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Potential Benefits:

STRUCTURING GERMAN-UKRAINIAN COOPERATION IN THE BIOMETHANE SECTOR

by Ann-Kristin Golz,
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LibMod Policy Paper

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Brief description of contributing organisations

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Zukunft Gas is the voice of Germany's natural gas and hydrogen industry. As an industry association, it represents the collective interests of its members, advocating on their behalf vis-à-vis the public, policy makers and consumers. Together with its corporate members, Zukunft Gas promotes the utilization of the potentials of hydrogen, biogas and fossil natural gas, as well as that of the existing fossil natural gas infrastructure, raises awareness of the opportunities and possibilities of gaseous energy carriers for our society and drives forward the transformation of the natural gas sector into one in which the new gases are front and centre. Zukunft Gas is an initiative of leading companies in the natural gas and hydrogen industry. Other industry associations and the heating equipment industry support the association as partners.

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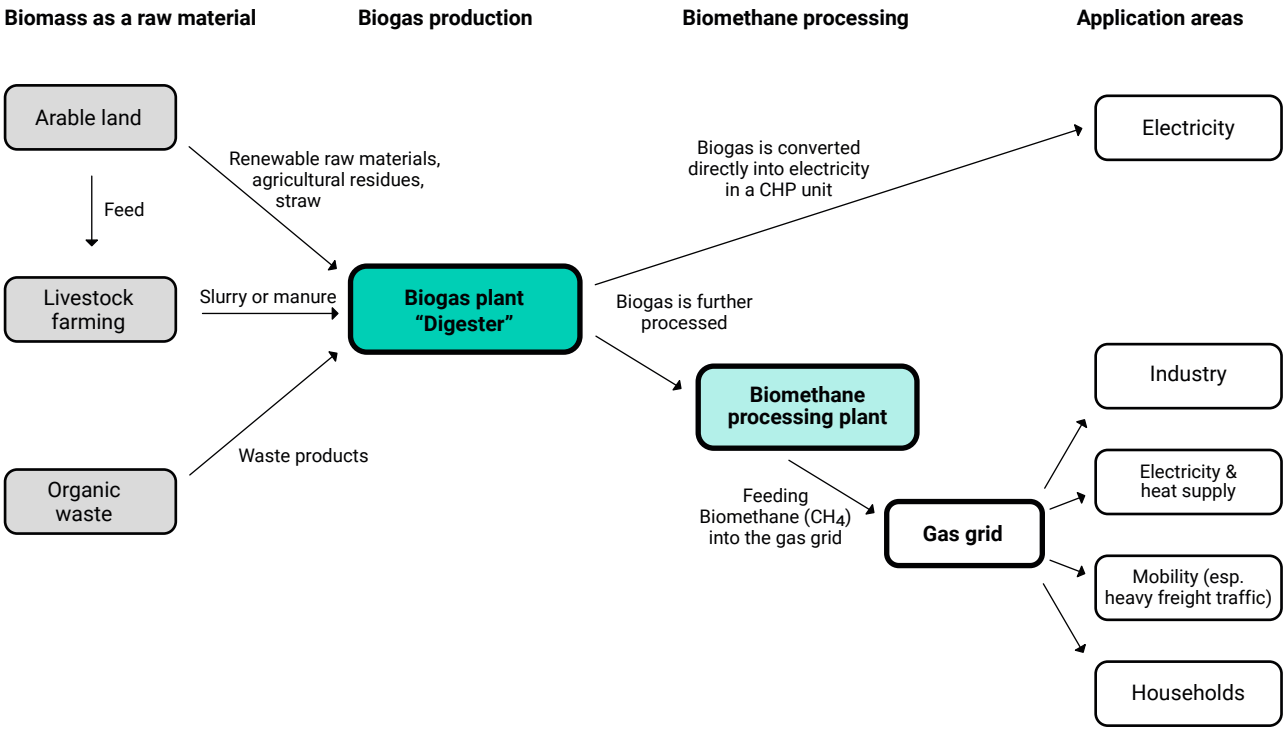
EXECUTIVE SUMMARY

- Biomethane has an important role to play, both in Ukraine and in Germany, in efforts to achieve climate neutrality by the middle of this century.
- Ukraine aims to bring biomethane plants with a total annual production of at least 11 TWh into operation by 2030. The total potential for biomethane production in Ukraine is 220 TWh per year.
- Researchers estimate that the market potential for biomethane in Germany could reach as high as 102 TWh in 2030 and 331 TWh in 2050.
- Enterprises in Ukraine see the export of biomethane as a promising business model.
- Exporting biomethane is also seen as a step towards a role for Ukraine as a long-term supplier of climate friendly energy and gases to the EU.
- There are currently regulatory obstacles in both Ukraine and Germany to the development of a flourishing biomethane market. On the Ukrainian side, the primary obstacle is the moratorium on the export of gas; on the German side, it is the lack of an EU-Ukrainian agreement on the recognition of guarantees of origin, which will be necessary once the amended EU Renewable Energy Directive (RED III) has been implemented.

Process diagram of biomethane production and use



1. INTRODUCTION

Ukraine has been in difficult straits, both militarily and economically since Russia's launched its 2022 invasion. However, Ukraine has continued to pursue concrete strategies and projects aimed at the country's modernisation despite continuing attacks by Russian forces on its civilian population and infrastructure. This modernisation includes the defossilisation of Ukraine's energy sector and the aim of becoming an export nation that supplies the European Union with sustainable energies. Biomethane plays a significant role in these plans as Ukraine is one of Europe's leading agricultural producers. Despite the upheaval caused by the war, one Ukrainian company has already succeeded in converting a biogas plant into one producing biomethane. Moreover, the expiration of the gas transit agreements between Russia and Ukraine in 2024 will create opportunities for the transmission of biomethane exports to the European Union.

Ukraine has the potential to produce large volumes of biomethane. The country has been a leading producer of agricultural products and their derivatives. Hence, the country could play an important role in the development of the European biomethane market both with respect to domestic consumption and as an exporter. A development of this kind would be consistent with Ukraine's agenda of European integration and with the European Green Deal.

Meanwhile, in Germany, there is a large market potential for imported sustainable gases. As a replacement for fossil natural gas, biomethane could play a key role in accelerating the development of green energies over the current decade. Unlike fossil natural gas, biomethane is renewable: it is an upgraded form of the biogas produced from the breakdown of organic matter. Because biomethane's chemical composition is essentially identical to that of natural gas, existing natural gas infrastructure and equipment can be used for the use, compression, liquification, transmission, distribution and storage of biomethane. Biomethane can replace fossil natural gas for use in industry, transport and in the production of electricity and heat, and because it can be stored, it can boost the resilience of the energy system.

The European Commission has identified biomethane as a strategically important pillar for a sustainable energy mix and has called for further development in this area.The Commission's REPowerEU Plan calls for an increase in annual biomethane production within the EU to 385 TWh by 2030, with the aim of reducing dependency on energy imports, and particularly Russian energy imports. The potential demand for biomethane is significantly larger than that, however. Cooperation in the biomethane sector holds out tremendous opportunities for the German and European economies, and, above all, tremendous opportunities or the Ukrainian economy and Ukrainian reconstruction on many levels. The advantages for the Ukrainian economy lie in the indigenous energy production, the generation of added value and job creation. Moreover, climate protection in Europe as a whole stands to benefit as well.

For all the advantages associated with biomethane, serious objections of various kinds have also been raised. It is essential that these be dealt with transparently, but also that they be met head on. There are now regulations in place that address the danger of "maizification", i.e. maize monoculture cultivation, in Germany. The "maize cap", a statutory limit on the percentage of maize in the substrate used to produce biogas, is being gradually lowered: down from the current 40 percent limit to 35 percent in 2024 and 30 percent in 2026. Moreover, there are vast quantities of biogenic residues and waste going unused in Ukraine that could be used to produce biomethane. The food vs. fuel issue has also been resolved to the greatest extent. Certificates of sustainability and guarantees of origin come into play in this respect, for instance, in relation to maize silage use.

