REGIONAL IMPACTS OF POST COPENHAGEN EMISSION REDUCTION PLEDGES USING TIAM-FR

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Outline of the presentation

- Model: ETSAP/TIAM-FR
- Context and scenario specification
- Results
- Conclusion

Model: ETSAP/TIAM-FR

- **TIMES Integrated Assessment Model** developped by ETSAP (Energy Technology Systems Analysis Programme) under the aegis of IEA
  - A technologically detailled bottum-up energy system model
  - A linear programming model with objective fonction minimizing the total discounted system costs
- A time horizon from 2000 to 2100
- A geographically integrated model in 15 world regions
  - Linked by energy, material and by a global trade in emission permit, if desired
- GHG emissions:
  - CO_2, CH_4 and N_2O
  - Carbon capture and sequestration and mitigation options for CH_4 and N_2O
- An integrated climate module
  - Atmospheric GHG concentrations and temperature changes

Context: Post Copenhagen climate policies

- International schemes for addressing anthropogenic climate change after 2012
- COP 15 was the final step of the two-year negociation process set by the Bali conference in 2007
- A political agreement: The Copenhagen Accord
  - Participation of all major industrialized countries and the fastest developing countries
  - A mitigation framework based on the announced pledges at the beginning of 2010
  - Global objective of keeping the increase in the global average surface temperature below 2°C and the accord committed to "*take action to meet this objective consistent with science and on the biais of equity*" (Copenhagen Accord)

Specification of scenarios

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

- **Scenario B**: 2 scenarios considering Post COP 15 pledges:
  - **Target_Low**: Low commitments for 2020 and weak assumptions for 2050 for 4 industrialized countries and 2 fastest developing countries: WEU, USA, JPN, CAN, AUS, CHI and IND
  - **Target_Up**: High commitments for 2020 and strong assumptions for 2050 for 4 industrialized countries and 2 fastest developing countries: WEU, USA, JPN, CAN, AUS, CHI and IND

Post COP 15 pledges scenarios

2020: Post Copenhagen emission reduction pledges

* **United States** and **Canada** also pledged a CO_2 mitigation target of **30% by 2025, 42% by 2030** and **83% by 2050**

Regions	Reference year	Level of commitment	Mitigation rate	Mitigation type
Western Europe (WEU)	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%	

2050: Assumptions for long-term targets

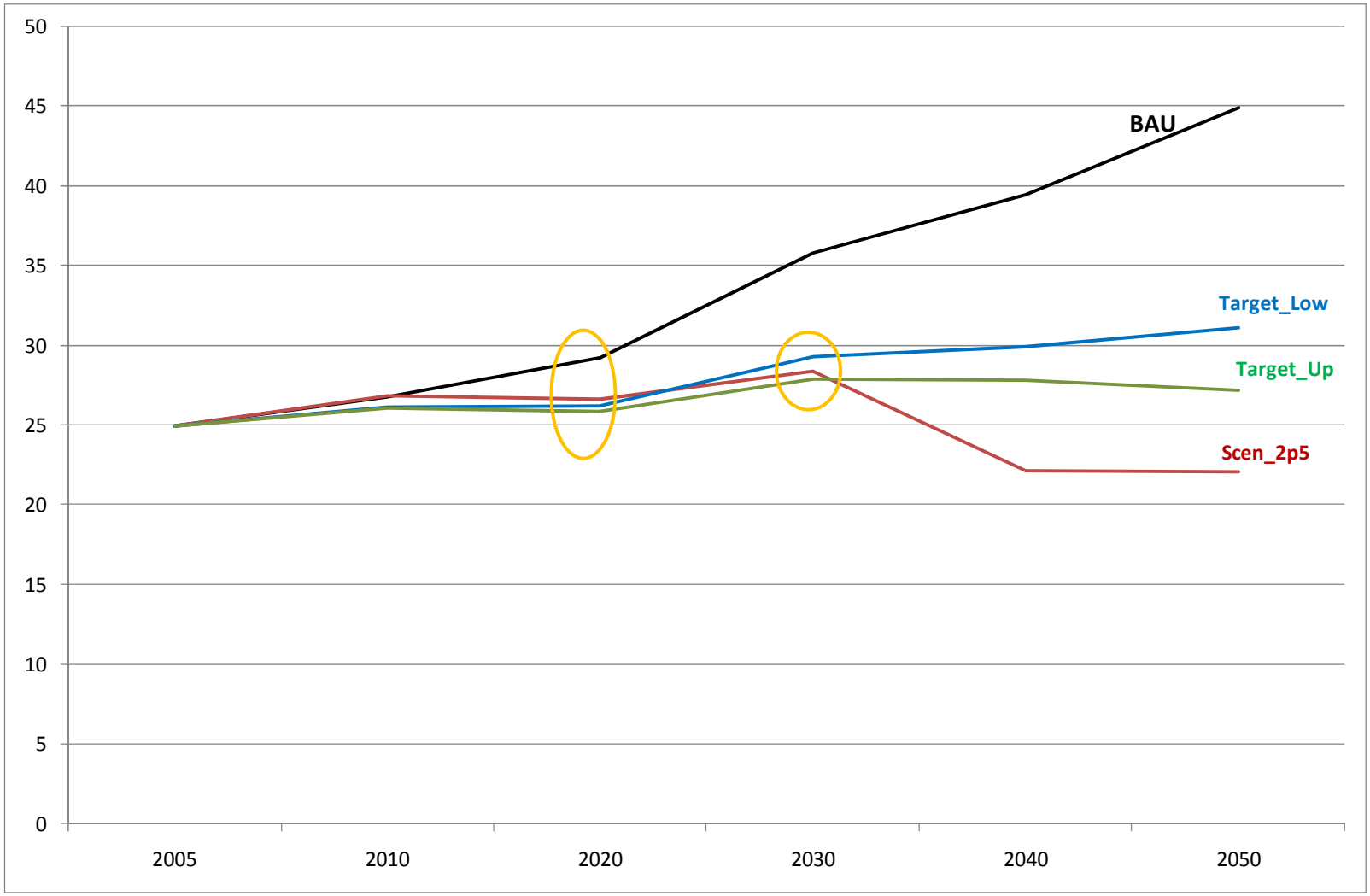
International convergence on long-term objectives for industrialized countries

Regions	Reference year	Level of commitment	Mitigation rate	Mitigation type
EU and JPN	1990	Low	60%	Emissions
		Up	80%	
AUS	2000	Low	60%	Emissions
		Up	80%	
CHI	2005	Low	90%	Carbon intensity
		Up	10%	**Emissions**
IND	2005	Low	60%	Carbon intensity
		Up	10%	**Emissions**

