TFTEI

Under the Convention on Long Range Transboundary Air Pollution

Guidance document on technical measures for reduction of methane emissions from landfill, the natural gas grid and biogas facilities

TFTEI technical secretariat
Simon Glöser-Chahoud (DFIU/KIT)

8th TFTEI Annual Meeting, October, 7th 2022, Rome, Italy

Agenda

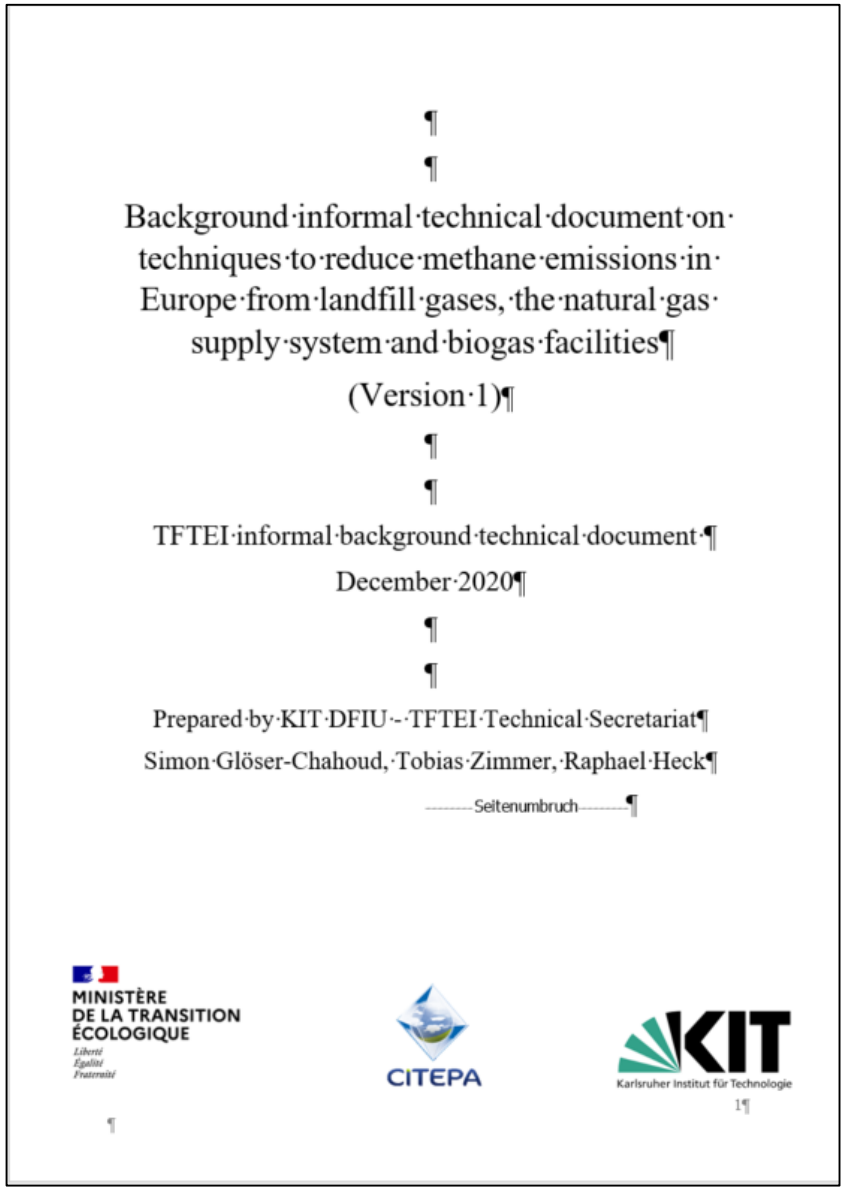
1. Existing technical background document on methane emissions
2. Preparation of an official guidance document in 2022
3. Basic content of the documents
   - Methane as a new pollutant included in the mandate of TFTEI
   - Methane emissions from waste storage / landfills
   - Methane emissions from natural gas supply
4. Conclusions & Discussion

Technical background document

- Informal technical document about methane emission prepared by TFTEI Technical Secretariat in 2020
  - Covers emissions from landfills and the natural gas supply system in Europe
  - The background document was made available to the parties' experts at the WGSR_58 meeting in December 2020

➡ As the “next step”, a draft guidance document about non-agricultural methane emissions focusing on landfill gas emissions and emissions from the natural gas grid is prepared

- Taking into account the specific guidance documents of the UNECE ‘Air Convention’ requirements



Background informal technical document on techniques to reduce methane emissions in Europe from landfill gases, the natural gas supply system and biogas facilities

(Version 1)

