Training session
Methane Emissions in the Gas Sector

Vienna, 26th and 27th of November of 2019

Welcome address

Predrag GRUJICIC

Introduction to the course

Francisco DE LA FLOR
Jos DEHAESELEER

Programme

DAY 1 – INTRODUCTION TO THE METHANE EMISSIONS CHALLENGE

9:30 - Arrival and welcome coffee

10:00 - Welcome address

Predrag GRUJICIC (Energy Community Secretariat)

10:10 - *Tour de table*

10:20 - Introduction to the course

Francisco DE LA FLOR (GIE) // Jos DEHAESELEER (MARCOGAZ)

10:30 – Why focus on methane emissions?

Francisco DE LA FLOR (GIE) // Jos DEHAESELEER (MARCOGAZ)

11:00 - The clock is ticking: limiting methane emissions a must

Carmen Magdalena OPREA (European Commission DG ENER)

11:30 - Methane emissions from oil and gas operations – where and how they are regulated?

Maria OLCZAK (Florence School of Regulation)

12:15 – Lunch break

13:30 – Introduction to the report "Potential ways the gas industry can contribute to the reduction of methane emissions" and to the European scenario

Francisco DE LA FLOR (GIE) // Jos DEHAESELEER (MARCOGAZ)

13:50 – Methane emissions. National inventories and industry initiatives

Luciano OCCHIO (GIE / MARCOGAZ)

14:20 – Methane emissions management: Assessment, reporting and validation

Ronald KENTER (GIE / MARCOGAZ)

14:50 – Methane emissions management: Main technologies and tools

Pascal ALAS (GIE / MARCOGAZ)

15:30 – Coffee break

16:00 – Emissions' reduction targets. Recommendations

Jose Miguel TUDELA (GIE / MARCOGAZ)

16:30 – Collaborative industry initiatives

Francisco DE LA FLOR (GIE)

16:50 – Wrap-up and next steps

Francisco DE LA FLOR (GIE) // Jos DEHAESELEER (MARCOGAZ)

17:00 - Closure of day one

DAY 2 – METHANE GUIDING PRINCIPLES – OUTREACH PROGRAMME

METHANE GUIDING PRINCIPLES

Trainers: Sustainable Gas Institute – Imperial College London (Dr Adam Hawkes and Dr Paul Balcombe)

8:30 - Arrival and welcome coffee

9:00 – 11:00

Short introduction

The Methane Emissions Reduction Business Case

Reducing methane emissions: Understanding methane

Introducing the Reducing Methane Emissions Best Practices - Overview

RMEBP and Case Study: Venting

RMEBP and Case Study: Pneumatic devices

11:00 – Coffee break

11:15 – 12:45

RMEBP and Case Study: Flaring

RMEBP and Case Study: Equipment Leaks

RMEBP and Case Study: Operational Repairs

Interactive session: Methane mitigation decision making- the RMEBP Cost Model

12:45 – Lunch break

14:00 – 16:00

RMEBP and Case Study: Energy Use

RMEBP and Case Study: Engineering Design and Construction

RMEBP: Continual Improvement

Interactive session: Methane management in action- the RMEBP Gap Assessment Tool

16:00 - Closure of the training programme

Why focus on methane emissions?

Francisco DE LA FLOR
Jos DEHAESELEER

The role of gas

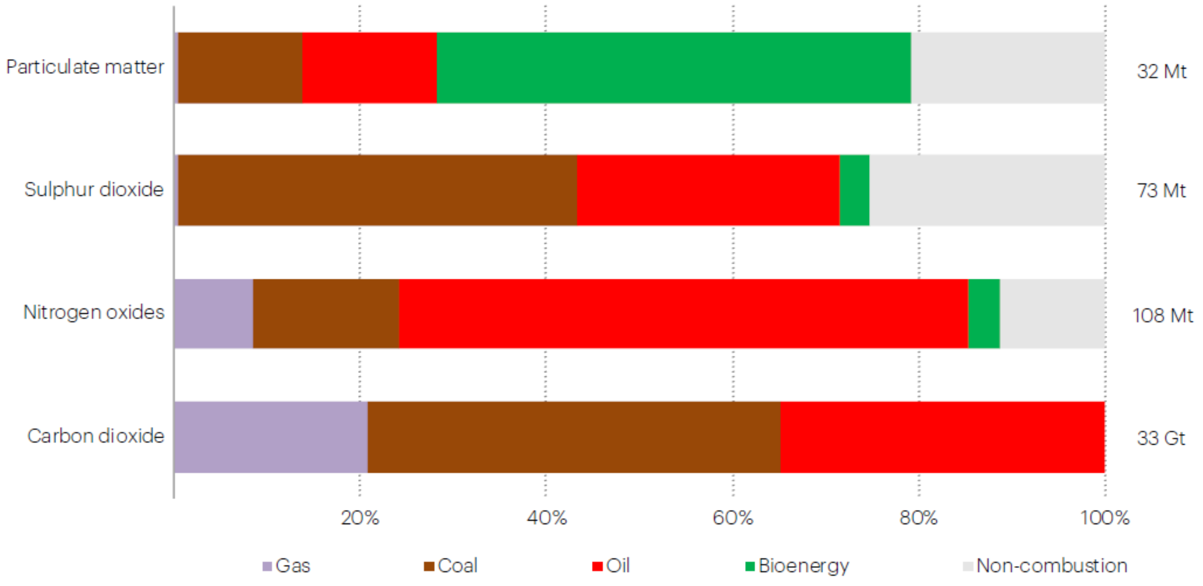
✓ Natural gas qualities:

- The most heat intensive and highest efficiency energy
- Low cost
- Contributes to integrate renewables
- Increase energy access
- Gas infrastructure has a strong role in achieving the Paris agreement

✓ Environmental credentials

- Enables clean air
- Reduces GHG emissions with respect to traditional fuels
- Reduces reliance on coal

Share of gas in total energy-related emissions of selected air pollutants (2015) and CO_2 (2018)

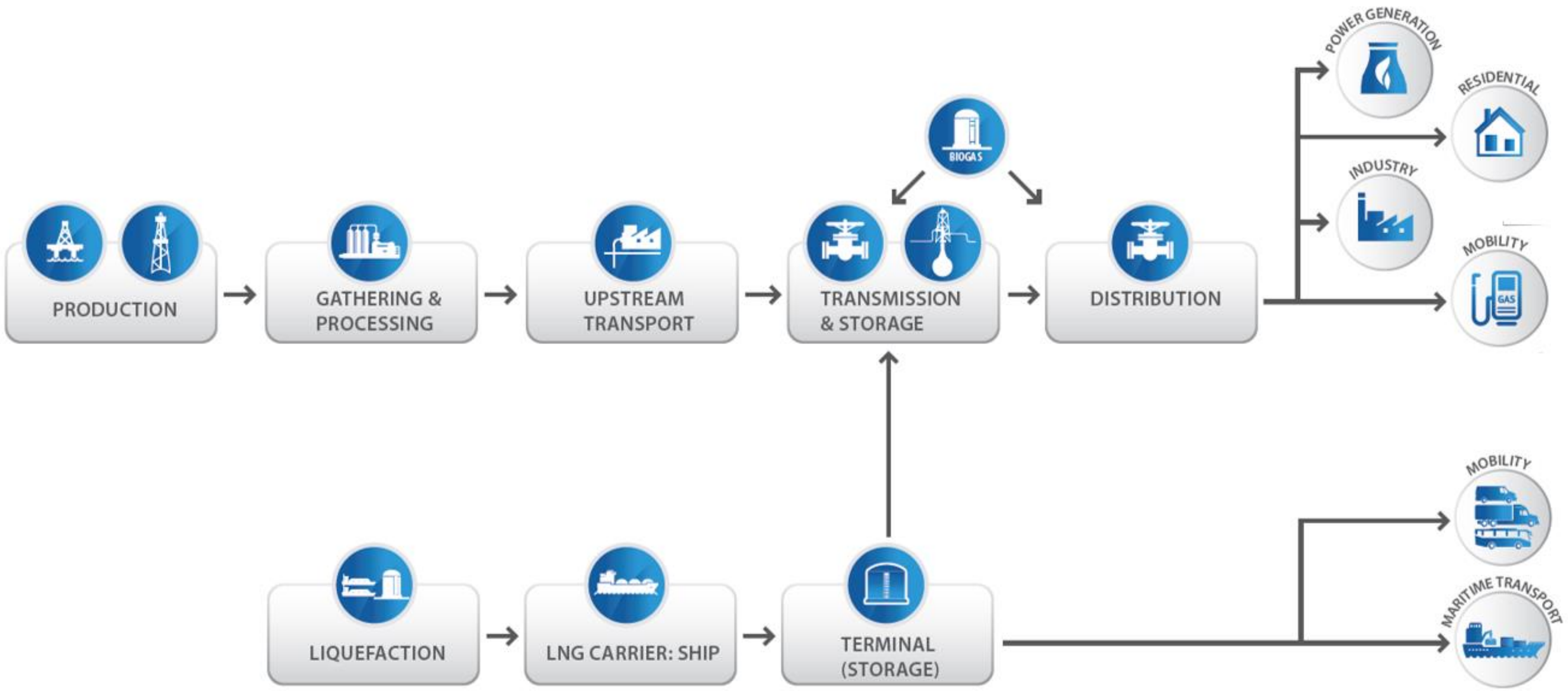


Source: IEA Methane Tracker

However… The role of gas in decarbonising energy systems depends on reducing methane emissions

Methane emissions

Methane emissions arise from all the stages of the gas value chain

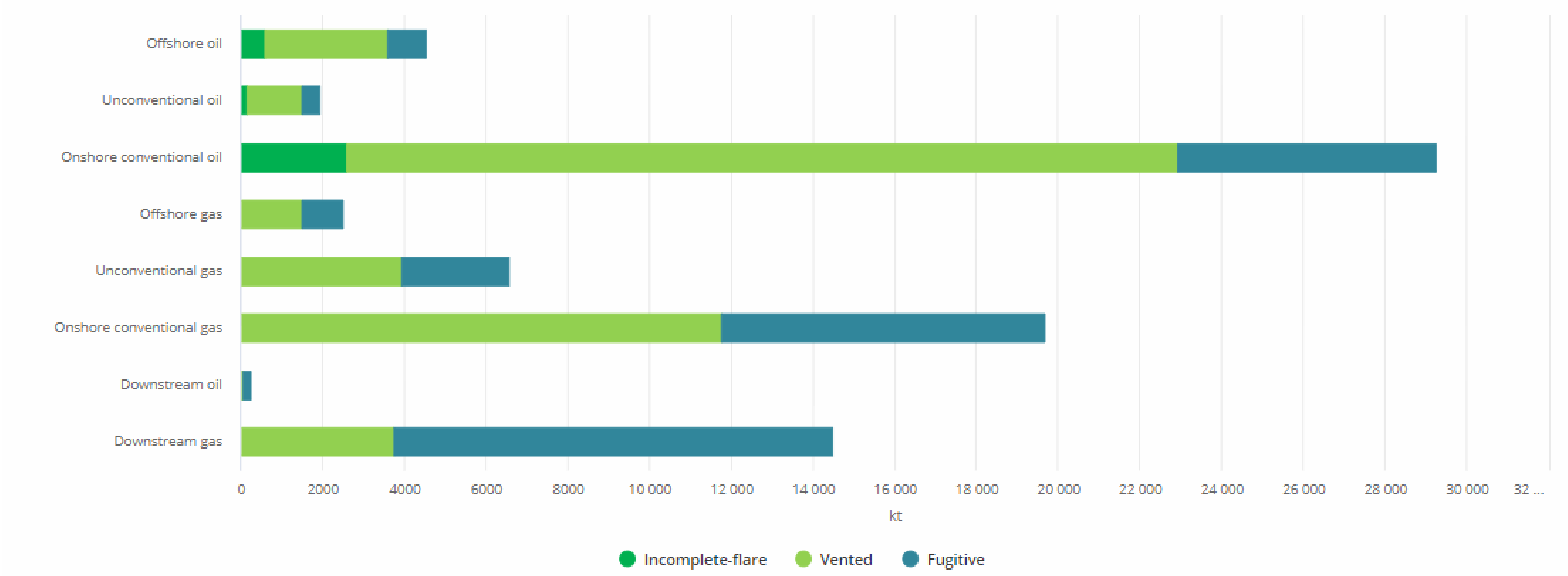


Types of methane emissions

- ✓ Fugitive
- ✓ Vented
- ✓ Incomplete combustion

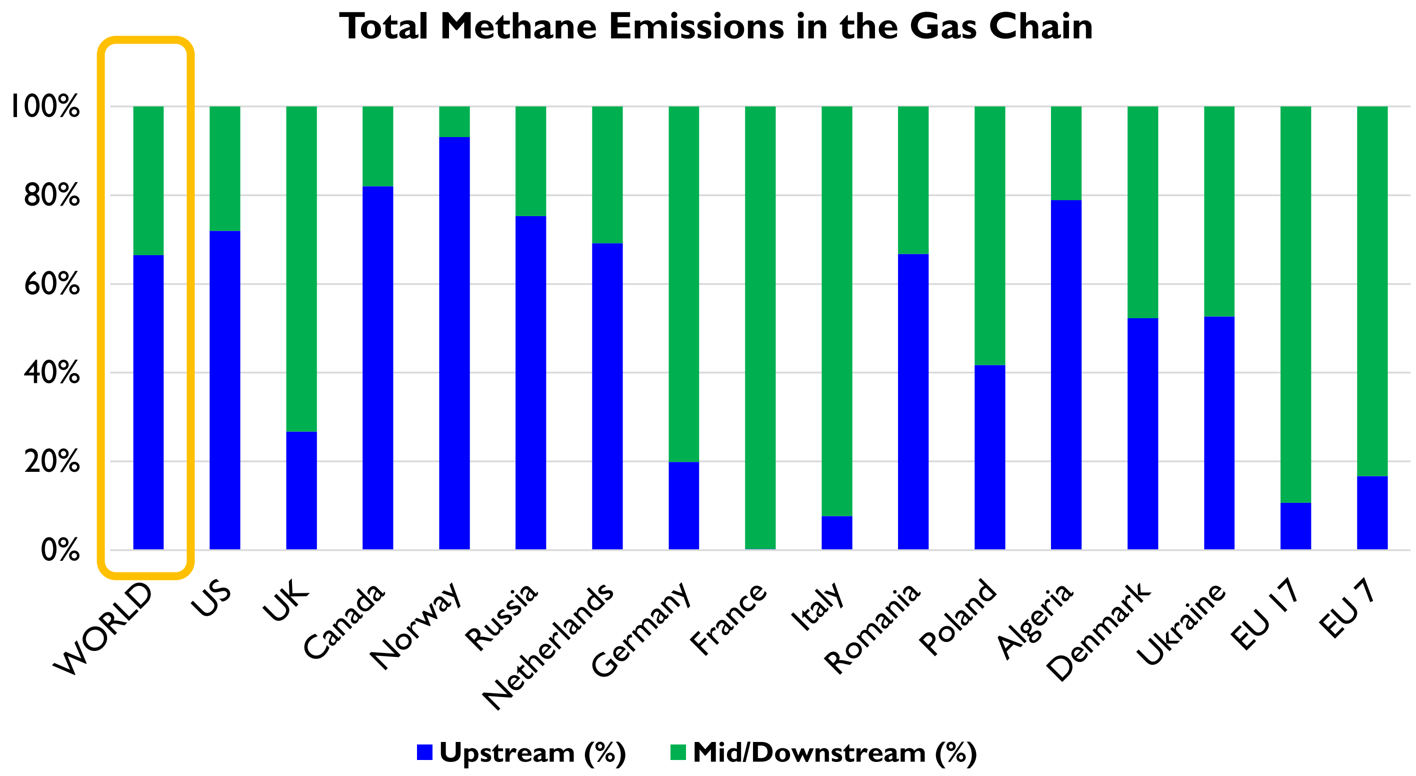
Global oil&gas methane emissions

Global oil & gas sector methane emissions: 79 Mt CH_4



Source: IEA, Methane tracker; www.iea.org/weo/methane /database

Methane emissions along the gas value chain

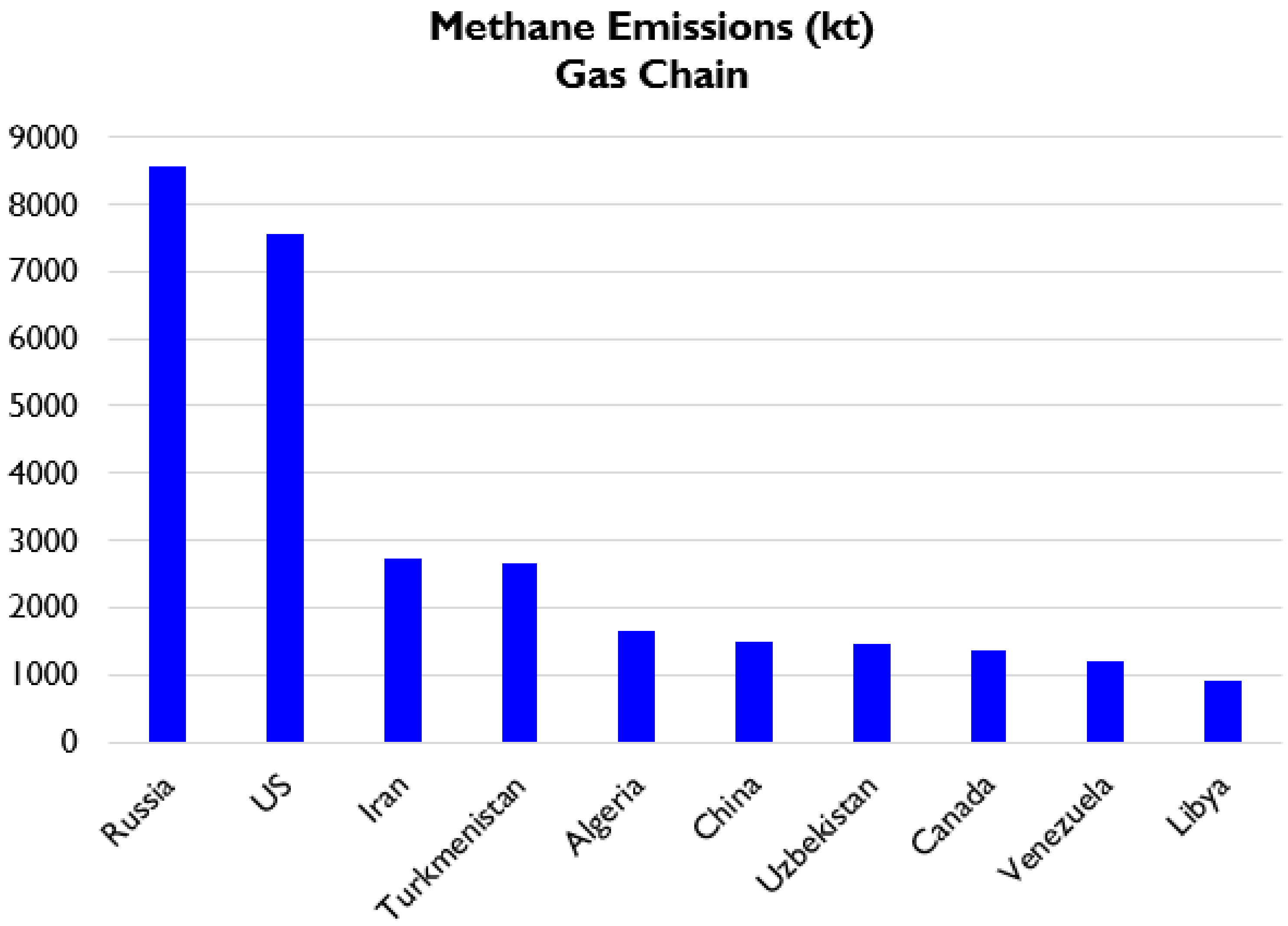


EU 17: Includes Latvia, Lithuania, Austria, Belgium, Czech Republic, Finland, Greece, Hungary, Ireland, Luxembourg, Portugal, Slovakia, and Spain

EU 7: Includes Bulgaria, Croatia, Cyprus, and Malta

Source: IEA Methane Tracker

Top methane emitters (gas chains)



Source: IEA Methane Tracker

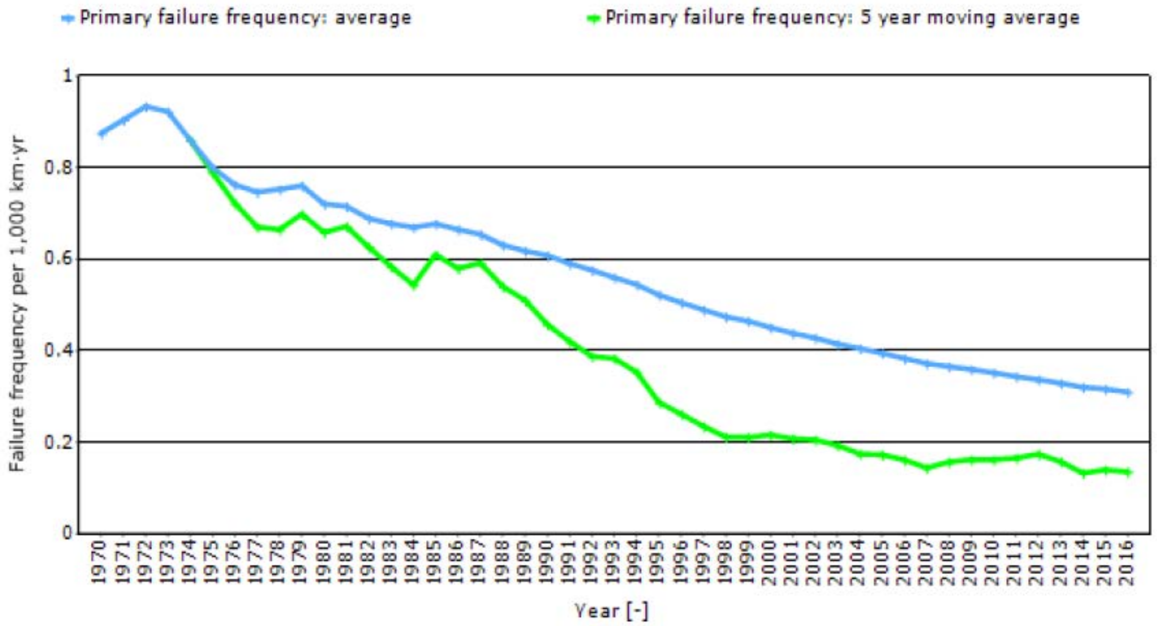
Why focus on methane emissions reduction?

✓ Main reasons to reduce methane emissions:

- Safety
- Climate change
  - Public opinion
  - Policy developments
- Commercial value

Safety

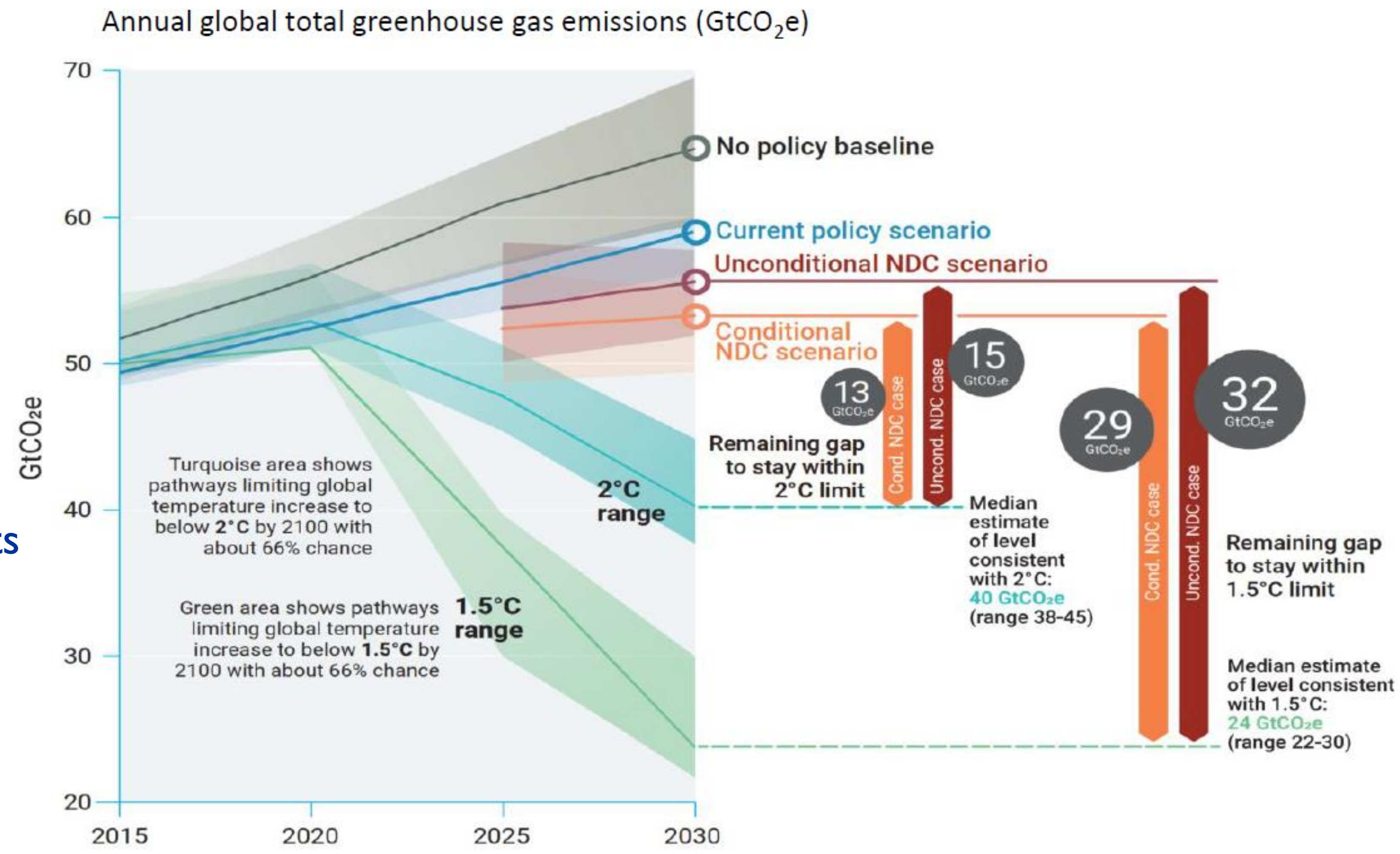
- ✓ For many years, safety has been the primary motivation for routinely detecting and reducing methane emissions
- ✓ Generally excellent performance improvements
- ✓ The safety driver has already reduced methane emissions, but not enough. Even small releases produce substantial climate impact



Source: EGIG report; 10th EGIG report, March 2018

Climate change

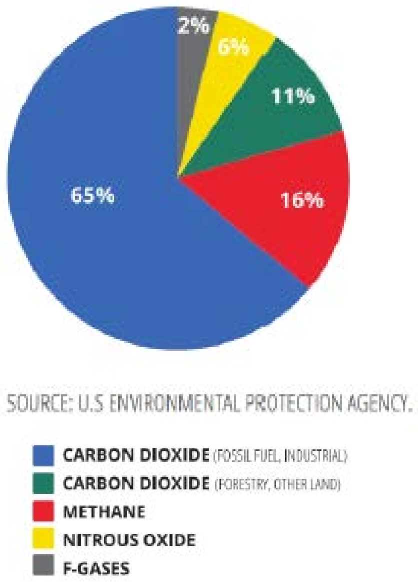
- ✓ Global CO_2 increasing
- ✓ Different scenarios lead to different temperature increases
- ✓ High reductions in GHG emissions required to meet temperature targets

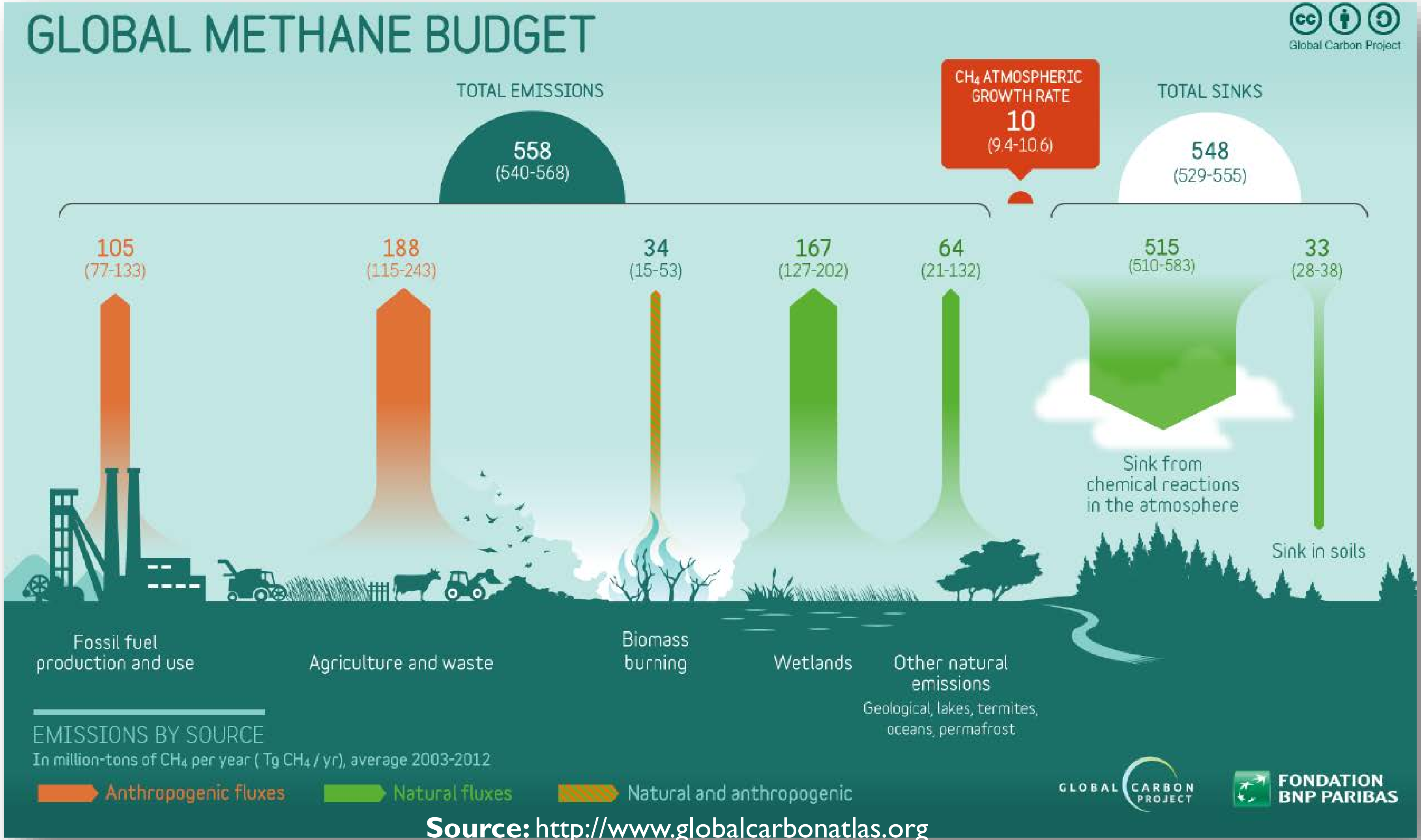


Source: UNEP, Emissions Gap Report 2018

Climate change

Methane is responsible for a 16% of global anthropogenic GHG emissions

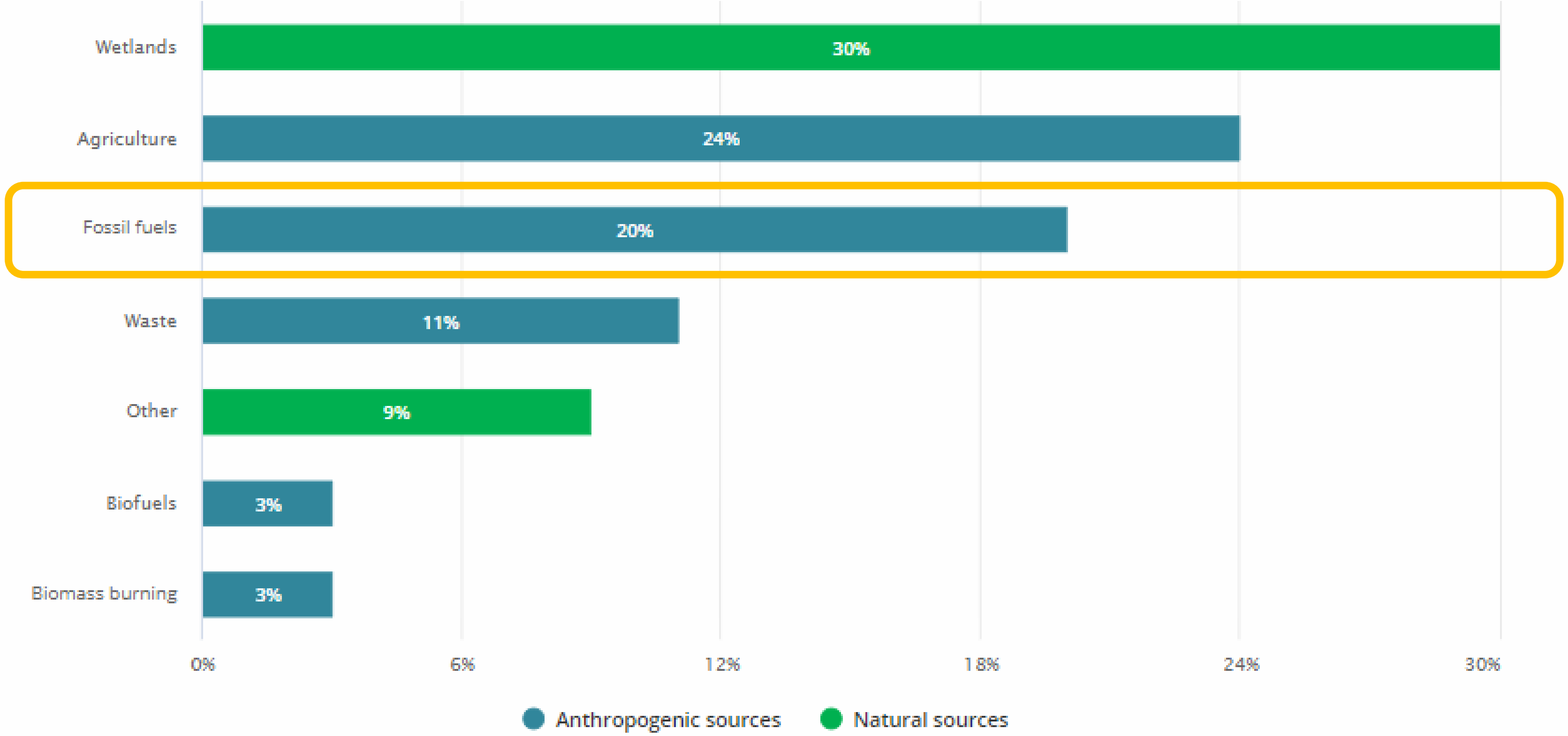




Source: http://www.globalcarbonatlas.org

Climate change

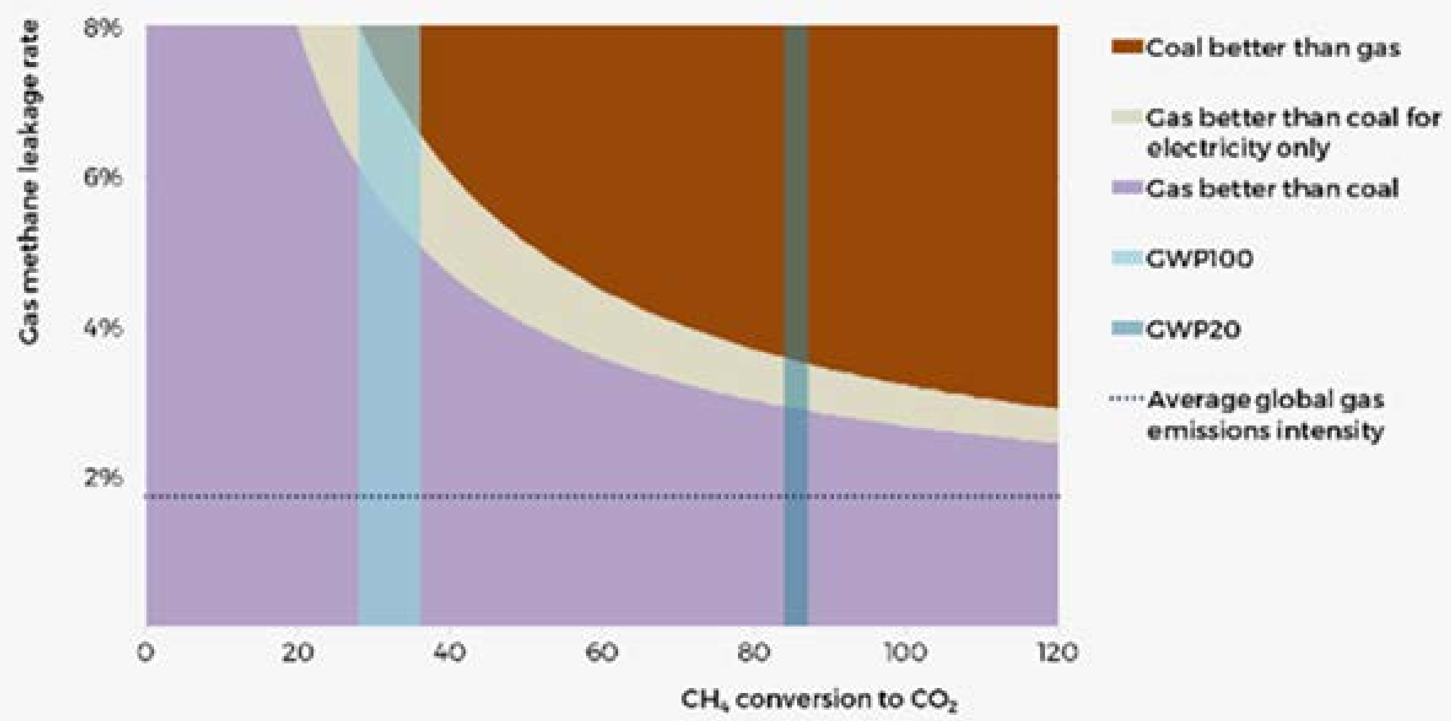
Fossil fuels are responsible for a 15 to 20% of global methane emissions