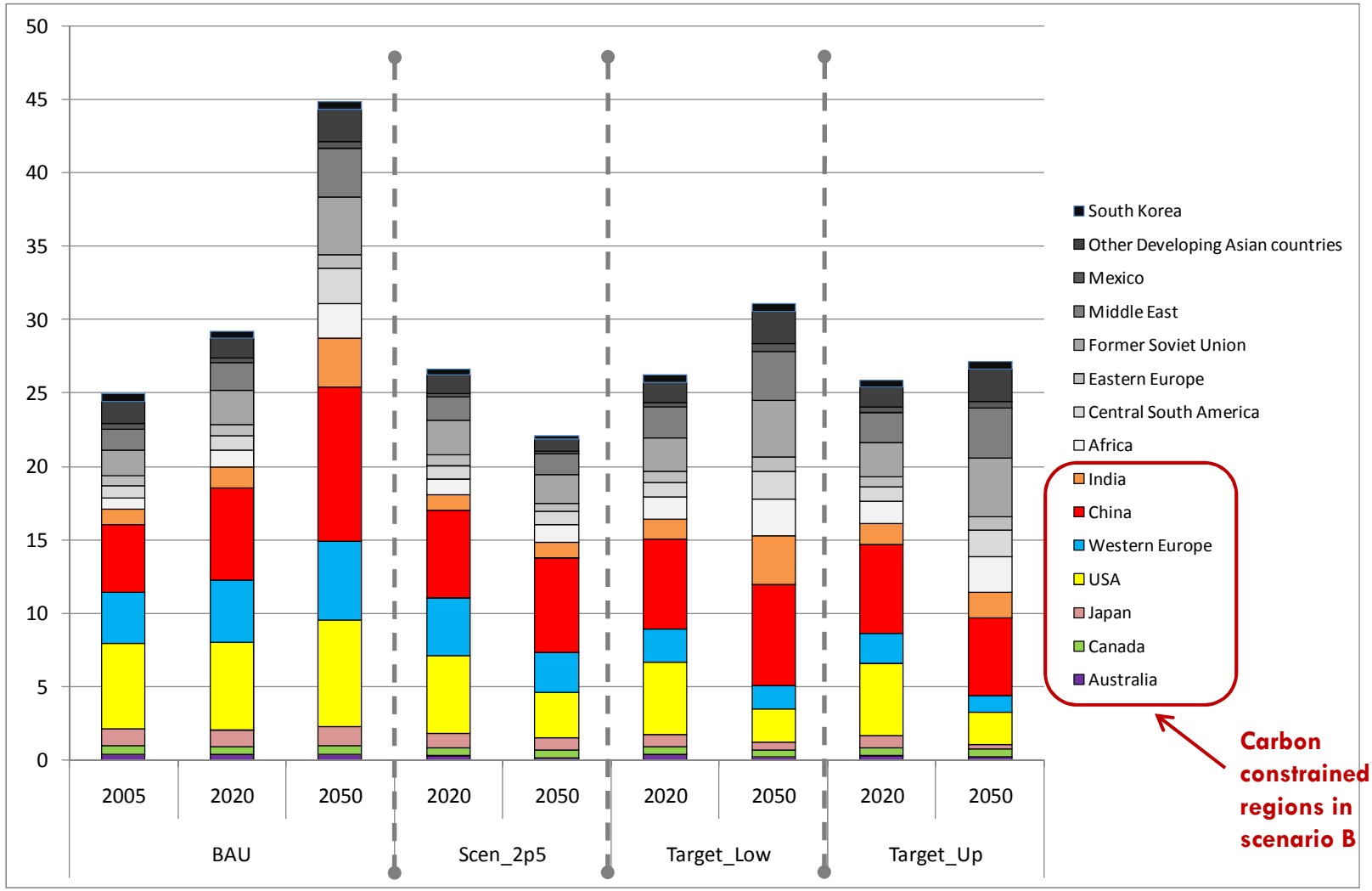
Results

- What international coordination and regional impact according to global or regional climate stakes?
- How the energy system can evolve over time to follow different low carbon future policies?
- Is it possible to keep warming to 2°C?

Global CO_2 emissions (Gt CO_2)



Regional CO_2 emissions (Gt CO_2)



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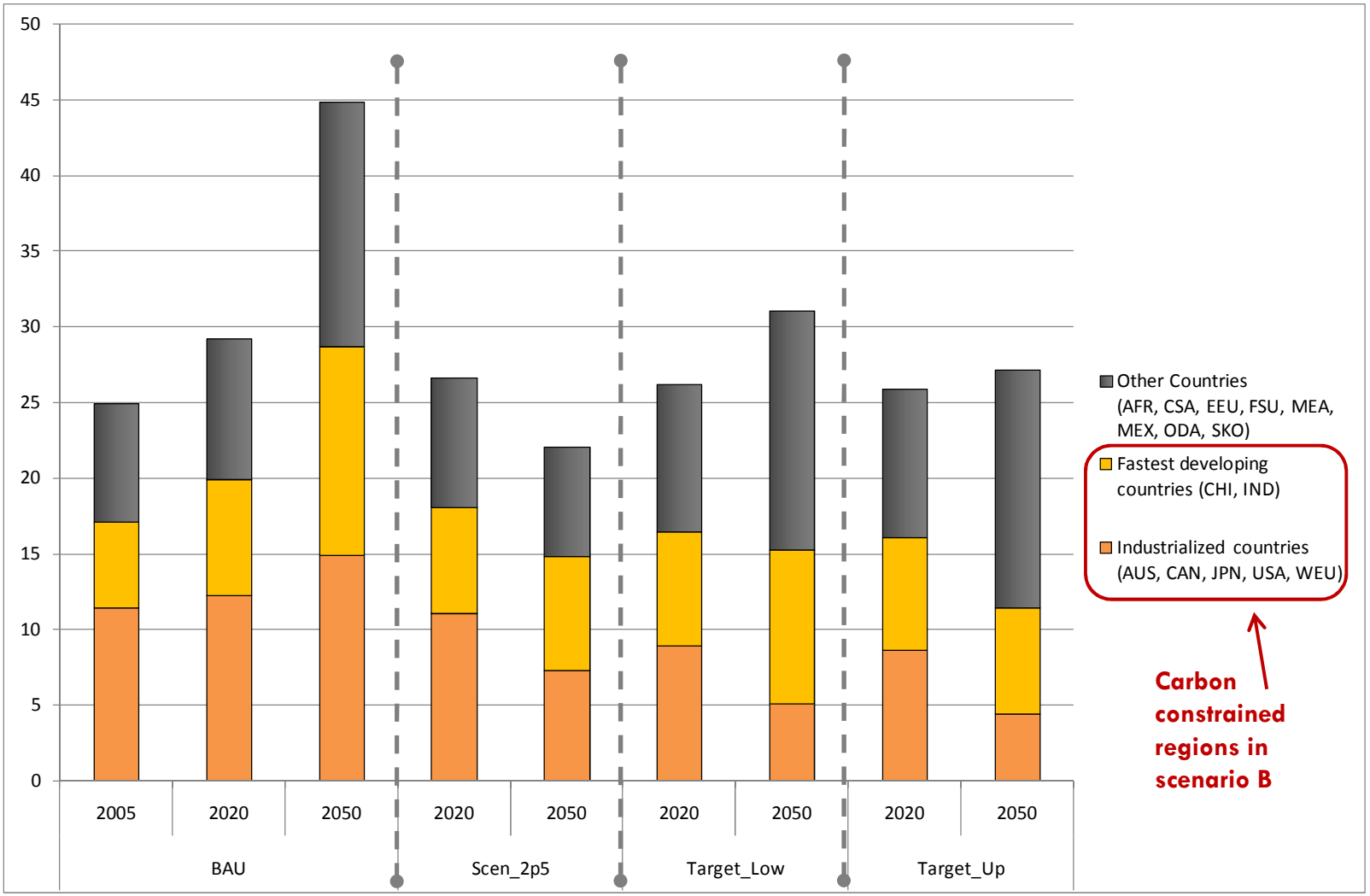
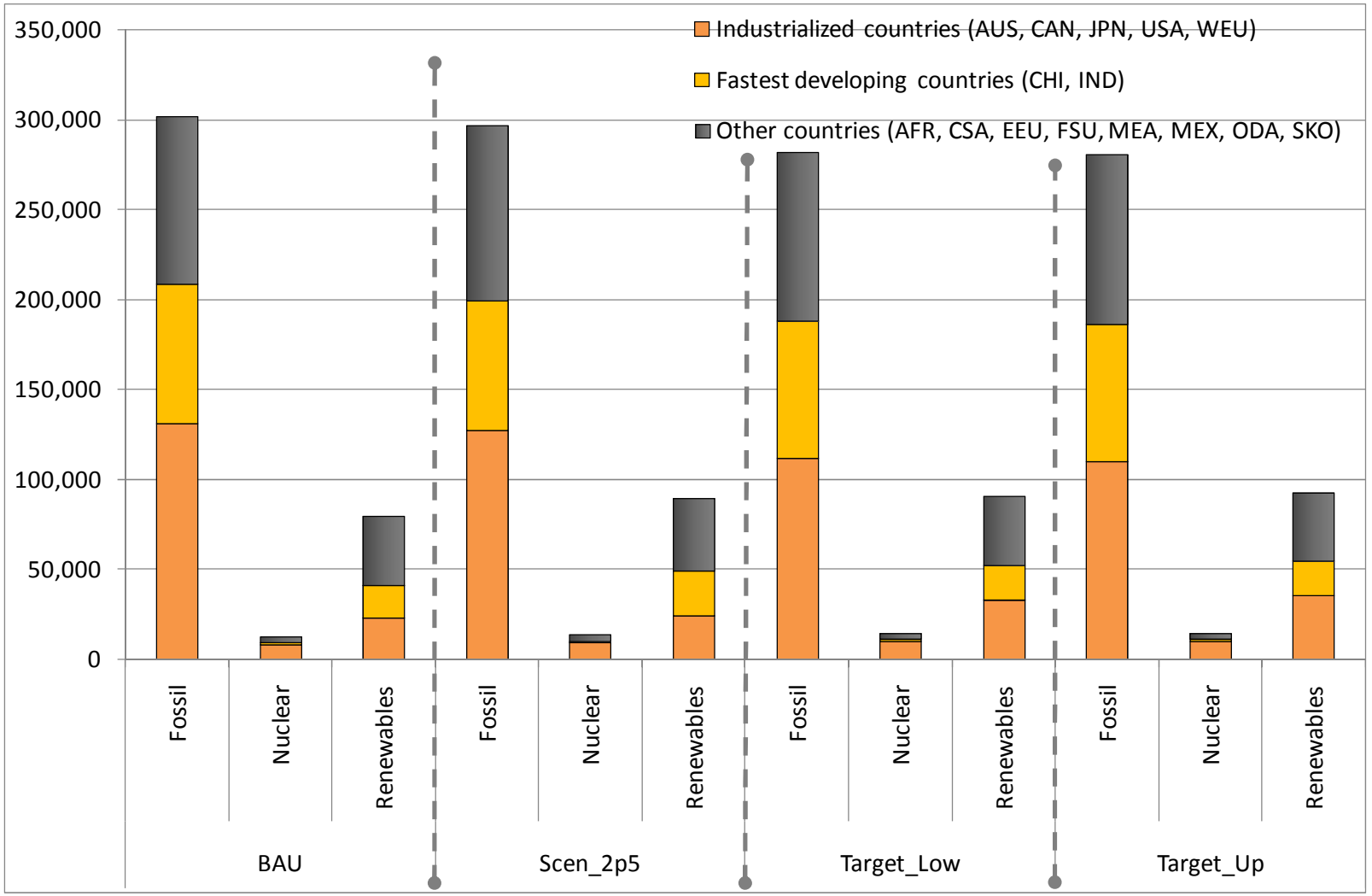
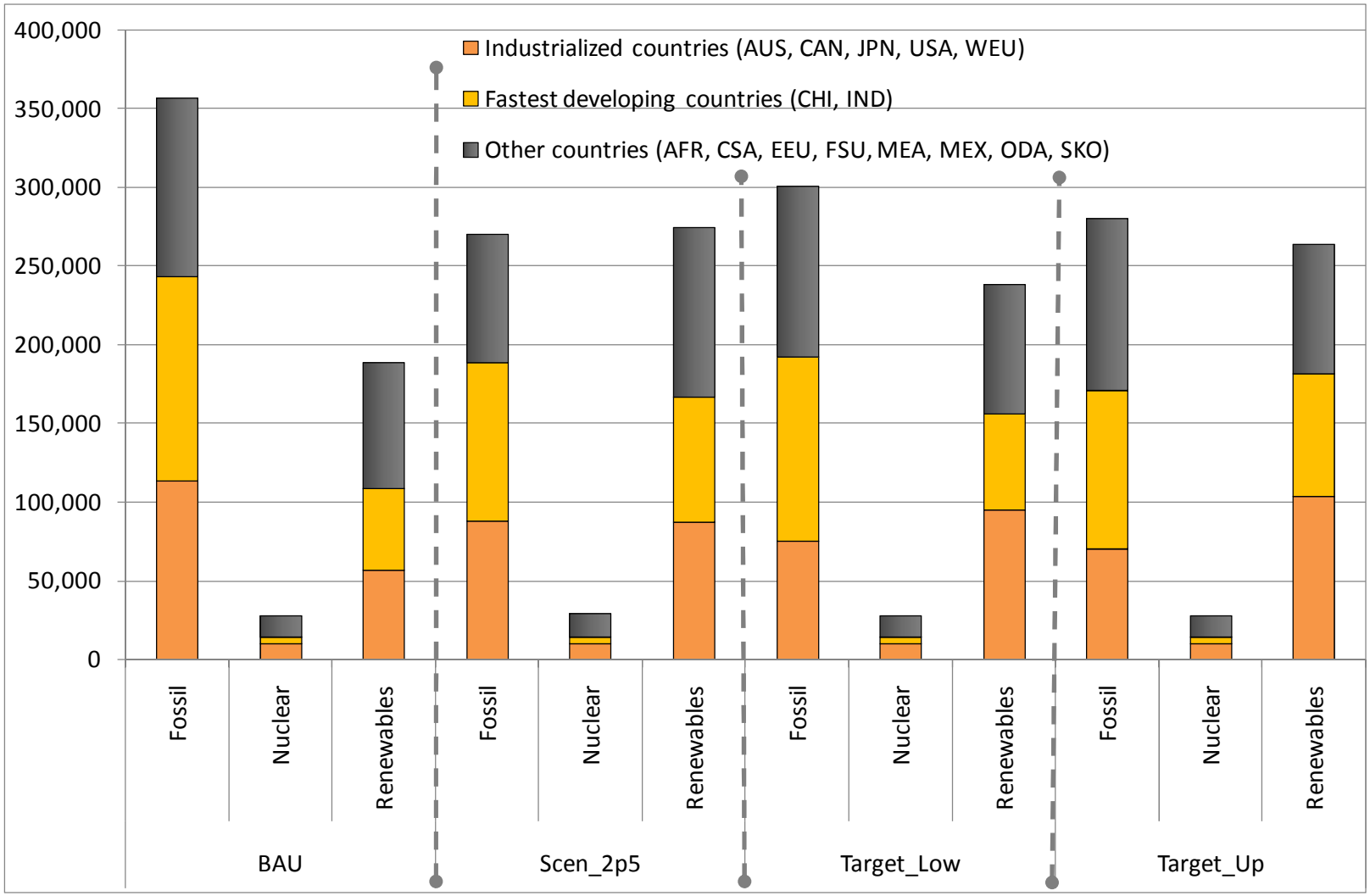


