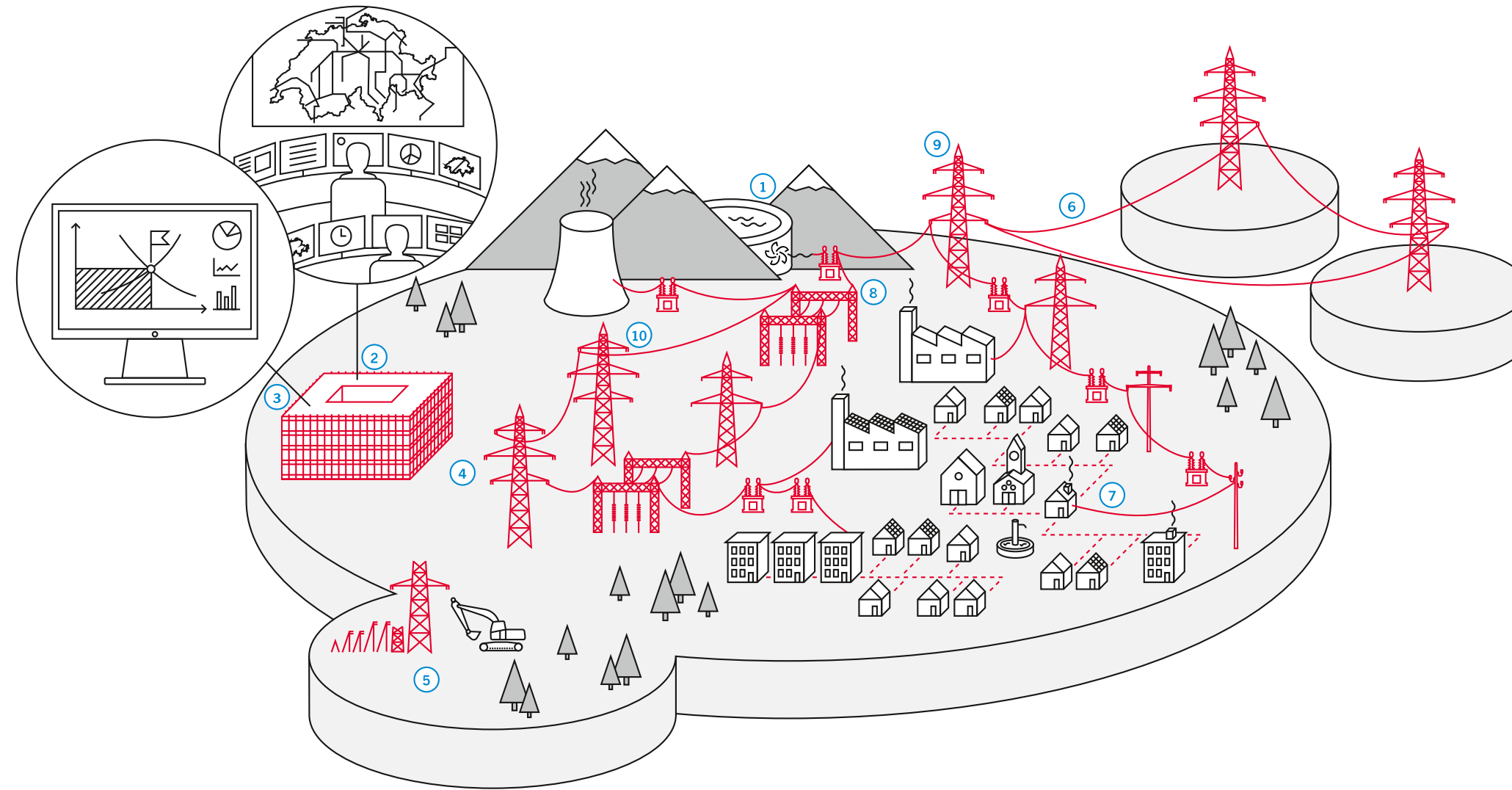# Bachelor Thesis Proposal
ML Approaches for Power Grid Load Forecasting

Omar Abdesslem, 10/12/2023

ML Approaches for Power Grid Load Forecasting
Abstract & Objective

- Who's Data? SwissGrid: National Energy Provider (Part of the Energy Dep.)

- How we met? Energy Hackathon in Zurich, where my team won a challenge =>
Visit to HQ, talked to some engineers

Data available

A huge collection of raw data from system operations, ranging from 2009 to current.

