International Energy Agency

Energy Technology Perspectives 2010

And way forward to 2012

Third meeting of the project « Monitoring of EU and national energy efficiency targets »
ODYSSEE-MURE
Warsaw, 6-7 October 2011

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Energy Technology Perspectives Project

- **Energy Technology Perspectives (ETP) publication - released every two years**
- **Providing advice to decision makers on role of energy technology policy for:**
  - delivering affordable energy supply and use
  - enhancing energy security
  - protecting the environment
- **Scenarios are key element of analysis**
- **Complemented by "how do we get there?"**
  - **Technology roadmaps**
  - **Technology policy, focus on emerging economies**
  - **R&D needs**
  - **Co-benefits**
  - **Finance**

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Scenarios & Strategies to 2050

ETP Modeling Framework

- Global MARKAL model supplemented with spreadsheet-based end-use sector models
- Time horizon: 2007-2050
- 15 world regions/countries in MARKAL model, additional regional detail in end-use sector models
  - Three spreadsheet-based end-use models: buildings (residential and services), transport and industry
- Cooperation with ETSAP IA and several national/regional modelling teams, e.g. for:
  - China (ERI, Tsinghua University, Fudan University):
    - Improvement of China region
  - USA (BNL)
    - Model comparison with 10-regional US MARKAL model
  - Europe (IER, Germany)
    - Model comparison with 30-regional TIMES model for Europe

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ETP Scenarios (for ETP2010)

- **Baseline scenario:**
  - Following the World Energy Outlook 2009 Reference Scenario
  - World GDP grows by factor 2.75 between 2007 and 2050
  - Energy prices: Oil USD 120/bbl in 2050, Coal USD 115/tonne
- **BLUE scenario:**
  - Target oriented: 50% reduction of energy related CO_2 emissions by 2050 compared to 2005
  - Options with marginal reductions of up to USD 175/t CO_2 are needed
  - Due to uncertainties number of variants being considered
    - For buildings: BLUE Heat Pumps; BLUE Solar Thermal; BLUE Buildings CHP.

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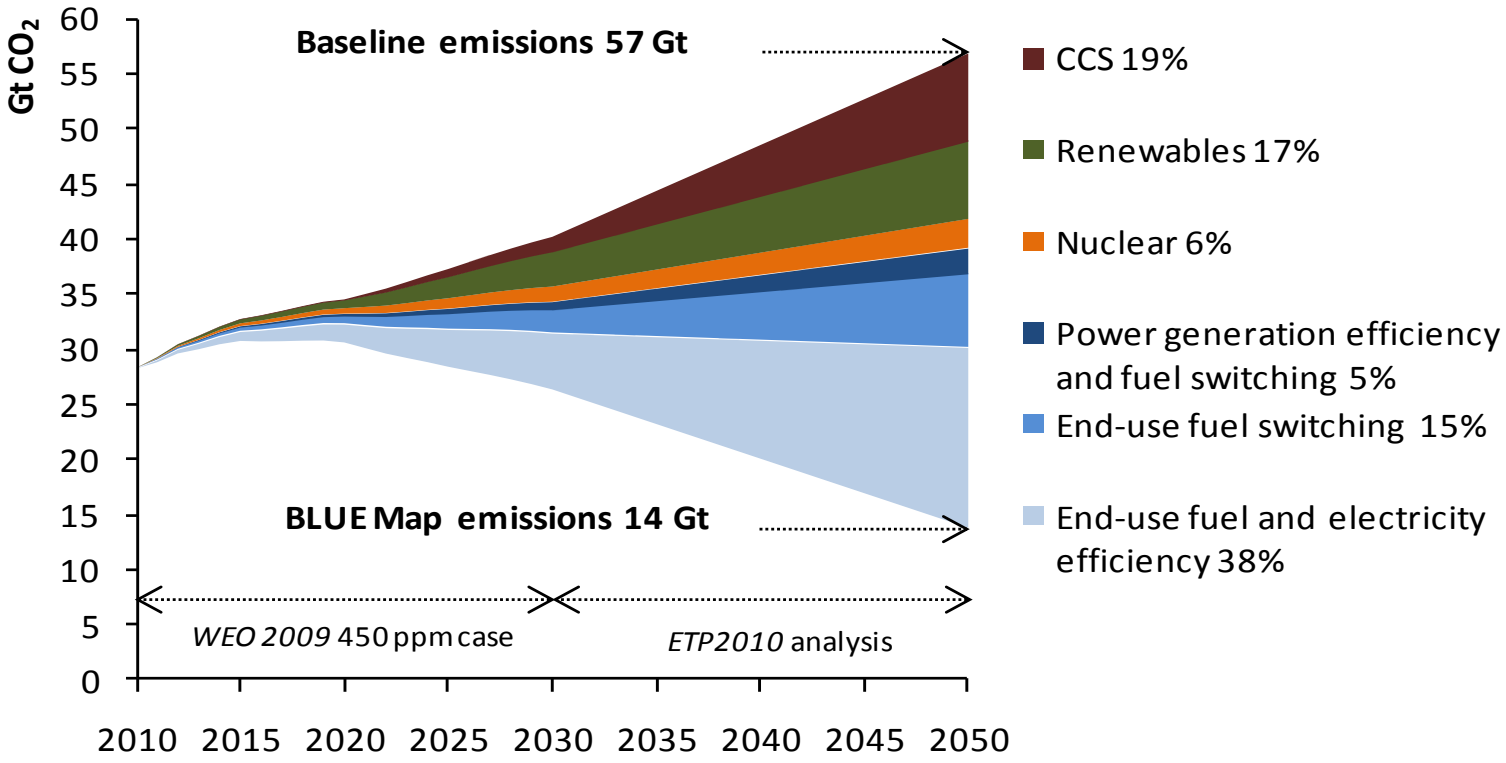
Key technologies for reducing global CO_2 emissions



