

Comparing the decarbonization potential of various technologies for the solid waste collection fleet in São Paulo

The decarbonization of São Paulo's solid waste collection truck fleet is mandated by Law No. 16,802/2018, which targets a 50% reduction in tailpipe carbon dioxide (CO₂) emissions by 2028 and a 100% reduction by 2038. Additionally, particulate matter (PM) and nitrogen oxides (NO_x) emissions, which impact air quality and health, must be reduced by 90% and 80%, respectively, by 2028, and by 95% in 2038.

A new ICCT study compares the environmental and economic performance of diesel, electric, and compressed natural gas (CNG) trucks by evaluating the life-cycle greenhouse gas emissions and total cost of ownership of readily available waste collection truck models in Brazil.

METHODOLOGY

The reference diesel truck is the Volkswagen Constellation 17.230 and the alternatives are the electric BYD eT18 and the CNG Scania P280. All trucks have a gross vehicle weight of 16 tonnes, 4x2 axle configuration, a 28-horsepower compactor, and comparable powertrains.

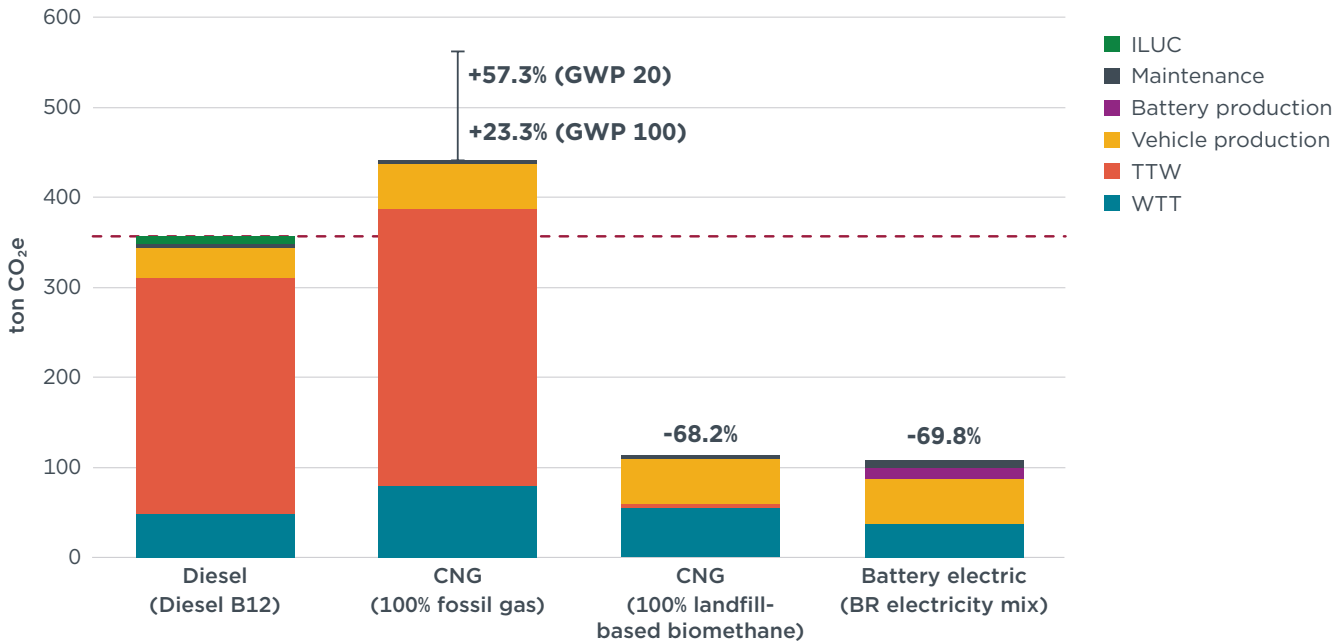
The Neighborhood Refuse Truck Cycle from the U.S. National Renewable Energy Laboratory (NREL) was used for standardized simulations that incorporated waste compaction cycles for additional energy expenditure. Simulations were conducted with Amesim software and adjusted and validated with real-world data. The trucks were assumed to travel 33,632 km annually and have a mandated replacement cycle of 5 years, as stipulated in city contractual agreements.

The life-cycle assessment considered emissions from the production of the vehicle, battery, fuel, electricity, and maintenance. The total cost of ownership (TCO) analysis included acquisition, financing, operation, maintenance, and energy costs over the vehicle's operating period of 5 years.

