

From Waste to Wheels

Turning organic waste into renewable fuel for transport.

HOW BIOMETHANE DECARBONIZES MOBILITY, MITIGATES METHANE EMISSIONS AND STRENGTHENS ENERGY SECURITY.



EXECUTIVE SUMMARY

A drop-in fuel for fleets that already exist

- Biomethane is produced from organic waste, including animal manure, food waste, sewage sludge, agricultural residues, agro-industrial by-products, municipal organic waste and landfill gas.
- In a single pathway it addresses climate change, methane emissions, waste management, energy security and the circular economy. Well-to-wheel GHG reductions vary depending on the feedstock and production pathway, with waste-based routes delivering some of the highest climate benefits.
- When methane abatement from manure management is credited, lifecycle GHG reductions can reach **up to -246% versus diesel**, resulting in net-negative emissions. Existing CNG and LNG vehicles run on biomethane with virtually no modification, supplied as Bio-CNG (compressed) or Bio-LNG (liquefied).
- In municipal waste-collection fleets, biomethane can reduce climate impacts by **68-98%** compared with diesel, making it an immediately deployable solution for cities.

up to -246%

net lifecycle GHG reduction versus diesel when avoided manure methane is credited

68-98%

lower climate impacts in municipal waste-collection fleets compared with diesel

SIGNIFICANT GHG REDUCTIONS



Better lifecycle performance.

GHG emission reduction in heavy duty transport: biomethane as a truck fuel reducing 50-75% GHG relative to diesel.

Methane warms about 84× as much as CO₂ over 20 years, and 28× over 100 years (IPCC).

Captured, the same methane becomes fuel instead of escaping.

Why biomethane matters?

ENVIRONMENTAL & ECONOMICAL BENEFITS



Energy security;
Methane mitigation;
Improvements in air quality/noise;
Circular economy;
Water quality;
Waste management.

IMMEDIATE COMPATIBILITY WITH VEHICLE TECHNOLOGIES



Fast adoption: compressed and liquified biomethane trucks already available in the market.

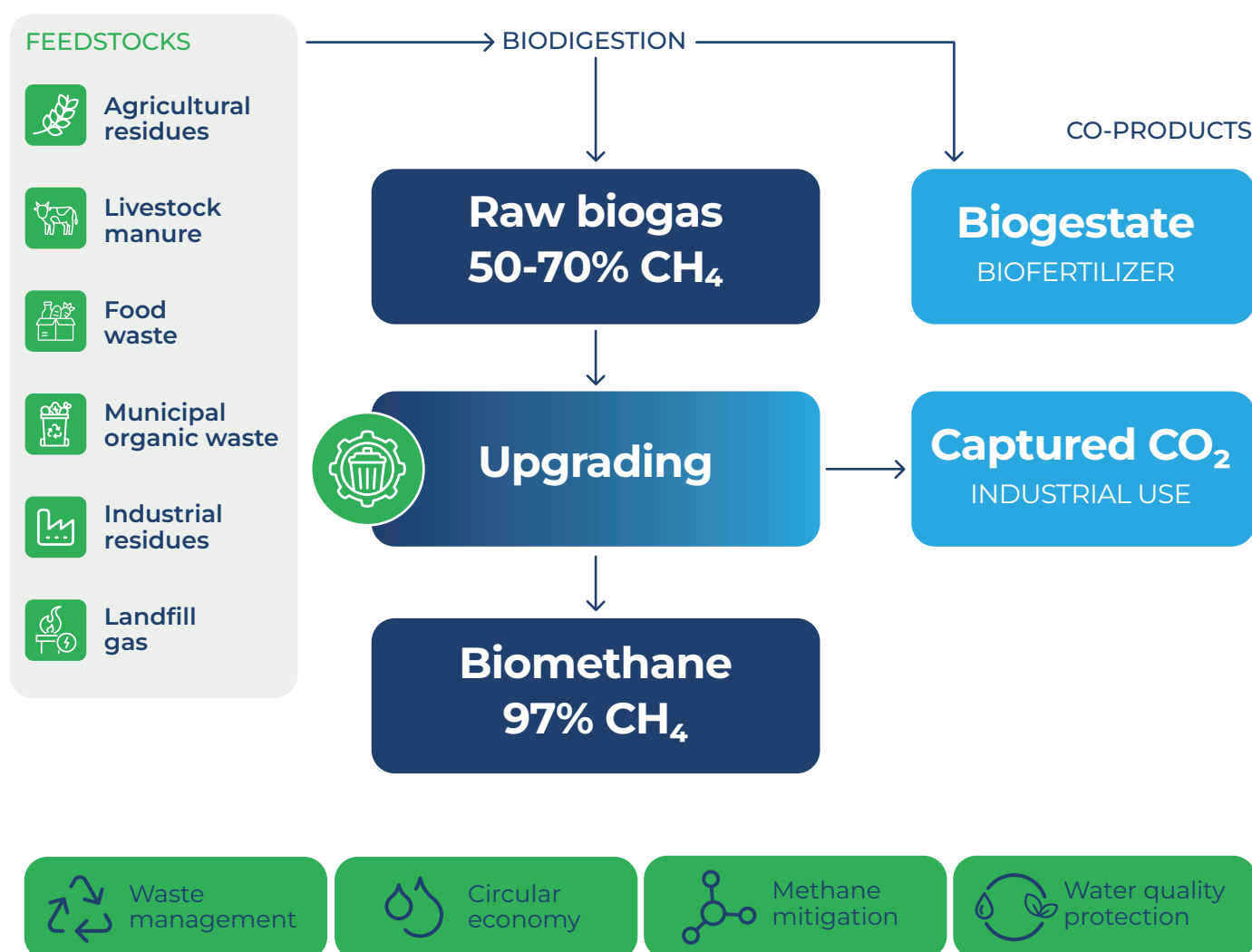
Compatibility with current fuel distribution systems.