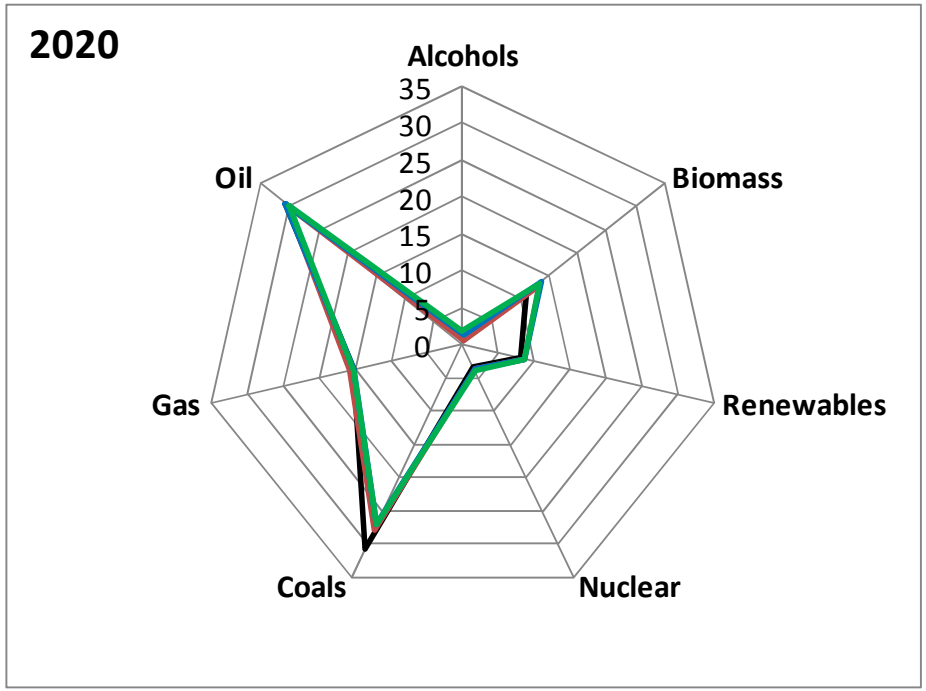
Total primary energy supply in 2020 (PJ)

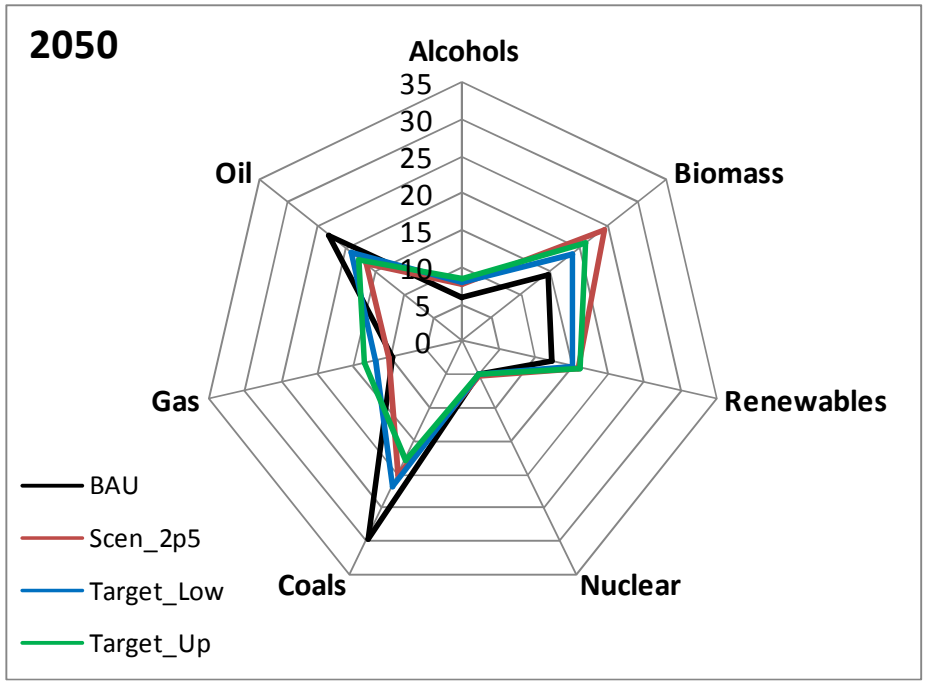


Total primary energy supply in 2050 (PJ)

