



International
Energy Agency

Emissions from coal fired power Generation

Workshop on

IEA High Efficiency, Low Emissions Coal Technology Roadmap

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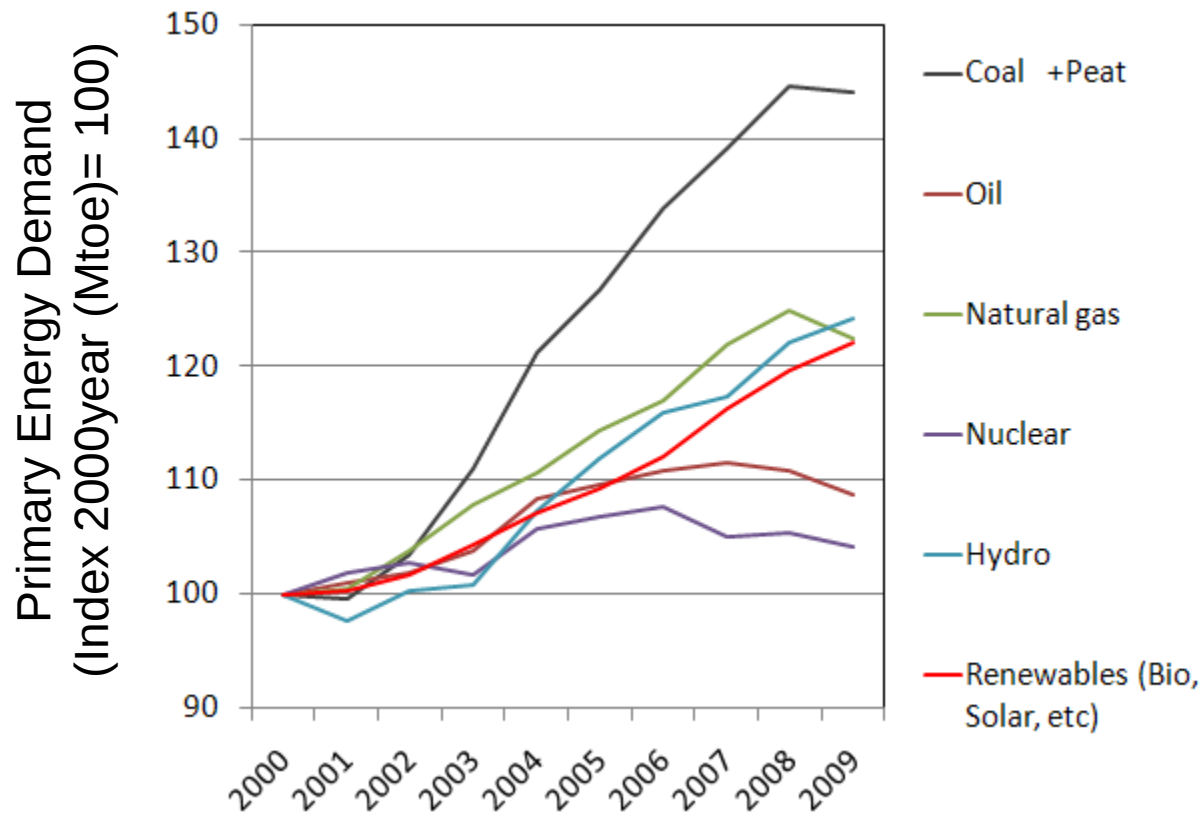
Energy Technology Policy Division

