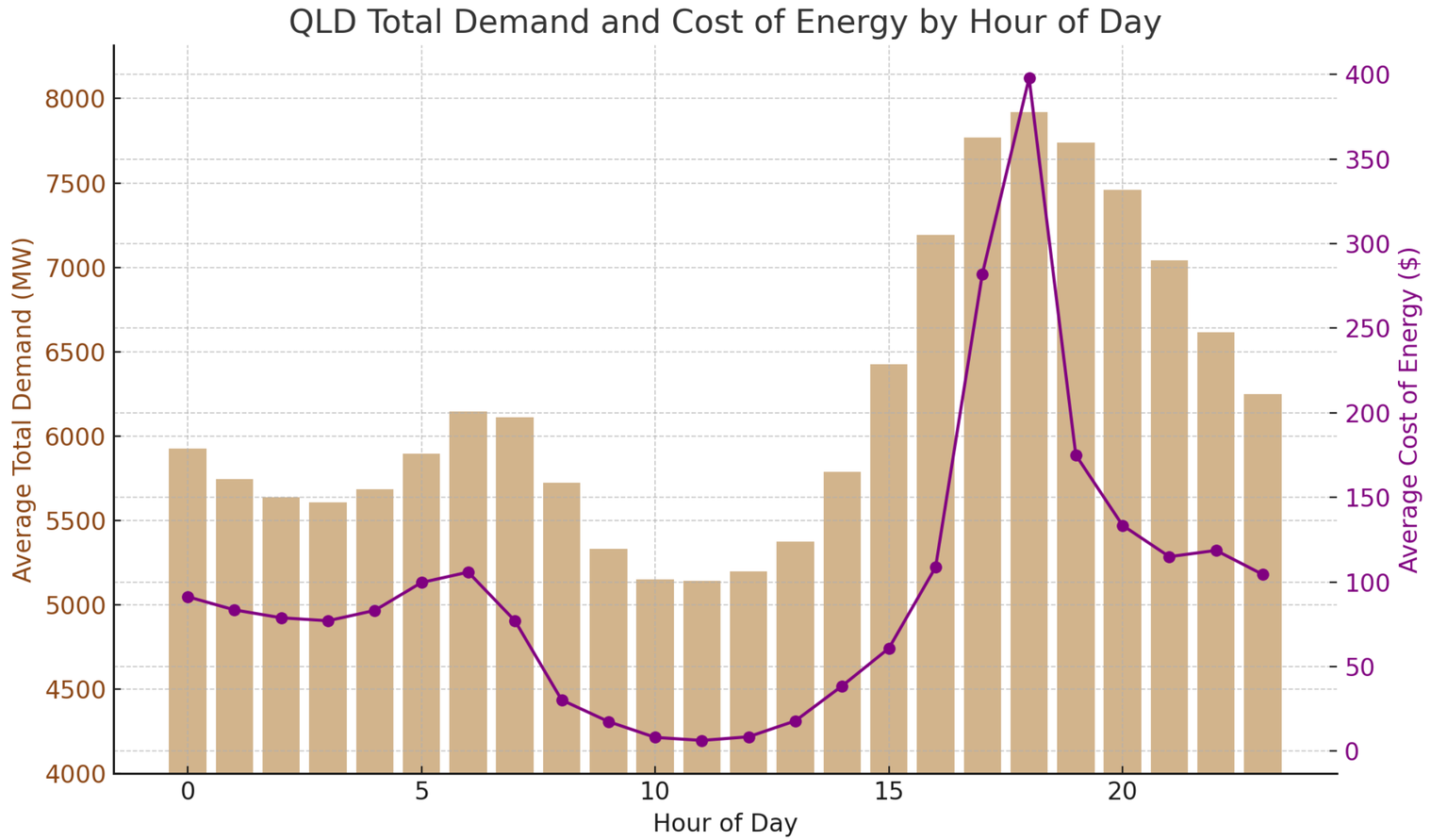
