



COMPARATIVE ANALYSIS OF CO2 EMISSIONS FROM DIESEL AND ELECTRIC BUSES:

A CASE STUDY OF ARUBA AIRPORT AUTHORITY N.V.

The year '2040' is rendered in a large, bold, sans-serif font. The top half of the numbers is a solid, metallic gold color. The bottom half of the numbers is filled with a vibrant green, textured pattern that resembles grass or dense foliage. Within the green sections, there are faint, semi-transparent images of wind turbines. The entire year is set against a light, hazy background and is reflected in a dark, glossy surface below it, creating a symmetrical effect.

2040

Join the REGENERATION

INTRODUCTION

- Comparative analysis of CO₂ emissions from Diesel and Electric buses Aruba Airport Authority N.V (AAA) case study
- Importance of studying CO₂ emissions





BACKGROUND AND OBJECTIVES

- AAA's vision to become the most sustainable airport
- What strategy should Aruba Airport Authority N.V. invest in to have an as low as reasonably possible impact on the environment?



BACKGROUND AND OBJECTIVES

- What is the current environmental impact of the vehicles owned by Aruba Airport Authority N.V.?
- What alternatives could be recommended to replace the current equipment?
- What are the emissions factors of the local energy-producing company?
- What are other social sustainability impacts between the compared strategies?

METHODOLOGY – LIFE CYCLE ASSESSMENT (JUST A SAMPLE)

[1]

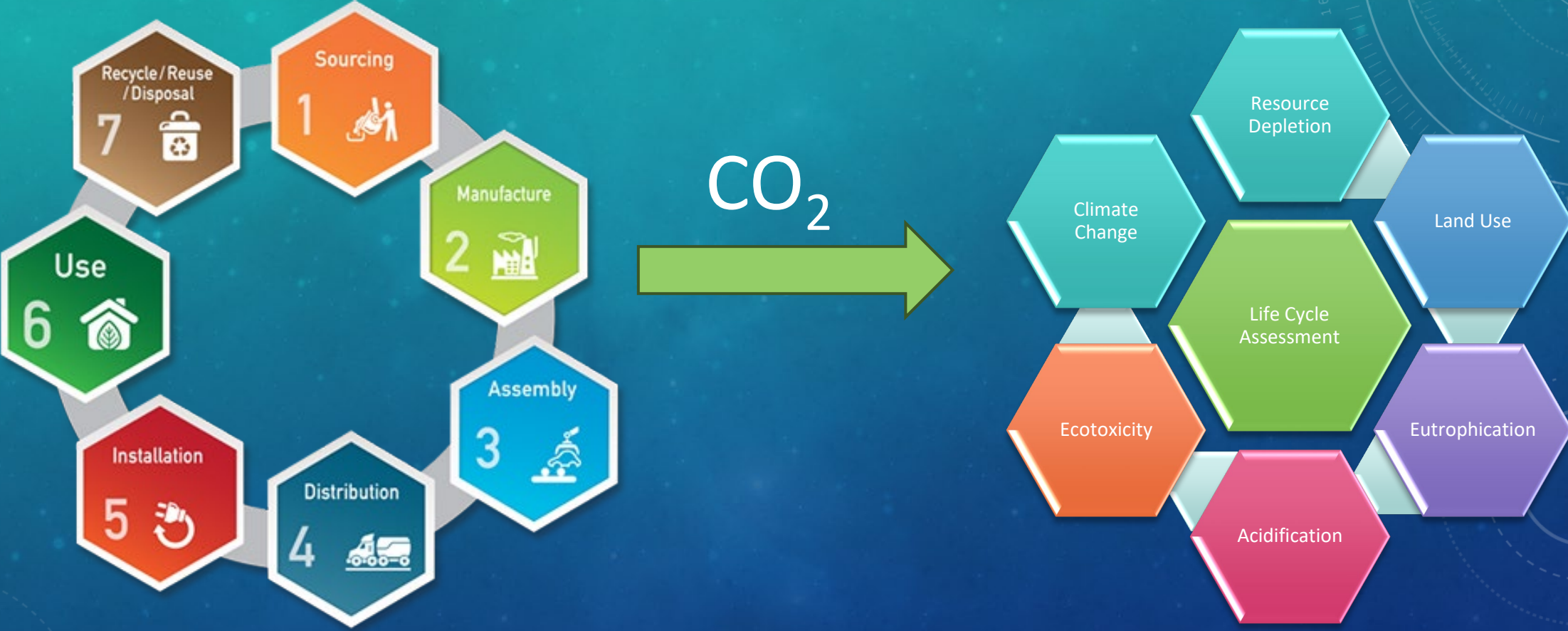


CLIMATE CHANGE



LIFE CYCLE ASSESSMENT – CLIMATE CHANGE IMPACTS

[1]



LITERATURE REVIEW – PRODUCTION^[2]