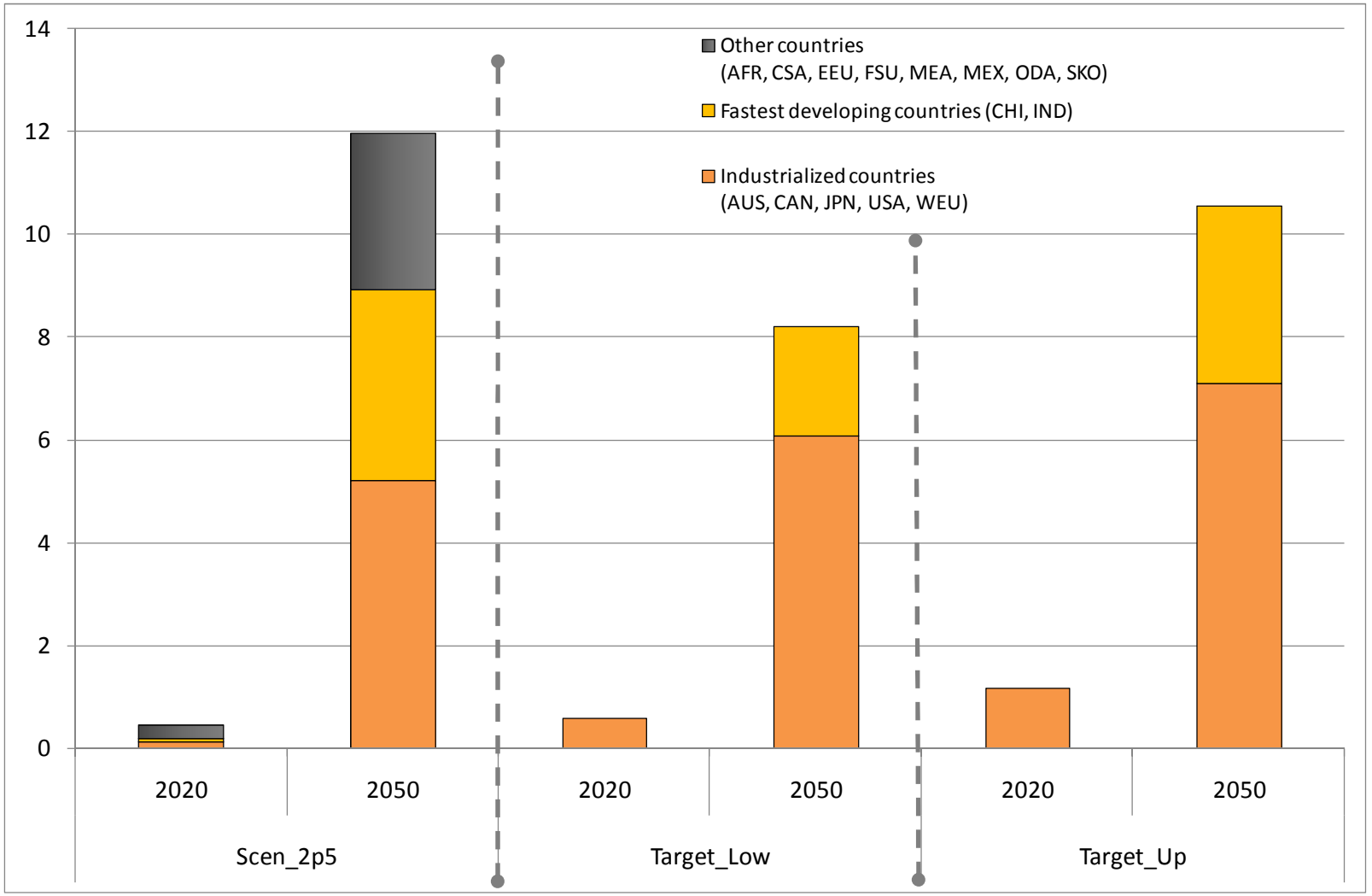


Fuel shares in the energy mix(%)

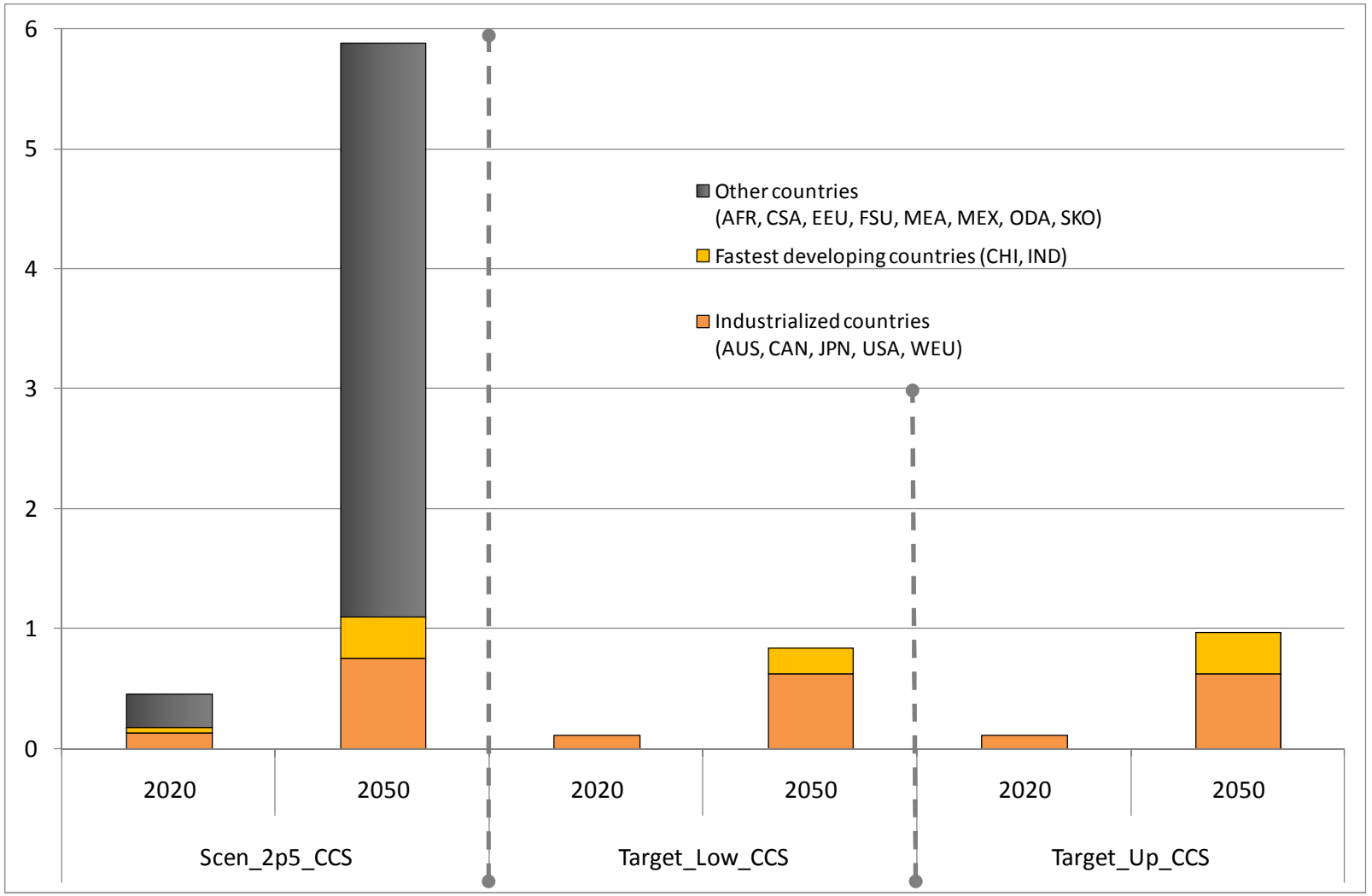




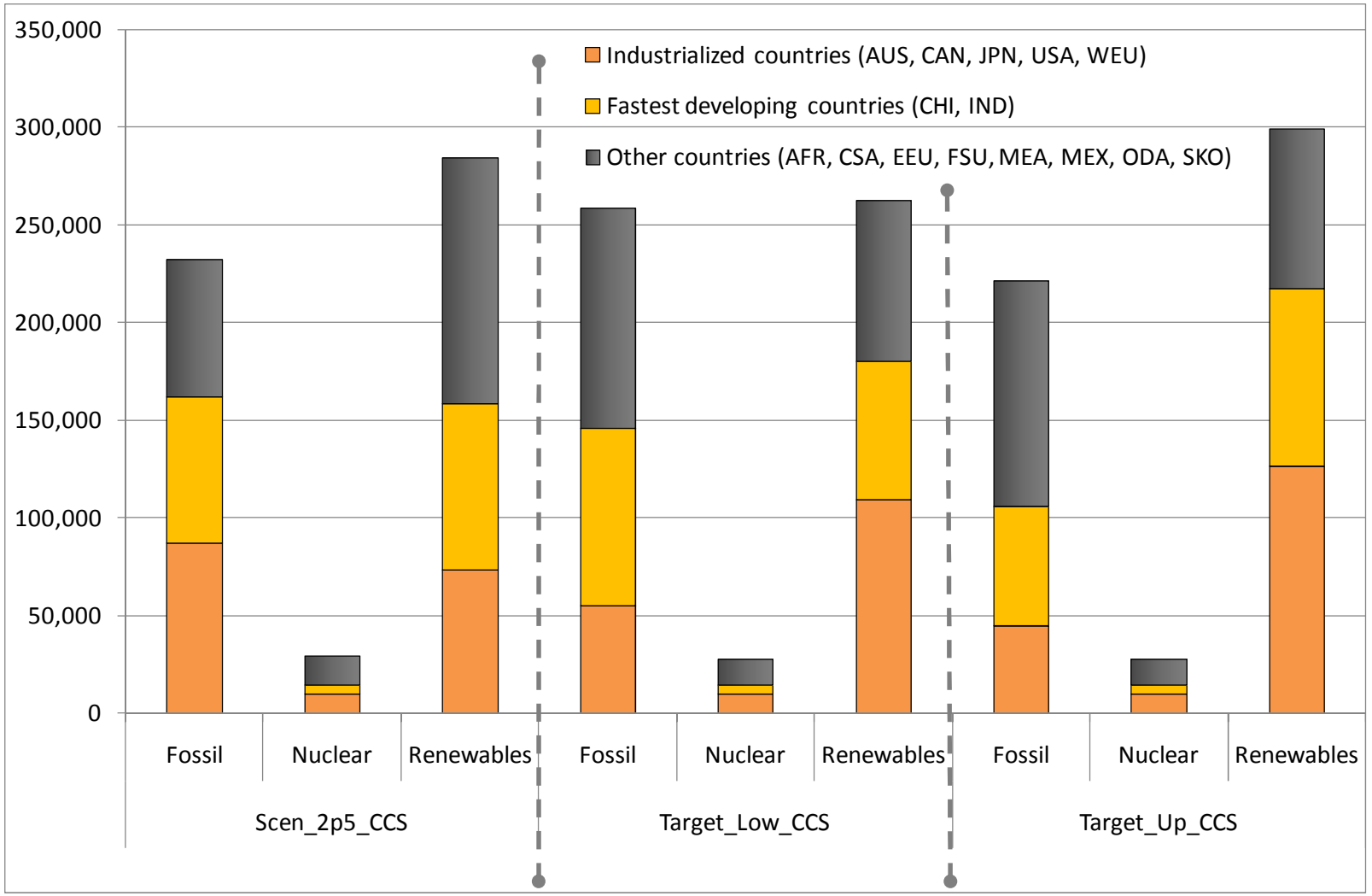
The deployment of CCS technologies ($GtCO_2$ sequestrated)



