The Role of
Natural Gas
In Decarbonization and Sustainability

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Head of Division

1992

United Nations Framework Convention on Climate Change

2015

PARIS AGREEMENT

General provisions:

- holding the increase in the global average temperature to below 2° C above pre-industrial levels

- the nationally determined contributions (emission reduction, adaptation etc.)

- financial assistance to developing countries

- technology transfer for the purpose of reduction in emissions and adaptation to climate change

Opportunities for gas industry:

increase of natural gas consumption by means of reduction of coal use

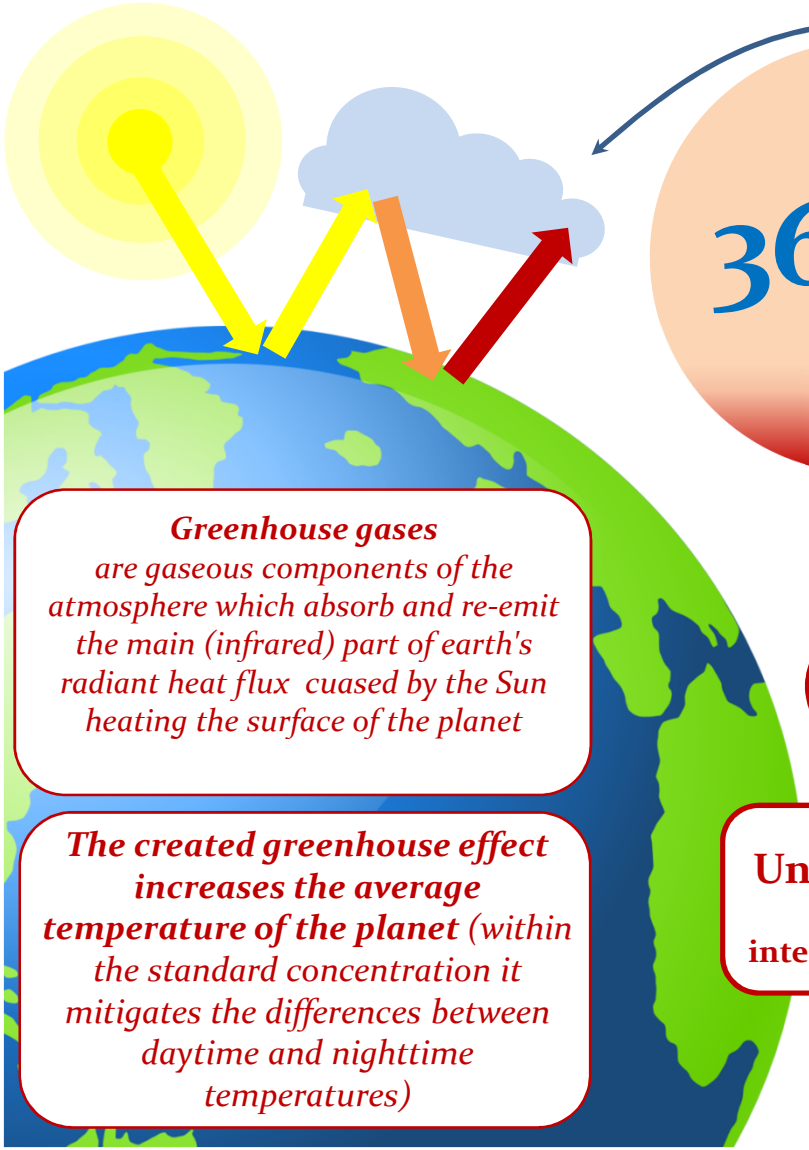
(plans for limitation of coal generation in Germany and the Netherlands, reduction of coal mining in China, etc.)

Risks for gas industry:

increase of the share of renewable energy sources in the general worldwide energy consumption –

possible reduction of the share in the foreign market

METHANE IMPACT ON THE CLIMATE



Greenhouse gases *are gaseous components of the atmosphere which absorb and re-emit the main (infrared) part of earth's radiant heat flux cuased by the Sun heating the surface of the planet*

The created greenhouse effect increases the average temperature of the planet *(within the standard concentration it mitigates the differences between daytime and nighttime temperatures)*