- Data about Energy Consumption, Energy Production, Transmission, Import-Export, Balancing, Cross-Border exchange from neighboring countries, Time, Geographical location, etc

- SwissGrid engineers want to leverage this data, access to powerful GPUs and supercomputers

Data Example

Zeitstempel	Summe endverbrauchte Energie Regelblock Schweiz Total energy consumed by end users in the Swiss controlblock kWh	Summe produzierte Energie Regelblock Schweiz Total energy production Swiss controlblock kWh	Summe verbrauchte Energie Regelblock Schweiz Total energy consumption Swiss controlblock kWh	Netto Ausspeisung aus dem Übertragungsnetz Schweiz Net outflow of the Swiss transmission grid kWh	Vertikale Einspeisung ins Übertragungsnetz Schweiz Grid feed-in Swiss transmission grid kWh	Positive Sekundär-Regelenergie Positive secundary control energy kWh	Negative Sekundär-Regelenergie Negative secundary control energy kWh	Positive Tertiär-Regelenergie Positive tertiary control energy kWh	Negative Tertiär-Regelenergie Negative tertiary control energy kWh	Verbundaustausch CH->AT Cross Border Exchange CH->AT kWh	Verbu Cross kWh
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01.01.2024 01:30	1435504,995	1290018,116	1969776,459	639205,237	837705,891	967	-264	37500	0	50000	
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01.01.2024 02:15	1416752,251	1318165,997	2008847,004	651549,602	863478,963	19871	-211	37500	-2500	32500	
01.01.2024 02:30	1400682,255	1299287,433	1995489,826	657624,5433	857069,013	10836	-228	37500	-2500	38300	
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Figures


