The Oil Drum: Europe
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The IEA WEO 2008: Will coal usage be phased out?

Posted by Rembrandt on November 25, 2008 - 10:39am in The Oil Drum: Europe
Topic: Supply/Production
Tags: climate change, coal demand, iea, scenarios, weo 2008 [list all tags]

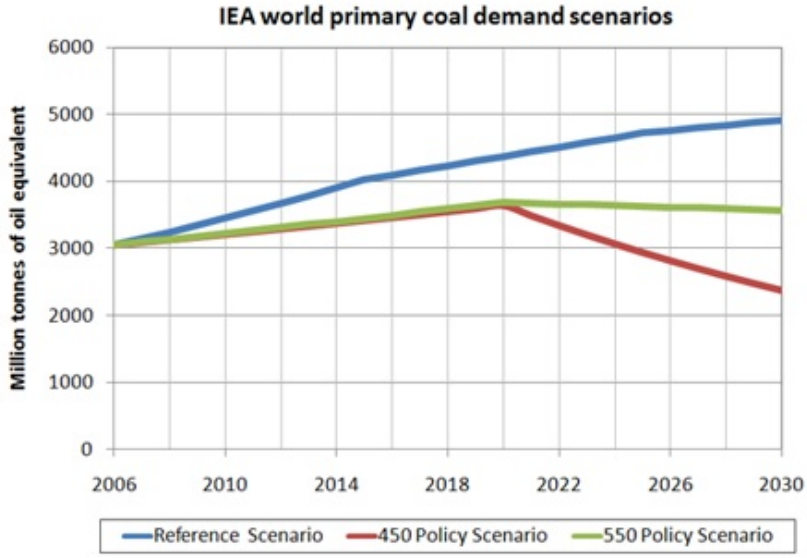

Figure 1 - World Energy Outlook 2008 coal demand scenarios, reference (blue), 550 policy (green), 450 policy (red).

In this post I summarize the climate policy scenarios of the World Energy Outlook 2008 in which coal usage is stabilized and ultimately phased out. A scenario that would render the question of coal availability useless if it becomes reality. According to the IEA a combination of energy saving policies, a large expansion of Nuclear and Renewable energy, as well as a large scale implementation of carbon capture and storage at coal and gas power plants are necessary to achieve stabilization of CO2 in the atmosphere between 450 and 550 parts per million, and the ultimate phase out of coal. The question of coal availability will be analyzed in a follow up post.

The three scenarios

This year the International Energy Agency has published two climate change scenarios in their World Energy Outlook next to the usual reference scenario. The climate change scenarios are named after the concentration of carbon dioxide emissions in the atmosphere. In the 550 policy scenario, the IEA has taken a look at the policies necessary to stabilize the CO2 concentration in the atmosphere at 550 parts of CO2 per million parts in the atmosphere by 2030. In the 450 policy scenario the goal is thus to stabilize CO2 concentration at 450 parts of CO2 per million in the atmosphere. Current atmospheric CO2 concentration lies around 385 parts of CO2 per million parts.

The stabilization of CO2 concentration at around 450 parts of CO2 per million implies, according to the IEA, that emissions should only slowly rise to 2020, after which emissions need to decline at a rapid rate (shown in figure 2).

