International Energy Agency

Energy Technology Perspectives 2010: Indian Industry Sector

Nathalie Trudeau

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ETP Scenarios

- **Baseline scenario:**
  - Following the World Energy Outlook 2009 Reference Scenario
  - World GDP grows by factor 2.75 between 2007 and 2050, India's GDP nearly by factor 8
  - Energy prices: Oil USD 120/bbl in 2050, Coal USD 115/ton
- **BLUE scenario:**
  - 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

Modelling framework for the industry sector

- Spreadsheet-based sector models
- Time horizon: 2007-2050, time steps: 2007, 2015, 2030, 2050
- 23 world regions/countries in model
- 5 industry sectors modeled in detail: iron and steel, cement, chemicals and petrochemicals, pulp and paper and aluminum
- Low- and high-demand variants for materials production

Industry Scenarios

- **Baseline scenario:**
  - Following the WEO 2009 Reference Scenario up to 2030
  - World GDP grows 3.1% per year between 2007 and 2050, OECD Europe's GDP rises 1.1%
  - New build based on mix of old and BAT
- **BLUE scenario:**
  - Direct energy and process emissions decline 24% in industry to achieve a halving in global energy related CO_2 by 2050
  - Energy efficiency reaches BAT levels worldwide by 2030, new build is based on BAT
  - Biomass use rises three to four fold
  - Decarbonised power sector critical to eliminate indirect emissions

