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Turning waste into wealth: The strategic role of biomethane in a net-zero future

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Executive summary

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Biomethane is rapidly emerging as a cornerstone of Europe's energy transition—offering a rare convergence of climate alignment, energy sovereignty, waste management, and economic resilience. In a geopolitical context shaped by the Russia–Ukraine war, volatile fossil gas markets, and the European Union's 2040 climate targets, biomethane presents a unique infrastructure-ready solution. Produced from organic waste streams such as agricultural residues and animal effluents, it is chemically identical to fossil gas and compatible with existing infrastructure—making it deployable at scale without costly retrofits.

For investors, biomethane represents a compelling asset class: it aligns with decarbonization mandates, benefits from diversified revenue streams, and is increasingly supported by market-based policy mechanisms such as Germany's GHG quota system. Beyond its role as a renewable fuel, biomethane unlocks additional value through by-products like digestate and captured CO_2, which can be monetized in agriculture and industrial applications.

Crucially, biomethane is not just a climate-aligned energy source—it is also a scalable solution to systemic waste and environmental challenges. Anaerobic digestion facilities serve as essential infrastructure for managing biowaste, reducing nitrate pollution, and supporting nutrient recovery flows.

In sectors where fossil gas is used not just for combustion but as a chemical feedstock—such as fertilizer production—biomethane offers a potential replacement that avoids costly retrofits. Unlike fossil gas, whose prices fluctuate with geopolitical shocks, biomethane's LCOE has remained relatively stable. Producers can secure predictable cashflows through long-term agreements such as Biomethane Purchase Agreements (BPAs), feed-in tariffs, and fixed price contracts such as take or pay.

The EU's Renewable Energy Directive III (RED III) sets ambitious sector-specific decarbonization targets, with transport emerging as a critical gap. Despite electrification efforts, transport emissions have risen since 2014. Biomethane, particularly in the form of bioLNG and bioCNG, offers a scalable and immediate solution for hard-to-electrify segments like heavy-duty transport and maritime shipping. Germany's GHG quota system serves as a blueprint for other Member States, including France, which is adopting similar frameworks in the transportation sector. These systems reward fuels with the highest emissions savings and introduce market-driven flexibility. As EU policy and national mandates shift toward carbon-intensity-based frameworks, sustainability credentials are becoming central to pricing power and bankability.

However, the evolution of regulatory frameworks remains a risk. Germany's draft transposition of RED III—by eliminating double-counting for advanced biofuels and extending greenhouse reduction targets to 2040—would offer greater planning certainty and help combat fraud involving falsely labeled sustainable biofuels. In this landscape, resilient offtake structures and the ability to contract revenues are essential for securing investor confidence.

Feedstock sustainability is central to Infranity's investment approach. Agricultural residues, livestock manure, and intermediate crops are prioritized for their environmental integrity and regulatory alignment. Dedicated energy crops, by contrast, raise concerns around land use and biodiversity. Digestate management also presents operational risks—requiring adequate storage, seasonal application planning, and compliance with nitrogen regulations.

Infranity applies a rigorous ESG methodology and site-level assessments to evaluate sustainability, operational resilience, and financial durability. This approach ensures that biomethane investments are not only bankable but also future-proof—delivering long-term value across environmental, social, and economic dimensions.

