

Increase in oil recovery index (ORI)

The Company is successfully introducing technologies to increase ORI and maintain base production levels:

- ▶ Use of technologies to incorporate previously undrained reserves into development (K_{sweep})
- ▶ Use of technologies to increase the efficiency of displacement from hydrophobic reservoirs (K_{disp})
- ▶ Selection of technologies to effectively incorporate previously unprofitable reserves into development

The following measures ensure positive production dynamics:

- ▶ Optimization of the natural reservoir pressure increase (NRPI) system in the terrigenous reservoirs of the White Tiger field

- ▶ Implementation of the hydraulic fracturing (HF) program on the shelf of Vietnam
- ▶ Highly effective geological and technical actions at major fields
- ▶ Use of polymer compositions at the fields of JV RUSVIETPETRO LLC and ZARUBEZHNEFT-Dobycha Kharyaga LLC
- ▶ Systematic and effective work with unbalanced deposits in the Ural-Volga region

Use of enhanced oil recovery methods. Smartflooding project

■ USE OF ENHANCED OIL RECOVERY METHODS

Zarubezhneft is actively working to improve the efficiency of its current assets and their ultimate oil recovery rate

SMARTFLOODING

Project

Four key focuses of the SMARTFLOODING project

Stage IV digital core – creating complex forecasting tools

- ▶ ZARUBEZHNEFT-DOBYCHA KHARIAGA LLC
- ▶ JC RUSVIETPETRO LLC

Stage III SWCTT on surfactant-polymer treatment

- ▶ ZARUBEZHNEFT-DOBYCHA KHARIAGA LLC
- ▶ JC RUSVIETPETRO LLC

Stage II Flow diverter technologies and remedial cementing

- ▶ JC RUSVIETPETRO LLC
- ▶ ZARUBEZHNEFT-DOBYCHA KHARIAGA LLC

Stage I Optimization of the water flooding system

- ▶ JV VIETSOVPETRO

The need to develop complex hydrophobic carbonate reservoirs has challenged the Company to search for effective innovative solutions to increase oil recovery. A 5% increase in ORI only at its Russian operating assets would enable Zarubezhneft to increase recoverable reserves by more than 15 million tons.

To Company decided to focus its efforts in this regard by initiating and implementing the SmartFlooding project, which seeks to increase the ORI of operating assets by, as mentioned above, improving technologies that aim to incorporate reserves that have not been drained into development (K_{sweep}) as well as technologies that aim to increase the efficiency of oil displacement from hydrophobic carbonate reservoirs (K_{disp}).

The need to develop complex hydrophobic carbonate reservoirs poses a challenge to the Company in terms of finding effective innovative solutions to enhance oil recovery.



Objectives of the SmartFlooding project

- ▶ Increase the efficiency of secondary enhanced oil recovery methods (EORM) by developing and introducing new approaches to organizing and monitoring the NPRI system
- ▶ Increase the ORI by 5–10% due to EORM in carbonate assets
- ▶ Plan EORM research and development (R&D) and a pilot project within Zarubezhneft
- ▶ Develop technological processes for EORM planning
- ▶ Improve business processes for organizing R&D on EORM with the aim of reducing the timeframe of R&D
- ▶ Develop expertise among specialists concerning modern EORM.

The Company already has an example of the successful application of EORM technologies. In particular, flow diverting technologies are employed at the Kharyaga oilfield, which has historically implemented an ion-modified water injection program. JC RUSVIETPETRO is conducting pilot testing on innovative stream diverting technologies, selective isolation, and, for the first time in Russia, a chemical tracer test to determine the effectiveness of surfactants.

