Potential of natural gas decarbonization:

Russian view of the cross-border gas value chain

Dr. Oleg Aksyutin
Dr. Alexander Ishkov
Dr. Konstantin Romanov

GAZPROM
CONSERVING NATURE

CLIMATE POLICY

COP21 DECISION

(on adoption of the Paris Agreement on Climate Change):

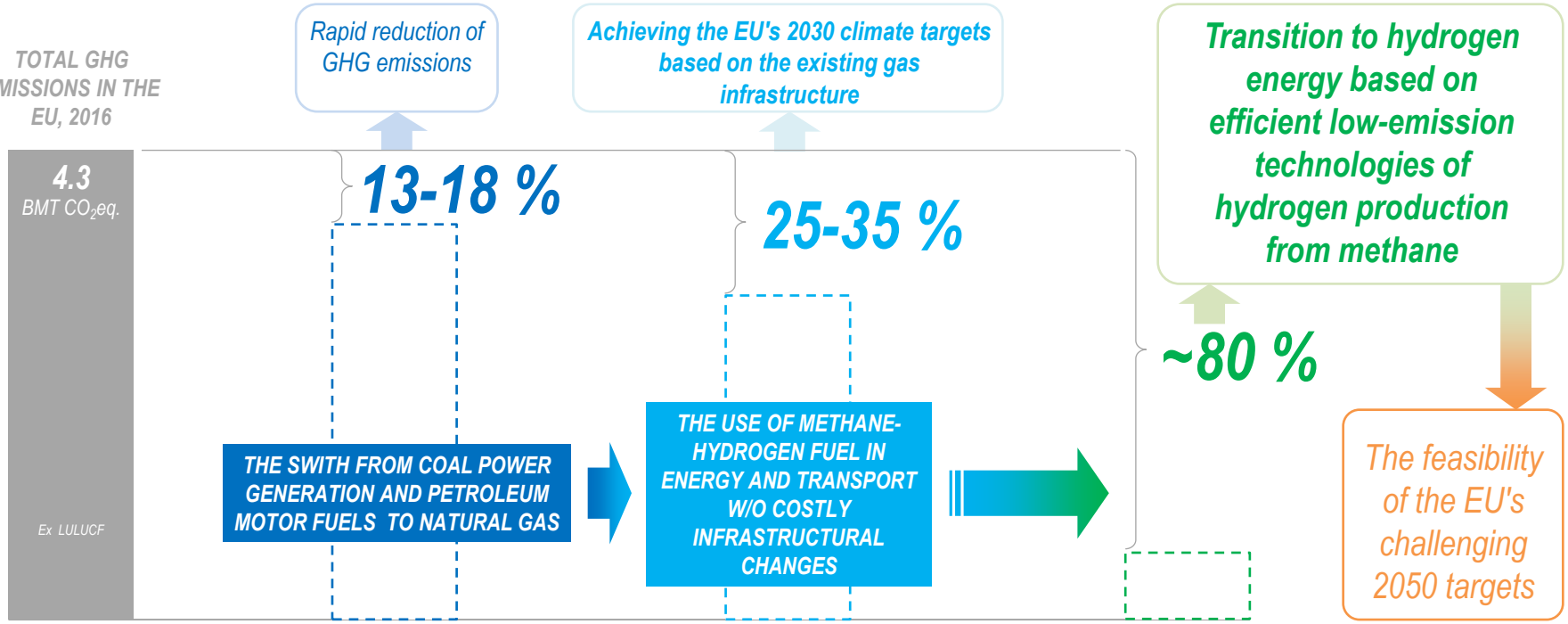
countries are required to prepare by 2020

2050 LONG-TERM LOW GHG EMISSION DEVELOPMENT STRATEGY

NATIONALLY DETERMINED CONTRIBUTIONS

NEW REGULATIONS

METHANE-HYDROGEN SCENARIO FOR LOW-CARBON DEVELOPMENT



https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-3742094/feedback/F13767_en?p_id=265612

GAZPROM
CONSERVING NATURE

A EUROPEAN STRATEGIC LONG-TERM VISION FOR A PROSPEROUS, MODERN, COMPETITIVE AND CLIMATE NEUTRAL ECONOMY

OVERVIEW OF MAIN SCENARIO BUILDING BLOCKS

	Electrification (ELEC)	Hydrogen (H2)	Power-to-X (P2X)	Energy Efficiency (EE)	Circular Economy (CIRC)	Combination (COMBO)	1.5°C Technical (1.5TECH)	1.5°C Sustainable Lifestyles (1.5LIFE)
Main Drivers	Electrification in all sectors	Hydrogen in industry, transport and buildings	E-fuels in industry, transport and buildings	Pursuing deep energy efficiency in all sectors	Increased resource and material efficiency	Cost-efficient combination of options from 2°C scenarios	Based on COMBO with more BECCS, CCS	Based on COMBO and CIRC with lifestyle changes
GHG target in 2050	-80% GHG (excluding sinks) ["well below 2°C" ambition]					-90% GHG (incl. sinks)	-100% GHG (incl. sinks) ["1.5°C" ambition]	
Major Common Assumptions	• Higher energy efficiency post 2030 • Deployment of sustainable, advanced biofuels • Moderate circular economy measures • Digitilisation					• Market coordination for infrastructure deployment • BECCS present only post-2050 in 2°C scenarios • Significant learning by doing for low carbon technologies • Significant improvements in the efficiency of the transport system.		
Power sector	Power is nearly decarbonised by 2050. Strong penetration of RES facilitated by system optimization (demand-side response, storage, interconnections, role of prosumers). Nuclear still plays a role in the power sector and CCS deployment faces limitations.							
Industry	Electrification of processes	Use of H2 in targeted applications	Use of e-gas in targeted applications	Reducing energy demand via Energy Efficiency	Higher recycling rates, material substitution, circular measures	Combination of most Cost-efficient options from "well below 2°C" scenarios with targeted application (excluding CIRC)	COMBO but stronger	CIRC+COMBO but stronger
Buildings	Increased deployment of heat pumps	Deployment of H2 for heating	Deployment of e-gas for heating	Increased renovation rates and depth	Sustainable buildings			CIRC+COMBO but stronger
Transport sector	Faster electrification for all transport modes	H2 deployment for HDVs and some for LDVs	E-fuels deployment for all modes	Increased modal shift	Mobility as a service			• CIRC+COMBO but stronger • Alternatives to air travel
Other Drivers		H2 in gas distribution grid	E-gas in gas distribution grid				Limited enhancement natural sink	• Dietary changes • Enhancement natural sink