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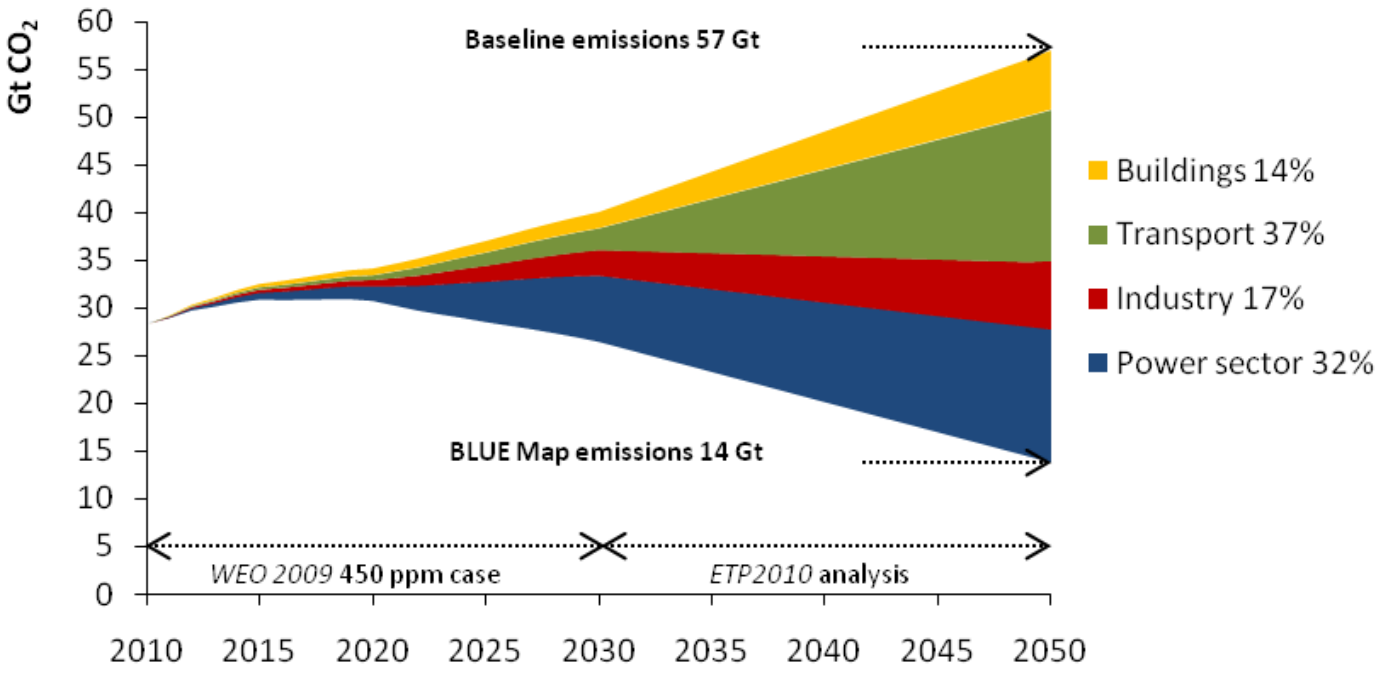
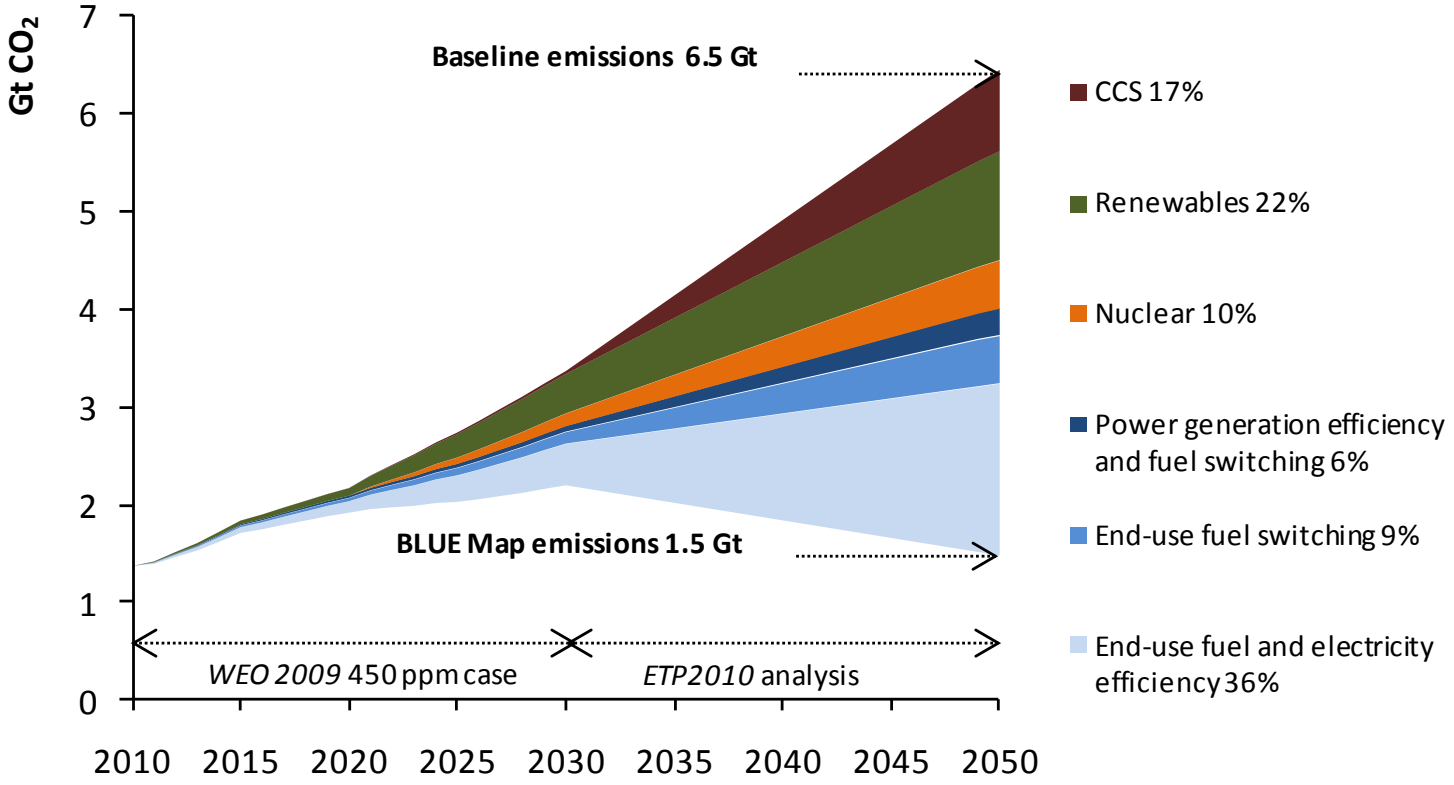
Global CO_2 emissions reduction in the BLUE Map scenario



The end-use sectors have an increasingly important role to play in reducing direct CO_2 emissions

