Clearing the air:

how continuous monitoring supports compliance with the latest EU methane regulations

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In April, the European Parliament reached a preliminary agreement with EU member states on legislation to reduce methane emissions from the energy sector. Find out what you need to know to ensure compliance and maintain operational excellence, especially when using continuous monitoring solutions such as Nubo Sphere.

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Executive summary

In April, the European Parliament provisionally agreed with EU members on a law to reduce methane emissions from the energy sector. Methane emissions are one of the largest contributors to global warming, after CO2. The EU Parliament states that “methane emission reductions of 45% by 2030, based on available targeted measures and additional measures in line with the UN Sustainable Development Goals, could avoid 0.3 °C of global warming by 2045.” These kinds of deep reductions are essential to limit global heating to 1.5 °C according to the Intergovernmental Panel on Climate Change.

This law has been adopted by the EU Council and will enter into force 20 days after being published in the EU Official Journal, which is expected to happen in June 2024. At that time, this regulation will introduce several bureaucratic hurdles—for authorities introducing penalties and defining reporting hubs, for regulatory bodies developing various standards (incl. for monitoring technologies, quantification, and venting), and for operators who must develop, submit and report on LDAR plans, as well as provide regular source- and site-level quantification summaries to authorities.

To help prepare, we’ve unpacked these regulations in this report.*

This regulation marks the culmination of more than two years of negotiation, aimed at reducing methane emissions in the fossil fuels and petrochemical industries. Its scope is broad, covering oil and natural gas exploration and production; natural gas extraction and processing; gas transmission, distribution, and storage, including LNG terminals; petrochemical operations; coal mines; and abandoned operations. Its reach even extends beyond the EU, applying to companies who import into the Union.

This report focuses on above-ground, onshore operations for crude oil and natural gas within the EU, although we do include a brief commentary on how these regulations might apply to importers.

You can find the regulations here.

At its heart are provisions for improved measurement, reporting and verification of energy sector methane emissions. This report breaks the regulations down according to articles relevant to methane emissions monitoring, covering articles on emissions monitoring and reporting, leak detection and repair, inactive wells, imported gas, and penalties for infringement. Accompanying each article, we have included a brief commentary on how our Nubo Sphere continuous monitoring solution will help operators comply with the regulations set out in these articles. By providing continuous monitoring, quick leak detection, and accurate quantification, Nubo Sphere meets the intent of this regulation: understanding methane emissions based on reliable data as well as identifying and repairing leaks as quickly as possible due to actionable emission event detection.

* This is not legal advice. Please consult qualified legal counsel.

Definitions and implications

These regulations provide definitions of terms referred to throughout this report. We have included them here, along with the implications for emissions monitoring, as a foundation to our analysis.

Term	Definition	Implications for emissions monitoring
Quantification	Activities to determine the quantity of methane emissions by means of direct measurements or, where direct measurements are not feasible, based on other methods such as simulation tools, and other detailed engineering calculations or a combination of such methods.	Nubo Sphere incorporates advanced equipment and monitoring methods to accurately quantify methane emissions.
Direct measurement	Measurement of the methane emission at source-level with a measuring device that allows such a measurement.	Whether a measurement with a continuous monitoring system like Nubo Sphere could be considered as direct measurement is open to interpretation. Depending on the installation on the site, Nubo Sphere can typically detect emissions from each source, but not distinguish them individually. However, in some cases, where there is a big distance between different sources, Nubo Sphere can also distinguish between different sources.
Site-level measurement	A measurement which captures a complete overview of all site-level methane emissions, including, for a pipeline network, emissions from segments of such a network, and typically involves the use of sensors mounted on a mobile platform, such as a vehicle, a drone, an aircraft, a boat or a satellite, or the use of other means, such as fixed sensors or continuous point sensor networks.	Nubo Sphere falls under this definition, as continuous, fixed-point sensor network, that can capture emissions across an entire site.
Site-level methane emissions	All sources of emissions within an entire site.	See site-level measurement.
Leak detection and repair survey (LDAR)	A survey to identify and detect sources of methane leaks and other unintentional methane emissions, and to repair or replace the relevant components.	Per these definitions, Nubo Sphere could be used as part of an LDAR survey, depending on the minimum detection limits for type 1 and type 2.
Type 1 (remote) LDAR survey	A remote leak detection and repair survey undertaken with the minimum detection limit and minimum leak threshold set out in this regulation.	See leak detection and repair.
Type 2 (contact) LDAR survey	A contact leak detection and repair survey undertaken with the minimum detection limit and minimum leak threshold set out in this article.	See leak detection and repair.
Continuous measurement	A measurement where the reading is taken at least every minute.	Nubo Sphere takes a measurement every five seconds and therefore qualifies as continuous measurement solution.