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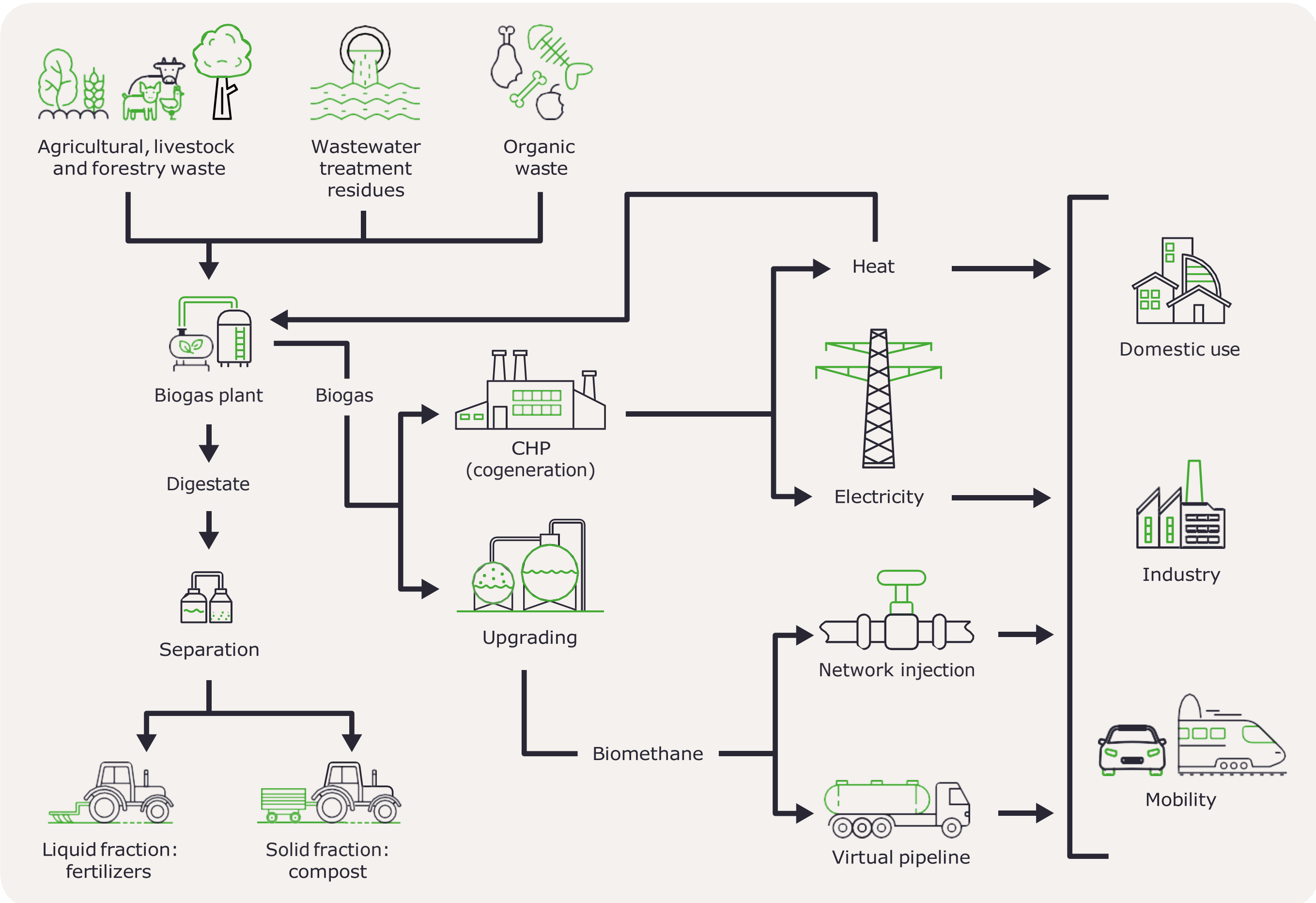
Biomethane:
Thinking beyond climate

Amid the ongoing Russia–Ukraine war, the erratic trajectory of U.S. trade policy —and the European Union's looming 2040 climate targets, **the triad of sustainability, sovereignty, and affordability concerns has emerged at the forefront of the EU's energy and infrastructure debate.** Within this evolving geopolitical and regulatory landscape, biogas and biomethane are emerging as critical enablers of Europe's energy transition. As a locally sourced, renewable alternative to fossil gas, bioenergy offers a rare convergence of climate alignment, energy independence, waste management and cost resilience. Biomethane can be stored, dispatched, and integrated into existing gas infrastructure — making it a uniquely "infrastructure-ready" solution. **For investors, this translates into a compelling proposition: a scalable asset type that aligns with decarbonization mandates while reinforcing regional energy sovereignty.**

Biogas is a renewable gas produced through the anaerobic digestion of organic materials such as agricultural residues, animal manure, and food waste. When upgraded to remove impurities, it becomes biomethane — a high-purity gas chemically equivalent to fossil natural gas. Biomethane can be used exactly like it's fossil counterpart, without any adaptation of equipment or processes. Beyond its role as a renewable fuel source, biomethane can thus be used across multiple industrial applications. In addition to biomethane being used for residential and industrial heating or as a feedstock in the chemical and fertilizer industries, the by-products of anaerobic digestion — such as CO_2 and digestate — offer further commercial opportunities. Captured CO_2 can be liquefied and sold for use in the food and beverage industry, while digestate, rich in nutrients like nitrogen and potassium, can be applied directly as organic fertilizer or further processed into commercial-grade fertilizers.



Biogas/Biomethane Value Chain

This makes biomethane production not only climate-aligned but also economically resilient. Producers who can efficiently capture value across the whole production chain — while maintaining a competitive levelized cost of energy (LCOE) around 90-100/€MWh — are best positioned to succeed. This success is particularly relevant in a market increasingly shaped by sustainability mandates, and a shift from traditional supply-side subsidies (such as feed-in tariffs and premiums) toward market-based mechanisms, such as Germany's GHG quota system for the transport sector.

