Europe energy future and the climate-security nexus: insights from the SECURE scenarios

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Scenarios and their policy settings

Main results of the SECURE scenarios

Consequences for EU energy imports

Insights for EU energy policy

SECURE: purpose of the study

- **The SECURE project – in FP7 – aims at analysing future energy Security of Supply for Europe**
- **Research and policy also needs to take into account the impacts of climate policies on the world energy system**
- **The POLES model is used to produce framing scenarios, in order to explore the « climate change and energy security nexus »**

5 scenarios + 3 sensitivity studies with the POLES model

Scenarios

1. The ***BaseLine*** case is a counter-factual, no climate policy scenario, used mostly for benchmarking
2. The ***Muddling Through*** scenario describes the consequences of non-coordinated, low profile climate policies
3. The ***Muddling Through & Europe Plus*** case represents the same settings but with a stronger effort in Europe
4. The ***Europe Alone*** case represents the outcome of a scenario in which only the European Union commits to strong targets (-80%)
5. The ***Global Regime*** explores a new world energy system, under strong emission constraint, consistent with the 2°C target

Sensitivity studies and shocks

1. Oil and gas shocks
2. Nuclear accident + phase out
3. Problems in the diffusion of the CCS

The carbon constraint according to IPPC AR4

ΔT °C ⟵ 2050/2000

Table SPM.5: *Characteristics of post-TAR stabilization scenarios [Table TS 2, 3.10][9]*

Category	Radiative forcing (W/m^2)	CO_2 concentration[c] (ppm)	CO_2-eq concentration[c] (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[b], [c] (°C)	Peaking year for CO_2 emissions[d]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[d]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000-2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000-2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010-2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020-2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050-2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060-2090	+90 to +140	5
						Total	177

SECURE scenarios, hypotheses and outcomes

	Carbon Price 2050 (€/tCO2)	Emissions 2050 / 1990	AR4 categories
Baseline	0	134%	Type VI (5-6°C) 700 CO2
Muddling Through	40 in Eur 32 in RoW	72% (EU: -21%)	Type IV (3-4°C) 500 CO2
MT E+	89 in Eur 32 in RoW	67% (EU: -40%)	Type IV (3-4°C) 500⁻ CO2
Europe Alone	185 in Eur 32 in RoW	59% (EU: -60%)	Type IV (3-4°C) 500⁻ CO2
Global Regime	392 in A1 257 in NA1	(2050/2000) -50% (Annex 1: -80%)	Type II (2-3°C) 400 CO2

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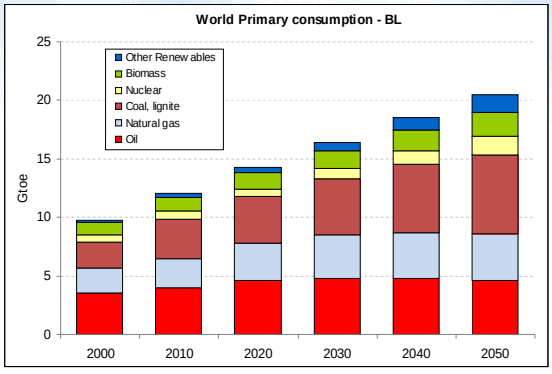
Unsustainability of the Baseline

- **In the Baseline case, Oil and Gas first increase but then peak in 2030 and 2040 and thus Coal more than doubles, to 6.5 Gtoe in 2050**
- **World energy consumption and CO2 emissions double in 2050: this is not sustainable from the climate perspective**

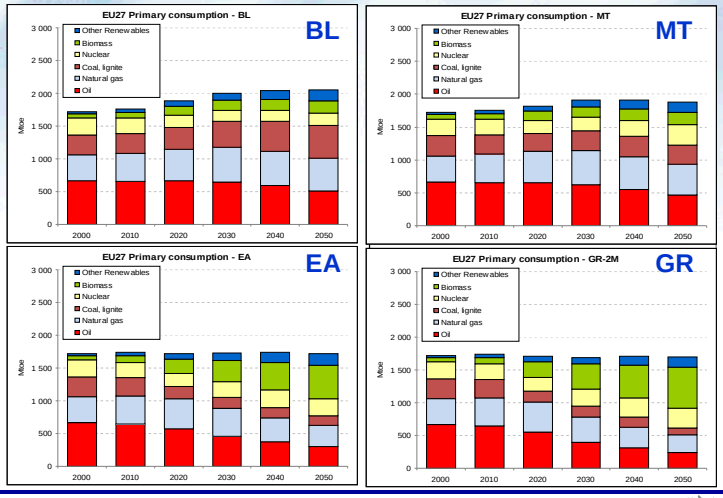


Global outcomes of the SECURE scenarios

- **The *Baseline* is not sustainable as it implies:**
  - a doubling of emissions in 2050 (5-6°C profile)
  - extremely high production levels for oil and gas with risks of crises
- **The *Muddling Through* and *Europe Alone* cases somehow alleviate tensions, but they don't solve the problems**
- **Only the *Global Regime* case can bring a sustainable energy system to 2050:**
  - an emission profile that is (almost) compatible with the 2°C target
  - lower energy prices (60 €/bl, instead of more than 100)

