The EU climate policy perspectives and their implications for Belgium

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Context and Tools

- EU climate and energy policy
  - 20% 2020 targets for GHG emissions, renewables and energy efficiency
  - 2050: 80% GHG reduction compared to 1990
- Tools
  - International fuel prices from POLES (EU Roadmap)
  - GEM-E3 EU for macroeconomic background
  - TIMES-EU and TIMES-BE

Approach

- Construction of a reference scenario (macroeconomic and energy) for the EU and for Belgium
- Pan-European TIMES model used to derive cost efficient allocation of EU GHG reduction within EU → GHG reduction for Belgium

The Reference scenario (1)

- Macroeconomic and price assumptions

	Unit	2015	2020	2030	2040	2050
Population	%/y	0.5%	0.5%	0.3%	0.2%	0.1%
GDP	%/y	1.7%	2.0%	1.9%	1.7%	1.6%
Import price crude oil	2005€/GJ	9.7	12.9	16.0	17.5	19.2
Import price natural gas	2005€/GJ	5.1	7.0	8.9	10.1	11.4
Import price coal	2005€/GJ	3.3	4.3	5.1	5.1	5.2

- Boundaries
  - Nuclear phase-out
  - Limit on import of electricity and biofuels from EU model
  - ETS extended to all industries, renewable target for BE but no other already implemented policy measures

The Reference scenario (2)

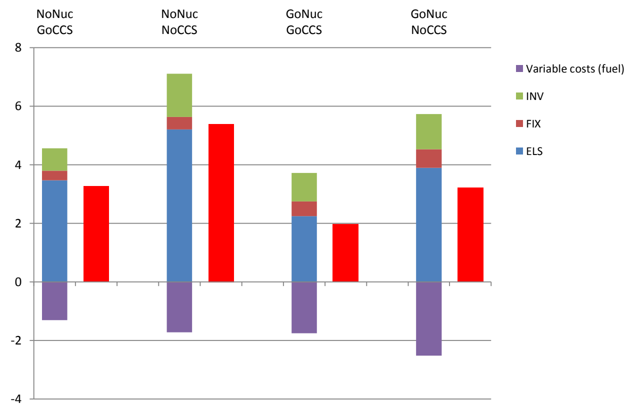
- Primary energy
  - shift to solids when coal power plants replace the nuclear power plants.
  - oil products keep a relatively high share but the increase in oil price induces a shift towards transport fuel derived from coal and natural gas.
  - renewable energy with a share of 6.7% in 2020, does not really penetrate much more after 2020.
- CO_2 emissions : 0.8% per yr

  $\rightarrow$ CO_2 reduction of 70% compared to reference

Scenarios

- EU CO_2 reduction target for Belgium: -70%
- Variants around nuclear and carbon capture
  - NoNuc-GoCCS: nuclear phase-out, carbon capture
  - NoNuc-NoCCS: nuclear phase-out, no carbon capture
  - GoNuc-GoCCS: nuclear and carbon capture
  - GoNuc-NoCCS: nuclear, no carbon capture

Welfare cost of the scenarios (B€/yr)



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Investment costs of the scenarios (B€/yr)

	2015	2020	2030	2040	2050	
Reference	13	17	24	30	33	
NoNuc-GoCCS	13	17	26	32	36	
NoNuc-NoCCS	13	18	27	33	40	
GoNuc-GoCCS	13	17	26	32	37	
GoNuc-NoCCS	13	17	26	32	39	
NoNuc-GoCCS	0.2	0.3	1.1	2.0	2.2	Delta
NoNuc-NoCCS	0.1	0.6	2.2	2.3	6.5	
GoNuc-GoCCS	0.1	0.4	1.1	2.2	3.7	
GoNuc-NoCCS	0.0	0.4	1.3	1.9	5.5	

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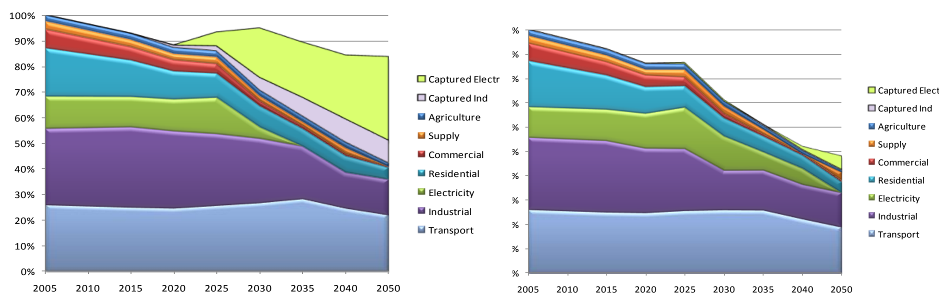
CO2 emission reduction by sector