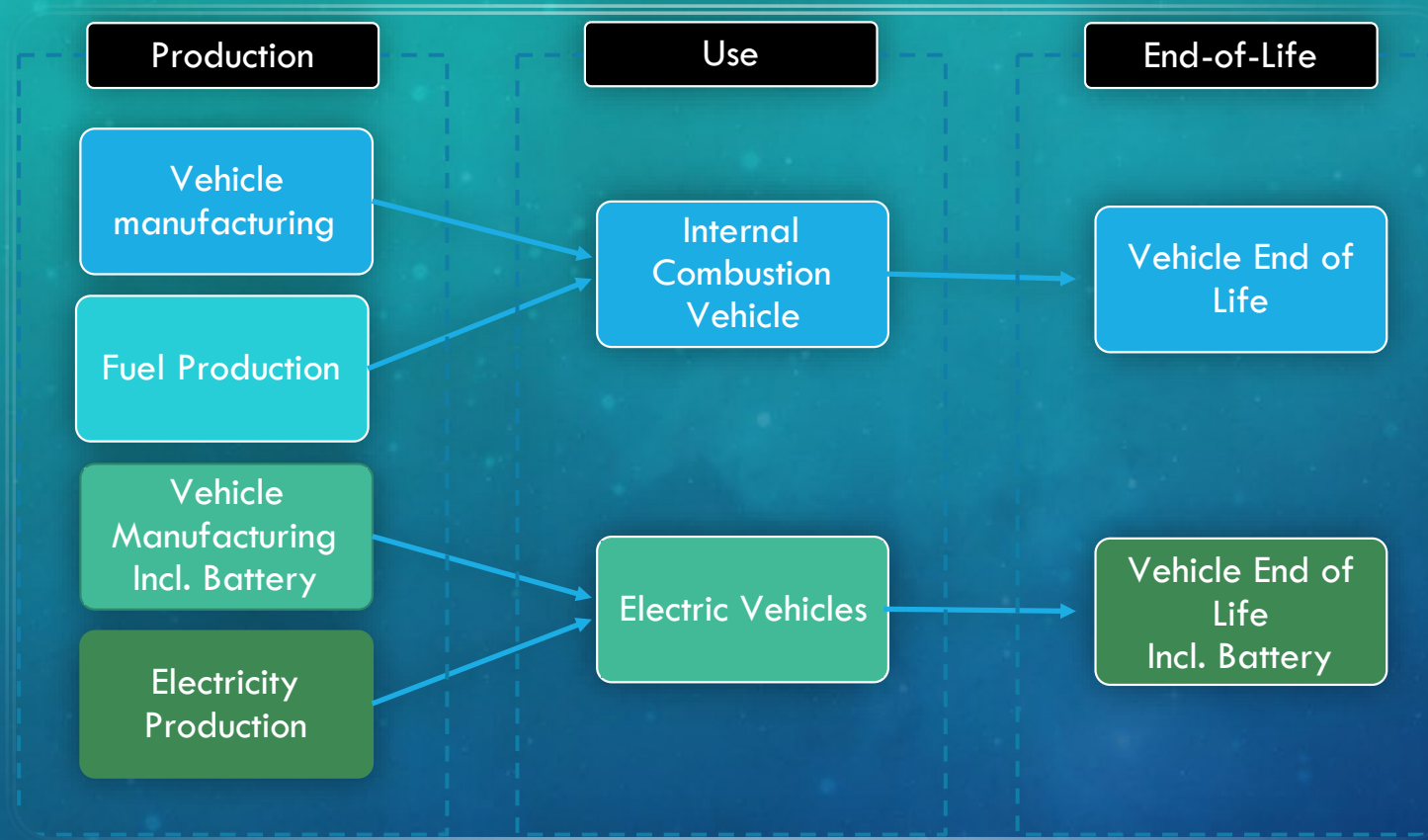
- Raw material extraction
- Metal, Plastic, Rubber
- Energy usage
- During extraction, processing
- Supply Chain
- Individual parts
- Transportation

DATA COLLECTION – USE & DISPOSAL

- Energy Consumption
 - Actual operations
 - Maintenance
 - Energy sources
- Disposal
 - Landfill
 - Recycle
 - incineration

