Evaluating Malaysia's Green Technology Master Plan (GTMP) Energy Targets

A Data-Driven Analysis and Policy Recommendation

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Date:
February 08, 2025

Bootcamp Program:
Eskwelabs Data Analytics Bootcamp

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Context and Methodology

Malaysia's Green Technology Master Plan (GTMP), launched in 2017, outlines strategic targets to shift the nation's energy trajectory toward sustainability. As part of a broader policy analysis team, my primary task was to evaluate the effectiveness of GTMP's energy sector targets using available CO_2 and energy consumption datasets. This report focuses solely on my contribution to the project—an analytical evaluation of two specific GTMP energy targets: (1) increasing the share of renewable energy in electricity generation, and (2) reducing energy consumption through efficiency and demand-side management. This report details the analysis, rationale, insights, and policy recommendations that emerged from my work.

To support this analysis, I utilized a large, multidimensional dataset composed of **79 columns and 50,000+ rows** of global climate and energy-related indicators. The dataset integrated a diverse range of trusted sources, including global energy and climate databases from *Our World in Data*, the *U.S. Energy Information Administration*, the *Energy Institute*, and the *Global Carbon Budget*. It also incorporated demographic and economic datasets such as the *Maddison Project Database* (2023), *ISO Region Classifications* (2023), and *Our World in Data population statistics* (2024).

The data was loaded and analyzed in **Power BI**, where I conducted a full exploratory data analysis (EDA), visualized time-series emissions and energy data, and structured the evaluation framework for policy comparison. My first step involved identifying relevant columns in the dataset that aligned with GTMP's targets. However, several critical gaps became immediately apparent—for instance, the dataset did not include direct metrics on the share of renewable energy in electricity generation or data that disaggregated energy consumption at the electricity level.

Faced with these constraints, I took the lead in developing the **Proxy Metric Identification** process: a methodology for selecting indirect but policy-relevant indicators to assess the GTMP energy targets. This process was crucial in creating a **structured and justifiable framework for evaluating the targets**, given the absence of ideal, direct metrics (such as a specific column for "renewable energy share"). The key steps involved were:

- **Understanding policy intent**: Clarifying the underlying goals of the GTMP, specifically what "increasing renewable energy" and "reducing energy consumption" meant within the context of the policy. This ensured that the selected proxies aligned closely with the intended policy outcomes.
- **Evaluating available metrics**: Conducting a thorough review of the dataset, examining dozens of columns to identify variables that could serve as meaningful proxies for the intended targets.
- **Triangulating evidence**: Using more than one proxy for each target (e.g., CO_2 by source + carbon intensity + low-carbon electricity share) to create a **more robust picture**.
- **Justifying limitations**: Acknowledging the limitations of the selected proxies, while still presenting what they *can* infer logically and reasonably.

These indicators were then modeled through a series of time-series charts and comparative dashboards in Power BI, allowing for a coherent narrative to emerge from complex data trends.

Throughout the process, I not only strengthened my technical proficiency in handling large datasets and creating compelling data visuals, but also honed my ability to make thoughtful analytical decisions under data limitations—an essential skill in real-world policy evaluation. The result is an evaluation methodology that bridges data science and environmental policy, delivering insights that inform both critique and constructive recommendation.