"Methane slip" is prevented, or at least reduced by subjecting biomethane plants, rather than only the biomethane they produce, to certification and auditing. Plants are assigned

a certain CO_2 emissions reduction value in conjunction with the certification process. If the plant exceeds a certain value, for instance due to methane slip, then the biomethane it produces cannot receive a guarantee of origin at a qualifying plant. The EU Renewable Energy Directive (RED III) further raises the level of greenhouse gas emissions reduction required.

Although continuous development and adjustment of the regulatory framework in this area over the past several years has provided Germany with the means to address these problems, it has also resulted in a foreclosure of the market. This is partly due to the sheer complexity of the regulatory framework but is also due to limitations on the scope of certain regulatory provisions to domestic entities. To facilitate the import of Ukrainian biomethane to Germany, it will be necessary to harmonise and export the German standards and rules in conjunction with the active cooperation of Ukraine, as well as of other countries.

This policy paper presents first the German perspective on a particular topic and then the Ukrainian perspective. Both perspectives make the ecological and economic importance of biomethane very clear. They also show, however, that several obstacles will have to be addressed before biomethane can be exported from Ukraine on a grand scale. These range from investment risks in Ukraine to regulatory obstacles in Germany, the latter relating, for instance, to the import of biomethane and crediting eligibility. Our aim with this paper is threefold: to draw attention to the enormous potentials that exist, to propose solutions to existing problems and to intensify the dialogue between German and Ukrainian business and policy circles.

2.1 POTENTIAL FOR BIOMETHANE DEMAND AND FIELDS OF USE IN GERMANY

Biomethane's role in Germany's energy transition

In its Climate Change Act, Germany set itself the goal of reducing greenhouse gas emissions by 65 percent compared to 1990 levels by 2030 and achieving climate neutrality by 2045. Meeting these goals will require the radical transformation of the energy system and its infrastructure and also of all economic sectors, including agriculture, and the consumption behaviours of society.

The transition to renewable energies is vital to achieving this goal. Rapid development of all renewable energy sources is essential to achieving climate neutrality in the electricity market. This would be true even if the demand for electricity were not increasing, but it is: the energy transition is coupled with a rise in "demand for electrons" across multiple sectors due, for instance, to the electrification of industrial processes, the transition to e-mobility and the installation of heat pumps. The supply of electricity generated by solar and wind power stations is subject to fluctuations, at least until large storage capacities become available. This means that Germany needs renewable energy sources that are capable of base-load power generation and that can be stored. Currently, electricity accounts for less than one fifth of Germany's total final energy consumption: 83 percent of final consumption is of energy carried by molecules rather than electrons.[1]

With demand for renewable energy sources increasing, it is imperative that all available alternatives be taken into account in strategies for ensuring a sustainable energy supply in the EU. To achieve the aims defined in the EU Renewable Energy Directive (RED II), the Fit for 55 package and the REPowerEU Plan, Germany, like all EU member states, is obligated to support and implement the relevant measures.

The energy transition involves a number of aspects associated with a great deal of uncertainty. Thus a substantial degree of resilience will have to be built into the transformation process. The coronavirus pandemic and Russia's war of aggression against Ukraine have clearly demonstrated that both the process to establish a climate neutral energy system and the future energy system itself must be robust and able to withstand crises. Reaching the climate goals will require renewable gases like hydrogen and biomethane in addition to electrification. These gases' ability to be stored and the creation of new "solution space" for the problem of reducing implementation risks means they can make key contributions to a resilient and climate neutral system. They will find uses in high temperature processes in industry, heavy duty vehicle road transport, securing the stability of the electricity and the heat supply. Biomethane, as a storable, renewable energy, offers a solution to some of the problems arising in areas where climate neutrality cannot be achieved even by exhausting the scope for energy-efficient design and electrification.[2]

As its chemical composition is almost identical to that of fossil natural gas, biomethane can be substituted for fossil natural gas in any setting. It can be transmitted and distributed over existing natural gas infrastructure without any technical modifications. As an upgraded form of biogas, biomethane is a renewable gas derived from biogenic matter (liquid manure, organic waste, plant residues etc.). It is nearly carbon-neutral and generates both added value and jobs, particularly in rural regions. Most of the biogas used in Germany today is produced domestically at facilities in a process called anaerobic digestion, in which biomass, in solid or liquid form, is "digested" in an airtight, thermally insulated container.

The chemical composition of the biogas yielded by this process varies – its methane content can be as high as 75 percent depending on the composition of the biomass used.[3] By adding an additional process step, biogas plants can upgrade the biogas to biomethane, which can then be fed into the existing natural gas grid. The emissions of this plant-fuel-energy cycle are net zero since the CO_2 that is released is CO_2 that the plants used as biomass have taken in from the atmosphere. Moreover, bioenergy with carbon capture and storage (BECCS) technology, which actively extracts the CO_2 formed during the production of biogas from the atmosphere, may even make it possible to generate energy with negative net emissions.[4]

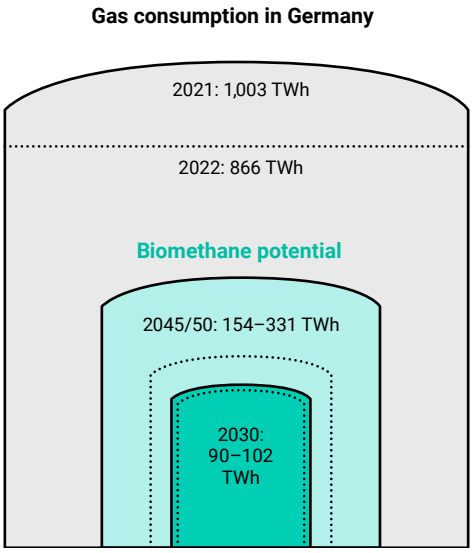
Biomethane holds out great potential for the energy transition. Germany consumed 866 TWh worth of fossil natural gas in 2022[5], and 1,003 TWh in 2021.[6] Were it available in sufficient quantities, biomethane could already be replacing those vast quantities of fossil natural gas, without any need for retrofitting infrastructure or technology, and the gas market could be defossilised overnight. Biomethane also holds out great potential for all of the areas in which electrification is approaching its limits and the use of hydrogen is not yet possible, is challenging to implement or is simply unreasonable from an energy efficiency standpoint. This is reflected in the assumptions made for recent studies about the future market potential of biomethane in Germany, which has been estimated in 90–102 TWh in 2030, 154–331 TWh in 2045/2050.[7]

Production and use of biomethane in Germany

In Germany, biogas production is concentrated mainly in the agricultural regions in the southern and northwestern parts of the country. Thus, most of the Germany's biogas plants are in Bavaria, Lower Saxony, North Rhine-Westphalia, and Baden-Württemberg. Woodland, bodies of water, settlement and traffic areas account for about half of the total surface area of Germany. The other half is used for agricultural purposes: 60 percent for feed crops, 22 percent for food and 14 percent for energy crops.[8] Energy crops are used in the production of bioethanol and biodiesel and as wood for pellets and woodchips in the heating market – and as biomass for biogas production.