Before diving into market specifics and policy mechanisms, it's important to highlight that the relevance of biomethane extends well beyond climate ambitions and energy security. Across Europe, biowaste management is emerging as a critical environmental and regulatory challenge. As national targets for reducing waste incineration become increasingly ambitious, the need to divert biowaste from conventional waste streams is more urgent than ever. In particular, animal effluents, particularly due to their contribution to nitrate pollution in soils and groundwater, are posing broader environmental issues. Today, less than 8% of livestock manure produced is treated to reduce emissions, despite its significant role in eutrophication, soil acidification, and biodiversity loss.

In this context, anaerobic digestion facilities are not merely energy assets — they are essential environmental infrastructure. They offer local communities and farmers a practical and scalable solution for managing organic waste, while simultaneously producing renewable energy, nutrient-rich digestate, and CO_2 for industrial reuse.

Biomethane production, therefore, is not just a climate-aligned option — it is a ground-level solution to systemic agricultural and ecological challenges, and an effective tool in regions where waste management and environmental protection are deeply intertwined.

While multiple decarbonization pathways exist — from heat pumps replacing gas heaters in buildings to battery energy storage systems (BESS) supporting intermittent renewables — biomethane occupies a distinct and irreplaceable niche. In sectors where fossil gas is used not just for combustion but as a chemical feedstock — such as in fertilizer production — other alternatives are not viable without overhauling or fundamentally redesigning entire production processes. Here, biomethane offers a potential- replacement that can be injected into existing gas infrastructure without disrupting operations or requiring costly retrofits.

Unlike fossil gas, whose prices have swung dramatically in response to geopolitical and economic shocks the levelized cost of energy (LCOE) for biomethane has remained relatively stable. Biomethane producers can secure predictable cashflows by diversifying their routes to market and locking in long-term, stable agreements. One common strategy is to enter Biomethane Purchase Agreements (BPAs) with utilities or industrial off-takers, which fix volumes and prices over 10–15 years and often include premiums for the gas's green attributes. Another route is leveraging government support schemes – many leading countries offer feed-in tariffs, premium prices, or contracts-for-difference for biomethane injected into the grid, providing steady income insulated from commodity volatility. Renewable fuel markets also play a key role: when used as vehicle fuel, biomethane earns tradable credits (such as Germany's GHG quotas or Italy's biofuel certificates), which producers can monetize through long-term deals with fuel suppliers.

In practice, successful biomethane projects either use one of these or blend these avenues – securing fixed-price offtake contracts such as take or pay, tapping into policy incentives, and selling Guarantees of Origin or other green certificates– to ensure reliable, multi-year revenue streams and investor confidence.

For instance, in Germany, even in the event of an extensive oversupply of biomethane, it is expected that the floor price would align with the LCOE of typical biomethane projects at scale—biomethane targeting volumetric markets, typically traditional crop-based biomethane (+10 gCO_2/MJ) between €85–95/MWh, while manure-based biomethane (-100 gCO_2/MJ) between €110–130/MWh. This relative stability is underpinned by long-term offtake contract structure, local feedstock integration, and policy-driven demand — insulating producers from the commodity price swings that have plagued the gas market. However, it remains essential to maintain constant market monitoring and remain cautious to the risk of unforeseen shocks—whether regulatory or geopolitical—that could reshape pricing dynamics.

Yet despite its strategic relevance, biomethane faces two critical limitations that must be acknowledged. First, its cost remains significantly higher than fossil gas—compared to fossil gas averages that have historically hovered below €50/MWh outside crisis periods. This price gap, while partially offset by policy incentives and carbon credits, continues to challenge its competitiveness in unsubsidized markets. Second, the scale of biomethane production is still far from sufficient to meet the decarbonization needs of European Union.

Diverging mandates, converging goals: Biomethane in transport

The European Union (EU) has set ambitious decarbonization goals for all member states, including a minimum 55% reduction in greenhouse gas (GHG) emissions by 2030 compared to 1990 levels, and a renewable energy consumption target of at least 42.5%, with aspirations to reach 45%, as outlined in the Renewable Energy Directive III (RED III). In addition to the major overall target, RED III encompasses sector-specific targets for transport, industry, buildings, and the heating and cooling sector. Biomethane's versatility allows it to serve multiple sectors—industry, transport, and buildings—each with distinct market opportunities shaped by national subsidies, carbon pricing mechanisms (such as EU-ETS in power and industrial sector) and energy efficiency mandates.

