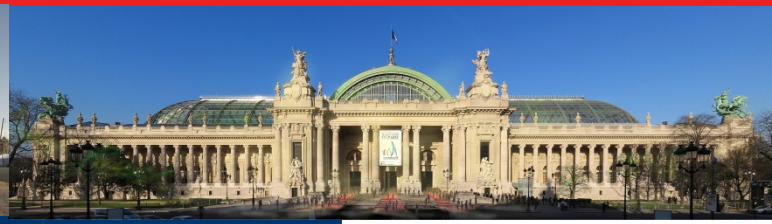
26th World Gas Conference

1 – 5 June 2015, Paris, France



UGS as Effective Tool for Optimizing Operational Mode and Investment Costs of New Export Pipelines

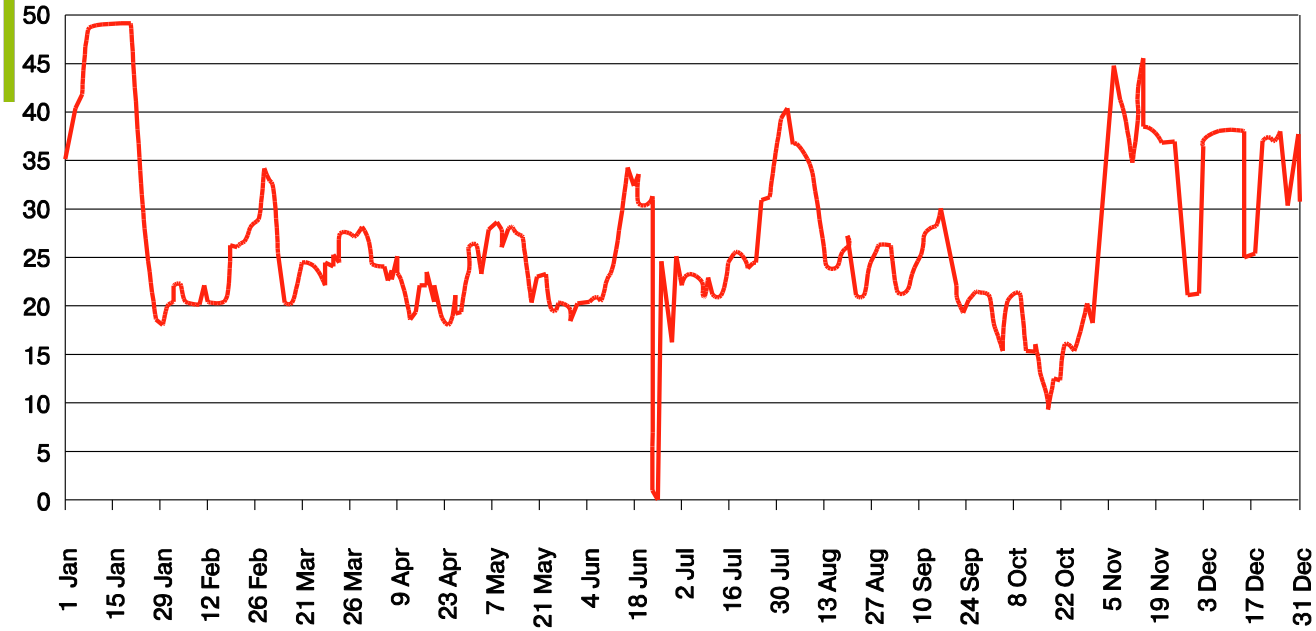
Oleg Aksyutin

JSC Gazprom, Russia

WOC2-SG2.1

WGCPARIS2015
WORLD GAS CONFERENCE

High uncertainty of Gas Demand

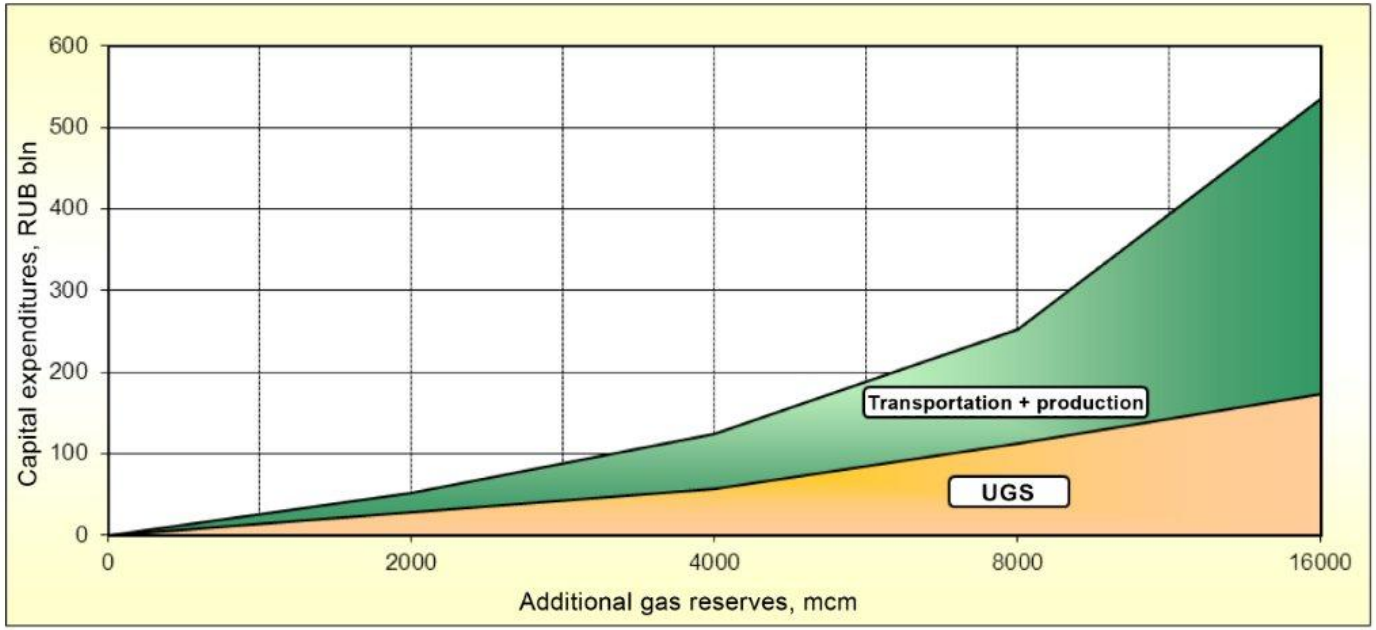


Gazprom's gas storage abroad is characterized by the following advantages:

- Covering seasonal fluctuations in gas demand;