Key results of 2020 from the use of EORM

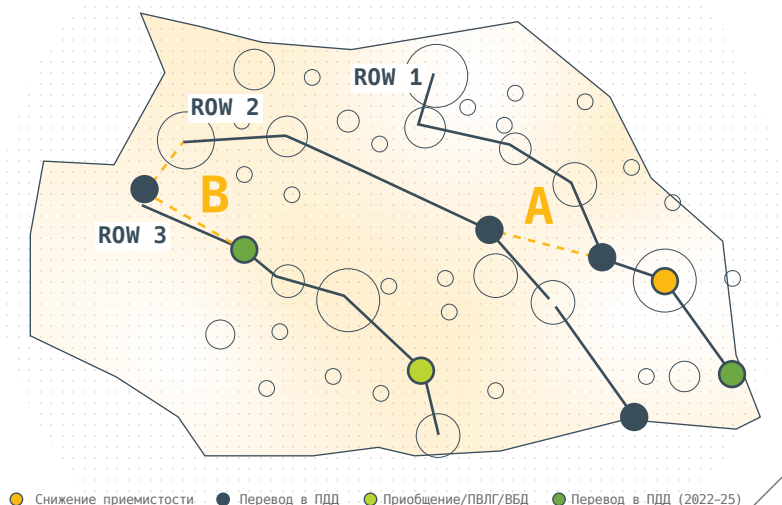
- ▶ Diverter solutions were pumped into four wells at the Kharyaga oilfield (production has increased by more than 200,000 tons since this technology started being used)
- ▶ A pilot project was conducted for bottom water shutoff at the Zapadno-Khosedayuskoye field (production has increased by more than 12,000 tons since 2019)
- ▶ A study was conducted on the effectiveness of the surfactant-polymer compound on a single well at the Kharyaga field using the chemical tracer method (under reservoir conditions, the recovery factor of the chemical compound was 17%, which is consistent with the results of lab studies)
- ▶ Pilot projects were launched to study the effectiveness of low-mineralized water at the Visovoye and Kharyaga fields
- ▶ Laboratory studies were completed on the selection of a surfactant-polymer compound for the terrigenous fields of Block 09-1 at JV Vietsovpetro

Key results in 2020

Flood optimization

~1.5 times

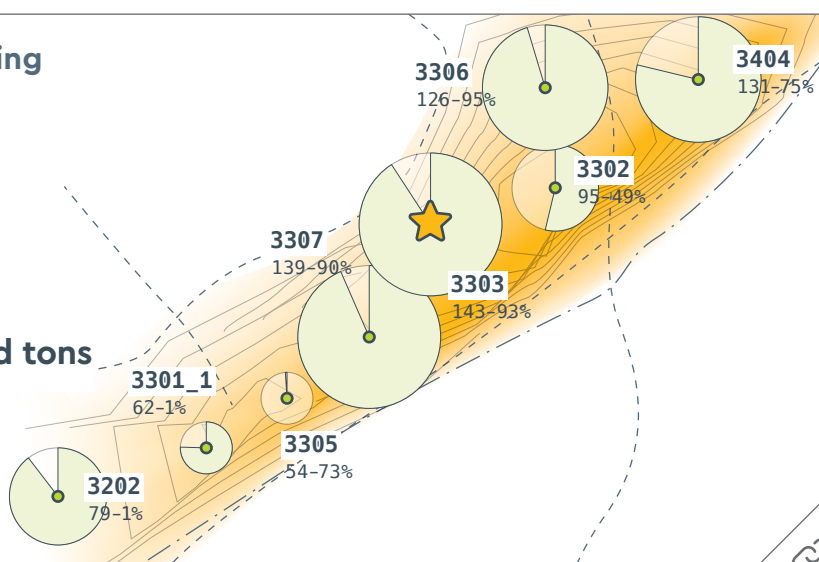
Reduction in the rate of decline in basic production since 2017 due to effective work with water cut without additional drilling



Diverting and cementing

~250 thousand tons

Due to the successful application of innovative flood diverting technologies at RVP fields