In the industrial sector, biomethane supports decarbonization by replacing natural gas in high-temperature processes whereas in buildings, it can be blended into heating systems to reduce carbon intensity, especially in regions where electrification is slower. However, despite the European Union's ambitious climate agenda, the transport sector remains the only major emitter in Europe where greenhouse gas (GHG) emissions have consistently increased since 2014—excluding the temporary dip during the COVID-19 pandemic.[1] This persistent trend exposes a critical gap in the continent's decarbonization strategy—one that electrification alone cannot bridge, in particular in the urgency of the decarbonization goals. While electric mobility is advancing, it currently lacks the scale, speed, and sectoral reach required to deliver the necessary emissions reductions, particularly in hard-to-electrify segments such as heavy-duty and long-mile transport and maritime shipping. Additionally, the supply constraints around raw materials for electric mobility are creating bottlenecks that limit rapid expansion.

Biofuels such as bioLNG[2] and bioCNG[3] —often dismissed as "transitional"—are increasingly proving to be structural components of the decarbonization pathway. Over the next decade, they will remain indispensable, in particular bioLNG, until the systemic challenges of full-scale electrification are resolved: battery scalability, cost competitiveness, payload limitations, and the electrification of long-haul corridors. In this context, accelerating the adoption of sustainable biofuels—particularly biomethane—is not merely an option; it is a strategic imperative.

Discussions are already underway among several EU stakeholders on how the proposed 2035 ban on internal combustion engine (ICE) vehicles needs to be adapted to allow the continued sale of combustion vehicles powered by sustainable biofuels and other low-carbon alternatives. While the EU's proposed ban on internal combustion engine (ICE) excludes heavy-duty vehicles (HDV)—the major offtaker of biomethane— the CO_2 standards for HDVs should adopt a lifecycle approach. This would ensure greenhouse gas (GHG) emissions are accounted for from production to end-use, thereby reinforcing biomethane's role as a sustainable, long-term solution for transport decarbonization. Meanwhile, EU Member States are intensifying their efforts, driven in part by sector-specific mandates under the RED III directive, which requires defined GHG reductions in transport relative to 1990 levels.

In 2023, the European Union (EU) adopted an amendment of the Renewable Energy Directive, which is referred to as "RED III". It thereby raised the collective target for renewable energy consumption across all sectors in Europe significantly to at least 42.5 % in 2030.

1. https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emissions-from-transport
2. Liquid Natural Gas
3. Compressed Natural Gas

These targets are prompting national governments to adopt more sophisticated policy instruments to scale up biofuel deployment. As the Directive defines targets without prescribing implementation pathways, Member States are responsible for developing their own national strategies—resulting in varying levels of policy maturity across the EU.

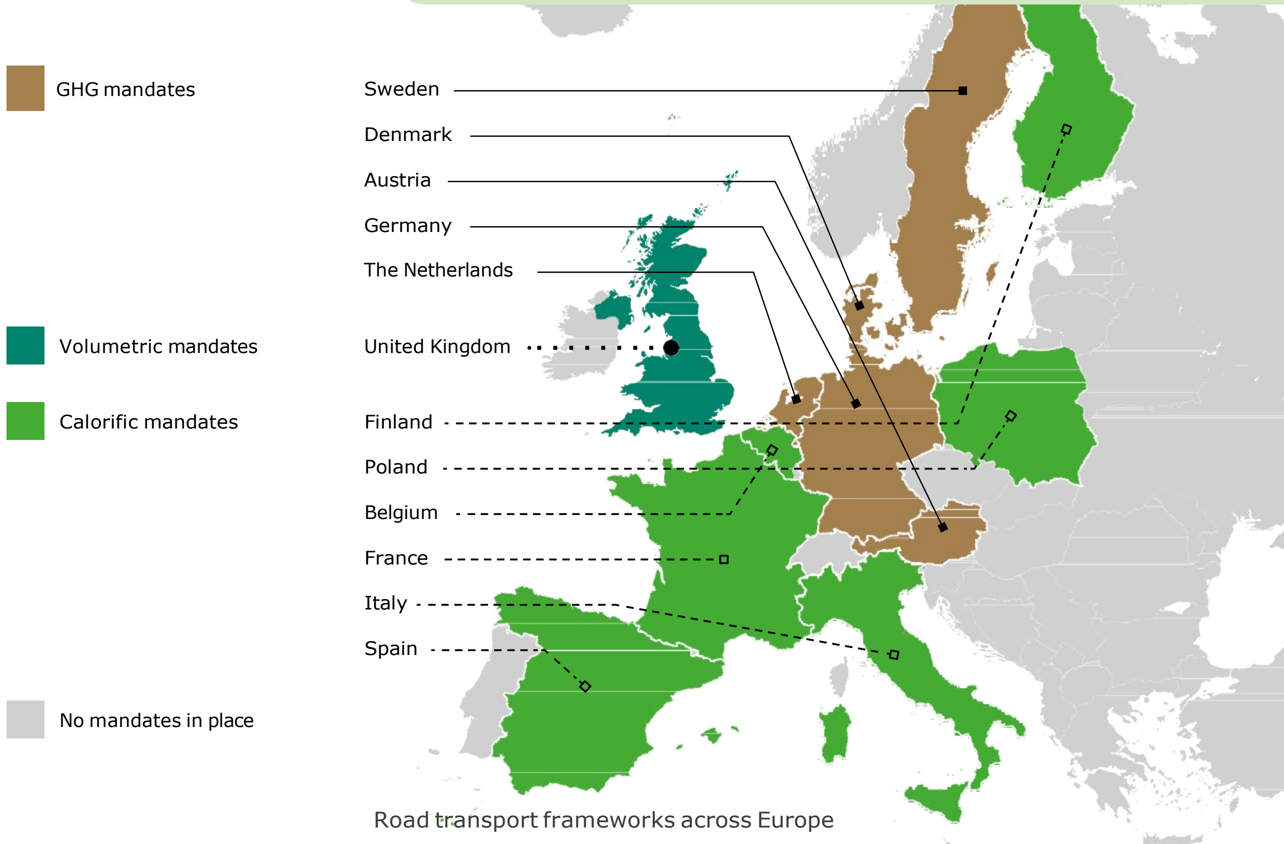
Germany has taken a leading role in this transition, with its market-based GHG quota system serving as a model for others. France, for instance, has announced plans to adopt a similar GHG-based mandate. Given the influential role that France and Germany play in the European policy ecosystem, the future of biofuel policy in Europe is likely to shift further toward carbon-intensity-based frameworks, with Germany's system offering a blueprint. This approach not only incentivizes fuels with the highest emissions savings but also introduces market-driven flexibility—allowing obligated parties to pursue the most cost-effective decarbonization pathways. Over time, more Member States are expected to move away from rigid volumetric or calorific blending targets and adopt GHG-based systems.

