



Dr. Tatiana Mitrova,  
Head of Oil and Gas Department  
**Energy Research Institute**  
**Russian Academy of Sciences**

**GLOBAL OUTLOOK UNTIL 2040:**  
**Medium- to long-term outlook and scenarios for liquid fuels markets**

Moscow  
28 October, 2013



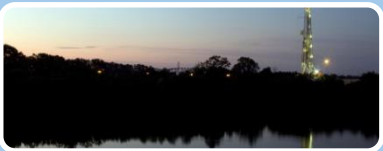
## Global trends



Baseline scenario: liquid fuel market



Baseline scenario: gas market

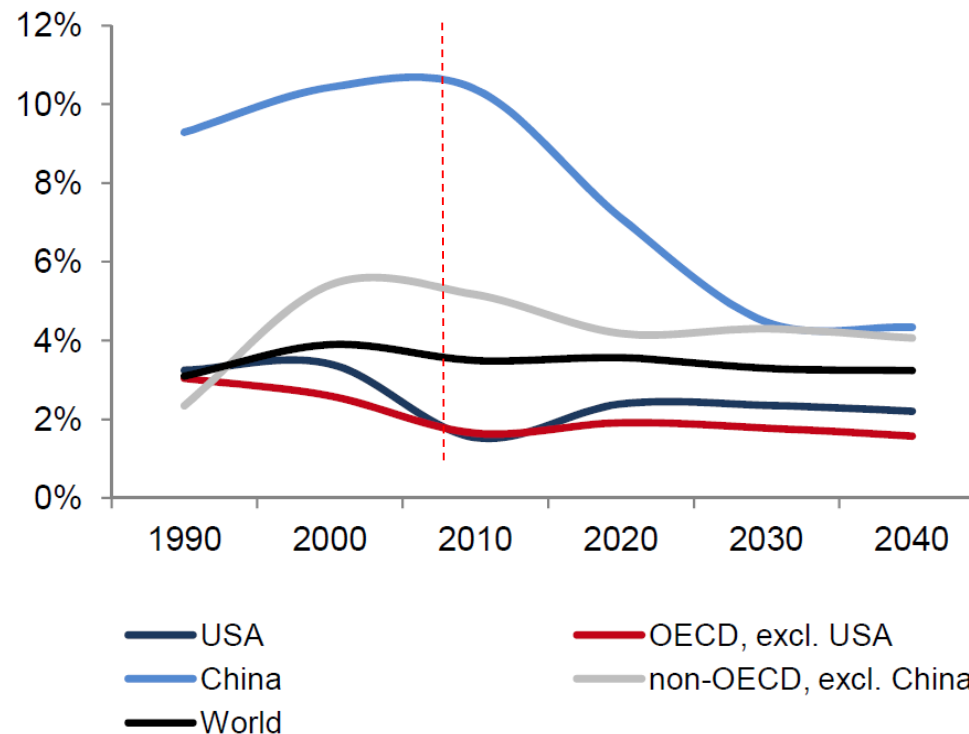


Shale Breakthrough scenario



## The protracted nature of the current global financial crisis reduces forecasts of economic and energy consumption growth

Average GDP growth by region



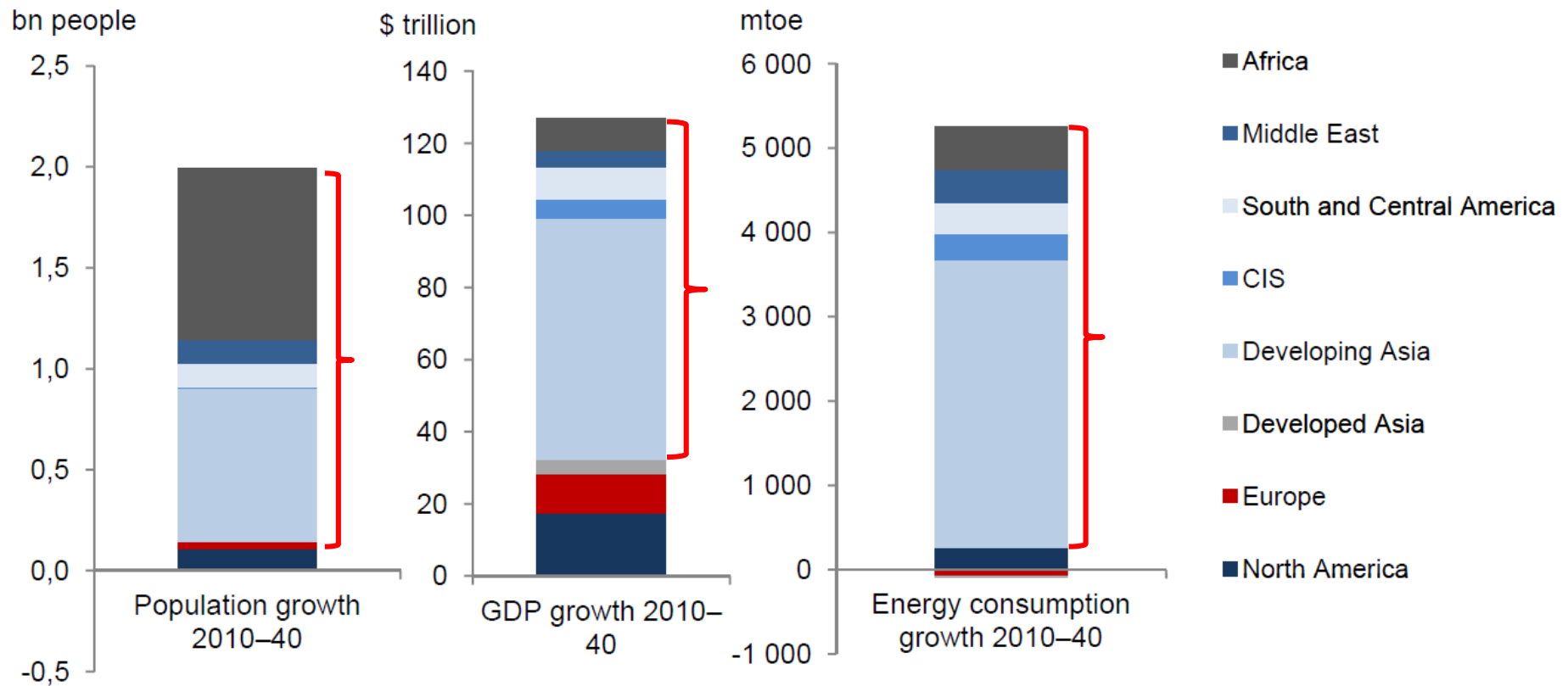
Source: ERI RAS

**GROWTH IS HINDERED BY THE DECLINING INTENSITY OF THE MAIN FACTORS OF PRODUCTION, THE SLOWDOWN OF POPULATION GROWTH, LIMITED OPPORTUNITIES FOR TERRITORIAL EXPANSION, AGGRAVATED WATER SUPPLY PROBLEMS, AND RISING PRICES FOR MAJOR NATURAL RESOURCES.**



## Growth will be mainly provided by the developing countries

### Population growth, GDP, and energy consumption by region



Source: ERI RAS

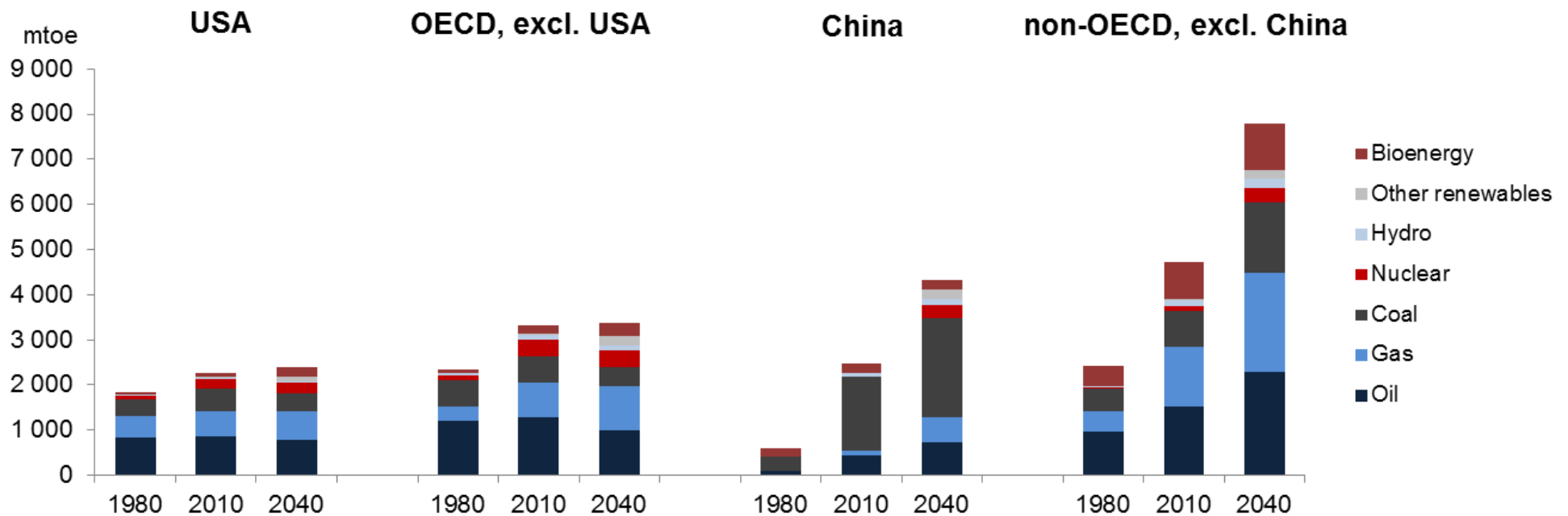
**POPULATION GROWTH IN DEVELOPING COUNTRIES IS FOLLOWED BY AN INCREASING SHIFT IN THE CENTRE OF ECONOMIC AND ENERGY CONSUMPTION TOWARDS THESE COUNTRIES**





## Centres of energy consumption will notably change their location

The growth of primary energy consumption by region and type of fuel



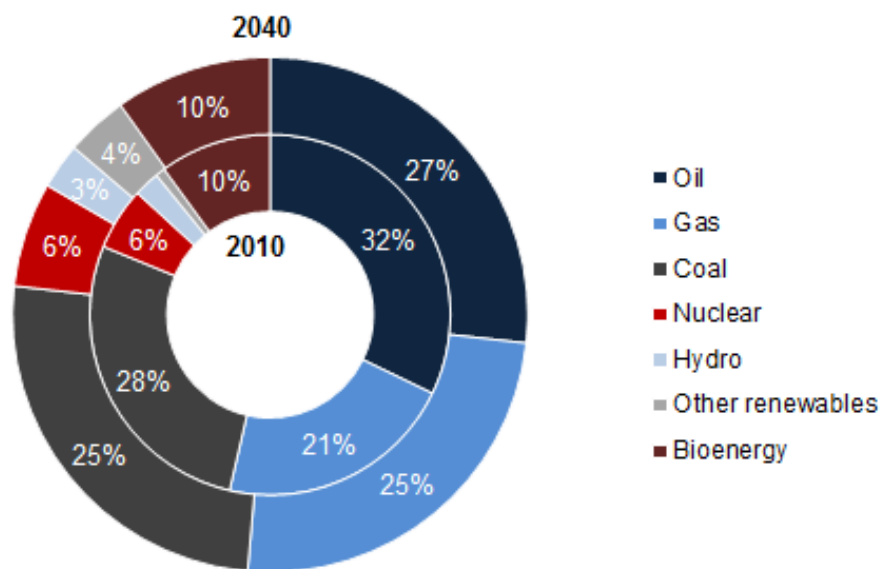
Source: ERI RAS

**THE CONSUMPTION OF PRIMARY ENERGY IN THE WORLD WILL INCREASE BY 1.1% PER YEAR ON AVERAGE BETWEEN 2010 AND 2040, WHICH IS SIGNIFICANTLY SLOWER THAN THE GROWTH IN ENERGY CONSUMPTION SEEN FOR THE LAST 30 YEARS, WHILE DEVELOPED COUNTRIES WILL ONLY INCREASE THEIR ENERGY CONSUMPTION BY 3% BY 2040.**



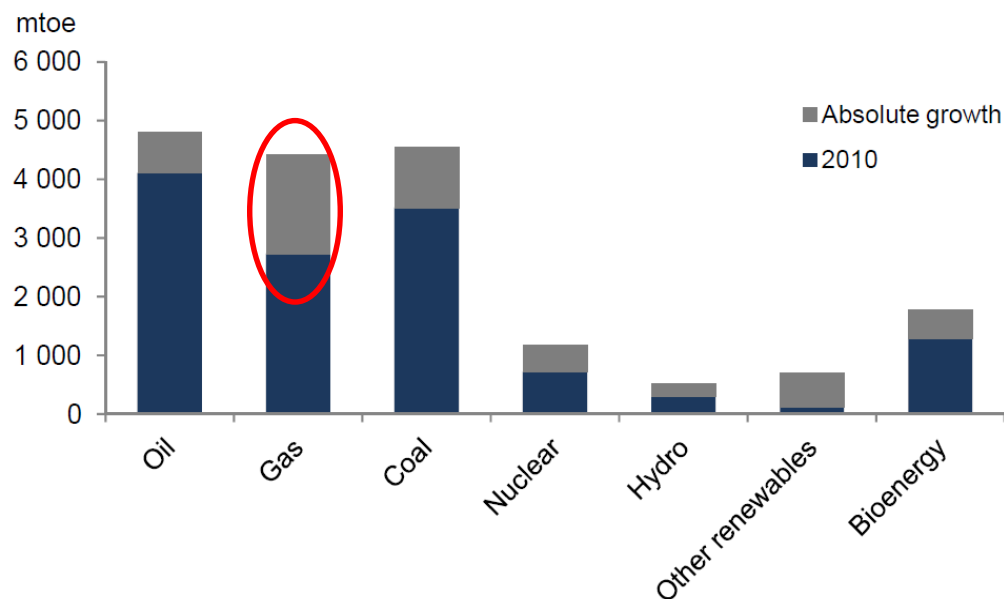
**The share of oil and gas in world primary energy consumption will remain practically unchanged: 53.6% in 2010 and 51.4% by 2040**

**Structure of world primary energy consumption by fuel type in 2010 and 2040**



Source: ERI RAS

**The growth of primary energy consumption by fuel type**

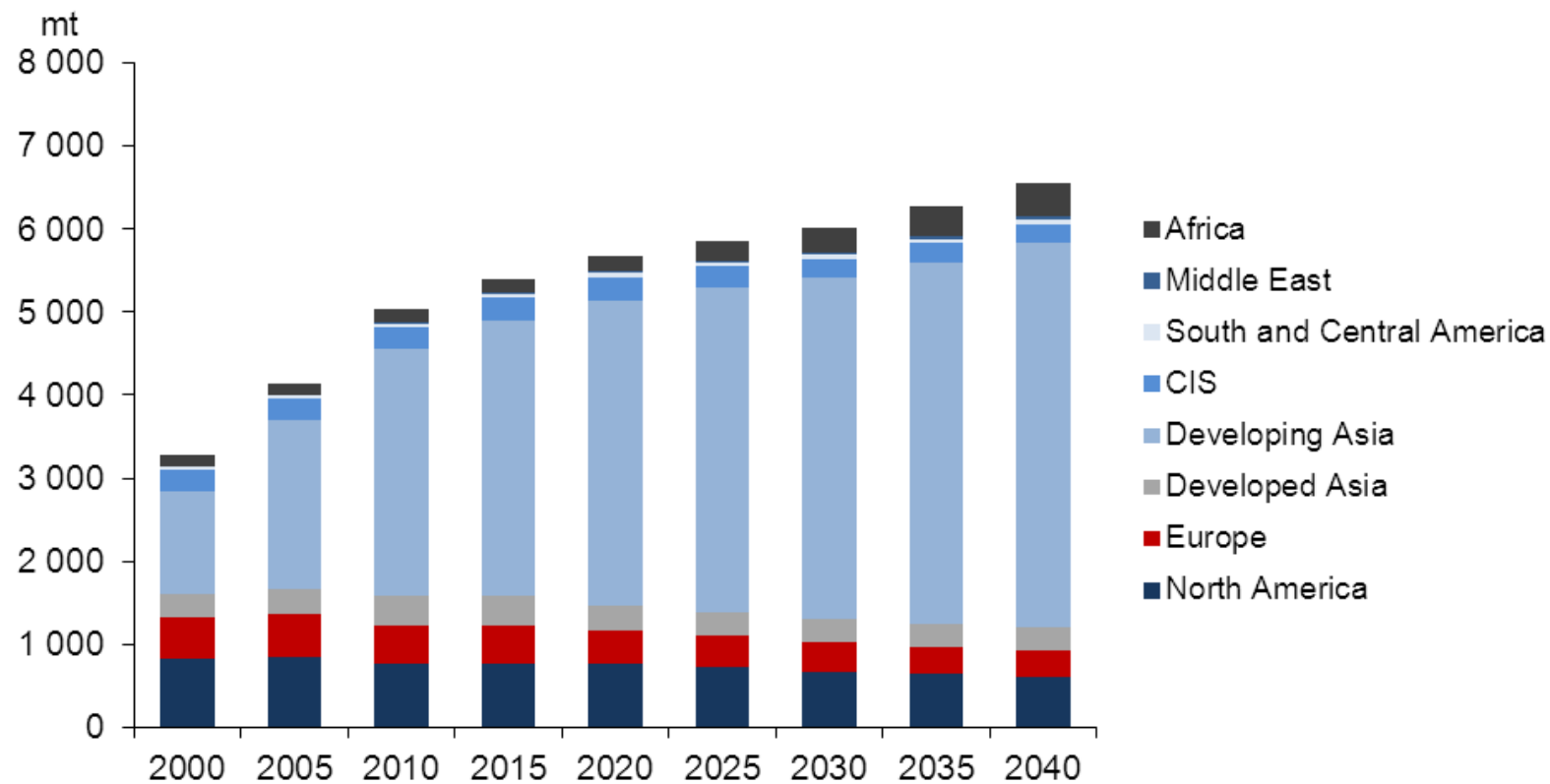


**IN THE LONG TERM, FOSSIL FUELS WILL REMAIN DOMINANT, AGAINST THE BACKGROUND OF A SLOWER GROWTH IN THE SHARE OF NON-HYDROCARBON ENERGY RESOURCES. THE HIGHEST CONSUMPTION GROWTH RATES IN THE FORECAST PERIOD WILL BE FOR RENEWABLE ENERGY: BY 2040 ITS SHARE IN GLOBAL ENERGY CONSUMPTION WILL REACH 13.8%. HOWEVER, NATURAL GAS WILL TAKE FIRST PLACE IN THE ABSOLUTE VOLUMES OF CONSUMPTION GROWTH, AND IT WILL HAVE THE LARGEST NICHE IN THE FUEL MIX, MAKING IT THE MOST DEMANDED TYPE OF FUEL FOR THE NEXT 30 YEARS.**