Note: Other natural sources includes: fresh waters, geologic seepage, wild animals, termites, wildfires, permafrost and vegetation
Source: Saunois et al. (2016)

Climate change

Gas versus coal for electricity generation – GHG emission intensity

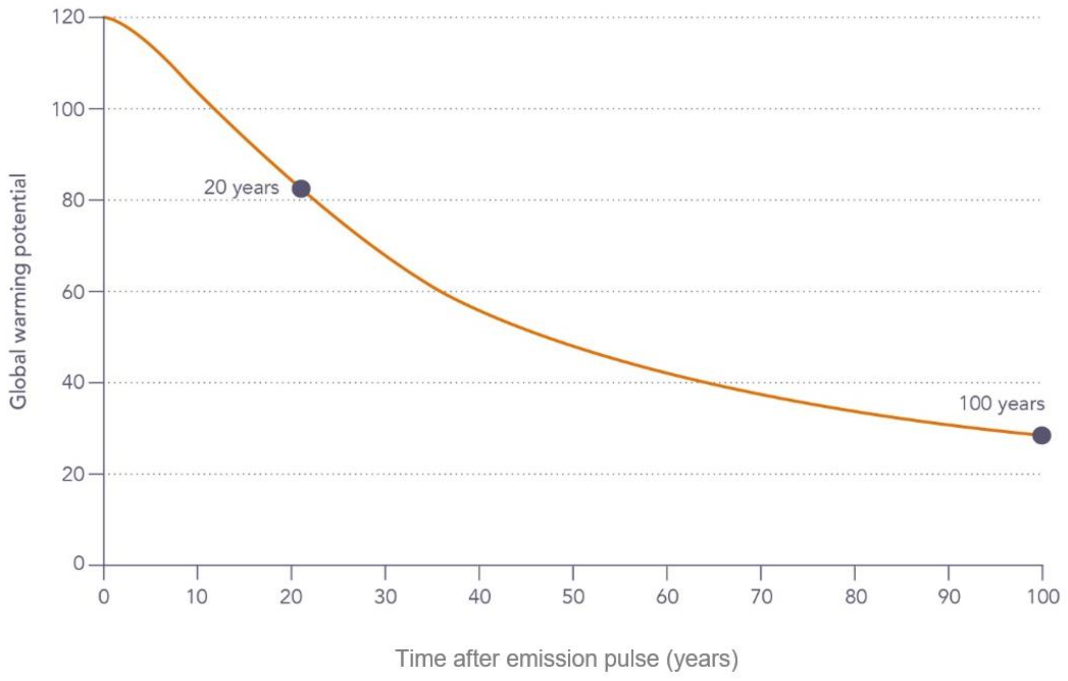


GWP20 = global warming potential over a 20-year timeframe
GWP100 = global warming potential over a 100-year timeframe based on the ranges from the Fifth IPCC Assessment Report (IPCC, 2014)

Source: IEA

Climate change

- ✓ The climate impact of methane changes over time
- ✓ CH_4 has a shorter atmospheric lifespan (average 8 – 12 years) than CO_2
- ✓ Both short term and long term climate impacts are important
- ✓ GWP100 is the most well-known metric and is used widely including for national and international emission reporting, such as the UNFCCC
- ✓ Whilst it is accepted that there is no single correct metric, the consistent use of GWP100 at least allows comparisons



Source: SGI

Public opinion

gie marcogaz Energy Community

TRANSPORT & ENVIRONMENT

Natural gas is a $22bn distraction for EU shipping that won't decarbonise the sector – study

The Guardian International edition

Fossil fuel industry's methane emissions far higher than thought

Emissions of the powerful greenhouse gas from coal, oil and gas are up to 60% greater than previously estimated, meaning current climate prediction models should be revised, research shows

Natural gas in vehicles – on the road to nowhere

HOME SEARCH The New York Times

ENERGY & ENVIRONMENT

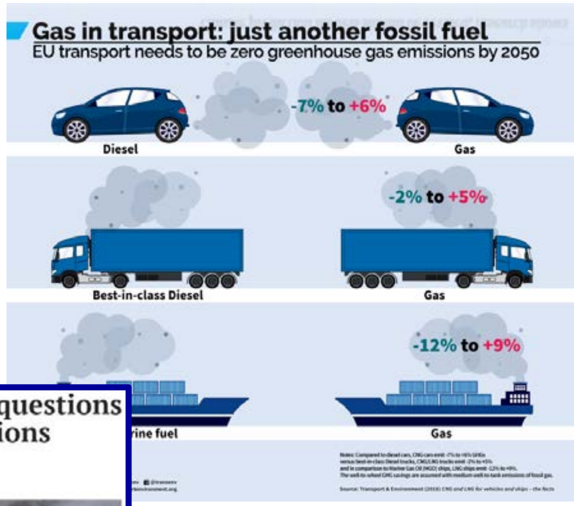
Future of Natural Gas Hinges on Stanching Methane Leaks

Natural Gas Makes No Contribution to Climate Protection

Switching from coal and oil to natural gas accelerates climate change through alarming methane emissions

Italy declares state of emergency after deadly gas explosion in Austria

One dead and 18 injured after blaze tears through Baumgarten gas hub, plunging Europe into energy crisis



California methane leak 'largest in US history'

26 February 2016

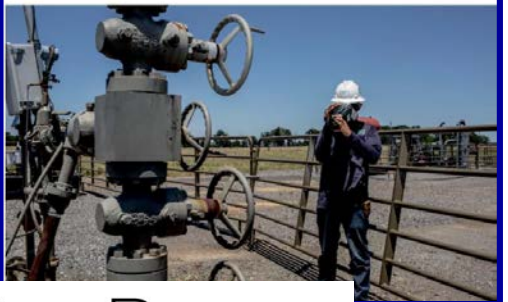
Methane explosions trigger questions about greenhouse gas emissions

March 15, 2018

Fracking's methane leaks drive climate heat

August 14th, 2019, by Paul Brown

The Natural Gas Industry Has a Leak Problem



Methane leaks

A dirty little secret

The Economist

Natural gas's reputation as a cleaner fuel than coal and oil risks being sullied by methane emissions

TRANSPORT & ENVIRONMENT

Natural gas is not a 'bridge fuel', as claimed, but an expensive dead-end on the pathway to decarbonising transport.

The New Gas Boom

TRACKING GLOBAL LNG INFRASTRUCTURE

WORSE THAN THE COAL BOOM: MEASURING THE CARBON FOOTPRINT OF THE LNG BOOM

Policy developments

EU Governance Regulation 2018/1999

Article 16 - Strategic plan for methane

Conclusion of 31st Madrid Forum, October 2018

GIE & MARCOGAZ report on the potential ways the gas industry can contribute to the reduction of methane emissions

Tender: "Limiting methane emissions in the energy sector"

Methane Supply Index (indicator of methane footprint) of the gas supply corridors to the EU (Norway, Russia, North-Africa, LNG and in the future, the Caspian route)

Climate Action Summit (UN)
New York, September 2019

Given the scale of the challenge, the EC is exploring further ways to better measure and report methane emissions across all hydrocarbon industries and reduce methane emissions from energy production and use. There is still a significant potential to reduce emissions with low costs.

Policy developments

European "Green Deal"

European Commission - Speech

[Check Against Delivery]

Opening Statement in the European Parliament Plenary Session by Ursula von der Leyen, Candidate for President of the European Commission

Strasbourg, 16 July 2019

"I want a Europe to strive for more being the first climate-**neutral continent"**

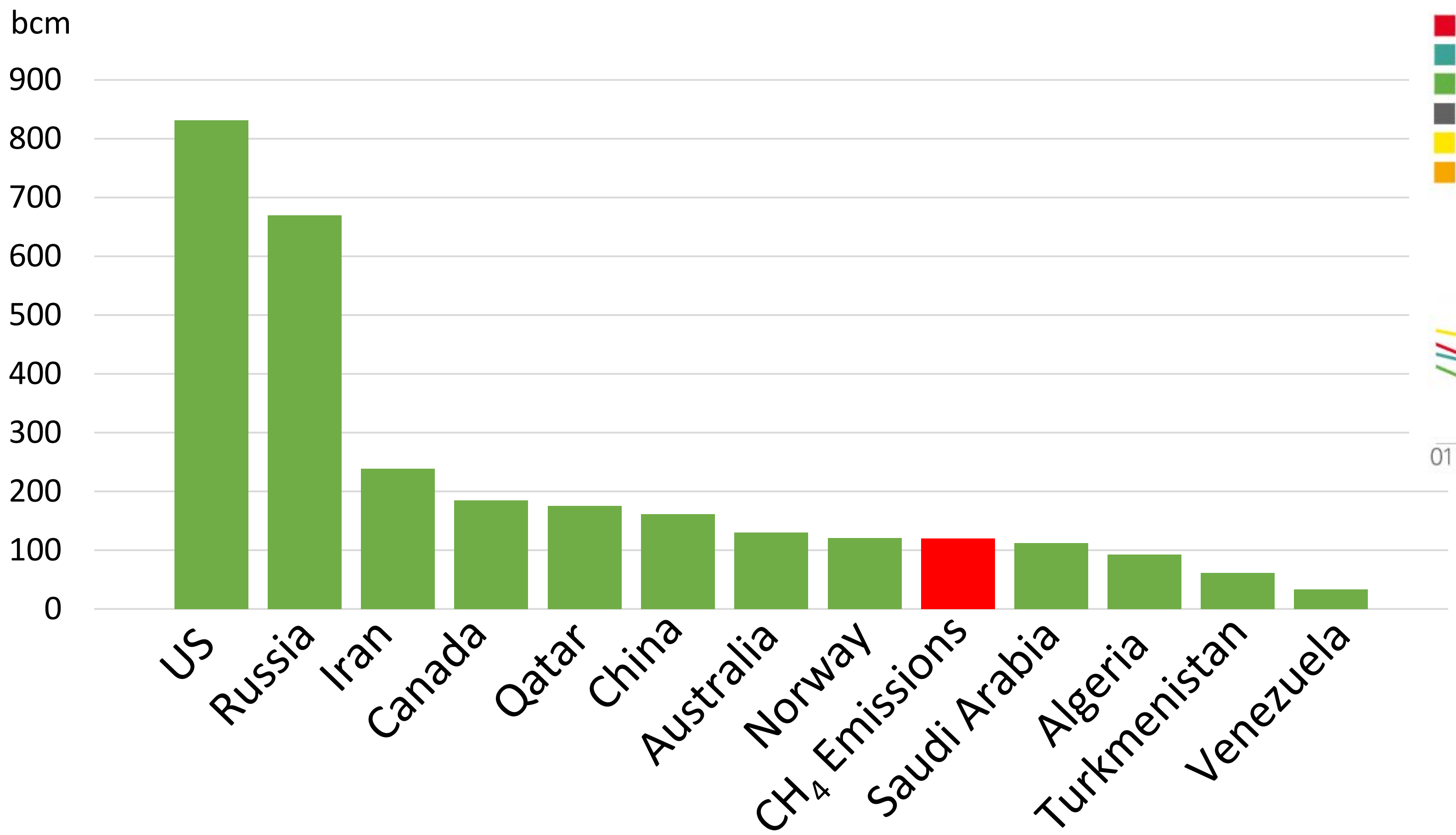
ACER - The Bridge Beyond 2025 - Conclusions Paper (19/11/19)

ACER
Agency for the Cooperation of Energy Regulators

TSOs, storage operators and LNG operators, as well as DSOs above a size threshold, should be **obliged to measure and report their methane emissions** according to a standard methodology, with sufficient granularity to allow the identification of the highest emitters. The data should be publicly available through a **European Methane Emissions Observatory**, as well as in the audited annual reports of the operators, which should also cover other sources of methane emissions. The measurements should be followed by an action plan at system operator level to address emissions. NRAs should recognise efficiently incurred costs for regulated entities. Once emission data are sufficiently robust, tradeable permits or taxes on actual emissions could be introduced.

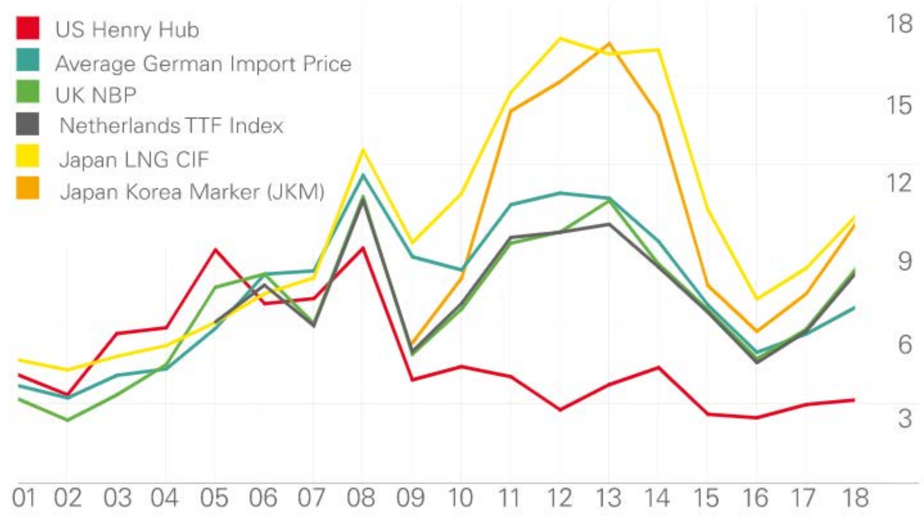
Commercial value

Gas production in some countries in 2018 (bcm)



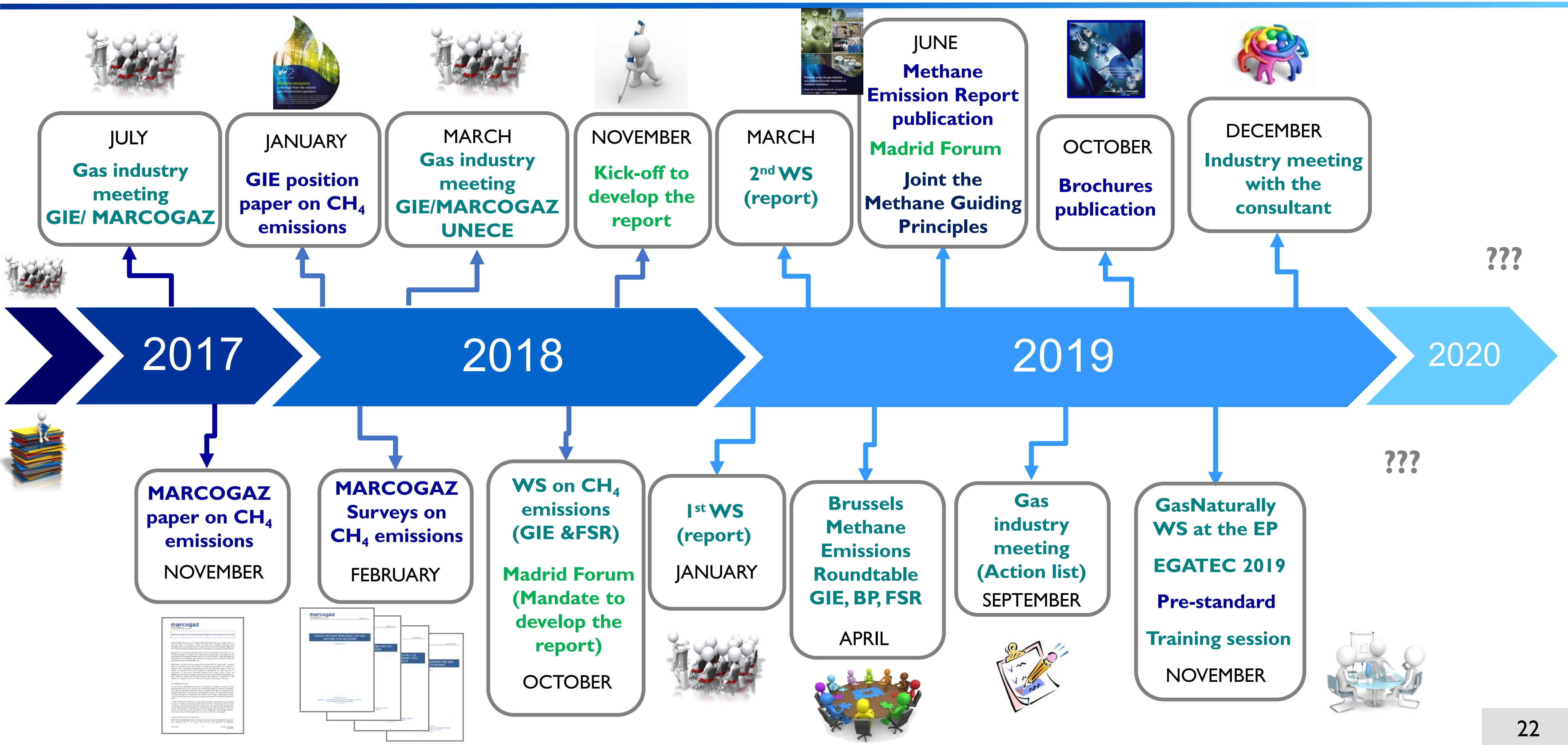
Source: Based on the IEA and BP Statistical Review of World Energy

Natural gas prices ($/mmBtu)



Source: BP, Statistical Review of World Energy

GIE & MARCOGAZ recent activities on CH_4 emissions



European Commission

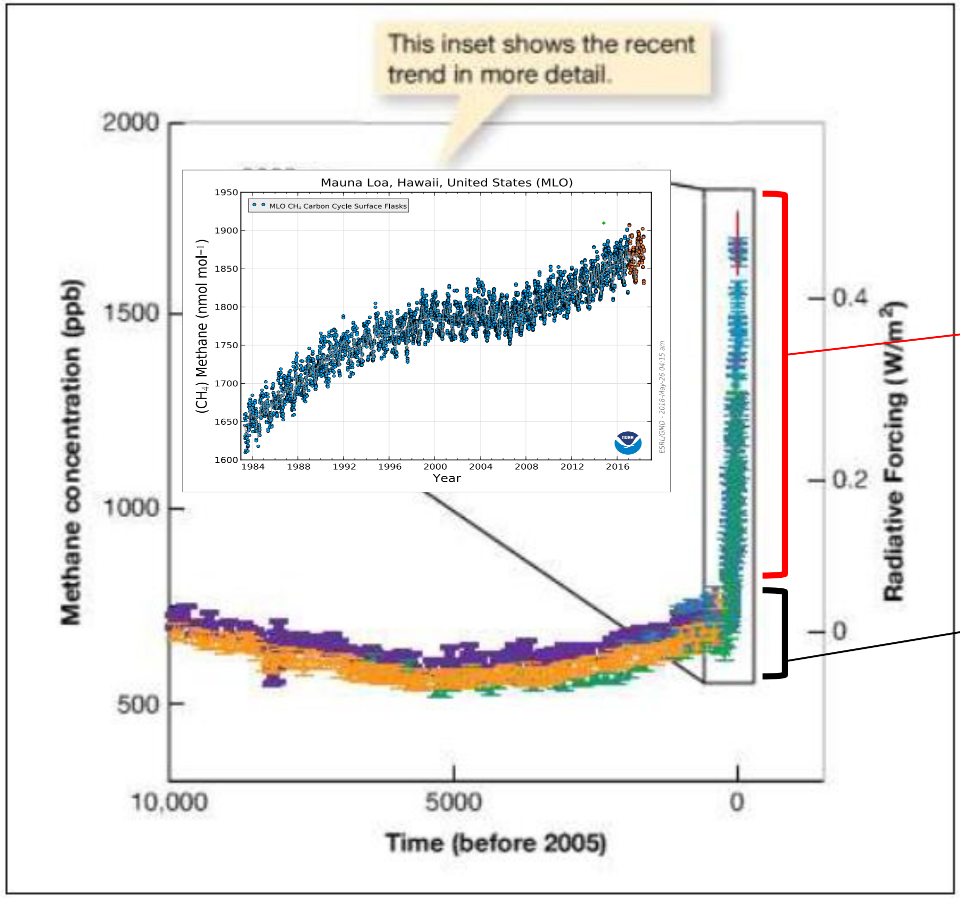
Clock is ticking: limiting methane emissions is a must!

Methane emissions mitigation along the gas value chain – The road ahead for a sustainable future

Vienna, 26 November 2019

Carmen Oprea
European Commission, DG Energy

Unprecedented levels of methane in the atmosphere



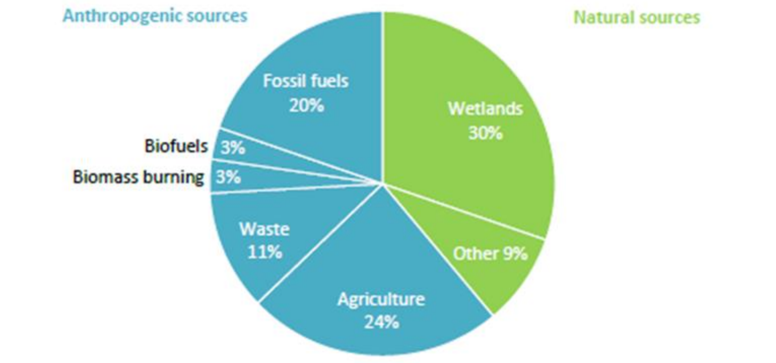
Threefold increase since pre-industrial levels

Industrialisation

Natural variation

Begon, Howarth, and Townsend (2014), based on IPCC

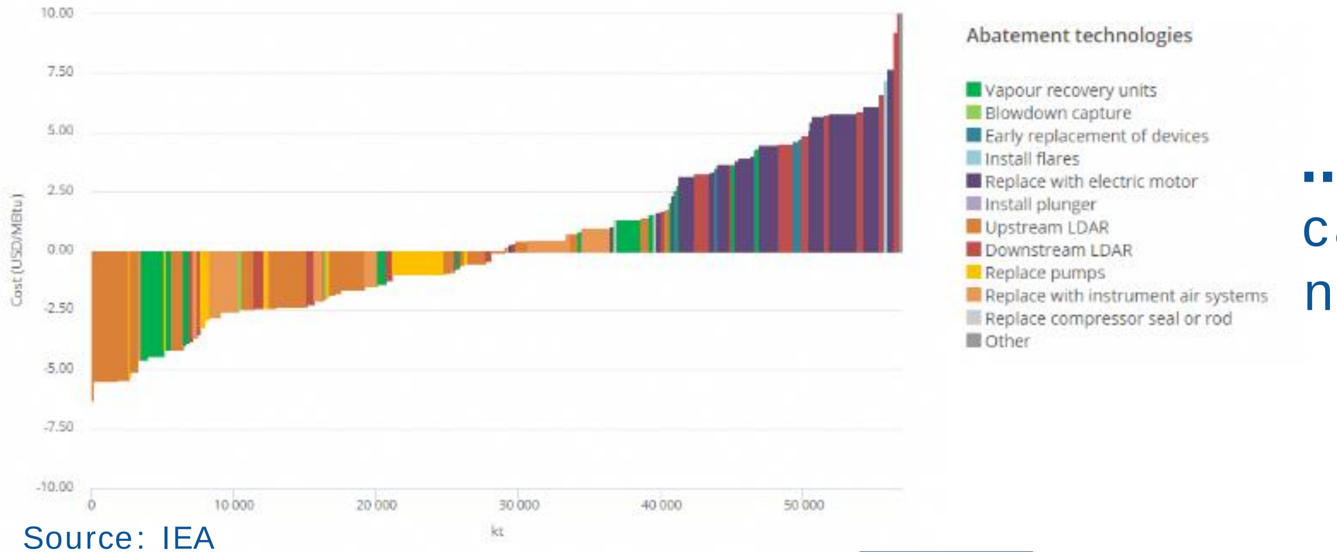
Methane is responsible for a quarter of today’s warming



Attributing methane emissions to specific sources is difficult, but human activity is likely to be responsible for the majority of the 570 Mt emissions in 2012

Source: Saunois et al. (2016).

A third of manmade methane emissions comes from energy…

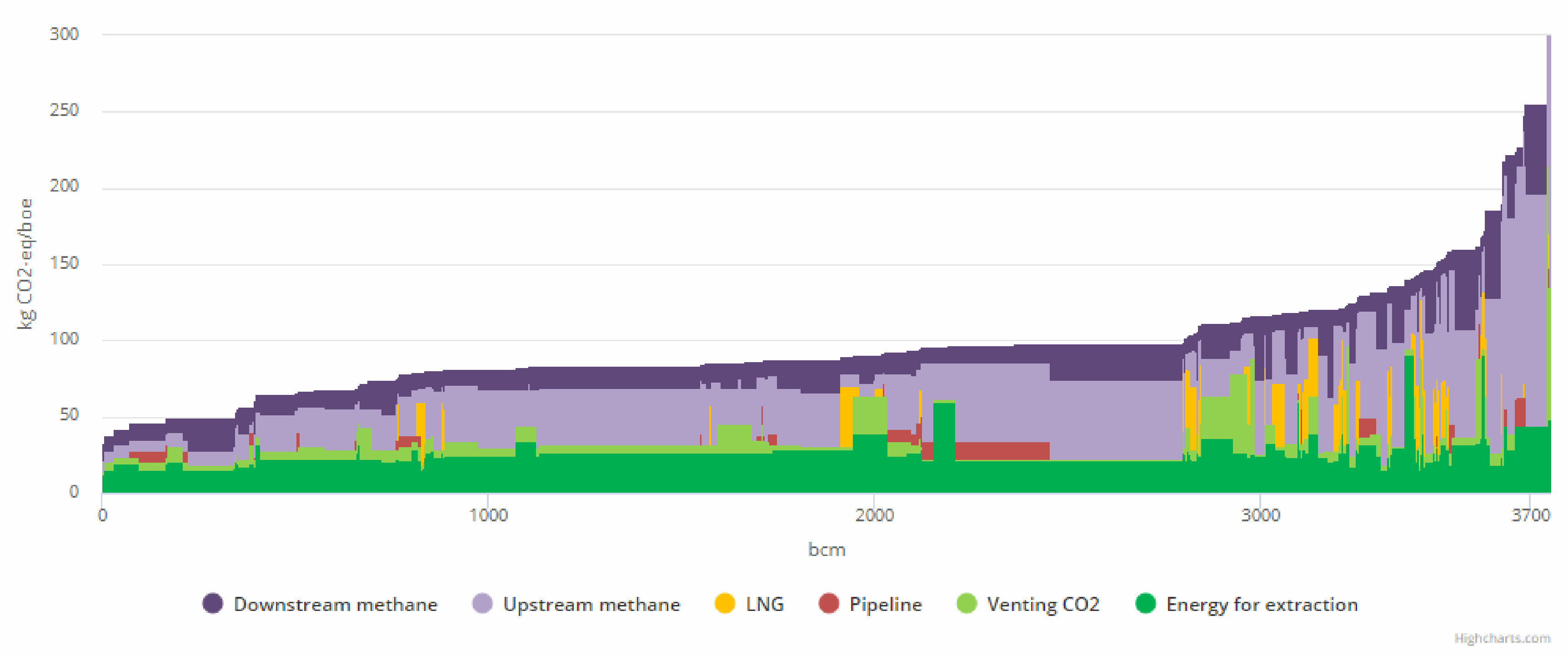


Source: IEA

…45% of which can be avoided at no net cost

Natural gas' credibility may depend on reducing methane emissions

Indirect emissions intensity of global gas production, 2017 (source: IEA)



European Commission

„I want a Europe to strive for more being the first climate-neutral continent” *(Ursula von der Leyen)*

European Green Deal

PEOPLE
- Just Transition
- European Climate Pact

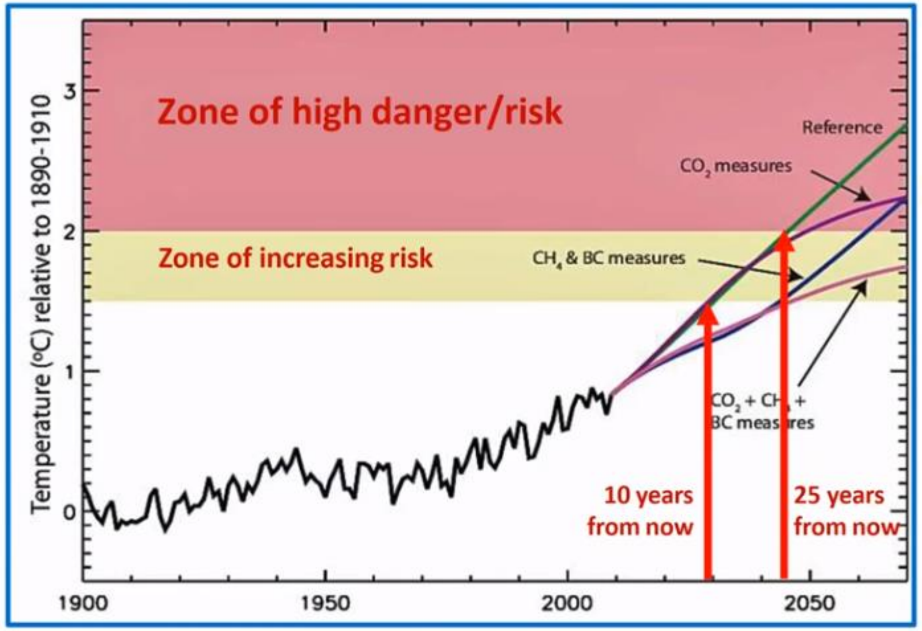
CLIMATE
- Climate Law
- Raising global ambition (2030)
- Clean energy and transport
- Taxation

ENVIRONMENT
- Zero Pollution
- Biodiversity
- Farm to Fork

ECONOMY
- European Semester / SDG
- Industrial Strategy
- Circular Economy
- Sustainable investment

Sustainable Europe

Methane reductions are critical; we cannot reach COP21 target with CO2 reductions alone



Shindell et al. 2012, *Science*

Energy is an attractive sector to reduce emissions

Holistic approach

- oil, gas, coal
- Venting, fugitives and flaring

Improving measurement is key

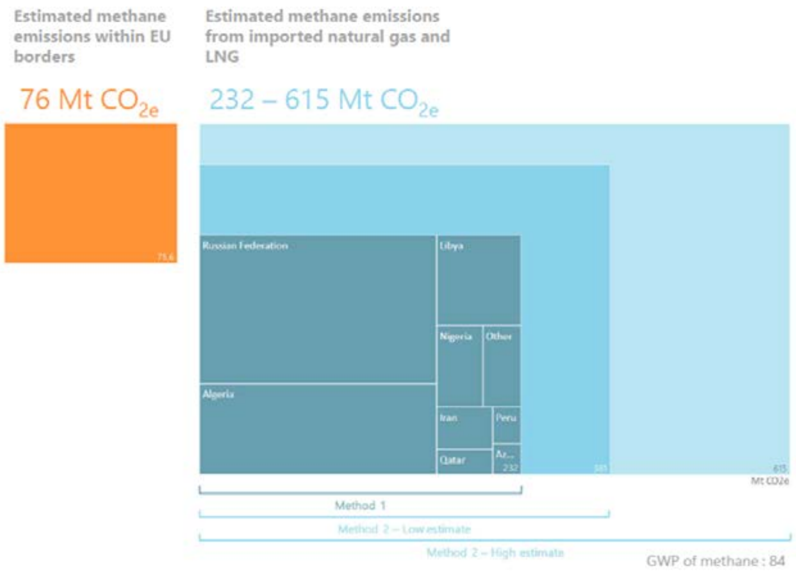
- In most EU countries, reporting CH4 emissions is a statistical exercise
- Inventories inherently underestimate emissions: no accidents or superemitters included

Focus on superemitters

- 50% of emissions come from 5% of sources

Global issue – global response:

- 75% of the emissions of the gas imported to the EU occur outside
- Handful of countries import most of the internationally traded gas



Source: carbon limits. GWP methane: 84

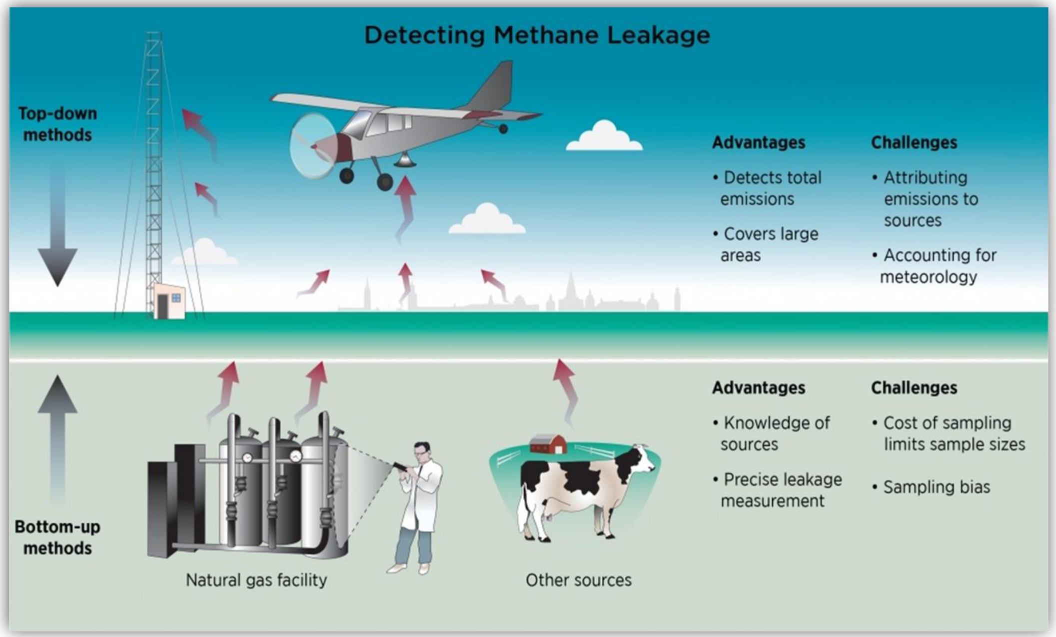
Holistic approach, so nothing escapes

Reduce methane emissions in the energy sector

Scope	Gas, oil, coal	Whole supply chain	Venting, fugitives, flaring, black carbon

Improving measurement is key

- Uncertainty of quantification and identification of sources
- Inventories inherently underestimate emissions
- Superemitters: 50% of emissions come from 5% of sources
- Combine top-down and bottom-up



Improving measurement is key

Reduce methane emissions in the energy sector

Scope

- Gas, oil, coal
- Whole supply chain
- Venting, fugitives, flaring, black carbon

Internal actions

- DG Energy study
- Identify hotspots, superemitters in the EU
- Copernicus for detection and verification
- Improve reporting (tier 3) – legislative proposal?

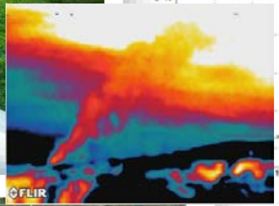
External actions

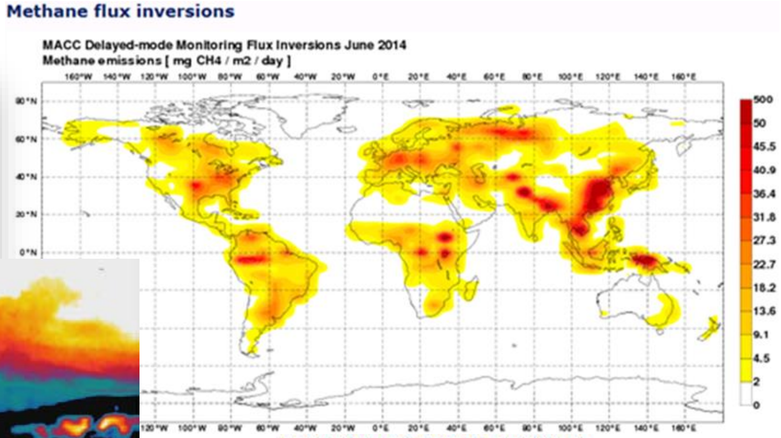
Cooperation under the UN CCAC
- Ambitious and transparent reporting
- Methane science studies

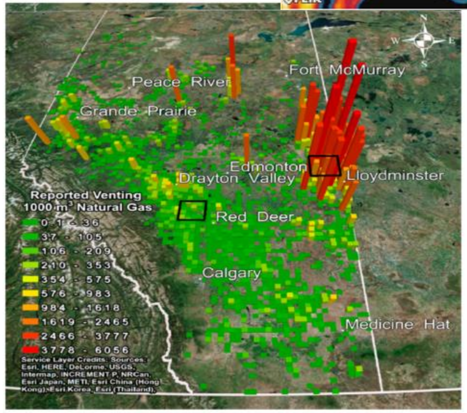
Global Gas Flaring Reduction (GGFR)
Energy diplomacy

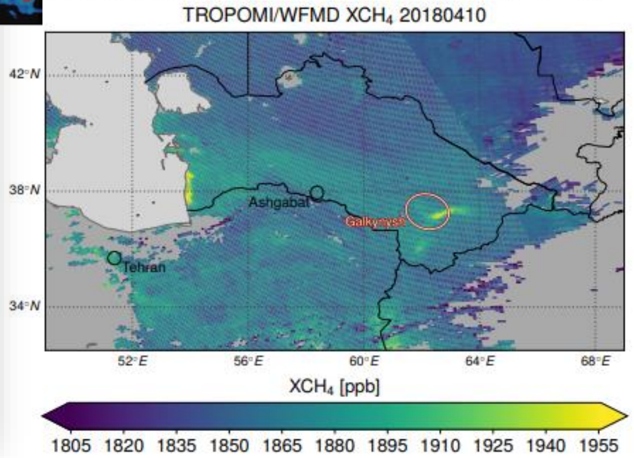
Measurement, reporting, verification

The role of technology and science









Measurement, reporting, verification

DG Energy study

Objectives:

- Perform CH_4 emission measurements in EU countries and Norway in all relevant energy sectors and supply chain elements where there is a gap in reliable data
- Develop a robust methane emission data and knowledge base
- Provide a basis to distinguish CH_4 emissions by source and propose the most effective scheduling of CH_4 emission reduction action by separate segment and any man-made supply chain
- Develop measurement techniques and a methodology
- Develop recommendations for an EU strategic plan on methane identifying policy measures or international cooperation

DG Energy study

Scope:

- CH_4 emissions include both deliberate (vented) and accidental (fugitive) emissions
- Relevant sectors: the whole gas supply chain and also CH_4 emissions associated with coal and oil production incl. abandoned/decommissioned wells, emissions accompanying flaring and venting practices, and also supply chain elements of renewable gases
- Gas value chain to cover drilling, production, processing, liquefaction, transmission, LNG shipping, regasification, storage, distribution and major end users (industry, transport)

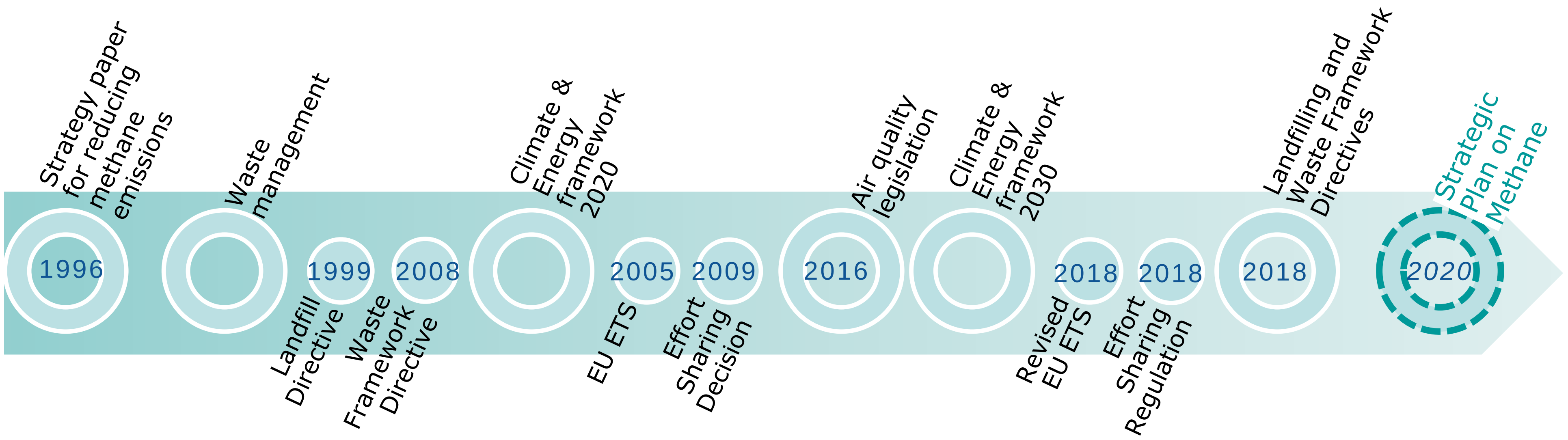
An EU methane strategy

"There will be an initiative in the field of methane and methane leakage, and Members of the European Parliament will be very closely involved in this strategy."

