



Current State and Prospects of Coal-Bed Methane (CBM) Production in Russia

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Estimated CBM Resources in Russian Coal Basins

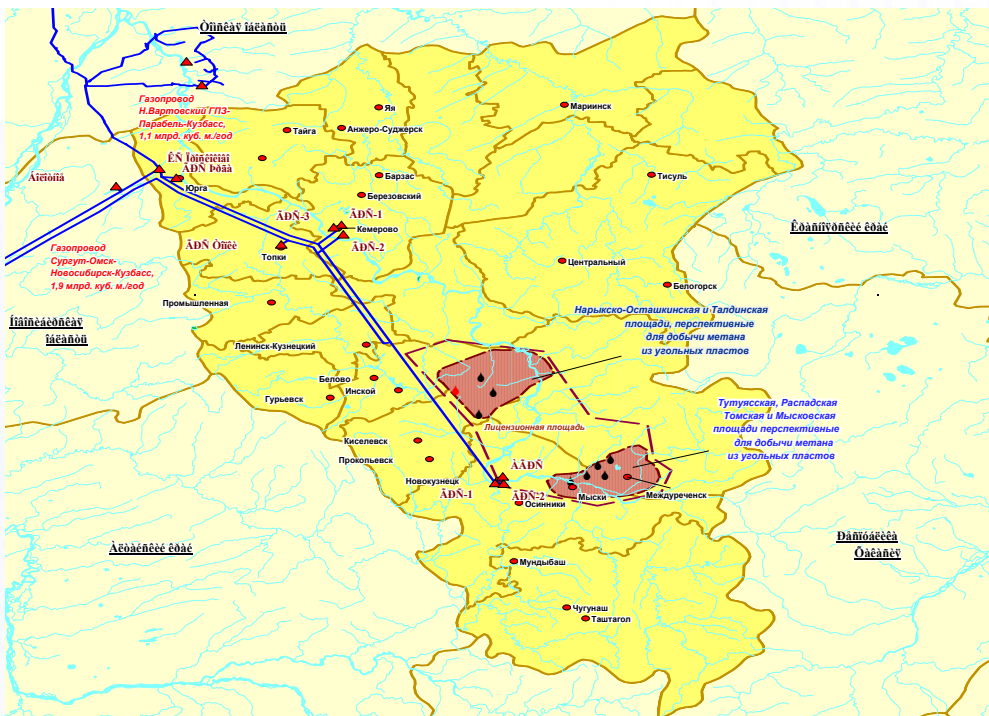


Basins, Fields	Resources, bln. cu. m.
Total	49051
Kuznetsk	13085
Pechorsky	1942
East Donetsk Basin	97
South- Yakut	920
Ziryansky	99
Tungusky	2000
Lensky	6000
Taimirsky	5500

Objectives of CBM Resource Development:

- to develop technologies to recover hydrocarbon resources from non-traditional and low permeability fields
- to decrease cost of recovering hydrocarbon resources

CBM Resources, Gas Market and Infrastructure in Kemerovo oblast



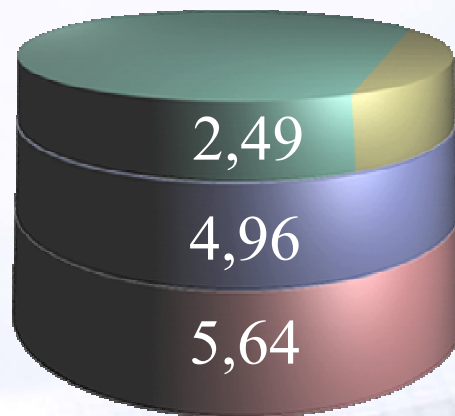
- 13 trln.m³ CBM resources up to the depth of 1800 m
- > 700 km gas main pipelines and branches, 1 compressor station, 12 gas distribution stations and distribution networks
- 6-9 bln. m³ per year gas demand in Kemerovo oblast and >15 bln. m³ - outside

trln. m³

600 м ---

1200 м ---

1800 м ---



0,21 trln. m³ within mine fields

GAZPROM CBM PROJECT

- 1998 : Agreements with Kemerovo Oblast
- 2001-2002 : Feasibility Study and Design
- 2003-2006 : Pilot Test Program
(construction of testing polygon and technology run)
- 2007 - ... : Commercial Production

GAZPROM CBM Project Developer

PROMGAZ – Gazprom Scientific-Research Centre

- 50-years experience of works in coal basins
- Technology of underground coal gasification: commercial use
- High-qualification staff
- Plant of gas equipment

