



Electricity Supply of Naryn Sukhait Coal Mine using Coal Bed Methane

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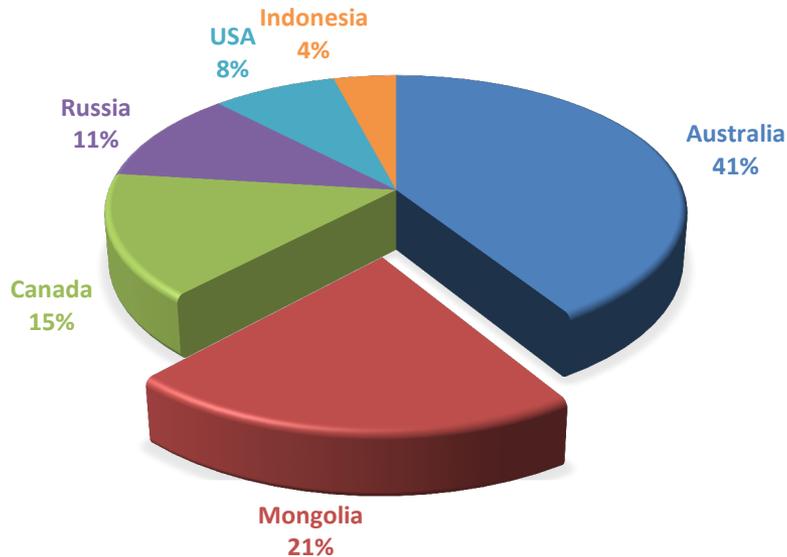
Naryn Sukhait Coal Mine



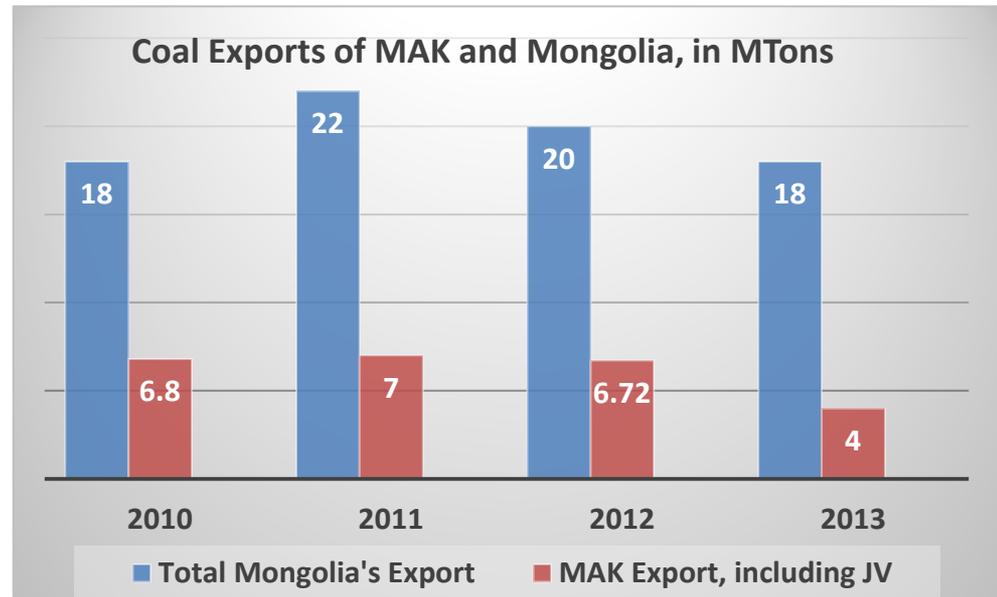
- Mongolia supplies 21% of Chinese import of coking coal from two major coal deposits: Tavantolgoi and Naryn Sukhait(NS).
- NS is strategically located close to Chinese market: 55 km from Chinese border
- Production capacity: 10 MT Per year,
- Annual coal export to reach by 2015: 15 MT,



CHINESE COKING COAL IMPORT IN 2013



Coal Exports of MAK and Mongolia, in MTons



Electrical Supply of NS

Currently:

- **Consumption: 4 MW**
- **Supply: 35 kV transmission line from China.**
Price of electricity: 195 tugrug/kWh. Twice expensive than Mongolian average price.

Near future:

- **Consumption will reach 68 MW.**
 - To save diesel fuel and reduce mining cost (12 million liters consumed in 2013 for 4 million tons of coal, 12 million tons of overburden, Diesel fuel cost is 25-35% of total mine cost).
 - More use of electrical equipment.
 - Conveyor transport for coal and rock.
- **Supply: Need to build power plant or new 110 kV transmission line from China.**
- **Coal-chemical plant in the future at NS.**
- **CBM is environmentally friendly & cheapest source for Power generation at NS.**

USER	MW
“Mongolyn Alt” (MAK) LLC	68
OTHERS	15
TOTAL	83



- Global Methane Initiative (GMI), United States Environmental Protection Agency (USEPA) sponsored a pre-feasibility study conducted by Raven Ridge Resources (RRR).
- Test conducted in the field using equipment during exploration for **4 wells** and depth **83-379 m**.
- Report prepared based of geophysical logs, adsorption isotherm and desorption tests.

