

METHANE EMISSIONS ALONG THE GAS VALUE CHAIN



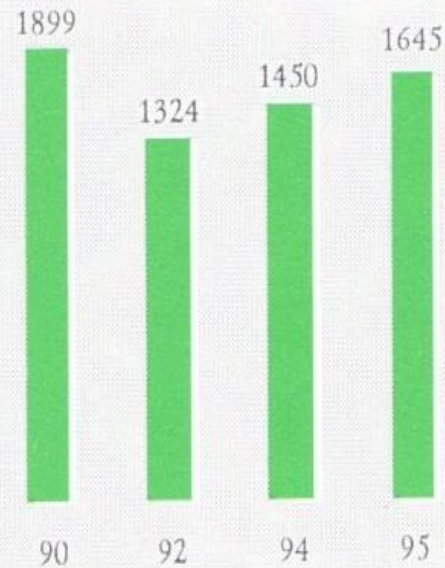
METHANE EMISSIONS REGULATION IN RUSSIA

Greenhouse Gas

Toxic Gas

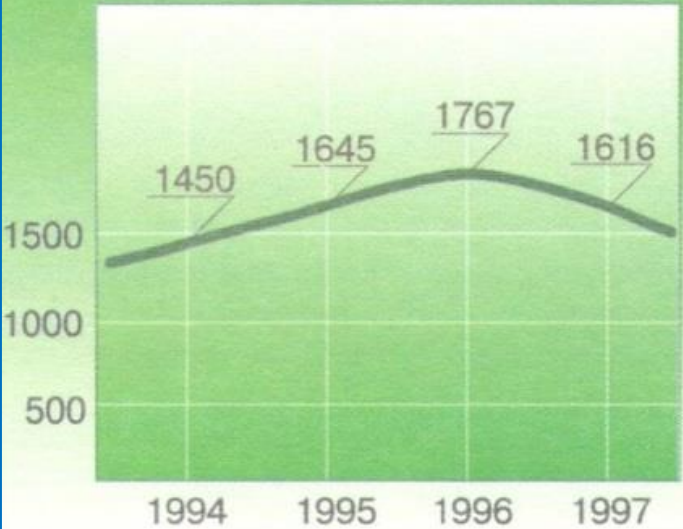
➡ **FEE** ➡ **KPI** (Reduction in GHG Intensity
CO₂-eq, %)

Methane emissions
(thousand tonnes)



Environmental Report 97

Methane emissions to air
(thousand tonnes)



The Power Within

Methane
emissions,
thousand tonnes

1,338.2



2016



STATE SYSTEM

PERMITTING

**LIMITATIONS
OF EMISSIONS
FOR EVERY
FACILITY
BY STATE BODIES**

Official reporting

FEE COLLECTION

**5 %
FEDERAL BUDGET**

**40 %
REGIONAL BUDGET**

**55 %
MUNICIPAL BUDGET**

SUPERVISION



**ENVIRONMENTAL AND TAX
AUTHORITIES
(EMISSIONS MONITORING
AND PAYMENT CONTROL)**



All methane emissions in Russia, kt

2012	2013	2014	2015	2016
3,241.3	3,382.3	3,221.8	3,302.0	3,376.2

State Environmental bulletins

http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/5e901c0042cb5cc99b49bf307f2fa3f8