Kadri Simson, Energy Commissioner-designate

First methane strategy in 1996

Followed up by several legislative and non-legislative proposals in the area of waste, landfills, air quality and climate



European Commission

Thank you for your attention!

Methane emissions from oil and gas operations – where and how are they regulated?

Maria Olczak

Florence School of Regulation

Training session "Methane Emissions in the Gas Sector"
26 November 2019, Vienna

Florence School of Regulation - Energy

Delivers high-quality and relevant academic thinking on EU policy and regulation

Founded by:

Ignacio Pérez-Arriaga

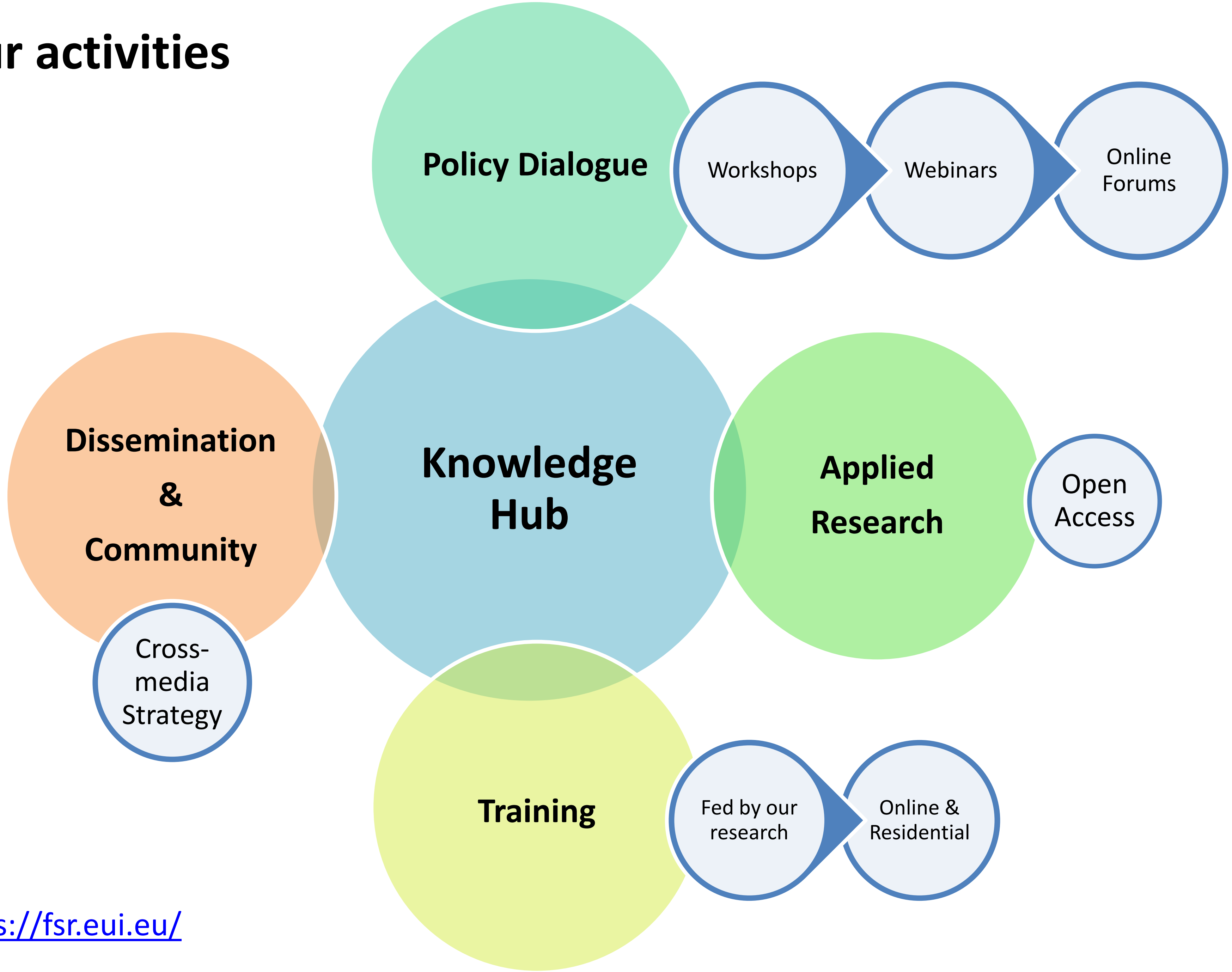
Pippo Ranci

Jorge Vasconcelos

Directed by:

Jean-Michel Glachant

Our activities



https://fsr.eui.eu/

Learning objectives

By the end of this presentation you will:

- know where are methane emissions from oil and gas (O&G) sector regulated
- understand different approaches to methane regulation
- be able to identify factors that influence the outcome of regulation based on case-studies

You will not:

- know what is the best way to regulate methane emissions (no silver bullet)

Presentation outline

1. Introduction

2. Regulations specific to O&G methane emissions by source category – examples from North America

3. Economic instruments that cover methane emissions (carbon tax/trading) – examples from Russia

4. Countries (jurisdictions) that do not have specific O&G methane emission measures – an EU example

European University Institute

ROBERT SCHUMAN CENTRE FOR ADVANCED STUDIES

FLORENCE SCHOOL OF REGULATION

PART 1: Introduction

Regulation is all around us

Technology

Facebook Scandal a 'Game Changer' in Data Privacy Regulation

By Stephanie Bodoni
April 8, 2018, 1:01 AM GMT+2 *Updated on Ap*

- U.K. privacy chief speaks about new rules coming int
- ICO is leading the European probe into Cambridge A

Cambridge Analytica scandal 'highlights need for AI regulation'

Lords report stresses need for artificial intelligence to be used for

The Guardian Essential Report
Data protection

@PeterLewisEMC
Wed 7 Aug 2019 03.18 BST

Facel

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Push for regulation comes amid backlasl

Camilla Hodgson in San Francisco and **Madhumita**

Facebook is calling for a new globa
ordered to overhaul the way it man
Cambridge Analytica scandal.

Up in smoke

Energy companies are divided over a plan to scrap methane-emission rules

The proposal is the latest effort by the Trump administration to unwind Obama-era environmental regulations

Alamy

Democracy in America ›
Sep 9th 2019 | by S.R.M.

of how

ulation
s ill prepared for next downturn
owers that were stripped away after the financial crisis
myFT

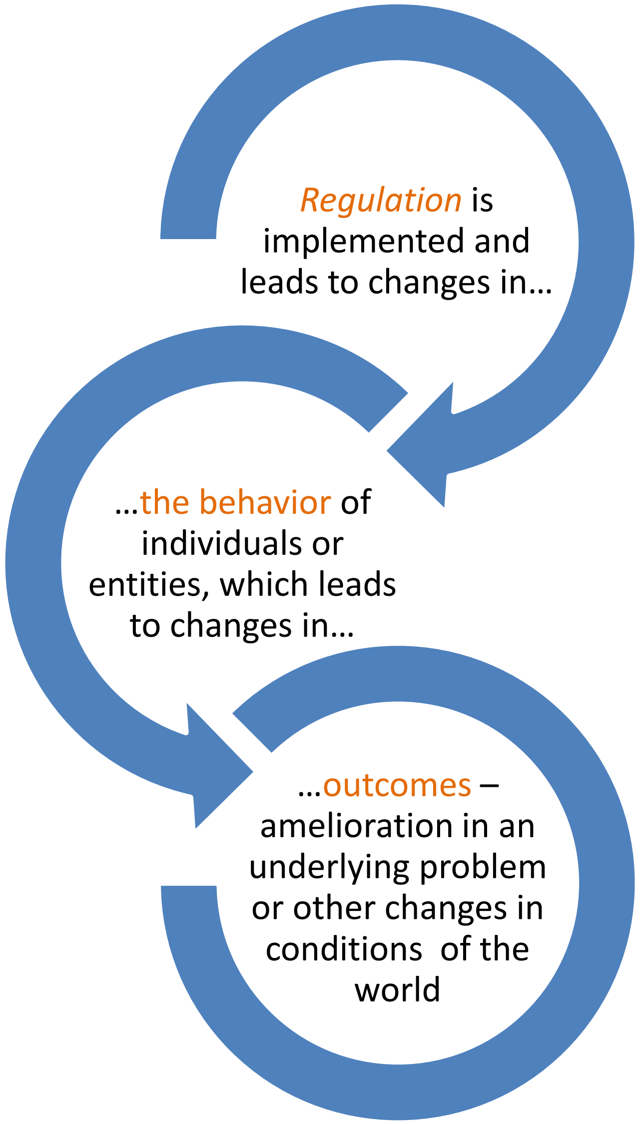
must be heeded to
elf-regulation
2017
& TACTICS | EXPERT GROUPS

tee on Emissions Measurements in
ts final inquiry report on the
s formed in 2015 after car maker
stematically cheated during emissions
testing. Its report highlights just how widespread emissions cheating has been
among manufacturers, and recommends action points for curbing excessive
car industry influence over emissions regulations.

EUI

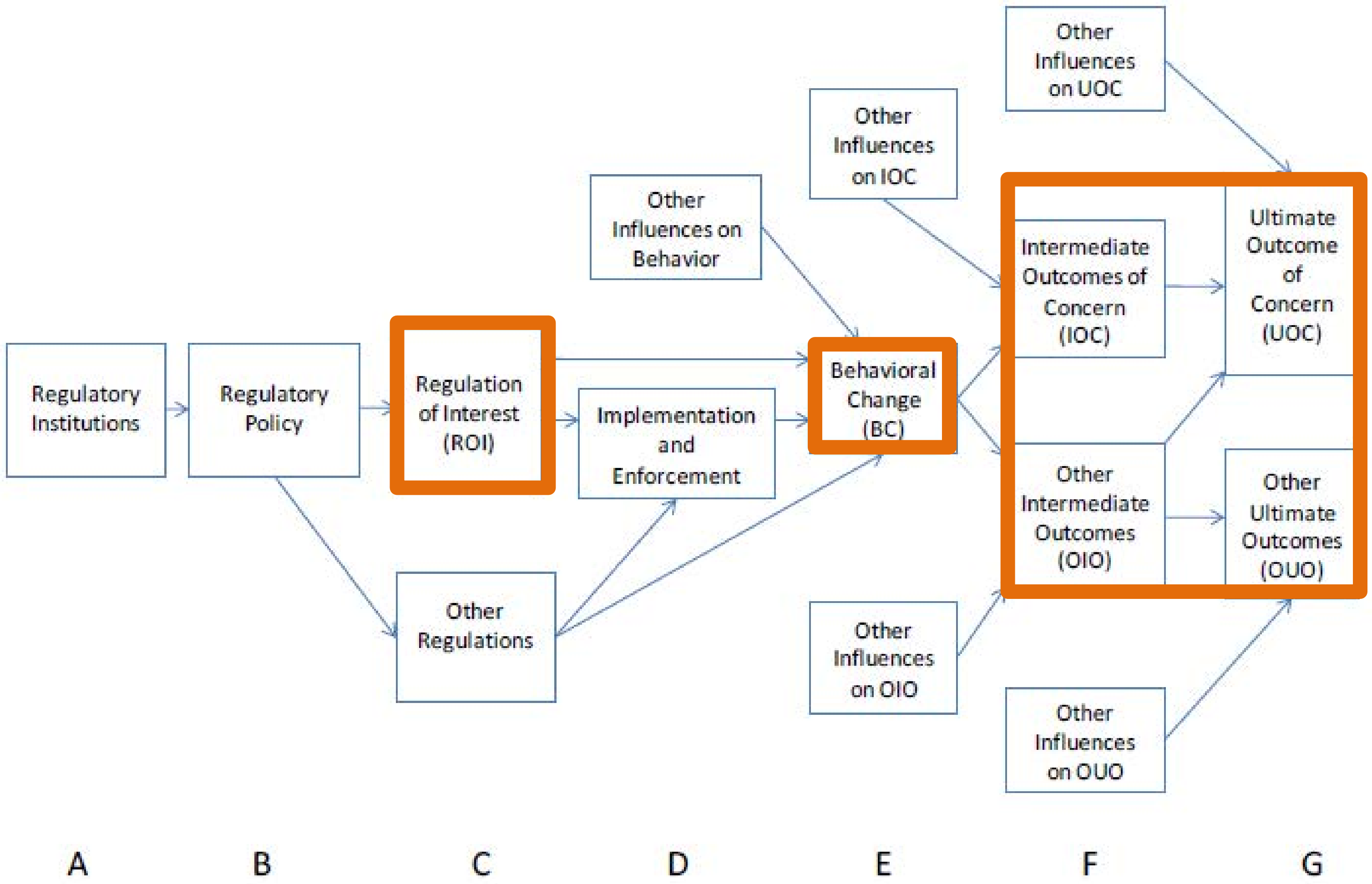
Regulation – the basics

- **OECD (2012):** Regulation is broadly defined as imposition of rules by government backed by the use of penalties that are intended specifically to modify the economic behaviour of individuals and firms in the private sector.
- **Koop et al. (2016):** Regulation **the intentional intervention in the activities of a target population**, where the intervention is typically direct – involving binding standard-setting, monitoring and sanctioning – and exercised by public-sector actors on the economic activities of private-sector actors.
- **Regulation** seeks to change **behaviour** in order to produce desired **outcomes**.
- Regulation "works", when it solves/reduces/ameliorates the problem that prompted the government to intervene



Source: OECD, 2012

Regulation and its effects



A causal map of regulation and its effects
Source: OECD, 2012

Quiz

What your opinion is the main reason why methane leaks should be regulated?

- Safety concerns
- Public health
- Environmental concerns
- Economic concerns
- Other reasons
- Methane leaks should not be regulated, the industry voluntary actions are sufficient

Why methane leaks should be regulated?

- Jaag, Trinkner (2011) need for sector-specific regulation due to:
  - Natural monopoly (high sunk costs and non-duplicable network)
  - Incomplete markets (externalities)
  - Market imperfections

Price Regulation and Environmental Externalities: Evidence from Methane Leaks

Catherine Hausman, Lucija Muehlenbachs

Abstract: We estimate expenditures by US natural gas distribution firms to reduce natural gas leaks. Reducing leaks averts commodity losses (valued at around $5/Mcf [thousand cubic feet]), but also climate damages ($27/Mcf) because the primary component of natural gas is methane, a potent greenhouse gas. In addition to this private/social wedge, incentives to abate are weakened by this industry's status as a regulated natural monopoly: current price regulations allow many distribution firms to pass the cost of any leaked gas on to their customers. Our estimates imply that too little is spent repairing leaks—we estimate expenditures substantially below $5/Mcf, that is, less than the commodity value of the leaked gas. In contrast, expenditures on accelerated pipeline replacement are in general higher than the combination of gas costs and climate benefits (we estimate expenditures ranging from $48/Mcf to $211/Mcf). We conclude by relating these findings to regulatory-induced incentives in the industry.

JEL Codes: D22, D42, L95, Q41

Keywords: natural gas, methane leaks, price regulation, utilities, pipelines, infrastructure

- Hausman, Muehlenbachs (2018) give an example from US local distribution:
  - o Natural gas distribution is a natural monopoly
  - o Price-regulation -> inefficiencies
  - o Distribution companies are reimbursed (in retail prices) for gas **bought** rather than **sold**
  - o Regulations are designed for the regulated company to recover its costs
  - o **Lost and unaccounted for gas**
  - o Distribution companies do no have motivation to invest in repairing leaks
  - o **SOLUTION:** incentive regulation

  - > reimburse utilities for the national average rate

Methane emission regulations – different approaches according to ERM:

- **Regulations specific to O&G methane emissions by source category**
  - Canada (and selected provinces)
  - Mexico
  - USA (and selected states)
- **Economic instruments that cover methane emissions (carbon tax/trading)**
  - Canada (including selected provinces)
  - Republic of Korea
  - Norway
  - Russia (emission fines)
- **Countries (jurisdictions) that do not have specific O&G methane emission measures**
  - Australia
  - European Union and UK
  - Japan

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PART 2: Regulations specific to O&G methane emissions by source category – examples from North America

Methane emissions policy and regulatory framework in North America

29 June 2016 – US, Canada and Mexico pledge to reduce their methane emissions from the O&G sector **by 40 to 45% from 2012 levels by 2025**

North American Leaders Summit in Ottawa, 29 June 2016
Source: U.S. Embassy & Consulates in Canada

6 Nov 2018 – Mexico published its methane regulations. North America becomes the first region with up-to-date regulations targeting methane emissions from the O&G sector

An overview (1/2)

ASPECT	US	CANADA	MEXICO
Paris Agreement GHG target (NDC)	-26 to 28% below 2005 levels by 2025	-30% below 2005 by 2030 • methane-specific target in O&G sector (40-45% reduction by 2025)	-22% below BAU unconditionally, up to -36% conditionally by 2030 -25% (GHG and SLCP) below BAU unconditionally and up to -40% conditionally
Methane reduction target	-40 to -45% below 2012 levels by 2025 from the oil and gas sector		
Key regulatory agency	US Environmental Protection Agency (EPA)	Environment and Climate Change Canada	Agency of Security, Energy and the Environment (esp. Agencia de Seguridad, Energía y Ambiente, ASEA)
Regulatory framework	**2012** New Source Performance Standards (VOCs) **2014** Strategy to reduce methane emissions **2016 New Source Performance Standards (VOCs and methane)** **2016** Bureau of Land Management venting and flaring rule **2019** regulatory rollback	**2016** Pan-Canadian Framework on Clean Growth and Climate Change **2018** The Greenhouse Gas Pollution Pricing Act **2018 Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)** entry into force: 1/01/2020; 1/01/2023	**2016** Mexico's Climate Change Mid-Century Strategy **2018 Provisions for the Prevention and Integral Control of Methane in the hydrocarbon sector** (Disposiciones Administrativas de carácter general que establecen los Lineamientos para la prevención y el control integral de las emisiones de metano del Sector Hidrocarburos) entry into force: 7/11/2018

An overview (2/2)

Scope of regulation	• Hydraulically fractured wells and other activities in oil and gas production, processing, transmission and storage • **ONLY** new, reconstructed and modified sources (after 18 September 2015) • onshore and offshore	• Upstream oil and gas facilities including well sites, processing plants and compressor stations • existing and new facilities • onshore and offshore	Facilities in which the following activities are performed: • exploration and extraction of hydrocarbons • treatment, refining, storage of oil • processing, compression, liquefaction, decompression, regasification, transmission and distribution • existing and new facilities • onshore and offshore
Leak Detection and Repair (LDAR) programs	• 2 times per year: well sites • 4 times per year: gathering & boosting and transmission compressor stations • standard repair time: 30 days	• 3 times per year • standard repair time: 30 days	• 4 times per year • standard repair time: 24h, 3 calendar days or 15 calendar days depending on the emissions threshold

Key identified sources of emissions	• Compressors (excl. those located at well sites)
	• Pneumatic devices
	• Well completions
	• Fugitive emissions
	    o From well sites and compressor stations
	    o Equipment leaks at NG processing plants
		• Venting from compressors
		• Venting from pneumatic devices
		• Venting from well completions involving hydraulic fracturing
		• Facility production venting
		• Fugitive leaks
			Regulated methane sources:
			• equipment
			• well operations
			• leaks
			
			ME categories:
			• emissions from destruction equipment (flaring)
			• leaks from equipment or operations
			• venting

USA

May 2016: New Source Performance Standard and Draft Information Collection Request (ICR)

- Covers additional sources: hydraulically fractured oil wells; pneumatic pumps at well sites and gas processing plants
- Sets emissions limits for methane (see an example below)
- LDAR (Leak Detection and Repair): at well sites (2/yr); and gathering &boosting and transmission compressor stations (4/yr)

SOURCE	SOURCE SUB-CATHEGORY	FINAL STANDARDS OF PERFORMANCE FOR GHGs AND VOC
Compressors (excl. those located at well sites)	Wet seal centrifugal compressors	95% reduction
	Reciprocating compressors	The rod packing replacement on or before 26,000 hrs of operation or 36 calendar months or route emissions from the rod packing to a process through a closed vent system under negative pressure.
Pneumatic devices	Pneumatic controllers/pumps at NG processing plants	Zero natural gas (NG) bleed rate
	Pneumatic controllers at locations other than NG processing plants	NG bleed rate ≤ 6 standard cubic feet per hour (scfh)
	Pneumatic pumps at well sites	95% control if existing control or process on site. Not required if routed to an existing control or if technically infeasible. Limited-use pneumatic pumps – those that operate for less than 90 days per year – are exempt from the requirements.

Source: EPA, 2016

Canada

	Emission Source	Requirements
Applicable to the facilities handling > 60 000m3	**Fugitive (leaks)**	• Implementation of a leak detection and repair (LDAR) program to stop natural gas leaks • Inspections for leaks three times per year • Corrective action when leaks are found • Date of implementation: January 1, 2020
Applicable to the facilities handling > 60 000m3	**General facility production venting**	• Venting limit of 1,250 m^3 of natural gas per month (15,000 m^3 per year) • Conservation of natural gas for re-use on site or for sale, or flaring / clean incineration of natural gas • Date of implementation: January 1, 2023
Applicable to the facilities handling > 60 000m3	**Venting from pneumatic devices**[1]	• Venting limit of 0.17 m^3 of natural gas per hour for pneumatic controllers • Conservation of natural gas for re-use on site or for sale, or replacement with non-emitting or low-bleed pneumatic device • Date of implementation: January 1, 2023
Applicable to all facilities	**Venting from compressors**[2]	• Annual measurements of emissions of natural gas from compressor vents • Corrective action when emissions are higher than the applicable limit • Date of implementation: January 1, 2020
Applicable to all facilities *except British Columbia and Alberta	**Venting from well completions involving hydraulic fracturing**[3]	• No venting • Conservation of natural gas for re-use on site or for sale, or flaring / clean incineration of natural gas • Date of implementation: January 1, 2020

Source: Government of Canada, 2018

Mexico

- Prevention and control regulation based on the annual assessment, prevention and control plans prepared by the regulated companies (PPCIEMs)
- PPCIEM:
  - **Step 1:** Assess (identify, classify and quantify) emissions
  - **Step 2:** Create PPCIEM (base year emissions, target, annual control and prevention actions, best practices/LDAR programmes) and submit it to ASEA
  - **Step 3: Continuous improvement:**
    - Internal evaluation (at least 1/yr)
    - Annual Compliance Report (quantification)
    - External audit (ACR will be evaluated by a 3rd Party) and submitted to ASEA

USA – regulatory rollback

- The Trump Administration has initiated the process of regulatory rollback.
- On **August 28, 2019**, the U.S. Environmental Protection Agency (EPA) signed proposed amendments to the 2012 and 2016 New Source Performance Standards (NSPS) for the Oil and Natural Gas Industry.
- EPA is organising **a series of public hearings** and will continue to collect comments **until the 25th of November 2019**.
- The proposal is expected to most impact **production from marginal US wells** (10% of US O&G output)

- EPA proposes:
  - **Removing some sources** (transmission compressor stations, pneumatic controllers, and underground storage vessels) **from federal regulation**
  - **Revoking methane limits from the production and processing** segments of the O&G and maintain emissions limits for Volatile Organic Compounds (VOCs)
  - **Alternatively:** revoking methane limits, but keeping transmission and storage sources regulated

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PART 3: Economic instruments that cover methane emissions (carbon tax/trading) – examples from Russia

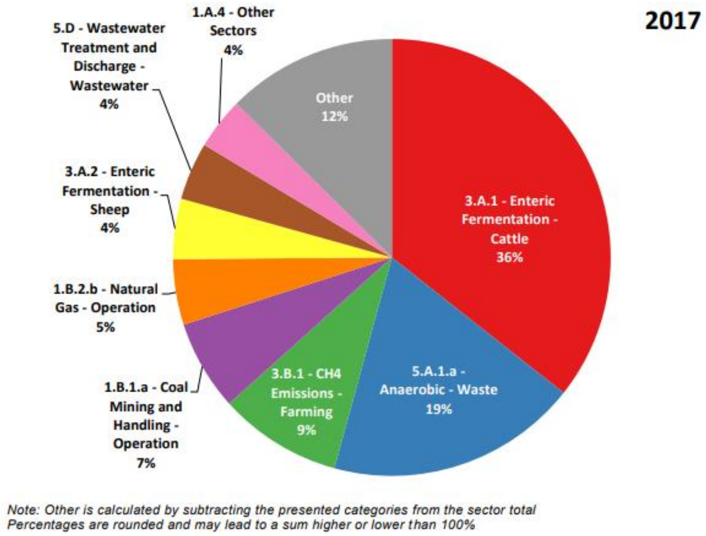
Environmental charge system in Russia

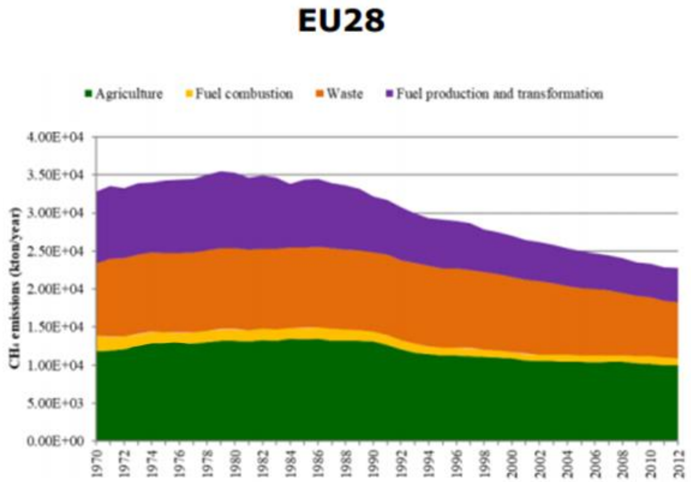
- Economy-wide environmental charges/fines for methane emissions and other pollutants (introduced 1990s, revised 2016)
  - Per a tonne of emissions - 108 rubles (~1.7 USD)
  - Additional charges can apply to flaring
  - 95% of associated gas must be used
- Natural resources tax
  - Gas is property of state, tax on extraction of state resource

PART 4: Countries (jurisdictions) that do not have specific O&G methane emission measures – an EU example

Methane emissions in Europe

- Europe's contribution to global methane emissions ≈6%
- Methane emissions account for 11% of total reported EU GHG emissions. Agriculture, waste and energy are the major sources.
- Between 1990 and 2017 methane emissions declined by 37%, partly thanks to the first methane strategy adopted in 1996.
- This trend continues, but the pace of decline is less pronounced.





Methane emissions in the EU
Source: EEA (2019), R. Dingenen et al. (2018)

The 1996 EU Methane Strategy. Not a complete success

	AGRICULTURE	WASTE	ENERGY
Actions proposed by the 1996 Strategy paper for reducing methane emissions	**Enteric fermentation:** Promotion of research and incentives to elaborate policy tools (EU and national level)	**General measures:** Promotion of measures aimed at minimising organic waste generation and recycling (All levels – EU, national, regional and local)	**Mining:** Encourage application of best available recovery techniques in coal mines (EU and national level)
	Animal manure: Use of anaerobic digesters or covered lagoons (with energy use or flaring) in 2 steps: 1st step: demonstration (all lev-els – EU, national, regional and local) 2nd step: obligation (EU level)	**Landfill gas recovery at existing and new land-fills:** EU legislation **Energy production from land-fill gas:** Incentives (EU and national level)	**Gas pipeline leakage:** Set minimum leakage standard at EU level; Increase control frequency of pipelines at national level
Expected CH4 reductions by sector (1990-2005) and (1990-2010)	-24% (2005) -34% (2010)	-45% (2005) -60% (2010)	-24% (2005) -34% (2010)
Reductions achieved by the in EU-15, percentage change (1990-2010)	**Total: -20%** Enteric fermentation (cattle, sheep): -12% Manure management: -0.2%	**Total: -33%** Managed waste disposal on land: -42% Wastewater handling:-20%	**Total: -54%** Coal mining: -86% Natural gas: -28%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Issue 2018/22
April 2019

POLICY BRIEF

FSR ENERGY
Florence School of Regulation

How far Should the new EU Methane Strategy go?

By Maria Olczak and Andris Piebalgs, Florence School of Regulation

Highlights

- The decarbonisation of the EU economy requires immediate action to avoid methane emissions. Methane is a potent greenhouse gas (GHG), but if captured, it provides economic value to energy production.
- The EU efforts to decarbonize its energy system have so far mostly been concentrated on CO2 emissions mitigation. The Regulation (EU) 2018/1999 on the Governance of the Energy Union requires the European Commission to propose the EU strategic plan for methane, which will become an integral part of the EU long-term climate strategy.
- Methane emissions accounted for 11% of total EU GHG emissions in 2016 with agriculture, waste and energy sectors as the major sources. Since the mid-1990s methane emissions have been decreasing, partly due to the adoption of the first EU methane strategy published in 1996. However, the 1996 strategy was not a complete success, since it failed to bring about the expected level of emission cuts.
- Based on the analysis of lessons learned, the authors propose that the new EU methane strategy should adopt a new approach based on:
  - a more transparent framework at international, EU and national levels;
  - better coordination of policy measures targeting emissions in agriculture, waste and energy sectors, given that captured methane is a source of energy;
  - setting a EU methane intensity target, which could be included in the revised EU climate pledge – Nationally Determined Contribution – which needs to be submitted by 2025;
  - cooperation with key EU gas suppliers to obtain accurate estimates of gas industry emissions across the entire gas supply chain. It is important that these data are aggregated not only at a corporate, but also a national level to ensure that national policies and regulations are based on accurate methane estimates.

fsr.eui.eu

The change in EU-15 methane emissions 1990-2010 – own elaboration
Data source: Annual EU GHG inventory 1990-2010 and inventory report 2012.

2013 Clean Air Policy Package

- Revision of the National Emission Ceilings Directive (NEC Directive)
- The EC proposed a **EU-wide 33% methane reduction target for 2030**, compared to level of emissions in 2005, with different **national targets ranging between -53% in Bulgaria to -7% in Ireland**.
- The methane target proposal has been rejected by the Council.

Non-paper on the methane reduction commitments in the proposed NECD revision

Rationale

Methane is both a potent greenhouse gas as well as an ozone precursor (also known as a short-lived climate pollutant). It has an atmospheric residence time of about 12 years and therefore has air quality impacts on the hemispheric and global scale and is a major reason for high levels of background and tropospheric ozone in the northern Hemisphere. These background levels have increased by about a factor of three over the last 50 years in the northern hemisphere and are currently close to levels that damage human health and the environment (mainly vegetation).

The levels of background and tropospheric ozone can only be reduced by significant reductions of methane (and also nitrogen oxides) emissions within the entire northern hemisphere. Benefits of emission reductions will be small but significant in the EU, but also on the hemispheric scale.

Currently the emissions of methane are regulated by a few EU directives (*e.g.* on landfills) and indirectly through the Effort Sharing Decision (that includes the Kyoto basket of pollutants). There is however a large margin to implement measures (in the EU and elsewhere) at no cost and even at "negative cost" (*i.e.* measures where the benefits of methane recovery outweigh the cost).

A specific commitment for the EU and its MSs on methane emissions would be a stepping stone for the EU to address global methane emissions and hence background ozone levels as well as short-lived climate pollutants at the international level.

Objectives and Reduction Commitments of the National Emission Ceilings Directive (NERC)

The objective of the methane NERC is to provide a first step towards international work on methane emission reductions.

The tabled NERCs include only measures that are at zero or negative costs assuming a commercial discount rate on revenue of 10%. The principal measures are farm scale anaerobic digestion (mainly pig farms), anaerobic digestion of waste in the food industry, improved biogas recovery from solid waste and wastewater plants, improved control of gas leaks in gas distribution and gas recovery during oil and coal production.

The overall effects of implementing these measures are cost saving in the range of €2.4 to 4 billion, depending on the level of technological progress up to 2030.

The breakdown of measures and costs by MSs will be provided on the review website shortly: http://ec.europa.eu/environment/air/pdf/review/GAINS_CH4zerocost_targets_2014.pdf

Methane emissions under Effort Sharing

	EU EMISSIONS TRADING SYSTEM (EU ETS) (2013-2020)	EFFORT SHARING DECISION (2013-2020)	EFFORT SHARING REGULATION (2021-2030)
EMISSIONS COVERED	40-45% of total EU GHG emissions	around 60% of total EU GHG emissions	around 60% of total EU GHG emissions
SECTORS COVERED	• power and heat generation • energy-intensive industry • domestic aviation	• transport (except aviation) • buildings • non-ETS industry • agriculture (except forestry) • waste	• transport (except aviation and shipping) • buildings • non-ETS industry • agriculture (except forestry) • waste
REDUCTION OBJECTIVE	-21% compared with 2005 levels by 2020	-9% compared to 2005 levels by 2020	-30% compared to 2005 levels by 2030
HOW?	EU-wide cap-and-trade system	binding annual targets for 2013-2020 period (from -20% to +20%) MSs to choose policies and measures	binding annual targets for 2021-2030 period (from 0% to -40%) Mix of national and EU-level measures

Own elaboration based on EEA, 2019

Thank you for your attention

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LUNCH BREAK

marcogaz

gie

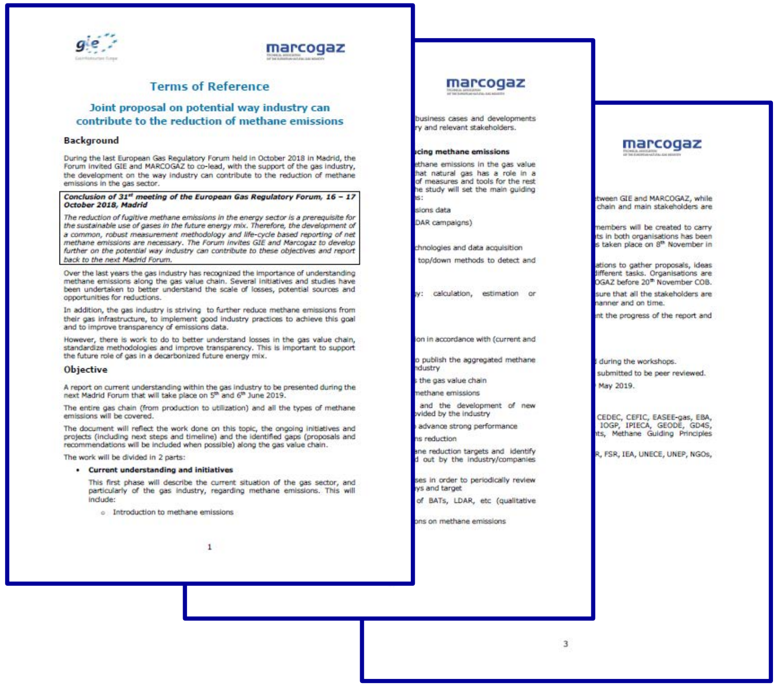
Energy Community

Report “Potential ways the gas industry can contribute to the reduction of methane emissions” and the European scenario

Francisco DE LA FLOR
Jos DEHAESELEER

Organisation of the project

Terms of Reference



Terms of Reference

Joint proposal on potential way industry can contribute to the reduction of methane emissions

Background

During the last European Gas Regulatory Forum held in October 2018 in Madrid, the Forum invited GIE and MARCOGAZ to co-lead, with the support of the gas industry, the development on the way industry can contribute to the reduction of methane emissions in the gas sector.

Conclusion of 31st meeting of the European Gas Regulatory Forum, 16 – 17 October 2018, Madrid

The reduction of fugitive methane emissions in the energy sector is a prerequisite for the sustainable use of gases in the future energy mix. Therefore, the development of a common, robust measurement methodology and life-cycle based reporting of net methane emissions are necessary. The Forum invites GIE and Marcogaz to develop further on the potential way industry can contribute to these objectives and report back to the next Madrid Forum.

