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Item 4 of the provisional agenda

Group of Experts on Gas

Methane Management in Extractive Industries

Note by the secretariat

Summary

At its 23rd session on 19–21 November 2014, the Committee on Sustainable Energy considered the potential role for the United Nations Economic Commission for Europe (ECE) in developing norms and standards in the area of methane management. The Committee requested that the relevant ECE expert groups prepare a coordinated, solutions-oriented report about methane management in extractive industries with a focus on establishing a baseline, benchmarking and scale of current methane emissions in those industries, with the aim of giving clear guidance to policy makers.

The ECE Group of Experts on Gas has a task force exploring best practices to reduce leaks in the natural gas system from source to use. The task force will present its results at the next meeting of the Group of Experts in 2016. The Group of Experts on Coal Mine Methane has included in its 2016–2017 work plan activities that can contribute to this work. There is no ECE body working on issues related to the oil sector, so contributions to this work depend on information obtained from The World Bank's Global Gas Flaring Reduction Partnership.

Given the timing of these various initiatives, work in response to this request is not yet complete. This draft report has been prepared by the Secretariat based on a literature review. The information that is available regarding methane is incomplete. There is neither a common technological approach to monitoring and recording methane emissions, nor a standard method to reporting them, which means that the extent of the challenge and opportunity remains undefined. There is also a need with respect to each of the fossil fuel extraction industries for a discussion of the best remediation approaches and technologies.

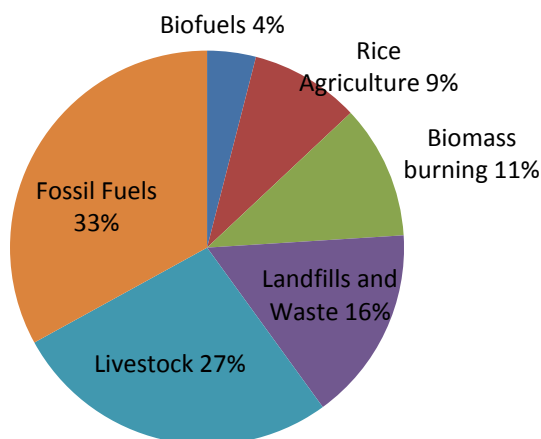
I. Introduction¹

1. Methane is a powerful greenhouse gas with a 100-year global warming potential 25 times that of CO₂, which by definition has a global warming potential of 1. Measured over a 20-year period, methane is 84 times more potent as a greenhouse gas than CO₂. The different figures reflect the fact that methane is a short-lived climate pollutant with an atmospheric lifetime of approximately 12 years, whereas CO₂ has a variable atmospheric lifetime between 5 and 200 years. The calculation of potency attempts to reflect the respective cumulative contributions to the greenhouse effect.

2. About 60% of global methane emissions are due to human activities. The main sources of anthropogenic methane emissions are the oil and gas industries, agriculture (including fermentation, manure management, and rice cultivation), landfills, wastewater treatment, and emissions from coal mines. Fossil fuel production, distribution and use are estimated to emit 110 million tonnes of methane annually.

Figure 1

Human Sources of Methane Emissions



3. Methane is the primary component of natural gas, with some emitted to the atmosphere during its production, processing, storage, transmission, distribution, and use. It is estimated that around 3% of total worldwide natural gas production is lost annually to venting, leakage, and flaring, resulting in substantial economic and environmental costs.

4. Coal is another important source of methane emissions. During the geological process of coal formation, pockets of methane get trapped around and within the rock. Coal mining related activities (extraction, crushing, distribution, etc.) release some of the trapped methane. Methane is emitted from active underground and surface mines as well as from abandoned mines and undeveloped coal seams.

5. As with coal, the geological formation of oil can also create large methane deposits that get released during drilling and extraction. The production, refinement, transportation and storage of oil are all sources of methane emissions, as is incomplete combustion of fossil fuels. No combustion process is perfectly efficient, so when fossil fuels are used to

¹ The factoids in the introduction section have been adapted from www.whatsyourimpact.org and <http://www.igsd.org>. These have been provided by <http://www.ccacoalition.org>.

generate electricity, heat, or power vehicles these all contribute as sources of methane emissions.

