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Session on
Energy and Climate Policies

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Natural gas infrastructure – Methane emissions

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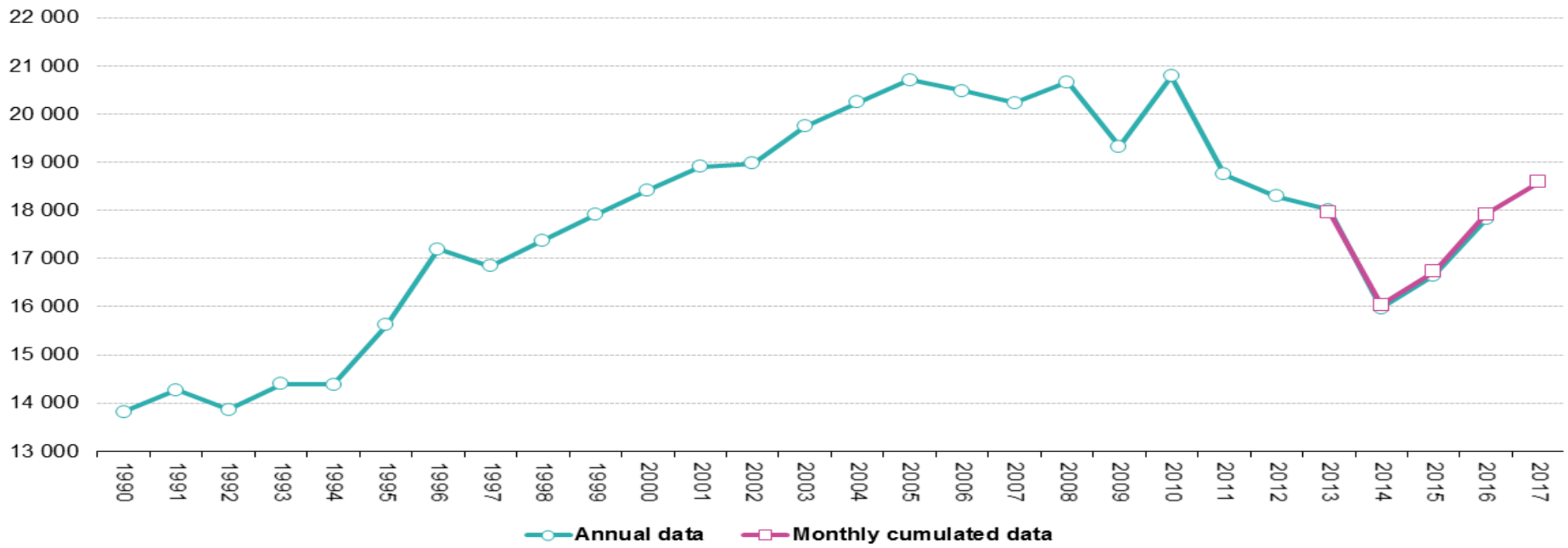
Agenda

- Consumption of natural gas in Europe
- Natural gas value chain
- Natural gas infrastructure – directions of development
- Methane as a greenhouse gas and air pollutant
- Sources of methane emissions
- EU environmental legislation affecting methane emissions
- Methane emission in Europe from natural gas infrastructure, types of emission
- Standards and protocols
- Industry activities (to mitigate CH_4 emissions)
- Innovations from the gas industry
- Establishment of a quantitative methane reduction target for the gas sector
- Conclusions

Consumption of natural gas in Europe

Gross inland consumption of natural gas, EU-28, 1990-2017
(thousand terajoules (Gross Calorific Value))



Note: Provisional data for monthly cumulated data for 2013-2015 and 2017
Date of extraction: 01/06/2018

Source: Eurostat (online data codes: nrg_103m, nrg_103a, nrg_124m, nrg_134m)

Natural gas value chain

- **Upstream** (exploration, production),
- **Midstream** (LNG terminals, transport, UGS)
- **Downstream** (distribution)
- **Utilization** (appliances)

Natural gas infrastructure – directions of development (1)