Contributions to CO_2 reductions in India



CO_2 emissions in Baseline more than quadruple between 2007 and 2050

In BLUE, CO_2 emissions in 2050 are stabilized relative to 2005

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Industry Sector Results for India

Main Comments from Review for the Industry Sector

- **Materials production growth assumptions too pessimistic**
  - The per capita consumption and total production of materials were revised following the January workshop
- **Economic growth assumptions too pessimistic**
  - Higher growth variants of the scenarios have been included in the working paper.
- **Technology transfer issues**
  - Diffusion of low-carbon technologies in emerging economies discussed in separate chapter in ETP 2010
- **How to achieve the BLUE Map scenario practically?**
  - This type of analysis is beyond scope of ETP 2010, but IEA has developed technology roadmaps on a global level and is planning to release a guidebook on how to build national roadmaps.
- **Technology table presents only limited mitigation options**
  - More details on the different technologies are included in the Industry chapter of ETP 2010 and the working paper.

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Change in materials production

	January 2010			Revised assumptions – ETP 2010		
	2007	Low-demand 2050	High-demand 2050	2007	Low-demand 2050	High-demand 2050
Crude steel	53	232	383	53	266	355
Cement	170	646	742	170	646	742
Primary aluminium	1.2	11	18	1.2	11	18
Pulp	4.0	8	12	4.0	13	21
Paper and paperboard	4.2	21	31	7.6	81	148
HVC	9.8	45	80	9.8	45	79
Ammonia	13	33	36	13	30	33

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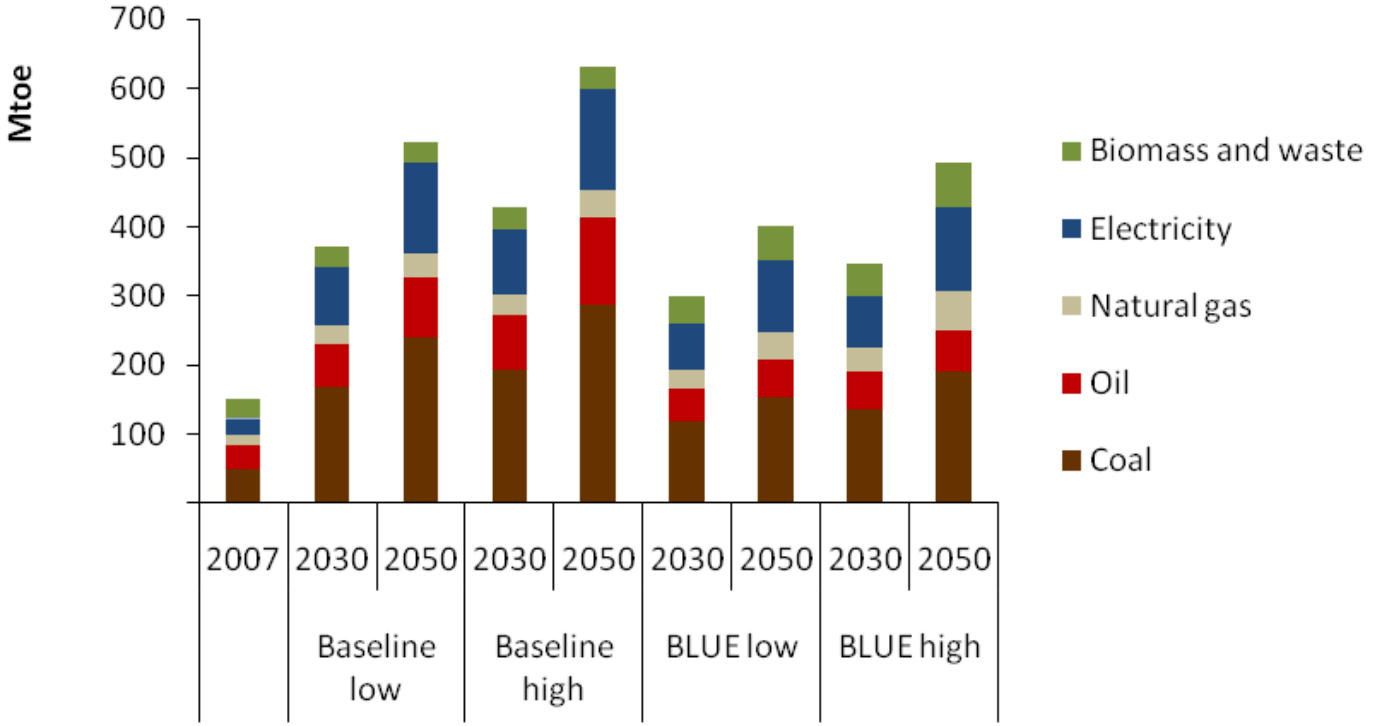
Energy use in industry by fuel type



