

Block 3: Natural Gas Processing, Transport and Marketing  
Forum 13: Sustainable Value Chains for Unconventional Gas

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## **Monetizing Gas of a Giant High Helium and Nitrogen Gas Reservoir – Amur Gas Processing Plant**

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### Unconventional gas:

- natural gas which **cannot be produced, processed or used in a conventional manner**

### Inert Limits (N<sub>2</sub> and CO<sub>2</sub>)

- most North American and European pipeline systems require a **maximum inert content of 3%** in order to ensure a **stable Wobbe-Index and proper performance of burners and gas turbines** operated from the pipeline system. The Russian norm specifies a maximum of 2,5%.

### Main Options to Monetize High Nitrogen Reservoir

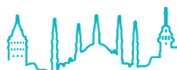
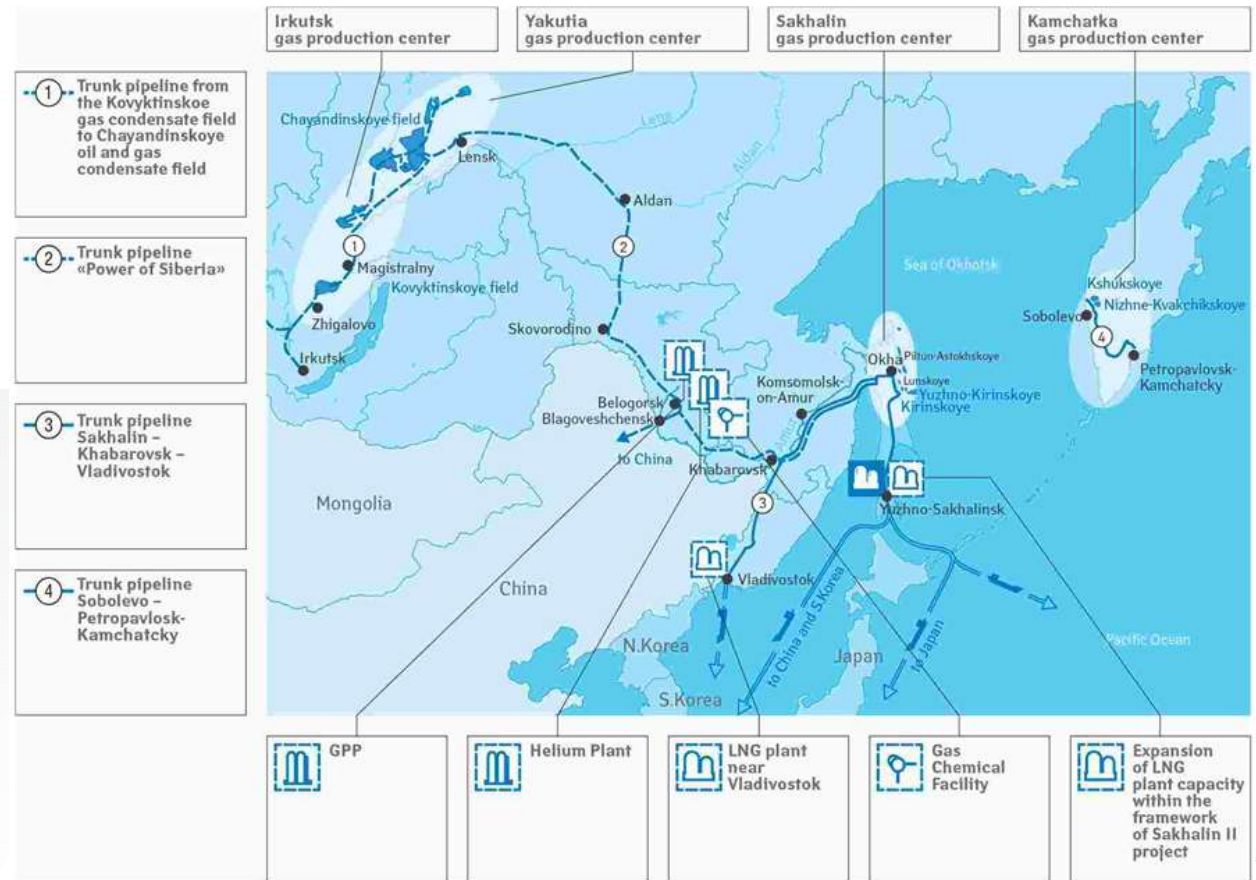
- dedicated pipeline system (e.g. Groningen, NL) or dedicated consumer (e.g. power plant, NH<sub>4</sub> plant)
- blending with other low N<sub>2</sub> gas sources
- **nitrogen rejection**