Biogas produced in Germany – some of it upgraded to biomethane – is predominantly used to generate electricity, very often in conjunction with the co-generation of electricity and heat. Remuneration for this is determined

Market potential of biomethane in Germany



on the basis of the Renewable Energy Sources Act. Some of the domestically produced biomethane is used in the fuel market to help businesses enterprises meet the greenhouse gas emissions reduction quota.[9] In addition, more than 11 TWh worth of biomethane was fed into the German natural gas grid in 2022.[10]

This represents somewhat more than one percent of natural gas consumption. If biogas use in electricity generation could be reduced and the biogas were upgraded to biomethane instead, the biogas plants already in operation would be capable of producing close to an additional 100 TWh worth of biomethane (approximate value, a small amount of new construction might be required to reach the full 100 TWh), and thus of supplying enough biomethane to substitute ten percent of the natural gas consumed in Germany.[11]

These new gases (hydrogen, biomethane) are particularly vital for segments in which electrification is not an option. These include parts of the industrial and transport sectors as well as the electricity and heating supply sector. In the energy system of the future, gas-fired power plants, which are now using fossil natural gas and will one day use renewable and decarbonised gases, will form the back-up system necessary to ensure the stability of the electricity supply at times when the volatile supply of renewable energy flowing into the grid is not sufficient to cover demand. Currently (2023), Germany's gas-fired power plants have a total installed capacity of 34.8 GW.[12] The Federal Ministry for Economic Affairs and Climate Action estimates that new power plant construction is needed to develop an additional 17–25 GW of capacity.[13] In the future, these back-up power plants will run on biomethane and hydrogen. The 2023 amendment of the Renewable Energy Sources Act provides for public tenders for biomethane "peaker plants". These are highly flexible power plants which run only for a few hours a year to cover peaks in demand.[14]

However, renewable and decarbonised gases also can be used, albeit to a more limited extent, in other areas. Even in areas in which electrification is indeed the option of choice, these new gases can serve as additional option for challenging situations and thus help ensure the robustness of the transformation towards climate neutrality. A case in point is the use of biomethane, in the form of bioCNG and bioLNG, for heavy duty vehicle transport. Biomethane may also one day be used in parts of the buildings sector: the latest amendment to the Buildings Energy Act permits a range of compliance options, including contracts for the supply of biomethane for natural gas heating systems in certain cases.

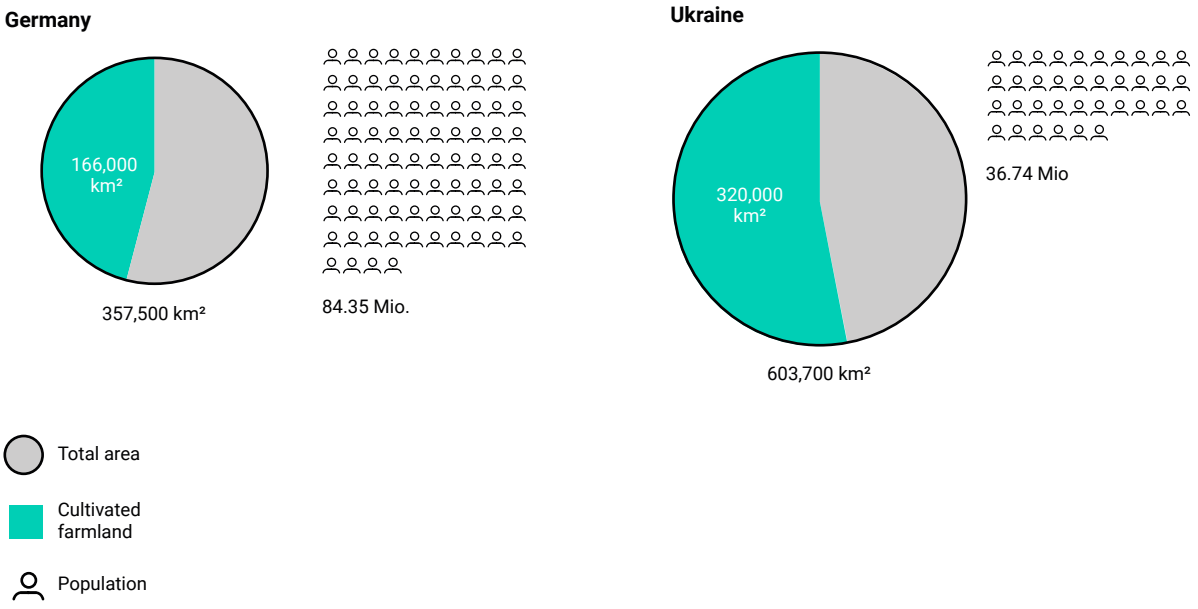
Biomethane imports: gamechanger for consumption and price trends

The construction of additional biomethane plants would be necessary in order for biomethane to supply a larger share of the current natural gas consumption. The options here are limited though, due to the country's population density. This lends greater significance to the possibility of importing biomethane from other countries. Thus far, imported biomethane has played only a subordinate role in considerations of possible development in consumption. Yet if there were large amounts of biomethane available, the defossilisation of the natural gas market could be accelerated.

In fact, great potential does exist in this area, particularly in the region to the east of Germany, where population densities are lower and agricultural land makes up a greater share of total land area. A glance at the World Bank's World Development Indicators for 2020 shows why: Arable land represents 33 percent of Germany's total land area, and the proportion is similar in Belgium (29 percent), France (33 percent) and the Netherlands (30 percent). In Denmark and Ukraine, by contrast, arable land accounts for over 56 percent of land area. Hungary has a similar potential (44 percent).[15]

International trade in biomethane would have a positive impact on production costs of biomethane as well. Recent studies predict that these costs will amount to EUR 75 per MWh in 2030 and their prognoses for 2045 and 2050 show costs ranging from EUR 47–93 per MWh.[16] The broad range is due to the differences in production costs associated with the anaerobic digestion of biomass and its thermal gasification, the latter being significantly more expensive.

Cultivated arable land and population in Germany and Ukraine in comparison



2.2 BIOMETHANE EXPORT POTENTIAL IN UKRAINE

Strategies and timeframes

Ukraine has defined achieving climate neutrality as a strategic goal both in national strategies that have already been adopted and in the context of strategies currently being developed. As a party to the Paris Agreement, Ukraine has pledged to reduce its greenhouse gas emissions by at least 65 percent of 1990 levels by 2030 and to achieve full climate neutrality by 2060.[17]

The development of biofuel production – including biomethane production using agricultural products, plant residues and waste – is understood as an important component of these strategies. The policy document outlining Ukraine's energy strategy emphasises the substantial potential in the country both for the generation of biogas and biomethane from agricultural waste to replace fossil natural gas and for the export of biomethane to Europe by way of the Ukrainian gas transmission system.

The Ukrainian Government's strategies for the long-term development of the country, both those already approved and those which are currently being developed, estimate that Ukraine could potentially increase its an annual biomethane production of one to five billion cubic meters (10.7–53.6 TWh) by 2030.[18] A more specific prediction about the medium-term development of biomethane production is nearly impossible at this time: much will depend on how long the war continues, the economic potential remaining in Ukraine when it is over, and how swiftly its economic recovery will proceed.

According to the UABIO, the Bioenergy Association of Ukraine, biomethane production could be increased to 11 TWh by 2030 and 50 TWh by 2050.[19] Assuming that security issues are resolved, sources of financing are available and that there is an attractive market environment for the sale of biomethane, an increase in biomethane production to 11 TWh by 2030 is an ambitious goal, but could be met under favourable conditions.

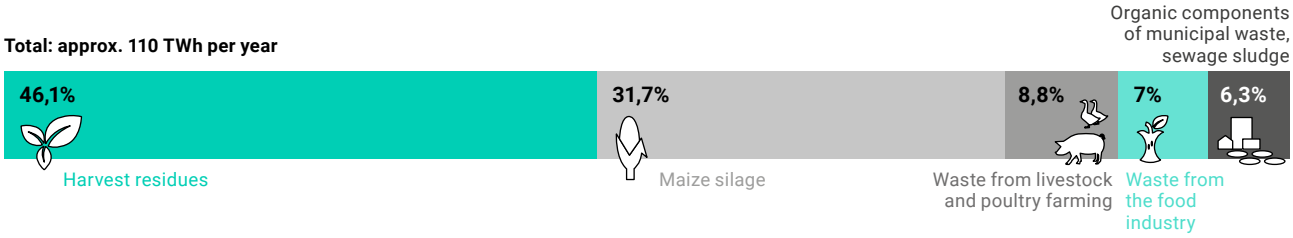
Development of the biomethane sector

The biomethane sector was born in Ukraine a year after the liberation of the Chernihiv region from Russian occupation in 2023, when the owner of a biogas plant there decided to expand it for the production of biomethane. The design capacity of the system is around 33 GWh per year.[20] The plant's operator, Agroholding Gals Agro, cultivates a total area of 35,000 hectares with a broadly diversified range of agricultural production.[21] Thus the holding company has access to around 400,000 tonnes p.a. of sugar-beet pulp and molasses, plant residues, energy-crop silage and liquid pig and cow manure that could potentially be used to produce biogas.[22]

The large potential in feedstock for biogas generation in Ukraine is a significant factor for the development of biomethane production in the country. Ukraine is a world leader in agricultural production, the world's third largest exporter of maize and the fifth largest exporter of wheat.[23] A majority of the total 33 million hectares of agricultural land in the country is either being actively used or suitable for diversified use, even with the losses of arable land through Russian occupation and the contamination from mines and grenades and the interruption of irrigation in Southern Ukraine following the destruction of the Kakhovka Damn.

