



Carbon Cast

Capstone Project

A deep dive into predicting carbon emissions

by Justin

Net zero
emission by
2050? Will we
reach there?

For now?
NO

Charting Singapore's Net Zero Future

Achieve net zero emissions by 2050

Long-Term Low-Emissions Development Strategy (LEDS)

**Reduce 2030 emissions to 60 MtCO₂e
after peaking emissions earlier**

2030 Nationally Determined Contribution (NDC)



Singapore's Green Plan 2030

Key Pillars:

•City in Nature:

- Plant 1 million more trees
- Increase greenery coverage by 10%

•Energy Reset:

- Quadruple solar energy deployment by 2025
- Explore renewable energy sources like hydrogen and biomass

•Green Economy:

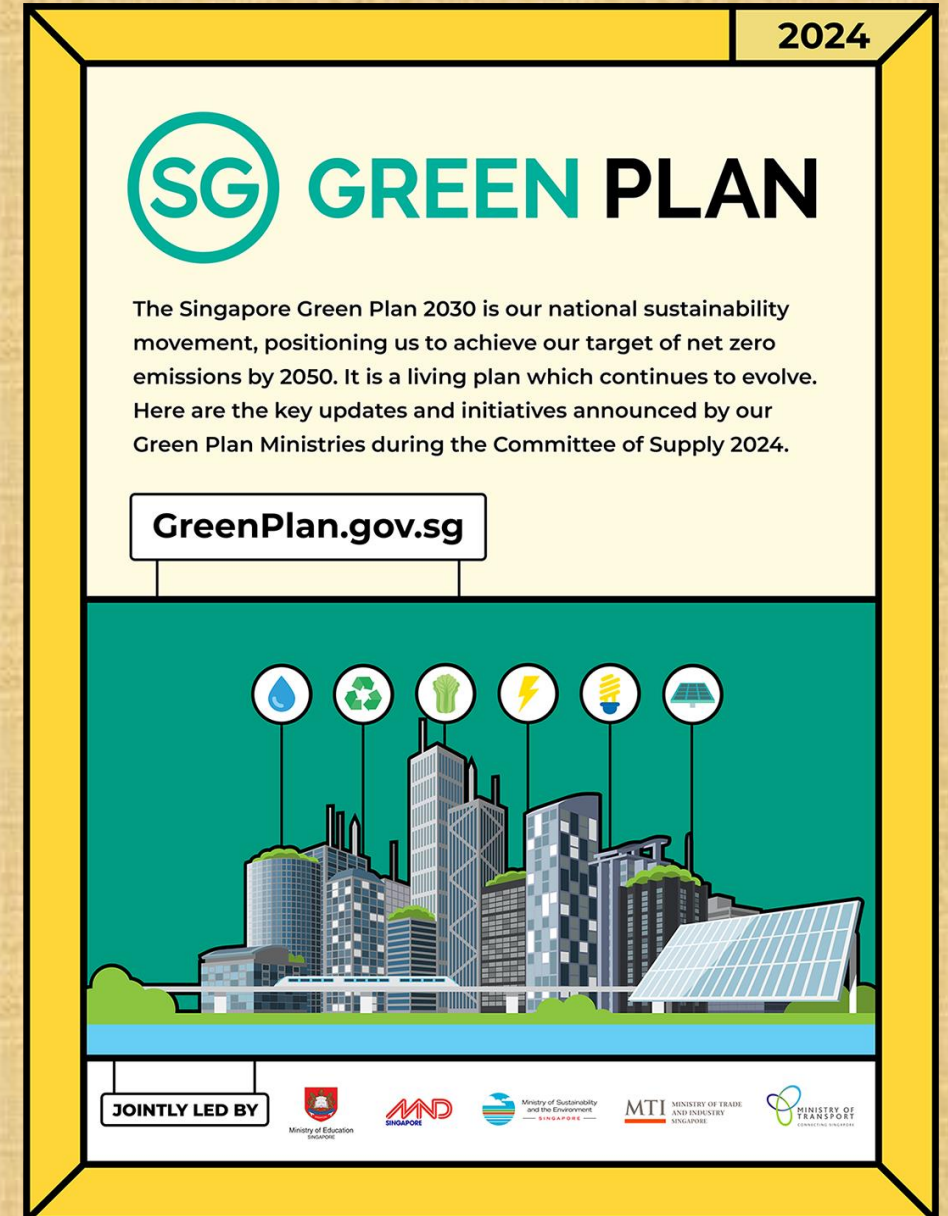
- Develop sustainable industries and businesses
- Foster innovation in green technologies