Heavy-duty freight, long-haul, municipal waste collection, urban mobility, agricultural machinery.

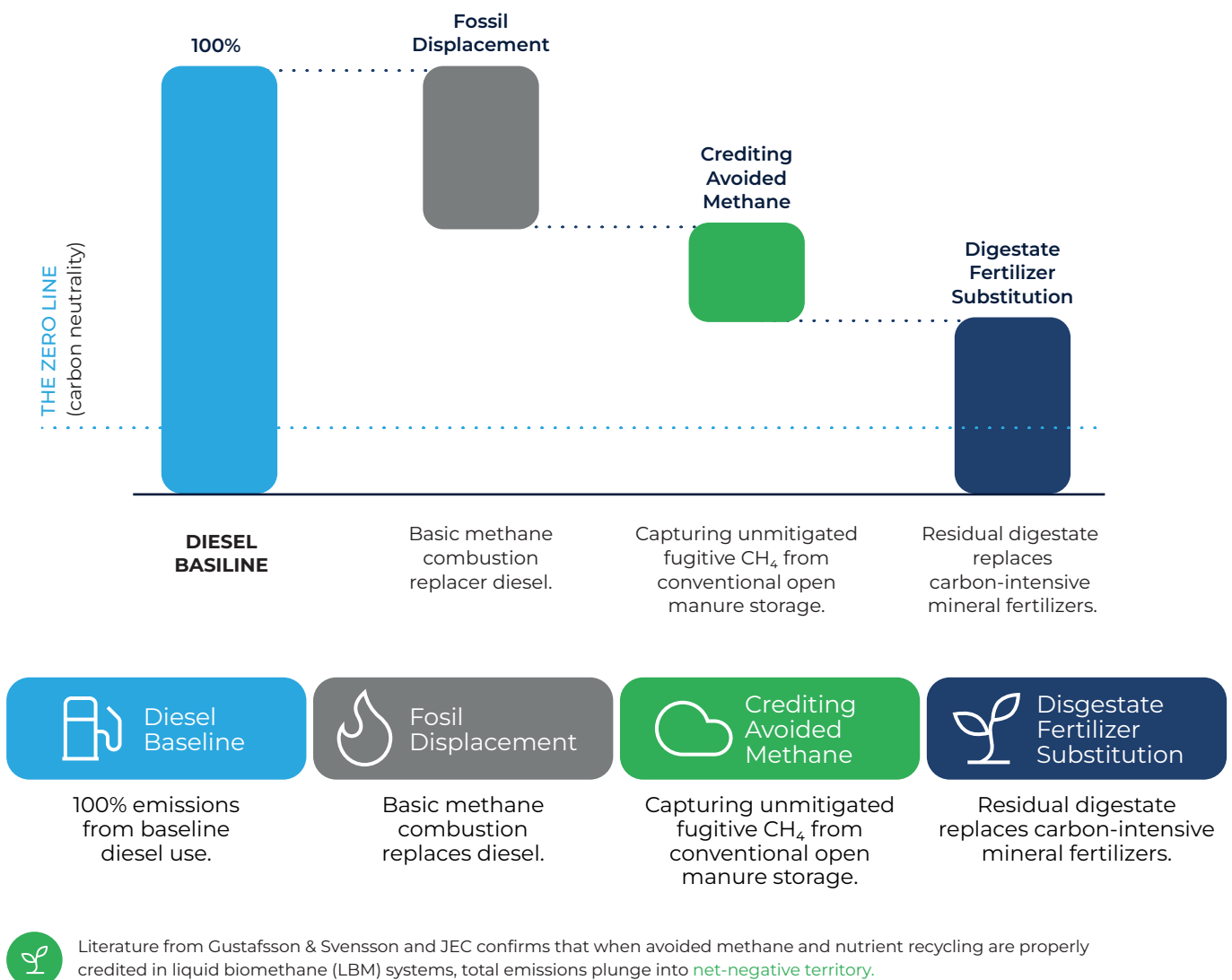
Turning environmental liabilities into economic assets.