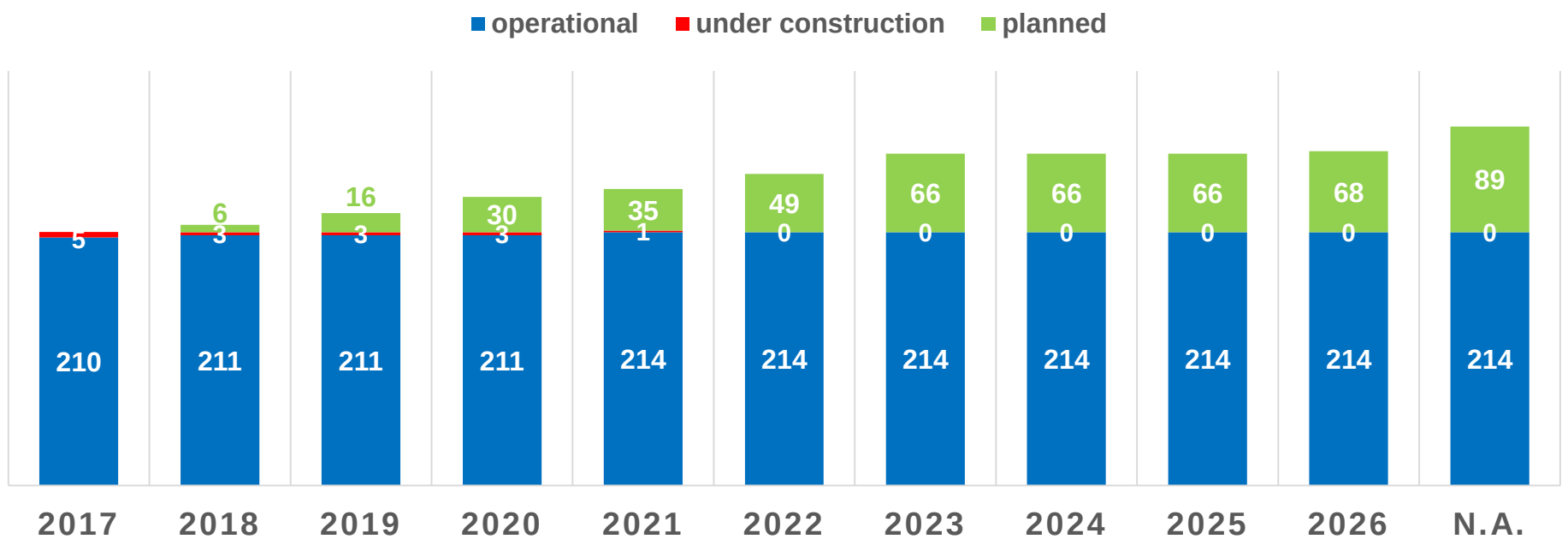
- ✓LNG terminals
- ✓Gas Storage
- ✓Biomethane
- ✓Network expansion

Natural gas infrastructure – directions of development (2)

✓LNG terminals

EU-28: REGASIFICATION CAPACITY OF LARGE-SCALE TERMINALS
(BILLION M³/YEAR)

