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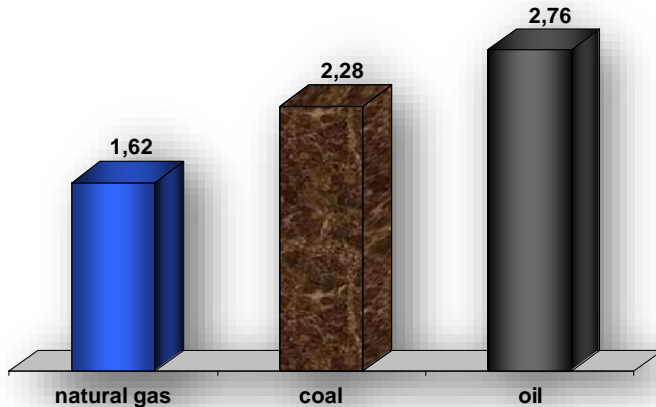
Natural gas life cycle assessment from the wells to the gas transmission system based on the case study of the largest gas production company OAO "Gazprom"

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Background

CO₂ emissions of different hydrocarbon fuel use (as compared with 1 tonne equivalent fuel)

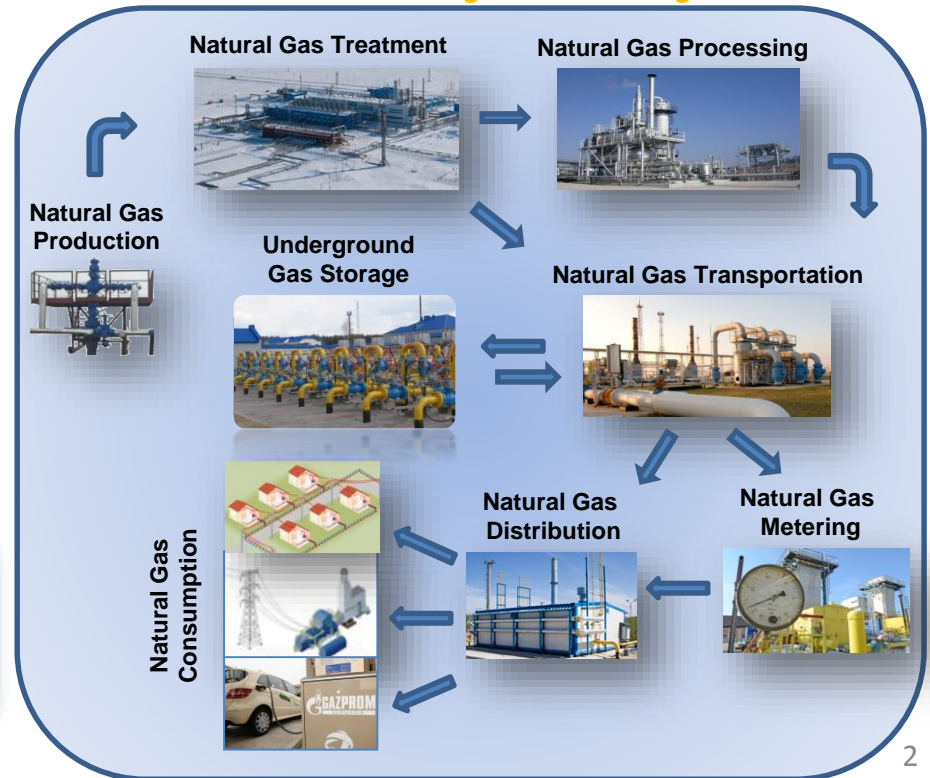


Natural gas is a clean, affordable, reliable, efficient, and secure energy source. It has a vital role to play in a sustainable energy future.

