

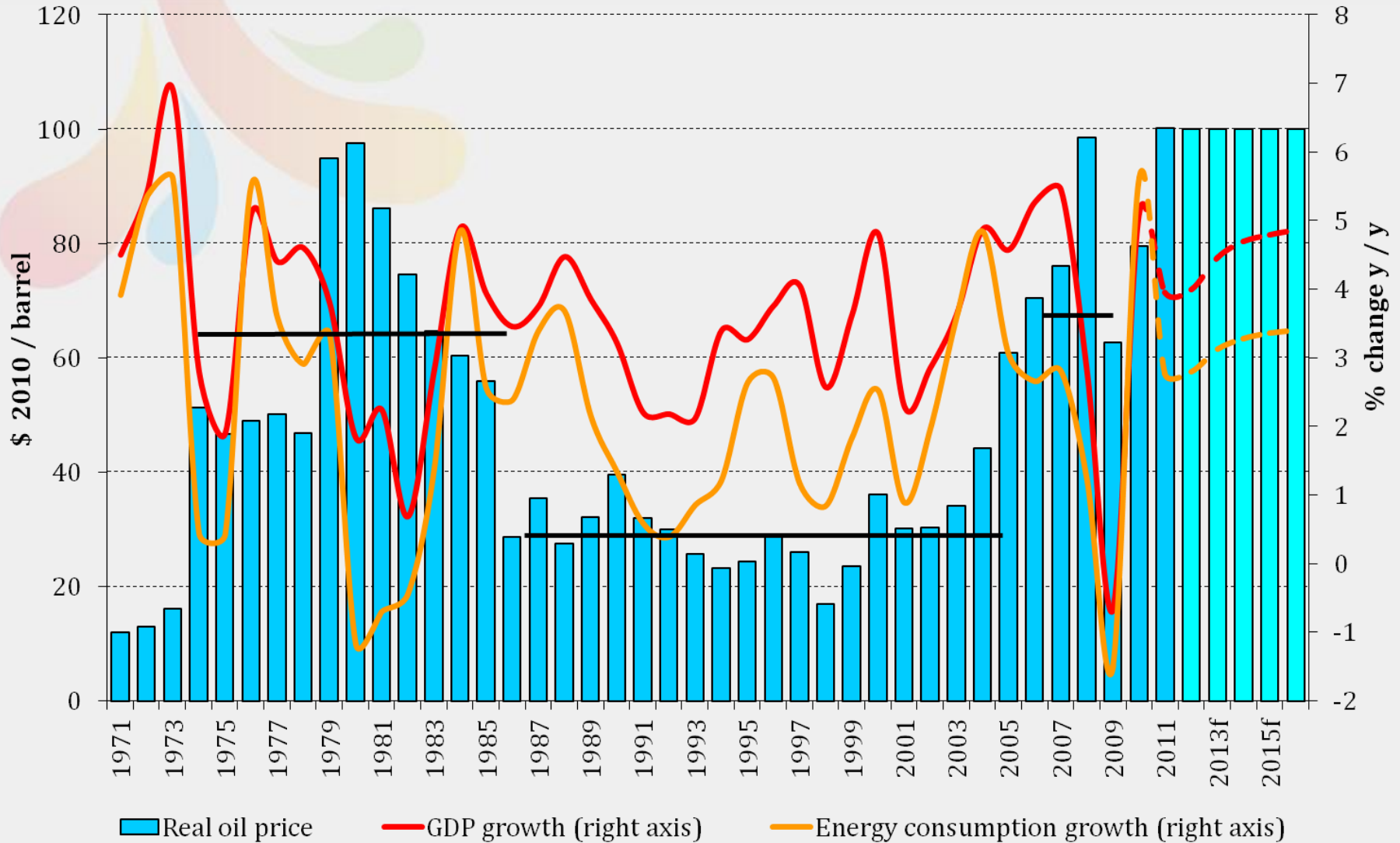
It is a Long Way to 2050

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Russian Energy Agency, Deputy Director General
Chair of Global Economy, HSE, Moscow

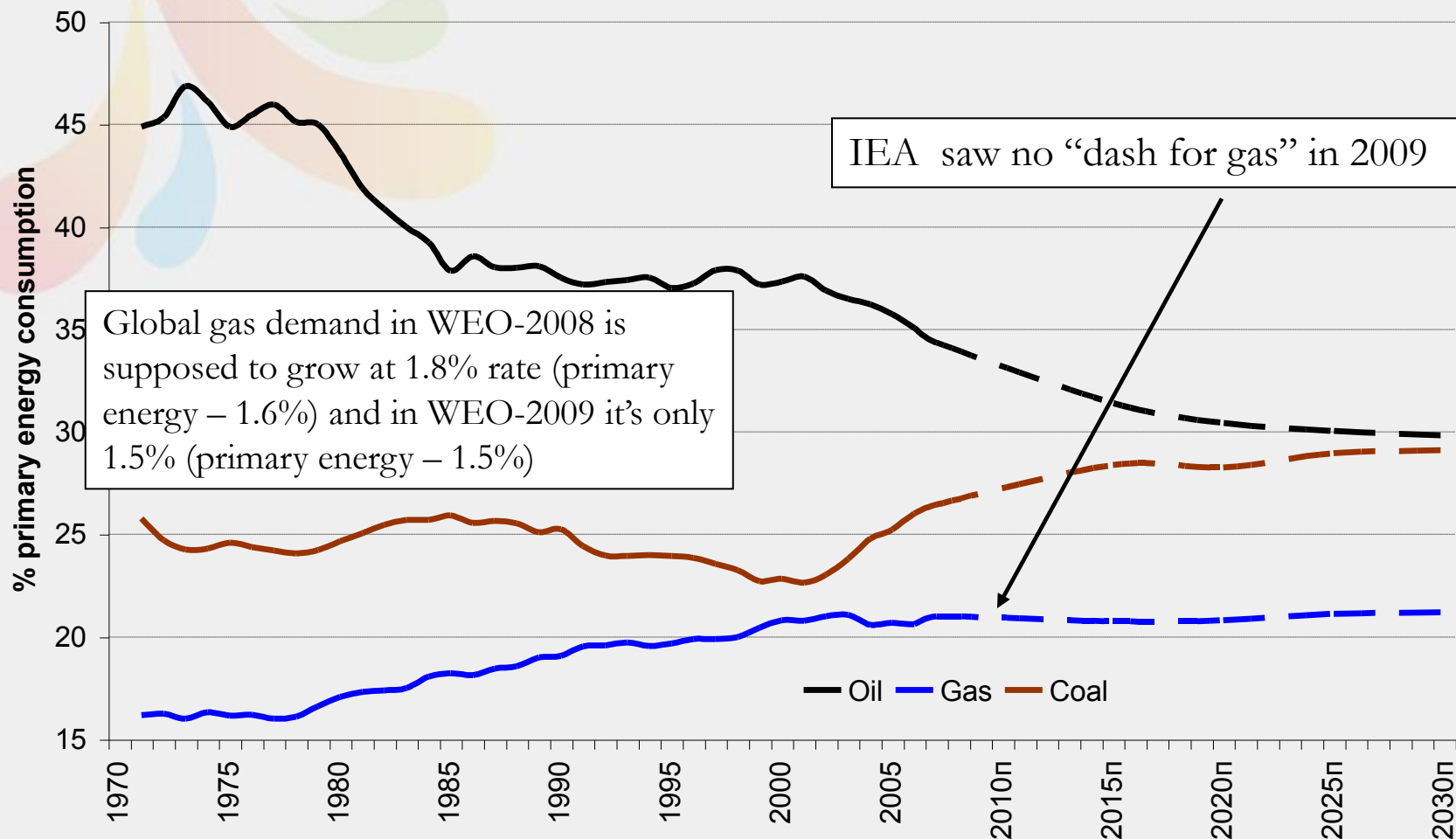
AGENDA until 2050

- Climate change prevention
- Growth in the OECD with the business cycle
- Fast Growth in Asia & other continents to the level of the OECD per capita GDP...
- Millennium Goals and Energy Poverty – UN
- Energy Efficiency and Prices along the road
- EU – the island of efficiency and security
- Russia – modernizing itself between all currents

