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GLOBAL OUTLOOK UNTIL 2040:
POTENTIAL IMPACT OF SHALE OIL AND GAS TECHNOLOGICAL BREAKTHROUGH ON THE LIQUID FUEL AND GAS MARKETS

WEC, Daegu
14 October, 2013

Methodology and assumptions

Baseline scenario: liquid fuel market

Baseline scenario: gas market

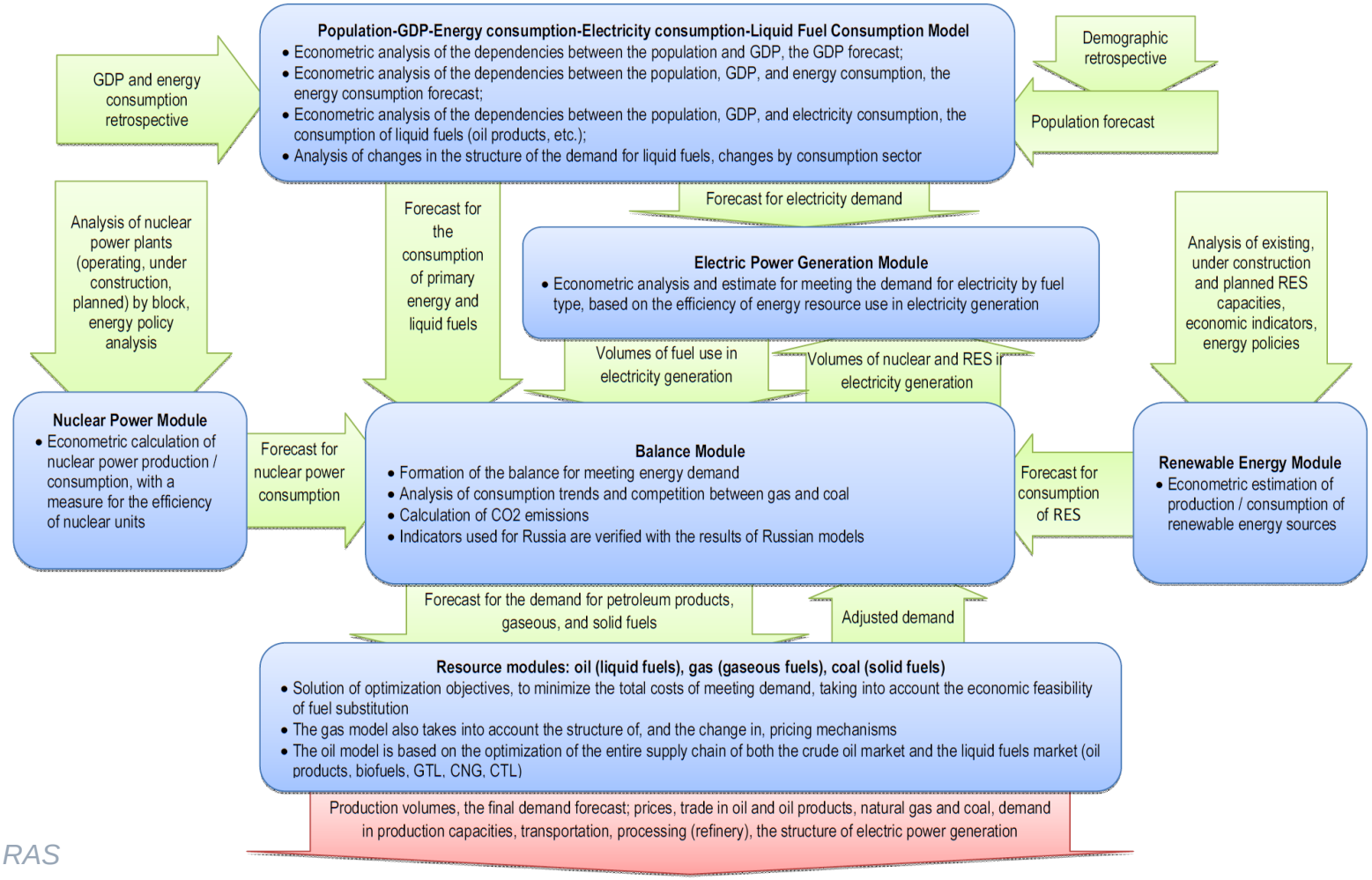
Shale Breakthrough scenario

The main **objective of this study** is to evaluate the actual trends in the global hydrocarbon markets, as well as their changes resulting from shale oil and gas production technological breakthroughs.

Two scenarios were developed:

- **A Baseline scenario** which shows the evolution of world energy and fuel markets based primarily on existing technologies
- **Alternative scenario based on the success** of the new technological breakthroughs in the production of shale oil and gas

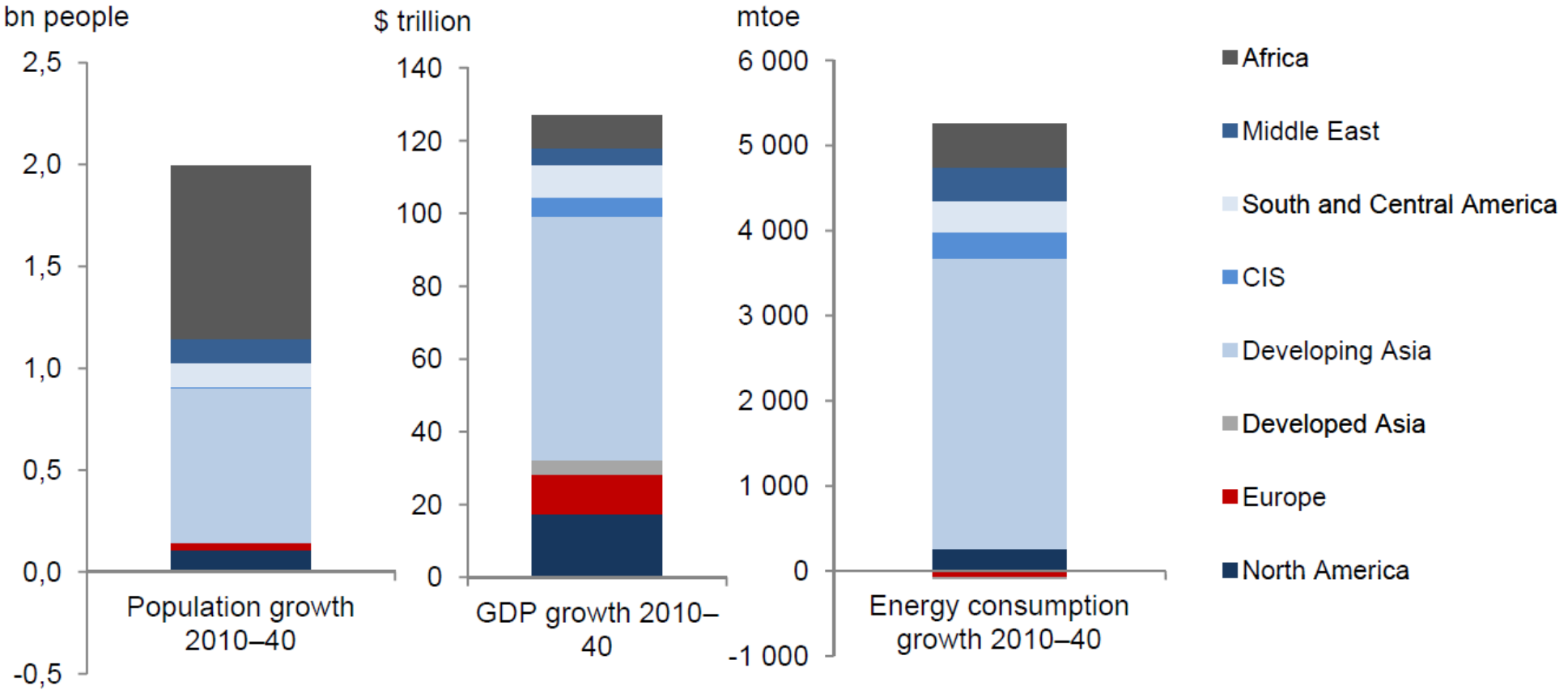
Modelling methodology



Source: ERI RAS

Main scenario assumptions

Population growth, GDP, and energy consumption by region



Source: ERI RAS

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Baseline scenario: liquid fuel market

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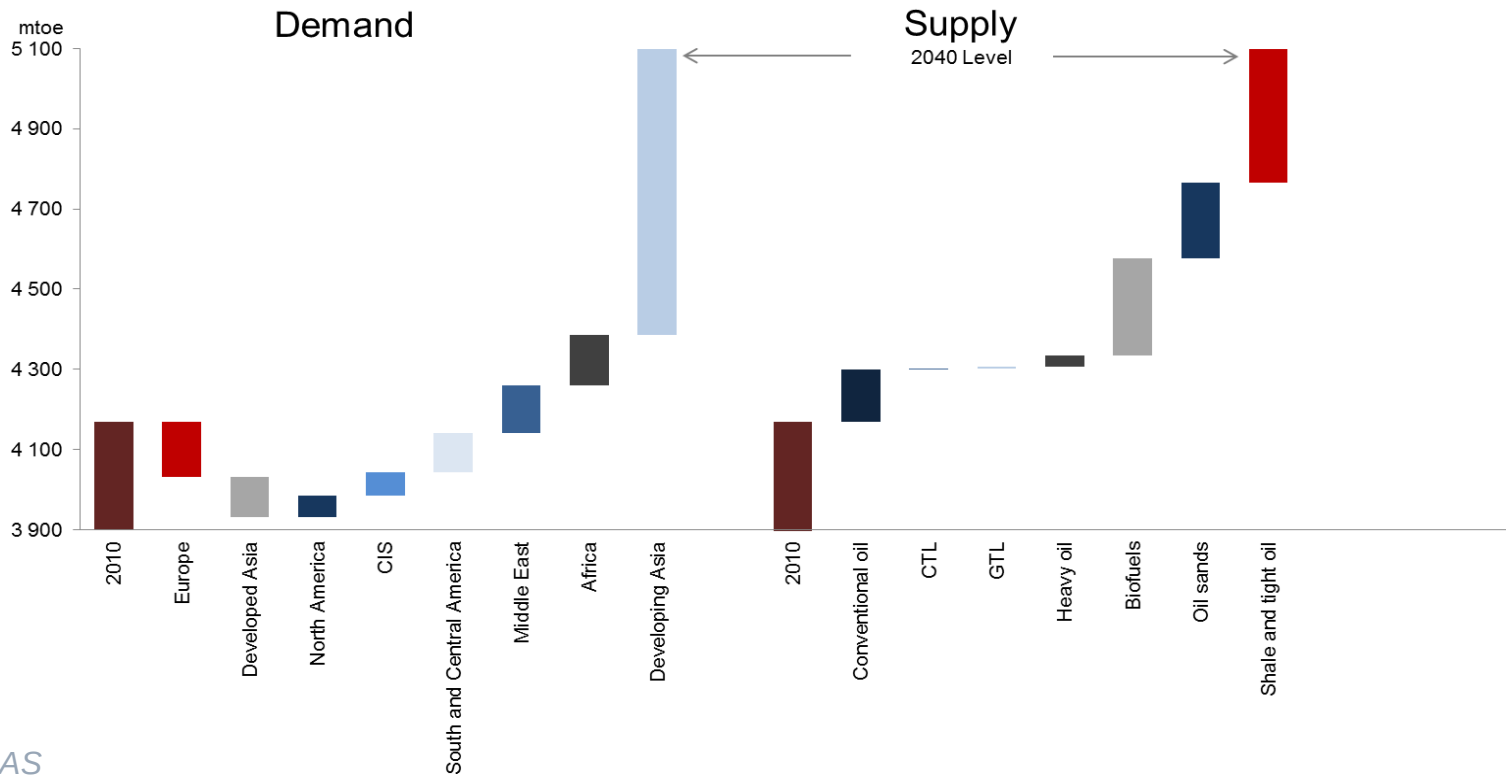
Shale Breakthrough scenario

