

Decision Support System for Determining the Location of Public Electric Charging Stations with Machine Learning

Oleh:

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Introduction



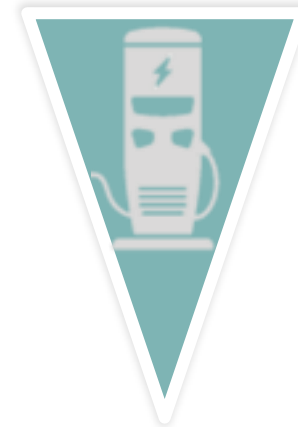
- **Indonesia's commitment to the 2016 Paris Agreement:** Reducing greenhouse gas emissions by 29% by 2030.
- **Presidential Regulation No. 55/2019:** Accelerating the electric motor vehicle program.

- **Increasing Electricity Demand:** Estimated 36.9 GWh in 2025 and 46.3 TWh in 2050 for electric vehicles.
- **Increasing Popularity of Electric Vehicles:** As an environmentally friendly alternative.



Development of Public Electric Charging Stations (ECS) by PT.

PLN: More than 7,000 units have been installed.



Main constraints: availability and accessibility ECS.

And the existing ECS installed has not been optimally used by customers (Amilia et al., 2022)



finish it with **Machine Learning**

The Problems



Problem Formulation

How is the process of determining the location of Public Electric Charging Stations using a Machine Learning-based decision-making system?



Research Objective

To understand the process of determining the location of Public Electric Charging Stations (ECS) using a decision-making system based on Machine Learning.



SDGs Catoegory

This research has a development objective related to SDGs 7, namely Affordable and Clean Energy.



Research Methodology

Data collection

From various related sources such as the Ministry of Energy and Mineral Resources, PLN, and location determination criteria data.

Data analyst

Using the AHP method to determine the criteria weights and Machine Learning analysis to find the optimal location.

Location determination criteria

EV density in the area, accessibility, land availability, stable energy infrastructure, environmental factors, and operating costs.

Use of AHP

To determine the weight of each criterion based on expert assessment.

Application of Machine Learning

Analyze location criteria patterns and data to identify strategic locations.

Expert Involvement

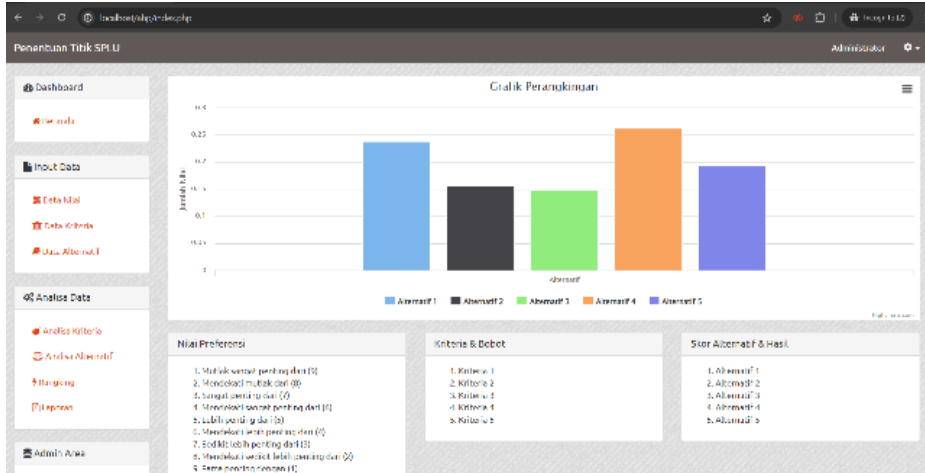
From various related fields for the assessment of location criteria and alternatives.

Research Output

Recommendation of the best ECS location based on comprehensive data analysis.

The location with the highest priority value from the AHP model is considered the best recommended location.