Agricultural products, plant residues and wastes are available in almost all regions of Ukraine. In the medium term, these will be the most important sources of feedstock for biogas and biomethane production. According to the UABIO, the total potential biomass available could supply biomethane production of around 110 TWh; broken down by volume, this biomass is made up of crop residues (46.1 percent), maize silage (31.7 percent), waste from cattle and poultry farming (8.8 percent), food industry waste (7 percent), and organic components of settlement waste and sewage sludge

Total potential and sources of biomass for biomethane production in Ukraine



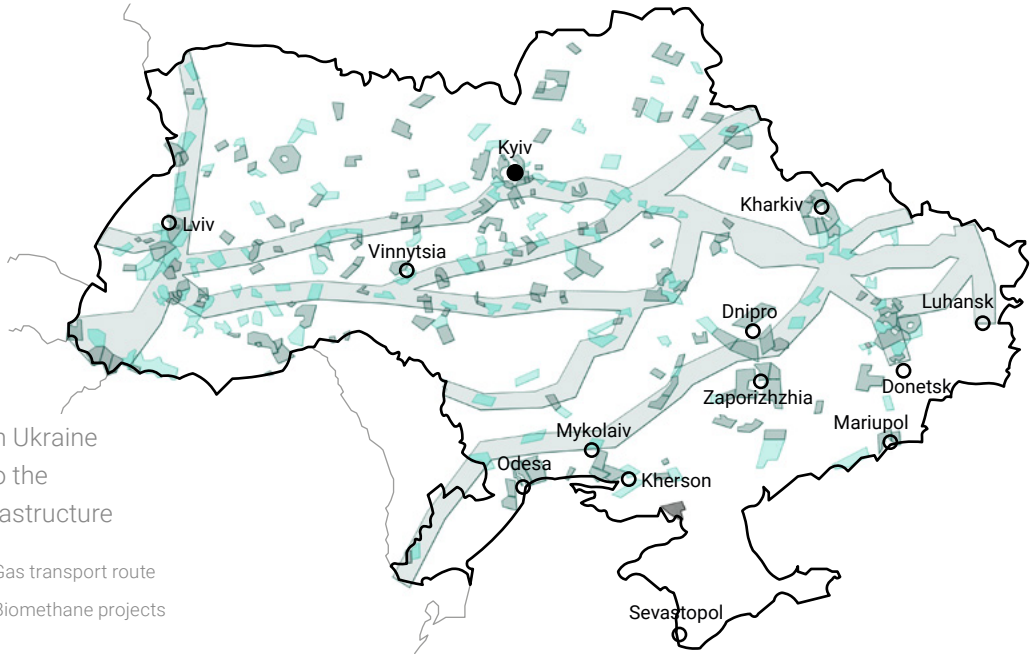
Around four million hectares of contaminated, unproductive and degraded land in Ukraine can potentially be used to grow energy crops, which could replace up to 220 TWh of natural gas, equivalent to the country's current natural gas consumption.

(6.3 percent).[24] The cultivation of cover crops on just 20 percent of the arable land in Ukraine would generate enough biomass to produce the same amount of biomethane again.

Agricultural enterprises are now actively looking for opportunities to produce biomethane using biomass with a higher proportion of waste and thus a lower proportion of energy crops (sugar-beet pulp, maize silage, etc.) with a view to developing opportunities for the export of biomethane. This could increase the profitability of their biomethane projects, in particular, through the introduction of technologies that use lignocellulosic biomass (maize stover, soy and wheat straw, etc.) in addition to biomass from cover crops and catch crops. There are over four million hectares of land in Ukraine that is contaminated, unproductive and degraded.[25] These areas could potentially be used to cultivate energy crops, which could be used to replace up to 220 TWh of fossil natural gas, i.e. the entire current fossil natural gas consumption in Ukraine.[26]

Along with increasing the use of agricultural wastes and residues, harnessing the potential of degraded and unproductive lands that cannot be used effectively for food crop cultivation but could be used for energy crops is probably the approach most likely to encourage the further development of bioenergy in Ukraine. Ukrainian farmers estimate that the use of as little as three to four percent of crop rotations for energy crops could make the agricultural sector energy-independent, and the use of eight percent of crop rotations would suffice to free the entire country from its dependence on Russian fossil gas. In Germany, which has less than one third the arable land and a population almost 2.5 times the size of Ukraine's, almost 13 percent of arable lands are currently being used for biogas production.[27] If the 4.3 million hectares of unproductive/marginal land mentioned above were used for biogas production in conjunction with some additional land, there would still be sufficient land available for food production. The generation of biogas and biomethane has additional advantages for domestic agriculture as well: for instance, the lowering of greenhouse gas emissions through the processing of plant and animal wastes into biogas, the improvement of soil fertility through the use of digestion residues from the biogas production, and the increase in the profitability of the agricultural sector created through the export of biomethanes.

The Gals Agro biogas plant mentioned at the start of this section has been operating since 2019. The plant was built for a power station generating electricity eligible for sale at a fixed feed-in rate (in Ukrainian, *zelenyy taryf*, the "green tariff"). However, biomethane projects promised greater returns, so Gals Agro decided to rethink its business strategy when payments of green-tariff remuneration stopped coming in during the war.[28] The agricultural holding company plans to equip a second biogas plant to produce biomethane by the end of 2023. This second system has a design capacity of



Biomethane projects in Ukraine and their connection to the gas transportation infrastructure

33 GWh per year. Gals Agro's long-term plan is to convert all of its bio-gas plants to biomethane production, if conditions allow. If it ever does so, the holding company should be able to produce as much as 385 GWh of biomethane annually.

In addition to the two Gals Agro projects, there are currently four other projects for the conversion of existing biogas plants for biomethane production in various stages of implementation in Ukraine. Once all four of these are in operation, they will collectively produce around 880 GWh of biomethane per year.

Prices for fossil natural gas in Ukraine are quite low right now, so the more expensive biomethane cannot compete. As there is no green tariff for biomethane fed into the domestic gas network, it does not make economic sense to produce biomethane for that purpose. Thus, the projects mentioned above are export oriented. They allow for the possibilities of feeding gaseous biomethane into the natural gas network and of liquifying it and transporting it in tanks by road or rail.

Both when these biomethane plants go into operation and the pace of this sector's further development in the short term will depend on when the current moratorium on biomethane exports is lifted (see page 15). Relevant legislation has already been initiated. If the changes go forward as planned, the export of biomethane should be possible by the end of this year or early 2024.

Gals Agro's experience with retrofitting a biogas plant to produce biomethane are telling with respect to the probable development of the biomethane sector in the near future. Ukraine's biogas plants were originally built to operate economically based on the fixed-rate remuneration for electricity fed into the grid, which continues to apply. An unfavourable change in the environment for the conversion of biogas into electricity (the rigid feed-in rate is slated to be replaced by an auction model as of 1 January 2024) is likely to have producers shifting their focus to the more lucrative production of biomethane. The owners of Ukraine's current biomethane projects (Myronivsky Hliboproduct, Teofipolska Energy Company, Gals Agro, Vit-Agro und Józefo-Mykolaivska Agrar Company) are all agricultural enterprises, most of which are either well diversified or concentrate on one core production area (sugar or poultry). These enterprises have adequate quantities of their own feedstock available for biomethane production and considerable financial resources of their own. Their assets and financial performance mean that they are well placed to attract external financing. They also have previous experience with bioenergy (biogas, bioethanol).