GAZPROM
CONSERVING NATURE

PROBLEMS WITH RES

1. DEPENDANCE ON RARE EARTH METALS EXTRACTION

(THE SHORTAGE OF CONSIDERABLE RESERVES IN THE EU)

Monopoly position of some countries

Risks of non-compliance with environmental standards

Social conflicts in extraction areas

2. DEPENDANCE ON ENERGY STORAGE SYSTEMS

NO CONTINUITY OF ELECTRICITY GENERATION

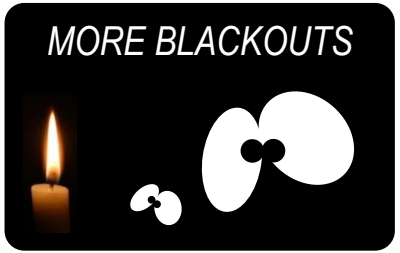
COMPARABLE TO THE ELECTRICITY GENERATION SYSTEM

THE NEED FOR AN UNMANAGEABLE POWER GRID SYSTEM (the refusal of land owners)

3. DEPENDNCE ON CLIMATE CHANGE

CLIMATE CHANGE – SHAKY FOUNDATIONS FOR RES

MORE EXTREME WEATHER EVENTS



ADVANTAGES OF NATURAL GAS OVER RES

Sources:

GAZPROM CONSERVING NATURE

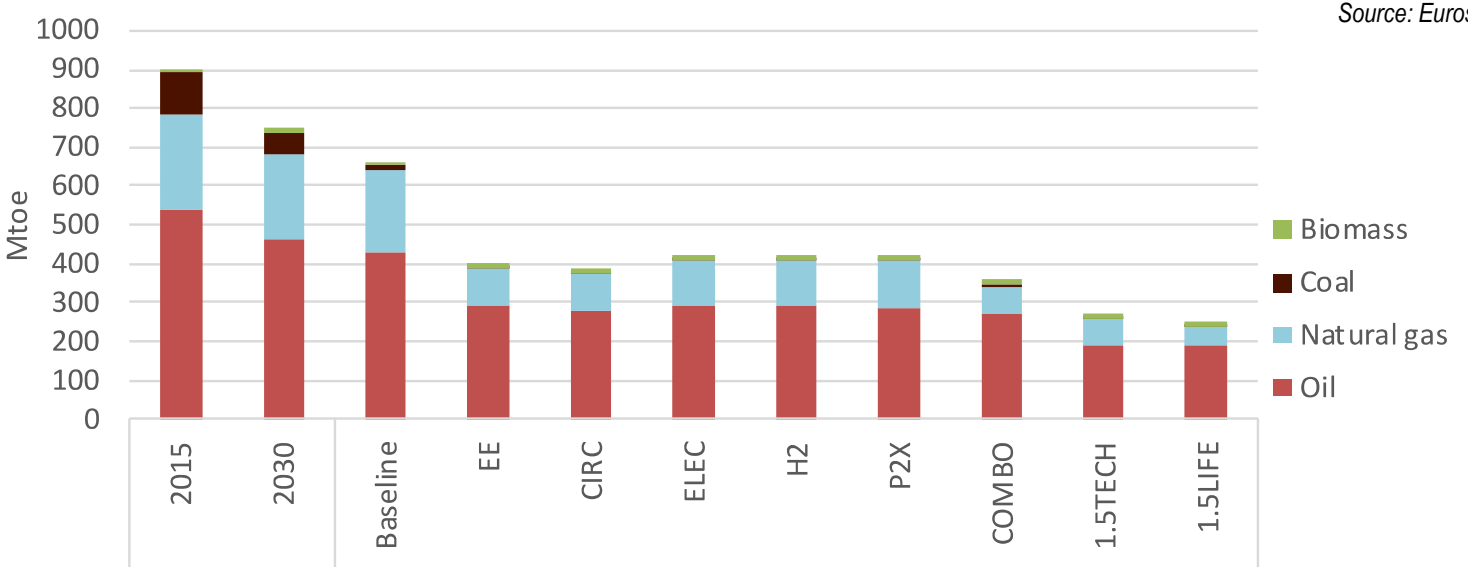
IN-DEPTH ANALYSIS IN SUPPORT OF THE EUROPEAN LONG-TERM STRATEGIC VISION

"Hydrogen has long been used by the chemical industry as a feedstock in industrial processes. Its role is likely to become more prominent in a fully decarbonised energy system"

"Hydrogen is also **assumed to be produced in the EU**. Clearly, building the necessary production assets – be it for hydrogen or e-gas production and upgrading the gas infrastructure (in case large quantities of hydrogen are to be distributed) in the light of currently high costs and nascent demand would be a challenge from the industrial policy perspective. **Studies indicate that some areas within the EU could be well suited to production of hydrogen**/e-gas be it because of abundant production of renewables (e.g. offshore in the North Sea or, in general, close to grids giving access to diversified and big amounts of renewables) or proximity to nuclear power stations or **close to industrial buyers"**