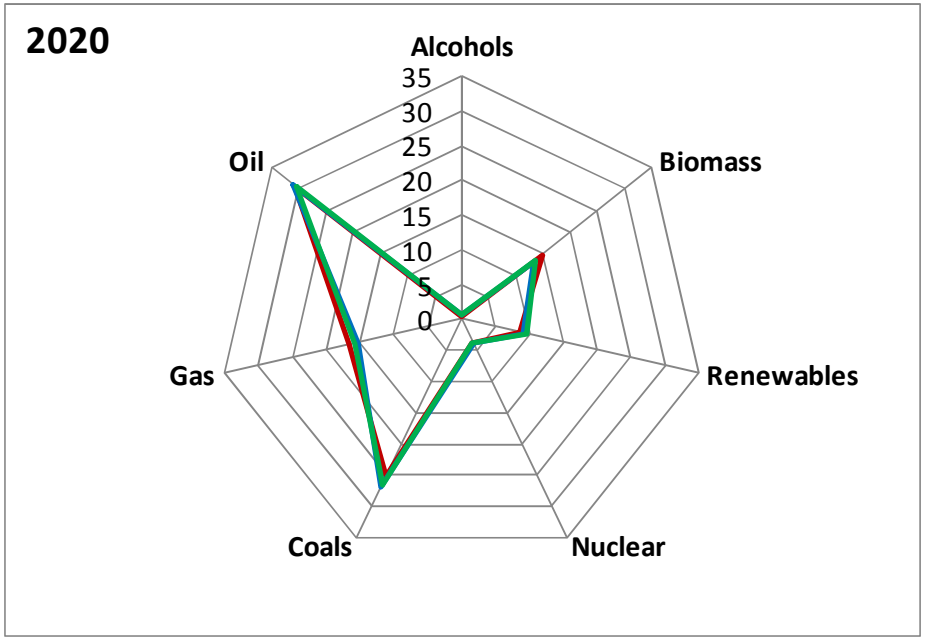
The limited deployment of CCS technologies ($GtCO_2$ sequestrated)

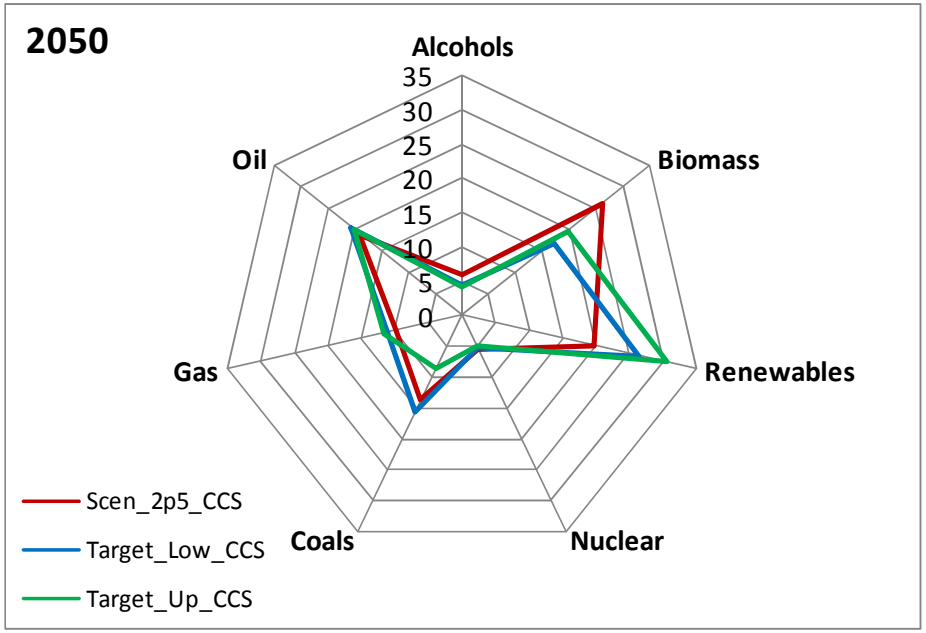


Total primary energy supply in 2050 according to limited CCS deployment scenarios (PJ)



Fuel share in the energy mix for limited CCS scenarios





Conclusion

Conclusion

- Key features of the Post Copenhagen climate policies
  - Weaker impact by 2020
  - Regional impact
- 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
  - Nuclear sensibility analysis
  - Detailled distribution of CCS potential and Renewables limits
  - Action on demand

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ANNEXES

A1- TIAM Business as usual (a)

General assumptions:

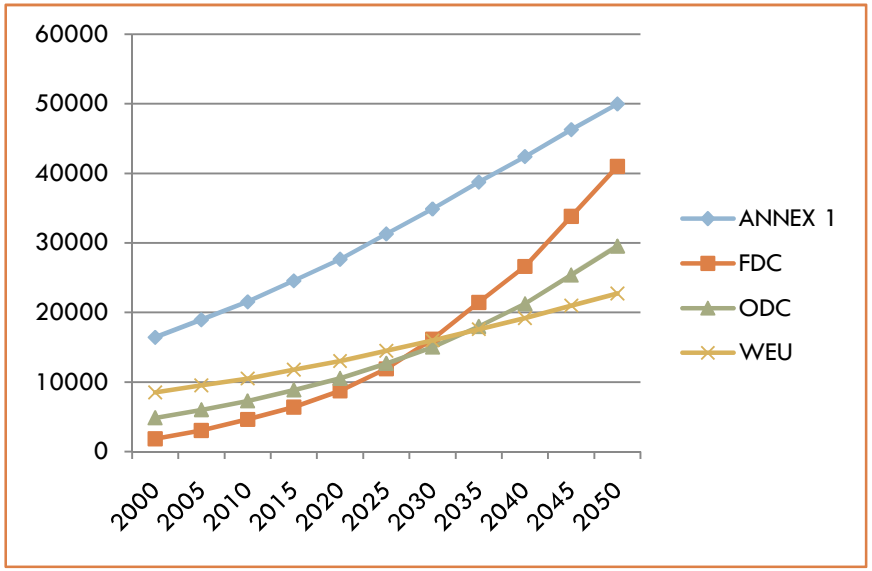
- Main socio-economic drivers: Energy consumption based on external projections of:
  - The growth of regional GDP (World AAGR [2000-2050] = 3.072%)
  - The growth of population (9 billions of people in 2050)
  - The level of various economic sectors: Agriculture, Iron and Steel, Services, etc.
- Fossil fuel extraction prices: prices for crude oil, natural gas and hard coal
  - World Energy Outlook
  - DGEMP (General Directorate for Energy and Raw Materials)
  - International Energy Agency
  - Department Of Energy (US)

A1- TIAM Business as usual (b)

