



**IEA Bioenergy**  
Technology Collaboration Programme



## The role of biomethane in a scenario with increased liquid methane fuelled vessels

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Zero Emission Shipping Workshop, Oslo, 19 November 2025

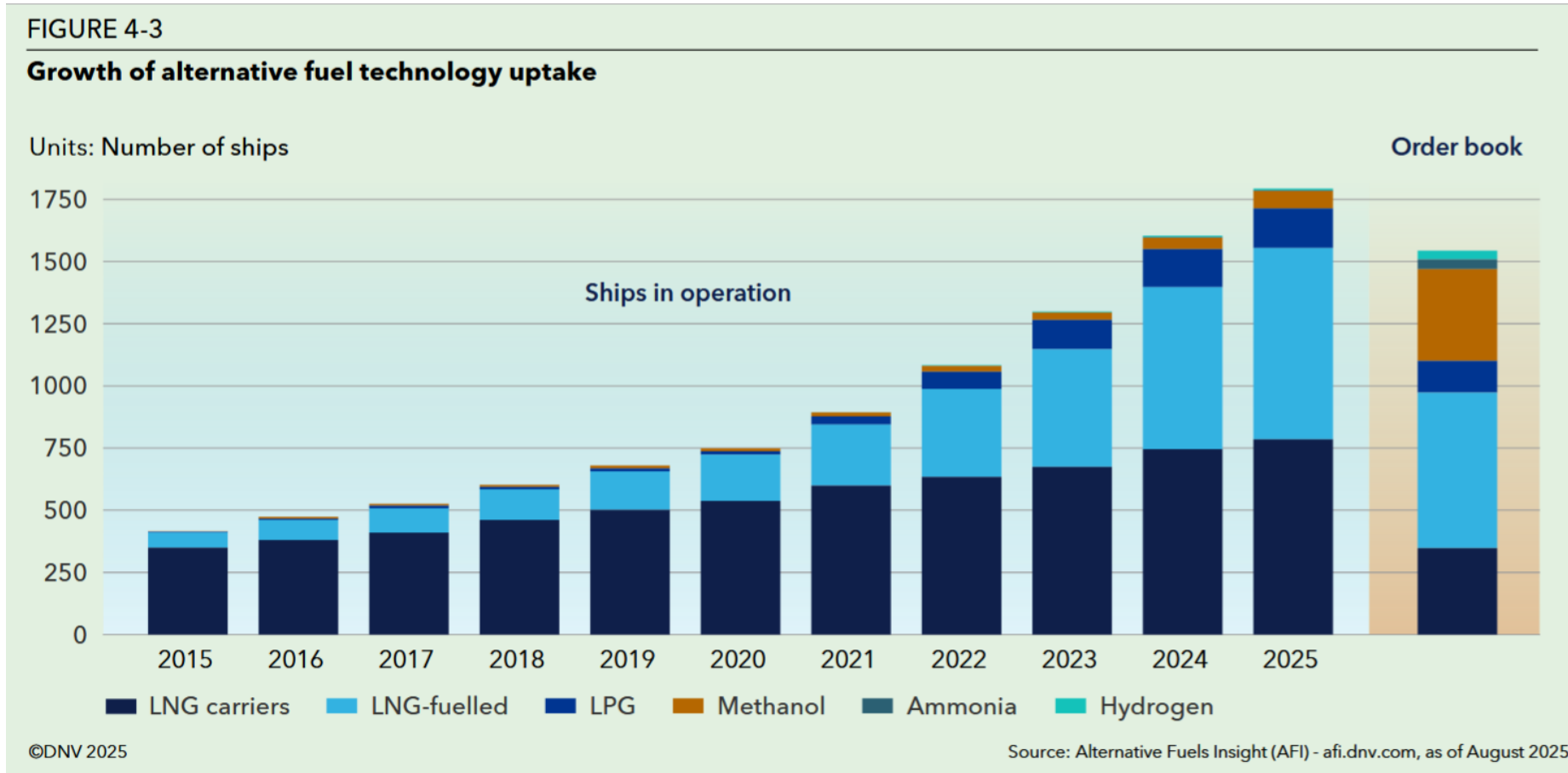
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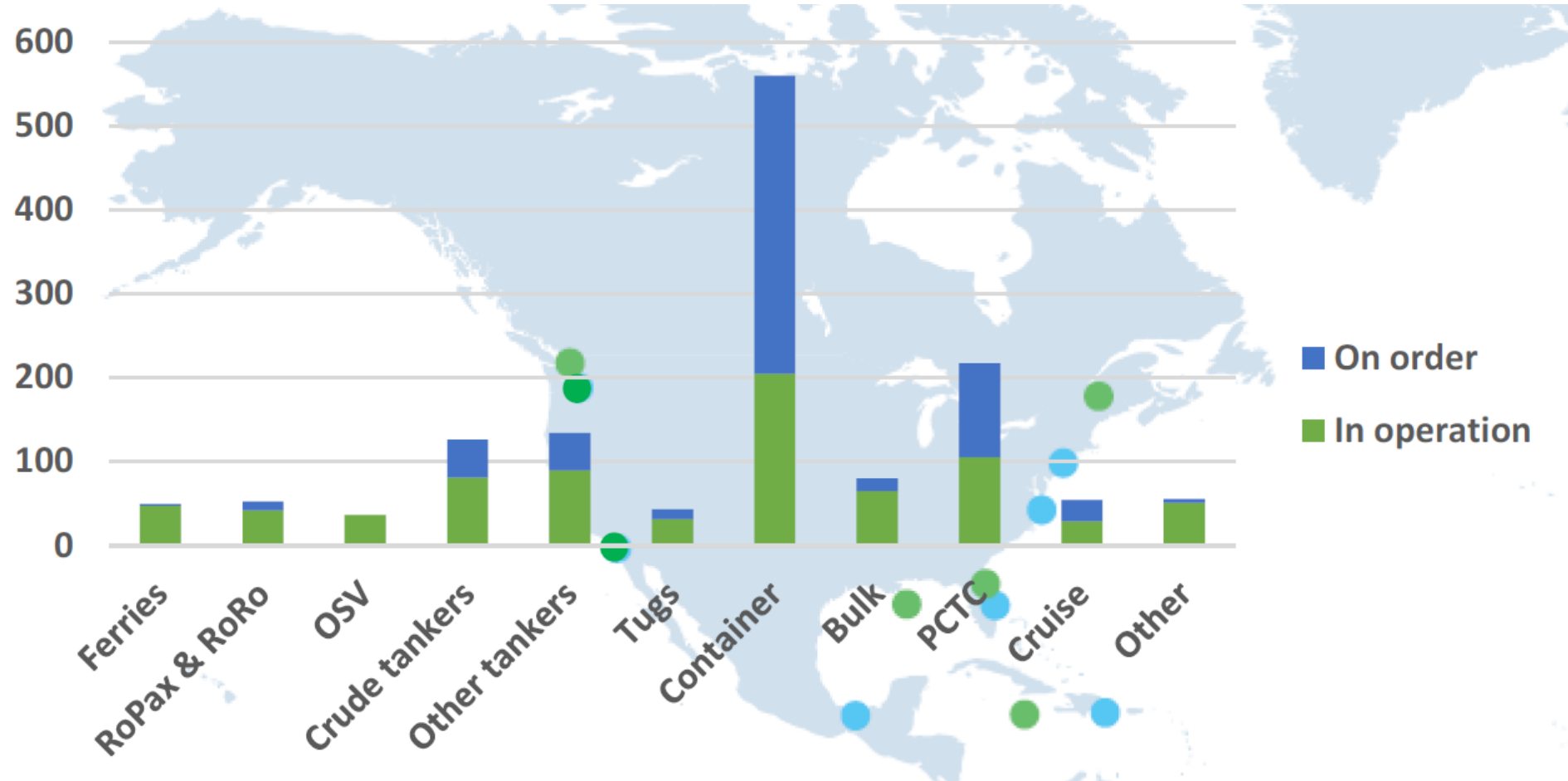
# *Introduction*

