Situation of the Ukrainian natural gas market and transit system

MARKET STUDY

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Nord Stream 2

Address: 1134 Budapest, Váci út 31.
Company registration: Budapest, Fővárosi Törvényszék Cégbírósága, no: 01-09-698768

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Abbreviations

ATI: Ananjiv–Tiraspol–Izmail

Bcm: Billion cubic metres

bn: Billion

CAGR: Compound Annual Growth Rate

CS: Compressor station

CEO: Chief Executive Officer

DUG-2: Dolina–Uzhgorod

EBRD: European Bank for Reconstruction and Development

EC Directive 2003/55: Energy Community Directive 2003/55

EIB: European Investment Bank

EKKP: Jelec–Kremenchug–Kriviy Rig

ENTSOG: European Network of Transmission System Operators for Electricity

EU: European Union

FGSZ: Földgázszállító Zárt Részvénytársaság *(Hungarian TSO)*

GDP: gross domestic product

GMS: Gas Metering Station

GSF: Gas Storage Facility

GTS: Gas Transmission System

IAEA: International Atomic Energy Agency

IMF: International Monetary Fund

incl. VAT: including Value Added Tax

JVCA: Joint Venture, Consortium or Association

KAB: Kemenchug–Ananijiv–Bohorodchani

KACHB: Kemenchug–Ananijiv–Ananjiv–Bohorodchani

KD: Komarno–Drozdovichi

KK: Kursk–Kyiv

KPI: Key Performance Indicator

LPG: Liquefied Petroleum Gas

MGPU: Main Gas Pipelines of Ukraine (MGPU)

MMD: Mott MacDonald study

MPa: Mega Pascal

m: Million

NBV: Net Book Value

NPP: Nuclear Power Plant

NSP: Nord Stream Pipeline

NSP2: Nord Stream Pipeline 2

PJ: Petajoule

P/L: Profit/Loss

PJSC: Public Joint Stock Company

SCADA: Supervisory Control and Data Acquisition system

SCC: Stockholm Chamber of Commerce

SLA: Service Level Agreement

SSO: Supply System Operator

TAG: Trans-Austria Gasleitung

TPA: Third party access

TSO: Transmission System Operator

UAH: Ukrainian Hryvnia

UGV: Ukrgazvydobuvannya

UGSFU: Underground Gas Storage Facility of Ukraine

UGTS: Ukrainian Gas Transmission System

USD: United States Dollar

UTG: Ukrtransgaz

UPU: Urengoy–Pomary–Uzhgorod Pipeline

VAT: Value-Added Tax

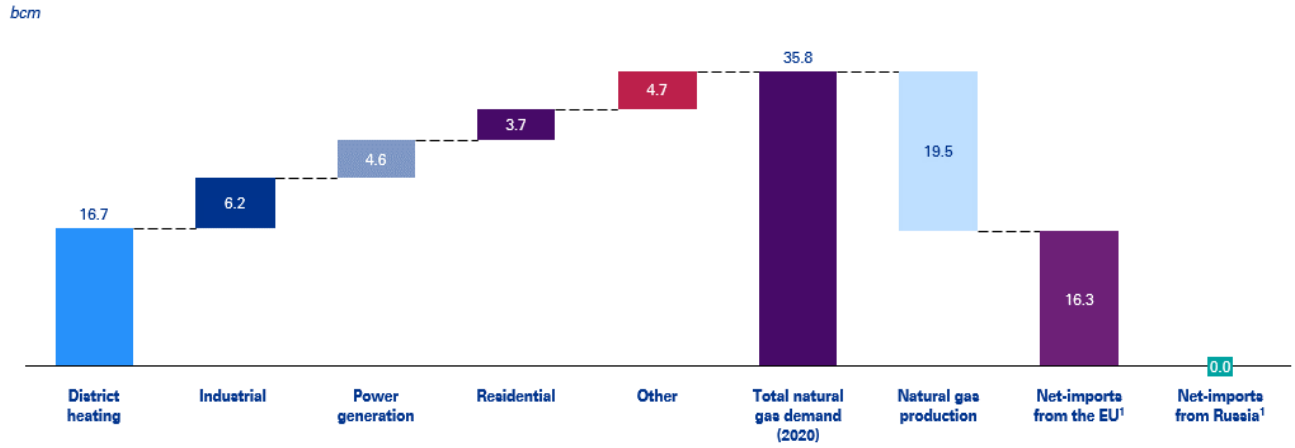
WB: World Bank

WNA: World Nuclear Association

1 Executive Summary

1.1. By 2020, Ukrainian natural gas demand can be covered without Russian imports, by using only domestic production and western inflows

Natural gas demand and supply (bcm)



Source: Russian Gas Transit Across Ukraine Post-2019 (p.8.) (Oxford Institute for Energy Studies, 2016); KPMG reasoning; World Bank Forecast until 2020 , Ukrstat Statistical Dashboard 2016; The Ukrainian residential gas sector: a market untapped, The Oxford Institute for Energy Studies 2016; Gas flow at entry and exit points of Ukrainian GTS in 2009-2015 (bcm), Naftogaz 2015

(1) In the forecast model, KPMG calculated with natural gas imports from Russia. Values shown in the graph show the technically possible outcome.

Overall natural gas consumption is expected to decrease from 2015 until 2020 by CAGR 0.3%, a compound effect of increasing energy efficiency, positive GDP growth and a slightly decreasing population:

- District heating: An expected decrease by CAGR 0.6% between 2015 and 2020 mainly due to planned building insulations, a switch towards renewables, a negative effect from increased energy efficiency and a population decrease.

- Industrial: An expected increase of natural gas consumption in the industrial sector by CAGR 0.1% between 2015 and 2020, mainly due to CAGR 2.4% in GDP growth during the same period stemming from strengthened industrial development in sectors such as metallurgy and fertiliser production.

- Power generation: An expected decrease in natural gas consumption by CAGR 0.1% in power generation from 2015 until 2020 due to a switch towards renewables and the negative effect of increased energy efficiency.

- **Residential:** An expected decrease by CAGR 0.7% in residential natural gas demand between 2015 and 2020. The main triggers are building insulations, a switch towards renewables (mainly biomass, biofuels and wood) and a population decrease.

- **Other:** Sectors such as transportation, commercial, public services and others. Between 2015 and 2020, others is expected to increase by CAGR 0.5% due to GDP growth and forgone investments resulting in higher network losses.

All in all, natural gas demand in 2020 is expected to reach 35.8 bcm, which can already be covered technically and physically without Russian imports in 2020 through domestic production and western inflows from the European Union (EU).

Natural gas production is expected to decrease at CAGR 0.4% between 2015 and 2020 based on the 2013 to 2015 production trend and expected forgone investments into the development of extraction facilities.

Net imports from the EU are expected to increase to 16.3 bcm and substitute for Russian imports based on reverse flow capacity-enhancing projects (possible increase up to 27.3 bcm in EU import capacity) of Ukraine and the EU.

All in all, Russian imports may be substituted by own production and imports from the EU by as early as 2020.

1.2. The emergency rehabilitation of the Urengoy-Pomary-Uzhgorod (UPU) pipeline (30 bcm/y) is in progress, while the refurbishment of the overall transit system (USD 3 bn over 7 years) will not start anytime soon due to lack of financing

The Seven-year refurbishment and development plan of the main transmission and metering facilities issued by Ukrtransgaz (UTG) in 2014 is in line with the conclusions drawn from the feasibility study on the modernisation options and costs of pipelines and storage facilities prepared by Mott MacDonald and presented by Azfar Shaukat at the EU-Ukraine International Investment Conference in Brussels (Belgium) on 30 September 2011[1].

In 2011 Mott MacDonald concluded that the natural gas transportation system of Ukraine was in an inadequate condition due to its poor design and construction, as well as due to the low or insufficient level of maintenance funding. These constraints were numerous and extensive requiring a program of rehabilitation works in the short, medium and longer term to improve system integrity.

The Mott MacDonald study (MMD) addressed two major issues:

i. Identifying a prioritised plan by reviewing UTG's "Priority Project" initially described as the emergency rehabilitation of UPU based on UTG's development program for 2009 – 2016

ii. Extending the review to the other pipelines (overall rehabilitation project)

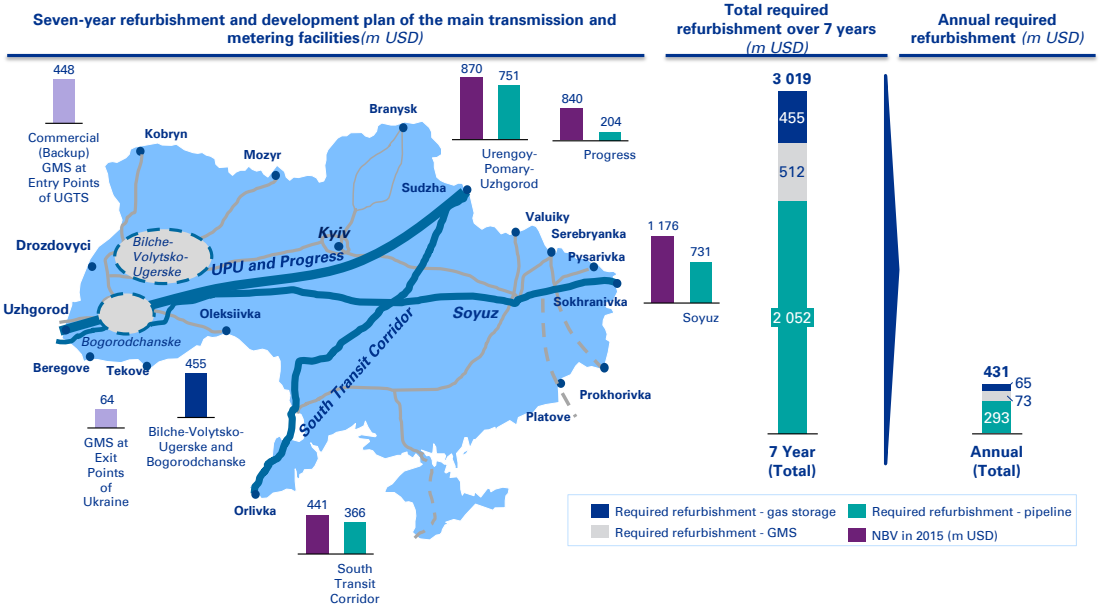
While the emergency rehabilitation of UPU with a capacity of 30 bcm/y is underway and expected to be finalised in 2020, financed with UTG's own funds and with loans from the European Investment Bank (EIB) and European Bank for Reconstruction and Development (EBRD), the overall rehabilitation project has made few progress and still lacks financing.

As a final conclusion of the MMD study, conducting the refurbishment program for the equipment replacement and repair works was already essential in 2011, but due to the continuous postponements and most importantly the lack of sufficient financing, the system has not improved compared to the MMD study of 2011, going back to a UTG concept of 2008. Therefore, the 2014 Refurbishment Plan is the same as the 2011 Refurbishment Plan, i.e. no progress was made, except for financing and procuring the Bar compressor station.

To cover the previously backlogged refurbishments and to achieve sustainable operations in the natural gas transportation and transmission system (by 2030) there is a refurbishment requirement of roughly USD 3.0 bn for seven years.

1 – "Ukraine – EU: On the Way towards the Single Energy Market" – Shaukat, A. (2011), presentation by Mott McDonald to the EU-Ukraine Conference, September 2011, Brussels, Belgium.

Seven-year refurbishment and development plan of the main transmission and metering facilities (USD m)



Source: Master Plan Ukrainian Gas Transmission System Priority Objects Modernization and Reconstruction. PJSC Ukrtransgaz 2014.

During the fulfilment of the refurbishment plan, annual refurbishment spending is expected to be USD 0.4 billion/year over 7 years.

On completing the planned refurbishment, the Ukrainian Transmission System Operator (TSO) expects to achieve the following[2]:

- increase in operating life of compressor units to 100,000 – 150,000 hours
- fuel gas savings at 600 Mcm per year
- decrease in influence of stress-corrosion on main gas pipelines
- online gas quantity and quality monitoring and alignment of UGTS with relevant European standards

Based on previous experience (Mott Macdonald study conclusions in 2011), historical underinvestment and the current financing agreements with the EIB/EBRD, we can conclude that the probability of an improvement in the condition of the natural gas transportation and transmission system is rather low.

According to present plans, the emergency rehabilitation of the UPU pipeline with 30 bcm/y is expected to be finished by 2020. However, the actions taken on the larger rehabilitation program of all four transit pipelines are minor (work on CS of Bar on the Soyuz pipeline with USD 83.2 m may start in 2017), for the

2 – "Ukrainian Gas Transmission System (UGTS) Priority Objects Modernization and Reconstruction" – Energy Charter (2014); Available at: http://www.energycharter.org/fileadmin/DocumentsMedia/Presentations/CBP-Ukraine_GTS.pdf ; "Modernization of the Ukrainian Gas Transmission System" – Ukrtransgaz (2015); Available at: http://utg.ua/img/news/2015/04/modernUGS280420154.pdf

bulk of the refurbishment work of about USD 3 bn, no financing is in sight. Considering the lead time between financing and the start of the construction work, and the overall construction time of 7 years, completing it by 2025 would be optimistic.

Taking into account the expert assessment by Mott MacDonald, the design capacity of the system is not sustainable after 2020 beyond the 30 bcm/y of the UPU pipeline refurbished under the emergency loans.

1.3. Main regulations of sector to be changed following Ukraine joining ENTSOG in 2015

In 2015, Ukraine joined the European Network of Transmission System Operators (ENTSOG). To comply with the organisation's regulations, a number of regulatory changes were adopted from 1 January 2016.

The following regulations have set the legal background for the natural gas market in Ukraine since 1996:

- On 15 May 1996, the *Law of Ukraine "On Pipeline Transport"* was adopted, aiming to ensure the reliable and safe operation of the network along with improving the ecological security of the pipeline system.

- The *Law of Ukraine "On Oil and Gas"*, adopted on 12 July 2001, sets out the basic legal, economic and organisational foundations of oil and gas activity in Ukraine.

- Since 20 April 2000, the *Law of Ukraine "On Natural Monopolies"* has regulated the supply of natural gas (and other substances) above a pre-defined volume.

- The *Law of Ukraine "On Commercial Metering of Natural Gas"*, adopted on 16 June 2011, governs the principles for ensuring the provision of natural gas metering stations to all customers, and laying the foundations for a complete commercial accounting scheme covering all domestic and imported natural gas supply.

- The most recent *Law of Ukraine "On the Natural Gas Market"*, in effect since 9 April 2015, sets out the legal foundations of the Ukrainian natural gas market along the principles of free competition, protection of customers and supply security. This law ensures the Ukrainian natural gas market is compliant with the EU's third energy package and permits the privatisation of 49% of the shares in the country's TSO (Ukrtransgaz).

- *ENTSOG network codes* were implemented from 1 January 2016 to facilitate interoperability, congestion management (CPM) and capacity allocation (CAM).

In addition to the regulations promoting international cooperation and trade on the Ukrainian natural gas market, certain legislation on sanctioning some parties was implemented:

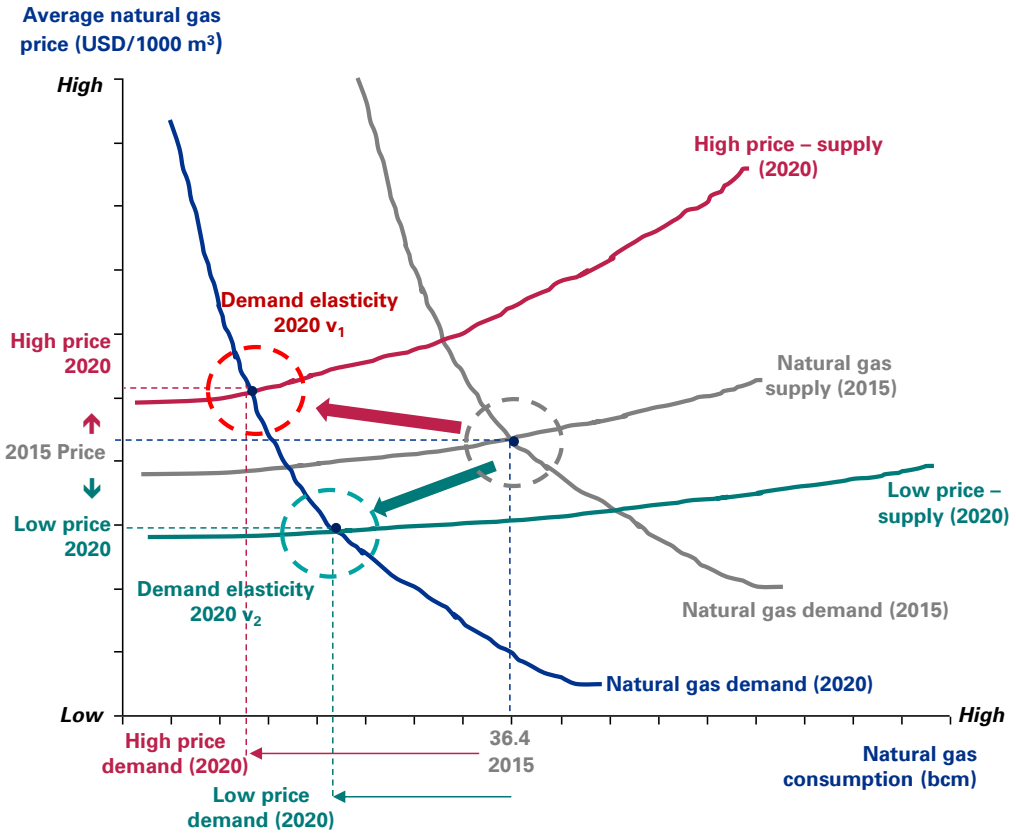
- On 17 October 2016, the *Law of Ukraine "On applying special economic and legal restrictions (sanctions) to physical and legal bodies"* was adopted and came into force. Its main provisions are the following:
  Introduction of economic and legal sanctions against certain physical and legal bodies which (according to the Ukrainian parliament) were obstructing the Ukrainian economy and sovereignty.

