



Energy Security in EU

Demand and Supply Scenarios of Renewables and Dependence on Russian Energy

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Business from technology

Introduction and outline

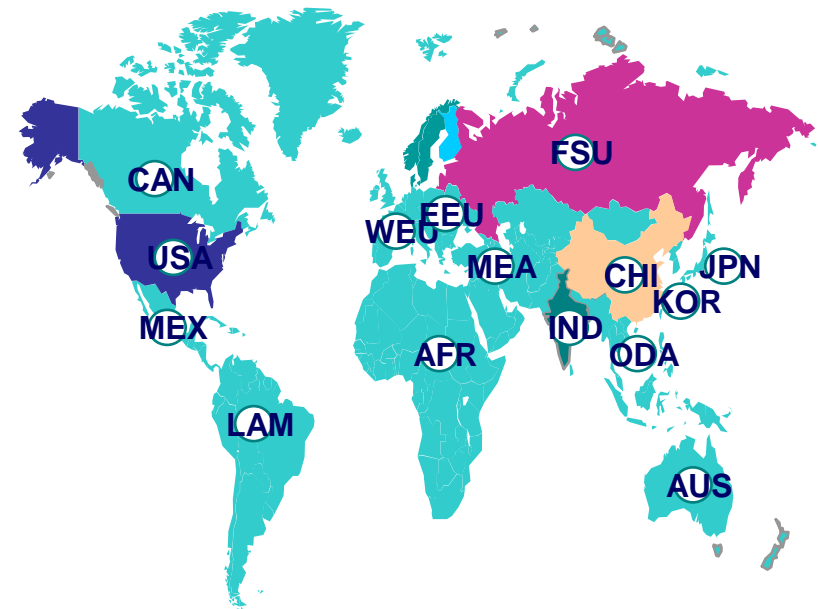
- The aim of the study is to investigate the energy security in the EU area with ambitious climate policies and constrained supply of natural gas to EU with Global TIMES (ETSAP TIAM) model
- Background
- Focus on bioenergy and wind potentials
- Assumptions on gas supply from Russia, Africa and Middle East
- Energy scenarios with Global TIMES model
- Conclusions

Background

- The European Parliament has proposed an EU CO₂ reduction target of 60 to 80% for 2050 as a strategic objective to limit the global temperature increase to 2 degrees Celsius above pre-industrial levels by 2100
- The presentation is based on the research results by VTT, MTT Agrifood Finland and Bank of Finland
- Co-authors of the presentation:
 - VTT: Tiina Koljonen, Antti Lehtilä, Rinat Abdurafikov, Martti Flyktman, Esa Peltola, Sanna Syri
 - MTT: Katri Pahkala, Oiva Niemeläinen, Kaija Hakala, Markku Kontturi
 - Bank of Finland: Laura Solanko, Iikka Korhonen

Global TIMES Model

- Partial equilibrium model
 - Supply-demand equilibrium for quantities and prices at each level
 - Maximization of the total surplus (suppliers+consumers)
 - Supply and demand curves are endogenously generated
- Long term (2100), multi-period (12)
- Based on the 15-region ETSAP TIAM model
- Technology rich, technology explicit
 - 1000s of processes, hundreds of commodities
- Integrated
 - Extraction, exports-imports, transformation, distribution, end-use of energy
 - Energy-intensive materials, emissions, climate module
 - Organized as Reference Energy System (RES)
- Includes all Kyoto gases (CO₂, CH₄, N₂O, F-gases)
- Detailed accounting of costs



Overview of the scenarios studied

- **Baseline**

- No new climate policy after 2012
- GDP growth assumptions based on ETSAP TIAM data
- No constraints for new oil or gas production, constraints for new nuclear based on the existing policies for the EU-30 countries

- **2 C-scenario**

- Maximum temperature increase by 2100 limited to 2 C degrees
- Ghg emission reduction target for Annex 1 countries: -20% in 2020, -70% in 2050 and -90% in 2090 compared to 1990 emissions
- Global emissions trading with "CDM policy" for Annex 1 countries: max. 20% in 2020 and max. 50% in 2050 of target by purchasing allowances

- **2 C gas-scenario**

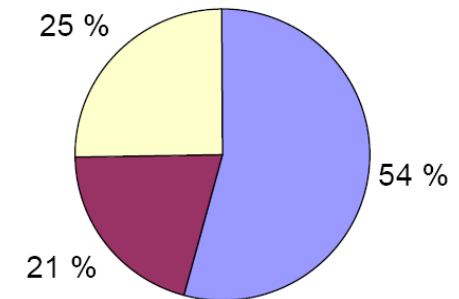
- 2 C scenario with constrained natural gas production and trade between world regions

Basis for biomass and wind power assumptions

Biomass potentials in EU-30 and globally by 2020

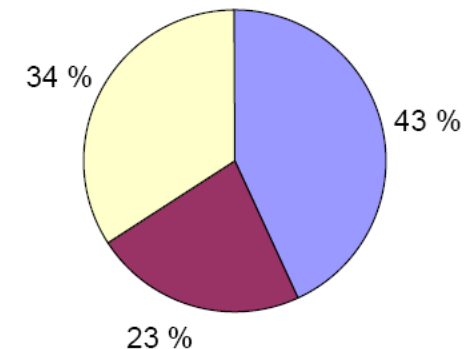
- Existing/well known cereals and crops and their residues
- Large changes in arable area can not be expected
- Large variations in crop yields along the same latitudes, for example between the East- and West-Europe
 - Possibilities to increase yield/ha
- Use of forest residues
 - Possibilities to increase efficiency (>50% of wood is used as firewood today)
- Use of waste
 - Possibilities to increase amount and efficiency