There are currently more than 70 biogas plants with a total installed capacity of 135 MW in Ukraine, around 40 of which operate at waste disposal sites. Large agricultural biogas plants (i.e., with an installed capacity in the 3–26 MW range) account for around 80 percent of total

installed biogas production capacity in Ukraine. If all of these were converted to biomethane production, they could produce a total of about 2.4 TWh per year.[29]

Is there sufficient transmission capacity available for use?

Ukraine has an efficient gas transmission system capable of transmitting 1,606 TWh worth of natural gas to the European Union. Biomethane could play a highly significant role for the future use of this gas transmission system, given the decline in the amounts of Russian fossil natural gas transiting through Ukraine, which were at an all-time low in 2022 (224 TWh), the high improbability of transits continuing at all throughout 2024, and the very low level of domestic fossil natural gas production in Ukraine at this time (206 TWh in Jahr 2022). The transmission capacity of the border crossing points on Ukraine's border to the EU freed up by the decrease in Russian gas transits could be used for the export of biomethane to the EU. Particularly advantageous in this respect is that the biomethane could be fed into the existing gas network without requiring any prior technical modification of it. It should be noted, though, that the biomethane will still have to get from the production sites to the nearest gas distribution grid, which will probably involve infrastructure construction.

How much biomethane is needed for domestic consumption, how much could be available for export?

Ukraine plans to phase out coal-fired power generation and develop carbon-neutral electricity sources for both the domestic market and export. Before the war, metal industry products (iron and steel) accounted for as much as 85 percent of Ukrainian exports to the EU. With a prewar fossil natural gas consumption of 20 TWh and an 80 percent export share of total production, the iron metallurgy sector has been the hardest hit during the war, including the loss of two steelworks in Mariupol representing at least 40 percent of its production potential.

It appears probable that Ukraine's industry will begin to compete with other buyers of biomethane from the EU once the economic situation there allows energy-intensive production again. As of 1 January 2026, the EU's Carbon Border Adjustment Mechanism (CBAM) will apply to exporters of electricity, fertilizers, cement, aluminium, and iron metals from Ukraine; this will fuel demand for biomethane in the country.

The development of other potential Ukrainian demand for biomethane will depend on more general economic developments in the country, including, for instance, on how long it takes before a carbon price in Ukraine is raised to the level of the emission allowances traded in the EU emissions trading system. Given that the carbon tax in Ukraine now is EUR 0.70 per tonne of CO_2 emitted,[30] it seems clear that a long transition period will be necessary to safeguard the competitiveness of the Ukrainian economy.

3.1 REGULATORY OBSTACLES IN GERMANY AND PROPOSALS FOR THEIR RESOLUTION

Biomethane is an energy source that is essential for achieving climate goals and for the success of the energy transformation – in Germany and in Europe. At this time, biomethane is used in Germany primarily to generate electricity in co-generation plants (biogas CHP plants) and in the transport sector to be credited towards the greenhouse gas emission reduction quota. This latter sector is the one in which customers are most willing to pay a high price for biomethane. This is due to the great challenges associated with direct electrification in this sector's long-haul heavy-duty vehicle transport segment, where biomethane is one of the few options available for compliance with the obligation to reduce greenhouse gas emissions.

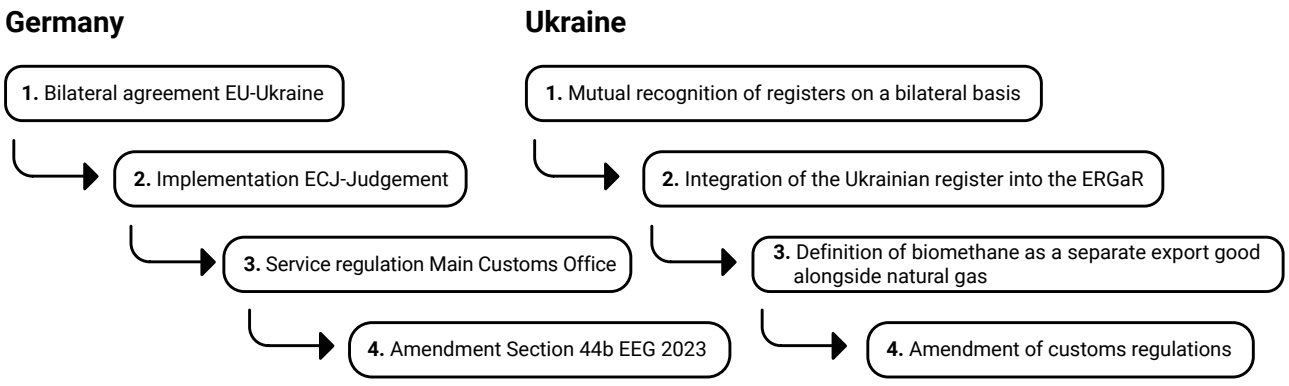
The import of biomethane via the gas transmission network is always covered by sustainability certificates recognised by the EU. Thus, biomethane that has been RED-cert-EU or ISCC certified can also entirely fulfil requirements for the application of the mass balance principle that the European Court of Justice has called for. This means that, in principle, the evidence-and-verification system necessary to prevent the double crediting of biomethane through cross-border trade is in place.[31] However, to the current legal environment makes it difficult to import biomethane.

1. Arrangement of bilateral cooperation between the German Energy Agency and its Ukrainian counterpart in accordance with the German Guarantees of Origin Register Act

Obstacle: In Germany, the German Energy Agency (dena) manages the "Biogas Register", the system for mass balance verification, in line with the Guarantees of Origin Register Act (GoO Register Act: *Herkunftsnachweisregistergesetz*). The dena entered into bilateral cooperation agreements with the energy agencies of several other countries that are gradually being replaced by a European system of the European Renewable Gas Registry initiative (ERGaR), the ERGaR Certificate of Origin Scheme. At this time, the dena has cooperation agreements in place within the ERGaR framework with Austria, the Netherlands and the UK, as well as a bilateral cooperation agreement outside the ERGaR framework with Denmark.[32] The agency does not have a cooperation agreement with Ukraine, however (see page 16).

Solution: Under section 3(3) of the GoG Register Act, gaseous energy sources produced outside of Germany that fulfil the relevant criteria are to be recognised by the competent German authority.[33] This does not relate only to other EU

Regulatory hurdles on the way to biomethane cooperation



countries: the provision refers explicitly to non-EU countries too. Extract from the statute:

With respect to gaseous energy sources produced outside the Federal Republic of Germany, the competent authority specified in the statutory instrument referred to in section 4 shall, on application, recognise guarantees of origin for gaseous energy sources in accordance with the provisions of the statutory instrument referred to in section 4. Foreign guarantees of origin for gaseous energy sources can be recognised only if they meet the requirements of Article 19(9) and (11) of Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (OJ L 328, 21.12.2018, p. 82), as last amended by Delegated Regulation (EU) 2022/759 (OJ L 139, 18.5.2022, p. 1). To this extent, the competent authority shall also be responsible for communication with the competent ministries and authorities of other Member States of the European Union and of third countries, as well as with bodies of the European Union.[34]

It will therefore be possible for the German Energy Agency and the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) to conclude a bilateral cooperation agreement along the same lines as that concluded between Germany and Denmark in 2017.[35]

Negotiations on the Renewable Energy Directive III (RED III) are currently underway at the European level, and the newly recast directive is expected to enter into force in 2024. However, once this directive has been implemented (in Germany this will occur by way of the GoO Register Act and the subsequent regulations), guarantees of origin from a non-EU member state will be recognised in the EU only if the EU has an agreement on the mutual recognition of such guarantees in place with the state in question. This means that it will then be necessary for the EU to conclude an agreement with Ukraine on the recognition of guarantees of origin. Whether such an agreement would be necessary even in cases where the guarantees of origins were only going to be used for purposes other than that of labelling gas for end consumers is a question that would have to be examined.