# Current situation - LNG-fuelled vessels are increasing



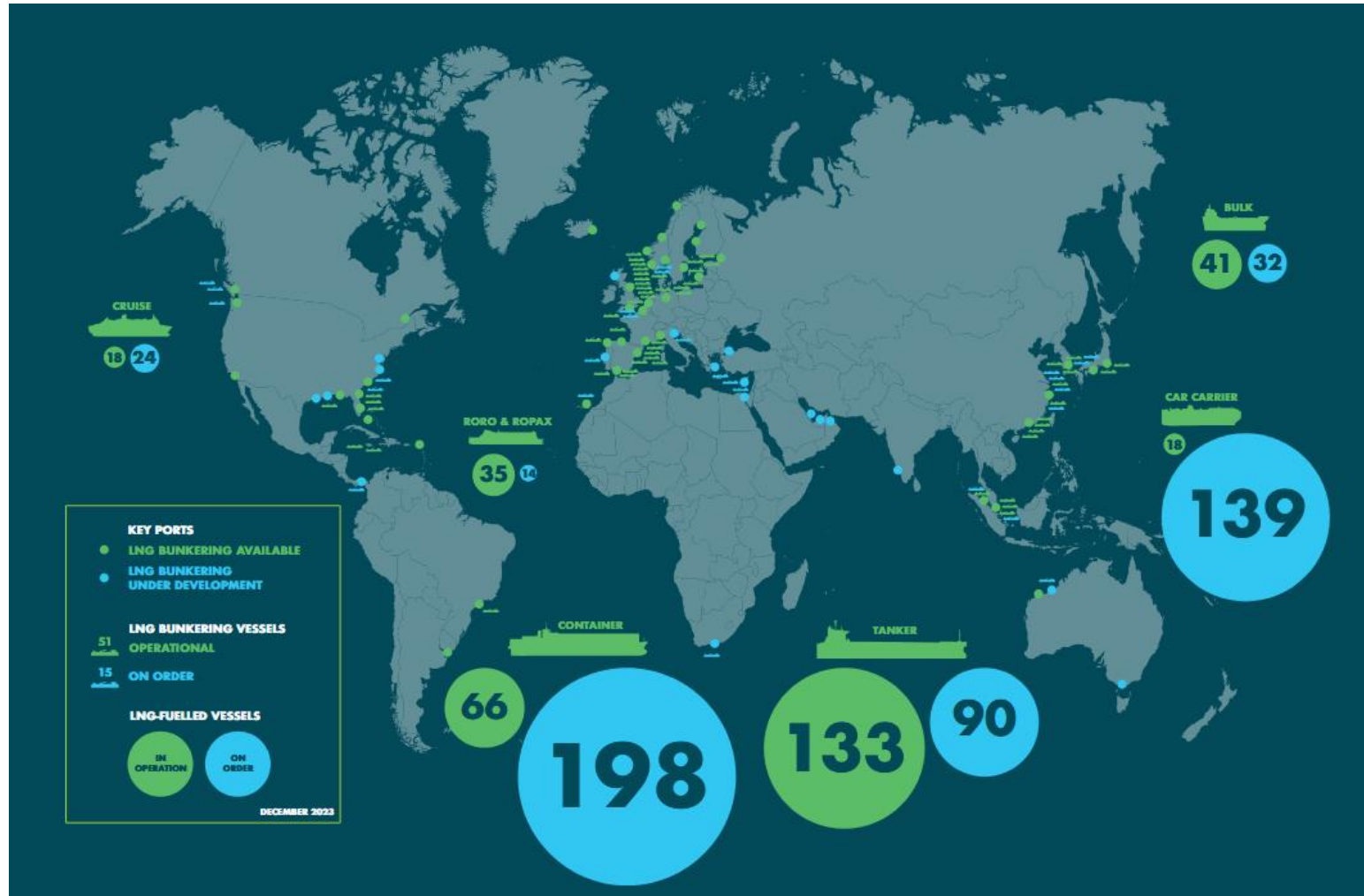
Source: DNV (2025) *Energy Transition Outlook 2025*. Maritime forecast to 2050, [www.dnv.com](http://www.dnv.com).