SOURCE: HTTPS://WWW.GIE.EU/INDEX.PHP/GIE-PUBLICATIONS/MAPS-DATA/SYSTEM-DEVELOPMENT-MAP

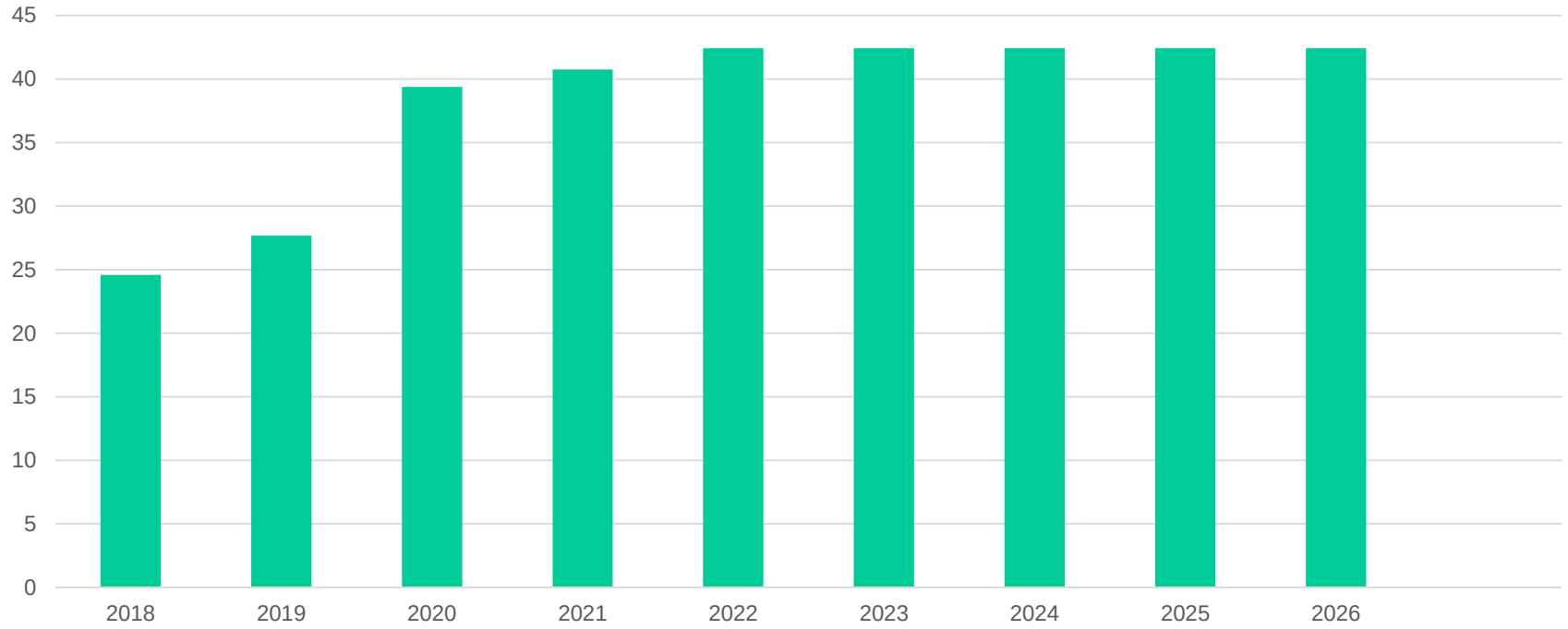


Natural gas infrastructure – directions of development (3)

✓Gas Storage

EUROPE: storage capacity under construction
operational in 2017: 1543,58 TWh

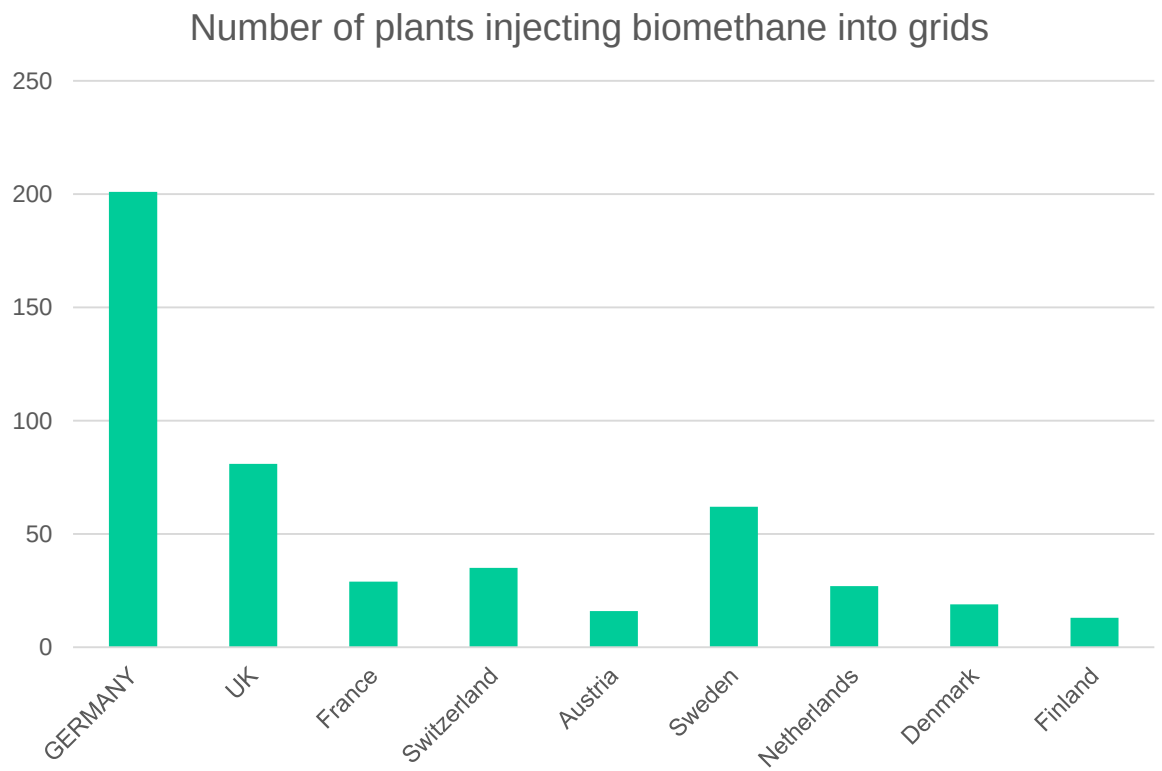
Source:
https://www.gie.eu/index.php/gie-publications/maps-data/system-development-map



Natural gas infrastructure – directions of development (4)

