

# Risk minimisation under UGSS expansion to Russia's East

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**Emergence of new risks attributable to the global financial crisis brings new challenges to the gas sector future in Russia while maintaining all current risks. In such conditions, analysis of risks involved in optimum solutions appears critical for better choice of gas strategy along with production and financial programme. The author focuses on key aspects of strategic solution risk analysis and its results ensuring sustainable gas industry development performance under internal and external uncertainties.**  
*Index Terms* – risk minimisation, gas sector development, energy system, Eastern vector.

## I. INTRODUCTION

The Russian Energy Strategy to 2030 (ES-30) approved by the government on 27 August 2009 assumes the following targets for gas sector development strategy:

- Meeting domestic and international gas market demand in sustainable, uninterrupted, and economically viable ways.
- Development of the Unified Gas Supply System (UGSS) and its expansion to Russia's East.
- On this basis: enhanced regional integration within Russia.
- Improvements with gas sector management structure, aiming to:
  - enhance gas sector performance and achieve gas market liberalisation;
  - ensure sustainable government revenues for Russia's consolidated budget.

To achieve these goals, Russian gas annual output would have to grow from 698 Bcm in 2008 to 840–884 Bcm by 2030 (as follows from ERI RAS gas outlook).

However, it is believed only possible to offset production declines at maturing mega-fields in West Siberia and to sustain the overall target

production growth when a comprehensive programme for bringing new fields on stream and construction of new pipelines, gas storage, and processing facilities is in place.

The gas sector is facing numerous challenges involved in sustainable support to Russian economic recovery and filling gas export needs, thereby calling for significant effort aimed at progressive gas development and raising huge investment. Over 2009–2030, cumulative investments for the gas sector are assessed under ES-30 at \$565–590 billion.

In this connection, the development of effective gas production and financing programme justifying the sector's key strategic targets is viewed now as one of the key national projects.

## II. ASSESSMENT OF GAS DEVELOPMENT RISKS WHEN DRAFTING FUTURE PRODUCTION AND FINANCING PROGRAMMES

In 2009, the global crisis severely hit the sustainable development of the Russia's gas sector. Falling gas demand and lower prices, domestically and in the international markets, brought significant adjustments to gas development targets and expectations. Existing gas development risks are maintained and getting more worse, and new risks emerge such as:

- Falling production at major fields in Nadym-Pur-Tazov area of Tyumen region calls for bringing on production the progressively costly gas resources as those are deeper plays away from major gas infrastructure.
- Great uncertainty exists about assessment of future global gas prices. Significant disparity exists between various assessments of oil prices and energy demand by leading global agencies (International Energy Agency, US Energy Department, and others), ranging \$23–200/bbl. Due to oil indexation, gas prices also tend to significantly vary.
- Slowing down liberalisation of the domestic gas market, along with constraints for development of a competitive market segment.

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- Impaired balance of interests between gas producers and consumers, in terms of gas demand lagging behind the expected growth profiles for both the domestic and foreign markets (even falling short of contracted gas offtakes).
- Build-up of spare gas production capacity and stranded investments.
- Emergence of gas shortage in the domestic market due to higher demand against earlier expectations attributable to limited success with energy-saving measures and technologies, and to gas displacement by other energy types.
- Higher inertia involved in the gas sector prohibits fast-track capacity expansion and changing capacity mix.
- Protracted low gas price environment affects investment opportunities and prospects for largely capital-intensive gas projects.
- Curtailed opportunities for raising external funding to invest into the domestic gas sector – expected to hit new cost-intensive gas projects.
- Expansion of projects for new, and cheaper, gas targeting Western Europe – from Northern Europe, Africa, Middle East, the Caucasus, and Central Asia – tends to drive excessive supply and lower gas prices.
- Emergence of threats to Russian gas competitiveness in export markets.

### III. TOOLS FOR GAS SECTOR DEVELOPMENT AND INVESTMENT PROGRAMME

ERI RAS is coming with its proprietary linear optimisation simulator for the gas industry (hereinafter OmoGas). It was designed for timely choice, under shifts in external development drivers (gas demand and prices), of gas investment strategy and for building gas production and transportation grid development profiles under which:

- domestic gas demand and export commitments will be met;
- all sectoral financial liabilities against lenders, governments, and shareholders will be assumed;

- gas sector financial stability and investor attractiveness will be maintained.

The initial setup for building an optimum production/financial gas sector development programme assumes maximisation – under preset gas demand and prices across 26 Russia's regions and export routes to European and Asian markets – of net present value (NPV) in this sector over the entire time frame under study, provided all production technology and an input set of criteria-related constraints are met.