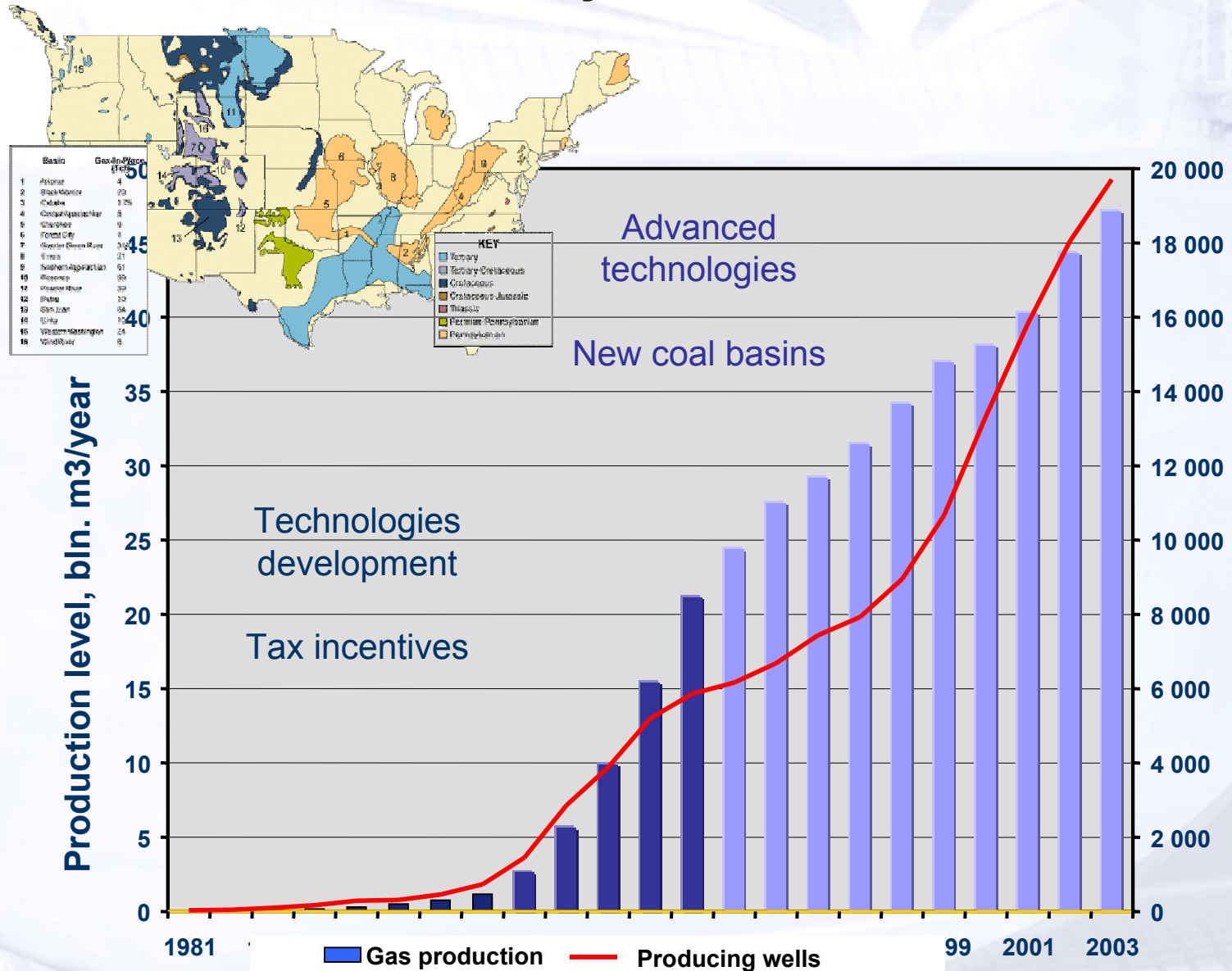
GAZPROM Feasibility Study: Background

- US Experience of CBM Production
- Collection, Analysis and Summarizing of Geological Data in Kuzbass
- World-wide Experience: Implementation of American CBM-recovery Technologies outside US

GAZPROM Feasibility Study: US Experience of CBM Production

- Analysis of geological conditions and production data of CBM wells in US (> 9800 wells)
- Study of advanced CBM-recovery technologies
- Organization of CBM industry
- Economics of CBM production (structure of capital investments and operation costs, price and tax rates, etc.)
- US Government Support