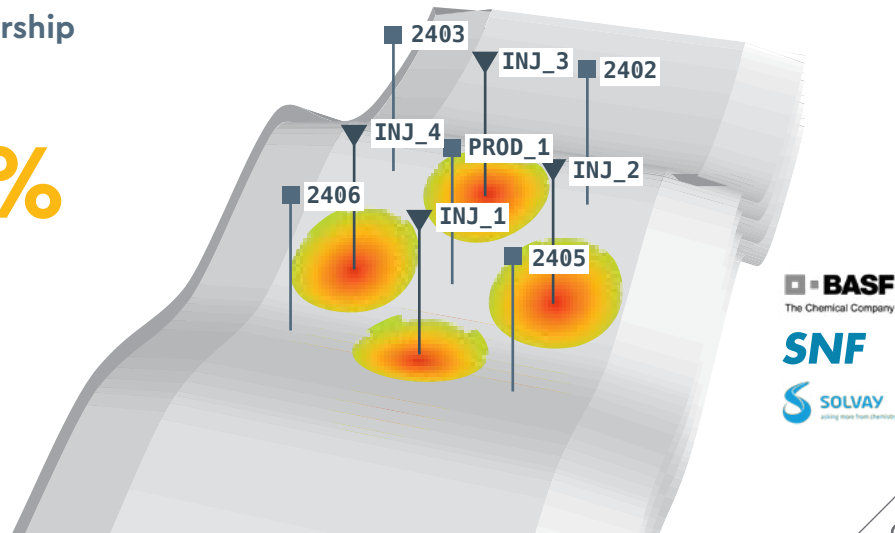
EORM in partnership

+5-10%

increase of ORI

RUB ~1 billion

NPV from the pumping of chemical compositions



Enhanced oil recovery technology for high-viscosity oil fields using catalytic aquathermolysis. Entalpy project

The introduction of modern thermal oil recovery methods based on innovative technologies has become a priority for Zarubezhneft since the Company has natural bitumen deposits with complex geological and physical conditions at the Boca de Jaruco field in Cuba. The development of innovative thermal EORM solutions will provide the Company with a competitive advantage in the development of fields with high viscosity and super-viscous oil as well as bitumen.

Since 2015, the Company has been carrying out pilot operations using thermal EORM to extract natural bitumen from the M formation of the Boca de Jaruco field. The field is located in the North Cuba heavy oil belt, 37 km

from Havana. The fractured carbonate formation M has a regional occurrence. It has significant oil resources (3.7 billion tons) that are classified as hard-to-recover because of the high viscosity of the oil. The viscosity of the formation M oil is more than 35,000 cP at 36 °C in initial formation conditions and more than 50,000 cP in standard conditions, which is among the highest levels in the world among developed natural bitumen fields. Oil density is 1.027 g/cm³ (6°API).

Even though significant bitumen reserves are concentrated in carbonate formations all over the world, the pilot work of Zarubezhneft is the only active pilot project in the world that involves the extraction of natural bitumen from such formations. A number of pilot projects in Canada that tested the ability to extract bitumen from carbonates using conventional thermal methods ended in failure.

EORM USING THERMAL ENERGY

Boca de Jaruco project in the Republic of Cuba

Project

ENTALPY

Oil reserves and resources

~195 mln tons

Geological reserves of natural bitumen in the contract area

722 mln tons

natural bitumen resources in the contract area

Rocks with bituminous saturation with high potential (not examined before) are found in the upper part of the cut

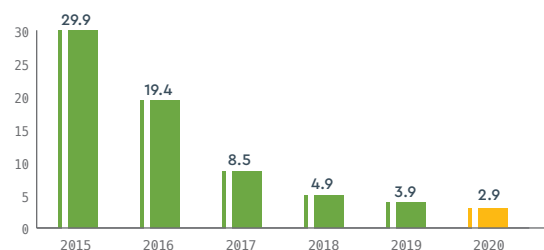
Photo of the core from the 1st production well



Unique technologies

- ▶ Super-viscous oil extraction using steam-heat methods
- ▶ Catalytic aquothermolysis for intrastratal oil upgrading
- ▶ Fiber optic thermometry system
- ▶ Steam-cycle well treatments using a producing pump

CHANGES IN THE STEAM-OIL FACTOR, tonnes of steam per 1 tonne of oil



-50%

Decrease in oil viscosity

-30%

Reduction in the molecular weight of resins

x3 Times reduction
in asphaltenes

+14%

Output of light fractions
in atmospheric distillation

3 new horizontal wells were drilled to the main bituminous M formation at a depth of 600m

An additional 4th well was drilled to test the new formation at a depth of 250 m. A gushing flow of bitumen was obtained following the steam treatment of the reservoir



Next steps in the project

190 mln EUROS

project investments

57 wells

project stock

3.7 mln tons

of oil production

Outlook

If well drilling produces positive results, the prospect of developing oil resources in northern Cuba is a feasible task in the foreseeable future. However, an industry solution for using the oil that is produced needs to be found.