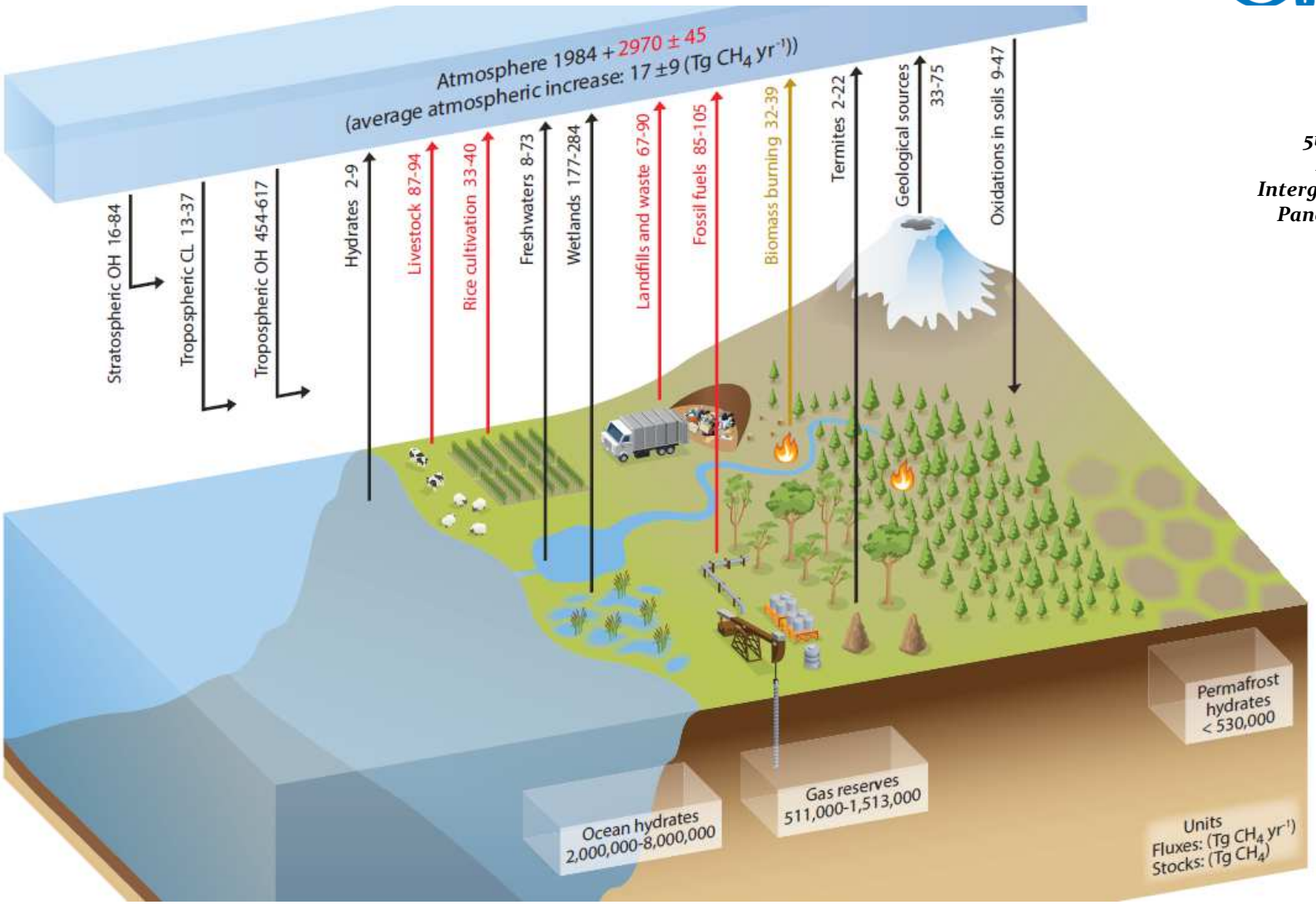
GHG contribution to warming

H_2O	CO_2	CH_4	N_2O	PFC-14	PFC-116	SF6
36-72 %	9-26 %	4-9 %				
2-3	1	25	298	7390	12200	22800

Unregulated by the international law

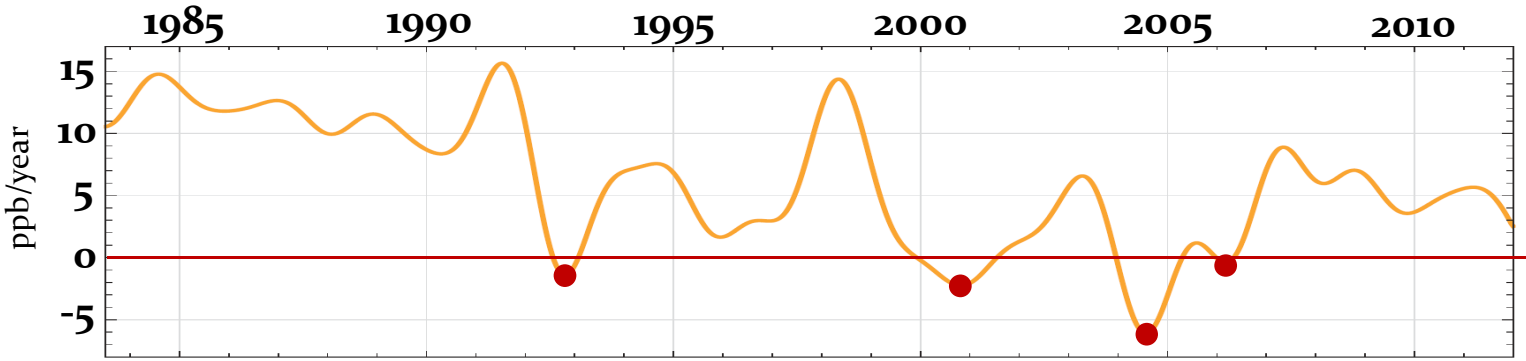
Global Warming Potential of substances

NATURAL AND ANTHROPOGENIC EMISSION SOURCES AND METHANE ABSORBERS (2011)



Source:
5th Assesment Report of the Intergovernmental Panel on Climate Change, 2013

DYNAMICS OF METHANE CONCENTRATION INCREASE/DECREASE IN THE ATMOSPHERE



Rates of methane concentration changes in the atmosphere

~ 556 ± 56

Mt / 2011

total methane emissions into the atmosphere

Including:

natural

~ 202 ± 35 Mt/ 2011

anthropogenic

~ 354 ± 45 million tons / 2011

~5,000

Mt

total methane in the Earth's atmosphere

~ 542 ± 56

Mt/ 2011

methane removal from the atmosphere

Removal mechanisms:

- *OH hydroxyl radical (tropospheric, stratospheric),*
- *tropospheric Cl,*
- *oxidation in soils.*

Source:
5th Assesment Report of the Intergovernmental Panel on Climate Change, 2013

GLOBAL ANNUAL NATURAL AND ANTHROPOGENIC METHANE EMISSIONS (2000-2009)

NATURAL METHANE EMISSIONS

217 *Swamps* *(177-284)*

54 *Ocean* *(33-75)*

Lakes and rivers **40** *(8-73)*

Wild animals **15** *(15-15)*

11 *Termites* *(2-22)*

6 *Hydrates* *(2-9)*

3 *Fires* *(1-5)*

1 *(0-1)* *Permafrost*

ANTHROPOGENIC METHANE EMISSIONS

89 *Ruminants* *(87-94)*

50 *Oil and gas industry* *(36-64) (biofuel included)*

36 *Rice* *(33-40)*

35 *Biomass combustion* *(32-39)*

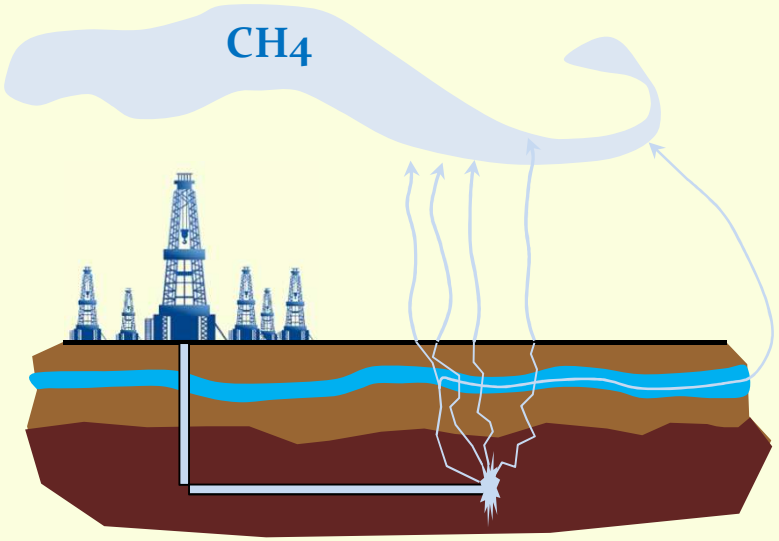
25 *Wastes* *(67-90)*

Source: 4th and 5th Assesment Report s of the Intergovernmental Panel on Climate Change, 2007, 2013

SHALE GAS PRODUCTION IMPACT ON METHANE EMISSIONS INCREASE

Aspects of shale gas production:

1. The higher emissions from shale gas occur at the time wells are **hydraulically fractured**.
2. **3.6% to 7.9%** of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the life-time of a well.
3. Methane emissions are **at least 30%** more than and perhaps more than twice **as great as those from conventional gas**.
4. The GHG footprint of shale gas is comparable with **coal** when compared **over 100 years**.