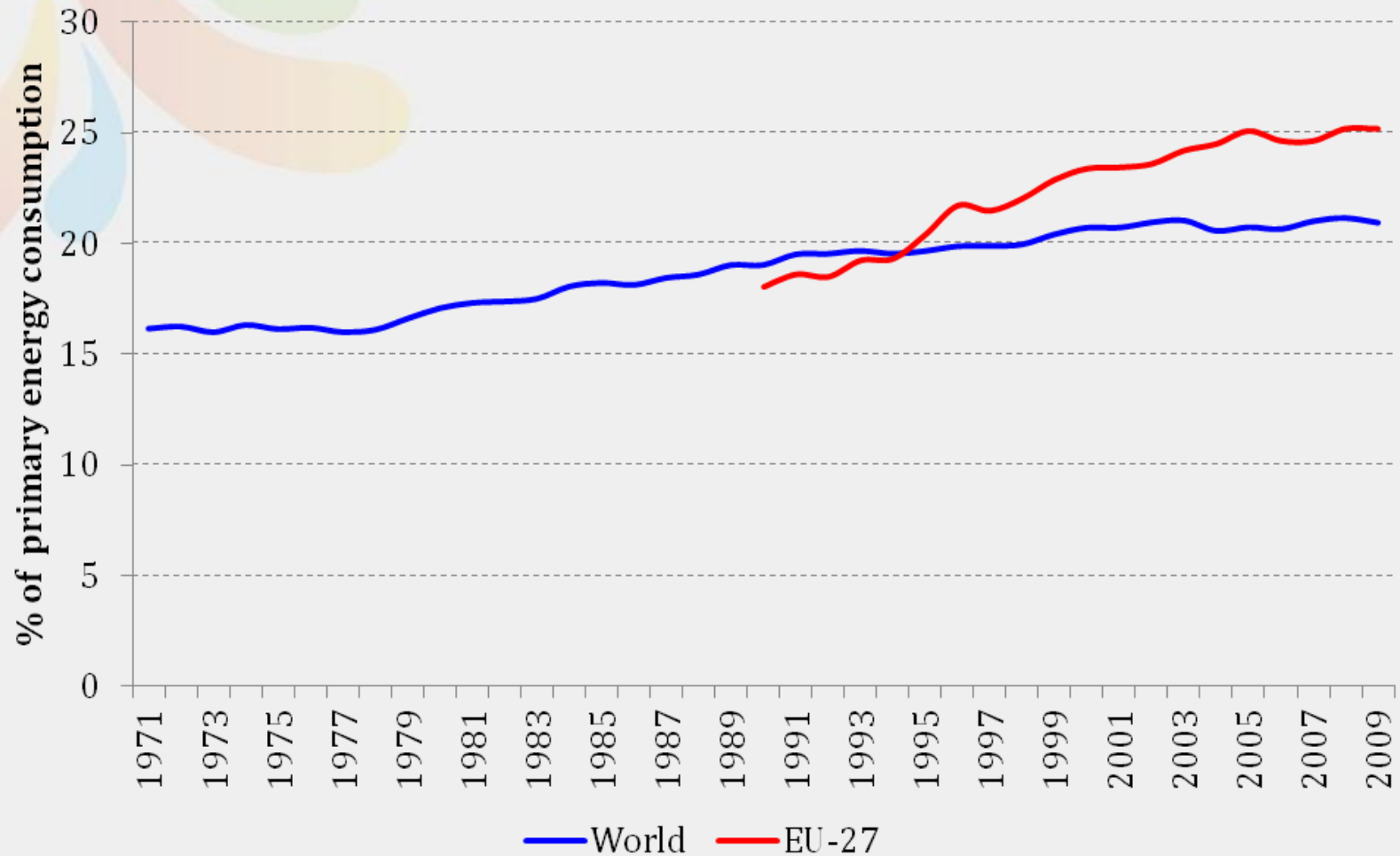
Oil prices and growth of GDP, energy consumption 1971 - 2016



IEA 2009 energy forecast

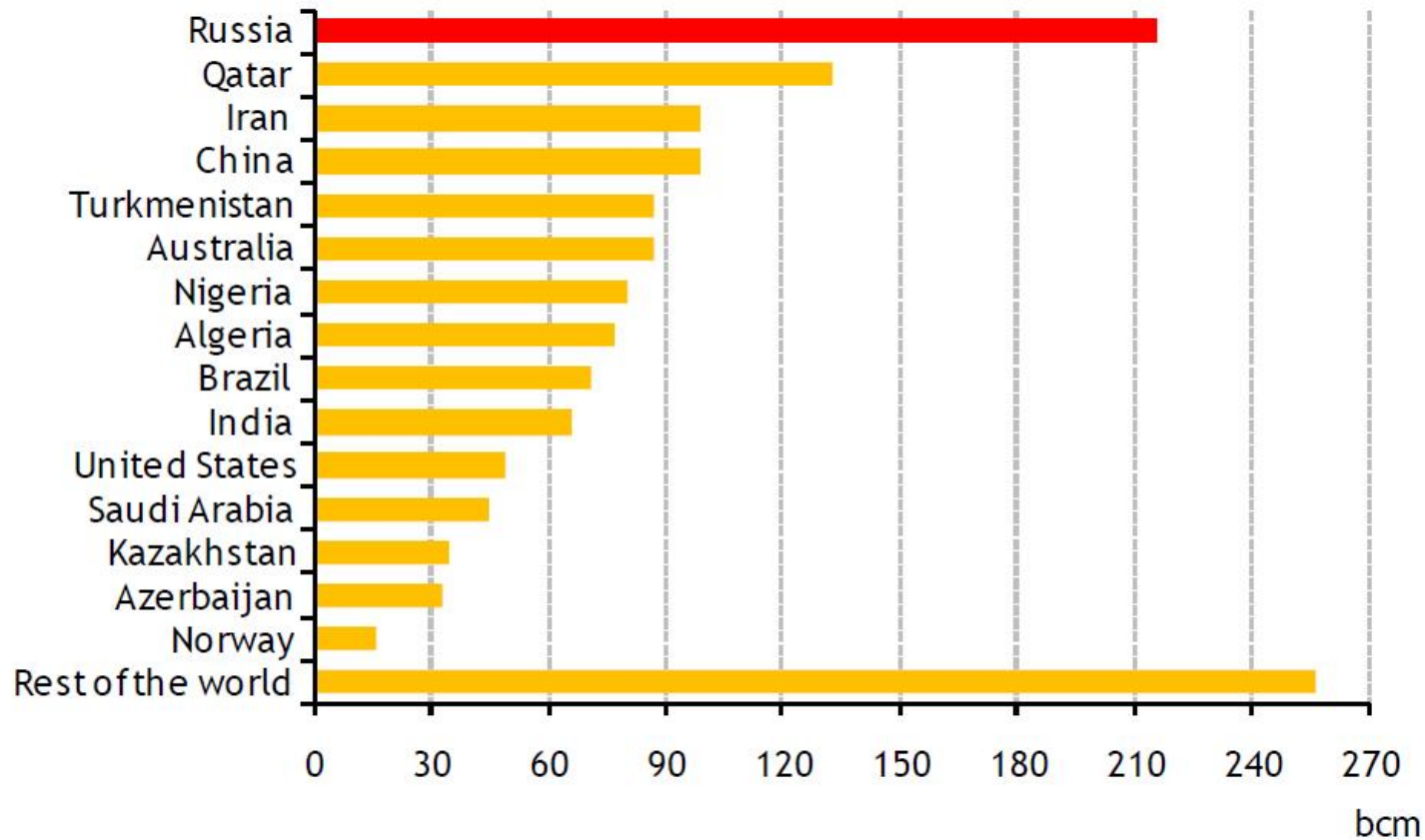


Share of natural gas in energy consumption 1971 - 2009, %



The largest producer... and also the main projected source of gas supply growth

Incremental gas production, 2009-2035



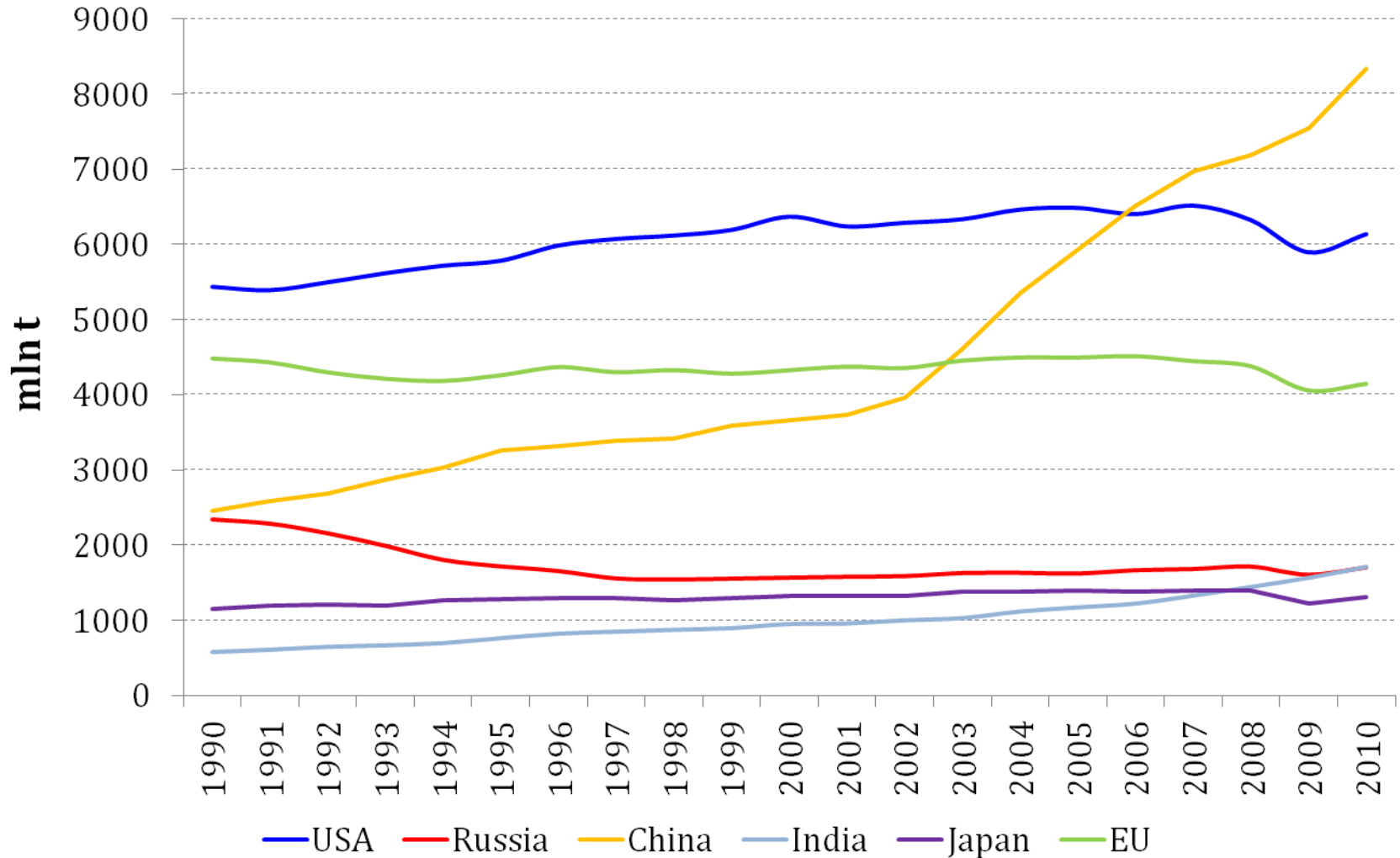
Projected Russian gas production reaches 800 bcm in 2035, making Russia by far the biggest contributor to incremental global gas supply to 2035