OBJECTIVES OF THE INNOVATIVE ENTHALPY PROJECT:

- ▶ Achieve target production levels at the Boca de Jaruco field
- ▶ Develop Huff and Puff (HNP)/SAGD modeling and design technologies
- ▶ Develop approaches to characterizing bitumen-bearing formations
- ▶ Develop technological processes for the production and processing of bitumen
- ▶ Develop technologies to monitor development using thermal methods
- ▶ Develop expertise among specialists on thermal EORM.

Jointly with Kazan (Volga) Federal University, Zarubezhneft conducted R&D on the development of a technology to increase the oil recovery of high-viscosity oilfields using catalytic aquathermolysis. The technology allows for the intensification of in-situ enrichment of heavy oil in steam-heat processing, which will improve the quality of oil produced, reduce its viscosity, and ultimately improve the energy and economic efficiency of the Boca de Jaruco field (and potentially other similar fields in the heavy oil belt of Cuba and other countries). On November 26, 2019, pilot testing of this technology began at well BH-3003; the pilot project was completed in 2020.

While working on the project, the Company achieved impressive results through the use of unique technologies and innovative approaches:

- ▶ Production infrastructure was built for oil production and steam injection into the reservoir
- ▶ Heavy oil flows with start-up flow rates of more than 20 tons/day were obtained from the M formation for the first time
- ▶ The steam-oil factor was reduced by almost 89% to 2.9 tons of steam/ton of oil per well
- ▶ Energy return on investment (EROI), a ratio that measures the amount of usable energy delivered from an energy source versus the amount of energy used to obtain said energy resource, per well increased fivefold to 5.1, which is on par with cost-effective projects worldwide. EROI is projected to continue growing.

5.1

EROI (energy return on investment) in the Enthalpy project, which is at the level of profitable projects around the world. EROI is forecast to continue to grow.

Introduction of technologies to develop low-permeability and unconventional reservoirs. Tight oil project

In line with the global trends of recent decades, oil companies are putting assets into production with hard-to-recover reserves concentrated in low-permeability reservoirs. The so-called shale revolution in the United States has significantly increased hydrocarbon production (both oil and gas) in North America and changed the global hydrocarbon production market. Numerous estimates project that the remaining recoverable shale resources exceed 50 billion tons.

Understanding the importance of this phenomenon, Zarubezhneft expanded its resource base in 2016 with unconventional reservoirs by acquiring the Lutseyakhskoye field. The remaining recoverable reserves of the Achimov deposits in Western Siberia, listed in the State Balance of the Russian Federation, exceed 2 billion tons, which creates broad prospects for increasing the Company's resource base and oil production if the Achimov deposits of the Lutseyakhskoye field are successfully commissioned.

Zarubezhneft is implementing new projects with hard-to-recover reserves. To effectively develop complex hydrocarbon reserves, Zarubezhneft has initiated and is actively implementing the comprehensive innovative Tight Oil project. The strategic goal of the project is to develop solutions to improve the efficient development of low-permeability reservoirs and to increase their oil recovery factor as a result.

OBJECTIVES OF THE INNOVATIVE TIGHT OIL PROJECT:

- ▶ Reduce the construction time and cost of horizontal wells with multistage hydraulic fracturing (MSHF) (work with equipment and materials rates and cost)
- ▶ Extend the horizontal well section up to 2–3 km without significantly increasing well costs
- ▶ Develop optimal hydrofracturing techniques for low-permeability reservoirs (selection of optimal equipment and materials: design, number of stages/clusters, pumping speed, etc.)
- ▶ Organize an effective system of NPRI with water injection
- ▶ Adapt tertiary enhanced oil recovery methods based on gas injection (HC, nitrogen, and air) and their derivatives (Huff & Puff and foam compounds)
- ▶ Conduct a comprehensive study of reservoirs (core, WLS, geochemistry, geomechanics, standards, etc.)