The model-driven estimates appear essentially adequate to describe Gazprom's and independents' production and financial aspects, along with their development vectors under long-term future interactions, as well as operating conditions in external and domestic gas markets, with adjustments for gas imports and transport services.

Structurally, OmoGas comprises:

- Production Module – to describe technology and resource-driven constraints, dynamic and technology-related links across the key activity areas of gas companies.
- Financial Module – to model financial flows, indicate dynamics of revenues, expenses, financial flow-sheet, gas sector assets, equity and borrowed funds. All ingredients of financial balance comprise model variables and are immediately recalculated under changing performance of and prices for pipelined gas and LNG.
- Ranking Module – indicates implications of production/financial decisions for asset profitability, own funds, investments, financial stability, with quantified company asset value and investment attractiveness. The critical ranking levels constitute constraints in this module as the gas company would likely go bankrupt beyond these levels. This module plays a role of a criterion-level requirement.

This model is getting progressively more complex as it is reflective of ongoing changes in the gas sector and its business [1, 2]. For example, a LNG Module was added to the model to analyse future development prospects for LNG; similarly, the Gas Processing Module applies. The Financial Module was supplemented by respective assessments.

At present, OmoGas makes provisions for the following gas company activity areas: gas reserves preparation; gas and condensate production; LNG production; gas and condensate processing; pipelined and LNG transmission and shipments (along with condensate and gas products transportation); gas, condensate, and

gas-derived product sales – domestically and internationally; gas acquisition in Russia and in foreign markets; financial support to gas company activity. The model outline and its outputs are shown in Fig. 1.

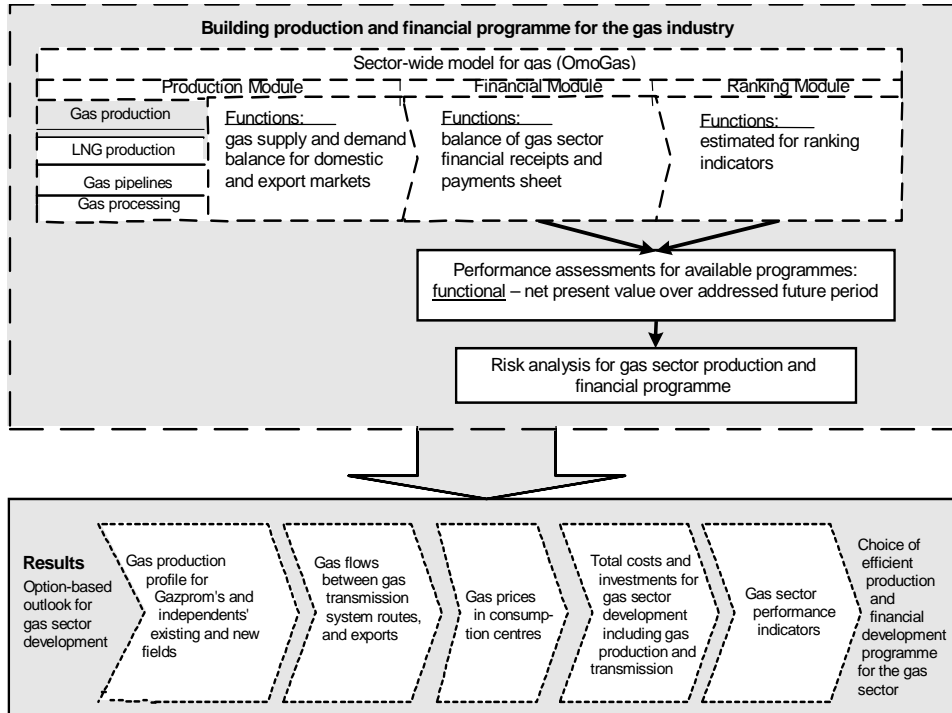


Fig. 1. Production/financial programme for the Russian gas sector: composition and performance assessment

Combined (within a single model) addressing all gas industry production and financial opportunities – as well as internal and external drivers for implementation performance – is expected to ensure comprehensive optimisation of production and financial development programmes with a choice of technologically and economically viable development options for: production, liquefaction, processing, and transportation of pipelined gas and LNG, along with condensate production and processing as well as gas sector financial status estimates.

#### IV. BRIEF OVERVIEW OF GAS SECTOR PRODUCTION AND ECONOMIC DEVELOPMENT PROGRAMMES UNDER OMOGAS

OmoGas enables to adjust gas sector outlooks based on assessments of external development drivers by 209 yearend, such as sector recov-

ery rate or domestic and global oil and gas price profiles.