A wide range of technologies will be necessary to reduce energy-related CO_2 emissions substantially.

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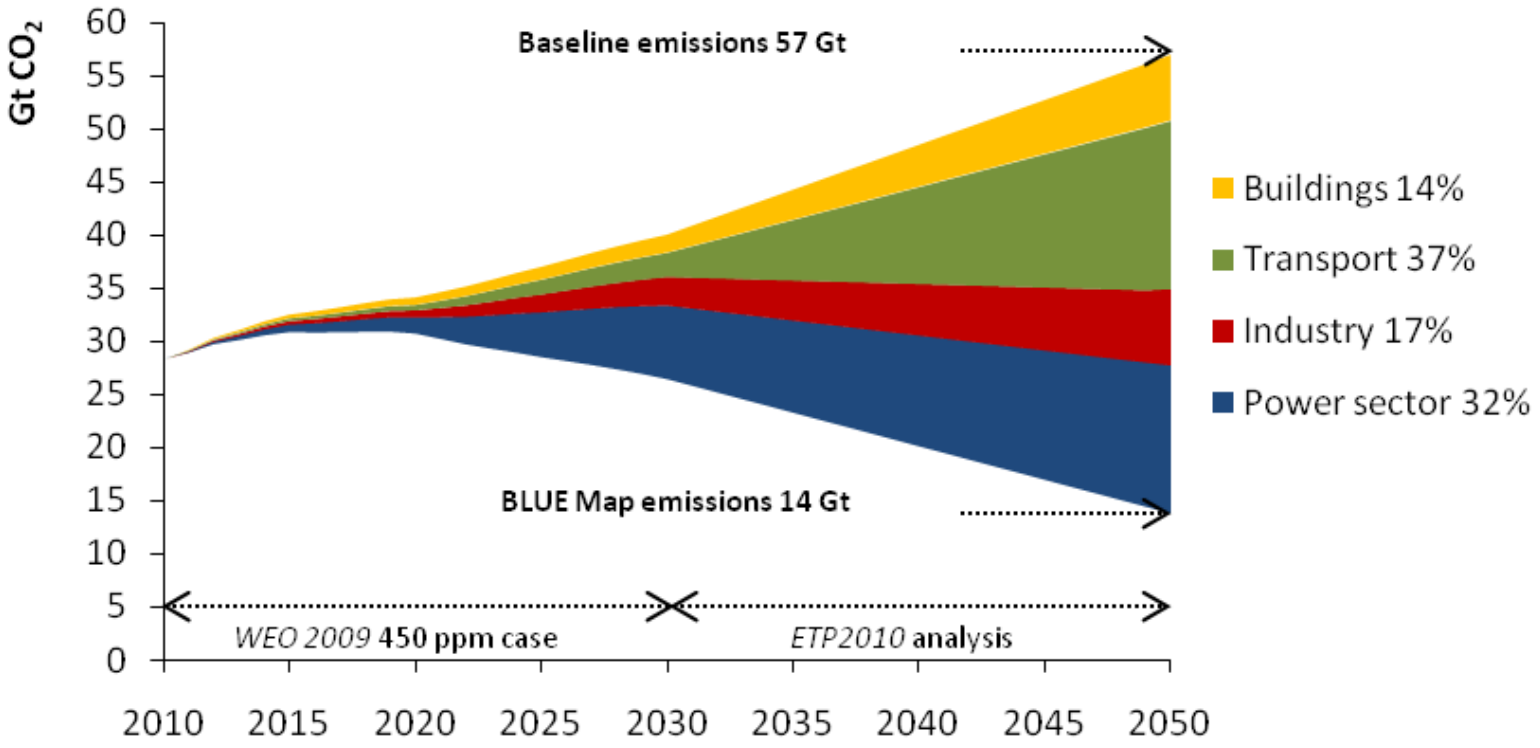
CO_2 emissions reductions by sector