# LNG-fuelled fleet by vessel type



Source: Steve Esau – SEA-LNG (2025) Biomethane and maritime decarbonization. Presentation at the European Biogas Conference - Biomethane: competitiveness at the steering wheel, 15th October 2025

# World-wide growth on LNG use and infrastructure



Source: SEA-LNG (2025) LNG – Leading maritime decarbonisation – A view from the bridge

[https://sea-lng.org/wp-content/uploads/2024/01/24-01-28\\_FINAL\\_A\\_View\\_From\\_The\\_Bridge\\_2024.pdf](https://sea-lng.org/wp-content/uploads/2024/01/24-01-28_FINAL_A_View_From_The_Bridge_2024.pdf)

# What is bio-LNG / biomethane?

... methane that is produced from biomass-based resources:

## Anaerobic digestion/Biogas (on the market):

In a biotechnological process the biomass (e.g. organic wastes such as sewage sludge, food waste, agricultural wastes, ...) is converted to biogas (a mixture of CH<sub>4</sub> and CO<sub>2</sub> and other trace gases). This biogas can be further purified to biomethane.

## Thermal gasification (close to the market):

In a thermal gasifier the biomass (e.g. wood residues) is converted to syngas (CO, H<sub>2</sub>, CH<sub>4</sub>, CO<sub>2</sub>, ...) which can then be further converted in a methanation step to biomethane.

In general biomethane/ bio-LNG has similar properties as natural gas.

# The role of biogas and biomethane in pathway to net zero



## The role of biogas and biomethane in pathway to net zero

Biogas is produced as the main product of anaerobic digestion (AD) of wet biomass. Biogas can be used locally for heat purposes or for power and heat production (CHP); as an alternative, biogas can be upgraded to bio-methane to replace natural gas. As such, it is one of the means to reduce the consumption of fossil fuels and contribute to the transition towards a net zero energy system.

This position paper - developed by members of IEA Bioenergy Task 37 ("Energy from Biogas") - provides a holistic perspective on the roles of biogas and biomethane. The main conclusion is that biogas and biomethane have a range of options which can be employed in pathways to net zero. They provide sustainable flexible systems that play essential roles in circular economy, energy, and environmental systems.

## PERSPECTIVES OF BIOGAS AND BIOMETHANE

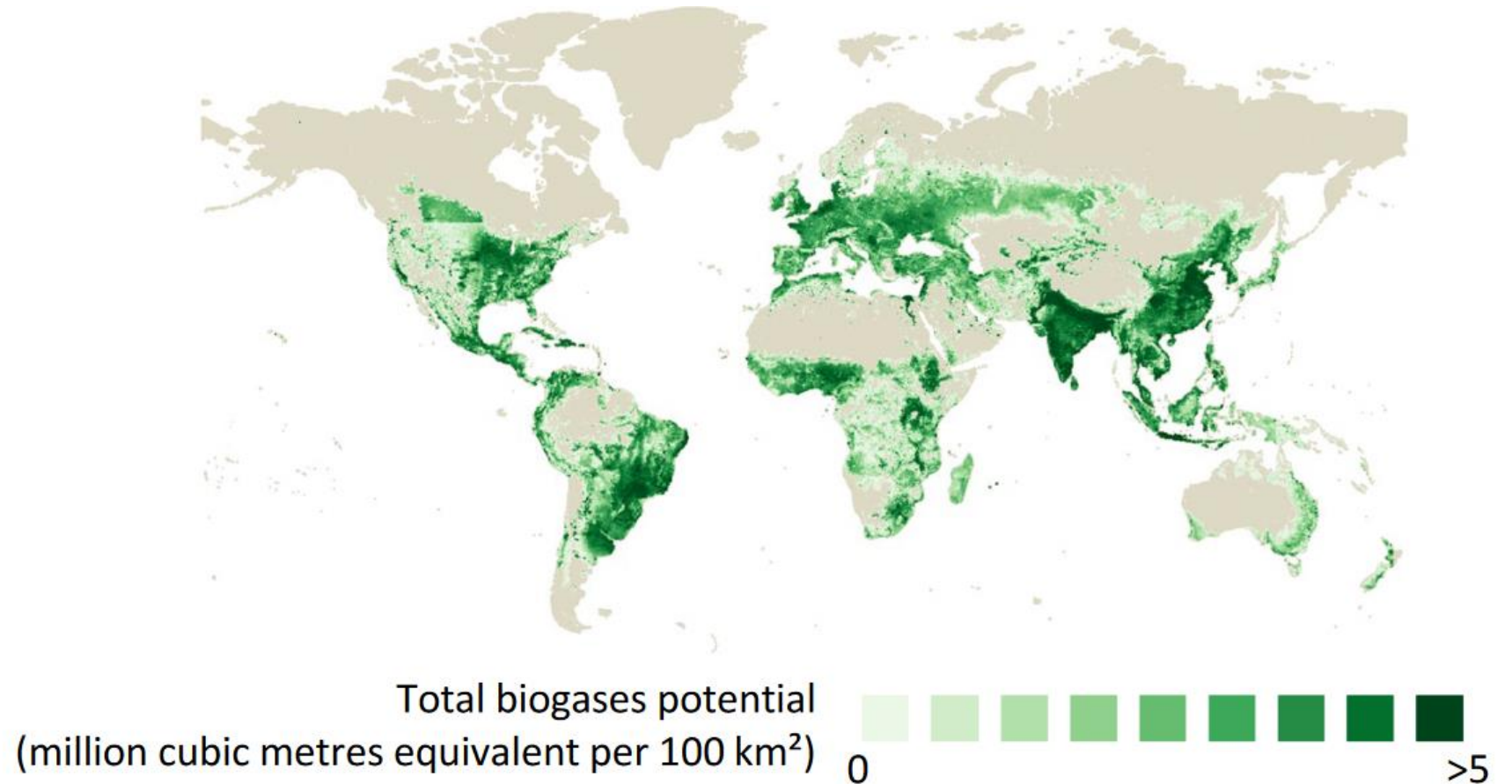
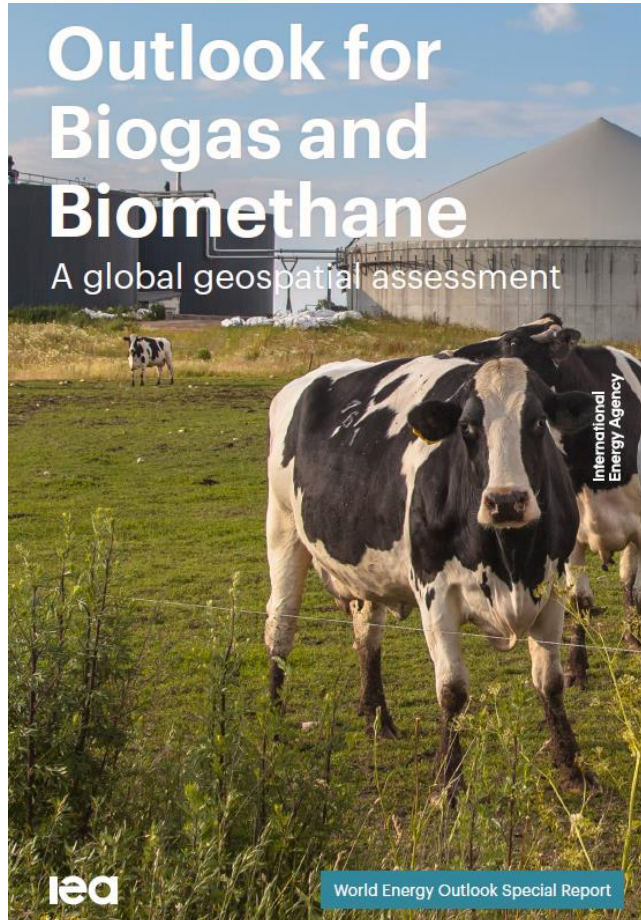
### Pathway to Net Zero