**Solid fuel market shows further growth, but only in developing Asia, which is slowing down due to the environmental reasons**

### Coal consumption by region, Baseline Scenario

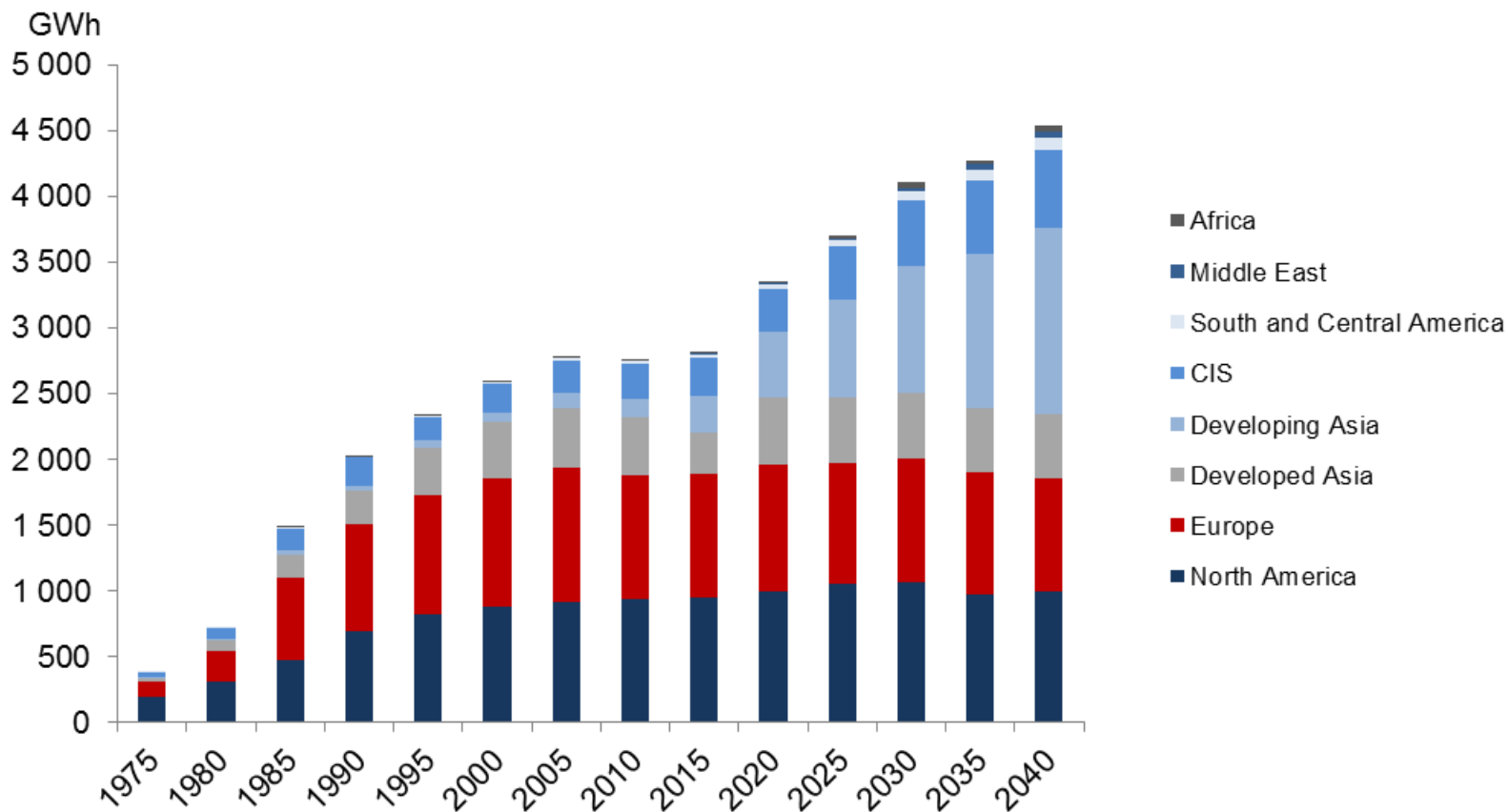


Source: ERI RAS



## Nuclear grows fast post-2020 in the non-OECD countries

### Nuclear electricity generation by region



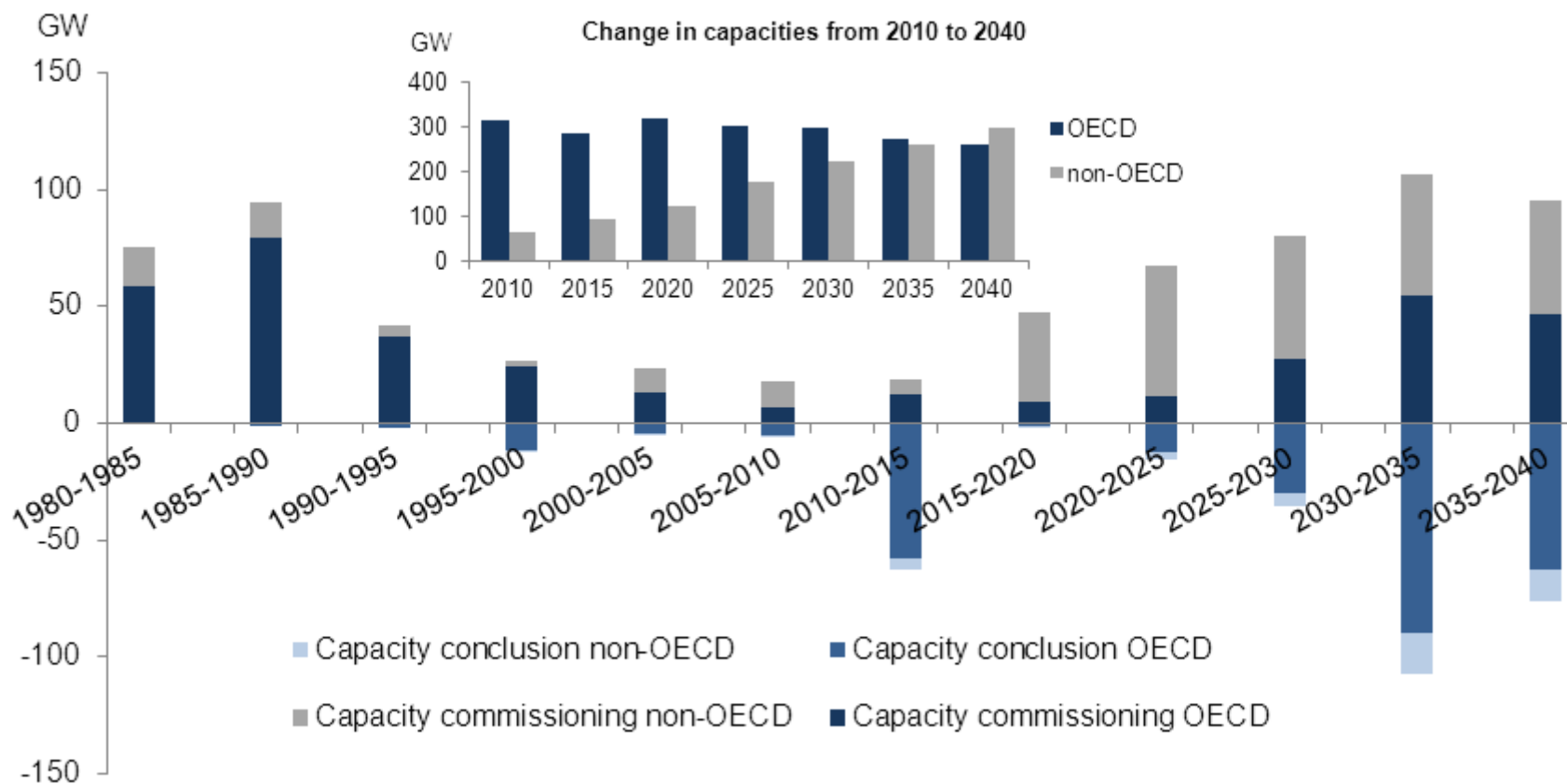
Source: ERI RAS





## Significant share of nuclear capacities has to be replaced

### The dynamics of nuclear capacities

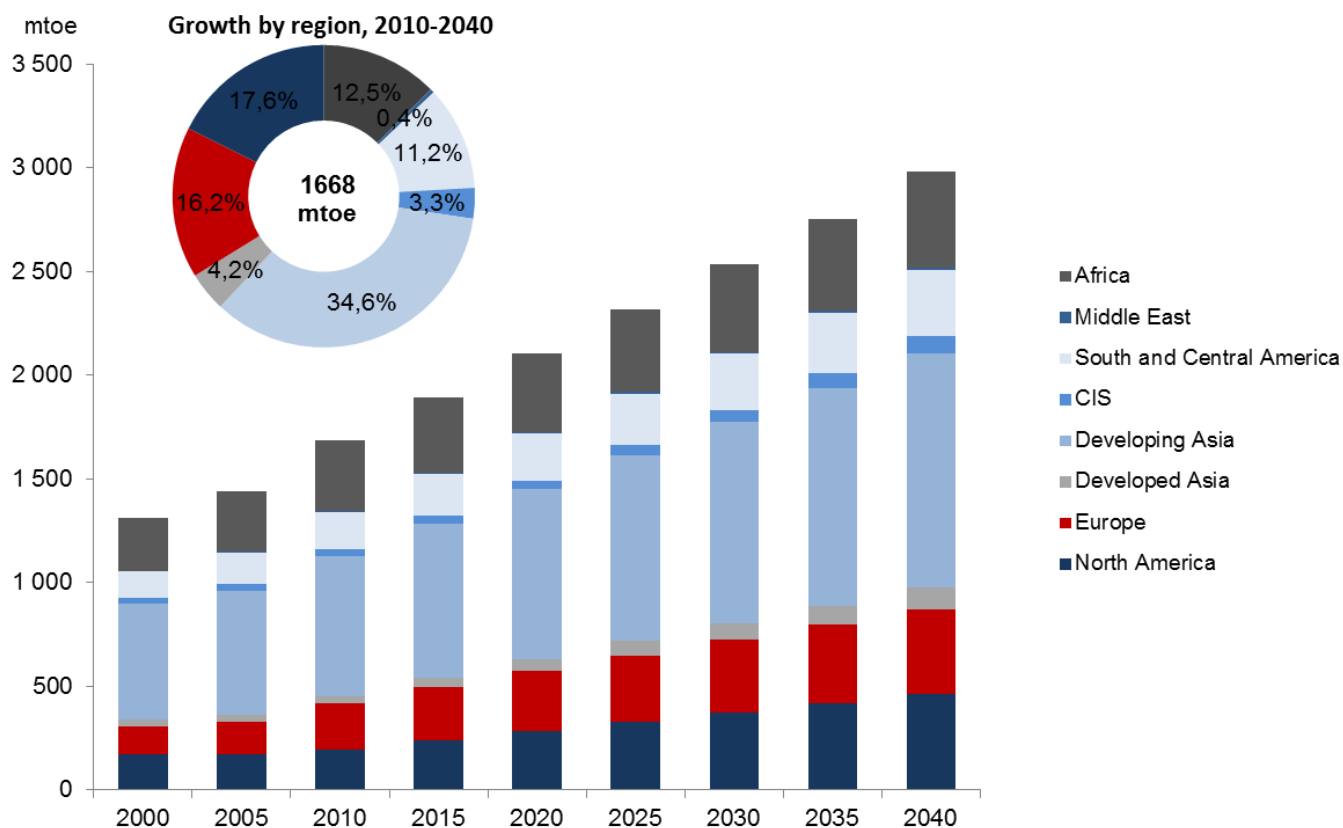


Source: ERI RAS



## Renewable energy shows the highest growth rates

### Renewable energy consumption and growth by region, Baseline Scenario

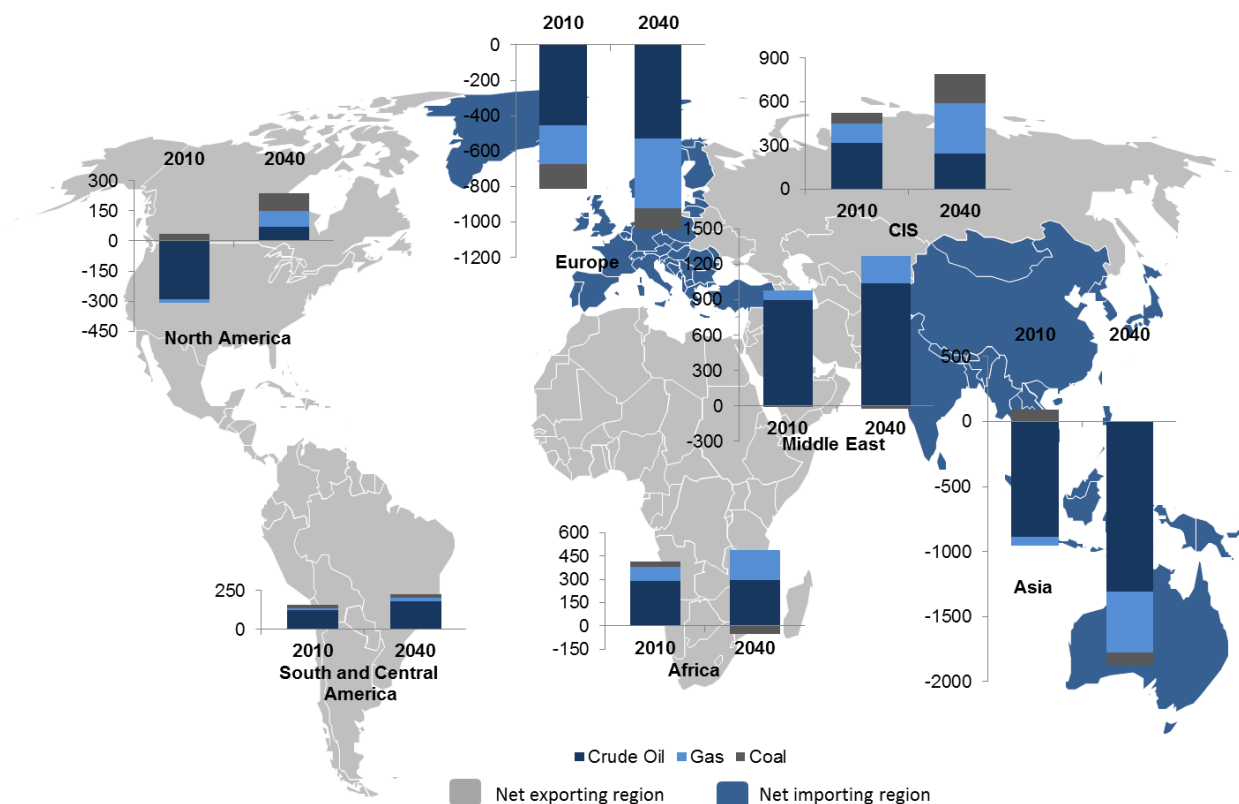


Source: ERI RAS



## Directions of the international energy trade are changing considerably

### International energy trade, mtoe



***THE DEVELOPMENT OF THE WORLD'S ENERGY TRADE WILL CONTINUE AGAINST THE BACKGROUND OF NORTH AMERICA'S GROWING SELF-SUFFICIENCY, DUE TO UNCONVENTIONAL OIL AND GAS RESOURCES. A SIGNIFICANT INCREASE IN SUPPLY VIA THE PACIFIC AND INDIAN OCEANS WILL CHANGE THE DIRECTIONS AND VOLUMES OF INTER-REGIONAL ENERGY TRADE.***



