

FUTURE OF NATURAL GAS AND GAS INFRASTRUCTURE

The new challenges and role for gas TSOs

Eustream – Slovak Gas TSO

Key part of the European infrastructure

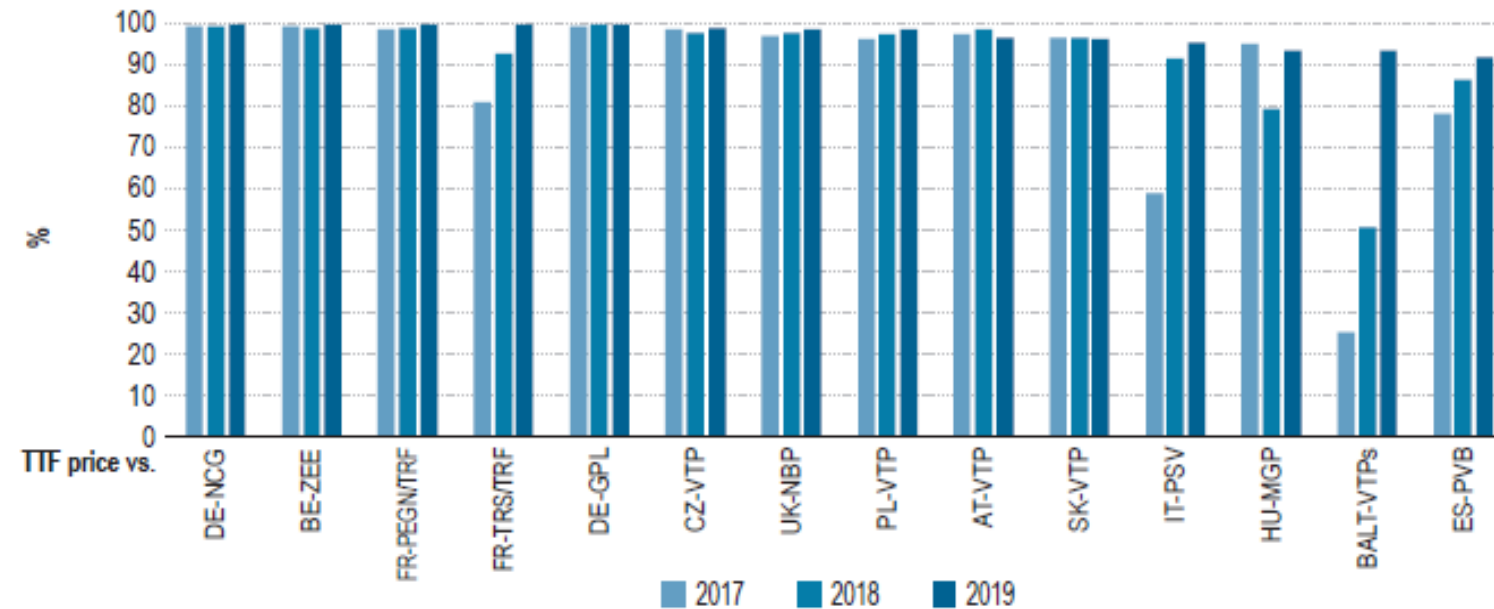
- **77.4 bcm/y**
technical capacity of the entry point Veľké Kapušany/Budince
- **59.7 bcm/y**
gas transmission in 2018
- **4 compressor stations**
total installed power 500 MW
- **2,273 km**
4-5 parallel lines 48"/56"
- **73.5 bars**
maximum operating pressure
- **5th compressor station**
recently finished,
installed power 46 MW