While there is growing consensus around the long-term role of carbon-based markets in transport decarbonization, the evolution of

FOCUS POINT

Anaerobic digestion in Germany

Germany's anaerobic digestion (AD) sector initially boomed by using dedicated energy crops (like maize) as feedstock, spurred by generous feed-in tariffs in the 2000s that incentivized thousands of farm-based biogas plants. However, this crop-centric expansion led to pushback: concerns about food-vs-fuel competition and "maize monocultures" driving up land rents prompted policymakers to tighten regulations in the 2010s – for example, the 2014 Renewable Energy Act revision slashed subsidies and imposed sustainability criteria to restrain excessive energy crop use. At the same time, Germany created a more favorable context for biomethane in transportation by introducing greenhouse gas reduction quotas for fuel suppliers (starting in 2015) and expanding biogas upgrading, so that by 2020 over half of the country's CNG filling stations were dispensing biomethane as vehicle fuel. Today, with roughly 9,600 biogas installations already in place, the industry's focus has shifted from building new plants to upgrading existing ones. These upgrades are driven by the need for new revenue models once 20-year feed-in tariffs expire and by new market opportunities for renewable gas. By converting biogas to pipeline-quality biomethane, operators can tap into transportation fuel quotas and natural gas markets, allowing older AD plants to stay profitable without traditional subsidies. The result is a shift in Germany's biogas landscape – fewer new digesters being built, but more existing biogas plants being transformed into biomethane suppliers to ensure long-term viability in a post-subsidy era. Yet a major drawback remains: the industry is still largely locked into energy crops – roughly half of German biogas feedstock comes from cultivated crops (mostly corn silage) – making it challenging to pivot toward waste and manure sources after years of crop-focused growth. Switching from crop-based feedstock to manure requires technical know-how and is capital intensive, primarily due to the significant difference in the energy yields (MWh)—manure requires approximately 10 times the volume to produce the same amount of energy (MWh) as energy crops.