Total in EU-30 in 2020: 12 EJ

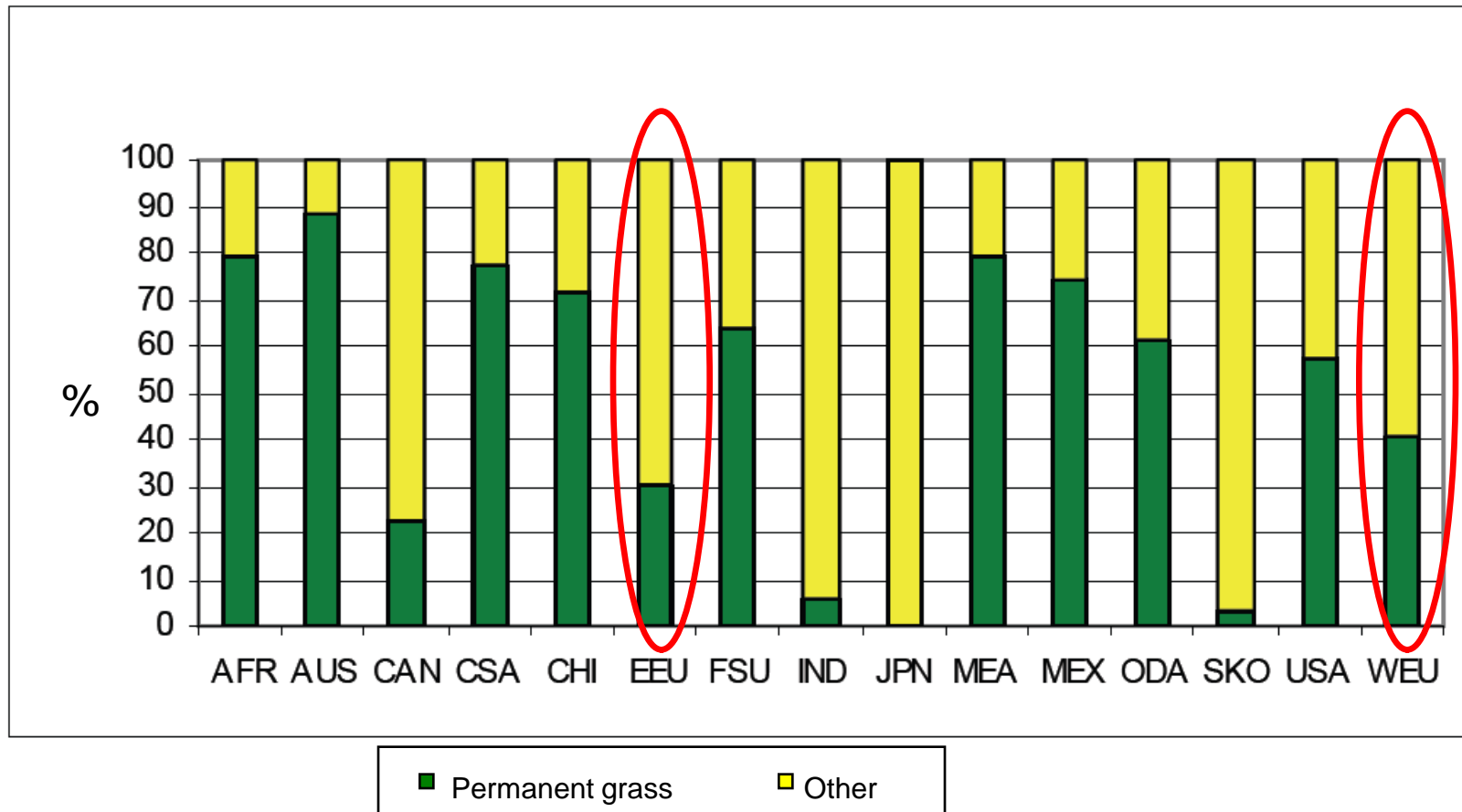


■ Biocrops ■ Agr. resid. ■ Wood

World total in 2020: 126 EJ

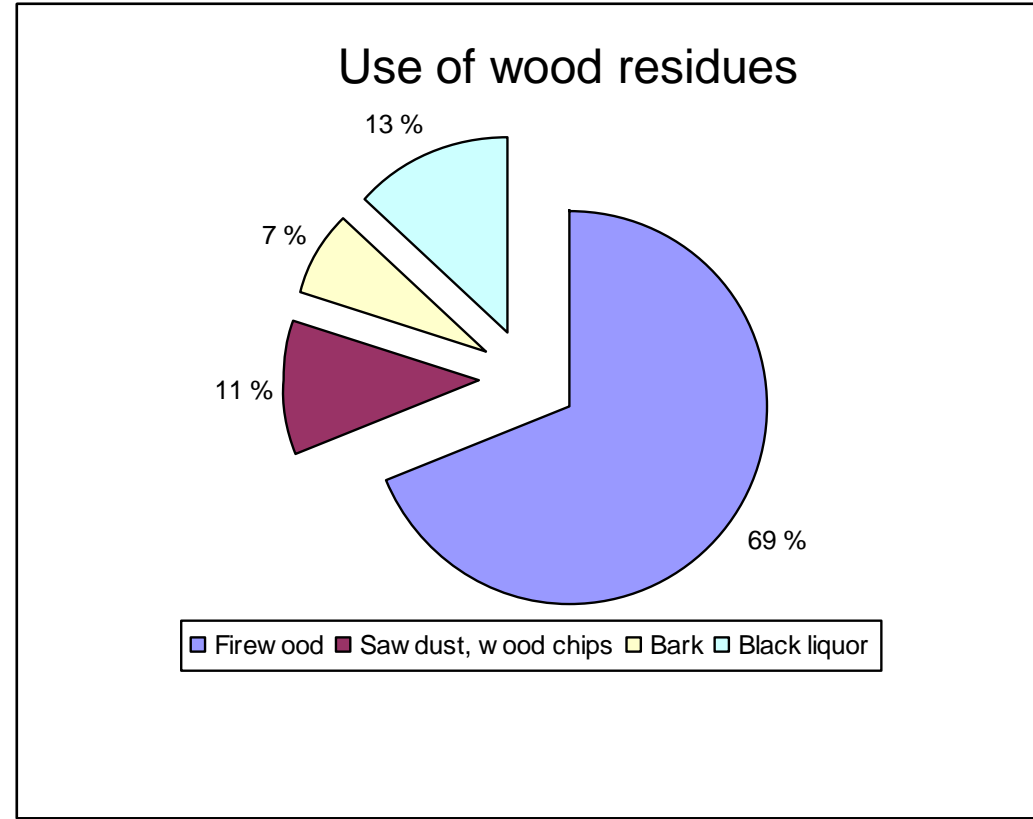
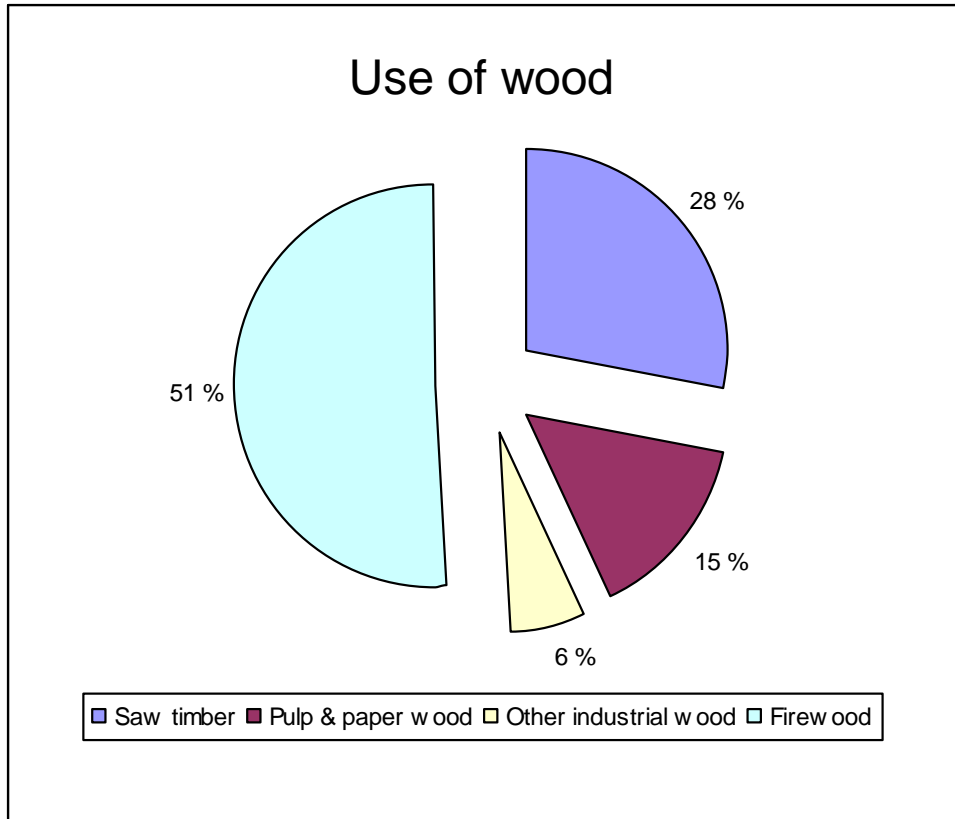