•Resilient Future:

- Adapt to climate change and sea level rise
- Improve water security and sustainability

•Sustainable living

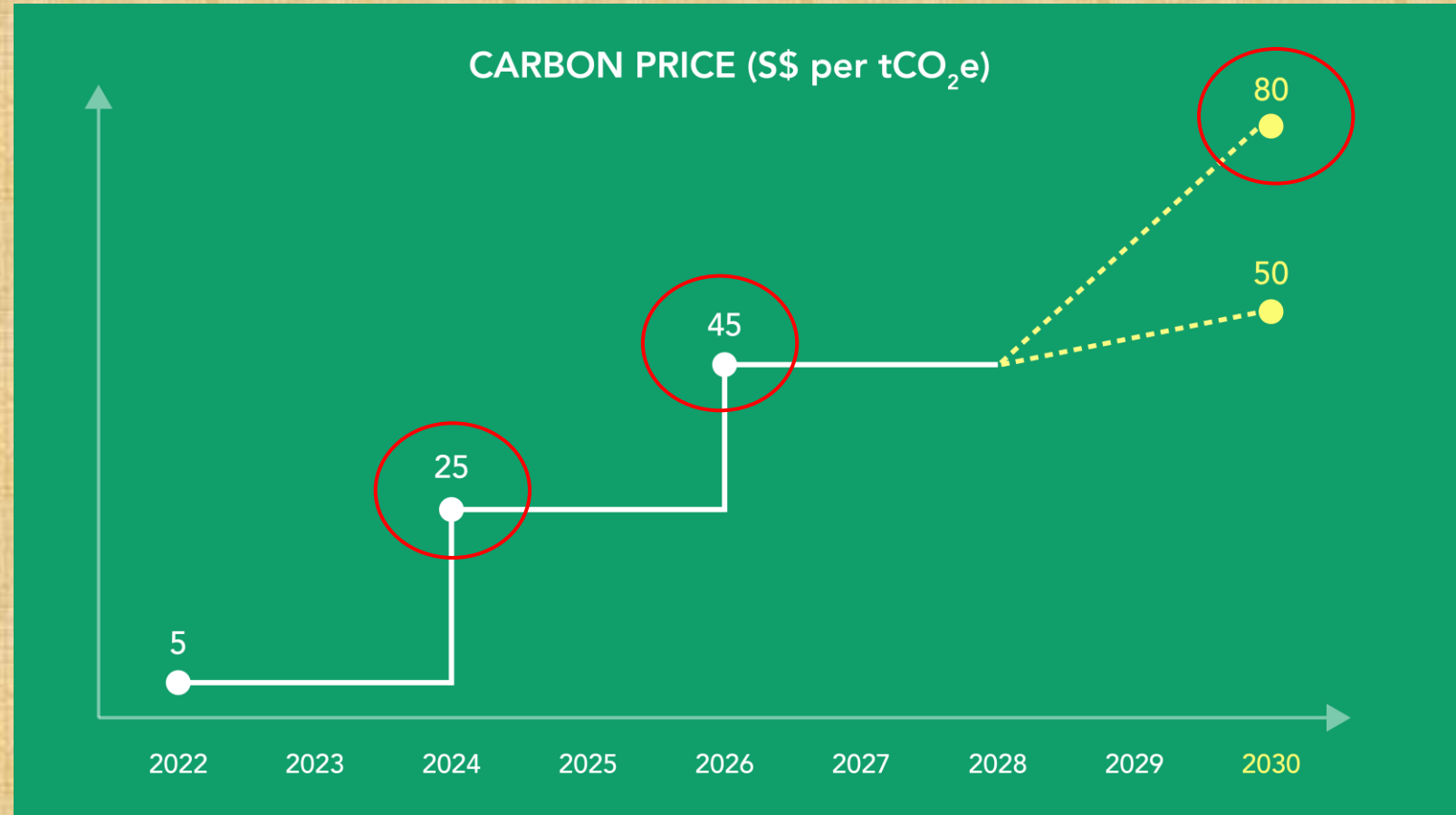
- Reduce carbon emission by consuming less and recycling more
- 'Reduce, Reuse and Recycle' as a norm