ENERGY IMPORTS

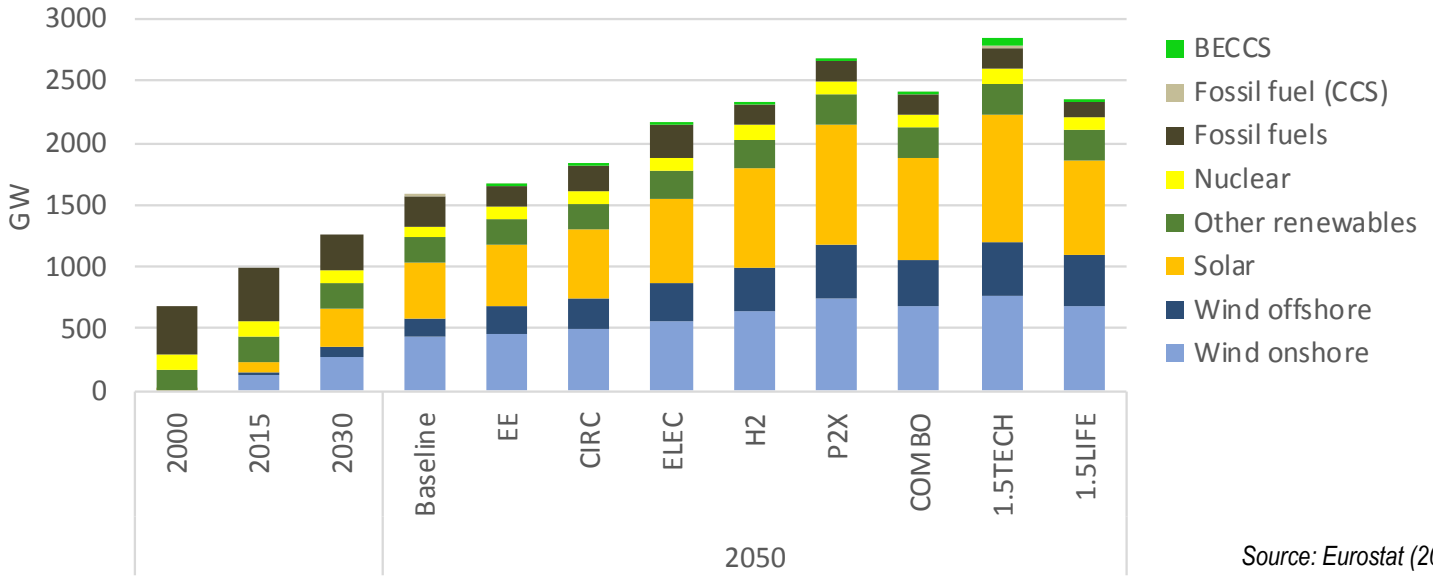
Source: Eurostat (2015), PRIMES



"The decarbonisation scenarios explored in this document assume that decarbonised energy carriers (electricity, **hydrogen**, e-gas, e-liquids**) would all be produced within the EU**. However, as it is the case today for oil, natural gas and biofuels, hydrogen and e-fuels could actually be globally traded commodities and imported from regions with comparatively cheaper, abundant renewables"

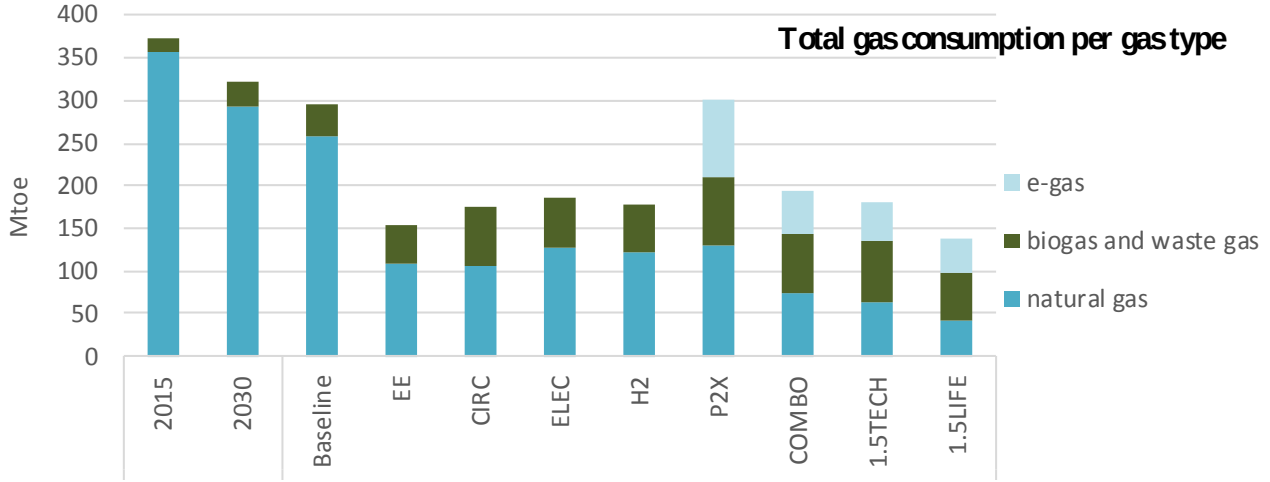
POWER GENERATION CAPACITY

"Finally, **it has to be noted that hydrogen is only marginally used in power generation** (some15 Mtoe in the H2 scenario), and that e-gas or e-liquids are virtually not used in this sector. Hydrogen provides important services as a chemical storage"