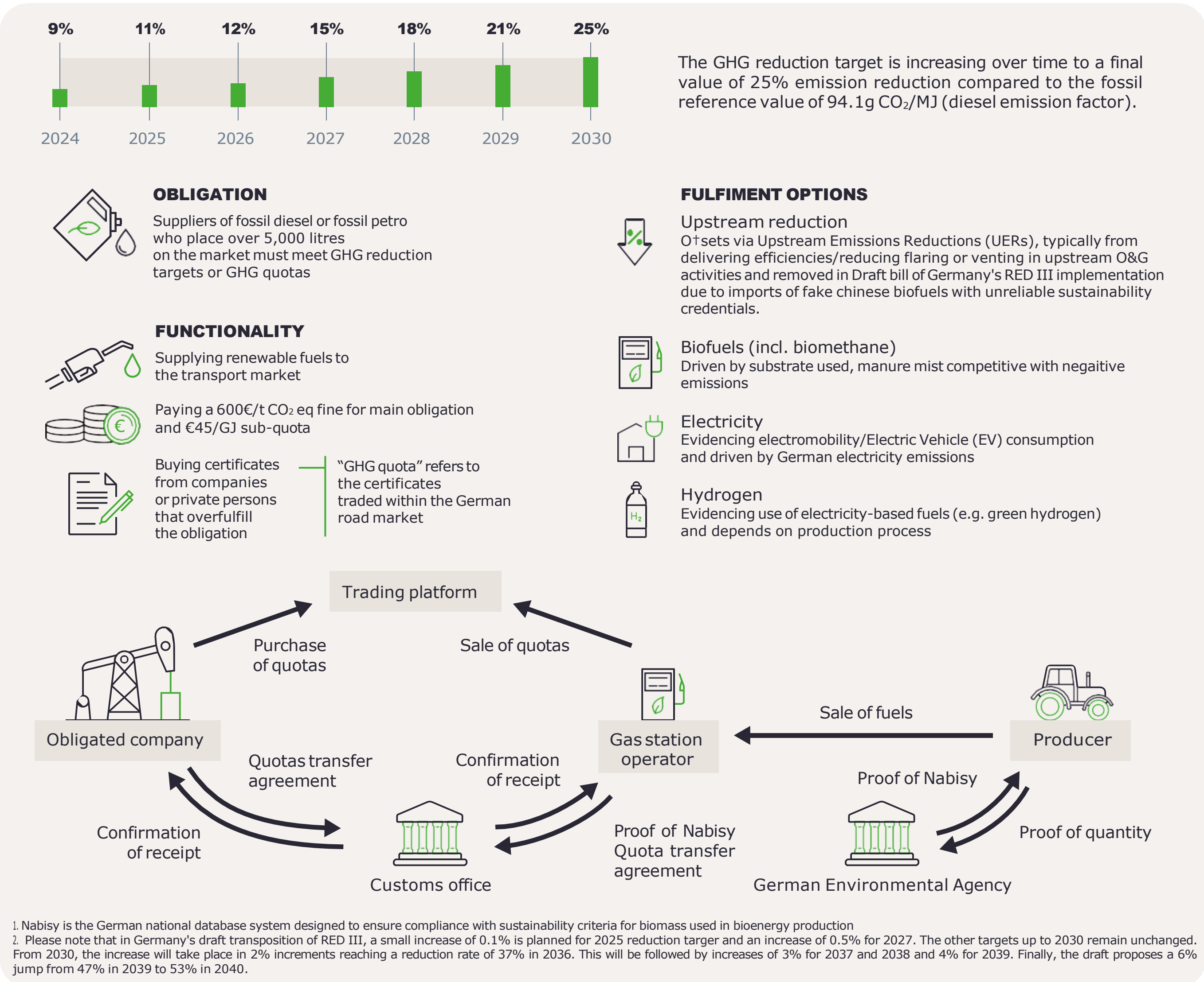
Road transport frameworks across Europe

regulation requires constant attention—particularly for project financing. A recent example is Germany's draft RED III transposition, which proposes to eliminate the double-counting mechanism for advanced biofuels and increasing the GHG reduction quotas through 2040. Removing double counting[4] is potentially a step in the right direction, as it could reduce the discrepancy between real and virtual climate protection—ensuring that reported emissions savings more accurately reflect actual decarbonization outcomes. This shift could potentially also stimulate demand for 'real' GHG tickets and raise their unitary price (without the multipler effect), potentially making double-counting unnecessary. Furthermore, the inclusion of the aviation sector within the same GHG quota scheme as road transport would also positively stimulate demand for GHG quotas that must be fulfilled, reinforcing the importance of GHG quota scheme. The exact pricing dynamics will need to be closely monitored if and when the regulation is formally enacted.

In this evolving policy landscape, the structuring and resilience of offtake agreements have become central to project viability and bankability. Securing long-term contracts that lock in volumes at defined prices not only stabilizes revenue streams but also provides a critical hedge against regulatory uncertainty—an essential consideration for infrastructure investments.

Moreover, the growing emphasis on biofuels derived from waste and residues, alongside tightening restrictions on crop-based alternatives, underscores that sustainability credentials are no longer peripheral. They have become a core driver of pricing power and negotiation leverage in biomethane offtake discussions.