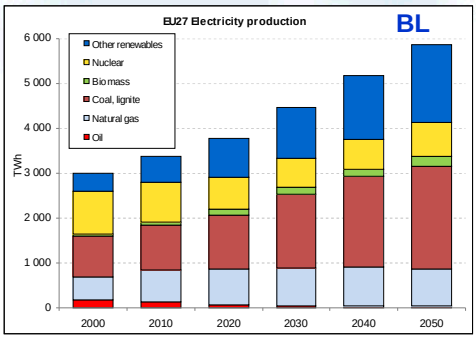
European primary mix by scenario

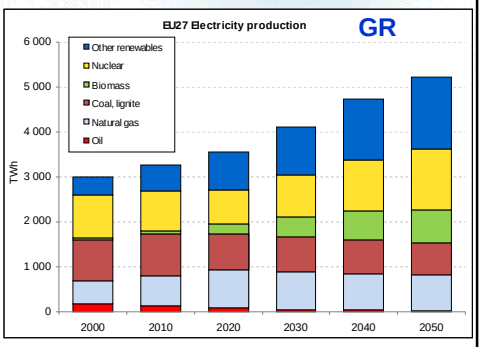
- **In the Global Regime total demand is 20% lower in 2050 than in the Baseline**
- **And non fossil sources represent almost two thirds of supply, compared to only one fourth in the baseline**



European electricity production by source

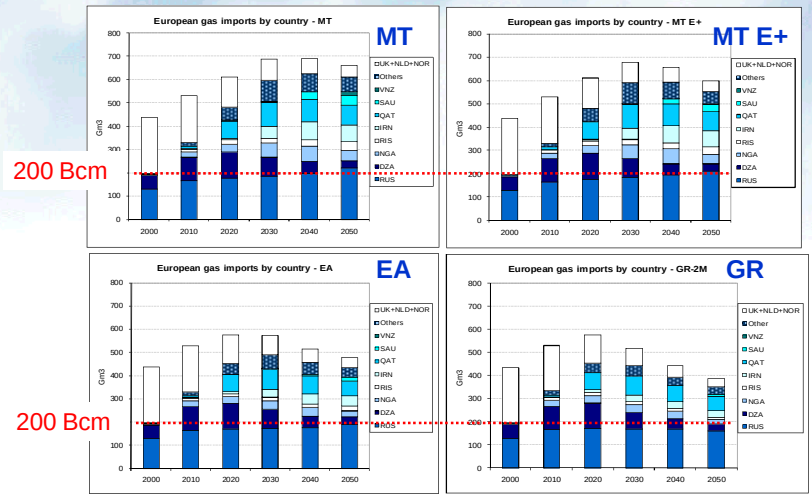
- **A strong carbon constraint induces more nuclear and renewables and triggers a substitution of coal-based by biomass-based generation while CCS develops**
- **Natural gas power generation is hardly impacted**





European Gas supply

- **Domestic production drops over time and as imports stabilize after 2040 at a level triple of today in BL and MT**
- **They peak in 2020 and then decrease in the EA and GR cases**



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Dependence rate, by energy and global

- **The dependence rate for each fossil source does not change very much from one scenario to the other**
- **While global dependence rate (on total GIC) is significantly altered, due to domestic sources**

			2000	2010	2020	2030	2050
Baseline	**Dependance rate**	Coal, lignite	30%	33%	39%	48%	56%
		Oil	76%	81%	84%	87%	86%
		Natural gas	46%	69%	83%	90%	[illegible]
		Total	45%	53%	58%	61%	**58%**
Muddling Through	**Dependance rate**	Coal, lignite	30%	32%	35%	44%	[illegible]
		Oil	76%	81%	83%	86%	85%
		Natural gas	46%	69%	83%	91%	96%
		Total	45%	53%	57%	60%	**53%**
Europe alone	**Dependance rate**	Coal, lignite	30%	31%	28%	35%	42%
		Oil	76%	81%	81%	82%	78%
		Natural gas	46%	69%	79%	81%	76%
		Total	45%	52%	51%	45%	**31%**
Global Regime	**Dependance rate**	Coal, lignite	30%	32%	33%	39%	45%
		Oil	76%	81%	82%	85%	83%
		Natural gas	46%	61%	73%	77%	[illegible]
		Total	45%	50%	51%	47%	**29%**