Source: Rosstat, 2016

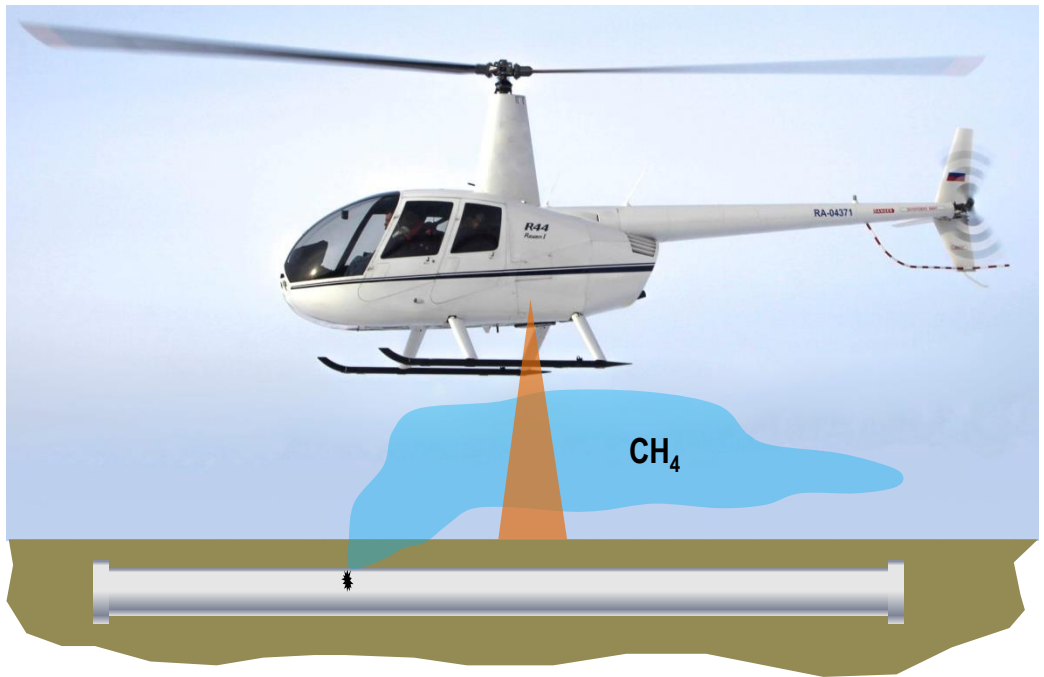


METHANE EMISSIONS DETECTION, MEASUREMENT AND ELIMINATION

CONTINUOUS MONITORING OF
NATURAL GAS CONCENTRATION
ON COMPRESSOR STATIONS BY
LASER TECHNOLOGIES



DISTANT PERIODIC MONITORING OF METHANE
EMISSIONS WITH TOTAL QUANTITATIVE
ASSESSMENT



LOCALIZATION OF
LEAKAGES BY
PORTABLE
INSTRUMENTS



INSPECTION

PERIODIC MONITORING OF
NATURAL GAS EMISSIONS
ON COMPRESSOR
STATIONS BY
HAND-HELD
CONTROL DEVICES



DISCOVERED LEAKAGE ELIMINATION

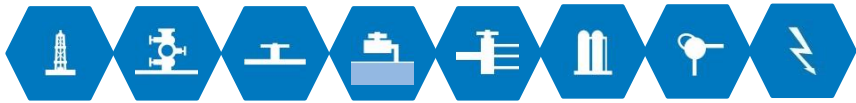
- Replacement of leaky facilities
- Bandaging
- Sealing of shut-off valves





EVALUATING METHANE EMISSIONS AT GAZPROM FACILITIES WITH FOREIGN PARTNERS

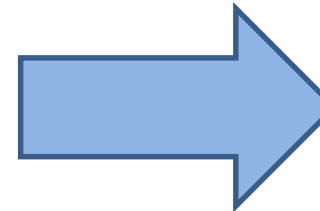
YEAR	PARTNERS	SUBJECT OF INVESTIGATIONS
1995	US EPA	<i>1 compressor station; 1 compressor shop</i>
1996-1997	Ruhrgas (Open Grid Europe)	<i>3 complex gas treatment plants; 2 well clusters; 3 compressor stations; 6 compressor shops; 5,000 km of linear routes of mains</i>
2002-2003	Ruhrgas (Open Grid Europe), Wuppertal Institute for Climate, Environment and Energy, Max Planck Institute for Chemistry	<i>5 compressor stations; 10 compressor shops; 4,000 km of linear routes of mains</i>
2004-2005	Sumitomo Corporation, Agra	<i>1 compressor station; 3 compressor shops; 750 km of linear routes of mains; 5 pipeline branches; 5 gas distribution stations</i>
2006, 2008	Sojitz Corporation	<i>2 compressor stations; 4 compressor shops; 600 km of linear routes of mains; 100 valve nodes; 80 valve nodes of pipeline branches; 32 gas distribution stations, 4 gas measuring stations</i>
2010	Global methane initiative, US EPA	<i>162 km of gas main pipeline; 2 compressor shops; 41 valve nodes</i>
2011	GDF-SUEZ (ENGIE)	<i>1 compressor shop; 2 junction points</i>
2013	Gasunie	<i>1 shop; 10 valve nodes</i>



ISOTOPIC EVIDENCE

Modern methods of determining the age and the source of methane (CH_4) are based on the registration of stable isotopes carbon-12 and carbon-13 and its natural ratio 98.92% and 1.08%.