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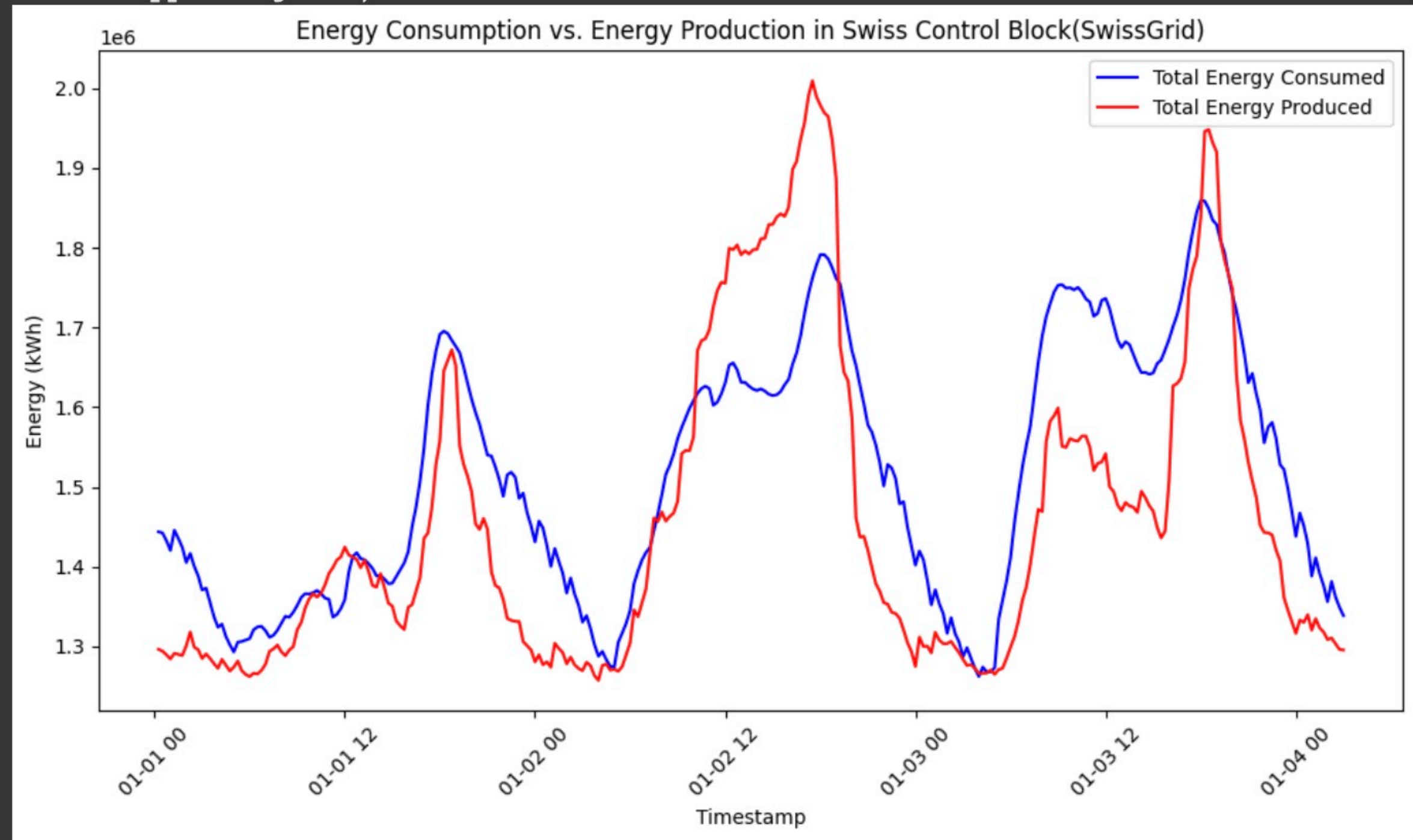
(Source: Distribution system operators)
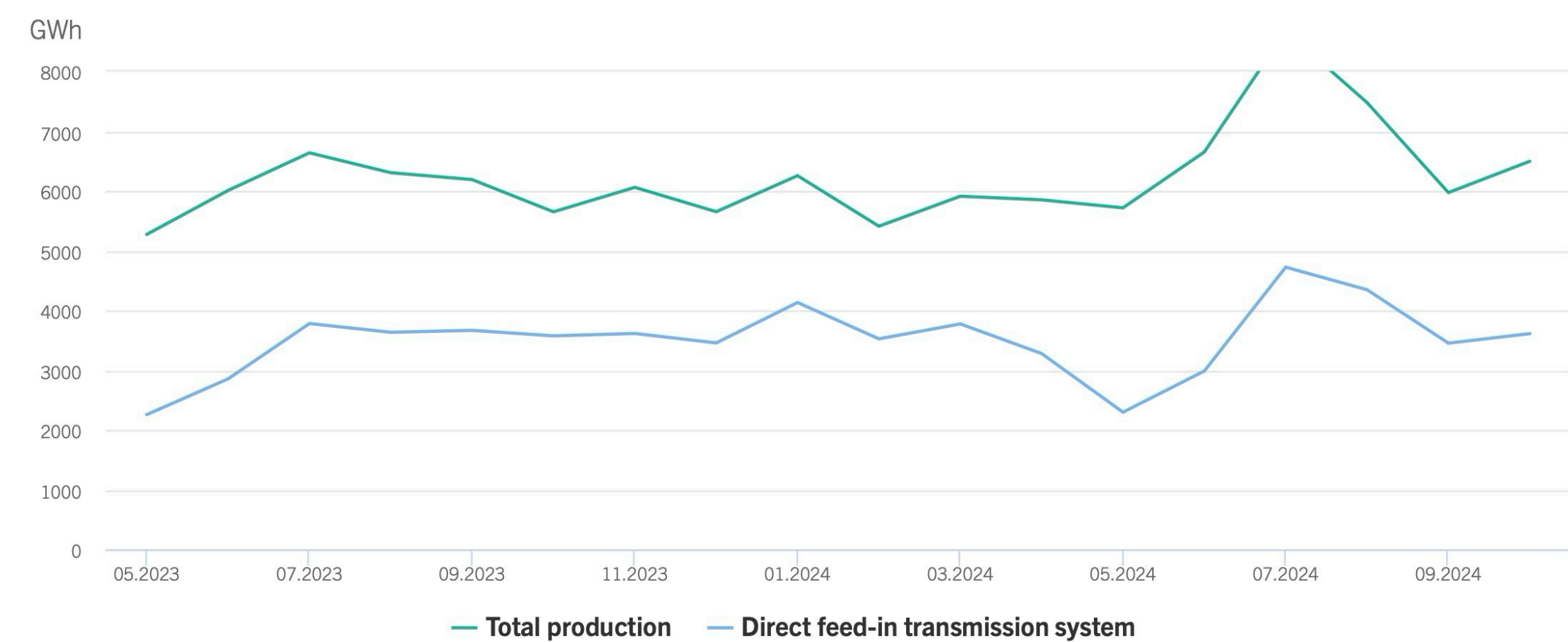
Ideas and Objectives

Load forecasting in the Grid | Predicting Power Outages

By leveraging this data along with weather and seasonal factors, the project aims to improve the accuracy of short-term and long-term load forecasts using ML (Linear Regression,Gradient Boost…). Using historical data —> probably supervised learning