GIC and volume of fossil imports

- **Dependence may be lower and also applied to smaller quantities**
- **In terms of global vulnerability, importing 40% of 200 Mtoe is not equivalent to 40% of 400 Mtoe**

			2000	2010	2020	2030	2050
Baseline	GIC (Mtoe)		1725	1764	1883	2004	2053
	Imports (Mtoe)	Coal, lignite	-94	-102	-130	-191	-285
		Oil	-505	-532	-560	-564	-440
		Natural gas	-180	-293	-393	-473	-475
Muddling Through	GIC (Mtoe)		1725	1759	1820	1911	1884
	Imports (Mtoe)	Coal, lignite	-94	-95	-96	-132	-146
		Oil	-505	-532	-543	-537	-399
		Natural gas	-180	-298	-399	-471	-448
Europe alone	GIC (Mtoe)		1725	1741	1723	1731	1724
	Imports (Mtoe)	Coal, lignite	-94	-88	-50	-58	-61
		Oil	-505	-524	-466	-378	-235
		Natural gas	-180	-292	-365	-350	-245
Global Regime	GIC (Mtoe)		1725	1748	1802	1845	1723
	Imports (Mtoe)	Coal, lignite	-94	-91	-76	-80	-73
		Oil	-505	-526	-497	-428	-218
		Natural gas	-180	-260	-351	-359	-206

Value of energy imports

- **From 1.8% of EU GDP (EA) to 2.2% (BL) in 2020 and from 0.5%(GR) to 2.5% (BL) in 2050.**

			2000	2010	2020	2030	2050
Baseline	Value of imports (G€05)	Coal, lignite	4.9	8.8	12.3	19.7	34.1
		Oil	96.1	202.6	250.6	310.6	359.1
		Natural gas	24.1	69.0	98.9	139.5	210.2
		Total	125.1	280.4	362.8	469.8	**603.5**
Muddling Through	Value of imports (G€05)	Coal, lignite	4.9	8.2	6.0	13.2	13.4
		Oil	96.1	202.7	240.7	284.4	291.3
		Natural gas	24.1	70.3	101.5	133.8	183.1
		Total	125.1	281.2	351.2	431.5	**490.9**
Europe alone	Value of imports (G€05)	Coal, lignite	4.9	7.5	4.7	5.7	6.8
		Oil	96.1	196.3	201.6	191.9	160.2
		Natural gas	24.1	69.1	94.6	98.1	95.3
		Total	125.1	272.9	300.9	295.7	**262.4**
Global Regime	Value of imports (G€05)	Coal, lignite	4.9	7.8	6.8	7.6	7.9
		Oil	96.1	197.8	208.8	199.8	70.6
		Natural gas	24.1	61.9	87.5	91.0	45.5
		Total	125.1	267.5	303.1	298.3	**124.1**

Risks and climate-energy policies

$Risk_{c/e}$ =	$Probability_e$	x $Magnitude_e$	x $Vulnerability_{c/e}$
Muddling Through	High	High	High
Europe Alone	High	High	Low
Global Regime	Low	Low	Low

- The international agreement on climate is not granted this increases the uncertainty in the energy sector
- But the climate dimension also introduces elements of visibility, associated to the physical emission constraints
- For Europe climate policies bring a significant double dividend in terms of reduced vulnerability to energy shocks, even in a non-cooperative framework

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Conclusions: the technical side

- **Beyond modeling exercises, many issues should be kept in mind, in particular the institutional dimension:**
  - Framework and incentives for electricity investment
  - Degree of integration of the European electricity system
  - Institutional factors in new technology chains (scale-up of CCS)
  - Regulatory framework for nuclear development
- **Across the different scenarios total electricity consumption remains strong as it is the main carrier of the decarbonisation**
- **The power generation technology mix changes a lot with more renewables, nuclear and CCS, but natural gas is almost not impacted**
- **From MT to GR, Europe's natural gas consumption is down by 40%, but imports from Russia only lose 20%, a clear sign of competitive advantage**

Conclusions: the political side

- **Climate policies strongly impact the energy-security problem and illustrate the type of uncertainties that EU and Russia will have to face in the next decades**
- **The debate on "Energy Charter Treaty or Pdt Medvedev's Energy Document … where to start ?" is part of the problem**
- **But this problem cannot be examined without taking into account the fundamentals of supply and demand in a global policy framework**

=> Efforts are needed to combine institutional solutions with a dialog on a Pluriannual Programming of Investments in the energy sector, *in a balanced and mutual understanding perspective*

Thank you for your attention