2. Implementation of the Judgement of the European Court of Justice

Obstacle: In 2017, the European Court of Justice issued a judgement in the proceedings E.ON Biofor Sverige AB v Statens energimyndighet (the Swedish Energy Agency), Case C-549/15.[36] The proceedings were about the Swedish agency's refusal to classify biomethane imports that were produced in Germany and transmitted to Sweden via the German and Danish gas networks as sustainable despite the fact that the biomethane remained covered at all times by the REDcert DE sustainability certificate issued in accordance with the German mass-balance verification system. In the view of the Court, the Swedish rules which led to the denial of recognition violated the principle of the free movement of goods under Article 34 of the Treaty on the Functioning of the European Union. Thus, the Swedish rules were in contravention of European law in the same way that the Main Customs Office of Frankfurt/Oder is with regard to its attempt to keep foreign biomethane from being credited towards the greenhouse gas reduction quota.

The European Court of Justice found that an EU member state that has established a mass balance system has an obligation to open that system to biomethane imported from other EU countries.[37] Germany has established a mass balance system, yet it has not followed up on this by adjusting its import practices.

Solution: Implementation of the European Court of Justice judgement in German law, enabling the free trade of biomethane that has legally valid sustainability certificates over any transport route within the EU. Aligning the law with this judgement would also have positive impacts on future international free trade in biomethane, synthetic methane and hydrogen, the legal environment for the imports of which has not yet been finalised.

3. Changing the service regulation of the Main Customs Office of Frankfurt/Oder on monitoring compliance with greenhouse gas reduction in line with section 37a(4) of the Federal Immission Control Act (BImSchG)

Obstacle: The Main Customs Office of Frankfurt/Oder is responsible for imports of biomethane and for verifying the greenhouse gas reduction quota. Under the rules set out in a service regulation of this office, only biomethane fed into the gas grid in Germany can be credited towards the greenhouse gas reduction quota. As a result, it has been impossible to meet the greenhouse gas reduction quota with biomethane obtained through cross-border trade into Germany via gas pipelines.[38] Thus foreign imports of biomethane are not "quota-qualified" in the fuel market: current administrative practice de facto prevents the grid-bound import of biomethane to Germany.

Landwärme GmbH, a company that supplies and trades in biomethane, and BMV Mineralöl Gesellschaft filed a complaint against this service regulation. In March 2023, the Fiscal Court of Berlin-Brandenburg ruled in favour of the plaintiffs, finding that it was permissible to credit biomethane produced abroad and fed into the natural gas grid toward the quota.[39] Neither the Main Customs Office nor the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection have appealed the judgement. However, at the time of writing, September 2023, the service regulation has not been updated to reflect the judgement.

Solution: Changing the service regulation of the Main Customs Office of Frankfurt/Oder on monitoring compliance with greenhouse gas reduction in line with section 37a (4) of the Federal Immission Control Act (BImSchG) to include countries of origin outside of the European Union is necessary to the extent that the regulation continues to rule out the option of crediting biomethane produced and fed into the grid in a foreign country toward the greenhouse gas reduction quota. This, because the service regulation contravenes European and national law to this extent and must therefore be characterised as unlawful.[40]

4. Amendment of Section 44b of the Renewable Energy Sources Act (EEG 2023) on EEG application in the electricity market

Obstacle: Under section 44b of the Renewable Energy Sources Act (EEG 2023), electricity generated from biomethane taken from the natural gas grid for that purpose is eligible for remuneration under the EEG scheme only if the quantity of the biomethane drawn from the grid corresponds to a quantity of biogas which was fed into the grid at another place in the Federal Republic of Germany within the framework of the mass balance system. This excludes the feeding in of biomethane at border crossing points and thus discriminates against biomethane produced abroad.

Solution: The amendment of Section 44b of the Renewable Energy Sources Act as follows would allow EEG remuneration for electricity generated from biomethane produced in another country:

(4) Gas taken from a natural gas system shall be regarded respectively as landfill gas, sewage treatment gas, mine gas, biomethane or storage gas,

1. to the extent that the quantity of the gas taken corresponds to the heat equivalent at the end of a calendar year of the quantity of landfill gas, sewage treatment gas, mine gas, biomethane or storage gas which has been fed into the natural gas system at another place in the Federal Republic of Germany ***or from another country over a border crossing point,*** *and*

2. if mass balance systems have been used for the entire transport and sale of the gas from its manufacture or extraction, its feed-in into the natural gas system and its transmission in the natural gas system through to its removal from the natural gas system.[41]

3.2 REGULATORY OBSTACLES IN UKRAINE AND PROPOSALS FOR THEIR RESOLUTION

Ukraine has been a signatory of the Treaty Establishing the Energy Community since 2011 and has held EU associated-country status since 2014. The Ukrainian state is engaged an ongoing process to harmonise its national law with EU energy legislation and is working towards the integration of energy markets. Ukraine is also striving to improve it regulatory practice in line with the European standards and coordinates its strategies and plans for the development of its energy sector with EU energy policy.

In the area of energy and climate, Ukraine is implementing the legislation known as the "EU Clean Energy for All Europeans" package, which includes the RED II provisions. In 2022, the Energy Community Secretariat estimated that Ukraine's implementation of the RED II directive was 58 percent complete.[42] The adoption of legislative amendments concerning the Ukrainian energy sector since then suggests that the country has made further progress toward full implementation.

Ukraine adopted legislation on the development of the biomethane market in 2021.[43] Technical specifications for biomethane to be fed into the gas transmission grid and gas distribution grids have been defined.[44] Provisions governing the biomethane register and national guarantees of origin for biomethane were also adopted.[45]

The register is expected to be introduced by the end of 2023. Moreover, the EU and Ukraine have signed a memorandum of understanding on strategic partnership on biomethane, hydrogen, and other synthetic gases. The aim is to deepen energy cooperation between the EU and Ukraine in the area of renewable gases such as biomethane, hydrogen and other synthetic and sustainably produced gases.[46] Despite this progress, there are still some barriers to be overcome with regard to the future development of a biomethane market.

1. The moratorium on natural gas exports and its effect on the export of biomethane

Obstacle: A moratorium on the export of natural gas is currently in force in Ukraine. Although the relevant Government order does not specifically ban the export of biomethane, the absence of an effective mechanism to verify the origin of natural gases means that such exports are de fact impermissible under the moratorium. Moreover, no customs clearance procedure has been approved for biomethane.

Solution: To lift the ban on exporting biomethane, it would be necessary to change customs regulations to allow the approval of a procedure for the customs clearance of gaseous biomethane. The details concerning the registration and clearance of gaseous biomethane would have to be determined by the Ministry of Finance. The order on the moratorium would have to be amended by adding a provision exempting both gaseous and liquid biomethane from the moratorium. The possibility of using international certificates, like those of ISCC or REDcert, could be considered as an additional option for the customs clearance of biomethane.

The following steps are necessary to remove the obstacles to the export of biomethane:

- Change the Ukrainian customs regulations with regard to the customs clearance of biomethane that is transmitted over pipelines; under current regulations, the customs clearance procedure for biomethane is the same as that for fossil natural gas. There is draft legislation before the Verkhovna Rada, Ukraine's parliament, that would provide for the measurement, in terms of energy units, of biomethane replaced by fossil natural gas in connection with exports of the former. The bill would also provide for a transition period (continuing until martial law is lifted), during which measuring the gas in volume units would continue to be permitted. The bill is currently has been approved by the relevant

committees; its adoption is expected by the end of 2023.[47]

- Change the Customs Tariff Law on the assignment of a customs tariff for biomethane to define biomethane as a separate export good alongside fossil natural gas, through the amendment of the law by the Verkhovna Rada.
- Change Order no. 629 of the Ukrainian Ministry of Finance, dated 30 May 2015, "On the customs formalities relating to pipeline transmissions and electrical lines" to specify a customs clearance procedure for biomethane transmitted by pipeline. The finance ministry is responsible for the elaboration and introduction of such changes.
- Change Order no. 448 of the Ukrainian Ministry of Finance, dated 20 April 2015, "On the approval of the list of goods to be cleared by Energy Customs of the State Customs Service of Ukraine" to include biomethane in the list of the goods to be cleared by Energy Customs. Energy Customs is a specialised territorial facility of the State Customs Service of Ukraine that deals with the customs control of energy sources. The finance ministry is responsible for the elaboration and introduction of such changes.
- Change Resolution No. 1466 of the Cabinet of Ministers of Ukraine, dated 27 Dec. 2022, "On the approval of the lists of goods whose import and export is subject to licencing and quota obligations for 2023" or a similar resolution determining the lists of goods whose import and export is subject to licencing and quota obligations for 2024, to exempt biomethane from the scope of the moratorium on gas exports in the case of gases transmitted by pipeline.