✓Biomethane

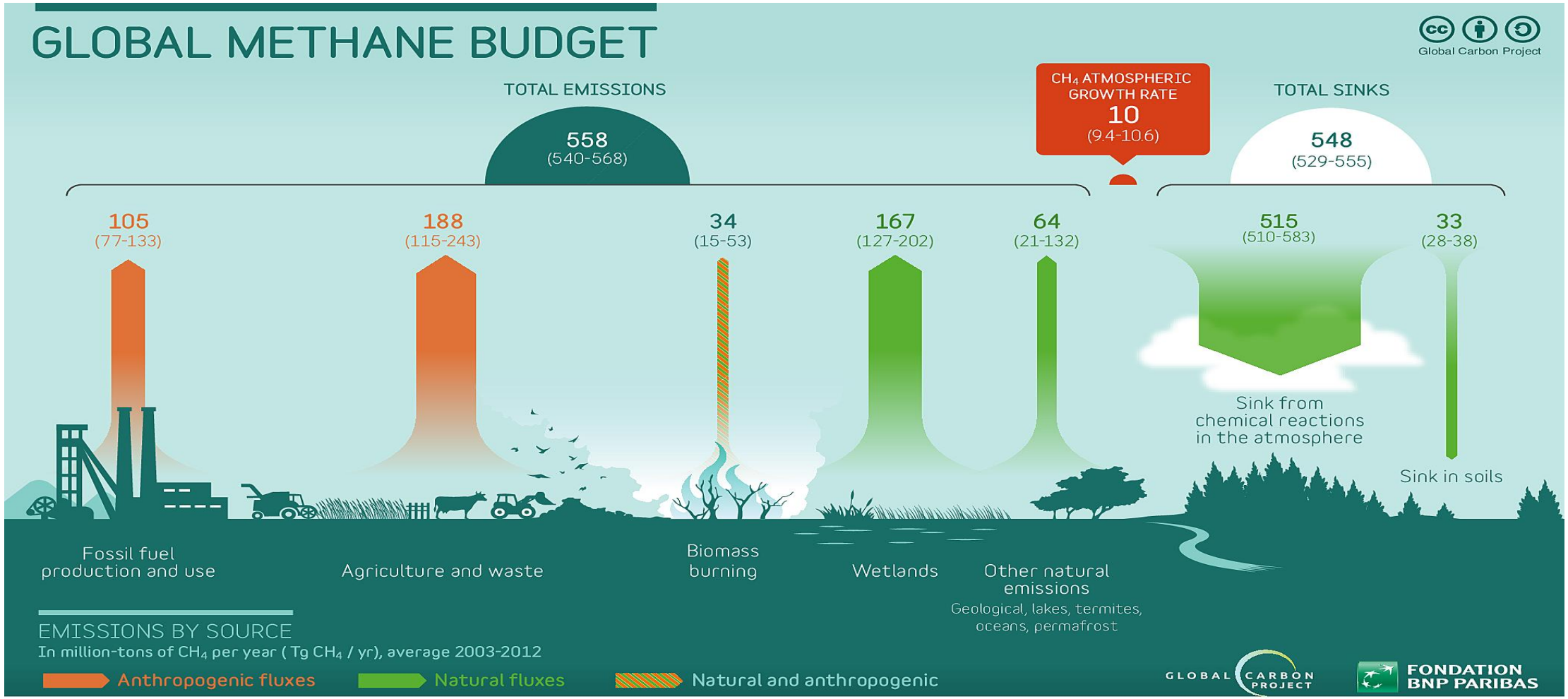
- Number of newly commissioned plants has dwindled since 2011 because of the change to the EEG* 2012 law, which capped the use of corn as a feedstock;
- The downward trend was aggravated by the introduction of even more restrictive measures (EEG 2014 law) on the use of energy crops for new facilities and the discontinuation of premiums for producing electricity via biomethane and using energy



source: https://www.eurobserv-er.org/biogas-barometer-2017/

*Erneuerbare-Energien-Gesetz (Renewable Energy Act)

Methane as a greenhouse gas – global budget



source:
www.globalcarbonatlas.org

Methane as a greenhouse gas (1)

Comparison to CO_2:

- Emissions of greenhouse gases are calculated into the equivalent rate of emission of the carbon dioxide.
- This value for gas depends on:
  - Efficiency of absorption of the thermal Energy radiated by the Surface of Earth;
  - Time of decay of the molecules of gas in the upper parts of the atmosphere;
- Surplus of anthropogenic CO_2 stays in the atmosphere for centuries, whereas CH_4 is intensively warming up Earth for one-two decades, before decaying into CO_2 and H_2O.