International Energy Agency



Increase in Primary Energy Demand, 2000-2009

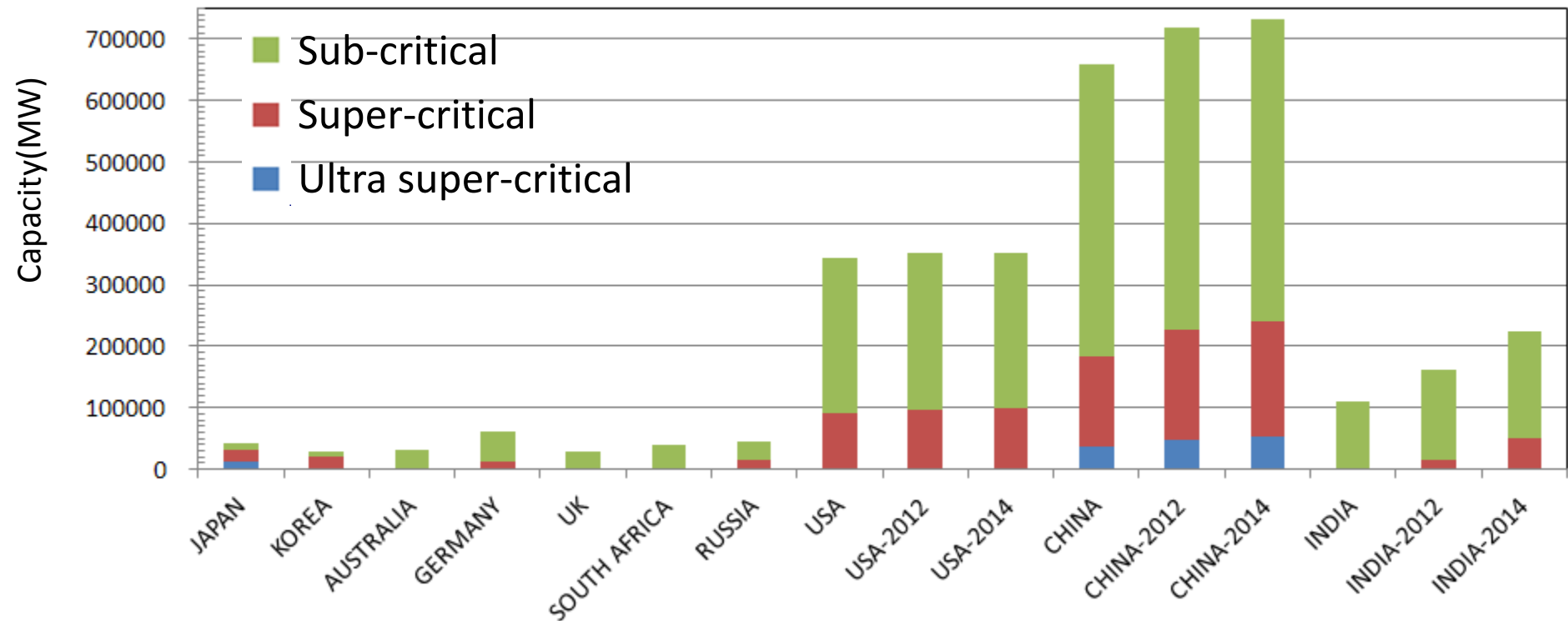
Demand for coal has been growing faster than any other energy sources.



Source: IEA Statistics

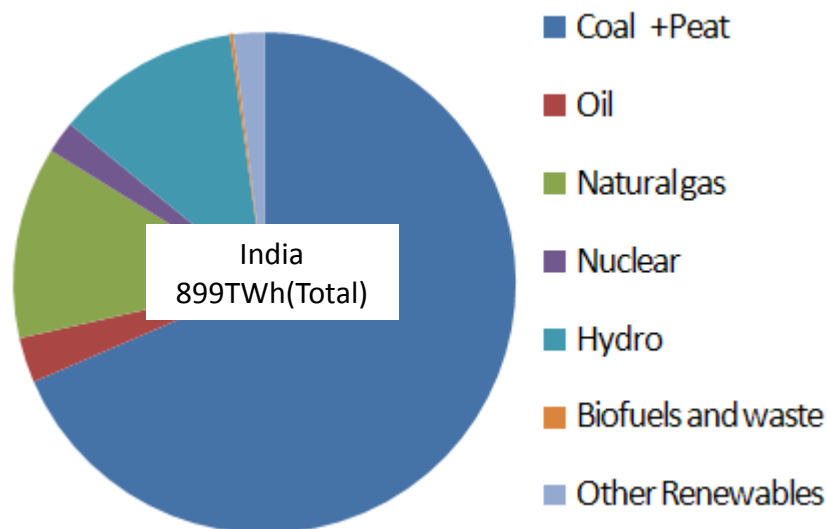
Share of boilers in major countries for each steam condition

Large amount of sub-critical plants are still being operated. It is possible to increase global average efficiency by adopting currently available Ultra super-critical, in particular, in China, US and India.