- Improving reliability and continuity of gas export supplies;
- Emerging option of the participation in spot gas markets;
- Increasing gas export volume;
- Maintaining status of strategic supplier.

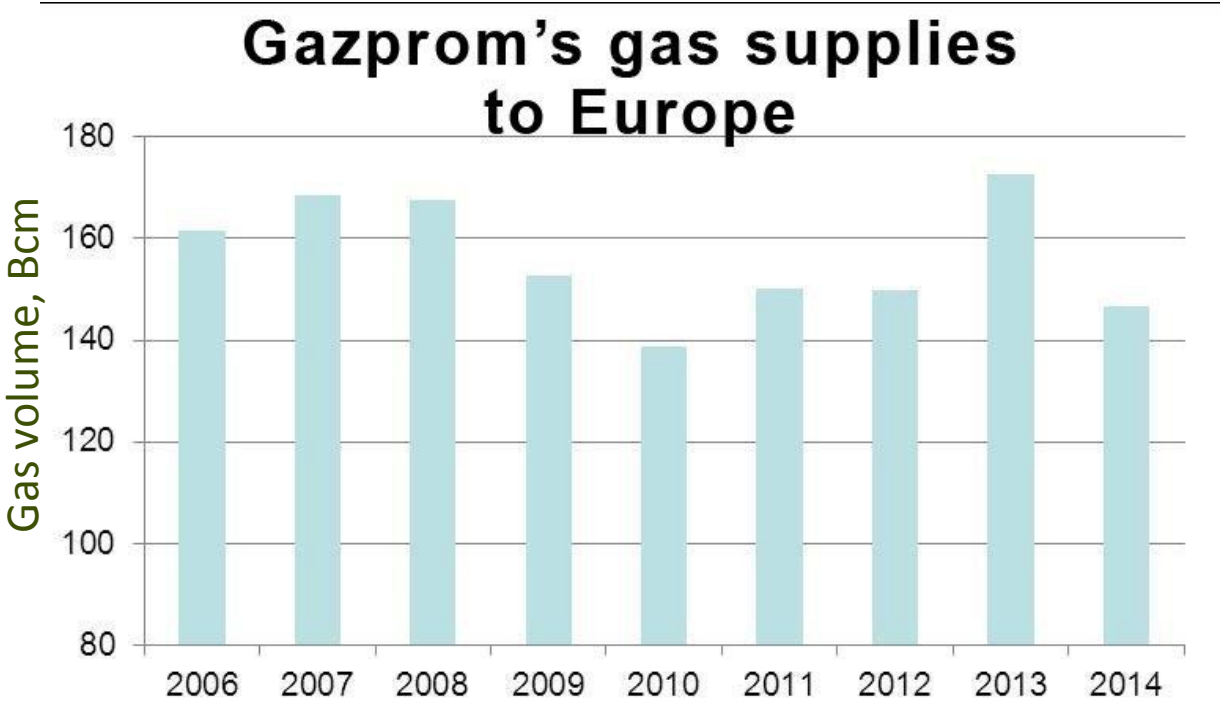
Gazprom Management Committee Directive No.5 dated January 27, 2011 "On building up Company's UGS capacities abroad" envisages Company's UGS capacities growth in foreign countries to achieving the active capacity of at least 5% of annual export supplies, with the priority of creating proprietary storage capacities.