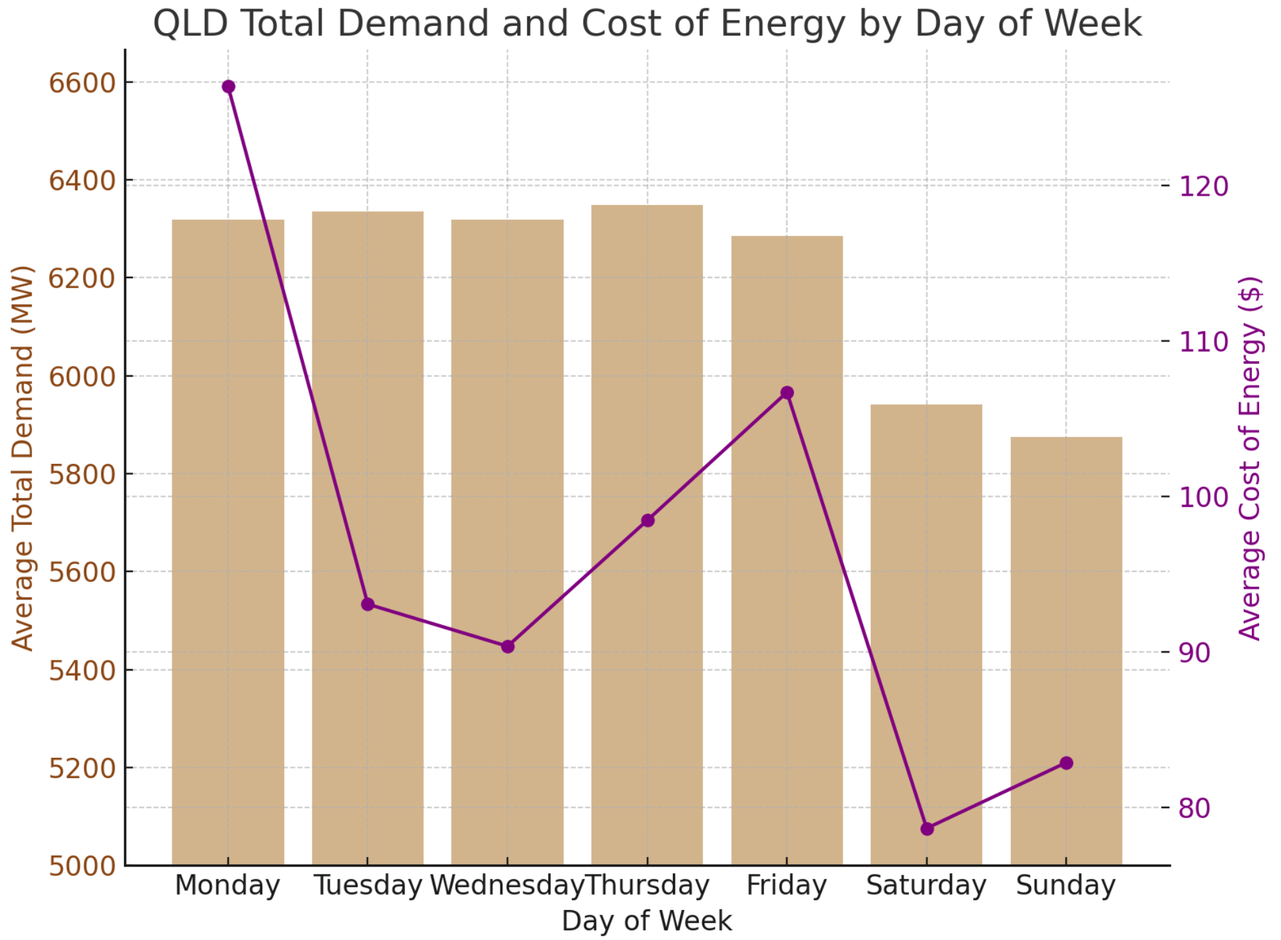
ANALYSIS OUTCOME