TFTEI informal background technical document

December 2020

Prepared by KIT DFIU - TFTEI Technical Secretariat

Simon Glöser-Chahoud, Tobias Zimmer, Raphael Heck

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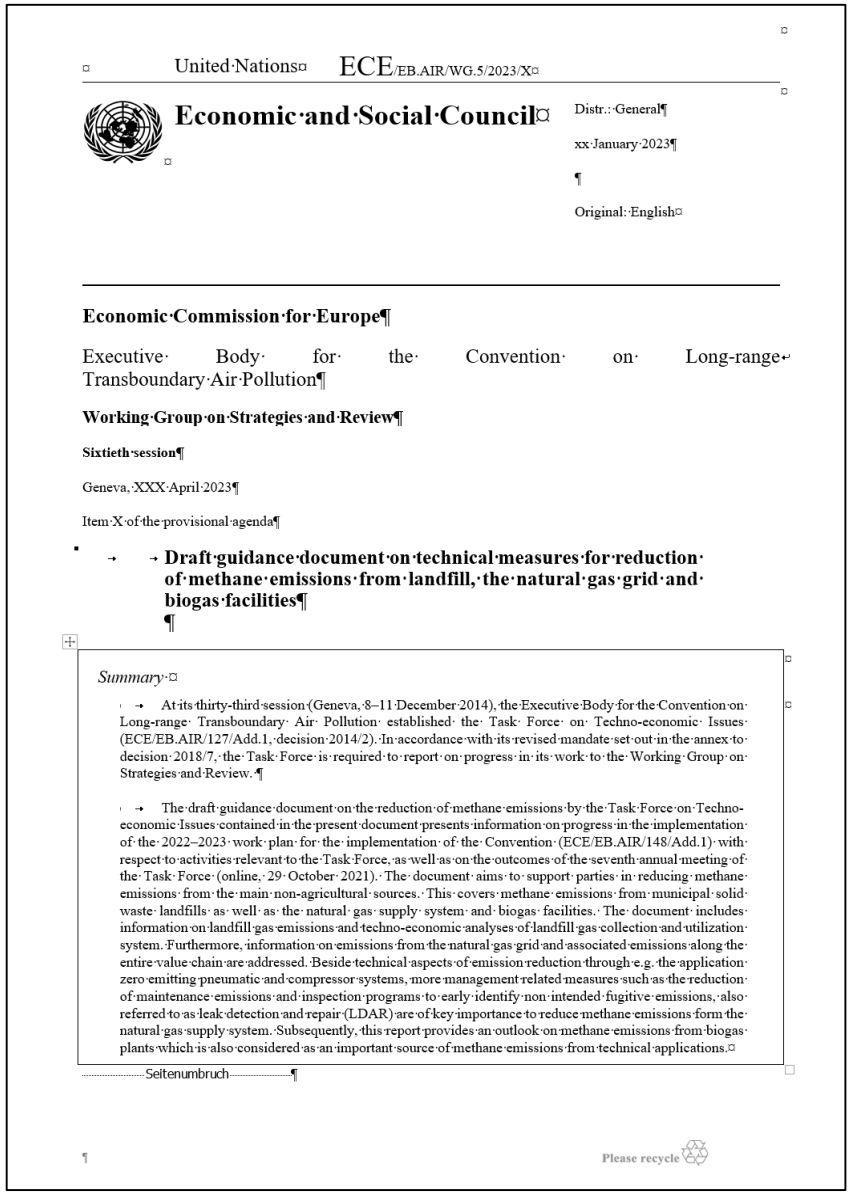
Guidance document

- Official document: established by the Ecxecutive Body (EB), at its annual meeting. Written in English and translated in French and Russian by the Segretariat UNECE, for the purposes of the discussion by the Parties, at WGSR springtime session (Geneva).

- Objective of the document: provide to the (51) parties of the Convention all the information useful for the implementation of the techniques and measures for abatement/mitigation of methane emissions from natural gas supply, landfills and biomass plants.

➡ The techniques and measures, described in the document, should be potentially applicable in all the countries, in the UNECE area (US, Canada, Europe, Russia and EECCAs).



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Working Group on Strategies and Review

Sixtieth session

Geneva, XXX April 2023

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Summary

At its thirty-third session (Geneva, 8–11 December 2014), the Executive Body for the Convention on Long-range Transboundary Air Pollution established the Task Force on Techno-economic Issues (ECE/EB.AIR/127/Add.1, decision 2014/2). In accordance with its revised mandate set out in the annex to decision 2018/7, the Task Force is required to report on progress in its work to the Working Group on Strategies and Review.

The draft guidance document on the reduction of methane emissions by the Task Force on Techno-economic Issues contained in the present document presents information on progress in the implementation of the 2022–2023 work plan for the implementation of the Convention (ECE/EB.AIR/148/Add.1) with respect to activities relevant to the Task Force, as well as on the outcomes of the seventh annual meeting of the Task Force (online, 29 October 2021). The document aims to support parties in reducing methane emissions from the main non-agricultural sources. This covers methane emissions from municipal solid waste landfills as well as the natural gas supply system and biogas facilities. The document includes information on landfill gas emissions and techno-economic analyses of landfill gas collection and utilization system. Furthermore, information on emissions from the natural gas grid and associated emissions along the entire value chain are addressed. Beside technical aspects of emission reduction through e.g. the application zero emitting pneumatic and compressor systems, more management related measures such as the reduction of maintenance emissions and inspection programs to early identify non intended fugitive emissions, also referred to as leak detection and repair (LDAR) are of key importance to reduce methane emissions form the natural gas supply system. Subsequently, this report provides an outlook on methane emissions from biogas plants which is also considered as an important source of methane emissions from technical applications.

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   - Transport system of natural gas and emissions
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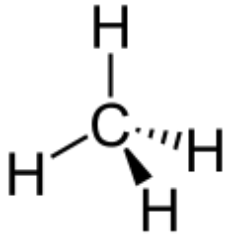


Methane as an air pollutant and GHG

Why is methane so relevant?

- Precursor for ground-level ozone (CH_4 as an air pollutant)
- CH_4 second most relevant greenhouse gas with a global warming potential (GWP) ~25 times higher than that of CO_2 (~80 times higher in the short-term)
- Natural gas has played an increasing role in energy supply (heat, electricity) due to comparatively low emissions / clean burning, flexibility of power plants