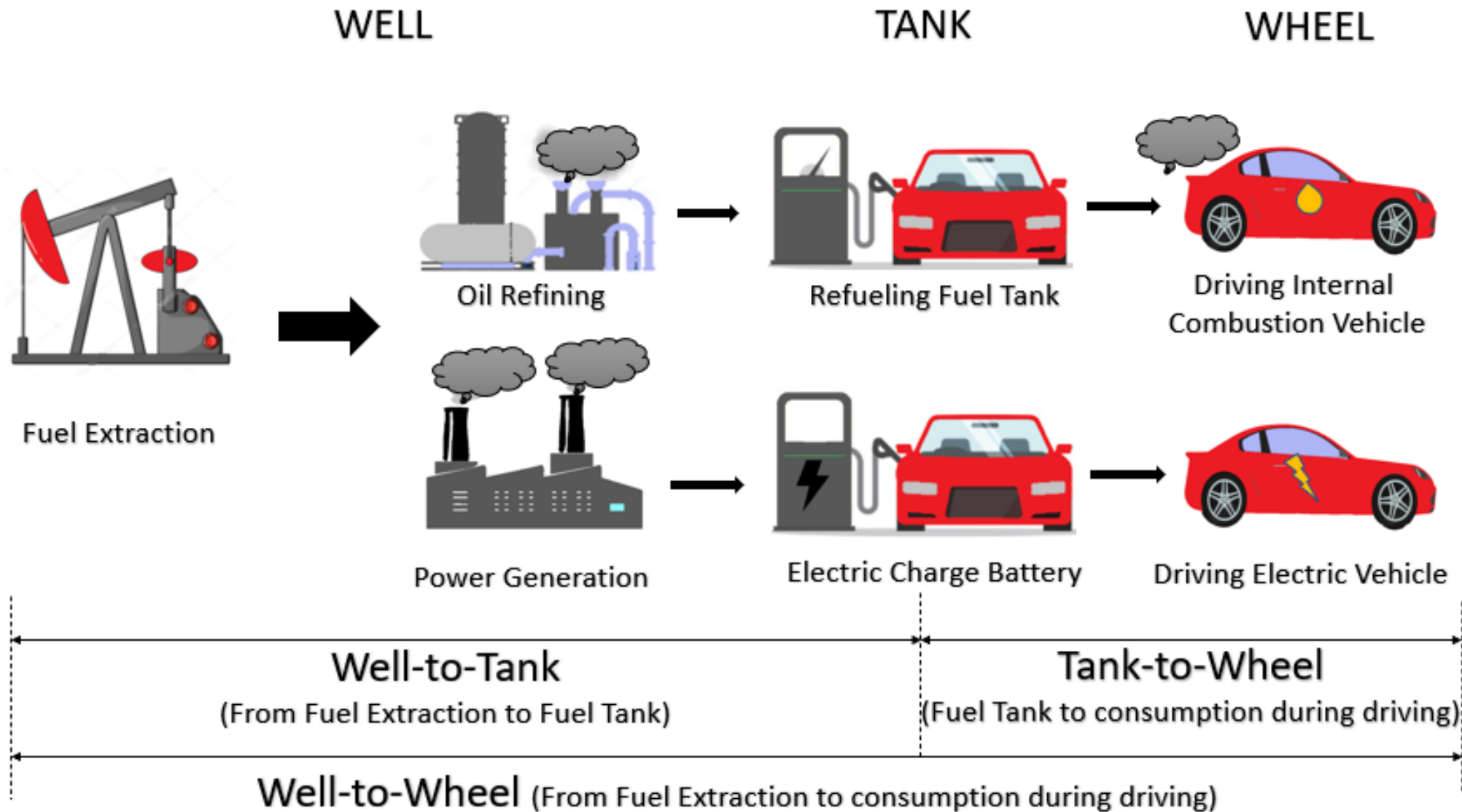


DATA COLLECTION



- Production – Existing studies [2][3][6][7]
- Use – Real-world Data
- End of life – Previous research & Experts [4][5]
- Parameters: fuel consumption, distance traveled, and emission factors