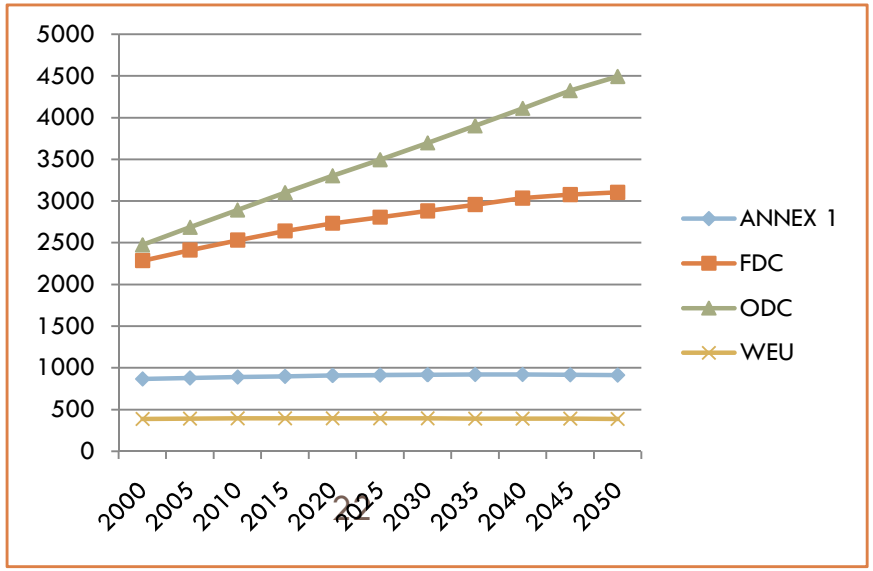
General assumptions:

- Main socio-economic drivers: Energy consumption based on external projections of:
  - The growth of regional GDP (AAGR [2000-2050] = 3.072%)
  - The growth of population (9 milliards of people in 2050)

Regional GDP (in billion current 2000 US $)



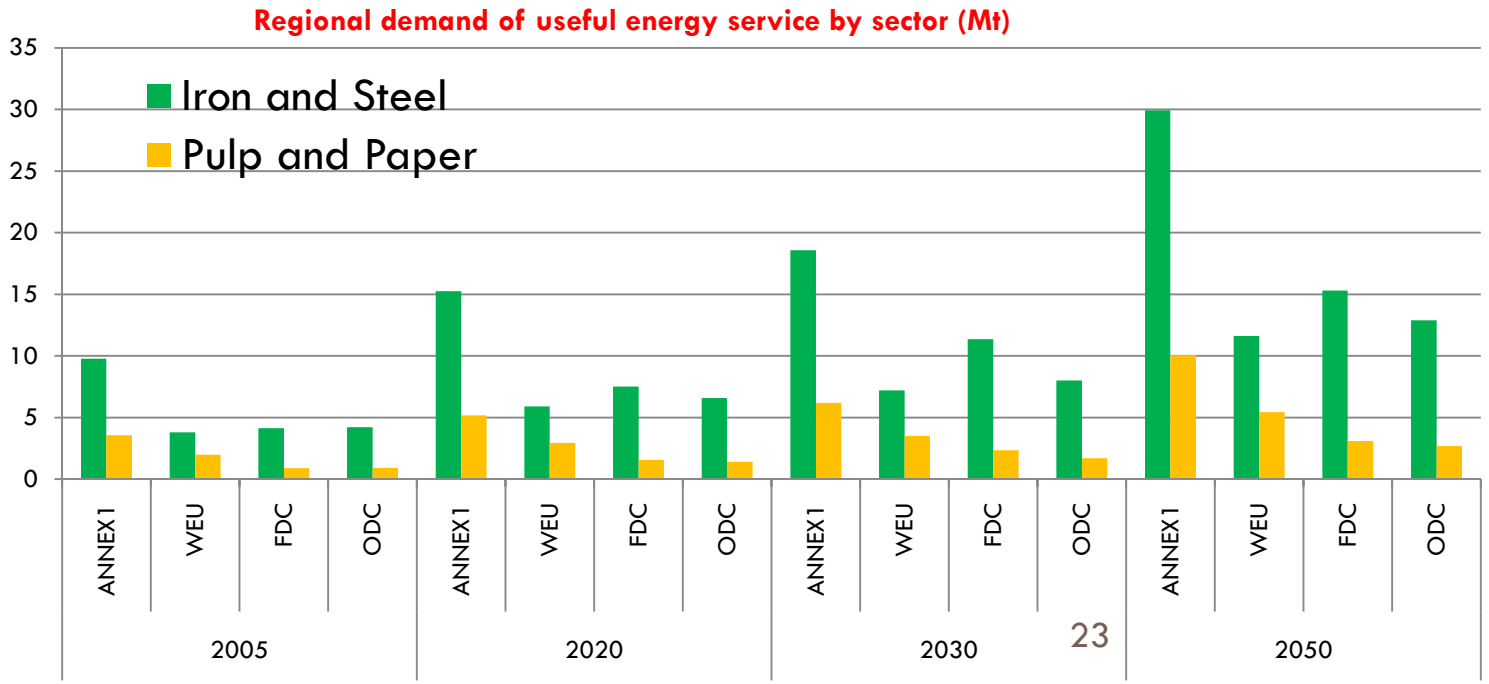
Regional population (in million)



A1- TIAM Business as usual (c)

General assumptions:

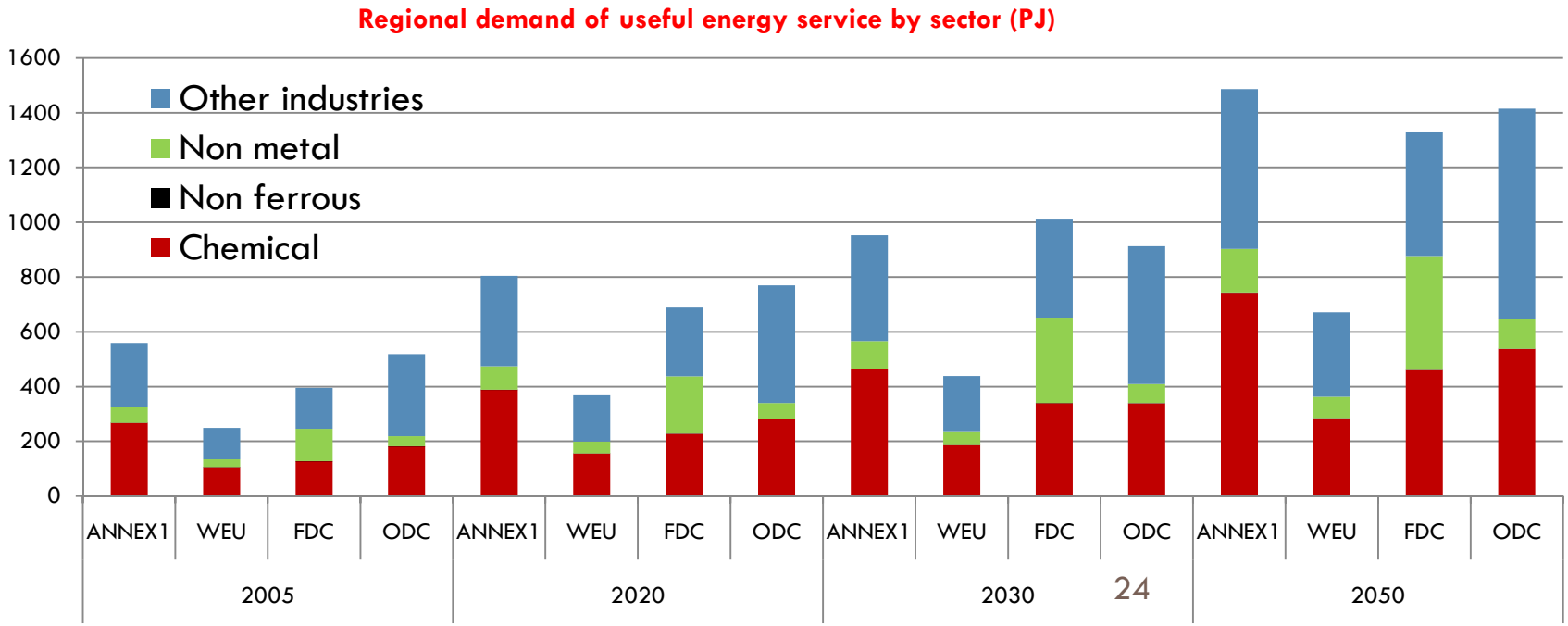
- Main socio-economic drivers: Energy consumption based on external projections of:
  - The volume of various economic sectors: Agriculture, Iron and Steel, Services, etc.