Comparison of power plants on different fuels – reminder

Table 10.4 • Assumed cost and technical parameters of power plants in the OECD starting commercial operation in 2015-2020

	Unit	Gas (CCGT)	Coal ultra-supercritical	Coal IGCC	Coal IGCC with CCS	Nuclear power	Wind onshore
Capacity factor	%	80%	80%	80%	80%	90%	27%
Thermal efficiency (net, lower heating value)	%	58%	47%	48%	38%	33%	n.a.
Capital cost (overnight)	\$2008/kW	900	2 400	2 800	3 400	3 800	1 700
Construction lead time	Years	3	4	4	5	5	2
Economic plant life	Years	25	35	35	35	40	20
Unit cost of fuel	Various*	11	95	95	95	10	n.a.
Non-fuel O&M costs	\$2008/kW	13	49	83	72	117	40
Long-run marginal cost	\$2008/MWh	78	69	78	95	72	94

CO2 Emissions - by region, 1990 - 2010



Source: BP

Future Global Fuel Mix

- Coal is still cheap, “local” and fast growing: China, India, USA, EU etc. But CO₂ (almost 900 g/KWH)
- Nuclear – 400+ power stations now. Fucusima... Issues of security, cadres, fuel, technology...
- Oil – transportation all around growing
- RES – time and cost issues, local fuel in EU?
- Gas – bridge before future efficiency
- Issues – how we go to 2050 – via what road?
- Rift between Scenarios and Forecasts...

GDP, Energy and Gas Consumption

average annual growth rates, 1986 - 2010

	GDP (PPP)				Energy Consumption				Gas Consumption			
	1986-2002	2003-2008	2009	2010	1986-2002	2003-2008	2009	2010	1986-2002	2003-2008	2009	2010
World	3.1	4.3	-0.6	5.0	1.8	3.0	-1.5	5.6	2.5	3.1	-2.5	7.4
<i>OECD</i>	<i>2.8</i>	<i>2.4</i>	<i>-3.5</i>	<i>3.1</i>	<i>1.6</i>	<i>0.6</i>	<i>-5.0</i>	<i>3.5</i>	<i>2.6</i>	<i>1.5</i>	<i>-3.2</i>	<i>6.4</i>
USA	3.1	2.3	-2.7	2.9	1.6	0.2	-5.0	3.7	1.7	0.2	-1.8	5.7
EU	2.4	2.3	-4.3	1.8	0.5	0.4	-5.9	3.2	2.5	1.4	-6.4	7.4
Japan	2.2	1.5	-6.3	5.1	1.9	0.2	-8.4	5.9	3.8	4.3	-6.7	8.1
<i>Non-OECD</i>	<i>3.5</i>	<i>7.5</i>	<i>3.3</i>	<i>7.4</i>	<i>2.1</i>	<i>5.7</i>	<i>1.8</i>	<i>7.5</i>	<i>2.5</i>	<i>4.8</i>	<i>-1.9</i>	<i>8.4</i>
Brazil	2.3	4.2	-0.6	7.5	3.3	3.9	-0.4	8.5	10.7	9.7	-19.7	33.8
Russia	-2.5*	7.1	-7.8	4.0	-1.5	1.5	-5.2	5.5	0.3	2.1	-6.3	6.3
India	5.5	8.3	9.1	9.7	5.1	6.3	7.9	9.2	11.3	7.0	23.3	21.5
China	9.5	11.3	9.2	10.3	4.7	10.5	5.2	11.2	4.9	18.6	10.1	21.8

* - GDP growth for 1990 - 2002

Oil and Coal Consumption, Electricity Generation average annual growth rates, 1986 - 2010



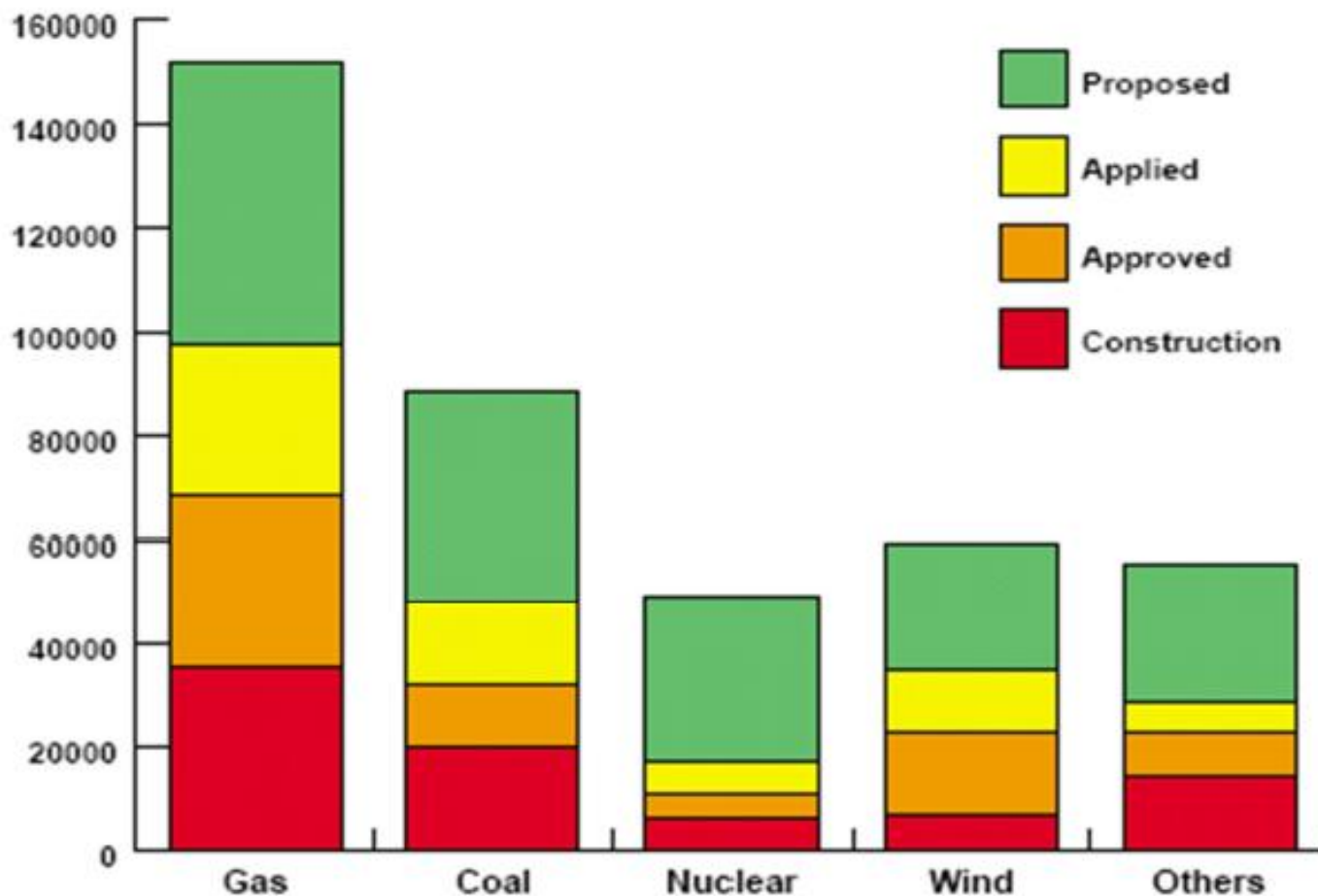
	Oil Consumption				Coal Consumption				Electricity Generation			
	1986-2002	2003-2008	2009	2010	1986-2002	2003-2008	2009	2010	1991-2002	2003-2008	2009	2010
World	1.7	1.6	-1.5	3.1	1.1	5.1	-1.1	7.6	2.6	3.9	-1.0	5.9
OECD	1.5	0.0	-4.3	1.0	0.3	0.6	-10.4	5.2	2.2	1.6	-4.1	3.7
USA	1.4	-0.2	-3.7	2.0	1.3	0.4	-12.0	5.7	2.0	1.1	-4.1	4.3
EU	0.7	0.1	-5.0	-0.9	-2.6	-1.1	-11.7	3.8	1.6	1.2	-4.9	3.7
Japan	1.1	-1.6	-9.2	1.4	2.2	3.2	-15.5	13.7	1.9	1.9	-5.9	2.8
Non-OECD	2.0	3.9	2.1	5.7	1.9	8.3	4.0	8.7	3.3	7.0	2.6	8.3
Brazil	3.1	2.7	0.7	8.5	0.9	2.8	-13.2	6.0	3.7	5.0	-1.4	6.2
Russia	-3.4	1.8	-3.3	9.0	-3.7	-0.4	-8.4	2.1	-1.6	2.6	-4.5	4.4
India	5.9	4.4	4.7	3.4	4.4	7.2	8.8	10.8	6.3	5.7	5.5	6.0
China	6.4	7.1	3.3	10.4	4.1	10.9	5.2	10.1	8.5	13.1	7.1	13.2

Road Map 2050 - EU

- Competition between free objectives:
 - ❖ Security of physical supplies
 - ❖ Climate Change Prevention
 - ❖ Economic growth and prices reduction by competition (and foreign policy?)
- Crucial Decade is till 2020 because of Irreversibility of Fixed Assets and “EU style Recovery” till 2013...
- 20-20-20 – nice objectives but what are realty?
- Why one should invest for fuel if RES is coming? But Russian companies are still optimistic on EU demand.