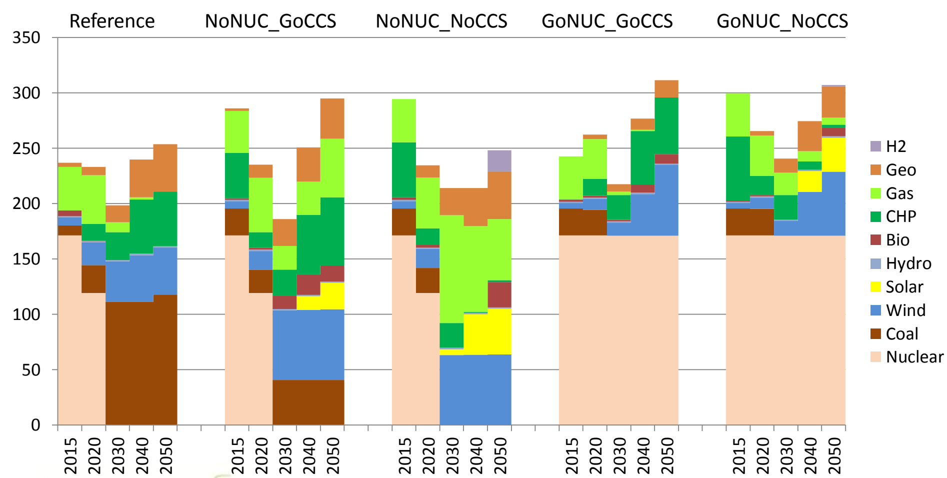
- CO_2 emissions in -58% scenario NoNuc-GoCCS and NoNuc-NoCCS



Electricity Production

- Electricity production is rather stable over the scenarios, except for the decrease in NoNuc NoCCS
- All climate scenarios have zero emissions in the electricity sector in 2050.
- Geothermal, WIND and GAS are present in all scenarios (GEO has high AF, is flexible and cost effective), but also fossil electricity production
- With no nuclear, nor CCS, then coming in
  - Renewable CO_2 consuming processes creating:
    - Fuel (can be interesting for transport)
    - Materials (only limited possibilities in our model)
  - CO_2 removal from the atmosphere (CDR), also called “negative emissions,” may or may not become a serious component of climate change policy some decades ahead.

Electricity Technologies (PJ/yr)



Energy services and final energy demand

- Decrease in energy service demand for all sectors
  - highest in industry (maybe not enough technologies modelled) and most sensitive to availability of nuclear or CCS
  - lowest reduction in transport
- Shift towards electricity in final energy demand, except in the NoNuc-NoCCS
- In industry more efficient and less carbon intensive technologies
- In transport, reduction only after 2030, mainly through shift to biofuel first, then electricity plugin car in 2050

Industry: iron & steel technologies

	NoNuc GoCCS	NoNuc NoCCS	GoNuc GoCCS	GoNuc NoCCS
Process	2020	2020	2020	2020
COREX with CCS	139	145	145	161
Blast Furnace direct coal injection	0	0	0	0
COREX	83	73	96	90
Cyclone Convertor Furnace CCF	26	49	50	48
Oxygen Blast Furnace TGR with CCS	0	37	0	28
Oxygen Blast Furnace Top Gas Recirculation	0	0	0	0
Oxygen Blast Furnace with CCS	52	86	60	84
	2040	2040	2040	2040
COREX with CCS	213	667	141	493
Blast Furnace direct coal injection	103	197	67	119
COREX	161	626	95	436
Cyclone Convertor Furnace CCF	269	443	189	272
Oxygen Blast Furnace TGR with CCS	0	44	0	14
Oxygen Blast Furnace Top Gas Recirculation	16	0	0	0
Oxygen Blast Furnace with CCS	330	558	231	423

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Transport Short distance (cost gap €/100km)

Cost decrease needed for penetration

	2020	2030	2050
Ethanol Plugin Hybrid	4	1.8	0
Ethanol Hybrid	0.8	0.9	2
Ethanol ICE	0	0	2.1
Gas ICE	0.2	0.4	2.7
Electric car with battery	11.3	6.8	3
Gasoline hybrid	1.6	1.5	3.2
LPG ICE	0	0	3.2
Gasoline ICE	0.2	0.6	3.4
Biodiesel ICE	0.3	0.5	3.8
Gasoil ICE	0.3	0.5	3.9
Biodiesel hybrid	1.9	2.1	4.1
Gasoil hybrid	1.9	2.1	4.1
Gasoline Plugin Hybrid	3.9	4.1	4.5
Hydrogen ICE	3.7	4.2	4.8
Hydrogen fuel cell	5.6	5.8	5.6
Hydrogen ICE (liquid)	4.9	5.1	6.2

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Transport Long distance (cost gap €/100km)

Cost decrease needed for penetration

	2020	2030	2050
Ethanol Plugin Hybrid	2.7	1.2	0
Ethanol ICE	0	0.1	1.7
Ethanol Hybrid	0.5	0.9	1.8
Gas ICE	0	0	2
Biodiesel ICE	0	0	2.3
Gasoil ICE	0	0	2.4
Gasoline ICE	0.1	0.7	2.8
LPG ICE	0.2	0	2.9
Gasoline hybrid	1.2	1.3	2.9
Biodiesel hybrid	1.3	1.6	3.1
Gasoil hybrid	1.3	1.6	3.1
Hydrogen fuel cell	3.6	3.9	3.6
Hydrogen ICE	2.6	3.3	3.7
Gasoline Plugin Hybrid	4	3.2	4.2
Hydrogen ICE (liquid)	3.7	4.1	4.7

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Conclusion

- It is possible to attain very stringent CO_2 reductions in Belgium. The welfare cost in annualized terms varies from 0.5% of the 2005 GDP when nuclear and carbon capture are available to 1.2% of GDP2005 when none of these options are available. The participation in a global EU CO_2 market is essential for Belgium.
- Availability of more efficient and more 'future' technologies are important. R&D on new technologies is therefore essential.
- Major financial flows towards energy system necessary to achieve high CO2 reductions (investment needs can double)
- A major contribution is obtained from a reduction in the energy service demand, part of it is maybe a modelling issue (not enough more efficient technologies mostly in industry)
- Either nuclear or carbon storage have to be available to limit the cost.

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