FLORENCE SCHOOL OF REGULATION

ROBERT SCHUMAN CENTRE

POLICY BRIEF

Energy security meets the circular economy: a stronger case for sustainable biomethane production in the EU

Highlights:

- The outbreak of the Russia-Ukraine war has revived discussions on the EU's dependence on fossil fuel imports from Russia. To ensure gas diversification, the EU Commission has suggested over a tenfold increase in EU biomethane production from the current ~3 billion cubic meters (bcm) to 35 bcm by 2030. While higher gas prices could provide some incentive for biomethane production in the short term, additional measures will be necessary to reach the 2030 target.
- The International Energy Agency (IEA) has suggested that putting a value on methane emissions (which would otherwise be emitted from the decomposition of organic waste in the agriculture and waste sectors) avoided could support biomethane production while reducing this potent GHG. This could be an interesting option for the EU to support achievement of its Global Methane Pledge commitment.
- The EU circular economy framework could help boost biomethane production by alleviating energy security concerns, but it requires better policy coordination. This policy brief identifies four focus areas: (a) measurement, reporting and verification of methane emissions from the agriculture and waste sectors; (b) continual improvement of best practices to mitigate methane emissions; (c) sustainable production of biomethane; and (d) responsible operation of biomethane plants.

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1. Introduction

Following the Russian invasion of Ukraine, the European Commission unveiled its REPowerEU plan to drastically reduce EU dependence on Russian gas supply.[1] Russia accounts for almost half the gas (43.5%) and coal (46%) imports and 27% of oil imports into the EU. The list of measures suggested includes doubling the Fit for 55 biomethane production target to 35 billion cubic meters (bcm) a year by 2030. With this objective, the EU Commission recommended directing additional funding for biomethane production under the Common Agricultural Policy (CAP) strategic plan.

To make biomethane more cost-competitive vis-à-vis natural gas in the longer term, the International Energy Agency (IEA) has suggested putting a value on methane emissions (which would otherwise be emitted from the decomposition of organic waste in the agriculture and waste sectors) avoided.[2] Some jurisdictions already allow such possibility, i.e. offsets generated through the installation of anaerobic digesters can be used for compliance under the California and Québec Cap-and-Trade systems. While, the government of British Columbia intends to adopt Methane Management Offset Protocol under the B.C. Offset Program this year[3].

This idea raises many questions. What is the current status of non-energy methane emission reporting in the EU? How could the existing circular economy framework support EU production of biogas and biomethane to strengthen methane reductions in agriculture and waste? To address these questions, this paper looks into the methane-relevant EU policy framework on agriculture and waste to identify policy measures which could enhance the sustainable production of biogas and biomethane. This policy brief is structured as follows. Section 2 provides background information on key methane emission sources and trends in the EU's agriculture and waste sectors. Section 3 analyses the policy and legislative framework and measures announced in the 2020 EU Methane Strategy. In Section 4, four groups of changes to the current framework are discussed. The final section draws some conclusions. An extended version of this policy brief will be published as a book chapter.

2. Non-energy methane emissions in the EU

In the EU in the last 30 years (1990-2019) methane emissions have decreased by 39% (from 729 to 443 Mt CO_2 equivalent), mostly driven by reductions in emissions from coal mining, anaerobic waste and enteric fermentation due to a decrease in the cattle population (-27.9% between 1990 and 2019).[4] However, the rate of reduction of methane emissions has been much slower in recent years. Currently, methane emissions account for 11% of EU GHG emissions and they originate mostly in three areas: agriculture (53%), waste (26%) and energy (19%).[5] Methane constitutes a significant part of total GHG emissions in agriculture and waste, accounting for 54% and 88% respectively.