Siberian gas fields have isotope ratio, which is would be unlikely to produce the shift observed



Russian natural gas is not the source of methane growth in the atmosphere

Isotopic studies indicate that the methane rise is a result of **increased emissions from biogenic sources**, e.g., extension of wetland and expansion in the number of methane emissions sources in agriculture: ruminants and rice fields

https://www.repository.cam.ac.uk/bitstream/handle/1810/261156/Nisbet_et_al-2016-Global_Biogeochemical_Cycles-VoR.pdf?sequence=1&isAllowed=y

Taking samples: US National Oceanic and Atmospheric Administration (NOAA)

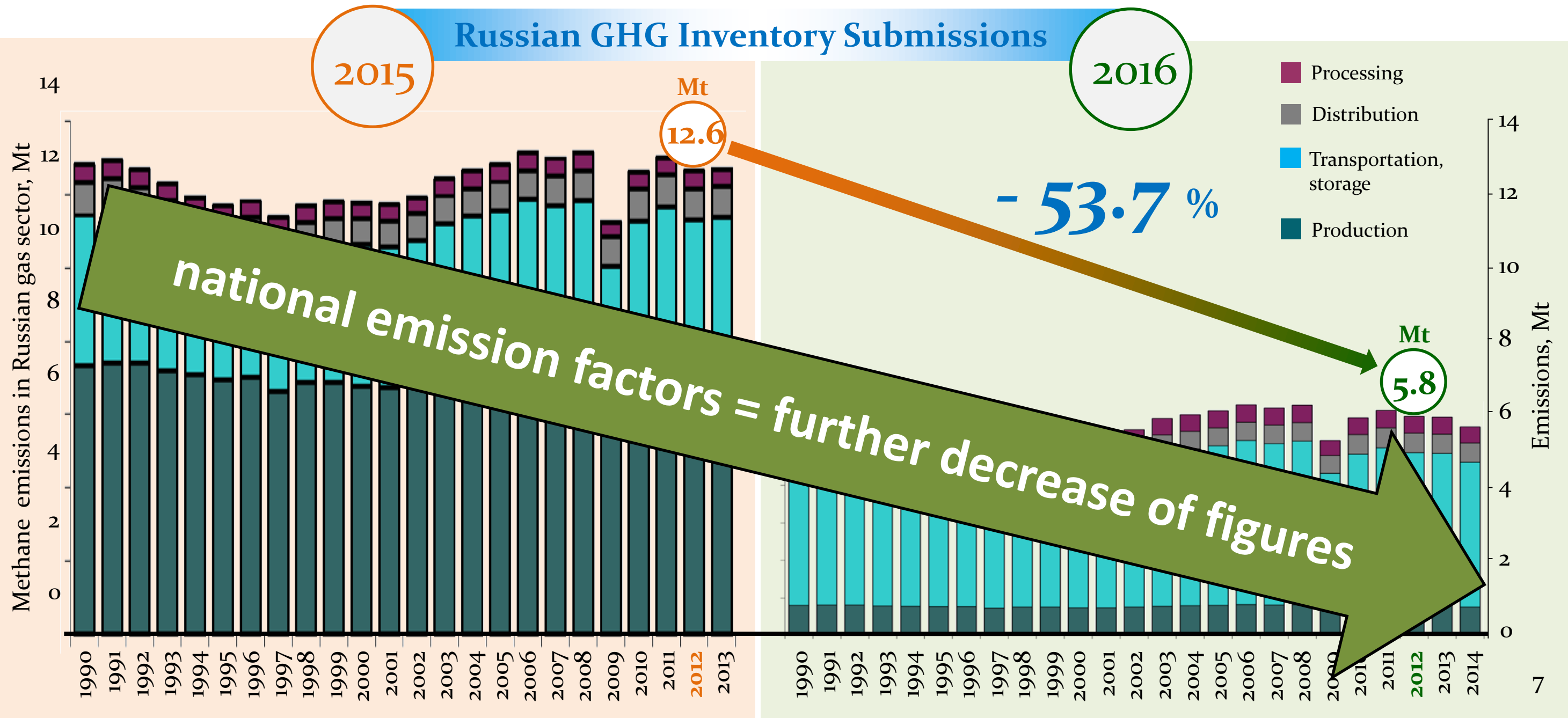
Isotopic analysis: Institute of Arctic and Alpine Research, Royal Holloway, University of London, University of Heidelberg



