Optimisation of Energy Usage in Singapore

CS5446 Group 29 Proposal

Hong Jiayong A0268260A
Chan Cheah Cha A0189006A

1 Introduction

The Singapore Green Plan 2030 outlines the nation's agenda against the global threat of climate change. About 40% of our carbon emissions is due to power generation (reference). With rising energy consumption, there is growing pressure to enhance energy efficiency. We propose the use of AI to optimise energy usage across different regions in Singapore based on fluctuating energy demands to reduce energy waste, lower carbon emissions, and support Singapore's long-term goal of achieving net-zero emissions.

2 Proposed AI Solution

To optimize energy usage across different regions in Singapore, we first have to understand energy consumption patterns before coming up with a energy redistribution strategy. Time-Series forecasting can be used to understand energy consumption trends and predict future demand for more proactive energy management. By leveraging on these predictions, Markov Decision Process (MDP) can then be used to come up with energy redistribution strategies to ensure more efficient energy consumption.

- Time-Series Forecasting for Energy Demand
  - Using historical data from the Singapore Energy Market Authority (EMA), predict future energy demand across regions.
  - More granular predictions based on housing type and energy type.
  - Forecasting will allow for proactive resource planning and allocation to prevent energy shortages or overconsumption.
- Energy Optimization Using Markov Decision Processes (MDP)
  - Energy consumption of different regions in Singapore by energy type (electricity/gas) and housing type can be modelled as a series of states in an MDP.
  - These states will represent various levels of energy usage, and actions may include calibration of required energy at a single point in time and redistribution of energy loads based on updated demand.
  - The goal of the MDP will be to minimize energy wastage by redistributing energy loads to regions experiencing higher demand while temporarily lowering the energy supply in regions with lower energy demands.

3 Project Milestones

Task	**Description**	**Person Responsible**	**Milestone Deadline**
Data Collection & Preprocessing	- Energy Consumption Data by Type: Electricity, Gas - Singapore Region Data - Housing Type	Jiayong Cheah Cha	Week 7
Energy and Gas Usage Optimization	Using MDP to model energy consumption states and actions like redistribution of energy	Jiayong	Week 8 - 9
Time-Series Forecasting	Using historical data to predict future energy demand.	Cheah Cha	Week 8 - 9
Visualisation	- Energy Demand Heatmap across Regions in Singapore - Energy Load Charts by Region and Housing Type	Cheah Cha	Week 10 - 11
API	Design and implementation of an API.	Jiayong	Week 10 - 11
Testing & Deliverables	Final testing and adjustments. Presentation and report summarizing the project.	Jiayong Cheah Cha	Week 12 - 13

4 Risk Assessment

Data Availability Real-time or highly granular energy consumption data can be difficult to obtain, which will limit model accuracy. To address this, we will be relying on publicly available datasets from Energy Market Authority Singapore for electricity and gas consumption data. For additional filters such as housing type and region, we may have to rely on assumptions or aggregated data if not publicly accessible.

Model Complexity The integration of MDPs and forecasting models may present computational challenges. Intermediate goals, such as optimizing energy for one group (e.g. energy type, housing type) first, will serve as fallback intermediate points.

5 References

- Singapore Energy Statistics
- Singapore Green Plan 2030
- Singapore Climate Change Action
- ChatGPT for report organisation