60,64 billions m³ of gas transported
in last financial year

Lets skip two energy policy pillars for today

Figure 24: Correlation between TTF and selected hubs' spot prices – 2017–2019

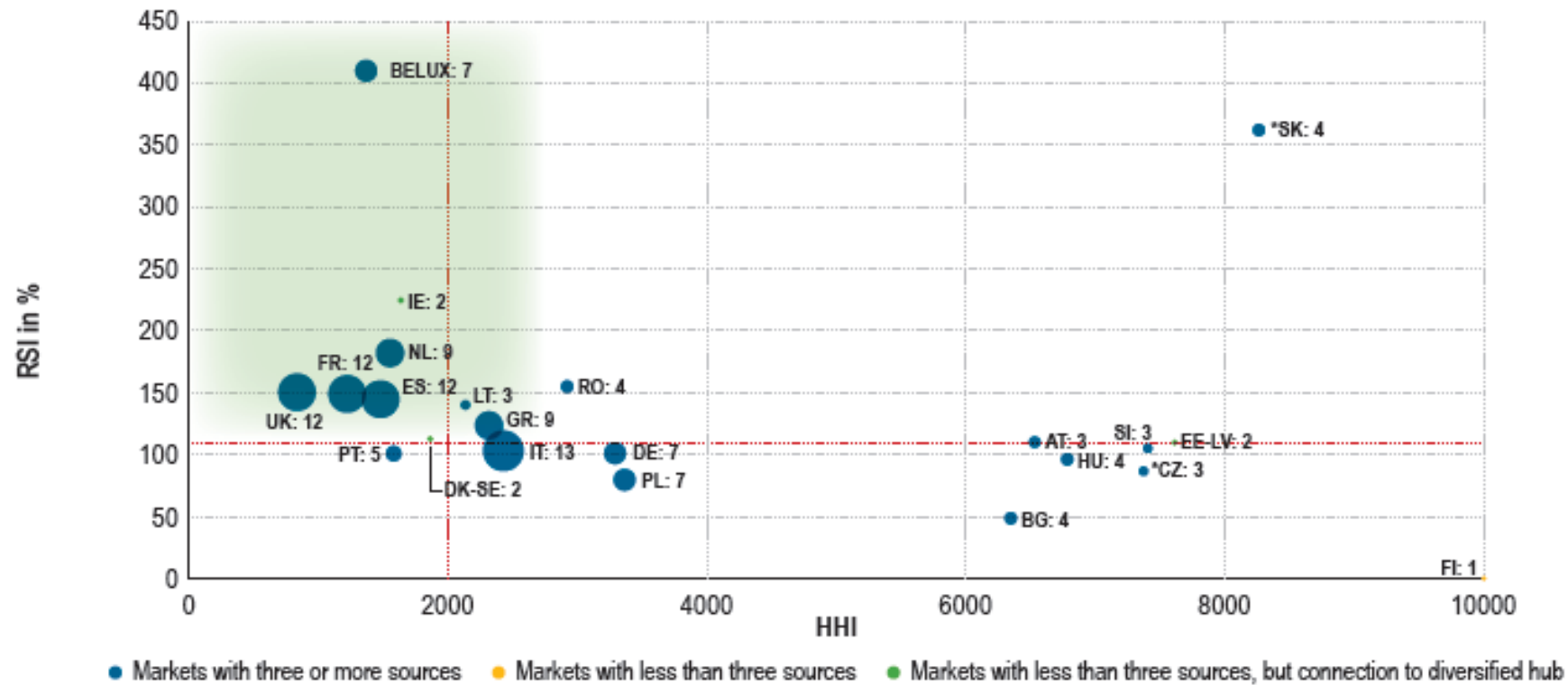


Source: ACER calculation based on Platts and ICIS Heren.

Note: Correlation measured as Pearson coefficient. The Pearson correlation coefficient is a measure of the linear correlation between two variables X and Y. In this example, X and Y are closing prices of gas for delivery on the next day at two EU gas hubs. 100% is total positive linear correlation, 0% is no linear correlation, and -100% is total negative linear correlation.



Figure 13: Overview of MSs according to AGTM market health metrics (Upstream company RSI, HHI and number of supply sources) – 2019



Source: ACER calculation based on ENTSOG capacity data, Eurostat and NRAs.

Note: Y-axis measures the percentage of demand in MSs that can be met without an entry capacity reliant on the largest supply origin. RSI gauges pipeline, LNG and domestic production supply capacity not controlled by the largest supplier. It is intended to quantify the competitive strength of the market. RSI disregards storage, but accounts for transits. The feasibility of physical volumes being acquirable is not evaluated, which could result in an overestimate of the RSI. The X axis measures the concentration of companies on the supply side – The HHI¹⁰ (see MMR 2015 Annex 1 for further details on the approach). The bubble size represents the number of distinct supply origin sources. The values for Slovakia and the Czech Republic are from the 2018 MMR due to lack of data availability for 2019.