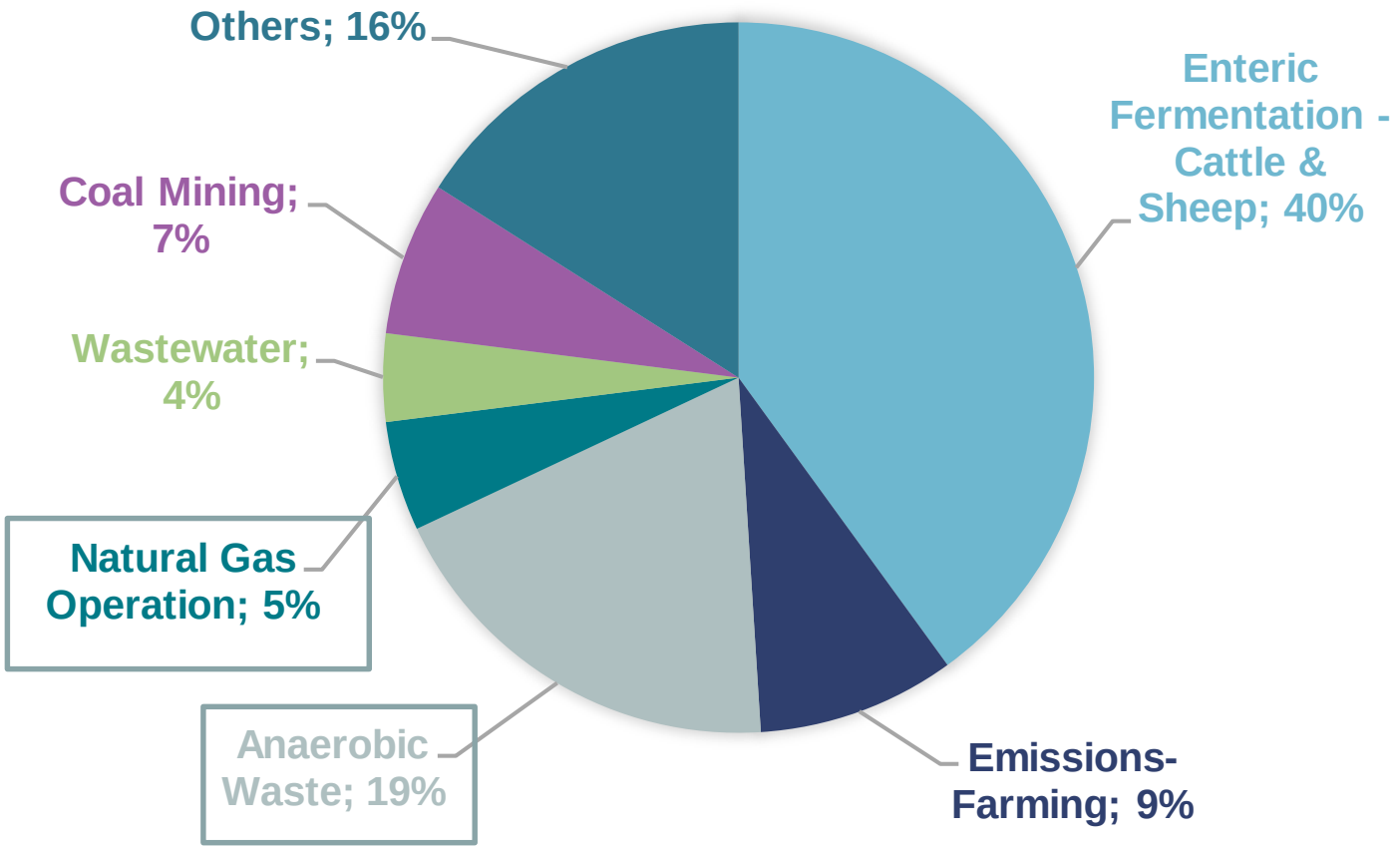
  → This might be changing in the EU due to the political tensions with Russia

GHG emissions in the EU28 (without Land Use, Land-Use Change and Forestry (LULUCF)):

GHG Emissions Mt CO_2 eq.	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CO_2 emissions (without LULUCF)	4478	4225	4189	4315	4171	3833	3949	3804	3746	3658	3489	3522	3505	3523
CH_4	740	679	618	557	523	511	501	491	487	476	469	469	465	466
N_2O	401	360	323	303	283	267	257	253	250	250	254	250	254	256
HFCs	29	44	55	77	97	98	104	106	109	111	114	110	107	105
PFCs	26	17	12	7	5	3	4	4	4	4	3	4	4	3
Total (without CO2 from LULUCF)	5691	5346	5210	5268	5087	4721	4822	4665	4603	4507	4335	4361	4343	4363

Source: Annual European Union greenhouse gas inventory 1990–2017 and inventory report 2019

Methane emissions by source in 2017



Source: Annual European Union greenhouse gas inventory 1990–2017 and inventory report 2019

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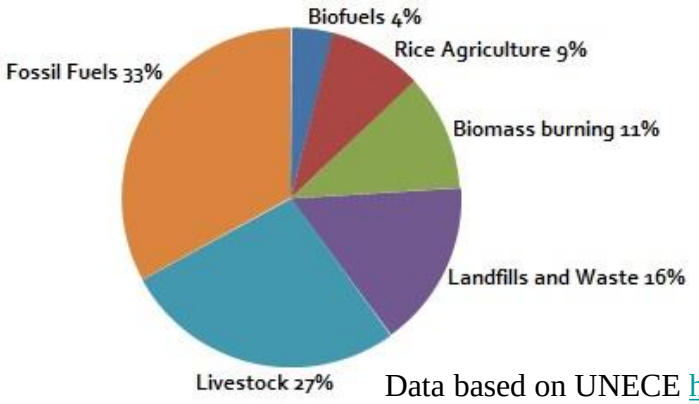
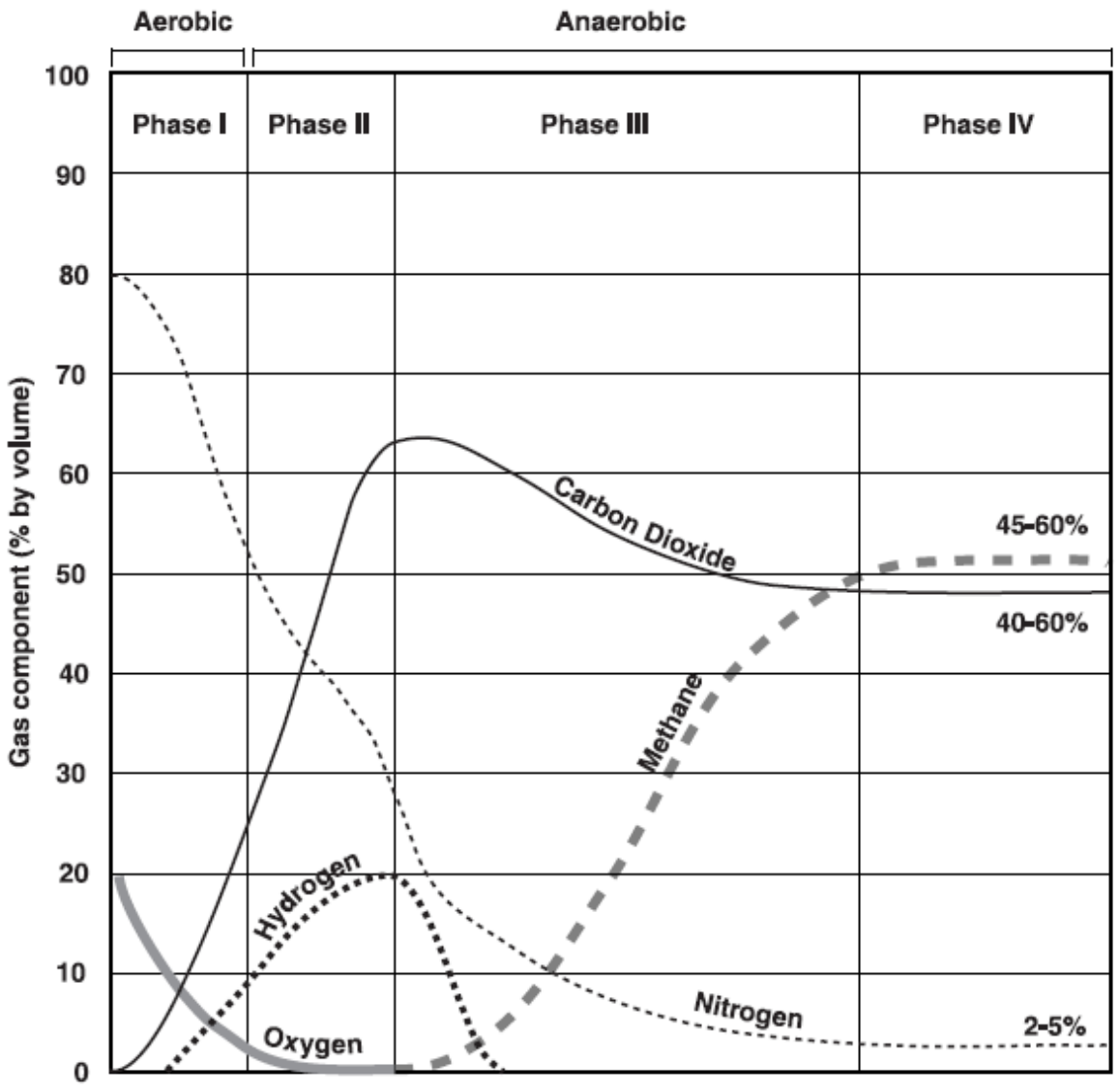
Landfill gas formation