The share of end-use sectors in emissions reductions increases between 2030 and 2050.

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The Industry Sector

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Modelling framework

- **Spreadsheet based model**
- **In ETP 2010**
  - **20 countries/regions: India, China and other developing Asia**
  - **Results from base year to 2050**
  - **4 time periods: base year, 2015, 2030 and 2050**
  - **Based on WEO 2009 and IEA Balance 2007**
- **In ETP 2012**
  - **36 countries/regions: India, China, Indonesia, Malaysia, Philippines, Thailand, Vietnam, other ASEAN and other developing Asia**
  - **Results from base year to 2075**
  - **Based on WEO 2011 and IEA Balance 2011**
  - **Updated current intensities/ indicators**
  - **Updated recent trends/ accounting for economic downturn**

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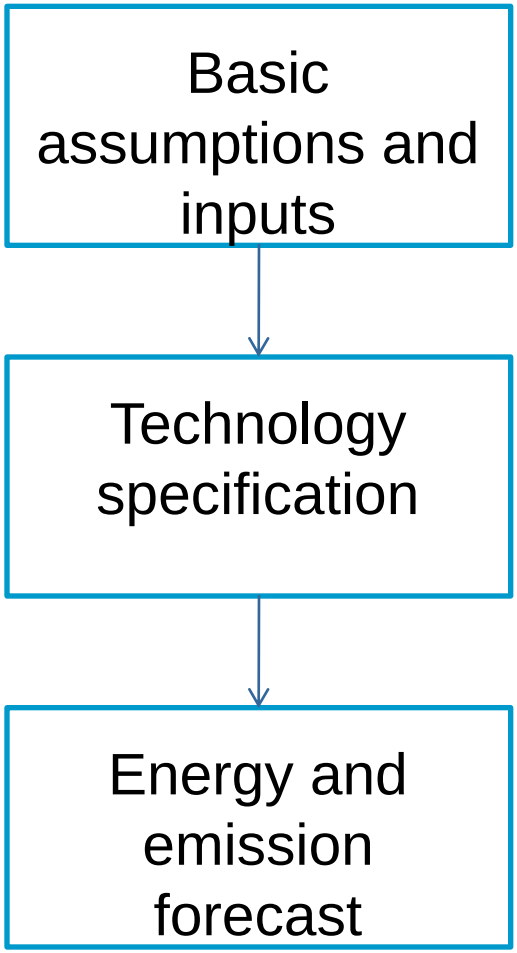
Modelling Framework