There are two major sources of farm-related methane emissions: enteric fermentation and manure management. Enteric fermentation involves emissions occurring due to fermentation in the digestive system of animals, mostly ruminants (non-dairy and dairy cattle). Despite a significant decrease in the last three decades (of 21% or 50.2 Mt CO2-eq), enteric fermentation remains the largest source of CH_4 emissions and is the key source of GHGs in agriculture. Since 2010, emissions from this category remained stable, decreasing by only 0.8% between 2018 and 2019. Manure (also referred to as animal waste) management accounts for 8.5% (40617.8 kt CO2 equivalent) of total EU methane emissions. Between 1990 and 2019 these emissions decreased by 18% or 9.2 Mt CO2-eq but they have remained stable since 2010.

Methane emissions occur from the solid and liquid waste streams. Emissions from an anaerobic decomposition of organic matter in solid waste disposal sites, are the second biggest source of methane emissions after enteric fermentation.

1 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, REPowerEU: Joint European Action for more affordable, secure and sustainable energy [2022] COM(2022) 108 final 2022.

2 IEA, 'Outlook for Biogas and Biomethane: Prospects for Organic Growth. WEO Special Report' (IEA 2020) <https://www.iea.org/reports/outlook-for-biogas-and-biomethane-prospects-for-organic-growth> accessed 10 March 2022.

3 Ministry of Environment and Climate Change Strategy, 'B.C. Offset Program Consultations - Province of British Columbia' (2022) <https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/offset-projects/consultation> accessed 22 April 2022.

4 EEA, 'Annual European Union Greenhouse Gas Inventory 1990- 2019 and Inventory Report 2021. Submission to the UNFCCC Secretariat' (European Environment Agency 2021) <https://www.eea.europa.eu/publications/annual-european-union-greenhouse-gas-inventory-2021>.

5 Ibid.

The amount of these emissions relates to the amount of biodegradable waste and the volume of landfill gas recovered and flared. The former decreased by 40% in 1990-2019 and the latter increased by 35% in the same period. The EU GHG inventory does not include information on the combustion efficiency of flares used at landfills. On average, 39% of methane from solid waste disposal is recovered or flared, with significant differences between MSs. Methane emissions from wastewater treatment and discharge decreased by 43.7% between 1990 and 2019. While emissions from domestic wastewater continue to decrease (-1.6% between 2018 and 2019), industrial wastewater emissions have been largely stable since 2009, with yearly fluctuations related to the economic situation in individual countries.

The quality of national GHG inventories is a serious concern. The Intergovernmental Panel on Climate Change (IPCC) Guidelines specify methods for estimating emissions in the inventories. These are divided in 3 tiers that categorise emission factors (EFs) and activity data used in calculations. Tier 1 (T1) involves the use of IPCC default values, Tier 2 (T2) is similar but includes country specific EFs and activity data and Tier 3 (T3) requires the development of site-specific EFs based on direct emission measurements. T3 is more accurate but also the most complex.

The majority of EU Member States (MSs) use a combination of T1 and T2 methods to report emissions from enteric fermentation (21 of 27) and manure management (20). Only two countries – France and Spain – use a combination of T2 and T3 methods. Five countries (Croatia, Finland, France, Germany and Portugal) use T2 methods. The majority of EU MSs (25) report methane emissions from managed waste disposal on land using the T2 reporting method. Only Czechia and Luxembourg use T1 methods. These estimates are important because they inform policymaking.

The next section presents the EU policy framework on agriculture and waste with direct or indirect effects on methane emission abatement.

3. The current framework

3.1 Effort Sharing legislation

GHG emissions from agriculture and waste together with other non-EU Emissions Trading System sectors come within the scope of the Effort Sharing Decision (2013-2020) and its successor the Effort Sharing Regulation (2021-2030).[6] The Effort Sharing Regulation sets national reduction targets for individual Member States ranging between 0% and 40% compared to 2005 levels by 2030. The reductions achieved by the EU MSs are expected to contribute to the overall reduction of 30% compared to 2005 levels by 2030 in the EU. The calculation and reporting of methane emissions, and also for ESR purposes, is based on a Global Warming Potential (GWP) 100-year time horizon.[7] However, recital 24 of Regulation (EU) No. 525/2013 calls on the Commission to analyse the implications for policies and measures of adopting a 20-year time horizon for methane.