KEY FINDINGS

Figure 1

Estimated life-cycle greenhouse gas emissions from waste collection trucks

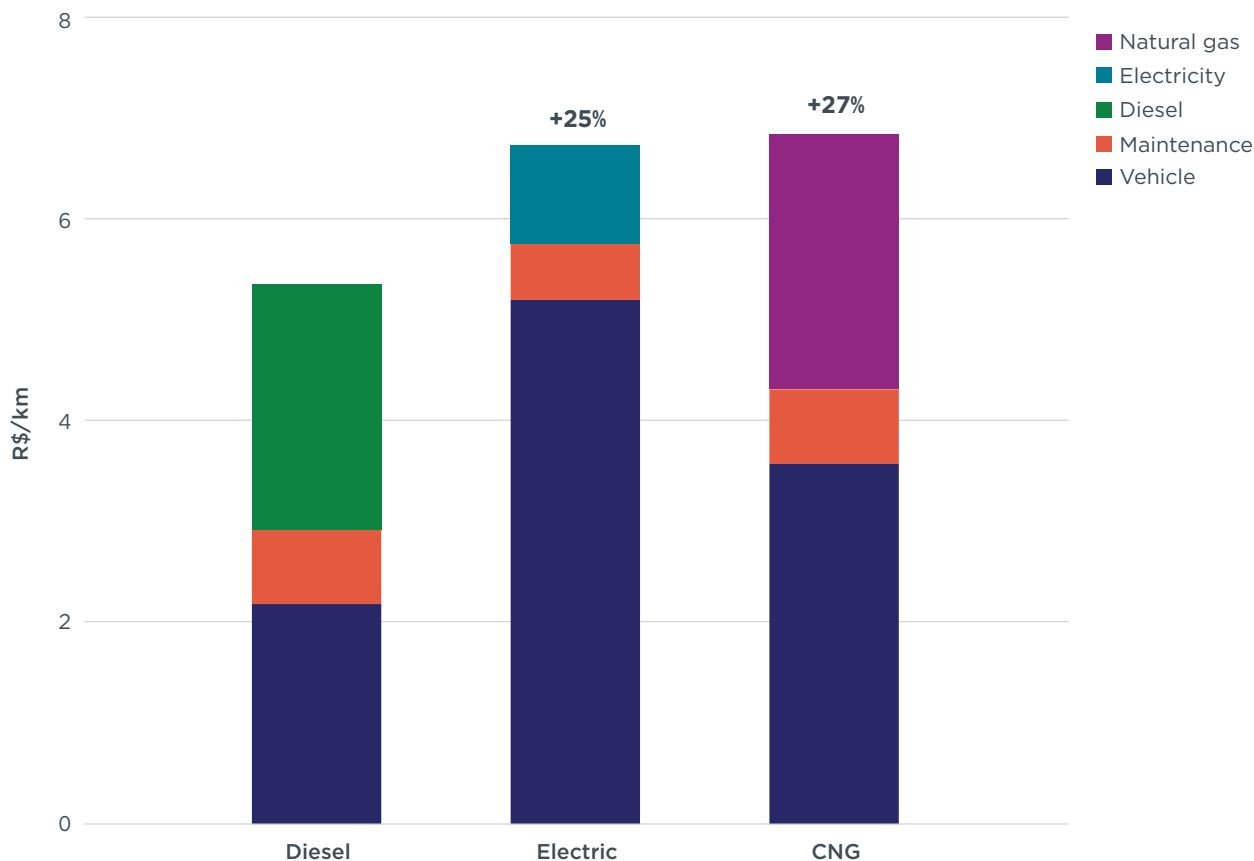


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- » The **battery electric truck** was estimated to have 69.8% lower life-cycle emissions than the diesel truck, due to the efficiency of electric motors and the low emission factor of Brazil's electrical grid.
- » Due to lower engine efficiency and methane leaks, the **CNG truck fueled with fossil gas** was estimated to emit 23.3% more greenhouse gas emissions than diesel. Using a 20-year global warming potential (GWP) instead of GWP 100, emissions were 57.3% higher due to the methane leaks. Consequently, fueling CNG waste trucks with fossil-based natural gas does not contribute to decarbonization.
- » As the emission factor of biomethane is about 80% lower than fossil natural gas, the **gas truck fueled with biomethane from landfills** was estimated to have 68.2% lower life-cycle emissions than diesel, primarily because methane emissions from landfills are captured.

Figure 2

Total cost of ownership of the waste collection trucks



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- » Battery electric trucks and CNG trucks were estimated to have 25% and 27% higher TCO, respectively, than diesel.
- » Making biomethane-powered CNG trucks cost competitive with current diesel-fueled counterparts would depend on the availability of biomethane from the city's landfills at roughly half the cost of fossil natural gas.
- » Incentives and operational changes can make electric waste collection trucks cost competitive. Our sensitivity analyses show that reducing interest rates for financing the acquisition of electric trucks and extending their operational life beyond the current 5 years can offset the current cost difference between electric and diesel trucks.

PUBLICATION DETAILS

Title: *Descarbonização da frota de coleta de resíduos de São Paulo*

Authors: André Cieplinski, Ana Beatriz Rebouças, Aviral Yadav, and Carmen Araujo

Download: <https://theicct.org/publication/descarbonizacao-da-frota-de-coleta-de-residuos-solidos-em-sao-paulo-oct24/>

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