Table 1: Key definitions according to EU regulations

Article 12: monitoring and reporting

Article 12 sets rules for EU-based operators to report emissions quantification from individual sources and sites to the authorities of the corresponding member state.

Operators will be required, by 12 months of entry into force, to submit quantification reports that are at least estimated using generic emission factors for all sources. They will have more time to submit quantification reports using direct measurements: 18 months from entry into force for all operated assets and 30 months for all non-operated assets. See Figure 1 for more information on the regulation's reporting timeline.

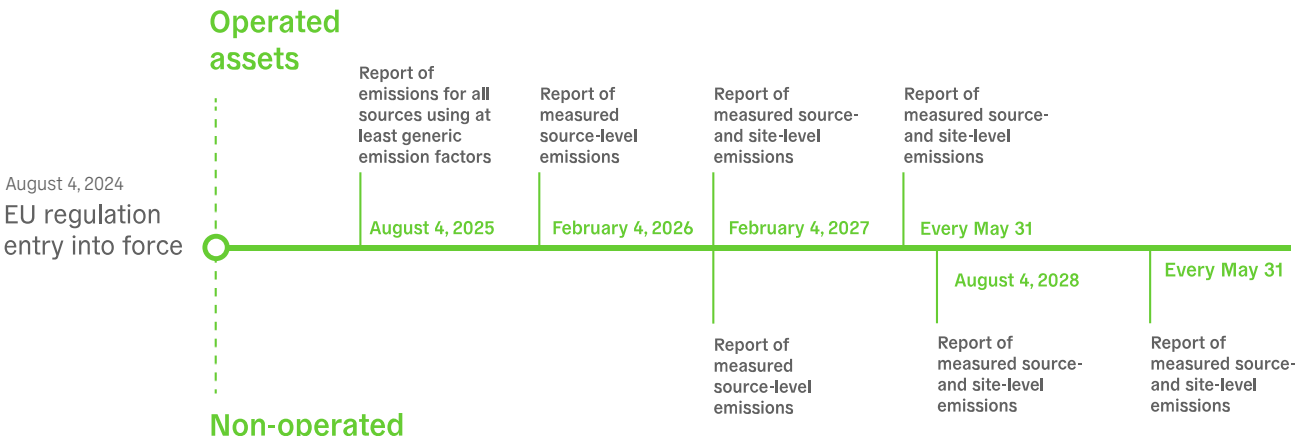

Figure 1: Timeline for submitting reports on source- and site-level emissions to authorities

Paragraph 4 regulates the content of these reports. Each report should cover the last calendar year and include the type and location of the emission sources; detailed data for each type of emission source, reported in tonnes of methane and in tonnes of CO_2 equivalent, using global warming potential; detailed information on the quantification methodology; all methane emissions for operated assets; share of ownership and methane emissions from non-operated assets multiplied by the share of ownership; and a list of the entities with operational control of the non-operated assets.

As per Paragraphs 4 and 5, the European Commission still needs to define the reporting template, by means of an implementing act. The European Committee for Standardization (CEN) is still developing standards for measurement and quantification which is expected no later than 2027. Until this process is complete, operators can use the technical guidance and reporting templates from OGMP 2.0.

Finally, Paragraph 6 mandates that these reports compare source-level and site-level emissions. If there is a statistically significant discrepancy, operators must alert authorities and begin a reconciliation process. During this process, operators should consider the causes of the discrepancy, including the accuracy and appropriateness of their means of quantification, and consider deploying more quantification or site-level measurement, before reporting to authorities.

How Nubo Sphere helps operators comply with regulations on monitoring and reporting

Nubo Sphere is an industry leading solution for emissions monitoring and quantification. Nubo Sphere can provide the site-level quantification required for these reports and accounts for the variability of site emissions. This supports a more comprehensive understanding than intermittent technologies, which in turn enables operators to prioritize their emission reduction activities. Furthermore, Nubo Sphere can, in some cases, provide source-level quantification—for instance, when monitoring a flare stack, the height of which makes monitoring difficult with traditional technology.