Over the last years the gas industry has recognized the importance of understanding methane emissions along the gas value chain. Several initiatives and studies have been undertaken to better understand the scale of losses, potential sources and opportunities for reductions.

In addition, the gas industry is striving to further reduce methane emissions from their gas infrastructure, to implement good industry practices to achieve this goal and to improve transparency of emissions data.

However, there is work to do to better understand losses in the gas value chain, standardize methodologies and improve transparency. This is important to support the future role of gas in a decarbonized future energy mix.

Objective

A report on current understanding within the gas industry to be presented during the next Madrid Forum that will take place on 5th and 6th June 2019.

The entire gas chain (from production to utilization) and all the types of methane emissions will be covered.

The document will reflect the work done on this topic, the ongoing initiatives and projects (including next steps and timeline) and the identified gaps (proposals and recommendations will be included when possible) along the gas value chain.

The work will be divided in 2 parts:

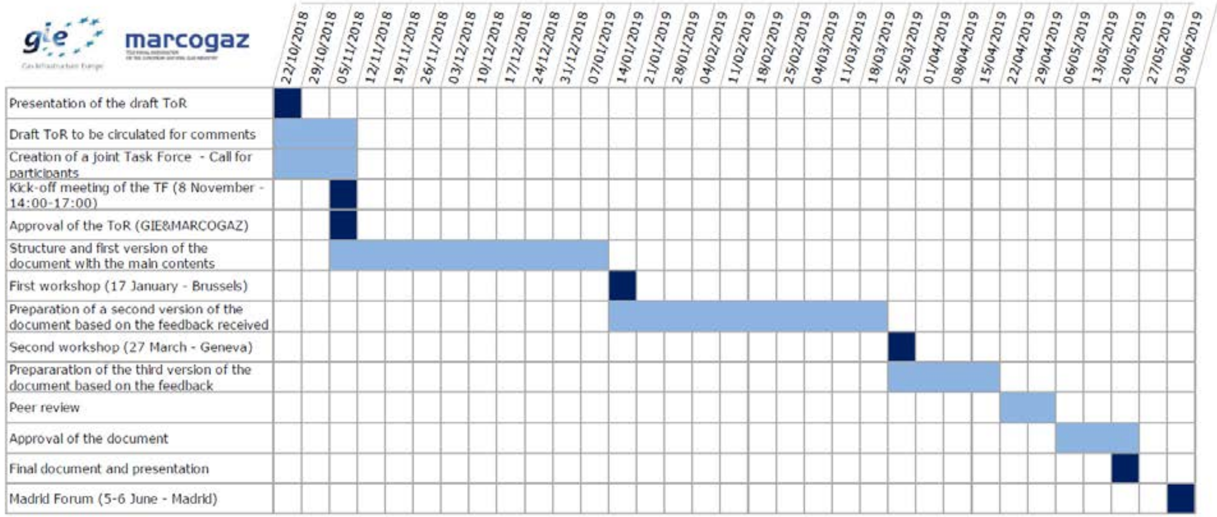
- **Current understanding and initiatives**

  This first phase will describe the current situation of the gas sector, and particularly of the gas industry, regarding methane emissions. This will include:

  - Introduction to methane emissions

1

Project plan



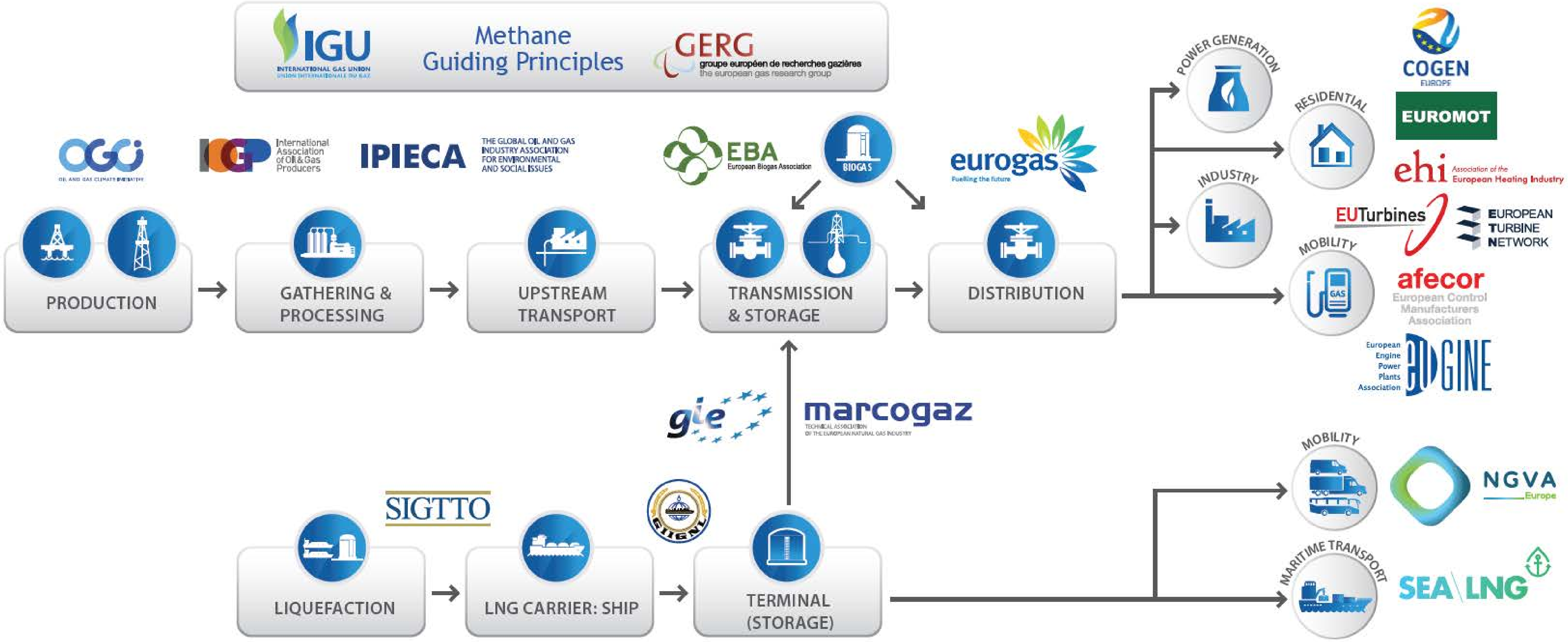
Peer review panel

1st WS (Brussels) - Almost 50 participants representing 37 organizations covering the entire gas chain, from production to utilization, the EC and NGOs

2nd WS (Geneva) – More than 90 participants representing gas industry, the EC, international institutions, NGOs and academics. Representatives from Third Countries

Contributions from representatives of the entire gas chain

From production to utilisation, including biomethane plants



Questions raised by the EC

Q1 - What is the current status of CH_4 emissions in the gas sector in the EU?

Q2 - What did the gas industry do until now?

Q3 - What are the ongoing initiatives and future commitments of the gas industry to further reduce CH_4 emissions?

Q4 - What are the identified challenges and future actions?

The role of the industry in reducing methane emissions

Reflecting

- Situation in Europe
- Work achieved
- Ongoing initiatives, projects, next steps
- Challenges and gaps Identified

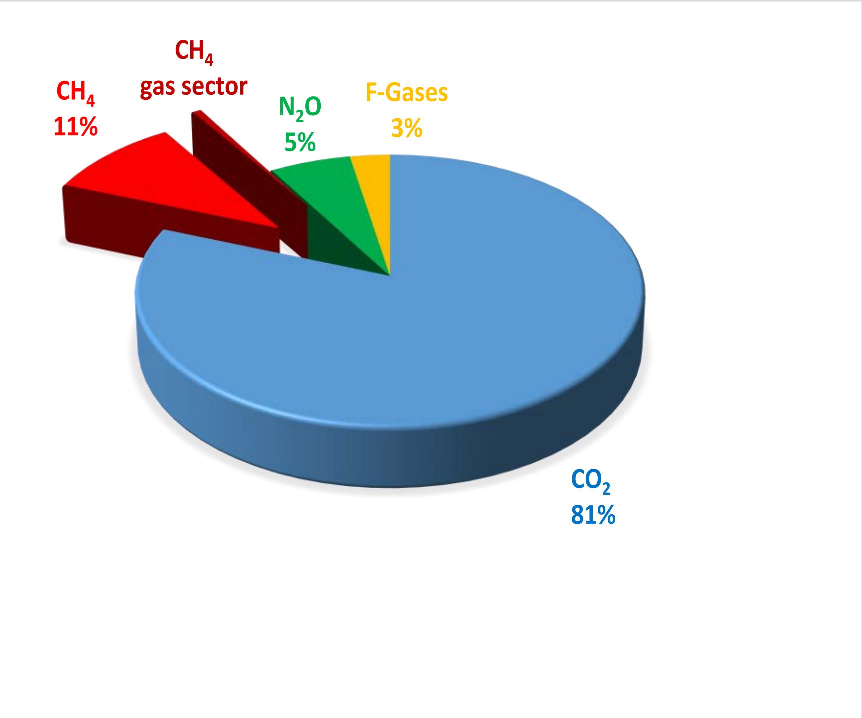
Covering

- Entire gas value chain
- All methane emissions

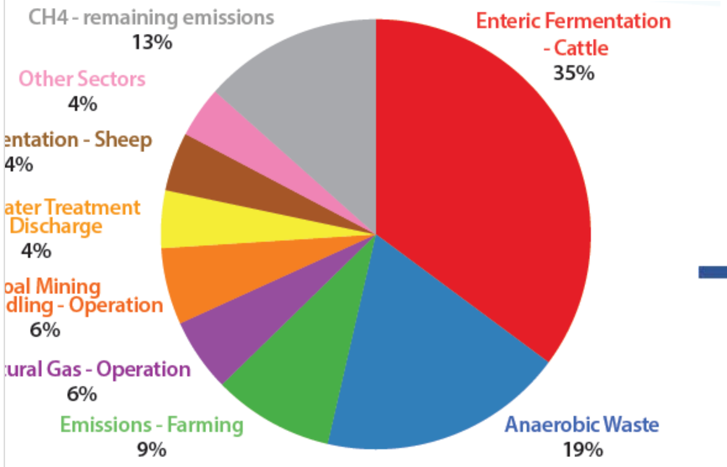
Link to the report: https://www.gie.eu/index.php/gie-publications/methane-emission-report-2019

Current status of EU CH_4 emissions (data 2016)

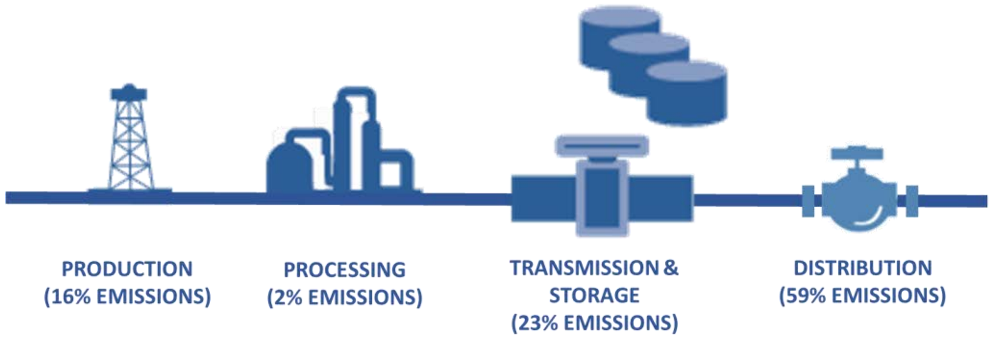
Total EU GHG emissions (in CO_{2-eq})



CH_4 emissions per source



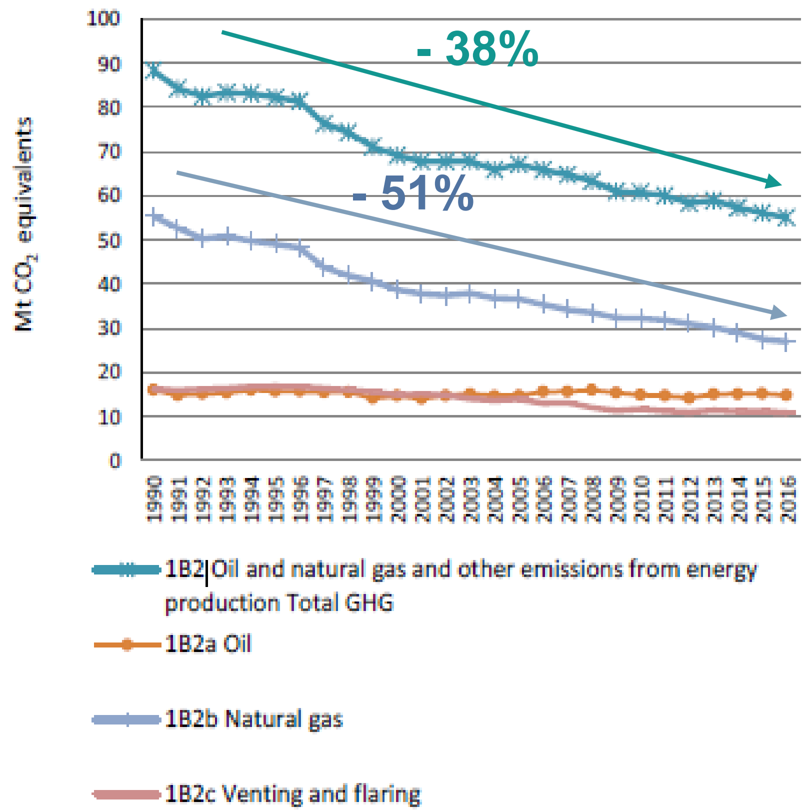
CH_4 emissions from EU natural gas operations



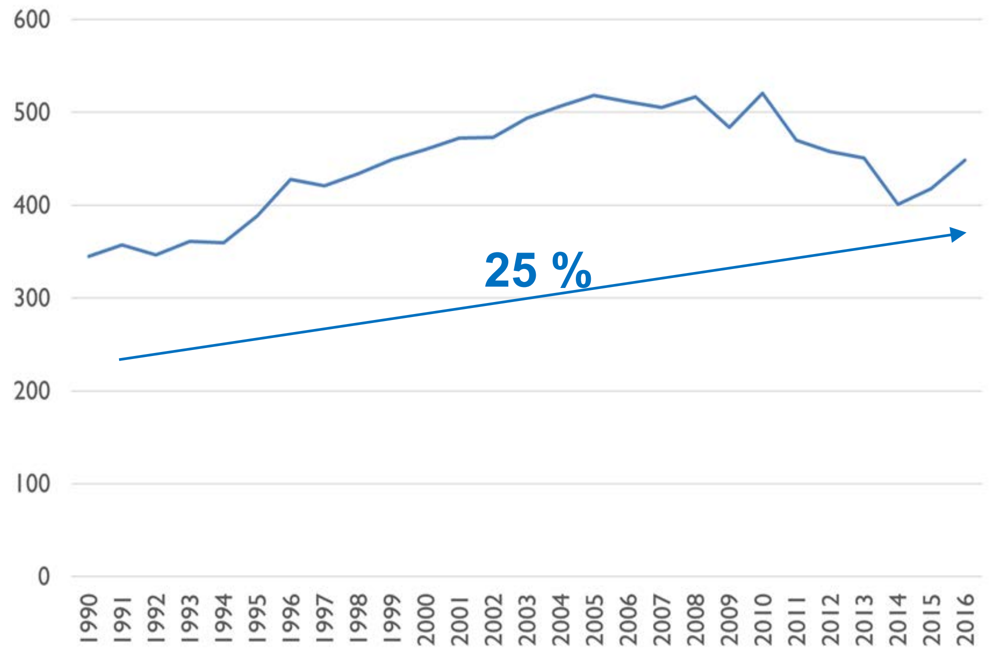
Source: Elaborated by the authors based on European European Environment Agency GHG report

Emissions in the gas sector

Emissions data trend 1B2 (oil&gas) in the EU (Mt CO_{2e})



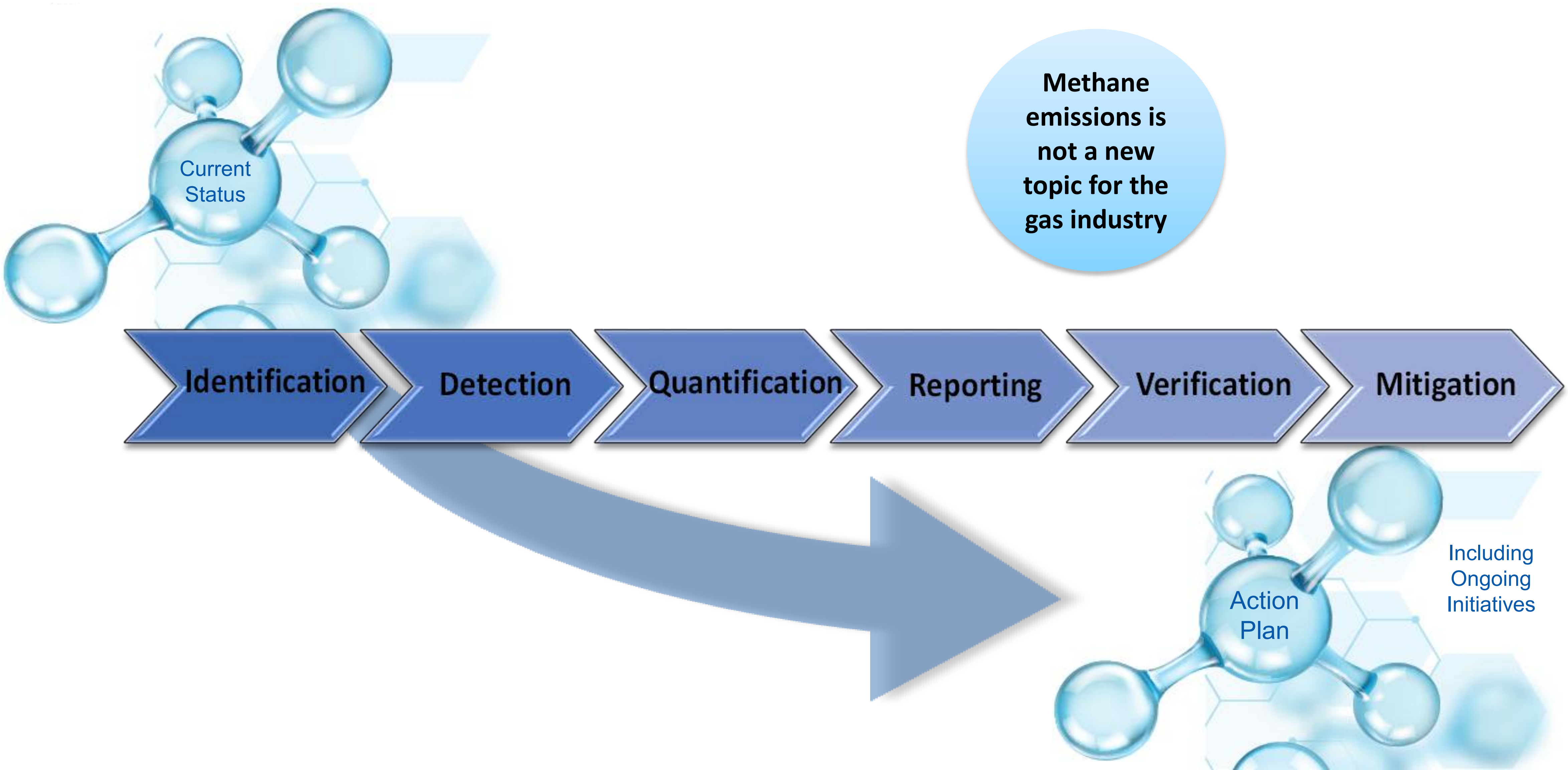
EU gas consumption (bcm)



Source: Data from EEA - Annual EU GHG inventory 1990–2016 and inventory report 2018

Report – Contents

Actions undertaken to reduce methane emissions



Actions undertaken to reduce methane emissions

Tools and technologies

Continuous progress

Innovation

BATs

Collaborative Initiatives

Reduction targets

Summary of existing activities

Production, transmission, LNG terminals, UGS and distribution	Type of emission		
	Fugitive	Venting	Incomplete combustion
Identification / Detection	LDAR-type programs involving use of IR cameras, sniffers, etc.	Equipment/process mapping	Equipment/process mapping
Quantification	Measured, calculated and/or modelled	Measured, calculated and/or modelled	Calculated and/or modelled
Mitigation	LDAR programs	Implementation of BAT	
Reporting	- Sustainability and carbon footprint reports (based on company inventories) - National Inventory Reports (to national authorities) - Partnership and associations methodologies (e.g. CCAC OGMP, OGCI, IOGP, IPIECA, MARCOGAZ) - Reporting initiatives (e.g. CDP, EDF)		
Validation / Verification	According to GHG Protocol, EN 15446, ISO 14064, ISO 14001, ISO 50001, ISAE 3000. Verification of emissions often done by a third party		

- ✓ The systematic approach to identify, detect, quantify, report and verify emissions is essential to close the current knowledge gap and enable gas industry to prioritise and allocate capital and human resources to efficiently target methane emissions at the lowest abatement cost.

After the report - Action plan

Dissemination activities and **training programmes** organise between GIE and MARCOGAZ based on the report

Brochure already published

Dissemination activities:

- ✓ Madrid Forum
- ✓ IGU Committees
- ✓ GasNaturally WS
- ✓ EGATEC 2019
- ✓ First training programme (Vienna)
- ✓ …

After the report - Action plan

AROUND 60 MAIN ACTIONS

Identification → Detection → Quantification → Reporting → Verification → Mitigation

Awareness

Challenges and gaps	Actions (timing)
Awareness and knowledge on the methane emissions topic	- Educational toolkit under development by Methane Guiding Principles *(by the end of 2019)* - Educational Outreach Programme under development by Methane Guiding Principles *(by the end of 2019)* - OGCI outreach to national oil & gas companies (NOCs) on BAT implementation with *(ongoing)* - OGCI engagement in downstream activities *(ongoing)* - Organisation of workshops for EU gas industry to share information on the main findings of the (present) GIE and MARCOGAZ report, ensuring involvement of all EU countries and utilisation *(end of 2019 / beginning 2020)* - IPIECA Methane mapping tool *(2019)*
Fragmented initiatives along the gas value chain	- Gas operators seeking guidance to address methane emission reduction and urge the associations to take an active role in the global initiatives *(ongoing)*
Aggregation of methane emission data along the EU gas value chain	- EU gas associations to work jointly on a proposal, including units *(TBD[10])*
Proper allocation of methane emissions to oil & gas chains	- Oil & gas producers to explore possible methodologies related to the allocation of methane emissions *(TBD)*
Harmonised definitions along the EU gas value chain	- EU gas associations to collaborate based on the IPIECA Glossary *(TBD)*

Standardisation & Measurement

Challenges and gaps		Actions (timing)
Reporting	Harmonised reporting	- Methane common reporting template developed by Methane Guiding Principles (2019-2020) - European voluntary system for control of methane emissions will be developed by EBA *(TBD)*
	Improve accuracy and transparency of national inventories	- Coordination between the gas industry and national authorities to improve quality of data. NIR should be based on Tier 3 approach for the entire gas chain in the future. *(TBD)*
	Improvement of harmonised quantification methodologies and gathering measured data	- CCAC Methane Science Studies, in collaboration with UNECE, EDF and OGCI *(ongoing)* - MARCOGAZ pre-standard for transmission and distribution related to identification and quantification *(2019)*
	Reconciliation of bottom-up and top-down approaches	- Collaboration between NGOs, industry and academia will lead to further reduction of uncertainty between methodologies (some ongoing CCAC Methane Science Studies, but more work in this area is required) *(TBD)*
	Improvement of companies' inventory data	- Verification and validation of emissions according to reference standards *(TBD)*
	Knowledge and data on utilisation	- Ongoing projects *(2019 & 2020)*

Challenges and gaps		Actions (timing)
Mitigation	Limited financial and economic incentives (in some cases) to put in place mitigation measures	- Gas industry to do cost/benefit analysis - Incentives from Authorities
	Establishment of methane emission reduction targets at company level	- Gas companies, who don't have it yet, to consider the establishment of reduction targets
	Employees engagement on methane emission reduction	- Once gas companies establish reduction targets, to evaluate the possibility to set up performance remuneration for the employees
	Dissemination of BAT information	- Analysis of the most efficient BATs - Gas industry to take part of the outreach programmes and participate in GIE and MARCOGAZ workshops
	Innovation on technologies	- OGCI (Climate Investments) initiative "Towards zero methane emissions"
Missing cross sectorial opportunities and exchange of views (i.e. innovative technologies, BATs) aimed at the reduction of methane emissions		- Creation of an industry/cross-sectorial Forum/Platform bringing together different EU sectors responsible for methane emissions and representatives of non-EU companies/organisations.
Methane emissions data of natural gas imports		- Enhance the collaboration with non-EU companies (suppliers)
Potential overlapping with existing EU and national regulation on methane emissions		- Analysis of EU and national regulation, including its impact (gas industry to support this action). *(TBD)*

Mitigation & Reporting

Methane emissions
National inventories and industry initiatives

Luciano OCCHIO

Content

- Introduction
- GHG Inventories
- Gas Industry reporting
- Conclusion, Next steps

Do we have a transparency problem?

The gas sector is accused for a lack of transparency in the reporting of methane emissions. The reason for this may have its origin that only overall numbers are published and that this numbers give no insight in the underlying data.

Further aspects that may play a role:

- several reporting standard cover very specific parts of the gas value chain,
- reporting standards are free to follow and there are no regulatory aspects.

This makes: reporting of the gas industry value chain is difficult to interpret and there can be large differences from country to country in the EU28.

Regulatory requirements to report methane emissions

According to Article 12 of the United Nations Framework Convention on Climate Change (UNFCCC) members are required to create "a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases"

Although the framework for reporting is fixed by the UNFCCC, the method of emission estimation can differ from country to country, and even between several data providers within one country, as long as this method can be scientifically justified

GHG Inventories

- ✓ The quality of GHG inventories relies on the integrity of the methodologies used, the completeness of reporting and the procedures for compilation of data.

- ✓ The Conference of the Parties (COP) has developed standardized requirements for reporting national inventories, covering emissions and removals of direct GHGs such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) from five sectors, including energy and industrial processes.

- ✓ Data are referred to all years from the base year to two years before the inventory is due (e.g. the inventories 2018 cover emissions for all years from the base year to 2016).

GHG Inventories – Tier approach

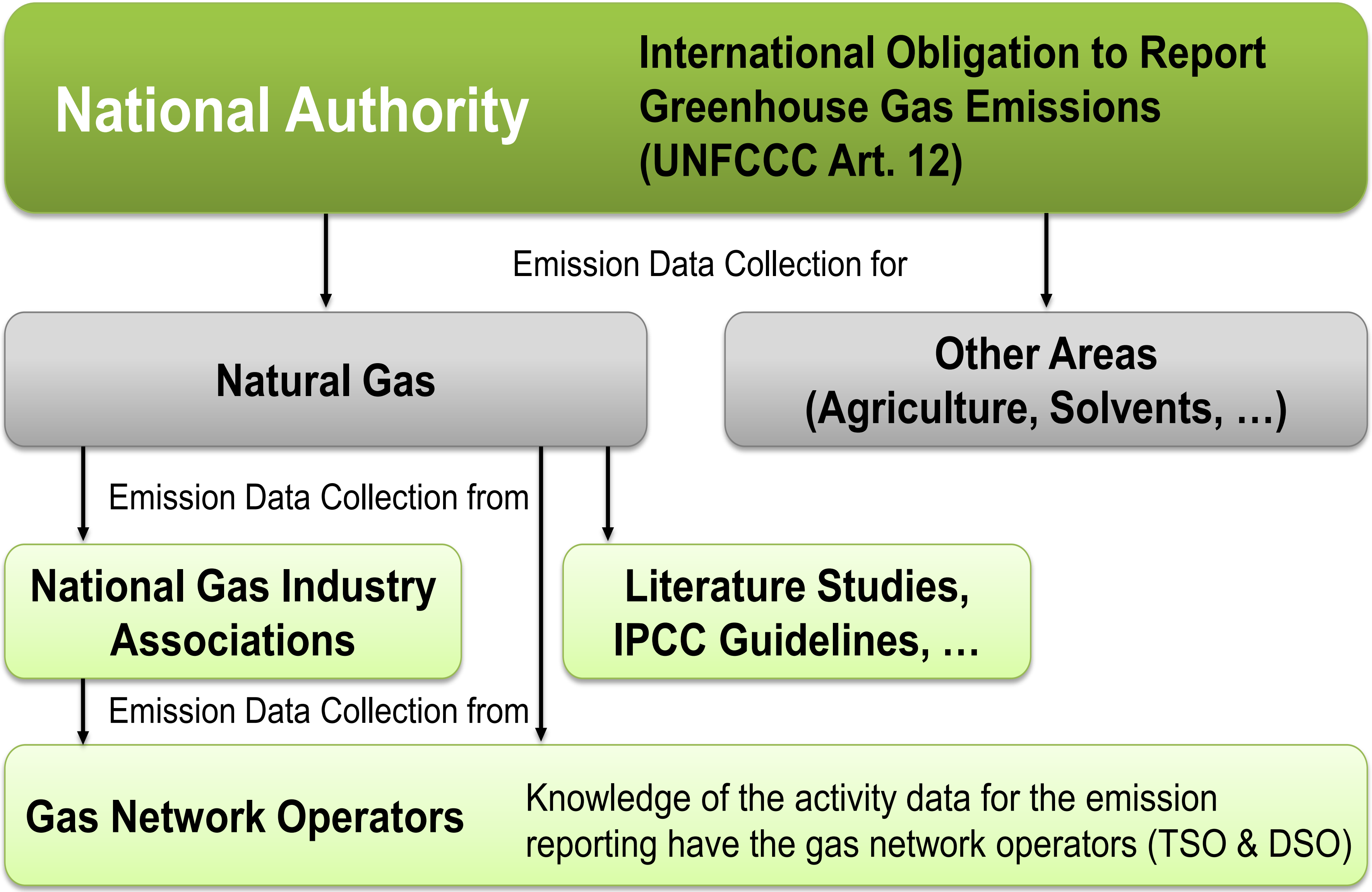
- ✓ All EU Member States are required to monitor and report their methane emissions under the EU GHG monitoring mechanism, which sets the EU's own internal reporting rules on the basis of internationally agreed obligations (IPCC Guidelines).
- ✓ The IPCC Guidelines distinguish between three methodological tiers for quantification of emissions:

1. Tier 1: It is the simplest approach; it comprises the application of appropriate default emissions factor to a representative activity factor (usually throughput). Default emission factors for a set of activity data are listed in the IPCC Guidelines.
2. Tier 2: Similar to Tier 1 approach. However, instead of default emissions factors, country-specific emission factors (developed from external studies, analysis measurement campaigns) are used.
3. Tier 3: The most detailed approach based on a rigorous bottom-up assessment at the facility level, involving identification of equipment-specific emission sources, equipment inventory, measurement of emission rates per equipment type, etc.

GHG Inventories – Tier approach

- ✓ Progressing from Tier 1 to Tier 3 represents a reduction in the uncertainty of GHG estimates. However, the ability to use a Tier 3 approach will depend on the availability of detailed production statistics and infrastructure data, which may require investments.
- ✓ The EU GHG inventory (Tier 1) is prepared by the EC, closely assisted by the EEA every year. The EU inventory is a compilation of National Inventory Reports (NIR), based on the emissions reported under the EU GHG monitoring mechanism.
- ✓ The accuracy of the NIRs have been questioned on several occasions due to, for instance, a lack of coordination between the industry and the authorities to verify reported data. Closing this gap is key to convert NIRs in credible and reliable sources of data.

How national Inventory data is collected

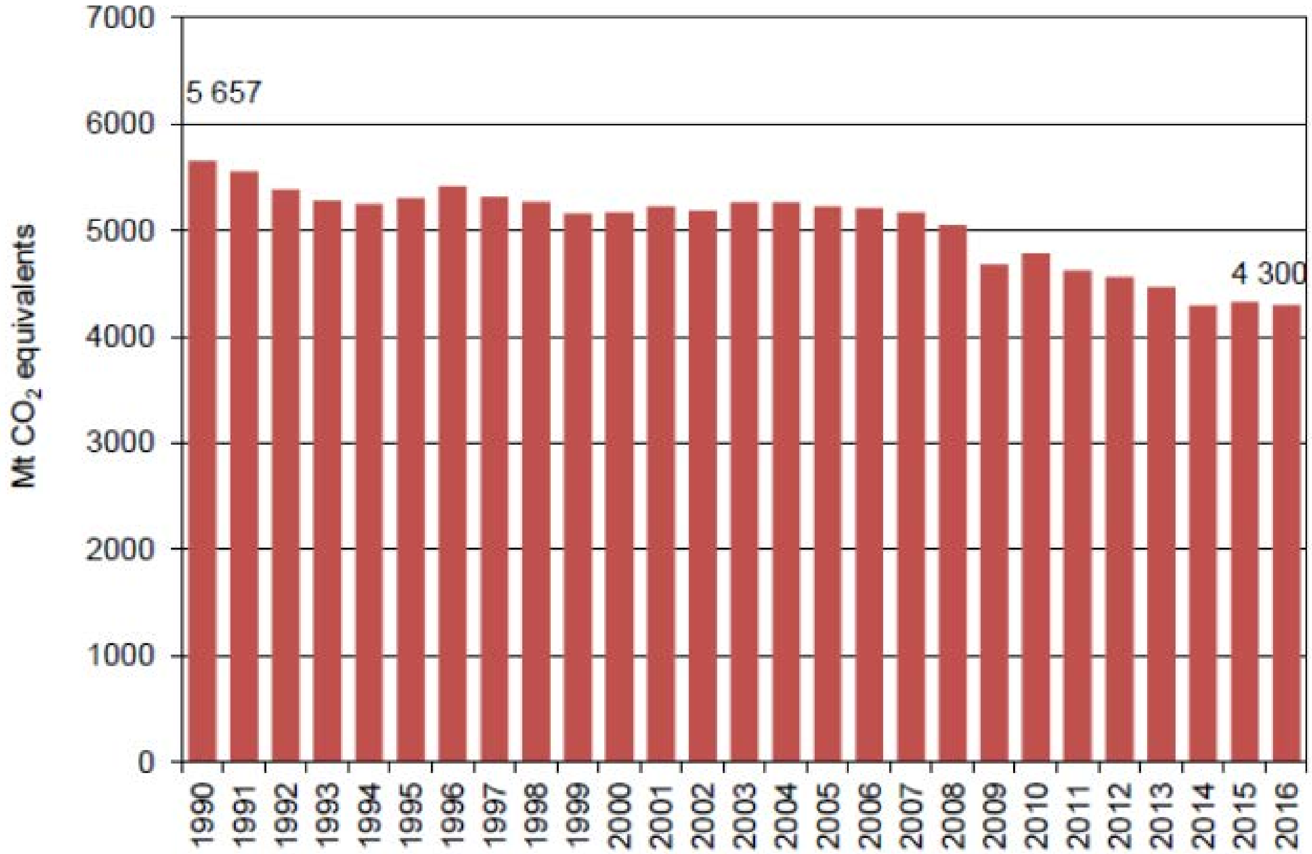


GHG Emissions

In 2016 EU GHG emissions amounted to 4,300 Mtons CO_{2eq}, -24% below 1990 levels.

The reduction in GHG emissions over the 26-year period was due to a variety of factors, including the growing share in the use of renewables, the use of less carbon intensive fuels and improvements in energy efficiency, as well as to structural changes in the economy and the economic recession.

Figure ES. 1 EU-28 plus Iceland GHG emissions (excl. LULUCF)

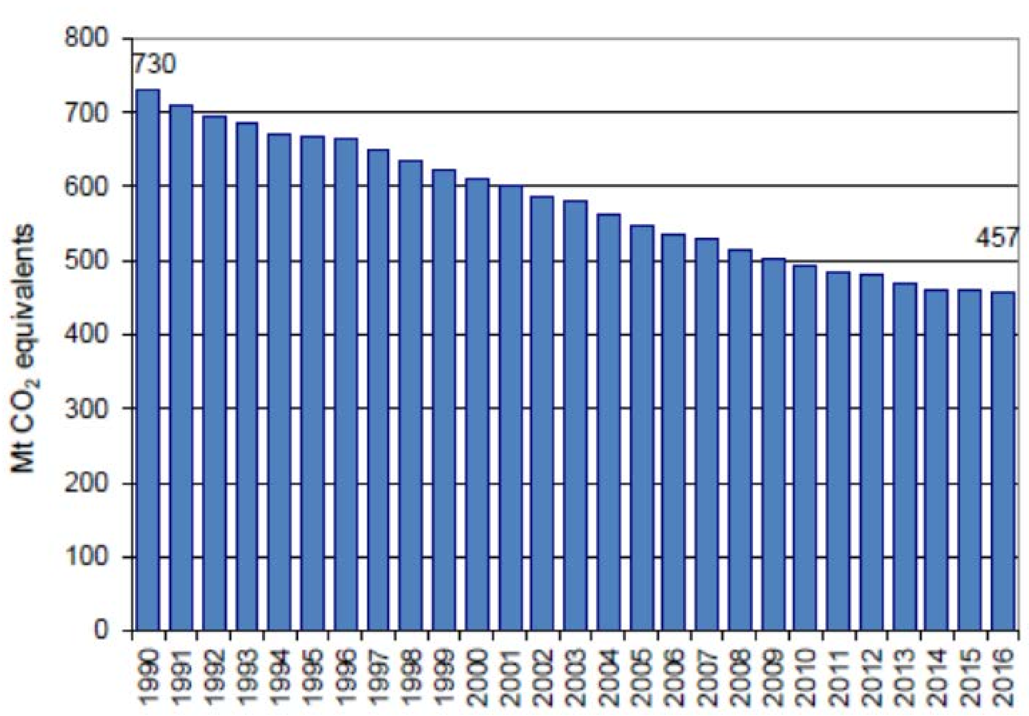


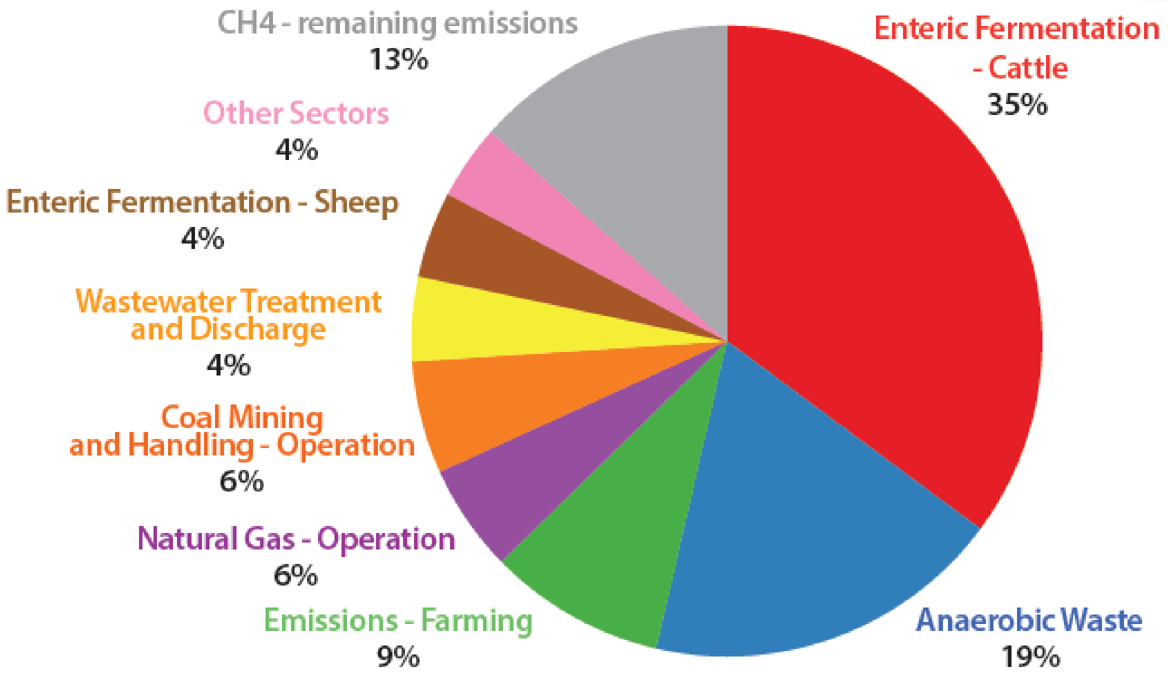
Methane Emissions

Methane emissions account for 11 % of total EU GHG emissions and decreased by 37 % since 1990 to 457 Mt $CO_{2\text{-eq}}$ in 2016.