Efficiency of the Unified Gas Supply System in relation to UGS facilities and export pipelines



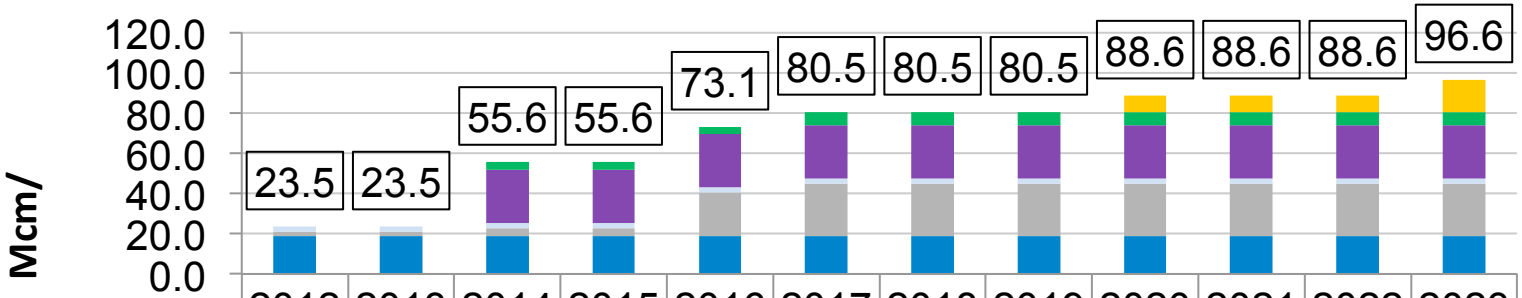
Each thousand cubic meters in UGS facilities provides for saving EUR 200 – 250, that is an UGS facility with the active capacity of 1 bcm provides for net saving of capital expenditures amounting to EUR 200 – 250 million. Besides, specific capital expenditures in making gas reserves become lower for UGS facilities and higher in a transportation system, with growing volumes of gas

Gazprom's gas supplies to Europe



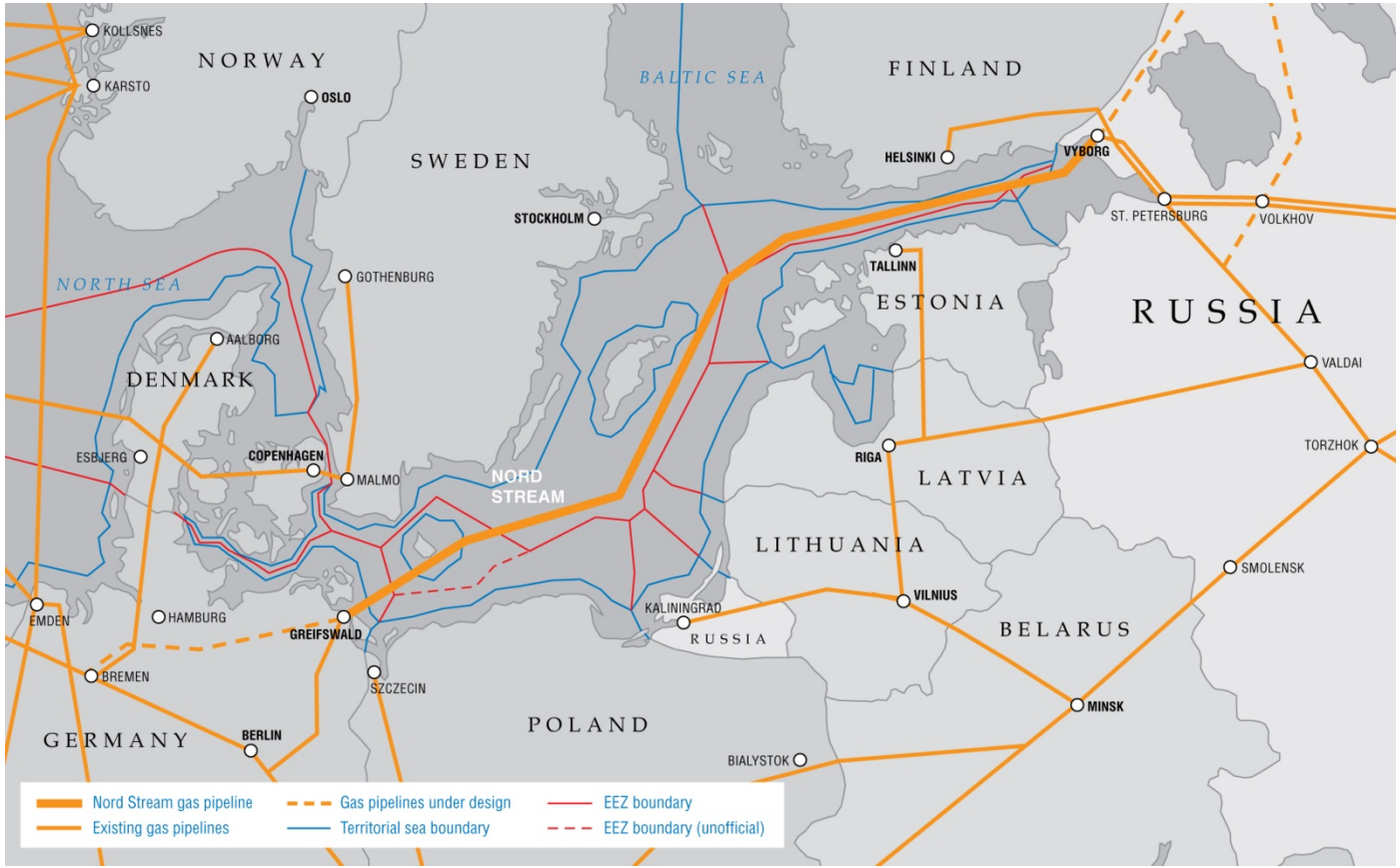
Gas supplies from Russia are still reasonably the most beneficial for Europe and they do not have a viable alternative. LNG capacities are less than one-third loaded, and for facilities built in recent 10 years the average utilization coefficient came to only 15%.