Biomethane systems convert organic wastes and residues into renewable fuel while creating additional value through digestate, renewable CO₂, waste-treatment services and environmental attributes.

What is biomethane & how it's produced



The mechanics of going below zero



One fuel that solves several problems at once

Climate

Liquefied biomethane from food waste cuts roughly 50-75% of climate impact versus heavy duty diesel; manure system can even run net-negative.

-50 to 75% GHG
up to -246% net-negative

Methane mitigation

Captures methane that would otherwise escape from organic waste and replaces fossil fuel: few renewable fuels do both.

CH₄ warms 84× CO₂
over 20 yr, captured not released

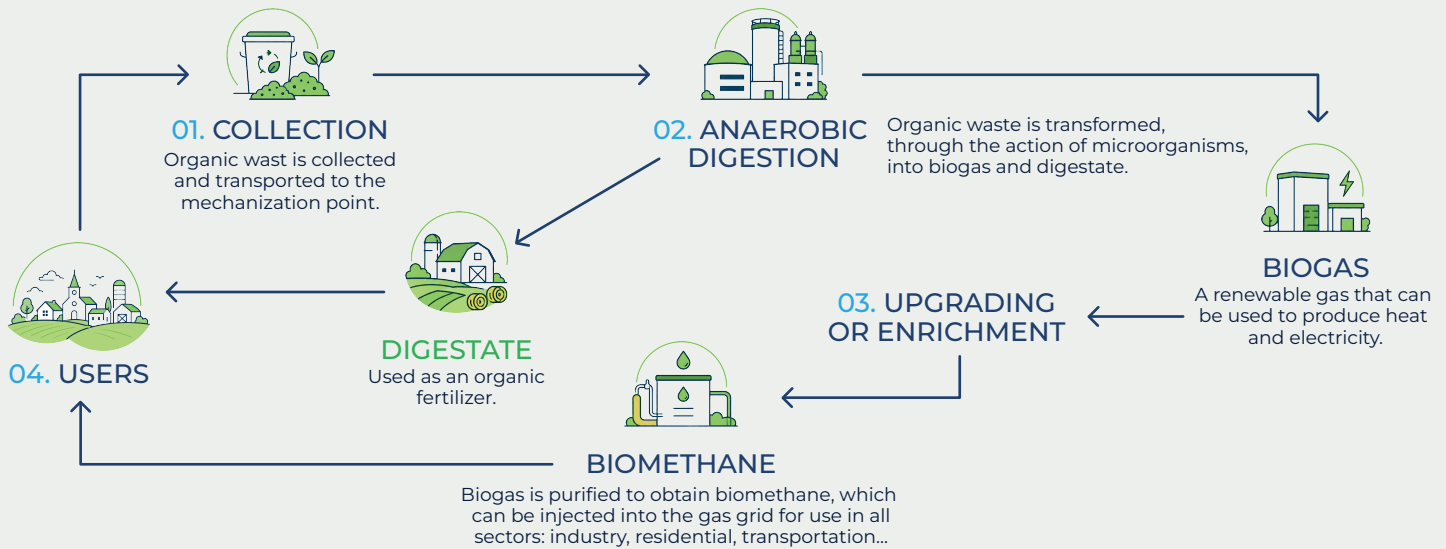
Waste management

Turns manure, MSW organics, food waste, sewage sludge, crop residues, agro-industrial by-products and landfill gas into fuel, cutting landfilling and uncontrolled methane.

6 waste streams → fuel
+ biofertilizer

Value that goes beyond fuel

CIRCULAR ECONOMY



AIR QUALITY

Cleaner air where people live

Methane burns essentially soot-free, so replacing diesel cuts the pollutants that harm health in cities. The biggest gains show up in dense urban areas, freight corridors and captive fleets.



up to 10x
lower PM - VOCs - PAHS

-67 to -82%
NOx, heavy-duty dual-fuel

-23 to -39%
smoke, dual-fuel tests

near-zero
SOx (sulphur-free fuel)

BUSES • FREIGHT CORRIDORS • DENSE URBAN AREAS • CAPTIVE FLEETS

Real-world gains depend on methane-slip control and well-maintained after-treatment; low slip keeps both the air-quality and climate benefits strong.

ENERGY SECURITY

Fuel you make with local resources