2. Next steps towards recognition in the EU and recommendations to the Ministry of Energy and the State Agency on Energy Efficiency

Legislation introducing guarantees of origin of biomethane was adopted in Ukraine in the autumn of 2021. At that time, Ukraine's Law on Alternative Fuels was amended to introduce the terms "biomethane" and "guarantees of origin for biomethane" to the Ukrainian legal framework. In addition, a legal basis was created for the establishment of a national register for guarantees of origin for biomethane and its distribution. The SAEE is the body responsible for managing the register for guarantees of origin for biomethane under the Law "on amendments to some laws of Ukraine regarding the restoration and green transformation of the energy system of Ukraine", which entered into force on 27 July 2023.[48]

Problem: The national register of guarantees for biomethane has not yet entered into force.

Solution: The SAEE is working closely with the German dena on the development and implementation of the register of biomethane guarantees of origin on the basis of a partnership agreement signed on 20 July 2023.[49] The German partners are providing practical assistance with the implementation of a mechanism for the issue of guarantees of origin of biomethane in line with the EU standard CEN-EN 16325. The register will be based on the well-established procedures of SAEE and software from Biogasregister Deutschland. This will ensure that the technical compatibility of the Ukrainian register and the German biogas register. Ukraine's register is expected to be fully functional by the end of this year.

The aim in the development of the Ukrainian register should be its integration into the European Renewable Gas Registry (ERGaR). This will require, inter alia, the conclusion of an intergovernmental agreement between Ukraine and the EU that opens the European biomethane market and biomethane guarantees of origin to Ukraine.

The mutual recognition of registers on a bilateral basis through the conclusion of intergovernmental agreements, particularly between Ukraine and Germany, as the European country with the greatest potential consumption of biomethane, but also between Ukraine and other EU countries can be seen as an interim step. Of importance in this respect is that Ukraine participates in projects aimed at aligning the rules regarding the generation, transport, and invoicing of biomethane as well as those regarding guarantees of origin in the EU.

3. Improving the environment for foreign private investment in Ukraine

Problem: Foreign investors need security and are deterred by corruption and excessive bureaucracy.

Solution: Even in the midst of the war, Ukraine is still carrying out an ambition programme of reforms to fulfil the criteria for EU accession. In March 2023, the Ukrainian Government announced that 72 percent of the association obligations had been fulfilled in its report on the status of implementation of the EU-Ukraine association agreement for the 2014–2022 period.[50]

As an EU-associated country and candidate for accession, Ukraine has been carrying out extensive reforms aimed at bringing the country into line with EU standards in several areas, such as combatting corruption, the rule of law, increasing the efficiency of institutions, eliminating monopolies, deregulation, and decentralisation. The pace of integration into the EU, one of Ukraine's strategic priorities, will be determined by how successful these reforms turn out to be. This will also determine the volume of foreign private investment, a key factor for the post-war reconstruction of Ukraine on the basis of sustainability and green transformation. Thus, the reforms' success is of central significance for the fate of Ukraine as a successful state and full member of the European Community.

Ukraine's efforts to combat corruption, one of the most important fields of reform have resulted in the adoption of an anti-corruption strategy for the period through 2025[51] and the state anti-corruption programme. These are aimed at creating greater transparency and convenient and legal alternatives to corrupt practices, ensuring that offenders can always be held liable for corruption offenses and strengthening the capacities of the anti-corruption authorities.

Pilot export contracts: Examples and findings

It appears likely that the owners of the first biomethane plants will swiftly conclude biomethane contracts with European buyers once the moratorium on exports of biomethane has been lifted. There have already been some negotiations on this, and great interest in importing biomethane from Ukraine has been expressed, even though the quantities at issue are not large. Leading energy trading enterprises are among the potential purchasers. According to one cooperation agreement, for instance, the Netherlands-based STX Group is a potential purchaser of biomethane from the Gals Agro plant.[52] There are also at least three German trading companies negotiating the purchase of biomethane from Ukraine: Uniper, Revis and Landwärme.

Naturally, the specific terms of each contract, including the purchase price, will be determined by the parties involved in each case. One option open to them is that of stipulating a fixed price for contracts of longer duration (five to ten years). Usually, such fixed prices are below the spot price, but they minimise the risk associated with the volatility of the natural gas market and boosts the bankability of the biomethane projects. Spot prices for biomethane are currently defined as the price of fossil natural gas plus an additional remuneration of EUR 14–73 pro MWh, depending on the carbon balance of the feedstock and the technology used to produce the biomethane. The export of liquified biomethane is also a promising area, it holds out the prospect of remuneration at a rate sufficiently high to cover the increased costs of liquification and transport. However, this is only the case when the raw materials used as feedstock are among those listed in Annex 9 of the RED II Directive.

A successful execution of the first biomethane export contracts in 2024 is likely to significantly accelerate the development of the biomethane sector in Ukraine.

4.1 NEED FOR INVESTMENT AND FINANCING MECHANISMS TO INCENTIVISE IMPORT OF BIOMETHANE

As the preceding discussion has shown, German-Ukrainian trade in biomethane can present an opportune business case for both sides. Germany stands to advance the defossilisation of its gas market through the import of large amounts of biomethane, thus contributing towards its own climate goals. For its part, Ukraine has an enormous potential for the long-term, large-scale supply of biomethane, due to its large amount of arable land. At the same time, Ukraine is interested in building up business areas and partnerships in the energy sector to generate income for the country.

Conditions in Ukraine are currently extremely challenging due to the Russian war of aggression. With this in mind, the following instruments for private-sector and state investment and securitisation could contribute towards developing and supporting future trading in biomethane.

Financing through long-term contracts

By providing financial security for Ukrainian investments, long-term procurement contracts would be a way of maximising the degree of financial security of Ukrainian businesses and investors. The European Union's REPowerEU plan aim of scaling up domestic biomethane production to 385 TWh by 2030 sends an important signal to German businesses: biomethane will continue to be an important energy source in the future. However, there has been no evidence of similar commitment by German politicians, who have paid little attention to the use of biomethane up to now. This sector is hoping for a similar stimulus from the German Government with the adoption of the National Biomass Strategy, which is slated for released by the end of 2023.

Foreign trade promotion instruments: Investment guarantees for direct investment by German businesses and untied loan guarantees (UFG) to protect lenders in foreign projects

The Federal Republic of Germany uses foreign trade promotion instruments to protect German businesses that invest directly in foreign projects against political risks abroad. Investment guarantees are one such instrument. Among the risks covered are expropriation, war and armed conflicts, payment embargoes or moratoriums, conversion and transfer risks, and breaches of commitments made by government entities.[53] No investment guarantees for projects in Russia or Belarus have been provided since the start of Russia's full-scale invasion of Ukraine in February 2022, however, as of August 2023, investment guarantees for projects in Ukraine have not been discontinued, and it is still possible to apply for them.[54]

Another instrument of German federal foreign trade promotion is the "UFK guarantee", or untied foreign loan guarantee. This instrument is aimed primarily at expanding and stabilising the supply of foreign-sourced raw materials for German industry. UFK guarantees facilitate access to raw materials by German enterprises, coming into play when the supply situation deteriorates due to supply shortages, trade distortions, dramatic price increases or political factors. Financial participation by a German business enterprise in the planned foreign project is not a criterion for the issue of a UFK guarantee but the existence of a long-term procurement contract with a German purchaser is required.[55]

4.2 NEED FOR INVESTMENT AND FINANCING MECHANISMS TO INCENTIVISE DEVELOPMENT OF BIOMETHANE CAPACITIES IN UKRAINE

The primary risks associated with a rapid increase in foreign investment in biomethane projects are those of the ongoing war, the unanswered question of whether the West will provide post-war military security guarantees for Ukraine and the risk of delay in the country's European and Euro-Atlantic integration. These risks have a strong negative impact on the extent of foreign investment, a very important factor for an accelerated development in the biomethane sector.