- Most landfill gas is produced by bacterial decomposition, which occurs when organic waste is broken down by bacteria that are naturally present in the waste and in the soil used to cover the landfill.
- Volatilization (vaporization) and chemical reactions also play minor roles
- Methane is produced in the **anearobic phase** after several years

➡ One of the major global sources of anthropogenic methane emissions



Data based on UNECE https://unece.org/challenge

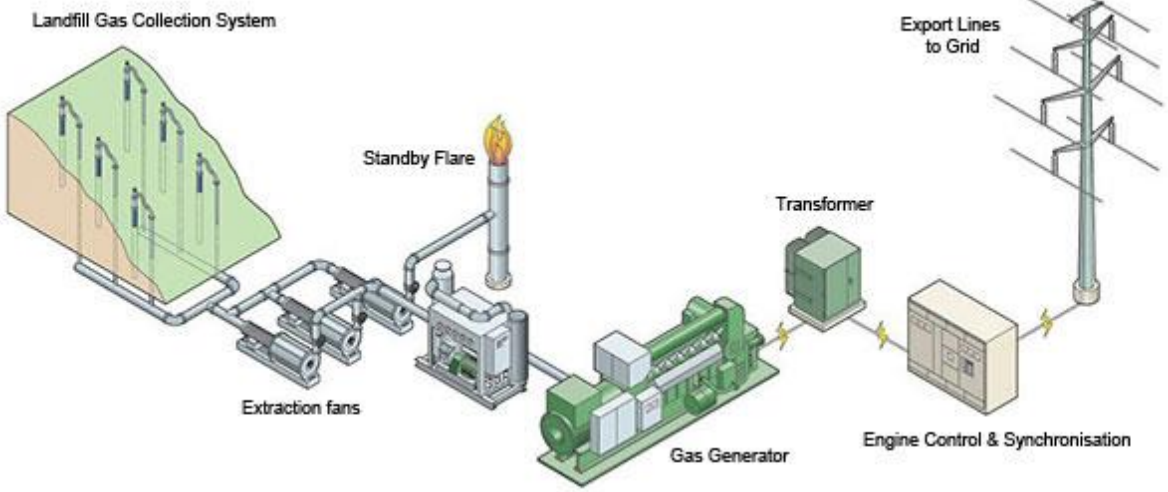


Source: Landfill Gas Primer - An Overview for Environmental Health Professionals

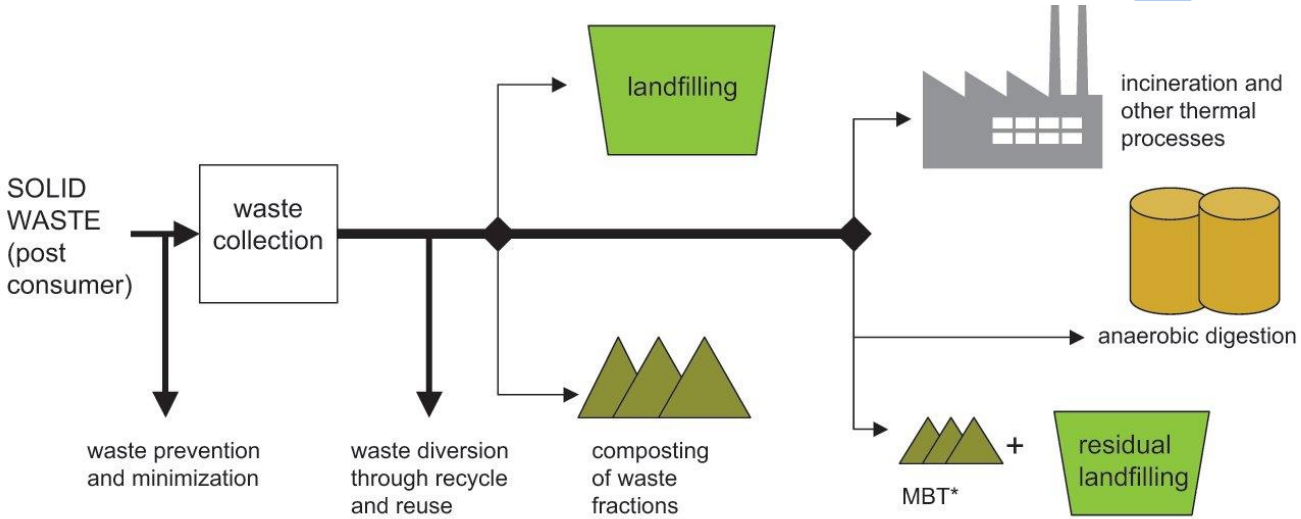
Mitigating CH4 emissions from landfills

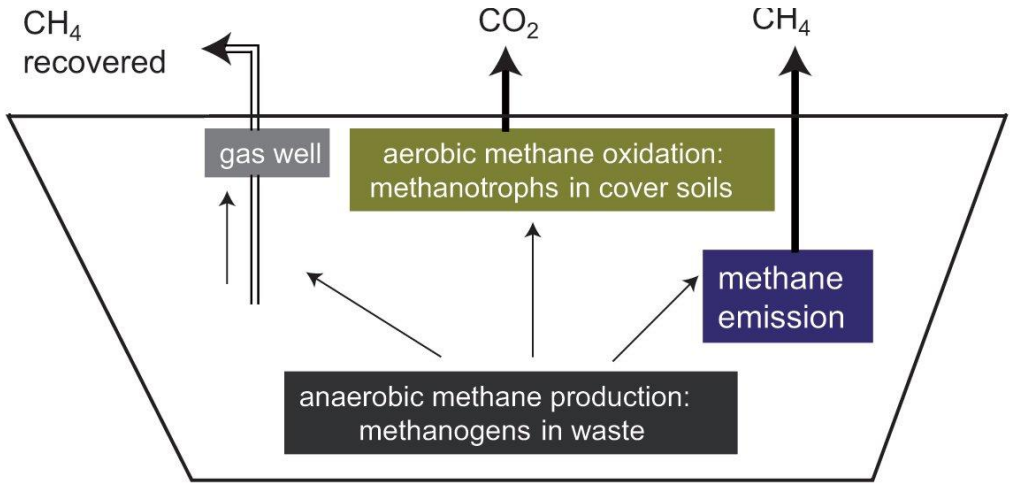
Main technologies for mitigating GHG emissions from landfills:

1. Oxidation (biocovers / biofiltration)
2. Landfill aeration
3. Gas collection and utilization
   - Flaring
   - Electricity generation
   - Direct gas use for heat generation
   - Other uses (gas grid injection, fuel cells)



Source: Landfill gas. Edited by Yellow Power Power Plant Solutions. Available online at http://www.yellowpower.com/solutions/landfill-gas





Simplified Landfill Methane Mass Balance

Methane (CH_4) produced (mass/time) = Σ(CH_4 recovered + CH_4 emitted + CH_4 oxidized)

Source: Metz, Bert (Ed.) (2007): Climate change 2007. Cambridge: Cambridge University Press.

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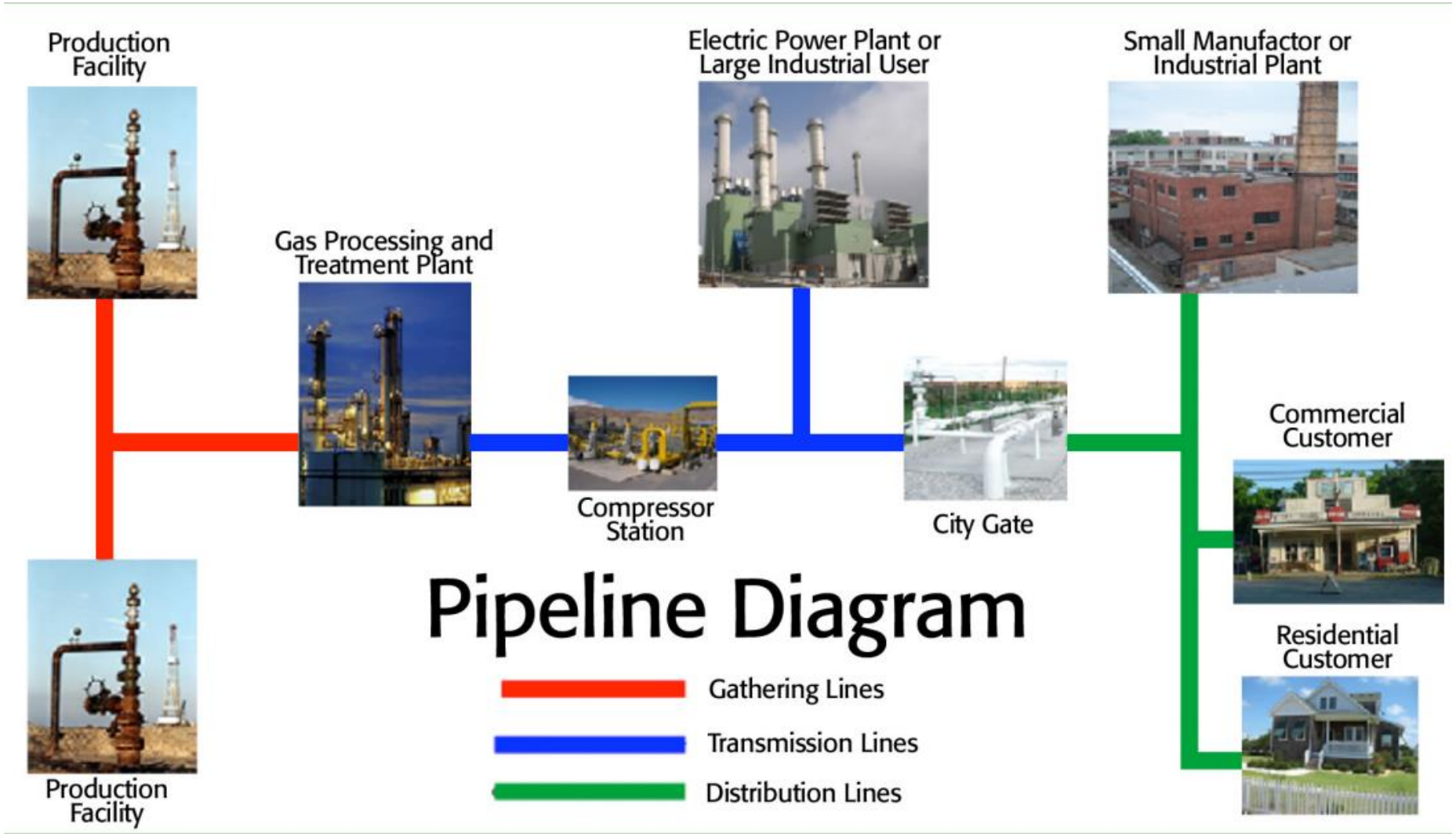
Key components of a natural gas grid