The share of permanent grassland from total agricultural land area



Source: MTT Agrifood Finland

The use of wood and wood residues in 2006

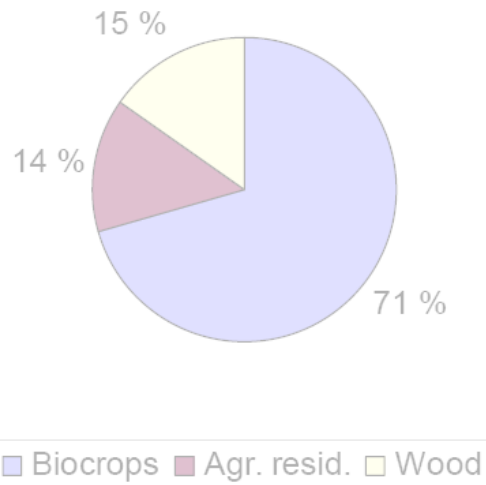


Data source: FAO statistics

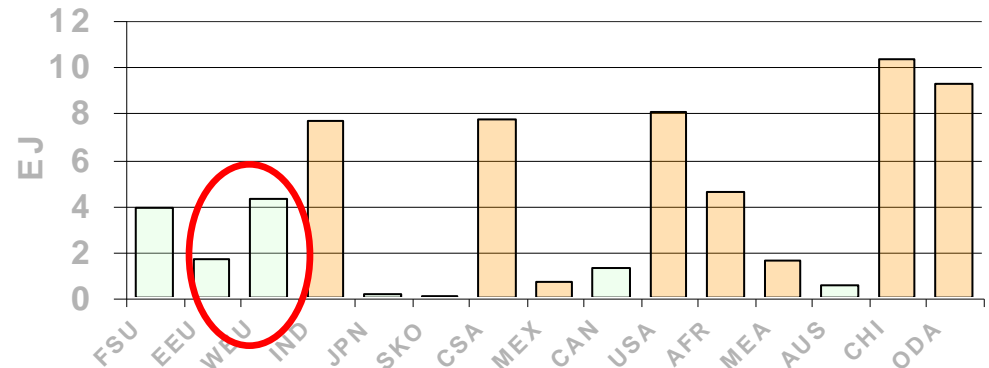
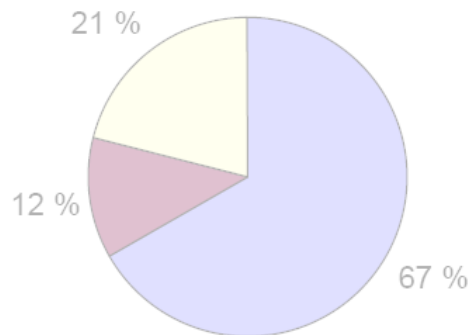
Biomass potentials in EU-30 and globally by 2050

Large variations in different literature sources (0-1000 EJ)

Total in EU-30 in 2050: 21 EJ



World total in 2050: 270 EJ

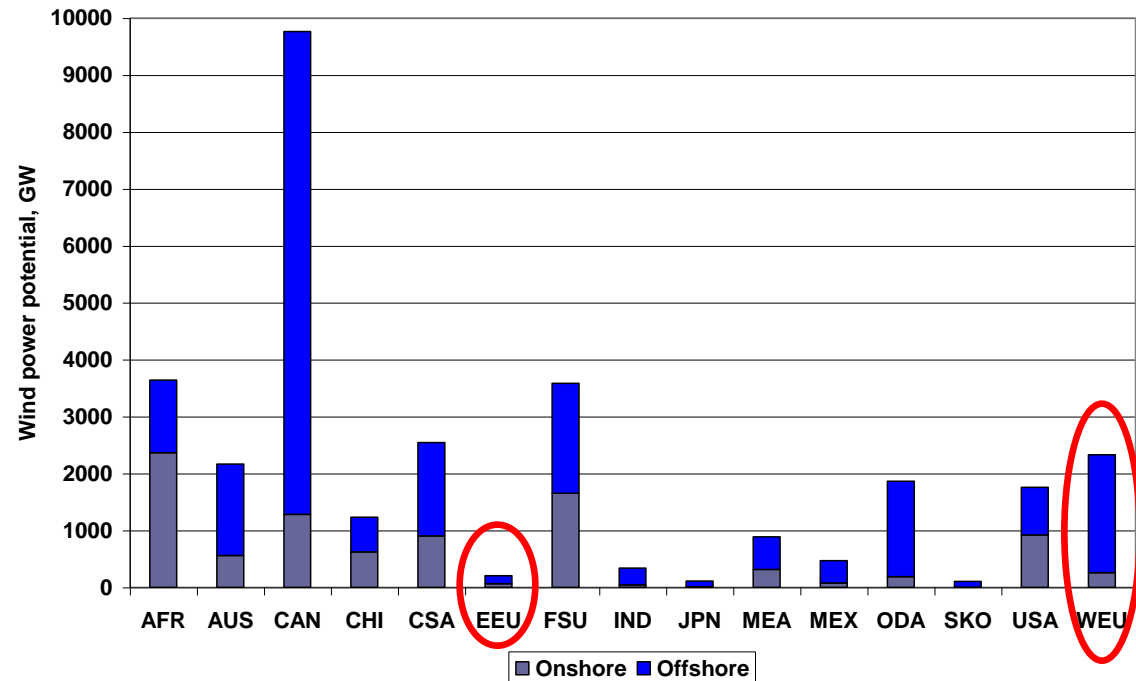


Agricultural residues based on 2006 data in 15 world regions. Orange bars represent areas, where production of energy crops has been forecasted to decrease due to climate change. Source: MTT Agrifood Finland

- Available land for energy crops?
- New crops with higher yield
- Impact of climate change?
- Water conservation
- Erosion control
- Soil biodiversity
- Amount of firewood and industrial side products
- Etc...

