

PROSPECTIVE ANALYSIS OF POST-COPENHAGEN CLIMATE POLICY: THE PLAUSIBILITY OF INVESTMENTS IN CARBON CAPTURE AND STORAGE

Sandrine SELOSSE, Edi ASSOUMOU, and Nadia MAIZI

Centre for Applied Mathematics, MINES ParisTech, France
Chair ParisTech Modeling for sustainable development



Chaire ParisTech Modélisation prospective
au service du développement durable



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Model: TIAM-FR



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The TIAM-FR model

Context and scenario specification

Results

Conclusion

- TIMES Integrated Assessment Model developed by ETSAP (Energy Technology Systems Analysis Programme) under the aegis of IEA
 - A technologically detailed bottom-up energy system model
- A time horizon from 2005 to 2100
- A geographically integrated model in 15 world regions
- GHG emissions:
 - CO₂, CH₄ and N₂O
 - Carbon capture and sequestration and mitigation options for CH₄ and N₂O
- An integrated climate module
 - Atmospheric GHG concentrations and temperature changes

Context: Post COP 15 climate policies



The TIAM-FR model	Context and scenario specification	Results	Conclusion
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2020: emission reduction pledges from the Copenhagen Accord

Regions	Reference year	Level of commitment	Mitigation rate	Mitigation type
Western Europe (WEU) + Eastern Europe (EEU)	1990	Low	20%	Emissions
		Up	30%	
Japan (JPN)	1990	Fix	25%	Emissions
Australia– New Zealand (AUS)	2000	Low	5%	Emissions
		Up	25%	
United States (USA) *	2005	Fix	17%	Emissions
Canada (CAN) *	2005	Fix	17%	Emissions
China (CHI)	2005	Low	40%	Carbon intensity
		Up	45%	
India (IND)	2005	Low	20%	Carbon intensity
		Up	25%	

* **United States** and **Canada** also pledged a CO₂ mitigation target of **30% by 2025, 42% by 2030** and **83% by 2050**

2050: Assumptions for long-term targets



2050: International convergence on long-term objectives for industrialized countries

Regions	Reference year	Level of commitment	Mitigation rate	Mitigation type
Western Europe (WEU) + Eastern Europe (EEU)	1990	Low	60%	Emissions
		Up	80%	
Japan (JPN)	1990	Low	60%	Emissions
		Up	80%	
Australia- New Zealand (AUS)	2000	Low	60%	Emissions
		Up	80%	
China (CHI)	2005	Low	90%	Carbon intensity
		Up	10%	Emissions
India (IND)	2005	Low	60%	Carbon intensity
		Up	10%	Emissions

Specification of scenarios



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- **Regional scenarios:**

2 scenarios considering Post COP 15 pledges:

- **Target_Low:** Low commitments for 2020 and weak assumptions for 2050
- **Target_Up:** High commitments for 2020 and strong assumptions for 2050