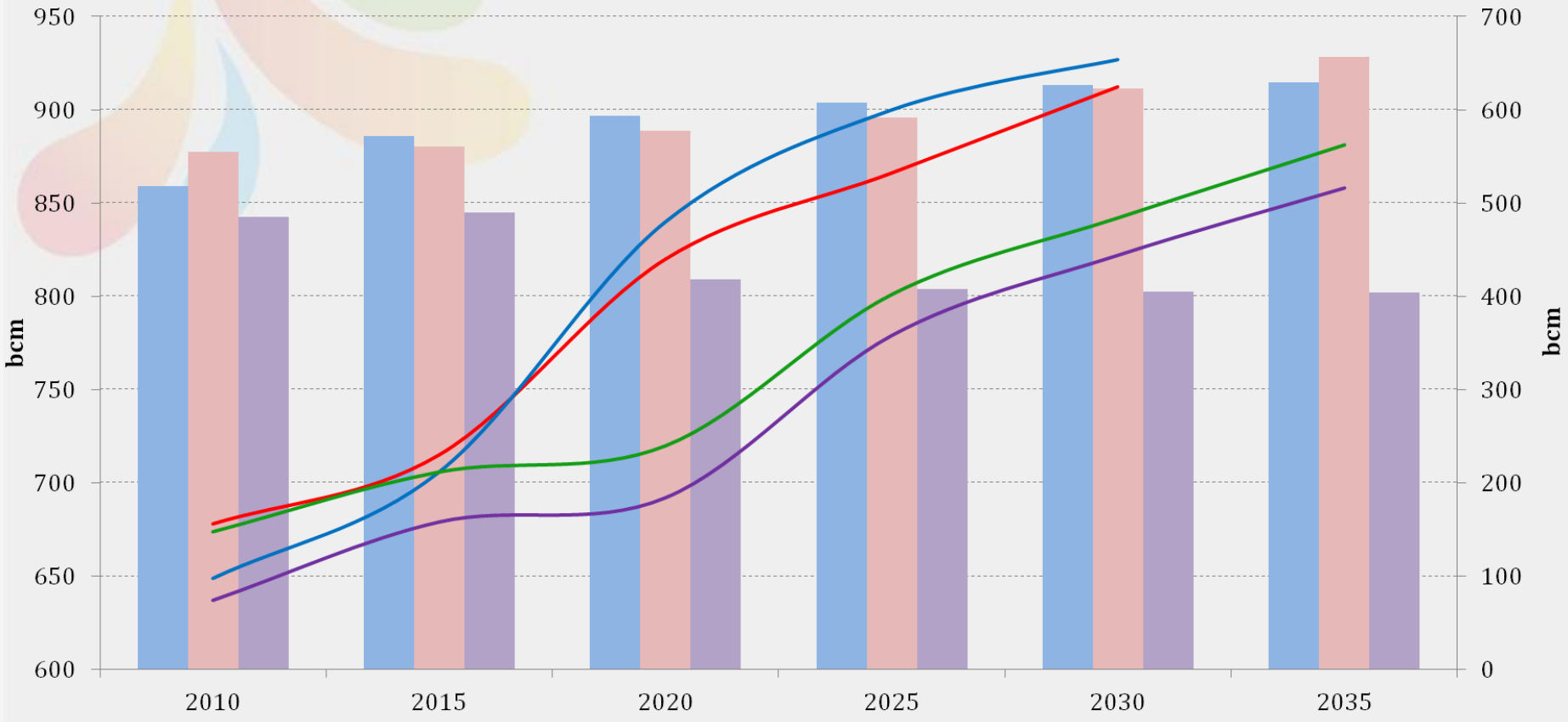
Power Plant Projects in Europe (2010), in MW



Source: A. Honore (2010)

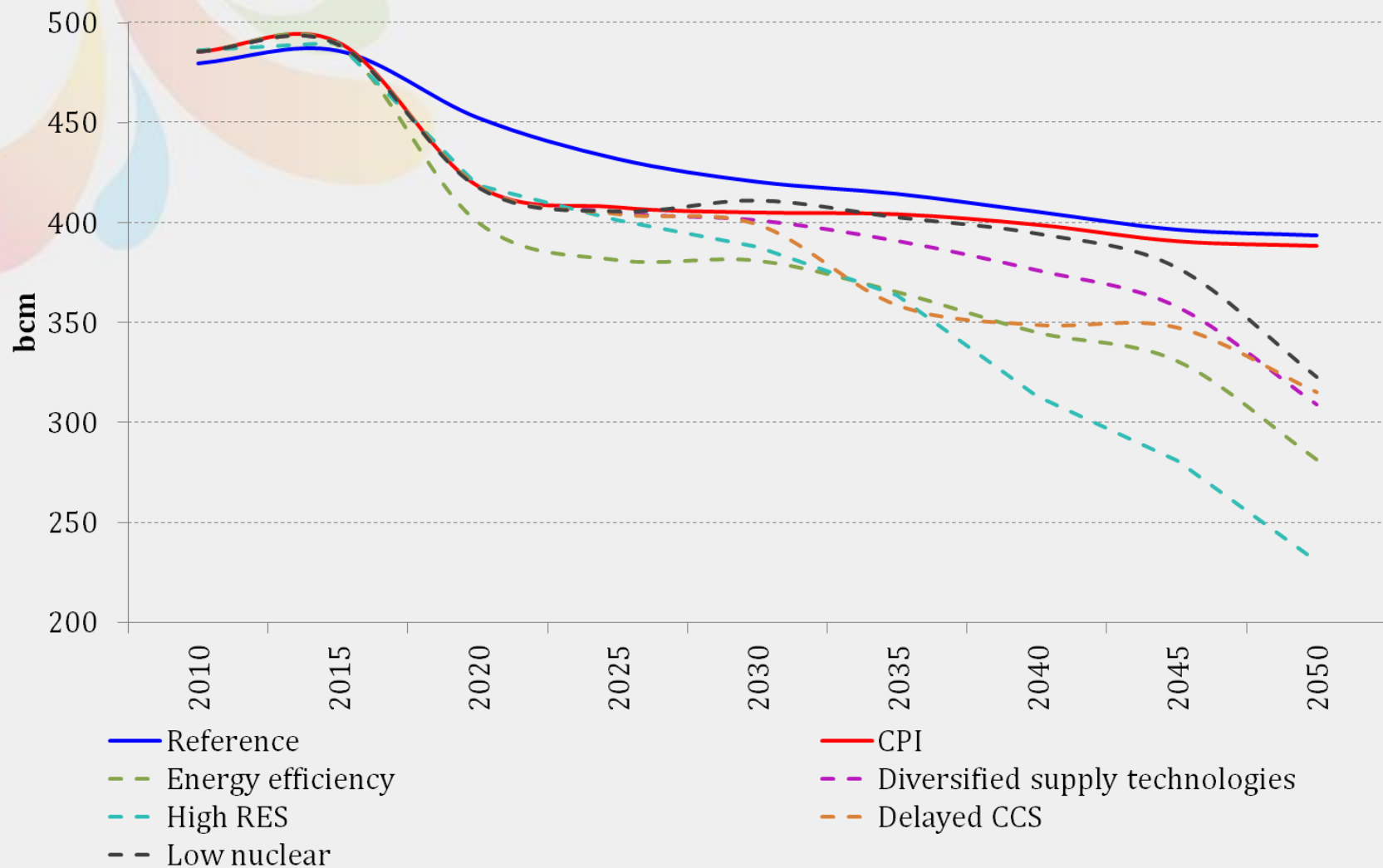
Forecasts till 2035:

Russian gas production (lines, left axis) and European gas consumption (bars, right axis), bcm