GAZPROM FS: Analysis of CBM Production in US



GAZPROM Feasibility Study: World-wide Experience

- Adjustment of US CBM-recovery to specific geological conditions around the world
- CBM production under specific conditions
- Results of pilot test projects and commercial production
- Government support

Commercial production:

Australia, Canada

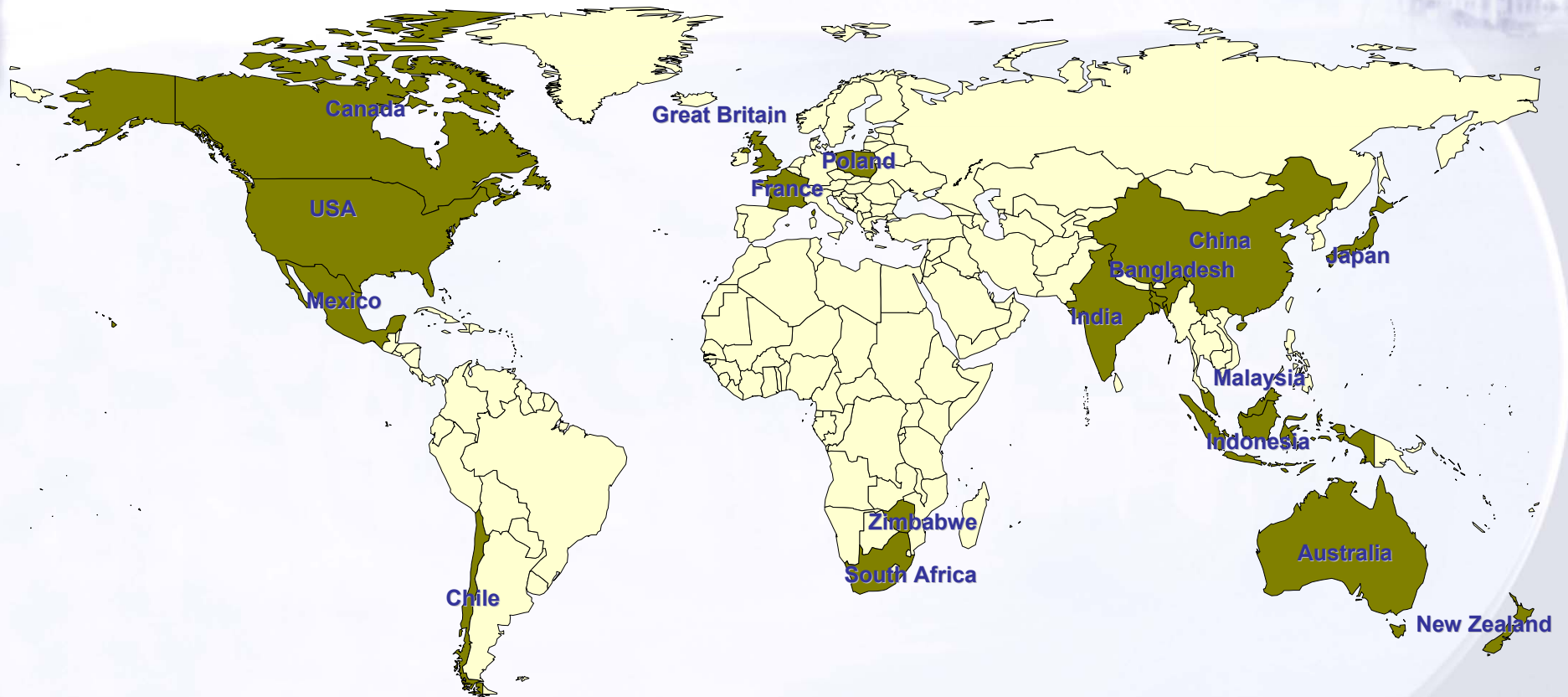
Pilot Test Projects:

China, Mexico

Underway Projects:

**France, Germany, Great Britain,
Chile, India, New Zealand, other
countries**

GAZPROM FS: International experience of CBM production

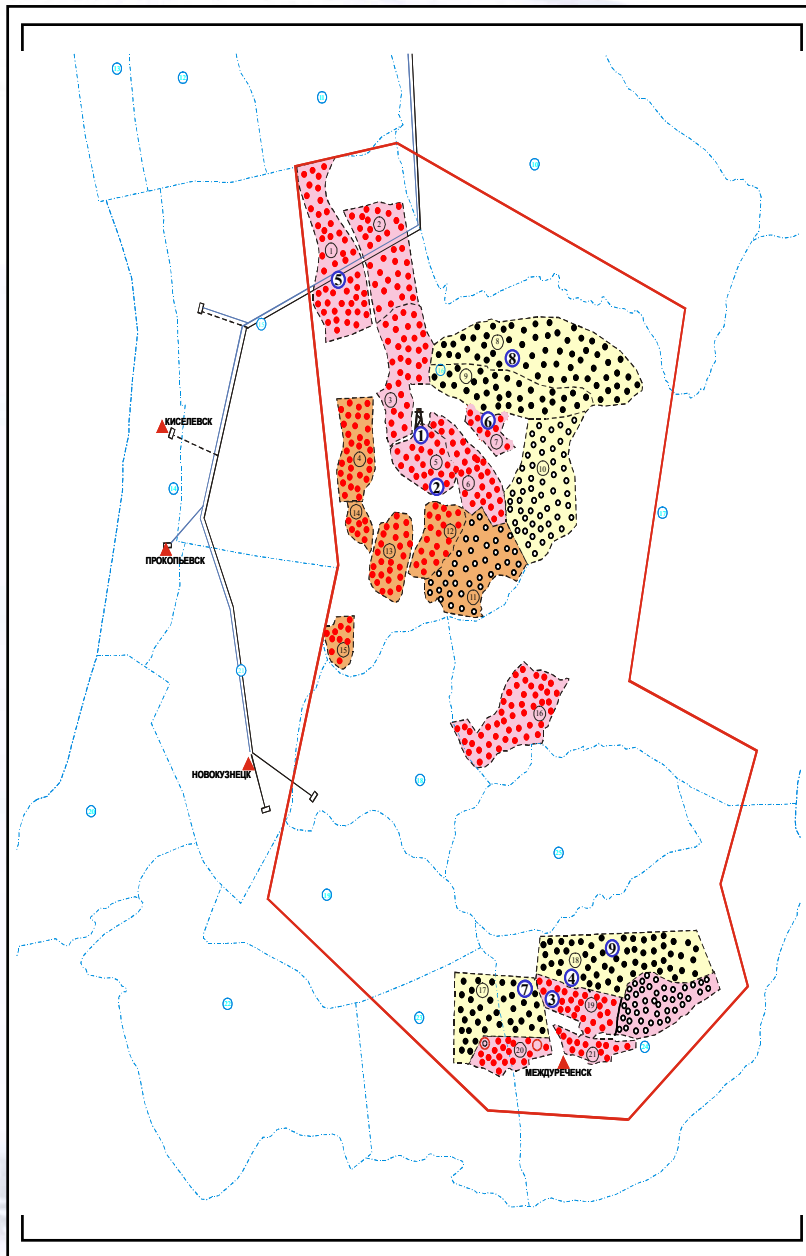


GAZPROM Feasibility Study: Collection, Analysis and Summarizing of Geological Data

(on the basis of more than 60 000 core wells)

- Analysis of lithology, tectonics, and coal rank
- Analysis of methane content and sorption properties of coals, permeability of coal seams
- Study of core well tests carried out by ARI, US
- Estimation of commercial CBM production on pre-feasibility study

GAZPROM FS: Geological Study of Kuzbass



Условные обозначения

--- Границы геолого-экономических районов

Районы

- | | |
|------------------|-----------------------------|
| 1 Анжерский | 14 Прокопьевско-Киселевский |
| 2 Кемеровский | 15 Усатский |
| 3 Барзасский | 16 Ерунаковский |
| 4 Завьяловский | 17 Терсинский |
| 5 Доронинский | 18 Байдаевский |
| 6 Титовский | 19 Осиновский |
| 7 Плотниковский | 20 Бунгуро-Чумышский |
| 8 Саптымановский | 21 Аралчевский |
| 9 Кривинский | 22 Кондомский |
| 10 Центральный | 23 Мрасский |
| 11 Ленинский | 24 Томь Усинский |
| 12 Беловский | 25 Тутуяский |
| 13 Бачатский | |