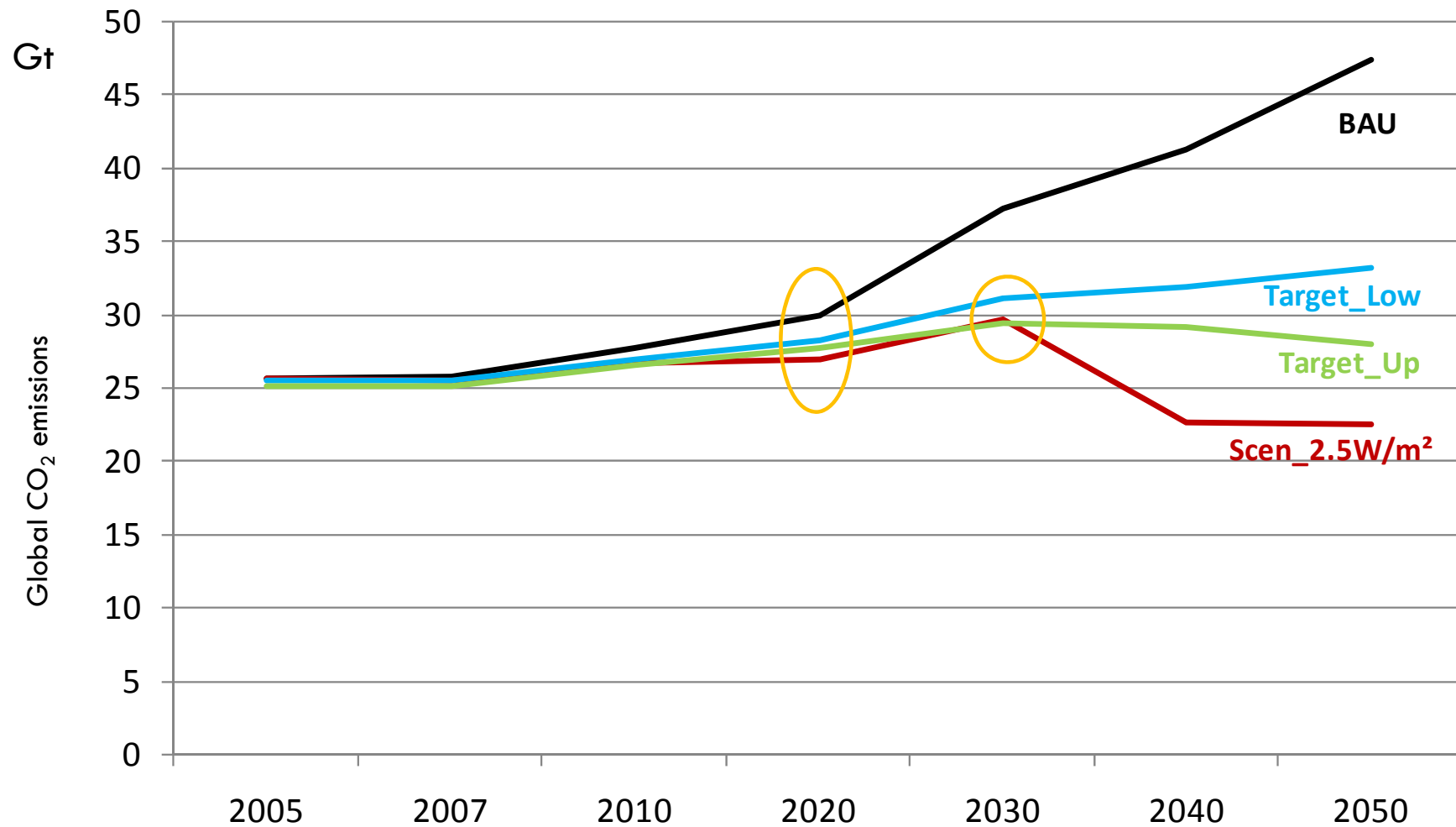
- **Global scenario:**

Global 2050 target scenario: **2.5 W/m² in 2050** according to the global objective of keeping warming to 2°C