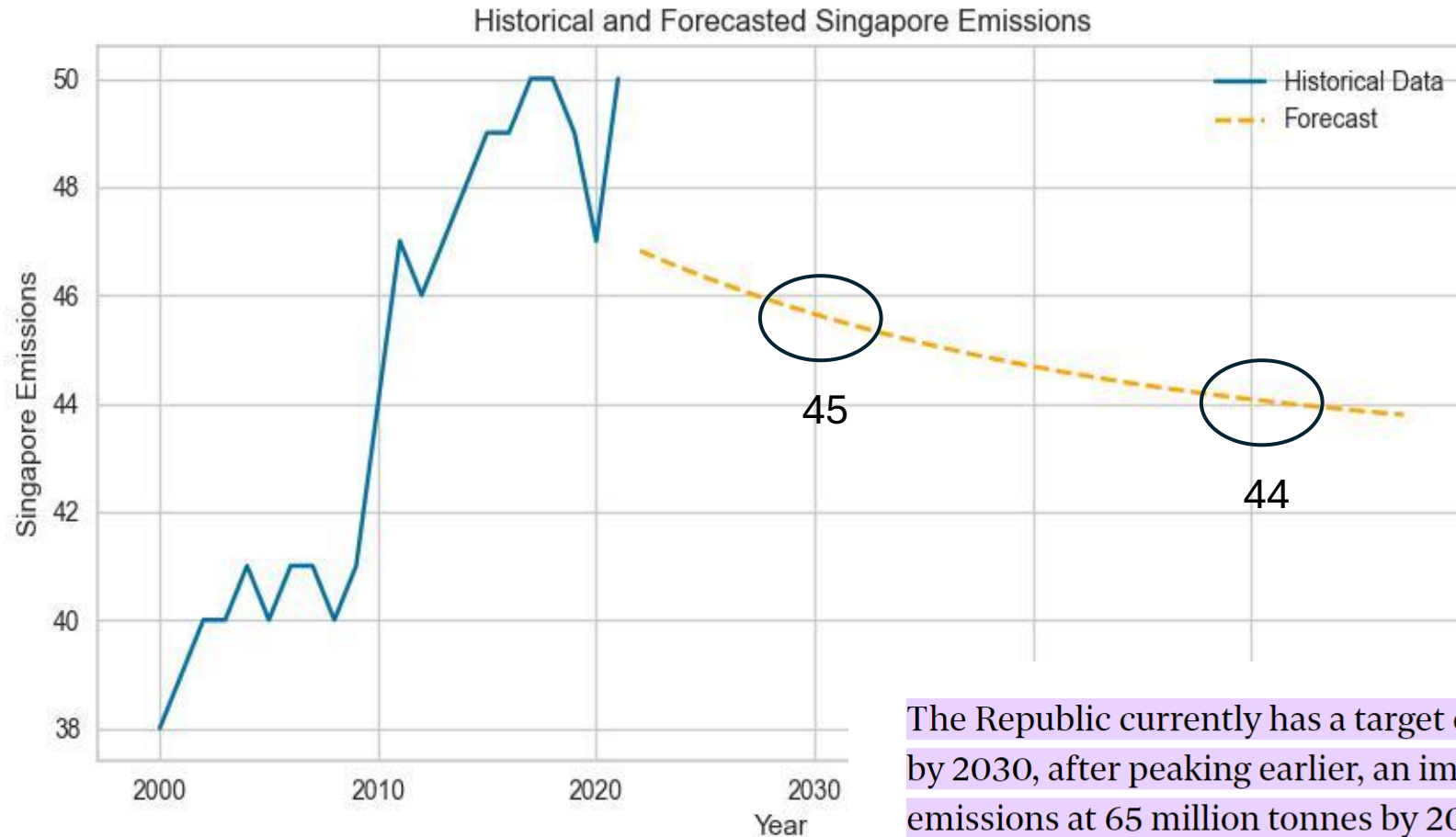
Carbon Tax Efforts in Singapore from 2024