- This legislation was based on the *Law of Ukraine "On sanctions",* which was accepted on 10 September 2014. The given regulation was initiated by the Cabinet of Ministers (Arsenij Jacenjuk) on 8 August 2014 and signed by the President on 10 September 2014.
- This regulation determines the reasons which may result in economic and legal sanctions if they hinder the national and territorial sovereignty of Ukraine, result in damage to private and national property, or hinder the sustainable economic development of the country. The regulation also states the methodology for sanctioning and determines types of sanctions which may be applied in the event of obstructions:
  - freezing of financial assets and restricting trading activities
  - partial or complete termination/restriction of transit resources, flights and transport via Ukraine
  - cancellation or suspension of licences, prohibition from privatisation

Introduction

1.1 Supply and demand forecast assumptions

Development of natural gas demand elasticity



Source: KPMG Forecast, Naftogaz Annual Statistics (2015), Available at: http://www.naftogaz.com/www/3/nakweben.nsf/0/AF9C268799B69AC5C2257EFB004AC76F?OpenDocument&year=2015&month=11&nt=News&

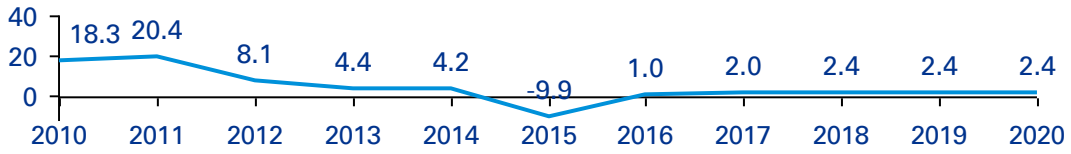
Natural gas demand is expected to decrease (by CAGR 0.3%) from 2015 until 2020 and reduce further at the same rate due to the compound effect of positive GDP growth (CAGR 2.4%), a CAGR 2.3% energy efficiency increase (negative effect on consumption) and a CAGR 0.4% population decrease.

There are two natural gas price scenarios which determine the level of demand fluctuation:

- High price scenario – natural gas demand is expected to decrease at a higher rate compared to the low price scenario
- Low price scenario – natural gas demand is expected to decrease at a lower rate compared to the high price scenario

1.2 Key drivers considered in the forecast model

GDP growth rate (%)



Source: World Bank Database (2016), Available at: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=UA&name_desc=true; Ukrstat Statistical Dashboard (2016), Available at: http://www.ukrstat.gov.ua/

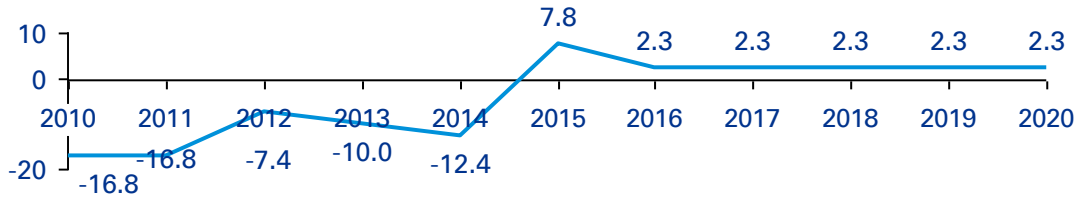
GDP growth rates are taken from the World Bank Country Forecast (2016):

- 1.0% in 2016
- 2.0% in 2017
- 2.4% from 2018 onwards

In the period between 2010 and 2015, the average GDP growth rate was around 7.6% and showed a declining trend. There was a serious decline in GDP in 2015 (-9.9%) due to the political and economic tensions in Ukraine.

Therefore, in the period between 2016 and 2020 the economy of Ukraine is expected to grow at a slower rate compared to the period between 2005 and 2014.

Energy efficiency growth rate (%)

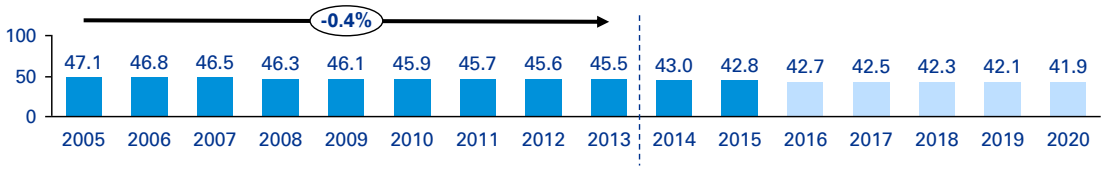


Source: KPMG calculation based on Ukrstat GDP data and Ukrstat energy balance data (2010-2015), Available at: http://www.ukrstat.gov.ua/; KPMG forecast (2015-2020)

In the period between 2015 and 2020 energy efficiency is expected to increase (2.3%) due to rising commodity prices, insulation of houses and the transition towards renewable energy sources. The reasons mentioned above are expected to have a negative overall effect on total energy consumption. The forecast of energy efficiency growth is determined based on the historical development of energy efficiency in the period between 2014 and 2015. The historical development of energy efficiency is calculated by KPMG based on GDP data

from 2013 to 2015 (available at Ukrstat, 2016) and energy balance statistics from 2013 to 2015 (available at Ukrstat, 2016).

Population (in m people)



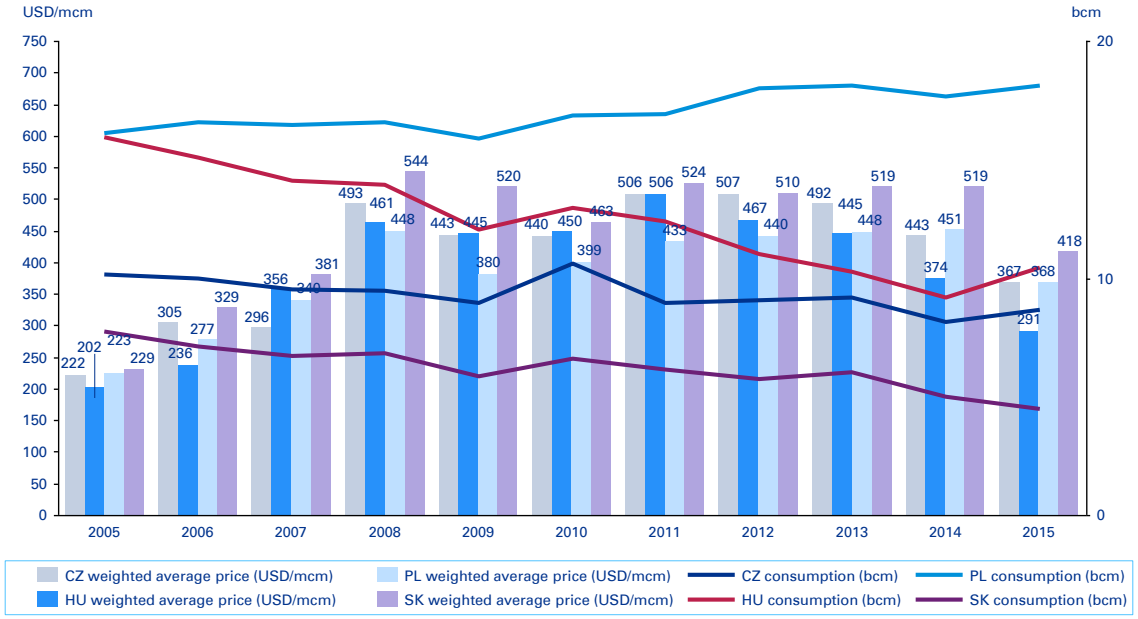
Source: Ukrstat Statistical Dashboard (2016), Available at: http://www.ukrstat.gov.ua/

KPMG assumes that the population of Ukraine will decrease by CAGR 0.4% in the period between 2016 and 2020 based on the trend during the period from 2005 to 2013. The reason for only considering 2005-2013 is the 3% population decrease in the period between 2013 and 2015, which causes a distortion.

The high population decrease in the period between 2013 and 2015 was mainly caused by political and economic tensions.

1.3 Price elasticity effect

Benchmark analysis of natural gas tariffs and consumption



Source: Eurostat Statistical Dashboard 2016; Ukrstat Statistical Dashboard (2016); Economist Statistical Dashboard (2016)

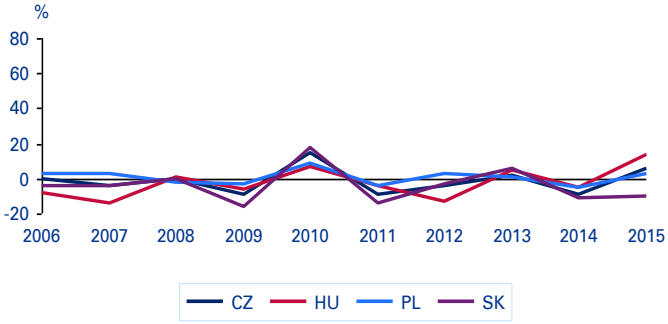
(1) The weighted average prices are based on the natural gas consumption of different sectors (households, industries).

KPMG examined how the development of natural gas demand has been affected in neighbouring countries where natural gas tariffs increased in the period between 2005 and 2011. It transpired that there is a weak negative correlation between average natural gas prices and natural gas demand in neighbouring countries. Nevertheless, the effect is not decisive as price fluctuations explain only about 10% of the change in demand.

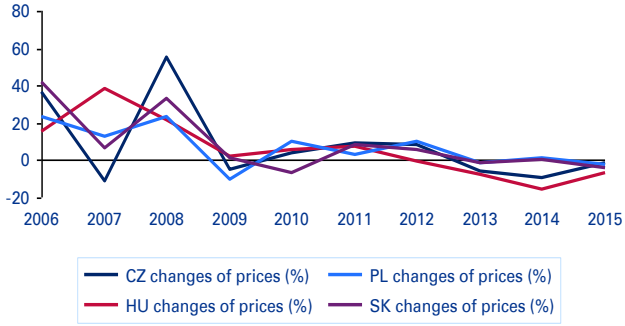
To obtain this result, KPMG conducted an analysis of the price elasticity of natural gas demand in benchmark countries (Czech Republic, Slovak Republic, Hungary and Poland) using historic ratios of changes in natural gas demand and natural gas prices. In the calculation of average price elasticity (-0.1) outliers[3] were not considered.

3 – Outlier indices were all those which had a value higher than 3.

Changes in natural gas demand (%)

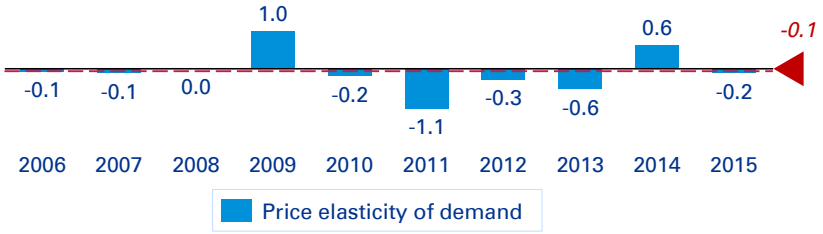


Changes in natural gas price (%)



Source: Eurostat Statistical Dashboard (2016); Ukrstat Statistical Dashboard (2016); Economist Statistical Dashboard (2016); Report on the performance of the National Commission State Regulation in the fields of energy and utilities, NERC (2015); KPMG's estimation of the price elasticity of demand is based on the collected data and formula: ΔD%/ΔP%, where outliers were not considered.

Average price elasticity of demand



Source: Eurostat Statistical Dashboard (2016); Ukrstat Statistical Dashboard (2016); Economist Statistical Dashboard (2016); Report on the performance of the National Commission State Regulation in the fields of energy and utilities, NERC (2015); KPMG's estimation of the price elasticity of demand is based on the collected data and formula: ΔD%/ΔP%, where outliers were not considered.

(1) Average elasticity is -0.1, which was calculated without outliers (country elasticity higher than 3). It means that the price decrease only has a 10% effect on the natural gas demand decrease.

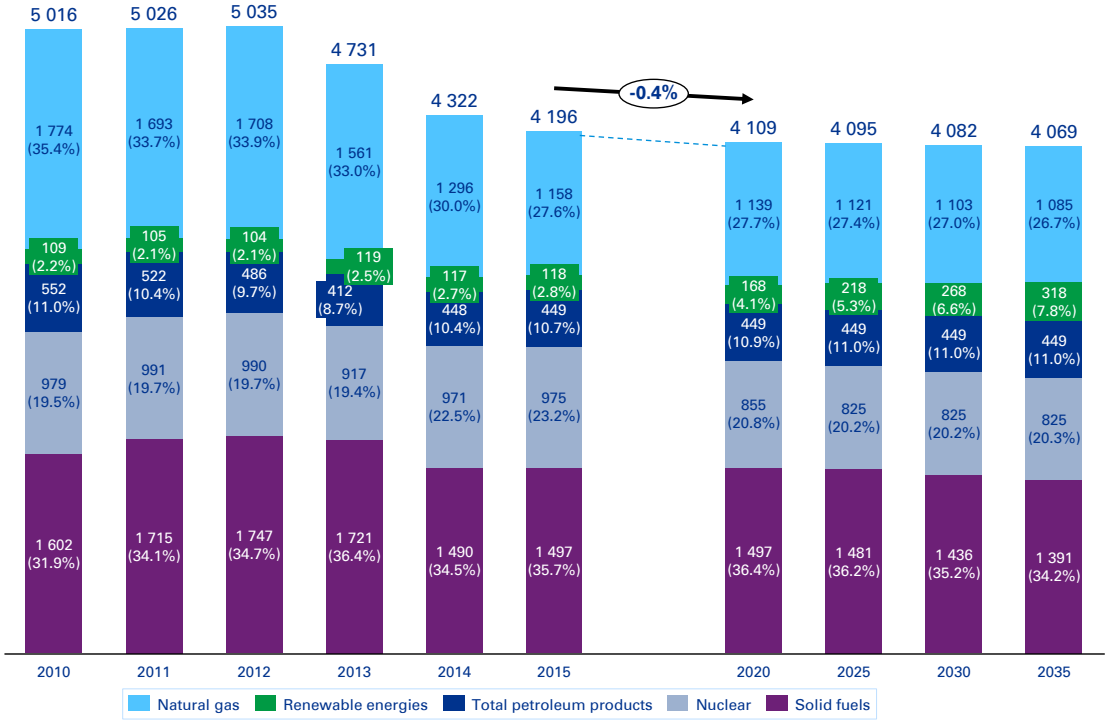
All in all, this proves that price elasticity has a moderate influencing effect on natural gas demand, as it explains only 10% of the change in natural gas demand. The remaining influencing factors are:

- GDP growth (~30%)
- Change in energy efficiency (~25%)
- Change in population (~20%)
- Price fluctuation of substitute resources (~10%)
- Network loss (~5%)

2 Natural gas market in Ukraine

2.1 Energy Mix

Energy Mix (PJ)



(1) Conversion rate MJ/m3 = 31.8 at 20 Celsius degree

Source: Ukrstat energy balance of Ukraine (2010-2015), Available at: http://www.ukrstat.gov.ua/; KPMG forecast (2016-2035)

2.1.1 Energy mix in the period 2010-2015

In the period between 2010 and 2015 total energy consumption decreased by CAGR 3.5%, mainly driven by a decrease in ***natural gas*** and ***solid fuel*** (coal) consumption. Lower demand in natural gas and solid fuels can mostly be explained by the following:

- Increased natural gas tariff both for households and industries
- Conflict zones (Donetsk, Lugansk and Crimea) dropping out of total consumption
- Improvements in energy efficiency
- Winter temperatures since 2012 have been above average

There was a slight increase in the share of ***renewables*** in the energy mix from 2.2% to 2.8% due to numerous projects to establish renewable power plants.

The share of total ***petroleum products*** in the total energy mix stagnated in the period between 2010 and 2015.

The share of ***nuclear energy*** in the total energy mix increased from 19.5% to 23.2% in the period between 2010 and 2015, caused by reactor safety and capacity upgrading on the South Ukraine 1 Nuclear Power Plant (NPP) *(World Nuclear News, 2013)*.

2.1.2 Energy mix in the period 2015-2035

Total energy consumption is expected to decrease by CAGR 0.4% between 2015 and 2020 and shrink further by CAGR 0.2% in the period between 2020 and 2035.