Electricity generation in India

Share of electricity generation in India by resources (2009)

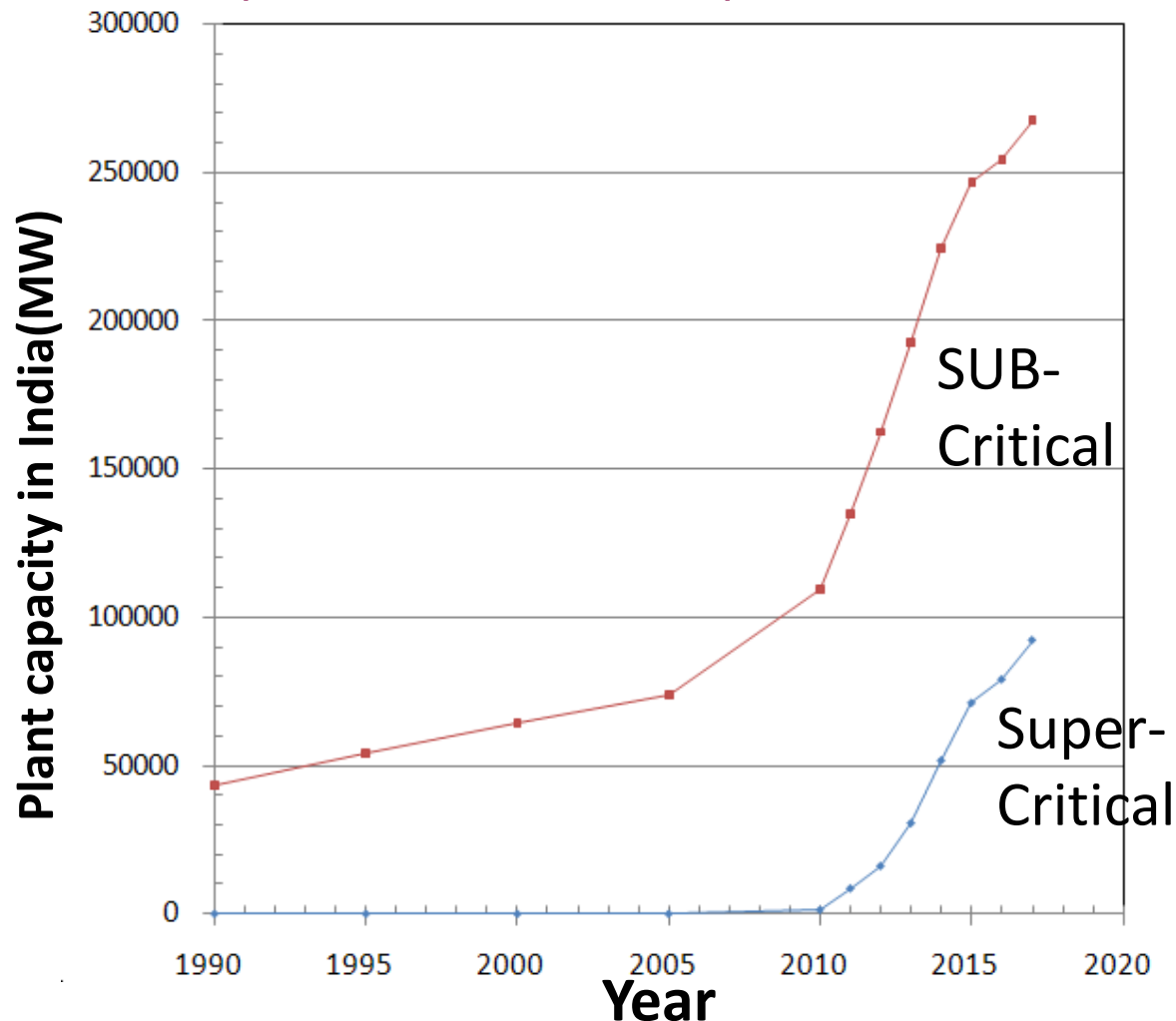


2009	Coal &Peat	Oil	Natural gas	Nuclear	Hydro	Biofuels &waste	Other Renewables	Total (TWh)
India	617	26	111	19	107	2	18	899
World	8119	1027	4301	2697	3252	288	370	20054