Furthermore, Nubo Sphere supports operators in reporting—for OGMP 2.0, for example. Given the existing alignment between OGMP 2.0 and this regulation, these reports are likely to also be EU regulation compliant. We will continue providing this support to our customers as EU regulations develop further.

Article 14: leak detection and repair

This article regulates the initiation, frequency and standards of LDAR activities. Refer to figure 2 below for an example survey schedule.

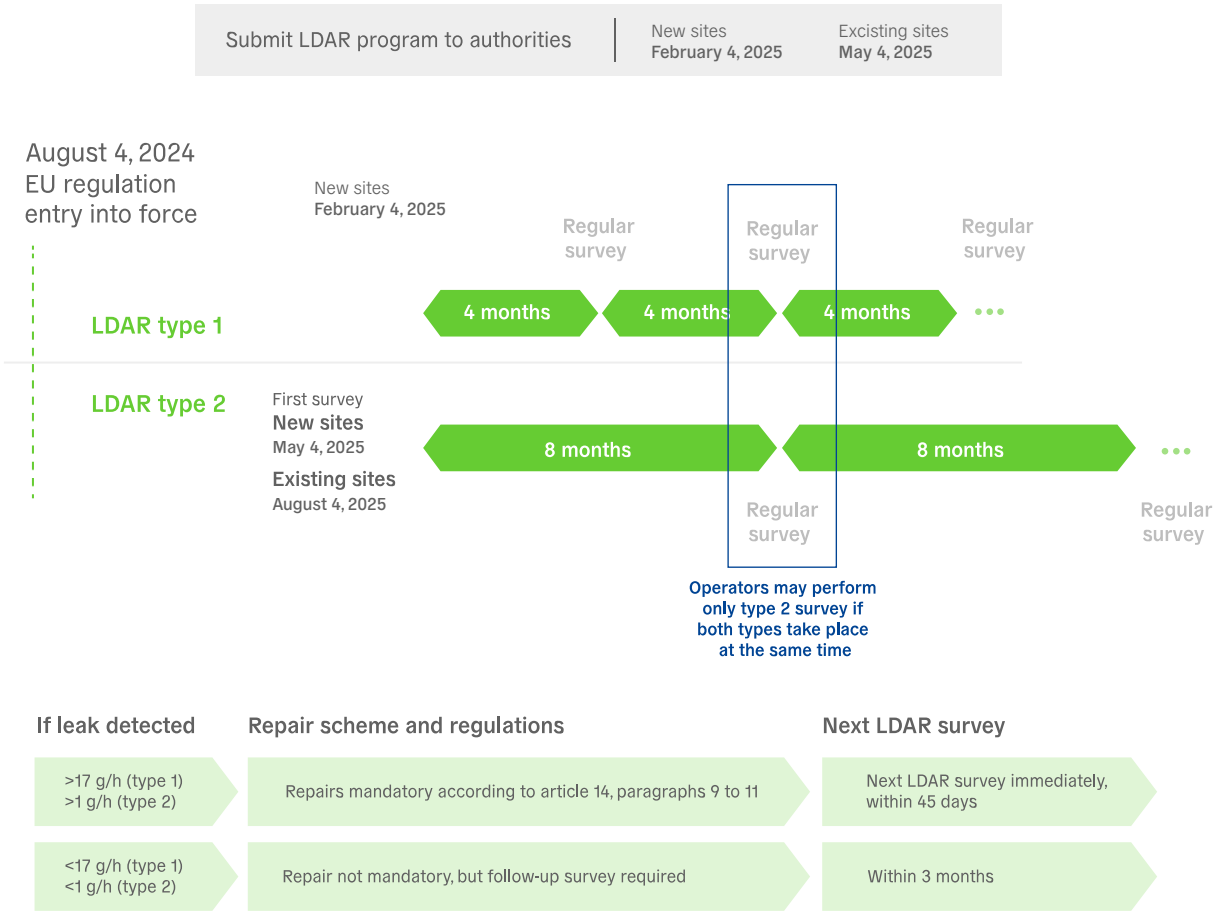

Figure 2: Example for an LDAR survey schedule for transmission compressor stations with >16 bar operating pressure

First, the article provides a timeframe for operators to submit LDAR plans—by nine months after entry into force for existing sites, and by six months after the start of operations at new sites. These plans should include descriptions of LDAR surveys and activities. They should also include information on devices used, detailed in Part 2 of Annex I: manufacturer information; information on leak-detection capabilities, reliability, and limitations; and a description of how the device will be used. Finally, LDAR plans must include the timeline for surveys, in accordance with the standards provided in the remainder of Article 14.