Energy consumption is about 23% lower in the BLUE scenarios than in the Baseline scenarios

Direct energy and process CO_2 emissions by industry sector

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Mt CO_2	2007	Baseline low 2050	Baseline high 2050	BLUE low 2050	BLUE high 2050
Aluminium	4	14	21	13	16
Iron and steel	151	703	858	333	362
Chemicals	48	132	173	68	77
Cement	128	422	483	275	291
Pulp and paper	8	36	62	17	31
Other	74	256	256	122	129
Total	413	1563	1852	828	906

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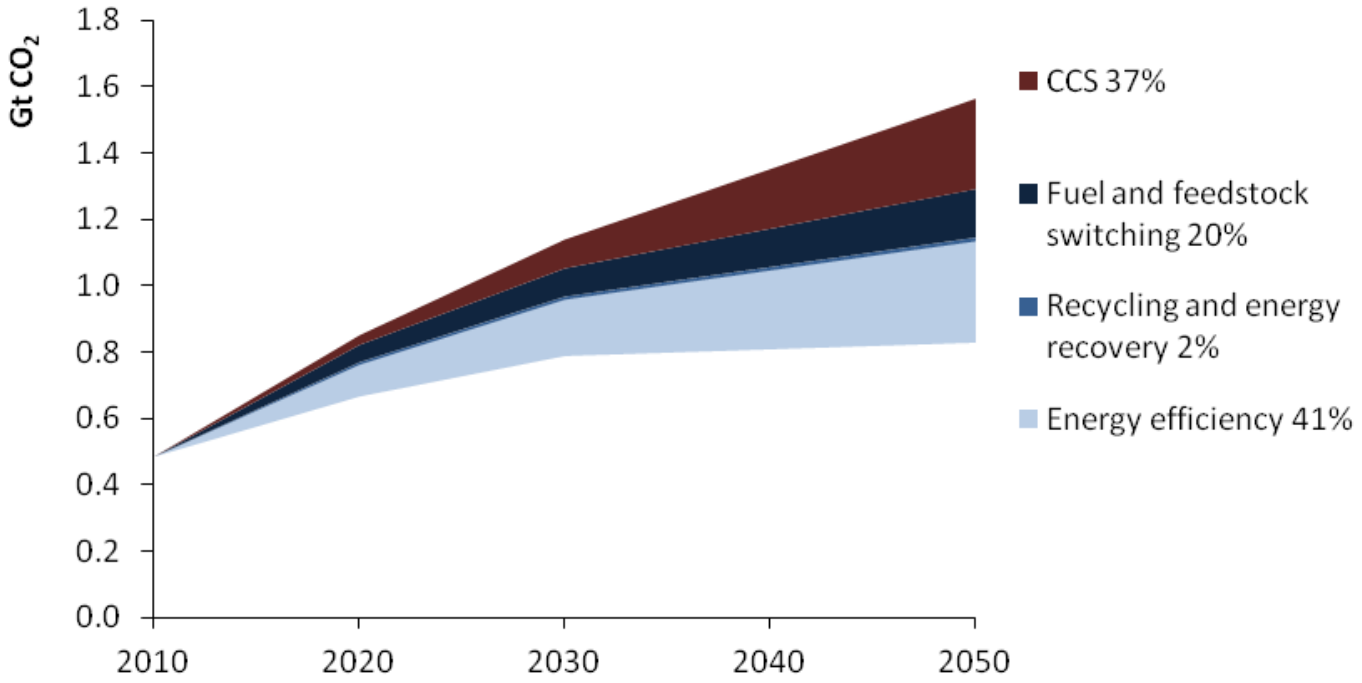
Options for reducing direct CO_2 emissions from industry



Energy efficiency and CCS represent the main opportunities for India to limit the growth in CO_2 emissions from the industrial sector.