The pathway to net zero requires far more than provision of renewable electricity. We must employ renewable hydrocarbons in the form of liquid and gaseous fuels with minimum carbon intensity. Indeed, we must go beyond energy and employ renewable green hydrogen in the production of chemicals such as ammonia (NH<sub>3</sub>) and methanol (CH<sub>3</sub>OH), and for steel. When we produce biomethane (CH<sub>4</sub>) or green hydrogen (H<sub>2</sub>), we are in both cases producing renewable hydrogen molecules within a renewable gas. We need these renewable gases and renewable hydrocarbons for dispatchable electricity, for long term energy storage and for sectors where electricity has limited applications. These applications (termed the hard to abate sectors) include: heavy-duty, long-distance transport (trucks, ships and planes); high temperature industrial heat (food and beverage sector, steel production, glass production); agriculture (renewable fertiliser such as green ammonia and biofertiliser); and chemical production (such as methanol).

- The pathway to net zero requires far more than provision of renewable electricity
- Biomethane as replacement for natural gas - can be fed into existing gas infrastructure
- Biogas and biomethane systems are mature and multi-functional
- Biogas systems can contribute to energy security since the whole production chain can be set up and operated locally
- Biogas production can utilize a wide variety of organic feedstocks

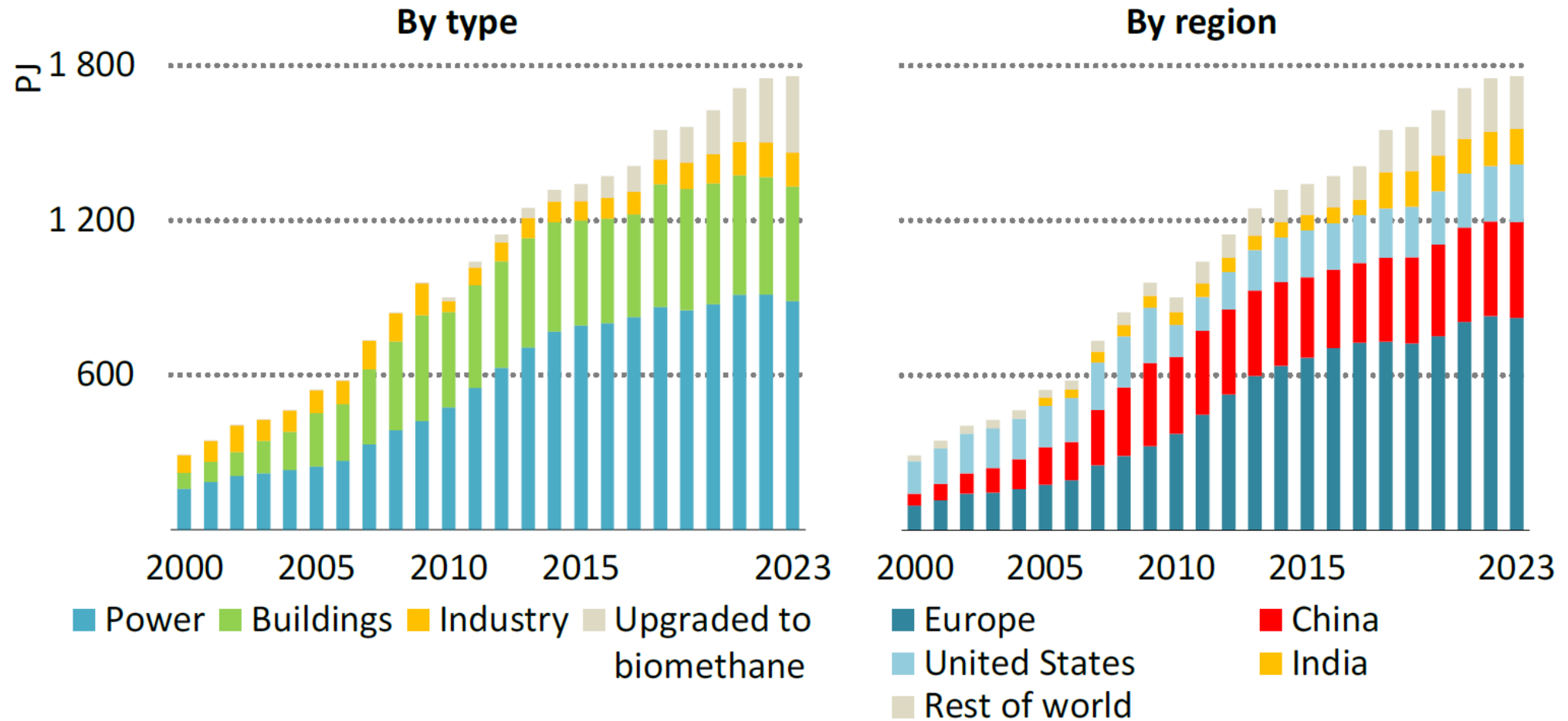
# *Biomethane / Biogas as a renewable fuel*