The Effort Sharing Regulation is currently under revision following the Fit for 55 package. The proposal suggests increasing the EU-wide emission reduction target for the effort sharing sectors from 30% to 40% compared to 2005 levels by 2030 and more ambitious national targets for Member States. With some exceptions, e.g. waste legislation and the Common Agricultural Policy (CAP), most of the policies affecting non-ETS sectors are determined by the Member States. While the non-ETS sectors met the 2020 target of reducing emissions by 10%, meeting the 2030 objective will be more challenging and will require effective policy coordination at the EU level.[8]

3.2 The new CAP: 2023-27 and the Farm to Fork Strategy

The Common Agricultural Policy (CAP) is a common policy for all 27 MSs and is managed and funded from the EU's budget. The Court of Auditors has found that so far the CAP has been ineffective in reducing farm-related emissions, including methane.[9]

6 Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 [2009] OJ L 140.

7 Regulation (EU) 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at the national and Union level relevant to climate change and repealing Decision No. 280/2004/EC [2013] OJ L 165 2013 (OJ L) 525.

8 Artur Runge-Metzger and Tom Van Ierland, 'The Effort Sharing Regulation,' in Jos Delbeke and Peter Vis (eds.), *Towards a Climate-Neutral Europe: Curbing the Trend* (Routledge 2019).

9 European Court of Auditors, 'Common Agricultural Policy and Climate. Half of EU Climate Spending but Farm Emissions Are Not Decreasing' (2021).

Farm-related emissions have not changed significantly since 2010 even though climate action has been one of the major CAP objectives and EUR 100 bln of CAP funds were attributed to climate action between 2014-2020.

The new CAP for the 2023-2027 period has been designed as a key tool to achieve the European Green Deal objectives for agriculture. The new CAP is based around ten objectives, three of which relate to the environment and climate change. They will constitute the basis for CAP strategic plans developed by Member States with SWOT analysis and quantified targets. The EU Commission will assess draft CAP Strategic Plans against the CAP's specific objectives and those specified in the EGD and Farm to Fork Strategy.[10] The Member States will be required to 'aim higher' regarding the environment and climate change in their use of CAP funds compared to the previous period. However, the improved EU Commission methodology for measuring and accounting for climate efforts may not be in place until 2026.

Building on developments in the waste sector, the Farm to Fork Strategy pursues the idea of a circular bio-based economy. It recognises the role of farmers in decreasing methane emissions from livestock through biogas production from agriculture waste and residues (e.g. manure), and waste from the food and beverage industry, sewage, wastewater and municipal waste. The strategy includes other measures fostering methane reduction: feed additives and the promotion of 'carbon-efficient' methods of livestock production. Moreover, it also suggests a number of behavioural measures in a customer empowerment and sustainable food labelling framework, improved availability and prices of sustainable food, and potentially tax incentives to nudge European consumers towards more sustainable and healthy diets, e.g. by reducing tax rates on organic food.

However, the above-mentioned objectives are not fully aligned with the new CAP, as the shift towards more sustainable and healthier diets implies a reduction in livestock. According to some assessments, attainment of the Farm to Fork Strategy objectives is expected to lead to a decrease in livestock production of 10-15%.[11]

3.3. The Waste Framework Directive

The Waste Framework Directive (WFD) is the foundation of the EU waste management acquis. It defines key concepts (e.g. 'waste,' 'by-product'), establishes major principles (e.g. the precautionary principle and the principle of proximity[12]) and allocates responsibilities between key stakeholders. Other pieces of waste law regulate specific waste streams (e.g. batteries and accumulators, packaging waste) or forms of waste management (e.g. landfilling). The latest revision introduced in Directive (EU) 2018/851 aligned waste management with the circular economy framework for sustainable production and consumption. This led to much more focus on waste prevention, e.g. by introducing an objective to halve per capita global food waste at the retail and consumer levels and to reduce food losses along production and supply chains by 2030.