(IEA statistics)

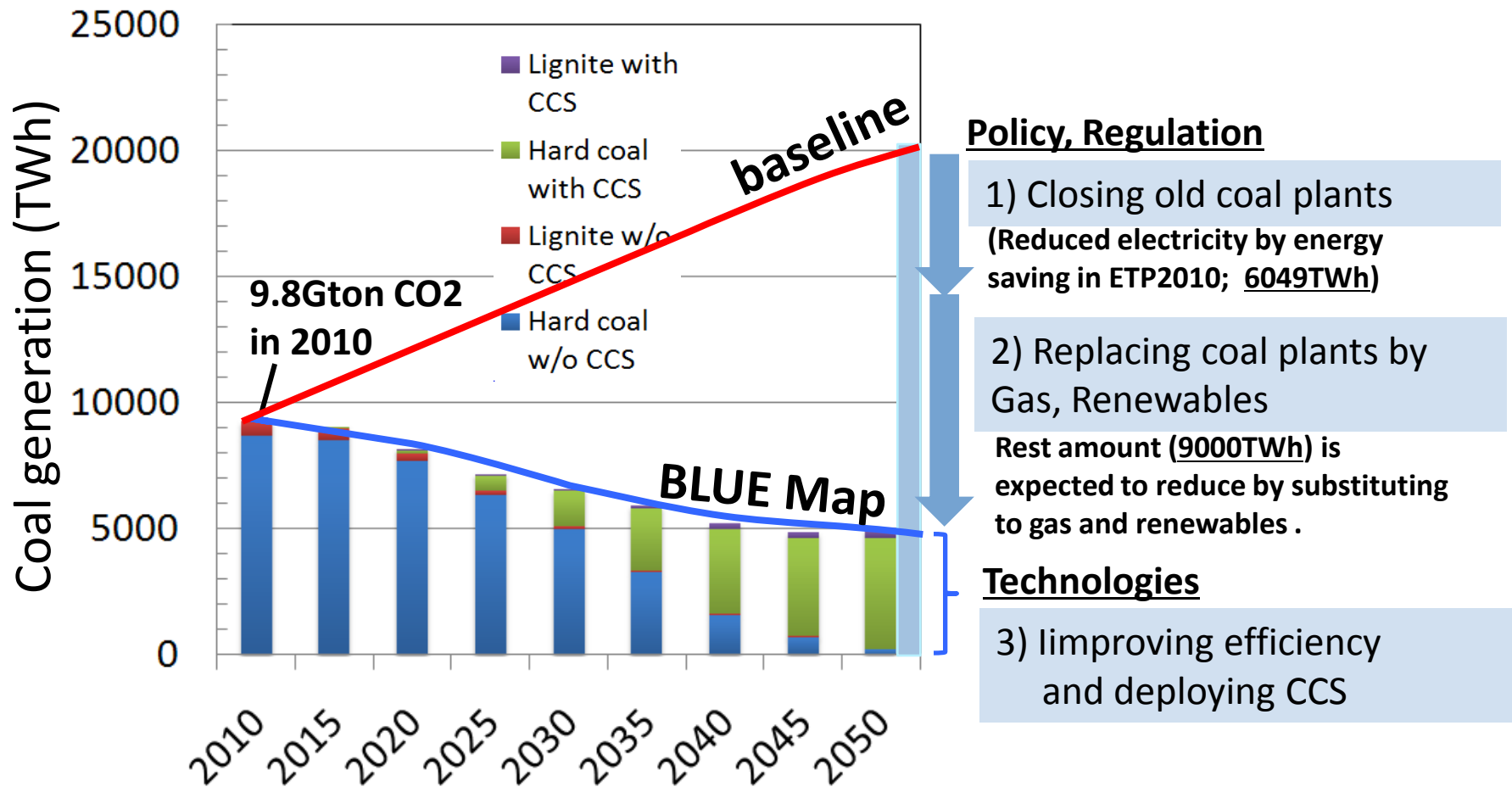
Breakdown of coal-fired plant capacity in India:

A large amount of new capacity has been added over the decade.
 Will this capacity increase continue to 2020 or after 2020?
 How much share of super-critical will be occupied after 2020?