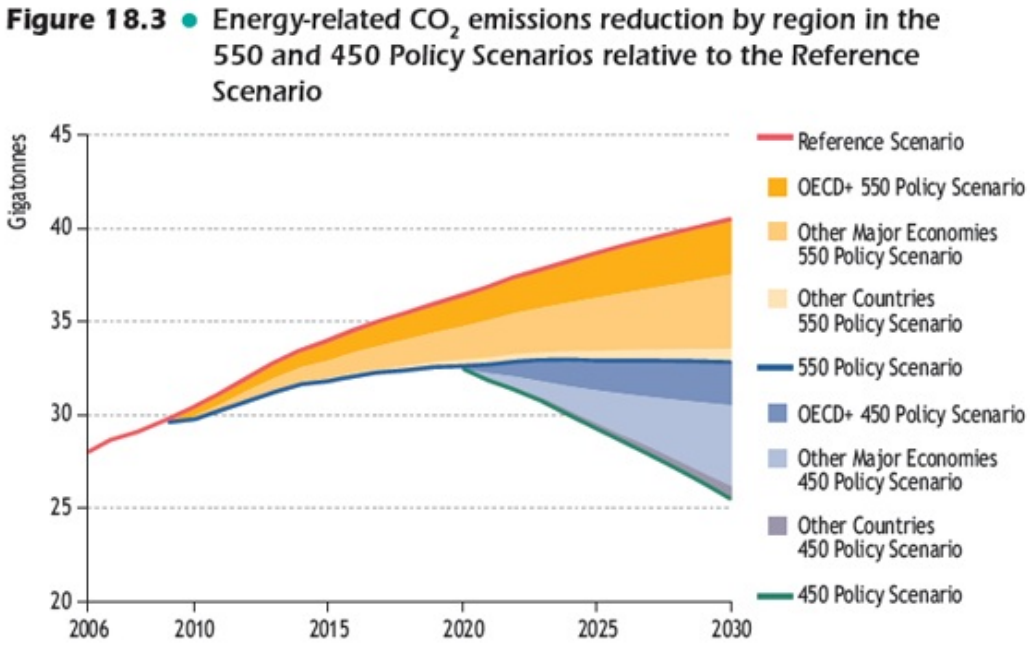

Figure 2 - Emissions in the reference, 550 Policy and 450 Policy scenario with their subsequent emissions reduction wedges.

The largest part of this decline in emissions comes from using less coal for electricity production. In the 550 policy scenario coal consumption is 27% lower than in the reference scenario in 2030, and in the 450 policy scenario coal consumption is 51% lower than in the reference scenario. The three coal scenarios are as follows:

Reference scenario - Coal demand grows by 2% on average between 2006 and 2030. Leading to an increase in coal consumption by 61% from 2006 to 2030.

550 policy scenario - Coal demand grows by 0.7% on average 2006 and 2030. Coal consumption increases by 21% from 2006 to 2020 and begin to decline thereafter. The decline is caused by to the introduction of national policies that constrain coal consumption, in particular according to the IEA: energy efficiency, nuclear, renewables and more efficient coal fired power plants. In 2030, coal demand is still 17% higher than today.

450 policy scenario - Coal demand peaks around 2020 and declines thereafter. In 2030 world coal consumption is similar to the level in 2002. The heavier decline after 2020 compared with the 550 policy scenario is the result of introducing carbon prices in other major economies (China, India) after 2020.

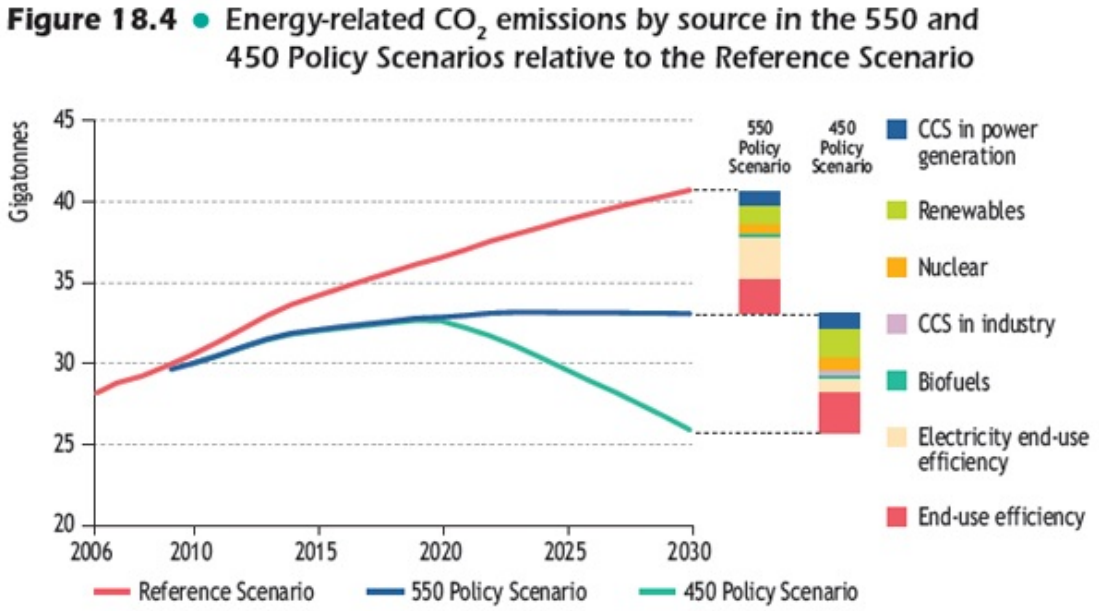

Figure 3 - Breakdown of alternatives that need to be implemented according to the IEA to reach 450 and 550 ppm.