Times have changed Climate action is of utmost priority



EU Climate Law

ENVI Committee, EP Vote – 5 Oct

Actions

- 60% GHG cuts by 2030
- 2050 target both for EU & MS
- Phase out of fossil subsidies by 2025

ITRE (in favor of 55% target) expected to oppose the draft report

Gas has to find its new role and to adapt

Importance of gas in CEE/SEE region

Figure 3.4 Average Exposure Indicator in 2016 and exposure concentration obligation



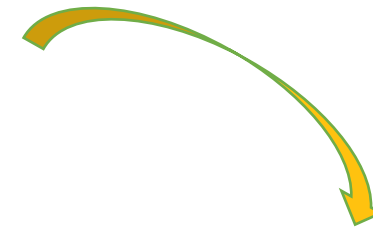
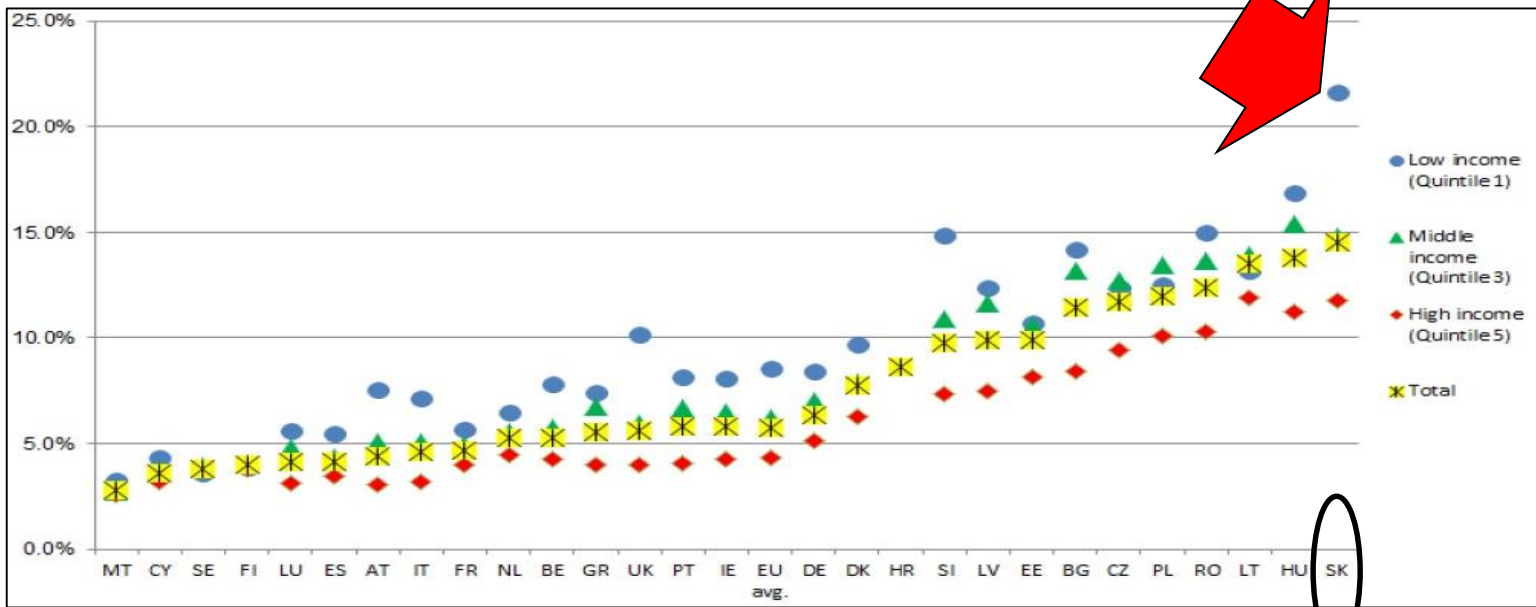
Situation in CEE is in many aspects dramatically different from the rest of EU.

Maintaining the role of gas can efficiently help to fight three main challenges of today:

- Deeply poluted air
- Energy efficiency
- Energy poverty

Another reason – Energy poverty

- The costs of energy for citizens in Slovakia represented up to 15% of total household costs, for low income households nearly 22%.
- Big ratio of polluting energy carriers is used
- Plus ruining forests – rapid decrease, leads to uncontrollable and often illegal wood production from forests



Share of household energy costs as per categories of income (2014)
 (source: Európska komisia (COM(2016) 769 final))

What gas infrastructure can offer

Gas infrastructure as enabler of change and part of solution

- The role of the gas infrastructure is more than to be a bridging solution
- Many studies have shown the potential for gas grids to contribute to the decarbonisation of the EU economy, namely by lowering the costs of the transition.