INCREASING THE EFFICIENT DEVELOPMENT OF LOW PERMEABLE RESERVOIRS

PROJECT

Making well designs more complex in low-power zones of ZARUBEZHNEFT-Dobrycha Kharyaga (ZNDK) and radio-frequency surveying

TIGHT OIL

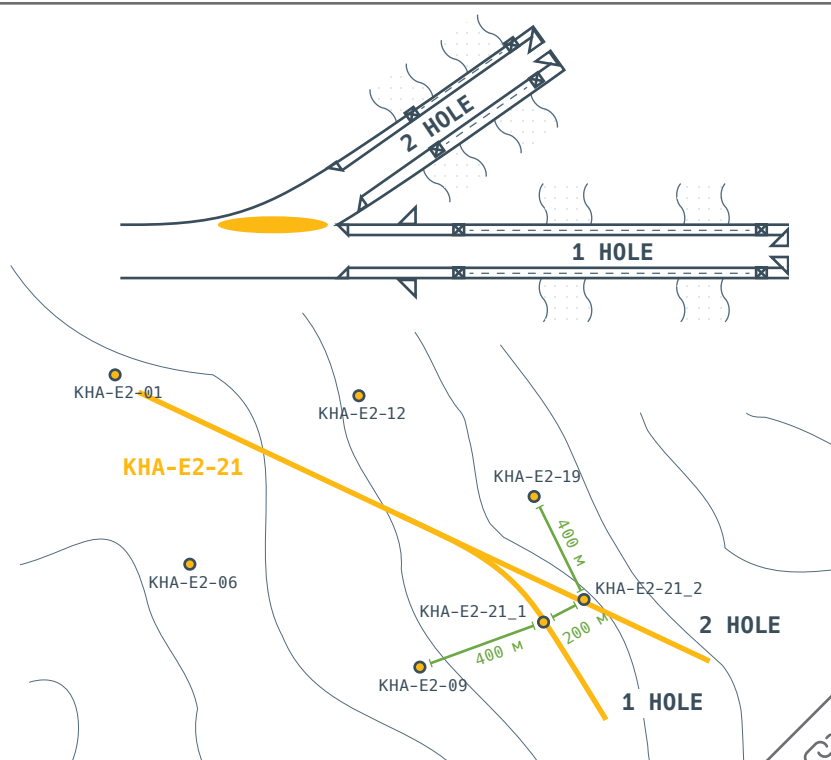
successfully drilled wells in 2020:

2 horizontal wells (HW) in radio-frequency surveying and ZNDK

1 Multilateral well at ZNDK

1 Black shale with MSHF at ZNDK

≤17 mln tons potential for development



Exploration of submerged dense oligocene formations in Block 09-1 with HF

TESTING DEEP LAYERS WITH HF

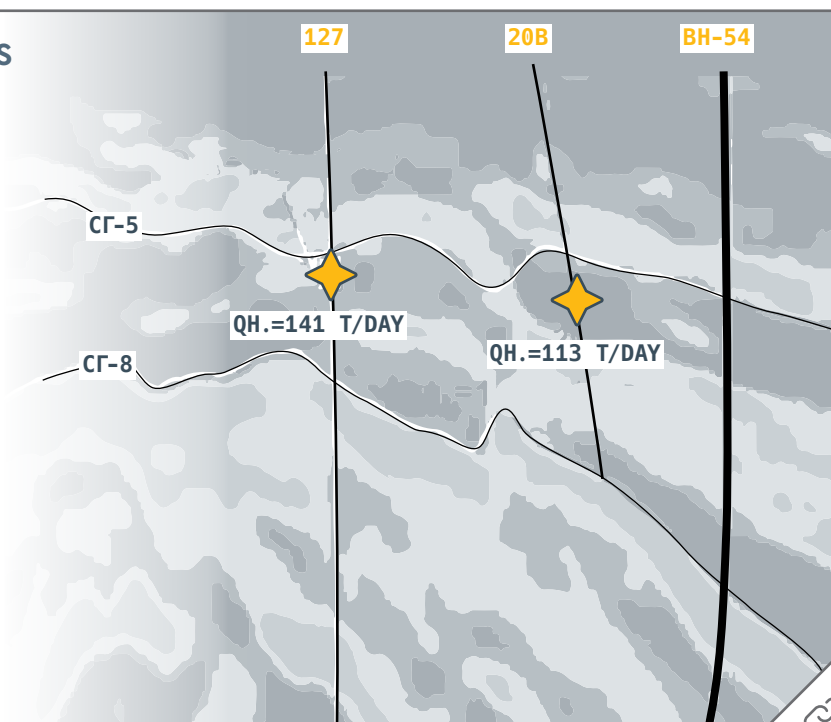
>4 thousand m

In exploration wells BT-54 and BT-57

They previously provided non-industrial oil inflows, were not on the balance sheet, and were not developed