The estimates assumed crisis-adjusted Moderate and Innovations-driven Options for Russian social and economic development [3, 4, 5]. This updated Innovations Option envisages reversing the declines and achieving GDP initial gains as early as 2010, followed by progressive growth, by 2015, to economy recovery rates (rather than levels) which comply with the Concept for Long-term Social and Economic Development of the Russian Federation approved by the government in November 2008.

These estimates within the gas sector production and investment development programme make provisions for financial challenges in 2009 and 2010 (initial post-crisis years) due to additional money inflow constraints, govern-

ment-controlled domestic gas prices, and price growth rates insufficient to sustain gas company revenues. Financial source shortage leads to delays with Bovanenko field (in Yamal Peninsula) start-up, to 2015 in the Moderate and to 2014 in the Innovations Option. Accordingly, construction of Yamal – Ukhta pipeline would be also delayed. In addition, 2015 can be expected a new target year for bringing on stream another development area – Ob and Tazov Bays. Among major projects in Tyumen region, 2015 stands for a plateau production year for South Russkoye field and entry of new areas in Yurkharovskoye field, as well as ramping up associate gas output attributable to its utilisation rate rising to 95%.

In the European part of Russia, the Innovations-driven Option envisages placing Shtokman field on production in 2015 at the earliest, while the Moderate Option assumes its feasibility well after 2015. A Caspian offshore project is expected to be launched, with priority commissioning for Yuri Korchagin field, followed by other fields awaiting production by 2015, with 14–20 Bcm cumulative output.

In the Russian Far East, only ramping up existing production is expected prior to 2015 in Sakhalin Island area, along with bringing a LNG plant (under Sakhalin-2 project) to design capacity of 13.6 Bcm.

After 2015, all new projects are expected to be given a boost, otherwise it would be unlikely possible to offset gas production declines at maturing fields and add cumulative volumes countrywide. In Yamal's Bovanenko field, current plans calls for boosting gas output to 140 Bcm and bringing onstream Kharasavey field (up to 32 Bcm capacity). The Innovations Option envisages Kruzenshtern field development and emergence of a new gas production region in Ob and Tazov Bays area, along with bringing online new fields in Bolshekhetsky Depression in Yamal-Nenets District and fields in the Caspian offshore. The Shtokman project assumes a LNG plant (given the changes in onstream dates for Shtokman).

The Rational Gas Option assumes emergence, after 2020, of a major gas production centre

based on resources in Irkutsk region, expansion of Yurubcheno-Tokhomsk oil and gas zone in Krasnoyarsk Krai, and initiation of CBM production in Kuznetsk basin. This is expected to boost gas output in East Siberia to 34 and 47 Bcm by 2030 in the Moderate and Innovations Options, respectively.

For the Russian Far East, the programme calls for continued expansion of Sakhalin gas output, through incremental production for existing offshore projects in the Sea of Okhotsk and launching new ones, as well as adding new LNG capacity. A principally new underlying base for gas is expected for Sakha Republic (Yakutia) where the commissioning of Chayandinskoye field after 2015 would be only viable if helium utilisation capacity is made available. When addressing gas exports of the Far Eastern gas to China, we can consider potential production growth to 76–84 Bcm there by 2030.

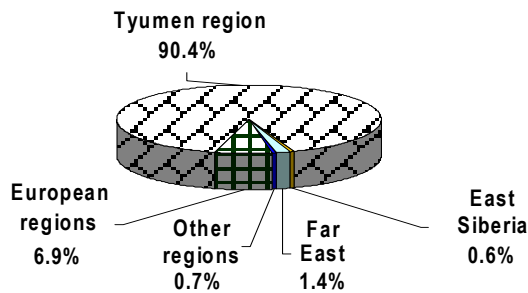
As a result of these expected shifts, the share of Tyumen region in Russian-wide gas output would likely fall from 90.4% in 2008 to 70%, of which 20% will probably come from new gas regions in Tyumen, while the share of eastern regions rising from 2% in 2008 to 14–15% in 2030 (Fig. 2).

Such changes in the gas sector resource base lead to a new phase in gas production – falling share of methane reserves placing greater emphasis on multicomponent formation mixture in available reserves and development of fields with higher C<sub>2</sub>–C<sub>4</sub> and helium content.