- Natural gas: The share of natural gas in the total energy mix is expected to decrease to 27% by 2025 due to a switch towards renewables. This would result in a 4 PJ (0.1 bcm) annual (CAGR 0.3%) decrease in natural gas consumption, which is in line with the average historical trend of benchmark EU countries (Bulgaria, Poland, Romania, Slovakia) for the period 2006, 2008 and between 2010 and 2014 *(Eurostat; 2016).*

- Renewable energies: The increase in renewables by CAGR 5.1% (annually by 50 PJ) is in line with the average of the benchmark countries which have recently joined the EU, such as Hungary, Romania, Slovenia, Slovakia, Latvia, Lithuania, Malta, Estonia, Poland, Czech Republic, Cyprus and Bulgaria for the period between 2006 and 2014 *(Eurostat; 2016).*

- Petroleum products: No change is assumed for petroleum product consumption based on the Ukrainian historical trend *(Expert interview; 2016).*

- Nuclear energy: KPMG took into account the ENERGOATOMs reactor shutdown plans, which expect the four oldest reactors to be shut down by 2020 (120 PJ in total) and one reactor to be reconstructed by 2025 (30 PJ). KPMG considered the following technical details which were published by the International Atomic Energy Agency (IAEA) and World Nuclear Association (WNA) *(Country Profiles, WNA (2016)):*

    - The NPP reactors planned to be shut down between 2015 and 2020 are: Rovno 3 (in operation since 1987), Zaporozhe 3 and 4 (in operation since 1987 and 1988) and Khmelnitsky 1 (in operation since 1988) *(Country Profiles, WNA, 2016).*

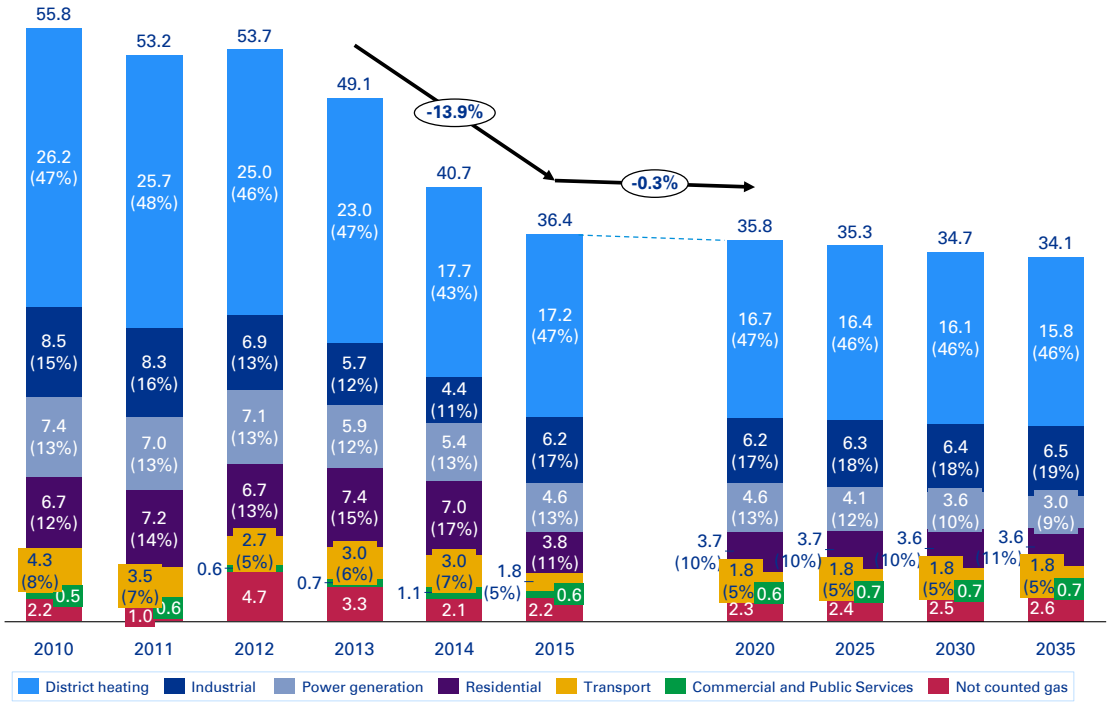
    - Only one NPP reactor is planned to be shut down between 2020 and 2025: South Ukraine 1 (Yuzhnoukrainsk) (in operation since 1983) *(Country Profiles, WNA, 2016).*

Solid fuels: The share of solid fuels is expected to decrease in line with selected EU countries (Bulgaria, Poland, Romania, Slovakia) for the period 2010-2013 (by CAGR -0.4%) *(Eurostat, 2015)*, but at a lower rate than expected by the EC Energy Roadmap 2050 (decrease in share of coal in the energy mix of the EU-28 countries to 12.4% on average *(EC Energy Roadmap 2050, 2011)*.

In the case of Ukraine, a CAGR 0.4% decrease in coal consumption was considered based on the average decrease in coal demand in the neighbouring countries (Bulgaria, Poland, Romania and Slovakia) from 2010 to 2013 *(Eurostat, 2016)*.

2.2 Natural gas demand

Natural gas consumption by market segment (bcm)



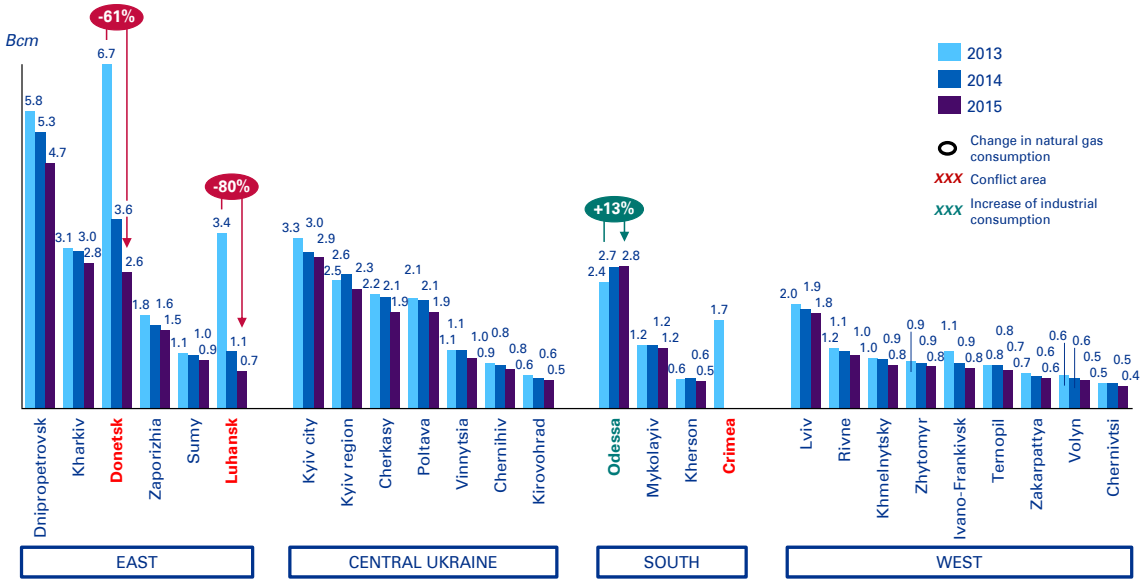
Source: KPMG forecast and estimation based on "The Ukrainian residential gas sector: a market untapped" (Piotr Rozwałka, Hannes Tordengren), The Oxford Institute for Energy Studies (June 2016), Ukrstat energy balance of Ukraine (2010-2015), Available at: http://www.ukrstat.gov.ua/; KPMG forecast (2016-2035)

2.2.1 Natural gas demand in the period 2010-2015

In the period between 2010 and 2015, natural gas demand declined (CAGR - 8.2%). The sharpest decline took place between 2013 and 2015 (by -12.7 bcm (CAGR -13.9%)), more than 66.5% of which was influenced by decreasing consumption in the conflict zones (Crimea, Donetsk and Lugansk regions), increased tariffs for consumers and higher average temperatures.

The highest decrease was noticed in district heating, residential and transportation sectors, which was mainly influenced by the increased tariff for industrial and household consumers.

Natural gas demand across regions (bcm)



Conversion rate MJ/m3 = 31.8 at 20 Celsius degree

Source: Wholesale Gas, Naftogaz (2016), Available at: http://www.naftogaz.com/www/3/nakweb.nsf/0/0BB987F47871C2D1C2257F1D003064D6?OpenDocument&Expand=1.6&; The Ukrainian residential gas sector: a market untapped (Piotr Rozwałka, Hannes Tordengren), The Oxford Institute for Energy Studies (June 2016)

Between 2013 and 2015, natural gas consumption decreased by 25.9% (-12.7 bcm) in Ukraine, which was markedly influenced by increased natural gas tariffs, political tensions in the conflict zones and the overall industrial slowdown due to the worsened economic situation. The share of the conflict zones in total consumption decreased from 24.0% to 9.1% in the period between 2013 and 2015.

The eastern and central regions of Ukraine are the largest gas consumers and accounted for more than half (36.0% and 31.0%) of Ukraine's natural gas consumption in 2015.

In 2015, natural gas consumption in the western region was 7.5 bcm, which was 20.6% of the total Ukrainian natural gas demand. The consumption of the southern region declined from 5.9 bcm to 4.4 bcm in the period between 2013 and 2015 due to the situation in the Crimea.

Eastern region: natural gas consumption was driven by the large consuming regions of Dnipropetrovsk, Kharkiv, Donetsk, Zaporizhia, Sumy and Luhansk. Due to the high level of industrialisation, natural gas is a decisive type of fuel for chemical and fertiliser production, steel and metal processing as well as the mining industries in these cities.

Therefore, annual natural gas consumption in the eastern region has been somewhat higher than in other regions. The severe decline in demand was due to political and economic tensions, especially in Luhansk and Donetsk. Natural gas consumption in these regions decreased by 80.0% and 61.0% respectively in the period between 2013 and 2015. In the other eastern regions, the decrease in natural gas consumption was mainly caused by the higher natural gas tariffs for households and industrial consumers as well as the overall industrial slowdown caused by macroeconomic conditions (high inflation rate and economic tensions). Therefore overall natural gas demand in the eastern region decreased by 39% between 2013 and 2015.

Central region: Compared to 2013, natural gas demand in 2015 fell by 11.73% (- 1.49 bcm) which was a modest decrease compared to the eastern region. In this region the main consumers of natural gas are households and district heating companies, thus the main reason for the fall in demand can be attributed to the higher natural gas tariffs (by almost 280%).

Western region: Nine smaller regions belong to the western region, where natural gas consumption decreased by more than 14.0% (-1.2 bcm). Similarly to the central region, this was mainly due to the increased natural gas tariff, which affected households and district heating companies the most.

Southern region: Natural gas demand declined from 5.9 bcm/year to 4.4 bcm/year in the period between 2013 and 2015 due to the situation in the Crimea and to a lesser extent the industrial slowdown. There was an overall slowdown in each southern county except for Odessa, where demand for natural gas increased by almost 13% (0.3 bcm) between 2013 and 2015. This can be explained by the intensification of the Odessa Port plant activities in fertiliser and other industrial segments, which have been able to compensate for the reduced household gas consumption.

2.2.2 Natural gas demand in period 2015-2035

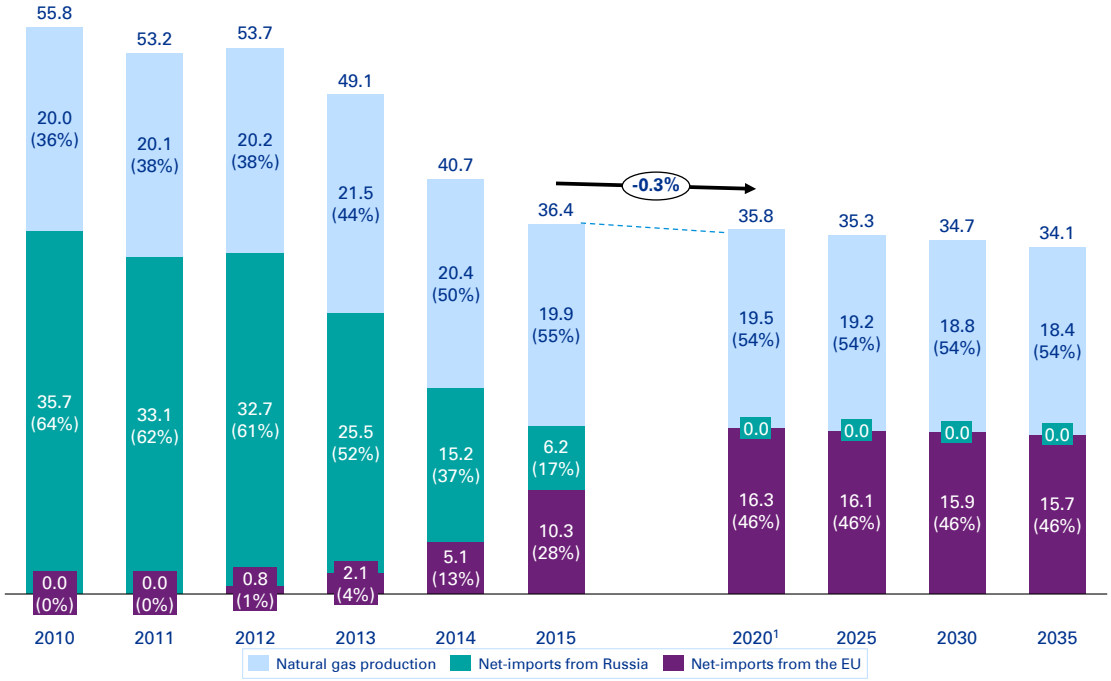
KPMG assumes overall natural gas consumption will decrease by CAGR 0.3% between 2015 and 2035 (for more details see section 2.2) in line with the following influencing factors:

- Effect of energy efficiency increase: natural gas consumption of district heating, power generation, industrial, transport, commercial and public sectors will decrease.

- **Population decrease:** natural gas consumption will decline in the district heating and residential sectors.
- **GDP growth:** will have a positive influence on natural gas consumption in all sectors, except for residential and "not accounted for natural gas".
- **Other factors considered in decreasing natural gas consumption**: housing insulations (by -0.037 bcm) and switch towards alternative fuels (biomass and biofuels).

2.3 Natural gas supply

Natural gas supply (bcm)



Source: KPMG forecast and estimation based on Ukrstat Statistical Dashboard (2016); Gas flow at entry and exit points of Ukrainian GTS in 2009-2015 (bcm), Naftogaz (2015), Available at: http://www.naftogaz.com/files/Activities/Gas-flow-via-Ukraine-2015.pdf

(1) Assumption of no natural gas net imports from Russia is based on current trends (2016), on the increased capacities from the EU and based on the agreement with Gazprom on natural gas consumption, which was not extended.

2.3.1 Natural gas supply and transit in period 2010-2015

In the period between 2010 and 2015 natural gas supply decreased by CAGR 8.2% in line with the decreasing natural gas demand.

Net imports from Russia and the EU

The share of ***Russian net imports*** displayed the highest decrease in the period between 2010 and 2015 (by CAGR -29.5%), mainly due to the lower natural gas demand and Ukraine's import diversification policy.

At the same time, *imports from the EU* (Hungary, Slovakia and Poland) increased from 0 bcm to 10.3 bcm. In 2015, more than 28% of Ukrainian natural gas demand was already supplied by natural gas imports from the EU.

The diversification of the natural gas imports was mainly driven by political issues and supported by EBRD and World Bank (WB) loans for natural gas consumption from prequalified EU-based suppliers.

In 2015, Naftogaz received a USD 300 m loan for natural gas consumption from the EBRD. Naftogaz used the funds to tender for purchases of about 1.1 bcm of natural gas in order to fill up Ukraine's strategic storage facilities ahead of the winter. The following companies were identified as prequalified suppliers:

- Unconditionally selected: CEZ a.s. (Czech Republic) and PGNiG SA (Poland)
- Conditionally selected: ArcelorMittal Energy S.C.A (Luxembourg), Axpo Trading AG (Switzerland), E.On Global Commodities SE (Germany), EDF Trading Limited (United Kingdom), Eni trading & shipping S.p.A (Italy), ENGIE SA (France) and GDF SUEZ and Földgázkereskedelmi Hungaria Kft (Hungary), Noble Clean Fuels Limited (United Kingdom), RWE Supply & Trading GmbH (Germany), Shell Energy Europe Limited (United Kingdom)

The prequalified companies had to meet the following conditions in order to be tendered:

- Listed on the stock exchange (joint stock company)
- Incorporation document or Joint Venture, Consortium or Association (JVCA) agreement required
- The individual value of such previous contracts should be no less than 60% of the estimated cost of the contract to be undertaken
- Operation rate of no less than 75% of the project's peak rate
- Reference on executing two or more projects of value no less than 60% of the estimated cost of the contract in the previous 3-5 years

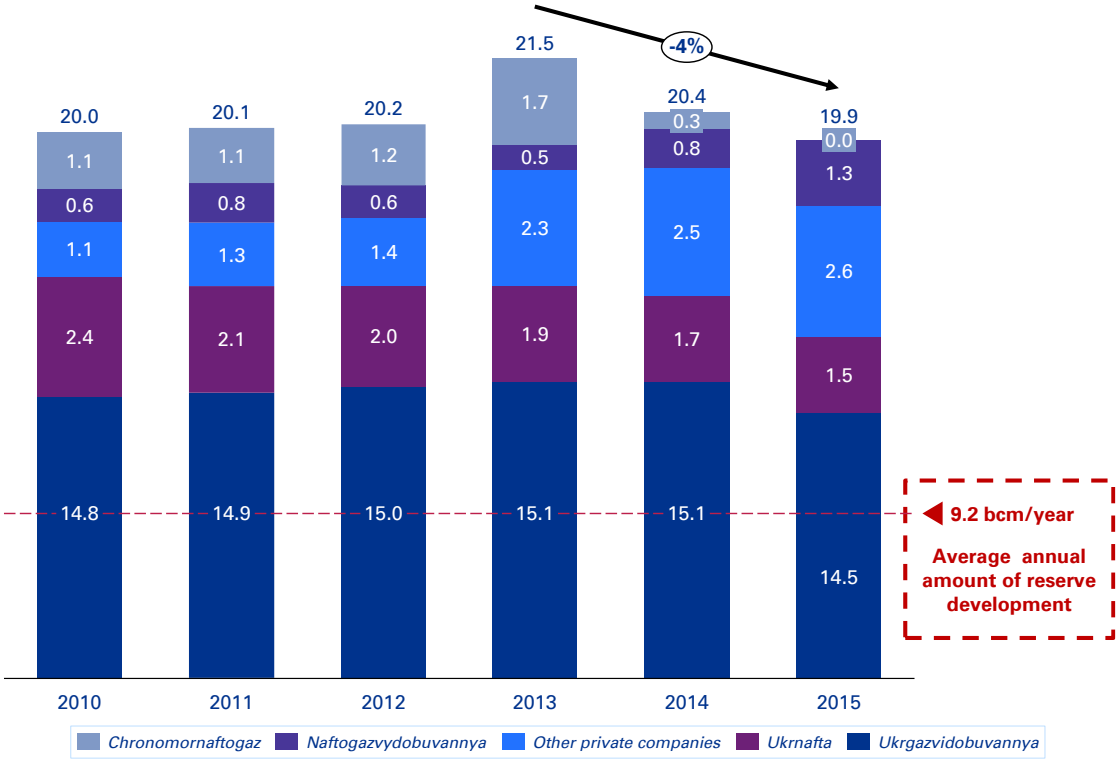
On 18 October 2016 the WB approved a USD 500 million loan guarantee for natural gas consumption for the 2016/2017 heating season. Naftogaz is expected to sign a loan agreement after all the necessary procedures are completed. The potential suppliers include: ENGIE, GAZPROM Export, and other European companies which are not yet identified.