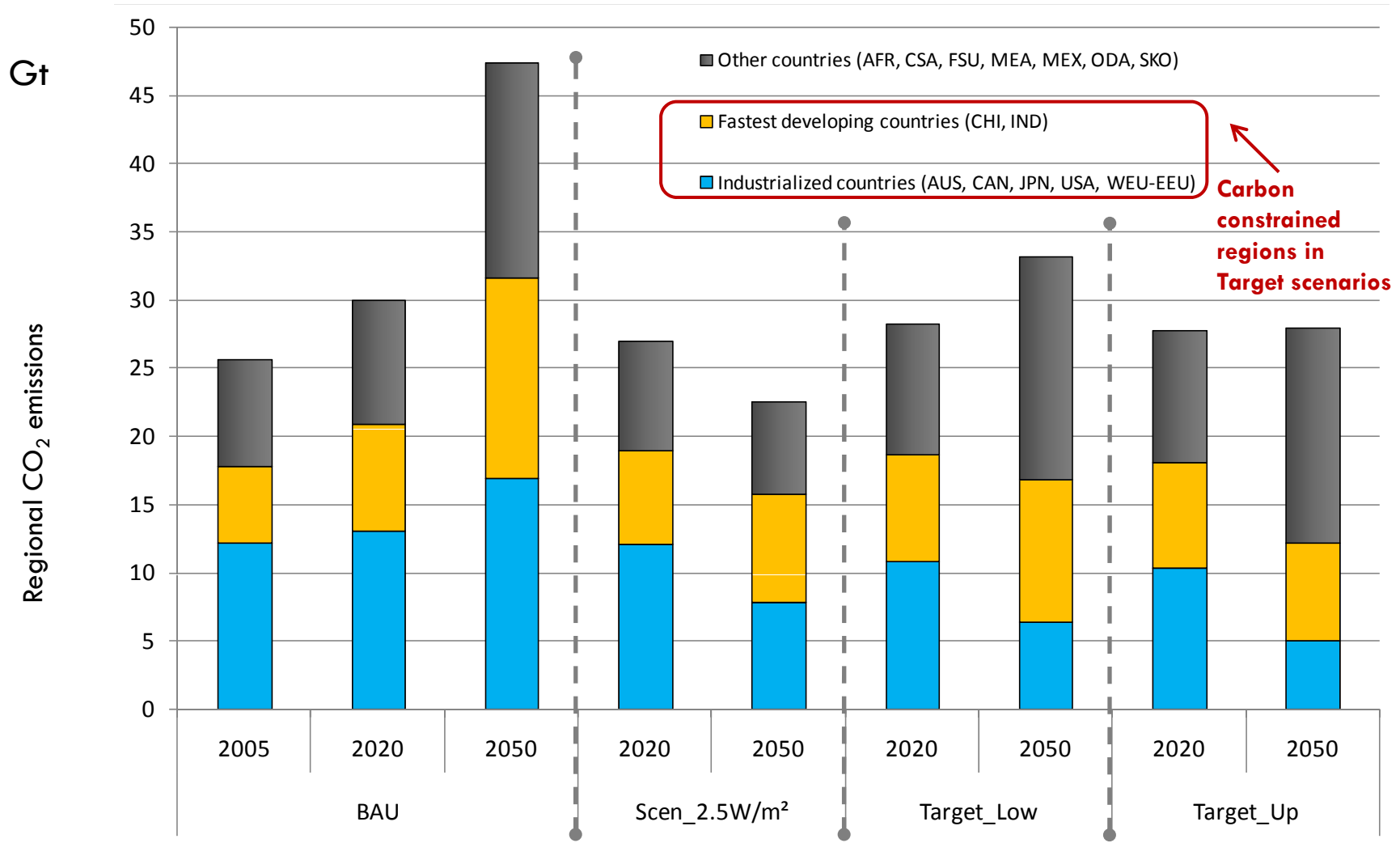
Results

- ❑ International coordination and regional impact
- ❑ Energy system evolution
- ❑ CCS solution plausibility