Coal Bed Methane (CBM) is a byproduct produced during the formation of coal from organic residue and refers to methane adsorbed into the solid matrix of coal. It is sometimes referred to as coal seam gas, because it may contain other gases such as CO₂.

CH₄ has 21 times higher impact a GHG than that of CO₂

Drilling Campaign Description Test Results

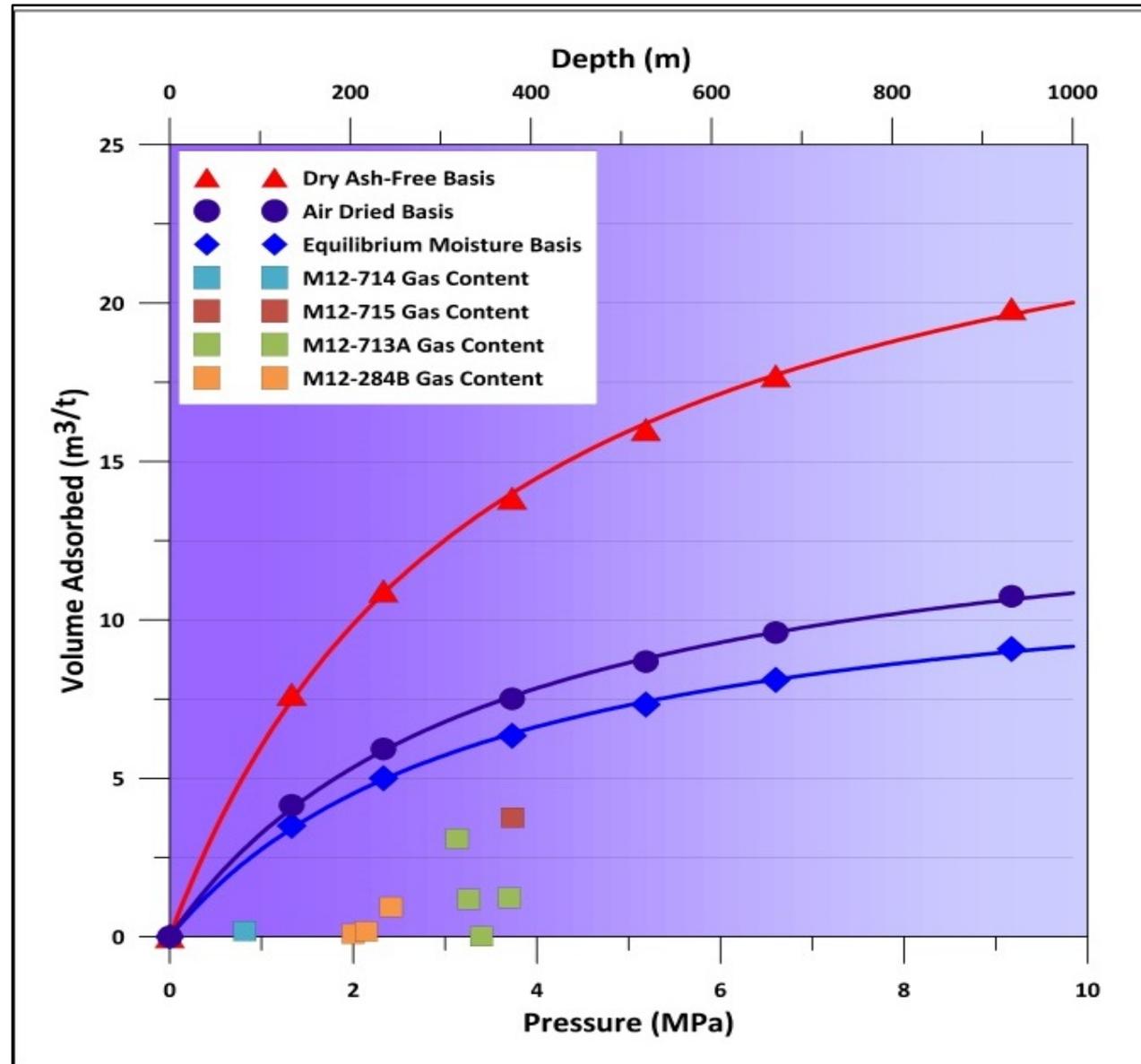


Sample Name	Borehole Name	Analysis Date	Sample Depth (m)	Gas Content	
				S&W (m ³ /t) (raw)	S&W (m ³ /t) (DAF)
CANISTER №1 29 October 2012	M12-714	11-Dec-12	83	0.184	0.193
CANISTER №2 09 November 2012	M12-715		379.7	3.758	3.758
CANISTER №3 15 November 2012	M12-713A	11-Dec-12	318.2	3.093	3.453
CANISTER №4 18 November 2012	M12-713A	11-Dec-12	331.2	1.185	1.573
CANISTER №5 22 November 2012	M12-713A	11-Dec-12	345.2	0.015	0.016
CANISTER №6 25 November 2012	M12-713A	11-Dec-12	376.2	1.231	1.334
CANISTER 1 - 524	M12-284B	17-Jun-12	203	0.09	0.168
CANISTER 2 - 525	M12-284B	17-Jun-12	217.4	0.172	0.0192
CANISTER 3 BTM - 526	M12-284B	17-Jun-12	245	0.941	1.753

- Adsorption testing was conducted at the Xian Research Institute of China Coal Technology & Engineering.
- Desorption tests were conducted during exploration drilling campaigns conducted in June and November.