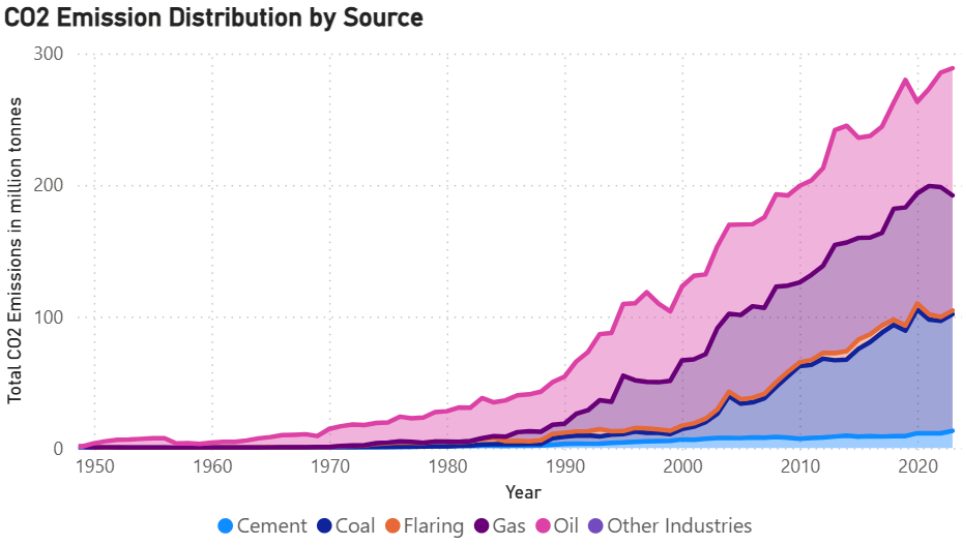
Findings: Measures of Effectivity of Malaysia's GTMP

Target 1: Shifting Toward a Cleaner Energy Mix

The first GTMP energy goal was to increase the share of renewables in Malaysia's electricity generation mix. However, the dataset did not provide direct metrics on renewable share. Interpreting the first target as Malaysia's goal to transition toward a cleaner and more sustainable energy mix, I identified and measured the following relevant variables in the dataset to serve as complementary proxies for assessing whether Malaysia's energy mix was, in practice, becoming cleaner.

1. CO_2 Emissions by Source

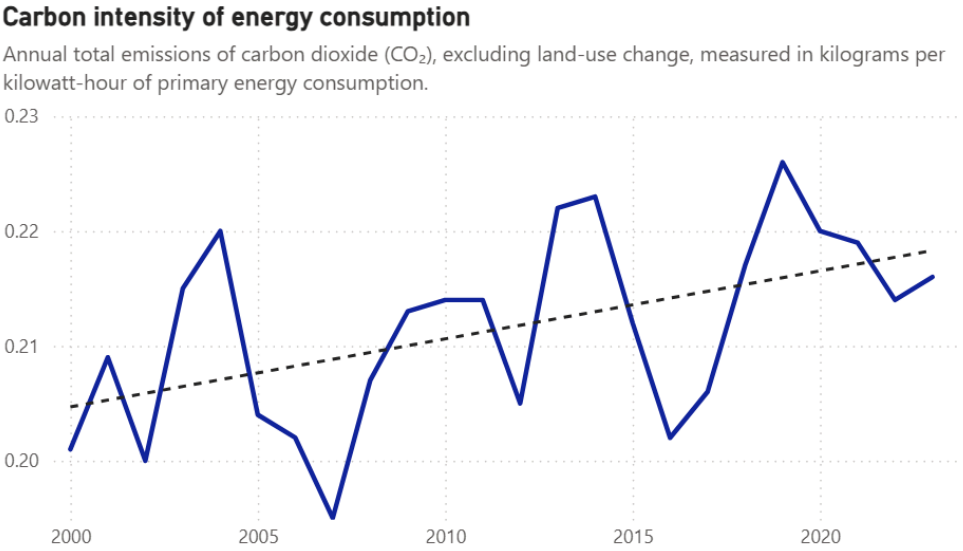
If Malaysia's energy mix is indeed becoming cleaner, CO2 emissions from fossil fuel sources–such as, coal, oil, and gas–should decline. To examine this, I used a stacked area chart in Power BI to visualize emissions from these sources between 1950 and 2023.



The chart shows a clear upward trajectory, particularly post-1990, signaling a continued reliance on high-carbon fossil fuels. These findings demonstrate that fossil fuels remain dominant in Malaysia's energy structure, contradicting the ambition of cleaner energy under the GTMP.