6. On a global scale, methane emissions from oil and natural gas systems account for 1,680 MtCO₂e. The estimates are considered to be uncertain and are thought to be low. There is general agreement that there is too little knowledge and awareness about the issue. Based on the best currently available data, around 3.6 trillion cubic feet (Tcf) (or 102 billion cubic meters (bcm)) of natural gas escaped into the atmosphere in 2012 from global oil and gas operations. This wasted gas translates into roughly \$30 billion of lost revenue at average 2012 delivered prices, and represented about 3% of global natural gas production². Emissions are expected to grow under a central growth scenario by 23% between 2012 and 2030. Regarding the global reduction potential by 2030, it is estimated that emissions could be reduced by 26% using existing technology (equal to 1,219 MtCO₂e).

7. The U.S. Environmental Protection Agency (EPA) issued a report on global anthropogenic non-CO₂ Greenhouse Gas Emissions for the period 1990–2030. The report used 3 sources of data to assess emissions and leakages: country-prepared emissions reports, activity data, and default emission factors. According to their analysis, the energy sector accounted for 25% of all non-CO₂ emissions and increased by 14% between 1990 and 2005. Fugitive emissions from natural gas and oil systems represent the largest source of non-CO₂ greenhouse gas emissions from the energy sector.

8. Despite methane's short residence time, the facts that it has a much higher warming potential than CO₂ and that its atmospheric volumes are continuously replenished make effective methane management a potentially important element in countries' climate change mitigation strategies. Unfortunately, the information that is available regarding methane is relatively sporadic and often based on estimates/guesstimates. There is neither a common technological approach to monitoring and recording methane emissions, nor a standard method to reporting them, which means that the extent of the challenge and opportunity remains undefined. There is also a need with respect to each of the fossil fuel extraction industries for a discussion of the best remediation approaches and technologies.

Recommendations:

(a) Agree on common philosophies, standards, and technologies for monitoring, recording, and reporting methane emissions at each stage of production, processing, storage, transmission, distribution, and use of fossil fuels, whether coal, oil, or natural gas, while recognising that there will be adaptation to specific situations;

(b) Raise awareness of the nature and scale of the problem and opportunities for mitigation throughout the ECE region;

(c) Agree on common philosophies, standards, and technologies for reducing methane emissions;

(d) Discuss appropriate mechanisms for mobilizing needed resources for deployment to reduce methane emissions;

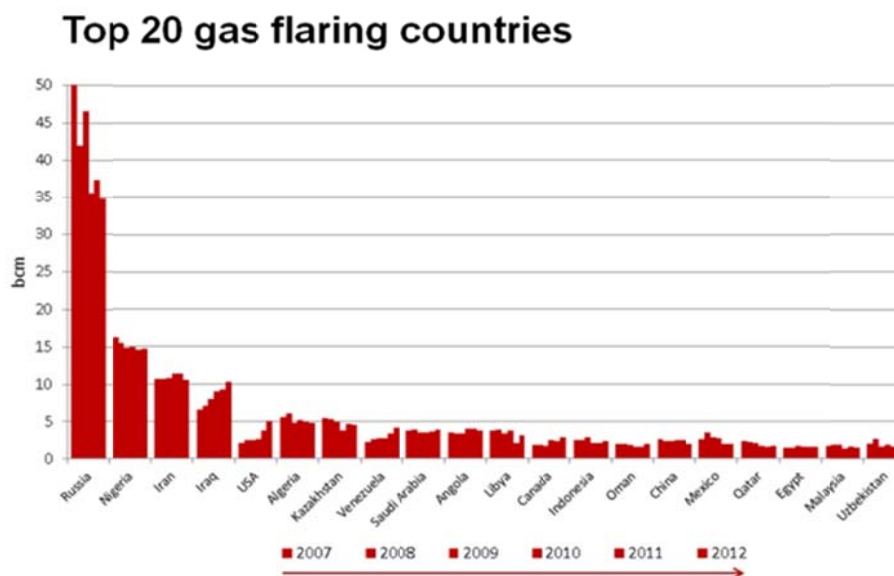
(e) Fund a detailed study, on a common basis across the ECE region, of the methane challenges and opportunities presented in the extractive industries. This work should consider and integrate the many initiatives underway across the region to avoid duplication.

² Untapped Potential: Reducing Global Methane Emissions from Oil and Natural Gas Systems. April 2015. Kate Larsen, Michael Delgado and Peter Marsters. Rhodium Group.