Global trends



**Baseline scenario: liquid fuel market**



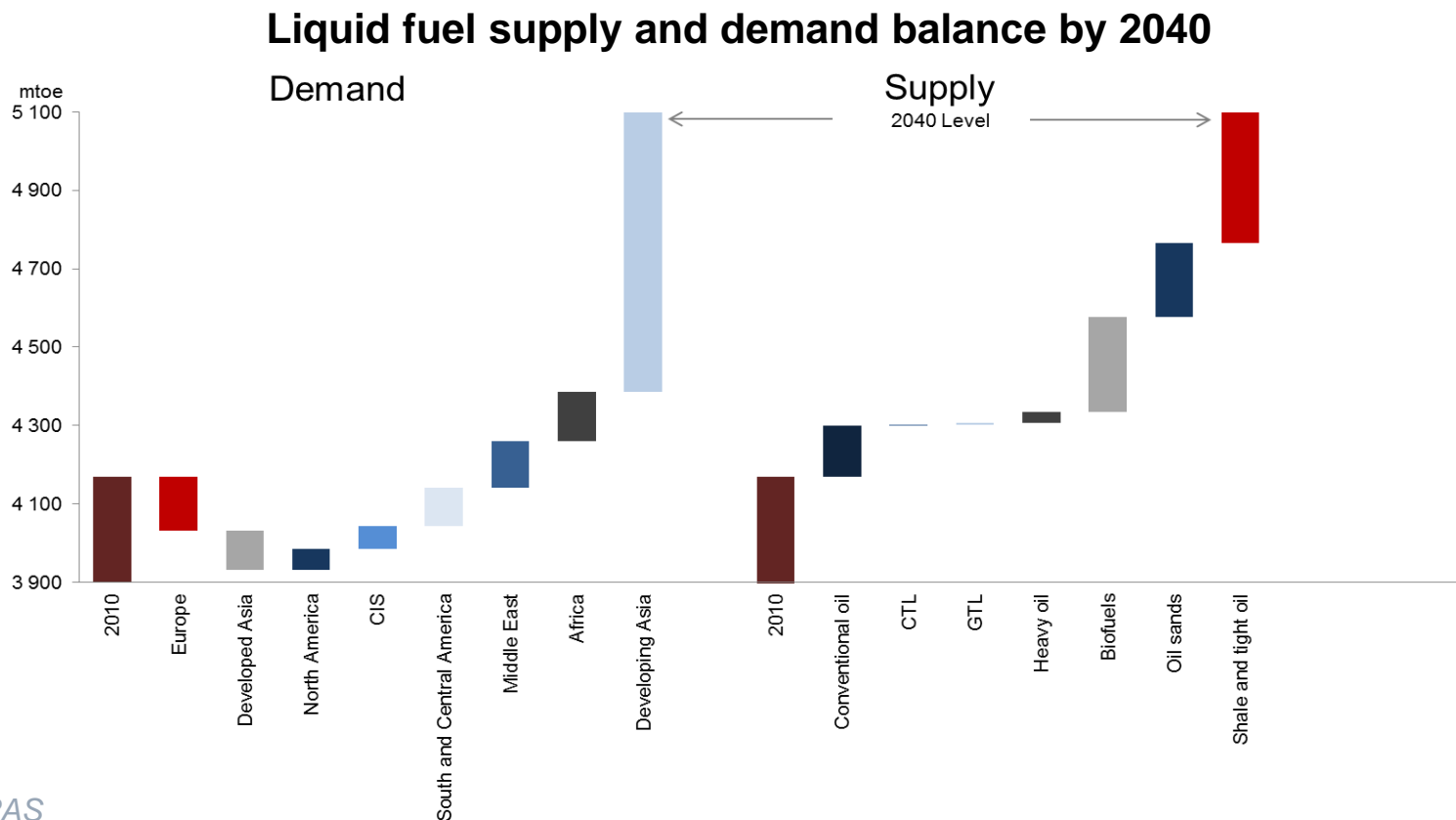
Baseline scenario: gas market



Shale Breakthrough scenario



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



Source: ERI RAS

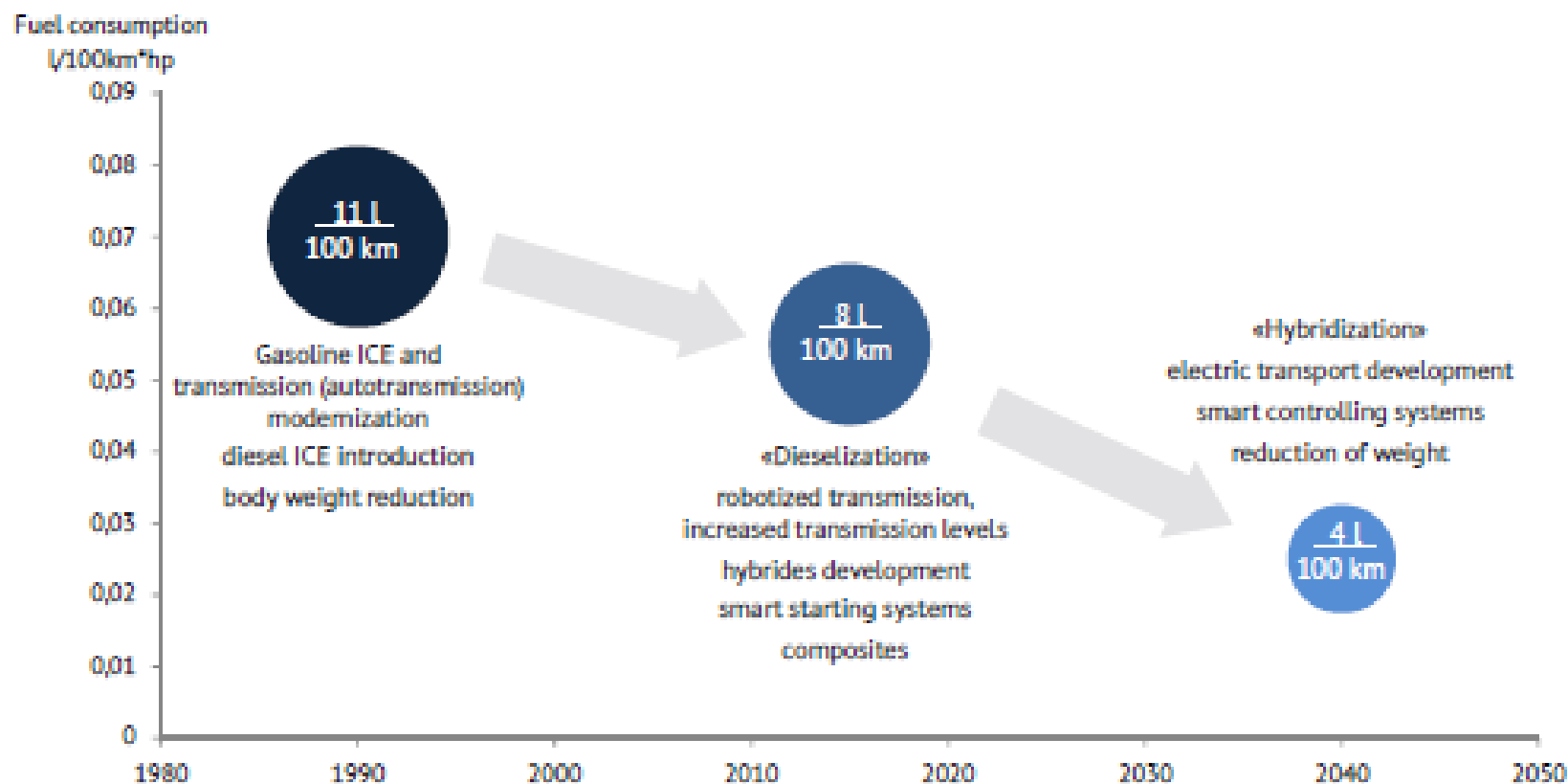
**MORE THAN 60% OF INCREMENTAL DEMAND FOR LIQUIDS WILL COME FROM THE DEVELOPING ASIA. MORE THAN 70% OF THE INCREMENTAL SUPPLY WILL BE COVERED BY DIFFERENT TYPES OF UNCONVENTIONAL LIQUIDS. UNCONVENTIONAL OIL (SHAPE OIL, TAR SANDS OIL, ETC.) WILL REACH 16.4% OF TOTAL PRODUCTION - 837M TONS BY 2040 – AND DRAMATICALLY CHANGE ALL STRUCTURE OF THE GLOBAL OIL TRADE AND PRICING.**