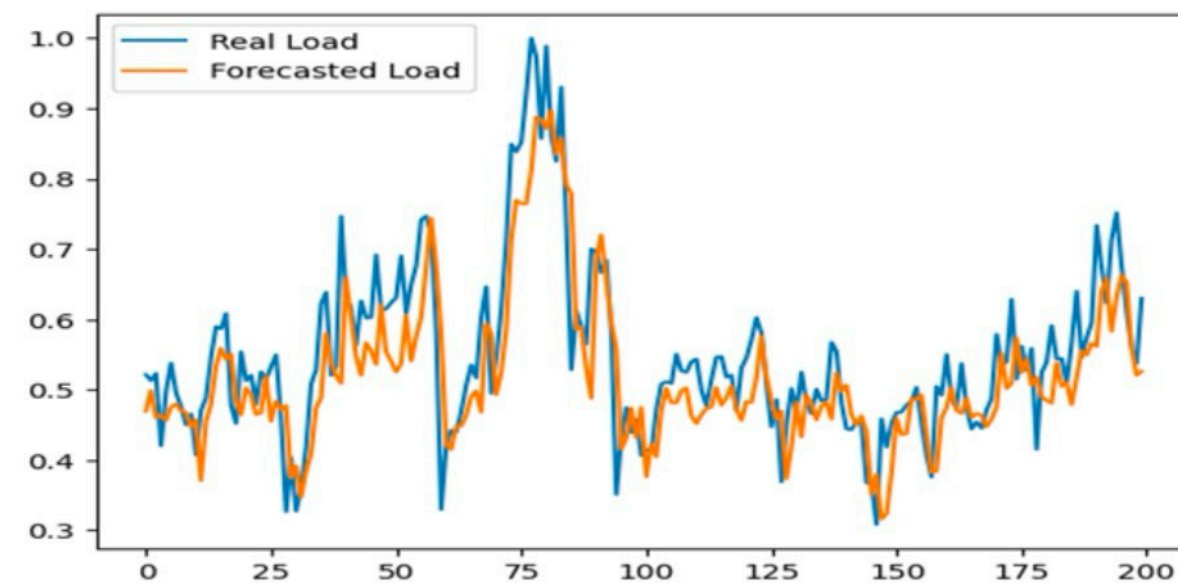The goal of which is to combine Machine Learning, Data Structures, and Physics to predict real-life energy trends.

Figure 3: Endgoal

Objectives

The primary objectives are:

1. Develop a scalable, modular framework for load forecasting that can be integrated into real-time energy grid management systems.

2. Implement the framework for use in operational energy load prediction systems.

3. Summary of findings, insights for research

Goals: Handling large datasets, Distributed systems (using Hadoop for example), exploring models
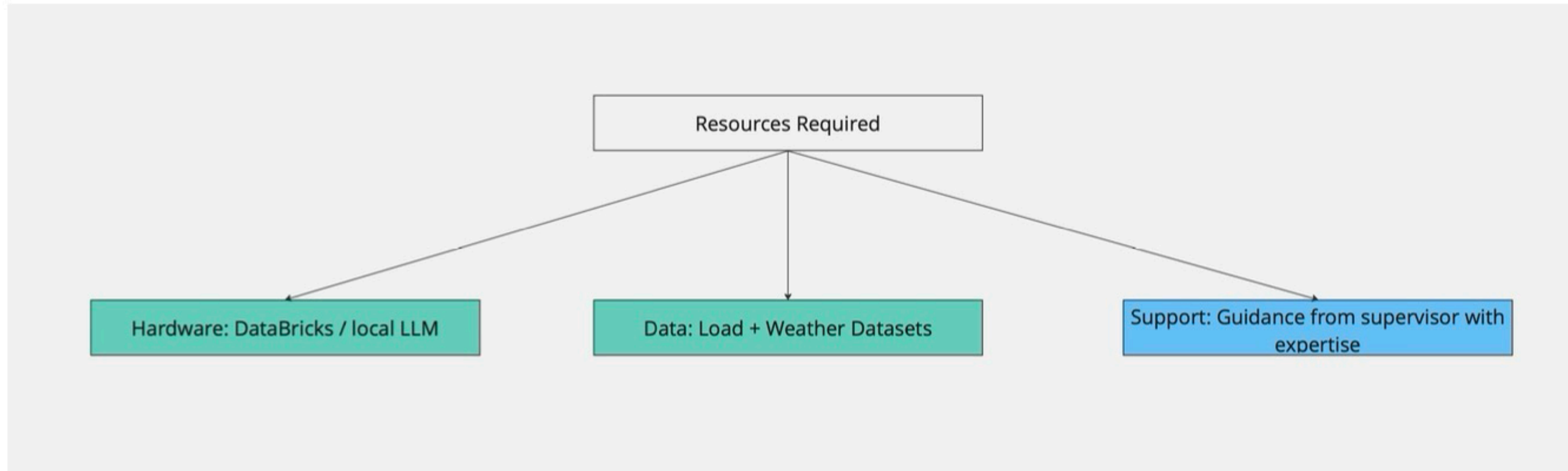
3 Resources Required

Figure 5: Requirements

Most notably:

- Support and guidance from the researchers and engineers who produced the data.