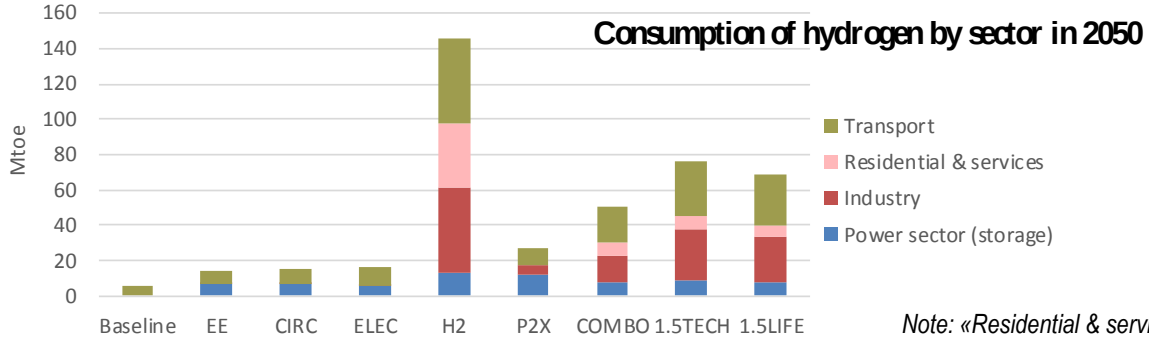


Source: Eurostat (2000, 2015), PRIMES

GAS VS HYDROGEN CONSUMPTION



Source: Eurostat (2015), PRIMES



Note: «Residential & services» also includes agriculture

THE SELECTION OF LOCATION FOR HYDROGEN PRODUCTION

GAZPROM
CONSERVING NATURE

GAS CHEMISTRY, ETC.

ONLY
METHANE

POTENTIAL CONSUMERS OF **DIFFERENT** METHANE-HYDROGEN BLENDS

X %
Y %
Z %

CH_4 + H_2

NATURAL GAS

GAS PRODUCTION

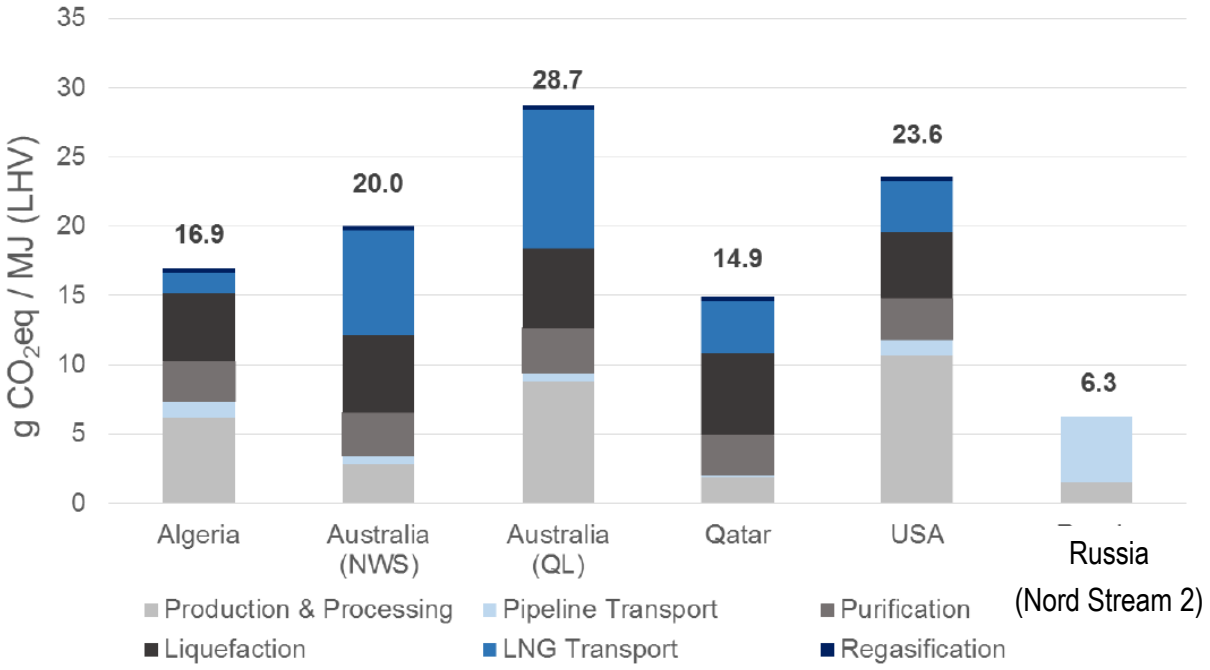
GAS TRANSPORTATION VIA PIPELINES

Efficient technologies of H_2 production without CO_2 emissions

CONSUMERS OF HYDROGEN

ONLY
HYDROGEN

DECARBONISATION OF GAS SUPPLY



DECARBONISATION OF GAS SUPPLY

GAZPROM CONSERVING NATURE

NORD STREAM 2 (L > 1220)

BOVANENKOVO — L = 4166 — GREIFSWALD

55

bcm per year

BOVANENKOVO-UZHGOROD-BAUMGARTEN

BOVANENKOVO — L = 6051 — WAIDHAUS

DIFFERENCE
IN GHG EMISSIONS

Calculated according to GHGenius 4.03

Mt of CO2-eq.

AMOUNTING TO ANNUAL EMISSIONS

ANNUALLY	**8.94**	**More than ICELAND + MALTA or CYPRUS**
IN 25 YEARS	**223.38**	**More than the NETHERLANDS or THE WHOLE TRANSPORT SECTOR OF GERMANY**

DECARBONISATION OF GAS SUPPLY: METHANE EMISSIONS MANAGEMENT

GAZPROM CONSERVING NATURE

TOXIC GAS (since 1989)

in accordance with the legislation of post-Soviet countries

- PERMITTING
- MONITORING
- FEE COLLECTION
- SUPERVISION

GREENHOUSE GAS

Guiding principles

«Reducing methane emissions across the natural gas value chain»