II. Oil Production

9. During oil production, associated gas is produced together with oil. Much of the gas is used or conserved by those governments and oil companies that have made substantial investments to capture it. Some of the associated gas is flared because of technical, regulatory, or economic constraints that impede its commercial use. The gas is flared when gas markets are undeveloped and appropriate gas infrastructure is unavailable. According to the World Bank, about 140 bcm of gas is flared every year worldwide, resulting in about 350 million tons of carbon dioxide in annual emissions. Eliminating the flaring and directing the gas to useful purposes would, in terms of emissions, be equivalent to taking 70 million cars off the road. Gas flaring has been reduced by 20 percent between 2005 and 2012 through a number of initiatives such as the World Bank’s Global Gas Flaring Reduction Partnership (GGFR). Satellite data on global gas flaring shows that overall efforts to reduce gas flaring are succeeding. From 2005 to 2012, flaring dropped 20 percent worldwide. Fewer than 20 countries account for more than 85 percent of gas flaring. And just four countries together are estimated to flare about 70 bcm of gas. Flaring in Russia has significantly declined over the last several years and in 2012 over 76 percent of associated gas was utilized. The second largest flarer in the world is Nigeria, which approximately 13 bcm annually. The government has had a policy of no flaring since 1984, but its enforcement of the policy has been weak. Methane that is not collected for use or flared is vented, and there is very little measured and recorded information on these amounts

Figure 2
Top 20 gas flaring countries



III. Coal

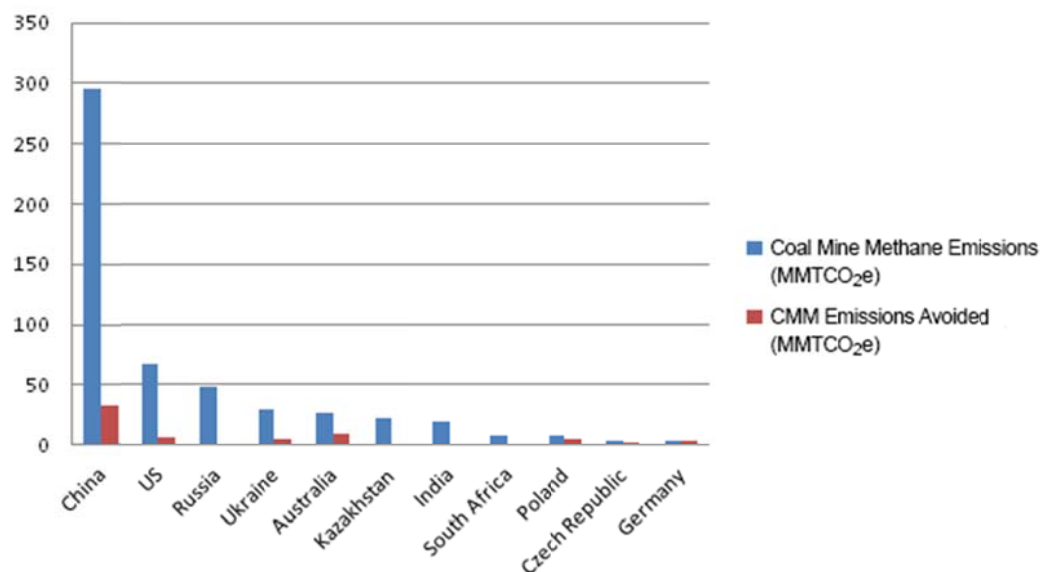
10. Methane is emitted in active coal mines, abandoned mines, and in undeveloped coal deposits. In 2015, global methane emissions from coal mines are projected to be about 630 mtCO₂e, accounting for 8 percent of total global methane emissions. China leads the world in coal mine methane emissions with nearly 300 mtCO₂e in 2010 (over 20 bcm annually). Other leading emitters are the United States (U.S.), Ukraine, Australia, the Russian

Federation, and India. In 2012, U.S. coal mines emitted about 60 mtCO_{2e}. Between 1990 and 2012, U.S. emissions decreased by over 30%, in large part due to the coal mining industry's increased recovery and utilization of drained gas.

11. There are significant challenges in the estimation and measurement of fugitive emissions, particular from open cast coal mines and undeveloped coal seams.