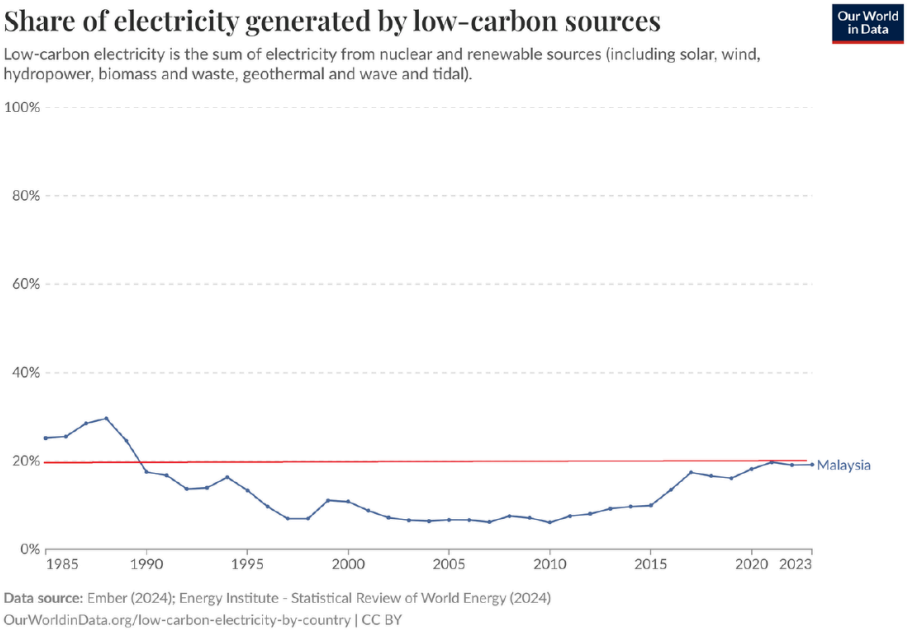
2. Carbon Intensity per Unit Energy

To further probe the "cleanliness" of the energy mix, I analyzed Malaysia's carbon intensity (CO_2 emissions per kilowatt-hour of energy consumed). This indicator reflects the amount of carbon emitted for each unit of energy consumed, excluding land-use emissions. A lower value or decreasing trend for this variable would mean that energy consumption does not produce as much CO2 as before, meaning a cleaner energy mix.



The Power BI line graph showed a gradually increasing trend from 2000 to 2023, indicating that Malaysia's energy mix is becoming "dirtier," not cleaner. The insight here is pivotal: even if energy consumption remains stable, the carbon cost per unit of energy is increasing, implying that renewable adoption is not keeping pace with fossil fuel dependence.

3. Share of Low-Carbon Electricity (External Data)



Recognizing the dataset's limitations, I supplemented our internal data with external sources to incorporate a chart on low-carbon electricity share from 1985 to 2023. This line chart showed that Malaysia's share of electricity from clean sources hovered below 20% for decades, only reaching 19.16% in 2023. A red threshold line marked the GTMP's 2020 target of 20%, demonstrating that Malaysia has only recently approached, but not surpassed, its renewable energy goals.