Article 14 asks that operators initiate the first type 2 LDAR survey as soon as possible after entry into force—and surveys conducted up to 24 months before entry into force count as initiation of surveys—surveys are mandatory within nine months from the start of operations on new sites, and 12 months from the regulations' entry into force at existing sites.

After the first survey, the regulations mandate the frequency and type of LDAR surveys for different types of equipment, as found in Article 14 paragraph 2, supported by the included tables from Annex 1. After carrying out the first type 2 leak detection and repair survey, type 1 and type 2 leak detection and repair surveys shall be carried out with the following frequencies:

- For all aboveground components, excluding transmission and distribution networks, leak detection and repair surveys as set out in Article 14 shall be carried-out as per the following minimum frequencies:

Type of component	Type of LDAR survey	Frequency
Compressor station, underground storage, LNG-terminal, regulating and metering station	Type 1 LDAR survey	4 months
Compressor station, underground storage, LNG-terminal, regulating and metering station	Type 2 LDAR survey	8 months
Valve station	Type 1 LDAR survey	9 months
Valve station	Type 2 LDAR survey	18 months

Table 2: LDAR survey schedules for non-transmission components

- For all components of transmission and distribution networks, leak detection and repair surveys as set out in Article 14 shall be carried-out as per the following minimum frequencies:

Type of component	Design pressure	Type of LDAR survey	Frequency
Compressor station, regulating and metering station	>16 bar	Type 1 LDAR survey	4 months
Compressor station, regulating and metering station	>16 bar	Type 2 LDAR survey	8 months
Compressor station, regulating and metering station	≤16 bar	Type 2 LDAR survey	9 months
Valve station	>16 bar	Type 1 LDAR survey	9 months
Valve station	>16 bar	Type 2 LDAR survey	18 months
Valve station	≤16 bar	Type 2 LDAR survey	21 months

Table 2a: LDAR survey schedules for transmission components

Paragraph 5 includes an alternative, less frequent surveying schedule for sites that have reported minimal leaks for at least five years.

Article 14 also refers to standards for detection devices that operators can use in LDAR surveys. While the establishment of these standards by the CEN is ongoing until 2027 at the latest, Article 14 mandates that until such standards are established, "operators shall follow state-of-the-art industry practices and [sic] the best technologies that are commercially available for LDAR surveys. Operators shall provide competent authorities and verifiers with information on the standards, including international standards, or methodologies used."

Paragraph 6 does mandate that "LDAR surveys shall be carried out with detection devices that allow to identify leaks… at a level as close as possible to each individual potential emission source…" According to Paragraph 7, operators can expect an establishment of minimum detection limits, according to a process detailed in Article 35—the Commission shall request and adopt standards set by European standardization organizations—by 12 months of this regulation's entry into force. In the meantime, "operators shall use the best available technologies and the best available detection techniques, in compliance with the manufacturer specifications for operation and maintenance."

Paragraph 8 provides the following thresholds for repair and replacement of leaking components:

> Operators shall repair or replace all components found to be emitting methane at or above the following levels at standard temperature and pressure and using detection devices in accordance with the manufacturer specifications for operation and maintenance:
>
> (a) for type 1 LDAR surveys: 7000 parts per million in volume of methane or 17 grams per hour of methane;
>
> (b) for type 2 LDAR surveys: 500 parts per million in volume of methane or 1 gram per hour of methane for aboveground components.

The balance of Article 14 concerns the repair activities that must follow leak detection. Notably, Paragraph 9 states that "If the repair cannot be carried out immediately after detection, it shall be attempted as soon as possible and no later than 5 days after detection and shall be completed within 30 days after detection." However, this paragraph includes flexibility, allowing operators 12 days to notify authorities of cases when repairs will not be possible in that timeframe due to safety issues, adverse environmental impacts, accessibility, availability of replacement parts, or the deterioration of gas supplies to crisis levels. Paragraph 10 builds in further flexibility, allowing up to a year for scheduled shutdowns when necessary, provided the leak is minimized within 24 hours.