A number of studies demonstrate that it is more cost effective to meet the climate goals with gases (and gas infrastructure) vs full electrification:

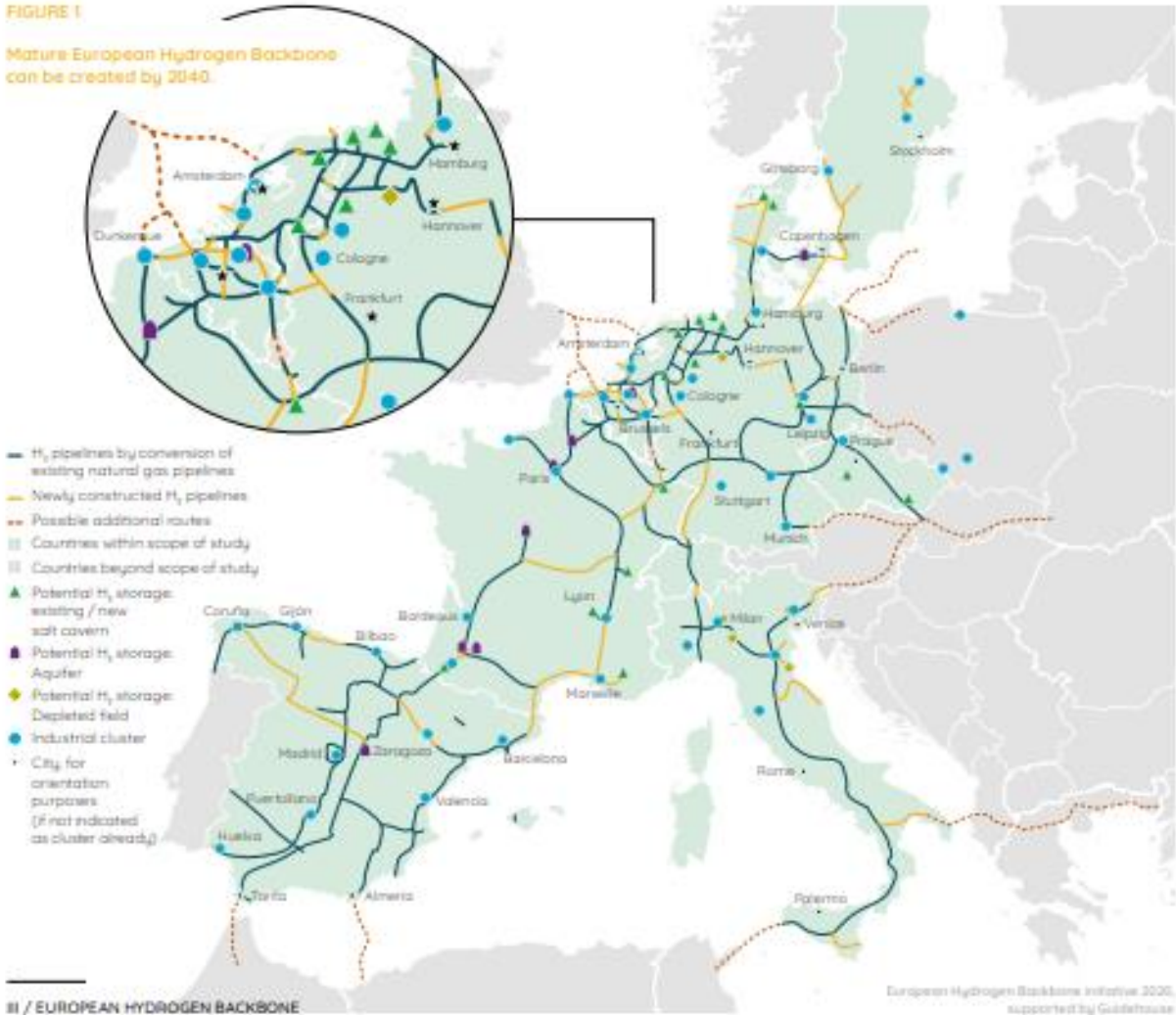
*Ecofys "Gas for Climate" study 2018 estimates **€138Bn per annum** savings*

Eurogas 2018 PRIMES study 2018

*Frontier Economics 2018 FNB Green Gas Study estimated **€12Bn per annum** savings in Germany alone*

*DNV GL 2020 study estimates **€130Bn per annum** savings*

Gas TSOs propose EU Hydrogen backbone



European Hydrogen Backbone

HOW A DEDICATED HYDROGEN INFRASTRUCTURE CAN BE CREATED
JULY 2020

Enagás, Energinet, Fluxys Belgium, Gasunie, GRTgaz, NET4GAS, OGE, ONTRAS, Snam, Swedegas, Teréga