To support Singapore's net zero target:

- the carbon tax was raised to S\$25/tCO₂e with effect from 2024. It will be raised to S\$45/tCO₂e in 2026 and 2027, with a view to reaching S\$50-80/tCO₂e by 2030.
- This will strengthen the price signal and impetus for businesses and individuals to reduce their carbon footprint in line with national climate goals.



Singapore Carbon Emission Forecast



- By 2030, Singapore's Carbon Emission will only be at 45 metric tonnes
- By 2050, it would be impossible to reach net-zero given on this forecast

The Republic currently has a target of reaching 60 million tonnes of carbon dioxide by 2030, after peaking earlier, an improvement from its earlier target of peaking emissions at 65 million tonnes by 2030.

Its emissions are still on the rise now, and they will need to peak at a certain level by 2030, before going on a downward trajectory to reach net zero by 2050.

Net-Zero, A Reality Check

<https://www.businesstimes.com.sg/opinion-features/net-zero-goals-talk-cheap-if-singapore-corporates-lack-road-map>

Net-zero goals: Talk is cheap if Singapore corporates lack a road map

Businesses need to spell out a clear pathway for cutting carbon emissions

SINGAPORE: The Singapore Business Federation (SBF) launched a registry on Monday (Apr 15) to help local businesses track and report their carbon emissions more easily and accurately.

<https://www.channelnewsasia.com/singapore/carbon-emissions-climate-reporting-greenhouse-gas-sustainability-grace-fu-4264736>

<https://www.enterprisesg.gov.sg/resources/media-centre/news/2023/august/smes-to-get-carbon-accounting-funding-support-by-year-end>

SMEs thus face near-term pressures to disclose their emissions figures and lower them – all the more as the mandatory climate reporting regime proposed last month (by a committee convened by the Accounting and Corporate Regulatory Authority, or Acra, and Singapore Exchange) is aligned with ISSB standards.



Problem Statement

With rising carbon emission more than ever, accurately predicting of carbon emissions, specifically **Scope 1, Scope 2, and Scope 3 emissions**, is essential for organizations to effectively manage their environmental impact and develop sustainable strategies.

Scope 1, 2 and 3,
What are they?