Source: Cornell University, 2011

Harvard University research (2016):

- U.S. methane emissions could account for 30–60% of the global anthropogenic growth of atmospheric methane seen in the last 20 years

- There is an obvious connection between rapid exploitation of resources by hydraulic fracturing and major methane leaks

Methane leak in Aliso Canyon, USA

4 months

Comparable with

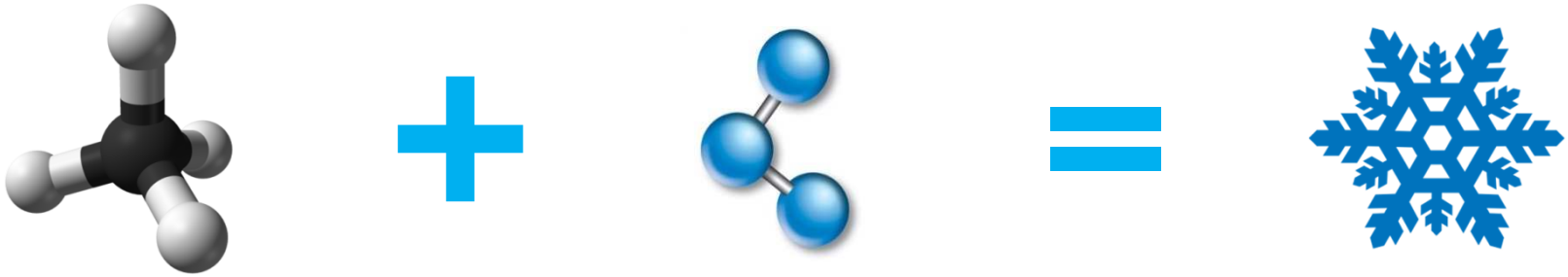
Source: NASA, 2016

Exhaust gases of 440,000 cars

1 year

Underestimation of methane leak scale in the USA

COOLING EFFECT OF METHANE AND NEW METRIC



Controls on anthropogenic emissions of methane
to lower surface ozone have been identified as 'win–win' situations, referring to both global **cooling** and warming

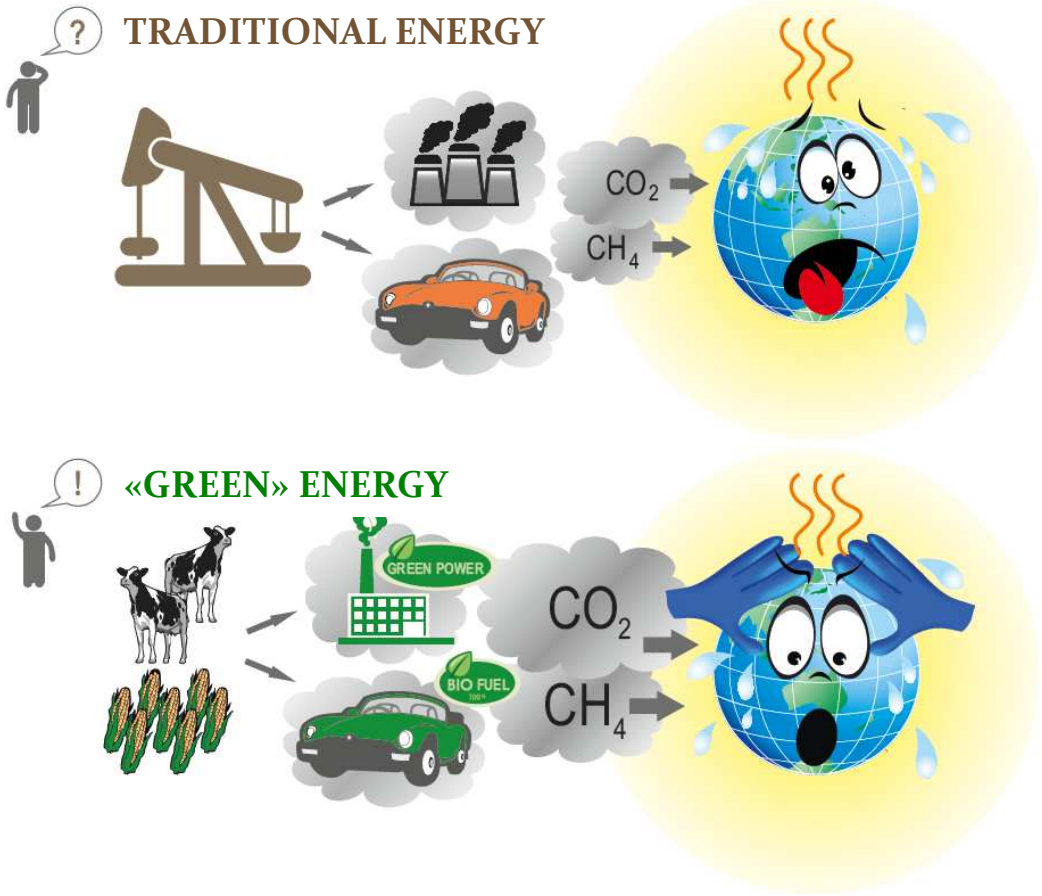
New metric

Different metrics can be used to quantify and communicate the relative and absolute contributions to climate change of emissions of different substances. The Global Warming Potential (GWP) is based on the cumulative radiative forcing over a particular time horizon, and the Global Temperature Change Potential (GTP) is based on the change in global mean surface temperature at a chosen point in time. The most common metric has been GWP. **There is now increasing focus on the Global Temperature change Potential (GTP).**

	GWP100	GTP100
without inclusion of climate–carbon feedbacks	28	4
with inclusion of climate–carbon feedbacks	34	11

Source: 5th Assesment Report of the Intergovernmental Panel on Climate Change, 2013

«CARBON FOOTPRINT» OF TRADITIONAL AND «GREEN» ENERGY



BIOFUELS MADE WITH CORN RELEASE

7 % MORE

GHG EMISSIONS COMPARED WITH CONVENTIONAL PETROL

Source: Nature Climate Change

GHG emissions from power generation (CO_2-eq./kW*h)

978 g – solar panels (production, transportation, etc.)
846 g- modern coal power plant
400 g – gas-fired power plant

European Climate and Energy Institute (EIKE)

If RES would save the climate?