# IEA Headquarter report - Biomethane/Biogas outlook



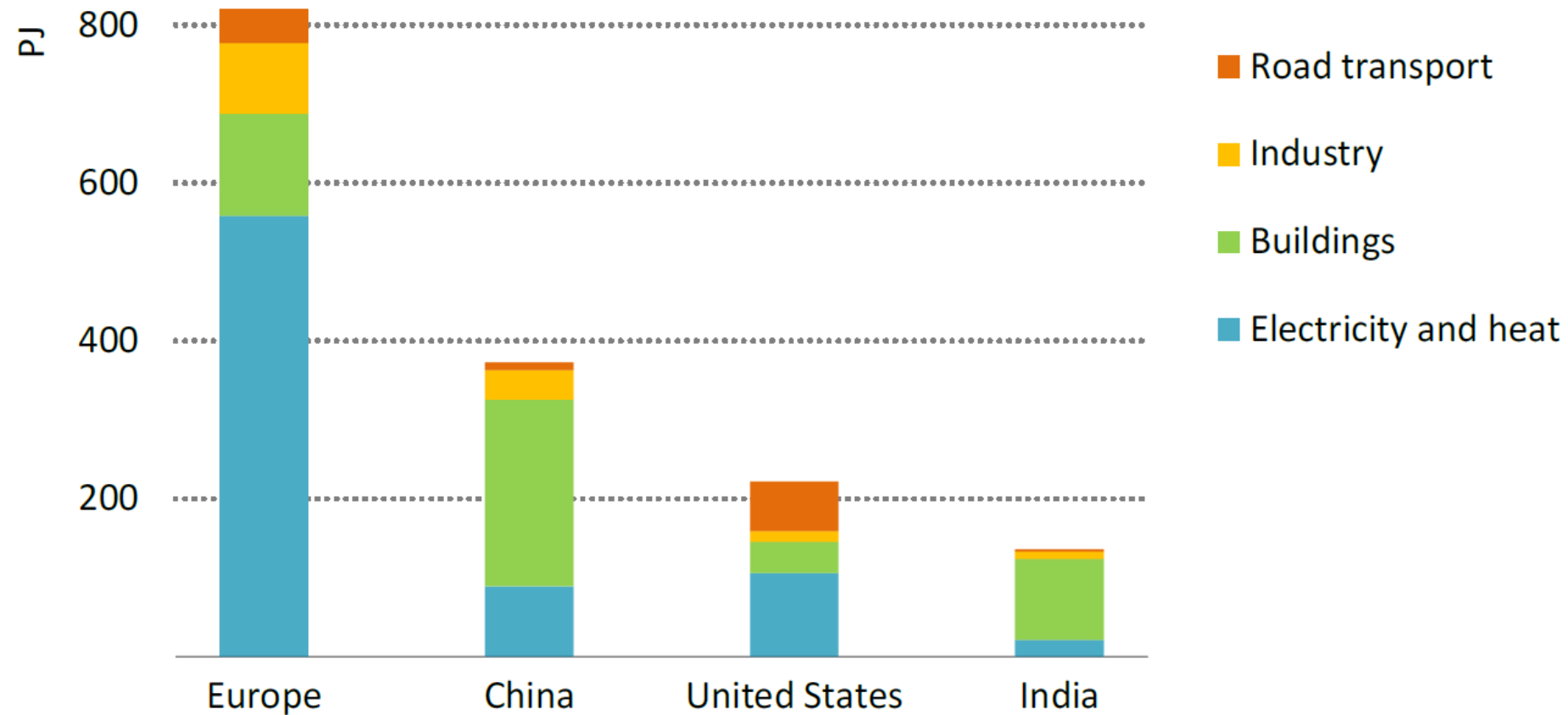
Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# Production of biogases by use type / region, 2000-2023