1. Уч. Соколовский
2. Уч. Караканский Южный
3. Северо-Талдинское месторождение
4. Уч-ки Кыргызские
5. Талдинская площадь
6. Уч. Жерновский
7. Уч. Новоказанский
8. Нарыкская площадь
9. Кыргыз-Осташкинская синклиналь
10. Кушинское месторождение
11. Уч-ки Ерунаковские
12. П. шх. Ульяновской
13. П. шх. Казанковской
14. П. шх. Усатской
15. П. шх. Ильинской
16. Уч-ки Кушеяковские
17. Уч. Мысовский
18. Тутуяская площадь
19. Уч-ки Распадские
20. Томская площадь
21. Уч-ки Ольжерасские Глубокие

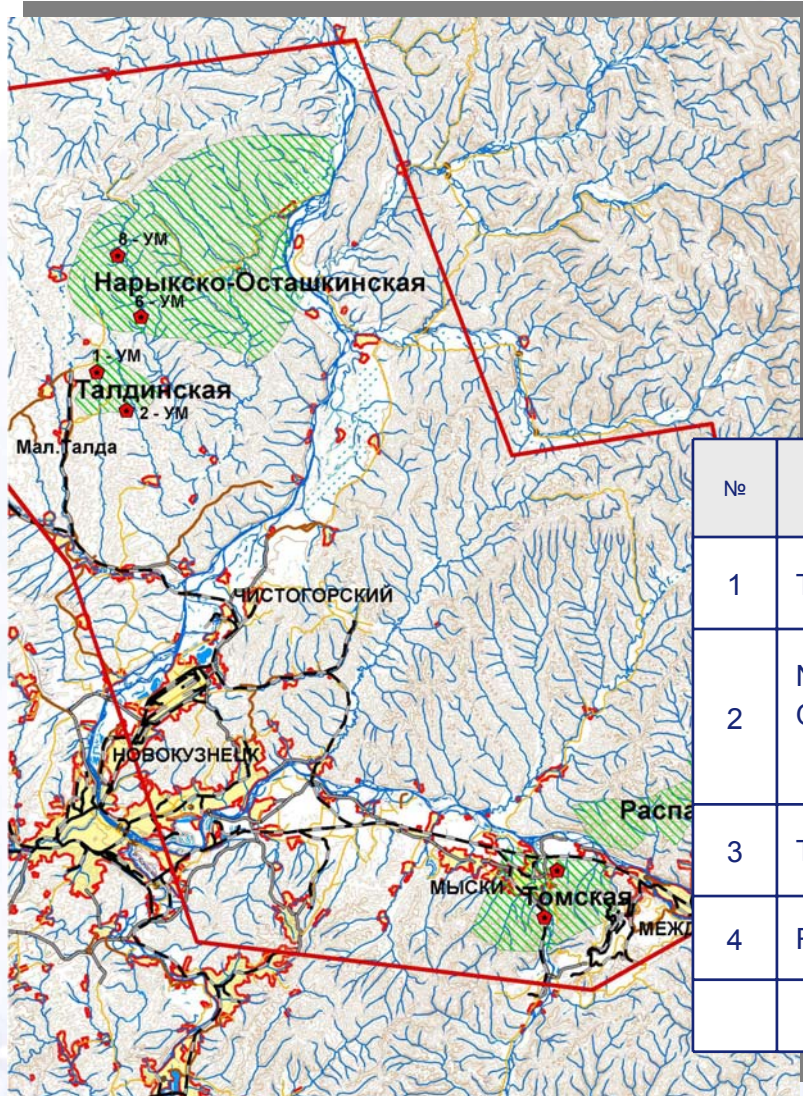
- Группа участков и площадей наиболее перспективных в настоящее время для промышленной добычи метана из угольных пластов. (Объекты I очереди).
- Группа шахтных полей и разведанных участков перспективных для промышленной добычи метана из угольных пластов в ближайшем будущем. (Объекты II очереди).
- Группа слабоизученных участков и площадей перспективных для добычи метана, на которых рекомендуется проведение поисково-оценочного кернового бурения. (Объекты III очереди).
- Граница горного отвода геолого-промышленной компании "Кузнецк"
- Существующие газопроводы-отводы
- Строящиеся газопроводы I очереди
- Строящиеся газопроводы II очереди
- Скважины тестовые, опытно-промышленные
- Скважина Томская глубина (2542м)
- Скважина Распадская (2336м)

Поисково-оценочные площади (1 – 3 скважины / км²)

Предварительно разведанные участки (4 – 10 скважин / км²)

Детально разведанные участки (30 – 50 скважин / км²)