Matching development time-frames between field development and building new capacity for liquids processing and C<sub>2</sub>–C<sub>4</sub> recovery from gas, along with transport opportunities, should be a priority for bringing new reserves on stream. In particular, this applies to fields in the country's East featuring higher (or even unique) helium content.

Wider gas processing management is expected to help avoid losses of valuable feedstock, but also to boost the overall performance of gas field development

2008.



2030

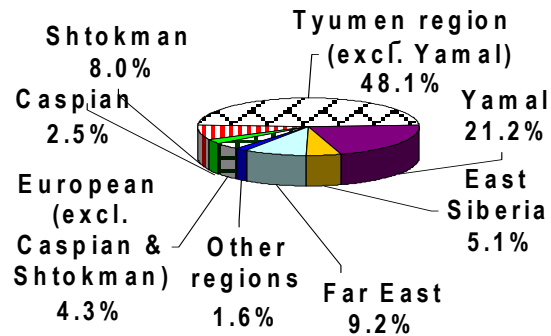


Fig. 2. Changing volumes and regional mix for gas production in Russia

The gas sector activity programme incorporates a significant gas transportation component. The largest construction projects – a multiple-loop pipeline system running from Bovanenko field to Ukhta, to be followed by Yamal gas flow distribution between existing and new pipelines to Gryazovets, Torzhok, and Cheboksary – are expected to help meet gas demand in the central Russia and to fill export needs.

The following construction projects are targeted to diversify Russian exports to Europe:

- North European gas pipeline (Nord Stream). Its first loop is expected online in 2011 to deliver 27 Bcm/y. The second loop targets boosting its capacity to 55 Bcm.
- The South Stream pipeline rated at 30 Bcm is targeting southern Europe. In our optimisation estimates regarding gas sector development, in the Moderate Option, a solution was found when the Nord Stream first phase start-up year was shifted to 2015, and that for the South Stream – to 2025, under 30 Bcm capacity. The Innovations Option featuring more favourable external conditions maintains the target year (2011) for Nord Stream first loop to be brought online. The South Stream could be likely started in 2020.

To bring Shtokman gas to the UGSS, a pipeline from the coastal Teriberka to Volkhov is planned.

In Russia's eastern regions, Sakhalin – Khabarovsk – Vladivostok pipeline will be a priority as it focuses both on the domestic market (its first phase is targeted for 2011) and on exports (from 2013 on). A gasline from Chayandinsko-

ye field in Sakha (Yakutia) to Vladivostok is expected to be built between 2016 and 2020. In the longer term, this system will likely receive gas, for exports to Asia Pacific, from Kovykta field as well. As follows from gas balance estimates, the new pipeline system to the China's border needs to average 50–60 Bcm capacity.

Gas sector-wide, the total length of new major pipelines, for the Russia's European part alone, would likely average about 9,500 km, and that for its eastern regions – some 7,000 km. In addition, extensive efforts will be required to upgrade existing gas transmission systems.

Implementation of this expected programme is believed possible under gas sector investment flow rising from Rb666 billion in 2008 to Rb772–872 billion in 2015. In the longer term, this sector would likely additionally need Rb13.7–13.9 trillion (or \$537–545 billion). Nearly half of these funds needs to be routed for gas transmission expansion.

It should be noted that funding shortage over 2010–2015 in the Moderate Option is critical for project and investment time shifts in years to come. For the Innovations Option, the scope of investment over 2011–2015 is expected to be about 30% higher than in the Moderate Option, i.e. new funding would be likely adequate for earlier project time-frame expectations.

## V. PROGRAMME RISK ANALYSIS

This gas sector development production and financial programme comprises a date-stamped time series of facility funding and commissioning for projects which had been initially appro-

ved and cannot be terminated, over longer term, without significant loss – with no regard to possible additional information inputs in line with progressive industry development. Expected deviations of gas sector development from initial path entered into these estimates incur some risks which need to be identified and properly assessed by individual project parties (the state and private companies) along with investors involved in project funding.

One basic approach is central to several aspects of risk analysis for gas sector and individual company production/investment development programmes. The risk analysis for an chosen investment project aims to define potential loss probability on date of project completion under unfavourable conditions. However, such approach is believed unsuitable for assessment of sector development in one key aspect: there is no predefined "project life" for any summary to be made thereafter. The path of gas sector activity (or plurality of dynamics indicative of sector's financial status) should be focal for the risk analysis as a whole, over the longer term, and needs to exceed any assumed life-span of any individual investment project. When addressing company development management, absolute profits would rather stand as one of preconditions for sustainable development. Assessment of risks involved in company's lower market value, potential ranking loss and, finally, threat of bankruptcy appears to be a primary concern here.

