

## Shale Gas in Ukraine

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### Recent developments in shale gas production in Ukraine

Since the beginning of 2009, when Ukraine signed a new gas contract agreement with the Russian Federation in Kharkov which fixed the price of imported gas at EU levels, the country has been actively exploring other options of energy supply. Shale gas was considered to be a serious and feasible option.

In 2013 Ukraine signed two production-sharing agreements (PSA) to explore and extract hydrocarbons in a “tight” gas fields in eastern and western parts of the country. The deals make Ukraine one of the few European countries to be pressing ahead with significant shale gas development, which has been held up in other countries by environmental concerns over the hydraulic “fracking” used to produce the fuel. Two major worldwide producers - Royal Dutch Shell and Chevron – estimate that due to these projects by 2020 Ukraine will become self-sufficient in gas.

### Shale gas deposits

Ukraine has significant gas reserves in shale formations and in consolidated rocks. According to the State Commission of Ukraine on Mineral Resources, shale gas resources are estimated at 7 trillion cubic meters (cm). At the same time, the Energy Information Administration assessed technically recoverable shale gas reserves at 3.6 trillion cm (1.75% of world shale gas reserves). The EIA world shale gas resources estimates were updated in June 2013. Ukraine’s initial shale gas estimates, made in April 2011, stood at 1.2 trillion cm.

There are two major deposits of shale rocks in Ukraine, where an extraction of shale gas is possible (*see Annex*). Lviv-Lublin basin on the west (reserves are estimated at 1.47 trillion cm) and the Dnipro-Donets basin on the east (reserves are estimated 2.15 trillion cm).

### Potential Production

Two on-going shale gas projects could provide Ukraine with an additional 11 to 16 billion cm of gas in five years' time. The start of commercial gas extraction may start in 2015-2022.<sup>1</sup> Annual extraction volumes may constitute 3-5 billion cm for Olesska field (see Annex 13 for more details) and 8-10 billion cm for Yuzivska field.

### Costs

#### Initial investments

According to Energy and Fuel Minister, total investments into development of Yuzivska and Olesska fields are estimated at USD 50 billion and USD 30 billion respectively. Shell’s first stage investment commitment is USD 200 million. Chevron’s exploration works in Olesska field are estimated at USD 350 million.

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<sup>1</sup> The Ministry of Energy and Coal Industry of Ukraine expects the start of shale gas extraction in 2015. This assumption is based on the study of the international company INS CERA, executed for the Ministry. According KPMG study, the start of extraction may be in 6-7 years (2018-2019). At the same time, Baker Tilly experts believe that the start of commercial shale gas production will start not earlier than in 2022.

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### **Projected production cost**

According to Baker Tilly estimates, based on comparative analysis of shale gas extraction in areas with comparable characteristics, the projected cost of shale gas in Ukraine equals USD 260-350 per 1,000 cm. Likely due to exclusion of investments on exploration and construction of infrastructure, the cost of production is estimated to be in the range of USD 100-150 per 1,000 cm (Apostolaka, 2013).

### **Environmental concerns and costs**

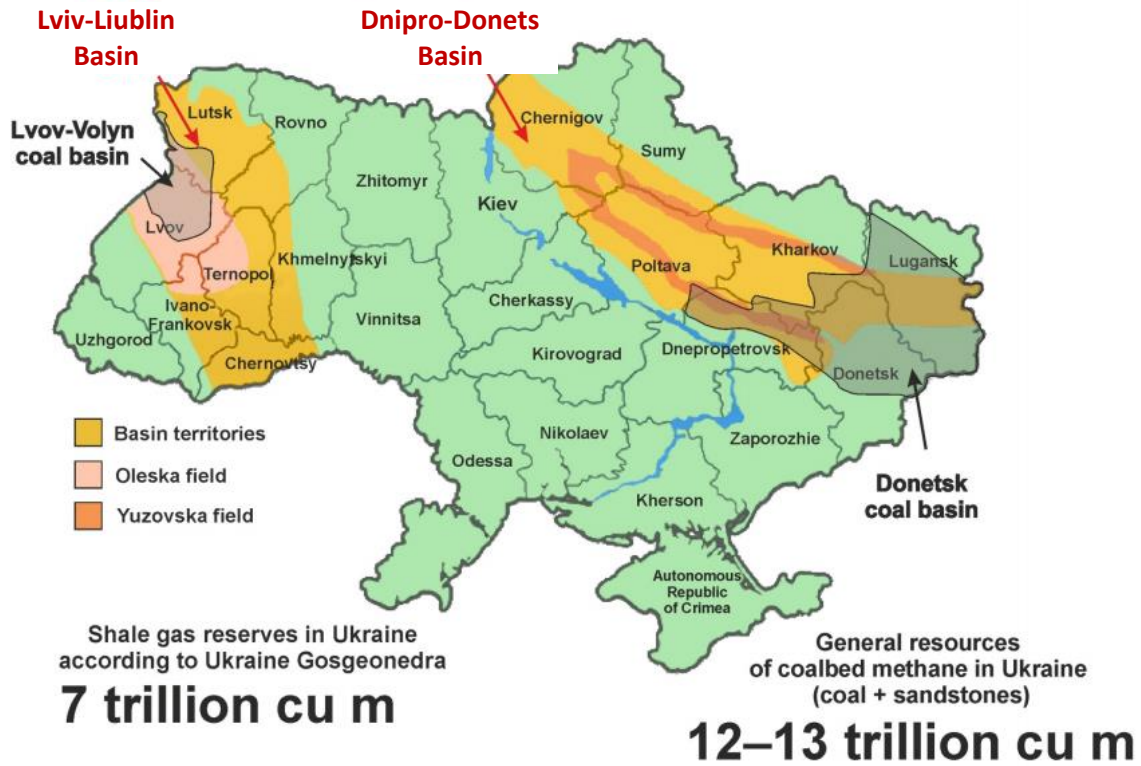
There are a number of environmental issues that raise concerns over the ecological consequences of the fracking process. In a long run the existing concerns might add significantly into the running costs of the shale gas companies.