The 550 policy scenario in detail

For the 550 policy scenario the main policy changes relative to the reference scenario were assumed to be:

- A cap and trade system which includes the power generation and industry sectors for OECD+ (OECD countries and non-OECD EU countries), resulting in a carbon price of $90 per tonne of CO2 in 2030. This makes renewables, nuclear and carbon capture and storage (CCS) more competitive against fossil based electricity generation.
- An intensification of research and development programs to reduce the cost of advanced technologies in OECD+
- Adoption of international sectoral agreements in road transport and aviation.
- An international agreement by aircraft manufacturers to increase the efficiency of new planes by around 20% by 2020 and around 30% by 2030 respective to 2006 levels.
- Targeted support mechanisms in OECD+ to speed up the deployment of technologies close to market competitiveness
- Development of grids to integrate renewables in OECD+
- Policies that improve the fficiency of fossil-fuel plants in other major economies (China, India etc.)
- Policies that encourage reducing electricity transmission and distribution losses in other major economies
- Policies that support acceleration of building nuclear power plants in other major economies
- Incentives and regulations boosting the deployment of renewables in other major economies

The effect of this policy change is estimated to be:

- Implementation of carbon capture and storage at 7 coal-fired power plants and 3 gas-fired power plants every year as soon as possible up to 2030
- The construction of 11 new nuclear power plants each year up to 2030 as soon as possible
- The construction of almost 12,000 wind turbines in the period to 2030
- The expansion of hydropower every two years up to 2030 by 64 gigawatt (equivalent of three dams with the capacity of China's Three Gorges Dam).
- The reduction of coal fired capacity power plant by 762 GW up to 2030
- An increase in gas fired power plant capacity by 107 GW by 2030.

- A global average efficiency in the light duty vehicle fleet in 2030 of 120 grammes of CO2 per kilometre (equivalent to approximately 5 liter per 100 kilometre or 47 miles per gallon)
- A global average efficiency in the heavy duty vehicle fleet in 2030 of 560 grammes of CO2 per kilometre, opposed to the current 840 grammes of CO2 per kilometre.

Table 18.7 • Capacity additions in the 550 Policy Scenario (GW)

	2007-2020				2021-2030			
	World	OECD+	Other Major Economies	Other Countries	World	OECD+	Other Major Economies	Other Countries
Coal	957	353	543	61	323	84	223	16
of which coal CCS	*22*	*19*	*4*	*0*	*101*	*59*	*42*	*0*
Oil	67	3	22	42	41	12	17	11
Gas	520	258	150	112	498	289	124	85
of which gas CCS	*10*	*10*	*0*	*0*	*28*	*24*	*4*	*0*
Nuclear	124	71	41	12	127	65	55	7
Hydro	490	95	294	101	250	40	119	92
Biomass	103	64	26	14	112	42	46	24
Wind onshore	310	218	82	10	353	225	91	37
Wind offshore	48	39	6	2	93	77	13	3
Solar photovoltaics	79	48	25	6	176	83	67	27
Solar thermal	7	7	0	0	36	23	7	6
Geothermal	9	5	2	2	10	4	2	4
Tidal and wave	2	2	0	0	7	6	0	0
Total	**2 717**	**1 164**	**1 190**	**362**	**2 025**	**949**	**765**	**310**

Table 1 - WEO 2008 table showing gross additional power plant capacity added in GW up to 2030. Net capacity which includes the

The 450 policy scenario in detail

In the 450 policy scenario the additional CO2 reduction effect comes from an assumed enlargement of the cap-and-trade regime in OECD+ to other major economies (India, China, Brazil etc.) around 2020. The resulting effect is that even more nuclear power plants, hydropower, renewable energy are built between 2020 and 2030 that offset the construction of coal- and gas fired power plants. In addition it is expected that even more CCS will be implemented. The difference between the 450 and 550 policy scenario by 2030 are shown in figure 4 and table 2.