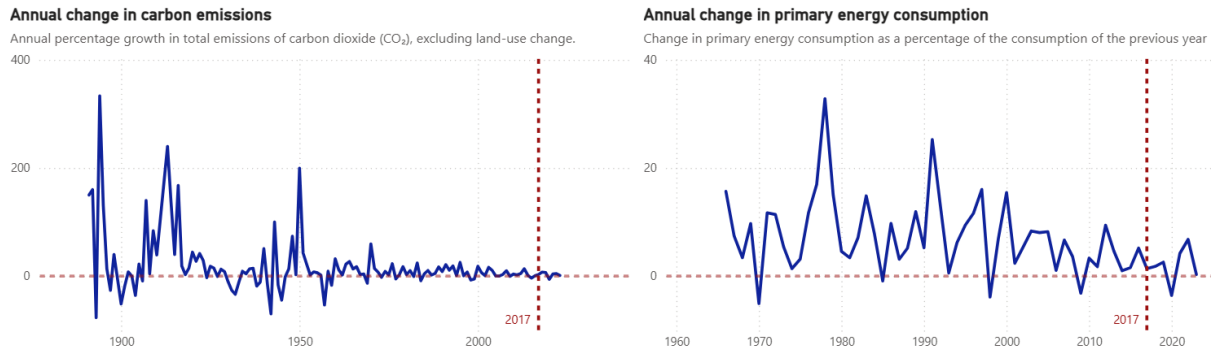
Target 2: Improving Energy Efficiency

The second GTMP target aimed to reduce energy consumption through energy efficiency measures—particularly on the demand side—thereby reducing overall carbon emissions. Given the lack of electricity-specific consumption data in the dataset, I used the following proxy metrics:

1. Annual Change in Energy Consumption vs. CO_2 Emissions

As outlined in Malaysia's GTMP, demand-side management is expected to reduce energy consumption spikes, ultimately leading to a decrease in carbon emissions. To evaluate this, I analyzed Malaysia's annual changes in both energy consumption and carbon emissions, comparing their respective trends to assess whether reductions in energy use were accompanied by corresponding emissions declines.

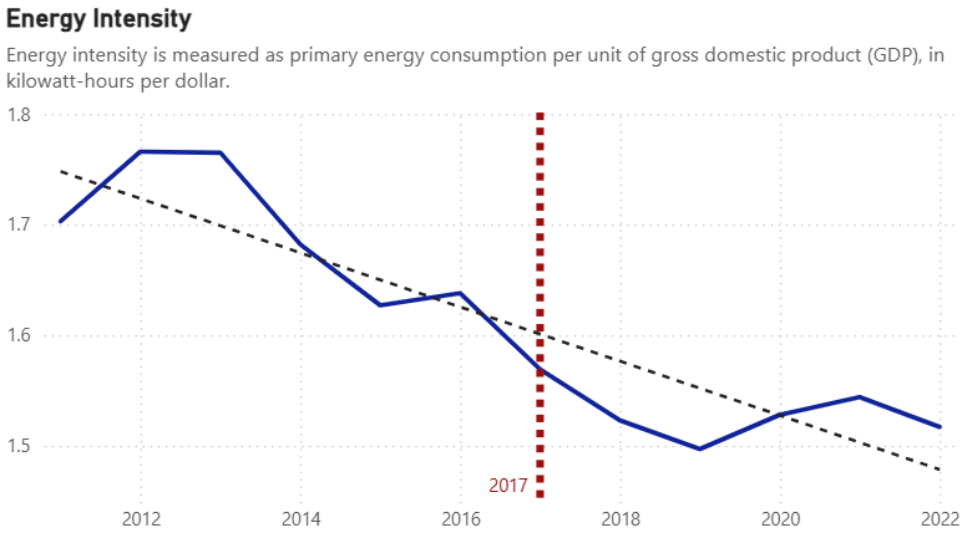
Using Power BI, I created two charts that juxtapose the annual growth rates of primary energy consumption and carbon emissions.



Both indicators have shown signs of **deceleration**. Although energy consumption continues to rise, the **slowing growth rate suggests the influence of demand-side energy management policies**. More notably, the tapering increase in CO_2 emissions reflects this trend, indicating that **energy efficiency initiatives may be achieving their intended impact**.

2. Energy Intensity (Energy per GDP)

A key metric for efficiency, energy intensity indicates how much energy is used to produce one unit of economic output. A declining trend in this metric would suggest more efficient economic growth.



The chart revealed that Malaysia's energy intensity has been decreasing since the early 2000s, with sharper drops post-GTMP implementation, suggesting meaningful progress in demand-side energy management. This simply means that Malaysia's economic activity has been less energy intensive throughout the years.