Domestic production

The level of natural gas production remained the same in the examined years – on average 20.4 bcm/year. Due to the lower demand in 2015, natural gas demand

was mainly supplied from domestic production. The share of domestic production in the total supply increased from 35% to 55% in the period between 2010 and 2015.

Natural gas production by company (bcm)



Source: Gas Production in Ukraine, 2014-2015. Naftogaz (2016), Available at: http://naftogaz-europe.com/article/en/GasProductioninUkraine20142015; Gas Production by "Naftogaz of Ukraine" (bcm), Naftogaz Europe (2015), Available at: http://naftogaz-europe.com/article/en/GasProductionbyNaftogazofUkraine, Production indicators of DTEK for 2015. USUBC (2016), Available at http://www.usubc.org/site/member-news/production-indicators-of-dtek-for-2015

There are two leading state-owned natural gas production companies (Ukrgazvydobuvannya and Ukrnafta) which contributed 80% to the total domestic natural gas production in 2015.

Among the privately owned gas producers, the largest was Naftogzvydobuvannya, which is part of the DTEK Group and had a 7% share in total domestic natural gas production in 2015.

Another significant gas producer is Burisma Holding, which is a group of independent gas companies that has been growing significantly since 2002 ("others'" share in domestic production was 7.9% in 2015*)*. ESCO-Pivnich, First Ukrainian Natural Gas and Oil Company, PARI, Nadragaz and Technoresurs are companies which belong to the Burisma Holding.

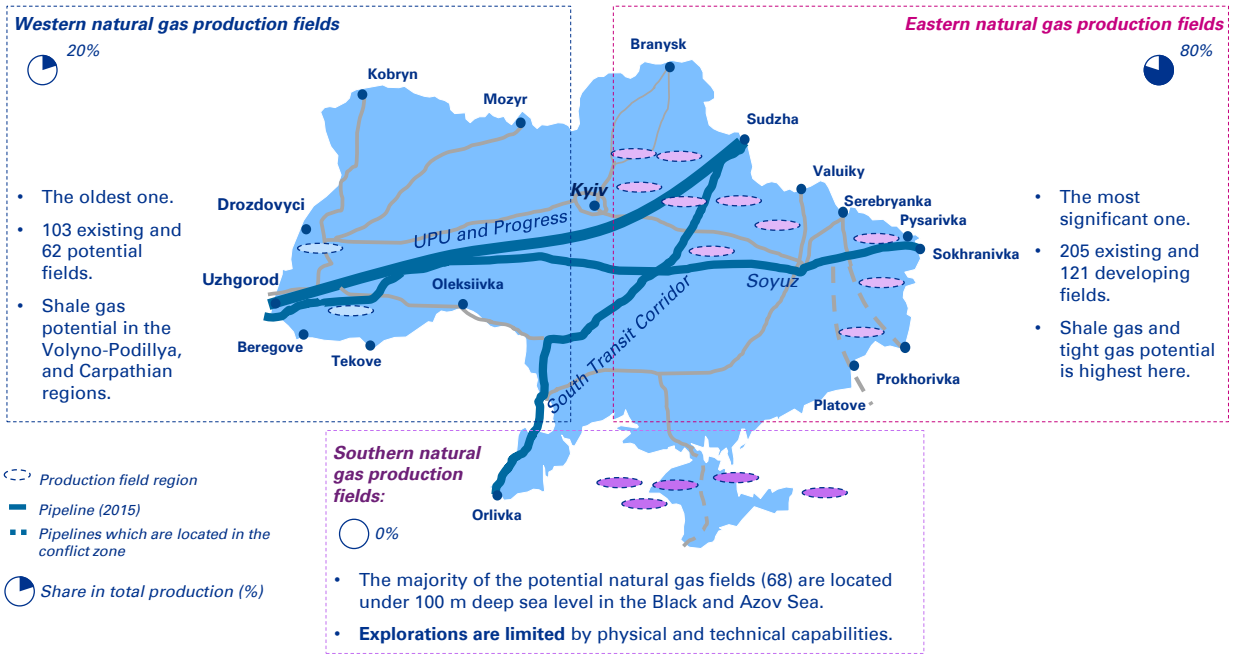
There was a modest increase in natural gas production between 2010 and 2013 (CAGR +2%). The sharp rise in 2013 (+6%) was mainly due to the development of privately-owned companies.

In the period between 2013 and 2015, gas production decreased by CAGR 4%, which was mainly influenced by the loss of control over Chornomornaftogaz's assets located in the Crimea and increased tax payments on extraction by more than 70% between 2014 and 2015. Extraction tax was reduced in April 2016 in an attempt to encourage production and the development of the natural gas reserves.

Between 2010 and 2015 Ukrainian companies managed to develop their natural gas reserves annually on average by 9.2 bcm.

In the period between 2015 and 2035 natural gas supply is expected to decrease by CAGR 0.32%, which should be supplied mainly by domestic production and net imports from the EU.

Natural gas production fields



Source: KPMG data on natural gas in Ukraine. Resources and proven reserves. (Ресурси і розвідані запаси. природний газ в україні традиційні джерела), NADRA Group (2010), Available at: http://ua-energy.org/upload/files/Pavlo_Zagorodniuk_Presentation_Ua.pdf; Expert interview

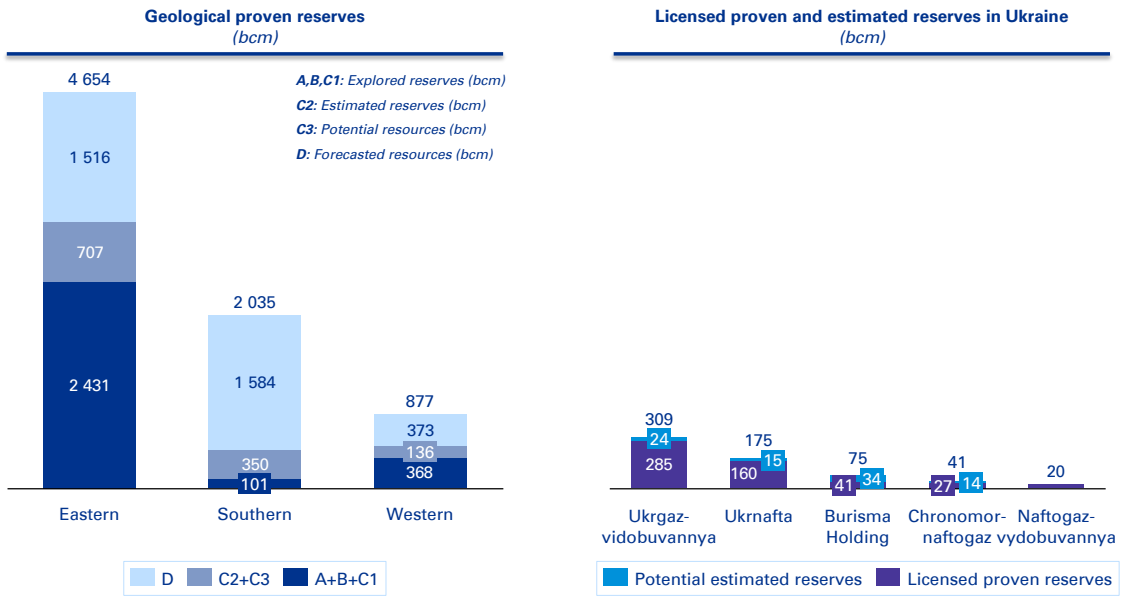
There are more than 350 natural gas and oil production fields in Ukraine, which are primarily located in the western, eastern and southern regions of the country.

The ***western natural gas fields*** were the first to be developed in Ukraine. Currently there are 103 existing and 62 potential gas fields, making up 20% of the total Ukrainian natural gas production capacity. In the regions of Volyno-Podillya and Transcarpathia, the potential for shale gas extraction is the highest compared to other western regions. Nevertheless, these fields have not yet been developed.

The ***eastern natural gas fields*** comprise 80% of Ukraine's total domestic production. There are 205 existing fields and 121 fields under development. The potential for shale gas extraction is the highest in this region. 14 fields are currently located in the conflict areas.

There are currently 42 developed natural gas fields and 68 under development in the ***southern region***. The majority of the potential natural gas fields are located more than 100 m below sea level in the Black and the Azov Seas. The exploration of these fields is limited by political, physical and technological capabilities.

Natural gas reserves (bcm)



Source of the geological proven reserves: Energy potential of Ukraine (Elizabeth Havrylenko, Deputy Director of Foreign Economic Activities Department), State Geological and Mineral Resources Survey (2014), Available at: http://iccua.org/wp-content/uploads/2015/08/ENERGY_POTENTIAL_Of-UKRAINE.pdf

Source of the licensed proven reserves: Introduction of the company, Naftogaz (2016), Available at: http://www.naftogaz.com/www/3/nakweben.nsf/0/2F6A8DAFC83F1A49C2257F9B0024168B?OpenDocument&Expand=1.1&; Ukrnafta expert interview; Introduction of the company, Burisma Holdings (2015), Available at: http://burisma.com/about-us/; Oil and Gas in 2014, Epravada (2015), Available at: http://www.epravda.com.ua/columns/2015/02/3/525569/; Who produces oil and gas in Ukraine, Antikor (2014), Available at: http://antikor.com.ua/articles/15289-hto_vidobuvaje_gaz_i_naftu_v_ukrajini._chastina_1 (Part 1), http://antikor.com.ua/articles/15826-hto_vidobuvaje_gaz_i_naftu_v_ukrajini._chastina_2 (Part 2)

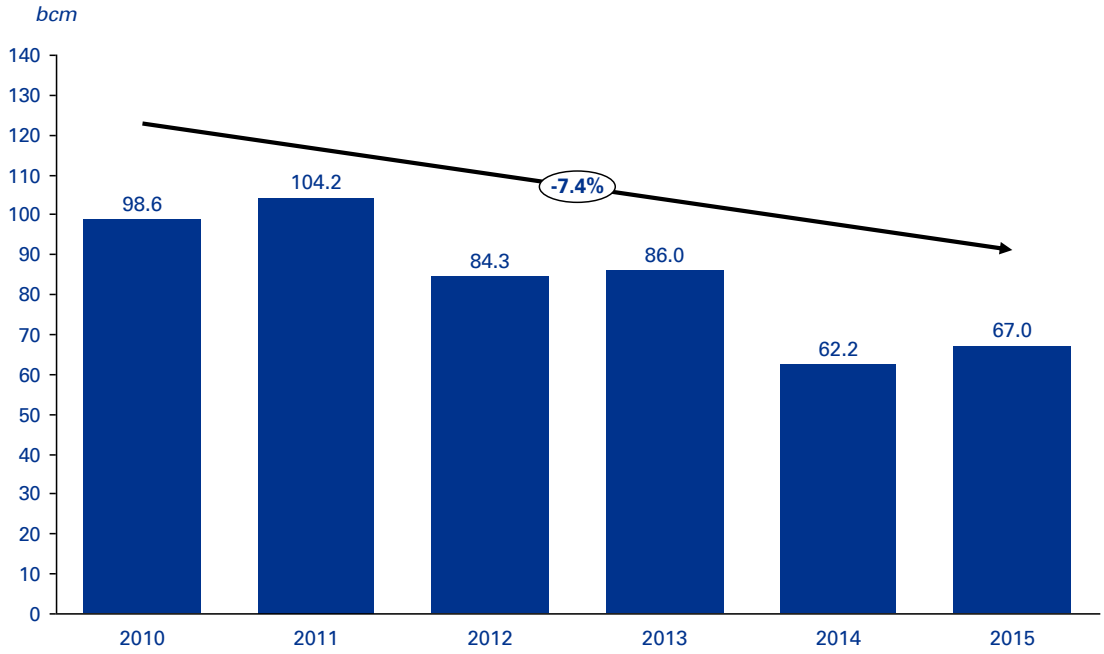
Based on the volume of proven reserves and reserves with an extraction license, the utilisation and development of extraction remains very low.

Out of the 2,900 bcm (category A, B, C1) in explored reserves, only 533 bcm are licensed for extraction to the largest natural gas companies.

The discrepancy between the geological and licensed reserves could be the result of complicated bureaucratic procedures with regard to license inquiries, the high extraction duty, and technological barriers. This may explain the fact that even Ukraine's largest and mainly state-owned production companies find it difficult to get approval for extraction licenses.

Transit

Natural gas transit from Russia to the EU (bcm)



Source: Gas flow at entry and exit points of Ukrainian GTS in 2009-2015 (bcm), Naftogaz (2015), Available at: http://www.naftogaz.com/files/Activities/Gas-flow-via-Ukraine-2015.pdf

Total transit flows from Russia decreased by CAGR 7.4% in the period between 2010 and 2015. The most significant decrease in transit flows took place between 2013 and 2015. During this period, natural gas flows decreased by CAGR 11.7%. The decline was mainly caused by the Russian natural gas transit diversification policy, establishing and initiating alternative transit lines (Yamal, Nord Stream 1 and Blue Stream) as well as the declining natural gas demand in the EU-28 (by CAGR -3.5% between 2010 and 2014). *(Eurostat Statistical Dashboard – Gross inland consumption (natural gas), 2015)*

2.3.2 Natural gas supply in the period 2015-2035

KPMG used the following rationale in the natural gas supply forecast:

- Natural gas production is expected to decrease by 0.4% annually based on the production trend of Ukrainian companies in the period between 2013 and 2015.

- Imports from the EU are expected to increase in line with capacity-enhancing projects, focusing on the development of an interconnector pipeline between Ukraine and Poland (5.0 bcm/year) and higher capacity at existing entry points from Slovakia (by 1.3 bcm/year), physically allowing an increase in import capacity from the EU up to 27.3 bcm.

- Imports from Russia are expected to decrease to 0 bcm in line with the trend in previous years and based on no imports from Russia in 2016.

  Ukraine ceased its natural gas purchases from Russia in 2016. The following declarations of the Ukrainian Officials support this:

  "The cabinet has decided to order Naftogaz to stop buying Russian gas …" "…We stopped buying it…" – Arseniy Yatsenyuk (Ukrainian Ex-prime Minister), on 25.11.2015 to TASS News Agency; Available at: https://themoscowtimes.com/articles/ukraine-to-buy-gas-from-europe-not-russian-gas-giant-gazprom-50910

  "…Ukraine could buy all the gas needed for the upcoming winter from Europe in the event of Russia closing its supply lines…" – Andrei Kobolev (CEO of Naftogaz), on 25.11.2015 to TASS News Agency; Available at: https://themoscowtimes.com/articles/ukraine-to-buy-gas-from-europe-not-russian-gas-giant-gazprom-50910

  "…Today is the first anniversary since Naftogaz stopped importing gas from Russia…" – Andrei Kobolev (CEO of Naftogaz), on 27.11.2016; Available at: http://www.forbes.com/sites/timdaiss/2016/11/27/ukraine-celebration-one-year-without-russian-gas/#7c4ac21a32fd

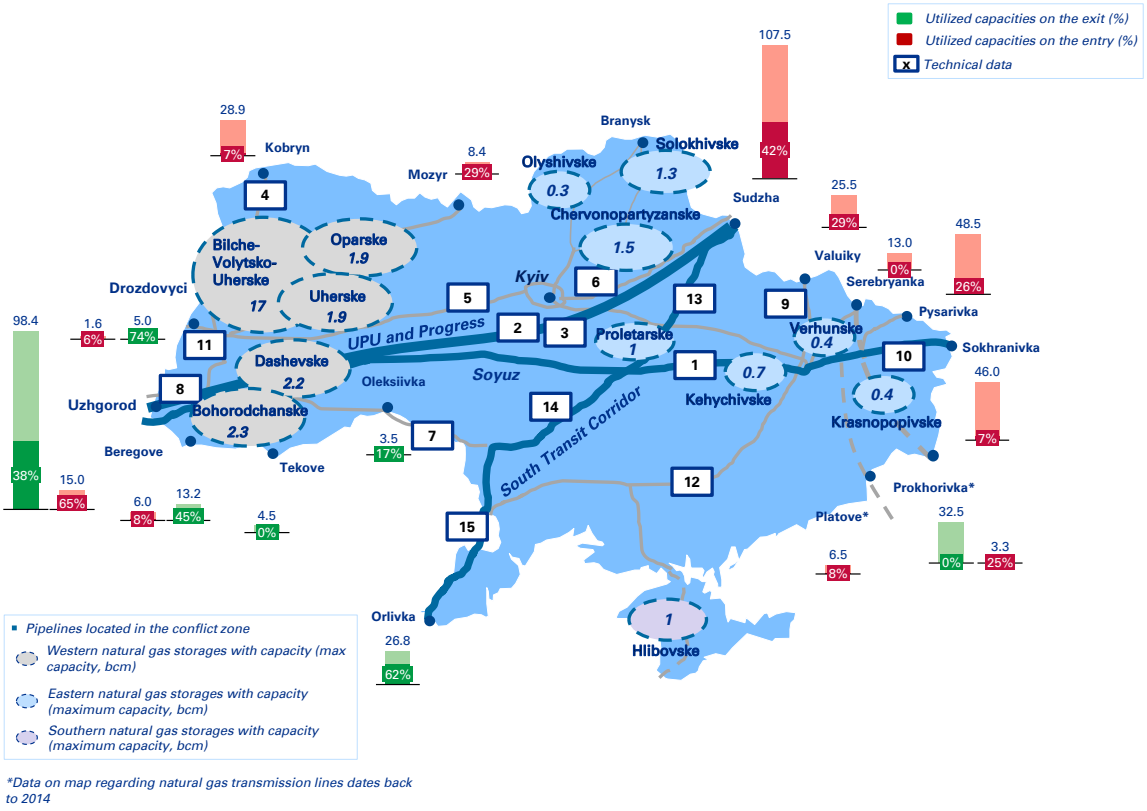
  At the end of 2015, after Ukraine stopped its natural gas imports from Russia, UTG introduced a publicly available real time counter which indicates the number of days without Russian natural gas imports. As of 14.12.2016 the counter showed 383 days, which is already more than a year without Russian natural gas imports. The counter can be seen here: http://utg.ua/still-alive/

  The underlying argument is that the import agreement will expire and it will not be prolonged after 2019. In 2020 and from 2020 onwards, Russian imports are expected to be replaced by import flows from the EU. This assumption is in line with the *"EU and Eastern Partner energy policies: Security versus transit benefits Study" (EU Parliament, 2016).*

3 Infrastructure

3.1 Overview of natural gas infrastructure system

Entry/exit points and capacity utilisation rates (bcm, %)



Source: *Gas flow at entry and exit points of Ukrainian GTS in 2009-2015 (bcm), Naftogaz (2015), Available at: http://www.naftogaz.com/files/Activities/Gas-flow-via-Ukraine-2015.pdf*

(1) Soyuz
(2) Urengoy-Pomary-Uzhgorod (UPU)
(3) Progress
(4) Ivacevichi-Dolina
(5) Kyiv-Western Corridor I/II
(6) Kursk-Kyiv
(7) Ananjiv-Bohorodchani
(8) Dolina-Uzhgorod
(9) Ostrogozjk-Shebelinka
(10) Novopskov-Shebelinka
(11) Komarno-Drozdovichi
(12) Shebelinka-Izmail
(13) Jelec-Kremenchug-Kriviy Rig
(14) Kemenchug-Ananijiv
(15) Ananjiv-Tiraspol-Izmail

Ukraine has an extensive natural gas transit and transmission system and owns one of the largest natural gas underground storage facilities in Europe.

