Regulations and public private partnership to improvement knowledge about methane emissions and mitigation options – Norway

Initial condition

Norway has a large oil and gas sector which accounts for about 25% of the country's total greenhouse gas (GHG) emissions. CO_2 emissions from energy generation required for the operation of offshore installations and land-based processing plants constitute a major part them. Emissions from flaring, direct venting, and leaks of methane are very low, with routine flaring being practically non-existent and direct venting and leaks being kept low by strict pollution control measures and a use of modern technology. Data reported to the UNFCCC on direct emissions of methane from the oil and gas sector have been at about 31 thousand tonnes of methane per annum,[1] which in comparison to other States is very low; it represents less than 0.4 per cent of global oil and gas methane emissions, while Norway's share of global oil and gas supplies is about 2.4 per cent.

Despite being a small source of GHG emissions, since 2015 methane emissions from the oil and gas sector attracted in Norway considerable attention. One important reason was for that, was the insufficient knowledge about the scale and nature of the emissions. The methodologies and practises for quantification of methane emissions from oil and gas installations had been in use for more than 20 years and were perceived to be incomplete and inaccurate. As such, there was a need to improve knowledge about methane emissions, with emphasis on offshore installations.

Improved knowledge on methane emissions levels

In 2014 a two-year-long study was initiated by the Norwegian Environment Agency to survey direct methane emission sources at offshore installations. The study, completed in 2016 (NEA 2016),[2] aimed to identify and categorize direct emission sources, quantify emissions, improve the methodology for quantification, and make recommendations for possible mitigation measures, including implementation of new BAT standards. The detailed analysis was conducted by a consultant with participation (and data input) from operating companies on

[1] National Inventory Reports 2017 available on the UNFCCCC website. These estimates are currently in the process of being revised downwards as further explained in this note

[2] https://www.miljodirektoratet.no/publikasjoner/2017/februar-2017/cold-venting-and-fugitive-emissions-from-norwegian-offshore-oil-and-gas-activities---module-3a-report---best-available-technique-bat-assessments/

and

https://www.miljodirektoratet.no/publikasjoner/2017/februar-2017/cold-venting-and-fugitive-emissions-from-norwegian-offshore-oil-and-gas-activities---module-1-surveying-installations-to-identify-potential-emission-sources

the Norwegian Continental Shelf, as well as the Norwegian Oil and Gas Association (NOROG), the Norwegian Petroleum Directorate and the Petroleum Safety Authority.

All permanent offshore oil and gas facilities were surveyed, 68 in total, of which 15 were selected for a thorough examination, while information about the rest (53 facilities) was collected by a questionnaire. The study showed that quantification obtained according to the existing methodologies and practises is incomplete and inaccurate. Some 48 different emission sources were identified, far more than previously reported by operators. Nevertheless, the overall level of emissions was estimated to be considerably below earlier estimates, albeit it was recognized that large uncertainties remain, particularly with regard to small emissions sources.

Based on the outcome of this bottom up analysis, new approaches were proposed for methane quantification. Specific methods are now recommended for individual emission sources and sub-sources. The most important emission sources and the proposed quantification methods are summarised in Table 1.

Table 1: Important emission sources and methane quantification methods

Methane emission sources	Share of total	Methane quantification method
Compressor seals	28%	Flow rate of primary gas into the seal
Produced water treatment	19%	Upstream pressure and produced water volume
Un-combusted flare gas	12%	Logging of time with unignited flaring
Leaks from processes	10%	Large leaks: duration, volume. Small leaks: OGI[3] leak/no-leak method using detection by IR camera
Glycol regeneration	4%	Calculation from computer programme (GRI-GLYCalc)

Source: Compiled from publications reference under footnote 2.