### Nitrogen Rejection Technology

- **cryogenic technology is only referenced choice for large scale N<sub>2</sub>-rejection.** Membrane or adsorptive technology not feasible.
- **inlet gas of cryogenic processes normally needs to be virtually free of H<sub>2</sub>O (< 1 ppm), CO<sub>2</sub> (< 50 ppm) and tolerates only small amounts of H<sub>2</sub>S, HHC's**

## Power of Siberia Pipeline

- connects **gas rich Eastern Siberia with Far East and populous China**
- link between high  $N_2$  Chayanda field in Yakutia and the border crossing near Blagoveshchensk (1<sup>st</sup> section)
- tie-back the Kovykta field in Irkutsk Region (2<sup>nd</sup> section)
- pipeline, **Amur Gas Processing Plant** and a new nearby gas petrochemical complex are key elements of Gazprom's **Eastern Gas Program** to boost the economic development of the Russian Far East.



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### Unusual Process challenge

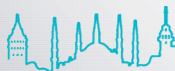
- **Rejection of  $N_2$**  from app. 8% to less than 2% in **large diameter international gas transmission line** (38 million  $m^3$ /year)

### Building Blocks and Commercial Products of Amur GPP

- **cryogenic rectification:** liquid  $CH_4$  is produced at the bottom of a large column (implicit LNG plant) and vaporized against other process streams to obtain sales gas
- options: integration of  $N_2$ -rejection into a LNG plant or (if not feasible) **separation of commercial co-products rather than selling at zero or heating value with sales gas**
- **production of  $C_2H_6$ , NGL's and liquid helium is synergetic compared to stand-alone production,  $N_2$  used as utility or vented with less than 100 ppm  $CH_4$**
- **development of a world-scale gas based petrochemical complex**

### Dominant cost drivers

- compression
- removal of  $H_2O$ ,  $CO_2$  and S

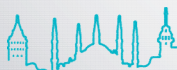
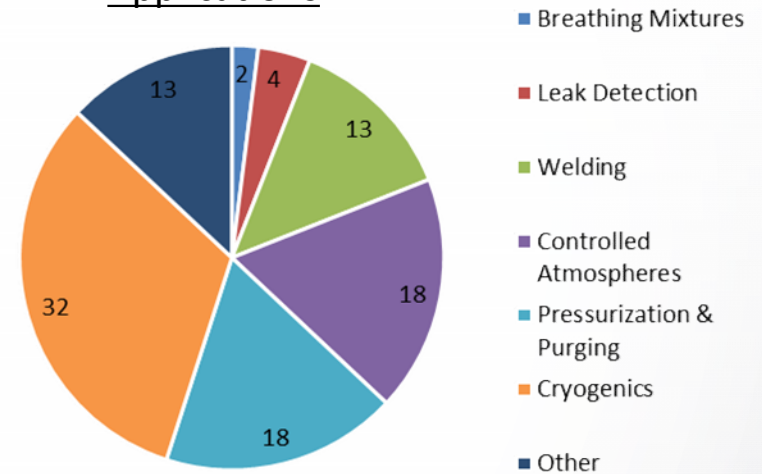