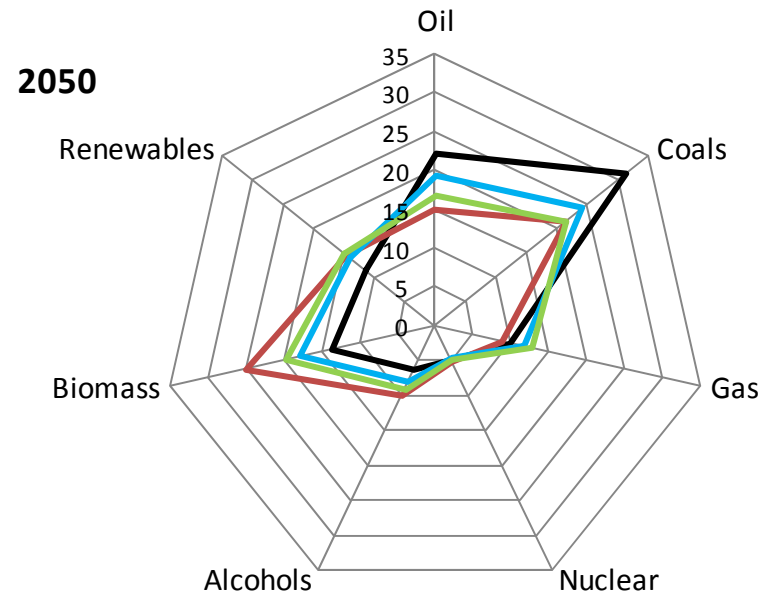
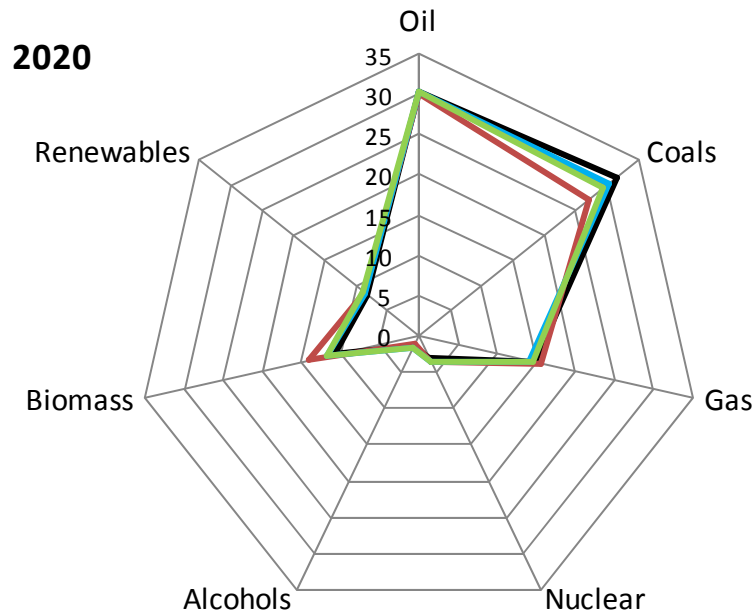
Global CO₂ emissions (Gt CO₂)



Regional CO₂ emissions (Gt CO₂)