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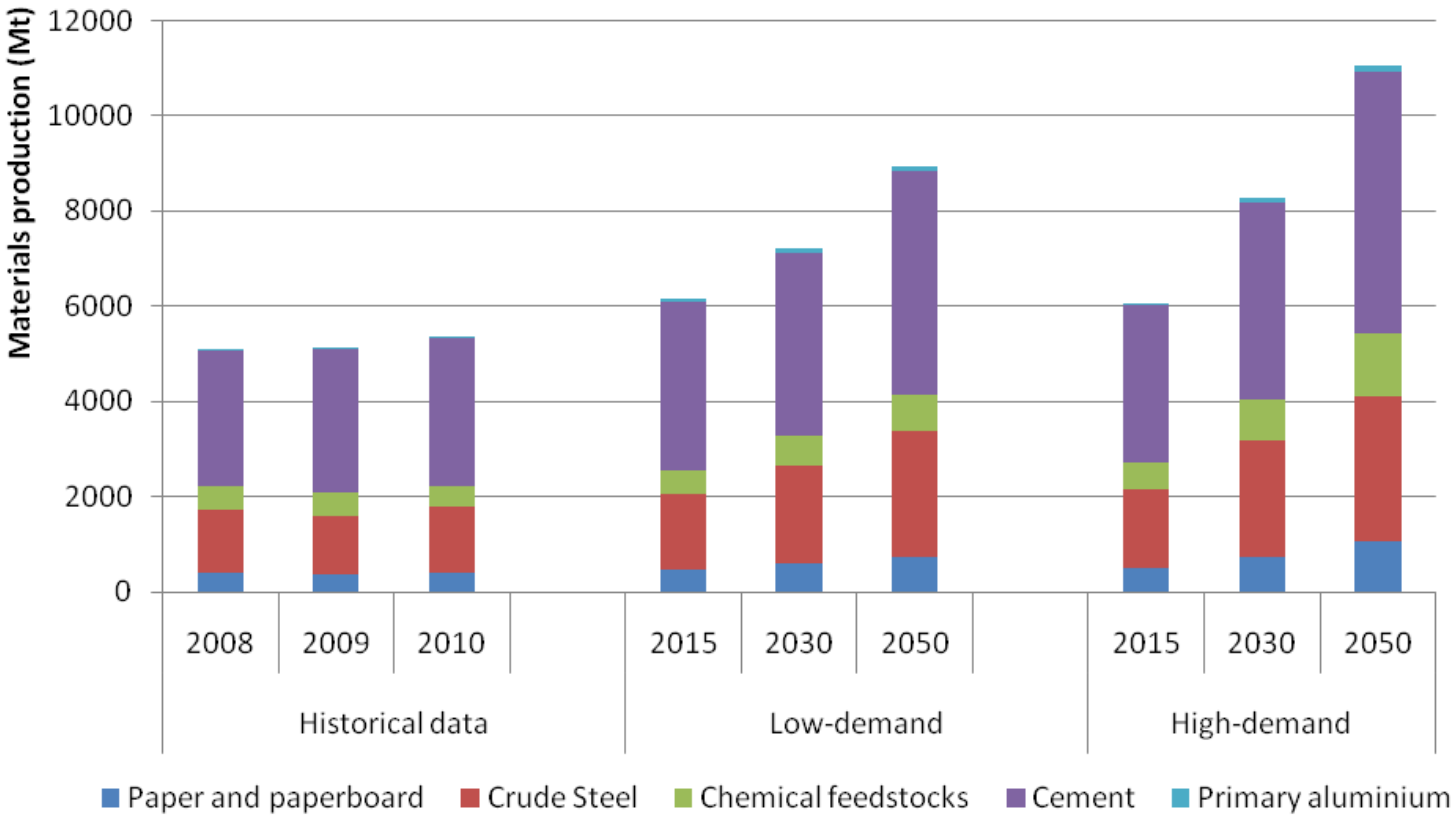
Materials production



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The role of indicators in our analysis