Moreover, the WFD introduced a five-step 'waste hierarchy': prevention, reuse, recycling, recovery for other purposes (e.g. energy) and disposal as the last resort.[13] According to the waste hierarchy, anaerobic digestion of organic waste resulting in the production of biogas and of digestate is regarded as recycling and one of the key waste-to-energy processes promoted in the EU.[14] Thanks to the new municipal-waste-recycling targets (at least 55% of municipal waste by weight will have to be recycled by 2025, 60% by 2030 and 65% by 2035), the separate collection of biowaste set in the Waste Framework Directive and application of the requirements specified in the Landfill Directive, which are presented below, the production of biogas derived from waste is expected to increase in the EU. The latest European Biogas Association data confirm that as of 2013, the share of biogas derived from energy crops has started to decrease compared to agriculture substrates, municipal waste and sewage sludge.[15]

10 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, a Farm to Fork Strategy for a fair, healthy and environ-mentally-friendly food system COM/2020/381 final 2020.

11 Johan Bremmer et al., 'Impact Assessment Study on EC 2030 Green Deal Targets for Sustainable Food Production: Effects of Farm to Fork and Biodiversity Strategy 2030 at Farm, National and EU Level' (Wageningen University & Research 2021) <https://research.wur.nl/en/publications/impact-assessment-study-on-ec-2030-green-deal-targets-for-sustain>.

12 The principle of proximity is that waste should be treated as close to its source as possible.

13 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives [2008] OJ L 312 2008.

14 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions The role of waste-to-energy in the circular economy [2017] COM/2017/034 final.

15 EBA (2021) Statistical Report 2021 presentation.

3.4 The Landfill Directive

The Landfill Directive does not directly address the issue of methane emissions but it has the broader aim of preventing and if that is not possible reducing the negative impact of landfills on the environment, in particular on surface water, groundwater, soil, air and human health.[16] This aim is to be achieved by introducing more stringent operational and technical requirements for waste and landfills. The directive mandates the EU MSs to implement national strategies to decrease the amount of biodegradable waste disposed of in landfills and sets out requirements for landfill site operators. They must apply for permits and provide additional information, including operating, monitoring and control plans, and details of closure and after-care procedures.

The Landfill Directive was amended by Directive (EU) 2018/850 to facilitate the transition to a circular economy.[17] This Directive introduced new restrictions on landfilling waste from 2030 and aims to limit the share of municipal waste landfilled to 10% by 2035. Additionally, it sets out rules to calculate the attainment of municipal waste targets, quality control and traceability systems for municipal waste landfilled. The EU MSs are required to send reports answering a predefined questionnaire on their implementation of the Landfill Directive to the European Commission every three years. Moreover, the European Commission and the European Environment Agency are required to prepare early warning reports identifying shortcomings in the attainment of the targets and recommending corrective action three years before each deadline. Last, the revised Landfill Directive allows MSs to apply economic instruments and other measures to promote the application of the waste hierarchy introduced in the Waste Framework Directive.

Moreover, the Guidance on Landfill Gas Control provides clarity on landfill gas management and establishes criteria for the collection, treatment and use of landfill gas. It suggests that recovered methane can be injected into the gas mains and thus used to generate electricity and heat, or be directly utilised as fuel.

3.5 The Urban Waste Water Treatment Directive

The treatment of urban wastewater is regulated by Council Directive 91/271/EEC.[18] The Directive introduced an obligation to construct the necessary infrastructure for collection and treatment of wastewater in agglomerations (urban areas) which generate >2000 population equivalents (p.e.) of waste water. Secondary treatment (biological treatment removing organic pollution, bacteria and viruses) of all discharges is required for agglomerations of > 2000 p.e., and more advanced treatment (removal of nitrogen and/or phosphorus) for agglomerations >10 000 population equivalents in designated sensitive areas and their catchments. Moreover, it also introduced a pre-authorisation requirement for all discharges of urban wastewater, discharges from the food-processing industry and industrial discharges into urban wastewater collection systems. Last, it also introduced monitoring and control of sewage sludge disposal and re-use.