4 Organisation

Result	Approximate Date
Data Collection and Preprocessing	Feburary 2025
Feature Engineering and Exploratory Analysis	March 2025
Model Prototyping and Short-Term Forecasting Framework	April 2025
Long-Term Forecasting Framework and Theoretical Analysis	Mai 2025
Final Evaluation, Report Writing, and Submission	June 2025

Ideas for Feature engineering
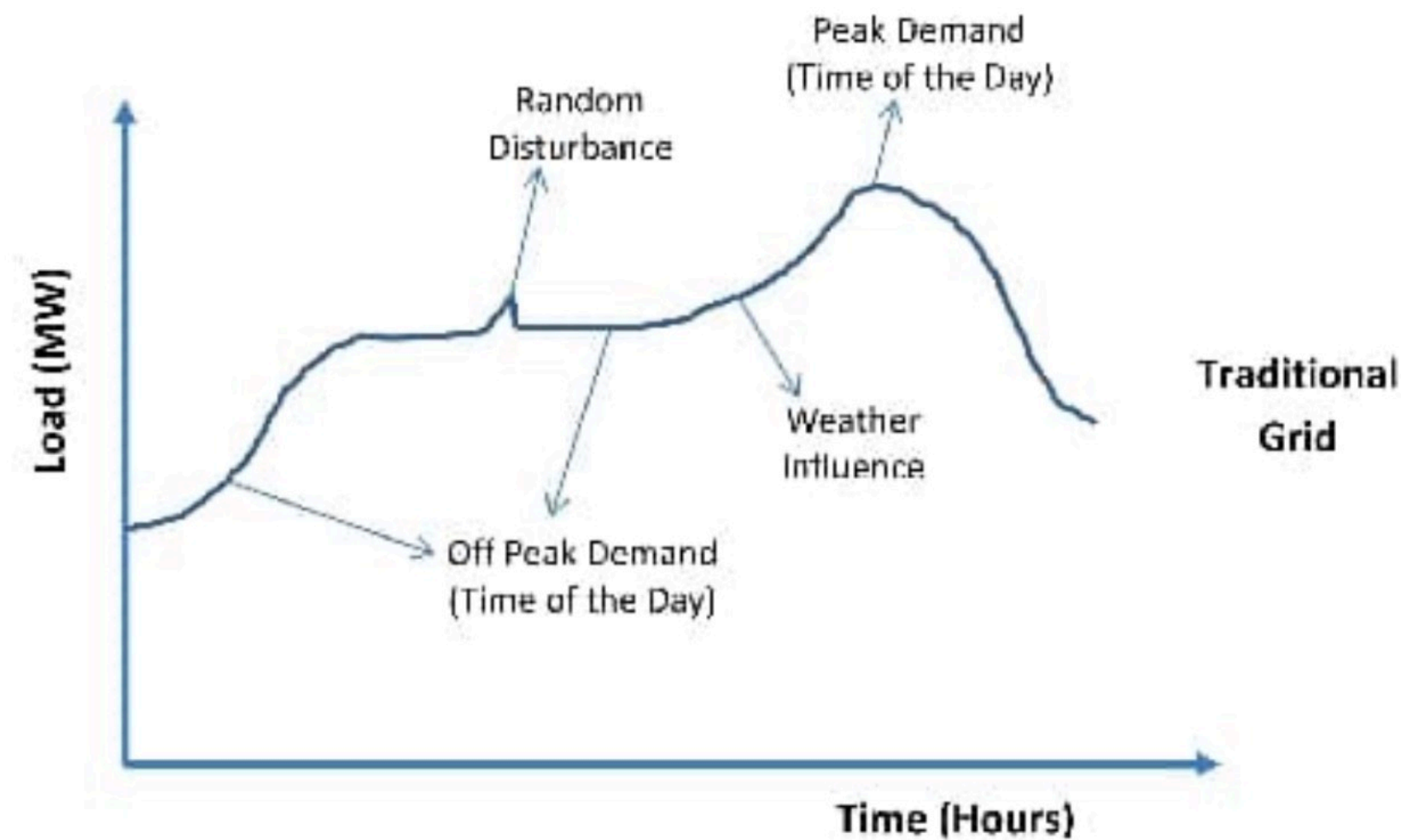
- Combine with Weather Data, Geographical location, National Holidays data to create new features

Figure 1: Load and influence