GWP20 i GWP 100:

- According to Intergovernmental Panel on Climate Change (IPCC) CH_4 is warming up Earth 86 time more than CO_2 in the time horizon of 20 years (GWP20).
- Time horizon of 20 years is usually neglected. Greenhouse effect of CH_4 in 100 years (GWP100) is used instead, resulting in an impression of CH_4 being less harmful than in reality. Greenhouse potential of CH_4 in the time horizon of 100 years is equal to 34 (IPCC).

Methane as a greenhousegas (2)

- According to Environmental Defense Fund (EDF) the value of GWP100 is underestimating the negative effect of CH_4 almost **5 times**.
- CH_4 is a catalyst of quick warming in a short period of time, it influences environemntal processes, such as blooming of flowers, according to American Geophysical Union (2015).
- **Environmental Protection Agency (EPA) estimates that reducing the global emission of CH_4 of 45% in the next 20 years time, would be equivalent to shutting down 1000 coal mines.**

Methane as an air pollutant

- Europe's most serious pollutants in terms of harm to human health, are PM, NO2 and ground-level O_3
- Ground-level (tropospheric) O_3 is formed from chemical reactions in the presence of sunlight, following emissions of precursor gases, mainly NOx, NMVOCs and **CH_4**.
- By combining modelled ozone concentrations with health-impact relationships that also consider exposure of population below the ozone air quality standards (in Europe Maximum daily 8-hour mean ozone of 120 microgram/m3 or ca. 60 ppb), West et al. (2006) demonstrated that **globally about 30,000 less premature deaths per year would result from a 20% reduction in anthropogenic CH4 emissions.** (Source: JRC Global trends of Methane Emissions and their impacts on ozone concentrations 2018)

Sources of methane emissions in 2012

Antropogenic sources

- Coal Mining - 13%
- Oil&Gas industry - 24%; Natural gas (7,3 - 16)%
- Enteric fermentation&manure - 30%
- Rice cultivation - 8%
- Biofuels burning - 3%
- Biomass burning - 5%
- Landfills&waste - 17%

Natural sources

- Wetlands - CH_4 from the anaerobic digestion of the organic materia by bacteria
- Others – termites, oceans, volcanos, permafrost, deposits, fires