EMISSION FACTOR



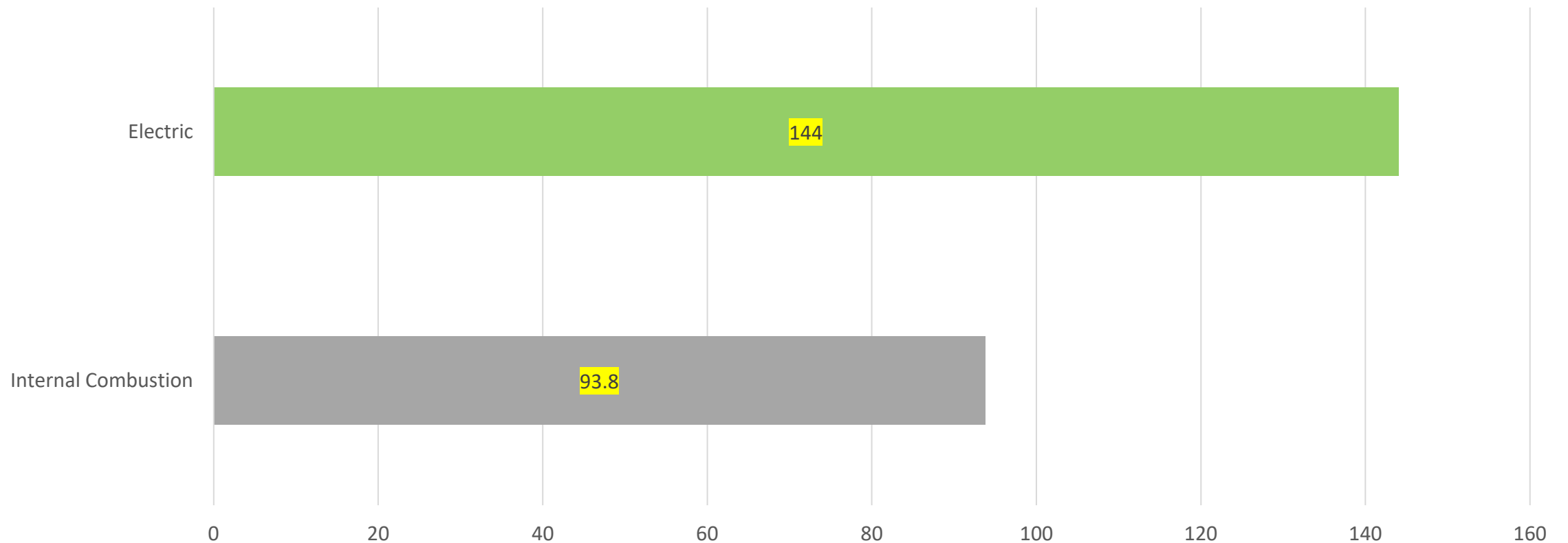
EMISSION FACTOR

- Airport Council International (ACI) - Airport Carbon Emissions Reporting Tool (ACERT)
 - Diesel emissions
 - Unit conversions
 - Emission Calculators