The two largest sources are enteric fermentation and anaerobic waste (53%). Methane emissions from gas operations represented 6% of the total

Figure 2.5 CH_4 emissions 1990 to 2016 in CO_2 equivalents (Mt)

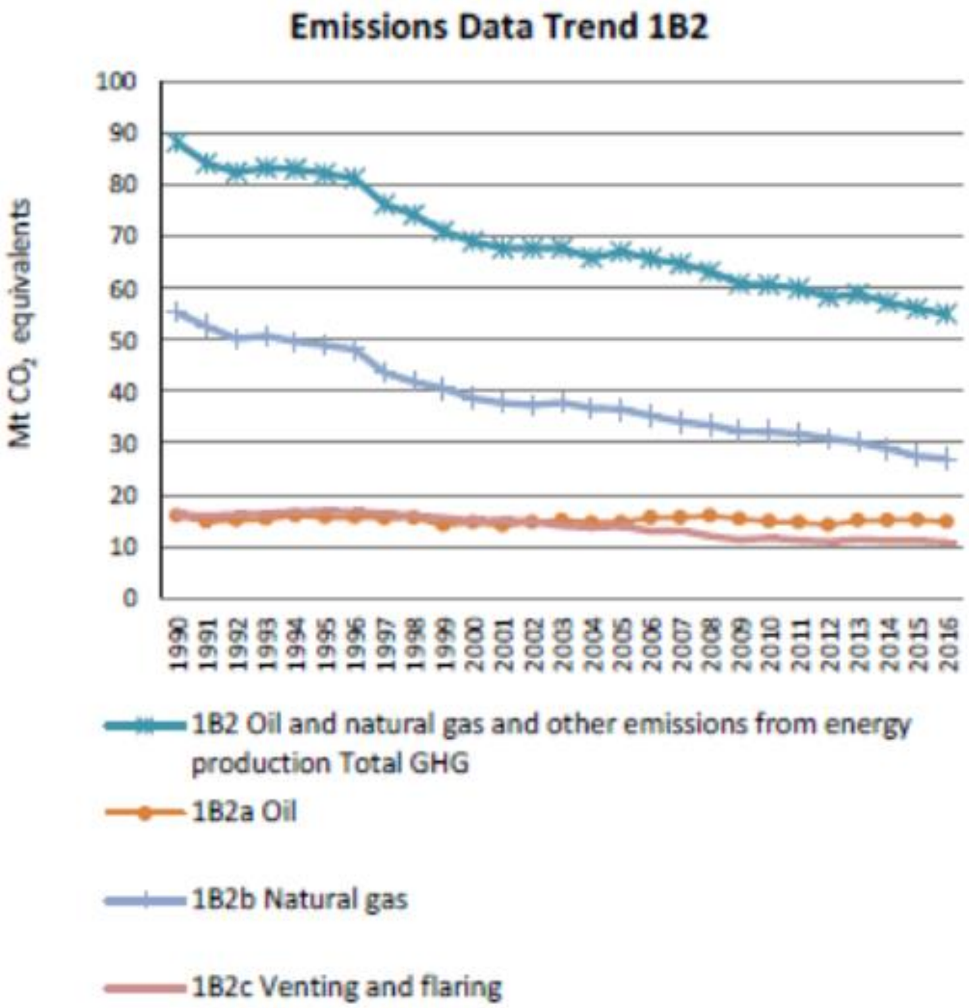




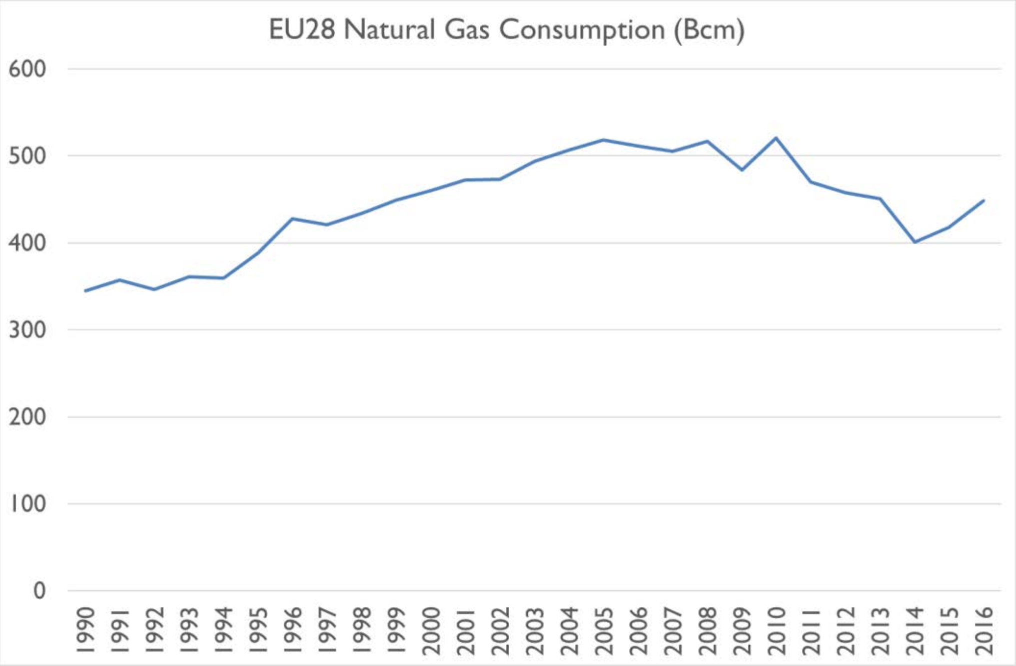
Fugitive Emissions from natural gas operations

Fugitive emissions from natural gas operations correspond to emissions from all sources associated with the exploration, production, processing, transmission, storage and distribution of natural gas.

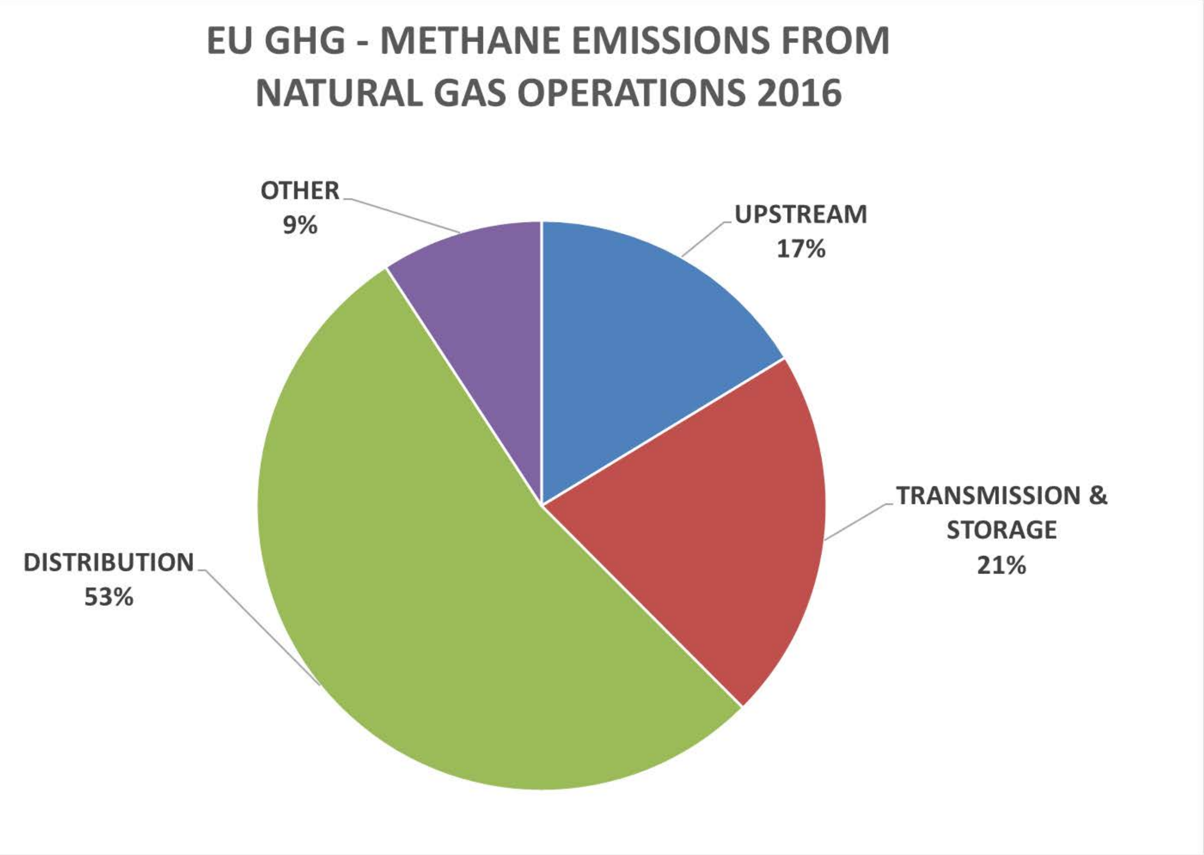
Methane emissions from gas infrastructure account for only 0.6% of total. Between 1990 and 2016, CH_4 emissions decreased by 51%, mainly caused by improvement of technology, by pipeline network, reduction of losses in gas distribution and decrease in production.

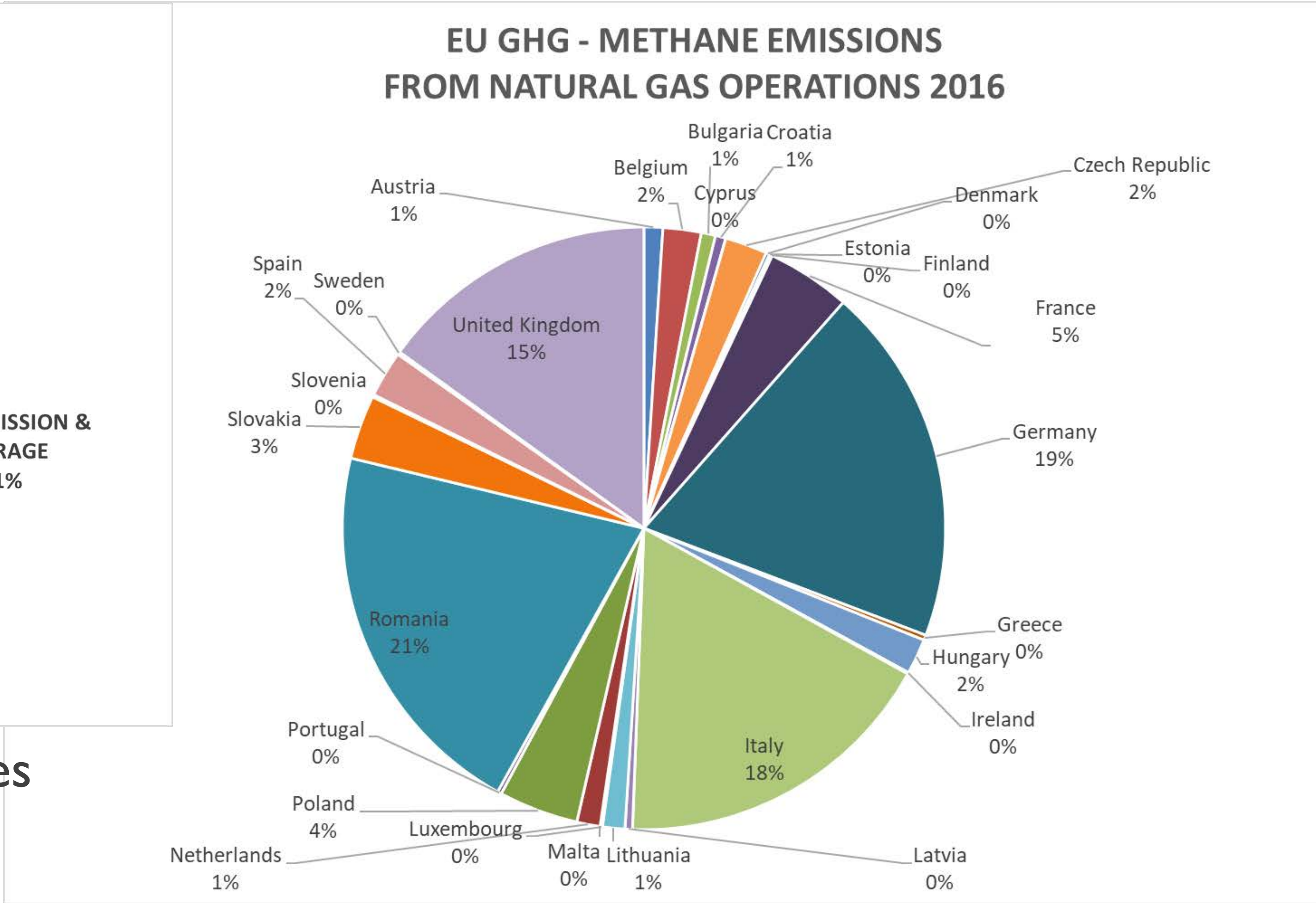


Gas consumption, in the same period, increased by 25% (from 360 to 449 bcm)



Fugitive Emissions from natural gas operations





Contribution vs. gas chain & countries

IOGP Upstream Reporting

- ✓ IOGP publishes its "Environmental performance Indicators (EPI)" on annual basis (this includes information on GHG emissions
- ✓ The 2018 EPI edition shows that:
  - 44 of the 56 member operating companies reported their 2017 data, equivalent to 27% of 2017 world production
  - Variation of regional coverage exists:
    - In Europe, where a high percentage (82% in 2017) of hydrocarbon production is represented, the information can be taken to approximate 'industry' performance in that region.
    - In Africa (57%), Asia/Australasia (32%) and South & Central America (49%), the data give a broad indication of industry performance.
    - For the Middle East (22%) and North America (18%), the regional coverage is less comprehensive

IOGP main results

- ✓ Methane s split by emission source

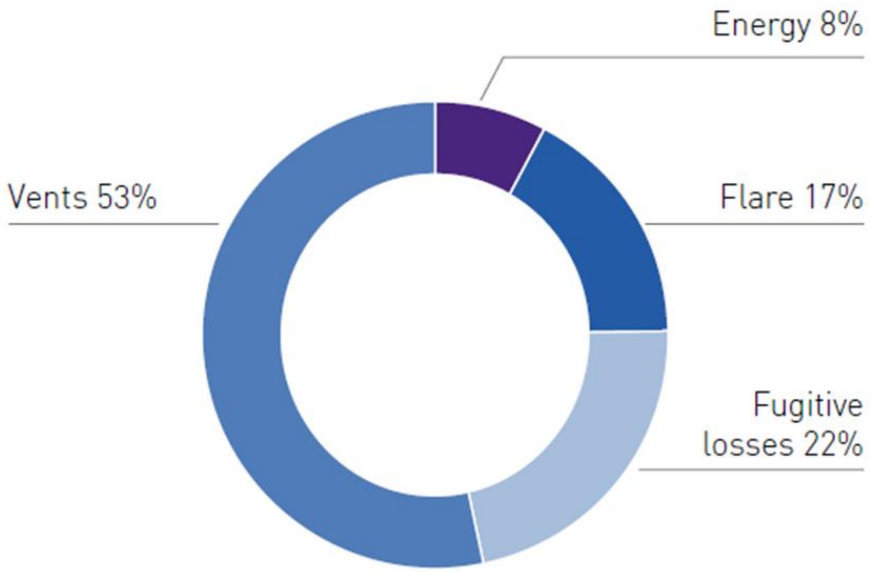


Figure 12: CH_4 emissions by source – 2017

- ✓ Methane intensity varies significantly by region: for Europe it is ~0.4

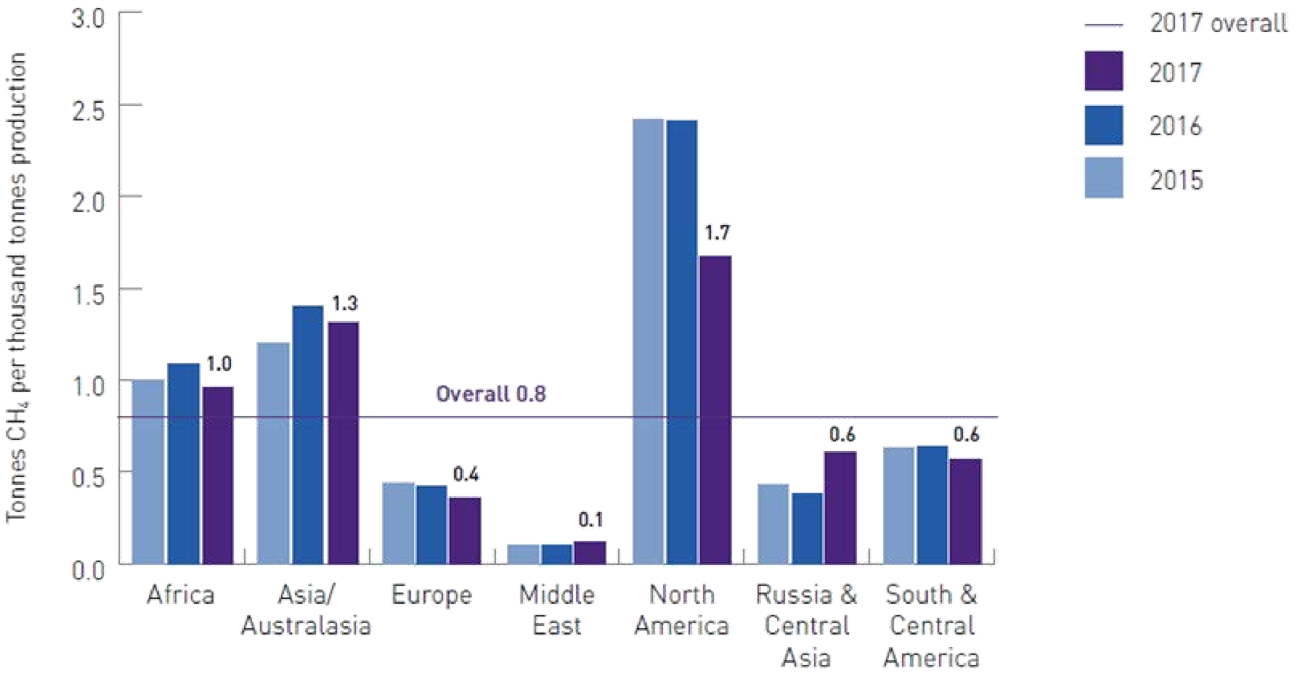


Figure 11: CH_4 emissions per unit of hydrocarbon production (by region)

Presentation of Marcogaz reporting

Marcogaz developed and published (2005) a methodology using all existing knowledge available within the group of European gas infrastructure operators. As Countries have differences in their operating regimes, the common methodology would allow a common approach to the estimation of methane emissions.

In 2017 Marcogaz, performed a technical study to **estimate** the **methane emissions from the midstream and downstream activities** for the year 2015

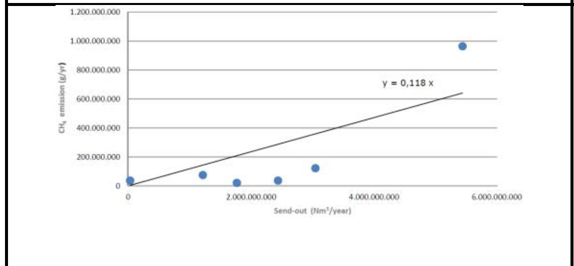
- ✓ updated with new emission data resulting from recent measurements and evaluations
- ✓ with an enlarged scope to cover the methane emissions from LNG terminals and from Underground Gas Storages facilities.

Marcogaz reporting standardization

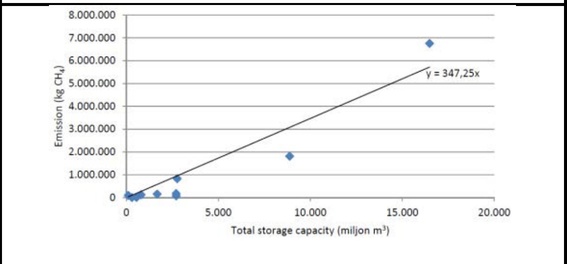
For every step of the gas value chain MARCOGAZ has analysed the methane emissions of the industry player to define a "macro" **Emission Factor** based on a relevant **Activity Factor**

These **EF** can then be applied at the global EU28 level

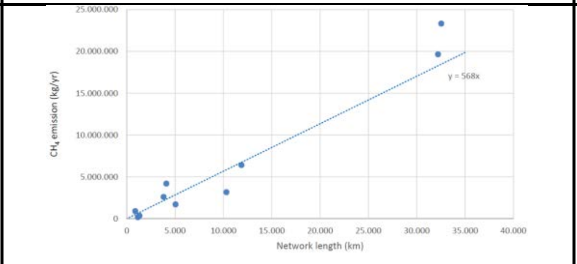
LNG terminals
0,12 gCH_4/m^3 send-out



Underground Storage
347 $kgCH_4$/ million m^3 storage capacity

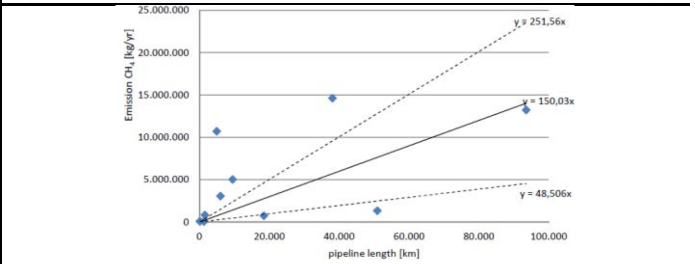


Transport (>16 bar)
568 $kgCH_4/km$



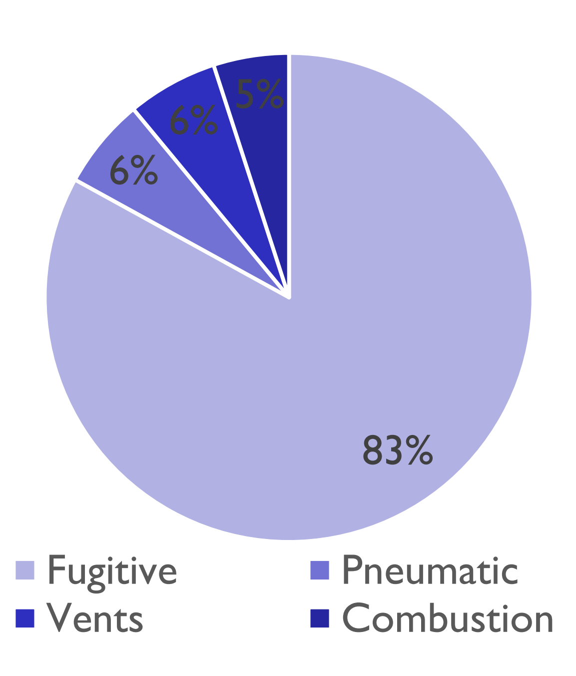
Distribution (<5 bar)

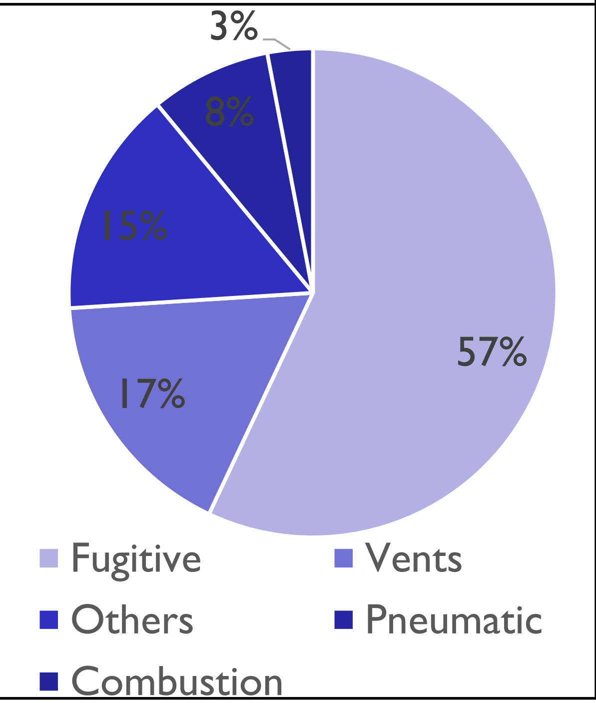
Pipeline material	Maximal emission rate	Share of the EU28 grid
Cast iron	1.388 kg CH_4 / km	2,5 %
Steel	198 kg CH_4 / km	39 %
Polyethylene	61 kg CH_4 / km	51 %
P.V.C.	34 kg CH_4 / km	5 %
Service lines	1,52 kg CH_4 / customer	

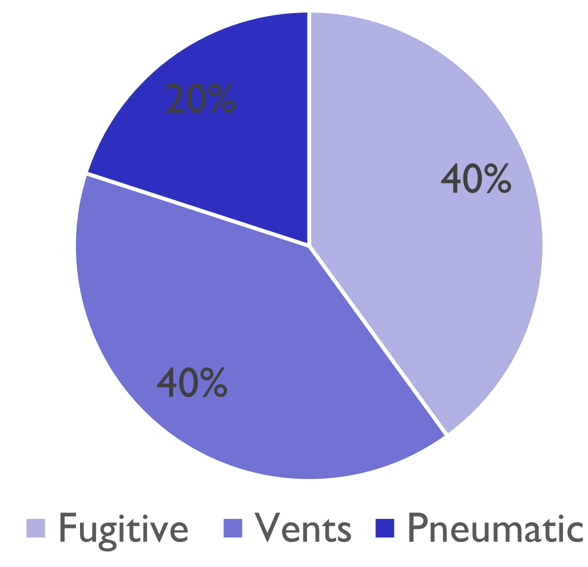


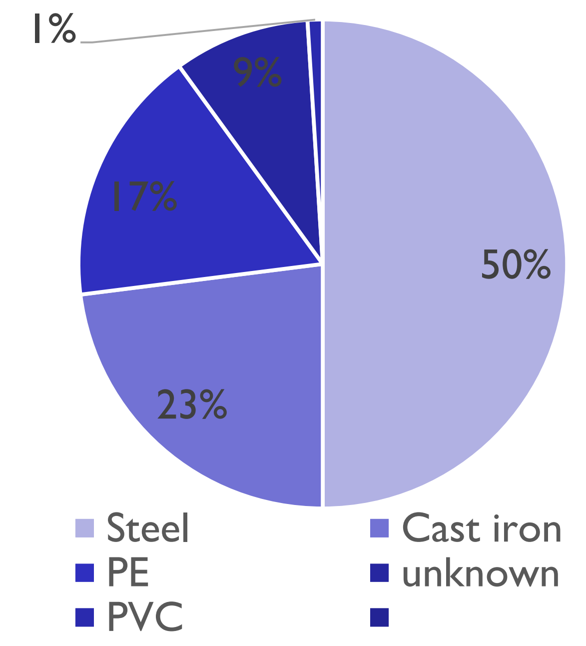
Marcogaz reports the methane emission by source type on the value chain

LNG terminals	Underground Storage	Transport (>16 bar)	Distribution (<5 bar)
0,9% with 4.700 tonsCH4	7,4% with 38.000 tonsCH4	25,8% with 133.000 tonsCH4	65,9% with 339.000 tonsCH4









Marcogaz Results

LNG	• 4,700 ton CH_4 • 0.002 % compared to the EU28 sales • 0.003% of anthropogenic CO_{2eq}
UGS	• 38,000 ton CH_4 • 0.01% compared to the EU28 sales • 0.02% of anthropogenic CO_{2eq}
TSO	• 133,000 ton CH_4 •0.05% compared to the EU28 sales • 0.08% of anthropogenic CO_{2eq}
DSO	• 339,000* ton CH_4 • 0.12% compared to the EU28 sales • 0.21% of anthropogenic CO_{2eq}

Remarks

- ✓ Results valid at global European level and not for an individual country.
- ✓ (*) 553,000 with 95% confidence level as mentioned in the report.

Reporting Vs National inventories

- The Midstream emission figure is showing a high level of correlation with the activity factor and the dataset gives a credible picture
- The data obtained for Midstream are lower (-16%) but similar to those provided by National Inventory.

CH_4 emissions in 2015 …	… from the EU28 grid *[Tons CH_4]*
Transmission and Storage (National Inventory 2015)	210,000
Transmission, Underground Gas Storages, LNG Terminals (Marcogaz estimation)	176,000

- Similar analysis can be done for Downstream but with less consistency in the data

=> Showing that some gaps have still to be filled in inventories and MARCOGAZ reporting.

Biogas and Biomethane plant operators

- ✓ There are voluntary based system to report methane emissions in Sweden (the Swedish Voluntary system for control of methane emissions) and in Denmark (Danish Voluntary system for control of methane emissions).
- ✓ The EvEmBi project is working on voluntary schemes in the European countries Germany, Austria and Switzerland.
- ✓ The European Biogas Association will develop a European voluntary scheme.
- ✓ Some countries require regular leak detection in the operation of biogas and biomethane plants in order to obtain a permit.

Area of improvements and closing the gap

The gas industry pushes for the following improvements:

- ✓ 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 utilisation perimeter (End-users and Appliances) - under progress -

Conclusion and Next steps

- ✓ Methane is the second most important anthropogenic GHG, accounting for less than 11% of EU GHG. Methane emissions from the gas chain represent a small fraction (0.6%) and are significantly and continuously decreasing (-51% between 1990 and 2016)

- ✓ Marcogaz performed a technical study to estimate CH_4 emissions from EU gas infrastructure (Mid and Downstream). The data are similar to those provided by National Inventories, showing some gaps that need to be filled.

- ✓ Recommendations / coordination between gas industry data vs. EU28 National Inventories to check consistency by country, including Tier approach, will be developed

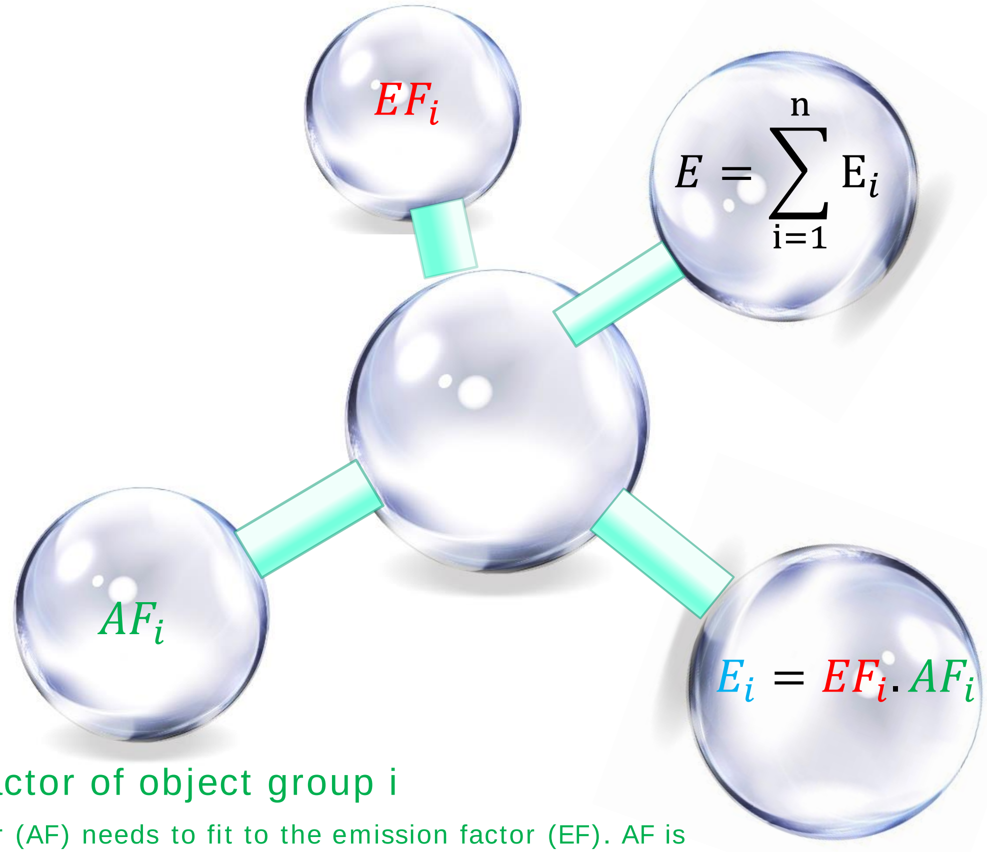
Reporting of Methane emissions. Validation and verification

Ronald KENTER

General concept

Emission factor of object group i

- ✓ Measurement
- ✓ Estimation
- ✓ Calculation



Total emission as a total of all object groups i (valves, installation, company)

Emission of group i:
Multiplying emission factor with activity factor

Activity factor of object group i

Activity factor (AF) needs to fit to the emission factor (EF). AF is typically expressed as the number of leaks per year (absolute or per km) or the number of incidents or events or the operating time.

Determination of EF

Framework

Production, transmission, LNG terminals, UGS and distribution	Type of emission		
	Fugitive	Venting	Incomplete combustion
Identification / Detection	LDAR-type programs involving use of IR cameras, sniffers, etc.	Equipment/process mapping	Equipment/process mapping
Quantification	Measured, calculated and/or modelled	Measured, calculated and/or modelled	Calculated and/or modelled
Mitigation	LDAR programs	Implementation of BAT	
Reporting	- Sustainability and carbon footprint reports (based on company inventories) - National Inventory Reports (to national authorities) - Partnership and associations methodologies (e.g. CCAC OGMP, OGCI, IOGP, IPIECA, MARCOGAZ) - Reporting initiatives (e.g. CDP, EDF)		
Validation / Verification	According to GHG Protocol, EN 15446, ISO 14064, ISO 14001, ISO 50001, ISAE 3000. Verification of emissions often done by a third party		

A systematic approach to identify, detect, quantify, report and verify emissions is essential to close the current knowledge gap and enable gas industry to prioritise and allocate capital and human resources to efficiently target methane emissions at the lowest abatement cost.