Biomethane is produced from local organic waste, so the feedstock is domestic and the supply chain is short. That brings independence from imported fossil fuels and shelters operators from volatile oil and gas prices. Because production is decentralized and sits close to where the waste is generated, it also builds resilience: many small sources are far harder to disrupt than a few large ones, and every plant reinforces national energy sovereignty.

Local waste in, domestic fuel out: supply that cannot be embargoed, shipped away or priced by a distant market.



Already a commercial reality, not an experiment

Produced in ~40 countries, used in transport in nearly 30 and at commercial scale in more than 12. Major OEMs already offer CNG/LNG platforms across passenger, freight, municipal and agricultural segments; virtual pipelines and distribution hubs extend refueling coverage.



● MATURE MARKETS • 11

Sweden	Finland
Germany	Switzerland
Italy	UK
France	Norway
Netherlands	California
Denmark	

● RAPIDLY EXPANDING • 8

Brazil	Spain
USA	Ireland
China	Austria
India	Belgium

EXISTING INFRASTRUCTURE TO BUILD ON

Europe

>100,000 industrial plants

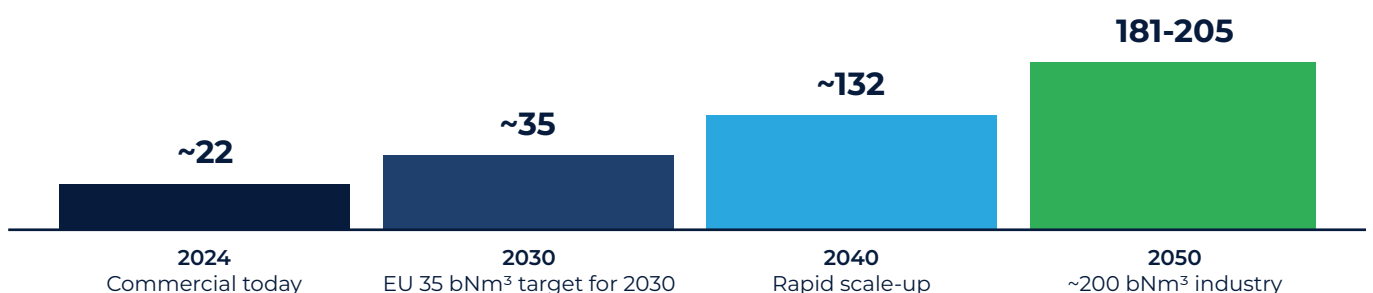
China

260,000 km gas grid

India

7.6 bNm³/year road CNG market

EUROPEAN BIOMETHANE TRAJECTORY (bNm³ • ESTIMATES)



From waste collection to heavy freight, and Brazil's potential

Where it already delivers. In São Paulo, biomethane is competitive with diesel and could replace ~50% of regional freight diesel. In MSW collection it cuts 68-98% of climate impact; on buses, ~70-85% of CO₂; and crop residues could generate ~3.8× the energy of the local tractor fleet.