GHG emissions

CH₄

CO₂



Arm and Methods

Study focuses on the application of the natural gas LCA for GHG emissions from the well to the gas transmission system based on the case study the Gazprom largest gas producer "Gazprom добыча Yamburg"



ISO 14040:2006 ISO 14041:98 ISO 14042:2000 ISO 14043:2001 ISO 14044:2006



LCA



GHG emission

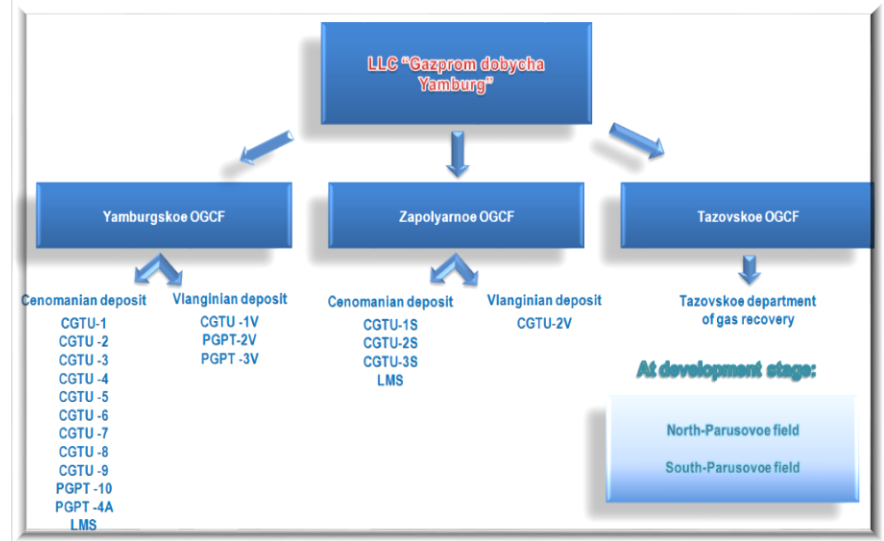
“Gazprom добыча Yamburg”: Production Characteristic



Gas treatment is carried out on **18** Complex Gas Treatment Units (**CGTU**)

2 thousand gas and gas condensate **production wells**

The total length of operated pipelines is over **2 thousand km**



The boundaries of the company's liability: **5 fields**
- Yamburgskoye, Zapolyarnoye, Tazovskoye, South and North-Parusovoye

Annual production: **220 - 230 billion m³** of natural gas and **1.5 million tons** of gas condensate

Production objects of "Gazprom добыча Yamburg"

Study stages. Inventory Coverage



The goal - to assess GHG emissions throughout the company's natural gas production chain, from the wells to the gas transmission system

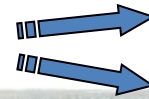
The study scope covers all processes of the main and supplementary operations that caused GHG emissions

The natural gas life cycle inventory analysis

GHG emissions of the company associated with:

- **production activity** (operations of the technological equipment)
- **supplementary activity** (use of motor vehicles, purchase of heat and electricity for own process needs, generate waste)

GHG emissions from production activity



process emissions

fugitive emissions

**Natural gas
(methane emission)**

- purging and emptying of pipelines
- GCU start up/shutdown
- venting of equipments
- incomplete combustion of natural gas
- natural gas leakage , etc

**Carbon dioxide
Emissions**

- generate heat and electricity
- operation of gas compressor units (GCU)
- burning of bleeding gas in flare units
- combustion of industrial waste, etc

The natural gas life cycle inventory analysis

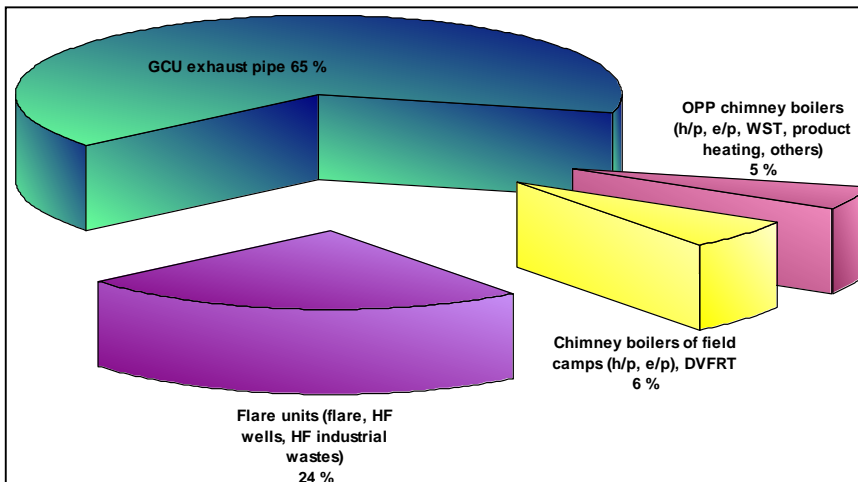
GHG emission sources from supplementary activity