Huge shifts on the liquid fuels market are foreseen even in the Baseline scenario

Liquid fuel supply and demand balance by 2040

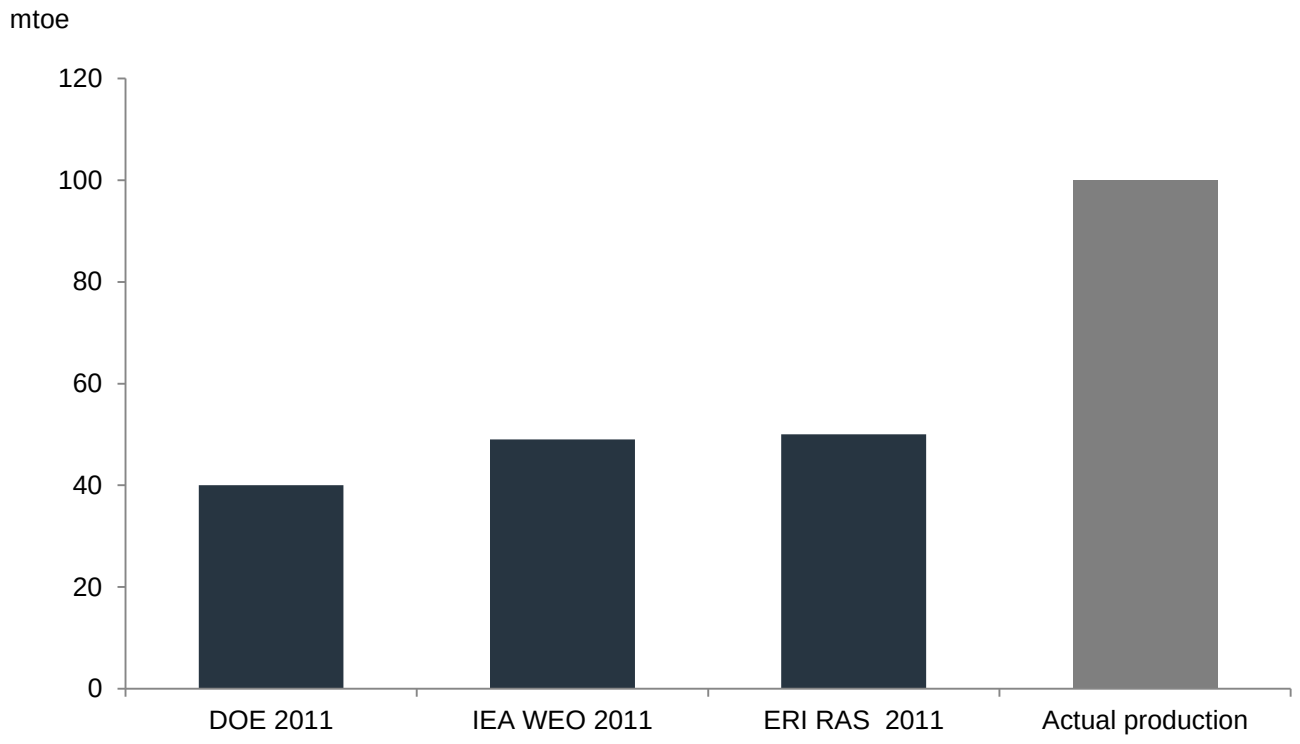


Source: ERI RAS

More than 60% of incremental demand for liquids will come from the developing Asia. More than 70% of the incremental supply will be covered by different types of unconventional liquids, which will dramatically change all structure of the global oil trade and pricing.

Unconventional oil potential, especially for low-permeability of US shale formations, has been evidently underestimated

Evaluated and actual oil production from shale formations in the USA in 2012

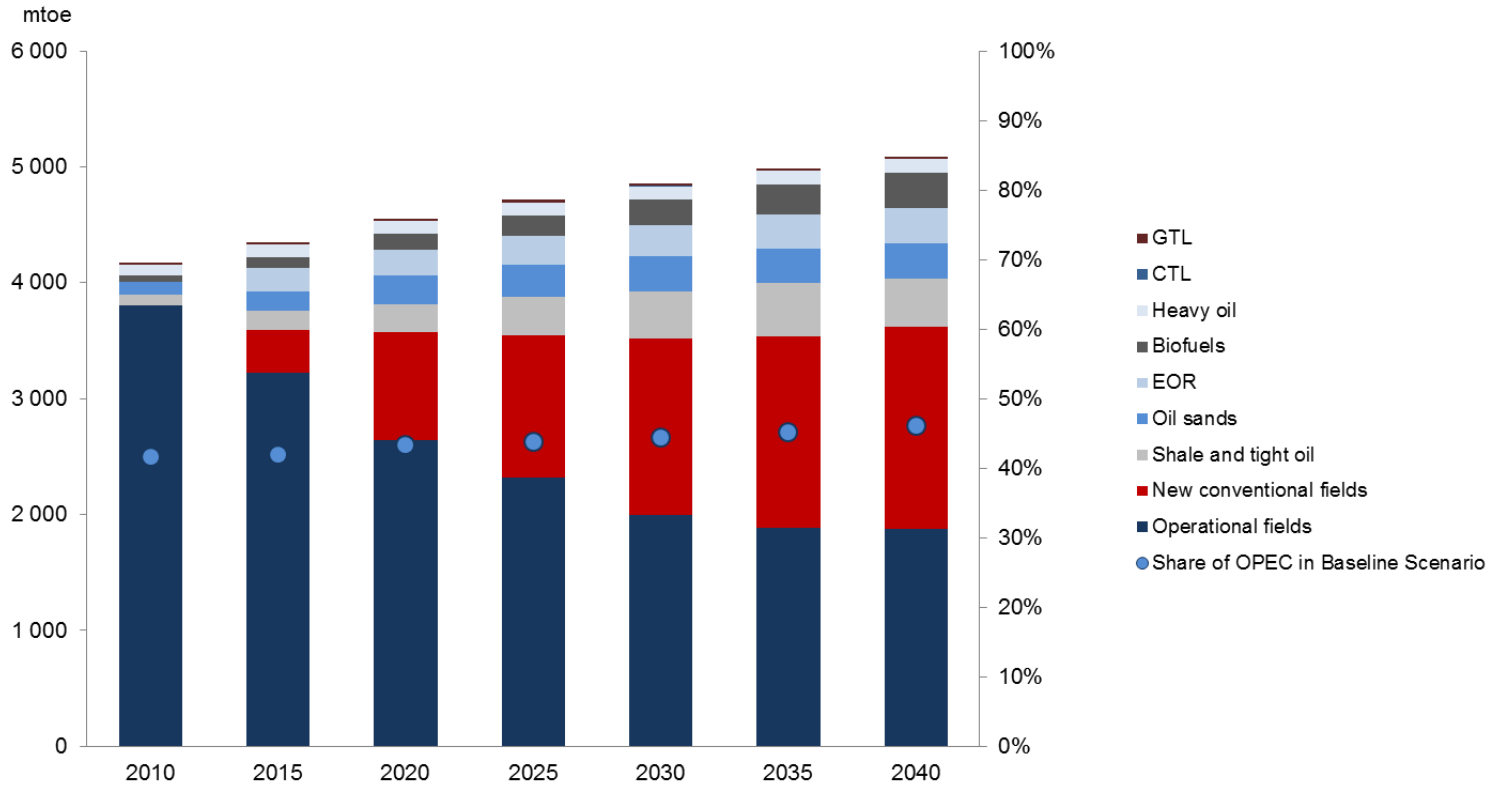


Source: ERI RAS

OIL PRODUCTION FROM SHALE PLAYS HAS INCREASED FROM 8M TONS IN 2007 TO 100M TONS PRODUCED IN 2012. SUCH A PACE IN THE DEVELOPMENT OF UNCONVENTIONAL OIL TURNS THE YESTERDAY'S "SHALE" SCENARIOS IN THE TODAY'S "BASELINE" ONES. IN OUR BASELINE SCENARIO, THE GLOBAL OIL PRODUCTION FROM THE SHALE PLAYS IS ESTIMATED TO REACH 420M TONS BY THE END OF THE FORECAST PERIOD AND IT WILL BE MOSTLY PROVIDED BY THE NORTH AMERICAN PLAYS.