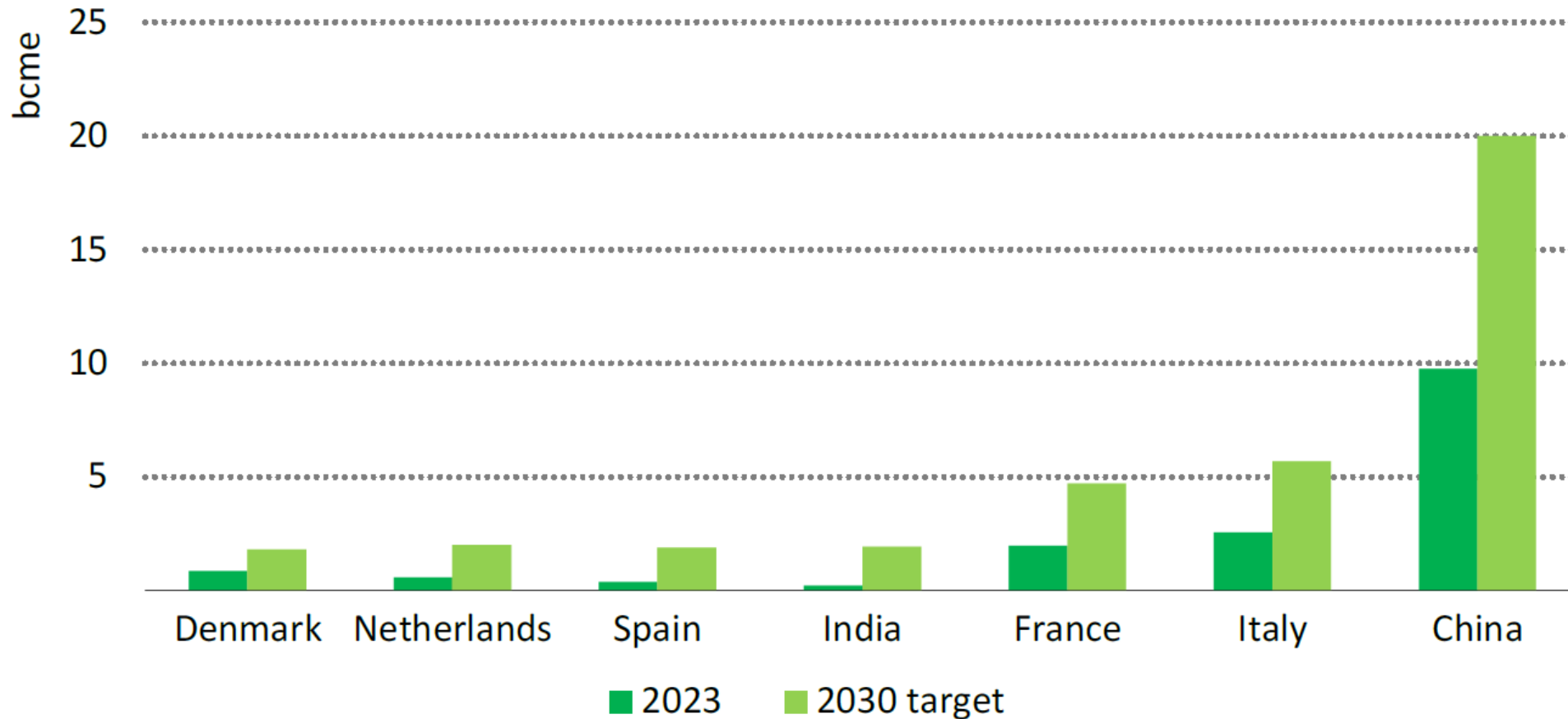
Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# Main uses of biogases in selected regions, 2023



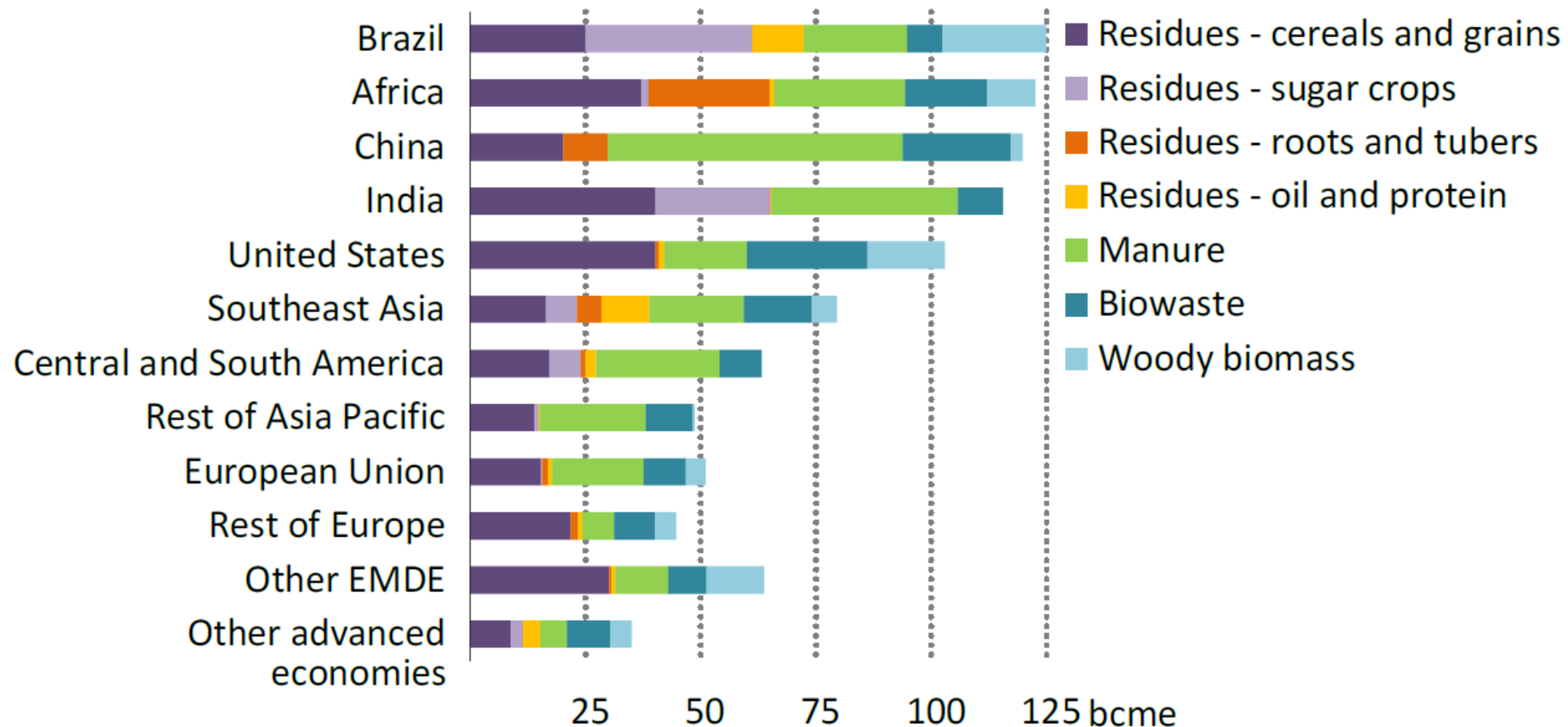
Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# Production of biogases in 2023 and targets for 2030 in selected countries