## Transportation sector will remain the main demand driver

### Dynamics of light motor car fuel economy

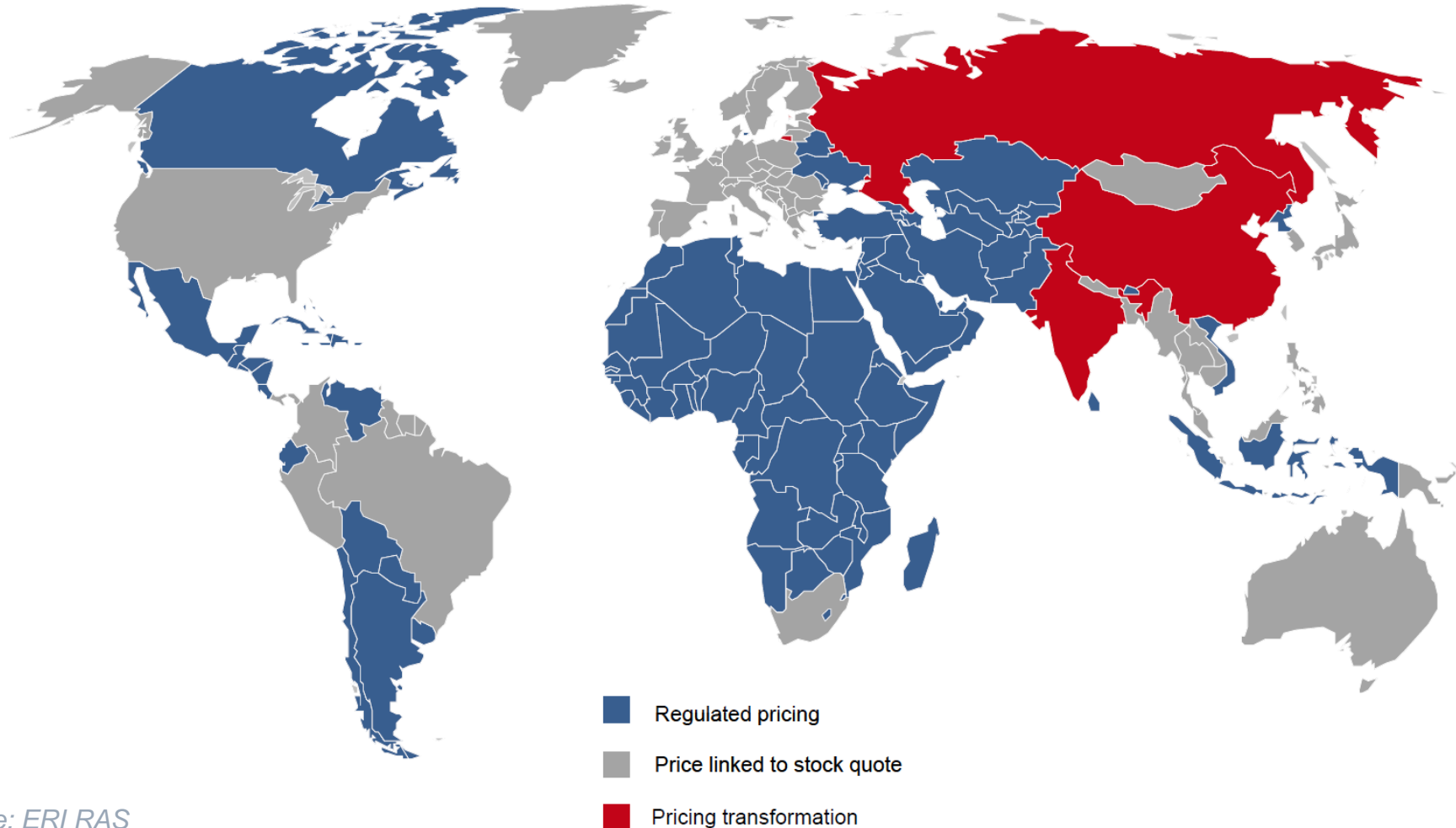


Source: ERI RAS



## Liquids demand in the developing countries is supported by subsidies for the petroleum products prices

## Regulation of petroleum products prices by country

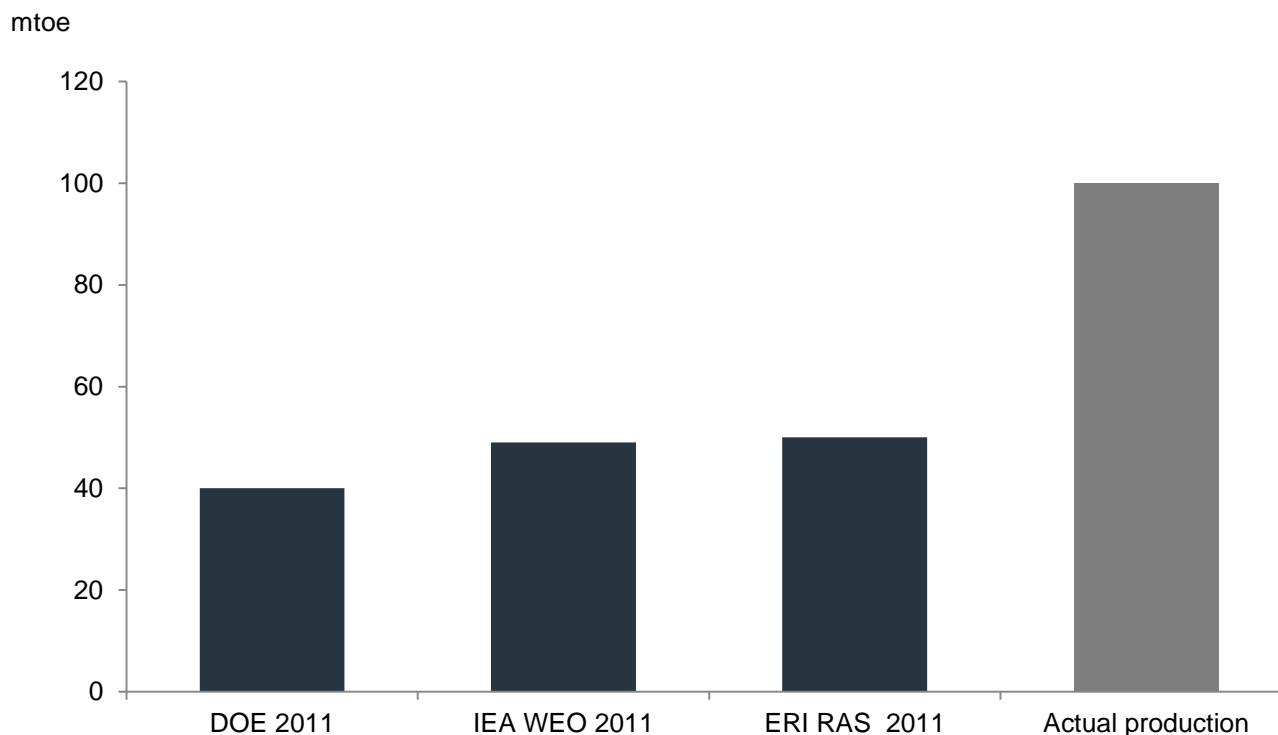


Source: ERI RAS



## 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

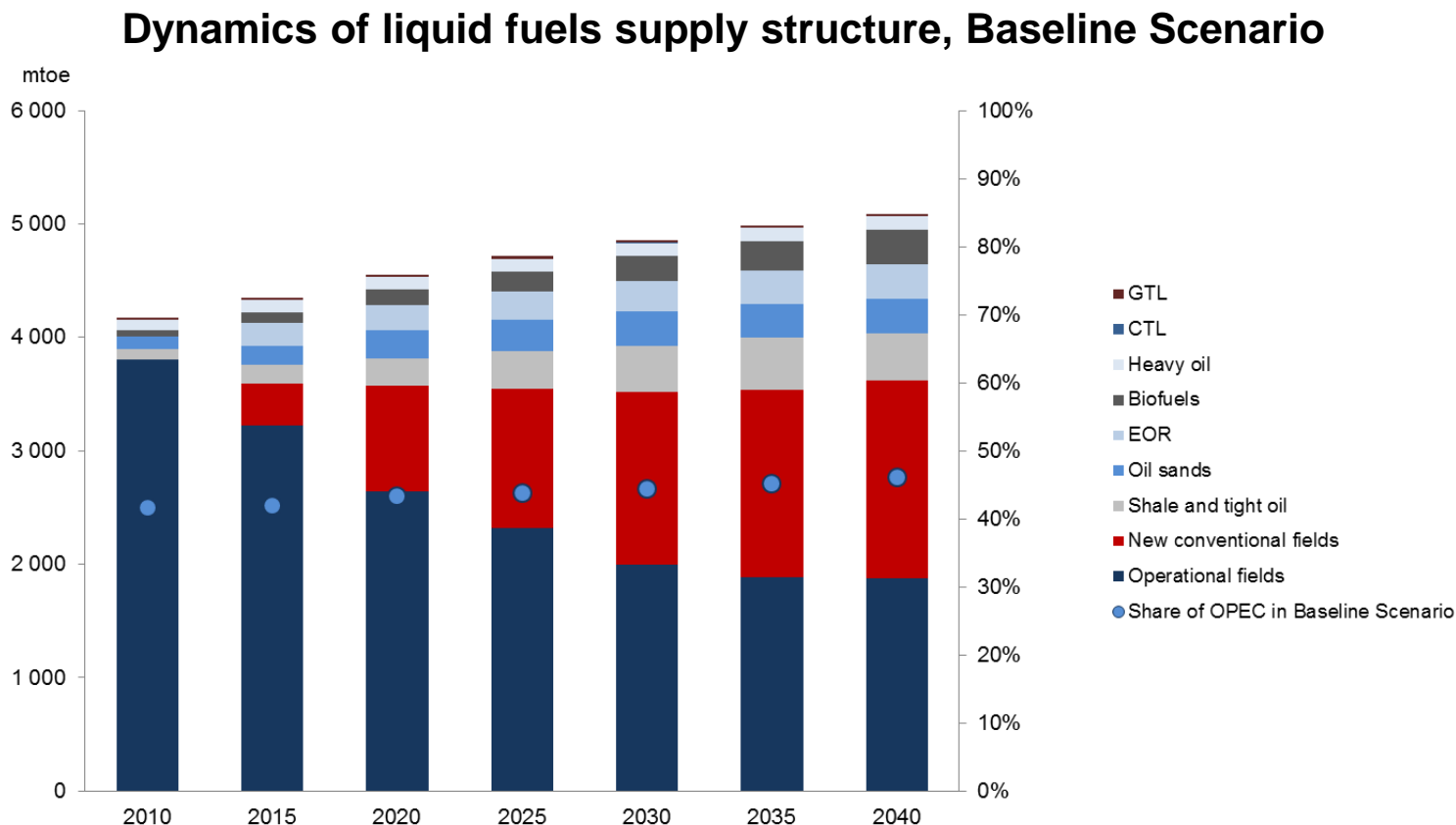


Source: ERI RAS

**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 "SHAPE" 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

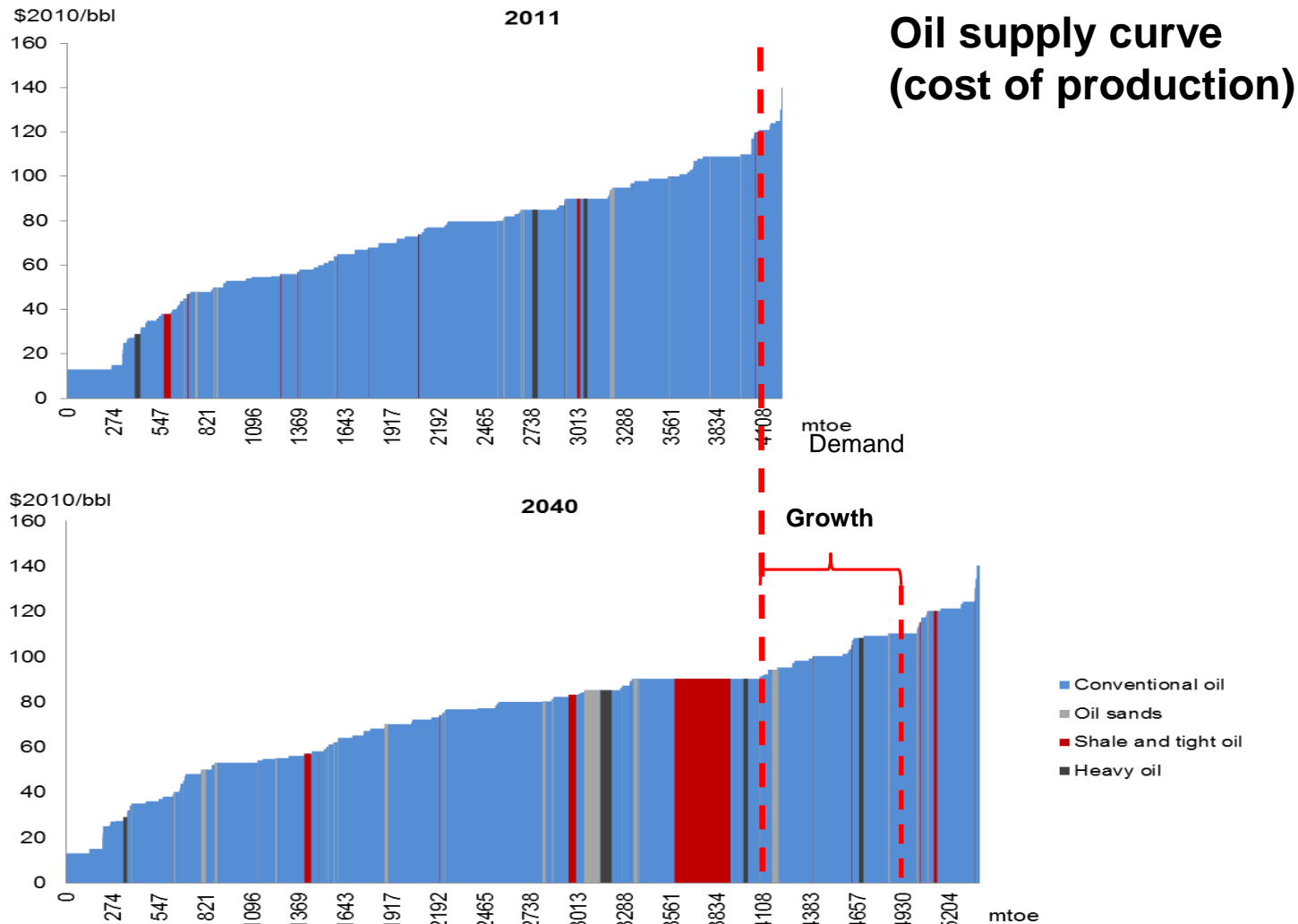


Source: ERI RAS

**OIL AND GAS CONDENSATE PRODUCED FROM TRADITIONAL FIELDS WILL AMOUNT TO 77% OF THE GLOBAL LIQUID FUELS PRODUCTION. UNCONVENTIONAL OIL (SHAPE 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