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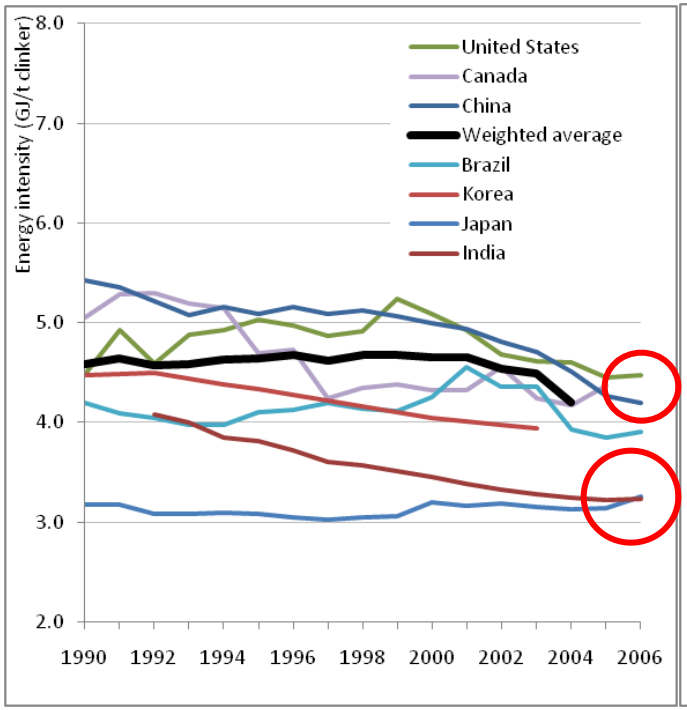
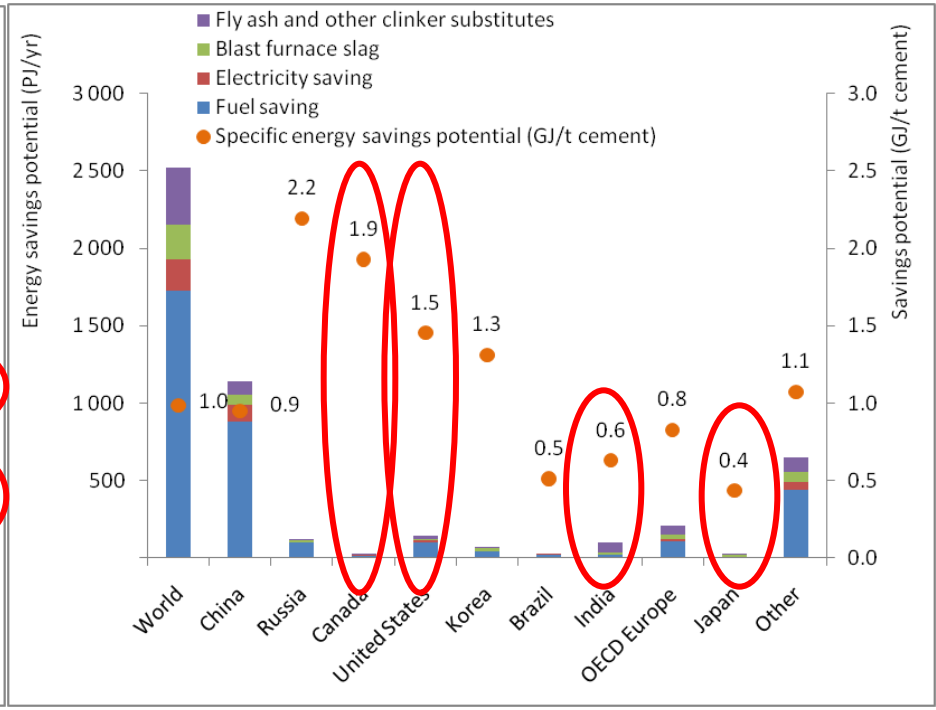
Thermal energy consumption by tonne of clinker