GAZPROM

Reduction Level

At least 40% domestic reduction in greenhouse gas emissions by 2030

Base Year

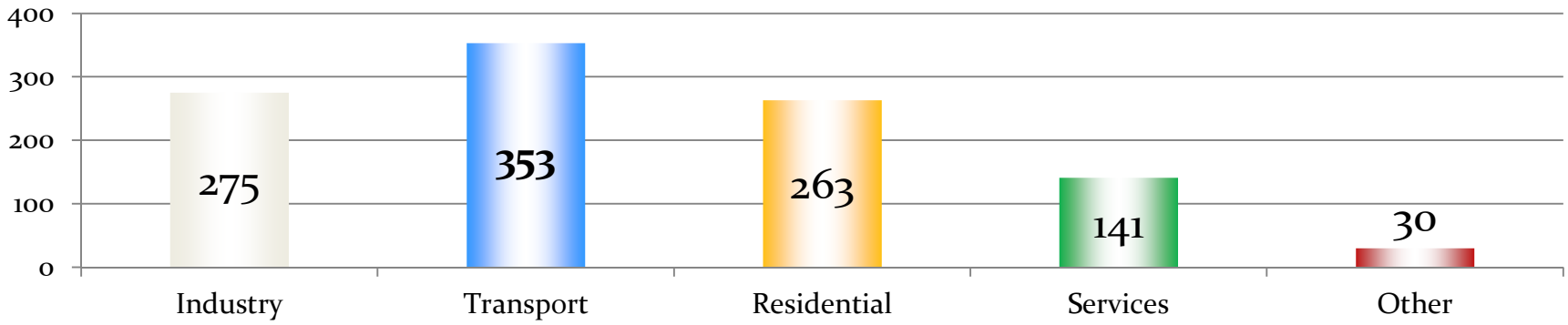
1990

Period

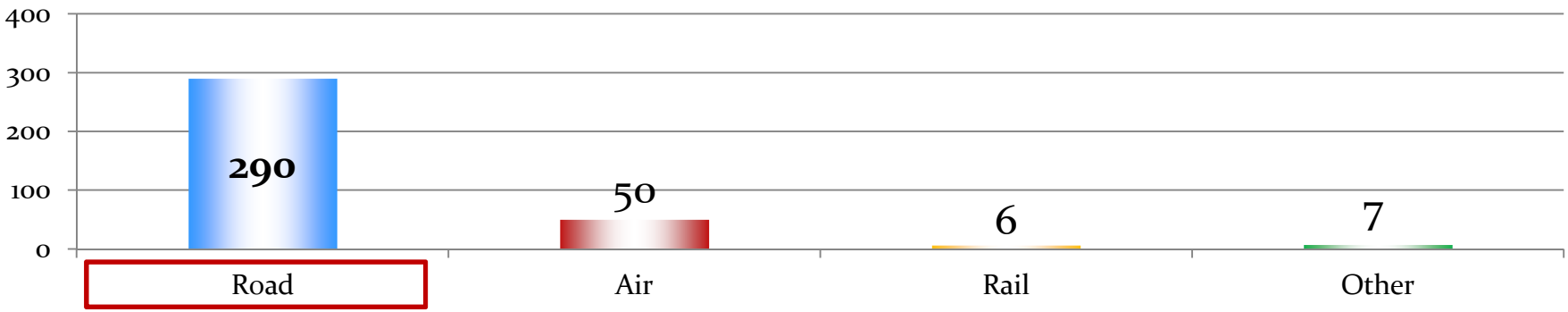
1 January 2021 – 31 December 2030

The target represents a significant progression beyond its current undertaking of a 20% emission reduction commitment by 2020 compared to 1990 (which includes the use of offsets). It is in line with the EU objective, in the context of necessary reductions according to the IPCC by developed countries as a group, to reduce its emissions by 80-95% by 2050 compared to 1990. Furthermore, it is consistent with the need for at least halving global emissions by 2050 compared to 1990. The EU and its Member States have already reduced their emissions by around 19% on 1990 levels while GDP has grown by more than 44% over the same period. As a result, average per capita emissions across the EU and its Member States have fallen from 12 tonnes CO_2-eq. in 1990 to 9 tonnes CO_2-eq. in 2012 and are projected to fall to around 6 tonnes CO_2-eq. in 2030. The emissions in the EU and its Member States peaked in 1979

Final energy consumption, by sector, EU-28 (Mtoe), 2014



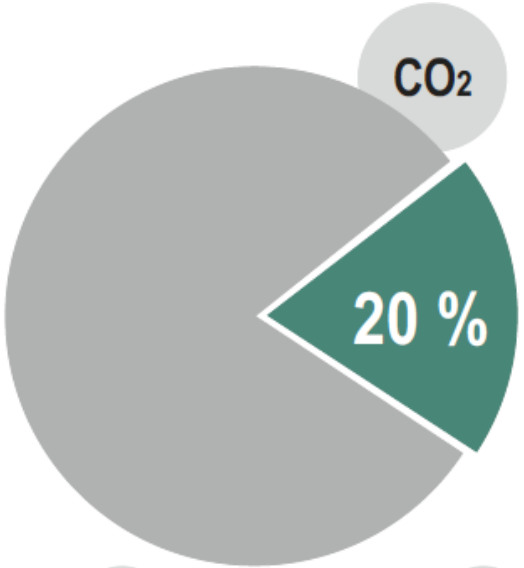
Final energy consumption, by mode of transport, EU-28 (Mtoe)