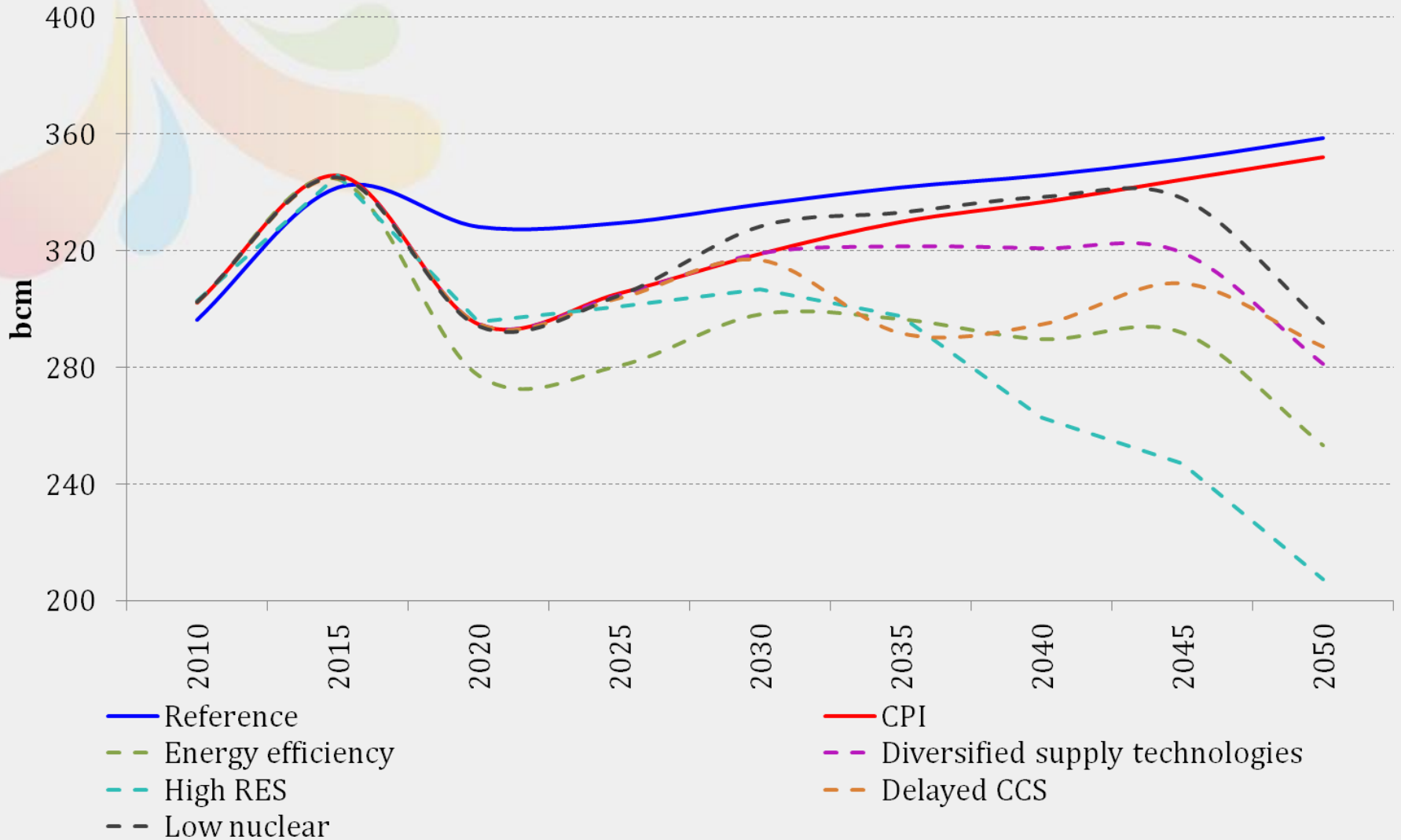


- EU gas consumption - IEA "NEP scenario" (right axis)
- EU gas consumption - EU ROADMAP 2050 CPI (right axis)
- Russian gas production - Energy Research Institute, RAS
- Russian gas production - IEA "Gas scenario"
- OECD Europe gas consumption - US EIA forecast (right axis)
- Russian gas production - Energy Strategy
- Russian gas production - IEA "NEP"

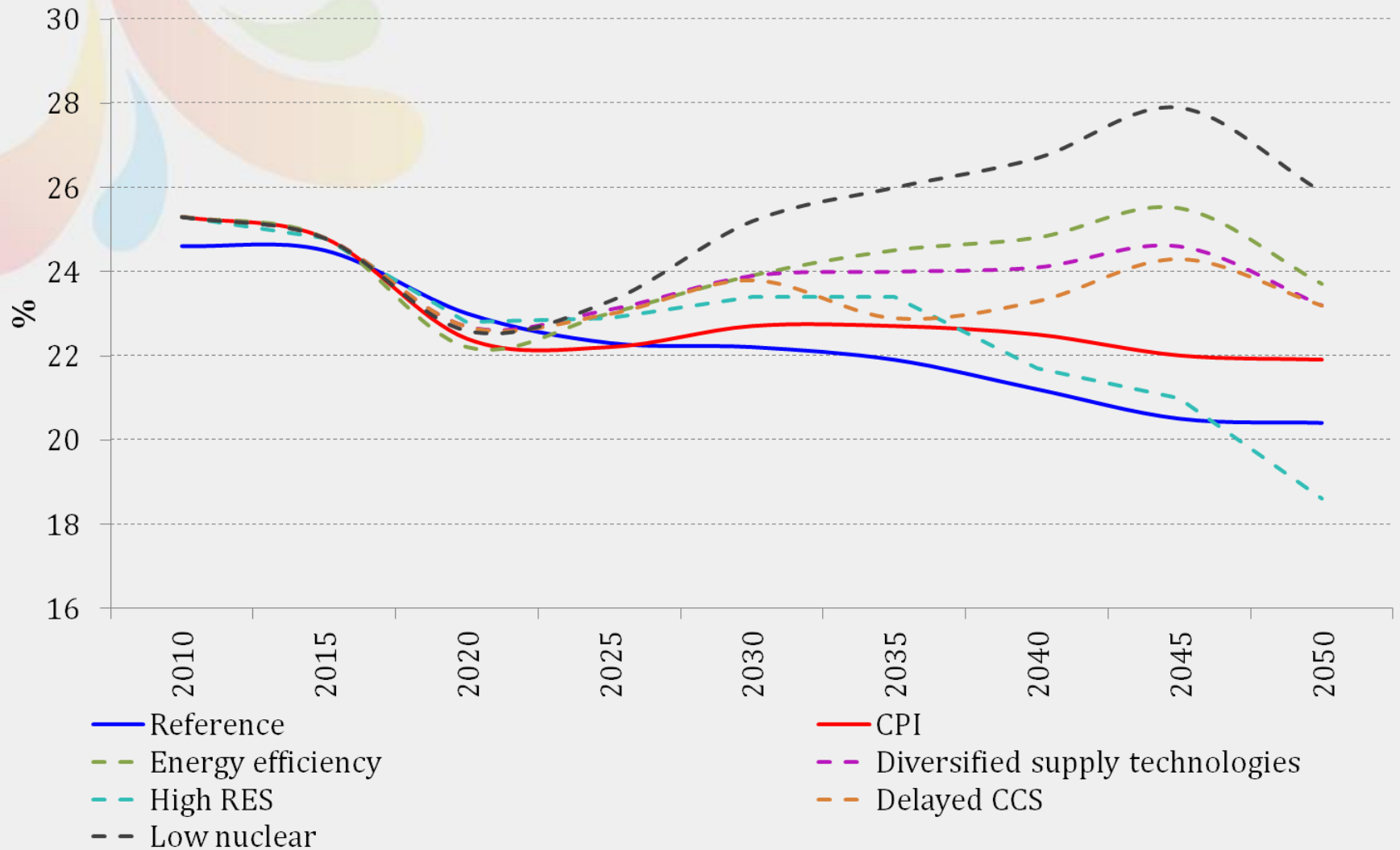
EU Roadmap 2050 Scenarios: EU Gas Consumption 2010 – 2050, bcm



EU Roadmap 2050 Scenarios: EU Gas Net Imports 2010 – 2050, bcm

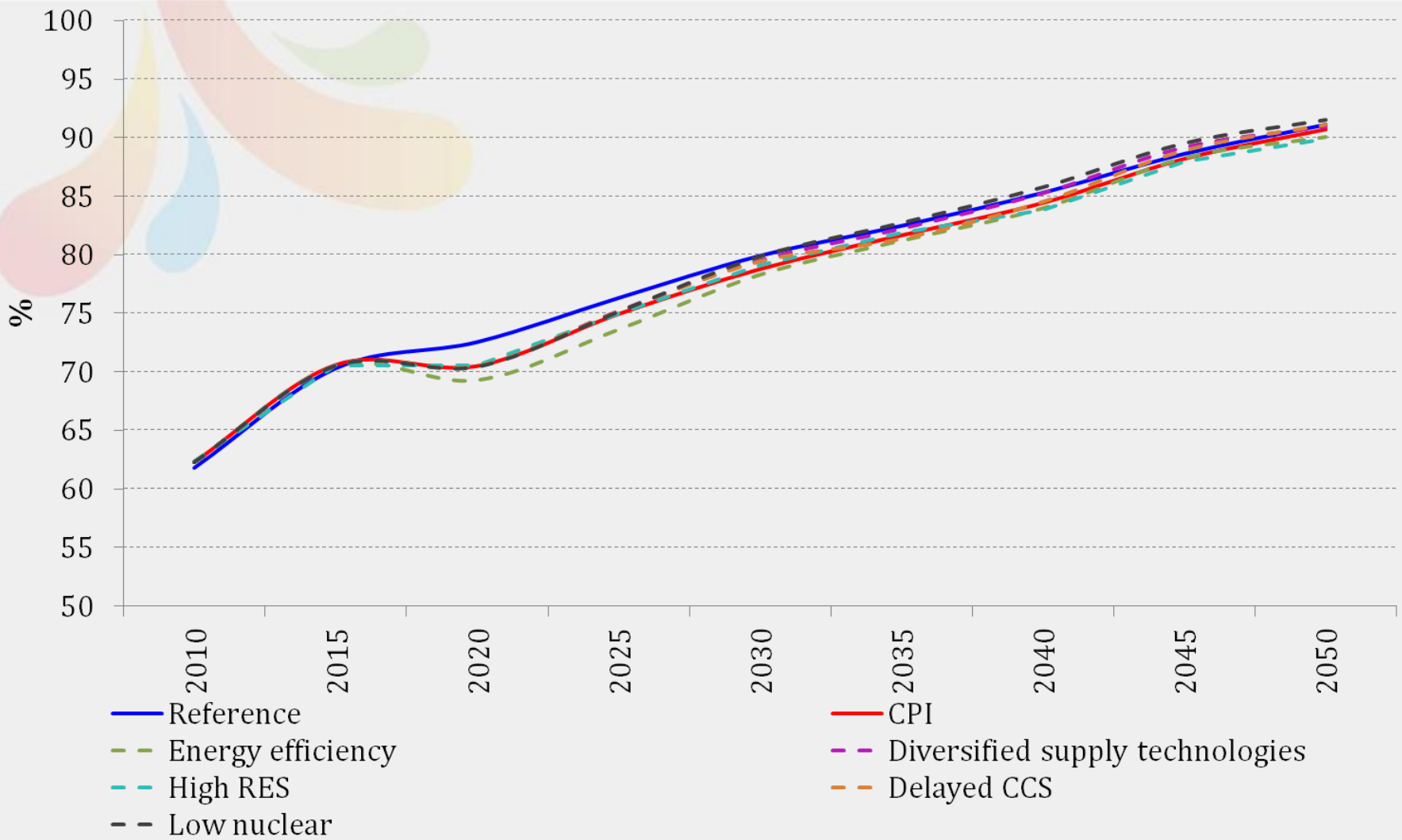


EU Roadmap 2050 Scenarios: Share of Gas in Gross Energy Consumption 2010 - 2050, %