Energy savings potential based on best available technology



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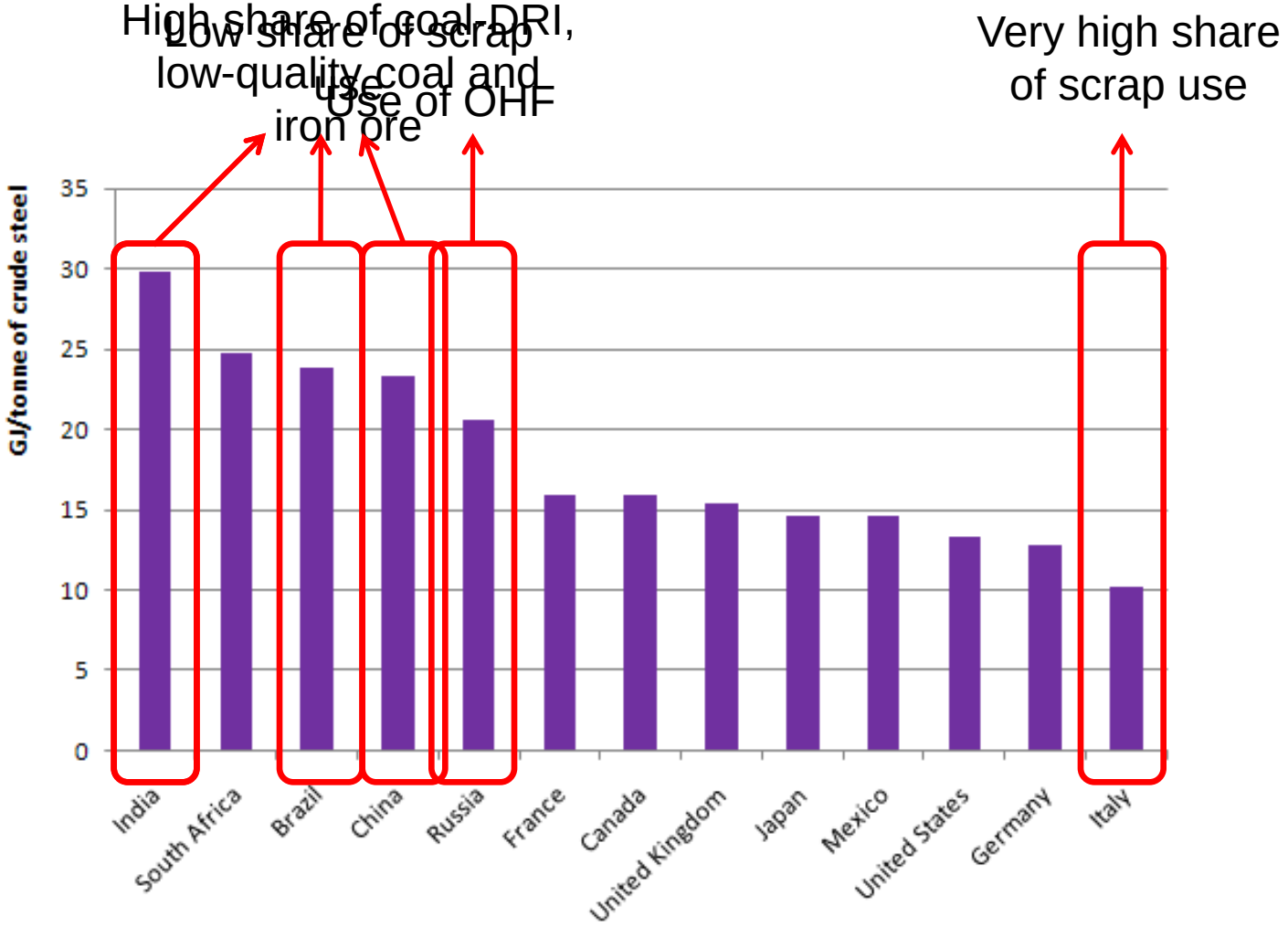
The need to go beyond basic indicators



Specificities of a country/an industry can explain large variations in energy intensity

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Key Options

Iron and steel	Cement	Chemicals	Pulp and paper	Aluminium
Application of current best available technologies Including CHP, efficient motor and steam systems, waste heat recovery and recycling				
Fuel and feedstock switching				
DRI, charcoal and waste plastics injection	Alternative fuels, clinker substitutes	Biomass feedstocks	Increased biomass	
New technologies				
Smelt reduction		Membranes	Lignin removal	Wetted drained cathodes
Electrification (MOE)		New olefin processes	Black liquor gasification	Inert anodes
Hydrogen		Process intensification	Biomass gasification	Carbothermic reduction
CCS for blast furnaces	CCS post-combustion	CCS for ammonia	CCS for black liquor gasification	
CCS for DRI	CCS oxyfuel	CCS for large scale CHP		
CCS for smelt reduction	CCS pre-combustion	CCS for ethylene		

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Emissions reduction by sector Preliminary 2012 results

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Direct emission reductions by sector in BLUE low- and high-demand scenarios, 2050

	BLUE low 2050 compare to 2009	BLUE high 2050 compare to 2009	BLUE vs. Baseline low in 2050	BLUE vs. Baseline high in 2050
Iron and steel	-7%	2%	-35%	-40%
Cement	-17%	-11%	-39%	-44%
Chemicals and petrochemicals	-8%	-6%	-53%	-59%
Pulp and paper	-19%	-4%	-58%	-65%
Aluminium	129%	114%	-11%	-38%