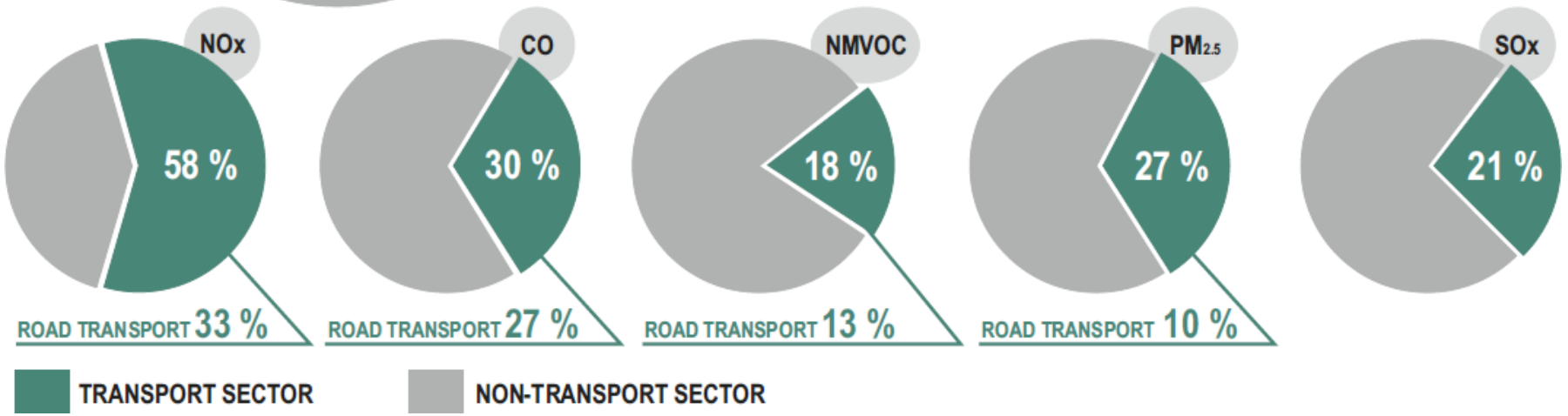


Source: Eurostat, 2016

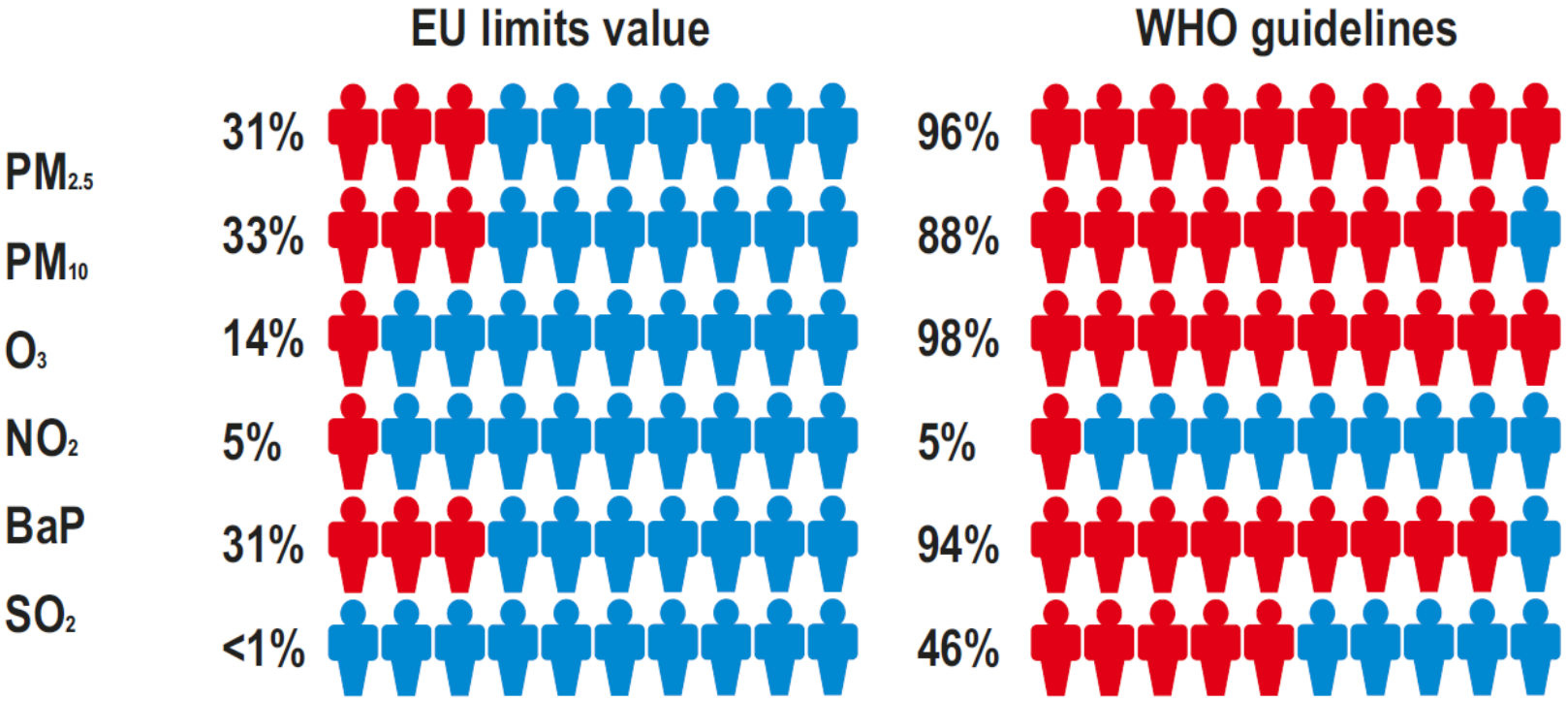
THE CONTRIBUTION OF THE TRANSPORT SECTOR TO TOTAL EMISSIONS OF EUROPE

Source: European Environment Agency (EEA), 2012





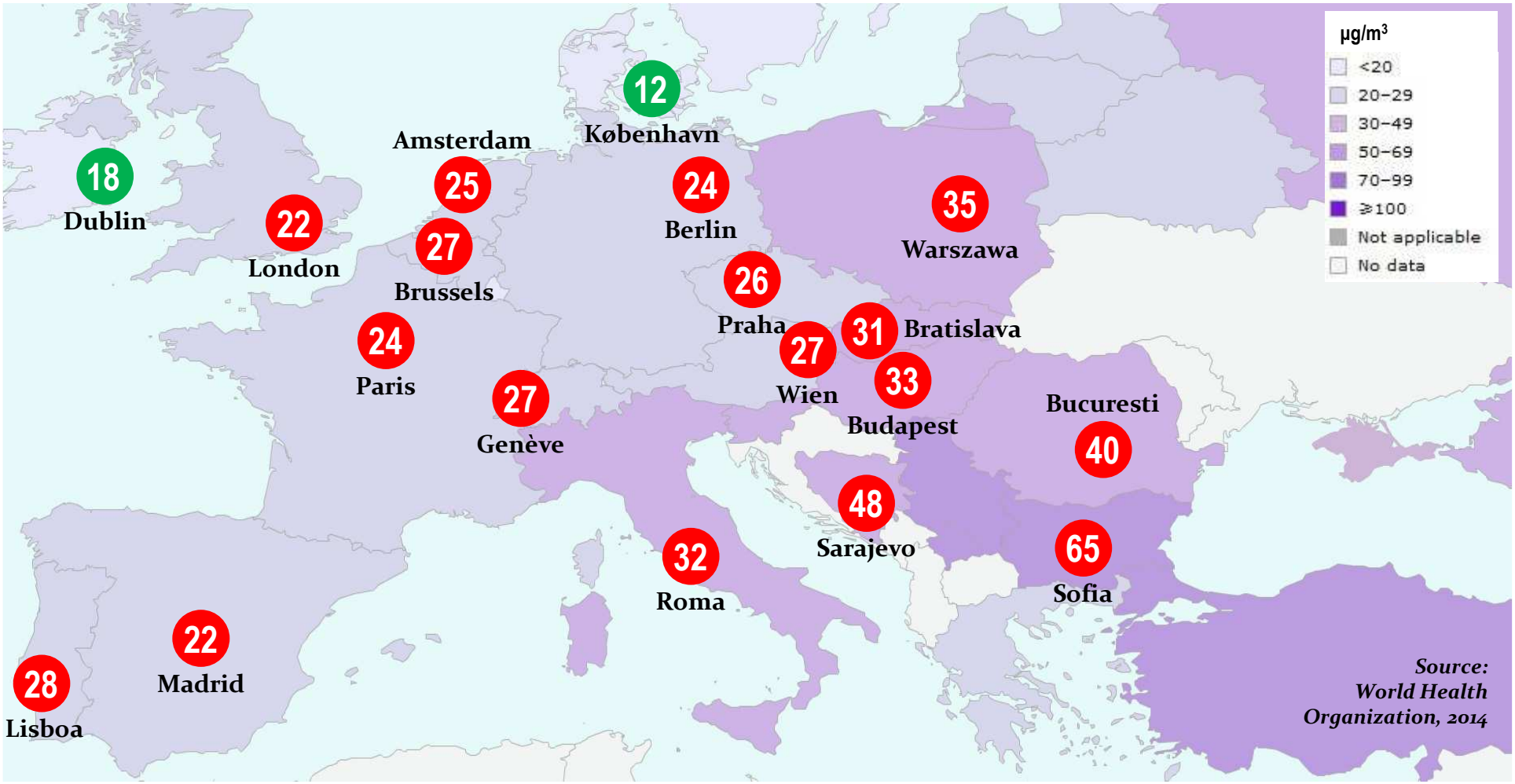
SHARE OF URBAN POPULATION EXPOSED TO DANGEROUS LEVELS OF AIR POLLUTION



! Up to a third of Europeans living in cities are exposed to air pollutant levels exceeding EU air quality standards. And around 90 % of Europeans living in cities are exposed to levels of air pollutants deemed damaging to health by the World Health Organization's (WHO) more stringent guidelines