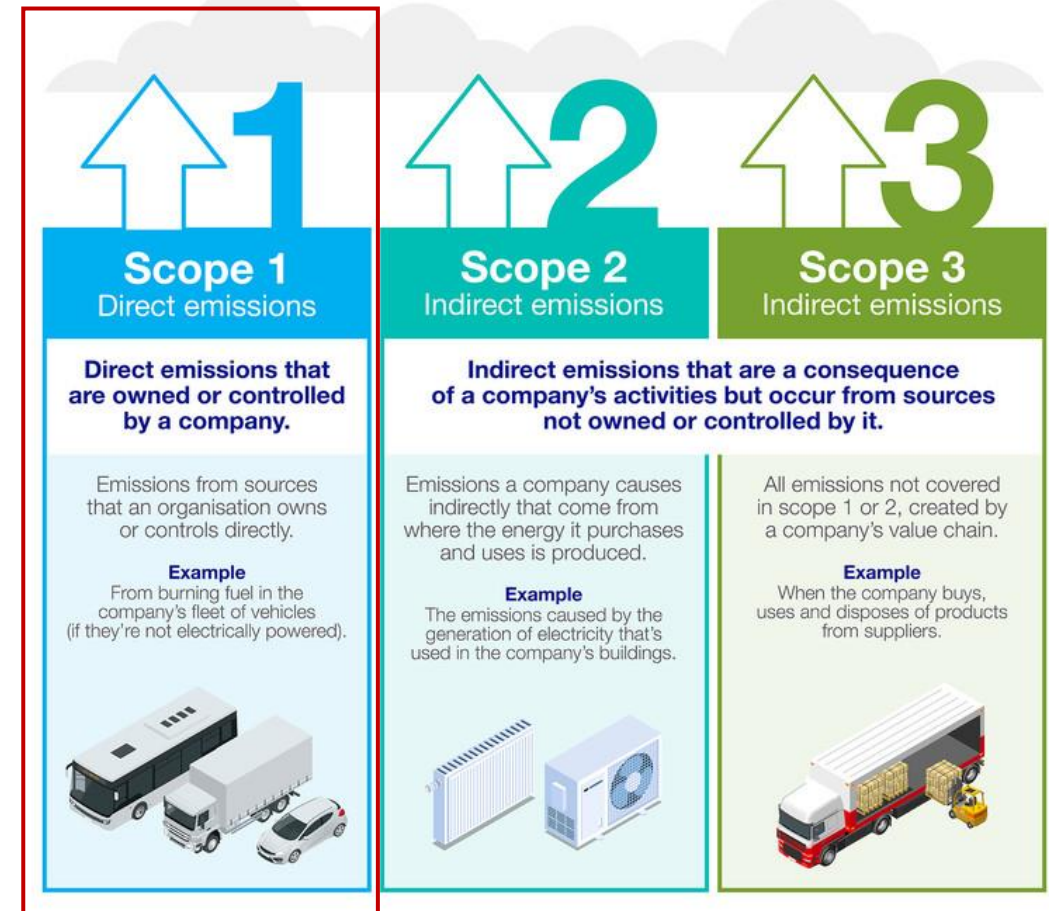
Scope 1

Direct emissions: These are emissions produced directly by your organization's activities.

- Examples include burning fuels for on-site energy generation, operating company vehicles, and emissions from industrial processes.

What are Scope 1, 2 and 3 carbon emissions?

The three scopes are a way of categorising the different types of greenhouse gas emissions created by a company, its suppliers and its customers.