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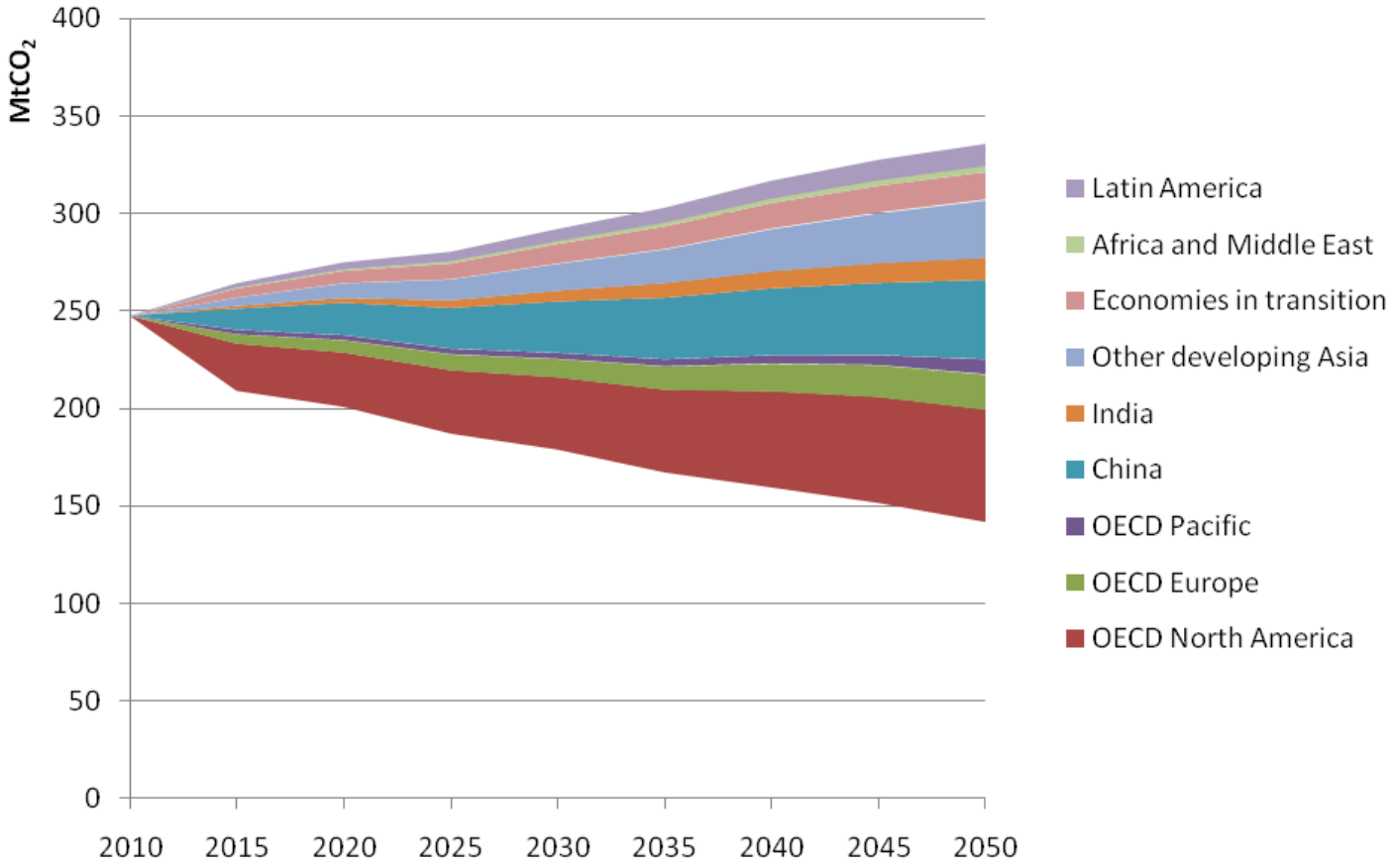
Regional contribution to reducing pulp and paper global direct CO_2