- use of motor vehicles
- collection, storage, landfilling of waste and the transfer to specialized third-party entities
- purchasing part of power

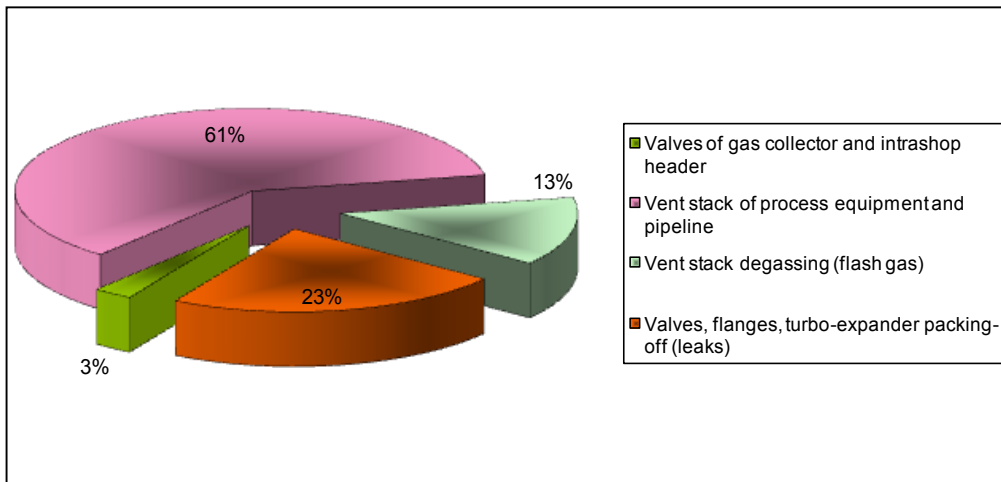


Sources of Process and Fugitive Emissions

Process emissions (CO₂ и CH₄) with natural gas combustion and its sources



Process and fugitive CH₄ emission sources without combustion



Methane with combustion products - 0.01% of the total greenhouse gas emissions

The major volume of **fugitive emissions** is produced by **vent stacks** - **74%** of the total emissions volume. **Fittings** make **26%**

Supplementary activity

Motor fuel consumption and carbon dioxide emission

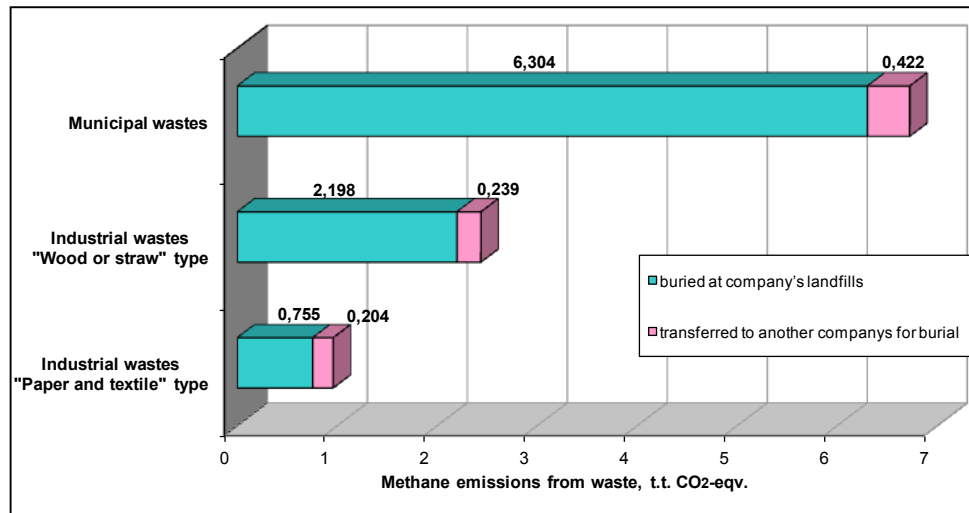
Fuel type	Quantity of motor vehicle	Consumption, ton
Diesel fuel	478	9671.343
Benzine	243	2104.608
Total	721	11775.951