### Excursion: Helium

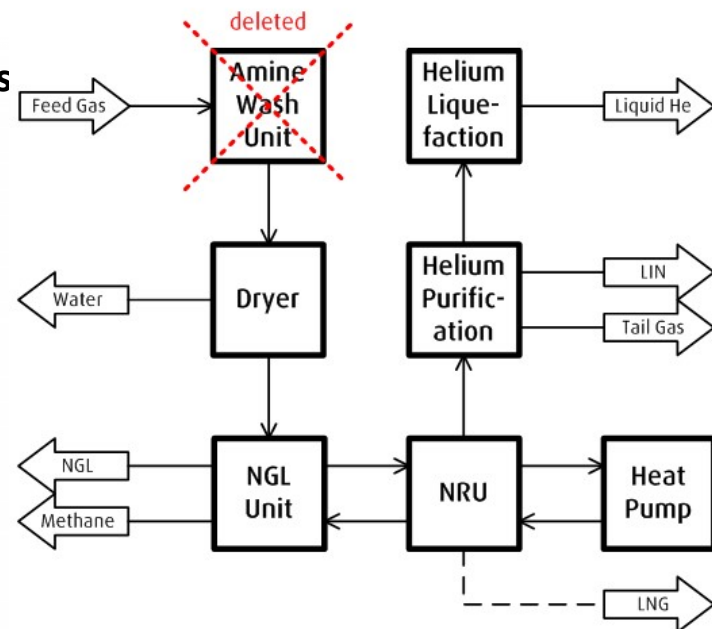
- **exclusively produced from natural gas**, coincides with high N<sub>2</sub>, however N<sub>2</sub> not necessarily coincides with He
- economically producible concentrations of He natural gas range from 0.05 to 0.30 mol-%
- 2<sup>nd</sup> lightest element to H<sub>2</sub>
- **smallest atomic radius**
- **lowest boiling point at 4.2 K**
- high thermal conductivity
- **most stable inert gas**
- current global He market ≈ 170 million m<sup>3</sup>/a (6.500 bcf/a), growth rate 1.5-2% p.a.
- presently three sources (BLM, Exxon Wyoming, Qatar) represent 80% of global production

### Applications



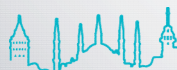
### Minimize Compression

- feed and sales gas tie-in at similar pressure, **need of a sales gas compression apparent**
- **no further compression** in sales gas and He-path
- **max. pressure at the inlet of the sales gas compression**
- **single column N<sub>2</sub>-rejection** process transfers N<sub>2</sub>/He concentrate at a significantly higher pressure compared to double column, overcompensating thermodynamic malus
- **external heat pump system** for cryogenic duty and integration of duties



### Minimize Pre-treatment

- feed gas free of H<sub>2</sub>O and CO<sub>2</sub> to avoid freeze out
- specific proprietary process design to **prevent freeze-out of CO<sub>2</sub> up to 3.000 ppm** and hereby **avoiding amine wash units and large dryer units**