A1- TIAM Business as usual (d)

General assumptions:

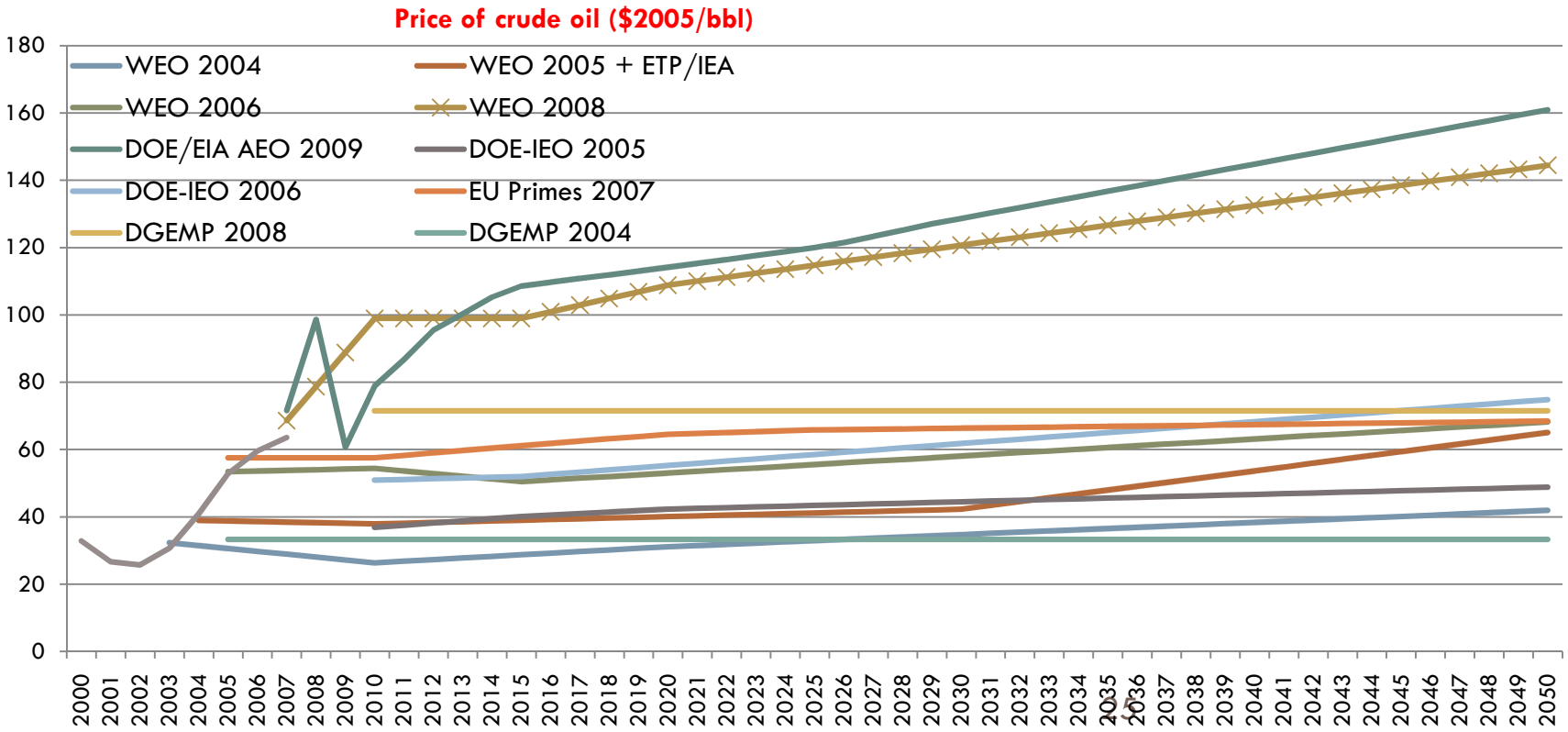
- Main socio-economic drivers: Energy consumption based on external projections of:
  - The volume of various economic sectors: Agriculture, Iron and Steel, Services, etc.



A1- TIAM Business as usual (e)

General assumptions:

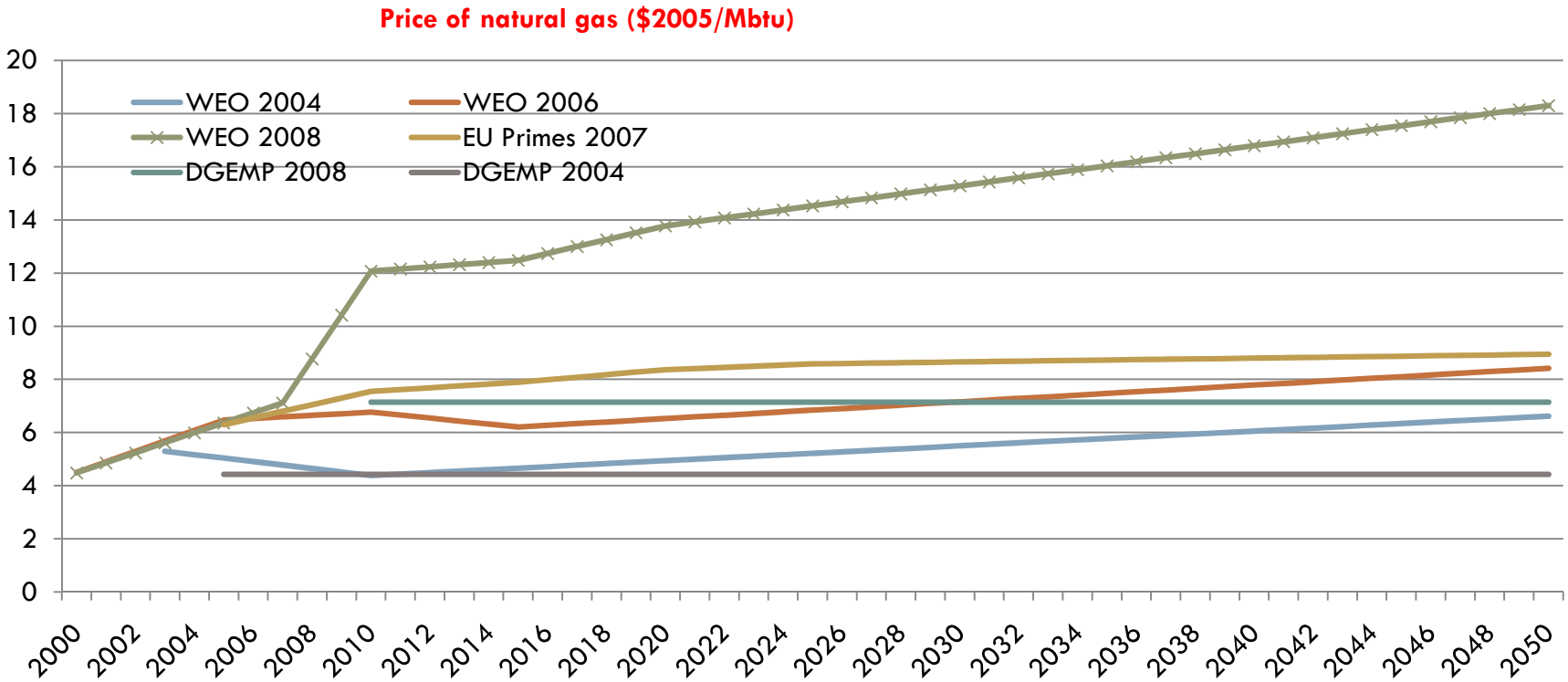
- Fossil fuel extraction prices: prices for crude oil, natural gas and hard coal



A1- TIAM Business as usual (f)

General assumptions:

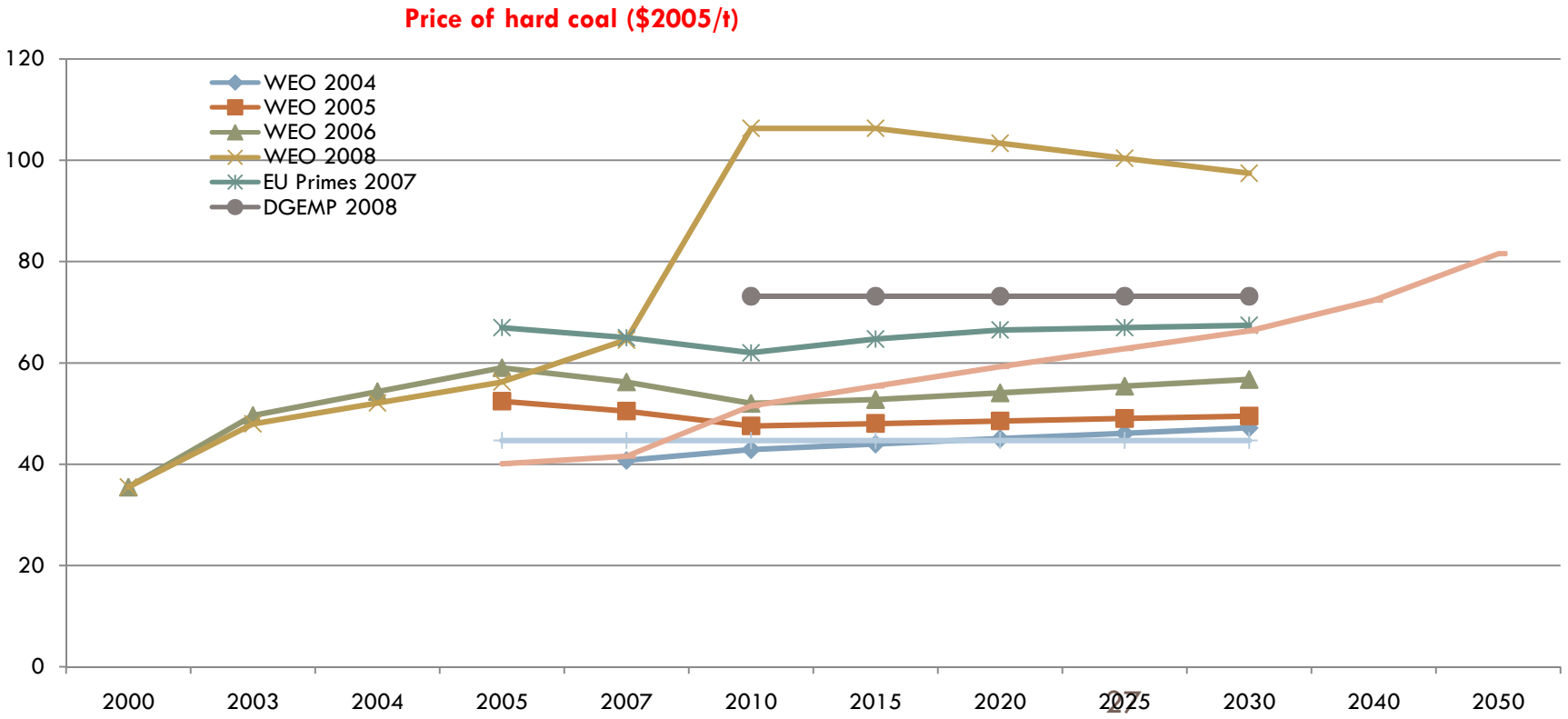
- Fossil fuel extraction prices: prices for crude oil, natural gas and hard coal