source: www.igu.org/publications-page

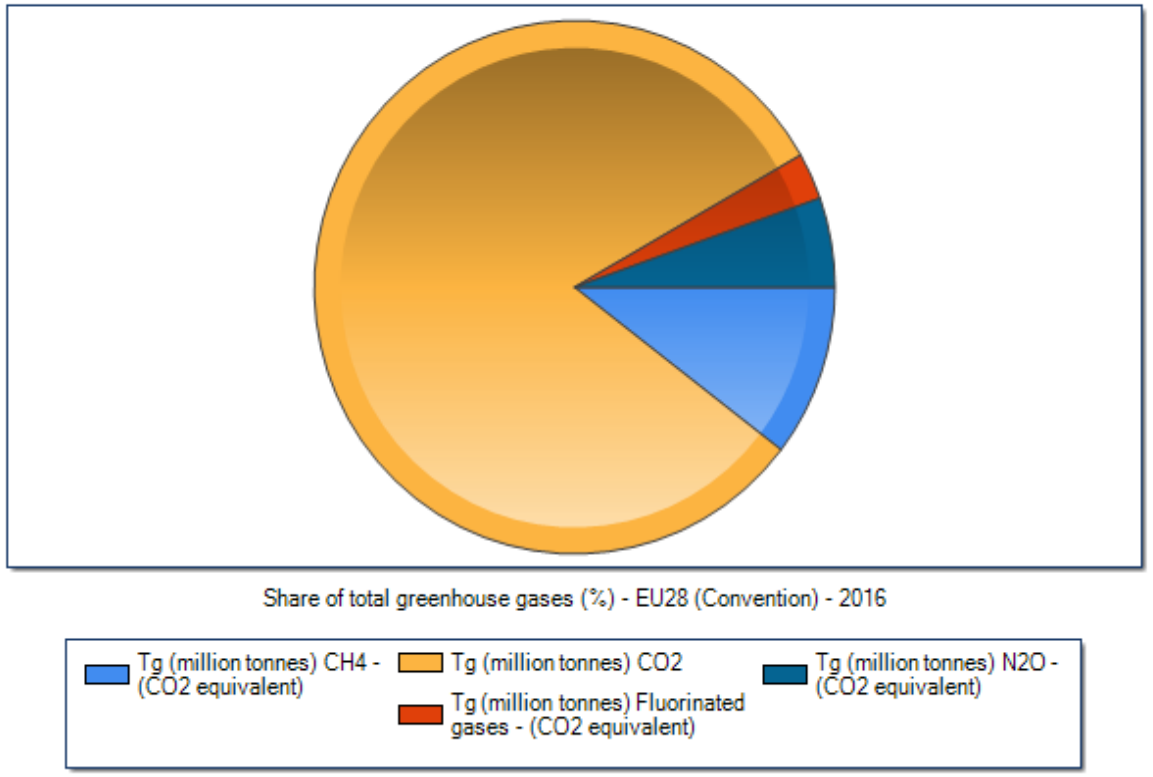
Methane Emissions in EU

- Methane Emissions account for 11% of total EU GHG Emissions,

(source: EEA, 2018)

- A note: natural gas has strong environmental benefits with the lowest emissions of PM, SO_x, NO_x compared to biomass.

[ref IEA WEO 2017 -Commentary: The environmental case for natural gas]



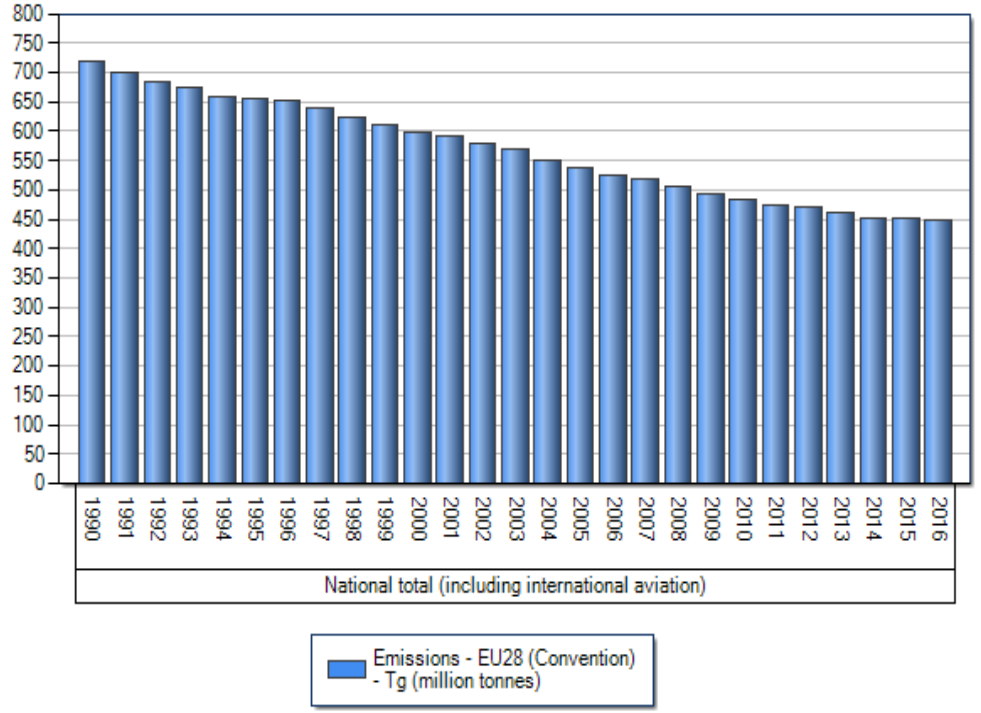
source: https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer

Methane emissions

- Total Methane Emissions decreased by 37% since 1990 to 457 Mt CO_2 eq. in 2016.

- Methane Emissions **from gas operations** represented 6% of the total (0,6% of the total EU GHG Emissions, which was about 4500 Tg)

(source: EEA, 2018)