3.6 The challenge of implementing waste-related directives

Despite significant progress, implementation of waste-related legislation across the EU is not complete. An EU Commission implementation report identified that 14 MSs are at risk of missing the target of 50% of municipal waste being prepared for re-use/recycling specified in the Waste Framework Directive.[19] Moreover, despite a fall in the amount of landfilled municipal waste (an EU average of 24%), significant discrepancies exist between the MSs, with 10 Member States still landfilling over 50% of municipal waste, and five reported rates above 70% in 2016. Moreover, the EU Commission suggests that improved planning and investment in wastewater infrastructure will be necessary to reach full compliance in the long term.[20] Hence, further measures will be necessary to ensure that agriculture- and waste-related emissions continue to decrease in line with the EGD objectives. Production of biogas/biomethane offers an opportunity to effectively reduce GHG emissions in agriculture and waste while increasing the supply of clean energy produced in the EU.

16 Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste [1999] OJ L 182 1999.

17 Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste [2018] OJ L 150.

18 Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) [1991] OJ L 135 1991.

19 Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of EU waste legislation, including the early warning report for Member States at risk of missing the 2020 preparation for re-use/recycling target for municipal waste [2018] COM(2018) 656 final 2018.

20 Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Tenth report on the implementation status and programmes for implementation (as required by Article 17 of Council Directive 91/271/EEC concerning urban waste water treatment) [2020] COM(2020) 492 final 2020.

4. Filling the gaps: policy recommendations

Over 110 jurisdictions including the EU joined the Global Methane Pledge (GMP), a joint commitment to reduce man-made methane emissions in all sectors by at least 30% below 2020 levels by 2030. Current methane policies focus on fossil methane emissions, for which mitigation measures are considered to be the most cost-effective. However, farm-related emissions constitute the bulk of methane emissions in the majority of world regions including Europe and have been one of the drivers of the recent methane emissions increase, along with fossil fuel use. Attention should now focus on abatement of methane emissions from the waste and agricultural sectors.

Such an approach brings climate and air quality benefits and could help to contribute to energy security in Europe. Improving waste and agricultural production-related methane emission management can be one way of generating sustainable and locally-produced energy. It will also contribute to job creation in rural areas and support farmers' income. To achieve this, further measures will be necessary in four areas: measurement, reporting and verification (MRV) of emissions in the agriculture and waste sectors; use of best practices to mitigate methane emissions; enhancement of sustainable biomethane production; and responsible operation of biomethane plants.

4.1 Measurement, reporting and verification of methane emissions from the agriculture and waste sectors

Understanding real emissions and emission sources is a starting point in the design of any policy. This is particularly challenging in the case of policies targeting methane emissions, which are characterised by high temporal and spatial variability. Hence, the EU Methane Strategy sets a priority of improving methane emission estimates by moving reporting at the company and national levels to Tier 3 reporting.[21]

The strategy sets a temporary objective of applying Tier 2 approaches in the agriculture sector because of the high number of stakeholders involved. While it is true that the total number of EU agricultural holdings is 10.3 million, this number includes the largest 278,000 farms generating a standard output of at least 250,000 EUR a year and contributing a half (54.4%) of the EU's total economic output in agriculture.[22] Moreover, while the vast majority of farms in the EU are family farms, this does not always holds true for the largest farms, as roughly 40% of them have a legal or group holding form. Improvements should be made regarding the wastewater sector to achieve Tier 3 level. The quality of reporting of waste disposal in landfills sites is considered to be satisfactory thanks to the existing framework: the Landfill Directive and the European Pollutant Release and Transfer Register.