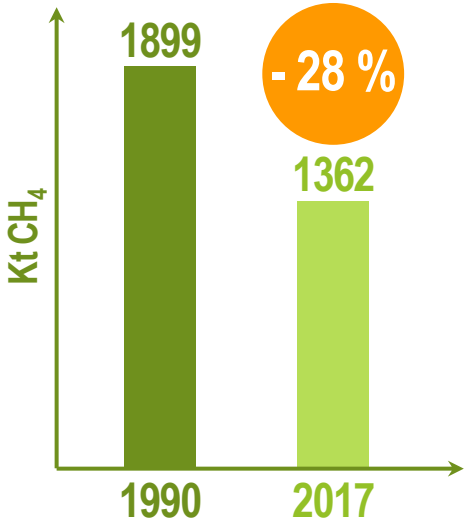
Methane emissions monitoring and detection

Prevention of gas venting

DECARBONISATION OF GAS SUPPLY: METHANE EMISSIONS MANAGEMENT

GAZPROM CONSERVING NATURE

Gazprom methane emissions (1990-2017)



Methane emissions by main activities, Gazprom, 2017

GAS PRODUCTION

0.02 %

of total produced gas

GAS TRANSPORTATION

0.27 %

of total transported gas

Russian Best available techniques Reference document (BREF, gas production) for permitting

0.06-0.18 %

GAS STORAGE

0.03 %

of total UGS gas

RENEWABLES IN GAZPROM

GAZPROM CONSERVING NATURE

RENEWABLE ENERGY SOURCES (EXAMPLES)

TELEMECHANICS SYSTEM UNIT FOR THE GROUP OF WELLS AT YAMBURG GAS-OIL CONDENSATE FIELD

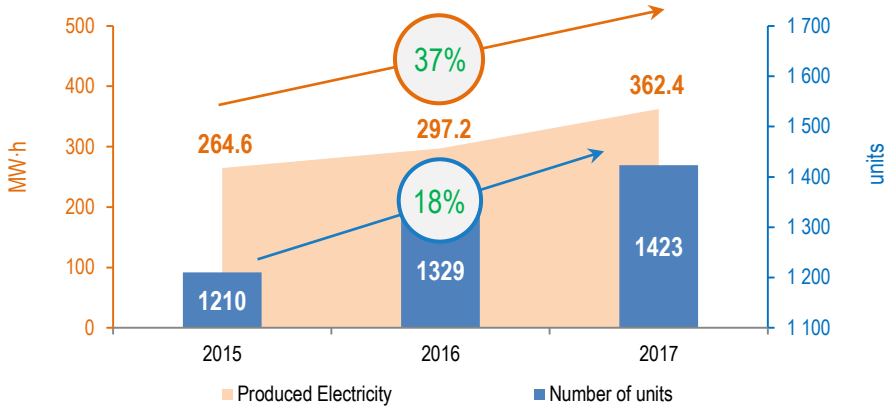
MODULAR PACKAGED ENERGY SAVING UNIT USING SOLAR MODULES AT GAS DISTRIBUTION STATION

ALTERNATIVE ENERGY SOURCES

THERMOELECTRIC GENERATORS AT GAS PROCESSING PLANTS

TURBO-EXPANDERS AT GAS DISTRIBUTIONS STATIONS

RENEWABLE AND ALTERNATIVE ENERGY IN GAZPROM, 2015-2017

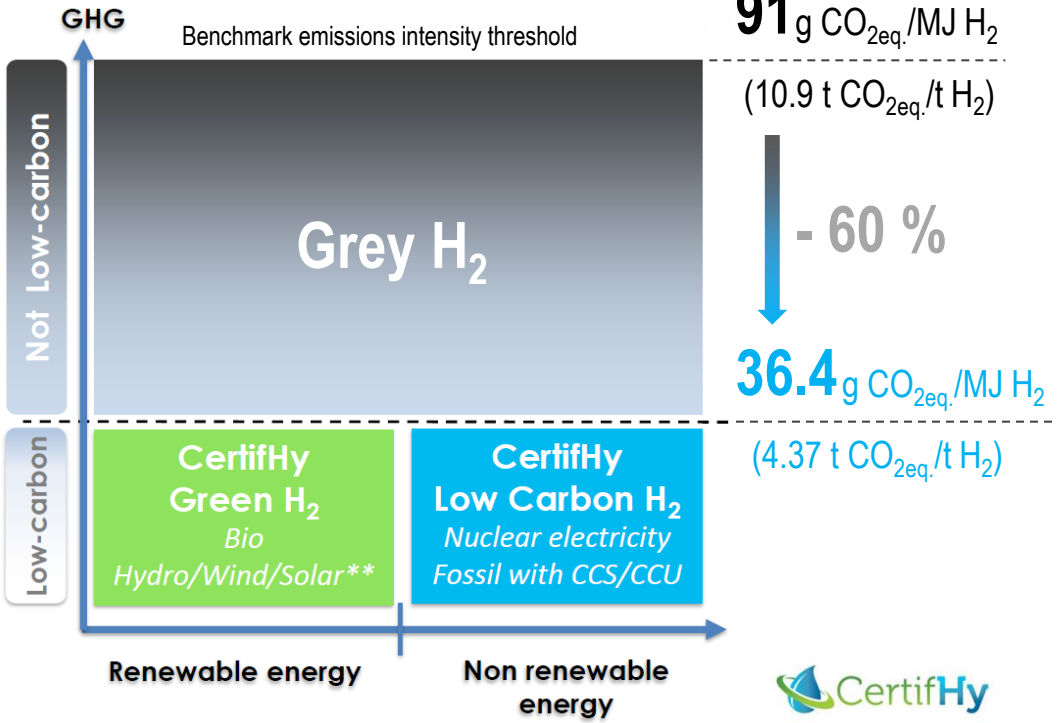


Gazprom bank financed the construction of solar power plants and windmills in Russia:

109.6 billion rubles, 1199 MW capacity

Source: PJSC «Gazprom»

EUROPEAN INITIATIVES



91 g $CO_{2eq.}$/MJ H_2

(10.9 t $CO_{2eq.}$/t H_2)