Growth of productivity of Gazprom UGS in Europe

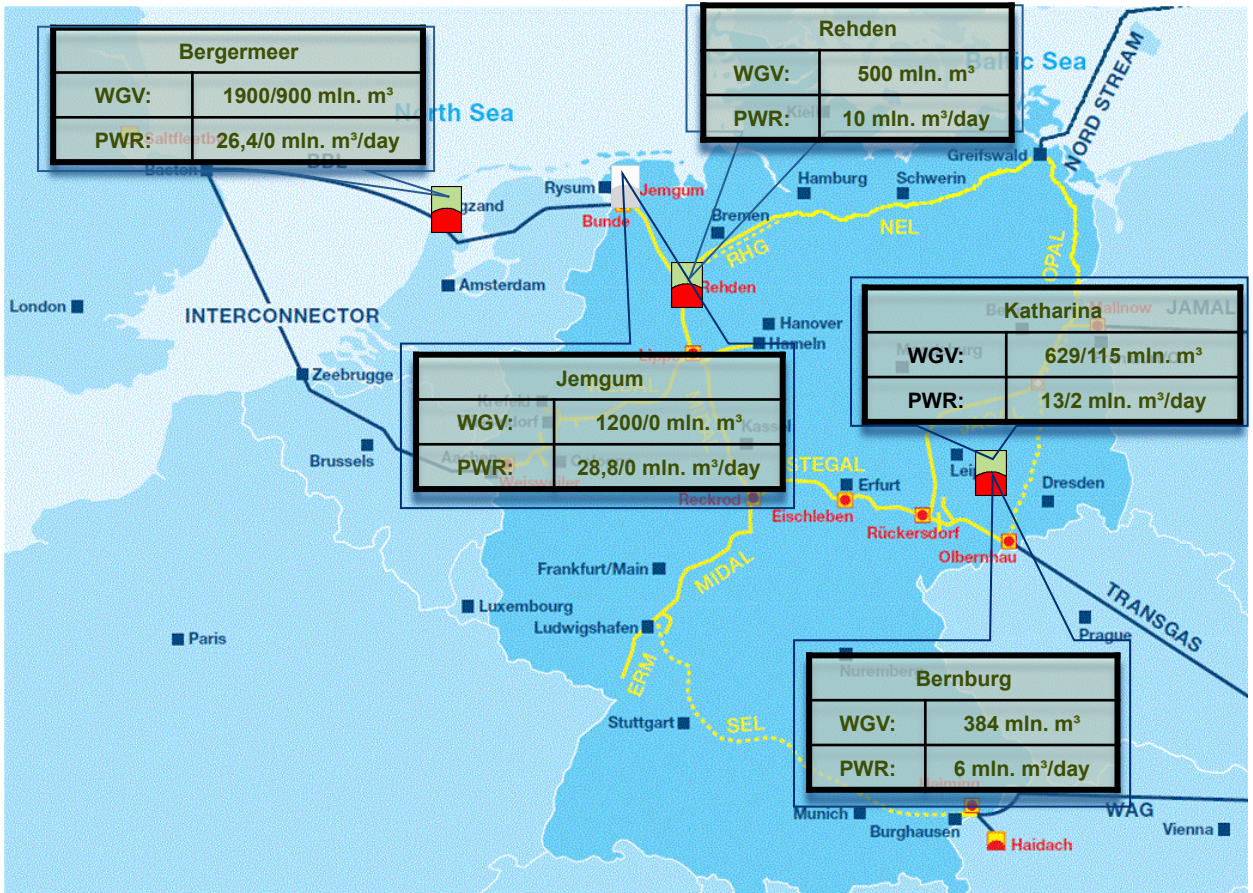


	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Tarsus									8.1	8.1	8.1	16.1
Damborjice			3.7	3.7	3.7	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Bergermeer			26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4	26.4
Banatsky Dvor	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Katharina	2.0	2.0	4.0	4.0	21.5	25.8	25.8	25.8	25.8	25.8	25.8	25.8
Hidach	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Total	23.5	23.5	55.6	55.6	73.1	80.5	80.5	80.5	88.6	88.6	88.6	96.6