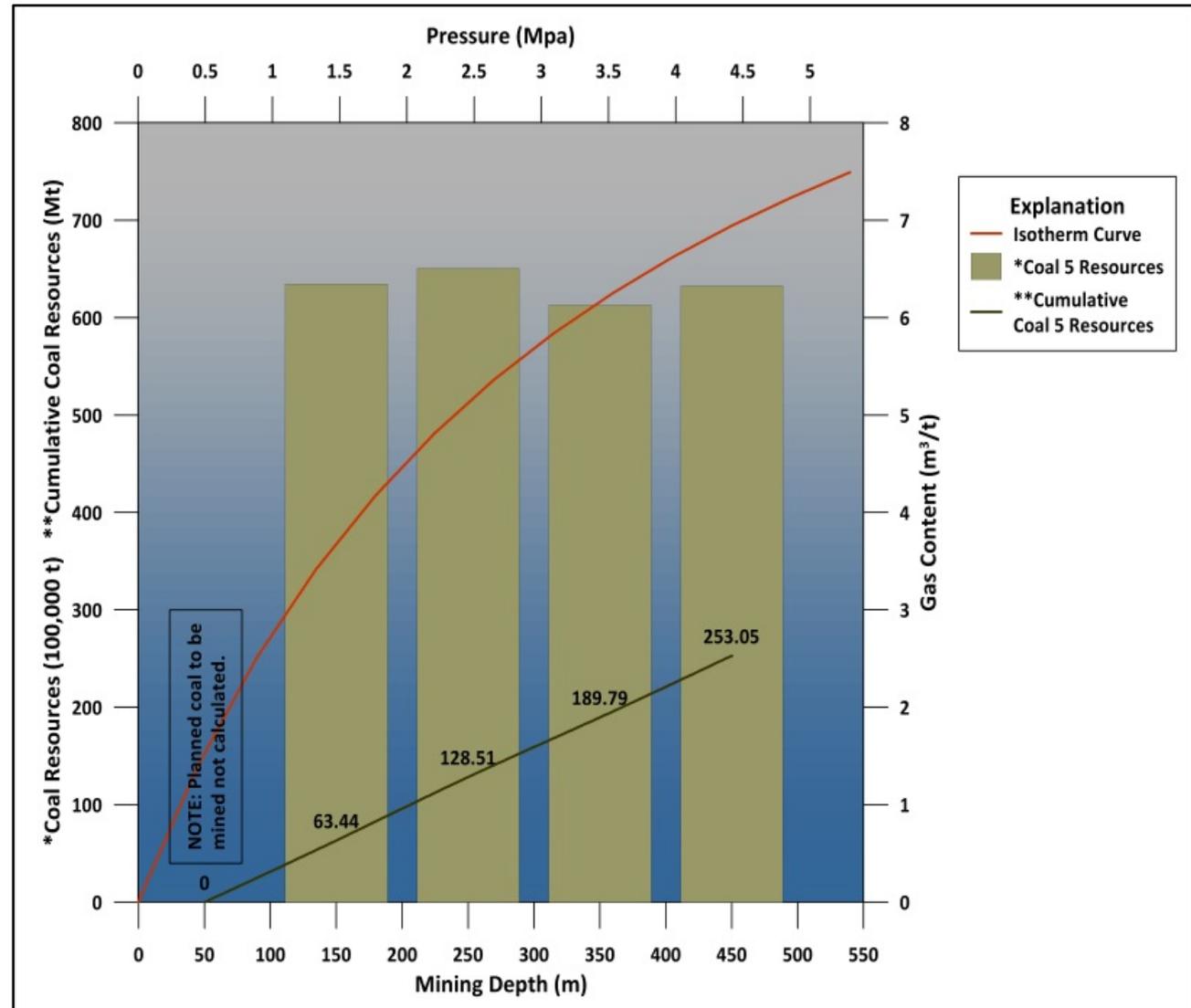
Adsorption Testing Results

- An adsorption isotherm describes the relationship between pressure and gas capacity under equilibrium conditions at a stable temperature representing the reservoir temperature of the coal seam at the depth of the sample.
- Coal sample taken from corehole M12-284B that penetrated coal seam 5.
- The isotherm may be broadly indicative of the gas capacity of coal seam 5 within the Naryn Sukhait mine.