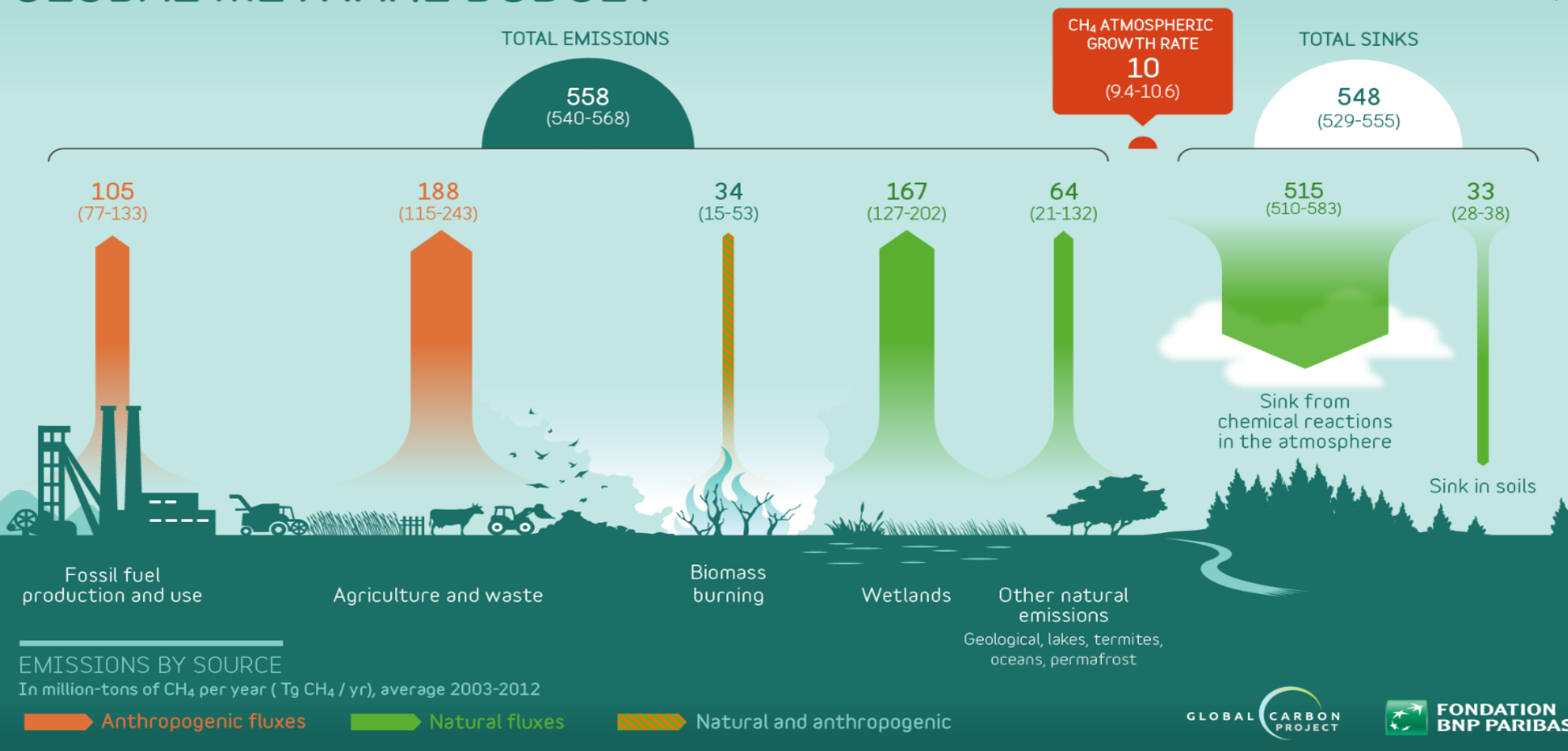
11 gas TSOs: Enagás, Energinet, Fluxys Belgium, Gasunie, GRTgaz, NET4GAS, OGE, ONTRAS, Teréga, Snam and Swedegas