Export trunk pipeline Nord Stream

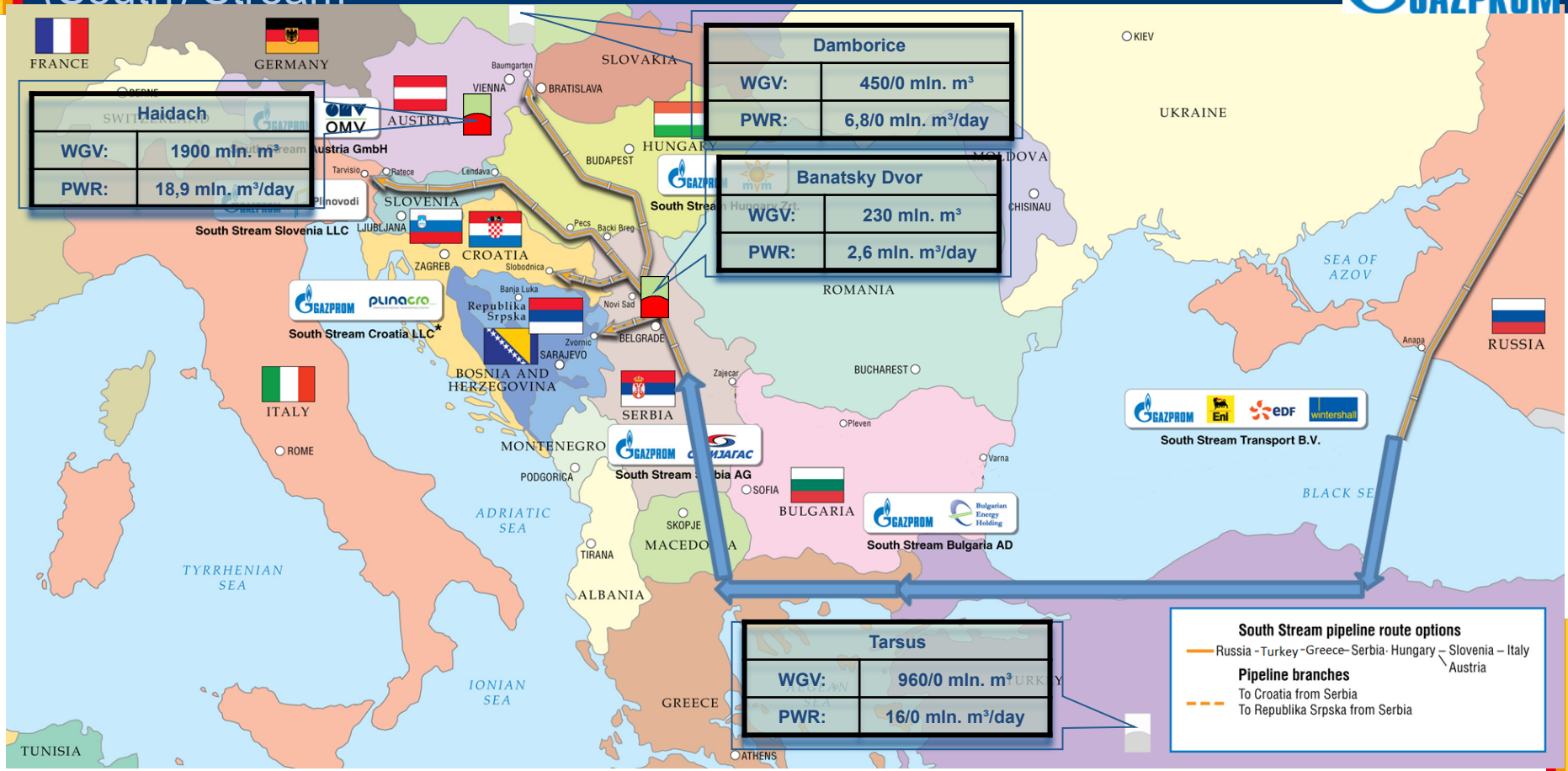


UGS to optimize operational mode of the Nord Stream

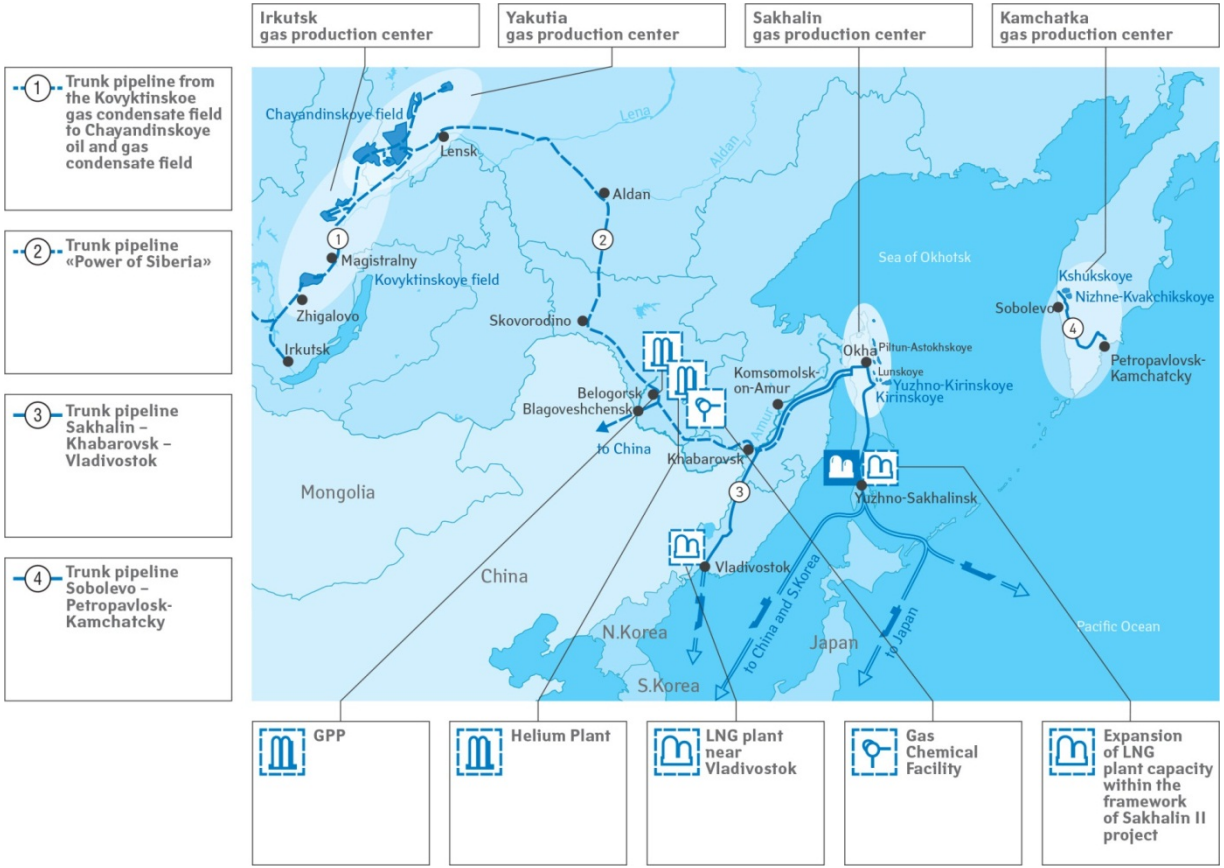


- TRANSPORT pipeline
- TRANSPORT pipeline under planning/construction
- Pipeline connection within the European network
- Pipeline connection within the European network under planning/construction
- underground storage facility
- underground storage facility under planning/construction
- TRANSPORT compressor station
- TRANSPORT compressor station under planning/construction

UGS to optimize operational mode of the Turkish (South) Stream



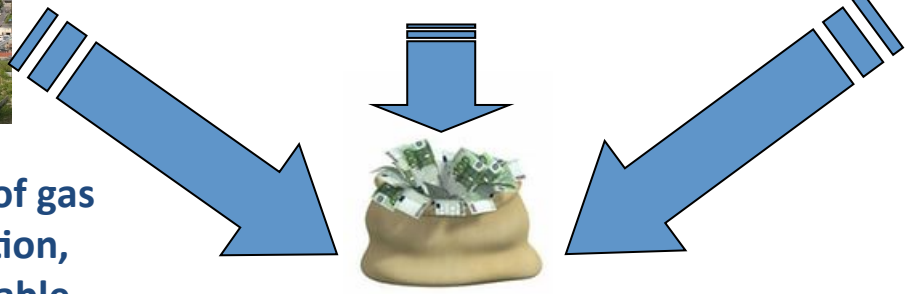
Eastern Gas Program of JSC «Gazprom»