Malaysia has been adopting demand-side energy management practices since the 1990s and gained further momentum with the GTMP. The three proxy metrics discussed earlier provide clear evidence that the GTMP's demand-side energy management policies have contributed to the deceleration in annual primary energy consumption, which in turn has led to a corresponding slowdown in annual carbon emissions. This trend is further reinforced by the consistent decrease in energy intensity, reflecting improved energy efficiency across the economy.

However, despite notable reductions in energy consumption and energy intensity, Malaysia's energy consumption continues to rely heavily on fossil fuels. This is evident from the rising carbon intensity, increasing CO_2 emissions from fossil fuel sources, and the persistently low share of renewables in the national energy mix. These indicators suggest that while Malaysia is using energy more efficiently, the progress is not sufficient to counterbalance the continued growth in carbon emissions.

Recommendations and Conclusion

Malaysia has been implementing demand-side energy management practices since the 1990s, gaining renewed momentum through the Green Technology Master Plan (GTMP). The analysis conducted in this project—through five carefully selected proxy metrics—provides compelling evidence that these policies are producing measurable impacts. The annual rate of increase in primary energy consumption has decelerated, which in turn has led to a noticeable slowdown in the growth of carbon emissions. This positive trend is reinforced by a consistent decline in energy intensity, suggesting that Malaysia is gradually becoming more energy-efficient in its economic activities.

However, this improved efficiency has not yet translated into a meaningful reduction in the carbon footprint of Malaysia's energy system. The country remains highly dependent on fossil fuels, as indicated by a steady rise in carbon intensity, increasing CO_2 emissions from coal, oil, and gas, and a persistently low share of renewables in the national energy mix. **These indicators collectively suggest that while energy is being used more efficiently, the type of energy being consumed remains a significant challenge**. **In essence, demand-side efforts have slowed the growth of carbon emissions, but have not reversed it.**

To align more closely with the GTMP's long-term objectives and the climate targets expected under COP30, Malaysia must pursue a dual-path strategy:

Path 1: Strengthening Demand-Side Energy Efficiency

1. Expand Demand-Side Efficiency Programs in Urban and Industrial Sectors
Scale up current initiatives by targeting a **15% reduction in national energy intensity by** 2030, using 2023 levels as a baseline. This can be achieved through expanded building retrofits, industrial process optimization, and urban energy audits. Annual progress should be tracked using standardized energy-per-GDP indicators.

2. Launch a National Energy Data Transparency Portal
By 2026, establish an **open-access data platform** consolidating energy production, emissions, and efficiency statistics. This initiative supports better tracking of both demand- and supply-side policies and addresses data transparency gaps identified during this study.

Path 2: Decarbonizing the Energy Supply Mix

3. Legislate a Renewable Energy Portfolio Standard (RPS)
Study the feasibility of passing a legislation requiring that at least **30% of electricity generation come from renewable sources by 2030**. This would align market behavior with national targets and provide a predictable framework for clean energy investment.

4. Introduce a Carbon Intensity Cap for Power Generation
Set a national carbon intensity ceiling of **0.40 kg CO_2/kWh** for electricity generation by 2032. This would incentivize utilities to diversify into low-carbon baseload sources such as nuclear and advanced geothermal, while discouraging continued reliance on coal and oil.

This project served as a pivotal opportunity for me to synthesize policy analysis with data science tools. Designing the scope of analysis, exploring proxy metrics under data constraints, and visualizing multi-decade energy trends in Power BI allowed me to apply—and strengthen—a broad range of analytical skills. More importantly, I learned how to draw actionable conclusions from imperfect datasets, a core competency for any data analyst working in real-world, high-impact domains. This experience deepened my understanding of energy policy evaluation and strengthened my ability to tell meaningful stories with data—skills I now actively carry forward into every new project.