# Final Project – Fundamentals in Machine Learning

# GAYATHRI YENIGALLA

**Executive Summary:**

"The research on fuel contracts, purchases, and costs recorded in Schedule 2, Part A of the EIA-923 form is presented in this report. The study investigates how to lessen fuel imports and use ecologically friendly chemicals for more sustainable power generation in the US while also examining the impact of petrochemicals like sulphur, ash, and mercury.

**Goal:**

This project's goal is to use clustering techniques to enhance observations and extract insightful knowledge from the data.

Problem assertion:

1.This is an overview of data analysis results.

2. The analysis shows that the fuel's Ash concentration is higher than its Sulphur and Mercury level, and it is necessary to assess the potential influence on the US power generation system.

3. Applying the best models as a method of data deduction.

Observations on the task:

The information points to the conclusion that the composition of fuel—coal, natural gas, and petroleum—has a significant impact on fuel consumption. The data show that all three fuel types are recorded on the same day, divided into three basic groups based on fuel type and fuel group code, and have constant sulphur, ash, and mercury contents .

**The following is included in the examination of fuel receipts:**

1. Fuel MMBtu cost and per-unit MMBtu are inversely related.
2. Out of the dataset's 1001 rows, 562 rows are made up of coal, which has a heating value of 24 MMBtu per unit and only comprises sulphur and ash. The cost of coal is $2.5 per MMBtu on average.
3. Natural gas is the only component of the 325 rows of natural gas in the dataset, with an average heating value of 1 MMBtu per order. Natural gas costs $7.5 per MMBtu on average. Depending on the location of the transfer, natural gas can be transported using either the firm or interruptible modes.
4. There are 116 rows of petroleum in the dataset, all of which contain petrochemicals for sulphur. The fuel typically costs $18 per MMBtu and has an average heating value of 4 MMBtu per unit.

The findings show that coal, with an average percentage of 15%, has the greatest ash level of the three fuel types. Ashfall is a possibility because of this, which may result in problems like clogged generator air intakes and off-site power sources, which could cause power outages or shut downs .

The need for additional procedures to remove the coal as slag results from its high ash level, which can reduce its carbon content and heat value. The blast furnace's heat balance may be impacted, which could reduce production and necessitate the acquisition of additional coal to make up for it.

Although sulphur is a ubiquitous component of all fuels, it should be noted that high concentrations can cause toxic sulphur oxide (SOx) emissions when burned. However, by generating a protective layer, sulphur in engine oils has proven useful in avoiding corrosive wear on engine parts. Similar to how mercury is released into the atmosphere when coal and natural gas are burned, this is a problem because of how it affects the environment.

**The Data Analysis:**

The Ash (10900), Sulphur (896) & Mercury(100) compositionA picture containing text, screenshot, diagram, line

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The Clustering of the data through K means strategy.

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Description automatically generated with low confidence

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Description automatically generated

Best Segmentation of K

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**Conclusion:**

The examination of fuel contract data, purchases, and expenses given in EIA-923 Schedule 2, Part A, has shown that the composition of fuels in terms of sulphur, ash, and mercury is an important component in the production of electricity. The three main fuel types used have distinct chemical makes up: coal, natural gas, and petroleum. It has been determined that coal's high ash content is a key factor lowering its productivity, increasing usage and related expenses. For US PUDL, switching to petroleum or natural gas as an alternative could be a way to protect the environment and save money.