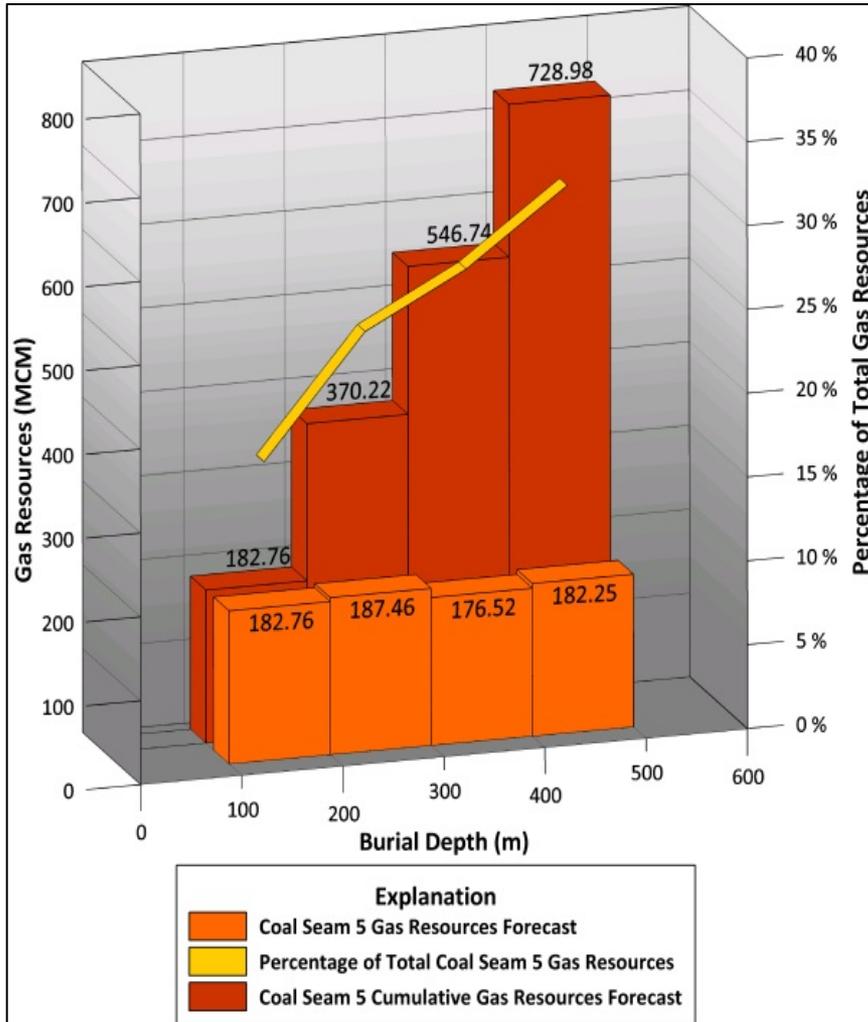


Gas Resource Calculations

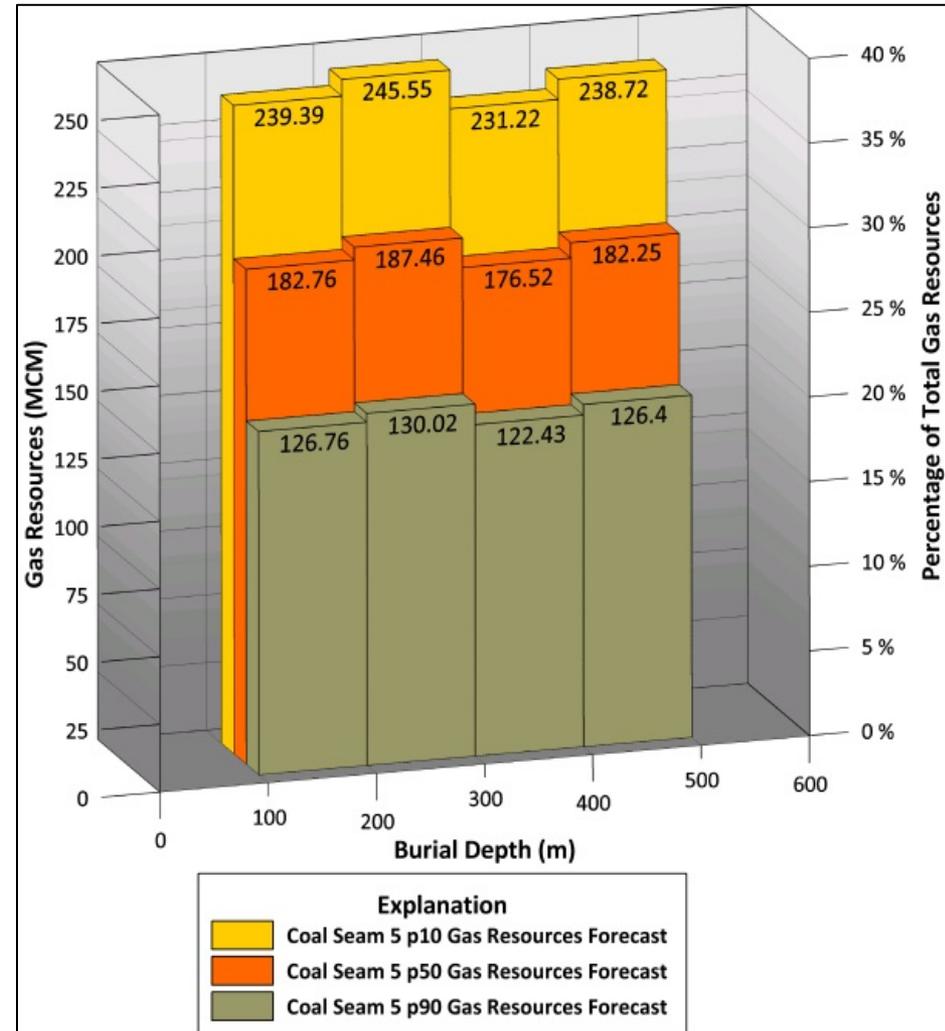
- The average density of coal seam 5 is **1.4 metric tons per cubic meter**.
- The calculations depth of **-150m -450m**.
- The cumulative Coal Seam 5 resources is **253.05 million tones**.