Rising attention to methane emissions has sparked a renewed focus on the Global Warming Potential (GWP) of different GHGs, a metric used to benchmark the per molecule contribution of GHGs to atmospheric temperature change relative to CO_2. A recent study concludes that using a 100-year GWP reference point is incompatible with the temperature objectives set in the Paris Agreement and suggest that each ton of methane should count as equivalent to 75 tons of CO_2 — substantially higher than the 100-year GWP values currently used.[23] However, the Enhanced Transparency Framework in the Paris Agreement recommends continued use of 100-year values.

The potential measures that the EU Commission could consider include: introducing a methane emission monitoring requirement for the largest agricultural holdings; continual improvement of EU reporting to UNFCCC (through methodological improvements, methane emission measurement campaigns, better coordination between UNFCCC reporting and the International Methane Emissions Observatory, R&D funding for prospective methane detection and quantification technologies and data analytics.

21 The Intergovernmental Panel on Climate Change (IPCC) Guidelines specify methods for estimating GHG emissions in national GHG inventories. They include three tiers that categorise emission factors (EFs) and activity data used in estimates. The simplest, Tier 1 (T1), involves the use of IPCC-recommended default values, Tier 2 (T2) is similar but includes country-specific EFs and activity data, and Tier 3 (T3) requires development of site-specific EFs based on direct emission measurements. T3 is more accurate with enhanced representativeness of facilities. See https://www.ipcc-nggip.iges.or.jp/public/2006gl/ (accessed 15/03/2022).

22 Eurostat, 'Agriculture, Forestry and Fishery Statistics — 2020 Edition' (2020).

23 Sam Abernethy and Robert B Jackson, 'Global Temperature Goals Should Determine the Time Horizons for Greenhouse Gas Emission Metrics' (2022), 17 Environmental Research Letters 024019.

4.2 Continual improvement of best practices to mitigate methane emissions

Reducing methane emissions in agriculture can be done with two types of solutions: supply side (technical solutions) and demand side or consumer side solutions. The former include novel approaches to feeding, e.g. improving the mix of feed materials like incorporating seaweed in cattle feed, feed additives and feeding techniques, and targeted research on the different factors that lead to methane emission reduction and development of a life-cycle methodology to estimate livestock emissions. To facilitate emission mitigation at the farm level the European Commission intends to provide a digital carbon navigator template and guidelines on common approaches to the quantitative calculation of GHG emissions and removals in 2022. Hence, dissemination of best practices and cooperation among farmers are important factors to mitigate methane emissions from agriculture. With this objective, an inventory of best practices and available technologies is being developed and technological developments are being supported by the European Innovation Council.[24] Moreover, the EIC Accelerator Challenge 'Technologies for 'Fit for 55'' supports development and scale-up of sustainable agriculture, including abatement of methane emissions.

A significant reduction of farm-related methane emissions is unlikely without consumer-side solutions such as dietary shifts. A recent study demonstrates co-benefits of shifting to a sustainable diet (e.g. in which animal source proteins constitute a limited part of the diet in favour of plant source proteins) in terms of both public health benefits (reduced cancer incidence rates) and reduction of greenhouse gas emissions and land use.[25] Measures at the EU level could start with awareness-raising campaigns and food labelling encouraging better consumer choices and promoting consumption of locally-produced and seasonal products.

In the waste sector, landfill operators are legally required to use landfill gas to generate energy or flare it. However, further obligations on flaring efficiency and venting would be useful. The obligation to collect biodegradable waste separately and an overall limit to landfilling of waste should considerably decrease methane emissions from landfills. Further requirements to mitigate methane emissions from wastewater and sewage sludge should be introduced. Applying new technologies and incentives for converting waste to biomethane could provide a step change in waste management.

4.3 Sustainable production of biomethane

Biogas produced from organic waste and agricultural residues can be used directly to generate heat and electricity or be upgraded to biomethane, which has a broad application range. Sustainable biogas production has an important potential to support decarbonisation of the EU's economy and mitigate methane emissions from the waste and agricultural sectors cost-efficiently. The technological process also produces digestate, which could replace mined fertilisers as a sustainable soil improver.