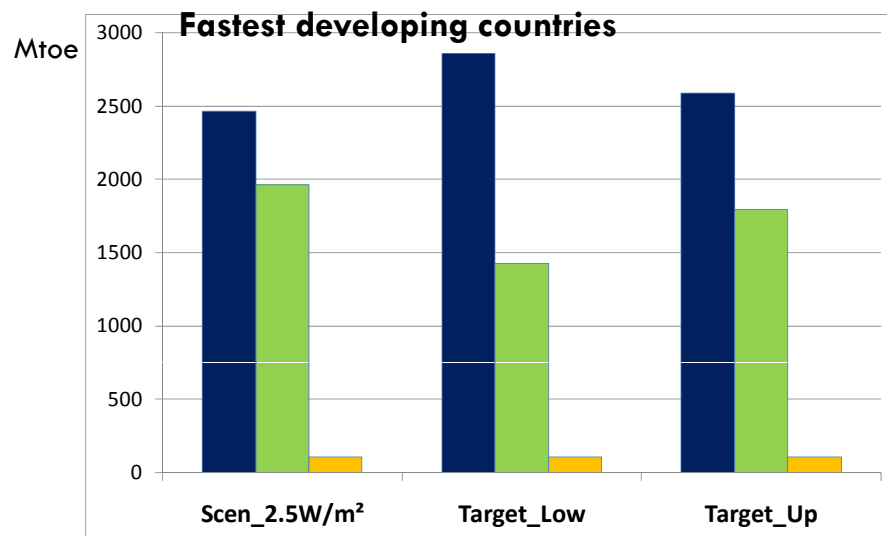
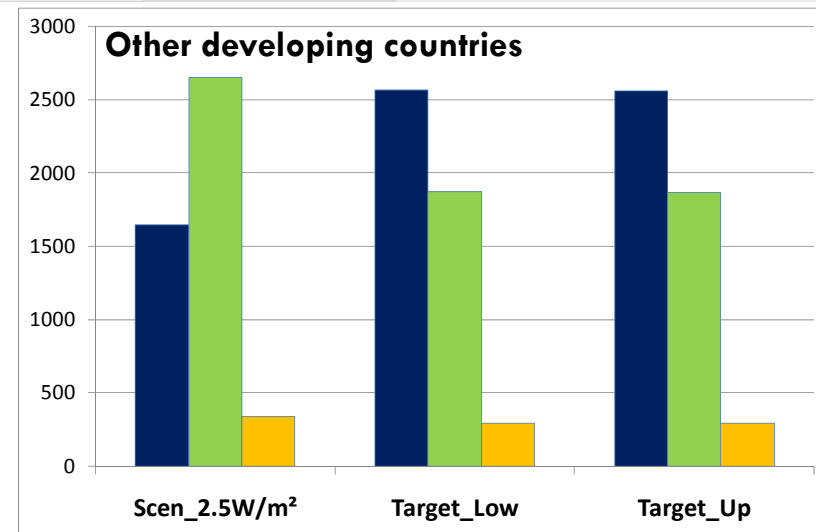
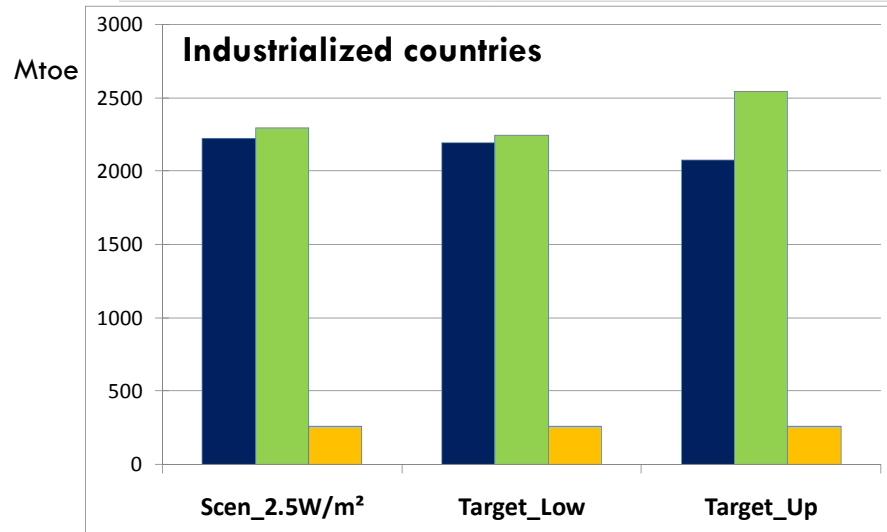