UGS in China


Altay Project
Eastern Project
From Turkmenistan
Djungar
Tufan-Hami
Hutubi
Xinjiang
Nord-West
Tarim
Caidam
Ordos
Shan 45
Nord-East
Sunliao
Heilongjiang
Jilin
Liaoning
Jen 11
Daqing
Hebei
East
Lujuan
Czintan
East China Sea
Sichuan
Syangosy
South-West
Yunnan
Guangxi
Guangdong
Hainan
LNG from Pacific and Africa
South China Sea
Gas demand, bln.m3
Optimal UGS location
Gas-bearing basin
LNG terminals under
LNG terminals
Gas pipe-line under
LNG delivery by sea

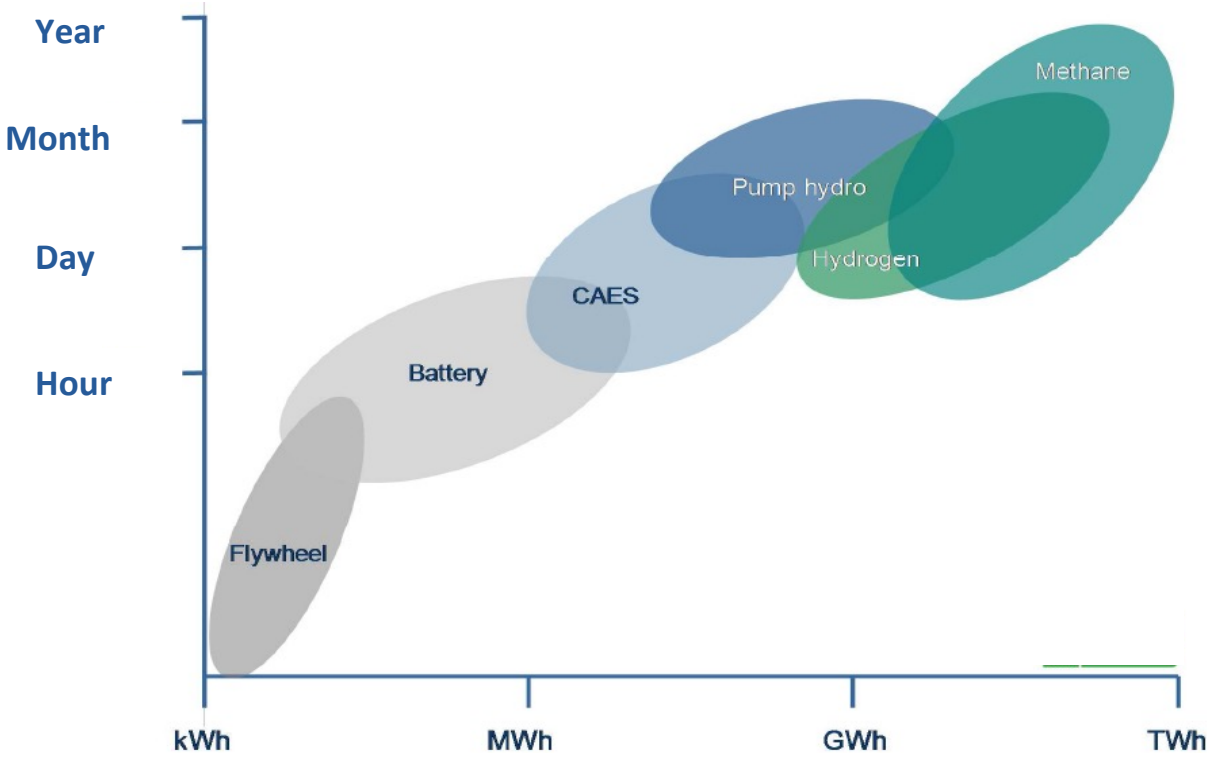
New functions of UGS



UGS as an efficient tool of gas market commercialization, maintenance of renewable energy sources (wind generators and solar batteries) and development of absolutely new areas in energy sector, such as 'energy storage‘

1. Pumped Hydraulic Energy Storage (PHS)
2. Compressed Air Energy Storage (CAES)
3. Conversion of electricity to H2 and/or “green methane” (Power2gas)
4. Other electricity storage options currently under development such as flywheels, batteries, condensators, supraconductors, etc

New functions of UGS



Source: International Gas Union

Respective characteristics of the main options available in terms of energy storage content

New functions of UGS

PHS - 400 facilities in operation, total capacities 125 GWh. Low capacity facility, below GWh. High capital cost.