Despite the war, Ukrainian businesses are very interested in investing in biomethane production and export projects. If the bureaucratic obstacles could be removed and low-interest loans and export financing were available for plants, the pace and scope of biomethane projects could increase significantly. If they could access affordable financing and gas could be transmitted for export on affordable terms, Ukrainian farmers would be in a position to build a large number of biomethane plants even in the absence of significant foreign investment. The biomethane projects currently being implemented are being financed by private sector investors, for instance. There are no government instruments to promote investment in biomethane in Ukraine, and no plans to introduce such instruments.

As mentioned above (section 2.2), Ukraine aims at a total annual biomethane production of at least 11 TWh by 2030. Gals Agro's costs for retrofitting an existing biogas plant to produce biomethane ran to circa 1.5 million euros, or around EUR 55 per MWh of capacity of annual biomethane production. Thus, the greenfield construction of such a biomethane plant would cost about EUR 200 per MWh of annual biomethane production.

The ambitious goal of 11 TWh of annual biomethane production by 2030 could be met by building of 420 biomethane plants with annual capacities of 26.4 GWh. If we take Gals Agro's EUR 200 per-MWh p.a. as a basis for the capital costs of such construction, then the total investment necessary for 420 plants can be estimated at 2.2 billion euros. Under this scenario an average of 60 biomethane plants would have to be built each year from 2024–2030, with total costs running to roughly 300 million euros each year.

Specific investment costs decrease as installed capacity increases. Thus, capital costs could be reduced 30 to 40 percent by building plants with capacities four times greater (110 rather than 26.4 GWh biomethane per year). These are only ballpark estimates, of course; more precise figures would have to be calculated based on parameters of actual projects and their costs at the time of realisation.

The cost of capital in Ukraine is an important factor determining the costs of the construction of biomethane plants and return on these investments. Currently, this cost is high due to the war and the associated the investment risks, which significantly reduce the possibility of obtaining foreign financing in Ukraine.

Objectively, biogas plants, due to their relatively small capacities, are decentral generation plants. This makes them less likely to be targeted by Russian missiles or drones, thus decreasing the risk of their damage or destruction. This, in turn, makes them one of the lowest risk investments in the energy sector. Clearly though, with the entire territory of Ukraine is exposed to Russian missile and drone attacks, the military threats and risks are high, and neither they nor the currency restrictions imposed to maintain exchange rate stability for the national currency are conducive to investment activity, particularly on the part of foreign banks and other investors from abroad.

The Federal Ministry for Economic Affairs and Climate Action's expansion of the scope of coverage of guarantees for German investments in Ukraine can help project developers in Ukraine to acquire financing for important projects there despite the military risks. With immediate effect, these guarantees cover not only property damage, up to the loss of the entire investment, but also conversion and transfer risks for interest payments on equity-like loans.[56]

European export credit agency mechanisms represent another important instrument for the acquisition of external financing for Ukrainian biomethane projects, particularly since most equipment used for the construction of Ukrainian biogas/biomethane plants is produced in the EU. A large share of that is imported from Germany. This means that a broader application of this mechanism in Ukraine could provide significant stimulus for the realisation of biomethane projects there. State guarantees of this kind cannot be seen as a one-size-fits-all solution for attracting large-scale investment though.

The retrofitting of Gals Agro's biogas plant, for example, was paid for partly by the holding company itself and partly through a loan from the Austrian Raiffeisenbank. The bank was willing to give this loan to Gals Agro due to previous positive experiences doing business with them. This example shows that it is possible to attract foreign financing in wartime.

Once security issues are resolved, active development of financing programmes for biomethane sector projects can begin – analogous to those active in the regenerative electricity sector in the first half of the 2010's. Back then, the regenerative electricity market was built practically from the ground up within just a few years thanks to special lending programmes of international financial institutions, primarily those of the European Bank for Reconstruction and Development[57] and the International Finance Corporation. These programmes stimulated the market, enabled the transfer of the necessary experiences to Ukrainian banks and ultimately the acquisition of financing from a great many national and international sources.

Biogas plants as decentralized generation plants are less vulnerable to missile and drone attacks by Russia, which reduces the risk of damage and destruction and makes them one of the lowest-risk investments in the energy sector.

Practical aspects of project financing and realisation in Ukraine

Economic conditions in the Ukrainian electricity market will play an important role in determining the scale of future biomethane exports from Ukraine. Electricity produced with biogas is currently remunerated at a fixed feed-in rate of EUR 0.124–0.136 per kWh (without VAT). The specific rate depends on how much Ukrainian equipment was used in building of the biogas plant. Exporting biomethane would be profitable both under the current and future conditions. With a premium surcharge (difference between the natural gas price and the feed-in tariff) of EUR 20 per MWh, the amortisation period for retrofitting a biogas plant to produce biomethane would run to one and a half to two years, for instance.

The development of biomethane business fields will also depend on the future development of the wholesale electricity price in Ukraine. Moreover, other domestic uses for biomethane will offer interesting advantages as well, such as the use of compressed biomethane (bio CNG) generated "in-house", as it were, as fuel for agricultural vehicles and equipment. The price of natural gas, which has been very volatile in recent years, will be another key factor determining the price for biomethane and thus the economic efficiency of biomethane projects. There is a danger that potential profits from the sale of biomethane in the premium segment would be lost as the result of a significant decline in the price of natural gas. Biomethane production from biomass ceases to be profitable when the price of natural gas falls to EUR 50–55 per MWh.

The remuneration for biomethane in Europe varies with the carbon footprint of the biomass and production technologies used and will change when with the implementation of European energy legislation (RED III, AFID directives and the national legislation of individual countries that might import Ukrainian biomethane. Other important factors to consider when examining the economic viability of biomethane projects include any additional investment that may be required to connect the plant up to the gas network, whether demand for biomethane can be expected to remain sufficiently high throughout the year (seasonality) and how much it will cost to transport/transmit the biomethane for export.

On the other hand, as markets and technologies develop, additional sources of income for biomethane projects will open up, such as the market for bio-manures, the use of the $C0_2$ captured during the purification of biogas and the use of biogas heat for the operators' own heating needs.

Also worth bearing in mind are the prospects for potential from energy alliances formed by smaller-scale biogas enterprises, the establishment of associations of large-scale biomethane purchasers and professional biomethane project developers. Large-scale biomethane purchasers are local traders who are in a position to purchase biomethane from small biomethane producers, pool those amounts and then sell them in larger quantities for export. This idea is being discussed, particularly by Naftogaz. Professional project developers negotiate partnerships with suppliers of raw materials for biomethane production. In this type of cooperation, local agricultural operations are offered joint ventures with a project developer who will be responsible for the financing, construction, operation, and maintenance of the plant (so called "EPCOM").

OUTLOOK

This paper highlights the great potential that exists for trade in biomethane between Ukraine and the EU, and in particular for trade between Ukraine and Germany. From the Ukrainian perspective, biomethane offers a means of generating urgently needed income and a way to strengthen political and economic ties with the West. For biomethane importing countries, this green gas plays an increasingly important role for the establishment of a future energy system that is resilient and free of fossil fuel.

We encourage stakeholders and decision-makers from both sides to start talking to one another, explore possibilities for cooperation and prepare the ground for doing business together in the future.

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In this policy paper, we highlight the great potential that exists for biomethane trade between Ukraine and the EU, and Germany in particular.

For the Ukrainian stakeholders, biomethane exports are an opportunity to generate urgently needed income and to forge closer political and economic ties with the West. For the consumer countries, this green gas is an increasingly important component of a fossil-free and resilient energy system of the future.

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