Figure 3

2010 Coal Mine Methane Emissions



IV. Natural Gas

12. Gas leaks are identified either through physical inspection of infrastructure using a range of technologies or through mathematical model simulations. Physical inspections are considered more accurate but involve more costs and time, whereas model simulations are less accurate but cost less. The choice of approach and technology has important consequences for the results obtained.

European Union data

13. The European Union (EU) emitted 405 million tons of CO₂ equivalent (MtCO_{2eq}) of methane in 2010, which represented a more than 30% reduction compared to 1990 levels of 595 MtCO_{2eq}. The energy sector accounts for 19% of fugitive emissions, which is below global figures, with oil, gas, and coal exploration being a minor source. The methane reduction potential in the region appears to be relatively small. Figure 4 shows the distribution of methane emissions in natural gas transmission in detail. This data is derived from operators of transmission systems evaluation of their methane emissions.³

³ Vorgang, J., Riva, A., Cigni, A., Hec, D. (date unknown) "Reduction Of Methane Emissions In The EU Natural Gas Industry", IAPG, p. 2, 7

Figure 4
EU-15 Methane Emissions from 1990 to 2012⁴

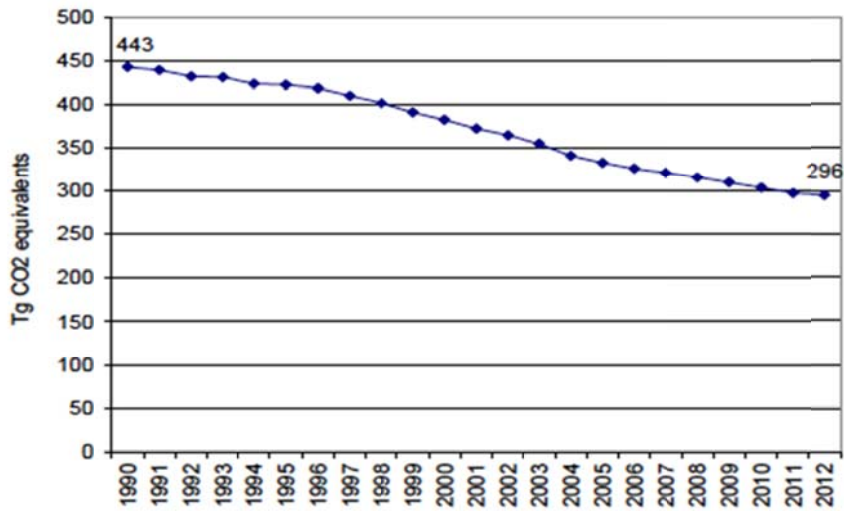
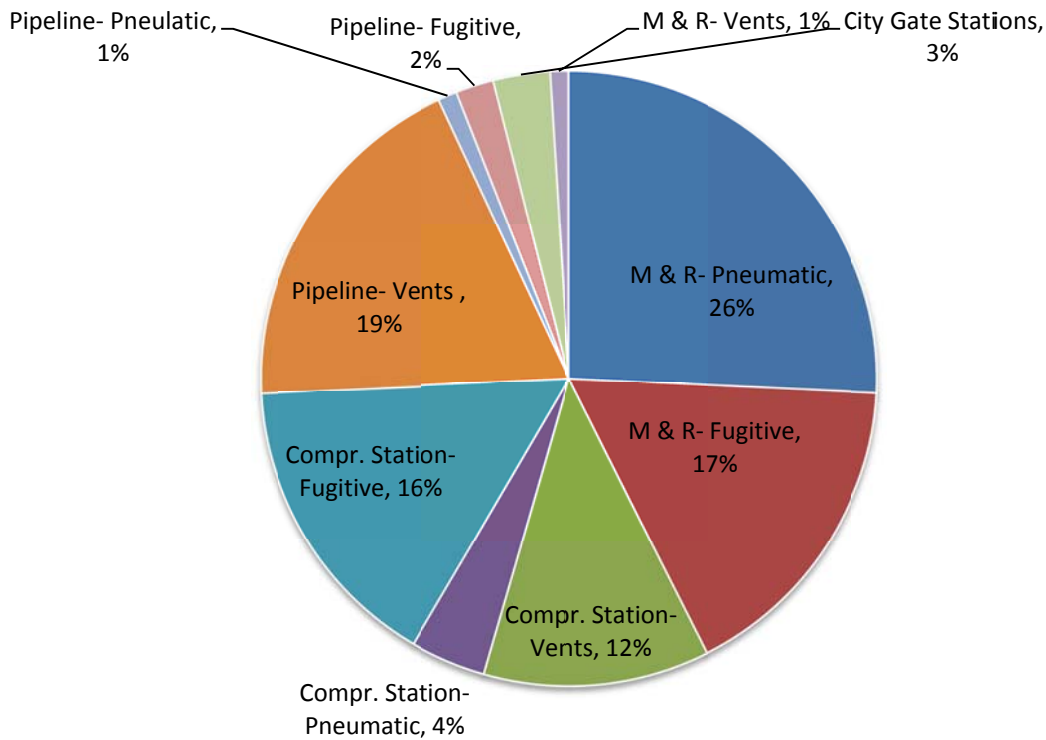