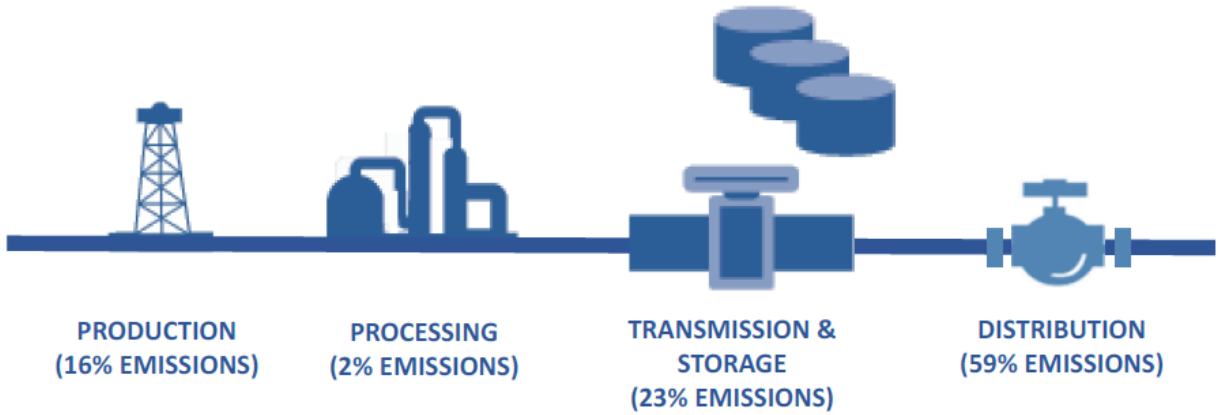


The gas pipeline transportation system from production to consumption

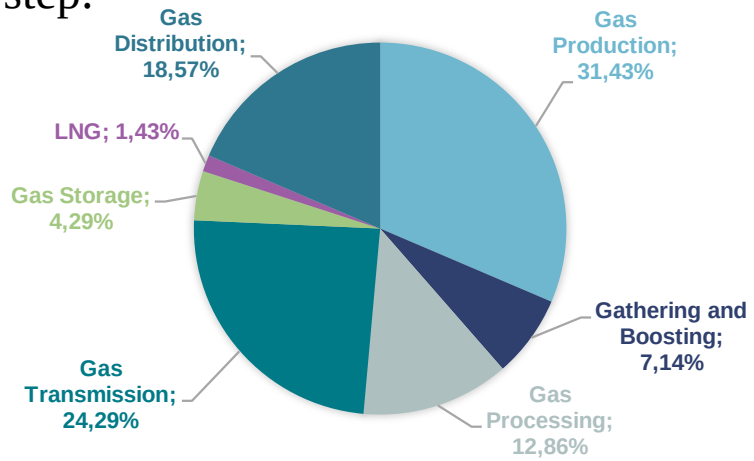
Source: Pipeline Safety Trust (2015): Pipeline Basics & Specifics About Natural Gas Pipelines

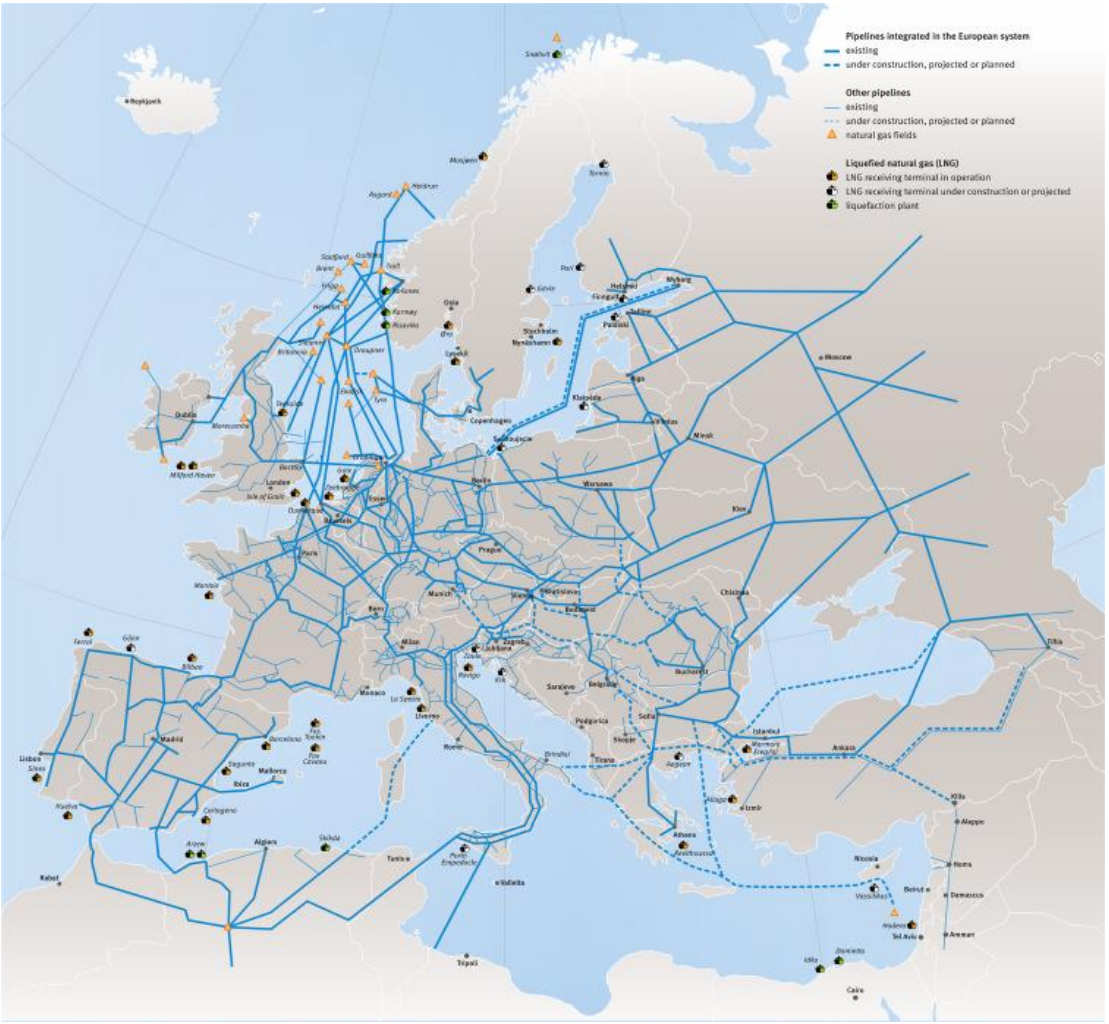
Emissions along the natural gas supply chain