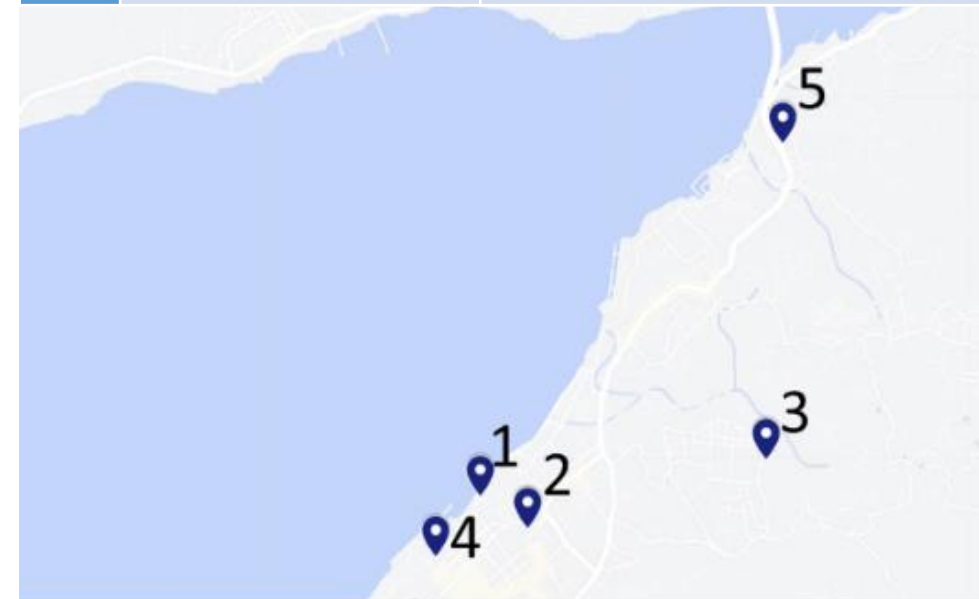
The Results (1)



The 'Tambah Kriteria' form includes fields for 'ID Kriteria' (containing 'C1') and 'Nama Kriteria' (containing 'Kriteria 1'). There are 'Simpan' and 'Kembali' buttons at the bottom.

The 'Tambah Alternatif' form includes fields for 'ID Alternatif' (containing 'A1') and 'Nama Alternatif' (containing 'Alternatif 1'). There are 'Simpan' and 'Kembali' buttons at the bottom.

No	Location	GPS coordinates
1	Mardika Beach Road	128.1802645, -3.691205
2	Mardika Field – Statue of Pattimura	128.1831823, -3.6931066
3	GOR Sport Hall Karang Panjang	128.1978378, -3.688899
4	Yos Sudarso Street	128.1774627, -3.6948806
5	Jalan Jenderal Sudirman	128.1988357, -3.6697457



Decision Support System with Machine Learning

- A web application developed specifically to assist PT PLN (Persero) UP3 Ambon and related stakeholders in making data-based and analytical decisions.
- Using the Analytical Hierarchy Process (AHP) method to assess and select SPLU locations.

The Results (2)

Table 1. Pairwise Comparison with Each Criteria

Comparison	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Weight
Criterion 1	0,692	0,871	0,468	0,320	0,243	0,519
Criterion 2	0,077	0,097	0,468	0,320	0,243	0,241
Criterion 3	0,077	0,011	0,052	0,320	0,243	0,141
Criterion 4	0,077	0,011	0,006	0,036	0,243	0,074
Criterion 5	0,077	0,011	0,006	0,004	0,027	0,025
Amount	1,000	1,000	1,000	1,000	1,000	1,000

Source: Processed Primary Data, 2024

Criteria:

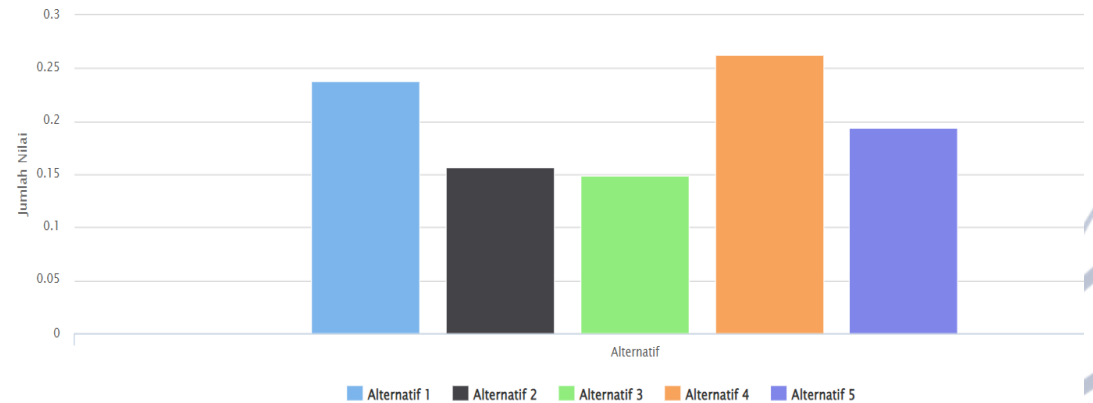
- Cat 1: Accessibility and Visibility
- Cat 2: Population Density & Traffic
- Cat 3: Proximity to Other Facilities
- Cat 4: Electricity Infrastructure Support
- Cat 5: Market Potential

Alternatives:

- Alt 1: Mardika Beach Road
- Alt 2: Mardika Field – Statue of Pattimura
- Alt 3: GOR Sport Hall Karang Panjang
- Alt 4: Yos Sudarso Road
- Alt 5: Jenderal Sudirman Road

Table 2. Results of Ranking of Alternative Candidate SPLU Location Points

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Results
Alternative 1	0,139	0,047	0,032	0,015	0,005	0,238
Alternative 2	0,089	0,036	0,017	0,011	0,004	0,156
Alternative 3	0,079	0,035	0,020	0,011	0,004	0,149
Alternative 4	0,134	0,067	0,034	0,021	0,007	0,263
Alternative 5	0,078	0,056	0,038	0,017	0,006	0,194
Amount	1,000	1,000	1,000	1,000	1,000	1,000



Source: Processed Primary Data, 2024



Yos Sudarso Rd.

Alternative Location Rankings:

- First: Yos Sudarso Rd. - High score in all criteria, especially accessibility and visibility.
- Second: Pantai Mardika Rd. - Strategic location with high visibility and easy access.
- Third: Jenderal Sudirman Rd. - Strategic position with high traffic volume but lacking in unique atmosphere.
- Fourth: Lapangan Mardika - Pattimura Statue - Historical location with high accessibility but lower population density.
- Fifth: GOR Sport Hall Karang Panjang - Good for big events but lacking in daily traffic and visibility.

Table 6. Income from the three SPLU locations in Ambon

No.	SPLU location	GPS coordinates	Income (Rp)
1	Yos Sudarso Street	128.1774627, -3.6948806	60.860.000
2	Mardika Beach Road	128.1802645, -3.691205	49.440.000
3	Jalan Jenderal Sudirman	128.1988357, -3.6697457	12.930.000

- **Effectiveness of Machine Learning:** The application of Machine Learning technology in SPLU location selection proves its effectiveness by providing recommendations based on objective and in-depth data analysis.
- **Performance of Selected Locations:** Selected locations such as Yos Sudarso Rd, Pantai Mardika Rd, and Jenderal Sudirman Rd show varying revenue performance, validating the accuracy of the Machine Learning model used.
- **Influence of Location on Revenue:** Revenue analysis shows a direct relationship between strategic location selection and revenue generated, with Yos Sudarso Rd as a prime example (Rp 60,860,000).
- **Suggestions for Future Development:** for modern city infrastructure planning, this research method can be used.

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