Finally, according to Paragraph 12, operators are required to survey emitting components no later than 45 days after repairs. Operators are also required to resurvey components leaking at rates below repair thresholds within three months of detecting the leak to determine if leak rates have changed or if repairs are necessary.

Article 14 also includes standards for record keeping and reporting throughout the LDAR process. Operators must record all leaks and decisions to delay repair and keep these records available to authorities for 10 years. Operators are also required to submit annual reports containing repair and monitoring schedules, and a summary of all LDAR surveys completed during the previous year.

How Nubo Sphere helps operators comply with regulations on leak detection and repair

Continuous monitoring systems such as Nubo Sphere will be allowed to support leak detection and repair surveys provided they meet three conditions: the approval of competent authorities, the continuous monitoring system takes measurements at the level of each individual potential emission source, and the continuous monitoring system can collect measurements meeting the minimum values set out in paragraphs 7 and 8.

Given that the approval of competent authorities is likely to be contingent upon satisfying the latter two conditions, we can focus on the second and third conditions.

Condition two states that "The measurement is undertaken at the level of each individual potential emission source". This leaves room for interpretation. If we understand that the measurement should cover each individual potential emission source and, therefore, measure any leak from each individual potential emission source, then Nubo Sphere would comply with this requirement, provided a device is installed 15 – 20 m from each emission source.

However, if this means that the detection device needs to take measurements individually for each potential emission source, and not cover multiple emission sources in a single measurement, then Nubo Sphere would only comply in those cases where it is installed close to an individual source that is also distant enough from other sources to prevent interference.

The third condition mandates that "(the continuous monitoring systems) comply with the minimum values as set out in paragraphs 7 and 8. While the requirements in Paragraph 7 remain to be seen, Nubo Sphere easily meets this condition for type 1 surveys given the minimum values in Paragraph 8. Nubo Sphere has been able to detect emissions down to 17 g/h and lower as verified by third-party institutes.

Furthermore, Nubo Sphere's unrivalled, laser-based sensor technology provides accurate, precise, and reliable information on emissions, enabling operators to quickly identify, 24/7, where their largest methane leaks are, and which assets need their attention. After repairs, Nubo Sphere immediately shows the operator if the action has successfully freed up resources, which can now be focused on other tasks. This stands to tremendously boost the efficiency of LDAR programs.

Article 18: inactive wells

This article provides regulations for monitoring inactive wells, including temporarily plugged and permanently plugged and abandoned wells.

Generally, this article provides requirements for reporting methane emissions quantifications, starting 21 months after the regulation's entry into force and recurring every May 31 until operators have demonstrated five consecutive years of reports with no emissions.

Article 18 includes an additional layer of complexity, related to creating inventories of inactive wells, that does not apply to most jurisdictions within the EU.