- 60 %

36.4 g $CO_{2eq.}$/MJ H_2

(4.37 t $CO_{2eq.}$/t H_2)

CertifHy

HYDROGEN INITIATIVE

launched by the Austrian presidency and signed in Linz in September 2018

Low carbon" defined as a 60% reduction compared to a BAT emission benchmark

1 t $CO_{2eq.}$/t H_2 = 8.33 g $CO_{2eq.}$/MJ H_2

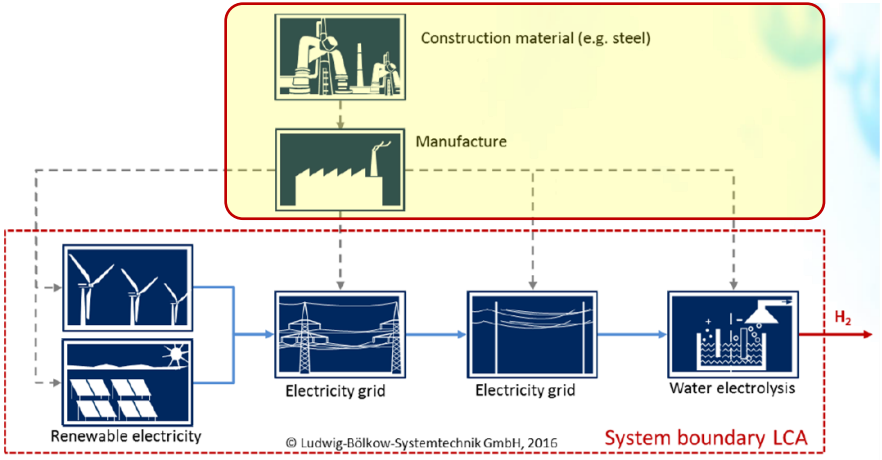
SYSTEM BOUNDARY FOR LCA

Electrolysis onsite: 100% renewable

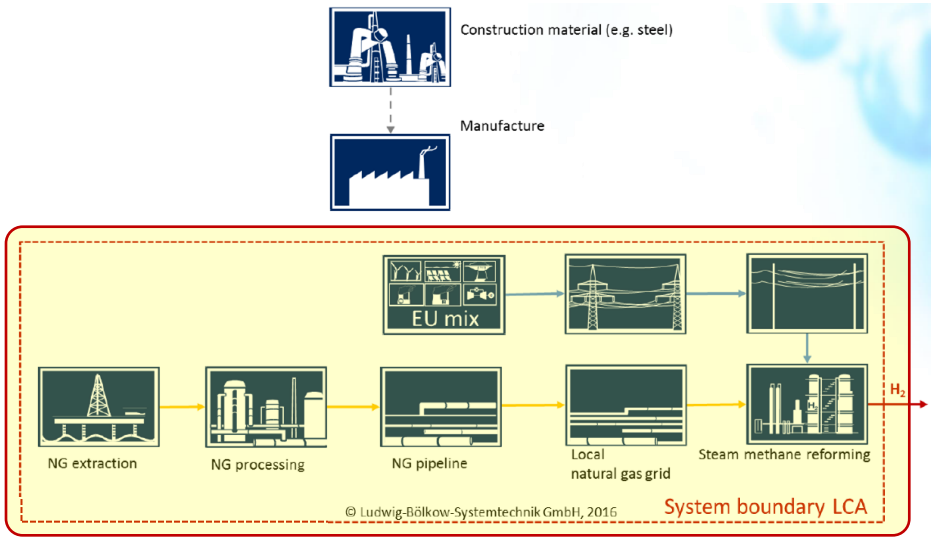
CertifHy

SMR onsite: 100% natural gas

greatest contribution is not taken into account



Supply of construction material and manufacture of power stations, electricity transmission lines, fuel production plants, and vehicles not taken into account