A1- TIAM Business as usual (g)

General assumptions:

- Fossil fuel extraction prices: prices for crude oil, natural gas and hard coal



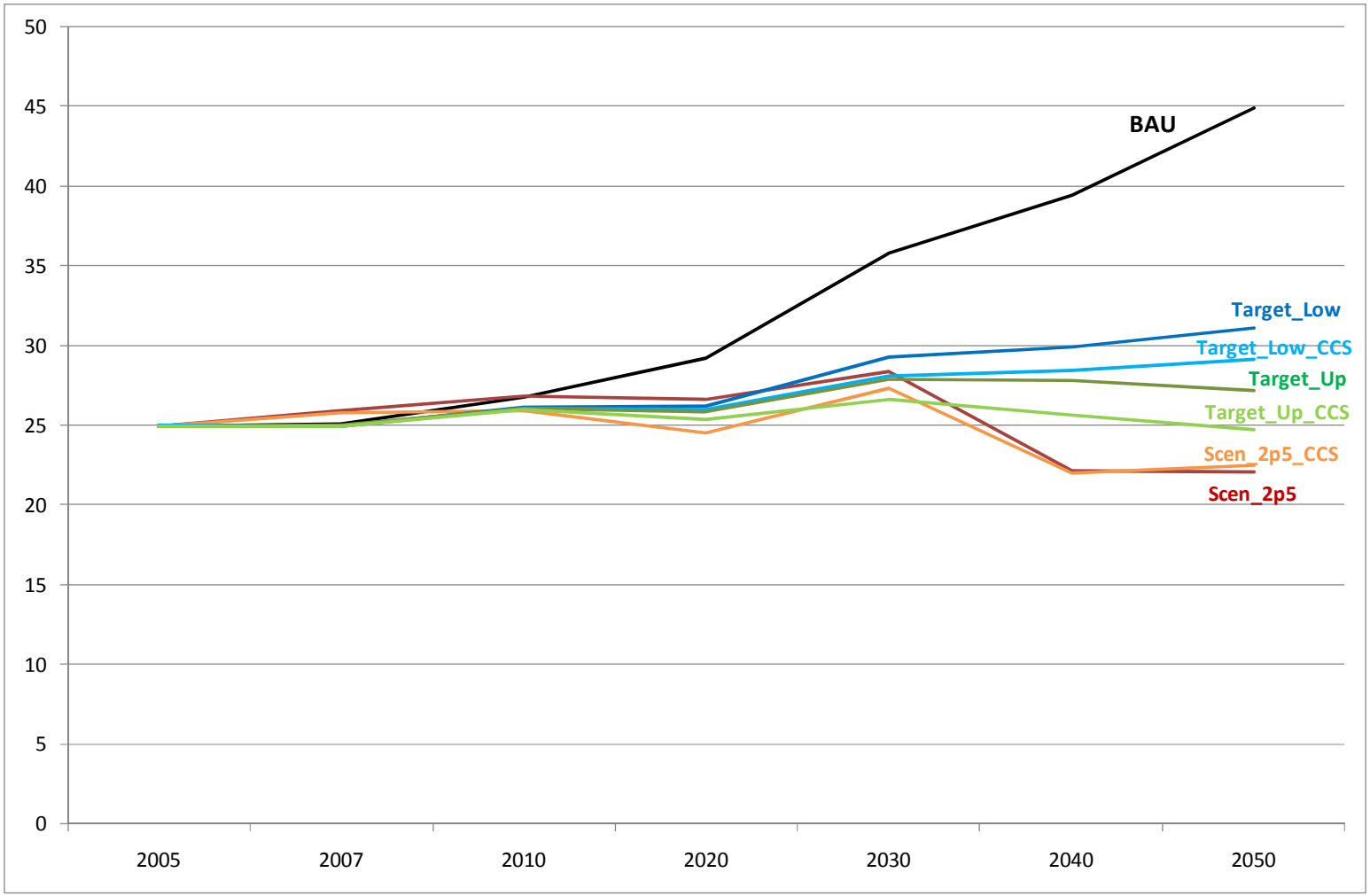
Understanding the targets

Regions	2020		2050	
	On 1990 scale	On 2005 scale	On 1990 scale	On 2005 scale
WEU	**From -20% to -30%**	From -45% to -52%	**From -60% to -80%**	From -72,5% to -86%
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. CO_2 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

Global CO_2 emissions (Gt CO_2)



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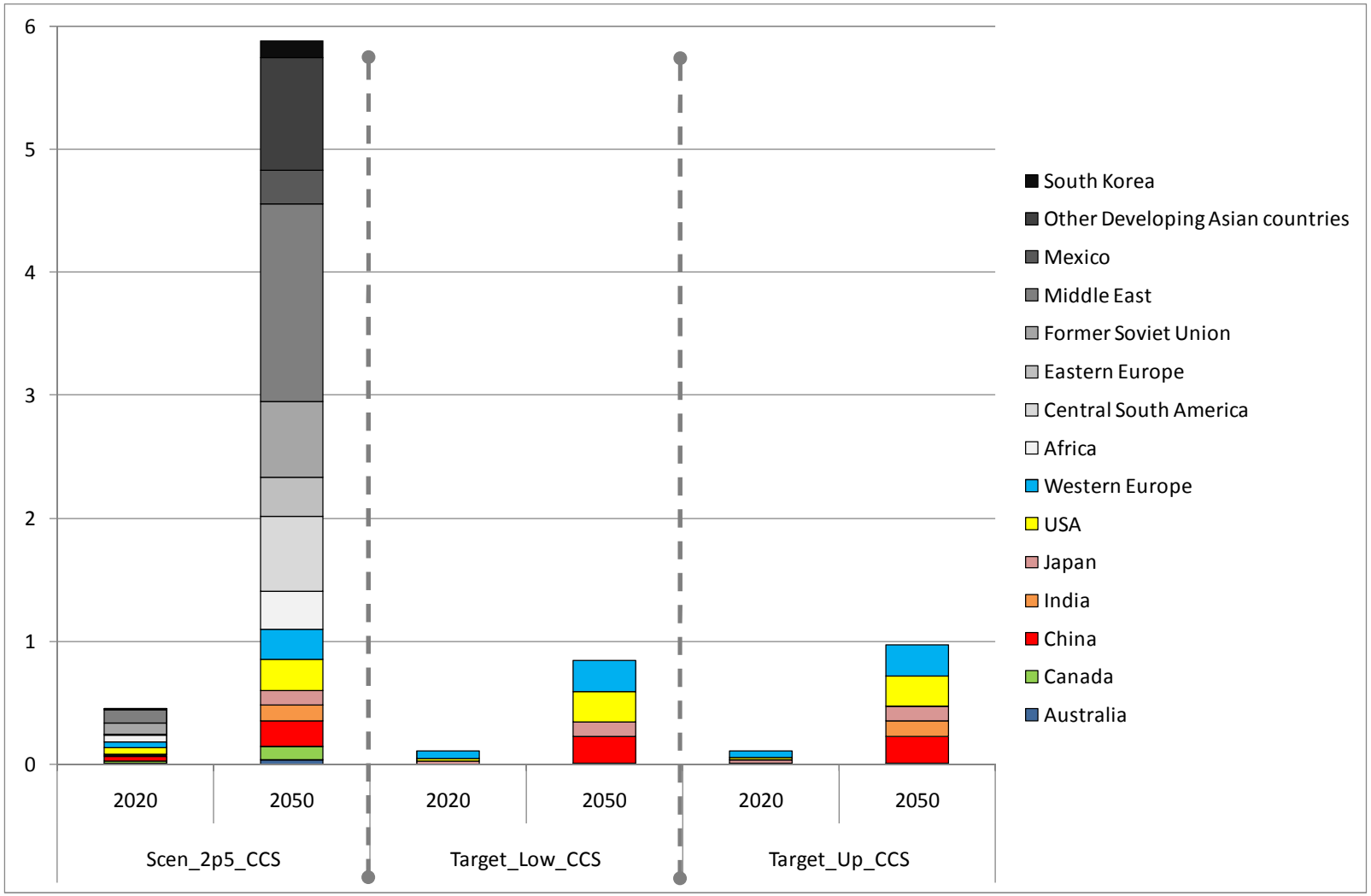

The deployment of CCS technologies ($GtCO_2$ sequestrated)