Eustream maps in details of changing gas pipes to hydrogen pipes

TSO: <i>Eustream, a.s.</i>	%vol	Marcogaz - Infographic Hydrogen Limits	type
0	<i>Example</i>	2%	Technical Elements Pipeline length [km]
1	<i>Eustream, a.s.</i>	2%	Technical Elements Pipeline length [km]
2	<i>Eustream, a.s.</i>	2%	Technical Elements Gas Chromatograph [pcs]
3	<i>Eustream, a.s.</i>	2%	Technical Elements Flow computer and volume converter software [pcs]
4	<i>Eustream, a.s.</i>	2%	Technical Elements Flow computer and volume converter [pcs]
5	<i>Eustream, a.s.</i>	2%	Technical Elements Compressor [units]
6	<i>Eustream, a.s.</i>	2%	Technical Elements Compressor Driver (e.g. turbine, electric motor)
7	<i>Eustream, a.s.</i>	2%	Technical Elements Compressor Software [pcs]
8	<i>Eustream, a.s.</i>	2%	Technical Elements Corrosion Protection [km]
9	<i>Eustream, a.s.</i>	2%	Technical Elements Pigging station [pcs]
10	<i>Eustream, a.s.</i>	2%	Technical Elements Filters & Separators
11	<i>Eustream, a.s.</i>	2%	Technical Elements Preheater
12	<i>Eustream, a.s.</i>	2%	Technical Elements Shut-off valve
13	<i>Eustream, a.s.</i>	2%	Technical Elements Pressure regulator
14	<i>Eustream, a.s.</i>	2%	Technical Elements Gas Relief Valve
15	<i>Eustream, a.s.</i>	2%	Technical Elements Odorant Injection nozzle
16	<i>Eustream, a.s.</i>	2%	Technical Elements Turbine Gas Meter
17	<i>Eustream, a.s.</i>	2%	Technical Elements Rotary Displacement Gas Meter
18	<i>Eustream, a.s.</i>	2%	Technical Elements Ultrasonic Gas Meter
19	<i>Eustream, a.s.</i>	2%	Technical Elements Diaphragm Gas Meter
20	<i>Eustream, a.s.</i>	2%	Technical Elements Coriolis Gas Meter
21	<i>Eustream, a.s.</i>	2%	Technical Elements Flanges & Fittings
22	<i>Eustream, a.s.</i>	2%	Technical Elements Fluid Catchers
23	<i>Eustream, a.s.</i>	2%	Technical Elements Vent & Blowdown Silencer
24	<i>Eustream, a.s.</i>	2%	Technical Elements Gas boilers
25	<i>Eustream, a.s.</i>	2%	Technical Elements Hydrogen Gas Alarms [pcs]
26	<i>Eustream, a.s.</i>	2%	Technical Elements Vortex Gas Meter
27	<i>Eustream, a.s.</i>	2%	Technical Elements Others [pcs]
28	<i>Eustream, a.s.</i>	2%	Operational Elements Quality Tracking System [pcs]
29	<i>Eustream, a.s.</i>	2%	Operational Elements C.S-Operation [pcs]
30	<i>Eustream, a.s.</i>	2%	Operational Elements Data exchange among TSOs
31	<i>Eustream, a.s.</i>	2%	Operational Elements Data provided to transmission system Users
32	<i>Eustream, a.s.</i>	2%	Operational Elements Other Supporting IT systems
33	<i>Eustream, a.s.</i>	2%	Operational Elements Trainings
34	<i>Eustream, a.s.</i>	2%	Operational Elements Safety Assessment [pcs]
35	<i>Eustream, a.s.</i>	2%	Operational Elements Maintenance
36	<i>Eustream, a.s.</i>	2%	Operational Elements Others [pcs]
37	<i>Eustream, a.s.</i>	2%	Project Elements Project for the transition to include hydrogen
38	<i>Eustream, a.s.</i>	2%	Technical Elements Pipeline length [km]
39	<i>Eustream, a.s.</i>	2%	Technical Elements Gas Chromatograph [pcs]
40	<i>Eustream, a.s.</i>	2%	Technical Elements Flow computer and volume converter software [pcs]

41	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Flow computer and volume converter [pcs]
42	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Compressor [units]
43	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Compressor Driver (e.g. turbine, electric motor)
44	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Compressor Software [pcs]
45	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Corrosion Protection [km]
46	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Pigging station [pcs]
47	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Filters & Separators
48	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Preheater
49	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Shut-off valve
50	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Pressure regulator
51	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Gas Relief Valve
52	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Odorant Injection nozzle
53	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Turbine Gas Meter
54	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Rotary Displacement Gas Meter
55	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Ultrasonic Gas Meter
56	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Diaphragm Gas Meter
57	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Coriolis Gas Meter
58	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Flanges & Fittings
59	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Fluid Catchers
60	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Vent & Blowdown Silencer
61	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Gas boilers
62	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Hydrogen Gas Alarms [pcs]
63	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Vortex Gas Meter
64	<i>Eustream, a.s.</i>	2%	NA	Technical Elements	Others [pcs]
65	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Quality Tracking System [pcs]
66	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	C.S-Operation [pcs]
67	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Data exchange among TSOs
68	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Data provided to transmission system Users
69	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Other Supporting IT systems
70	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Trainings
71	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Safety Assessment [pcs]
72	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Maintenance
73	<i>Eustream, a.s.</i>	2%	NA	Operational Elements	Others [pcs]
74	<i>Eustream, a.s.</i>	2%	NA	Project Elements	Project for the transition to include hydrogen