EU Roadmap 2050 Scenarios: EU Gas Import Dependence

2010 – 2050, net imp./cons., %



McKinsey & Company

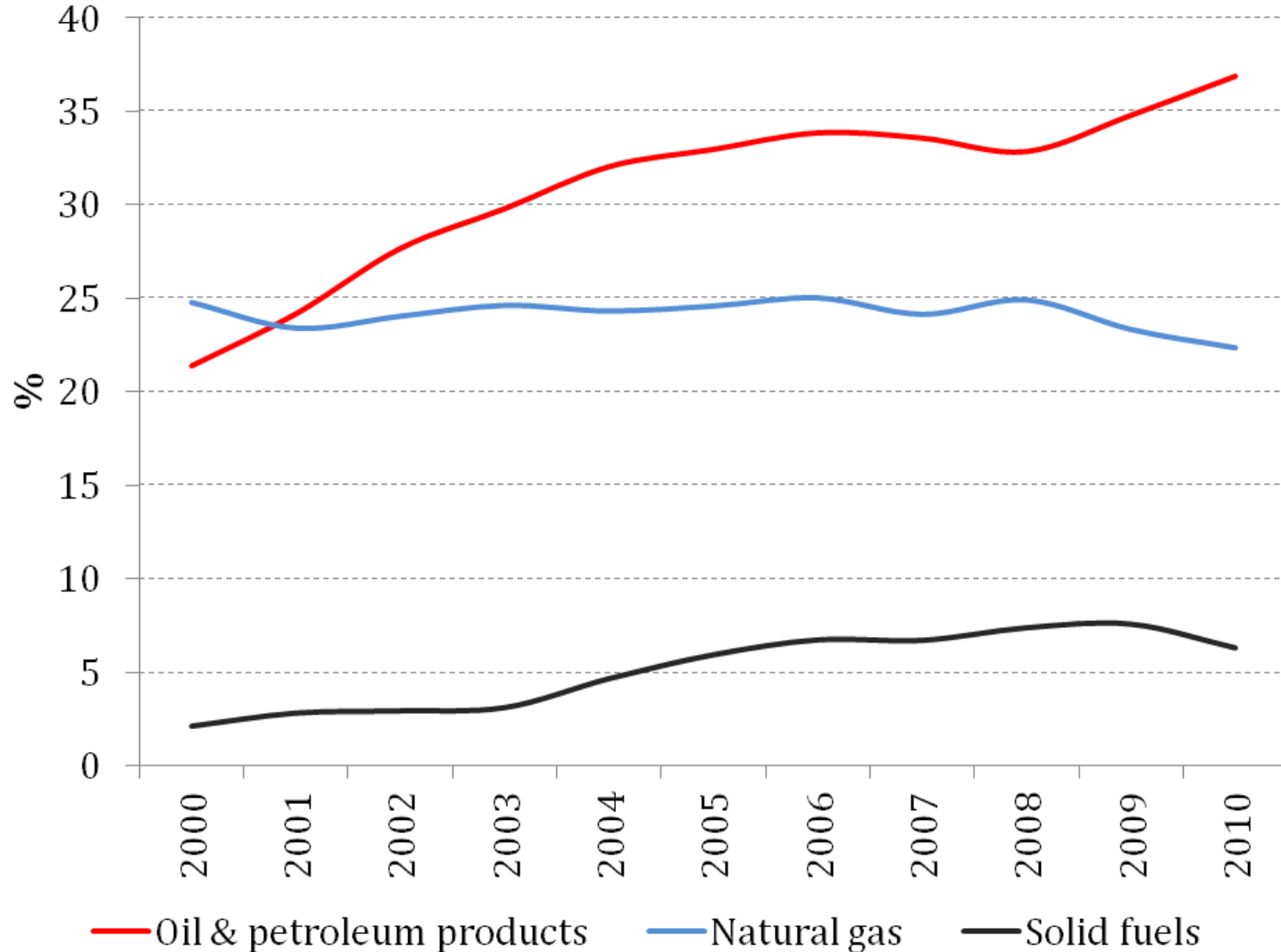
Scenarios for 80% CO2 reduction till 2050



Scenario	Gas demand, bcm			Share of gas in electricity generation, %		
	2010	2030	2050	2010	2030	2050
Baseline (80% CO2 reduction is not achieved)	518	610	716	26	29	29
"60% RES"	518	384	261	26	19	10
"Low gas price"	518	502	354	26	33	19
"Low gas price, nucl. sensitivity"	518	532	501	26	36	34
"High gas price"	518	387	302	26	19	14