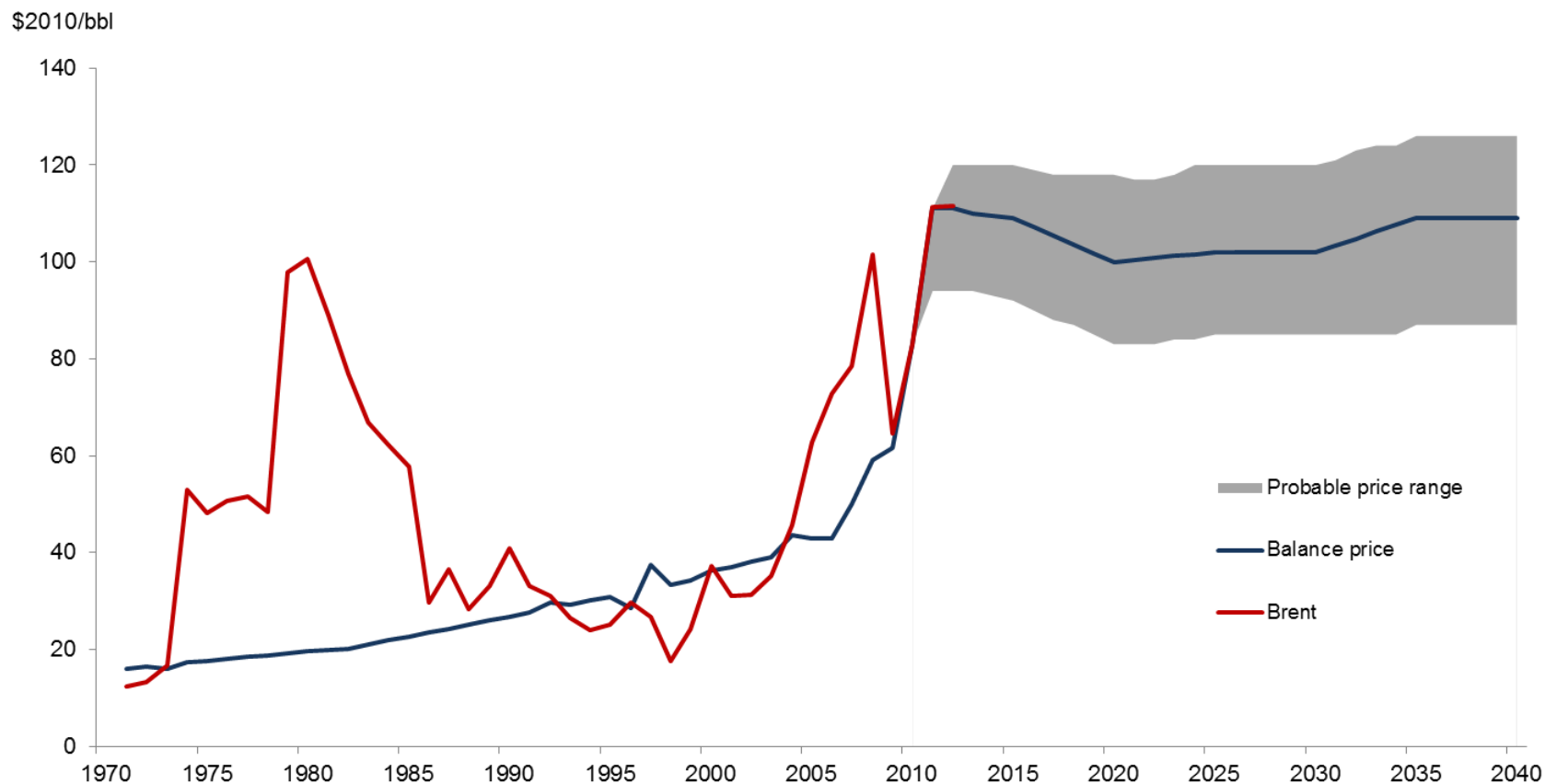
Source: ERI RAS





**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**

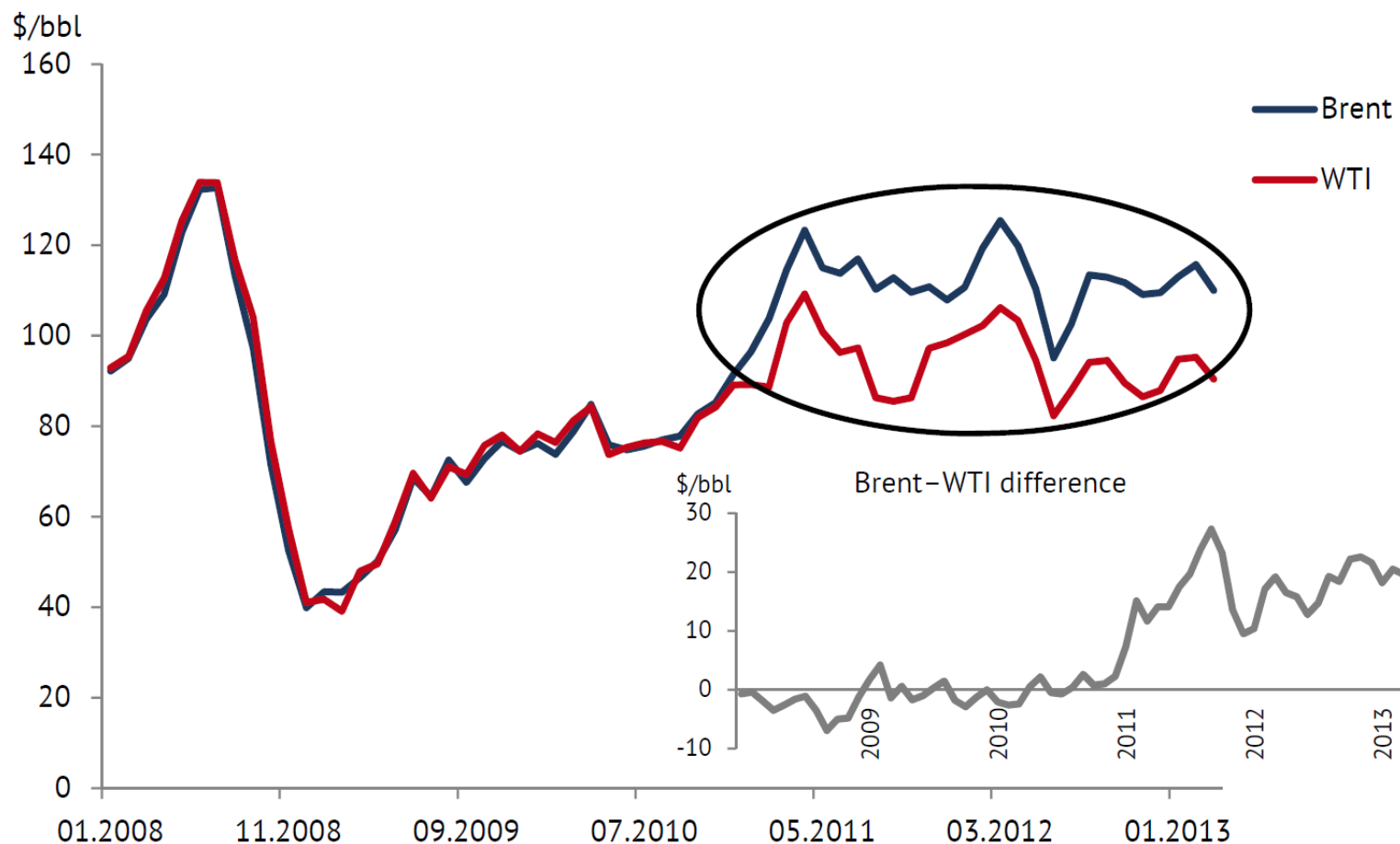


Source: ERI RAS



**The gap between oil markers is widening,  
reflecting continued regionalization of the oil market**

### Historical WTI and Brent price dynamics

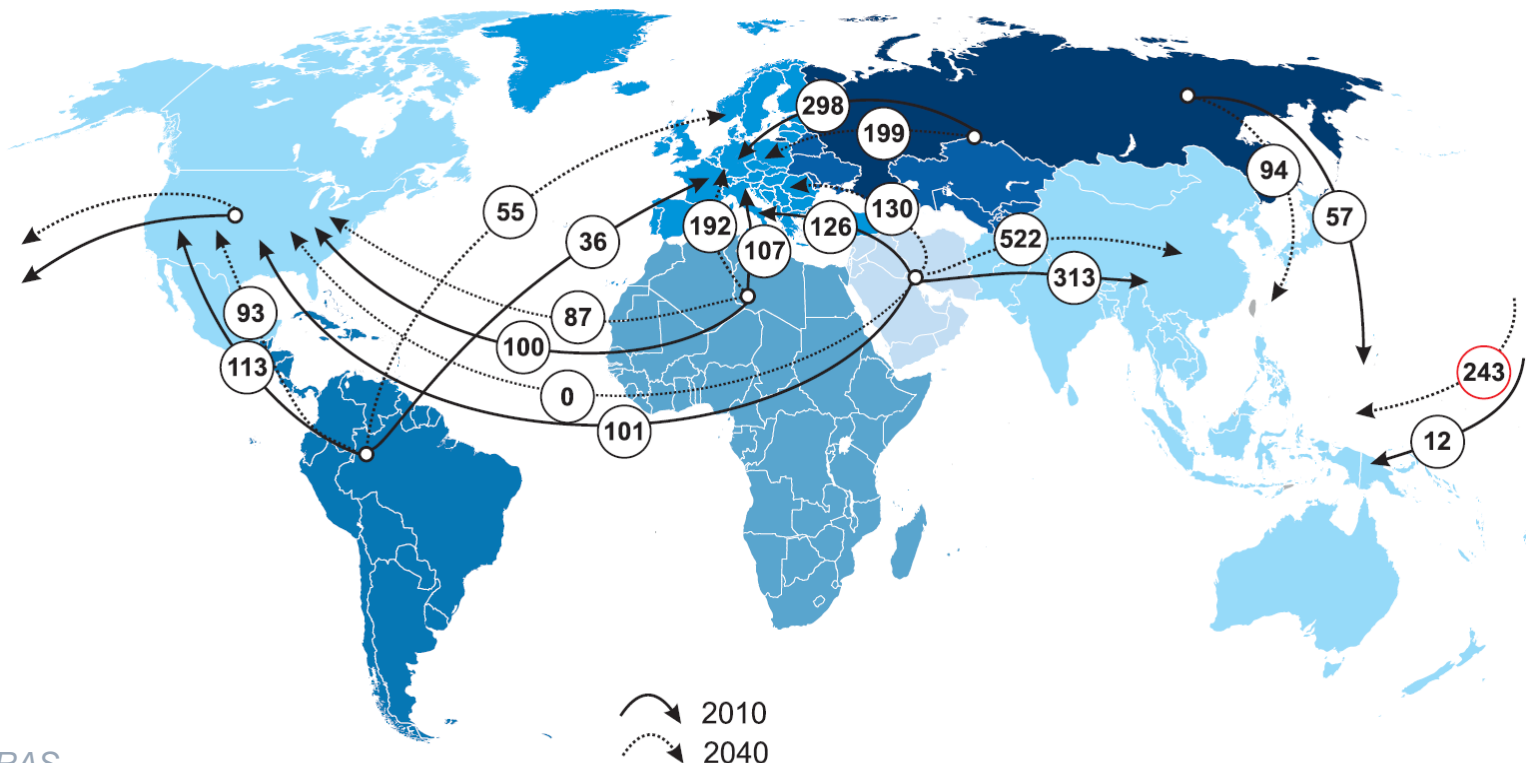


Source: ERI RAS



## Trade flows in the oil market will change fundamentally by 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.**



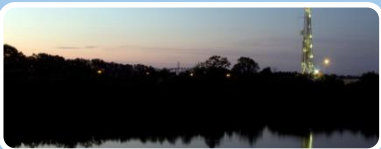
Global trends



Baseline scenario: liquid fuel market



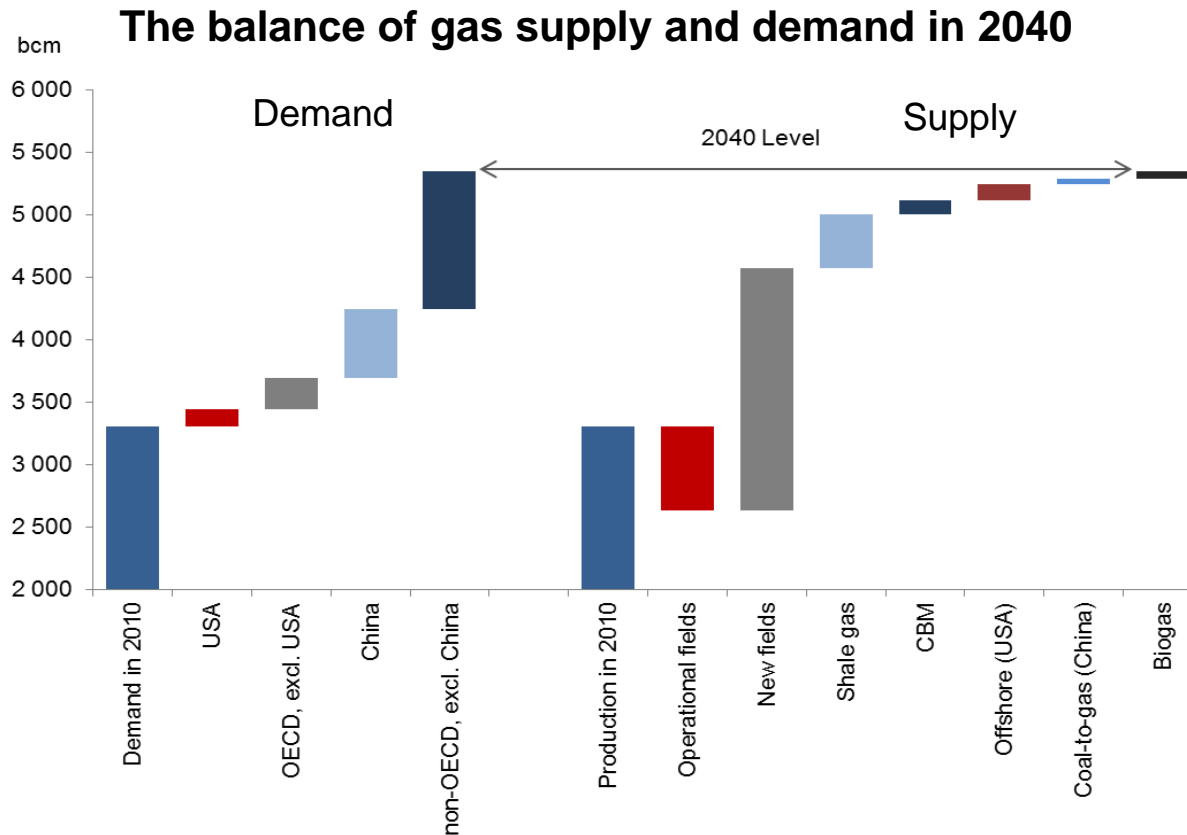
**Baseline scenario: gas market**



Shale Breakthrough scenario



## Gas market remains more traditional



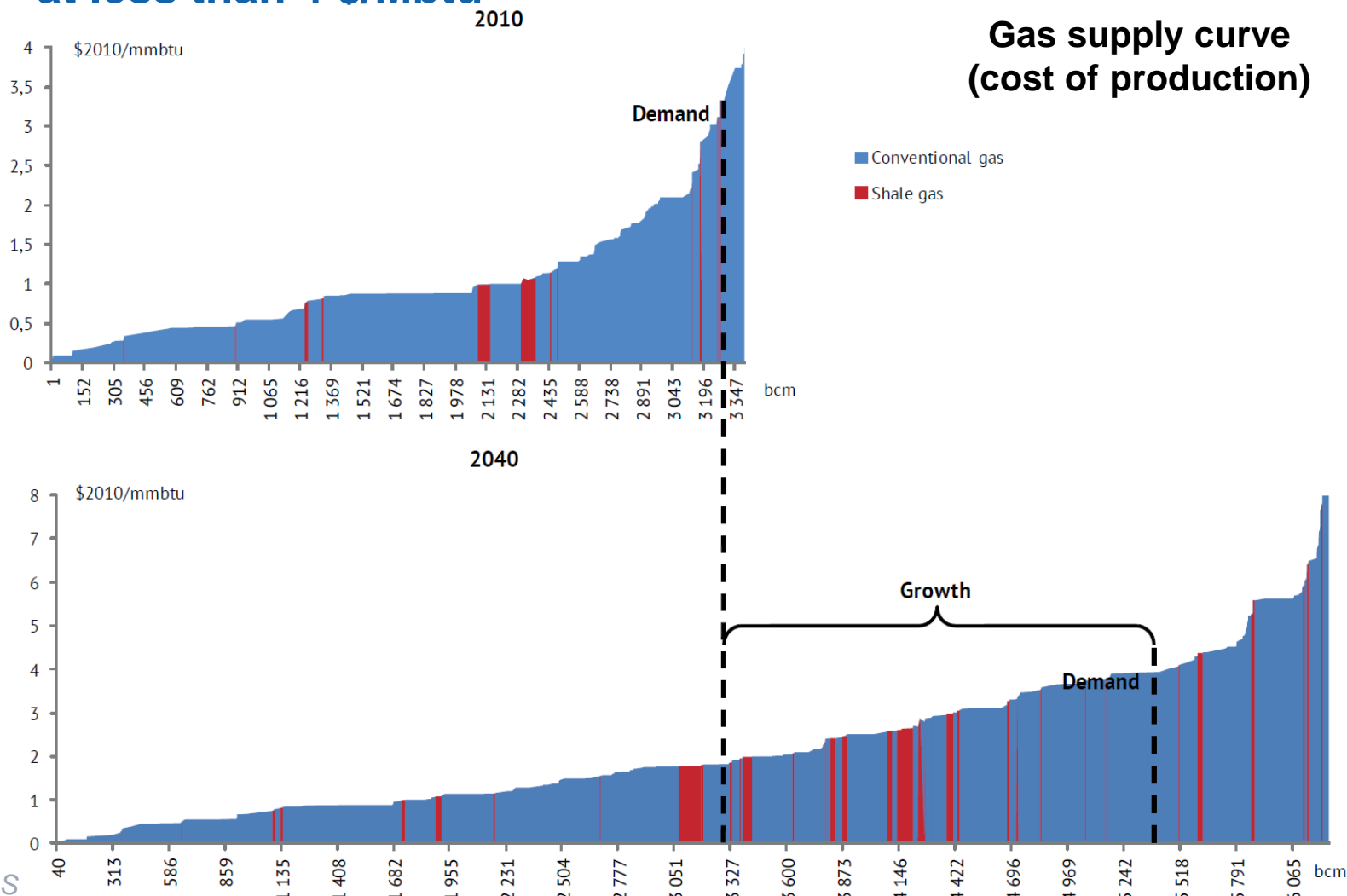
Source: ERI RAS

**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.**





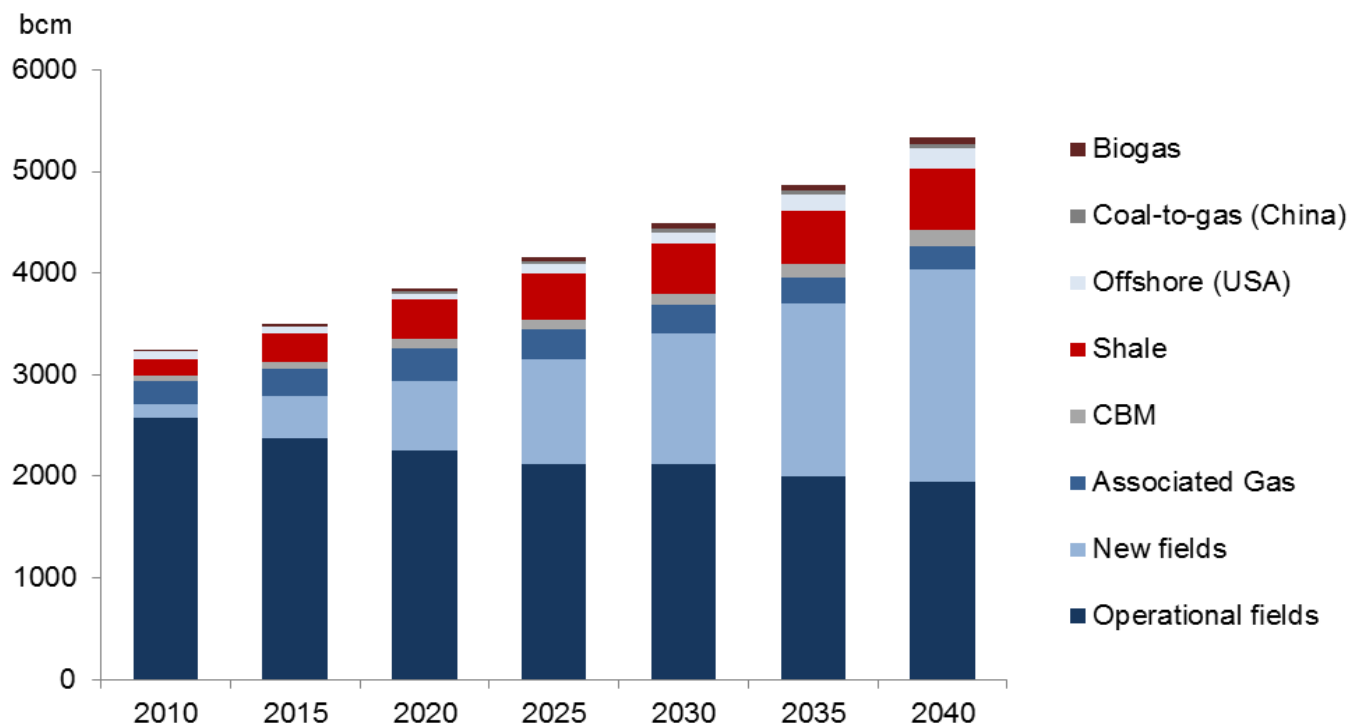
By 2040 it will be necessary to expand gas production by 2 tcm,  
there are sufficient reserves which can be produced  
at less than 4 \$/Mbtu





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

Gas Production by Source, Baseline Scenario



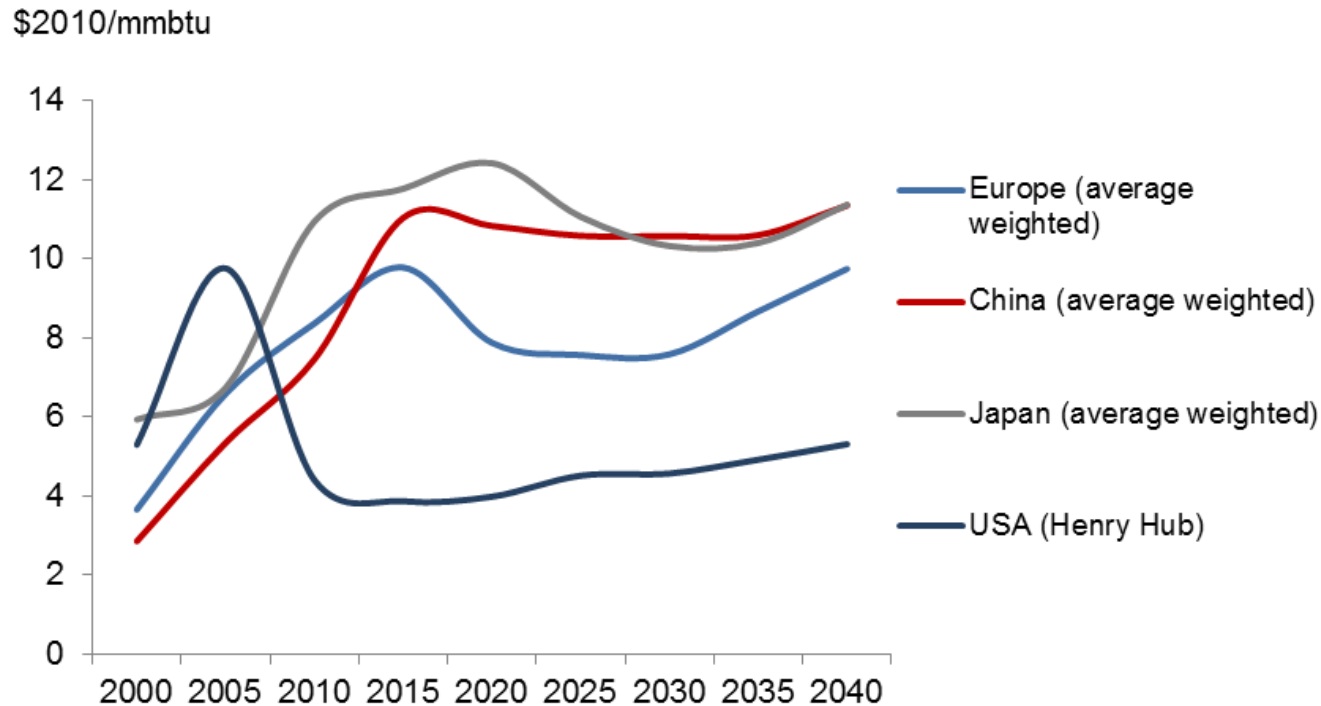
Source: ERI RAS

**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

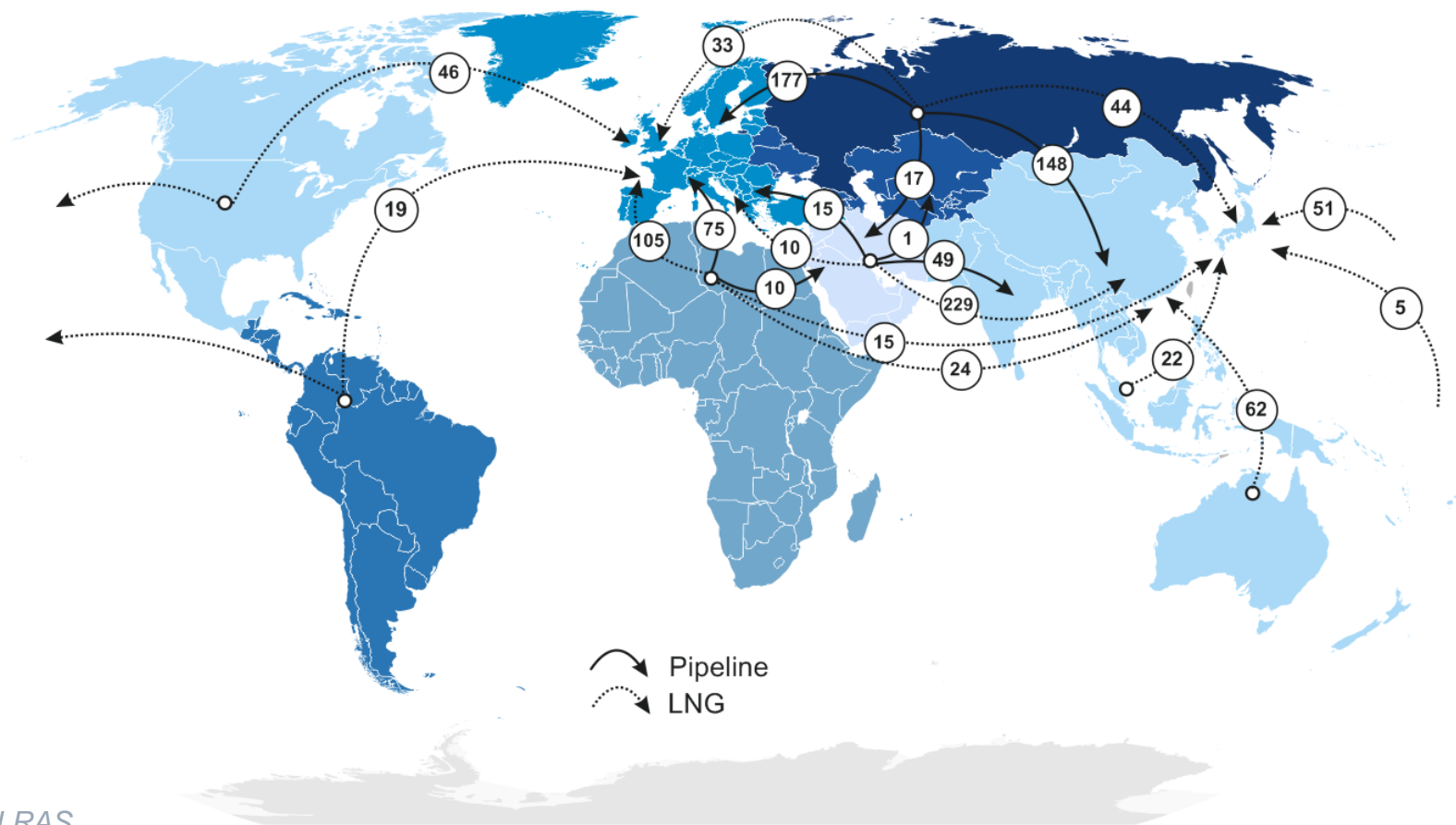
\* Weighted average price between the prices of long-term contracts linked to alternative fuels, and spot prices.