Gas in Place by Depth Interval

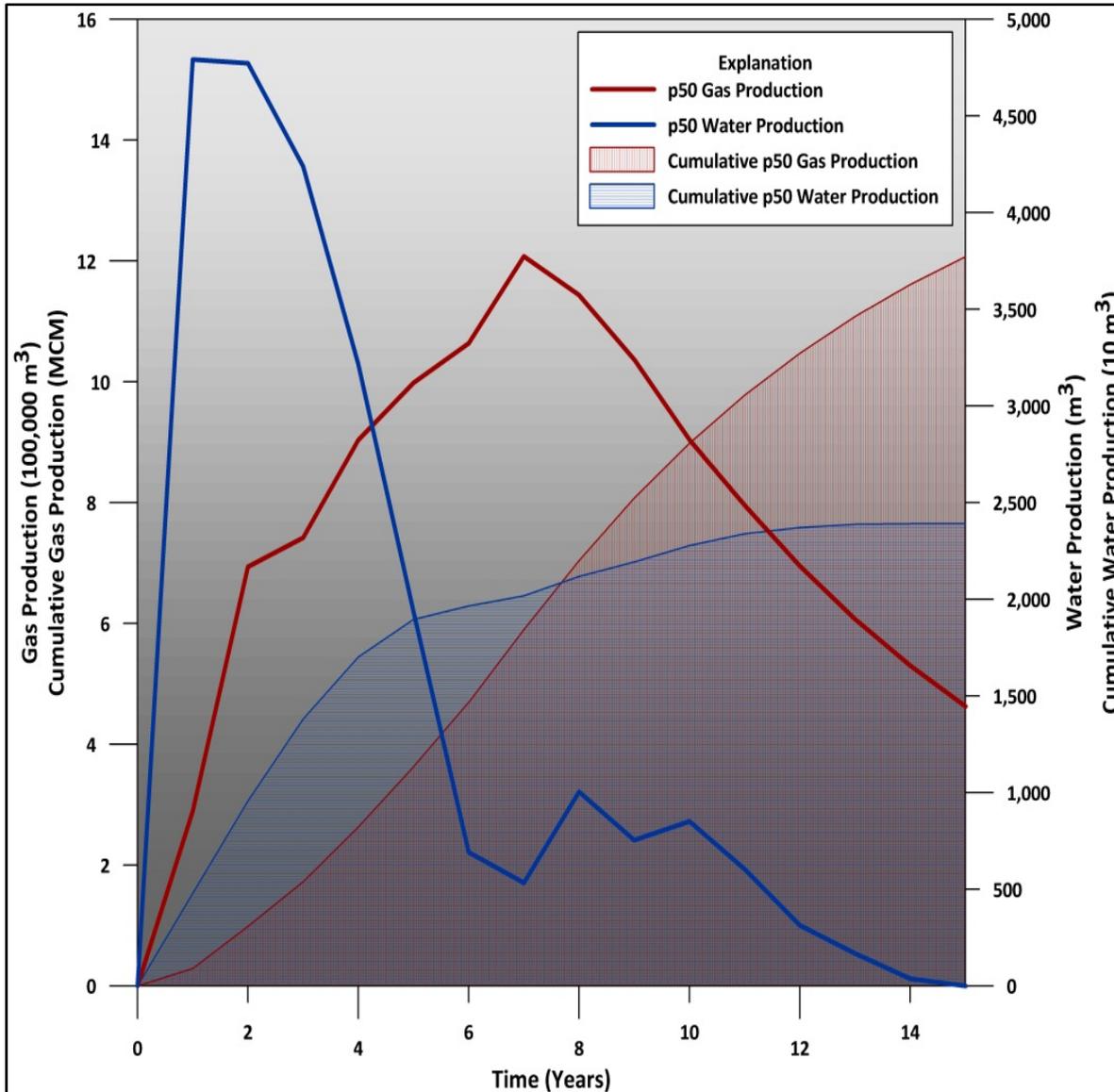


Depth interval, -150m -250m -350m and -450m.
 The total estimated gas in place is **728.98 million cubic meters**.



Total gas in place between the p90 to p10 gas resource forecasts is **505.61 – 954.88 million cubic meters**.

Gas and Water Production Forecast Based on p50



Water is future important resource for Coal handling and Preparation plant and Power plant

Total 286,180 cubic meter water is produced.

Proposed well Location Plan



DISCLAIMER: This map is designed to be an informational tool for the purpose of displaying design schematics and is not intended to be used as an accepted or engineered design plan. The information presented was provided by source(s) listed below and is believed to be accurate and suitable for modeling purposes, and is subject to the limitations stated above.

Project Name:	Naryn Sukhait MAK Pre-Feasibility Study EPA
Map Document:	FFS - Drainage Map.mxd
Drawn By:	Candice L.M. Tello
Approved By:	Raymond C. Plicher
Source:	Naryn Sukhait MAK, 2011 Esri, Delorme, NAVTEQ, TomTom
Current Revision No.:	Original
Revised By:	N/A