Regional wind power estimates based on VTT studies

- Parameters and constraints
 - Regional wind conditions
 - Onshore geographic and population density
 - Length of the coastal line and offshore area up to 12 miles
 - Installation density
 - Maximum capacity
 - Maximum share of wind power from total electricity production (during every season)



Basis for gas supply assumptions

World Gas Reserves and Production in 2007 (data source: BP)

	Proved reserves 1000 bcm	Share of world res. %	Production bcm	Export bcm	R/P ratio years
Russian Federation	45	25,2	607	148	74
Iran	28	15,7	112	6	>200
Qatar	26	14,4	60	39	>200
Saudi Arabia	7	4,0	76	0	94
United Arab Emirate	6	3,4	49	6	>100
USA	6	3,4	546	23	11
Nigeria	5	3,0	35	21	>100
Algeria	5	2,5	83	25	54
Venezuela	5	2,9	29	n.a	>100
World total	177	100	2940	690	60

- TIMES Database:

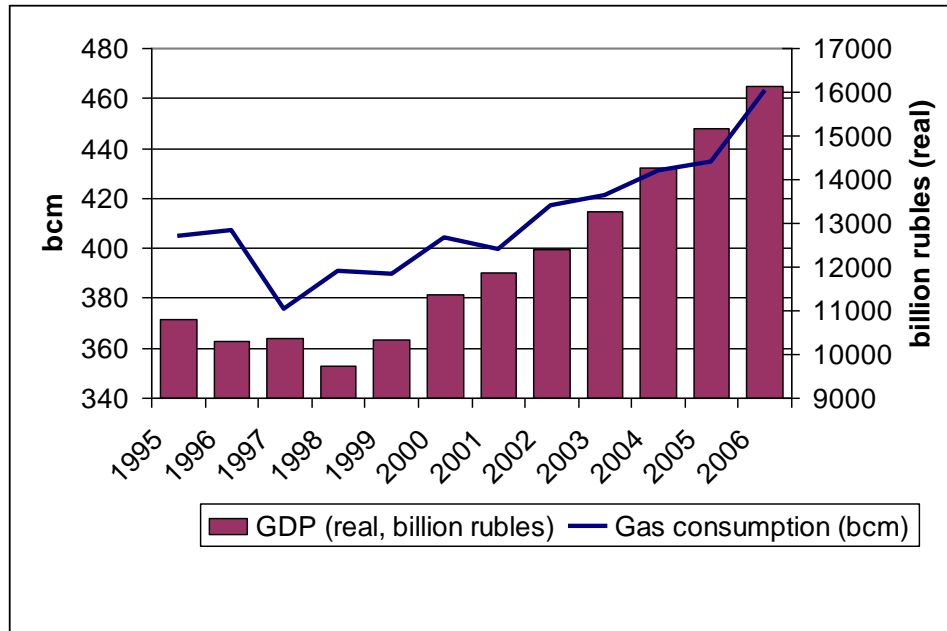
- Conventional reserves 345 000 bcm
- Conventional resources 152 000 bcm
- Unconventional reserves & resources 740 000 bcm

Total 1 400 000 bcm

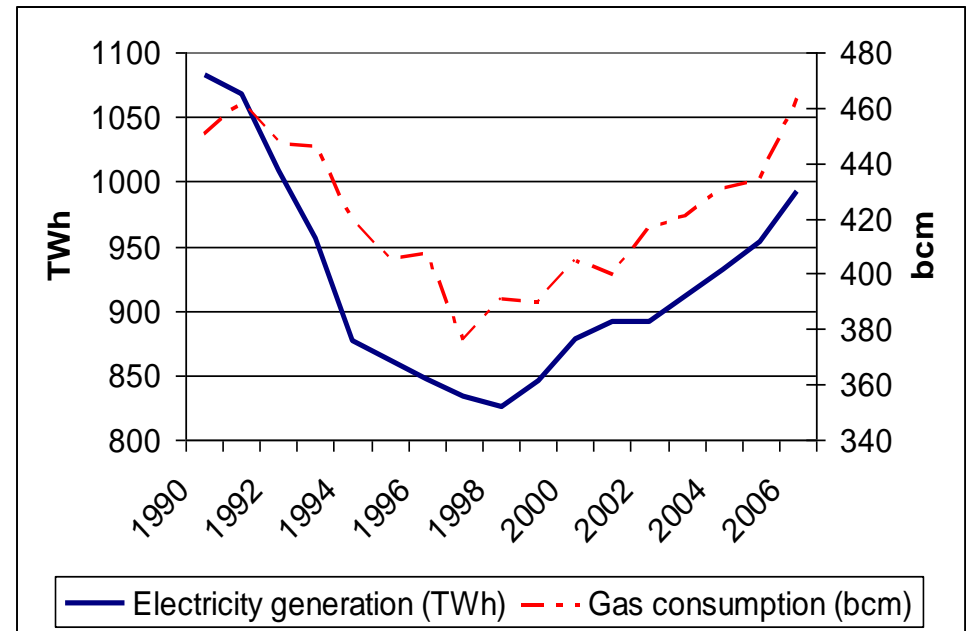


Consumption of Russian gas

Clear correlation between GDP growth and gas consumption => Domestic use of gas is increasing



Gas is mainly used for electricity generation

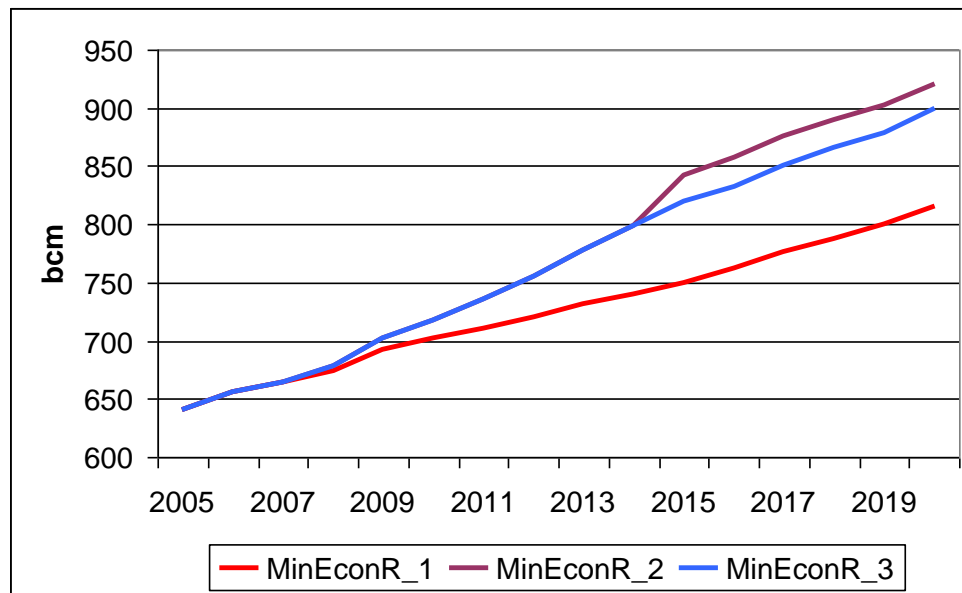


Source: Bank of Finland

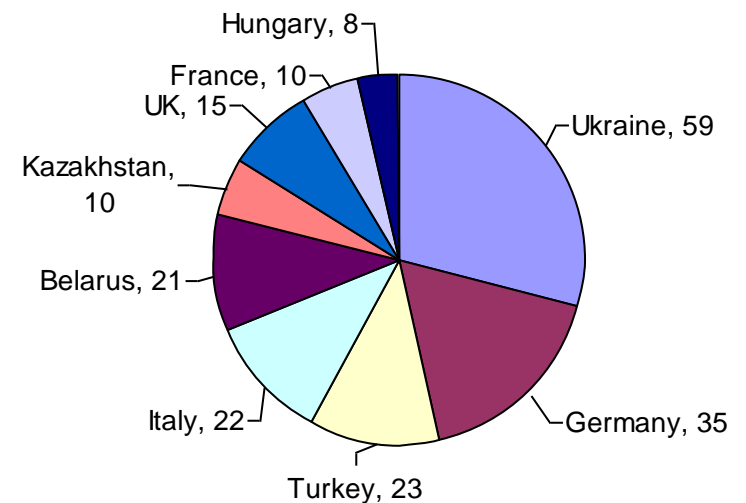
Source: Bank of Finland

Production and export of Russian gas

- Gazprom produces about 80% of Russian gas
- One third of Russian gas production is exported by Gazprom
- Production is not expected to increase considerably in the near future