Figure 18.17 • World electricity generation fuel mix in the 450 Policy Scenario relative to the 550 Policy Scenario

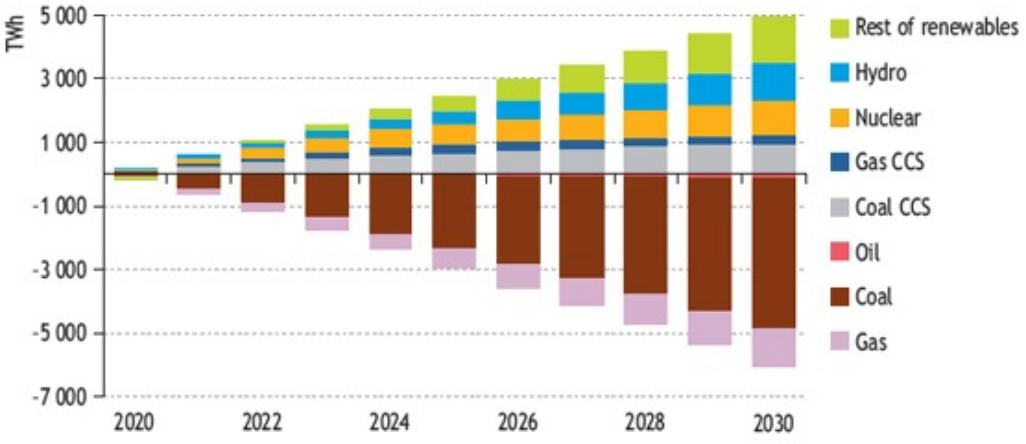

Figure 4 - World electricity generation fuel mix in the 450 policy scenario relative to the 550 policy scenario in 2030.

Table 18.12 • Capacity additions in the 450 Policy Scenario relative to the 550 Policy Scenario, 2020-2030 (GW)

	World	OECD+	Other Major Economies	Other Countries
Coal without CCS	-117	-25	-80	-12
Coal CCS	127	42	85	0
Oil	41	-3	44	1
Gas without CCS	-115	-183	-4	73
Gas CCS	60	50	11	0
Nuclear	140	81	61	-3
Hydro	322	44	184	94
Biomass	66	12	29	25
Wind onshore	248	94	112	42
Wind offshore	29	17	9	3
Solar PV	75	30	20	25
Solar thermal	62	18	31	12
Geothermal	15	4	4	6
Tidal and wave	3.6	3.0	0.5	0.1
Total	**768**	**92**	**410**	**266**

Table 2 - Capacity additions in the 450 Policy Scenario relative to the 550 Policy Scenario from 2020 to 2030.

A few observations to end with

The first questions that arise when I look at the 550 policy scenario table outlining capacity additions from 2007 to 2030 (table 1) involve CCS and the more unknown renewable energy sources.

CCS - The IEA assumes 22 gigawatts of coal fired and 10 gigawatts of gas fired power plants with Carbon Capture and Storage globally by 2020. This hinges heavily on the assumption that CCS will be implemented due to the emissions trading scheme of the European Union, or that the US government will put a lot of public money in CCS. In Europe the European Union has decided that

it is up to member states to invest in CCS individually. To my knowledge the investments for only one small (300-400 megawatt) demonstration power plant in Great Britain have been secured so far. Is the assumption of 32 gigawatts of installed CCS at coal and gas fired power plants by 2020 realistic?

Renewable energy - The IEA assumes that by 2030 only 36 gigawatts of solar thermal, 10 gigawatts of geothermal and 7 gigawatts of tidal and wave will have been built. While this improves somewhat in the 450 policy scenario (especially for solar thermal) it makes one wonder on what cost assumptions the very low growth figures of Solar Thermal, Geothermal and Tidal and Wave power by 2030 have been based. To my expectation these technologies have much more potential than assumed by the IEA.