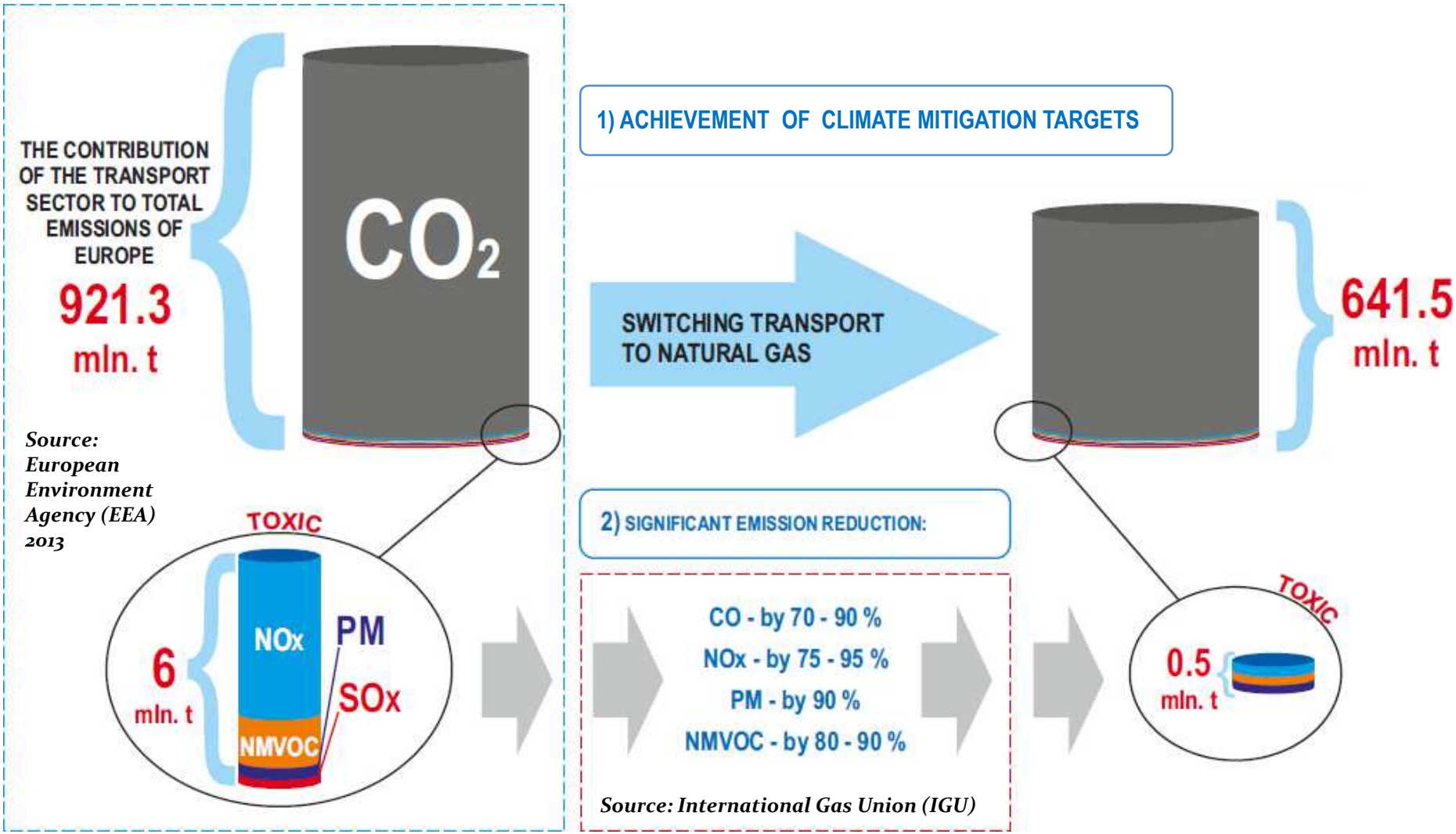
Source: European Environment Agency, 2013

EUROPEAN ANNUAL MEAN CONCENTRATIONS OF PM10 (2008-2013)