How to get started

Preliminary estimation of methane emission
- Split your assets into groups and quantify activity (AF)
- Use standard emission factors for groups (EF)
- Calculate E = $\sum EF \times AF$

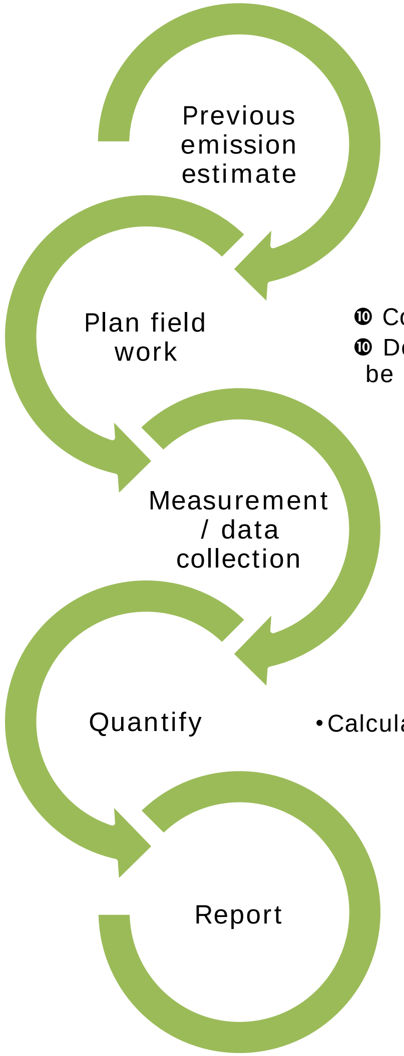
Plan field work
- Based on knowledge contribution of each group of assets.
  - Decide for which group measurements will be performed
  - Decide on which group estimates will be used

Maesurement / data collection
- Perform a measuring and data collection campaign
- Document company specific emission factors and data

Quantify
- Calculate the total emission using measured and estimated data

•Report
- Make an uncertainty estimation of methane emission
- Report emissions

Improvements



- Consider asset groupsNeed for more detailed split into groups
- Need for more detailed split into groups

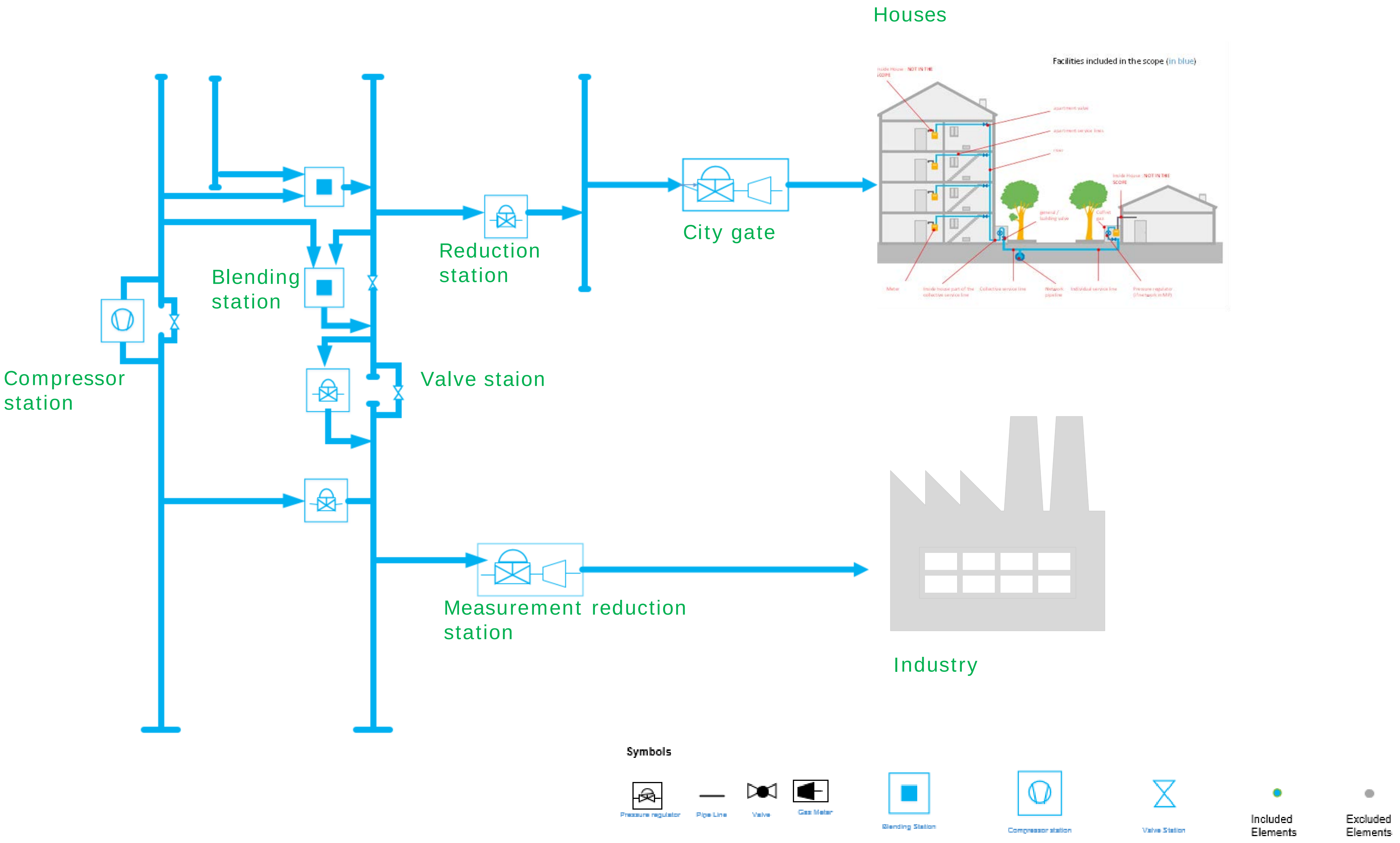
- Consider new groups to be measured
- Decide for which asset groups and types of emission, data needs to be improved or validation

- Document new, improved and validate existing data (i.e. EF)

- Calculate the total emission using measured and estimated data

- Make an uncertainty calculation
- Report emissions
- Consider improvements
- Consider actions or changes in your asset management

Scope: DSO and TSO network



Identification: Types of emissions

gie marcogaz Energy Community

<table>
<tr><th colspan="4">Methane emissions</th></tr>
<tr><th colspan="3">Types of emissions</th><th>Examples</th></tr>
<tr><td rowspan="2">Fugitives</td><td colspan="2">Leaks due to connexions</td><td>Tightness failure</td></tr>
<tr><td colspan="2">Permeation</td><td></td></tr>
<tr><td rowspan="4">Vented</td><td rowspan="3">Operational emissions</td><td>Purging/venting for works, commissioning and decommissioning</td><td>Works, maintenance</td></tr>
<tr><td>Regular emissions of technical devices</td><td>Pneumatic emissions actuators, flow control valves, ...</td></tr>
<tr><td>Starts & stops</td><td>Emissions from start and stops of compressors, ...</td></tr>
<tr><td colspan="2">Incidents</td><td>Third party, corrosion, construction defect/material failure, ground movement, failure of installation</td></tr>
<tr><td colspan="3">Incomplete combustion</td><td>Unburned methane in exhaust gases from combustion installations.</td></tr>
</table>

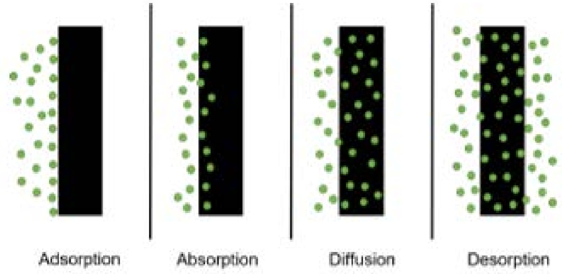
Identification

Groups of assets		Types of emissions						
		Fugitives		Vented				Incomplete combustion
				Operational emissions			Incidents	
		Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Groups of assets	Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
	Connections (flanges, seals, joints)		§ 6.4.2					
	Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
	Valves[2] (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
	Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
	Safety valves		§ 6.4.2				§ 6.6	
	Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
	Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
	Flares					§ 6.5.2.3		§ 6.7

Identification

Groups of assets (marcogaz – TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY)	Types of emissions						
	Fugitives		Vented				Incomplete combustion
			Operational emissions			Incidents	
	Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
Connections (flanges, seals, joints)		§ 6.4.2					
Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
Valves[2] (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
Safety valves		§ 6.4.2				§ 6.6	
Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
Flares					§ 6.5.2.3		§ 6.7

Fugitive emissions: Permeation



$$q_V = PC_{CH4} \cdot \pi \cdot SDR \cdot p_{CH4}$$

Permeation Coefficient (original)		Unit
Value	Material, temperature	
0.019	PE100, 20°C	$cm^3_{CH4}/(m \cdot bar \cdot d)$
0.056	HDPE, 20°C	$cm^3_{CH4}/(m \cdot bar \cdot d)$
34.1	PE100, 20°C	$(ml \cdot mm)/(m^2 \cdot bar \cdot d)$
1.11E-09	PE80, 8°C	$cm^2_{CH4}/(bar \cdot s)$
0.006	PE100, 8°C	$cm^3_{CH4}/(m \cdot bar \cdot d)$
0.29	Plastic, 8°C	$m^3_{CH4}/(km \cdot bar \cdot yr)$

Identification

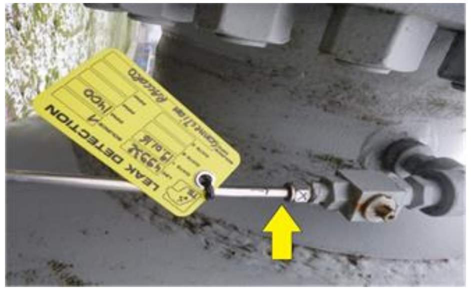
Groups of assets	Types of emissions						
	Fugitives		Vented				Incomplete combustion
			Operational emissions			Incidents	
	Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
Connections (flanges, seals, joints)		§ 6.4.2					
Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
Valves[2] (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
Safety valves		§ 6.4.2				§ 6.6	
Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
Flares					§ 6.5.2.3		§ 6.7

Fugitive emissions: Connection

e.g. flanges, equipment, joints, seals

Methods applied

- Direct measurement



- Emission factors
  - estimate of average emission flowrate via surveys
  - average duration
  - number of leaks

Identification

		Types of emissions						
		Fugitives		Vented				Incomplete combustion
				Operational emissions				
		Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop	Incidents	
Groups of assets	Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
	Connections (flanges, seals, joints)		§ 6.4.2					
	Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
	Valves² (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
	Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
	Safety valves		§ 6.4.2				§ 6.6	
	Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
	Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
	Flares					§ 6.5.2.3		§ 6.7

Vented emissions: Operational emissions

$E_{venting}$

Operational emissions

$E_{technical\ devices}$

$E_{purging}$

$E_{start/stop}$

Identification

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY		Types of emissions						
		Fugitives		Vented				
				Operational emissions				
		Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop	Incidents	Incomplete combustion
Groups of assets	Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
	Connections (flanges, seals, joints)		§ 6.4.2					
	Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
	Valves² (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
	Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
	Safety valves		§ 6.4.2				§ 6.6	
	Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
	Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
	Flares					§ 6.5.2.3		§ 6.7

Emissions from incidents

Incident causes

- External interference (i.e. third-party damage)
- Corrosion
- Construction defect / material failure
- Hot tap made by error
- Ground movements
- Venting caused by system failure

TSO Individual based

- Volume
  - Diameter
  - Length
  - pressure
- Duration
- Geometry of leak

DSO Grouping

- Average flow rate
- Average duration
- Average number of incidents

Identification

Groups of assets		Types of emissions						
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	Flares					§ 6.5.2.3		§ 6.7

Incomplete combustion

measured $E_{combustion} = \int Qm_t . dt$

Estimated $E_{combustion} = \sum_{i=1}^{n} \mathrm{E}_i = EF_i . AF_i$

Measuring techniques

Technique	Description of technology / operation	Advantages	Disadvantages	Device
Pressure decay / Flow fluctuation	The pressure decay method can be used as a quantitative leak measurement technique, where the methane emissi pipeline is measure isolated parts of a c network. Pressure i during a specific tin calculated from the known (estimated) The sensitivity of th depends on the leal the outlet of the pip no change in pressu	• Simple and requires no telemetry.	• Uncertainty associated with unknown changes of gas	Pressure sensors, flowmeters
Refraction wave method (acoustic pressure waves)	The acoustic pressu refraction waves pro When a pipeline wa escapes in the form produces negative p propagate in both d and can be detectec of a pressure wave			
Balancing methods	These methods bas conservation of mas flow entering the le the mass flow leaving it. Mass imbalance indicates leak.			
Point-source measurements	Measurement of emis points based on flow composition. Engines typical point-source e			
			over large source areas • Single bagging may not capture all variability in emissions. Provides an measurement that must be repeated to capture temporal trends.	
			• Quantifies diffusive emission rates from a small source area (typically 1 m^2 or less). • Labour intensive • Provides measurement that must be repeated to capture	Chambers of different volumes

Leak Flow capturing

Technique	Description of technology /operation	Advantages	Disadvantages	Device
	monitoring periods by the chamber volume/area ratio. Dynamic chambers quantify emissions using inlet/outlet methane concentrations with a known rate of the flux.	• Can measure the variability of emissions over large source areas	• Provides measurement that must be repeated to capture temporal trends	
External tracer	Relea... from trac plum emis and	• Measures total methane	• Difficult to isolate individual	
Perimeter facility line measurements	Mea boun alon emis	temporal trends in emissions	• Appropriate topographic and meteorological conditions are necessary. • Difficult to determine the area contributing to leakage	

Method	Description	Technical Specifications
Thermal dispersion	Gas leak rate is estimated based on the size of the cloud observed from thermograms. The amount of gas released depends of the upstream pressures and leak sizes.	
Electrochemical detection[5]	Electrochemical detectors use the porous membrane through which the detected gas goes to the electrode on which it is either oxidized or reduced, resulting in the change of the electric current.	
Soap Bubble Screening	It is easy, quick and low cost to detect leaks with a soap solution. Soap bubble screening consists to spray all the junctions with a mixture of water and soap (or with a specific commercial foaming product). All the junctions (even the junctions inserted in a coating) are targeted (the actuator of the valves, flanges, fitting, caps, insulating joints, ...). It is necessary to stay a short time in front of each junction to watch the creation of bubble. This technology can be used for an efficient and fast leak detection and repair campaign, operational team are familiar with that very well know historical methodology. Not effective on large openings. Cannot be used on equipment above the boiling point or below the freezing point of water.	-

Method	Description	Technical Specifications
Flame ionisation detection	The operation is based on the ionization of the detected gas in the hydrogen flame that is generated inside the FID. It enables to detect the methane concentrations from very low levels, but reacts not only to methane, but to other hydrocarbons as well.	The sensitivity of a GC-FID machine is around 0.1 ppm[4] and a maximum range of about 2000 ppm.
Semiconductor based	In the presence of the detected gas, the semiconductor's resistance decreases due to the oxidation, or reduction, of the gas on the metal oxide surface. The method is not selective, as some other gases, such as ozone, volatile organic compounds ...ensor must come in ...tor sensors work ...r ultrasonic	Detection concentration: 200-10.000 ppm (Natural gas / Methane), Operating temperature: 14 to 122°F (-10 to 50°C)
	...n sensors to detect ...nd-held or remotely ...s or through mobile ...-held units are a ... of components. The ...d detect function. An ...y viewing a live image ...ration required, some	Min. detectable leak rate (methane) – 0,35 g/h

Method	Description	Technical Specifications
Acoustic leak detection	Acoustic leak detectors capture the acoustic signal of pressurized gas escaping from a valve plug or gate that is not tightly sealed. They can detect either low or high frequency audio signals and are useful for detecting internal through valve leaks or ultrasonic signals from blowdown valves and pressure relief valves (ultrasonic signals at a frequency of 20 - 100 kHz). Most detectors typically have frequency tuning capabilities which allow the sensor to be tuned to a specific leak. The operator can also gain a relative idea of a leak´s size as a louder reading will generally indicate a higher leak rate. For airborne ultrasonic signals, an ultrasonic leak detector is pointed at a possible leak source up to 30 meters away and by listening for an increase in sound intensity through the headphones. Ultrasonic leak detectors can also be installed on mounting poles typically around 2m above the ground around a facility and send a signal to a control system indicating the onset of a leak.	Sensitivity: Detects a leak of 0,1 mm at 3 bars at 20 m Temperature range: - 10°C to + 50°C
Laser leak detection	A popular detector is the Remote Methane Leak Detector (RMLD), which uses a tunable diode-infrared laser that is tuned to a frequency which is specifically absorbed by methane. As the laser beam from an RMLD device passes through a gas plume (and is reflected back to the camera) it will detect if methane is present in the beam path by comparing the strength of the outgoing and reflected beams. Simple to operate, especially handheld versions, useful for detecting methane leaks originating from hard-to-reach sources or throughout difficult terrain. Allows the detection of methane in the beam path up to a distance of approximately 30m. Specifically tuned to detect methane and does not give a false reading for other hydrocarbons (No cross-sensitivity) require a background surface to reflect back laser beam (not applicable for open fields).	Measurement Range: 1-50k ppm
Combustible gas detection	When gas that is aimed to be detected goes through the catalyst it is combusted what heats up the catalyst and changes the resistance, which subsequently enables detecting of the searched gas. The catalyst poisoning may be an issue decreasing its reliability.	Measurement Range: 1ppm-100%

Methods

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Balancing methods	*Point-source measurements*	*Suction method (aspiration method)*	*Bagging*	*Flux chamber*	*External tracer*	*Perimeter facility line measurements*
These methods base on the principle of conservation of mass. In steady state, the mass flow entering the leak-free pipeline will balance the mass flow leaving it. Mass imbalance indicates leak.	Measurement of emissions from fixed source points based on flow rate and methane composition. Engines and compressors represent typical point-source emissions.	Capturing as much of the leakage by partially enclosing the leaking components, diluting the leakage using suction. The method is suitable for measurement of small to medium size leaks in shallow buried pipelines	 A leak rate is measured by enclosing an equipment piece in a bag to determine the actual mass emission rate of the leak to determine a fugitive or vented flow rate.	Method in which natural gas escaping from earth surface is measured using chambers of special construction.	Release of tracer gas (C_2H_2, N_2O) at known rate from source area. Measurement of methane and tracer concentrations across well-mixed downwind plumes to derive emission rate.	*Perimeter facility line measurements*

Detectors

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Flame ionisation detection

- In the presence of the detected gas, the semiconductor's resistance decreases due to the oxidation, or reduction, of the gas on the metal oxide surface. *Optical gas imaging*

Semiconductor based detection

- OGI infrared cameras are equipped with sensors to detect hydrocarbons. The equipment may be hand-held or remotely operated from ground-mounted installations or through mobile deployment (vehicular & aerial). Hand-held units are a recommended solution for a broad range of components.

Optical gas imaging

- Acoustic leak detectors capture the acoustic signal of pressurized gas escaping from a valve plug or gate that is not tightly sealed. They can detect either low or high frequency audio signals and are useful for detecting internal through valve leaks or ultrasonic signals from blowdown valves and pressure

Acoustic leak detection

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Laser leak detection

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Combustible gas detection

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Thermal dispersion

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Electrochemical detection

- It is easy, quick and low cost to detect leaks with a soap solution. Soap bubble screening consists to spray all the junctions with a mixture of water and soap (or with a specific commercial foaming product). All the junctions (even the junctions inserted in a coating) are targeted (the actuator of the valves, flanges, fitting, caps, insulating joints,

Soap Bubble Screening

Uncertainty calculation

$$E = \sum_{i}^{n} E_i$$

Basic formula to evaluate

To calculate uncertainty is difficult.

MARCOGAZ proposes to use some simpel equations to derive uncertainty:

Therefore:

- ✓ Quadratic model is used or Monte Carlo simulation
- ✓ Standard deviation E_i must be knowm

Using ref

JCGM-100. Evaluation of measurement data - Guide to the expression of uncertainty in measurement. s.l. : Committee for Guides in Metrology (JCGM/WG 1), 2008.

JGCM-101. Evaluation of measurement data — Supplement 1 to the “Guide to the expression of uncertainty in measurement” Propagation of distributions using a Monte Carlo method. s.l. : JCGM, 2008.

Validation / Verification

Methane emissions and their quantities can be assessed and verified by an external body, independent from the emitting company. This provides several benefits to the company, industry and interested parties:

- ✓ Transparency of the true nature and quantity of methane emissions;
- ✓ Assurance in the reported emissions figures and their confidence factors;
- ✓ Reliability on methane emissions reductions
- ✓ A means of comparison for interested parties and the industry to assess performance
- ✓ More reliability in national inventories as they are built upon data provided by companies
- ✓ Better performance in sustainability indexes rankings

Methane emissions should be verified as part of the carbon footprint verification process in order to provide a framework and sense to initiatives.

Validation / Verification

Standard / Protocol	PROS	CONS
ISO 14064	• Methodical approach to identifying sources and sinks; provides framework for emissions inventory system • Requires collection of direct and indirect emissions (through boundary setting) • Requires organisations to record activities to reduce emissions • Outlines requirements to state uncertainty • Total organisational emissions inventory	• GHG emissions must be expressed as CO2e • Organisations can establish own boundaries for emissions capture, however these must be stated (transparency issues) • Organisations can identify the CO2e conversation factors, rather than using a single point source (consistency for comparison)
GHG Protocol: Corporate Standard	• Identifies a methodical approach to identifying, quantifying, assuring, reporting, verifying and target setting. • Outlines requirements for external verification and reporting • Identifies tools for calculating emissions • Provides examples	• Large standard, labour and cost intensive (however thorough)
EPA 21	• Identifies the specific equipment and methodologies for detecting and quantifying emissions • Point source emission identification and quantification	• Aimed at individual asset's emissions; no framework for organisations. • No detail provided for verification • Minimal detail for quality control
EN 15446	• Identifies the specific equipment and methodologies for detecting and quantifying emissions • Detailed methodology for report writing and data capture • Point source emission identification and quantification	• Aimed at site or point source emission; doesn't provide framework for organisation emissions inventory • Not necessarily verifiable but is supported by third party accreditation

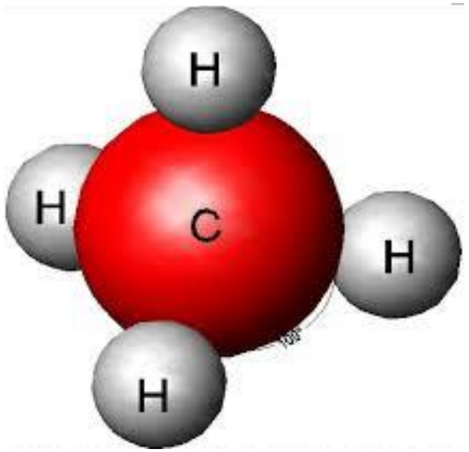
Several routes to independently verify the data collected through one of the standards or protocols.

Methane emissions management: Main technologies and tools

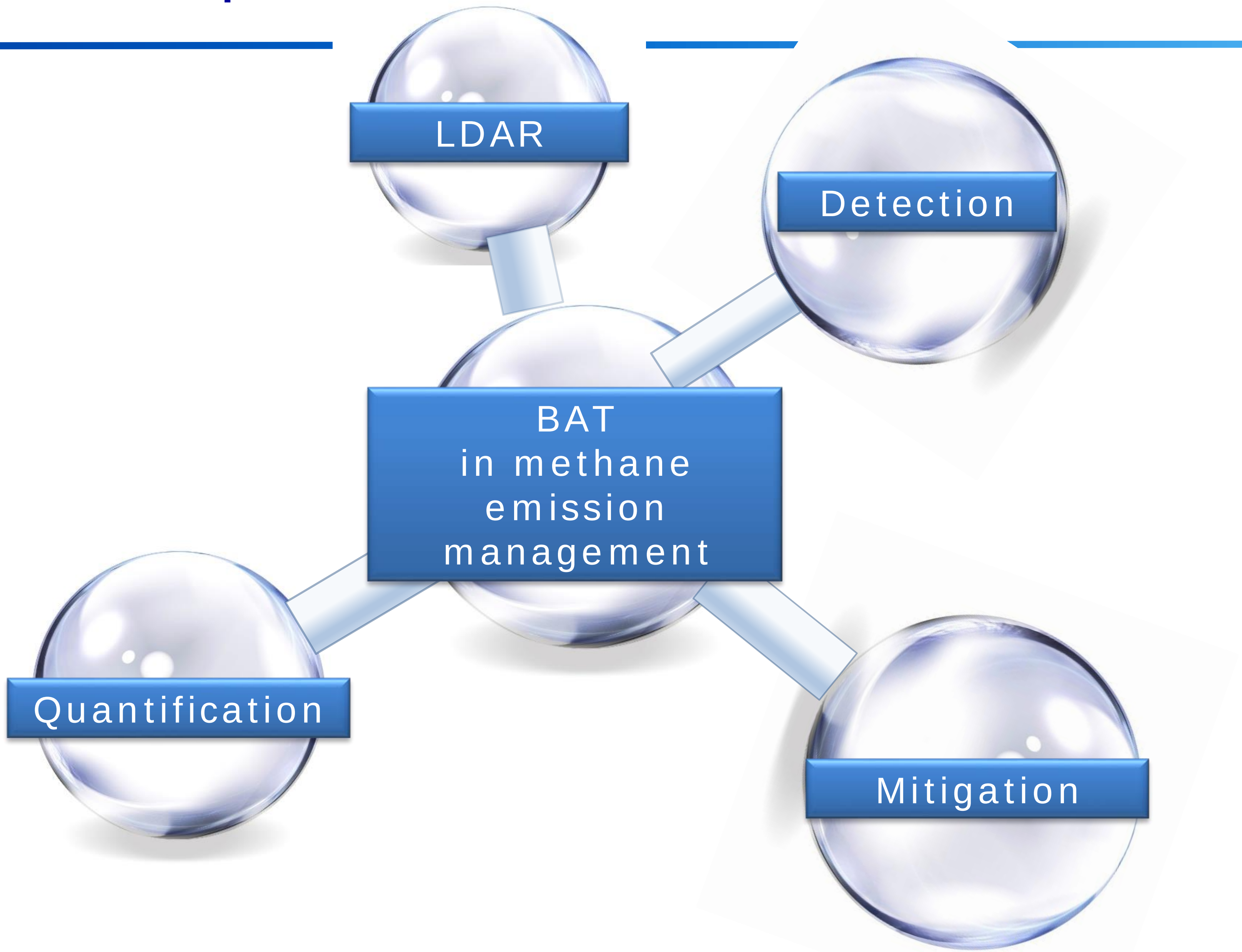
Pascal ALAS

Best Available Techniques

- ✓ Methane emission detection, quantification and mitigation well known and emerging technologies are numerous in the gas industry.
- ✓ But not necessarily equally known/applied across the gas value chain
- ✓ That presentation is not exhaustive. But meant to cover common technics used in gas infrastructures.
- ✓ For more completeness please refer to the GIE/Marcogaz Report



Best Available Techniques



LDAR (Leak Detection And Repair)

LDAR : the very basis of methane emission management and mitigation

Methane emission management program major condition of success →	**Periodic LDAR program**

Identifying and quantifying the Methane emissions →

- Make an inventory and classify sources
- Make decisions on the mitigation strategy to apply

Repair, trace and follow-up →

- Rapidly reduce the original emission numbers
- Confirm the strategy efficiency
- And that the proper maintenance/repair is applied
- Making possible a transparent periodic reporting

LDAR Methodology

System of procedures used to identify and repair leaking components, in order to minimize methane emissions

1 Inventory of fugitive emission sources at the facility

Documentation analysis and identification of potentially leaking elements

2 Definition of leaks

Definition of leak classification criteria

3 Detection/Measurement program

Onsite monitoring and detection of methane leaks, additional leak identification, emission estimation/ quantification, classification of leaks

4 Maintenance and repair

Immediate repairs and development of a maintenance plan based on leak classification and cost effectiveness.

5 Follow-up and traceability

Record of the leaking element, detection and repair date…

Monitoring to assess if the repair was successful

Systematic leakage search on distribution grid (GRDF example)

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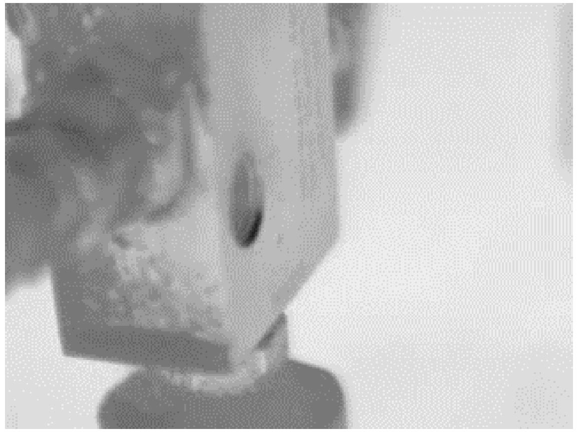
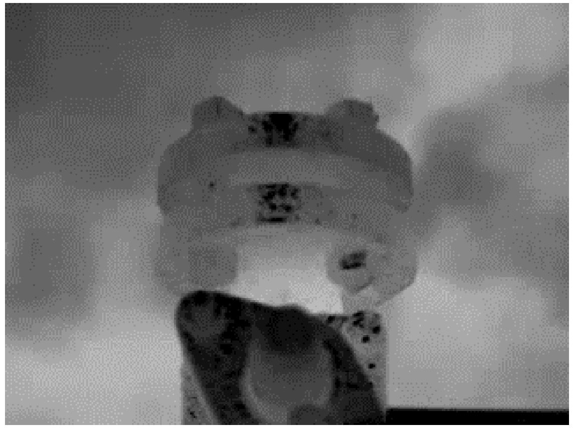
- ✓ **The gas distribution network is monitored throughout the year by a systematic leakage search, divided into two distinct methods, Pedestrian and Vehicular (depending on the accessibility of the area).**
- ✓ **~100 000 km checked every year**
- ✓ **Measurements are taken at ground level by sampling tubes mounted on a suction ramp. The vehicle, equipped with a GPS, transmits to an embedded software the necessary information to track the detected leaks.**
- ✓ **Every leak detected is reported and considered in GRDF methane emission quantification.**
- ✓ **If immediate action is needed, the emergency security office sends a specialized team for intervention. For the other leaks (lower severity) a repair program is set.**

Detection
Optical Gas Imaging and IR Camera

InfraRed Camera

Detection of gas emissions from the distance using infrared radiation. Hydrocarbons absorb infrared light at certain wavelength, IR cameras use this characteristic to generate an Optical Gas Imaging, that can be analysed by operators.





- ✓ **Operator can scan a wide potential emission area in real time.**
- ✓ **It is probably the fastest way to detect methane emissions**
- ✓ **Detection threshold is dependent on atmospheric conditions.**

Detection
Optical Gas Imaging and IR Camera

Detection
Soap Bubble Screening

Soap bubble screening

It is easy, quick and low cost to detect leaks with a soap solution. Soap bubble screening consists to spray all the junctions with a mixture of water and soap (or with a specific commercial foaming product). All the junctions (even the junctions inserted in a coating) are targeted (the valves actuator, flanges, fitting, caps, insulating joints, …).

- ✓ **This technology can be used for an efficient and fast leak detection and repair campaign, operational team are familiar with that well know historical methodology.**
- ✓ **Not effective on large openings.**
- ✓ **Accessibility can be an issue**

The bottom-up principles

BOTTOM UP

- ✓ The gas industry uses the bottom-up approach to quantify its methane emissions
- ✓ The bottom-up approach is a source specific quantification approach, the emissions from each identified sources are individually quantified
- ✓ The total emissions are calculated by adding the different source results
- ✓ The bottom-up quantification is the more suitable to properly characterize the emissions per source and efficiently mitigate them

Emissions can either be :

Measured

Field data are measured either punctually or continuously

Calculated

Field or/and design data are collected to calculate the emissions of a given source

Estimated

Emissions are modelled using an Emission Factor (**EF**) multiplied by an Activity Factor (**AF**)

- the **EF** represent a typical emission from a component or an emission event
- the **AF** can be the number of emitting components, the number of events, the pipeline length …

Marcogaz Reporting Methodology (I)

"Bottom > Up" methodology: based on an aggregation of collected data from the field (>< "Top > Down")

Total CH_4 emissions

=

Σ(**Emission factor** * **Activity factor**)

Emission factors describe typical methane emissions of a component or part of the gas system (e.g. valve, pipeline section).

The **Activity factors** are the population of emitting components such as pipelines (length), installed compressors, the number of venting activities, accidental perforation, etc.

Marcogaz Reporting Methodology (II)

The first step is to collect data on CH_4 emissions for EU28.

1) To **collect data** from different european companies

Included emissions

- ✓ Fugitive emissions
- ✓ Vented emissions (maintenance + incidents + operations)
- ✓ Unburned CH_4 in combustion processes

2) To check the **correlation** between CH_4 emissions and Activity Factor

3) Conclusion on **representative dataset**

Marcogaz Reporting Methodology (III)

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Example

METHANE EMISSION Calculation for Distribution

Organisation	
Company:	
Emissions for the Year:	
Responsible Person:	

Natural Gas Composition		
Average Methane Content of Natural Gas:		% (Vol.)
Density of Methane:	0,7175	kg/m³
Conversion Factor from m³ Nat.gas to g CH	0	g CH4 / m³ Gas

Calculation

			Activity Factors		Emission Factors						Total Emissions		Source for own factor			
					Marcogaz Range*				Company		Nat.Gas	Methane				
No.	System Category	Pressure	Data	Unit		Minimum	Maximum		Data	Unit	m³/a	g/a	Measurement	Literature	Estimation	Remark (please specify, if possible)
1.	Distribution Lines															
1.1	Grey cast iron with lead joint	Low		km	M			M		m3/km						
		Medium		km	M			L		m3/km						
		(1)		km						m3/km						
1.2	Ductile cast iron	Low		km	L			L		m3/km						
		Medium		km	M			L		m3/km						
		(1)		km						m3/km						
1.3	Steel	Low		km	L			L		m3/km						
		Medium		km	L			L		m3/km						
		(1)		km						m3/km						
1.4	Steel with cathodic protection	Low		km	L			L		m3/km						
		Medium		km	L			L		m3/km						
		(1)		km						m3/km						
1.5	Steel without cathodic protection	Low		km	L			M		m3/km						
		Medium		km	M			M		m3/km						
		(1)		km						m3/km						
1.6	Plastic Polyethylene PE	Low		km	L			M		m3/km						
		Medium		km	M			L		m3/km						
		(1)		km						m3/km						
1.7	Plastic PVC	Low		km						m3/km						
		Medium		km						m3/km						
		(1)		km						m3/km						

Quantification bottom-up
FID

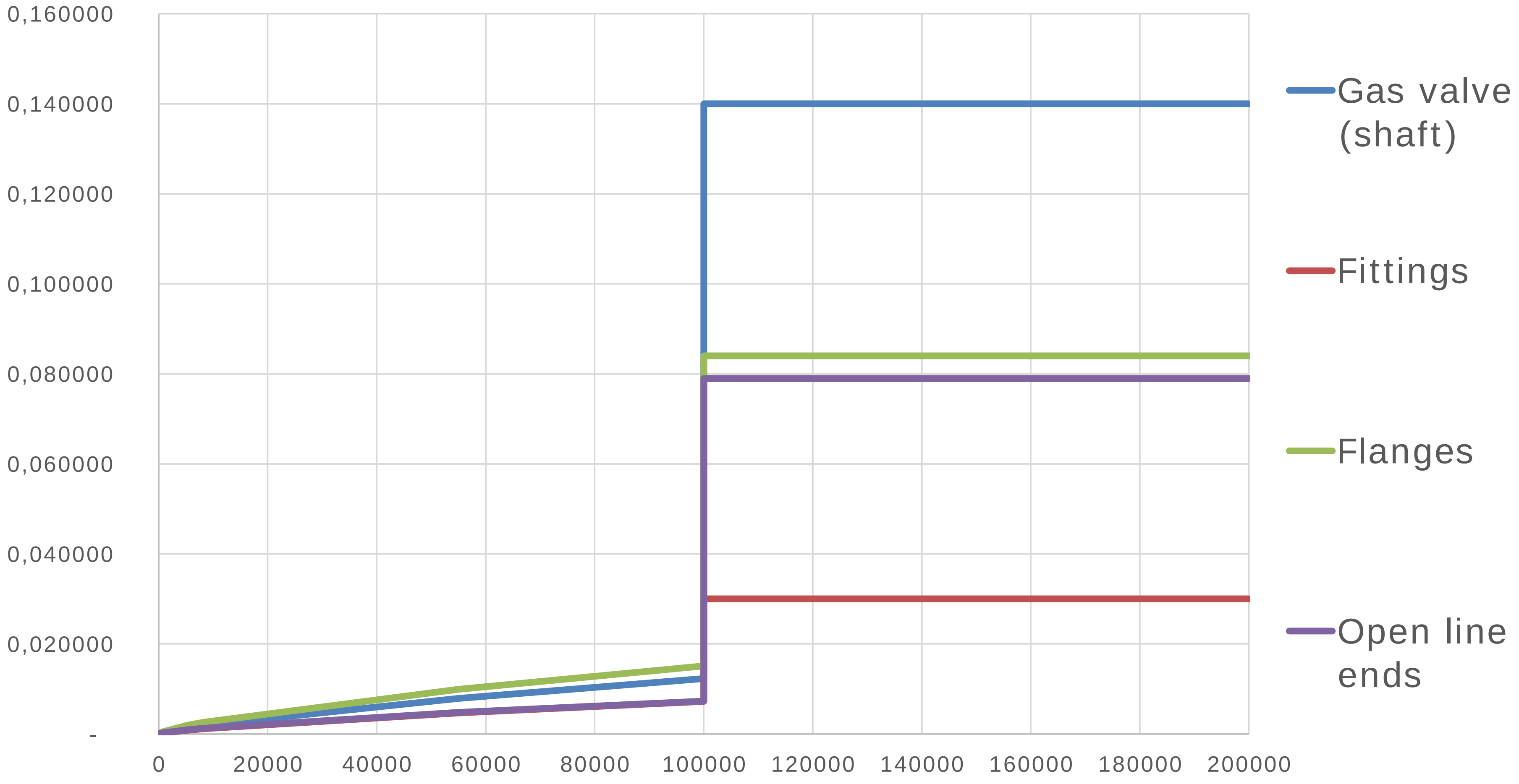
Flame Ionisation Detector

The operation is based on the ionization of hydrocarbon molecules in an hydrogen flame. These ions, will generate an electrical signal varying with the concentration.

- ✓ **It enables to detect the methane concentrations from very low levels, reacts not only to methane, but to other hydrocarbons as well.**

Quantification bottom-up
EN15446 Application

Correlation curve KG CH_4 per Hours / PPM



Quantification bottom-up
Bagging

Bagging

An equipment piece is enclosed in a bag to determine a total leakage flow rate based on a suction flow and a measured hydrocarbon concentration.

- ✓ **Accurately measures emissions from individual or small groups of leaks in a controlled environment.**
- ✓ **But long and labor intensive (20 to 30 minutes per measurements)**

Examples of calculated emissions :

Vented Volumes

When a pressurized system is vented (ie : a part of a compressor station when an emergency stop occurred), the emitted data can be easily derived from the geometrical volume and the differential pressures

Chromatographs

The emissions related to chromatograph sampling flow can be calculated, simply using the constant, set on site, sampling flow rate.