4. Where the advanced biofuels placed on the market by the obligated parties exceed the minimum percentage, suppliers have so far been able to have the fixed minimum quota counted twice towards the GHG quota. According to the draft, this will no longer be permitted.
5. International Sustainability and Carbon Certification



Germany's GHG Quota System (THG-Quote) in Transport

From waste to worth: Sustainable feedstock as a value driver

The sustainability of biomethane production is fundamentally shaped by the nature of its feedstock. Infranity's investment approach prioritizes feedstock strategies that align with ethics, environmental integrity, regulatory compliance, and long-term economic viability. Biomethane derived from agricultural residues, livestock manure, intermediate crops[5] if chosen well and organic waste is widely recognized as sustainable—an assessment reinforced by its inclusion in the EU taxonomy. These feedstocks not only avoid competition with food production but also deliver co-benefits such as improved waste management and reduced nitrate pollution. In contrast, the use of dedicated energy crops—such as maize or rapeseed—raises significant sustainability concerns due to land-use pressures, competition with food production and adverse impacts on biodiversity.

While animal effluents are inherently linked to meat and dairy production—industries with well-documented climate impacts—their responsible and optimized management through biogas production does not promote increased consumption of these products. Instead, it serves as a pragmatic solution to mitigate environmental harm. Given the distinct scale differences between agricultural activity and biogas infrastructure, there remains ample room to reduce overall consumption while still leveraging waste streams to lower greenhouse gas emissions.

To address these challenges, Infranity applies a rigorous, due diligence process, underpinned by its proprietary, sector-specific ESG methodology, to assess feedstock sustainability from both environmental, social and economic perspectives. This scrutiny is increasingly critical considering heightened EU oversight on the sustainability of imported biofuels—particularly following the suspension of ISCC[6] certification amid concerns over fraudulent Chinese imports.

While animal manure can be a sustainable feedstock, its proper handling remains essential to prevent disease transmission and environmental contamination. On-site visits and coordination with technical advisors are key to evaluating operational practices and feedstock management at the project level. These site-level assessments strengthen the investment case by providing direct insight into sustainability performance and risk mitigation.

Digestate: Sustainable potential, operational risk

Digestate—the nutrient-rich by-product of anaerobic digestion—is often highlighted as a successful example of resource recovery and environmental efficiency. When properly managed, it can displace synthetic fertilizers, return organic matter to soils, and help close nutrient loops. However, digestate also represents one of the most underestimated environmental and operational risks in biomethane project development. The challenge extends well beyond compliance with the EU Nitrates Directive. Digestate application is inherently seasonal, governed by crop cycles, soil conditions, and weather patterns. As a result, it cannot be applied uniformly throughout the year. This creates a critical need for adequate storage infrastructure—both in terms of volume and timing—to prevent over-application, runoff, or regulatory breaches.

From an investment perspective, digestate sizing is a material operational and financial variable. Undersized storage can lead to forced disposal, environmental penalties, or costly emergency logistics. Oversizing, on the other hand, inflates capital and operating expenditures without guaranteed utilization.

Infranity incorporates digestate management into its due diligence framework —supported by technical advisors— by assessing:

- Storage adequacy relative to feedstock mix and regional agronomic calendars;
- Land access and spreading agreements with local farmers;
- Regulatory constraints on nitrogen application and end-of-waste status;
- Potential for valorization into commercial-grade fertilizers or soil enhancers.

5. Intermediate crops are grown together with or between two main crops in a crop rotation, instead of leaving the soil bare.
6. International Sustainability and Carbon Certification

Infranity's edge: Navigating risks, seizing opportunities

Biomethane sits at the intersection of infrastructure-grade stability and carbon market volatility. While the sector offers long-term decarbonization potential, it also presents a complex risk landscape—from feedstock availability, sustainability and regulatory shifts to offtake concentration and market price exposure. Infranity's investment strategy is designed to navigate this complexity through a dual lens: seizing opportunity while mitigating risks.

Leveraging deep sectoral expertise and a proprietary ESG framework, Infranity applies a multi-dimensional due diligence process that spans the entire biomethane value chain with each project assessed not only for its climate impact but also for its operational resilience and financial durability.

While project-specific drawdown and financing structural protections based on project specifics remain essential—just as in any infrastructure financing—Infranity places equal emphasis on active engagement with project management and technical teams at the core. This dialogue is critical to understanding a project's agility: its ability to adapt, diversify in other markets with different regulatory mandates, or pivot in response to evolving market conditions and regulatory shifts. In a sector shaped by policy uncertainty and shifting incentives, this flexibility is not a luxury—it is a prerequisite for long-term success. This approach ensures that investments are not only bankable but also resilient and future-proof.