Fuel shares in the energy mix(%)



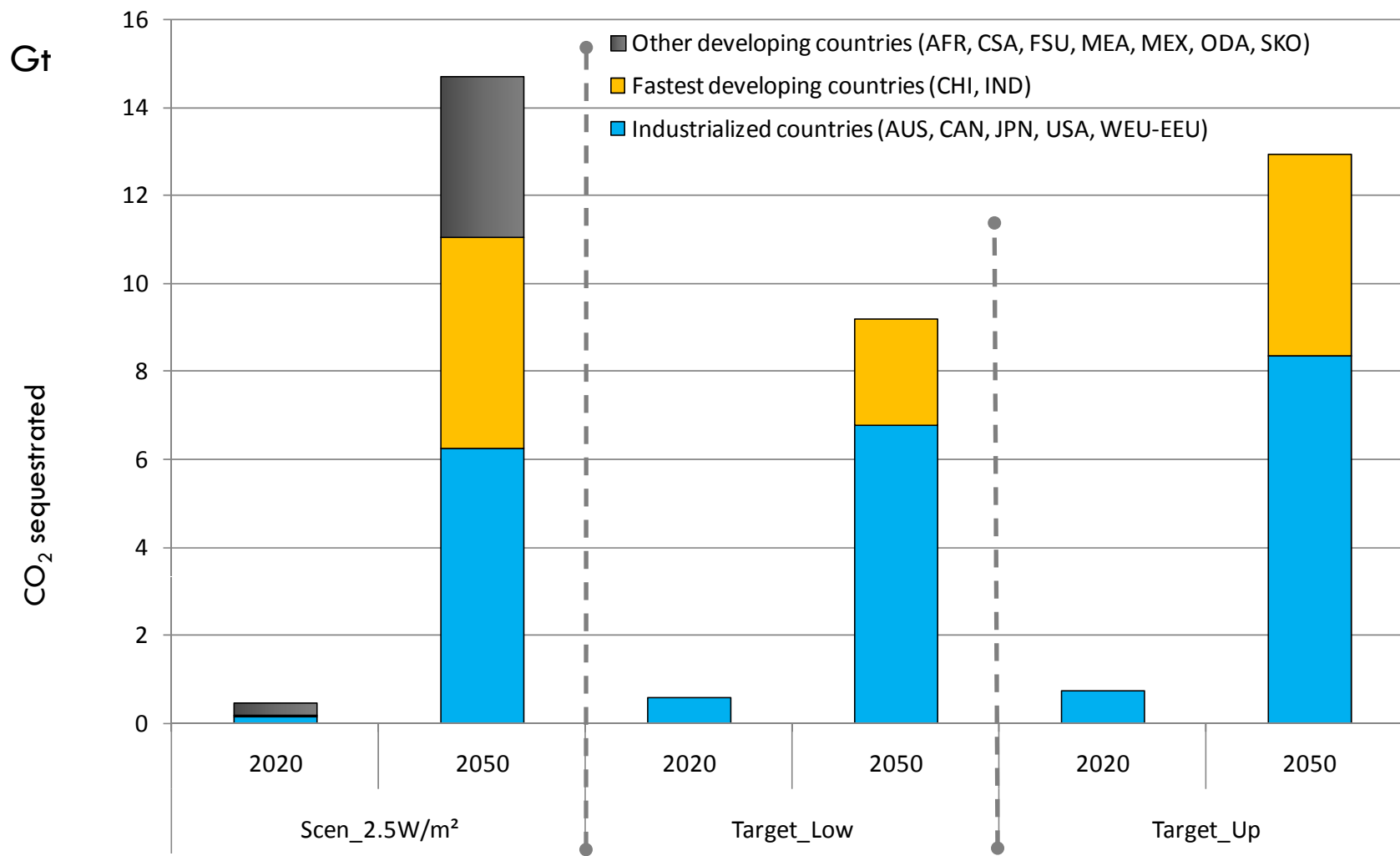
— BAU — Scen_2.5W/m² — Target_Low — Target_Up

Total primary energy supply in 2050 (Mtoe)