The gas industry cannot be confined to risk analyses of individual projects – due to their high inertia involved, along with capital intensiveness and sharing common technologies (such as exploration, production, transportation, and marketing). One distinctive feature of this gas-specific risk analysis – unlike an investment project, such programme appears to be a "must do" application.

ERI RAS is coming with its risk analysis methodology targeting gas sector production and financial programmes over the entire implementation period. Its stages are shown in Fig. 3.

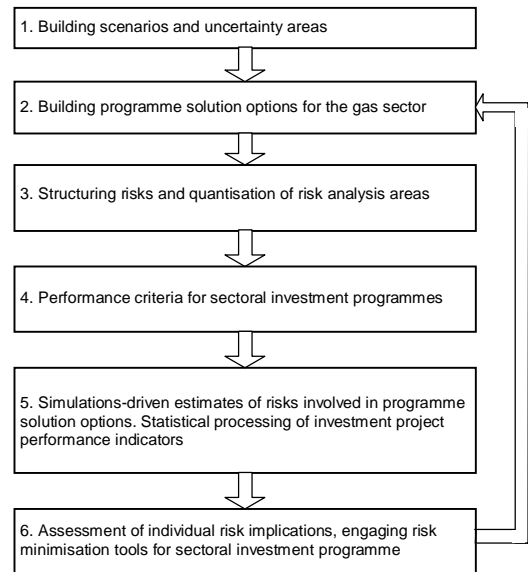


Fig. 3. Investment programme risk analysis stages

The underlying idea for risk analysis is built around simulations-driven experiments. This implies estimates over numerous simulation runs related to implementation of an investment programme under study. Inherently different outlooks for external factors involved in gas sector development are addressed as individual scenarios, while random variations in both internal and external drivers seen as simulations within a single scenario.

Under each simulations-driven experiment, validity of key financial stability criteria is checked by the system: scenarios against programme-based analysis of a particular option. The Monte Carlo method is central for management of all computations within this simulations framework [6, 7]. In a scenario, source data for each simulation run are built using a random number sensor operating within preset (by experts) ranges and risks. The simulation run is assumed successful if it is possible to model the investment programme's interrelations and criteria-driven conditions for each target year within the addressed time interval. Plurality of such simulations describes the diversity of possible investment programme futures which fit into experts' descriptions. The conclusions are driven by statistical processing of simulations data.

The next step in this simulations-driven modelling concerns the estimates relating to potential

implications of individual risks. With this in mind, the sector financial status estimates apply to the simplest case (when there are no control actions which enable the programme path to be altered depending on new information inputs – assumed unknown at present) using a deterministic scheme.

The optimum solutions produced for each random combination of risks, with respective gas sector programme performance, undergo statistical processing whereby feasible ranges, averages, and other data are defined for each sectoral performance item. Preferable strategies and their inherent risks are assessed based on quantitative analysis of gas sector functioning within the addressed time frame.

If, in a chosen simulation run, at least one of established investment programme criteria failed to be met at least in one year, this simulation is assumed unsuccessful. Risks are assessed from simulations as a ratio between unsuccessful runs and their total. The count of individual simulations is defined given a desired assessment accuracy.

Programmes with elevated (unjustifiably) levels of risks need to be rejected, but a minimum risk

programme would not be given a preferential treatment. For example, if risk minimisation appears associated with curtailed production, greater priorities should be likely attached to gas programmes with higher risks involved, but those avoiding production shut-ins. The final decision can be made after weighting programme performance against its inherent risks.

## VI. CONCLUSIONS

ERI RAS has conducted its risk analysis exercise for the following Russian gas industry development options: Moderate, Innovations, and Innovations plus greater Far East LNG. It is summarised in Table I.

The following conclusions can be drawn from this analysis:

- the Moderate Option poses the lowest common risks, but it is the worst case for net income;
- all risks involved in the higher LNG share would be under those for the Innovations Option;
- the Innovations Option with higher eastern LNG share is believed most attractive.

TABLE I. RUSSIAN GAS INDUSTRY STRATEGY RISKS

Risks \ Options	Moderate	Innovations	LNG capacity expansion
NPV	8.5%	8.5%	7.5%
Discounted dividends	4.4%	3.9%	3.4%
Net profits	14.7%	13.9%	12.1%
Capital leverage	10.4%	11.3%	10.9%
Credits	20.7%	24.2%	23.2%
Totals	21.3%	24.2%	23.5%

## 5. REFERENCES

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## 6. BIOGRAPHY

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