## Project Status

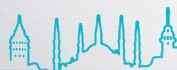
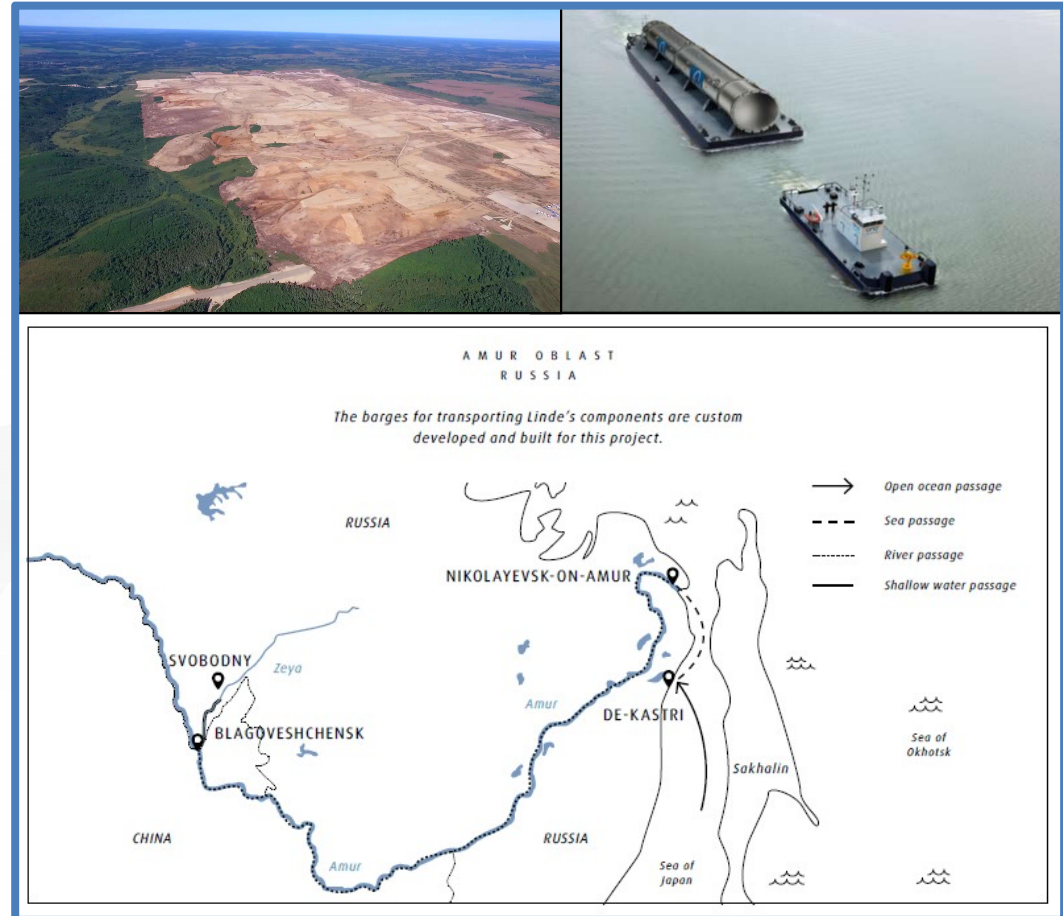
- selection of Linde technology by Gazprom and award of EPSS-contract for **five construction phases** by NIPiGas Pererabotka (general contractor) in 2015
- 1<sup>st</sup> phase: **two gas processing ( $C_2H_6$ /NGL/NRU) trains and one Helium train**
- 2<sup>nd</sup> to 5<sup>th</sup> phase: **additional four gas processing and two Helium trains**
- 1<sup>st</sup> phase engineering works beyond 90% model review, first documents issued for construction
- PO's for major equipment/material placed, fabrication of key equipment advanced
- first material arriving in summer 2017
- 2<sup>nd</sup> phase started with **time-lag to optimize** engineering, procurement, transport resources, construction work
- When completed **Amur GPP** will be **one of the world's largest gas processing and the world's largest He-plant** with nameplate capacities of 42 billion m<sup>3</sup>/a of natural gas, 60 million m<sup>3</sup>/a of He respectively





## Site and Logistic

- **remote greenfield area**, entailing construction of jetty, roads, warehouses and rail access to site
- **transport** of oversize & heavy lifts **across Amur and Zeya river within limited navigation window**
- **draft of 110 cm** requires a special design barges, tugs and floater system
- Linde site services during construction, commissioning, start-up





## Conclusions

- **Development and production of a large high N<sub>2</sub> gas reservoir and export** to a natural gas market with infrastructure designed to low inert levels **poses a particular technical challenge**
- **Industrial scale nitrogen rejection requires methane condensation** (implicit LNG plant) and entails significant investments
- **Synergies through co-production of C<sub>2</sub>H<sub>6</sub>, NGL's and He** as a starting point of **high value chains for the benefit of the national and regional economy**, such as the petrochemical and helium value chain
- **Pioneering natural gas export from Russia to China** – connecting the resource rich Russian Far East with the populous Chinese mainland – represents a **historic milestone in the history of natural gas infrastructure** and will have **long-lasting economic and environmental benefits**