The **main transmission system consists of 15 pipelines** which include the longest and most important transit pipelines, such as Soyuz, UPU and Progress. These pipelines mainly serve transit needs, transmitting natural gas from Russia (Gazprom) to the EU-based company (Gazprom), which in turn transfers gas to its EU-based customers.

The theoretical maximum entry and exit capacity of the system is high, 306.7 bcm/year and 183.9 bcm/year respectively. The main entry-exit points based on the high available capacity in the western area are Drozdovyci, Uzhgorod and Beregove, while in the eastern area these are Sudzha, Valuiky, Pysarivka and Sokhranivka.

Nevertheless, the whole system is underutilised, which means there is 73% unutilised capacity at the entrance to the system, and 64% at the exit. The system is underutilised due to Ukraine's changed natural gas production volumes: Ukraine (as part of the unified Soviet transmission system) was a net exporter in the period between 1950 and 1970, since then there has been a gradual transformation from net exporter to net importer.

The other reason for the underutilisation of entry and exit capacities is Russia's diversification of its transit routes to Europe (Yamal since 1997, Blue Stream since 2003, pipeline 1 of Nord Stream 1 since 2011 and pipeline 2 of Nord Stream 1 since 2012).

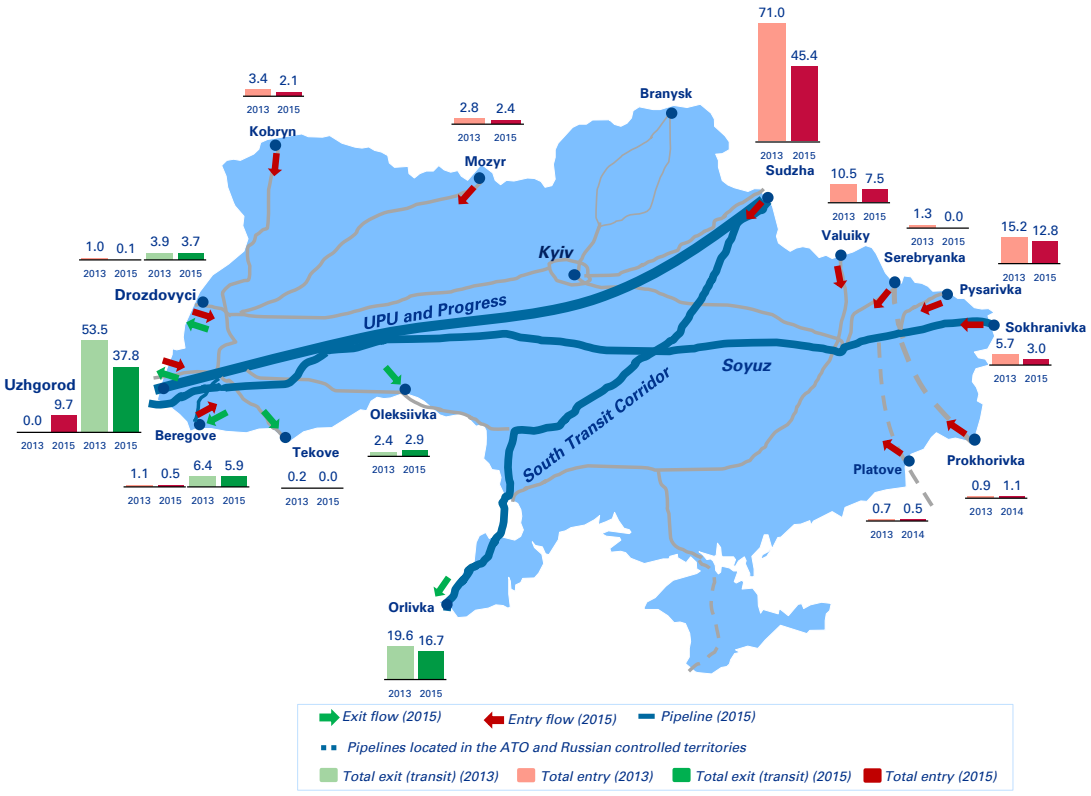
One additional reason for the decreased transit capacities through Ukraine was the declining EU-28 natural gas demand (CAGR - 3.5% between 2010 and 2015).

Storage facilities:

There are 13 underground natural gas storage facilities (GSFs) which can be identified based on three geographical areas:

- *East:* There are 7 GSFs with a total 6.1 bcm maximum available capacity. These mainly satisfy local internal consumption needs.
- *West:* There are 5 GSFs with a total 25.3 bcm maximum capacity, mainly used for swaps with gas taken from transit volumes in the east in winter to serve the demand for transit to the EU (not used directly for transit purposes).
- *South:* There was only one storage facility (Hlibovske) which is located in the Crimea with a total capacity of 1 bcm. Since 2014 this storage facility has not been operated by the Ukrainian TSO anymore.

Entry-exit flows with border crossing points (bcm)



Source: Gas flow at entry and exit points of Ukrainian GTS in 2009-2015 (bcm), Naftogaz (2015), Available at: http://www.naftogaz.com/files/Activities/Gas-flow-via-Ukraine-2015.pdf; Gas Balances in Ukrainian Underground Storages, Naftogaz (2016), Available at: http://naftogaz-europe.com/article/en/englstorage

*(1) *The data is from 2014*

Based on the exit-entry flows in the period between 2013 and 2015 we see significant changes, which show a declining trend in entry flows from the east and an increasing trend in natural gas entry flows from the west.

Natural gas transit flows from Russia between 2013 and 2015 have decreased by 19 bcm (from 86 bcm/year to 67 bcm/year), resulting in a more than 22% decrease overall. The main influencing factors are the escalating political conflicts, Russia's transit diversification policy and Ukraine's diversification of natural gas import routes (increase of net imports from the EU).

Compared to 2013, entry flows from EU countries in 2015 were 3.9 times higher, which means an increase from 2.1 bcm (2013) to 10.3 bcm (2015). Similarly to the above-mentioned reasons, this growth is attributed mainly to Ukraine's import diversification policy and political tensions. The main reverse flow routes crossed western transit points at the following entry points: Drozdovyci, Uzhgorod and Beregove, routing from Poland, Slovakia and Hungary.

Entry capacities on the western border of Ukraine are planned to be increased by almost 6.3 bcm, allowing an increase in net imports from the EU up to 27.3 bcm. There are four planned or in-progress projects regarding capacity increases:

- Capacity increase on the existing pipeline between Slovakia and Ukraine by 1.3 bcm up to 15.3 bcm (construction work started in 2016, scheduled for operation from 2019 onwards).

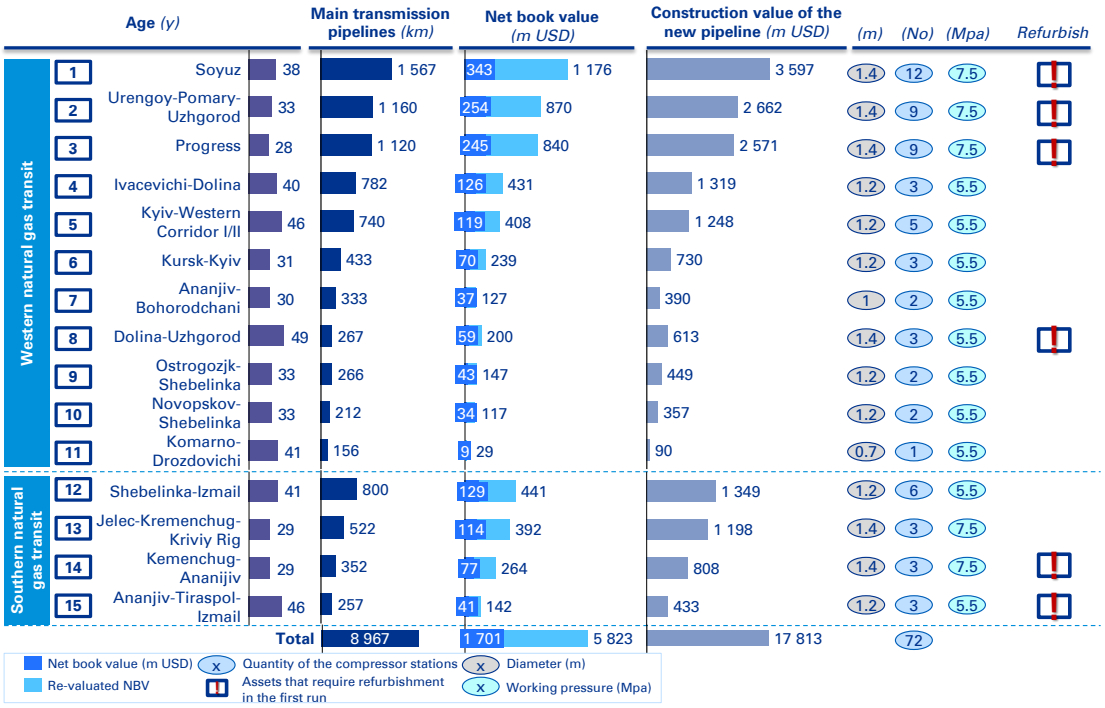
- Development of an interconnector between Poland and Ukraine by 5 bcm; this will increase existing capacity to 6.5 bcm (start of construction in 2017) *(Phase 1).*

If the first two projects succeed, negotiations on the following projects may take place:

- Further capacity development of the existing pipeline between Poland and Ukraine by 8 bcm, up to 14.5 bcm. The initiation of the project depends on the success of the first phase *(Phase 2).*

- Development of pipeline between Romania and Ukraine by 20 bcm. The given project is currently in the planning phase.

3.2 Technical characteristics of transit and transmission pipelines



Source: Ukrtransgaz Annual Report (2015), Naftogaz Annual Report (2015), Report on the evaluation of assets, BT (2012); Specialist interview on Mott MacDonald study about Ukrainian gas infrastructure improvements in 2011 (Conducted on 08.08.2016); Expert interview; KPMG estimation based on BT report

The total length of the Ukrainian natural gas transportation and transmission system is 35,600 km, which consists of 22,200 km in transmission and 13,400 km in connecting pipelines.

The main transmission pipelines total 8,900 km with a total annual available capacity of 327 bcm/year. More than 57% of all pipelines are trunk pipelines. The working pressure varies from 5.5 to 7.5 MPa.

There are two main natural gas transit directions going through Ukraine from Russia to the EU:

- *Western natural gas transit route:* The longest and most important pipelines are Soyuz, UPU and Progress, which mainly fulfil the demand for transit to the EU. The average age of the western transit pipelines is 35.6 years.

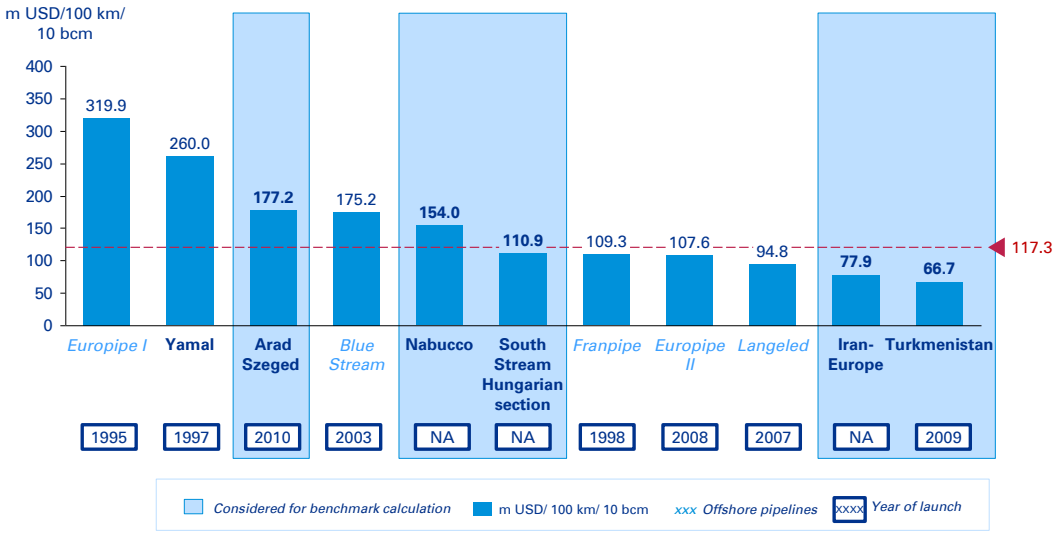
- *Southern natural gas transit route:* The largest and most important one is Shebelinka-Izmail, the average age of which is 36.3 years.

There are 72 compressor stations (CS) and 1,455 gas distribution stations. 7% of the pipelines are considered to be over-aged, which violates both national (max.

3%) and European regulations (max. 1.5%) *(VOX Ukraine, 2016; Ukrtransgaz – Characteristics of the Transmission system, 2016)*.

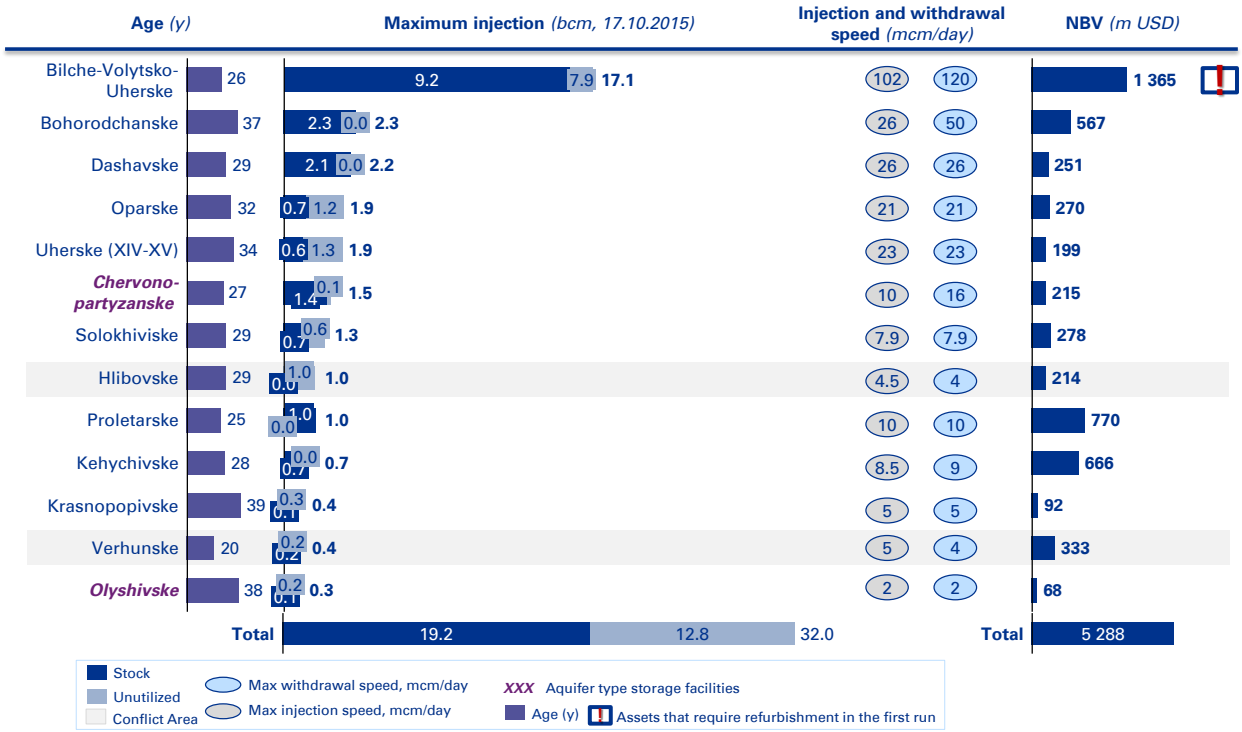
The replacement value of the main transit pipelines would amount to USD 17.8 bn, which was calculated based on the international benchmark and volume of the system. Thus the pipelines with the highest replacement value (gross book value) are Soyuz, UPU and Progress, which are the most important transit pipelines. We used a benchmark of international pipeline construction costs of 117.3 m USD/100 km/10 bcm. This figure is determined based on the following pipelines: Arad-Szeged, Nabucco, South Stream Hungarian Section, Iran-Europe and Turkmenistan pipeline.