Quantification
Top-down methodology

TOP DOWN

TOP-DOWN quantification methodologies are mainly based on aerial measurements of the methane concentration in ambient air, E.G. :

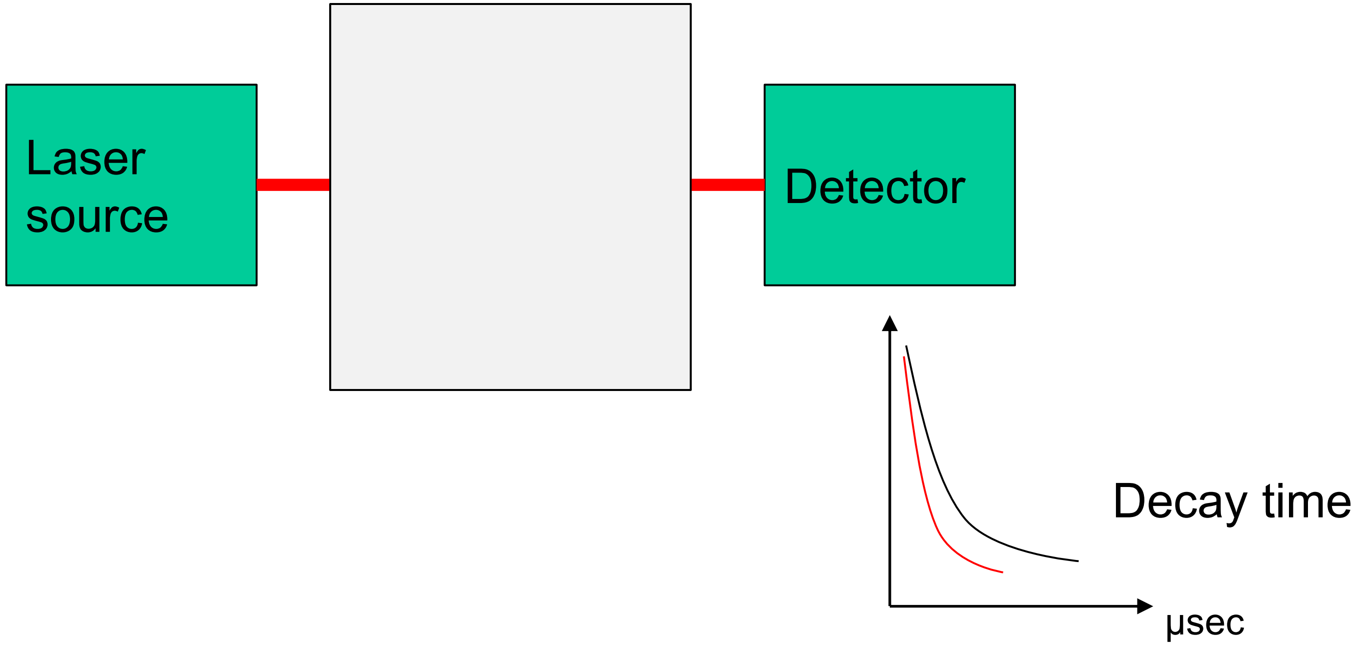
- ✓ **aircraft measurements**
- ✓ **ground based / area (facility) downwind measurements**
- ✓ **but also satellite technologies (I.E. : the Copernicus program)**

What ever will be the methodology, top-down quantification will depend on a challenging reverse dispersion modelling to properly assess a given methane flux from an emission source

Quantification - Top-down
Laser based technology

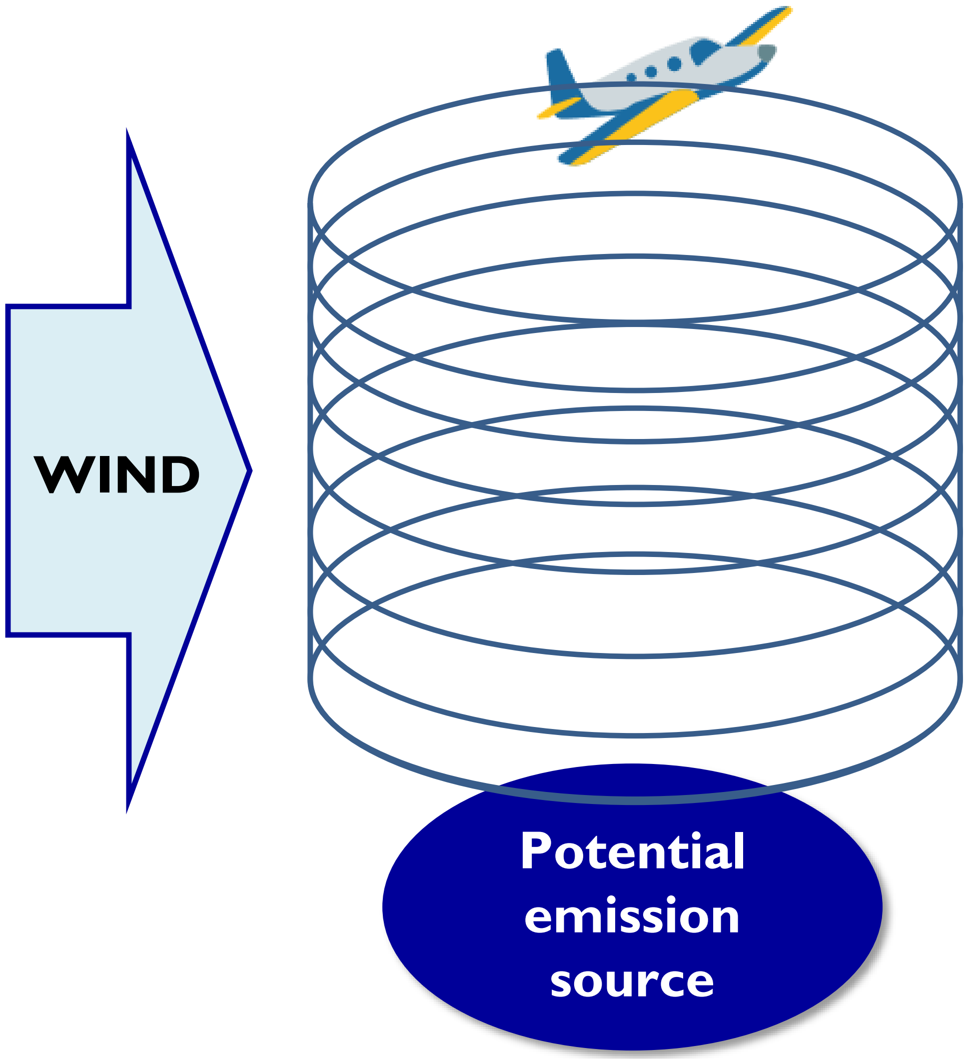
Near InfraRed laser based Spectroscopy

Derives the methane concentration from the level of absorption of a specific wavelength laser by the analyzed air sample



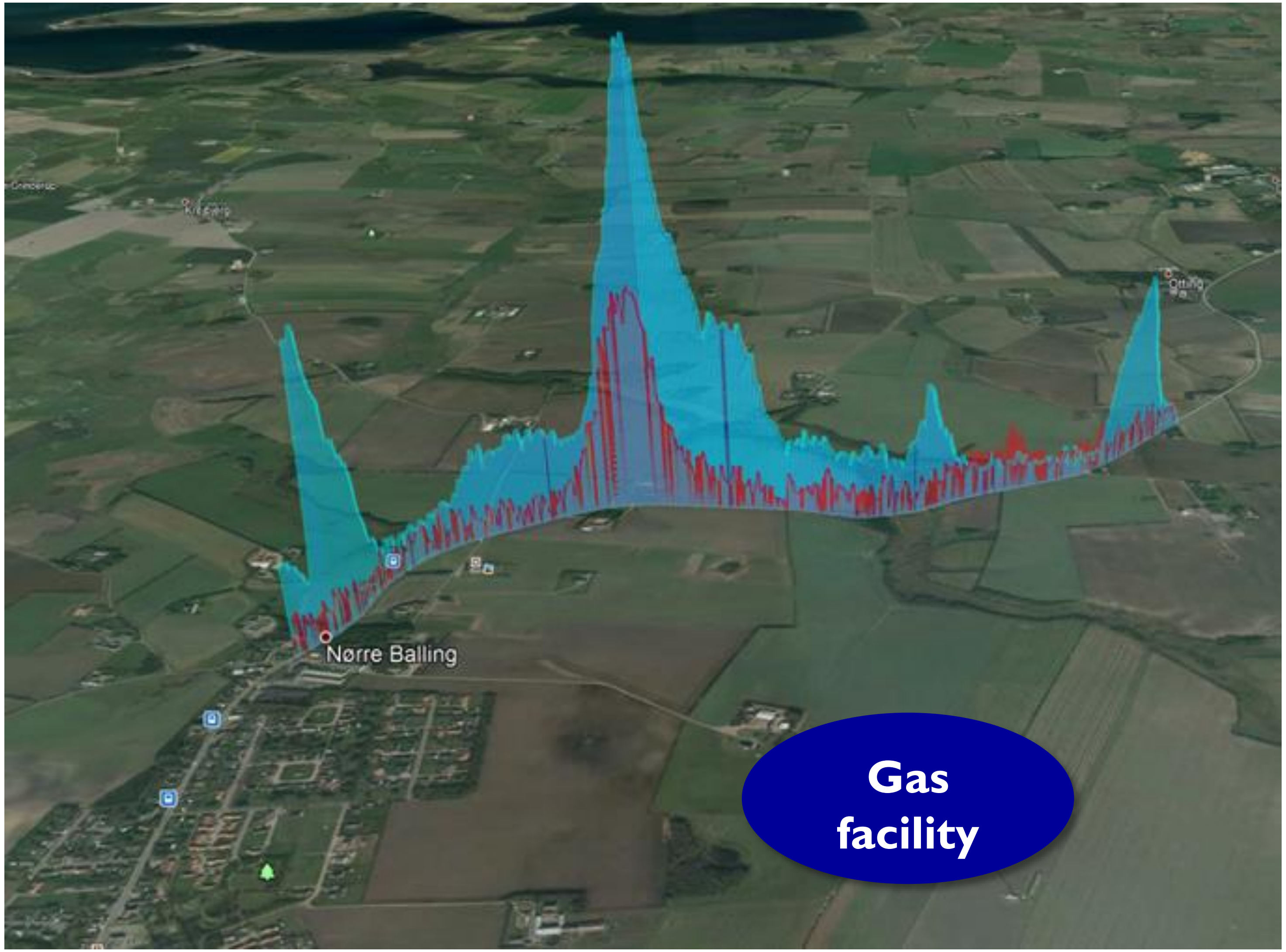
- ✓ **Measure atmospheric concentration down to ppb order of magnitude.**
- ✓ **Used for aircraft and vehicle based measurements**
- ✓ **Capability in isotopic analysis/Ethane measurements**

Quantification - Top-down
Aerial based measurement

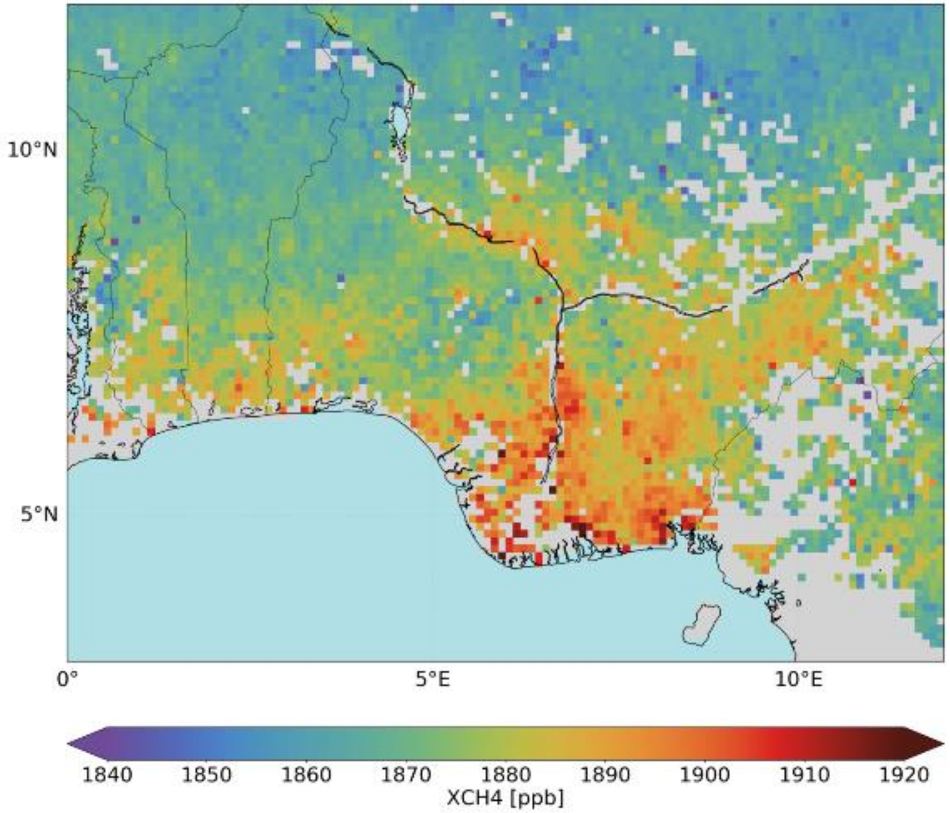


- ✓ **Measurement of UP-WIND and DOWN-WIND methane concentrations blended in the atmosphere at each levels**
- ✓ **The methane flux is derived from the concentration measurements**
- ✓ **The type of source can be identified by isotopic analysis/ethane measurement**

Quantification - Top-down
Vehicle based measurements



Quantification - Top-down
Satellite based measurements



— Methane over wetlands in Nigeria

- ✓ **Copernicus Sentinel 5P**
- ✓ **Satellite based Multi spectral imaging spectrometer to image methane concentrations in the Troposphere (Tropomi)**
- ✓ **7x7 km resolution**

Source : ESA site - http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Methane_and_ozone_data_products_from_Copernicus_Sentinel-5P - 03/2019

Quantification - Top-down and bottom-up
The key elements

- ✓ **The bottom-up approach is source specific, which allow the industry to efficiently spot and tackle its emissions, the difficulty being to properly quantify when estimations are necessary and to exhaustively account for all the potential sources.**

- ✓ **The top-down approach is global as it relies on atmospheric concentration measurement but the modeling process used to quantify the emissions based on the concentration is challenging, as well as the complementary analysis necessary to differentiate the sources.**

- ✓ **Both are improving, should be used, potential gaps explained (numerous ongoing studies in Europe)**

Mitigation

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY	Types of emissions						
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Measurement devices (chromatographs, analysers ...)		§ 6.4.2		§ 6.5.2.2			
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Flares					§ 6.5.2.3		§ 6.7

Mitigation

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY	Types of emissions						
	Fugitives		Vented				Incomplete combustion
			Operational emissions			Incidents	
Groups of assets	Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop		
Main lines & service lines	§ 6.4.1	§ 6.4.2	§ 6.5.2.1			§ 6.6	
Connections (flanges, seals, joints)		§ 6.4.2					
Measurement devices (chromatographs, analysers …)		§ 6.4.2		§ 6.5.2.2			
Valves² (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
Safety valves		§ 6.4.2				§ 6.6	
Combustion devices (turbines, engines, boilers…)		§ 6.4.2	§ 6.5.2.1		§ 6.5.2.3		§ 6.7
Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
Flares					§ 6.5.2.3		§ 6.7

Mitigation

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Valves[2] (regul. stations, blending stations, compressor stations, block valve stations)		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2			
Pressure / Flow regulators		§ 6.4.2		§ 6.5.2.2			
Safety valves		§ 6.4.2				§ 6.6	
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Compressors & compressor seals		§ 6.4.2	§ 6.5.2.1	§ 6.5.2.2	§ 6.5.2.3	§ 6.6	
Flares					§ 6.5.2.3		§ 6.7

Mitigation, operational emissions
Purging

- ✓ **Instead of purging gas from pipeline sections meant to be maintained, the pressure in the pipeline is first lowered as much as possible using consumptions**

- ✓ **Then the section is isolated and the gas pumped and recompressed to the next section in service using a mobile compressor**

- ✓ **The residual gas can be flared**

Mitigation

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY		Types of emissions						
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				Operational emissions				
		Permeation	Leaks due to connections	Purging/venting for works, commissioning and de-commissioning	Regular emissions of technical devices (e.g. pneumatic)	Start & Stop	Incidents	
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Mitigation

gie marcogaz Energy Community

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY		Types of emissions						
		Fugitives		Vented				Incomplete combustion
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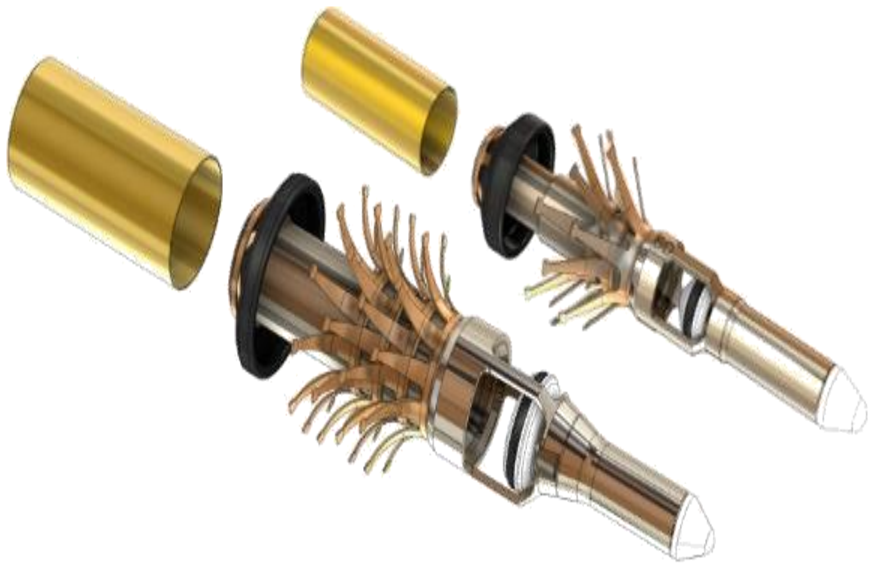
	Flares					§ 6.5.2.		§ 6.7

Mitigation: Incidents
Example from distribution network

- ✓ **Improved organisation and prevention actions to avoid third party damages on network:** improvements of network cartography accuracy, analysis and feedback after third-party damages, partnerships with relevant stakeholders such as the national federation of civil works or local authorities, outreach and prevention actions on third party damages

- ✓ **Maintenance policy & modernization and renewal program** that takes into account the feedback from incidents on these types of installations

- ✓ **Protection devices on new and existing service lines:** automatically stop gas flow in case of third party aggression.



Mitigation

marcogaz
TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY

Groups of assets	Types of emissions						
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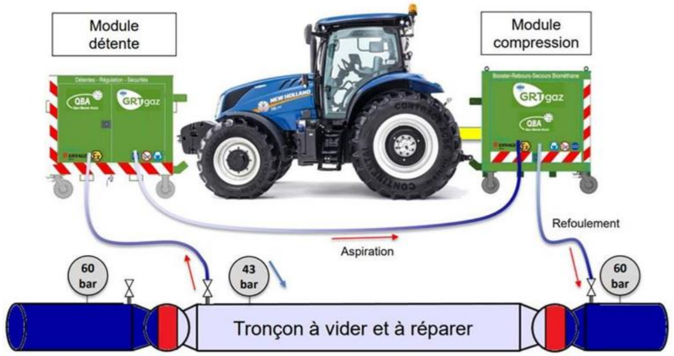
Flares					§ 6.5.2.3		§ 6.7

Mitigation : Start/Stops
Slow depressurisation

✓ **Mobile small size compressor that can be used for natural gas compressor slow depressurisation**



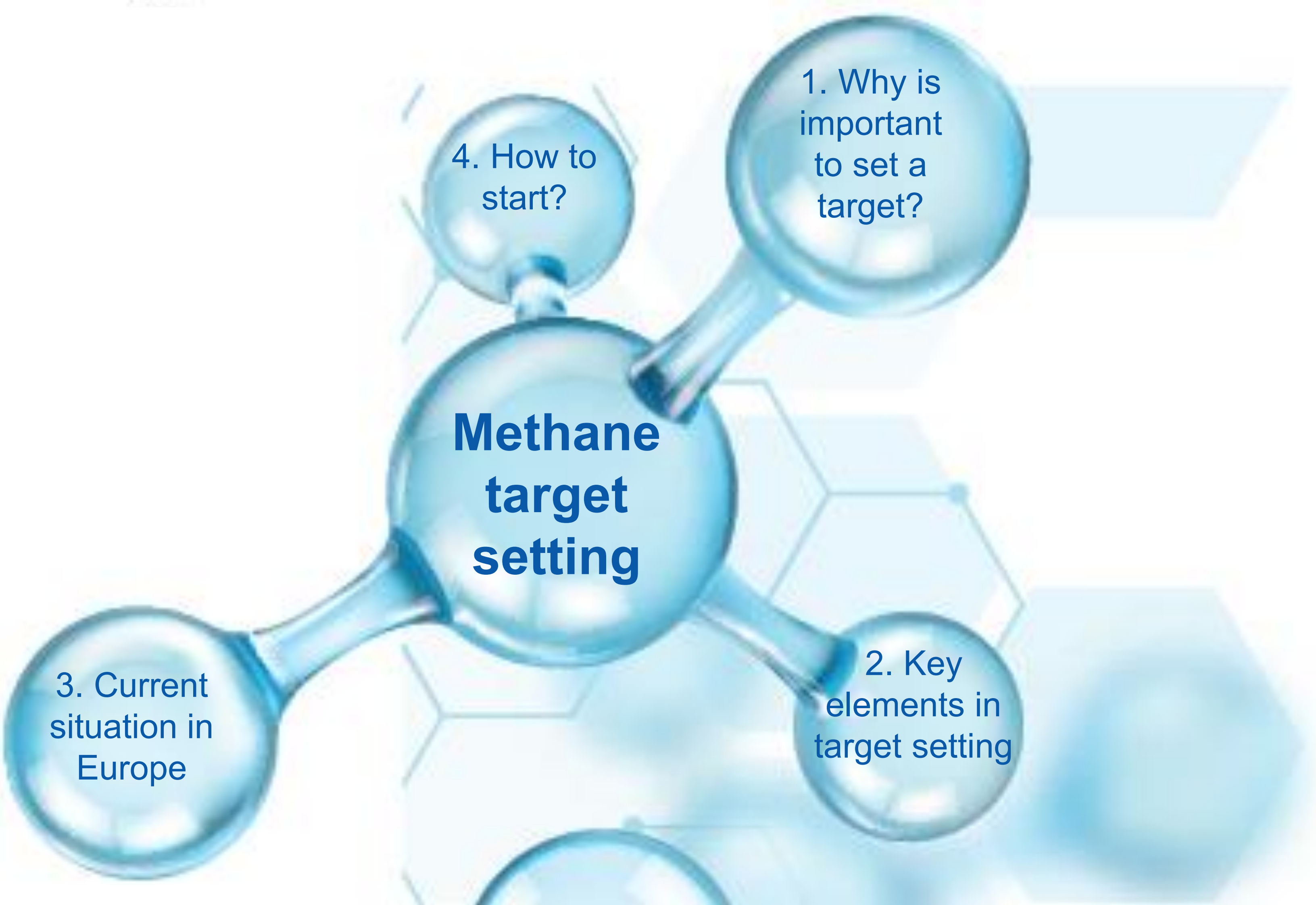
✓ **Can be shared between several sites / installations on the same site**

COFFEE BREAK

Methane target setting

Jose Miguel TUDELA

Content


Methane target setting
1. Why is important to set a target?
2. Key elements in target setting
3. Current situation in Europe
4. How to start?

Content

1. Why is important to set a target?
4. How to start?
Methane target setting
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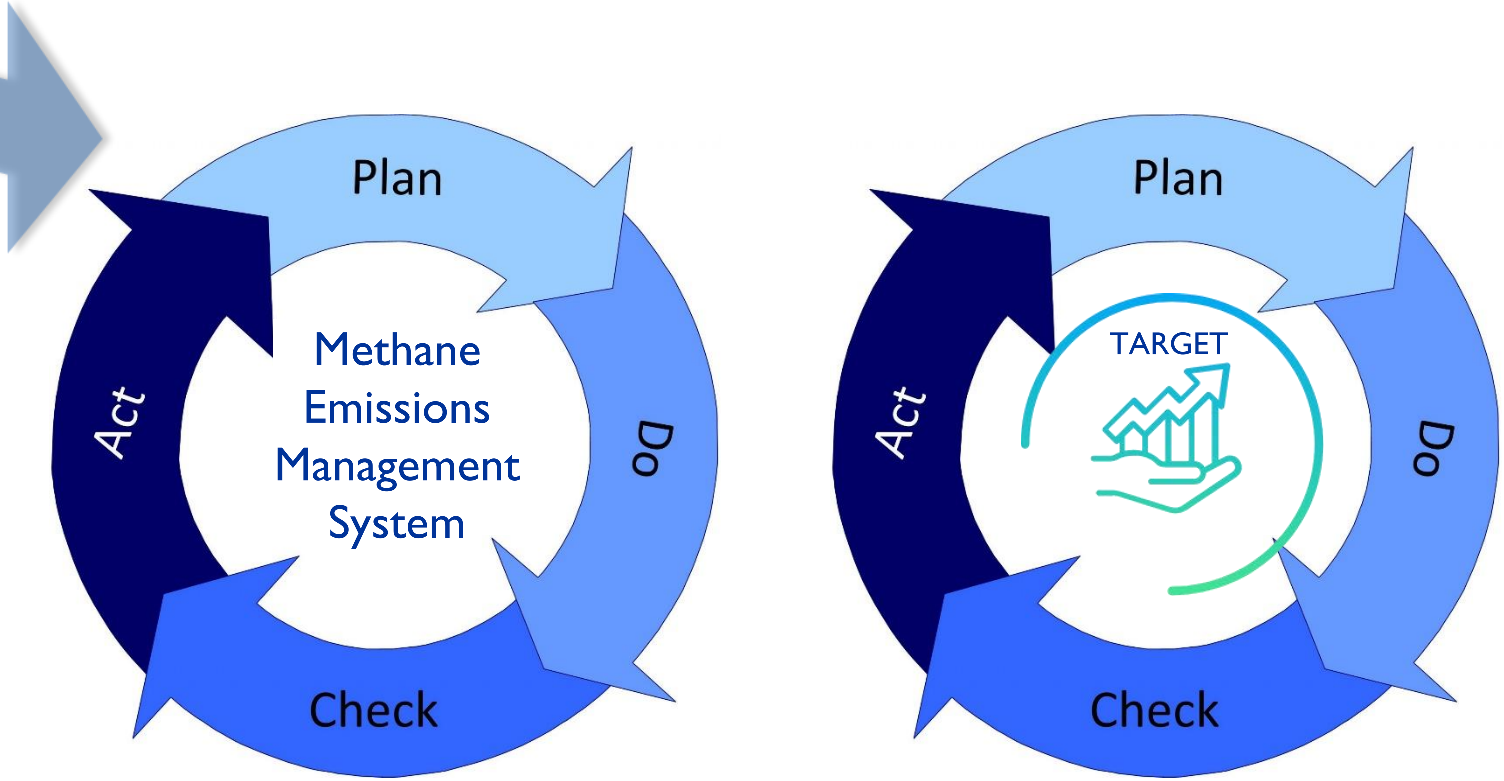
1. Why is important to set a target?

INTERNAL APPROACH

Identification → Detection → Quantification → Reporting → Verification → Mitigation



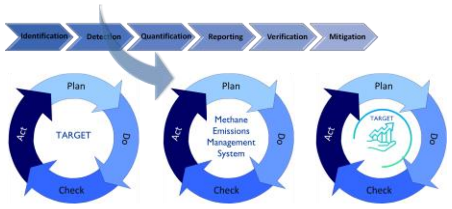
1. Why is important to set a target?

EXTERNAL APPROACH

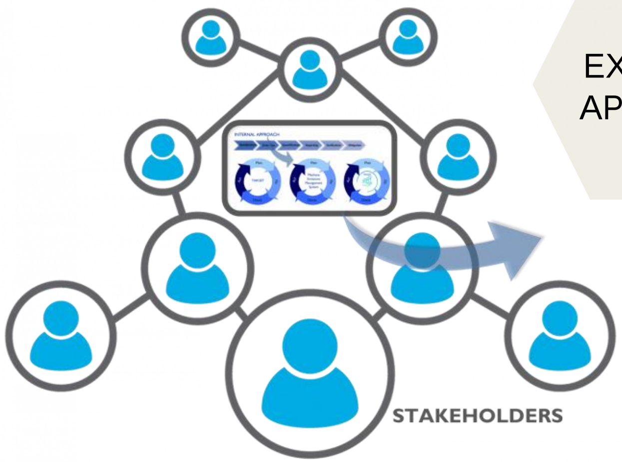
COMMITMENT

TRANSPARENCY

1. Why is important to set a target?



INTERNAL APPROACH



EXTERNAL APPROACH

Why Set a CH_4 Target?

stimulating INNOVATION

Demonstrating TRANSPARENCY AND COMMITMENT

Preparing for future REGULATIONS

Achieving COST savings

Planning for necessary INVESTMENT

Minimizing and managing GHG/Methane RISKS

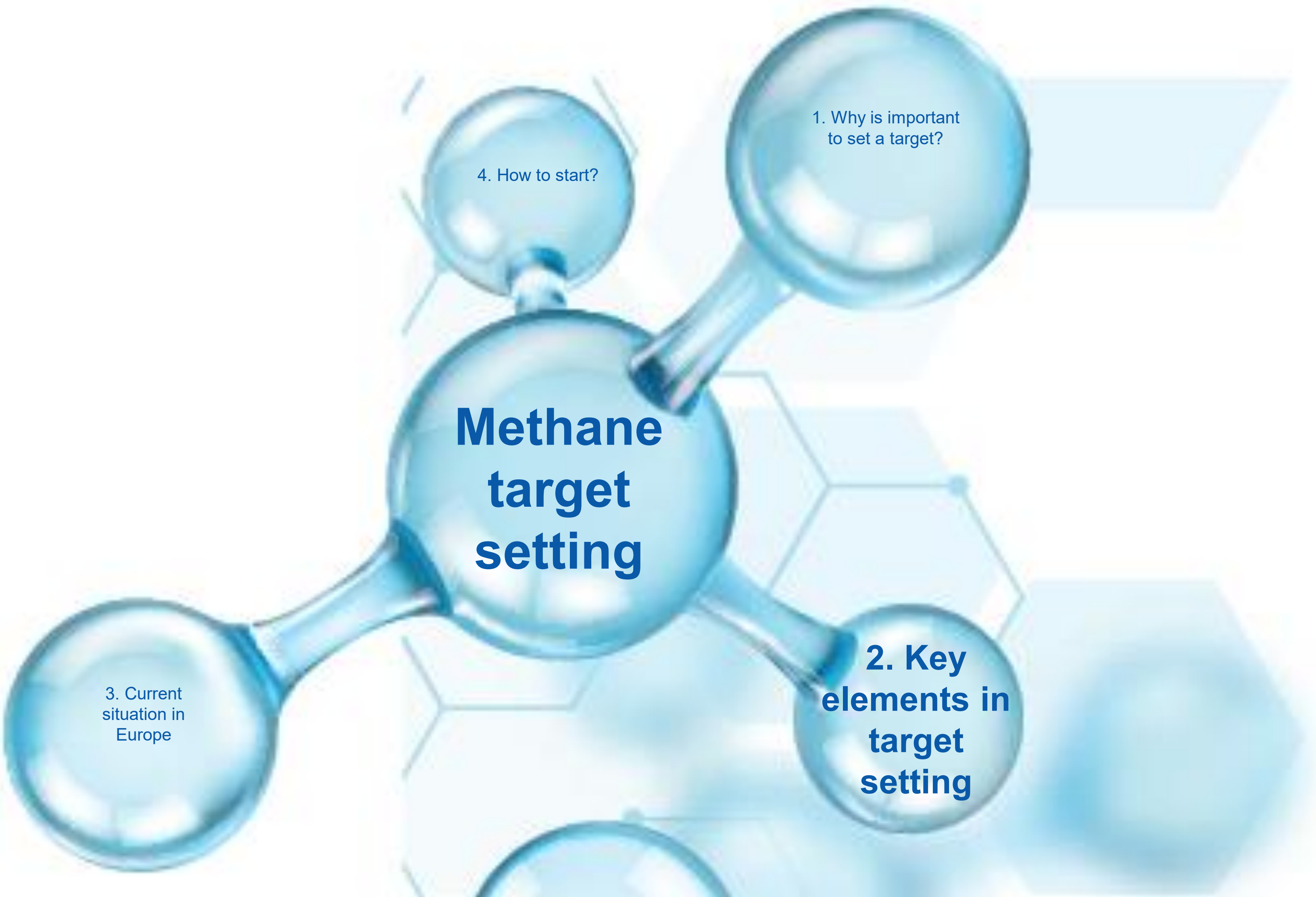
Participating in VOLUNTARY PROGRAMS

Demonstrating Leadership and CORPORATE RESPONSABILITY

Focusing on what matters in the gas value chain to play a real role in ECONOMY DECARBONIZATION

Source: GHG Protocol and own elaboration

Content



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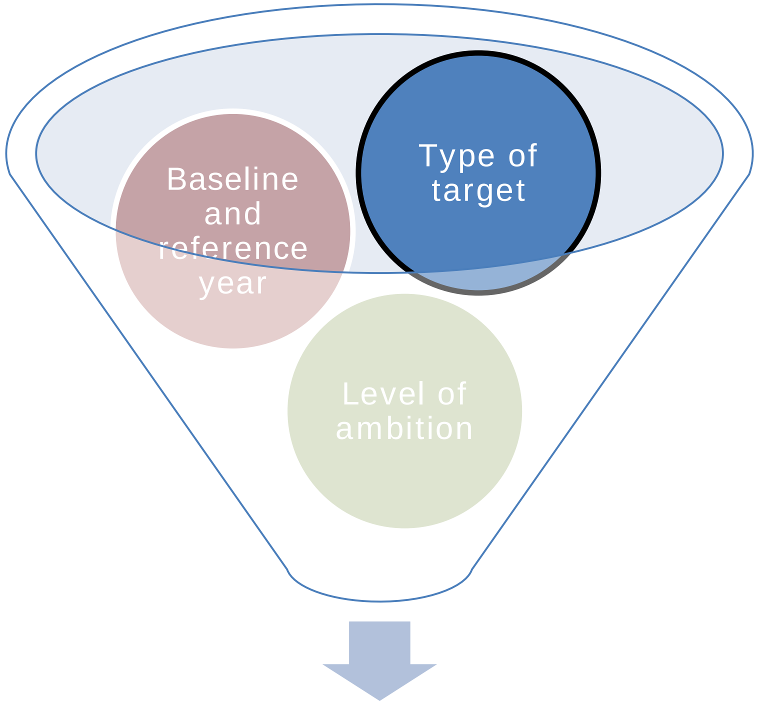


Key elements in target setting

Absolute vs intensity target

An absolute target describes a reduction in actual emissions in a future year when compared to a base year.

Intensity target describes a future reduction in emissions that have been normalized to a business metric when compared to the same normalized business metric emissions in a base year.

It is important to well-define the relationship of scale between the absolute quantities and the normalization factors. In general, when using intensity targets, organizations should define the target in ways that align with business decision making and in ways that allow clearer communication of performance to stakeholders.

GHG vs Methane Targets

In general, GHG targets are set in CO_2e and include all GHGs derived from an organization activities covered by the kyoto:

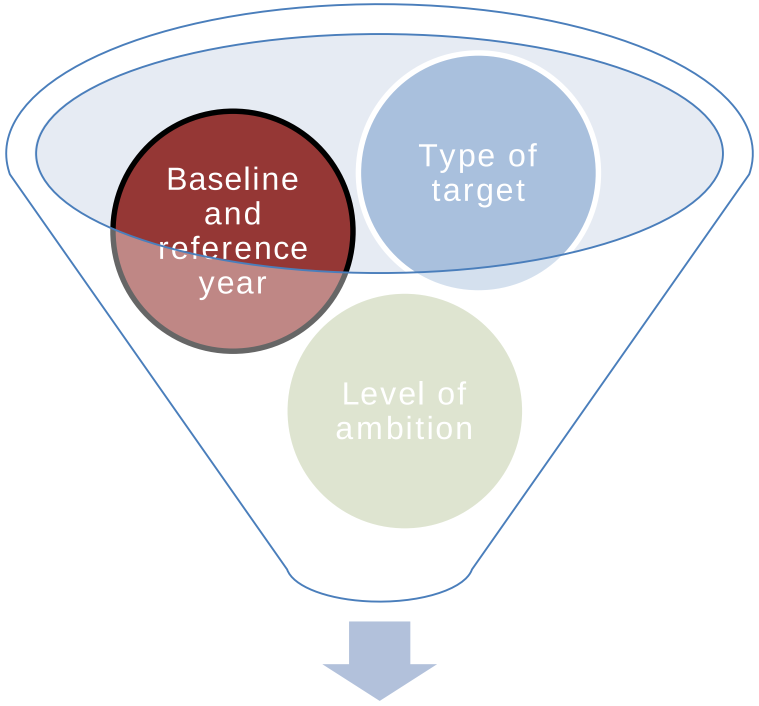
- CO_2
- CH_4
- N_2O
- HFCs
- PFCs
- SF_6
- NF_3

GHG targets can relate to Scope 1, Scope 2 and/or Scope 3 emissions in full or in part.

Methane specific targets are usually set in tCH_4 and are set individually apart from a global GHG target.

Investors are increasingly asking for specific methane targets in the O&G sector, so it is considered a Best Practice to set Methane Specific targets.

2. Key elements in target setting



Key elements in target setting

Baseline year

The base year is the year against which you are comparing your reduction target

Organizations can have:

- Year-on-year rolling target (base year will be the previous reporting year)
- Targets based on financial years.
- Target based on average emissions over a period of time (e.g. 5-year average).

Reference year

Target year defines the target completion date and depends on the length of the commitment period.

Organization can have:

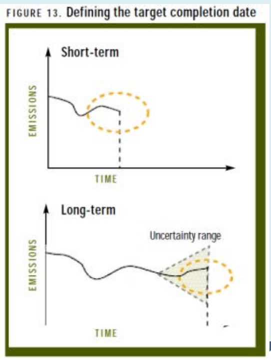
- A single year commitment period.
- Multi-year commitment period.

The target completion date determines whether the target is set for the short, medium or long term.

Best Practices for GHG targets include the setting of at least two targets to cover both both the medium (5-15 years) and long time frames (>15 years).