Infranity also recognizes that the biogas and biomethane sector remain under scrutiny from environmental stakeholders, particularly regarding the sustainability of feedstock sources. Ensuring that feedstock is derived from waste and residues—not from crops competing with food production—is central to navigating these concerns. Each project's contribution to climate change mitigation is evaluated against the EU Taxonomy's technical screening criteria and further validated through Infranity's proprietary sector specific net-zero methodology.

This rigorous approach is grounded in a clear theory of change: that targeted investment in sustainable biomethane infrastructure can simultaneously reduce emissions, improve waste management, and strengthen regional energy systems.

By aligning capital with measurable environmental and social outcomes, Infranity positions biomethane's potential not only as a climate-aligned infrastructure asset—but as a high-impact investment class capable of delivering long-term value across multiple dimensions.

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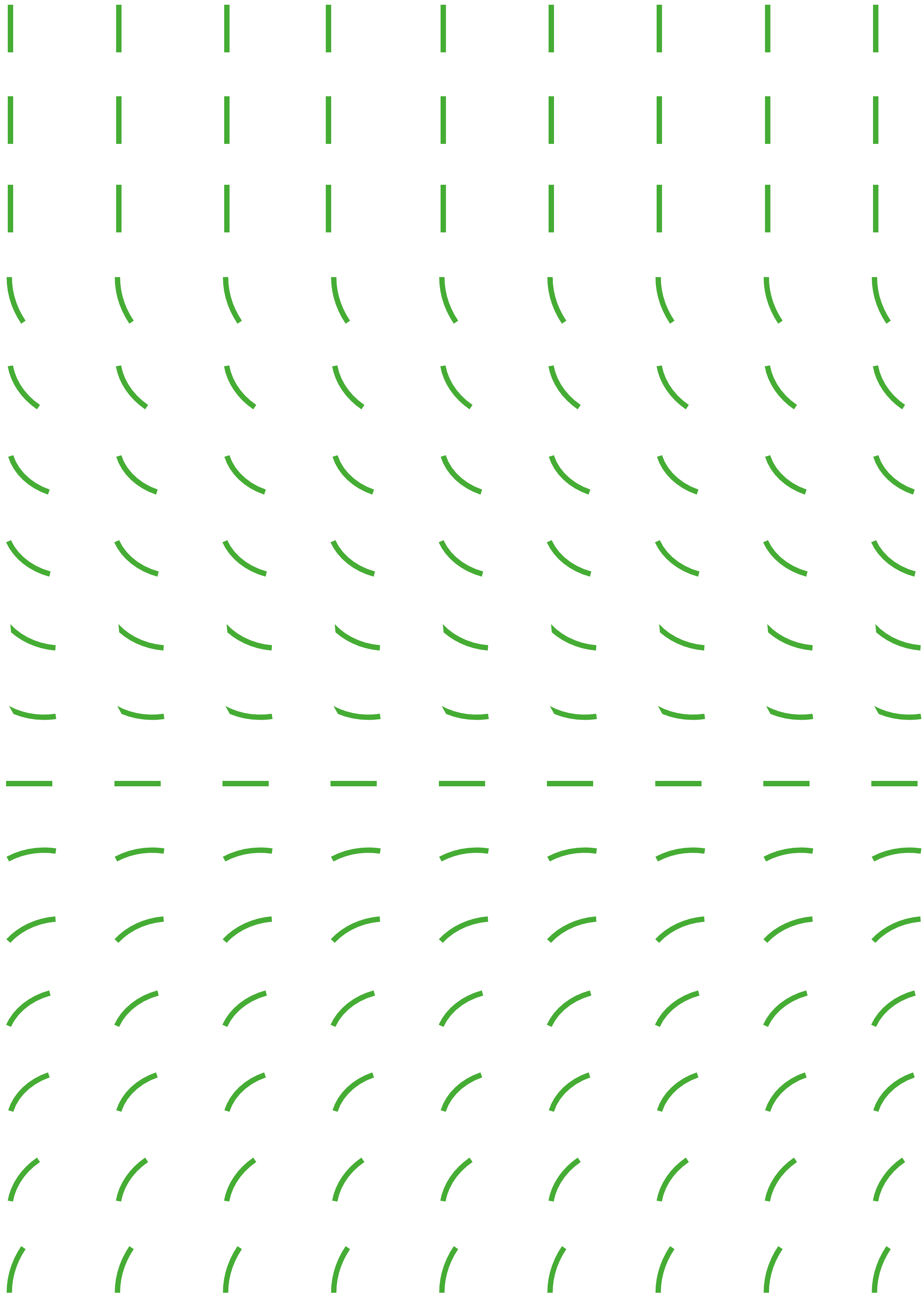

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