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New scenario for India

- India is one of the countries which is expected to realise the strongest growth
- The 'Strong Growth' scenario assumes more rapid development of GDP and industrial production

		ETP 2010 scenario			Strong growth scenario		
	2007	2015	2030	2050	2015	2030	2050
GDP (billion USD using PPP)	4 025	6 916	16 340	31 280	8 020	25 189	55 192
GDP (billion USD using exchange rates)	771	1 325	3 131	5 993	1 536	4 826	10 574
GDP per capita (thousands USD using exchange rates)	3 583	5 343	11 007	19 383	6 197	16 967	34 200
GDP per capita (thousands USD using PPP)	686	1 024	2 109	3 713	1 187	3 251	6 552
Growth rate from previous period	-	7.0%	5.9%	3.3%	9.0%	9.0%	6.3%

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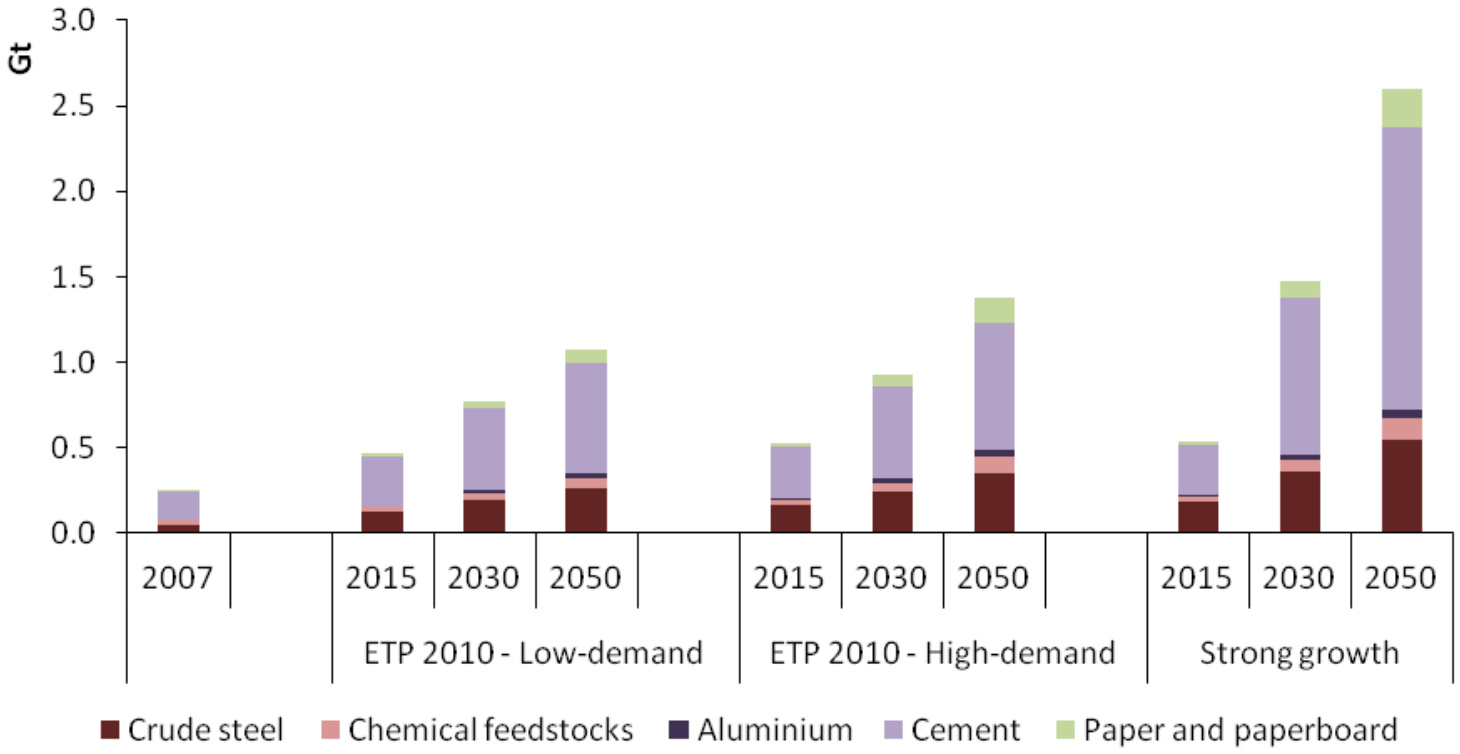
Materials production in India