source: https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer

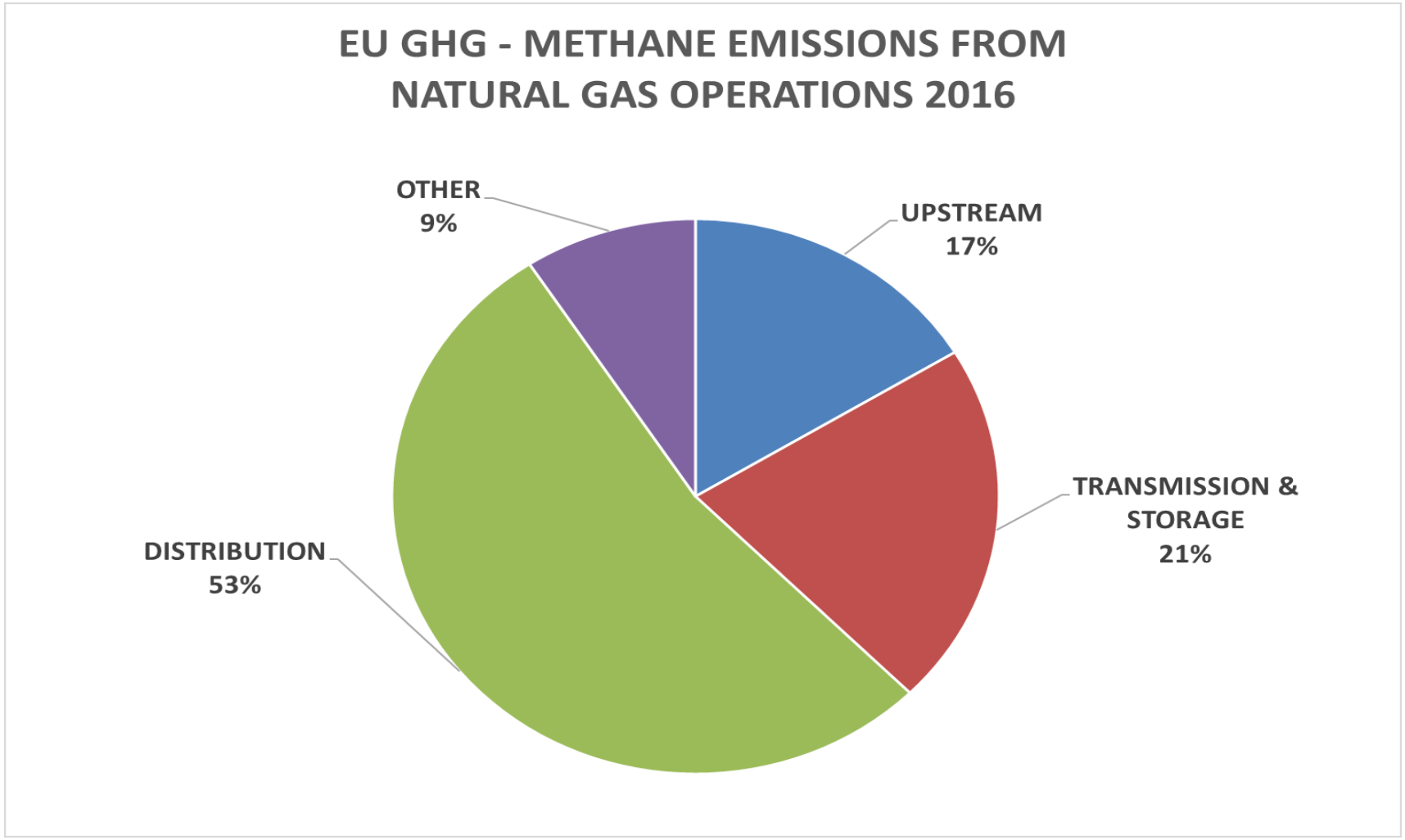
EU environmental legislation affecting methane emissions

- Waste Framework Directive/ EU Directive on the Landfill of waste (EU) 2018/850
- Fuel Quality Directive - reduction of the GHG intensity of transport fuels by a minimum of 6% by 2020
- Air quality legislation (Directive 2016/2284)
  - Commission declaration to further assess the impact of methane emissions and consider measures
  - JRC report on methane emissions' contribution to ozone
- Energy and Climate Framework 2030: reduce GHG emissions by 40% (base 1990)
  - ETS: 43% reduction in 2030 (base 2005)
  - Effort Sharing Regulation: 30% reduction in 2030 (base 2005)
  - Reporting – UNFCCC emission inventory
- Energy Union Governance Regulation -> Strategic Plan for Methane

Methane emission in Europe from natural gas infrastructure, types of emission

- **Fugitive emissions**: residual leaks from flanges, pipe equipment, valves, joints, seals and seal gas systems etc. that are more or less continuous sources
- **Pneumatic emissions**: emissions caused by gas operating valves, continuous as well as intermittent emissions
- **Vented emissions**:
  - **Maintenance vents**: emissions from planned operating conditions where natural gas is released from the gas infrastructure for maintenance purposes
  - **Incident vents**: emissions from unplanned events like failures of the system due to third party activity and external factors normally outside of the control of the gas company
  - **Operation vents**: i.e. starting and stopping of the compressors
- **Incomplete combustion emissions**: unburned methane in the exhaust gases from gas turbines and engines