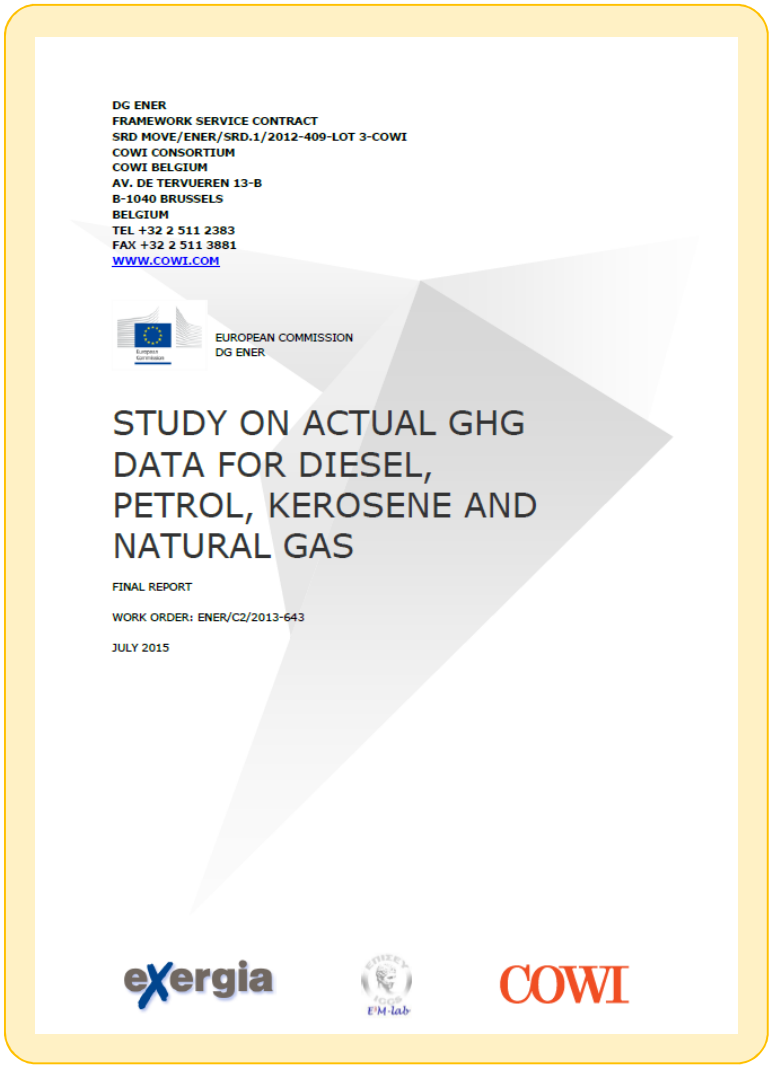


20 µg/м³ – WHO air quality guideline level

EMISSIONS REDUCTION POTENTIAL IN EUROPEAN TRANSPORT SECTOR



NEW STUDY ON ACTUAL GHG EMISSIONS

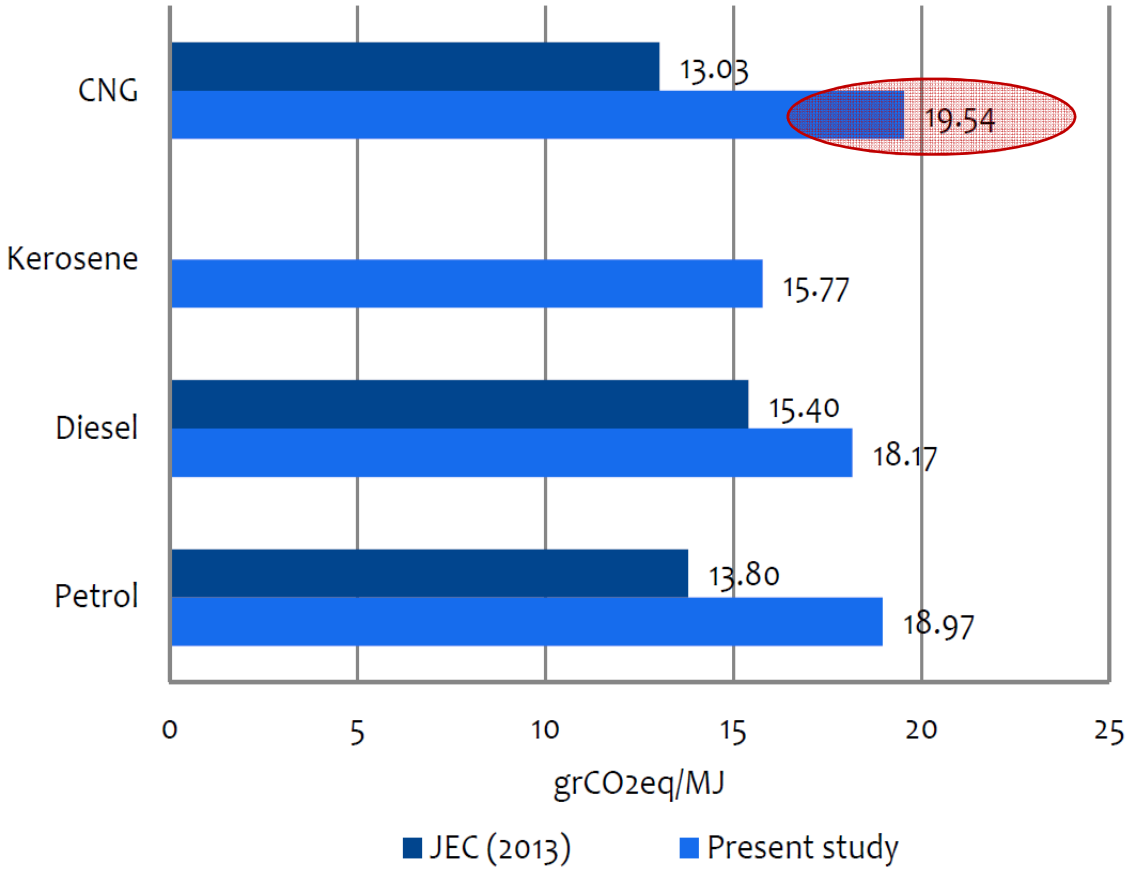


The overall objective is to provide information about the lifecycle GHG emissions of fossil fuels used in transport

In this study, the lifecycle Carbon Intensity (CI) of petrol, diesel, kerosene and natural gas have been assessed in a “Well-To-Tank” approach. A chain of significant process stages of oil and gas, such as exploration, exploitation, upgrading, transportation, transmission, refining, distribution, dispensing etc. are considered; thus excluding the final stage of combustion in the vehicle internal combustion engines

Finally, 105 streams (35 for each one of diesel oil, petrol, kerosene) of oil products are considered in the downstream stage up to the tank of transport means

COMPARISON OF AVERAGE CARBON INTENSITY OF OIL PRODUCTS AND GAS STREAMS WITH JEC VALUES



The previous version of this report has been published by the JEC Consortium in July 2013 (JRC - EU Commission's Joint Research Centre, EUCAR - the European Council for Automotive R&D and CONCAWE – the oil companies' European association for environment, health and safety in refining and distribution)

Conclusions of the study:

The Fuel Quality Directive could be eventually revised to include a maximum value of Carbon Intensity of fossil fuels that would be allowed to be used in the EU

For any future policy development in this sector it will be necessary to develop a robust certification and verification system for all fossil fuels used in the EU similar to that developed for biofuels and bioliquids under the Renewable Energy Directive and the Fuel Quality Directive

COMPARISON OF AVERAGE CARBON INTENSITY WITH PREVIOUS STUDIES

Natural gas suppliers	Exergia et al. (kg CO_2-eq./ GJ)	BDEW + GEMIS (kg CO_2-eq./GJ)	Value change
Germany	15,2	12,1	1,3
Russia	35,9	22,9	1,6
Netherlands	8,3	7,1	1,2
Norway	12,6	8,2	1,5
Denmark	11,3	9,98	1,1
Great Britain	13,3	11,9	1,1
AVERAGE	19,4	13,3	1,5

Conclusions: according to the study the **natural gas suppliers have disimpoved last years**

	Input data of Exergia Study		Input data of Gazprom
production	**2,375,880** 100%	absolute methane emissions, t	**69,949** 74% production
transmission	**4,823,670** 100%	absolute methane emissions, t	**1,329,294** 100%
energy consumption	**0.000045**	energy inputs, J/J×km	**0.000024**
"Higher compression rate of gas in Russia results in higher level of energy consumption…*Lower compression rate of gas in foreign systems is associated with a **larger** diameter of pipelines*" ???	**1.45** **(Russia)**	gas compression rate **1.3 – 1.35** **(foreign systems)**	**1.3 – 1.36** **(Russia)**

Ø 1200-1400 (Russia) > Ø 700-1000 (foreign systems)

September 2016

The date due, set by the EU for the updated/corrected data submission

June 30, 2016

Meeting in the European Commission

DBI Study (Zukunft ERDGAS and gas companies)

November 16, 2015

Meeting of the Director General for Energy with the gas industry representatives to discuss the correctness of the study conclusions

September 1, 2015

Joint letter of European associations of Marcogaz, Eurogas, GERG, GIE, IOGP and NGVA addressing the Director General of the European Commission Dominique Ristori with a request of involving gas industry representatives into the study

July 8, 2015

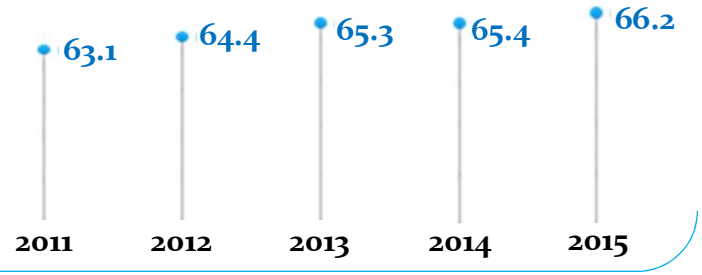
Directorate General for Energy of the European Commissions presents the draft version of the Study on Actual GHG Data for Diesel, Petrol, Kerosene and Natural Gas

GAZPROM CONTRIBUTION TO REDUCTION OF GREENHOUSE GAS EMISSIONS

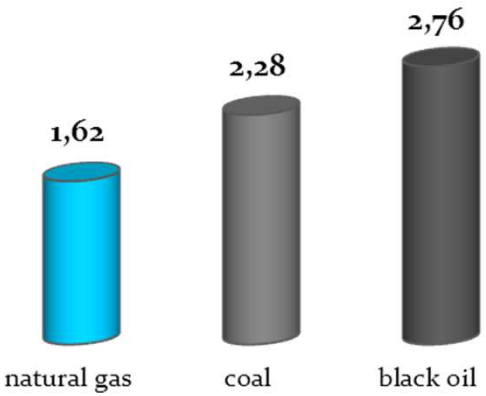
Gas infrastructure expansion

in regions

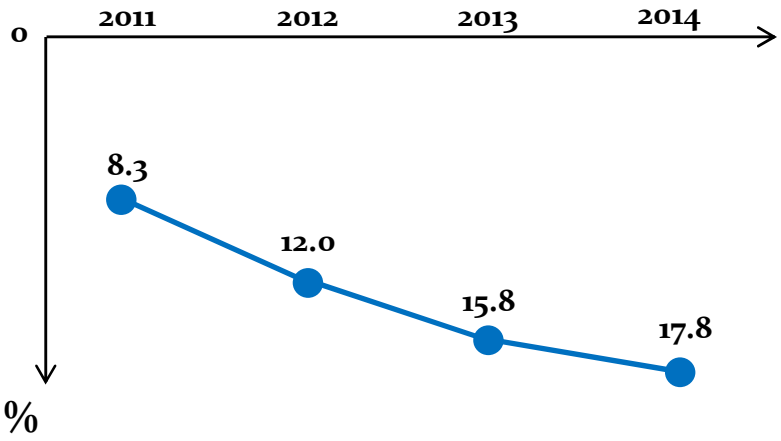
Gas infrastructure expansion level in the regions of Russia, %