Unconventional oil will reach 16% of total production

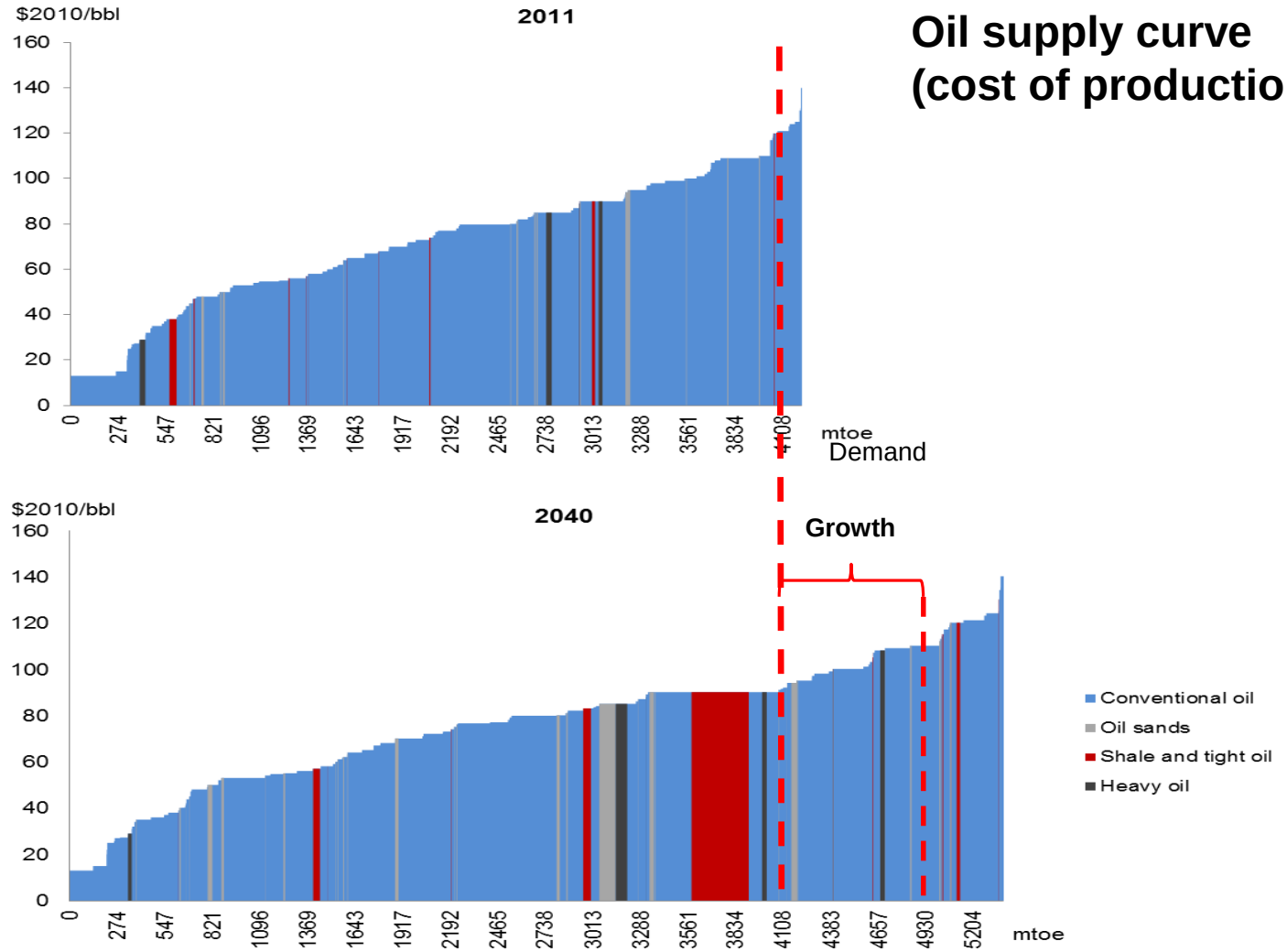
Dynamics of liquid fuels supply structure, Baseline Scenario



Source: ERI RAS

UNCONVENTIONAL OIL (SHALE OIL, TAR SANDS OIL, ETC.) WILL REACH 16.4% OF THE TOTAL PRODUCTION (837M TONS BY 2040). THE REMAINING SUPPLY VOLUMES IN 2040 WILL BE PROVIDED BY BIOFUEL (5.9%) AND LIQUID FUELS PRODUCED FROM NATURAL GAS AND COAL, WHICH WILL AMOUNT TO JUST 23M TONS.

By 2040, the supply of oil will increase by 1 bn tons
There are no fundamental reasons for significant growth of oil prices at the forecasted levels of demand

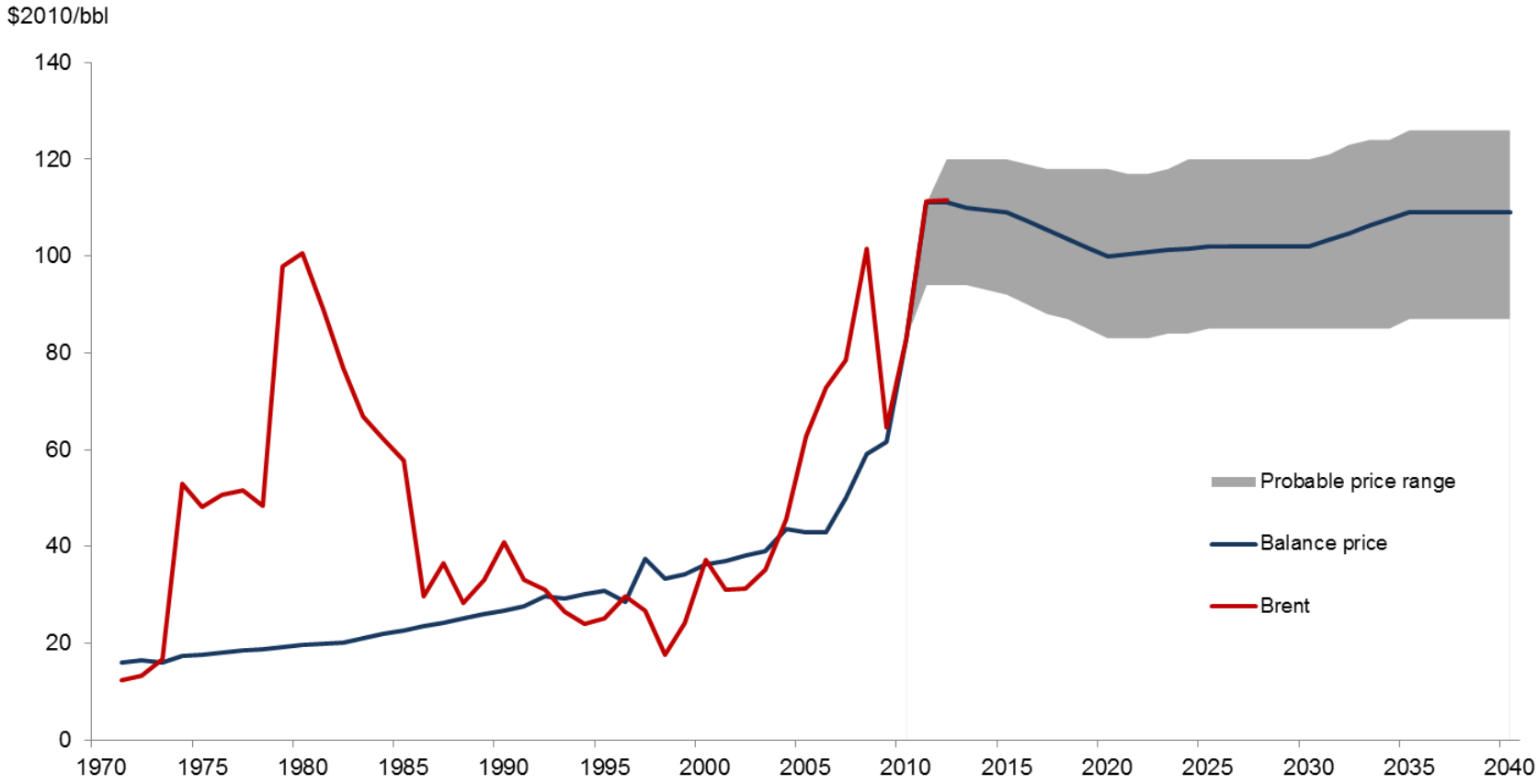


Oil supply curve (cost of production)

Source: ERI RAS

Equilibrium oil prices will remain within the price range corridor 90-120 $/bbl, defined as the possible deviation of local oil markers in European, North American, and Asian markets