The Norwegian Oil and Gas Association (NOROG[4]) together with the oil and gas companies operating in Norway played a key role in the development and deployment of new quantification methodologies and guidelines for reporting methane and non-methane volatile organic compounds (NMVOCs). Guidelines for quantifying and reporting methane emissions are made public on the NOROG web site[5] and are used by all companies in their submissions of the environmental data to the authorities. These guidelines are regularly updated as new knowledge become available. Methods and emission factors for methane were modified following the NEA 2016 studies mentioned above. The result was a downward revision by almost 50% of methane emissions from direct emission sources on offshore installations at

[3] Optic Gas Imaging.

[4] https://www.norskoljeoggass.no/en/#

[5] https://www.norskoljeoggass.no/contentassets/cd872e74e25a4aadac1a6e820e7f5f95/044--guidelines-for-discharge-and-emission-reporting_ver17_2019.pdf and https://www.norskoljeoggass.no/contentassets/cd872e74e25a4aadac1a6e820e7f5f95/044---appendix-b-voc-emmissions-guidelineline.pdf

the Norwegian Continental Shelf for 2017[6] (this change, however, is not reflected yet in the National Inventory Report submitted to the UNFCCC).

The companies operating on the Norwegian Continental Shelf are continuing their efforts to improve methods for quantifying emissions. Recently the focus has been on improving methods for quantifying methane emissions from gas turbines, flares, and other leaking components. The industry is pursuing direct measurements and remote sensing of emissions sources as important new supplements to bottom-up quantification methods.

In Norway the cooperation on quantification of emissions between the authorities and the oil and gas industry has some unique features. All parties have actively taken part in efforts to improve methods and the empirical basis for quantification, and in the case of methane, that led to improved guidelines for quantification and reporting. The guidelines, developed by the oil and gas industry and its association (NOROG) and approved by relevant regulatory agencies, are the basis for all data being reported through national database.[7]

Abatement opportunities and costs

In addition to the initiatives to improve knowledge of the nature and the scale of methane emissions, the industry and the authorities have also taken a number of steps to reduce those emissions, as well as the emissions of NMVOCs. For instance:

1. The Norwegian Pollution Control Act regulating permissible emission level, together with the EU-based technical norms, elevated the standards for methane and NMVOCs emissions (e.g. those related to issuance of new licences for exploration and production at offshore installations).
2. Since 1991 there has been a CO_2 tax at offshore installations. The same tax rate has been levied on all gas being used for energy generation, flaring, or venting. Since 2017 the tax rate for reported volumes of vented gas increased, to reflect better the global warming potential of direct gas releases to the atmosphere. It represented more than a seven-fold increase, to 7,41 NOK per Sm^3 (about 25 US$/MMbtu). The tax covers about 75% of cold venting at offshore installations. Although the tax level is high, it is yet unclear whether it in itself has had any significant impact on emissions reduction efforts.[8]
3. The NEA 2016 studies, which also to some extent covered abatement opportunities, triggered additional efforts from oil and gas sector operators to further scrutinize methane emission reductions options and their related costs.

[6] "IEAs Methane Emissions from Norwegian Offshore Oil and Gas Activities" Memo from NEMS 2019-12-17.

[7] https://epim.no/eeh/

[8] https://www.miljodirektoratet.no/klimakur. Only available in Norwegian.

4. An industry cooperation (VOC Industry Cooperation, VOCIC) coordinates measures to meet regulatory emissions limits of NMVOC. Simultaneously, it undertakes steps to address methane emissions from offshore crude loading, by, among other things, reporting emissions levels to the regulator, and financing measures to capture VOCs. Emissions limits are set for individual loading installations, but compliance is achieved if emissions from all loading points are verified to be within the collective permissible quota. This offers flexibility and an overall compliance cost reduction for the industry as a whole.

The VOCIC is one example of an effective and cost-efficient model of cooperation for achieving emission reductions.