Emissions along the EU28 natural gas supply chain:



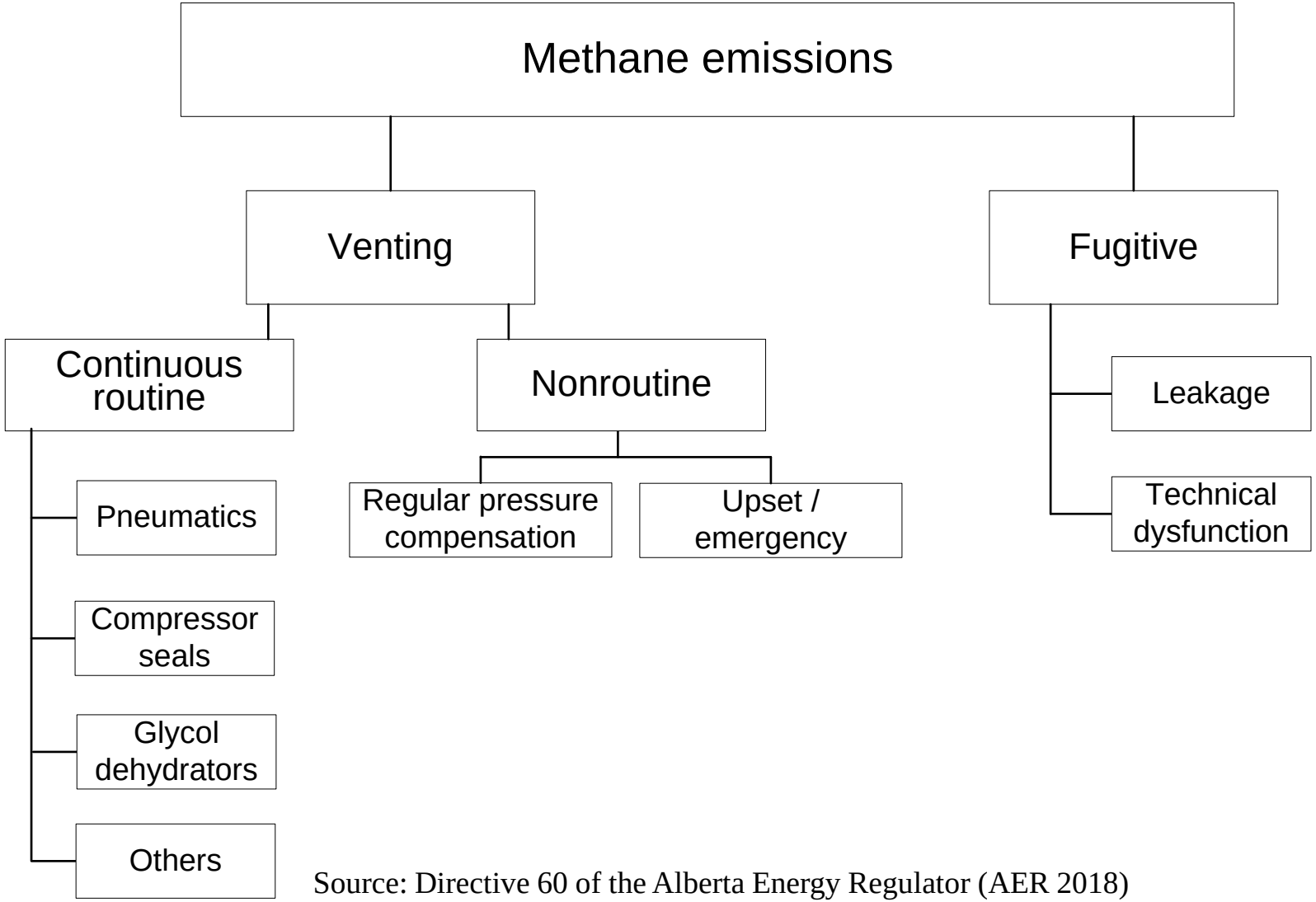
Share of US emissions from the natural gas supply system by processing step:





Sources: ICF International (2014), Marcogaz (2019), Oxford Institute for Energy Studies (2017)

Characterization of methane emission from the natural gas supply system



Source: Directive 60 of the Alberta Energy Regulator (AER 2018)