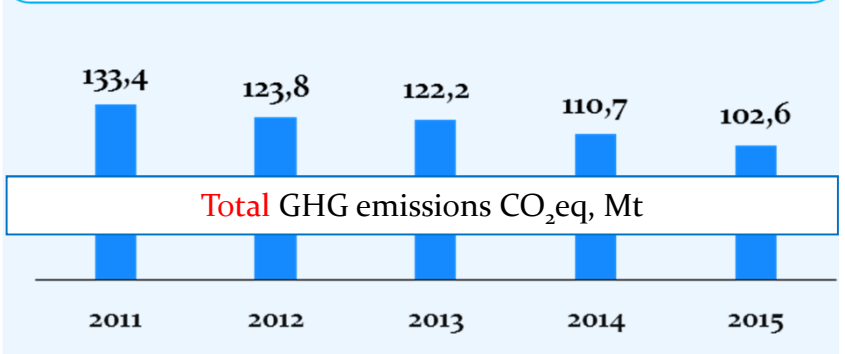


'Carbon footprint' (CO_2 emissions, tonnes) using different fuel types in terms of 1 TFOE



Reduction in GHG Intensity CO_2-eq, %





GAZPROM is recognized

the best Russian energy company

(Carbon Disclosure Score)

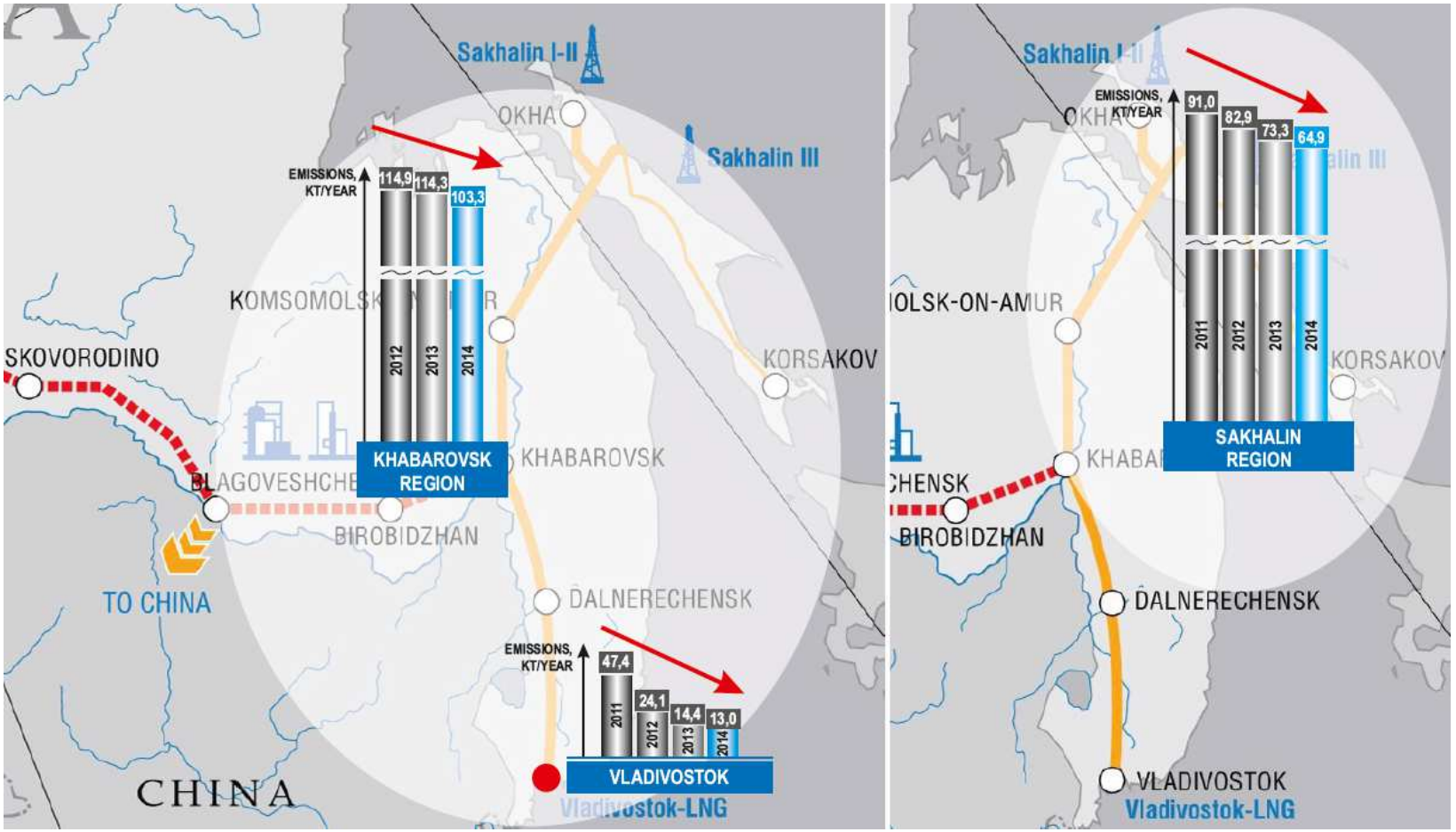
GAZPROM performance score:

Governance	Emission Performance
better than "Global 500 Overall" Rank	better than "Global 500 Overall" and "Global 500 Energy" Ranks

Carbon performance band "C":

Gazprom
BP
Total
Petrobras
Schlumberger
Noble Energy

REDUCTION OF POLLUTING EMISSIONS AFTER GASIFICATION



ASSESSMENT OF REPLACING RUSSIAN NATURAL GAS (150 BCM) BY COAL IN EUROPEAN COUNTRIES

Substances	Increasing of emissions in Europe (ton)
CO_2	199 163 000
SO_2	3 959 000
NO_x	1 029 000
Ash (aerosol)	6 231 800
Other substances (heavy metals, CO, organic compounds)	400 160
Total	**211 113 900**

Source: Gazprom VNIIGAZ

GAZPROM

NORD STREAM 2

BOVANENKOVO — L = 4270.8 — GREIFSWALD

55 bcm/yr

BOVANENKOVO-UZHGOROD-BAUMGARTEN

BOVANENKOVO — L = 6063.7 — WAIDHAUS

Calculated according to GHGenius 4.03

DIFFERENCE
IN GREENHOUSE GAS EMISSIONS

Mt of CO_2 equivalent

PER YEAR — 8,94

IN 25 YEARS — 223, 38

ANNUAL EMISSION:

more than ICELAND + MALTA or CYPRUS

more than the NETHERLANDS or THE WHOLE TRANSPORT SECTOR OF GERMANY

55 billion cubic metres =

150 oil tankers via the Baltic Sea

550 LNG shipments via the Baltic Sea

55 **coal-fired** plants

23 new **nuclear power stations**

19 new **hydroelectric power stations**

240,000 **wind mills**

90,000-100,000 square kilometres of corn fields to produce **bio-ethanol**

Thank you for attention!