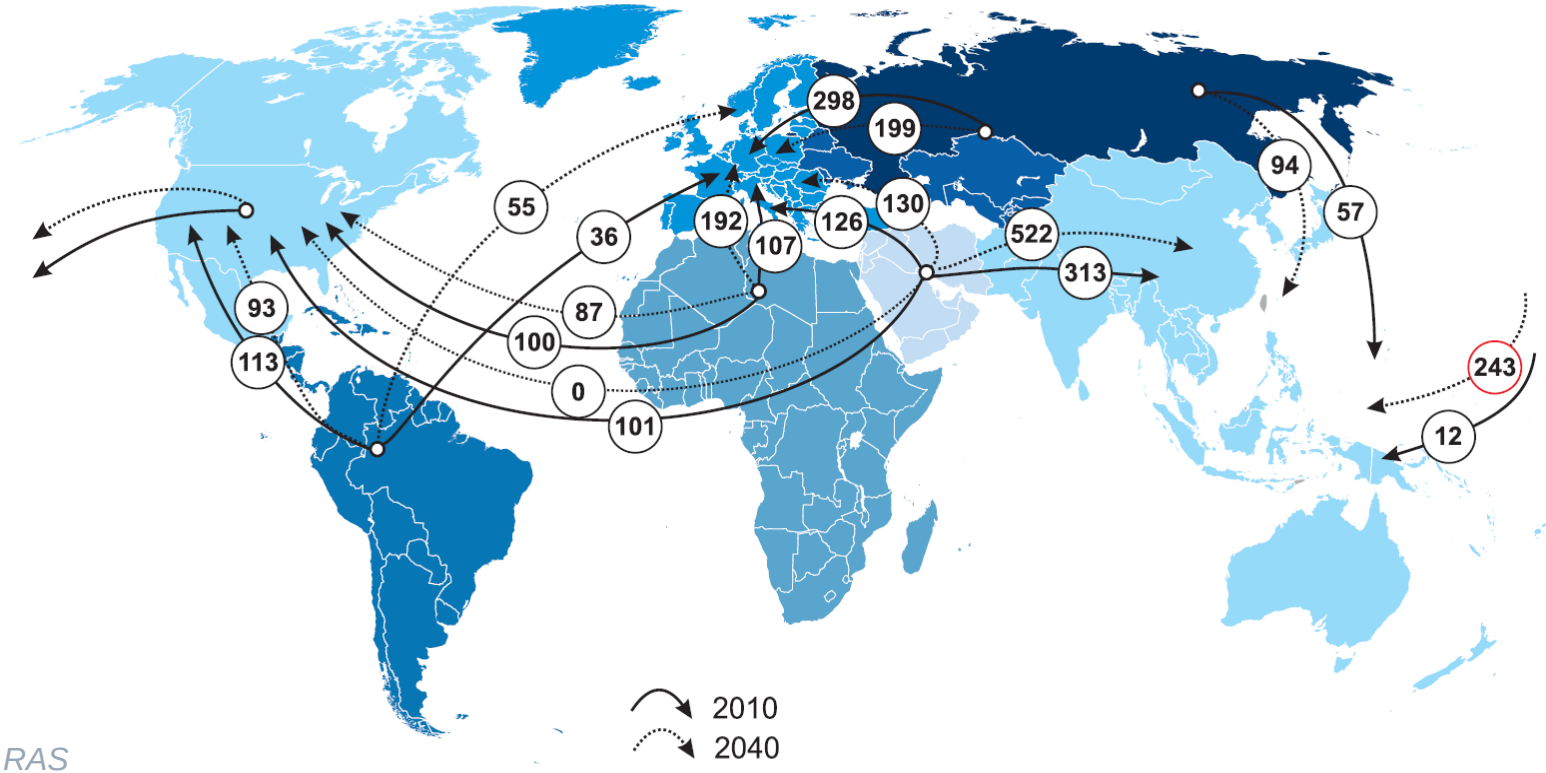
Projected price range of equilibrium oil prices



Source: ERI RAS

Trade flows in the oil market will change fundamentally y 2040: export market niches will narrow by 275 m tons for key producers, compared to 2010

Main directions of oil flows, million tons



Source: ERI RAS

THE VOLUMES OF OIL IMPORTS TO EUROPE WILL REDUCE DUE TO THE DECREASE IN THE UTILIZATION LEVEL OF EUROPEAN REFINERIES AND STAGNANT DEMAND. DUE TO THE GROWTH IN OIL PRODUCTION FROM THE US SHALE FORMATIONS AND CANADIAN TAR SANDS, THE NORTH AMERICA WILL BECOME A NET EXPORTER AFTER 2025 ALREADY. THE MOST PROMISING MARKET FOR CRUDE OIL IS THE APR - THE ONLY REGION WHERE IMPORTS INCREASED COMPARED TO 2010.

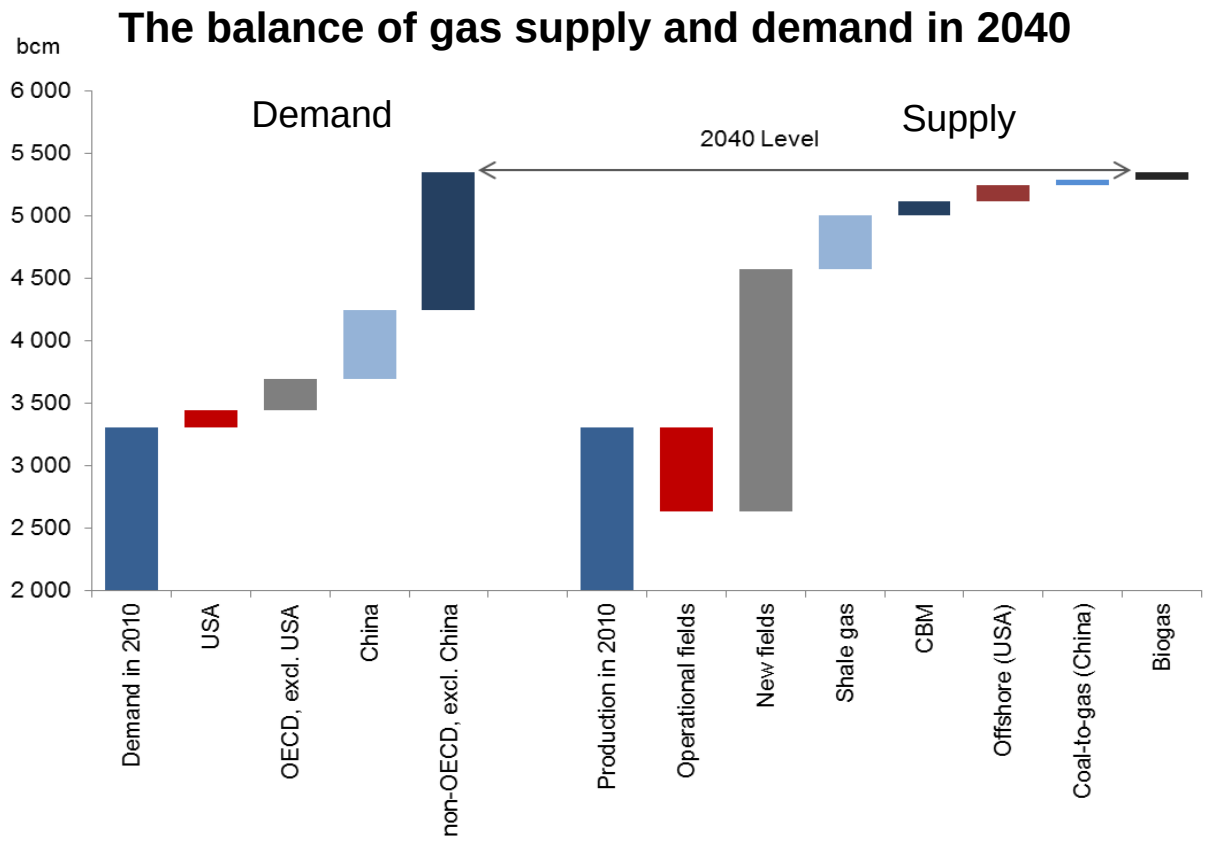
Methodology and assumptions

Baseline scenario: liquid fuel market

Baseline scenario: gas market

Shale Breakthrough scenario

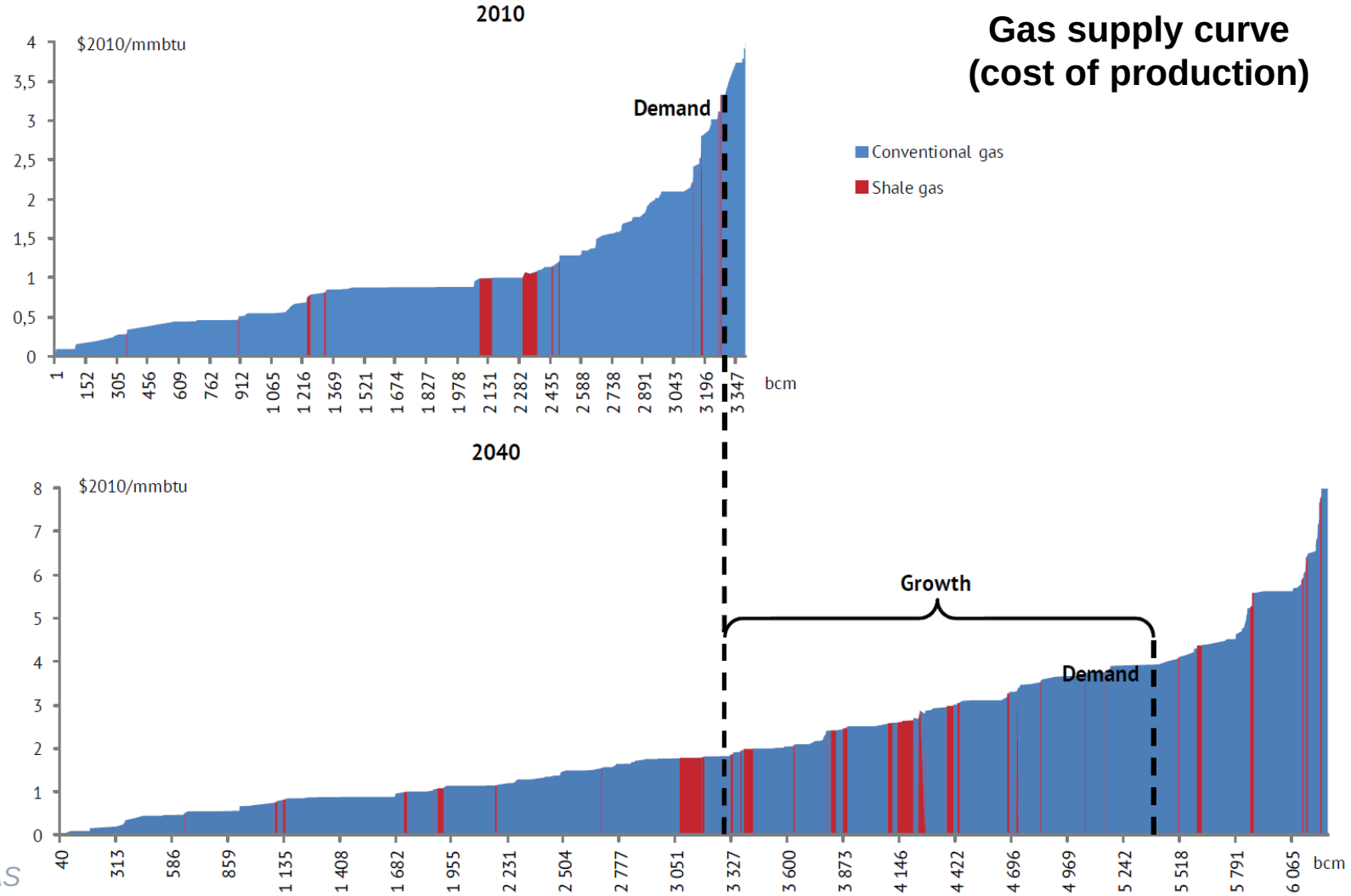
Gas market remains more traditional



Source: ERI RAS

BY 2040 GLOBAL GAS DEMAND WILL INCREASE BY 60%, MAINLY DRIVEN BY THE POWER SECTOR, WHERE GAS IS AN IDEAL ENVIRONMENTALLY FRIENDLY FUEL TO COVER GROWING DEMAND FOR FLEXIBLE ELECTRICITY SUPPLY. ANOTHER EXTREMELY PROMISING GAS APPLICATION IS GAS USE FOR THE TRANSPORTATION SECTOR – IT IS DRAMATICALLY IMPROVE AIR QUALITY AND HAS MUCH SMALLER FOOTPRINT FOR LOWER PRICE. GAS SUPPLY ADDITIONS WILL BE MAINLY PROVIDED BY THE NEW CONVENTIONAL FIELD DEVELOPMENT.