>5 mln tons

potential for reserve growth





For more information
see the Company's website

Lutseyakhskoye field

~7 mln tons

of recoverable reserves

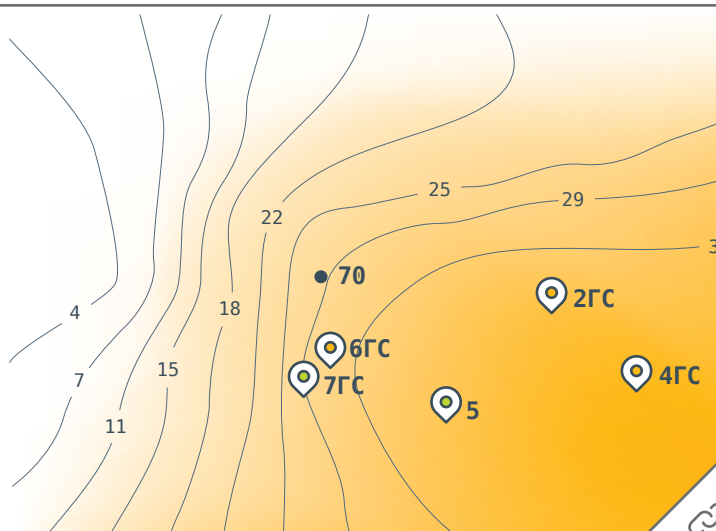
4000 thousand m²

deposit area

~0.1 mD

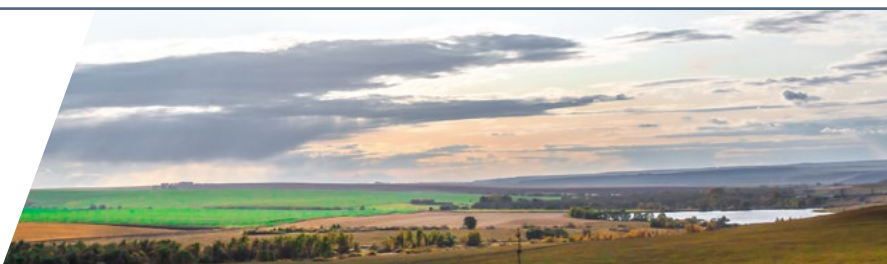
permeability

- ▶ Hard-to-recover reserves of the Achimov deposits
- ▶ Formation of a pilot plot 2020-2021



Salym plots no. 3 And no. 5

- ▶ Horizontal well with 15 HF stages
- ▶ Natural oil flow



In order to achieve the strategic goals of the Tight Oil project in 2020, the following work was carried out on sub-projects:

- ▶ Implementation and support of the pilot project at the Lutseyakhskoye field
- ▶ Selection and adaptation of low-permeability core survey methods
- ▶ Design of HF for conditions at the Lutseyakhskoye field

Key Tight Oil project results in 2020

- ▶ In 2020, JC RUSVIETPETRO drilled the first horizontal well at the low-permeability, thin D3fmIV formation. The well was launched with a flow rate of 50 tons per day. Two additional horizontal wells will be drilled and fractured at this location with HF in 2021. If the results are successful at the pilot project stage, this technology will make it possible to develop more than 15 million tons of geological reserves at the D3fmIV formation, which currently are not being developed by JC RUSVIETPETRO.
- ▶ ZARUBEZHNEFT-Dobycha Kharyaga drilled the first two-hole well to the edge zone of the D3fm formation with a flow rate of more than 100 tons per day. The Company plans to replicate the technology in 2021.
- ▶ Zarubezhneft drilled a horizontal well with a 15-stage HF operation at the Bazhenov deposits for the first time. An oil flow to the surface was obtained, and tests are in progress.
- ▶ Drilling began on a pilot project section at the Achimov deposits of the Lutseyakhskoye field (Yamalo-Nenets Autonomous Area (YNAO)), which has permeability of about 0.1 mD. The Company plans to drill four horizontal and one directional well. Within the pilot project section, the plan is to select the optimal technology for multistage fracturing and ways to influence the reservoir in order to increase the efficiency of oil displacement from low permeability formations.
- ▶ The Company launched R&D to create a geo-mechanical model of the Lutseyakhskoye field to optimize HF.
- ▶ A specialized program of low-permeability core research based on the best domestic and foreign practices has been prepared and is being implemented