**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**

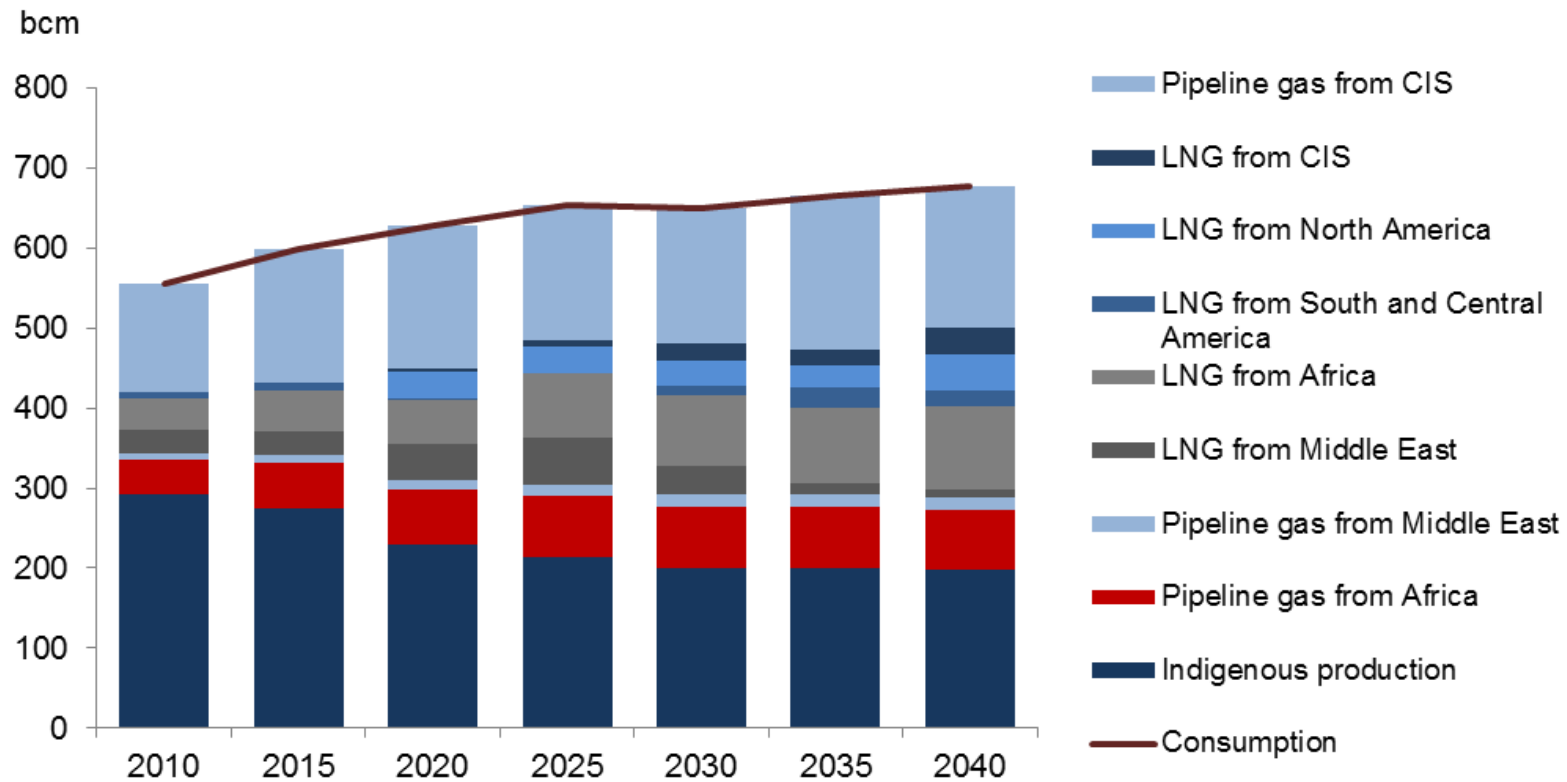
**Inter-regional gas trade in 2040, bcm**





## Gas Market

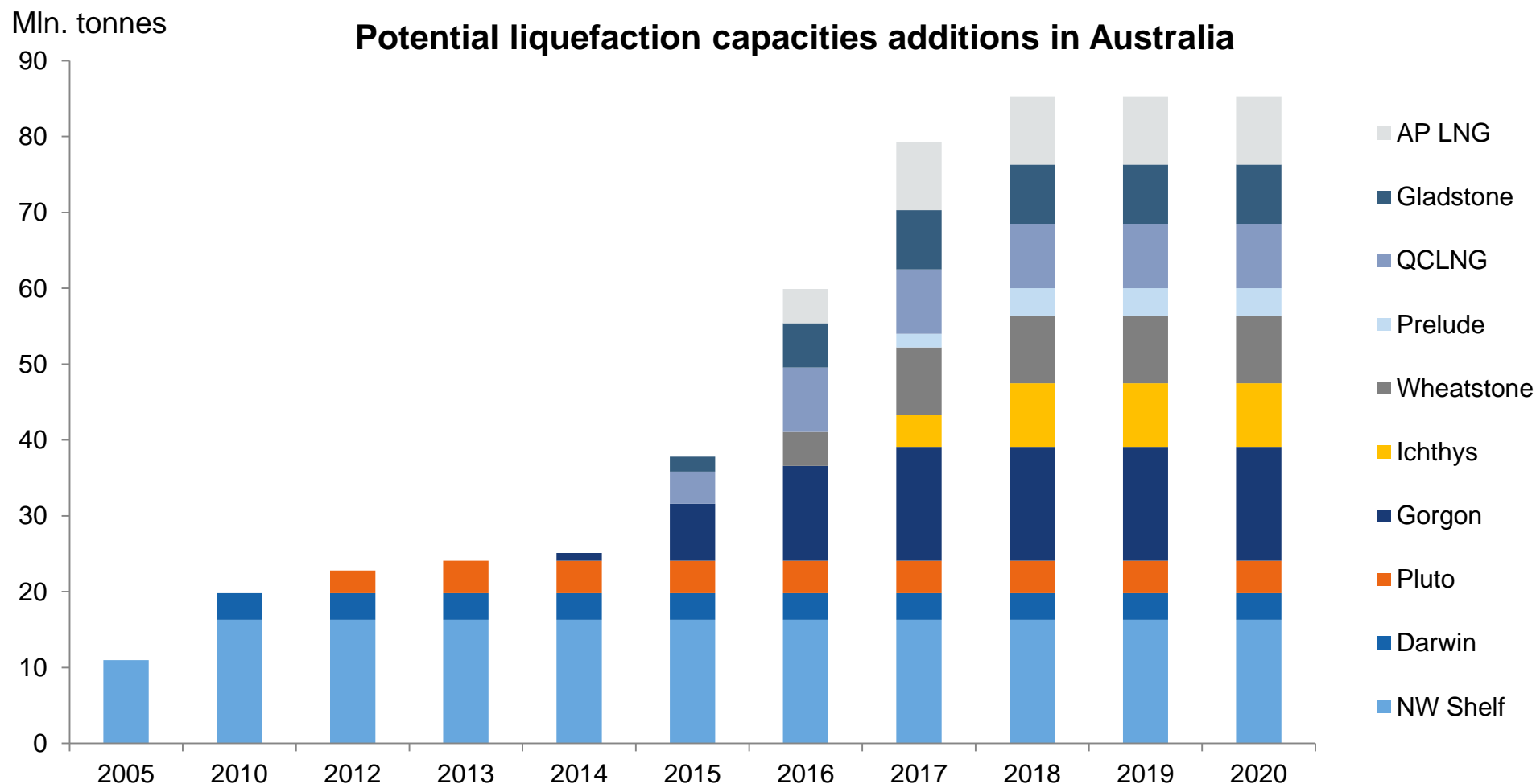
### Gas balance in Europe







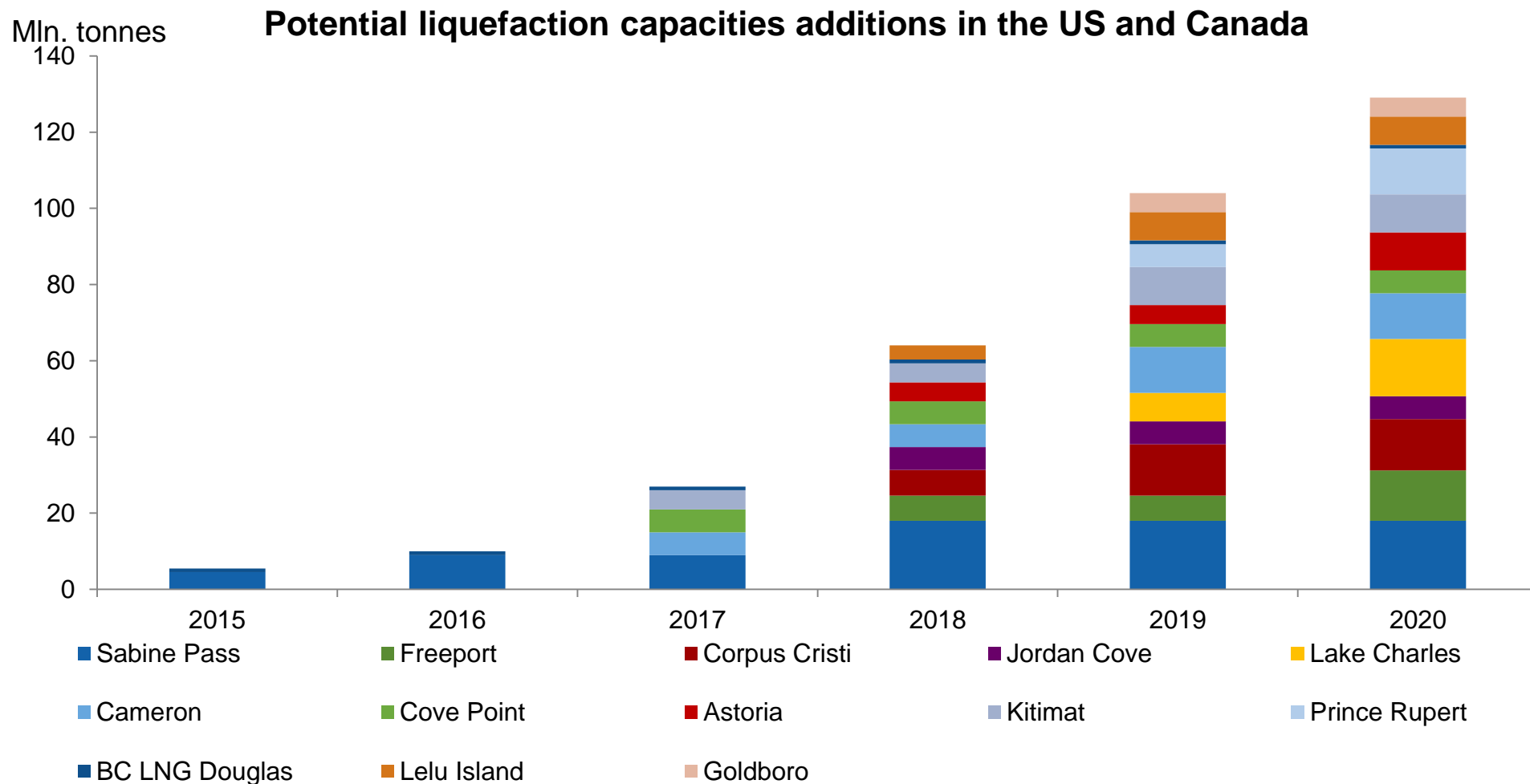
## New LNG projects will make Australia LNG producer #1 by 2018, but they face delays and cost overruns



Source: ERI RAS



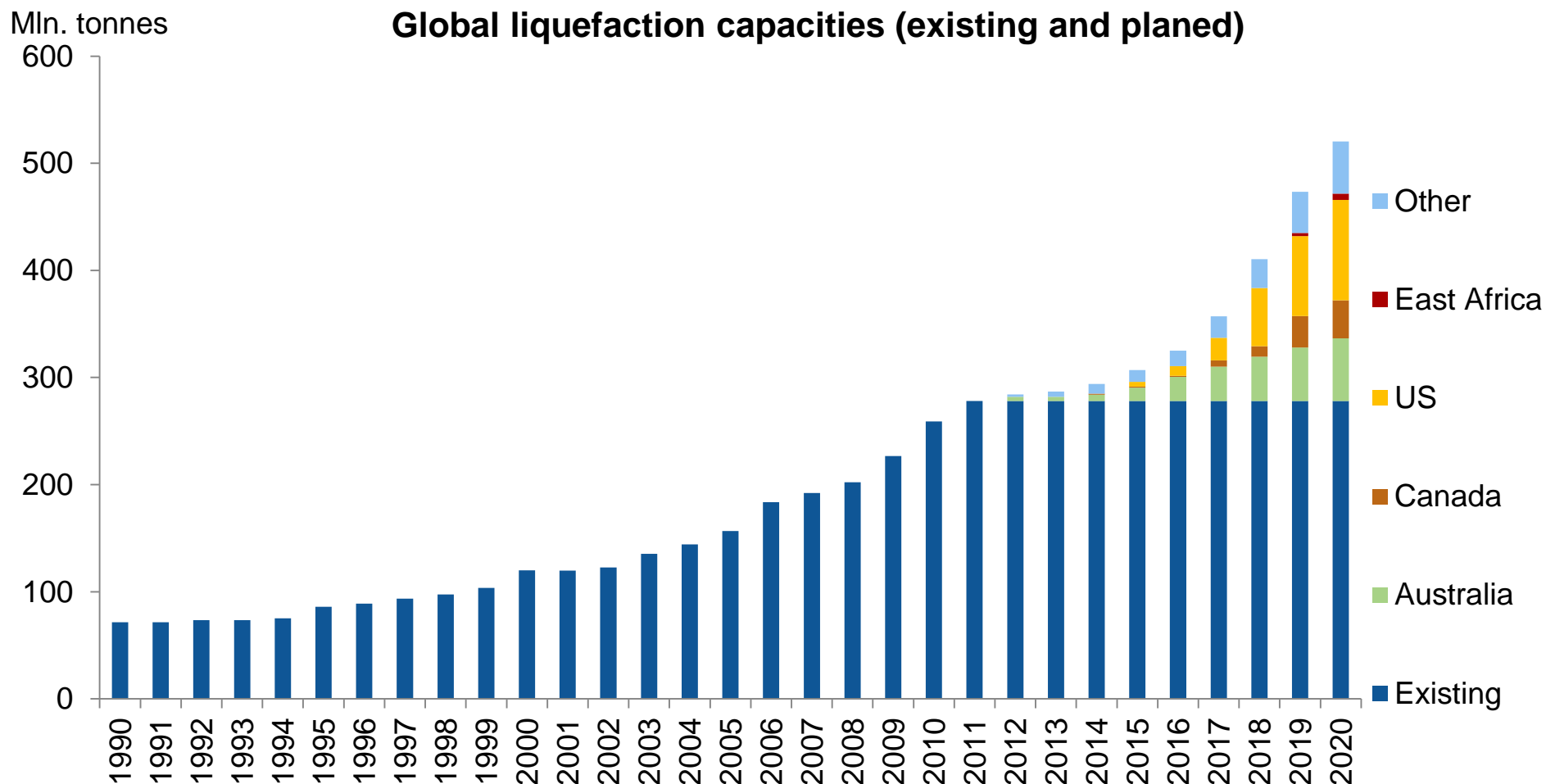
## We don't know the future US (and Canadian) LNG export volumes