GLOBAL METHANE BUDGET



- Methane emissions account for about 16% of the total of anthropogenic GHG emissions; the Global Warming Potential of methane is **28 – 34 times vs. CO₂** (100-year timescale) .
- The oil and gas industry contribute roughly **a quarter** of the world’s anthropogenic methane emissions and operators in the sector have been trying to reduce their emissions for years, to **demonstrate their credibility to stakeholders.**

Eustream - Methan leakage reduction effort

Rok	Objem ZP tis. m3 / rok	CH4 v ZP tis. m3 / rok	CH4 t / rok	CO2 equivalent t /rok
2016	14 419	13 265	8 715	217 886
2017	20 888	19 217	12 626	315 639
2018	17 473	16 075	10 561	264 035
2019	10 818	9 953	6 539	163 471
Total	63 598	58 510	38 441	961 029



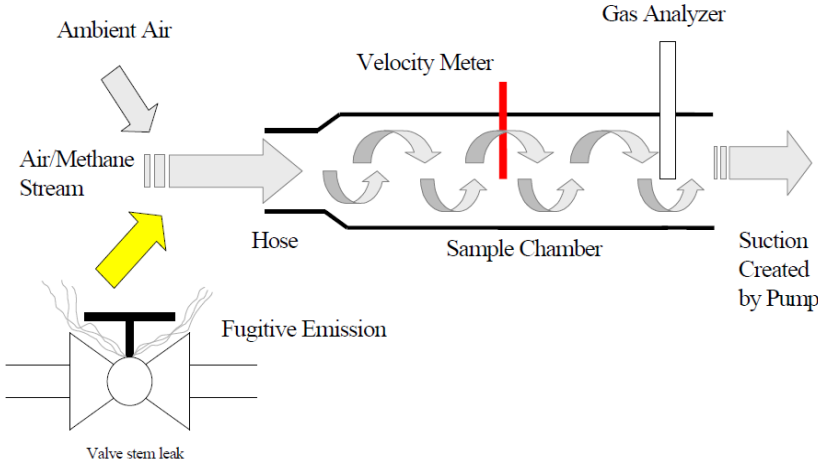
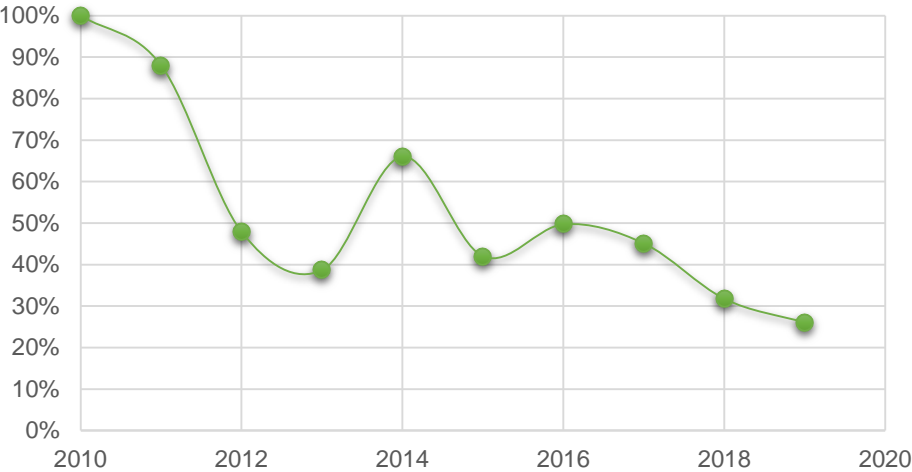
CH4 v ZP (min)	CH4 density kg/m3	CO2 eqv
92%	0,657	25

- Evacuated more than 330 mil. m³ of gas
- About 1 million tons of CO2 equivalent was saved last 4 years due to our effort and Best Available Technology in use
- Efficiency of process boosted from 36 % to 95 %