Gazprom sales abroad in 2007, bcm

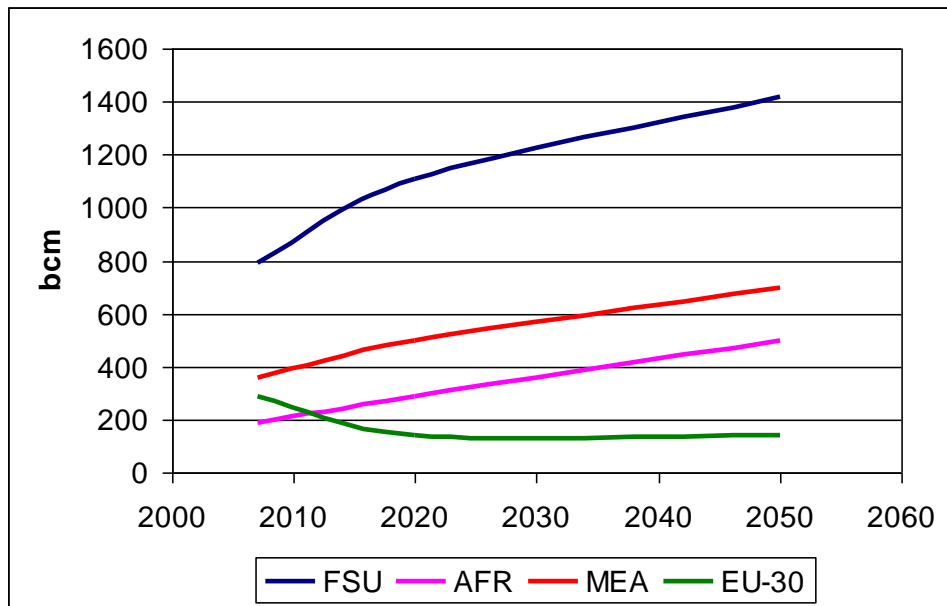


Source: Bank of Finland, Rosstat, MinEcon

NB: Shown figures represent Russian standard volumes for gas!

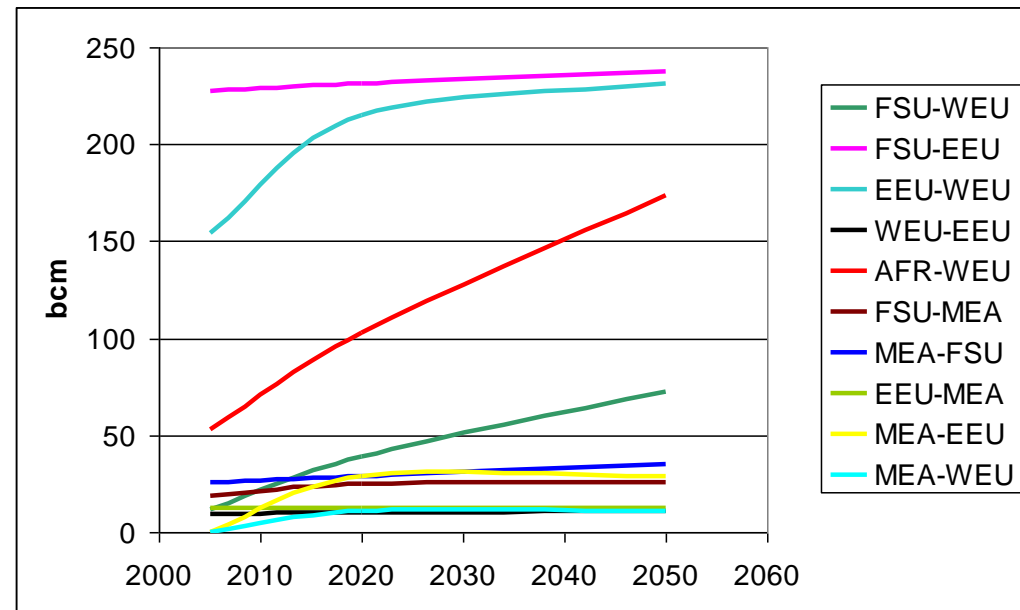
Assumptions for maximum gas production and gas transmission 2 C gas-scenario

Maximum gas production



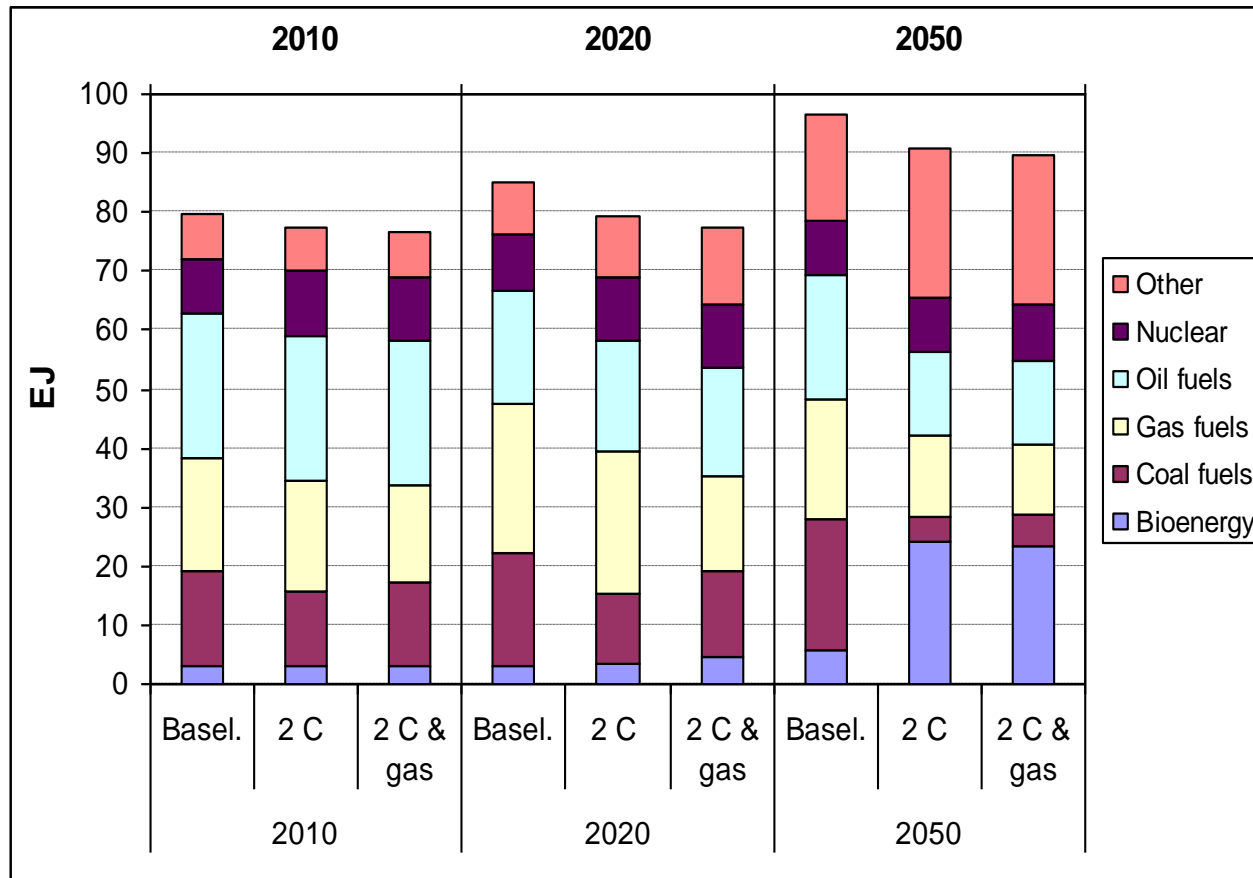
FSU: Investments in Bonanenkovo, Jamal, Stokhman, small fields operated by independent gas companies and increased production in other FSU area; AFR & MEA: Conservative estimates based on historical data; EU-30: New investments after 2020 to replace old fields