Source: ERI RAS








**Global LNG supply is expected to boom during the next decade, but this growth is associated with great uncertainties**



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	



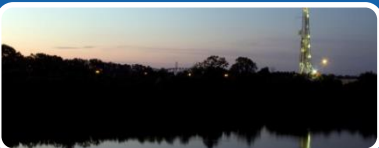
Global trends



Baseline scenario: liquid fuel market



Baseline scenario: gas market



**Shale Breakthrough and Shale Failure scenarios**





## Shale technologies create the greatest uncertainty

### ***‘Shale Breakthrough’***

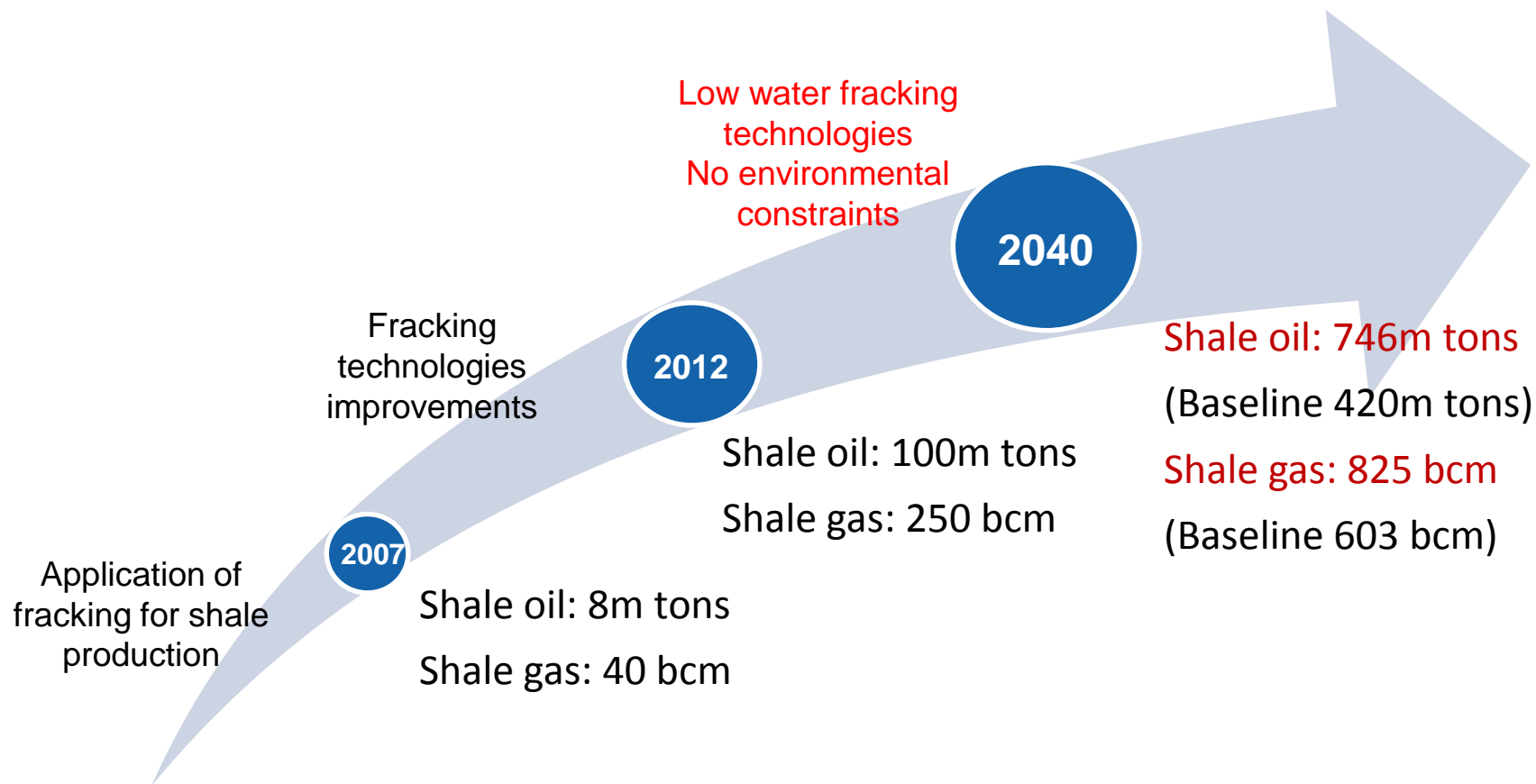
- By 2020, the new waterless technology for the production of oil and gas from low-permeability formations will be fully developed. As a result, oil and gas fields located in China, Jordan, Israel, Mongolia, and other countries will enter into operation
- Environmental restrictions on oil and gas production from shale plays would be removed
- Global shale oil production costs would equal the levels of US production costs (less than \$80/bbl of oil and \$150/1000 m<sup>3</sup> for gas)
- Shale oil production in the world by 2040 will reach 745 m tons, and shale gas - 825 bcm

### ***‘Shale Failure’***

- Significant cost increase for new production projects
- No confirmation of large resource base
- Introduction of strict environmental constraints
- New waterless and heat extraction technologies for shale oil and gas production are inappropriate, for economic and/or environmental reasons
- Starting from 2020, shale oil and gas production in the USA begins to decline rapidly, and practically stops by 2025
- Production of shale oil and gas continues only in countries where it has already commenced and rapidly reduces to zero



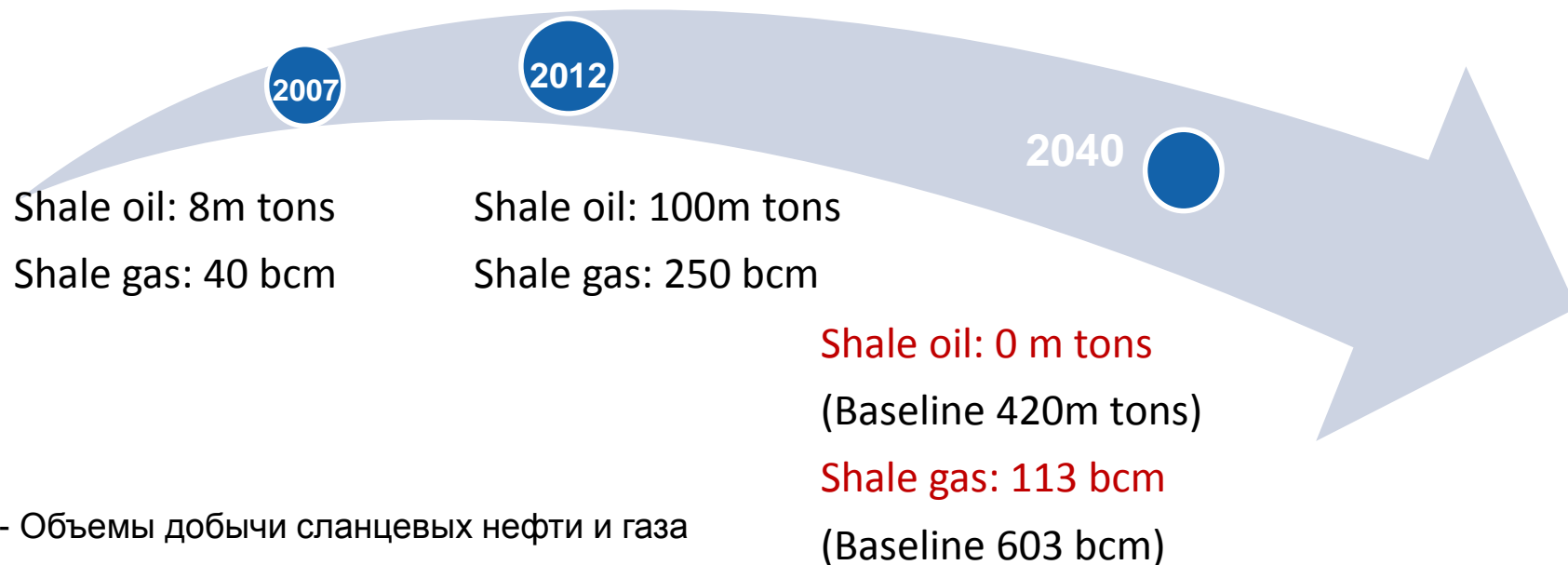
## Shale Breakthrough scenario assumptions: removing cost and environmental constraints





## Shale Failure scenario assumptions: all expectations fail

- Growing costs
- Lower resource base
- Strict environmental regulation
- No low-water technologies

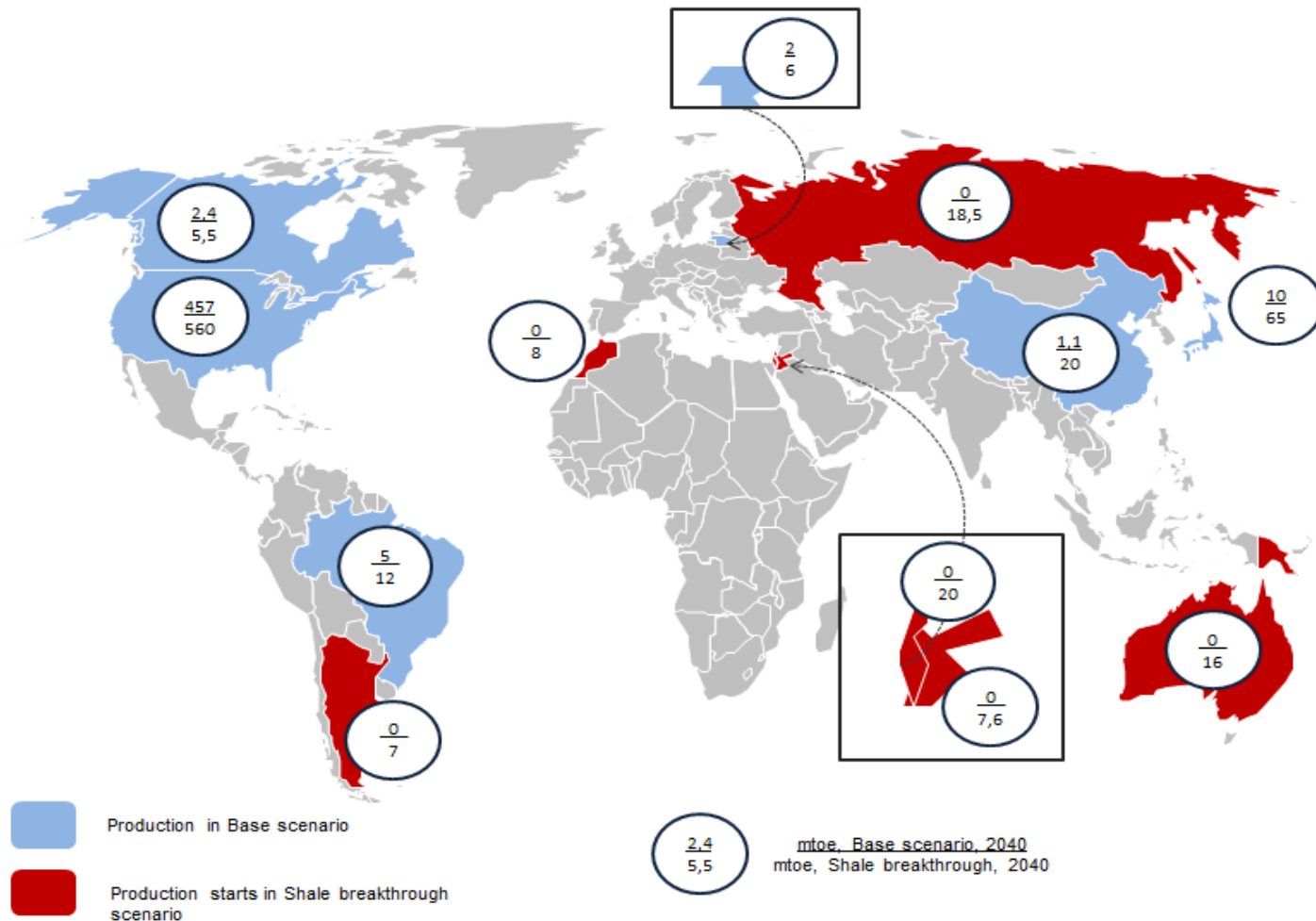


\* - Объемы добычи сланцевых нефти и газа



**In Shale Breakthrough production of shale oil will become possible in the countries where oil has not ever been produced**

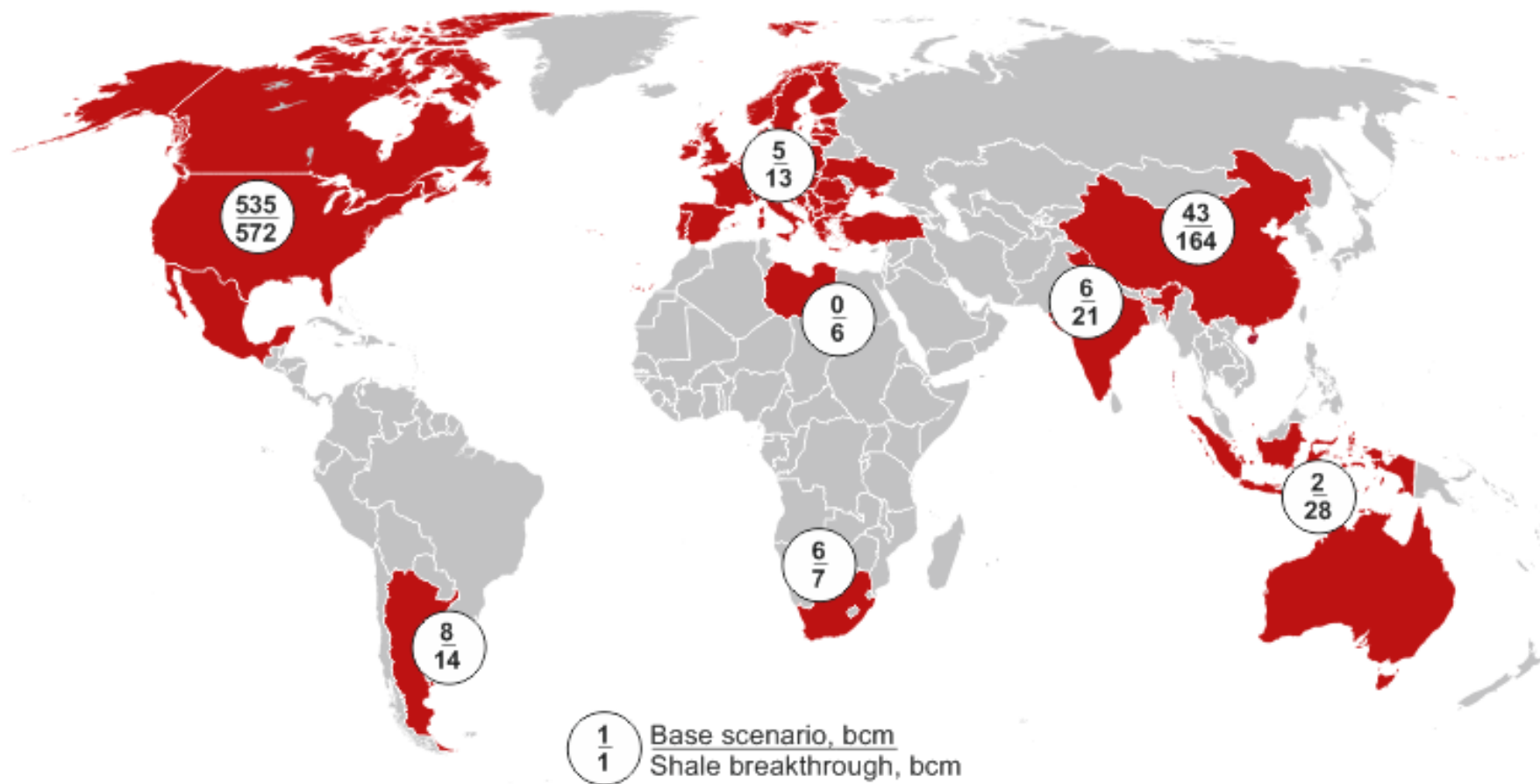
### Shale Oil Production in 2040, Baseline and "Shale Breakthrough" Scenarios