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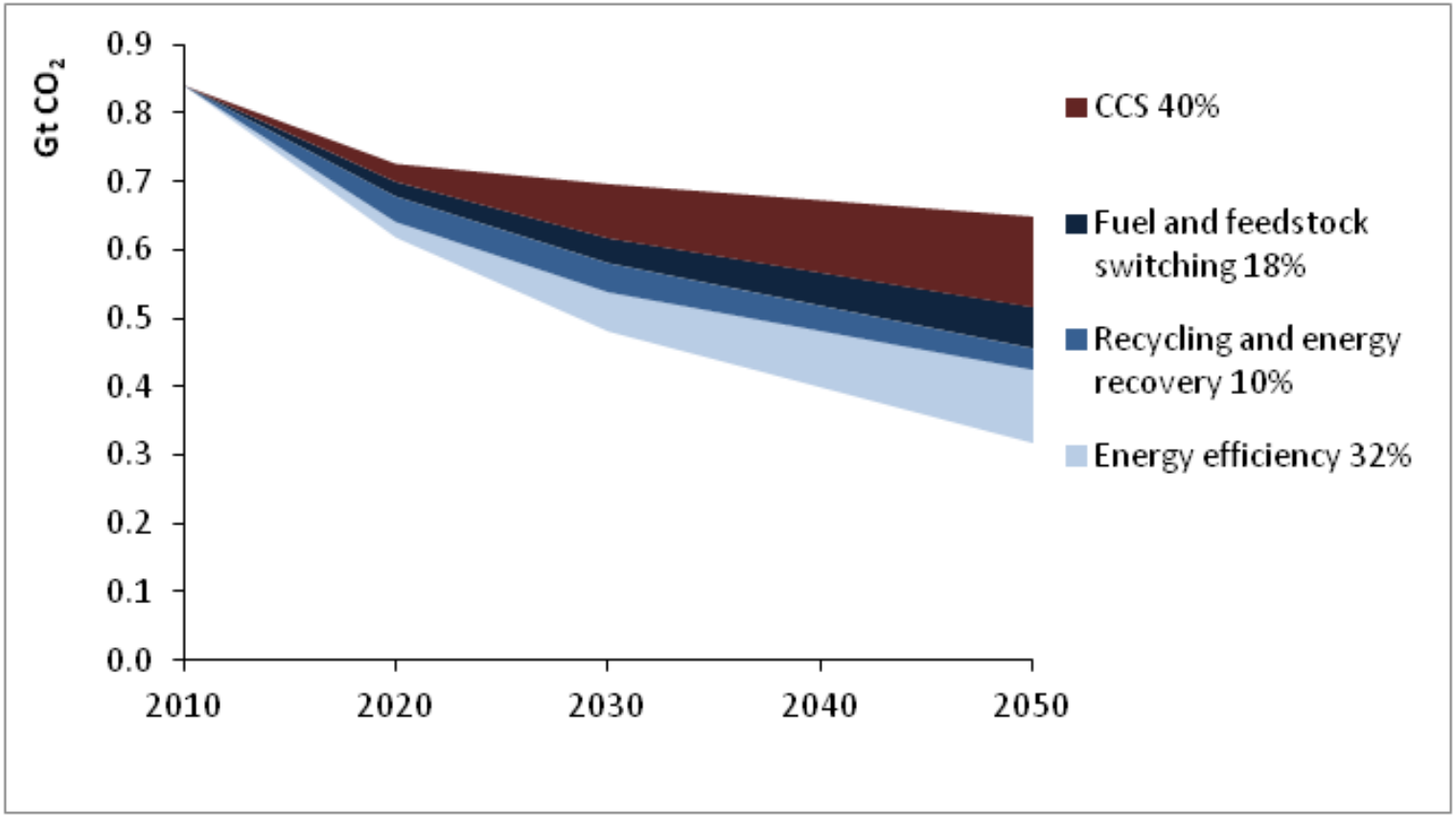
Europe: CO_2 Abatement Options Final ETP 2010 results



Energy efficiency and CCS offer the best important opportunities to decrease Europe's industrial CO_2 emissions.

Direct energy and process emissions only

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Key Findings – ETP 2010

- Global deployment of BAT could improve energy efficiency by 20 to 30%
- … but this is not enough – demand will double or triple by 2050
- New technologies are needed for deep CO_2 reductions
  - CCS is a key option of the sector
  - Biomass will play an important role
- De-carbonised power sector is critical
- Total additional investments needed for BLUE are estimated at USD 2 – 2.5 trillion

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Industry Chapter in ETP 2012

- Sector-specific
- Low and high-demand scenario
  - Discussion on alternative scenario such as low CCS
- Focus on 2000 – 2010
- Scenarios, including discussion on
  - Projections to 2075
  - Investments required
  - lock-in analysis
- Technology options
  - Current
  - Break-through
  - "Game changer"

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