Gaseous compound emissions with indirect greenhouse effect, ton

CO	NO _x	SO ₂	NMVOC
17780.5	6485.2	2.3	2348.8

The main sources of gaseous compound emissions with indirect greenhouse effect are similar to carbon dioxide emissions sources.

Methane emissions from waste



94% of municipal waste were buried at own landfills, and **6%** - transferred
90% of "wood or straw" - buried at company's landfills, and **10%** - transferred
79% "Paper and Textile" - buried at company's landfills, and **21%**- transferred

The natural gas life cycle impact assessment

Climate change is the **category of impact** in this study



The methodology of the IPCC is a characteristic model for re-calculation of quantitative values of greenhouse gas emission into **Gg CO₂-equivalent**

The global warming potential (GWP₁₀₀) is a characteristic ratio

The conversion factors CO₂ и CH₄ emissions with natural gas combustion

Fuel type	Factor of CO ₂ emission with account of incomplete combustion, t CO ₂ /TJ	Factor of CH ₄ emission as the result of incomplete combustion, t CH ₄ /TJ
Natural combustion gas	55.82	0.005

The global warming potential in compliance with the IPCC 1996:

- for carbon dioxide is **1**
- for methane is **21**

The results of evaluation of the GHG impact. Production activity

Processes/operations accompanied by emissions of combustion products into the atmosphere	GHG emissions, Gg CO ₂ -eqv.	
	CO ₂	CH ₄
Blowing of wells with burning on a horizontal flare (fluid plugs, after drilling, inspections)	650.701	1.224
Work of booster CS (fuel gas of gas-compressor units)	2603.426	4.897
Work of boiler stations for heat energy generation	24.872	0.047
Work of boiler stations for electric energy generation	62.756	0.118
Product (condensate, methanol, DEG) heating	92.822	0.175
Flare (burning of gas after equipment blowdown)	5.611	0.011
Drain water disposal at horizontal industrial effluents flare	308.440	0.580
Work of field camp boiler stations for electricity generation	245.022	0.461
Work of field camp boiler stations for heat generation	1.306	0.002
Needs of the Technical Transport Department	1.127	0.002
Other operations	7.055	0.013
Total	4003.138	7.530

Processes/operations accompanied by natural gas emissions into the atmosphere	Methane, Gg CO ₂ -eqv.
Blow-down of gas-collecting system and collector and intershop header	4.123
Emptying of process equipment	85.381
Displacement of air by gas	3.356
Blowing of process equipment	0.370
Maintenance (blowing) of supervisory and automatic devices	2.123
Degassing (flash gases)	20.517
Sampling	4.013
Leaks	35.140
Total	155.023

The results of evaluation of the GHG impact. Supplementary activity

Carbon dioxide emission due to motor fuel consumption

Type of motor fuel	CO ₂ emission, Gg CO ₂ -eqv.
Diesel fuel	31.031
Benzine	6.534
Total	37.565

Consumption of purchased energy and carbon dioxide emission from purchased energy consumption

Energy consumption, kW*h	CO ₂ emission, Gg
11736.626	3.814

Methane emission from waste

Methane emission from waste:	Category of wastes			Total methane emission, Gg CO ₂ -eqv.
	Paper and textile	Wood or straw (excluding carbon lignin)	Municipal waste	
- own landfills	0.755	2.198	6.304	9.256
- transferred to outside specialized organizations	0.204	0.239	0.422	0.864