It is essential for biogas production to be based on waste or residues as biogas derived from food or feed crops could potentially lead to an increase in methane emissions. This could require incentives to collect and use high methane-emitting organic wastes and residues, and policy coordination. Measures to support biogas production should be carefully designed in line with the general criteria for bioenergy and avoid creating perverse incentives that could lead to an overall increase in waste. Monitoring and verification of the sustainability of biomethane produced should accompany those developments.

4.4 Responsible operation of biomethane plants

The biogas industry uses anaerobic digestion to reduce methane emissions from waste and agricultural residues. While anaerobic digestion helps to avoid methane emissions, the emissions occurring during the process should be avoided. A recent methane quantification study found that fugitive losses related to biogas production can be as high as 9%.[26] However, the potentially leaking components and ways to prevent and reduce such leaks are well known.

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24 EIC, 'European Innovation Council Accelerator' (2021) <https://eic.ec.europa.eu/eic-funding-opportunities/eic-accelerator_en#ecl-inpage-136> accessed 19 January 2022.

25 Jessica E Laine et al., 'Co-Benefits from Sustainable Dietary Shifts for Population and Environmental Health: An Assessment from a Large European Cohort Study' (2021) 5 The Lancet Planetary Health e786.

26 Semra Bakkaloglu et al., 'Quantification of Methane Emissions from UK Biogas Plants' (2021) 124 Waste Management 82.

Emissions in the receiving stage can be avoided with tight covering of open tanks and controlling the temperature and pH value. Diffusion through gas holder membranes can be considerably reduced by performing regular maintenance of foils. Gas holders should not be filled above 50% to avoid emissions from safety valves. The residual biogas should be kept in gas-tight covered digestate storage tanks that are connected to the gas system. During biogas utilisation, methane emissions can occur in a biogas plant. In the case of malfunction of a Combined Heat and Power (CHP) plant, the excess gas must be burned in flaring, so that the methane is converted to carbon dioxide and water. Plant operators should carry out regular leak detection and repair programmes (LDAR) to identify and fix leaks. These efforts could be combined with emission quantification at the source/site level and transparency obligations. The existing voluntary initiatives could serve as a blueprint.[27]

5. Conclusions

The accelerated transition to the circular economy could help to address climate change threats and energy security concerns. Achievement of the European Green Deal will not be possible without reducing the methane emissions dominating GHGs in the agriculture and waste sectors. Captured methane could also provide a clean source of EU-produced energy. While in the waste sector some regulatory steps were already made in the 1990s, in the agriculture sector we are still at the beginning.

Globally, a step change could be achieved by putting activities and targets related to mitigation of methane emissions from all sectors under Nationally Determined Contributions (NDCs). This would provide a more focused and stable policy framework. At the regional/national level, regulatory framework incentives to promote biogas and biomethane production are needed, because these low carbon fuels compete with fossil fuels. An increased carbon price or putting a value on abated methane could be helpful, but more efforts are needed to monitor the sustainability of biogas value chains.

In the EU, the Taxonomy Regulation recognised anaerobic digestion of bio-waste and sewage sludge as economic activities contributing substantially to climate change mitigation.[28] The regulation also introduced technical screening criteria for the construction and operation of dedicated facilities for treatment of separately collected bio waste through anaerobic digestion, with a resulting production and utilisation of biogas, digestate and/or chemicals. This requires monitoring and contingency plans to minimise methane leakage at facilities and requirements on input feedstock (the share of food and feed crops should be limited to 10%). The biogas produced could be directly used to generate electricity and heat or upgraded to biomethane and injected in the gas grid. With more targeted incentives, the circular economy could contribute to climate objectives and enhance energy security in the EU.

27 European Biogas Association, 'Quantification of GHG Emissions from Biogas Plants' (2020) <https://www.europeanbiogas.eu/biogas-plant-operator-workshop-quantification-of-ghg-emissions-from-biogas-plants/> accessed 15 March 2022.

28 Commission Delegated Regulation (EU) …/... supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives [2020] C/2021/2800 final 2020.

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