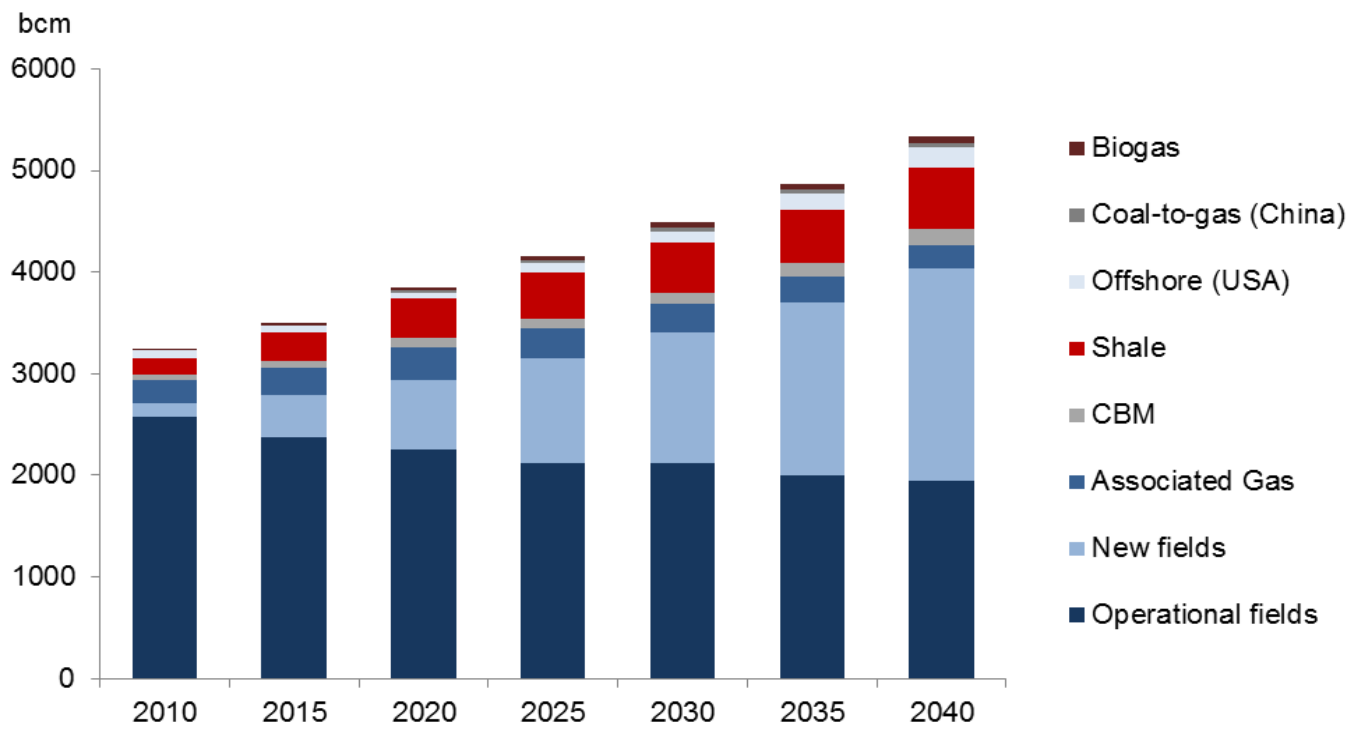
By 2040 it will be necessary to expand gas production by 2 tcm, there are sufficient reserves which can be produced at less than 4 $/Mbtu



Gas supply curve (cost of production)

Source: ERI RAS

Unconventional gas will reach 15% of the global production by 2040

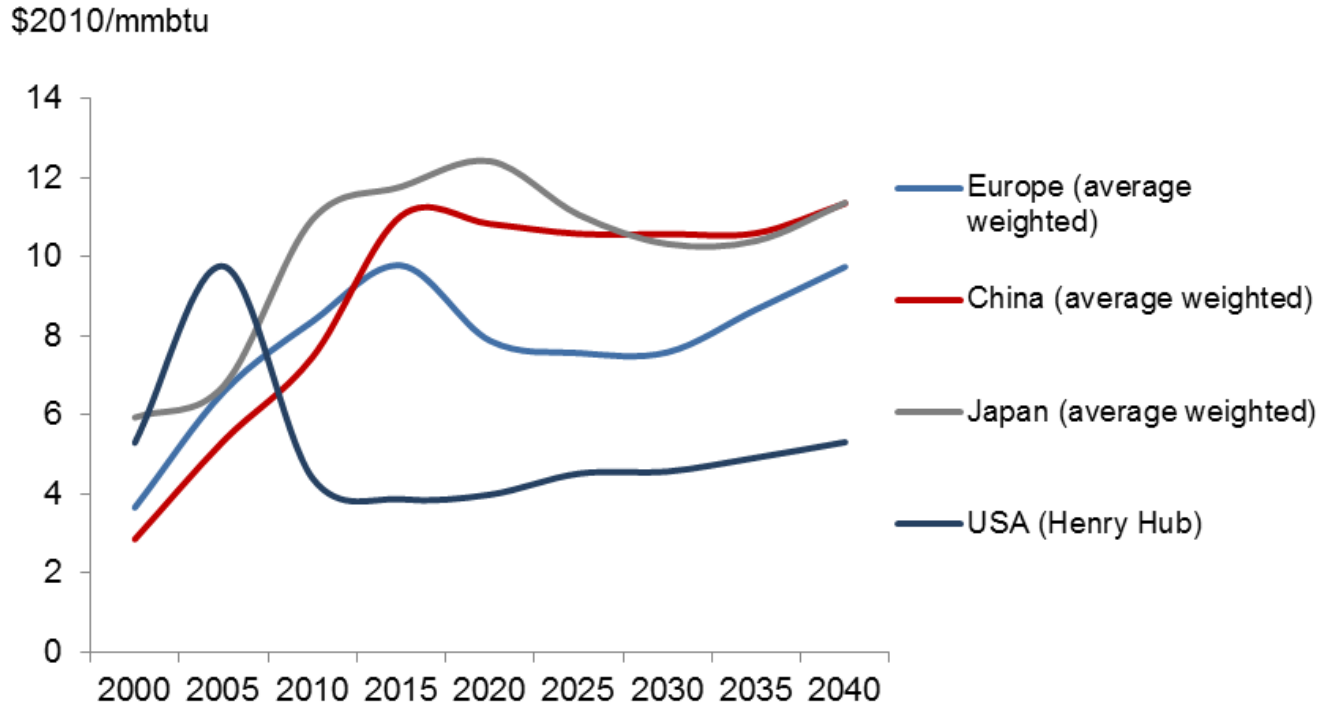


Source: ERI RAS

MAJOR PRODUCTION GAINS WILL BE PROVIDED BY NEW RESERVES OF CONVENTIONAL GAS AND FURTHER EXPANSION OF UNCONVENTIONAL GAS, WHICH BY 2040 WILL MAKE 15% OF THE WORLD GAS PRODUCTION (11% - SHALE GAS, 3% - COAL-BED METHANE AND 1% - BIOGAS). NORTH AMERICA WILL SHOW THE LARGEST INCREASE OF UNCONVENTIONAL PRODUCTION. IN THE BASELINE SCENARIO ASIDE FROM THE NORTH AMERICA SHALE GAS PRODUCTION WILL NOT EXCEED 70 BCM IN TOTAL BY 2040.

Gas prices will exceed the current levels only by the end of the forecasting period