BRAZIL • THE UNTAPPED OPPORTUNITY

41.4 bNm³/yr

sugar-energy biogas potential

< 2%

of that potential tapped today

~345

sugar mills in operation

755

biogas plants, capacity growing



STARTS AT 1% IN 2026, RISING TO 10%

"FUEL OF THE FUTURE" BLEND (FROM 2026) • RENOVABIO



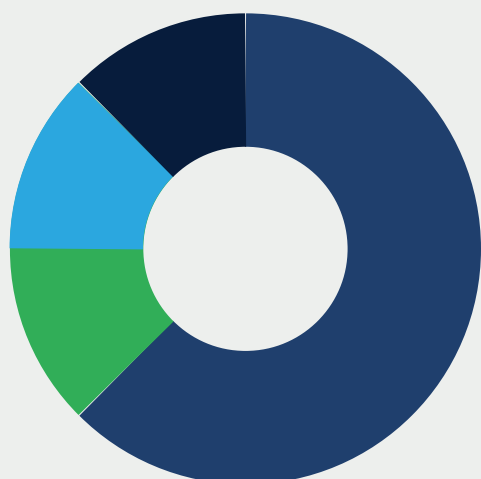
BIO-LNG VS DIESEL 86-94%

REFUSE TRUCK (VS CNG) 55-75%



Agricultural fleets:
Replacing diesel with biomethane not only cuts emissions but also eliminates fuel logistics to remote farms, improving operational resilience.

AVERAGE REVENUE MIX • NON-FUEL REVENUES CAN REPRESENT APPROXIMATELY 20–60% OF TOTAL PROJECT REVENUE IN MATURE MARKETS.



Fuel sales
Digestate
+ renewable CO₂

Waste treatment
Carbon credits
& guarantees of origin



Digestate, renewable CO₂, waste-treatment services and carbon credits diversify the business model beyond fuel sales.



WHAT UNLOCKS THE MARKET • POLICY & MARKET ENABLERS



CARBON & FUEL PRICING, FUEL STANDARDS AND TAX PARITY

LCFS, renewable targets,
production incentive
= grants/feed-in

• IEA • CARB LCFS
• EU RED III

PRODUCTION INCENTIVES

Grants,
feed-in tariffs

• Sweden
• IRA - AFTC

INFRASTRUCTURE DEPLOYMENT

Refueling,
grid injection

• California • India
• US MHDV

WASTE-TO-ENERGY INTEGRATION

Landfill bans,
source separation

• EU Waste Framework
• GOBAR-Dhan

CREDIT MECHANISMS

RenovaBio CBIOS,
mandates

• Italy Decree
• HVIP • Quebec



SCALE

~1 trillion Nm³
yearly global sustainable potential

~ 25%
of current global gas demand



CLIMATE

45-75%
GHG cut vs diesel

2.33-4.37
MtCO₂e avoided/bcm



METHANE

~ 75 billion Nm³
CH₄/yr from global landfills

under 10%
captured globally today

1 Nm³ BIOMETHANE ≈ 1 LITRE OF DIESEL (ENERGY EQUIVALENT)

ONE FUEL ADDRESSES FIVE POLICY PRIORITIES

Transport Decarbonization

Methane Mitigation

Waste Management

Energy Security

Rural Development



**From farm and city waste to clean
transport, worldwide.**

AUTHORS

Glaucia Mendes Souza · University of São Paulo

Luiz Augusto Horta Nogueira · Federal University of Itajubá

Clayton Barcelos Zabeu · Mauá Institute of Technology

Heitor Cantarella · Agronomical Institute of Campinas

Instituto MBCBrasil

MOBILIDADE DE BAIXO CARBONO



SCAN HERE TO ACCESS THE FULL STUDY