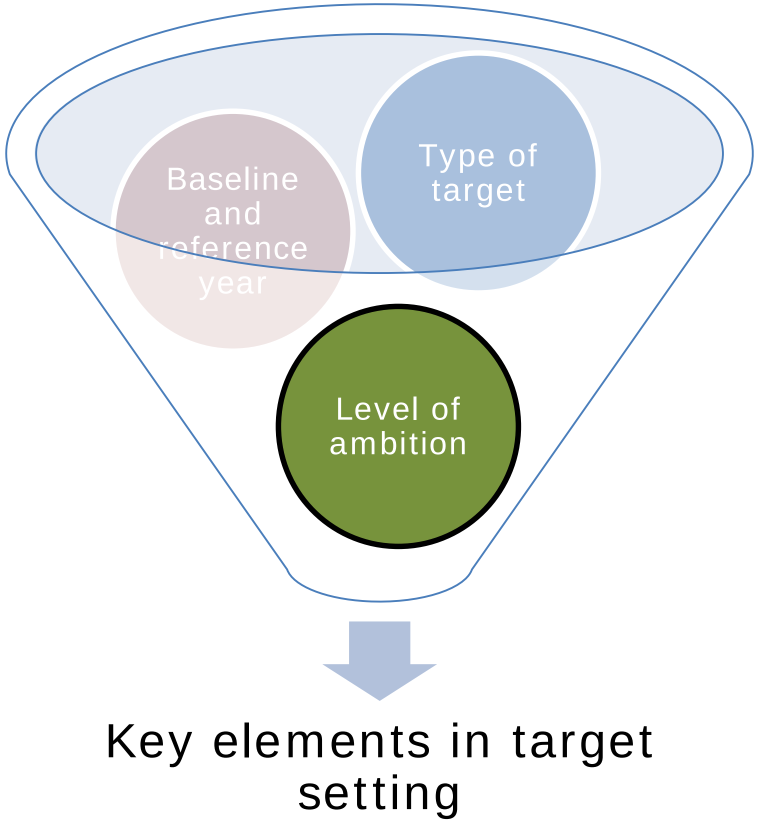
For Methane Targets, International initiatives such as the Global Methane Alliance refers to 2025 and 2030.

Many companies may set long-term visions for 2050 and beyond on emissions. Adding intermediate targets and/or milestones increases the credibility of these long-term commitments by giving investors more clarity on how this vision is going to impact the short-term.



Source: GHG Protocol

2. Key elements in target setting



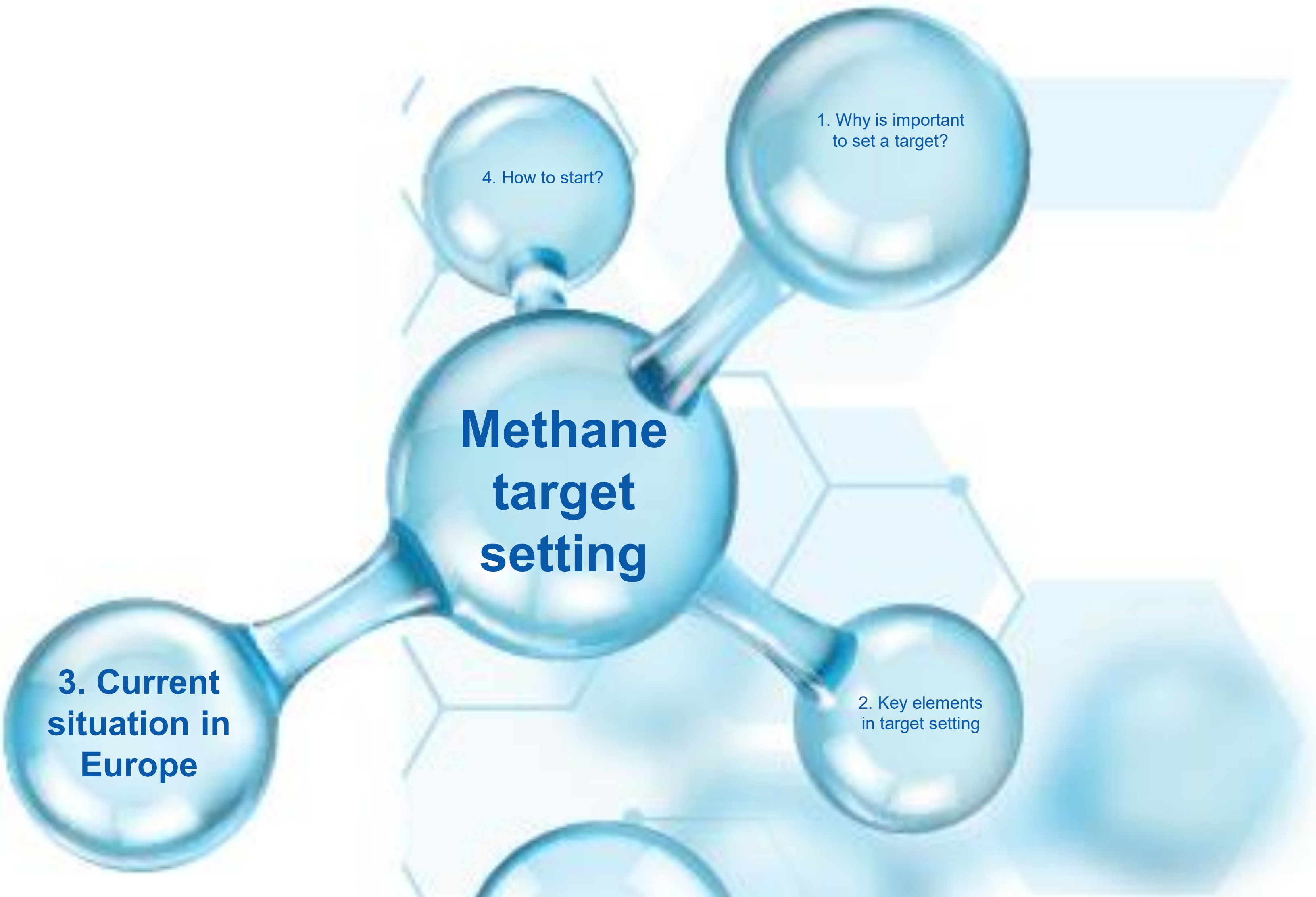
Level of ambition

Main factors to determine the level of ambition include:

- Methane reduction potential based on the implementation of BATs.
- Drivers affecting methane emissions, this is, the relationship between methane emissions and business metrics, investment and growth strategy.
- International/national initiatives with a specific level of ambition (eg. MGA ambition level: reduce by 45% by 2025 and 60%-70% by 2030 methane emissions compared to 2015).
- Alignment with private companies (benchmarking of methane targets with similar organizations).
- Science based targets scenarios to ensure that targets are in line with the 1.5ºC or well below 2°C scenario of the SBTi.

Generally, organizations that have not previously invested in energy and other GHG reductions should be capable of meeting more aggressive reduction levels because they would have more cost-effective reduction opportunities.

Content


1. Why is important
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Methane
target
setting
3. Current
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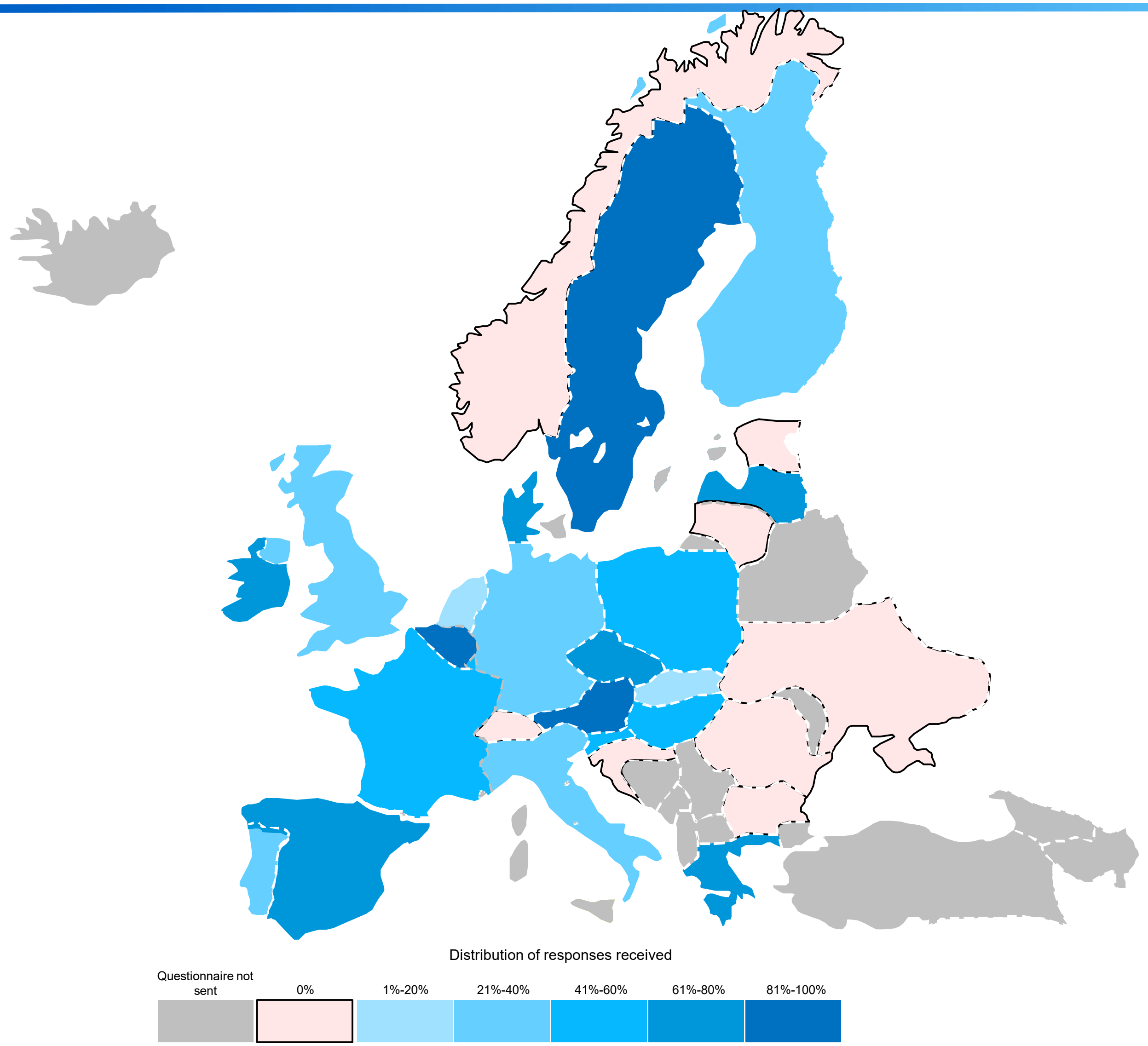
2. Key elements
in target setting

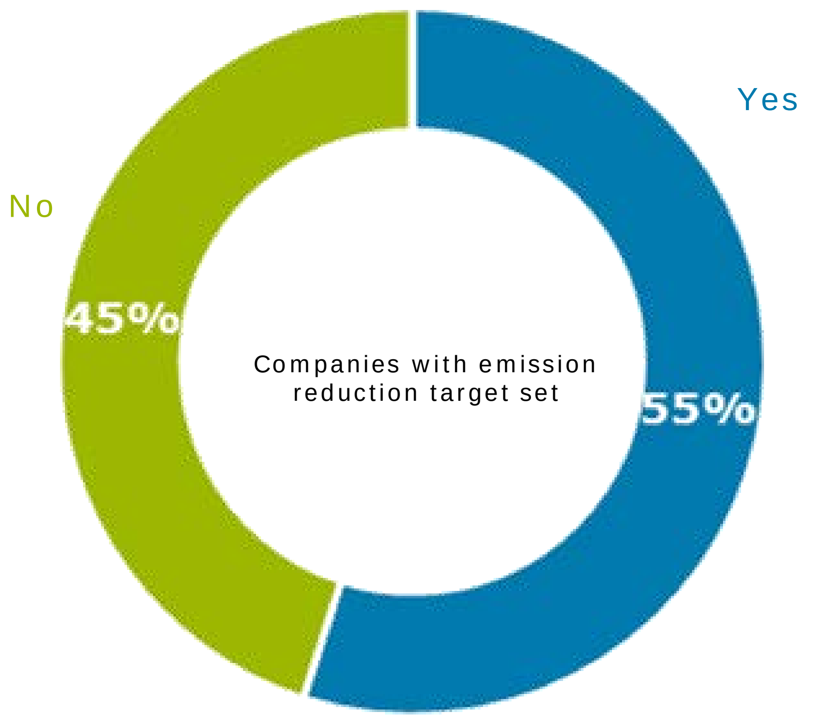
3. Current situation in Europe

A short questionnaire on CH_4 emissions was sent. Up to date, answers from 40 companies have been received covering all parts of the gas value chain.



3. Current situation in Europe

European companies with emission reduction target



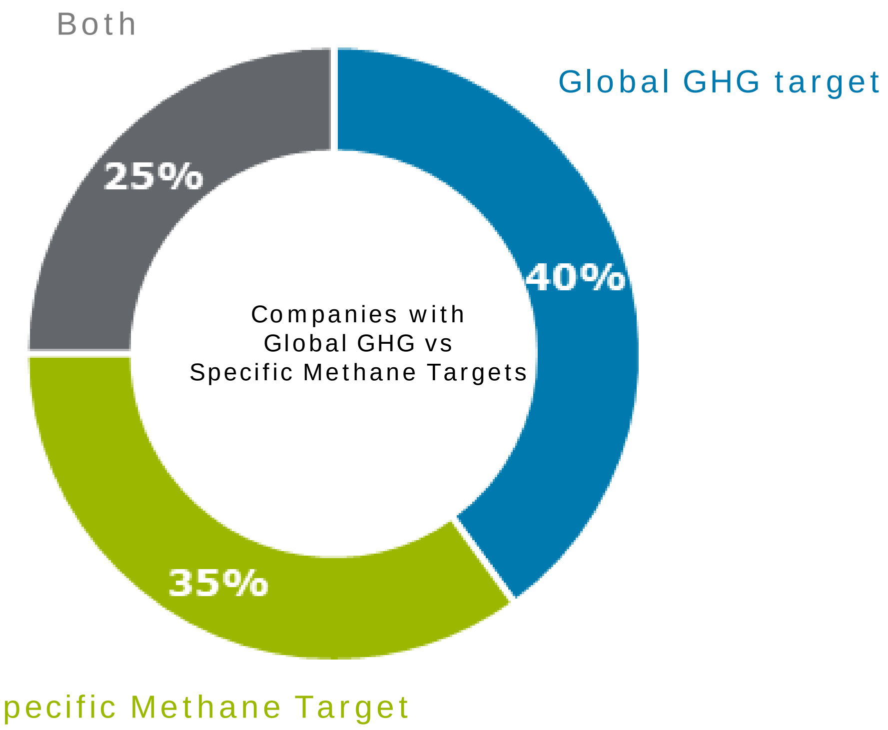
55% **of the Companies have already set Emission Reduction Targets.**

33% **of companies with no targets are willing to implement them**

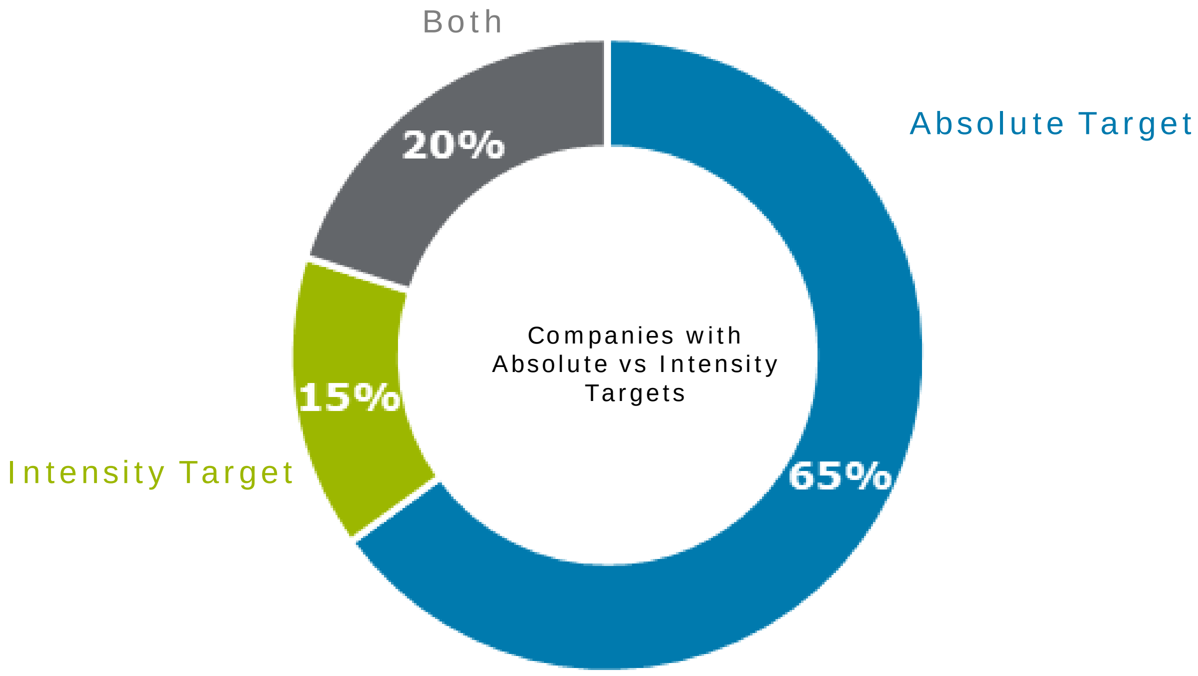
3. Current situation in Europe

TYPE OF TARGET

GHG vs Methane Targets



Absolute vs intensity target



(*)32% of companies with more than 1 target set.

3. Current situation in Europe

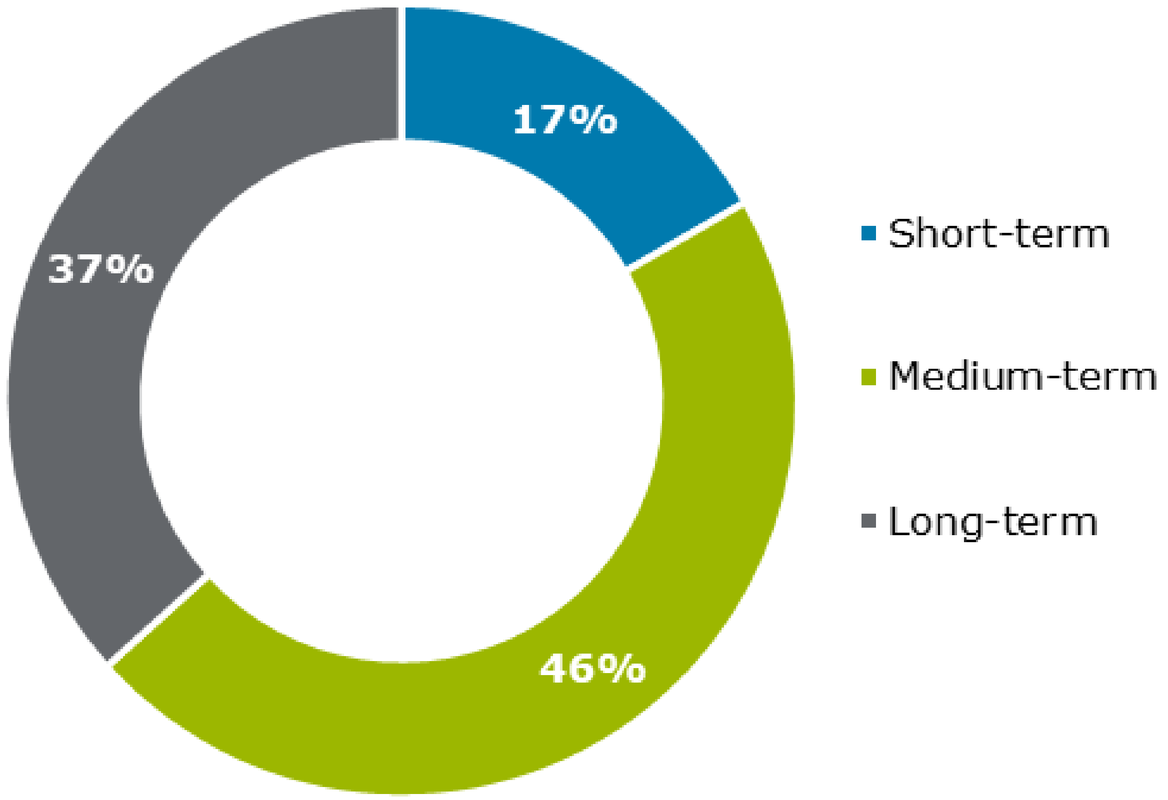
BASELINE AND REFERENCE YEAR

Baseline Year

- 2018 is the "most popular" base year among targets reported by companies.

Reference Year

- 2030 is the "most popular" target year among targets reported by companies.
- Only one company has established a target beyond 2030.

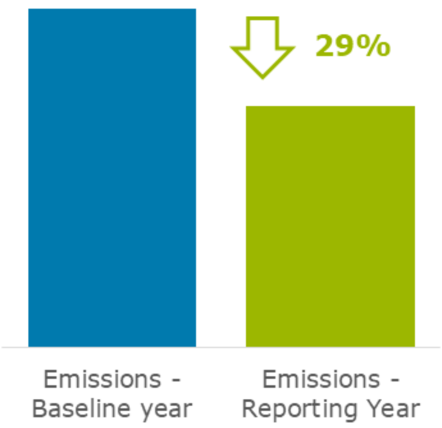


(*) *Timeframe (years): Short-term: 0-3; Medium-term: 3-10; Long-term: 10*

LEVEL OF AMBITION

How much has the gas sector reduced to date?

Methane emission reduction already achieved:



650,878 tCH_4
from 22 companies

(*) Emissions in baseline year represents 88% of European Methane emissions considered by Methane Tracker (2,582 ktCH4).

What is the level of ambition for the future?

GHG

- Most of the **GHG absolute targets** have been set for **2020**-2040 with **a level of ambition between -5% and -60%** (compared to baseline years between 2012-2018).
- Only **one company** has established a target to become **GHG neutral** by 2020.

Methane

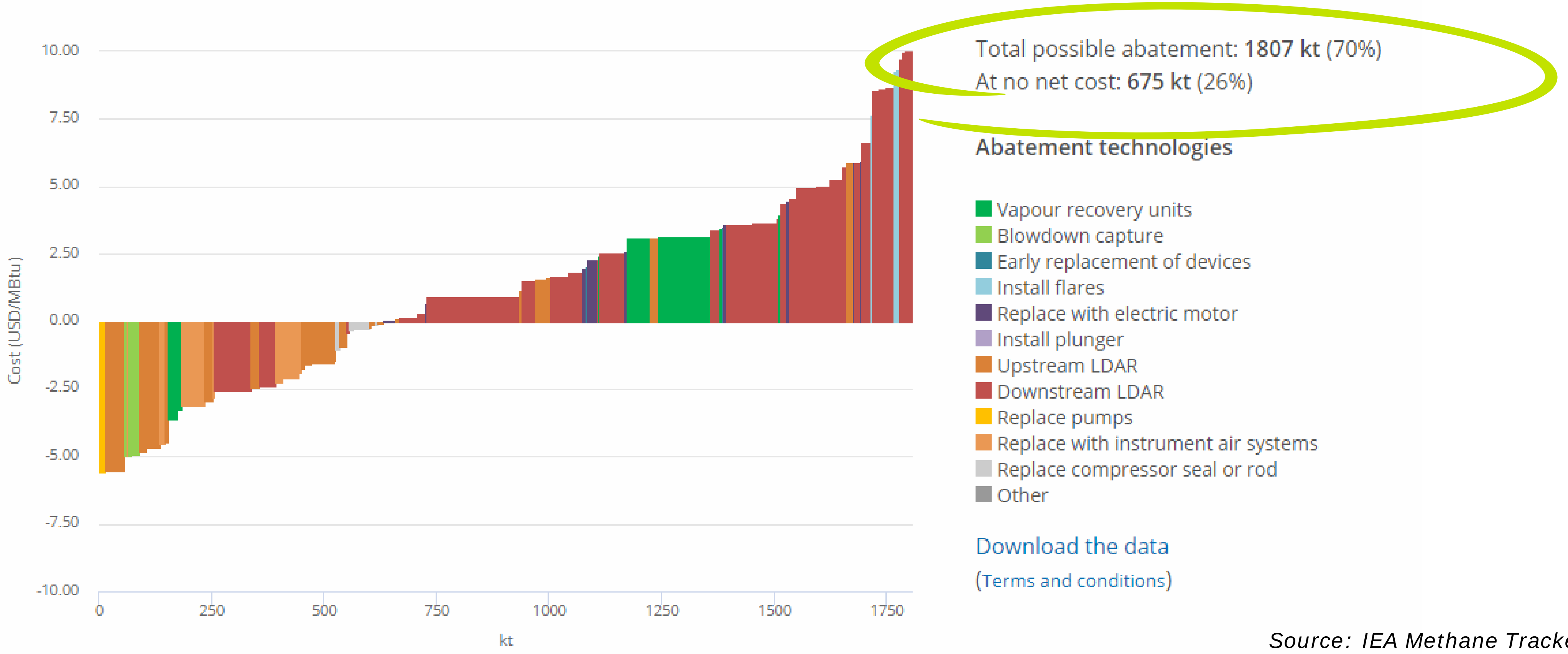
- Most of the **methane absolute targets** have been set for 2020-2025 with **a level of ambition between -7% and -66%** (compared to baseline years between 2014-2018)
- Only **two companies** have established **methane reduction targets for 2030** (reduction between 60% - 80% compared to 2014 and 2013).

3. Current situation in Europe

LEVEL OF AMBITION

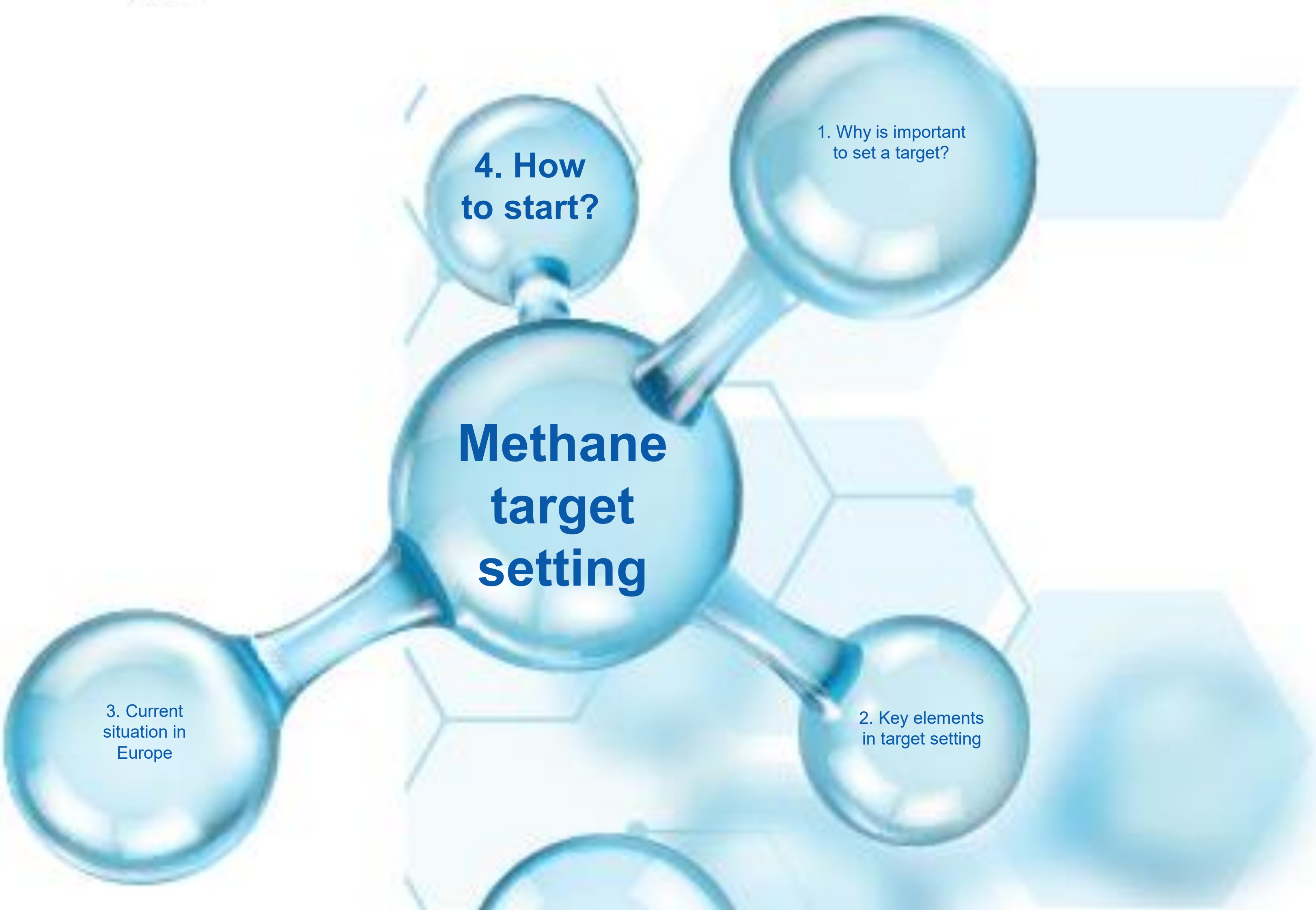
The aggregated reduction already achieved 650,878 tCH_4 means around **1/3 of the possible abatement** identified by the IEA.

Estimated abatement potential



Source: IEA Methane Tracker

Content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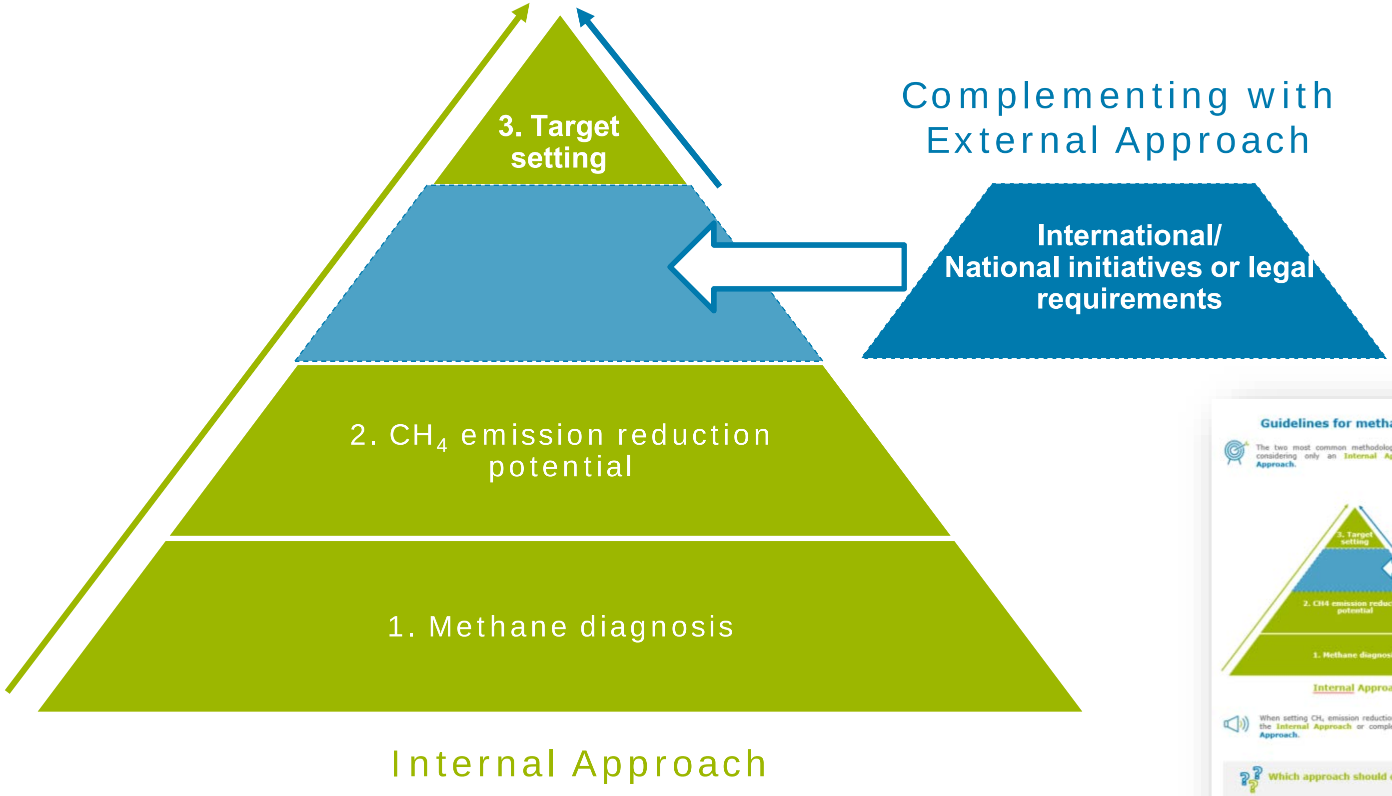
4. How to start?
A guideline in target setting

The two most common methodologies used for CH4 target setting are considering only an Internal Approach and adding an External Approach.



A Guide for Methane target setting is under elaboration, expected to be released in December 2019. A draft has been already prepared including main contents.

Collaborative initiatives

Francisco DE LA FLOR

Collaborative initiatives

gie marcogaz Energy Community

✓ Several collaboration initiatives (on voluntary basis)

✓ Gas industry contributes to increasing transparency via studies, research, analysis and initiatives, in order to overcome the uncertainty about CH_4 emissions.

CLIMATE & CLEAN AIR COALITION TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

OGCI OIL AND GAS CLIMATE INITIATIVE

Global Methane Initiative

METHANE GUIDING PRINCIPLES

ONE OUR NATION'S ENERGY FUTURE

NaturalGas EPA POLLUTION PREVENTER

GGFR Global Gas Flaring Reduction A Public Private Partnership

OIL & GAS METHANE PARTNERSHIP

THE ENVIRONMENTAL PARTNERSHIP

gie

marcogaz TECHNICAL ASSOCIATION OF THE EUROPEAN NATURAL GAS INDUSTRY

Methane Guiding Principles

A voluntary, international multi-stakeholder partnership between industry and non-industry organisations with a focus on priority areas for action across the natural gas supply chain,

✓ In 2017, a set of Methane Guiding Principles were developed collaboratively by a coalition of industry, international institutions, non-governmental organisations and academics. They focus on areas of action to reduce methane emissions.

1. Continually reduce methane emissions
2. Advance strong performance across the gas supply chain
3. Improve accuracy of methane emissions data
4. Advocate sound policy and regulations on methane emissions
5. Increase transparency

✓ 20 signatories and 14 supporting organisations

OGCI

- ✓ Voluntary CEO-led initiative which takes practical actions on climate change.
- ✓ Launched in 2014, it is currently made up of 13 oil and gas companies that collaborate to reduce GHG emissions.
- ✓ OGCI Climate Investments - $1B+ investment fund established to lower the carbon footprint of the energy and industrial sectors.
- ✓ Focused on:

Climate and Clear Air Coalition (CCAC) Oil and Gas Methane Partnership (OGMP)

- ✓ The CCAC created a voluntary initiative to help companies to reduce methane emissions in the oil and gas sector. Launched at the *United Nations Secretary General Climate Summit* in September 2014
- ✓ The initiative currently has the following partner companies:
- ✓ A company joining the CCAC Oil & Gas Methane Partnership voluntarily commits itself to the following in its participating operations:
    - Survey for nine 'core' sources that account for much of methane emissions in typical upstream operations;
    - Evaluate cost-effective technology options to address uncontrolled sources; and
    - Report progress on surveys, project evaluations and project implementation in a transparent, credible manner that demonstrates results.

CCAC Oil and Gas Methane Science Studies

- ✓ International organizations and institutions working together on a series of peer-reviewed scientific studies to measure methane emissions in the oil and gas sector (started in October 2017).

- ✓ The studies are governed by a Steering Committee of funders.

- ✓ The Coalition, whose Secretariat is hosted by UN Environment, has made this new science initiative an official part of its work.

- ✓ Over $6 million has been committed by EDF and the companies of the Oil and Gas Climate Initiative.

Global Methane Initiative

- ✓ International public-private partnership composed of 45 partner countries
- ✓ Project network that reaches more than 1,200 members, including private companies, financial institutions, universities, and other governmental and non-governmental organisations
- ✓ Focused on reducing methane emissions from several key sectors: oil and gas systems, coal mines, and biogas
- ✓ Collaboration with international partners:

- ✓ Group of natural gas companies working together to voluntarily reduce methane emissions across the natural gas supply chain in the U.S. (created in 2014).
- ✓ Goal: lower emissions to 1% by 2025

The Environmental Partnership

- ✓ Comprised of companies in the U.S. oil and natural gas industry. Some participants:

- ✓ Committed to continuously improve the industry’s environmental performance

- ✓ Participants have committed to continuous learning about the latest industry innovations and best practices that can further reduce their own environmental footprint

Global Methane Alliance

UN environment
United Nations Environment Programme

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

A Global Alliance to Significantly Reduce Methane Emissions in the Oil and Gas Sector by 2030

The Climate & Clean Air Coalition Mineral Methane Initiative calls on countries, organisations and companies to commit to reducing oil and gas methane by 45% by 2025 and 60% to 75% by 2030.

Wrap-up (Day 1) and next steps

Wrap-up

- ✓ Methane emissions management and reduction is among the top priorities of the European gas industry.
- ✓ Not all the methane emissions of the gas industry can be measured as such. Methodologies to quantify have been developed.
- ✓ Methane emissions reduction is on the European policy agenda. Industry should be engaged early and often in any new policy development to ensure that proposed measures are workable and effective
- ✓ The gas industry is continuously improving. An action plan is prepared with contributions of representatives of the entire gas chain.
- ✓ The gas industry considers minimisation of methane emissions as an opportunity to actively contribute to short-term mitigation of climate change, accelerate environmental commitments and further enhance the environmental value of natural gas.
- ✓ The gas industry is committed to building a culture towards net zero methane emission by 2050.

Next steps

- ✓ GIE and MARCOGAZ invite the participants to join the action and the gas industry meetings
- ✓ A follow-up will be done bilaterally in 6 months
- ✓ GIE and MARCOGAZ invite the participants to contact us for additional information and support
    - Quantification and reporting of data
    - Mitigation measures and setting reduction targets

Thank you.

marcogaz gie Energy Community