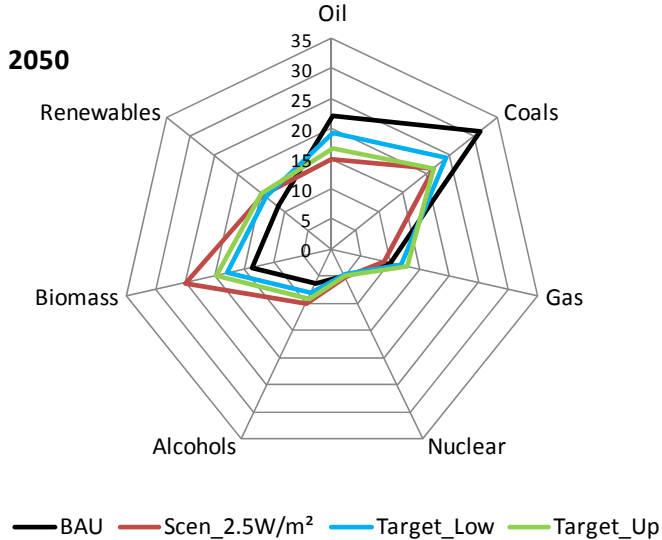


- Fossil
- Renewables
- Nuclear

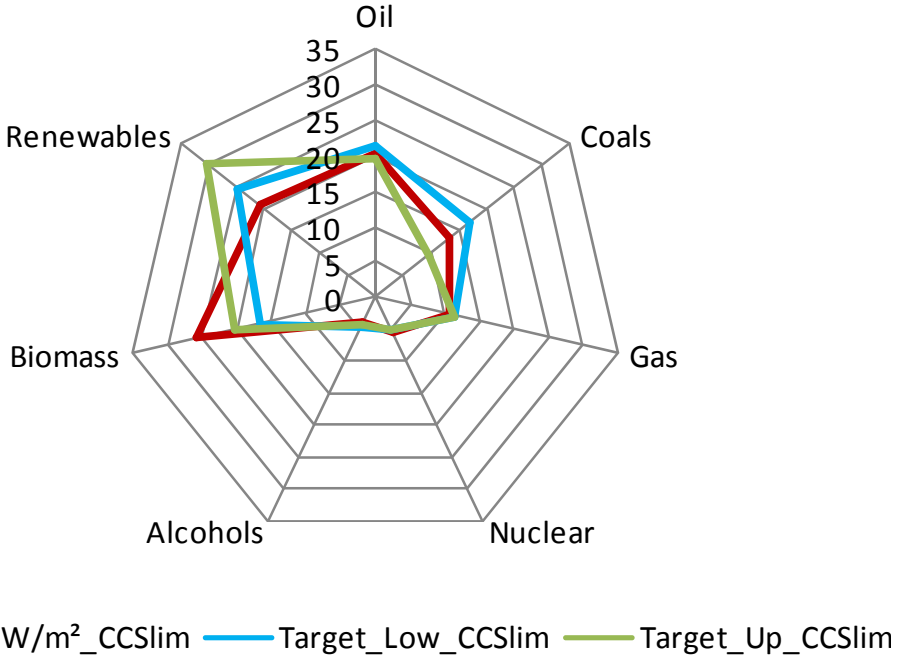
The deployment of CCS technologies (GtCO₂ sequestered)



Fuel share in the energy mix for limited CCS scenarios



2050



Marginal cost of carbon (\$/tCO₂)



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Scenario	Year	Australia	Canada	China	Eastern Europe	India	Japan	USA	Western Europe
Target_Low	2020	0	12	0	0	0	58	15	12
	2050	13	18	77	0	0	248	221	227
Target_Up	2020	16	12	0	0	0	55	15	12
	2050	11	13	144	35	56	503	221	445

- Scenario 2.5 W/m²
 - 2020: 16 \$/tCO₂
 - 2050: 73 \$/tCO₂

Marginal cost of carbon in limited CCS situation (\$/tCO₂)



Scenario	Year	Australia	Canada	China	Eastern Europe	India	Japan	USA	Western Europe
Target_Low_CCSlim	2020	2	12	0	0	0	61	13	1
	2050	9	17	169	0	0	358	1605	750
Target_Up_CCSlim	2020	16	12	0	0	0	57	12	17
	2050	14	15	340	39	144	771	1607	7542

Scenario 2.5 W/m²_CCSlim

- 2020: 28 \$/tCO₂
- 2050: 124 \$/tCO₂

Is this plausible?



Conclusion

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- The deployment of CCS and renewables technologies as a response of carbon constraints but feasibility of this development ?
 - Uncertainty
 - Technological limits: stability of the electric system
 - Economic limits: costs, scale...
- Further developments
 - Investment cost analysis
 - Detailed distribution of CCS potential and Renewables limits
 - Action on demand