1. Water availability for other uses. The drilling and fracturing of wells requires large amounts of water. In some areas (e.g. Lviv region, which is known for water supply shortages, including the city of Lviv) significant use of water for shale gas production may affect the availability of water for other uses.
2. Wastewater. During the drilling and fracturing, large amount of wastewater, which may contain dissolved chemicals and other contaminants, is produced. It requires special treatment before recycling or reuse. In case of leakages, it may cause contamination of groundwater.
3. Failure to deal with the chemicals.
4. Air pollution. Air pollution occurs from leaking methane and the use of heavy machinery (diesel-powered rigs and trucks) for drilling.
5. Unwanted seismic activity. It is known that pumping fluids into or out of the Earth has the potential for inducing seismic events. A series of small seismic events in Arkansas, Ohio, Oklahoma and Texas in the US over the past several years raised concerns they may be linked to shale gas production in these regions. In 2011, two earthquakes were felt in the Blackpool area, UK. They were suspected to be linked to hydraulic fracturing at the Preese Hall (UK), which caused a temporary ban on shale gas extraction in Great Britain.

Some existing estimates suggest that clean-up costs associated with fracking accidents in the US would be around USD 250 million. However, the estimate for Ukraine is absent.

Annex 1

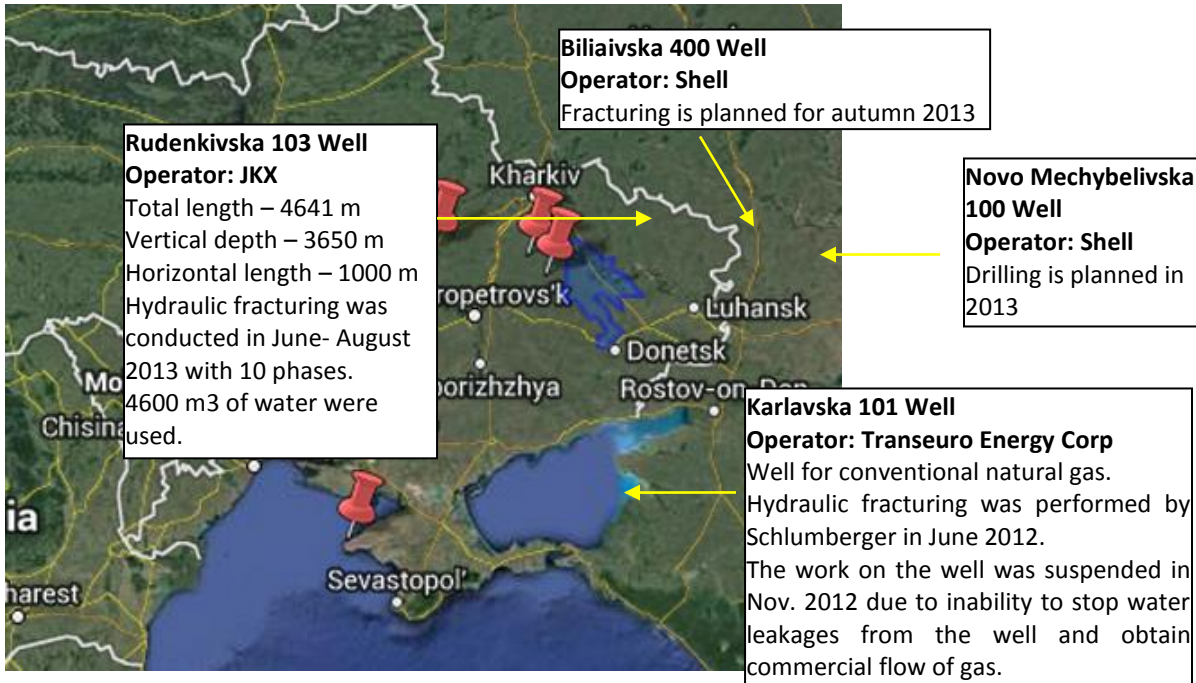
Shale Gas Basins in Ukraine



Source: Rudko, G. and Lovyniukov, V.I., 2013. 'State Classification of Mineral Resources and Reserves of Ukraine as an Evaluation Instrument of Investment Proposals on Energy Resources.' Black Sea and Caspian Sea Energy Conference

Annex 2

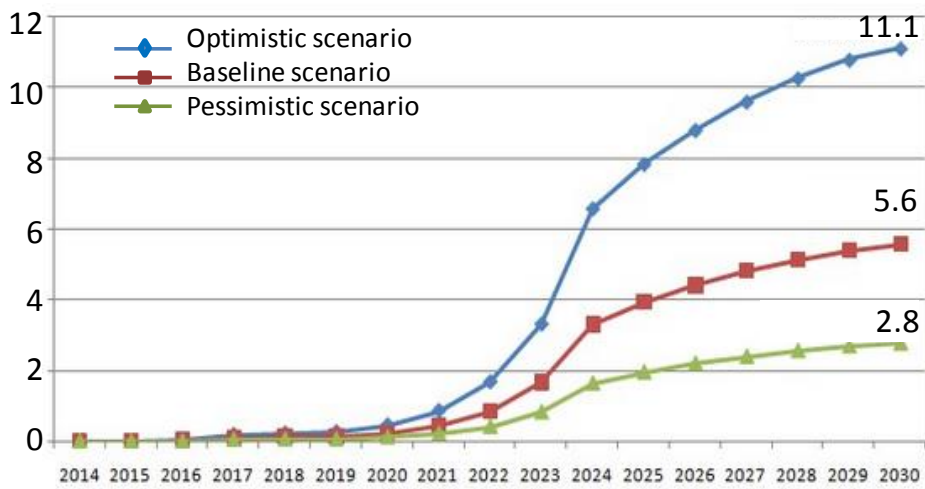
The Map of Wells in Ukraine with Planned or Carried Out Hydraulic Fracturing



Source: Shale Gas Project in Ukraine

### Annex 3

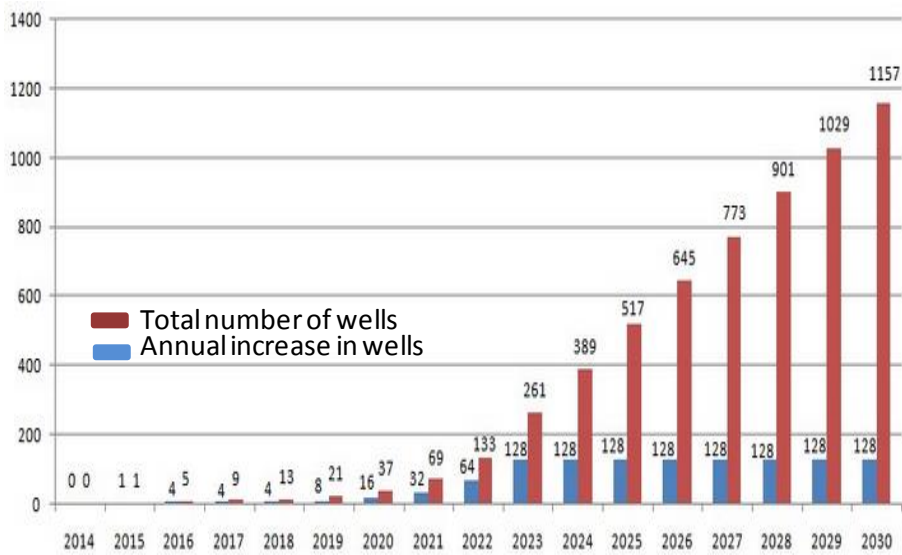
#### Olesska Field Shale Gas Production Forecast



Note: To reach specified production volumes about 1000 wells should be drilled and around 200 well pads with the area from 1 to 3 ha each should be constructed. Commercial shale gas extraction is expected to commence in 2019. It is assumed that each well is exploited for 7 years, producing from 22 to 88 million cm of gas. About half of all shale gas produced by each well will be extracted during the first year of its operation with declining production rate thereafter, which will constitute only about 10% of initial production at the end of 7<sup>th</sup> year.

Source: Shale Gas Project in Ukraine

#### Projected Number of Wells at Olesska field



Source: Shale Gas Project in Ukraine