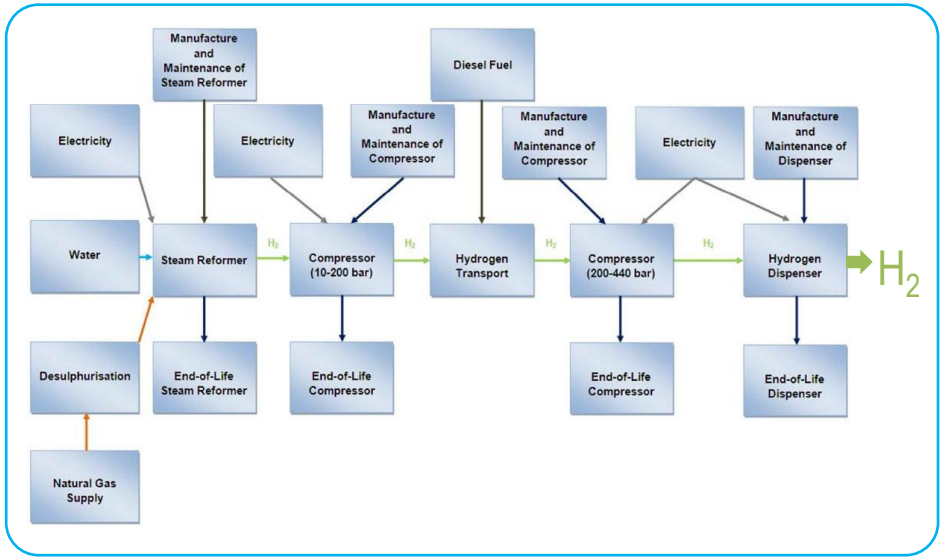


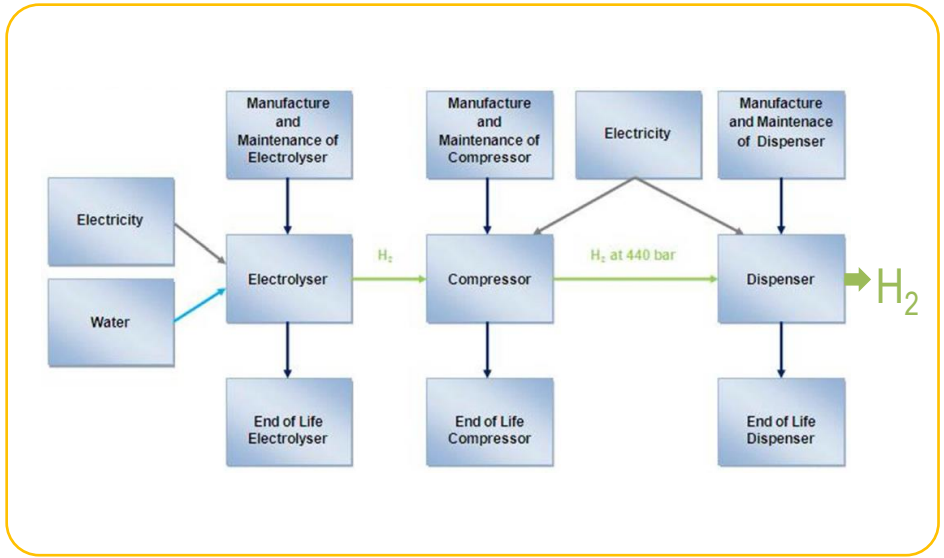
greatest contribution is taken into account