Share of imports from Russia in EU-27 consumption

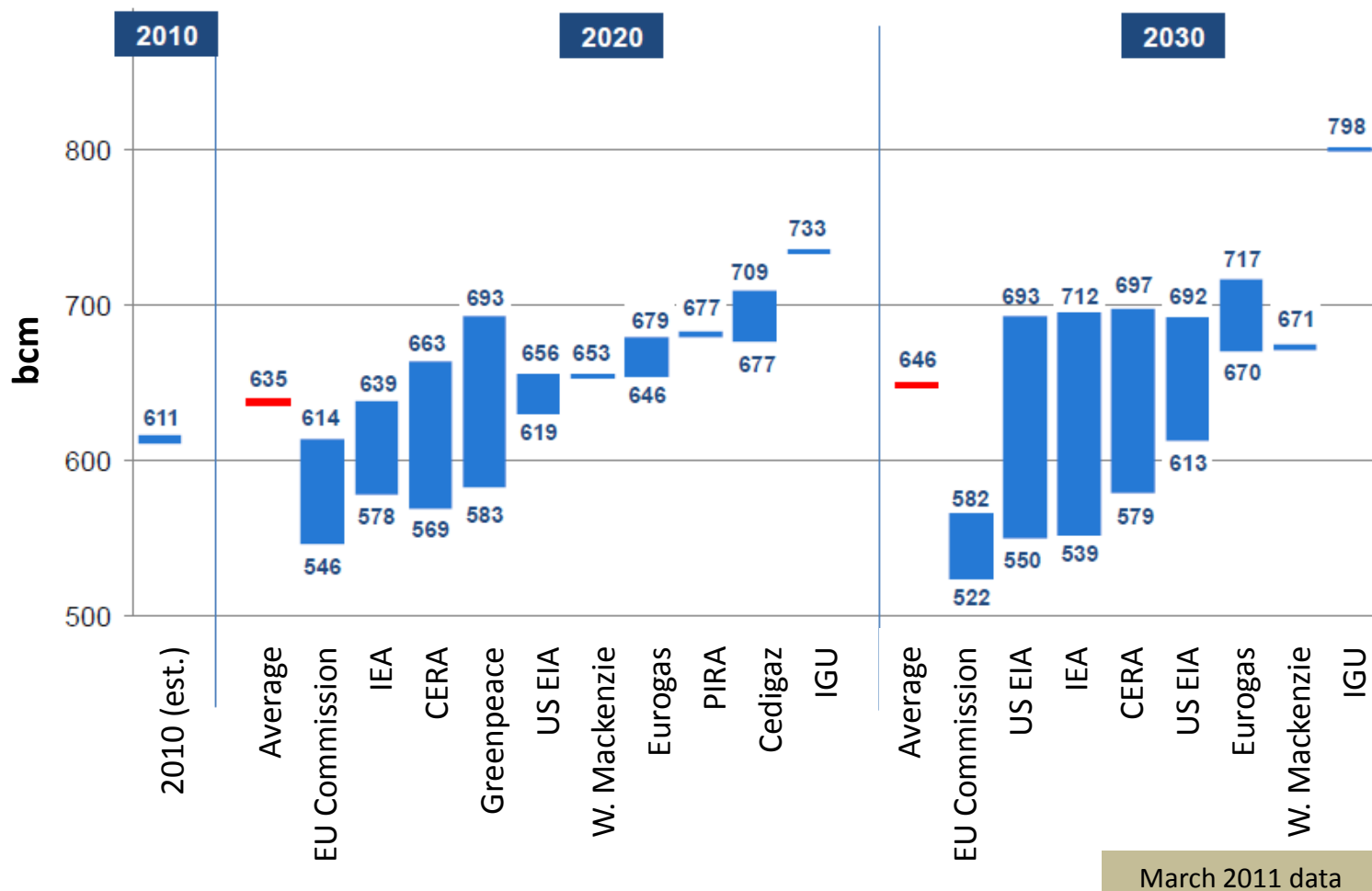
by fuel, 2000 - 2010



Source: Eurostat

Gas consumption in Europe: long-term forecasts

Scenarios and forecasts from leading experts



Differences between various lists of European countries are negligible

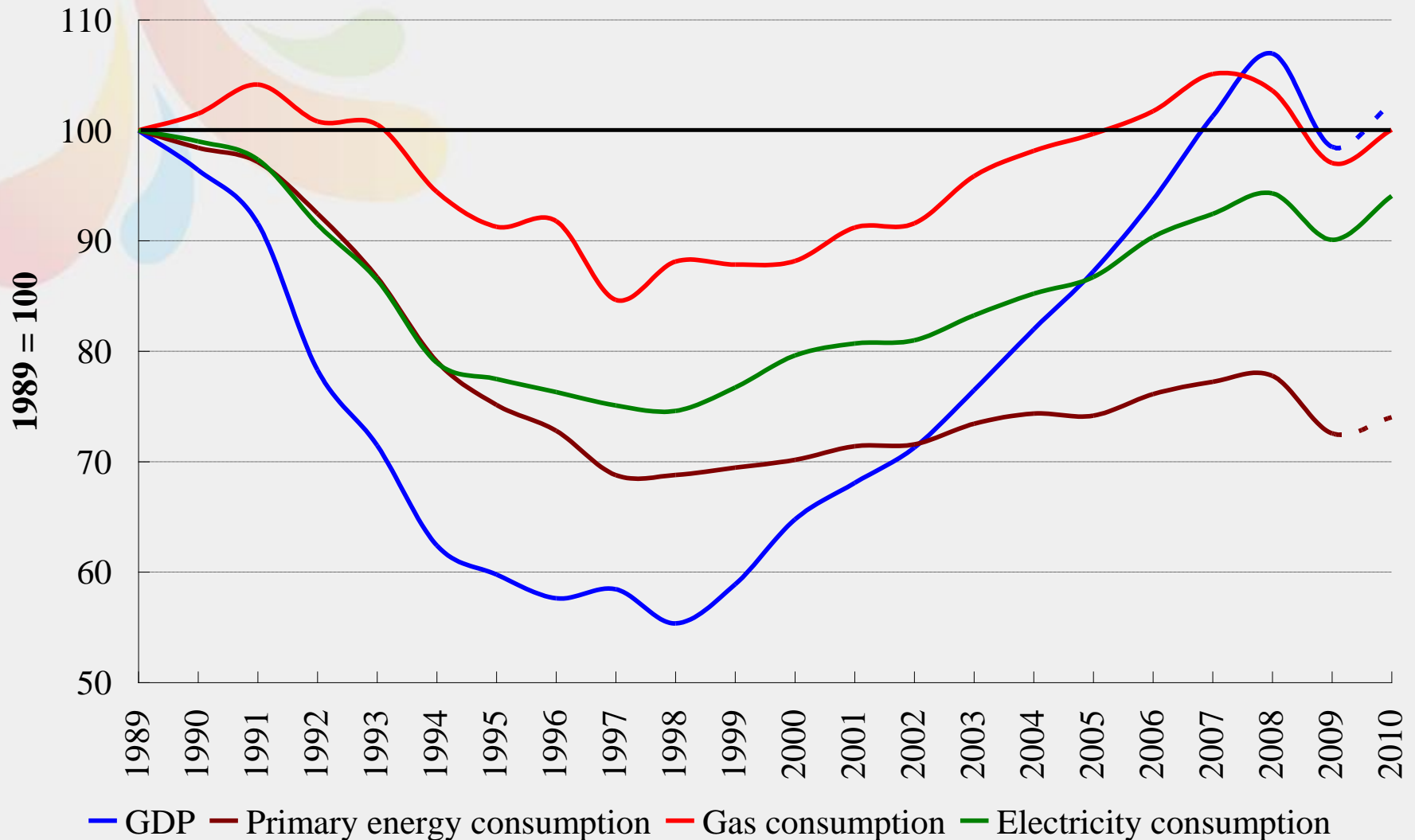
All the forecasts and scenarios are re-evaluated on the basis of average estimated growth rates for the purpose of comparison

Russia – difficult choices

- Transitional crisis is over, but GDP 2011 is just above 1989, capital formation is under...
- Domestic agenda and a fight for investments between Modernization and Development, Energy, and Social & Infrastructure. So far Energy wins!
- Russian companies are optimistic on demand and ready to take risks of investing but they are struggling with the rising barriers.
- Security of suppliers = demand and price stability – for Investments and Budget. Before Modernization comes as our Independence from Energy.

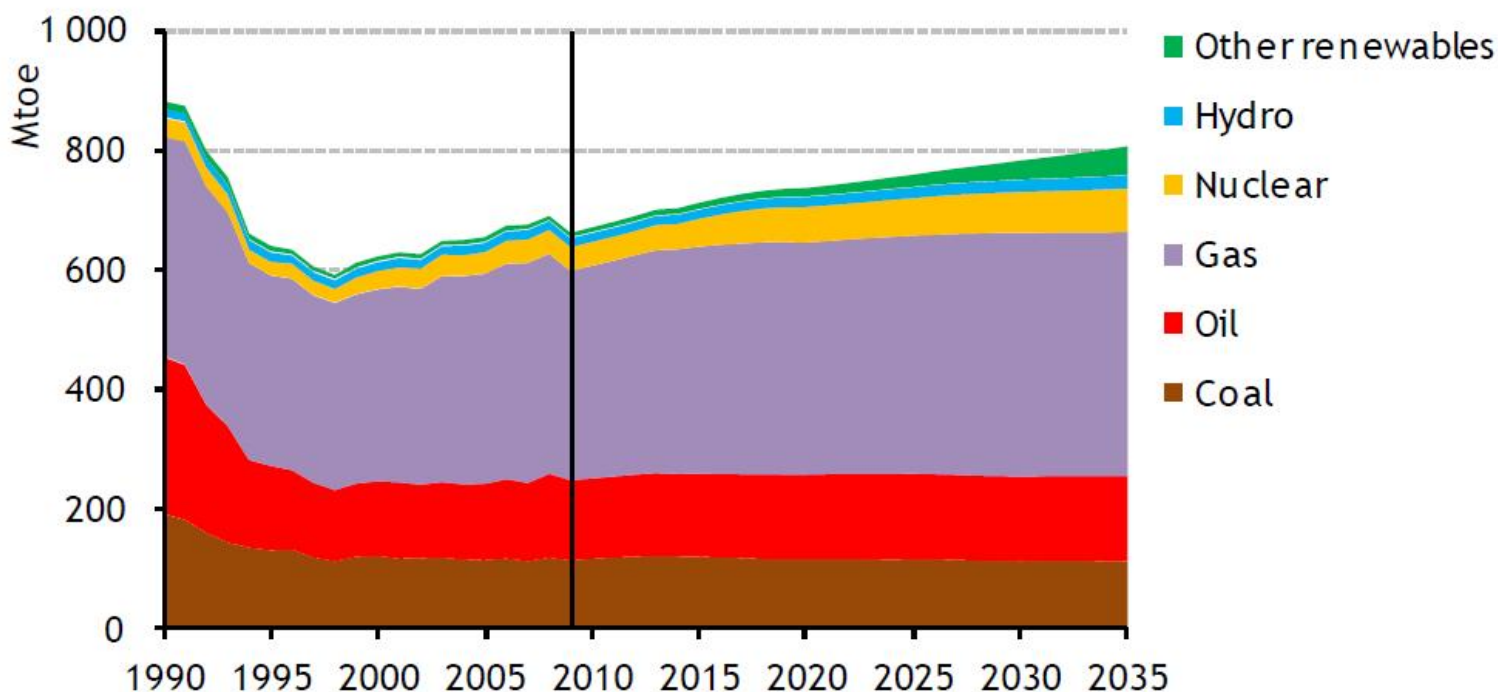
Russia: GDP and energy indicators

1989 - 2010



Future demand very sensitive to policy choices on pricing and efficiency

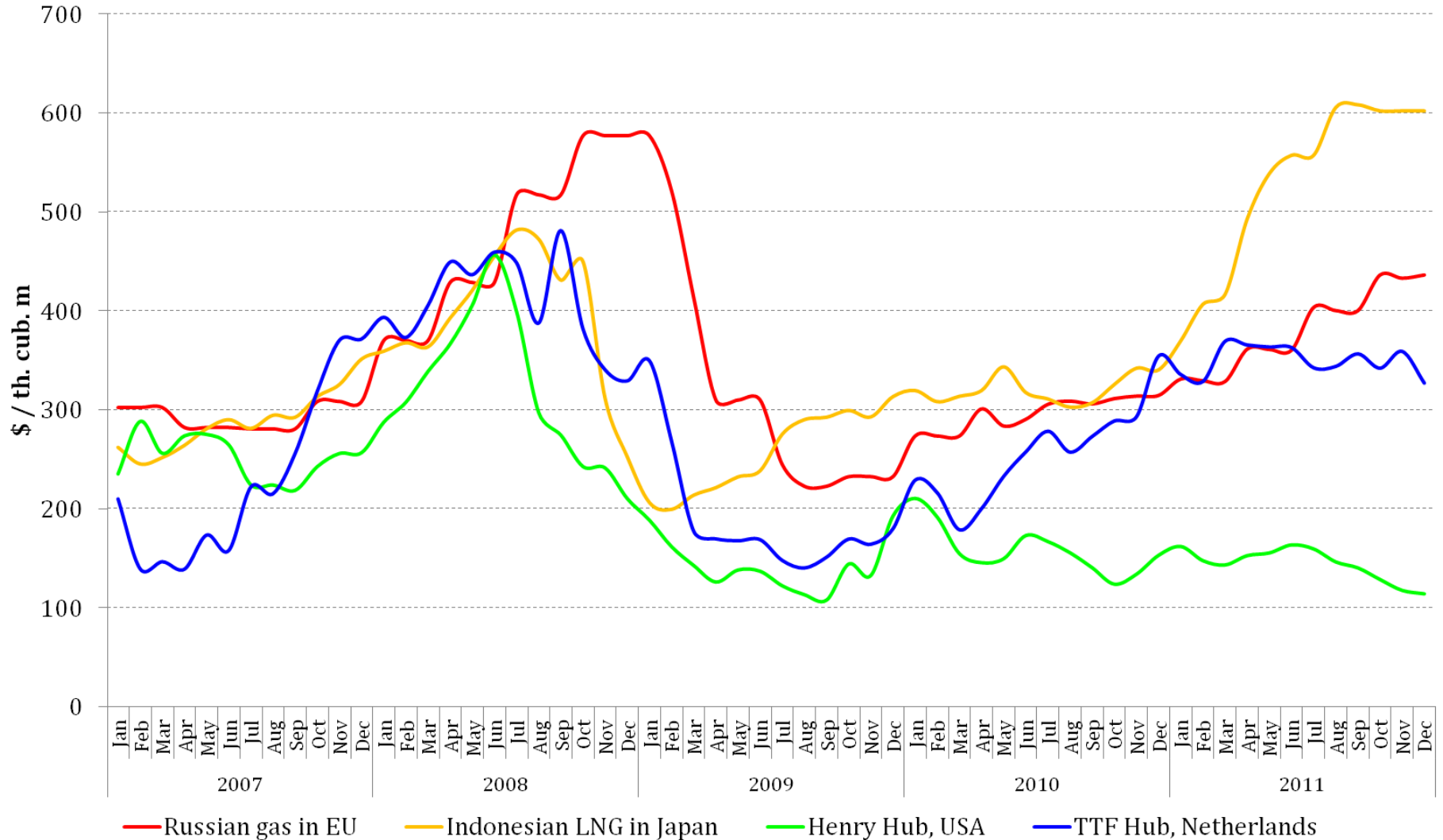
Russia Primary Energy Demand by Fuel, 2009-2035