CAES – even less capacity, only two facilities in operation, total capacity 0,7 GWh. Technology still under development. CAES need to be located at "sweet spots" of the grid at reasonable distance from both intermittent renewable energy production sources and the high voltage electric transportation system in order to avoid high connection costs, especially if buried lines are considered. No one project have been constructed in the last 30 years .

New functions of UGS

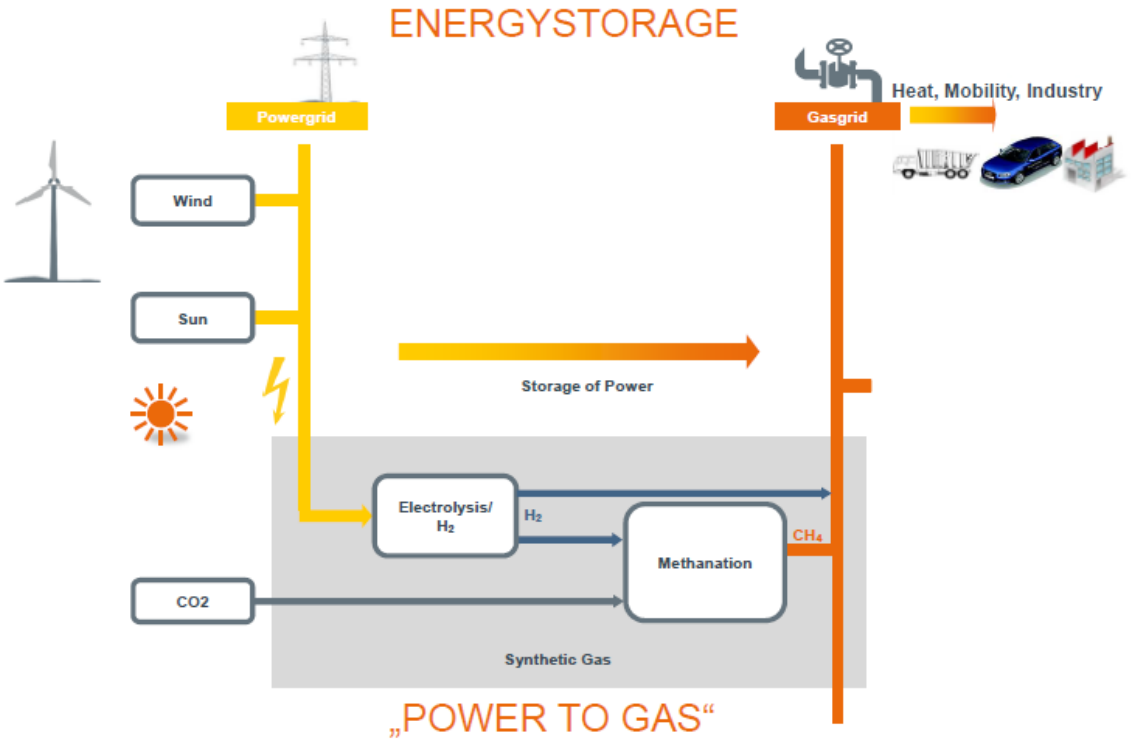
One 500 000m3 cavern with a typical 120 bar operating pressure range can accommodate the following working gas:

- **45 Mm3 (n) i.e. some 4000 tons Hydrogen or some 135 GWh**

or

- 60 Mm3 (n) Natural gas i.e. some 700 GWh

Power2gas



Source: RAG company

UGS as Effective Tool

Other electricity storage options currently under development such as flywheels, batteries, condensators, superconductors, etc. do not seem as of today, to offer a field of application for UGS solutions.

One European household needs 10 000 kWh (1000м3) for heating in wintertime.

Modern batteries

- Volume - <1 kWh
- Cost ≈ € 10/kWh/год

UGS

- Volume – tens billions kWh
- Cost ≈ € 0,005/kWh/год

UGS as Effective Tool

Gas is the cheapest and most efficient means of storage and transportation

Comparison of technical and economical characteristics (case study Europe) *Source: International Gas Union*

Electricity: - Length - 260 km; - Capacity – 1 GW; - Capital cost – 600 mln.€; - Operation cost per unit – 230 € per kW/100 km	Gas pipeline: - Length - 230 km; - Capacity – 20 GW; - Capital cost – 500 mln.€; - Operation cost per unit – 11 € per kW/100 km «Nord Stream» - 9 € per kW/100км

UGS as Effective Tool

Hence despite undisputable importance of UGS as an efficient tool of gas market commercialization, maintenance of renewable energy sources (wind generators and solar batteries) and development of absolutely new areas in energy sector, such as 'energy storage' in pure form, support of energy security of vast regions in continental scale remains the primary function of underground storage. Implementation of such system can only be provided under conditions of the United Gas Supply System functioning, with UGS and main gas pipelines being its integral elements.

Thank You for Your Attention!