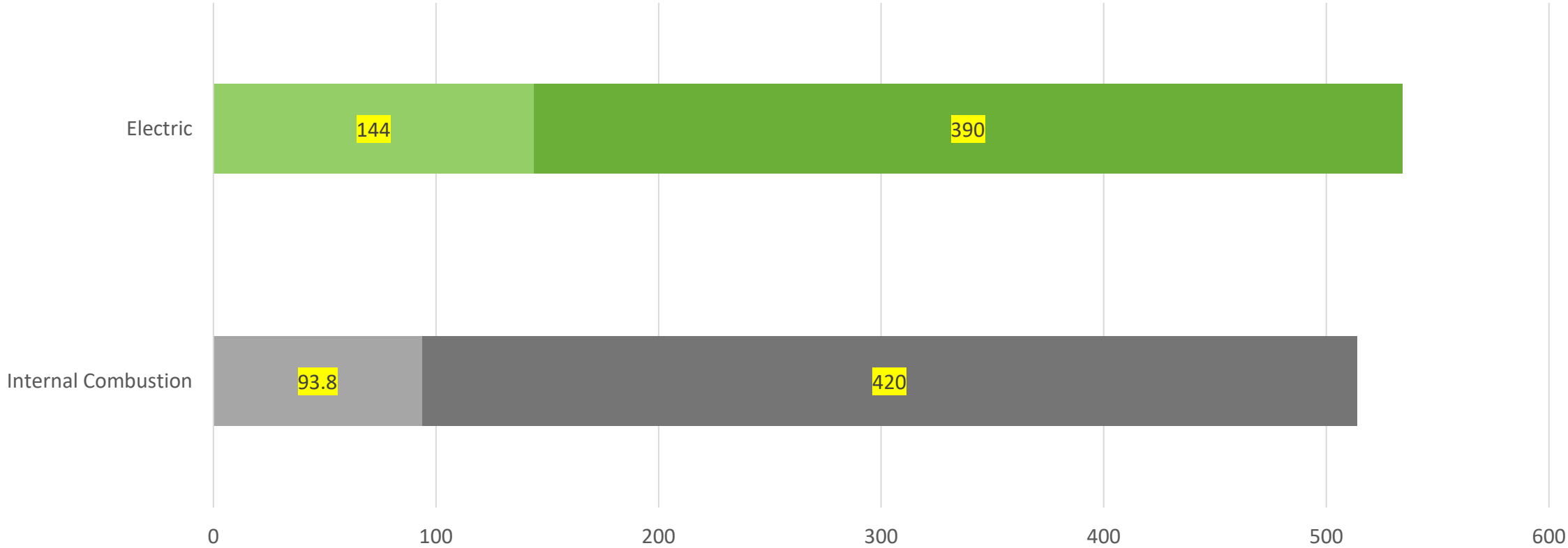
PRODUCTION

Lifetime (15 years) total emissions with 0.709 kg CO₂/kWh



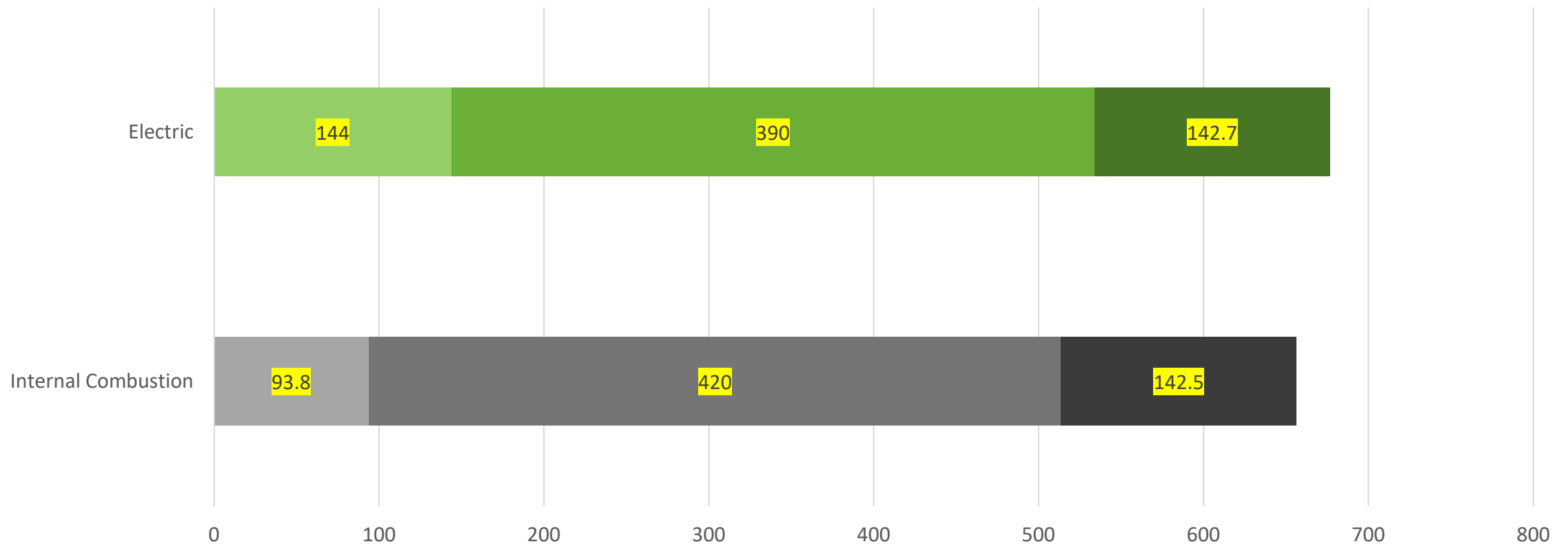
PRODUCTION + USE

Lifetime (15 years) total emissions with 0.709 kg CO₂/kWh



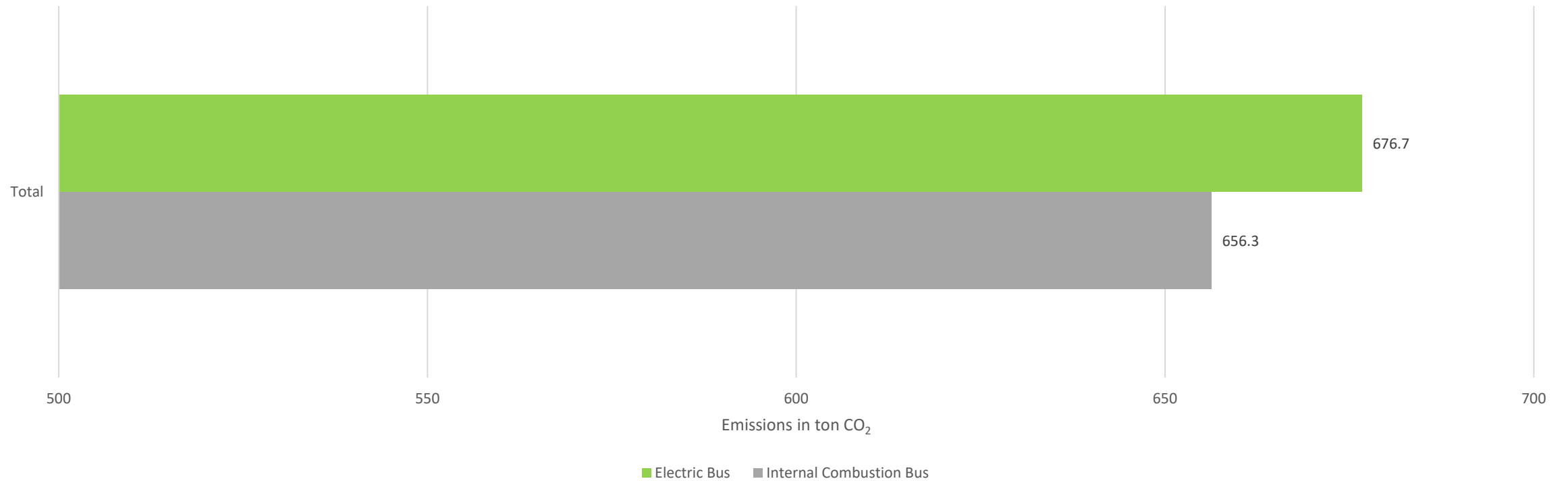
PRODUCTION + USE + EOL

Lifetime (15 years) total emissions with 0.709 kg CO₂/kWh



RESULTS AND ANALYSIS

Lifetime (15 years) total emissions with 0.709 kg CO₂/kWh



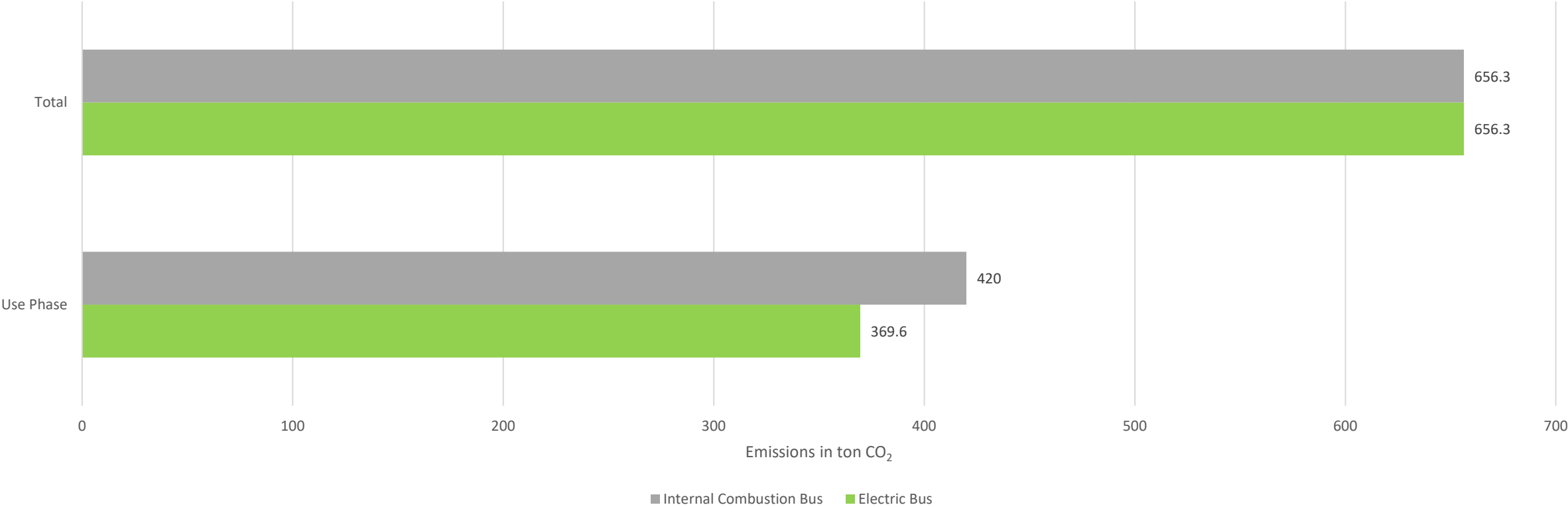
BREAK EVEN POINT

The background of the slide features a series of wind turbines silhouetted against a vibrant sunset sky. The sun is a bright yellow-orange orb positioned centrally in the lower half of the frame, casting a warm glow. The sky transitions from a deep orange near the horizon to a soft purple and blue at the top. The turbines are scattered across the landscape, with some in the foreground and others receding into the distance.

- Reach an emission factor of 0.659 kg CO₂/kWh
- 5 more Wind turbines of 15 MW are needed