Maximum pipeline transmission



Transmission: Planned investments by 2020 included (pipelines, LGN import and export terminals)

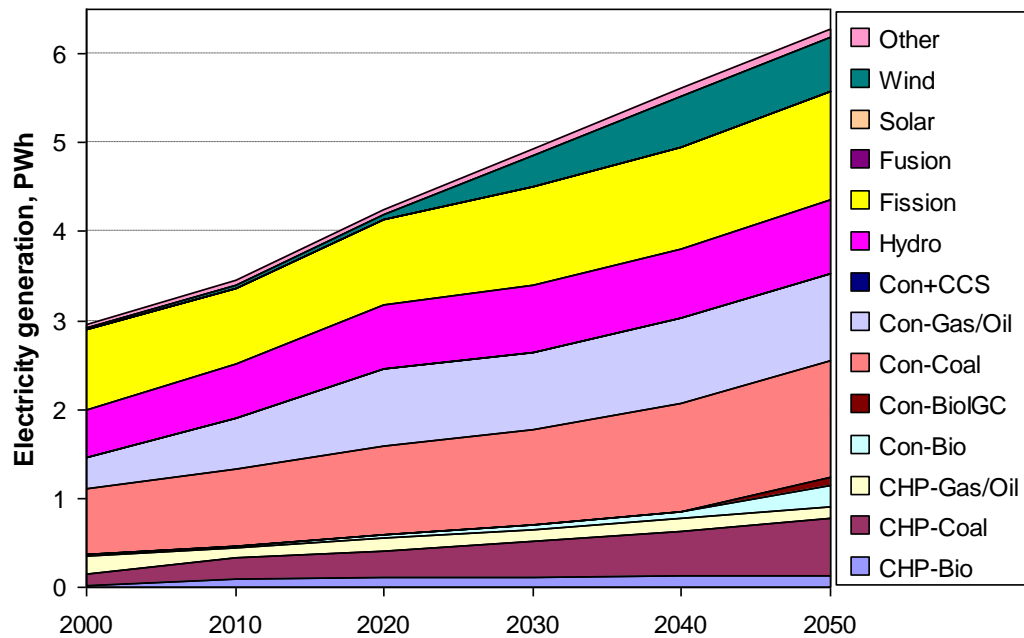
EU-30 Primary Energy Supply to 2050



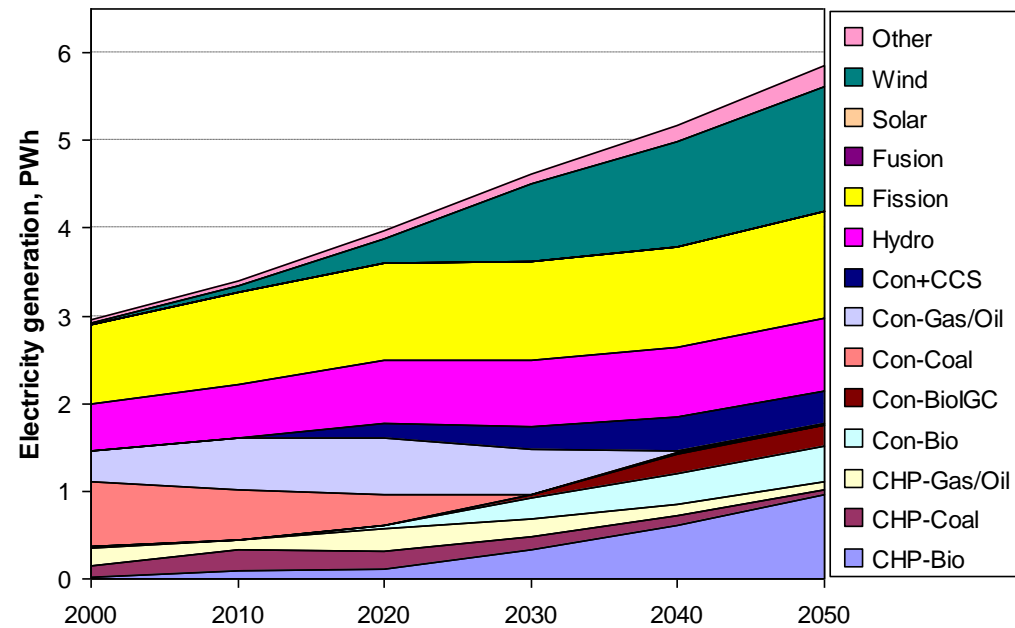
- Maximum usage of biomass in 2 C and 2 C gas scenarios in 2050
- The share of gas from primary energy supply increases up to 2020 and decreases by 2050
- With gas constraints the share of gas decreases especially in 2020
- Production of Russian gas is at its maximum from 2010 to 2050