General measures to reduce emissions from the natural gas supply system

Reduction of operating emissions

- Use of low or zero emitting pneumatic and compressor systems with re-use of the gas instead of venting:
  - Replace centrifugal compressor seal oil systems (recover methane from seal oil)
  - Install low bleed pneumatic devices

Reduction of maintenance emissions

- Use of a mobile compressor to pump gas from a section to be vented into a neighboring sections
- Use of a mobile flare unit to burn vented gas at pipeline maintenance works

Inspection and maintenance programs: Organizational measures to detect emissions earlier and stop them, also referred to as leak detection and repair (LDAR)

- Optimize compressor shutdown practices, minimize venting before pipeline maintenance
- Perform periodic cost-effective leak inspections
- Innovative leak detection (sensors, drones, machine vision, infrared cameras, satellites)

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Conclusions

Methane emissions are gaining increasing attention

- ✓ Methane is an important GHG (80 times higher GWP compared to CO_2 in the short term)
- ✓ Methane is an air pollutant and precursor of ground-level ozone
- ✓ EU Commission adopts EU Methane Strategy as part of European Green Deal (2020):

European Commission

Press release | 14 October 2020 | Brussels

Reducing greenhouse gas emissions: Commission adopts EU Methane Strategy as part of European Green Deal

- ✓ Improve measurement and reporting of methane emissions among member states
- ✓ The EU's Copernicus satellite programme will also improve surveillance and help to detect global super-emitters and identify major methane leaks
- ✓ To reduce methane emissions in the energy sector, an **obligation to improve detection and repair of leaks in gas infrastructure** will be proposed and legislation to **prohibit routine flaring and venting practices** will be considered.
- ✓ In the waste sector, the Commission will consider further action to **improve the management of landfill gas, harnessing its potential for energy use while reducing emissions**, and will review the relevant legislation on landfill in 2024.

Conclusions

Landfill gases

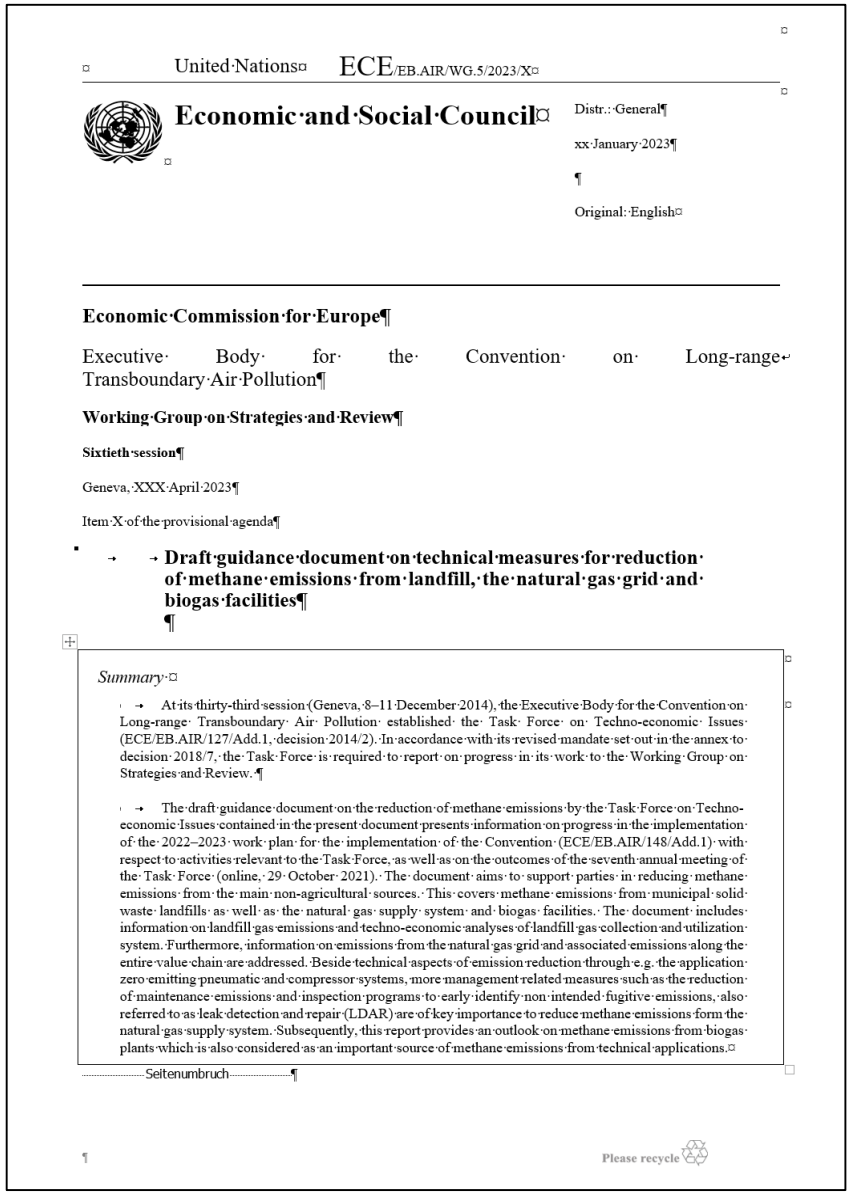
- Most relevant source of methane emissions with around 20% of European emissions (even larger share at the global level)
- Reduction/banning of landfilled biodegradable waste is the most important measure to reduce emissions in the long term
- Main technologies for mitigating GHG emissions from landfills:
  - Oxidation (biocovers / biofiltration)
  - Landfill aeration
  - Gas collection and utilization

Natural Gas Grid

- Methane emissions from natural gas network show high diversity (fugitive emissions, emissions from devices, venting)
- Reduction measures include technical (improvement / replacement of specific devices) and organizational components (maintenance / leak detection)
- The entire processing chain of natural gas needs to be taken into account when regarding measures for reduction (production, compression, transmission, distribution)

Conclusions / Discussions

- The Guidance Document is subject to discussion in WGSR (April 2023), with possible amendments requested by the Parties to achieve an ‘agreed text’ which is then sent to the EB (December 2023) for the final adoption. Published on the Convention web site.
- November 2022 for internal TFTEI review
- Last deadline January 15., 2023.



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Thank you very much for your attention! Questions?

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