Forecasted average weighted price* of gas by regional markets, Baseline Scenario



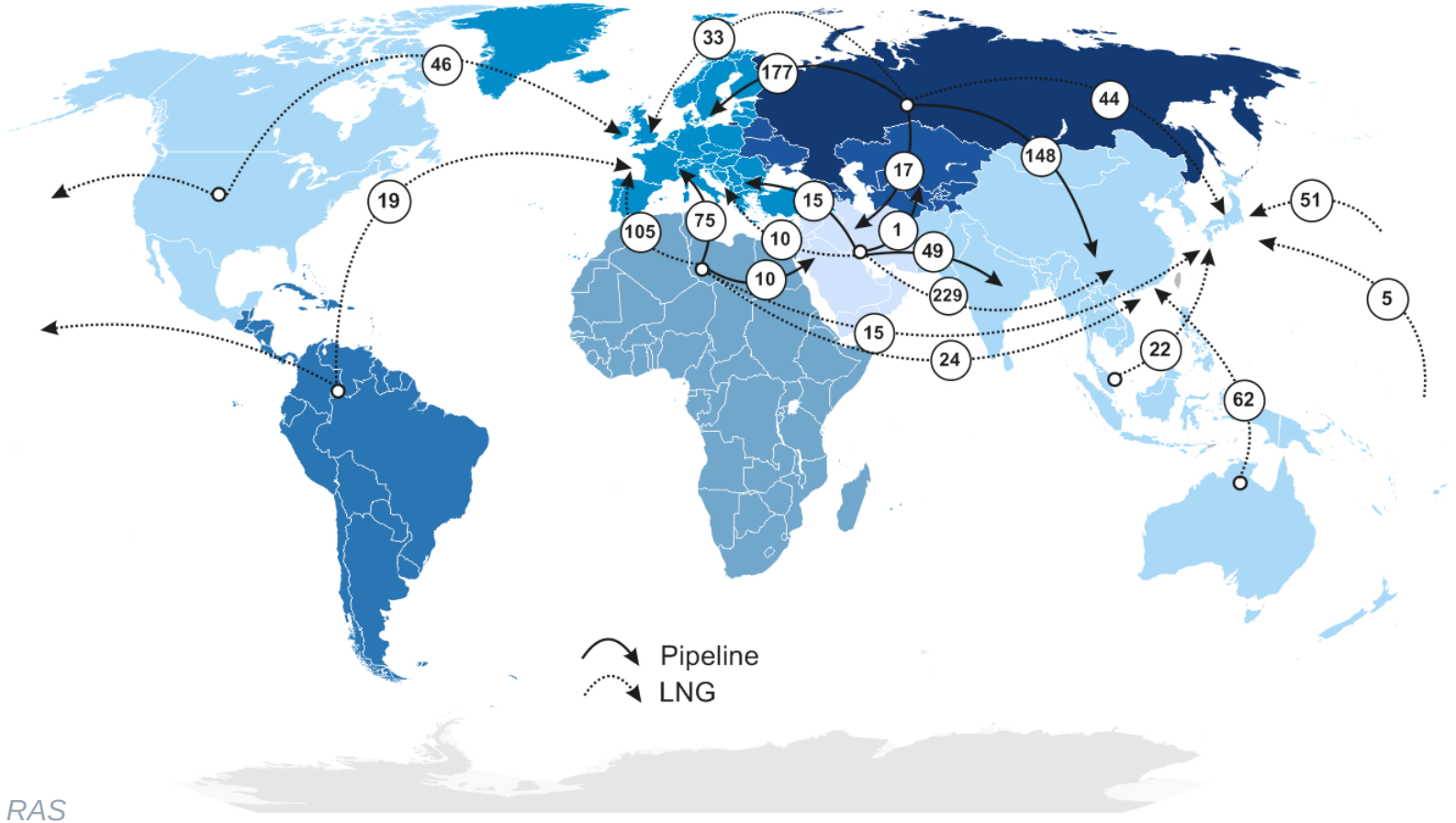
Source: ERI RAS

** Weighted average price between the prices of long-term contracts linked to alternative fuels, and spot prices.*

THE SIGNIFICANT DIFFERENCE OF REGIONAL GAS PRICES, WHICH TOOK PLACE IN 2006-2012, WILL REMAIN, PRICES WILL OVERCOME CURRENT LEVELS ONLY BY THE END OF THE PERIOD.

For the next three decades, the main focus of the international gas trade will be Asia which will increase its net imports by nearly 500 bcm by 2040

Inter-regional gas trade in 2040, bcm



Source: ERI RAS

Positions of the key market players: there will be a redistribution of the influence in the Baseline Scenario

Country/group	Market power
USA	
OPEC	
Exporting non-OPEC producers	
Russia	
China	

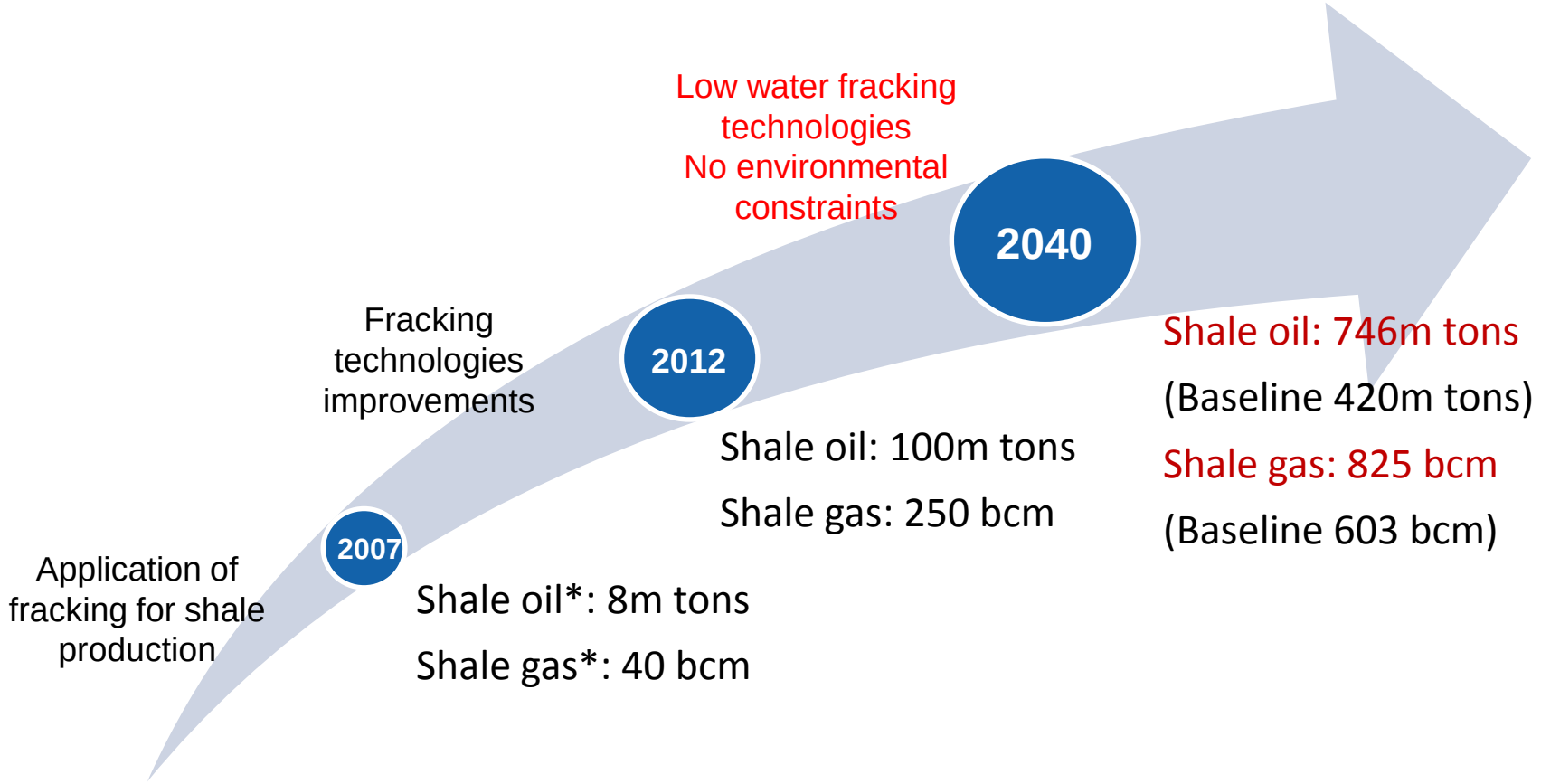
Methodology and assumptions

Baseline scenario: liquid fuel market

Baseline scenario: gas market

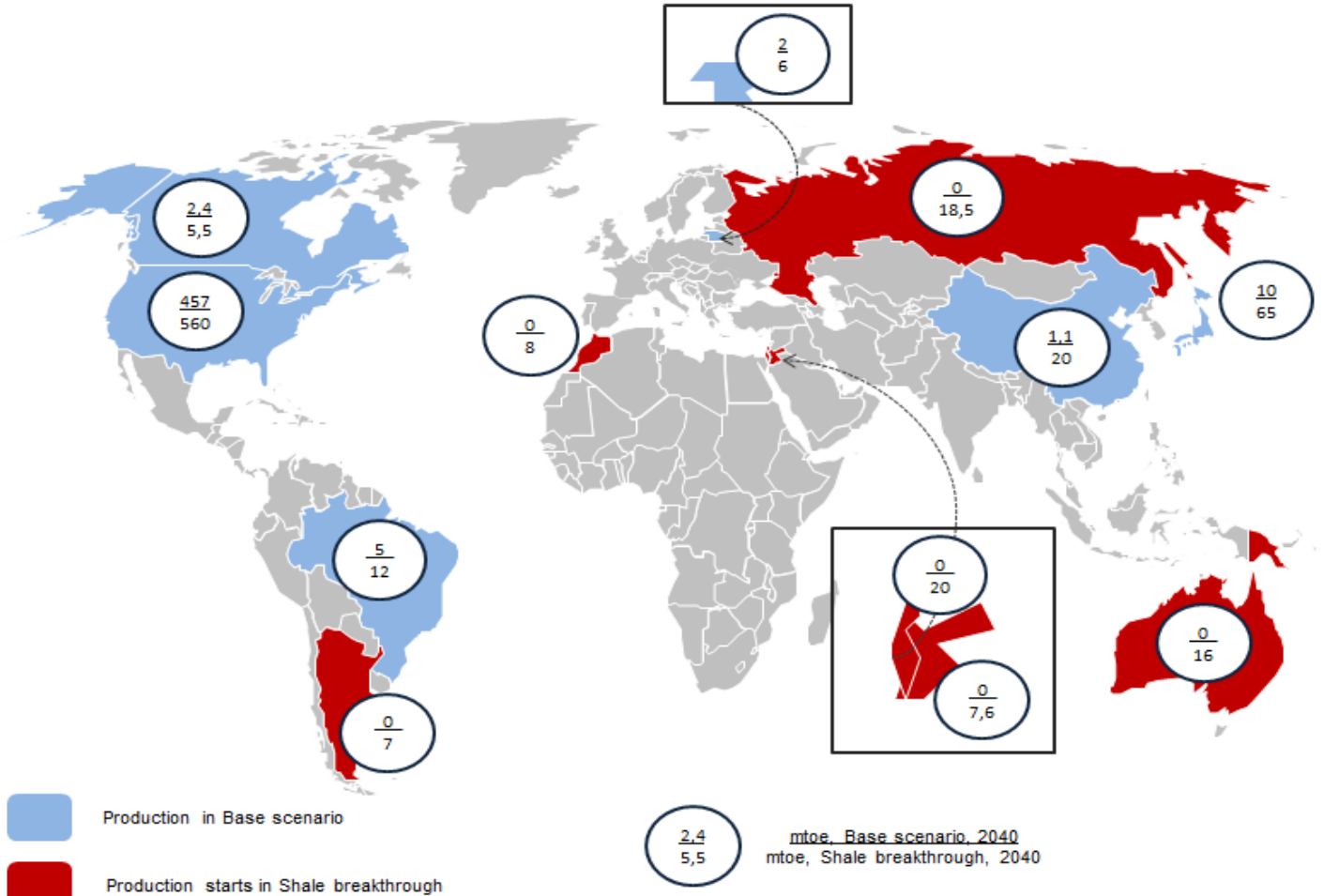
Shale Breakthrough scenario

Shale Breakthrough scenario assumptions: removing cost and environmental constraints