International benchmark of pipeline construction costs



Source: Pipelines and offshore facilities, NPD (2009), Available at: http://www.npd.no/Global/Engelsk/3%20-%20Publications/Facts/Facts2009/Chapters/Kap15.pdf; Yamal – Europe Gas Pipeline, Russia, Hydrocarbons-Technology (2016), Available at: http://www.hydrocarbons-technology.com/projects/yamal-europegaspipel/; The Western European Gas Market (Bertrand Rossert), European Investment Bank (1996), Available at: http://www.eib.org/attachments/pj/western_european_gas_market_en.pdf; the Arad-Szeged gas pipeline will be inaugurated on 29 July. Communicate Wall-Street (2010), Available at: http://www.wall-street.ro/articol/Economie/89545/Conducta-de-gaze-Arad-Szeged-va-fi-inaugurata-pe-29-iulie.html; New step towards the implementation of the Arad-Szeged pipeline, FGSZ (2009), Available at: https://fgsz.hu/en-gb/media/hirek/ujabb-lepes-az-arad-szeged-vezetek-megvalositasaert; Blue Stream Pipeline, Hydrocarbons-Technology (2016), Available at: http://www.hydrocarbons-technology.com/projects/bluestream-pipeline/; Europe's Nabucco Pipeline Delayed Again, The New York Times (2011), Available at: http://www.nytimes.com/2011/05/10/business/global/10nabucco.html?_r=1; Putin brings forward South Stream gas pipeline build, BBC News (2011), Available at: http://www.bbc.co.uk/news/world-europe-16367396; Iran seeks to Build 4 billion Gas Pipeline to Europe, Bloomberg (2008), Available at: http://www.bloomberg.com/apps/news?pid=newsarchive&refer=europe&sid=aez49fNjJoMU; 2011 Worldwide Pipeline Construction Report, Pipeline & Gas Journal (2011), Vol. 238(1), Available at: http://www.pipelineandgasjournal.com/2011-worldwide-pipeline-construction-report?page=show

3.3 Technical characteristics of natural gas storage facilities



Source: Ukrtransgaz Annual Report (2015), Naftogaz Annual Report (2014); Report on the evaluation of assets, BT (2012); Specialist interview on Mott MacDonald study about Ukrainian gas infrastructure improvements in 2011 (Conducted on 08.08.2016); Expert interview; KPMG estimation based on BT report

There are 13 storage facilities around Ukraine:

- *Western* (Bilche-Volytsko-Uherske, Bohorodchanske, Dashavske, Oparske, Uherske XIV-XV);
- *Southern* (Hlibovske) – not under Ukrainian control anymore.
- *Eastern* (Chervonopartyzanske, Solokhiviske, Proletarske, Kehychivske, Krasnopopivske, Verhunske, Olyshivske).

Only one of the storage facilities (Hlibovske) was operated by Chornomornaftogaz (subsidiary of Naftogaz). The other twelve storages are operated by UTG. The majority of underground storage facilities were built within depleted gas fields, while two of them were built on the foundations of water-bearing structures (aquifers).

The Ukrainian underground gas storage system has one of the largest available capacities in Europe – 32.4 bcm. The largest storage facilities are located in the western part of Ukraine, their capacity is mainly used for swaps with gas taken from transit volumes in the east in winter, in order to satisfy the demand for transit to the EU (they are not used directly for transit purposes) and they are

connected to the main transit transmission lines (Soyuz, Progress and UPU). Their combined capacity is 25.3 bcm, making up 79.2% of Ukraine's total Underground Gas Storage (UGS) capacity. The eastern storages have a combined capacity of 6.1 bcm (17.6% of Ukraine's total UGS capacity) and the southern storage has 1 bcm (3.1% of Ukraine's total UGS capacity).

With an average age of 32 years, the western storage facilities are the oldest ones, while the eastern and the southern storages have an average age of 29 years. This is considered old compared to the average age of the EU storage facilities, which is approximately 17 years.

On the maximum injection day (17 October 2015) the highest rate of utilisation was only 51%, which is moderate compared to the EU average (65%)[4]. Nevertheless, it was sufficient to satisfy transit needs.

Due to their age and physical condition (porous), the storage facilities are inflexible in terms of injection and withdrawal. So injection mostly takes place in the summer, while withdrawal is typically in winter. Generally there are technical and time limitations to switch instantly from injection to withdrawal and vice versa.

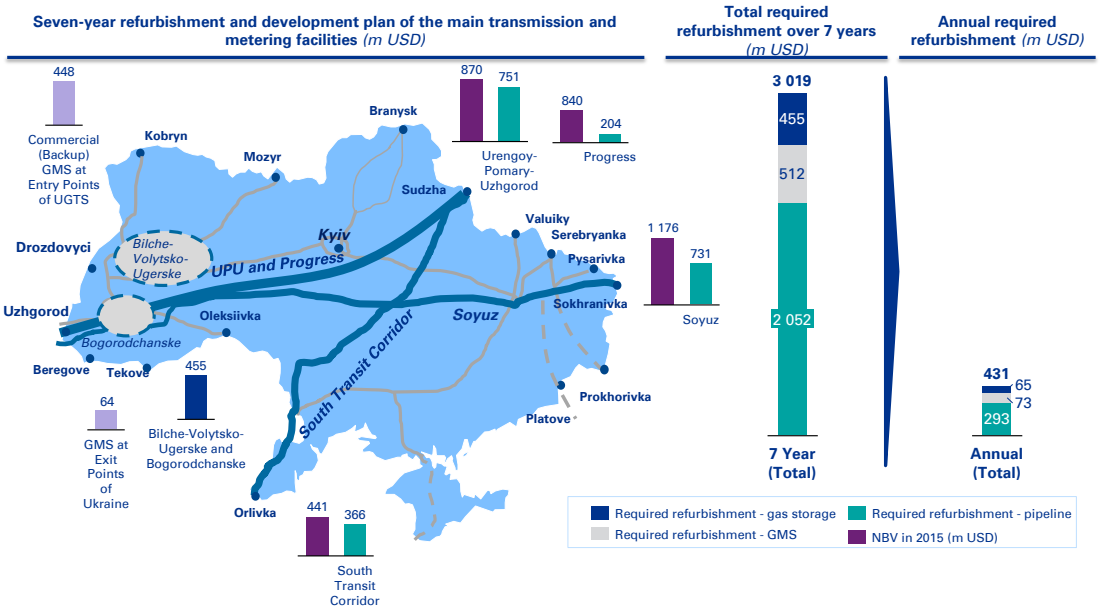
In late 2014 Chornomornaftogaz lost its access to the Hlibovske storage facility located in the Crimea and UTG lost its Verhunske storage facility located in the conflict zone in eastern Ukraine. However, these events had a negligible impact on transit activities as these storage facilities mainly served domestic demand. As a result, the storage utilisation in these facilities is essentially zero.

4 – According to the GIE database, utilisation of the EU storage facilities in 2016 was around 65% throughout the whole year. (GIE Database available at: https://agsi.gie.eu/#/historical/1 ; retrieved on: 201612.13).

3.4 Refurbishment requirement

In 2014 PJSC Ukrtransgaz presented a Seven-year refurbishment and development plan of main transmission and metering facilities – "*Master Plan for Ukrainian Gas Transmission System Priority Objects - Modernisation and Reconstruction"*, according to which a coordinated investment plan for the transmission pipeline network, compressor refurbishment strategy (refurbishment and/or replacement) and the establishment of a modern ***Supervisory Control and Data Acquisition system*** (SCADA) system are expected.

Seven-year refurbishment and development plan of main transmission and metering facilities (USD m)



Source: Master Plan Ukrainian Gas Transmission System Priority Objects Modernization and Reconstruction. PJSC Ukrtransgaz 2014.

The Seven-year refurbishment and development plan of main transmission and metering facilities issued by UTG in 2014 is in line with the conclusions drawn from the feasibility study on the modernisation options and costs of the pipelines and storage facilities prepared by Mott MacDonald and presented by Azfar Shaukat at the EU-Ukraine International Investment Conference in Brussels (Belgium) on 30 September 2011[5].

Mott MacDonald concluded in 2011 that the natural gas transportation system of Ukraine was in an inadequate condition due to its poor design and construction as well as the subsequent low or insufficient level of maintenance funding. These

5 – "Ukraine – EU: On the Way towards the Single Energy Market" – Shaukat, A. (2011), presentation by Mott McDonald to the EU-Ukraine Conference, September 2011, Brussels, Belgium.

constraints were numerous and extensive, requiring a program of rehabilitation work in the short, medium and long term to improve system integrity. The following constraints were identified by Mott MacDonald[6]:

- Application of ***tape-wrap coating*** instead of factory-applied corrosion protection system and stress corrosion cracking resulted in higher vulnerability of the transmission system, seen particularly in several explosions on the UPU pipeline and operational incidents on the CSs.

- Majority of the ***compressors and drivers*** serving transit corridors were qualified as ***over-aged and under-maintained with low levels of efficiency*** because they exceeded their design operating hours and maintenance and overhaul work was undertaken at reduced service intervals compared with design norms. It was considered that it was not possible to keep the ageing machinery operating indefinitely without risks of major faults occurring, and that a machinery replacement program was essential.

- The existing UGTS ***SCADA system*** was qualified as *outdated and generally poor* compared to a modern SCADA system because the existing one provides only minimal status information (some on pressure and temperature sensors and/or some on cathodic protection status) and in some cases the system is no longer functional (as spares are no longer available for the equipment).

The study of Mott MacDonald addressed two major issues:

i. Identifying a prioritised plan by reviewing the UTG "Priority Project" initially described as the emergency rehabilitation of UPU based on the UTG development program for 2009 – 2016

ii. Extension of the review to the other pipelines (overall rehabilitation project)

While the emergency rehabilitation of UPU with a capacity of 30 bcm/y is underway, financed by UTG own funds and by loans from the EIB, the overall rehabilitation project has made little progress and still lacks financing.

i. Emergency rehabilitation of UPU pipeline

So far, two loan agreements have been signed for renovation and refurbishment works on the key pipeline UPU.

On 11 November 2014, UTG and the EBRD signed a loan agreement regarding **an emergency upgrade and *modernisation project*** involving a 115-km long

6 – "Statement on Security of Energy Supply of Ukraine" – Ministry of Energy and Coal Industry of Ukraine, January (2012), Available at: https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/1676177/0633975ABAE57B9CE053C92FA8C06338.PDF

section on the *Urengoy-Pomary-Uzhgorod pipeline*. The EBRD is to finance USD 135.3 m out of the USD 270.6 m total project cost. Tendering for the replacement of four critical sections of the pipeline took place between 11 November 2016 and 6 December 2016. The assignment is expected to start in the second quarter of 2017. The whole project is to be completed by 2020.

On 1 December 2014, UTG and the EIB agreed on a loan regarding *infrastructure rehabilitation* of a different 119-km long section of the *Urengoy-Pomary-Uzhgorod pipeline*. The EIB is to provide USD 166.3 m of the USD 388 m total project cost. Tendering started in the third quarter of 2016 in line with the EBRD project, and similarly, the project is expected to be finished by 2020.

From a total of USD 270.6 m + USD 388 m = USD 658.6 m, an amount of USD 135.3 m + USD 166.3 m = USD 301.6 m was financed by the EBRD and EIB, while the remaining USD 357 m was financed by UTG. At the same time, total UTG spending on refurbishments during the years 2013 – 2015 were USD 200.9 m (just half of the USD 402.6 m originally planned for the years 2013 – 2015) UTG spending on refurbishments during the years 2013 – 2015 of USD 200.9 m (just half of the USD 402.6 m originally planned for the years 2013 – 2015) *(See figure below)*. While it is unclear if that was spent on refurbishing the UPU pipeline, it does in any case fall short of the amount required for the UPU emergency refurbishment.

ii. General refurbishment

On the other hand, only marginal amounts were spent on refurbishments beyond the emergency rehabilitation of the UPU, i.e. a general refurbishment of the transit system beyond the UPU pipeline has not yet started.

The only refurbishment project so far outside of the emergency refurbishment of the UPU pipeline is a smaller project (USD 83.2 m) to reconstruct the Bar compressor station of the Soyuz Pipeline.

On 30 December 2015, UTG and Ferrostaal Industrieanlagen GmbH signed an agreement on financing the ***reconstruction of the BAR compressor station on the Soyuz pipeline.*** The project is expected to increase the station's capacity up to 85 mcm/day and increase its lifespan by up to 15 years. Ferrostaal's financing partner is Deutsche Bank, which is to provide USD 70.72 m of the total project cost amounting to USD 83.2 m, while the rest is expected to be provided by the state of Ukraine. Ferrostaal confirmed that Sumy NPO would be one of their suppliers on the project. Tenders for procuring the necessary equipment were completed in 2016.

As a final conclusion of the MMD study, we can say that conducting the refurbishment program for the equipment replacement and repair works was already essential in 2011, but due to the continuous postponements and most

importantly the lack of sufficient financing the system has not improved compared to the 2011 MMD study, going back to a UTG concept of 2008. So the 2014 Refurbishment Plan is the same as the 2011 Refurbishment Plan, i.e. no progress – except for the financing and procurement of the Bar compressor station – was made.

To cover the previously backlogged refurbishments and to achieve sustainable operations (until 2030) of the natural gas transportation and transmission system there is a refurbishment requirement of USD 3.0 bn for seven years.

By realising the planned refurbishment, UTG expects to achieve:

- increase in operating life of compressor units to 100,000-150,000 hours
- fuel gas savings at 600 Mcm per year
- decrease in influence of stress-corrosion on main gas pipelines
- online gas quantity and quality monitoring and alignment of UGTS with relevant European standards

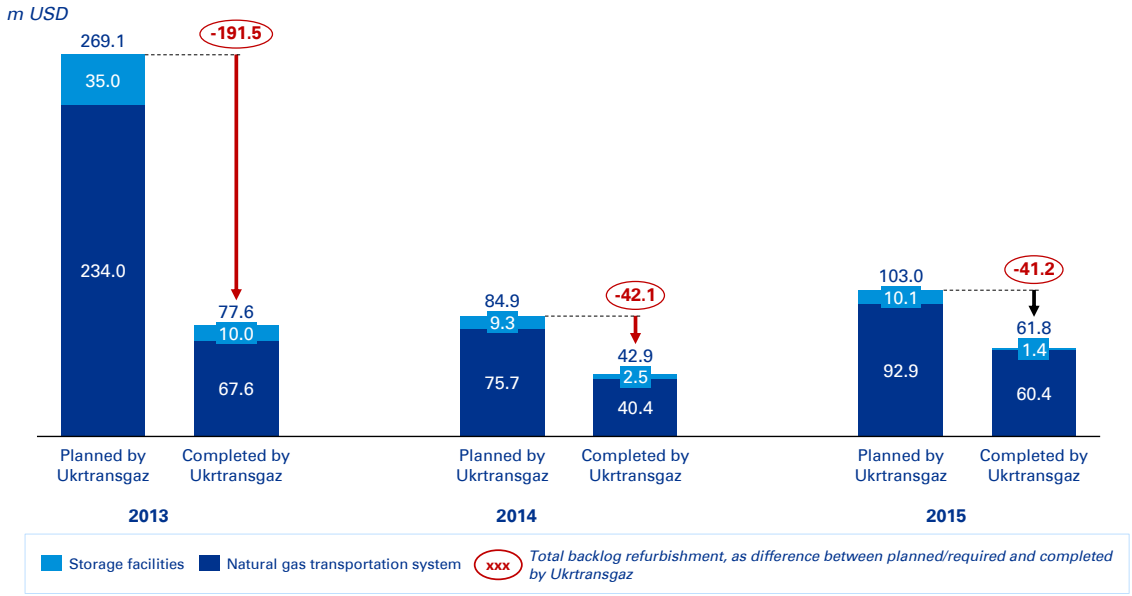
According to the investment plans, the total refurbishment cost is divided as follows:

- USD 2.1 billion for the Progress, Soyuz, UPU and South Transit Corridor pipelines
- USD 0.5 billion for the gas metering stations on the same pipelines
- USD 0.5 billion for the western natural gas storages

The refurbishment plan would take seven years, corresponding to an annual refurbishment spending of roughly (average) USD 0.4 billion/year.

Nevertheless, in the previous three years there was significant under-planning and underspending in the transmission system (without storage): instead of the USD 402.6 m of planned refurbishment costs, only USD 182.3 m (less than 50%) was spent.

Development of refurbishment costs in period 2013-2015 (USD m)



Source: Report on the performance of the National Commission State Regulation in the fields of energy and utilities, NERC 2015, Master Plan Ukrainian Gas Transmission System Priority Object Modernisation and Reconstruction, PJSC Ukrtransgaz 2014

(1) WB Exchange rate: in 2013 1 USD=7.9 UAH; 2014: I USD=11.9 UAH; 2015: 1 USD=21.8 UAH

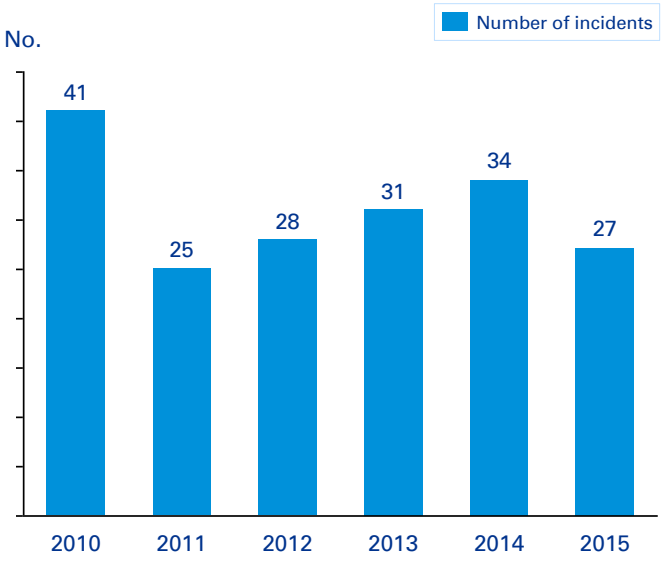
Based on previous experiences (MMD study conclusions in 2011), the historical underinvestment and current financing agreements with the EIB/EBRD leads to the conclusion that the probability of improving the condition of the natural gas transportation and transmission system is rather low.