## 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



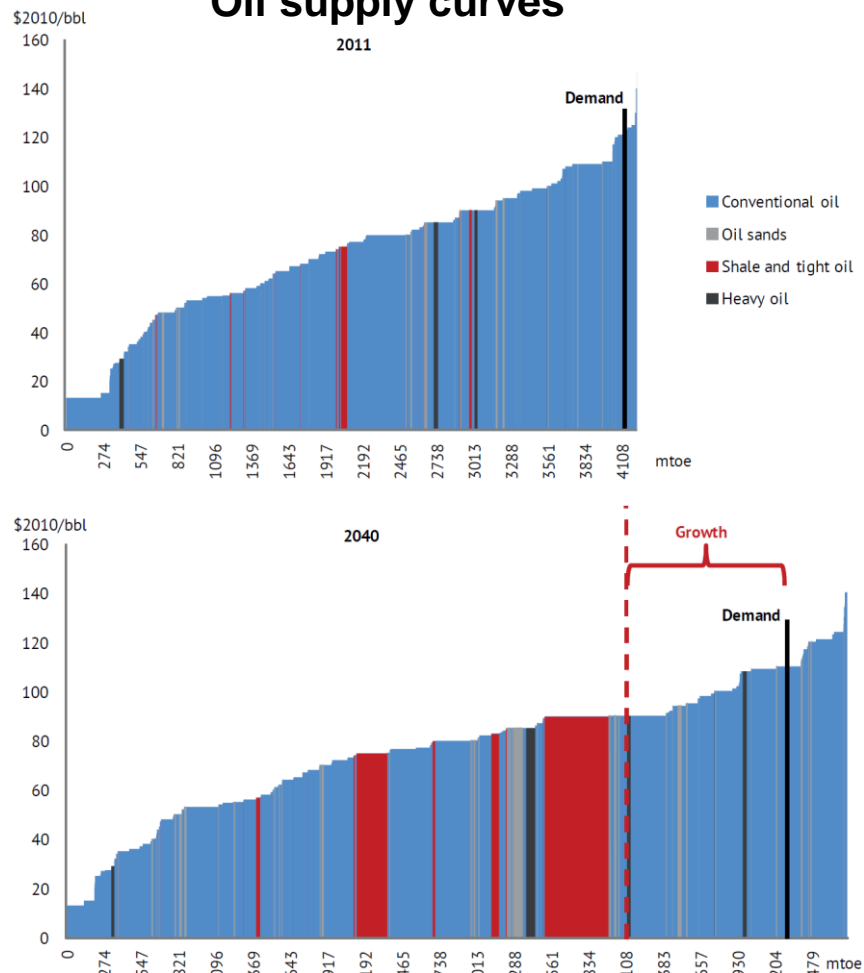
Source: ERI RAS



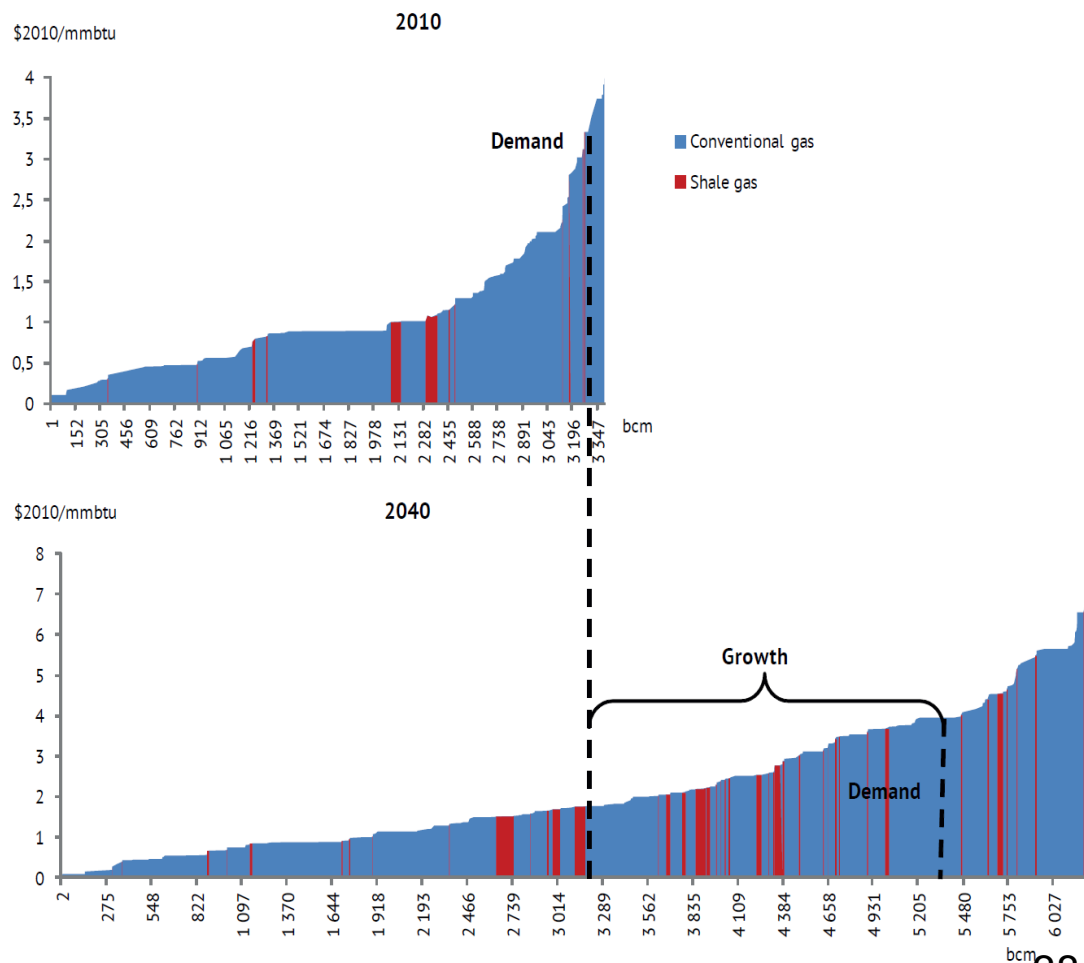


**In the Shale Breakthrough, the oil and gas supply curves are considerably expanded and get more flat, which means an increase in the supply of oil and gas in the mid-price range**

**Oil supply curves**



**Gas supply curves**

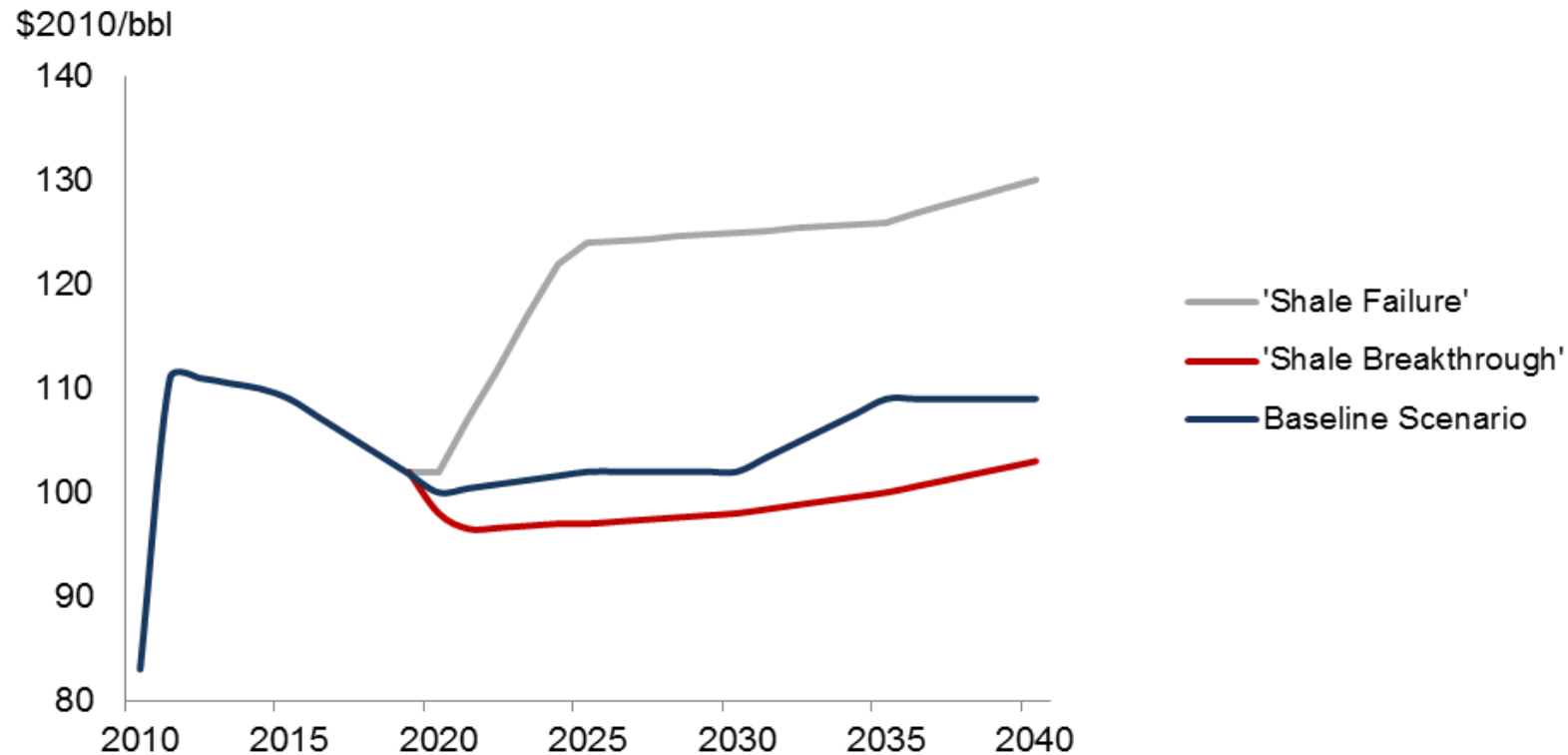


Source: ERI RAS



## 'Shale Breakthrough' and 'Shale Failure' Scenarios: oil prices

### Equilibrium oil prices in the three scenarios



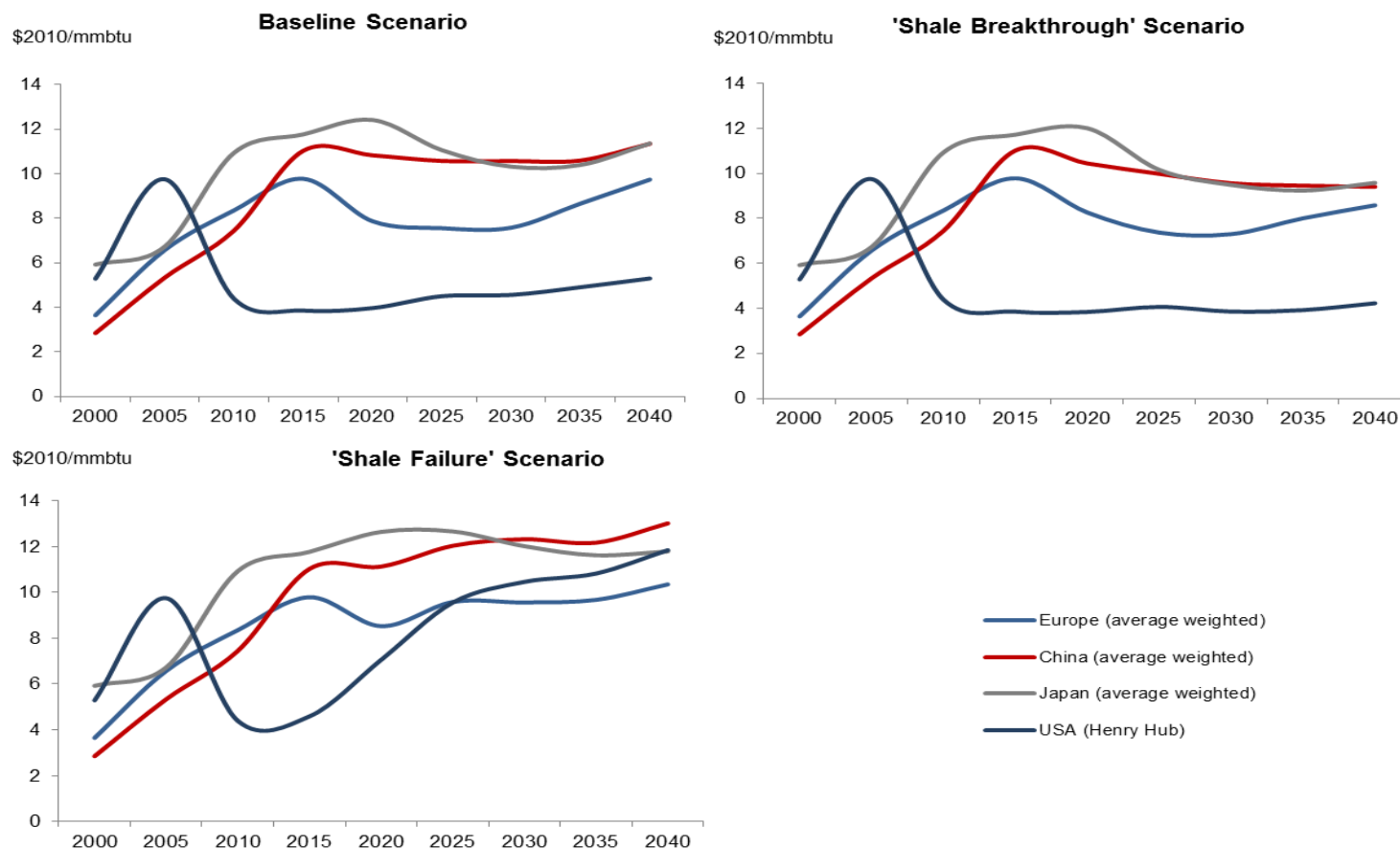
Source: ERI RAS

**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 (MEAN REDUCTION IS ABOUT \$5/BBL FOR OIL AND 1,5 \$/MBTU FOR GAS).**



## 'Shale Breakthrough' and 'Shale Failure' Scenarios: gas prices

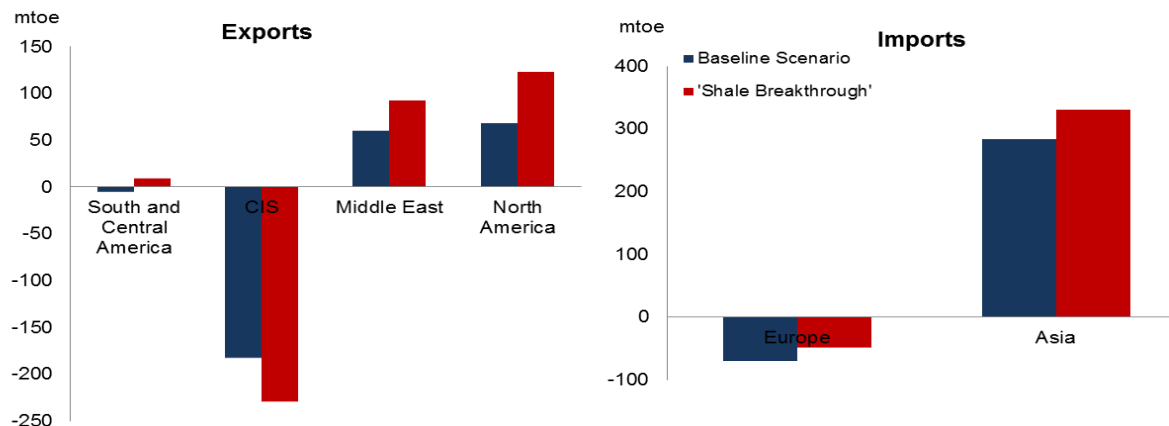
### Equilibrium gas prices in the three scenarios



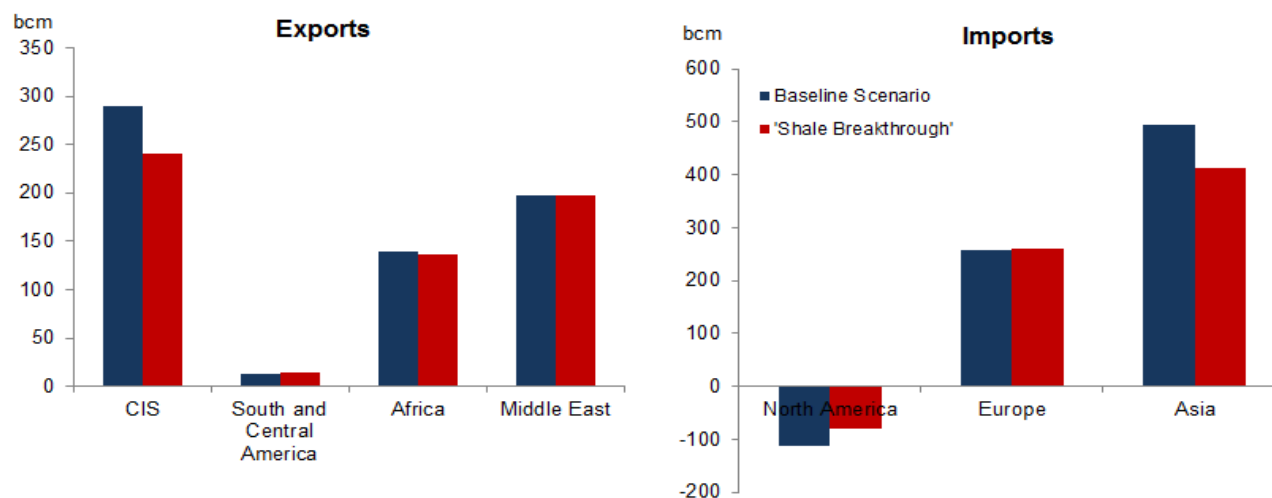


# The impact of Shale Breakthrough on the global hydrocarbon trade is contradictory

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




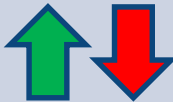













Changes of gas net export and import volumes in 2040 relative to 2010, Baseline and 'Shale Breakthrough' Scenarios



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	Market power Shale Failure
USA			
OPEC			
Exporting non-OPEC producers			
Russia			
China			





## Conclusions

- ❑ There are no fundamental reasons for alarmist forecasts predicting either too high, or extremely low, prices within the period under review. In all cases – ranging from future success to possible failure of shale technologies – oil prices in 2040 will not move out of the range \$100–130/bbl with the similar dynamics of the gas prices.
- ❑ Natural gas will account for the most substantial increase in absolute volumes of consumption, and the share taken by gas in primary energy consumption will increase more than that of any other fuel. The next 30 years could, quite reasonably, be considered as ‘the era of gas’.
- ❑ The expected transformation of the hydrocarbon markets will not significantly change the fuel markets themselves, but the positions of the leading market participants will be noticeably rebalanced, while some of the global players will get additional influencing possibilities.



## Energy Research Institute of the Russian Academy of Sciences

Nagornaya st., 31, k.2, 117186, Moscow,  
Russian Federation

phone: +7 985 368 39 75

fax: +7 499 135 88 70

web: [www.eriras.ru](http://www.eriras.ru)

e-mail: [mitrovat@rambler.ru](mailto:mitrovat@rambler.ru)