The natural gas life cycle interpretation

Emissions of GHG as the result of production activity of “Gazprom dobycha Yamburg”

Greenhouse gas emission, Gg CO ₂ -eqv				
Methane emission				Carbon dioxide emission from burning of natural gas as a part of combustion products
Total methane emission, including:	- from process and fugitive sources of emissions as a part of natural gas	- from wastes buried at the landfills of the Company	- from burning of natural gas as a part of combustion products	
171.809	155.023	9.256	7.530	4003.138
Rating of value	B	C	C	A
Rating of controllability	B	C	C	B

Rating of value: A – significant emission requiring high-priority measures for reduction
 B - emission recommended for reduction, C- insignificant emission that can be neglected.

Rating of controllability allowing for improvement: A - major control capabilities,
 B - limited control capability, C - non-feasibility of high-priority control due to insignificance of emission.



Example of the natural gas life cycle interpretation

Processes/operations accompanied by emissions of combustion products into the atmosphere	GHG emissions, Gg CO ₂ -eqv.		Rating of controllability
	CO ₂	CH ₄	
Blowing of wells with burning on a horizontal flare (fluid plugs, after drilling, inspections)	650.701	1.224	A
Work of booster CS (fuel gas of gas-compressor units)	2603.426	4.897	B
Work of boiler stations for heat energy generation	24.872	0.047	B
Work of boiler stations for electric energy generation	62.756	0.118	B
Product (condensate, methanol, DEG, fuel start-up gas, WST) heating	92.822	0.175	B
Flare (work of a pilot burner, burning of gas after process equipment blowdown)	5.611	0.011	C
Drain water disposal at horizontal industrial effluents flare	308.440	0.580	B
Work of field camp boiler stations for electric generation	245.022	0.461	B
Work of field camp boiler stations for heat generation	1.306	0.002	C
Needs of the Technical Transport Department	1.127	0.002	C
Other operations	7.055	0.013	C
Total	4003.138	7.530	B

Processes/operations accompanied by natural gas emissions into the atmosphere	Methane, Gg CO ₂ -eqv	Rating of controllability
Blow-down of gas-collecting system and collector and intershop header	4.123	B
Emptying of process equipment	85.381	B
Displacement of air by gas	3.356	B
Blowing of process equipment	0.370	C
Maintenance (blowing) of supervisory and automatic devices	2.123	C
Degassing (flash gases)	20.517	A
Sampling	4.013	C
Leaks	35.140	B
Total	155.023	B

Conclusions

- The evaluation data of the well-to-pipeline life cycle were obtained in the greenhouse gas emission context considering the evaluated uncertainty
- The technological processes and sources with the most or insignificant of the GHG emissions:
 - the carbon dioxide emissions as a combustion product - **95.9 %** of total GHG emissions
 - methane emitted from natural gas technologic operations - **3.7 %** of total GHG emissions
 - the methane emission from the incomplete fuel combustion - **0.2%** of the total GHG emissions from combustion
 - methane emissions from waste - **3%** of the company total methane emissions
 - carbon dioxide emission from motor fuel combustion - **0.8%** of the company 's total carbon dioxide emission
 - carbon dioxide indirect emission from purchased energy - **0.05%** of the company's total carbon dioxide emissions

Conclusions

- Possibility to assess the natural gas impact on climate at each stage of production in different companies and facilitate emission reductions in companies, where it can be achieved
- The results of this study are used by the company for production control and GHG emissions management, as well as the development of rational, cost-effective and environmentally friendly solutions for the emissions mitigation and reduction
 - for example, flash gas stands for a significant CH₄ emission “Gazprom dobycha Yamburg” (13 % of all CH₄ emissions). “Gazprom VNIIGAZ” and “Gazprom dobycha Yamburg” jointly proposed flash gas emission reduction solutions for Nadym-Pur-Taz region based on the corporate inventions of patent protected model № 135095 «Flash gas utilization unit» and patent protected invention № 2515242 «Flash gas utilization technique»



Thank you for your attention!