RESULTS AND ANALYSIS – BREAK EVEN POINT

Lifetime (15 years) total emissions with 0.659 kg CO₂/kWh



SWOT ANALYSIS



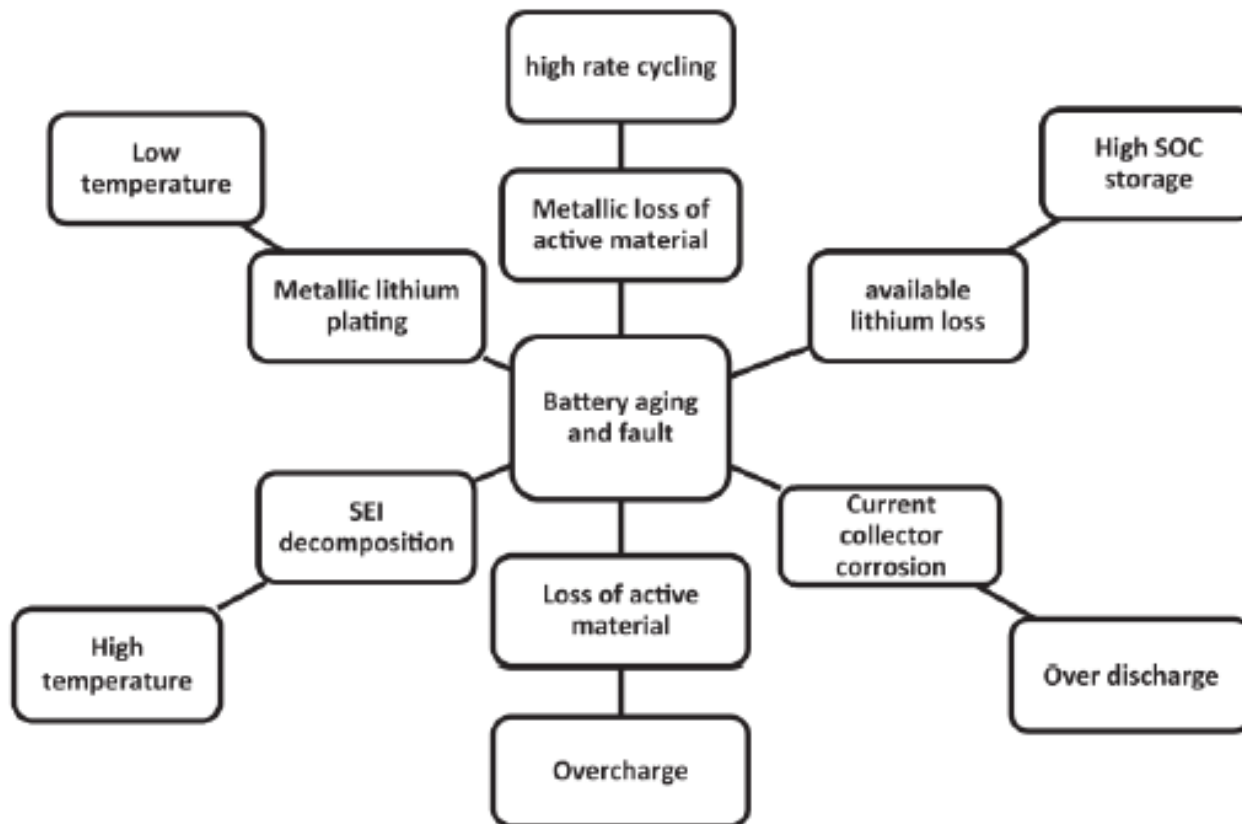
- S- Long term sustainability, economical resiliency & influence
- W – Many uncertainties and high fixed cost on imports
- O – Innovations in industry and island
- T – Changing policies, prices and environment

BATTERY MANAGEMENT

- High environmental impacts

- Saltpeter & Humidity – Corrosion

- High temperature – Overheating, Higher degeneration rate





RECOMMENDATIONS

- Centralized data management
- Expanded Life Cycle Assessments
- Supplier Collaboration
- Systems analysis – Utilities, GoA, DCCA
- Partnership with Arubus
- Climate Change Data Collection
- Battery management Focus



CONCLUSION

- Emission of the buses over the year 2021 is 28.1 *ton CO₂*. According to EPA.gov, this is 3.5 American homes' energy use for one year
- Electric Bus would have a higher impact regarding CO₂ with current emission factors
- To Reach 15-year break even point 5 more Wind turbines of 15 MW are needed
- AAA's economical influence could play a major role in R&D of the technology as a system's approach