Figure 5
Distribution of Methane Emissions in Natural Gas Transmission



⁴ Methane emissions 1990 to 2012 in CO2 equivalents (Tg) as cited in European Environment Agency (27 May 2014) "Annual European Union greenhouse gas inventory 1990–2012 and inventory report 2014. Submission to the UNFCCC Secretariat", Technical Report No 09/2014, p. 116

14. In the EU-15, methane emissions represent 8 % (296 Tg CO₂ equivalent) of total EU-15 greenhouse gas emissions for 2012, which represents a decrease of 33% since 1990.

15. In the oil and natural gas industry, the EU greenhouse gas inventory includes fugitive emissions from this sector from “exploration, production, processing, transport, and handling of oil and natural gas”. Methane emissions from natural gas represented 46% of all fugitive emissions in EU-15 for 2012.

United States Data

16. The U.S. Environmental Protection Agency (EPA) inventory published in 2015⁵ shows anthropogenic greenhouse gas emissions between 1990–2013 using a methodology consistent with the Intergovernmental Panel on Climate Change (IPCC) approach. Methane emissions from the natural gas systems (measured in MtCO₂eq) were reported as follows: 1990- 179.1; 2005- 176.3; 2009- 168.0; 2010- 159.6; 2011- 159.3; 2012- 154.4; 2013- 157.4. In 2013 the percent of methane as part of total greenhouse gas emissions based on MtCO₂eq was 9.5% with 157.4 MtCO₂eq of atmospheric methane emissions. The figure represents a 21.8 MtCO₂eq or 12.2% decrease from 1990 levels. Methane emissions in production were 30% of the total, and have declined 21% since 1990. There have been reductions as well in distribution as a result of the replacement of “unprotected steel and cast iron pipelines” with plastic pipelines.”

17. The U.S. assessment determined that methane and non-combustion CO₂ emissions include emissions coming from:

- Normal operations:
 - Natural gas engine and turbine un-combusted exhaust
 - Pneumatic controllers’ bleed and discharge emissions
 - Fugitive emissions from system components
- Routine maintenance:
 - Pipelines
 - Equipment
 - wells
- System upsets

18. Methane emissions from natural gas systems in MtCO₂eq break down as follows: Transmission and storage accounted for most emissions (54.4%) in 2013, followed by Field Production (47%), Distribution (33.3%) and Processing (22.7%). Since 1990 emissions decreased from 179.1 MtCO₂eq to 157.4 MtCO₂eq in 2013.

19. The U.S. 2014 GHG inventory shows that about 1.4% of produced gas is leaked.

V. Ongoing Activities

20. In January 2015 the Group of Experts on Coal Mine Methane offered to participate in the Task Force on methane management in extractive industries. In support of this activity, the Group of Experts included in its 2016–2017 work plan activities to: 1) cover integrated coal mine methane management, including early pre-mining drainage and related

⁵ EPA (15 April 2015) “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990- 2013”, Available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>

unconventional natural gas extraction; 2) explore other economic, environmental and social aspects of coal mine methane, with a view to treat coal mine methane management in the context of sustainable development, green economy, and green job creation; and 3) develop recommendations on the enabling role of coal mine methane projects in restructuring coal mining industry through adopting new business models that facilitate transition from a single community producer to an integrated energy company.

21. The Group of Experts on Gas has established a task force to explore best practices to reduce leaks in the natural gas system from source to use. The text on natural gas in this document has been derived from the work of that task force, which will present its full results at the next meeting of the Group of Experts in 2016.

22. There is no ECE body dedicated to activities in the oil sector, so the material presented herein has been obtained from the activities of The World Bank on Gas Flaring.
