THE GNCS FACTSHEETS

Mitigating Methane Emissions from Natural Gas and Oil Systems

Methane (CH_4) makes up nearly 14% of global greenhouse gas emissions.[1] It is the third most abundant greenhouse gas in the atmosphere, after carbon dioxide (CO_2) and water vapor. Of the estimated 6,875 million tons of CO_2 equivalent ($MtCO_2e$) global methane emissions in 2010, approximately 1,355 $MtCO_2e$ (20%) was released from leaks and venting in pipelines, compressor stations or wells in natural gas and oil systems.[2] Emissions from these sectors are expected to increase by around 35% by 2020.[3] Molecule for molecule, methane is a much more powerful greenhouse gas than CO_2 but remains in the atmosphere for a relatively short time (roughly 12 years).[4] Therefore policies to reduce methane emissions would not only be extremely beneficial from a climate change mitigation perspective, but could be enacted and results achieved in a timeframe attractive to policymakers.

Methane Emissions from Natural Gas and Oil Systems

In 2008, natural gas and oil systems provided 54% of the world's total primary energy demand.[5] Almost 3% of all greenhouse gas emissions occur from leakages and venting in natural gas and oil systems. Methane emissions occur at all levels of the natural gas and oil industries, from production and processing to transmission and distribution. The principal sources of CH_4 emissions in the natural gas sector are unintentional equipment or pipeline leaks.[6] These fugitive emissions occur as the gas circulates at extremely high pressure through different parts of the infrastructure of natural gas systems and escapes into the atmosphere through tattered connections in the pipelines, worn pump and compressor seals, valves or flanges.[7] Emissions also occur during maintenance and venting activities, as well as through accidents and equipment failures.[8] In the oil sector, CH_4 emissions occur mainly from gas venting from oil wells, oil storage tanks and production equipment.[9] Methane emissions from natural gas and oil systems account for, respectively, 18% and 2% of global methane emissions.[10] Emissions are expected to grow as natural gas and oil consumption increases in a business as usual scenario, mainly due to an increase in global energy demand and aging infrastructure.[11]

Abatement Options

There are numerous technological options (over 100) for reducing leakages in natural gas infrastructure.[12] The capture and use of gas, flaring or reinjection can replace venting from oil systems.[13] Abatement options for both sectors can be divided into three categories:

1. *Equipment Changes/Upgrades.* For natural gas, *e.g.*, replacing high-bleed pneumatic devices – which are designed to release gas during the course of their operation – with low-bleed pneumatic devices would reduce the escape of methane into the atmosphere by approximately 6% from a baseline scenario.[14] This can also be achieved by substituting compressed air for natural gas within pneumatic systems, though at a much

[1] GMI. (2010). *Global Methane Emissions and Mitigation Opportunities*. Global Methane Initiative. Washington D.C.
[2] EPA. (2006). *Global Mitigation of Non-CO_2 Greenhouse Gases*. US Environmental Protection Agency. Washington D.C.
[3] *Ibid.*
[4] *Ibid.*
[5] IEA. (2010). *World Energy Outlook 2010*. Paris: International Energy Agency.
[6] Robinson *et al.* (n.d.). *Methane Emissions Mitigation Options in the Global Oil and Natural Gas Industries*. ICF Consulting & EPA.
[7] EPA (2006).
[8] Picard, D. (n.d.). "Fugitive Emissions from Oil and Natural Gas Activities." *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. IPCC Guidelines for National Greenhouse Gas Inventories. Task Force on National Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change.
[9] Robinson *et al.* (n.d.).
[10] GMI. (2008). *Oil and Natural Gas System Methane Recovery and Use Opportunities*. Website. Global Methane Initiative. Available at: http://www.globalmethane.org/oil-gas/.
[11] US EPA (2006). *Global Anthropogenic Non-CO_2 Greenhouse Gas Emissions: 1990-2020.* Office of Atmospheric Programs Climate Change Division. US Environmental Protection Agency. Washington D.C.
[12] See *ibid.* p. II-23–25 for a summary of natural gas mitigation options.
[13] *Ibid.* p. II-37–38.
[14] *Ibid.* and Robinson *et al.* (n.d.).

higher cost.[15] In the oil sector, abatement can be achieved by installing vapor recovery units to capture natural gas that is vented during crude oil storage,[16] which can then be used to produce energy.[17]