CHANGE OF EMISSIONS FACTORS

(from developing country to developed country)

Emissions calculation in inventories: $\text{scope of activity} * \text{emission factors (IPCC or national)}$





IPCC EMISSION FACTORS



Intergovernmental Panel on Climate Change



2006 IPCC Guidelines for National Greenhouse Gas Inventories

Volume 2

Energy

Edited by Simon Eggleston, Leandro Buendia,
Kyoko Miwa, Todd Ngara and Kiyoto Tanabe



IPCC National Greenhouse Gas Inventories Programme

IGES

TABLE 4.2.4
TIER 1 EMISSION FACTORS FOR FUGITIVE EMISSIONS (INCLUDING VENTING AND FLARING) FROM OIL AND GAS OPERATIONS
IN DEVELOPED COUNTRIES^{a,b}

Category	Sub-category ^c	Emission source	IPCC Code	CH ₄		CO ₂ ¹		Units of measure
				Value	Uncertainty (% of value)	Value	Uncertainty (% of Value)	
Gas Production	All	Fugitives ^d	1.B.2.b.iii.2	3.8E-04 to 2.3E-03	±100%	1.4E-05 to 8.2E-05	±100%	Gg per 10 ⁶ m ³ gas production
		Flaring ^e	1.B.2.b.ii	7.6E-07	±25%	1.2E-03	±25%	Gg per 10 ⁶ m ³ gas production
Gas Processing	Sweet Gas Plants	Fugitives	1.B.2.b.iii.3	4.8E-04 to 10.3E-04	±100%	1.5E-04 to 3.2E-04	±100%	Gg per 10 ⁶ m ³ raw gas feed
		Flaring	1.B.2.b.ii	1.2E-06	±25%	1.8E-03	±25%	Gg per 10 ⁶ m ³ raw gas feed
	Sour Gas Plants	Fugitives	1.B.2.b.iii.3	9.7E-05	±100%	7.9E-06	±100%	Gg per 10 ⁶ m ³ raw gas feed
		Flaring	1.B.2.b.ii	2.4E-06	±25%	3.6E-03	±25%	Gg per 10 ⁶ m ³ raw gas feed
		Raw CO ₂ Venting	1.B.2.b.i	NA	NA	6.3E-02	-10 to +1000%	Gg per 10 ⁶ m ³ raw gas feed
Gas Transmission & Storage	Transmission	Fugitives ^{fk}	1.B.2.b.iii.4	6.6E-05 to 4.8E-04	±100%	8.8E-07	±100%	Gg per 10 ⁶ m ³ of marketable gas
		Venting ^{gk}	1.B.2.b.i	4.4E-05 to 3.2E-04	±75%	3.1E-06	±75%	Gg per 10 ⁶ m ³ of marketable gas
	Storage	All ^k	1.B.2.b.iii.4	2.5E-05	-20 to +500%	1.1E-07	-20 to +500%	Gg per 10 ⁶ m ³ of marketable gas



IPCC EMISSION FACTORS



Intergovernmental Panel on Climate Change



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TABLE 4.2.5
TIER 1 EMISSION FACTORS FOR FUGITIVE EMISSIONS (INCLUDING VENTING AND FLARING) FROM OIL AND GAS OPERATIONS
IN DEVELOPING COUNTRIES AND COUNTRIES WITH ECONOMIES IN TRANSITION^{a,b}