Scope 2

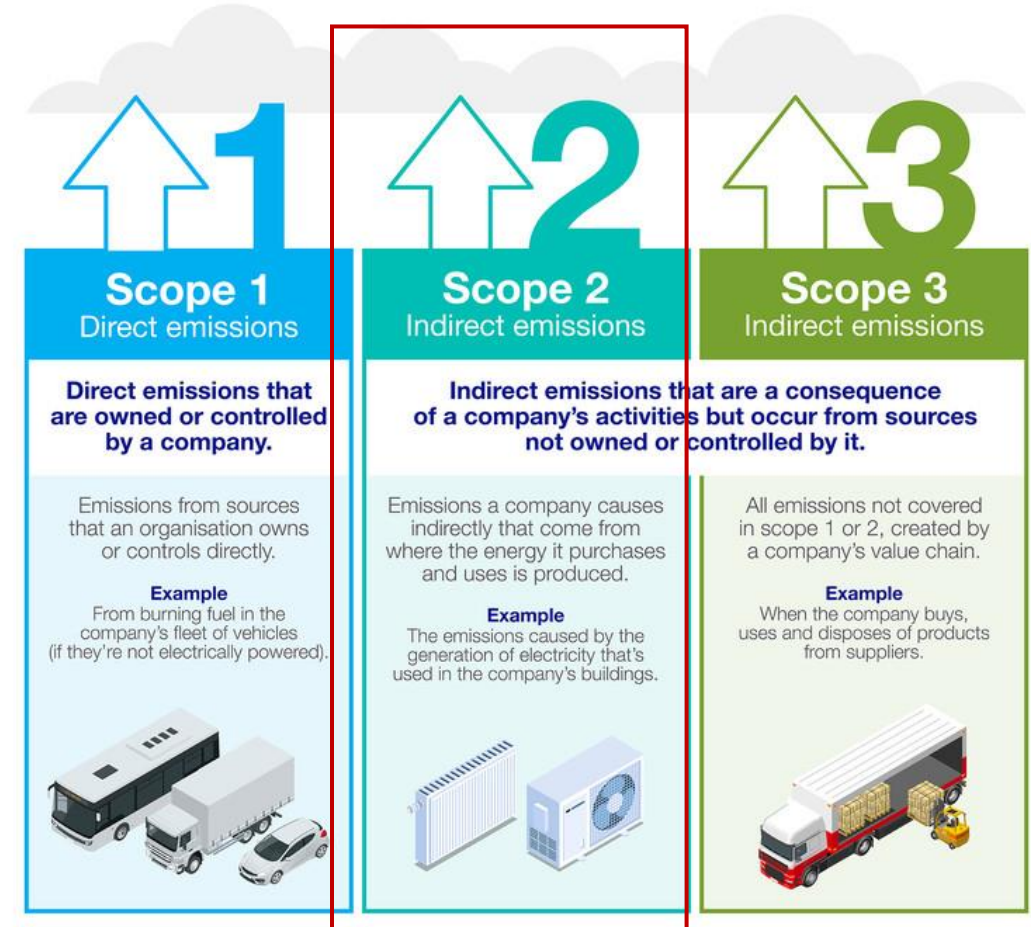
- **Indirect emissions:**

These are emissions associated with the purchase of electricity, heat, or steam from external sources.

- When you consume these forms of energy, the emissions released during their production are attributed to your organization.

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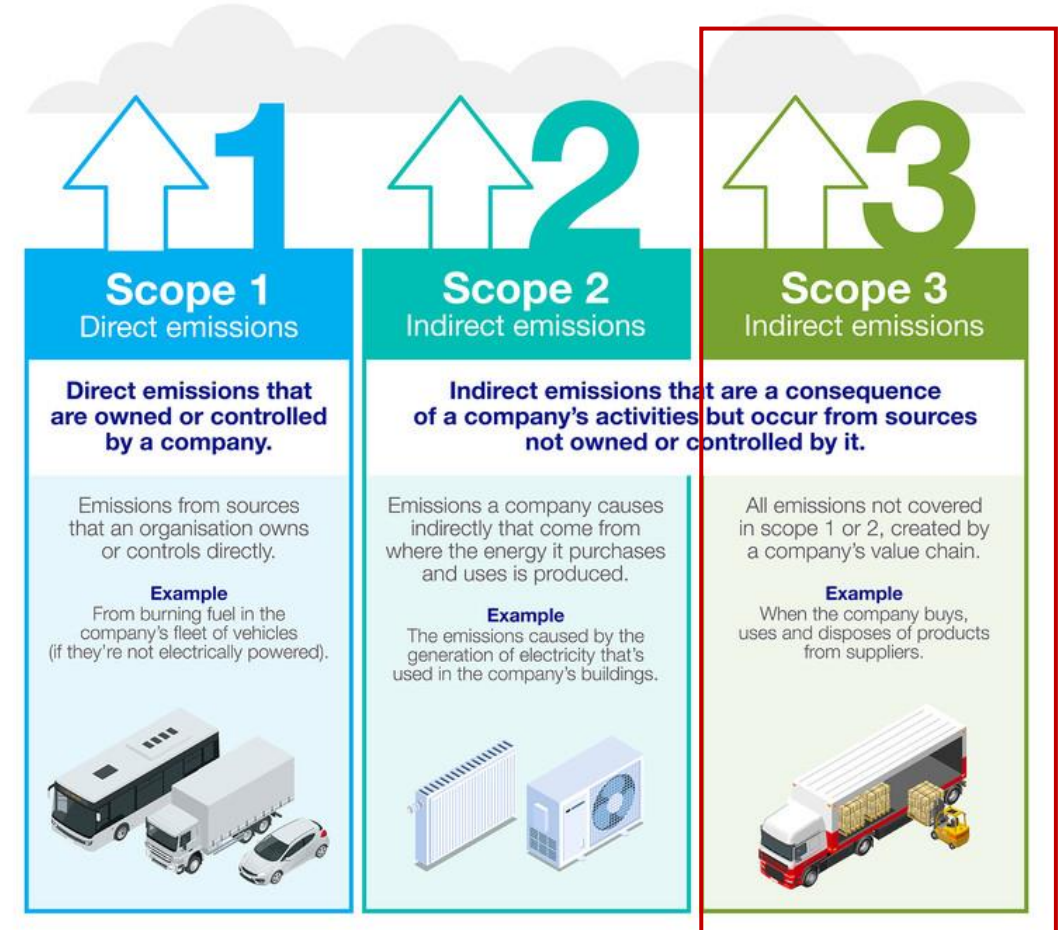
Scope 3