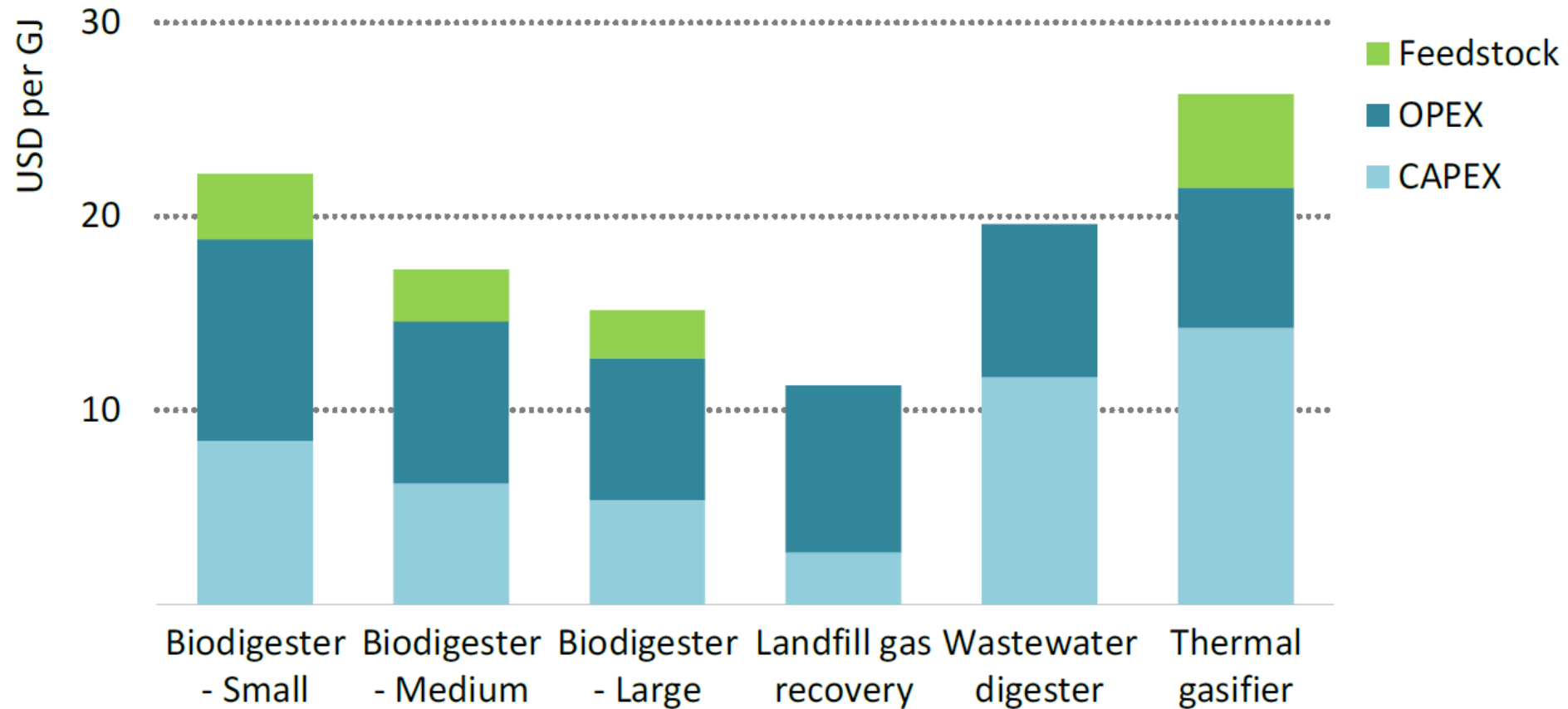
Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# Potential for biogases by region and by feedstock type



Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# Total average estimated costs of producing biomethane by technology



Source: IEA – International Energy Agency (2025) Outlook for Biogas and Biomethane, <https://www.iea.org/reports/outlook-for-biogas-and-biomethane>

# *Discussion/Statements on using Biomethane as Maritime Fuel*

# Bio-LNG shows high potential for application as fuel

Progress status		Low GHG fuels				
		Bio-based diesel / e-diesel (mono-fuel vessels)	Bio-LNG/ e-LNG	Bio-methanol/e-methanol	Blue ammonia / e-ammonia	Blue H <sub>2</sub> / e-H <sub>2</sub>
Ship technologies	Technical maturity	Conventional (mature)	Mature	Limited engine models available	Under development	Under development
	Safety regulations	Conventional (mature)	Mature	Interim IMO guidelines	Interim IMO guidelines (high-level)	Alternative design approval process
	Vessels in operation* (number of vessels)	Majority of vessels in operation	1 539	70	3	8
	Order book* (number of vessels)	Majority of newbuild order book	966	336	38	33
	Potential annual fuel consumption (Mtoe)*,**	Majority of potential annual fuel consumption	~40	~6	~0.2	~0.04
Fuel supply	Global fuel production (Mtoe)	~20***	~9	~1	~0.1	~3
	Supply to shipping (Mtoe)	~0.7	~0.1	~0.1	0	0
Infrastructure	Bunkering facilities (dedicated facilities only)	>670	106	3	1	1

©DNV 2025 \*values include vessels using cargo as fuel, e.g. liquefied natural gas (LNG) carriers, methanol tankers, and ammonia tankers; \*\*includes vessels in operation and order book; \*\*\*only accounting for bio-based diesel produced from non-food and non-feed sources

Source: DNV (2025) *Energy Transition Outlook 2025*. Maritime forecast to 2050, [www.dnv.com](http://www.dnv.com).