Significant fluctuations in energy cost are observed, aligning with changes in demand throughout the day.

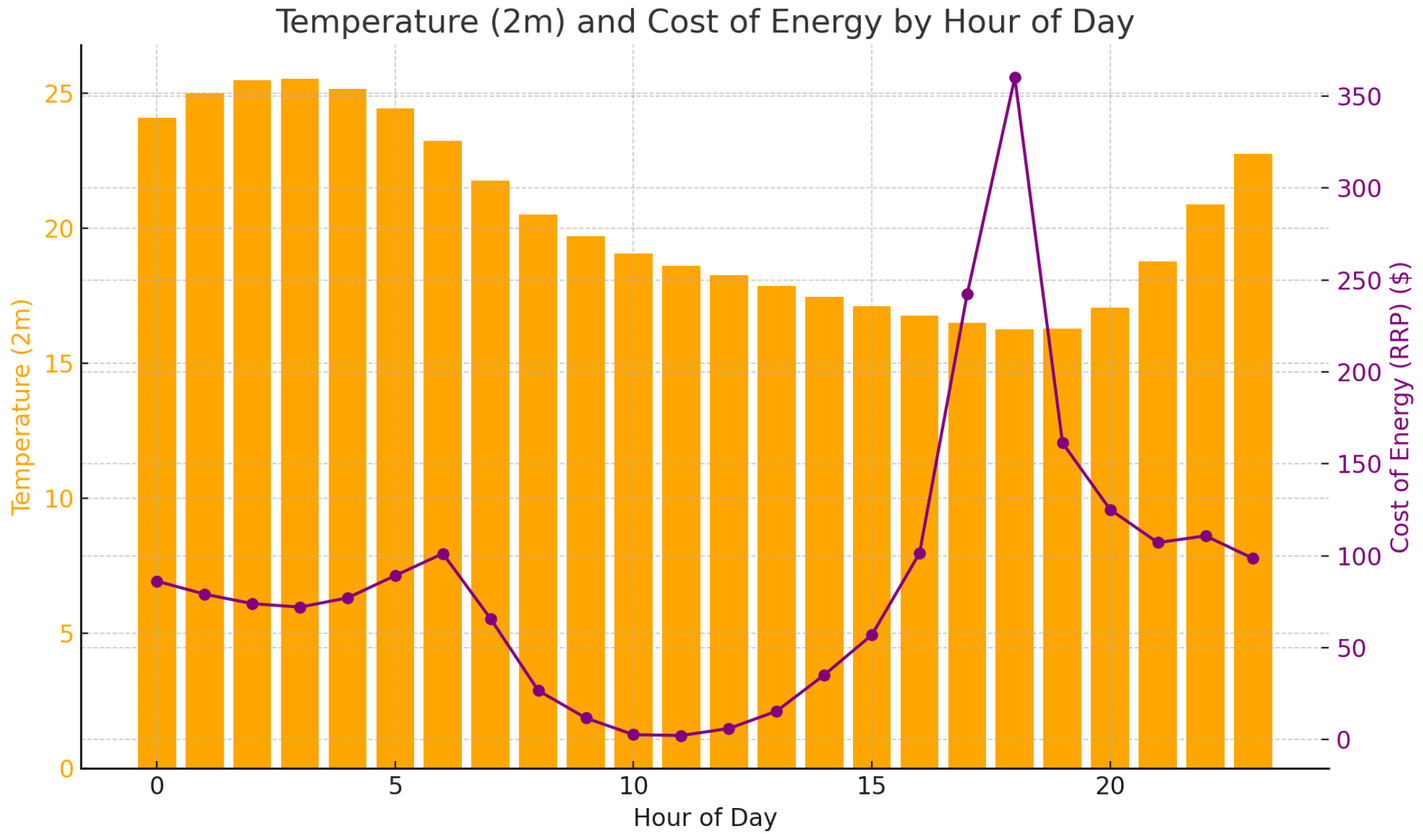
ANALYSIS OUTCOME

Energy costs are lowest during the weekend, with a noticeable dip mid-week.



ANALYSIS OUTCOME

No significant correlations were found between temperature and energy costs.



ANSWER TO OUR QUESTIONS

Energy prices fluctuate both throughout the day and across the week. ✅

No correlation was found between temperature and energy prices. ⭕

A strong positive correlation exists between demand and energy prices based on the time of day. ✅

ENERGY USERS

Maximize your energy usage during the middle of the day.
Avoid using energy-intensive appliances in the early evening when prices tend to spike.
Utilise more energy on weekends and focus on saving energy during Mondays and Fridays.

ENERGY PRODUCERS

Prepare for high demand during peak hours, such as early mornings and evenings.
Increase energy generation during these periods to meet the heightened demand.

POLICY MAKERS

Encourage the public to conserve energy during peak hours by promoting off-peak usage through incentives.

THANK YOU FOR WATCHING