In Shale Breakthrough production of shale oil will become possible in the countries where oil has never been produced

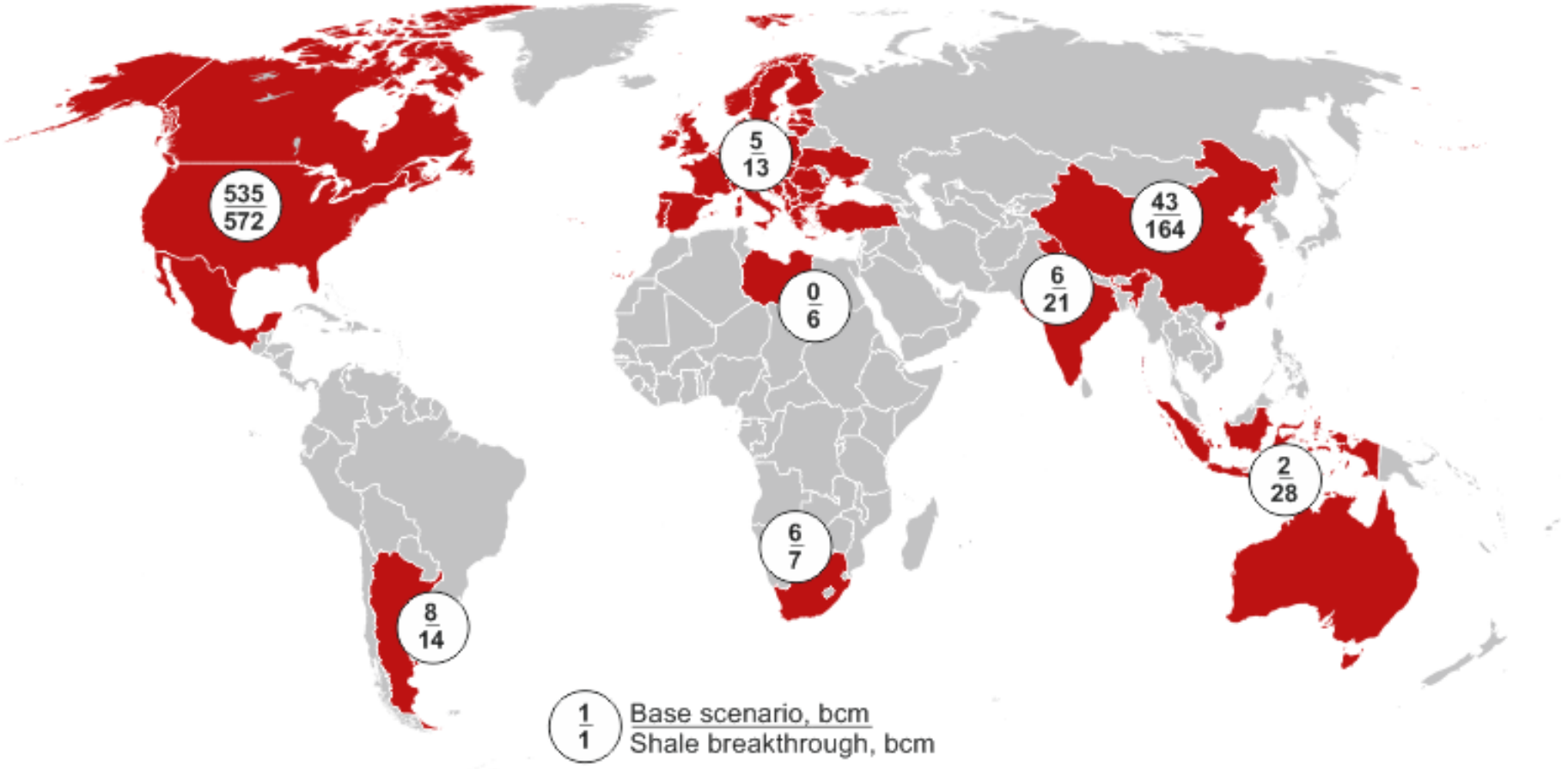
Shale Oil Production in 2040, Baseline and "Shale Breakthrough" Scenarios



Source: ERI RAS

In Shale Breakthrough production of shale gas will increase in the non-US regions – especially in China

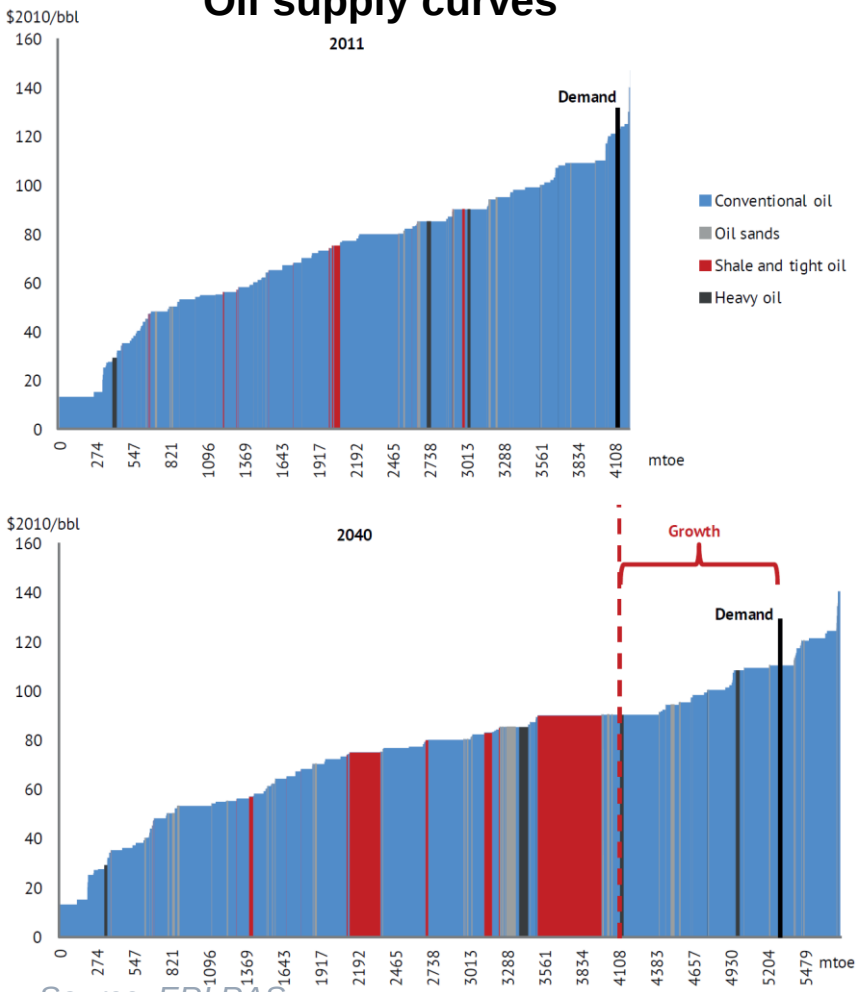
Shale Gas Production in 2040, Baseline and "Shale Breakthrough" Scenarios



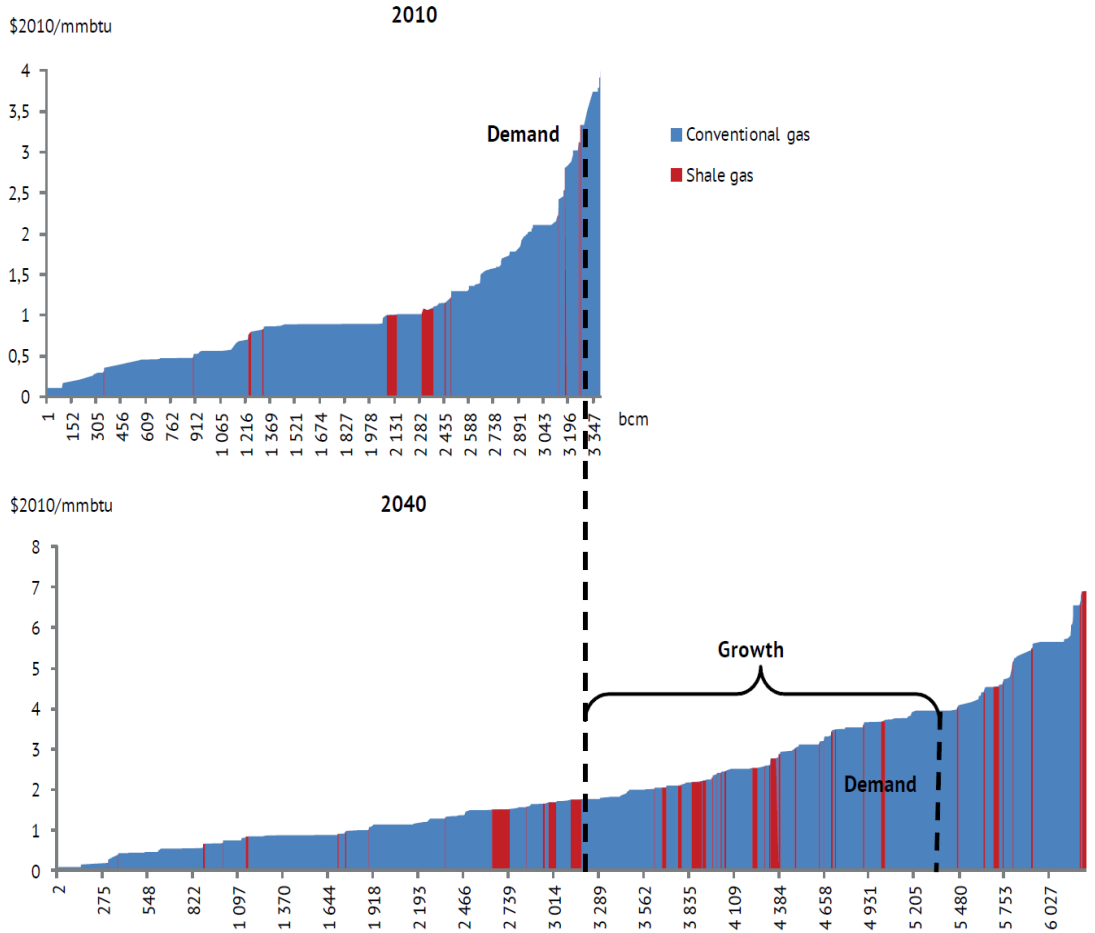
Source: ERI RAS

In the Shale Breakthrough, the oil and gas supply curves are considerably expanded and get more flat, which means an increase in the supply of oil and gas in the mid-price range