According to the current plans, the emergency rehabilitation of the UPU pipeline of 30 bcm/y is expected to be finished by 2020. However, the actions taken on the larger rehabilitation program of all four transit pipelines are minor (work on the Bar compressor station on the Soyuz pipeline at USD 83.2 m may start in 2017); no financing is in sight for the bulk of the refurbishment work of about USD 3 bn. Considering the lead time between financing and the start of construction, and the overall construction time of 7 years, completing it by 2025 would be optimistic.

So taking the expert assessment by Mott MacDonald into consideration, the design capacity of the system is not sustainable beyond the 30 bcm/y of the UPU pipeline refurbished under the emergency loans.

3.5 Network vulnerabilities

Number of incidents (no.)

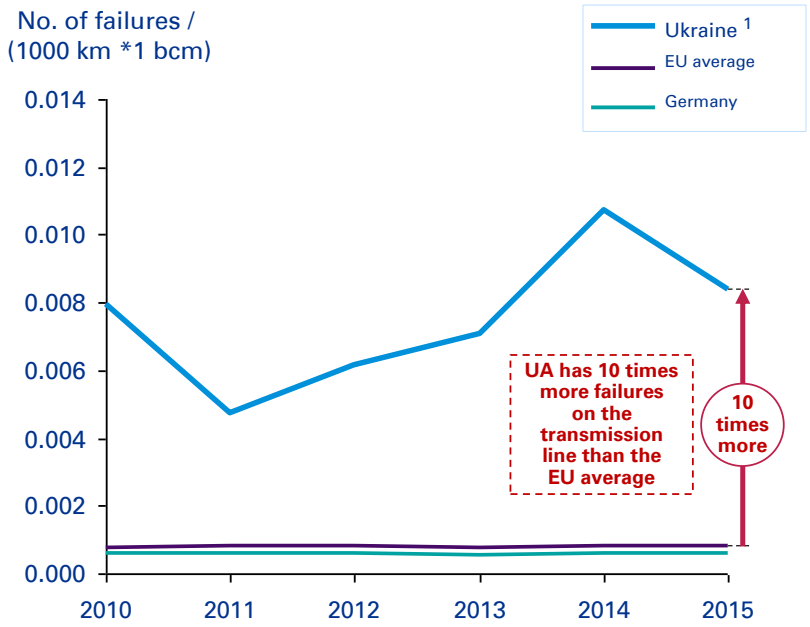


Source: Ukrtransgaz Publication on Incidents in the transmission system („У 2015 році кількість відмов на магістральних газогонах України зменшилась на 21%" Published on: 15/06/2016)

Based on the UTG report about the annual quantity of failures, the number of failures on the natural gas pipelines fell by 39% in 2011 compared to 2010. Since then, however, the number of failures in the transmission pipelines increased by CAGR 11% between 2011 and 2014, indicating that network vulnerability is high (transit security is vulnerable because of the high number of incidents on the transmission and transit pipelines).

Intentional damage in the network was concentrated within the eastern conflict zone. The rise in intentional failures suggests that Gas Transmission System (GTS) operating activities in Ukraine continue to face severe security challenges.

*Failure rate international benchmark (no. of failures/ (1000 km*1bcm))*



Source:

(1) *Ukrtransgaz Publication on Incidents in the transmission system („У 2015 році кількість відмов на магістральних газогонах України зменшилась на 21%") Published on: 15/06/2016; Available at: http://utg.ua/utg/media/news/2016/06/u-2015-rocz-klkst-vdmov-na-magstralnix-gazogonax-ukrani-zmenshilas-na-21.html*

(2) *9th Report of the European Gas Pipeline Incident Data Group 1970 – 2013, EGIG, Published in: 02/2015; available at: https://www.egig.eu/uploads/bestanden/ba6dfd62-4044-4a4d-933c-07bf56b82383*

(3) *Sicherheit von Gasfernleitungen – das Technische Regelwerk im Licht der aktuellen Rechtsprechung (2011; 2013; 2015); Available at: https://www.di-verlag.de/media/content/3R/PDF/PDF_NR_DVGW.pdf?xaf26a=d7b9fb4e000bf6c72783658bf859557c*

(4) *Eurostat Statistical Dashboard – Natural gas imports of Germany, EU 28 – Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_production_and_imports#Imports*

(5) *KPMG calculation based on above-mentioned sources.*

KPMG calculation methodology for failure index (no. of failures/ (1000 km*1 bcm)):

(1) Ukraine: Calculated based on number of failures (published by Ukrtransgaz, 2015), the 38,000 km long transmission system, the sum of transit and net imports from Russia.

(2) EU average: Number of incidents per 1000 km (published by EGIG, 2015) and quantity of imports from Eurostat Statistical Dashboard.

(3) Germany: Number of incidents per 1000 km taken from DVGW 2011 statement and quantity of imports from Eurostat Statistical Dashboard.

The definition applied in the analysis is determined by KPMG and based on the applied methodology and criteria of EGIG (available at: https://www.egig.eu/uploads/bestanden/ba6dfd62-4044-4a4d-933c-07bf56b82383 (Chapter 2; page 8):

The failure rate is the result of the number of incidents and system failures within a period, divided by the product of the corresponding total system length and throughput quantity of imports.

Setting the Ukrainian failure rate against the international benchmark, Ukraine has the most failures per 1000 km x natural gas throughput.

Although an improvement was seen in 2015, which means the number of failures was 20.6% (quantity of failures and incidents was 27) less than in 2014,

the Ukrainian failure rate is nevertheless 10 times higher than the EU and 13 times higher than the German average.

Experts point to the lack of funds allocated for transmission system maintenance as the primary reason for the high failure rate on the Ukrainian GTS. Aged and obsolete fuel CSs were identified as the key elements contributing to the unreliability of the GTS.

As evidenced by a selection of recent and significant pipeline incidents outlined below, the majority of gas network failures recorded since 2013 were primarily a result of depressurisation, gas leaks, pipe body damage and intentional armed damage due to the political conflict[7] *(Ukrtransgaz, 2016)*. It is important to note that in the majority of these cases the network operator conducted the necessary repair works and ensured that gas transits via Ukraine to Europe would not be affected by the incidents.

- On *17 June 2014,* an *explosion on the Urengoy-Pomary-Uzhgorod pipeline*[8] in the Poltava region disrupted the transmission service. The cause of the explosion remains unclear, as the Ministry of Interior cited sabotage while the Ministry of Energy referred to depressurisation as the cause of the explosion. Poltava's local government claimed to have informed the network operator of the poor condition of the pipeline on the section in question, but the TSO refused to conduct the recommended repairs.
- *On 12 June 2015, intentional damage on the Kramatorsk-Donetsk-Mariupol* pipeline resulted in a 5.2 mcm loss of natural gas, and required 105 working hours and USD 1.4 m to be repaired.
- *On 1 January 2016* an *explosion occurred on the Soyuz pipeline* near the Hungarian border in Transcarpathia. An underground gas leak was identified as the cause of the explosion. As a result of the incident, the concrete pillar supporting the pipe shrank 10 m in height. The pipeline operator dispatched teams immediately to address the situation. According to reports, the incident had a limited impact on the environment. Repair works lasted for 63 hours. The approximate loss due to the incident was 809,000 cubic metres of natural gas, with a USD 0.3 m repair bill.
- *On 10 January 2016,* as a result of the *depressurisation on the Komarno-Drozdovichi pipeline,* a crack emerged on the pipeline body which resulted in 859,000 cubic metres of lost natural gas. The repair work lasted for 38 hours and resulted in a cost of USD 0.3 m.

7 – Ukrtransgaz: "Accidents and failures on the natural gas transmission pipelines in 2015-2016"; Available at: http://utg.ua/failures_ua.pdf

8 – Detailed information on the Urengoy-Pomary-Uzhgorod blast is available at the following link: http://newseurope.eu/2014/06/18/blasted-section-russian-ukrainian-gas-pipeline-emergency-condition/; published on: 18.06.2014

- *On 19 August 2016,* three natural gas *pipelines were damaged in the Donetsk* region. The cited cause of the damage was artillery fire. The pipeline operator Dombassgaz immediately dispatched teams to repair the damage; the disruption to the transit service was negligible.
- *On 28 August 2016,* a *natural gas leak caused the temporary suspension of gas transit to Moldova*. Investigating teams identified a crack in the pipe body as the cause of the leak (approximately 445,000 cubic metres). The repair works lasted for 98 hours and amounted to USD 0.1 m.
- *On 9 September 2016, natural gas imports from Poland to Ukraine were temporarily halted due to a gas leak*[9], which was caused by the depressurisation of the main pipeline. Operator UTG immediately dispatched teams to address the issue. The repair works lasted for 44 hours and resulted in the loss of 802,000 cubic metres of natural gas. The total repair cost was more than USD 0.3 m.

The Ukrainian transit system has a large design capacity and a very large storage capacity in the west.

Ad-hoc utilisation of the transit system under its present load seems possible for the near future in view of the large redundancy and high storage capacity. However, the design of the transit system is old (1980s), and it has not been well maintained or refurbished since it started operation in the 1980s.

While emergency measures of the UPU pipeline with a 30 bcm/y capacity are starting to be undertaken with the emergency refurbishment loans from the EIB and EBRD, the main refurbishment of the overall transit system amounting to USD 3 bn was already on the agenda in March 2009. Naftogaz earnings from the transit fee paid by Gazprom under the transit contract would have been more than enough to pay for such an investment *(See chapter 4.5)*.

There is no detailed information available on the current technical status of the system, starting with the system of corrosion protection applied or the result of any pigging operation conducted on the pipelines as a result of the maintenance work. For lack of that information it is not possible to give any reasonable assessment on how long the transit system can continue to be operated on an ad hoc basis.

The study of Mott MacDonald concludes that it is only the skill and diligence of the operations and maintenance staff at the compressor facilities that has managed to keep the system operable using substandard locally sourced spares, and without this the system would have probably collapsed.

9 – UA Today: "Ukraine suspends gas imports from Poland over pipe depressurisation"; Available at: http://uatoday.tv/news/ukraine-suspends-gas-imports-from-poland-over-pipe-depressurisation-743475.html

4 Regulations

4.1 Regulatory background

In 2015, Ukraine joined the ENTSOG. To comply with the organisation's regulations, a number of regulatory changes were adopted from 1 January 2016.

Before the changes, the following regulations set the legal grounds for the natural gas market in Ukraine from 1996:

On 15 May 1996, the Law of Ukraine "On Pipeline Transport" was adopted, aiming to ensure the reliable and safe operation of the network along with improving the ecological security of the pipeline system. It also promotes international cooperation as part of pipeline transport. The law prohibits the privatisation of pipeline systems and defines the supervisory and control functions of the various state bodies. Moreover, the law declares that use of pipelines by foreign companies is regulated by legislative acts, while pipeline construction and repair permits are issued by the government directly.

The Law of Ukraine "On Oil and Gas", adopted on 12 July 2001 sets out the basic legal, economic and organisational foundations of oil and gas activity in Ukraine. The law regulates commercial activities linked to oil and gas production, storage, transportation, refining and conversion, along with the sale to customers and the employment of oil and gas industry workers.

Since 20 April 2000, the Law of Ukraine "On Natural Monopolies" regulates the supply of natural gas (and other substances) above a pre-defined volume. The purpose of this law is to ensure the efficient functioning of the markets, with a natural monopoly being more effective at meeting market demand.

The Law of Ukraine "On Commercial Metering of Natural Gas", adopted on 16 June 2011, governs the principles for ensuring the provision of natural gas metering stations to all customers, setting the foundations for a complete commercial accounting scheme covering all domestic and imported natural gas supply.

The most recent Law of Ukraine "On the Natural Gas Market", in effect since 9 April 2015, sets forth the legal foundations of the Ukrainian natural gas market based on the principles of free competition, subject to the protection of customers and supply security. Additionally, the law regulates the Ukrainian market's integration capability with markets of Energy Community member states, for example, with respect to the creation of regional natural gas markets. This law ensures the Ukrainian natural gas market's compliance with the EU's third energy package and permits the privatisation of 49% of shares in the country's TSO (Ukrtransgaz).

ENTSOG network codes were implemented from 1 January 2016 to facilitate interoperability, congestion management (CPM) and capacity allocation (CAM).

In addition to the regulations promoting international cooperation and trade on the Ukrainian natural gas market, some legislation on sanctioning certain parties was implemented:

On 17 October 2016, the *Law of Ukraine "On applying special economic and legal restrictions (sanctions) to physical and legal bodies"* was adopted and came into force. The main provisions include:

Introduction of economic and legal sanctions against certain physical and legal bodies that (according to the Ukrainian parliament) were harming the economy and sovereignty of Ukraine.

This legislation was based on the *Law of Ukraine "On sanctions",* which was accepted on 10 September 2014. The given regulation was initiated by the Cabinet of Ministers (Arsenij Jacenjuk) on 08.08.2014 and was signed by the President on 10.09.2014.

This regulation determines the reasons that may result in economic and legal sanctions if they hinder the national and territorial sovereignty of Ukraine, result in damage to private and national property, or hinder the sustainable economic development of the country. The regulation also states the sanction methodology and determines the types of sanctions which may be applied in the event of obstructions:

- freezing of financial assets and restricting trading activities
- partial or complete termination/restriction of transit resources, flights and transport via Ukraine
- cancellation or suspension of licenses, prohibition from privatisation

4.2 Interruptible reverse flow

The 2016 Law of Ukraine "On the Natural Gas Market" called for the diversification of Ukrainian natural gas imports, aiming to solve the issue of Ukraine's long-standing dependence on natural gas imports from Russia. As a result, an action plan was approved to develop reverse flows from the West.

The Law defines the principle of equality in the right to carry out natural gas import and export activities to and from Ukraine, aiming to end Gazprom's monopolistic position as an importer of natural gas. The resulting action plan called for more flexibility and diversification of natural gas import flows, i.e.

securing contracts ensuring bidirectional natural gas flows and supply source diversification.

- On 16 July 2016, an agreement between Ukraine, Romania and Bulgaria set out the need to provide interruptible transportation capacity, interruptible reverse flow capacity and bidirectional virtual flows spanning the region from Ukraine to Greece.

- The development of the Budince pipeline connecting Ukraine and Slovakia was approved on 4 April 2016 and the construction of a 99.3 km long pipeline was approved between Ukraine and Poland on 17 December 2014 (construction to commence in 2017). Both pipelines are expected to allow the reverse flow of natural gas via interconnectors.

The successful legal and technical implementation of the above projects would enhance Ukraine's ability to meet domestic natural gas demand without gas imports from Russia.

4.3 Third-party access (TPA)

Article 19 of the Law of Ukraine "On the Natural Gas Market" regulates third-party access to the natural gas transportation system, stating that natural gas market players are equal in their right to be granted access to the gas transmission and distribution network, gas storages and LNG facilities. As an immediate result of this new legislation, capacity booking and capacity allocation is open to all market players and not only to Gazprom, as was the case previously.

According to Article 19, TPA may only be denied if one or more of the following conditions are true:

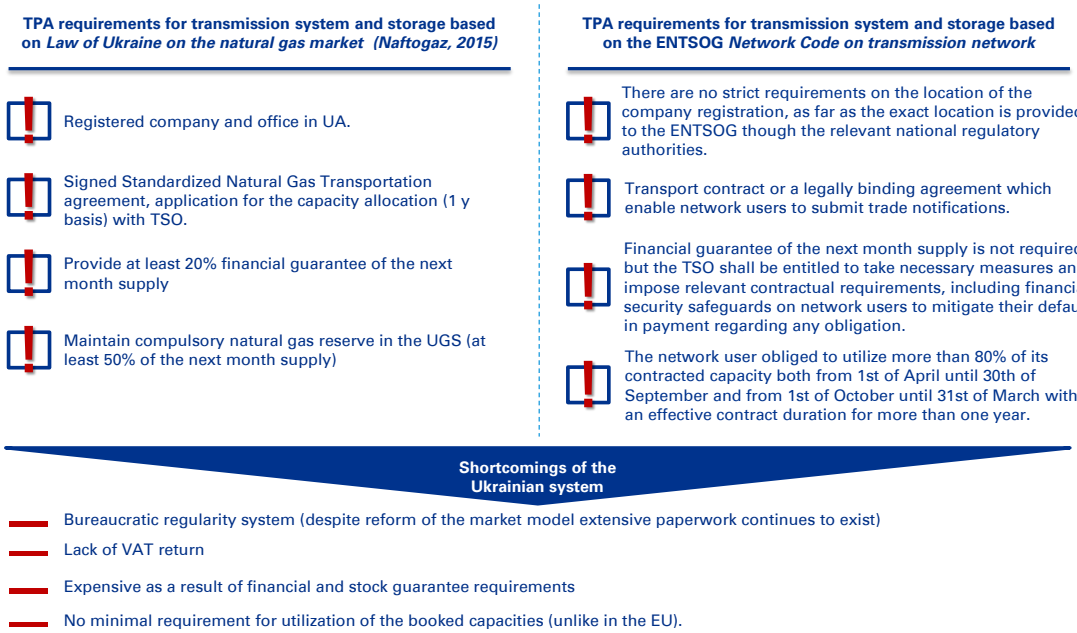
- Capacity in the facilities is insufficient or absent

- The granting of access will constitute an obstacle for an operator with special obligations to fulfil these obligations as defined in Article 11 of the Law of Ukraine "On the Natural Gas Market"

- The transmission system operator's refusal to grant access is substantiated by the Regulator. For example, Article 55 states that in the case of severe economic and financial difficulties arising from the non-fulfilment of the "take-or-pay" obligations, the Regulator may permit the network operator to refuse the granting of access to its facilities

4.3.1 TPA requirement for transmission system and storage facilities

Comparison of TPA requirements in Ukraine and according to the ENTSOG Network Code on access to the transmission system and storage facilities



Source: Law of Ukraine on the natural gas market – Naftogaz (2016); Network code on Gas Balancing of Transmission Network, ENTSOG (2013)

The details of the TPA requirements in Ukraine are still under development; therefore, requirements for third parties that intend to use the transportation system and storage facilities remain inflexible in terms of the number of requirements to access the facilities and the physical prerequisites of the facilities.