PLATE 2: Naryn Sukhait Mine Lease and Proposed Borehole Location Plan

SCALE 1:10,000

0 100 200 400 600 800 1,000 Meters

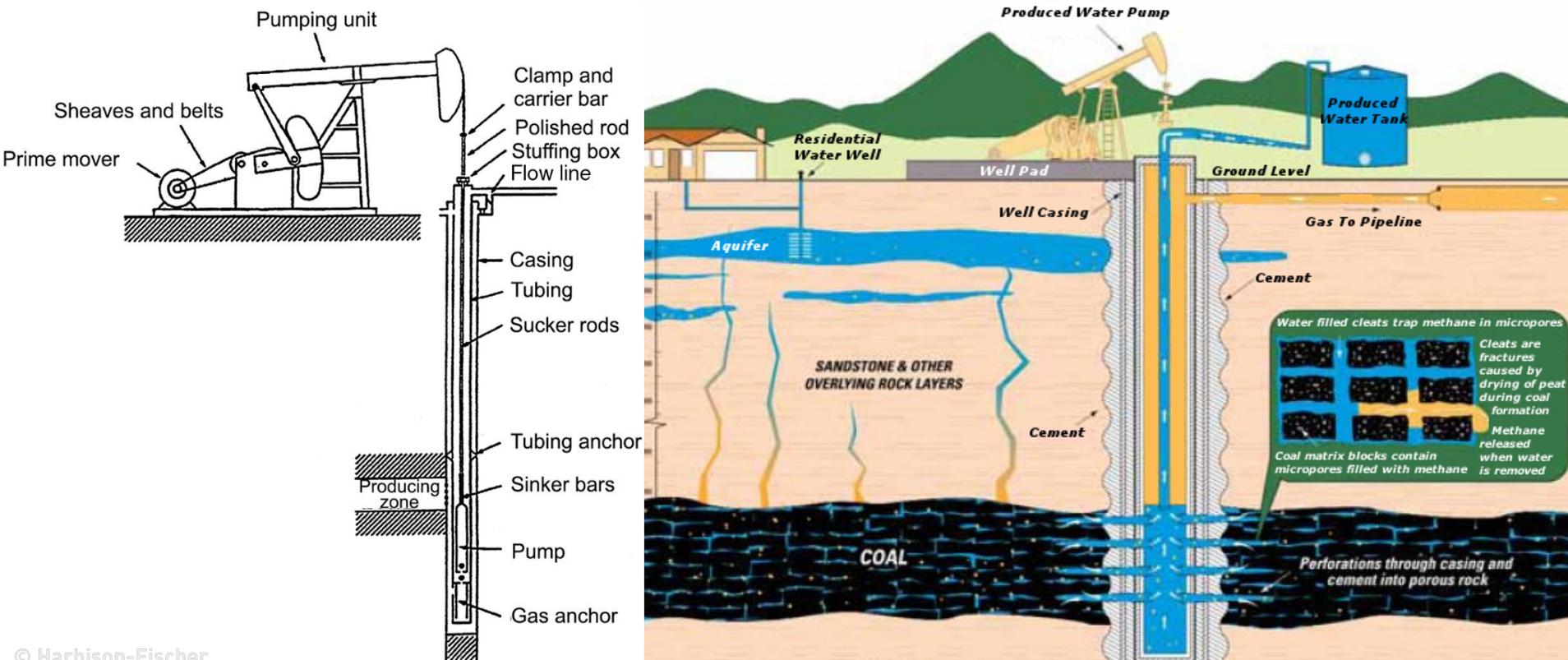
MONREF 1997 UTM Zone 47N

Forecasted drainage efficiency for the p50 percentile class is 57 percent

Percentile Class	p90	p50	p10
GIP per 32.4 hectare well location	5,639,982	12,073,142	18,043,670
Potential Drainage Efficiency	37%	57%	85%

Test Drilling Program

- Project team determined **12 wells** and target seam raging in depth from **225 to 600m**.
- The proposed testing will include open-hole geophysical logging, permeability testing and coal core desorption testing.
- The proposed wells are drilled on centers at **642 meter** spacing between wells, providing for a drainage area of approximately **32.4 hectares**.



Inputs and Assumptions Used in Economic Model

Project Duration	15 years	
Drilling costs	140 USD / meter	Quote from drilling contractor with experience in Asia
Casing costs	80 USD / meter	
Production well operating costs	700 USD / well / month	
Drilling Rig Mob / demob	125,000 USD	
Gas hook-up lines	25,000 USD / km	Industry standard “rule of thumb” costs
Main gas gathering line	100,000 USD / km	
Plant construction	Site construction and installation is conducted in the first year, additional generator sets are installed in years two, three and five.	
Capital Investment for p50 scenario	Power Stations & auxiliary facilities includes drilling and completing 12 production wells: 7.77 million USD	Power station investment based on unit costs 916.23 \$/kilowatt
Annual Power Sales	Electricity generated available to mine: 58,400 MWh	
Gas Consumption efficiency	0.2475 m ³ per kWh generated Utilizes 5.0% of gas stream as fuel for compressors.	Based on manufacturer’s representatives.
Annual project operating costs	25 percent of capital costs for gensets annually. 700 USD per well per month for producing wells.	Based on information provided by manufacturer’s representative and drilling contractor

Power Generation Option



Evaluation Scenario	Base Case	Alternative Case 1	Alternative Case 2
Annual Operating Hours	8,000	8,000	8,000
Gas Forecast-Project (million m³)	144.86	144.86	67.7
Total CAPEX (million USD)	7.77	7.77	4.57
Tons of CO₂e (x thou.)	187.9	191.82	80.7
Carbon Sales Price (USD)	1.00	1.00	1.00
Plant Size (MW)	8.55	8.55	4.28
CAPEX/Tons CO₂e	0.04	0.04	0.06
Electricity Sales Price (₮/kWhr)	105	105	194
Water Sales Price (USD/m³)	0.00	8.00	8.00
NPV/Tons CO₂e	0.02	0.02	0.08
NPV (Million USD)	3.28	4.52	6.39
IRR (%)	16.3%	18.9%	23.8%
Payback Period (yrs)	6.75	6.17	6.25