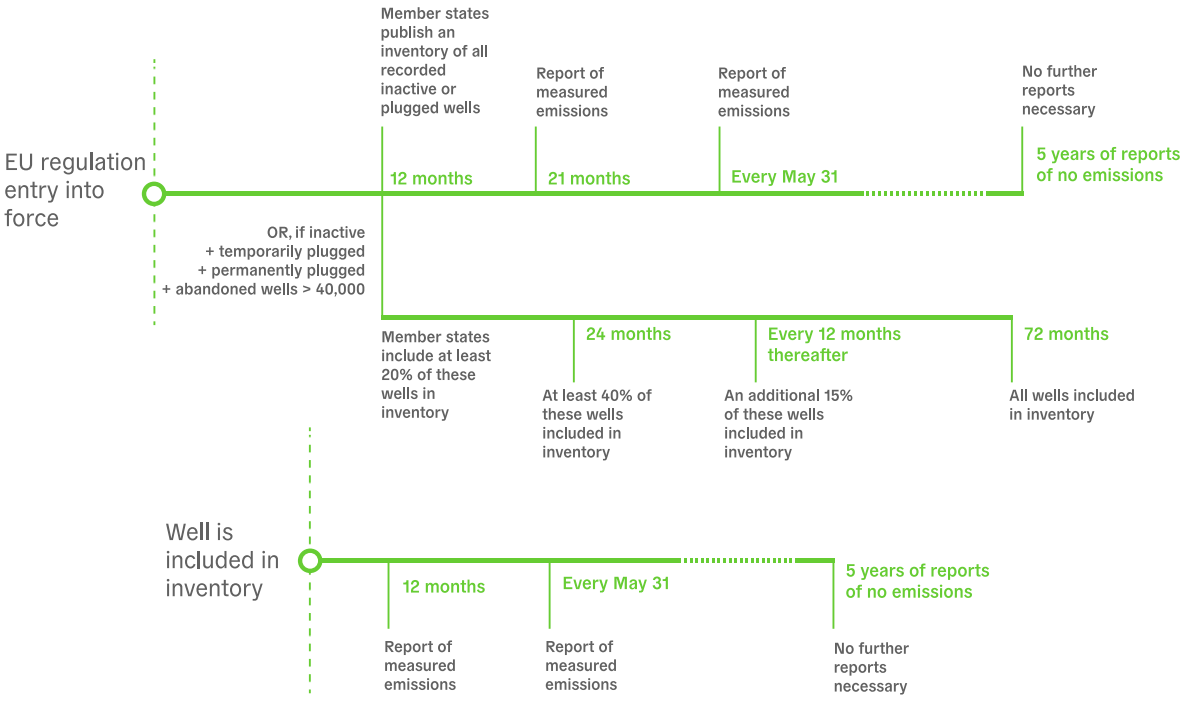

Figure 3: Timeline for reporting on emissions from inactive, temporarily plugged, permanently plugged or abandoned wells

How Nubo Sphere helps operators comply with regulations on inactive wells

Nubo Sphere provides quantification that meets the standards of this regulation. Operators could use Nubo Sphere when reporting quantification of inactive wells and temporarily plugged wells to competent authorities.

Article 27: methane emissions occurring outside the EU

These regulations include standards for importers and a discussion on methane reporting and verification (MRV) standards in third countries. From January 1 2027, importers shall demonstrate and report to the authorities of the Member State in which they are established that the crude oil, natural gas, or coal produced outside the Union and imported by them is subject to methane monitoring, reporting, and verification equivalent to the regulations for local operators set by the EU. For crude oil and natural gas, the producer must apply monitoring and reporting measures equivalent to those defined in Article 12 for the importer to be compliant. Compliance with OGMP 2.0 level 5 is automatically seen as equivalent. Other local regulations outside the Union might be ranked as equivalent, too, if regular reporting of source- and site-level quantification is ensured. These regulations include standards for importers and a discussion on methane reporting and verification (MRV) standards in third countries. Starting January 1, 2027, importers will be required to demonstrate, for all contracts renewed or entered after entry into force of this regulation, that the production of the material they import is subject to MRV standards "equivalent to those set out in this Regulation."

Article 27 contains the following standards for MRV equivalence:

> (a) crude oil, natural gas and coal are subject to independent third party verification equivalent to that set out in Articles 8 and 9 and the producer established in a third country applies:
> (i) for crude oil and natural gas, monitoring and reporting measures ensuring quantification of methane emissions equivalent to those set out in Article 12 or monitoring and reporting at OGMP 2.0 level 5;
> (ii) for coal, monitoring and reporting measures equivalent to those set out in Article 20; or
>
> (b) the third country has in place and applies to producers and exporters established in that third country and supplying crude oil, natural gas or coal to the Union market a regulatory framework on monitoring, reporting and verification that is at least equivalent to that applied in the Union; in particular, the third country has demonstrated that those monitoring and reporting requirements ensure at least source- and site-level quantification and regular reporting equivalent to those set out in Article 12, for crude oil and natural gas, and in Article 20, for coal, and that effective verification by an independent third party, equivalent to that set out in Articles 8 and 9, as well as effective supervision and enforcement are in place.

Commentary on Article 27

Following the spirit of this regulation—indirectly affecting a global reduction in methane emissions by directly protecting domestic producers from heavily emitting competition—the EU may simply choose to designate MRV regulations in other jurisdictions, such and the United States and Canada, as "equivalent". This would satisfy the aims of Article 28 without disrupting the supply of fossil fuels in the EU.

To learn more about the latest EPA regulations on methane emissions in the United States, see our article here.

Elsewhere in the regulations, Article 30 sets the framework for a to-be-established methane transparency database, which will include information on third countries' regulations and international commitments to methane reduction. This may prove instrumental to determining MRV equivalency in these countries to determining MRV equivalency in these countries.