# World Biogas Association - Biomethane as maritime fuel?

## Advantages:

- bio-LNG as shipping fuel virtually eliminates SO<sub>x</sub>, drastically cuts NO<sub>x</sub>, and slashes particulate emissions
- bio-LNG could realistically cover up to 3% of the total energy demand for shipping fuels in 2030, increasing to 13% in 2050
- Studies suggests that bio-LNG is the lowest cost green fuel, with significantly lower costs of production compared with bio-methanol and electro-fuels (e-fuels), including e-ammonia and e-methanol

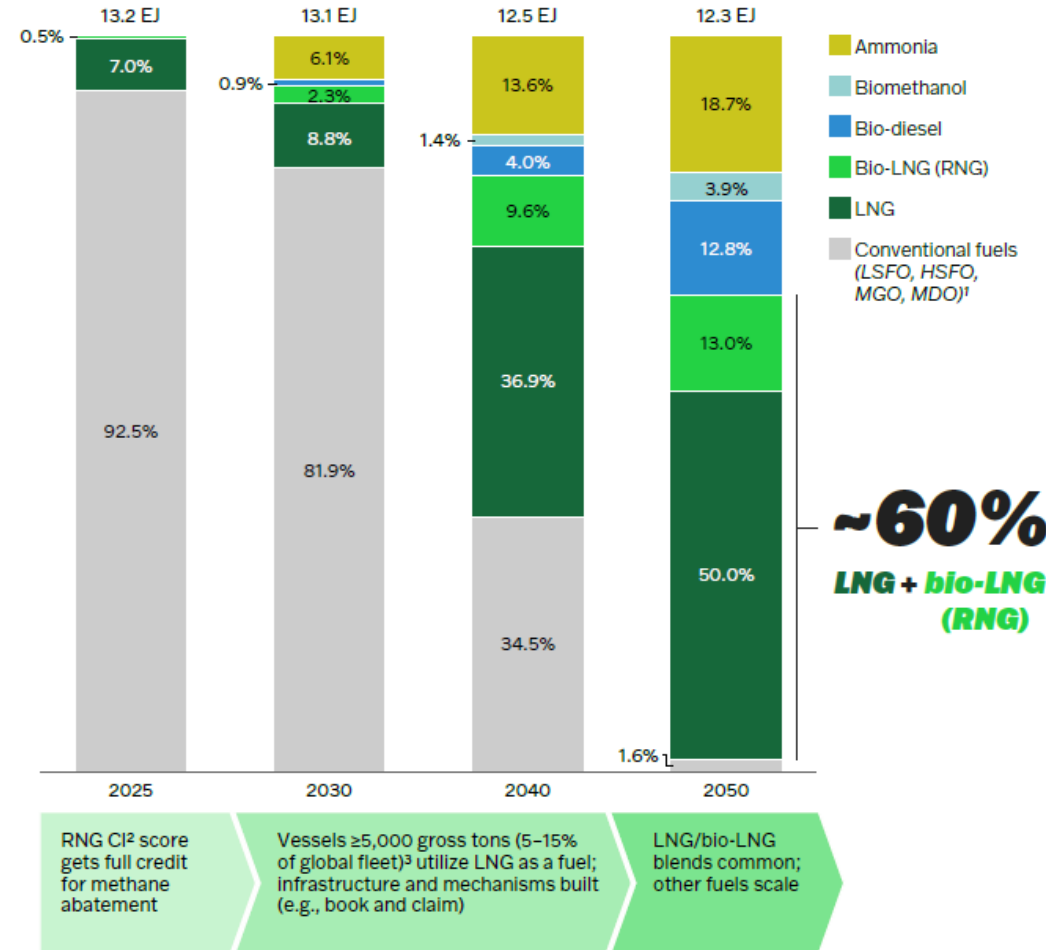
## Drawbacks:

- Supply constraints: Global biomethane production must scale; policy and investment support can accelerate capacity expansion
- Methane slip: Technology solutions (engine improvements, after-treatment systems) are emerging to mitigate leakage
- Competing uses: With competing demands for biomethane across multiple sectors, the maritime industry's prospects will depend on a combination of market dynamics, domestic demand and geographical positioning to determine its relative favourability

Source: World Biogas Association (2025) *Biomethane as a maritime fuel – position statement*, <https://www.worldbiogasassociation.org/biomethane-fuel-a-critical-component-to-decarbonise-the-maritime-industry-and-meet-climate-targets/>

# Bio-LNG and LNG together could comprise 60% of the global maritime shipping fuel mix (by 2050)

Maritime shipping fuel mix



# *Conclusions*

# Conclusions

- LNG infrastructure and LNG-fuelled vessels are increasing which gives bio-LNG an opportunity as drop-in solution
- Other future options such as e-Methane/e-LNG or bio-LNG from gasification can also use the same infrastructure
- Biomethane is an existing technological solution with increasing world-wide production (2023: 1,800 PJ of Biomethane+Biogas)
- Scaling world-wide production is a challenge - sustainable approaches have to be guaranteed (carbon intensity!)
- Competing use of biomethane is an issue
- Biomethane is currently cheaper than other options, such as bio-methanol and electro-fuels (e-fuels), including e-ammonia and e-methanol

Thank you for your attention!

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