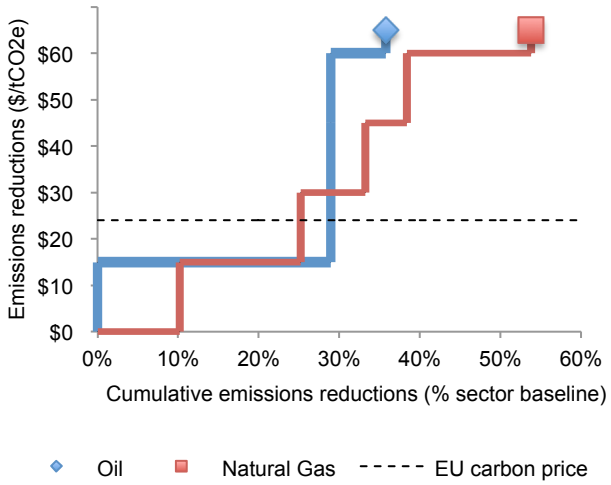
2. *Changes in Operational Practices.* There is potential for improvement when it comes to routine maintenance procedures. "Pumpdown" techniques, which remove natural gas from sections of the pipeline before maintenance or repair, could reduce the amount of methane released in the atmosphere by approximately 4% from a baseline scenario.[18] Also, new practices like composite wrap repairs enable maintenance and repairs to be undertaken without shutting down and venting gas from the pipeline.[19] The methane vented during oil production can be captured and sequestered or used for energy. In climate terms, gas flaring is a better option to venting, as the resultant CO_2 is a less potent greenhouse gas than methane. However, the health, climate and environmental damages associated with flaring, as well as its economic wastage, has led to several initiatives to improve the capture of methane from oil systems.[20]

3. *Direct Inspection and Maintenance (DI&M).* The goal of DI&M is to be able to detect and repair leaks as fast as possible by conducting constant leak detection surveys of the infrastructure.[21] According to the US Environmental Protection Agency (EPA), implementing DI&M programs could abate up to 80% of fugitive methane emissions. However, the full implementation of these programs is prohibitively expensive.

Mitigation Potential and Costs

While there is high mitigation potential for both sectors, many abatement technologies and solutions are currently too costly to be feasible at a large scale. The figure below indicates EPA estimates of the potential for abatement of methane in the natural gas and oil sectors as a percentage of total methane emissions per sector in 2020. The vertical axis denotes the cost per additional ton of abatement – or the marginal abatement cost (MAC) – of CO_2 equivalent emissions. For comparison, the price of permits being traded under the EU Emissions Trading System, as of April 2011, was about \$24/tCO_2e. Abatement options below that price include installing low-bleed pneumatic devices in natural gas systems, and the capture and use of vented methane on oil platforms.

2020 MAC for Methane Emissions from Natural Gas and Oil Systems



Source: EPA (2006)
Note: EU price ~\$24/tCO2e in April 2011

International Coordination

The reduction of methane emissions in natural gas and oil systems is not part of any current international agreement per se (although methane is part of the greenhouse gases regulated under the Kyoto Protocol). It is, however, part of the Global Methane Initiative (GMI), a voluntary international partnership and non-binding framework for reducing methane emissions from key sectors, including natural gas and oil systems.[22] The GMI comprises 39 countries and hundreds of private sector entities, accounting for 70% of manmade methane emissions. It facilitates the sharing of best practices and supports numerous methane abatement projects, including over 30 in the oil and gas sectors.

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Further resources are available at **www.theGNCS.org**

[15] *Ibid*. Substitution of compressed air systems costs about \$85.
[16] Robinson (n.d.).
[17] Hendricks, C. & de Jager, D. (2001). *Economic Evaluation of Methane Emission Reduction in the Extraction, Transport and Distribution of Fossil Fuels in the EU.* Contribution to a Study for DG Environment, European Commission. Ecofys Energy and Environment, AEA Technology Environment and National Technical University of Athens.
[18] Pumpdown techniques are used to remove gas from sections of the pipeline or a closed chamber with a vacuum pump. EPA (2006).
[19] Robinson (n.d.).
[20] See, e.g., the World Bank's Global Gas Flaring Reduction initiative.
[21] Robinson (n.d.).
[22] GMI. (2011). *Global Methane Initiative*. Website. Available at: http://www.globalmethane.org/index.aspx.