Emissions of methane are also included in the scope of the revised climate roadmap for the oil and gas industry which was completed in February 2020 (KonKraft: The Energy Industry of Tomorrow on the Norwegian Continental Shelf[10]). This is a part of a broader commitment through KonKraft whereby the industry aims to reduce the total carbon footprint of its operations. The oil and gas industry in Norway announced a commitment to reduce its absolute greenhouse gas emissions by 40 per cent, as compared to 2005 level, by 2030, and to attain near zero by 2050.[9] Methane emissions are only a small part of total GHG emissions from the industry (approximately3% of the offshore emissions) and their further deep cuts might be difficult to achieve partly for technical and partly for economic reasons.

Estimates of the costs of the oil and gas sector's methane emission reductions have been recently published by the Norwegian Environment Agency. They are part of a broader national study (Klimakur 2030[10]) on climate mitigation opportunities and costs from emission sources that are outside the Norwegian emissions trading system (which is an integral part of EU ETS). Key results for the oil and gas sector's methane emissions are summarized in the table below.

[9] https://www.norskoljeoggass.no/contentassets/63d3f735faa54c488f41c37f66b364ac/roadmap-270220-eng.pdf

[10] https://www.miljodirektoratet.no/klimakur. The report, called "Klimakur 2030" (Climate cure 2030) is as of March 2020 available only in Norwegian.

[10]The Energy Industry of Tomorrow on the Norwegian Continental Shelf https://www.norskoljeoggass.no/contentassets/63d3f735faa54c488f41c37f66b364ac/roadmap-270220-eng.pdf

Table 2: Methane emissions and abatement potential for main categories of the Norwegian upstream oil and gas industry

Categories of emission sources	Emissions 2018 (%)	Abatement potential 2021-2030 (million tons CO_2 eq.)			
		Total	Low costs	Medium costs	High costs
Offshore installation -excl. crude loading	55%	1,16	0,74	0,23	0,19
Offshore crude oil loading	24%	0,28		0,28	
Land-based processing plants	21%	0,23	0,06	0,05	0,12

Note: Cost categories. Low costs: below 500 NOK (50 Euros) per ton CO2 eq. Medium costs: 500-1500 NOK (50-150 Euros) per ton CO2 eq. High costs above 1500 NOK (150 Euros) per ton CO2 eq.

Offshore installations have the largest share of methane emissions (55%) and an even larger share of the total abatement potential (69%). The most important part of the potential is in the low-cost category. Several measures are a net zero costs, but it should be noted that some of these opportunities (e.g. at the Snorre A platform) are already under implementation. In certain cases, there are barriers to implementation, notably if the measures have to be implemented during maintenance shut down and there is not enough time to have them all adopted. It is because extending the shutdown would be prohibitively expensive. It is possible that the large increase in the tax for offshore venting might have already shifted the priorities during shutdown periods, but at the moment it is yet still unclear what effects the tax has had.

The scale of abatement opportunities at offshore crude oil loading points are modest. One important reason for this is that for more than 20 years the Authorities have already had the set strict limits for emissions at these installations, largely driven by national commitments to curb NMVOC emissions under the Gothenburg Protocol.[11] From the economic standpoint, they are all in the medium cost category, hence, as compared internationally, the expenses are expected to be high.

Abatement opportunities at land-based institutions are also modest and typically high cost.

CONCLUSIONS:

Through the successful collaborative process, which started in 2014, the oil and gas sector operators and the regulatory authorities in Norway have gained new knowledge about the scale and nature of methane emission from direct emission sources. Data is now reported by all operators in accordance with the new methods and guidelines. Reports are made through a common web-based system, which ensures consistent and timely submissions from all operators to the relevant public authorities and NOROG. New and revised estimates show that methane emissions from the oil and gas sector are small, and the improved knowledge about emissions have led to mitigation measures, which further reduced the opportunities for "low hanging fruit" abatements. This is in stark contrast to the large opportunities for low or negative abatement cost opportunities, which exist in many other countries.

[11] https://www.unece.org/env/lrtap/multi_h1.html