Russia's primary energy demand is projected to grow by more than 20% to 2035, but this would still leave total demand 10% lower in 2035 than in 1990

World gas prices

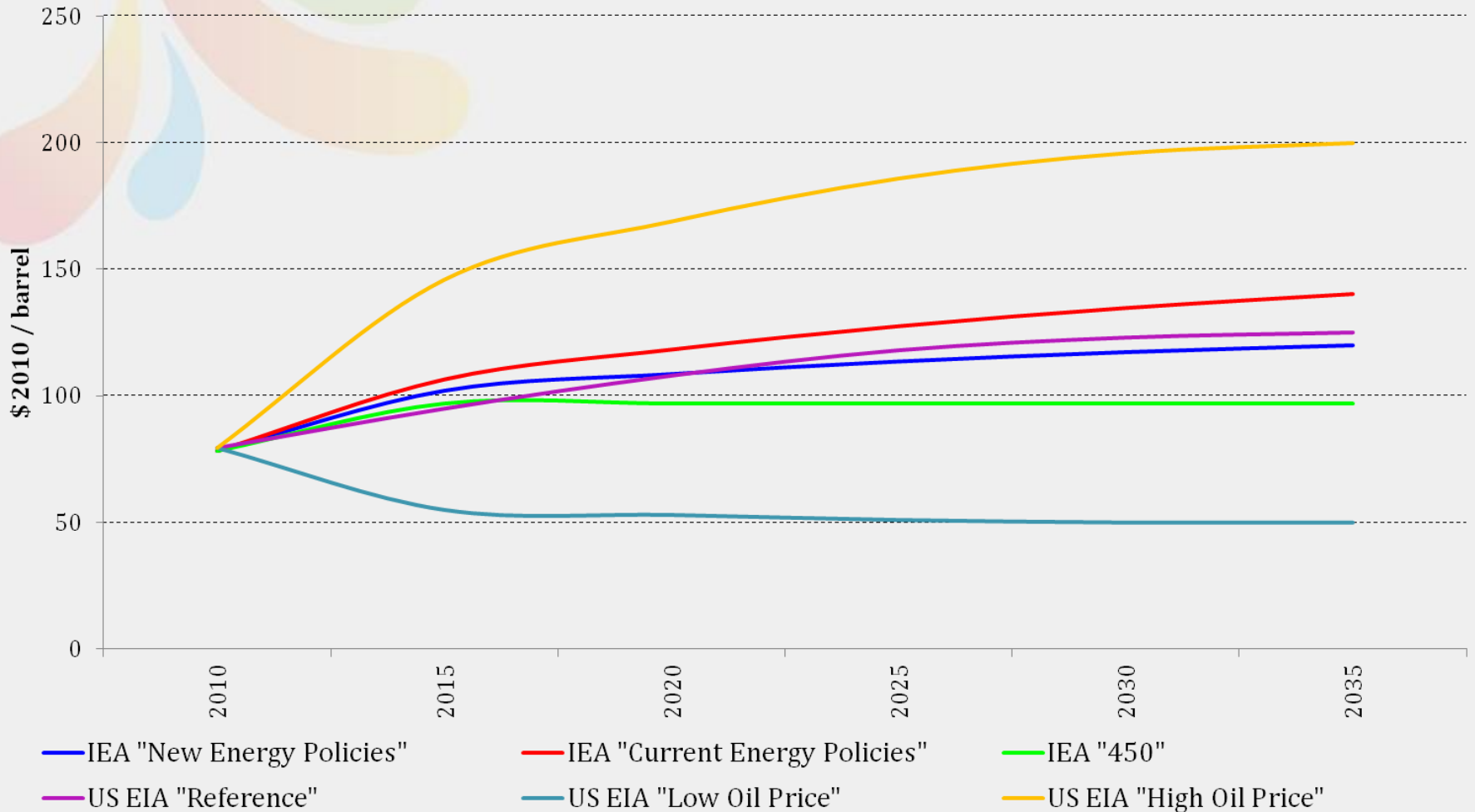
2007 - 2011, \$ / th. cub. m.



Source: IMF, APX Endex²⁵

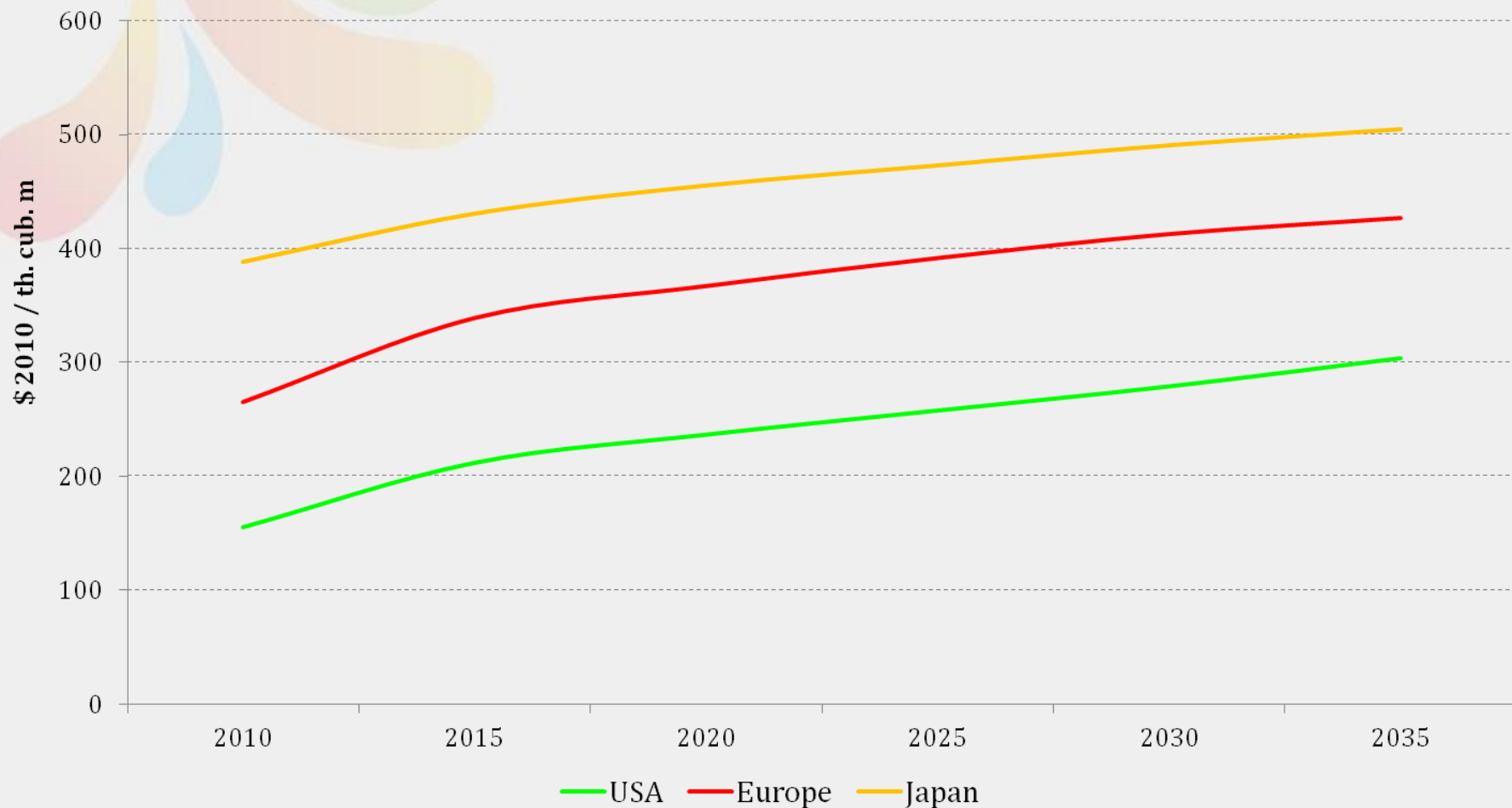
Oil price forecasts

real price, 2010 - 2035



Natural gas price forecasts

IEA-2011, "New Energy Policies", real price, 2010 - 2035



Investment Risks for Russia

- Russia's Capacity to supply the Global Economy was built by Soviets without any commercial considerations.
- Current reproduction cost of Russian Energy Infrastructure is beyond any measure. Russia invests 4-4.5% of its GDP in Energy Sector.
- With 2.3% of World Population and GDP produces 9.6% of Global Primary Energy, and exports 4,3-4,5% of it.
- Russia Exports: 2/3 of produced Oil, 1/3 of Coal, 1/3 of Gas + Export of Aluminum, Fertilizers. Equal to two Germany' volumes of annual energy consumption.
- Russia is the Global supplier with domestic agenda – Modernization in both Energy and non Energy sectors.