GAZPROM FS: Priority areas in Kuzbass



- Study of 121 geological structure and 26 areas

- Selection of 4 priority areas with summary CBM resources of 1,5 trln. m³

- Selection of 9 test well sites

№	Areas	Structure space km	CBM Resources bln. m	CBM density bln. m /km	Total thickness of coal seams m
1	Taldinskaya	31	95,3	3,0	140 - 150
2	Narixsko-Ostashkinskaya	330	918,0	2,78	от (30 - 35) до (130 - 150)
3	Tomskaya	45	121,1	2,69	62 - 65
4	Raspadinskaya	134	357,2	2,83	70 - 75
	TOTAL:	540	1 491,6	2,76	-

GAZPROM FS: Comparison of Kuzbass (Russia) with San Juan Basin (U.S.)

Characteristics	Kuzbass	San Juan
CBM resources	Total 13.1 trln. m ³ , including 3.0 trln. m ³ in the promising south regions	Total 2.3 trln. m ³ , including 1.4 trln. m ³ in Fruitland formation, and 0.9 trln. m ³ in Menefi formation
CBM density	from 500 to 3500 mln. m ³ /km ²	от 350 до 1000 млн. m ³ /km ²
Total thickness of coal seams	Total thickness of coal seams reaches 120 m, thickness of several seams is 10-18 m	Total thickness of coal seams is 30 m, thickness of several seams is 8-10 m
Coal bedding depth	Up to 4000 m, for estimation only coal seams no deeper than 1800 m were considered	Not lower than 1200 m (Fruitland formation)
Number of productive intervals	6-8 in intervals of 100-150 m in the cross-section to the depth of 1800 m	one in the interval of of 100-130 m in the cross-section to the depth of 1200 m
CBM content	Not higher than 25-30 m ³ /t	Not higher than 15-20 m ³ /t
Coal rank	0.6 - 2.0% (at the most promising areas 0.75 - 1.2%)	0.7 - 1.5% (within the producing zone 0.78-1.2%)
Coal seam permeability	Not higher than 50 mD, some measuring data exceeded 100 mD	35-50 mD

GAZPROM FS: Methods for stimulation of CBM recovery from coal seams

Stimulation methods	Applicability conditions	Frequency of use
Hydro fracturing of coal seams	Can be used under different geological conditions	>85%
Cavitation (pneumo-hydro-dynamic stimulation)	Coal seams with summary thickness of >20 m in gross interval of < 100 m, permeability >30 mD. Over pressured coal seams (> hydrostatic pressure).	<10%
Open hole enlargement	Coal seams with permeability of 100 mD-3 D and higher	<5%
Directional and horizontal drilling	Coal layers with low permeability and thickness of >2 m	<1%

Gazprom Test Pilot Project: Objectives

Purpose:

Organize commercial CBM production in Kuzbass



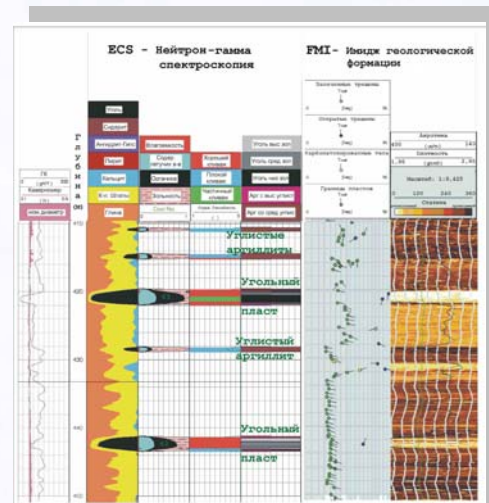
Major tasks:

- Obtain commercial gas flow rates from test wells
- Develop technologies and run
- Evaluate proven reserves on the basis of estimated CBM resources and results of Test Program
- Prepare geological and technological basis for commercial CBM production

Gazprom Test Pilot Project: Results



- Constructed testing polygon in Kuzbass
- Drilled 4 test wells;
- Fulfilled geophysical, core and hydrodynamic investigations
- Developed technologies and facilities for CBM production
- Prepared geological and technological basis for commercial CBM production within 4 high-priority areas
- Test wells are under probe exploitation



Результаты комплексной интерпретации геофизического каротажа в скважине УМ-1 бис3. Выделены угольные пласты 63 и 62, отнесенные к числу перспективных объектов для добычи угольного метана после проведения гидроразрыва.

GAZPROM Pilot Test Project: Scientific Research and Computer Technologies for CMB Development