Electricity production in the EU-30 area in the baseline and 2 C scenarios

Baseline

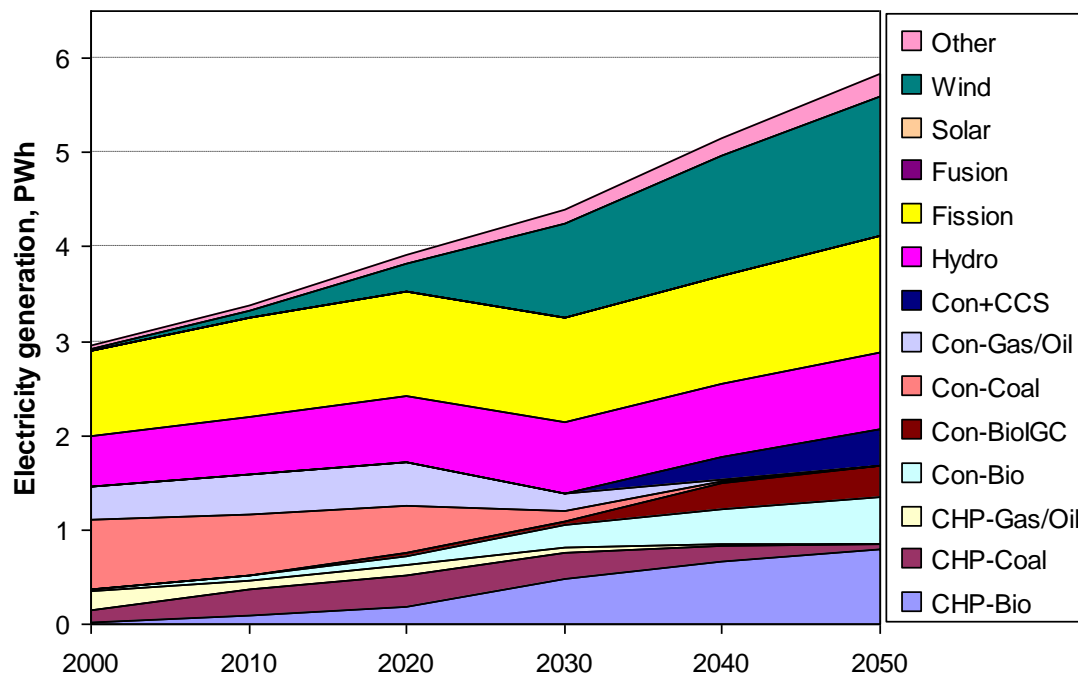


2 C scenario



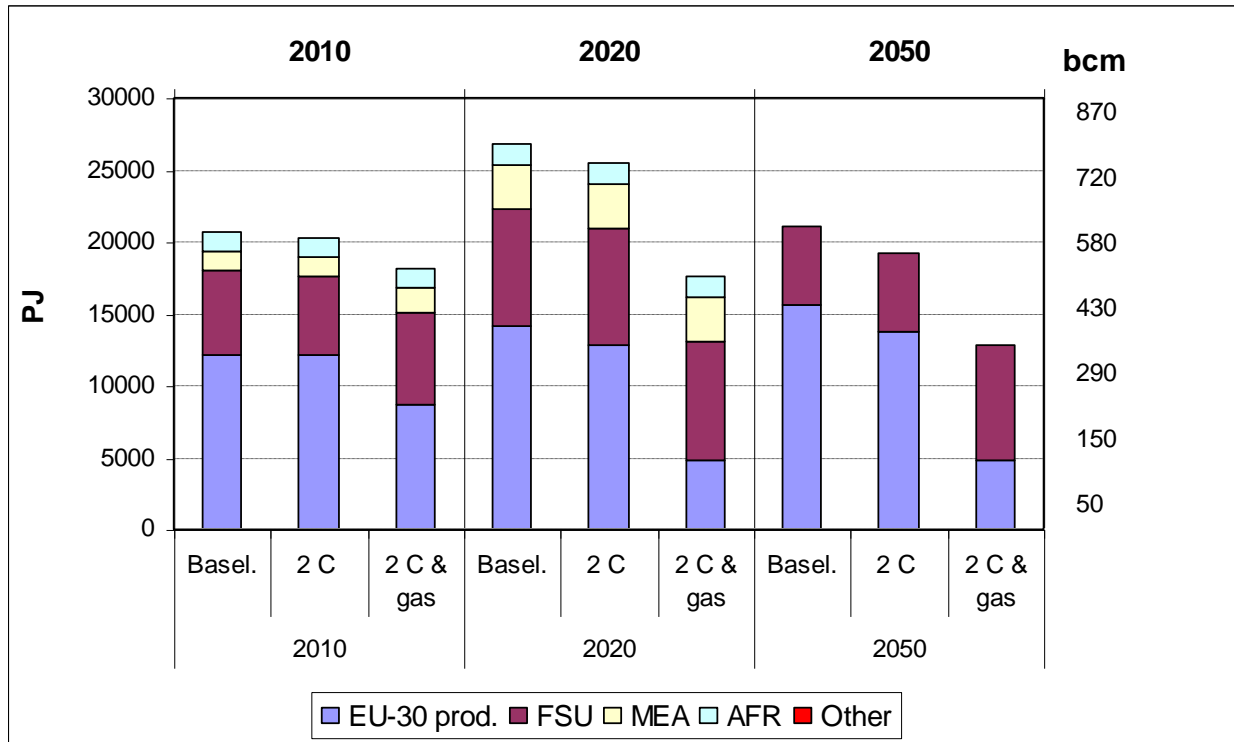
Electricity production in the EU-30 area

2 C gas scenario



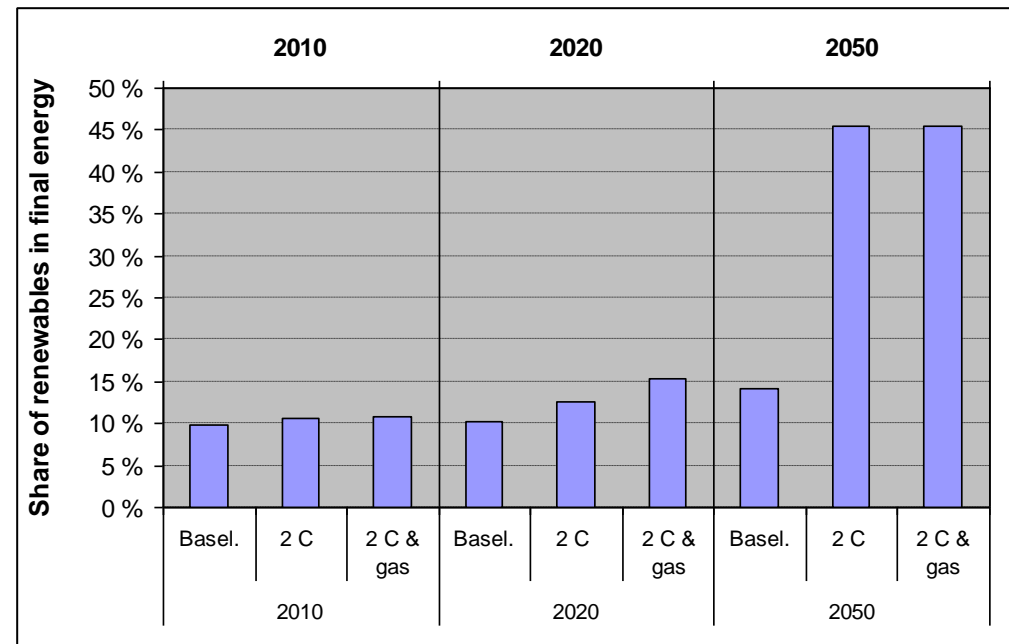
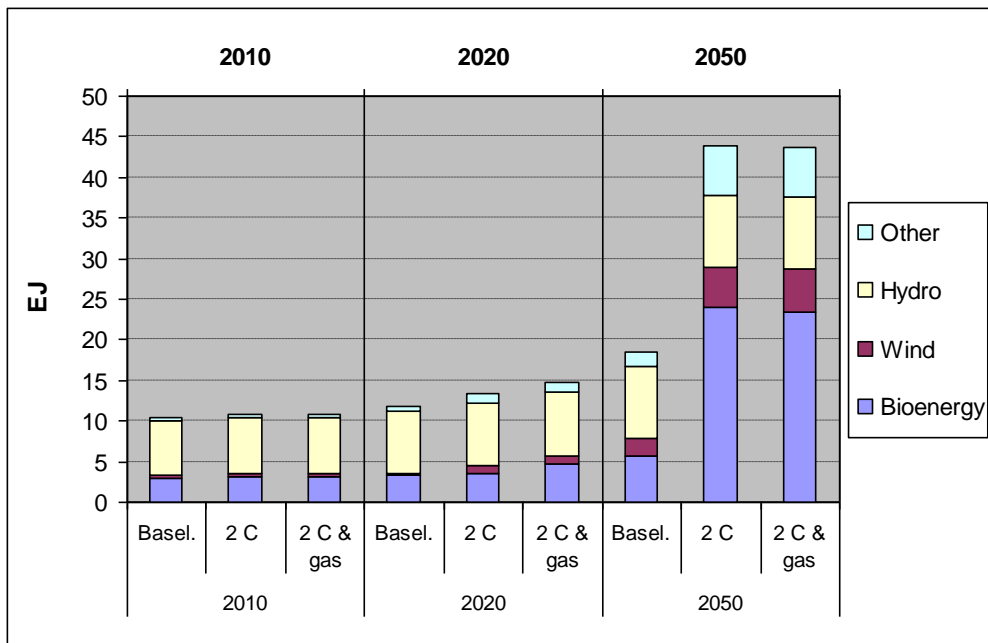
- Decreasing trend in total electricity production:
Baseline > 2 C > 2 C gas
- Rapid increase in wind power and biomass fired CHP production in policy scenarios
- In 2 C gas scenario gas fired condensing power production decreases rapidly after 2020