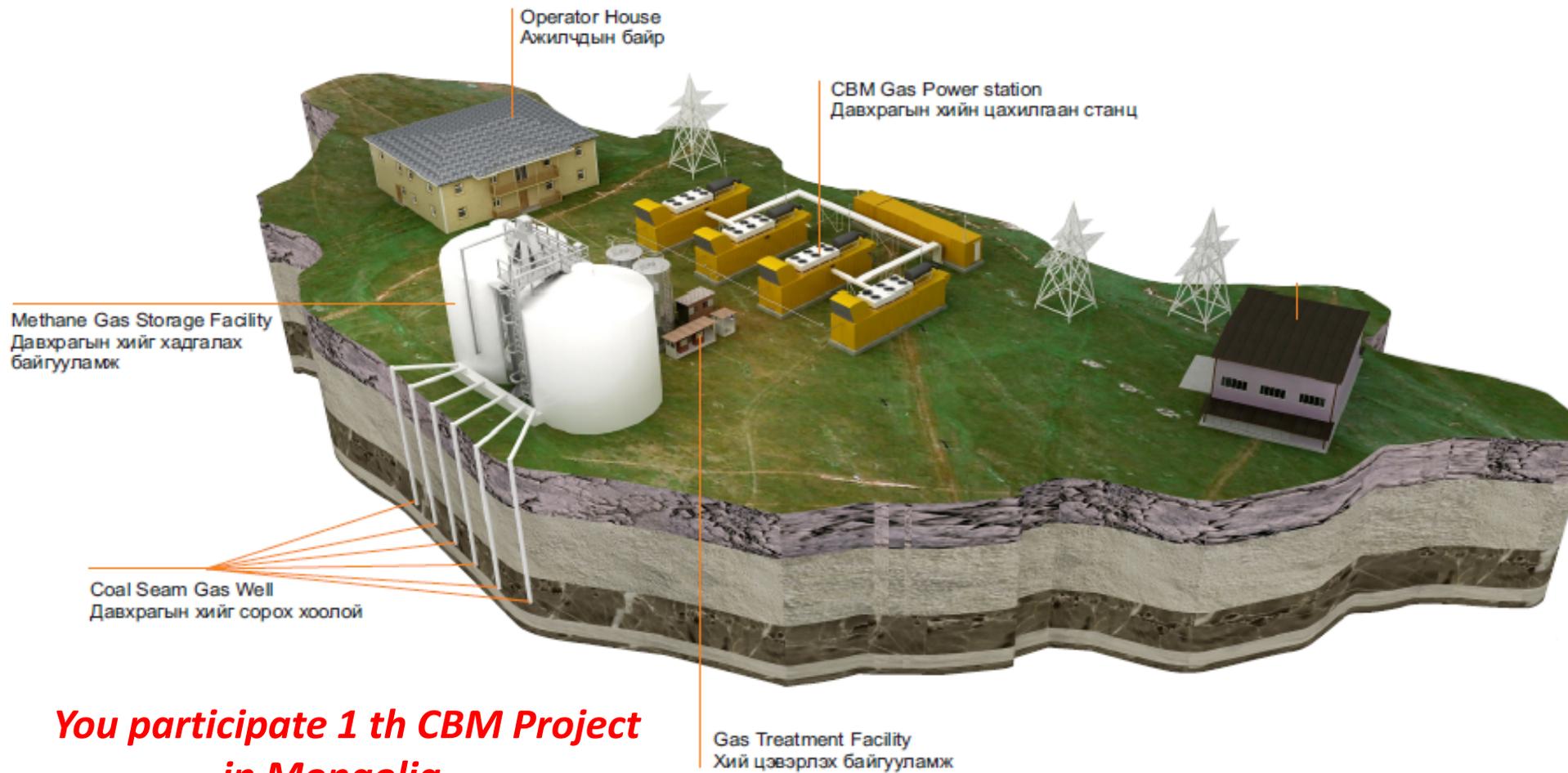
Base Case: p50 production, 7.5¢ / kWhr electricity price & no water sales,

Alternative Case 1: p50 production, 7.5¢ / kWhr electricity price & \$8.00/m³ for water,

Alternative Case 2: p90 production, 14¢ / kWhr electricity price & \$8.00/m³ for water.

CONCLUSIONS

- 1) NS is strategically important deposit for coking coal export to China.
- 2) Ready and long term reliable demand for electricity.
- 3) NS coal deposit has significant source of methane which can be converted to electricity.
- 4) Potential to produce **204.1 million** cubic meters of gas by the proposed **12 well pilot** drainage system.
- 5) Proposed pilot project could produce enough gas to fuel a **8.5 MW power generation** facility to be used by the mine.
- 6) The capital costs are estimated to be **\$7.7 million USD** with an **IRR of 16.1** percent and a payback period of **6.75 years**.
- 7) Carbon emissions would be reduced by **187,900 tons of CO₂** over the project's **15 year life**.



***You participate 1 th CBM Project
in Mongolia...***

THANK YOU

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JINCHENG-1 (CMM-120 MW)





GERIKE (CBM – 10 MW, CNG)



KAIJIA (CMM – 25 MW)



YANGQUAN (CMM – 20 MW)