Production of the five key materials is expected to increase tenfold by 2050

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Direct CO_2 reductions in industry by sector

	Total industry	Iron and steel	Cement	Chemicals	Pulp and paper	Aluminium	Other industries
Direct CO2 Emissions (Mt CO_2)							
2007	413	151	128	48	8	4	74
Baseline low 2050	1564	703	422	132	36	14	256
Baseline high 2050	1852	858	483	173	62	21	256
Baseline strong growth 2050	2807	1153	1060	229	87	22	256
BLUE low 2050	827	333	275	68	17	12	122
BLUE high 2050	906	362	291	77	31	16	129
BLUE Strong growth 2050	1519	532	676	119	50	22	122
Changes in BLUE 2050 vs. 2007							
BLUE low 2050	100%	121%	114%	42%	113%	214%	65%
BLUE high 2050	120%	140%	126%	61%	285%	321%	74%
BLUE Strong growth 2050	268%	253%	426%	149%	507%	469%	65%
Changes in BLUE 2050 vs. Baseline 2050							
BLUE low 2050	-47%	-53%	-35%	-48%	-52%	-16%	-53%
BLUE high 2050	-51%	-58%	-40%	-55%	-49%	-24%	-50%
BLUE Strong growth 2050	-46%	-54%	-36%	-48%	-43%	-1%	-53%

Insights from analysis of Indian industry sector

- The economic growth in India over the next 40 years will be one of the strongest worldwide
- India has some of the best plant in the world, but also has a large share of small and inefficient facilities
- Most of the industrial capacity is still to be built and will remain in place for a long time. The challenge is to achieve this economic growth while improving energy security and without locking in high emissions.
- Special attention should focus on coal-based DRI, pulp and paper making and small-scale cement kilns
- Industries offer attractive opportunities, with international support, for the early demonstration of CCS
- Recognising the impact of economic growth and industrial production on the energy sector and the environment, India is moving in the right direction and is taking an active role in developing strategies to improve energy efficiency and energy security

Possible Future Areas for Cooperation

- Better characterisation of Indian energy and materials resources and industrial technologies
- Improving the energy statics of different industrial sector, notably regarding the use of biomass
- Improved modelling of the future contribution from different industry sector options
- Developing technology roadmaps for the Indian context
- Analyses of national and international policies and mechanisms needed to achieve a low-carbon transition for the power sector


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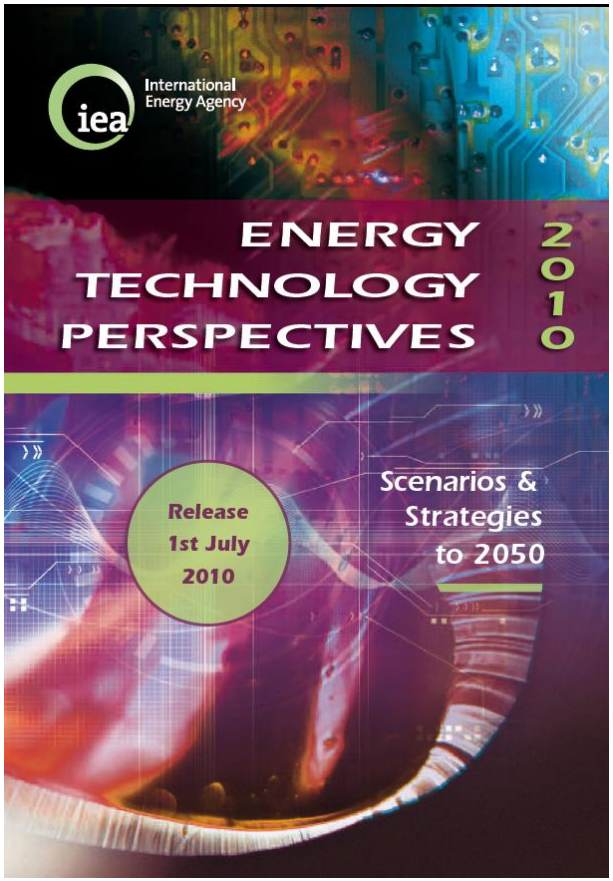
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