Upstream and downstream emissions: These are emissions that occur outside of your organization's direct operations but are linked to your value chain.

- Examples include emissions from the production of materials you purchase, the transportation of your products, and emissions from your customers' use of your products.

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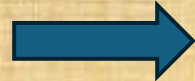




DATA
COLLECTION/CLEANING

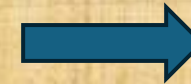
Data collection/cleaning

Step 1:



Finding companies
past years carbon
emission (5 in total)

Step 2:

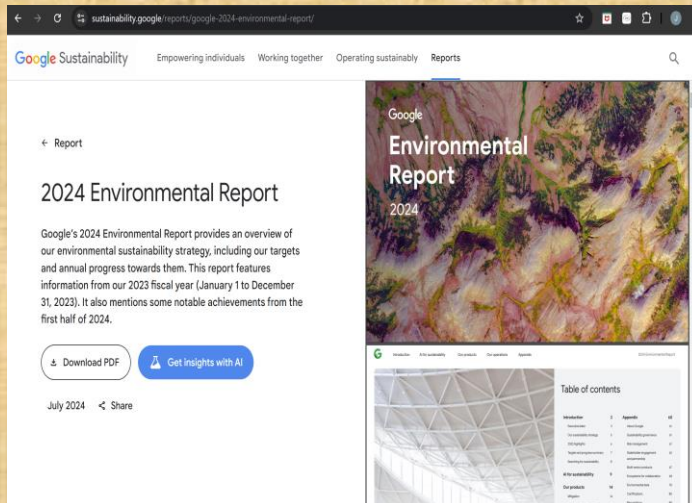


Extracting the carbon
emissions numbers

1. Scope 1
2. Scope 2
3. Scope 3

Step 3:

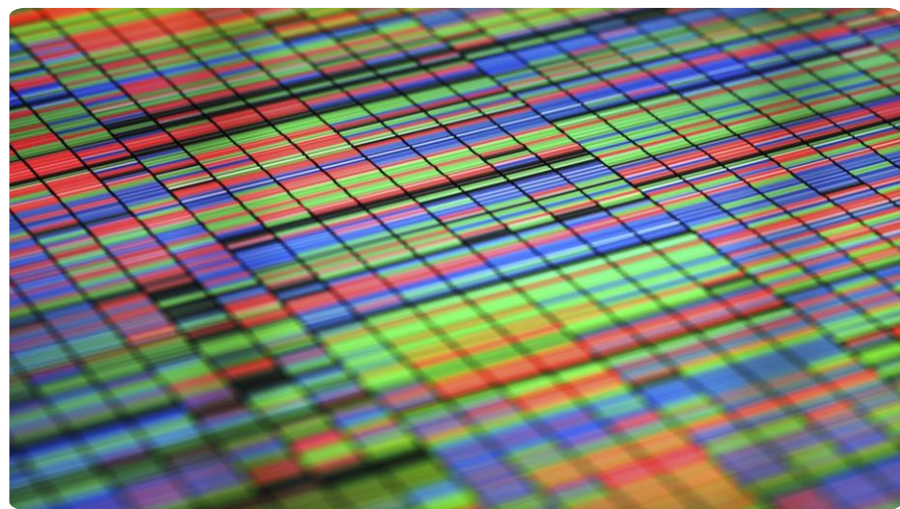
Separating into
different scopes for
Machine Learning



Year	Scope1
1/1/2018	90462
1/1/2019	113412
1/1/2020	118100
1/1/2021	123704
1/1/2022	139413
1/1/2023	144960

Year	Scope2
1/1/2018	183329
1/1/2019	275375
1/1/2020	456119
1/1/2021	429405
1/1/2022	288029
1/1/2023	393134

Year	Scope3
1/1/2018	8875235
1/1/2019	7765660
1/1/2020	11653000
1/1/2021	13839000
1/1/2022	16111000
1/1/2023	16624000



DATA MODELLING

ARIMA MODEL

In simple terms,

ARIMA blends these three ideas (AR, I, MA) to model the underlying patterns in your data and predict future values effectively. It's commonly used for **time-dependent data** like stock prices, sales figures, or climate trends.

- ARIMA (AutoRegressive Integrated Moving Average) is a popular statistical method used for **time series forecasting**. It helps predict future values based on past data.

IT COMBINES THREE IMPORTANT ELEMENTS:



Due to 15 models' variances, a proportion
base on the top 3 is represented



Models	Proportion of Models with Train MAPE < 0.3	Proportion of Models with Test MAPE < 0.3	Run Time
Best performing model	0.80	0.80	1.01 seconds
Second Best performing model	0.73	0.85	1.69 seconds
Third Best performing model	0.73	0.73	1.32 seconds



Streamlit
demo



The background is a vibrant, abstract digital scene. It features a dark blue space filled with glowing orange and red light trails that curve and sweep across the frame, suggesting high-speed data flow or network connections. Scattered throughout are various elements of binary code, including large, semi-transparent '0's and '1's, and smaller, more numerous digits. Some of these digits are also part of the light trails, appearing as if they are being carried along by the data stream. The overall effect is one of dynamic, futuristic technology.

Limitation & Future works



Limitations and Future Works

Addressing challenges and exploring future directions.



Data Availability

Limited data sources



Model Accuracy

Improving predictions



Carbon Tax Inclusion

Carbon tax to account into



Climate & Weather Data

Temperature, rainfall to account

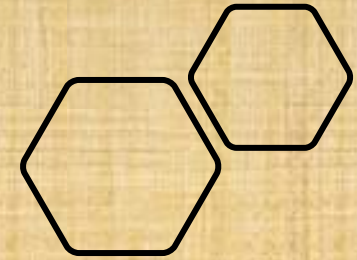


Real Time Monitoring

Track Emission Trends

Carbon Emission Predictor

A Valuable tool for
Societal and Organization
Benefits



Usage of:
Scope 1
Scope 2
Scope 3



Conclusion

A significant step towards a sustainable future.

- Review internal business operational and determine which scope can be lowered to bring down over emissions
- Scope 1, 2, 3 predicted values will help businesses to AIM for a lower emissions in the future.

A dramatic sunset scene over a city skyline. The sky is a mix of orange, yellow, and blue. Thick, dark smoke billows from several points along the horizon, rising and swirling to form a large, stylized skull shape in the upper half of the frame. The city lights are visible in the lower portion of the image, partially obscured by a dark grey banner.

THANK YOU