Annexes



Understanding the targets



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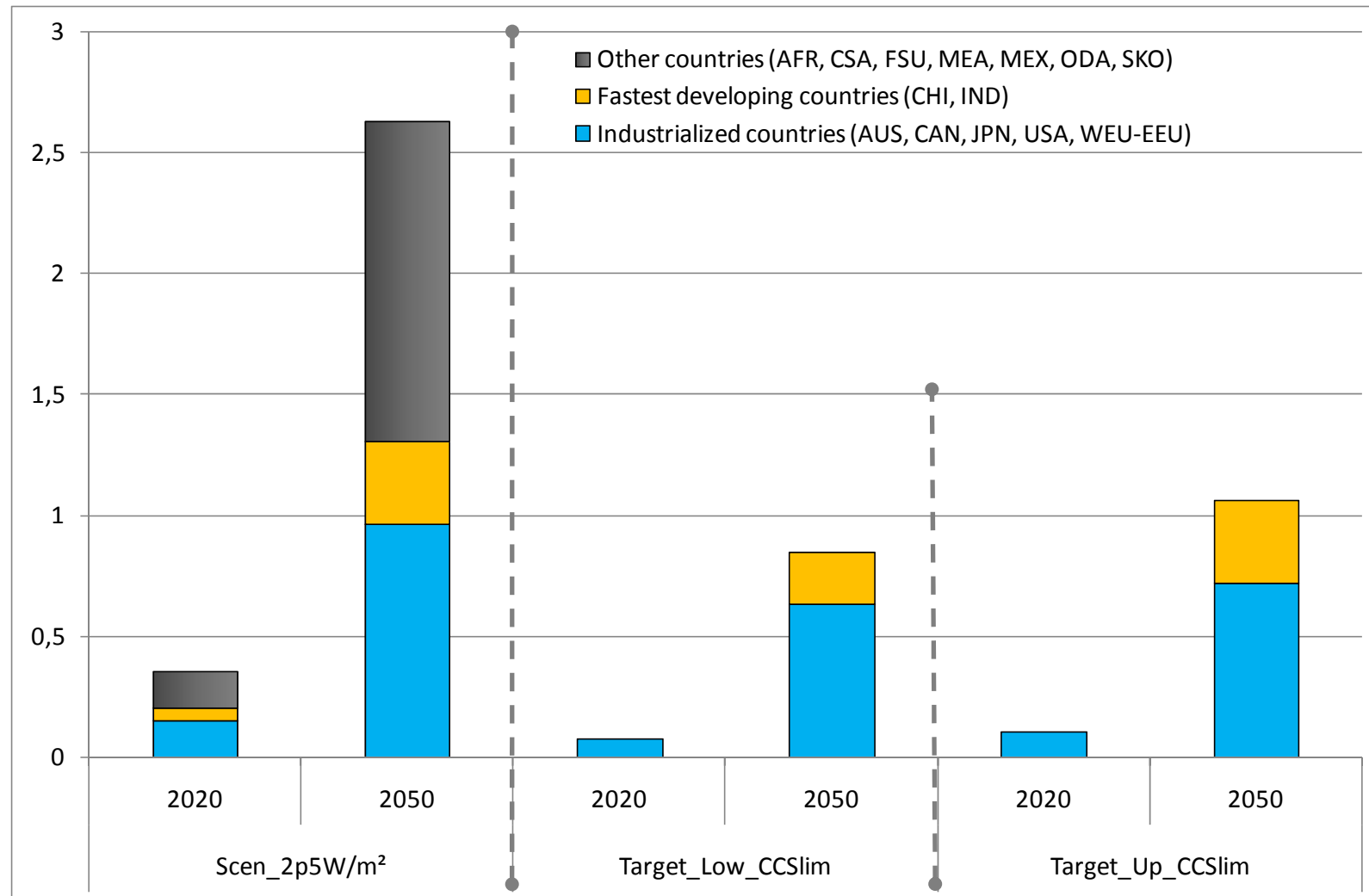
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Regions	2020		2050	
	On 1990 scale	On 2005 scale	On 1990 scale	On 2005 scale
WEU+EEU	From -20% to -30%	From -2.8% to -14.9%	From -60% to -80%	From -51% to -76%
JPN	-25%	-32,4%	From -60% to -80%	From -64% to -82%
AUS	From +8% to -14,5%	From -14% to -32%	From -54% to -72%	From -64% to -82%
USA	-0,30%	-17%	-79,6%	-83%
CAN	+3,2%	-17%	-78,9%	-83%
CHI	From +295% to +262%	From +69% to +54,5%	From +195% to +111%	From +26% to -10%
IND	From +423% to +390%	From +154% to 138%	From +1318% to +86%	From +588% to -10%

➔ Conversion of the pledges according to the same reference year (1990 or 2005) and following the same type of reduction, i.e. CO₂ emission mitigation

➔ For example, in the case of China, by reducing carbon intensity by 40% by 2020 compared to 2005 is equivalent to limiting the increase of its CO₂ emissions by 295% compared to 1990 and by 69% compared to 2005

An added constraint: The limited deployment of CCS technologies (GtCO₂ sequestered)



Total primary energy supply in 2050 according to limited CCS deployment scenarios (PJ)



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