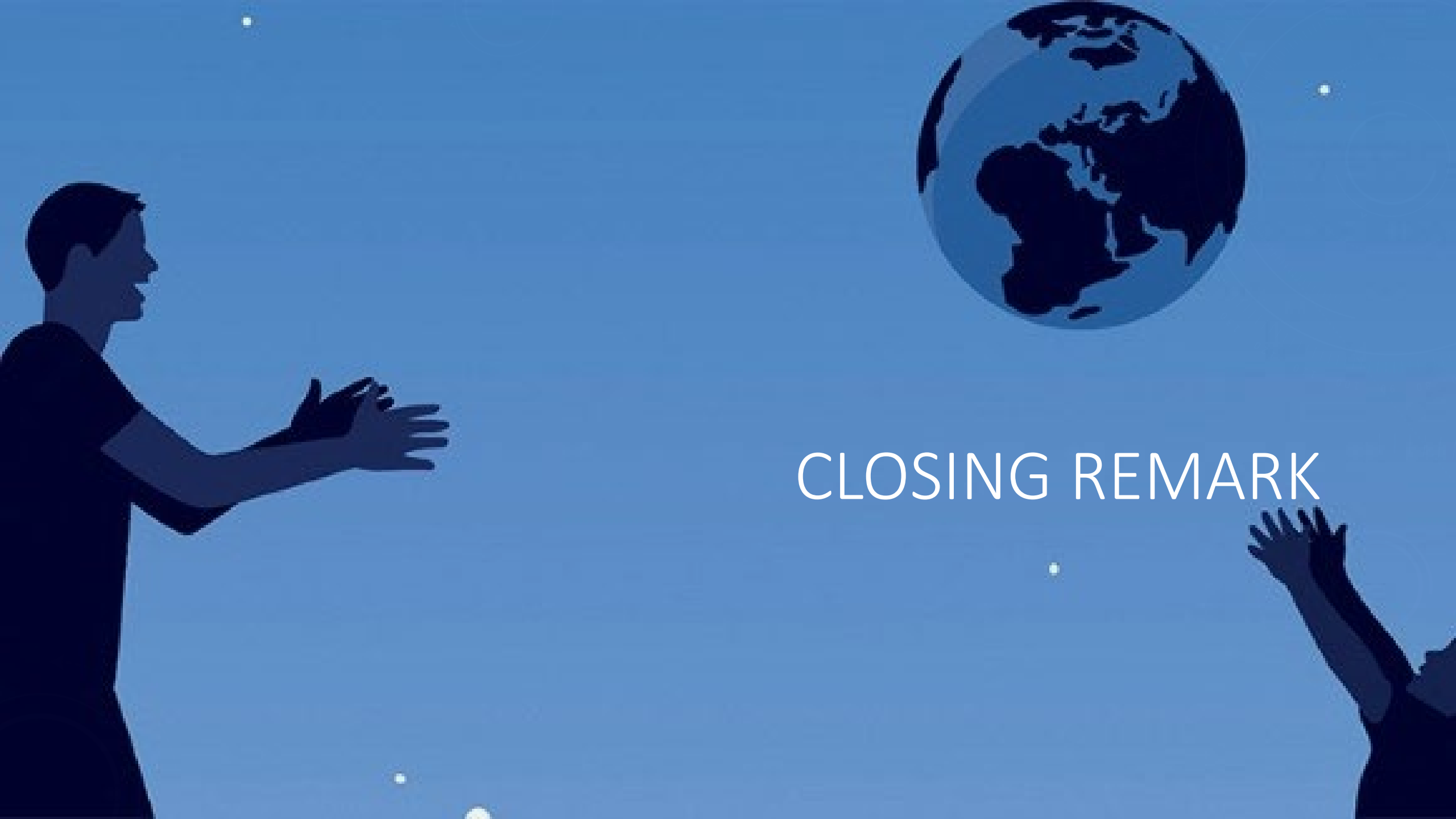
IN RETROSPECT

- Transparency and Data is still a major stumbling block for research
- AAA could capitalize in developing valuable data that can be used by other external parties
- Aruba could shift from tourism towards investing in more skilled workforce in science & engineering starting in **Education**
- **We need critical thinkers & problem solvers for future crisis**
- Establish partnerships



CONCLUSION

- For Aruba Airport – Infrastructure and policies aren't their... YET.
- Teamwork makes the dreamwork!



CLOSING REMARK

A large, light gray 3D question mark stands on a wooden floor against a dark red wall. The wall is decorated with faint, technical diagrams including circular gauges with numerical scales and arrows. The floor is made of light-colored wooden planks. The overall scene is dimly lit, with the question mark being the central focus.

QUESTIONS AND DISCUSSION



ACKNOWLEDGMENTS



THANK YOU



1. iso.org. (2022, October 21). *iso.org*. Retrieved from <https://www.iso.org/standard/37456.html>: <https://wapsustainability.com/wp-content/uploads/2020/11/ISO-14040.pdf>
2. Gabriel, N., Martin, K., Haslam, S., Faile, J., Kamens, R., & Gheewala, S. (2021). *A comparative life cycle assessment of electric, compressed natural gas, and diesel buses in Thailand*. Bangkok: Elsevier.
3. International Civil Aviation Organization. (2013, October 9). *Airport Carbon Emissions Management*. Retrieved from icao.int: <https://www.icao.int/APAC/Meetings/2015%20AOPWG3/ACI%20ACA%20and%20ACERT%20aopwg3.pdf>
4. European Chemical Transport Association. (2011). *Guidelines for Measuring and Managing CO2 Emissions from Freight Transport Operations*. ECTA.
5. Gohlich, D., Jefferies, D., Fay, T., Lauth, E., Kunitz, A., & Zhang, X. (2018). *Design of Urban electric bus systems*. Beijing: ResearchGate.
6. Ernst & Young . (2021). *Abbreviated Financial Statements 2021*. Oranjestad: Water en Energiebedrijf Aruba (WEB N.V.).
7. WEB N.V. . (2023, April 09). *Aruba's Realtime Renewable Energy Monitor*. Retrieved from [webaruba.com](https://webaruba.com/renewable-energy-dashboard/aruba): <https://webaruba.com/renewable-energy-dashboard/aruba>