Category	Sub-category ^c	Emission source	IPCC Code	CH ₄		CO ₂ ⁱ		Units of measure
				Value	Uncertainty (% of value)	Value	Uncertainty (% of value)	
Gas Production	All	Fugitives ^d	1.B.2.b.iii.2	3.8E-04 to 2.4E-02	-40 to +250%	1.4E-05 to 1.8E-04	-40 to +250%	Gg per 10 ⁶ m ³ gas production
		Flaring ^e	1.B.2.b.ii	7.6E-07 to 1.0E-06	±75%	1.2E-03 to 1.6E-03	±75%	Gg per 10 ⁶ m ³ gas production
Gas Processing	Sweet Gas Plants	Fugitives	1.B.2.b.iii.3	4.8E-04 to 1.1E-03	-40 to +250%	1.5E-04 to 3.5E-04	-40 to +250%	Gg per 10 ⁶ m ³ raw gas feed
		Flaring	1.B.2.b.ii	1.2E-06 to 1.6E-06	±75%	1.8E-03 to 2.5E-03	±75%	Gg per 10 ⁶ m ³ raw gas feed
	Sour Gas Plants	Fugitives	1.B.2.b.iii.3	9.7E-05 to 2.2E-04	-40 to +250%	7.9E-06 to 1.8E-05	-40 to +250%	Gg per 10 ⁶ m ³ raw gas feed
Gas Transmission & Storage	Transmission	Fugitives ^f	1.B.2.b.iii.4	16.6E-05 to 1.1E-03	-40 to +250%	8.8E-07 to 2.0E-06	-40 to +250%	Gg per 10 ⁶ m ³ of marketable gas
		Venting ^g	1.B.2.b.i	4.4E-05 to 7.4E-04	-40 to +250%	3.1E-06 to 7.3E-06	-40 to +250%	Gg per 10 ⁶ m ³ of marketable gas
	Storage	All	1.B.2.b.iii.4	2.5E-05 to 5.8E-05	-20 to +500%	1.1E-07 to 2.6E-07	-20 to +500%	Gg per 10 ⁶ m ³ of marketable gas



Устойчивое
Энергетическое
Развитие



Международный центр
под Эгидой ЮНЕСКО



The development of country-specific emission factors and parameters for greenhouse gas inventory in the Russian oil and gas sector was initiated