How Nubo Sphere helps operators comply with regulations on methane emissions occurring outside the EU

In theory, with the same regulations applying to both importers and domestic operators, Nubo Sphere will support both non-EU and EU operators in all the ways explained above with the quantification of their methane emissions. This is supported by the increasing deployment of Nubo Sphere in well-regulated jurisdictions such as the US and Canada.

Article 33: penalties

Article 33 provides for EU member states to create rules and penalties for infringing upon the above regulations. These penalties should be proportional to the negative externalities of non-compliance, at least sufficient to deprive those responsible of the economic benefits of infringement and increasing in the case of serious, repeat infringement. They will also include periodic penalties to compel operators to quickly end infringements.

Paragraph 7 provides indicative criteria for member states to use when imposing penalties:

> (a) the duration or temporal effects, the nature and the gravity of the infringement;
> (b) any action taken by the operator, undertaking, mine operator or importer to timely mitigate or remedy the damage;
> (c) the intentional or negligent character of the infringement;
> (d) any previous or repeated infringements by the operator, undertaking, mine operator or importer;
> (e) the economic benefits gained or losses avoided, directly or indirectly, by the operator, undertaking, mine operator or importer due to the infringement, if the relevant data are available;
> (f) the size of the operator, undertaking, mine operator or importer;
> (g) the degree of cooperation with the authorities;
> (h) the manner in which the infringement became known to the authorities, in particular whether, and if so to what extent, the operator, undertaking, mine operator or importer timely notified the infringement;
> (i) any other aggravating or mitigating factor applicable to the circumstances of the case, including third party actions.

Finally, as per paragraph 8, member states will annually publish the type and size of penalties imposed, as well as the infringement and operator responsible.

Commentary on Article 33

These regulations are designed to produce a timely impact on methane emissions, thus reducing both local and global environmental impacts quickly. To be an effective deterrent, penalties will have to present operators with significant costs. As the regulation states, they will at least negate the economic benefits of infringement—a punitive element is almost certain.

However, it's worth noting that only EU member states can enforce penalties. This has two implications. First, penalties will not affect US and other non-EU operators, but they will affect importers who buy from US and other non-EU operators. Second, it's up to EU members to actually apply penalties. It's still not clear how or whether each member will.

How Nubo Sphere helps operators avoid penalties for non-compliance Article

We will be watching the development of penalties closely and will update this report as the situation develops. However penalties manifest, Nubo Sphere will support operators in avoiding these costs while maintaining overall low costs of operation for the monitoring solution.

Conclusion: a future-proof solution for the future of emissions monitoring regulation

In effectively regulating measurement, reporting, verification, and repair schemes for methane emissions in the energy sector, these regulations will have wide-ranging implications for oil and gas operations within the EU. While it is still not clear how these regulations will affect importers, or what enforcement mechanisms may develop for non-compliance, the potential exists for these regulations to significantly reduce methane emissions from oil, gas and coal operations.

By meeting the standards set for continuous monitoring solutions, Nubo Sphere will support operators in compliance with the above regulations, ensuring continuous operation and seamless adaptation to new monitoring and reporting requirements. Operators who use continuous monitoring for methane emissions benefit from timely information when emissions happen, which can drastically improve the efficiency of LDAR programs. Nubo Sphere's verified ability to detect emission rates down to 17 g/h offers an advantage over other technologies—especially in the European market where leak rates are often low. Meanwhile, the solution's increasing use in well-regulated exporter countries to the EU will support importer compliance, and it is positioned to preserve low operating costs by protecting against potential penalties.

Sensirion Connected Solutions will continue to follow and report on the implementation of these regulations after their entry into force. We will also continue to actively support operators in navigating a changing regulatory landscape. If you have any questions or need a partner to support you in complying with these regulations, please reach out here.

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About us

Sensirion Connected Solutions specializes in sensor-based IoT-solutions and services for emissions monitoring in the energy sector. By integrating proprietary sensor technology, advanced data analytics and an intuitive user interface, Sensirion Connected Solutions provides the transparency and actionable insights needed to reduce emissions.

The company aims to help oil and gas operators comply with regulations, meet their ESG goals, improve safety and enhance operational efficiency. Headquartered in Stäfa, Switzerland, and Chicago, Illinois, USA, Sensirion Connected Solutions is part of Sensirion Holding, a leading global manufacturer of high-performance digital microsensors for environmental and flow sensing applications.