Eliminating uncontrolled CH₄ leakages

Methane emissions reduction effort



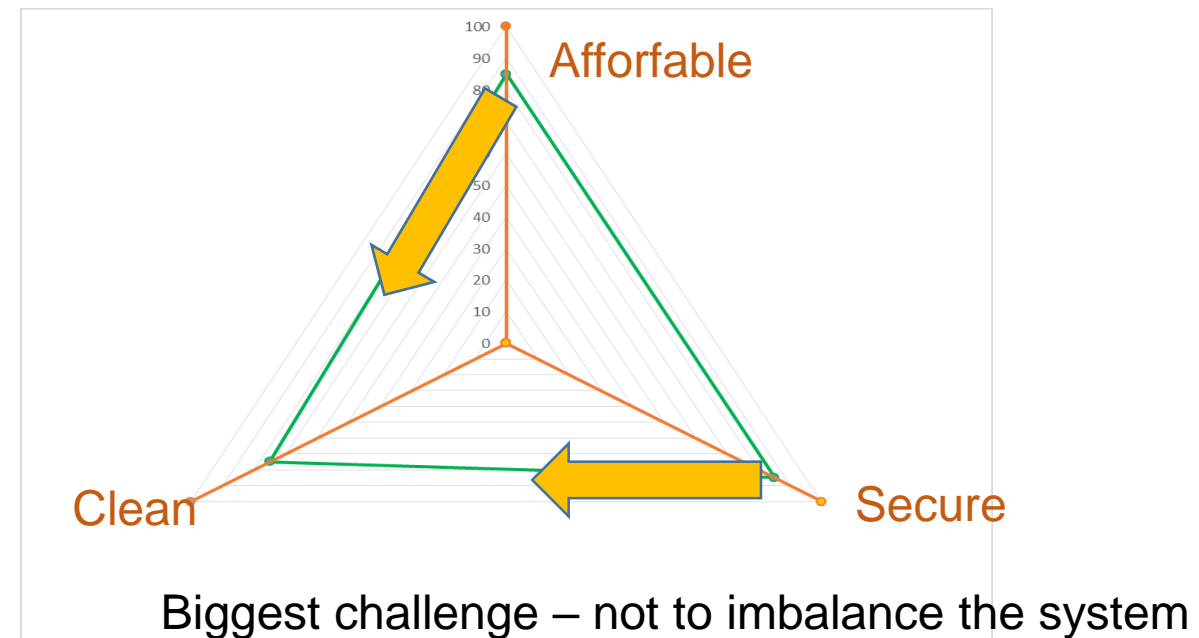
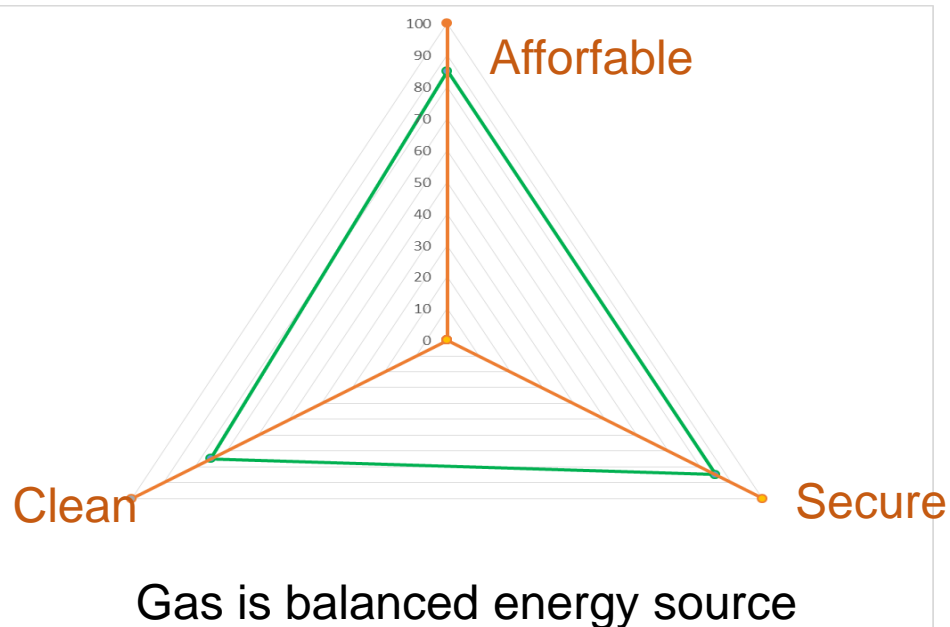
Quantify leakage



Use best available technology to detect leaks

Some concluding remarks

- Decarbonization \neq only atoms
- Decarbonization = also molecules (hybrid energy system)
- Energy system integration = sine qua non condition for success
- Natural gas = an effective trajectory (if conditions are met)



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Thank you for your attention.