Oil supply curves



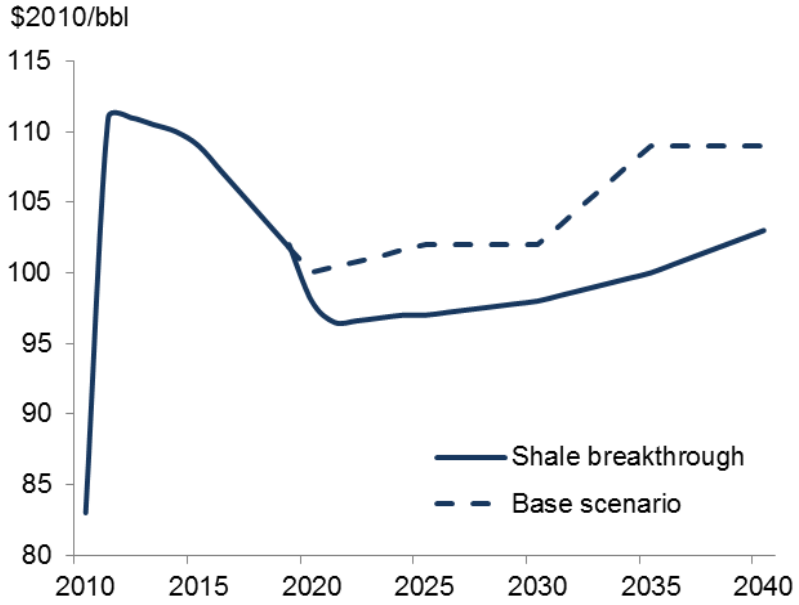
Gas supply curves



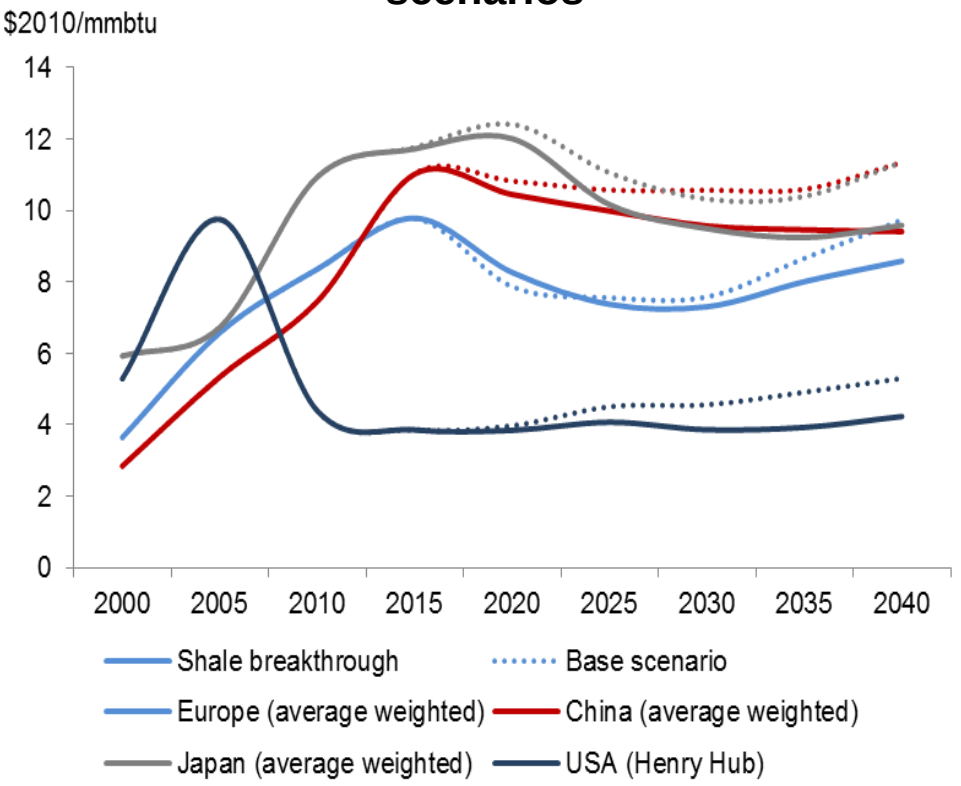
Source: ERI RAS

The Impact of Technological Breakthroughs on oil prices

Equilibrium oil prices in two scenarios



Equilibrium regional gas prices in two scenarios

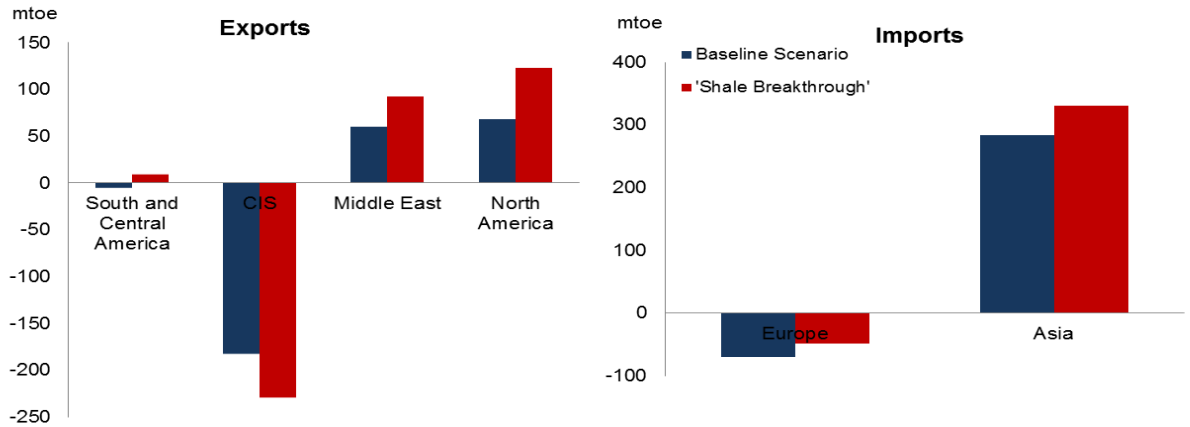


Source: ERI RAS

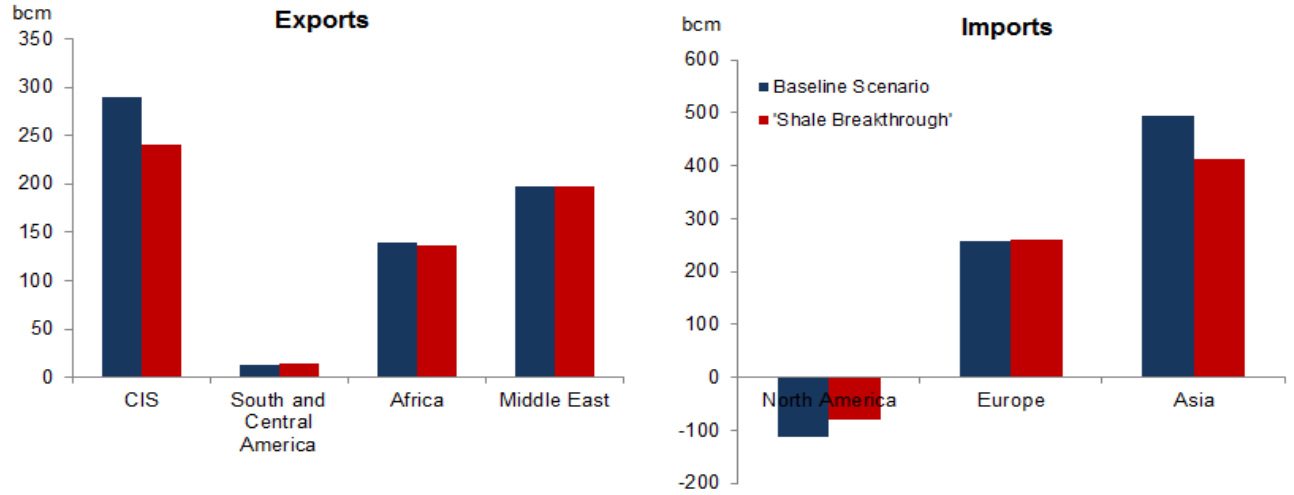
On the contrary to a widely discussed estimates, our calculations show that in the "shale breakthrough" scenario there is no significant drop in the price of oil and gas as compared to the baseline scenario (average reduction is about $5/bbl for oil and 1,5 $/Mbtu for gas).

The impact of Shale Breakthrough on the global hydrocarbon trade is contradictory

Changes of oil net export and import volumes in 2040 relative to 2010, Baseline and 'Shale Breakthrough' Scenarios



Changes of gas net export and import volumes in 2040 relative to 2010, Baseline and 'Shale Breakthrough' Scenarios



Source: ERI RAS

Changes of the market power of the key market players in two scenarios

Country/group	Market power Baseline	Market power Shale Breakthrough
USA	↑	↑↓
OPEC	↓	↓
Exporting non-OPEC producers	↓	↓↓
Russia	↓	↓↓
China	↓	↑

Conclusions

- There are no fundamental reasons for alarmist forecasts predicting either the drop of hydrocarbon prices due to the shale revolution. In all cases oil prices up to 2040 will not move out of the range 100–130 $/bbl with the similar dynamics of the gas prices.
- The expected transformation of the hydrocarbon markets will not significantly change the fuel markets themselves, but the positions of the main market participants will be noticeably rebalanced, while some of the global players will get additional influencing possibilities.

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