Fugitive emissions from natural gas operations



Standards and protocols

- ISO 14064 Greenhouse Gas Emissions Reporting and Verification
  - ✓ Requires organisations to record activities to reduce emissions and outlines requirements to state uncertainty
  - ✓ GHG emissions must be expressed as CO_2 eq.
- GHG Protocol: Coroporate Standard (first edition in 2001, by World Bussiness council for sustainable development, a basis for accounting and reporting)
  - ✓ Outlines requirements for external verification and reporting
  - ✓ Identifies tools for calculating emissions and provides examples, Labour and cost intensive
- EPA Method 21 Determination of Volatile Organic Compund Leaks
  - ✓ Identifies the specific equipment and methodologies for detecting and quantifying emissions
  - ✓ Point source emission identification and quantification
- EN 15446 Fugitive and diffuse emissions of common concern to industry sectors. Measurement of fugitive emission of vapours generating from equipment and piping leaks
  - ✓ Detailed methodology for report writing and data capture
  - ✓ Doesn't provide framework for organisation's emissions inventory

Industry activities (to mitigate CH_4 emissions)

The gas industry pushes for the following improvements:

- ❑ develop further quantification and reporting standardization;
- ❑ continue to improve data coverage and data consistency for upstream, midstream and downstream;
- ❑ separate methane emissions between the gas and the oil value chains and allocate them properly;
- ❑ review through its members all EU28 National Inventories to check consistency by country;
- ❑ include gas Utilization: End-users and Appliances

Innovation in industry (1)

Upstream

- Using compressed air instead of natural gas to operate pneumatic equipment;
- World Bank program: Zero Routine Flaring by 2030 in upstream operations;
- Investment in a local nitrogen production plant to replace NG as a purging agent;
- Comparison of CH_4 emissions with bottom-up and top-down technologies;
- Implementation of innovative technologies that will help reduce Emissions.

Innovation in industry (2)

Midstream

- Development of a system to collect CH_4 to produce electricity with a micro CHP system or recompressing it into the grid (key to reach the target of "The zero emission compressor station");
- GERG: project for evaluation of best measuring techniques;
- Development of an efficient leakage control method for natural gas pipeline networks using Airborne Remote Monitoring (LIDAR detection of CH_4 from the air).
- Development of a new "High Flow Sampler" device to quantify leaks in a more reliable way and to quantify leaks down the 5L/hour;
- Development of innovative emissions detection technology;
- Analysis of emissions parameters, in addition to costs, inventing for example portable flares or injection of nitrogen when carrying outworks in pipelines.

Innovation in Industry (3)

Downstream

- Development of a technology to eliminate vented emissions by using a vacuum pump to avoid the need to release any methane into the atmosphere.

- Development of a catalyst based system to oxidize into CO_2 the methane normally released by the natural gas online analyzers on the grid.

Establishment of a quantitative methane reduction target for the gas sector

Oil and Gas Climate Initiative sets first collective methane target for member companies:

- Target to reduce by 2025 the collective average CH_4 intensity of its aggregated upstream gas and oil operations by one fifth to below 0.25%, with the ambition to achieve 0.20%, corresponding to the reduction by one third;
- Achieving this agreed intensity target would reduce collective emissions by 350,000 tonnes of CH_4 annually, compared to the baseline of 0.32% in 2017.

Establishment of a quantitative methane reduction target for the gas sector (2)

- The target for OGCI member companies will be defined from a bottom-up approach,
- Best available techniques will be used for the whole gas value chain, including:
  - Fugitive emissions monitoring during operations, with leak screening techniques and/or direct measurement, which could include periodic facility inspections using detection equipment, flange management, etc.
  - Gas to Power units to use the vented or flared gas at remote production sites (avoid venting the associated gas)
  - Minimise venting of hydrocarbons from purges and pilots, through measures including installation of purge gas reduction devices, flare gas recovery units and inert purge gas
  - Minimise leakage through “soft seat valve” and “green completion”
  - LDAR (leak detection and repair) campaigns
  - Minimize vents (optimising the operation and trying to align it with the maintenance works; flaring instead of venting; reinjection of vents)

Conclusions

- CH_4 emissions from the natural gas infrastructure are dangerous not only because of safety and economic reasons, but also because:
  - CH_4 is a greenhouse gas and has a significant negative effect on a climate;
  - CH_4 is a precursor gas for ozone formation which is harmful to human health;
- Natural gas industry is very much aware of it, so any structural changes that are due to happen will be closely scrutinized for possible impact on methane emissions. Organizations like Marcogaz, GIE and others help to perform such scrutinies;
- NG industry takes many actions to mitigate CH_4 emissions;
- Whole natural gas chain is involved (from production to utilization);
- NG industry will contribute to the establishment of a quantitative methane reduction target (keeping in mind the previous efforts of the companies).

Thank you.

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