EU-30 gas import needs by 2050

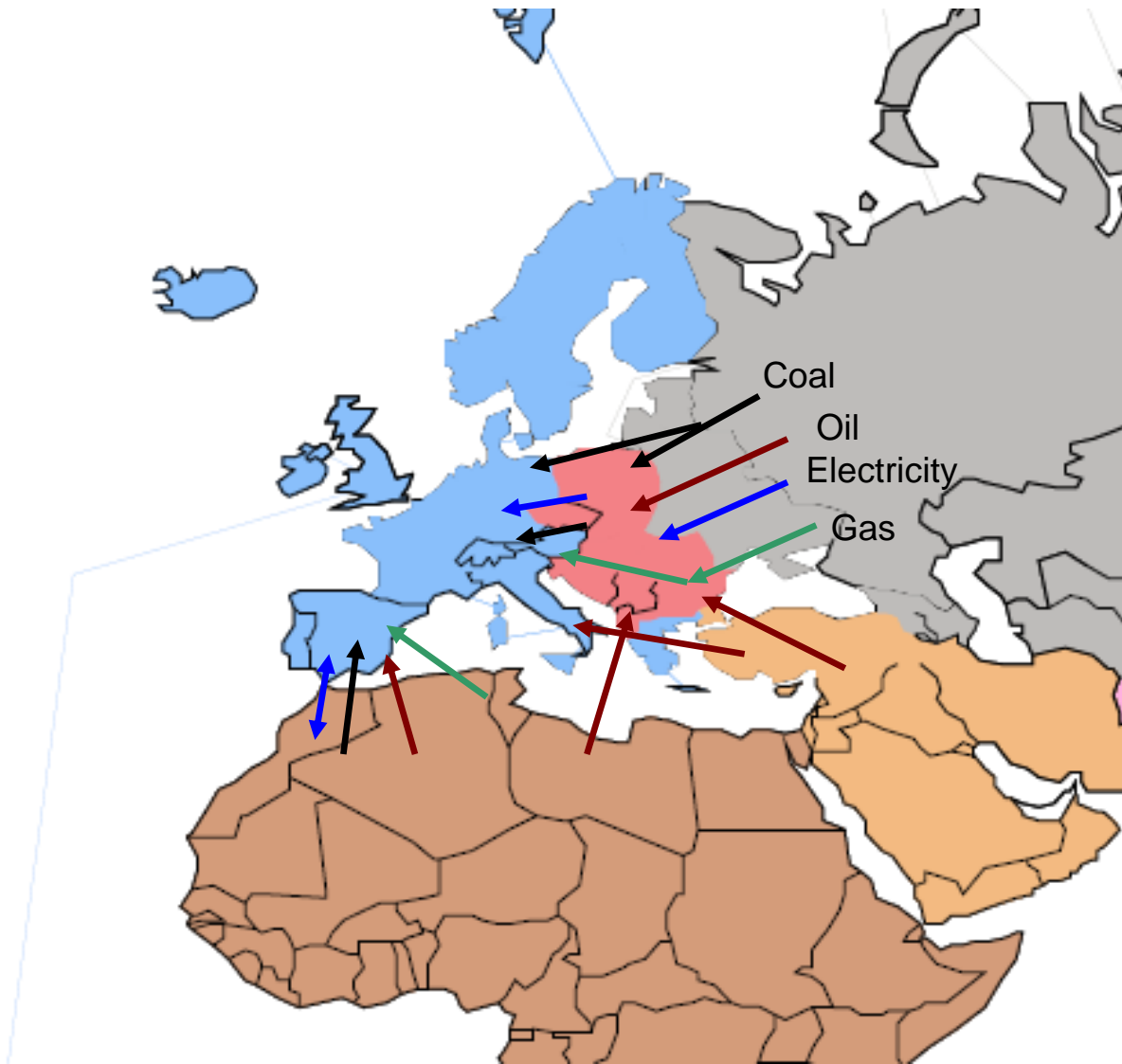


- In 2 C gas scenario most of gas is imported from Russia
- In 2050 the gas import from Africa and Middle East decreases down to zero
- Gas consumption is at its highest level in 2020 in all the scenarios

The share of renewables from energy consumption in EU-30 increases rapidly after 2020



Dependence on Russian energy



Import form Russia in 2020:

- Gas import 8000-8200 PJ
- Oil import 8000-8500 PJ
- Coal import 1500-1800 PJ
- Electricity import 40-60 PJ
 - Max. 25% from total primary energy

Import form Russia in 2050:

- Gas import 5000 -8000 PJ
- Oil import 0 PJ
- Coal import 1600-2800 PJ
- Electricity import 20-50 PJ
 - Max. 15% from total primary energy

Conclusions

- With ambitious climate policies the assumptions of maximum production capacities of gas up to 2020 would have great impact on energy mix in the EU-30 area.
 - ⇒ Investments in Russian gas, assumptions for GDP growth in Russia
 - ⇒ New gas production in the EU-30 area
- In 2050 the assumed maximum potentials of renewables (especially wind and biomass) would be critical with ambitious climate policies.
- The use of indigenous energy sources didn't change remarkably with 20% ghg reduction target. With 70% reduction target in 2050 the share of renewables increased up to 45%.

Thank you

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