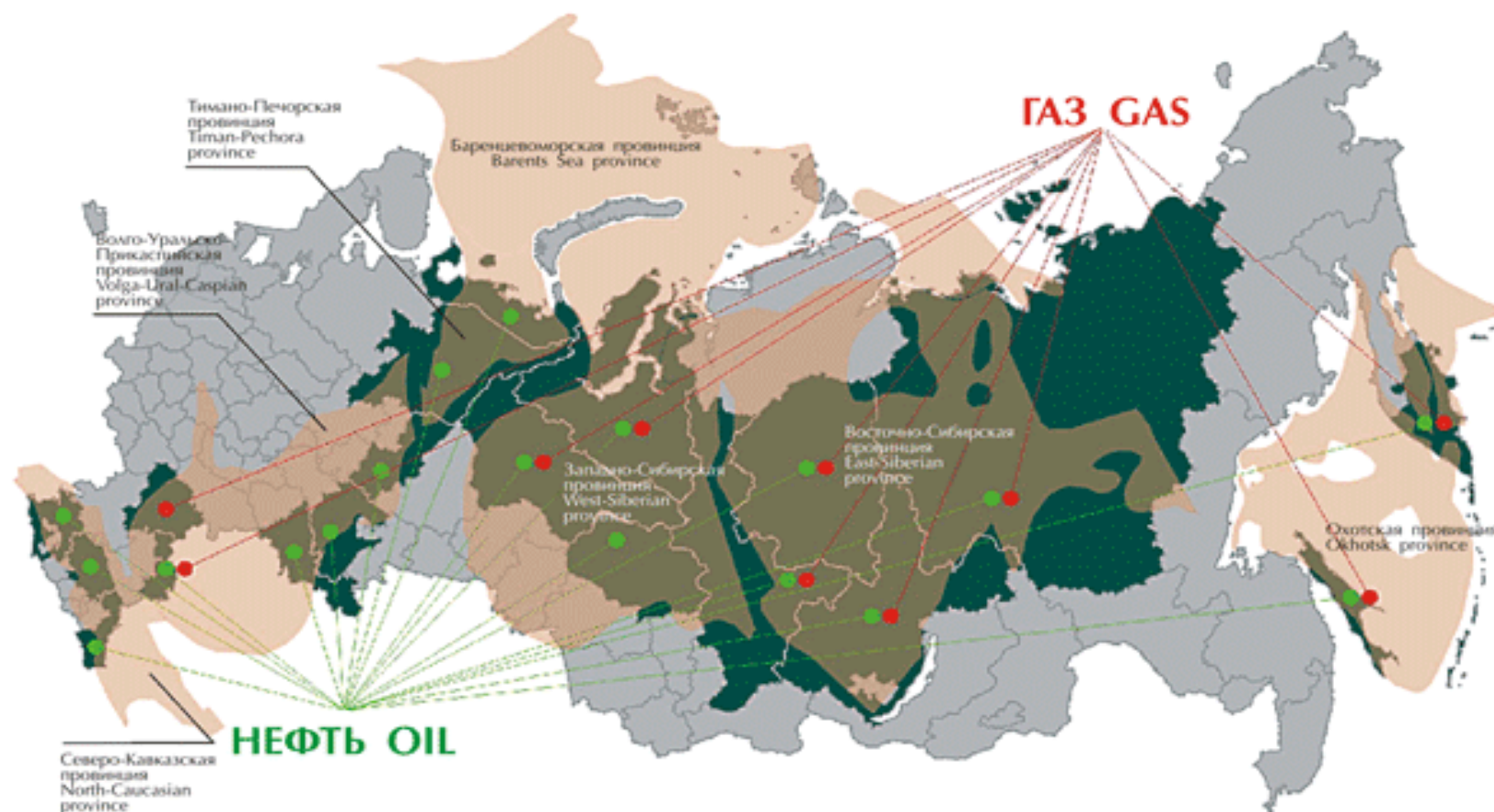
under the support of

- Ministry of Energy of the Russian Federation (contract 16/0411.3070390019.241/02/170 of 21-09- 2016)
- Federal Service for Hydrometeorology and Environment Monitoring of the Russian Federation



EMISSION FACTOR DEVELOPMENT FLOW CHART

- Data from oil and gas fields and infrastructure operated by main oil and gas companies were used
- CO₂ and CH₄ emission factors were developed for leakage and flaring of associated petrol gas and leakage on natural gas for their production and transport operations
- The representative average parameters for associated petrol and natural gas were developed along with the national emission factors



Source: Rosnedra (2016)

The work was performed in accordance with general IPCC requirements and procedures

[IPCC, 2006]



COUNTRY-SPECIFIC EMISSION FACTORS DEVELOPED

Emission category in gas sector	Emission type	Emission factor value and its uncertainty		Units
		CH ₄	CO ₂	
NG production and processing (well testing and servicing is included)	Leakage and venting	$2.13 \cdot 10^{-4} \pm 50\%$	$3.92 \cdot 10^{-6} \pm 50\%$	Gg/ 10 ⁶ m ³ NG produced
	Flaring	$1.12 \cdot 10^{-7} \pm 50\%$	$1.95 \cdot 10^{-4} \pm 50\%$	Gg/ 10 ⁶ m ³ NG produced
NG transport	Leakage and venting	$1.93 \cdot 10^{-3} \pm 50\%$	$1.68 \cdot 10^{-5} \pm 50\%$	Gg / 10 ⁶ m ³ NG transported
NG underground storage	Leakage and venting	$3.73 \cdot 10^{-4} \pm 50\%$	$2.11 \cdot 10^{-6} \pm 50\%$	Gg / 10 ⁶ m ³ NG stored

GHG inventory with national emissions factors enabled for:

- Enhancing accuracy of estimates of fugitive emissions;
- First estimates lower than those with IPCC defaults (left graphs) by:
 - ✓ 20.1 per cent for gas sector (top right graph);
 - ✓ 38.2 per cent for oil sector (bottom left graph)
- 4.8 times reduced national inventory uncertainty



ERDGAS 

 **DBI** ^{GUT}
Gas- und Umwelttechnik GmbH

**CARBON FOOTPRINT OF NATURAL GAS
CONSUMED IN CENTRAL EU**



NGVA
Europe
for sustainable mobility



thinkstep

GHG INTENSITY STUDY ON NATURAL GAS

DELIVERY UPDATED BEST DATA TO PUBLIC



+

FINISHING VERIFICATION OF GAZPROM GHG EMISSIONS

THANK YOU FOR YOUR ATTENTION!



V INTERNATIONAL CONFERENCE
“ENVIRONMENTAL SAFETY IN THE GAS INDUSTRY”
Moscow, December 5-6, 2017
contact: M_Plotnikova@vniigaz.gazprom.ru