In Ukraine, third parties are currently still required to:

- Have their company registered and their headquarters located in Ukraine
- Have a signed Standardised Natural Gas Transportation Agreement, which is needed to apply for capacity allocation with the TSO on a yearly basis
- Provide at least a 20% financial guarantee for the following month's supply
- Maintain compulsory natural gas reserves in underground gas storages of at least 50% of the following month's supply

The major structural shortcoming of the existing regulatory system is the inflexible bureaucracy, which continues to rely on extensive paperwork despite regulatory reforms. Also, the Value–Added Tax (VAT) refund procedure is a considerable obstacle. Lastly, TPA is expensive due to the associated financial and stock guarantee requirements.

4.3.2 TPA requirements for transit

In addition to the 2016 Law of Ukraine "On the Natural Gas Market", access of third parties to the natural gas transit system is regulated by the Gas Transmission Network Code.

To use the natural gas transit system, similarly to the requirements valid for third parties who want to access transmission and storage facilities, third parties are required to have a signed Standardised Natural Gas Transportation Agreement and have applied for capacity allocation on a yearly, monthly or daily basis. Additionally, they are required to provide a financial performance guarantee for 20% of the potential cost of balancing gas.

Transit is open to all potential clients for the entry points Budince, Hermanovychy, Beregdaroc and the exit point Budince based on the signed agreement between UTG and the Polish TSO (Gas System S.A.), the Slovak TSO (Eustream) and the Hungarian TSO (FGSZ ltd). Other entry and exit points on cross-border pipelines are used for the existing transit agreement between Gazprom and Naftogaz until the expiry of this transit agreement on 1 January 2020.

UTG allocates free capacities at the entry and exit points according to the following three categories:

- *Guaranteed capacity* (the operator guarantees a pre-defined capacity for a pre-defined period set out in a Capacity Allocation Agreement)
- *Intermittent capacity* (the operator may allocate, but does not guarantee, a pre-defined capacity for a pre-defined period)
- *Reverse capacity* (flows transited through Ukraine and subsequently reimported from neighbouring countries)

TPA to physical interstate entry/exit point capacity is only permitted if:

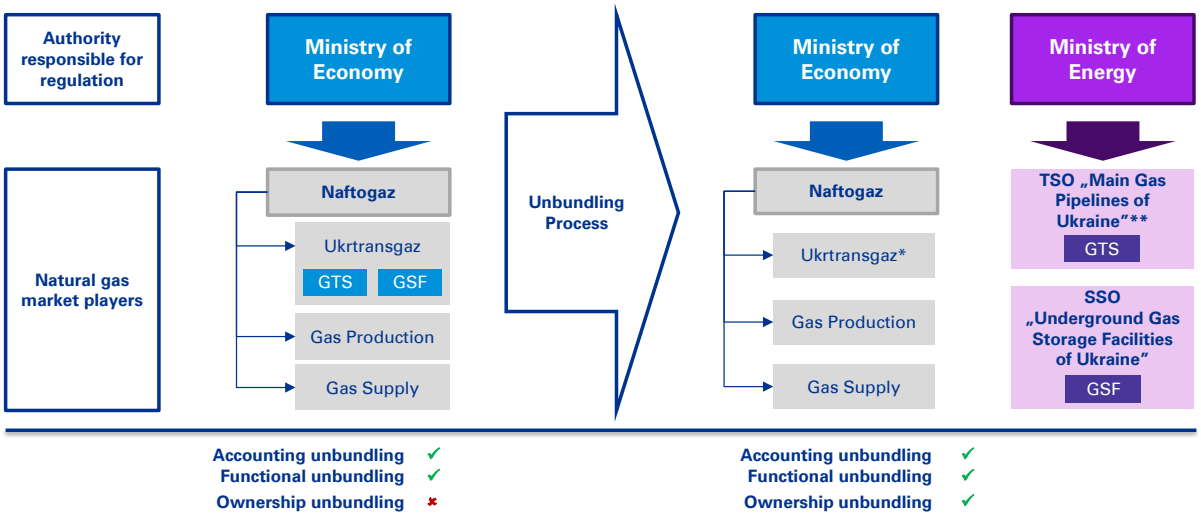
- Capacity provided on a yearly basis does not exceed 90% of the entry/exit point's technical capacity
- At least 10% of technical capacity is available at any point for quarterly periods during a gas year

- Any unsold balances that were not sold for yearly and quarterly periods are available for monthly periods at least one day in advance

Application materials, deadlines and fees are published on the TSO's (JSC Ukrtransgaz) official website.

4.4 Unbundling

Map of the planned unbundling process



Source: Naftogaz Unbundling Plan Adopted (Vitaliy Rachenko), CMS – Law Now – Ukraine (2016), Available at: http://www.cms-lawnow.com/ealerts/2016/07/ukraine-naftogaz-unbundling-plan-adopted

On 1 July 2016 the Government of Ukraine approved a plan in line with the regulations of the 2016 Law of Ukraine "On the Natural Gas Market" setting out the corporate restructuring of Naftogaz. The plan is the result of cooperation between Ukraine's government and the Energy Community, ensuring that the unbundling process is fully compliant with the Energy Community's regulatory requirements and the EU's third energy package. Accounting unbundling and functional unbundling is already a reality, and ownership unbundling is the final step towards full compliance with the energy community and EU regulations.

The currently state-owned Naftogaz and its subsidiaries have a monopoly on the Ukrainian market as an oil and natural gas producer, transmitter, as well as storage provider. The Government's unbundling plan requires that Ukraine's TSO (Ukrtransgaz) is legally and functionally independent of natural gas production and supply operations performed by its parent Naftogaz and any other subsidiary.

During the unbundling process, ownership unbundling will be performed to separate the GTS and the SSO from UTG and transfer their ownership to the state, under the management of the Ministry of Energy, creating two new public JSCs, "Main Gas Pipelines of Ukraine" and "Underground Gas Storage Facilities

of Ukraine". Naftogaz and its production and supply elements will remain under the Ministry of Economy and UTG is likely to be restructured and its assets privatised after unbundling and the settlement of disputes.

The planned deadlines of the UTG unbundling process were originally structured as follows:

- The two new public TSO and Supply System Operator (SSO) were planned to be incorporated on 1 October 2016. An action plan to transfer assets from UTG to the new TSO and SSO was also planned to be adopted at that time, along with plans laying down the control of these new companies by the Ministry of Energy and other state bodies.

- On 1 November 2016 an amendment was planned to be made to the Gas Market Law regarding the transmission assets not previously subject to privatisation.

- On 1 July 2017 an analysis of the gas storage facilities in terms of development and effective use in the future was planned. The process was to be finalised on 1 August 2017, while the resolution on transferring the GSFs to the public JSC "Underground Gas Storage Facilities of Ukraine" was to be adopted on the same day as well.

Carrying out the planned gradual unbundling changes of the Ukrainian natural gas market is delayed due to political tensions in Ukraine between UTG and Naftogaz and the related ministries.

In addition, further moves are dependent on the two arbitration cases on the supply contract and the transit contract, both dated January 2009, between Naftogaz and Gazprom in Stockholm. The arbitral rulings are expected by mid-2017.

The transfer of assets from UTG may take place as early as 30 days after the effective date of the settlement of the Naftogaz-Gazprom arbitration cases.

Within 60 days of the arbitration taking effect, the public JSC "Main Gas Pipelines of Ukraine" will apply for a TSO license at the relevant regulatory authority.

The first moves of the Naftogaz unbundling process started in mid-September 2016, which means Naftogaz no longer has control over its subsidiary, UTG, thereby meeting the country's commitment to the European Union's Third Energy Package.

Nevertheless, there are numerous concerns arising from the unbundling process, one of which is the question of the controlling institution. Instead of the Ministry of Energy, the Ministry of Economy took control over the TSO UTG,

which is operated by the National Joint Stock Company Naftogaz. The Energy Community's regulatory requirements and the EU's Third Energy Package were therefore not complied with exactly.

The unbundling of the Ukrainian natural gas market needs to take place to comply with the EU's Third Energy Package, but there are currently delays.

4.5 Entry and exit point tariffs

The transportation tariffs are determined by the **National Regulatory Authority (NERC)**[10], which is a governmental agency responsible for the energy and utilities sector. The tariffs are set on a yearly basis according to the methodology approved by NERC in its resolution *"On approval of the methodology on the definition and calculation of the natural gas transportation tariffs at the different entry and exit points of the transmission system"*[11].

Entry and exit tariffs are determined and published on a yearly basis by the regulator based on the evaluation of the licensees (currently only the Ukrainian TSO Ukrtransgaz) and key indicators, which are submitted to the regulator twice a year. These indicators are the following:

- Depreciation of assets *(based on their value as of 30 June 2014)*
- Forecasted flows of natural gas transit and imports
- Level of operational and material costs and losses;
- Price of natural gas for technical purposes
- Inflation rate

The Regulator applies the following formulas to determine the entry and exit tariffs:

$$\text{Entry point tariff} = \frac{\left(\text{Forecasted annual required transportation revenue} - \text{Forecasted annual rent payment for transit} - \text{Not refunded VAT}\right) X1000}{\text{Forecasted annual booked capacity on the entry points}} X \text{ Coefficient of the TSO's operational costs of distribution}$$

(1) Entry point tariffs are the same for each entry point.

$$\text{Exit point tariff} = \frac{\text{Specific tariff for transportation of natural gas via cross-border pipelines} \times \text{Sum of the projected turnover for the i-th route in the given year (1000 m}^3\text{/100 km/y)}}{\text{Forecasted annual booked capacity on the entry point}}$$

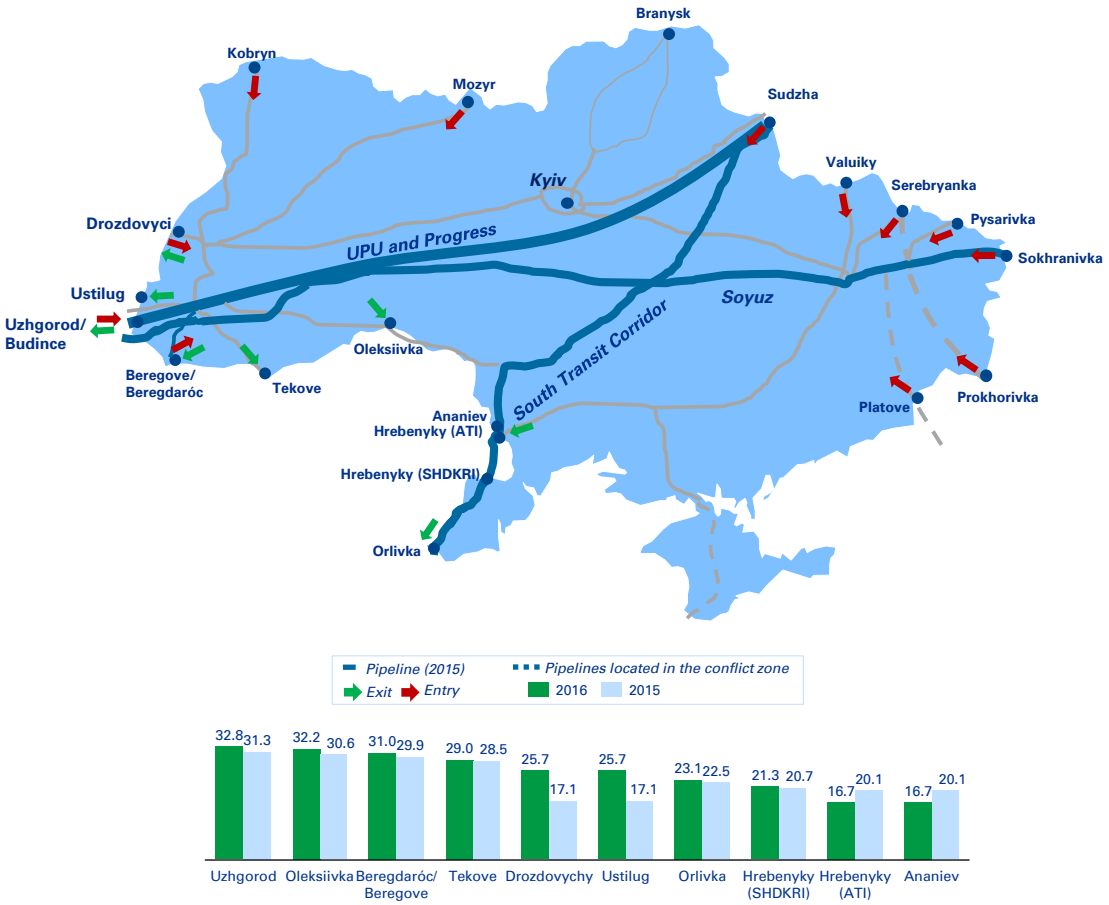
(2) Exit point tariffs are different from point to point.

Source: KPMG summary based on Ukrtransgaz natural gas transportation tariffs, Naftogaz 2016, Zakon3 Rada: law on tariffs № 243 valid from 22.04.2015; Law issued by National Energy and Utilities Regulatory Commission of Ukraine dated 12.29.2015 №3159.

Transit system entry tariffs are set uniformly at 12.5 USD per 1 000 m^3 (including 20% VAT) rate.

10 – National Regulatory Authority (NERC), official web-page available at: http://www.nerc.gov.ua/
11 – Resolution "On approval of the methodology on the definition and calculation of the natural gas transportation tariffs at the different entry and exit points of the transmission system"; Accepted on: 30.09.2015; Valid from: 26.11.2015 – Available at: http://zakon5.rada.gov.ua/laws/show/z1388-15

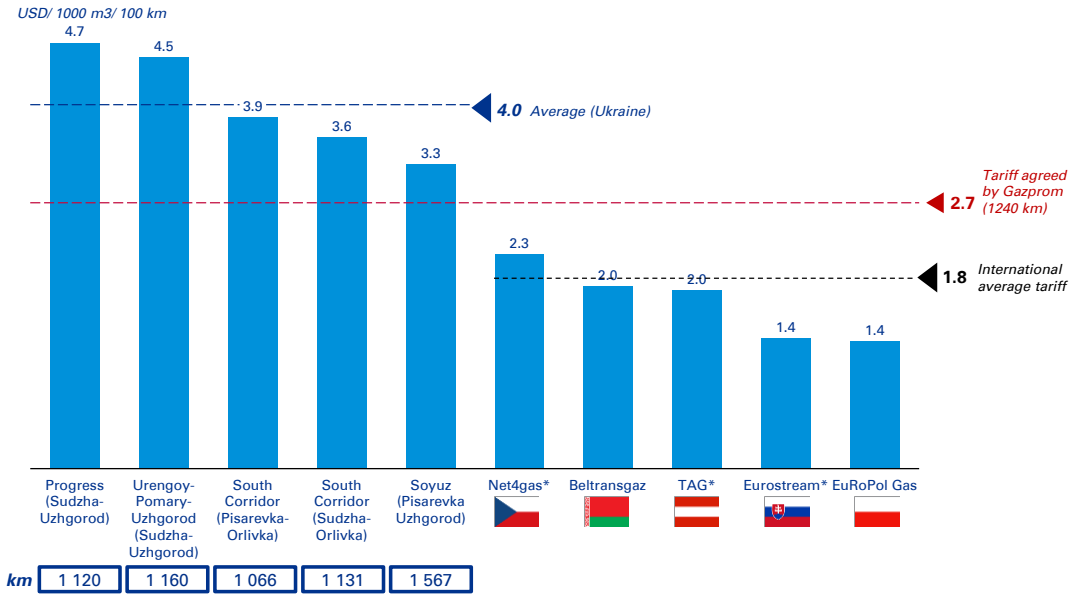
Transmission system entry and exit tariffs in 2015 and 2016 (USD/1000 m3)



Source: KPMG summary based on Ukrtransgaz natural gas transportation tariffs (2016), Available at: http://utg.ua/utg/business-info/price-tariffs.html

Compared to 2015, entry/exit-point based natural gas transportation tariffs increased by almost 7% in 2016.

Transit tariffs for the main transit lines in Ukraine and in the EU (USD per 1000 m³ per 100 km)



** - Data available only for 2012.*

Source: KPMG estimation based on Report on the evaluation of assets, BT (2012; Ukrtransgaz natural gas transportation tariffs (2016), Available at: http://utg.ua/utg/business-info/price-tariffs.html; Expert interview, Law of Ukraine on Pipeline Transport (1996), NERC regulation of natural gas transit tariffs (2016)

Methodology:

KPMG estimated the possible infrastructure utilisation transit fee for the specified transit pipelines based on the sum of the entry and exit tariffs stated in the legislation published by NERC in 2016 (See the following graph: "Transmission system entry and exit tariffs in 2015 and 2016 (USD/1000 m³)") and length of the pipelines published by Ukrtransgaz on its web page (Available at: http://utg.ua/utg/gts/description.html)

The compressor gas component of the new possible transit tariff was estimated based on the fee for the compressor gas component published in the Oxford Study – 262.6 USD/mcm (Available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/02/Russian-Gas-Transit-Across-Ukraine-Post-2019-NG-105.pdf p.17.) and based on the 2.1% and 2.7% of the estimated throughput on the given transit pipelines.

2.7% of throughput was considered in case of UPU, Soyuz, Progress, while 2.1% was considered in case of the Southern way (Available at: Ukrtransgaz natural gas transportation tariffs (2016), Available at: http://utg.ua/utg/business-info/price-tariffs.html)

Transmission tariffs were calculated based on the newly established entry/exit tariff for the main transit pipelines: Progress, UPU, South Corridor and Soyuz.

In 2016 there was a modification to the regulation on the entry/exit tariffs (they increased by almost 7% between 2015 and 2016), based on which the average transit tariff should be around 4 USD per 1 000 m³ per 100 km. This is significantly higher (by 1.3 USD per 1 000 m³ per 100 km) than the current tariff agreed by Gazprom and Naftogaz (2.7 USD per 1 000 m³ per 100 km) in the transit agreement, which is valid until 2020. The newly set Ukrainian tariffs are also significantly higher than the international benchmark (by approximately 2.2 USD per 1 000 m³ per 100 km).

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