SYSTEM BOUNDARY FOR LCA

GUIDANCE DOCUMENT FOR PERFORMING LCA ON HYDROGEN PRODUCTION SYSTEMS

FC-Hy Guide

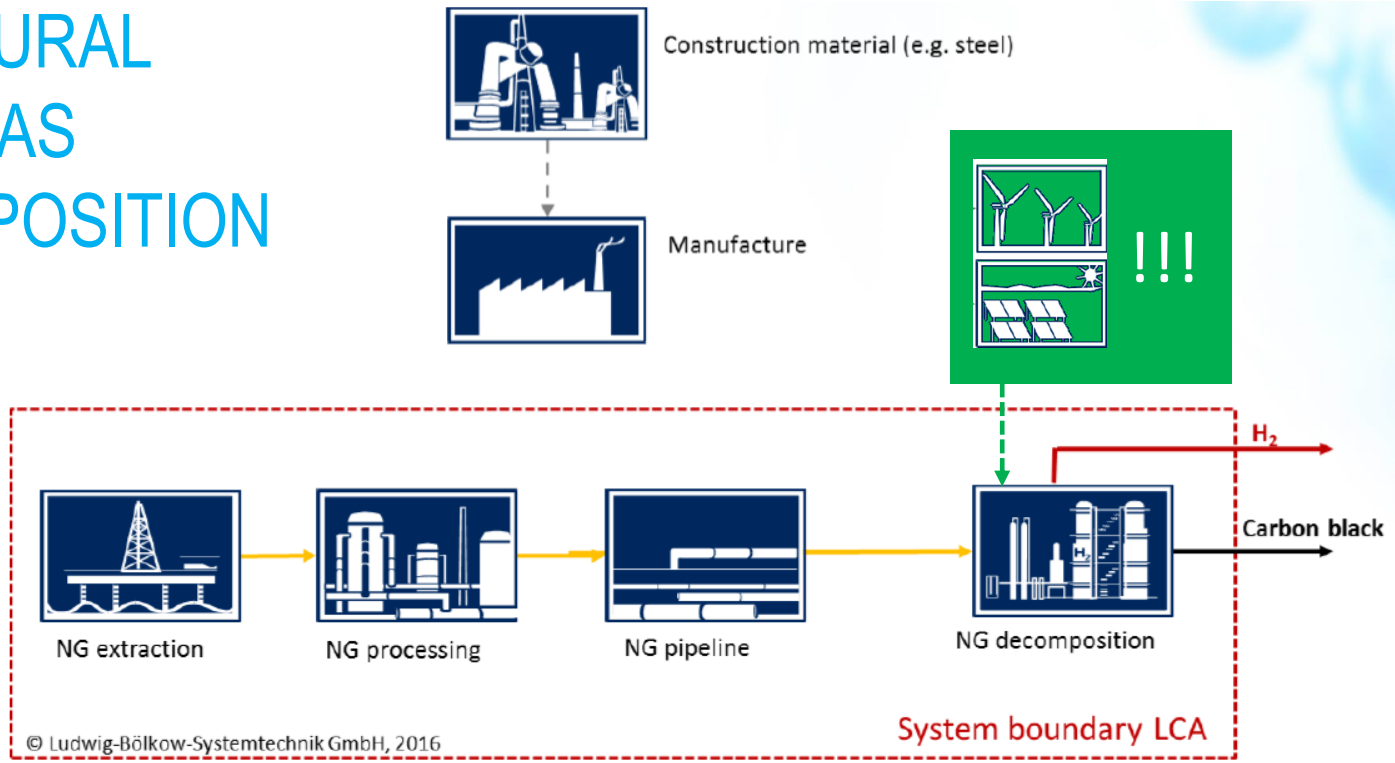




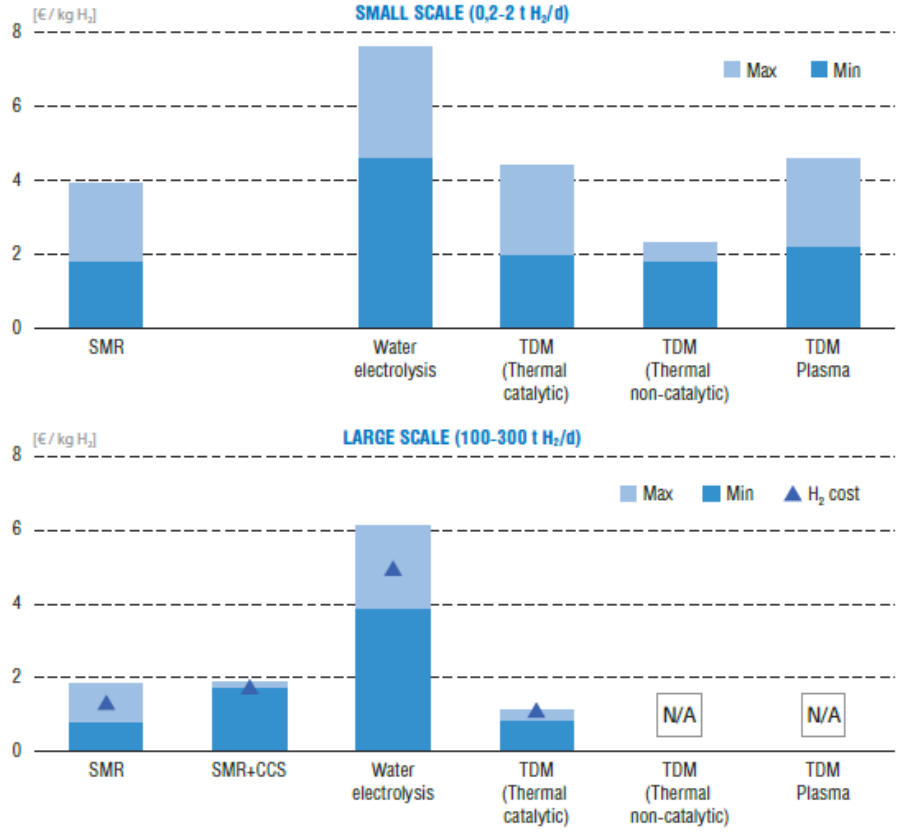
SYSTEM BOUNDARY FOR LCA

CertifHy

NATURAL GAS DECOMPOSITION



Thinkstep STUDY

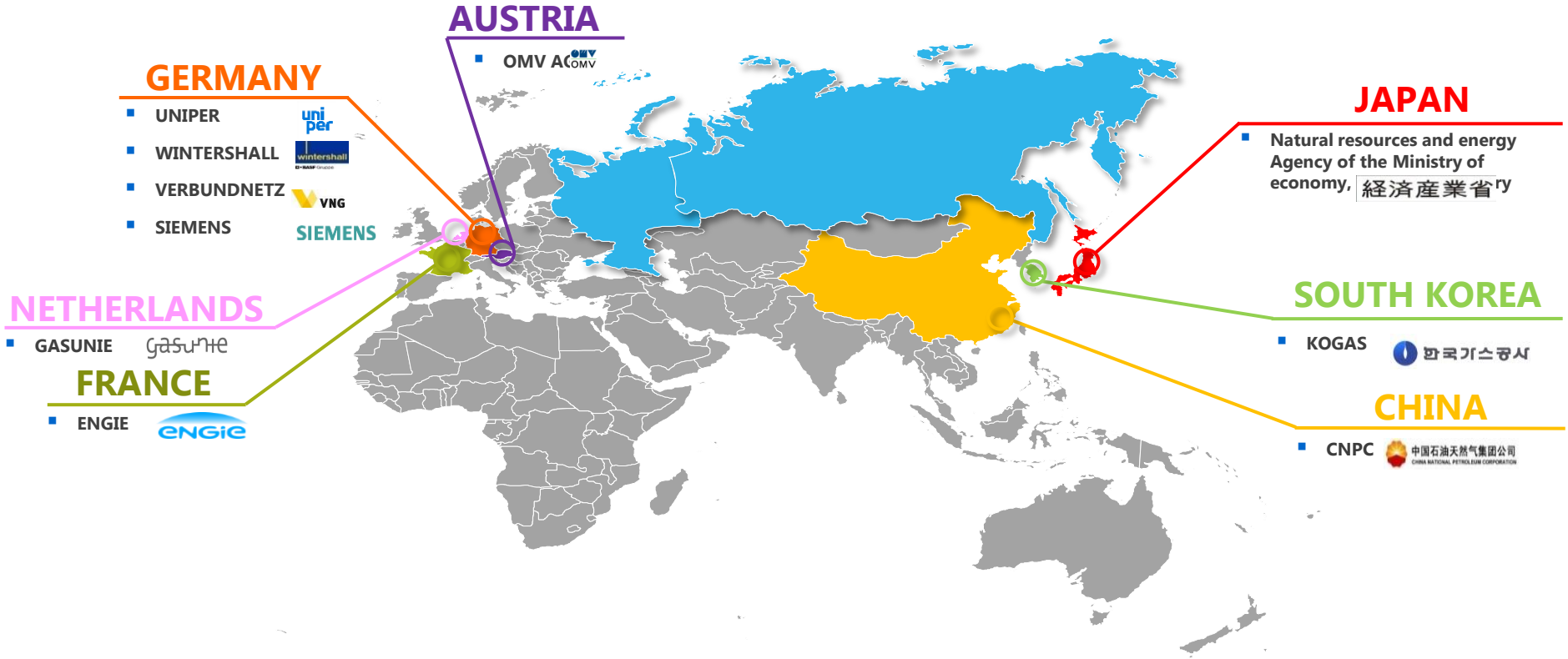


thinkstep

- H_2 cost from small scale TDM starting @ ~1,80€/kg H_2 up to 4,70€/kg H2 (using solar energy)
- H_2 from TDM predicted to be cheaper than H_2 from electrolysis and close to cost from small scale SMR
- For large scale H_2 production via TDM only data for catalyst based process identified
- TDM @ 1,14€/kg H_2 cost competitive with SMR, SMR+CCS and water electrolysis
- Market size for H_2 in 2050: ~134 Mt H_2 or 153 billion € (@1,14€/kg H2)

October 2018

HYDROGEN COOPERATION



GAZPROM

THANK YOU FOR YOUR ATTENTION !