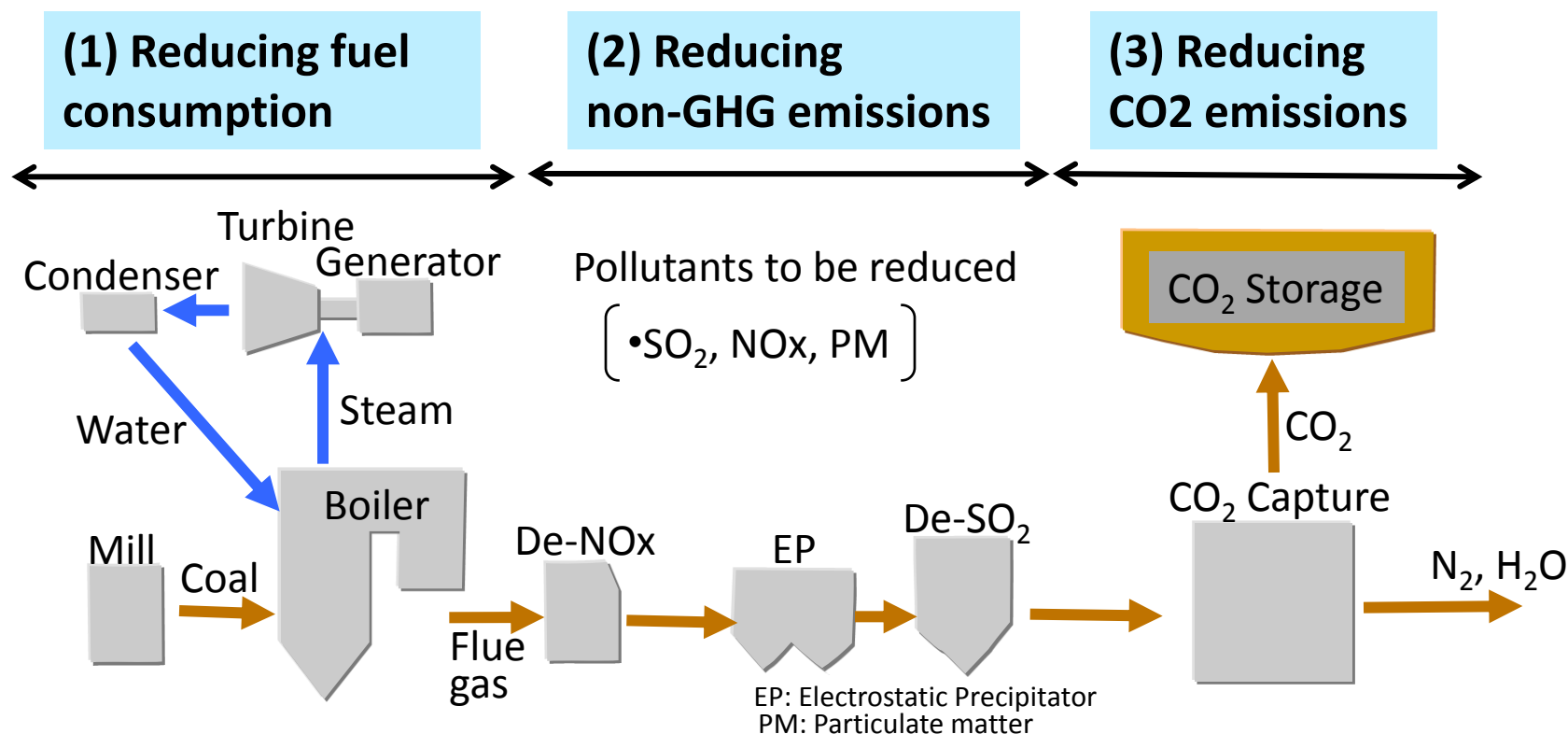


Coal generation in BLUE Map scenario

In order to reduce CO₂ emissions, two actions will be employed. One is an action by the measure of policy & regulation. The other action is the development of technologies.

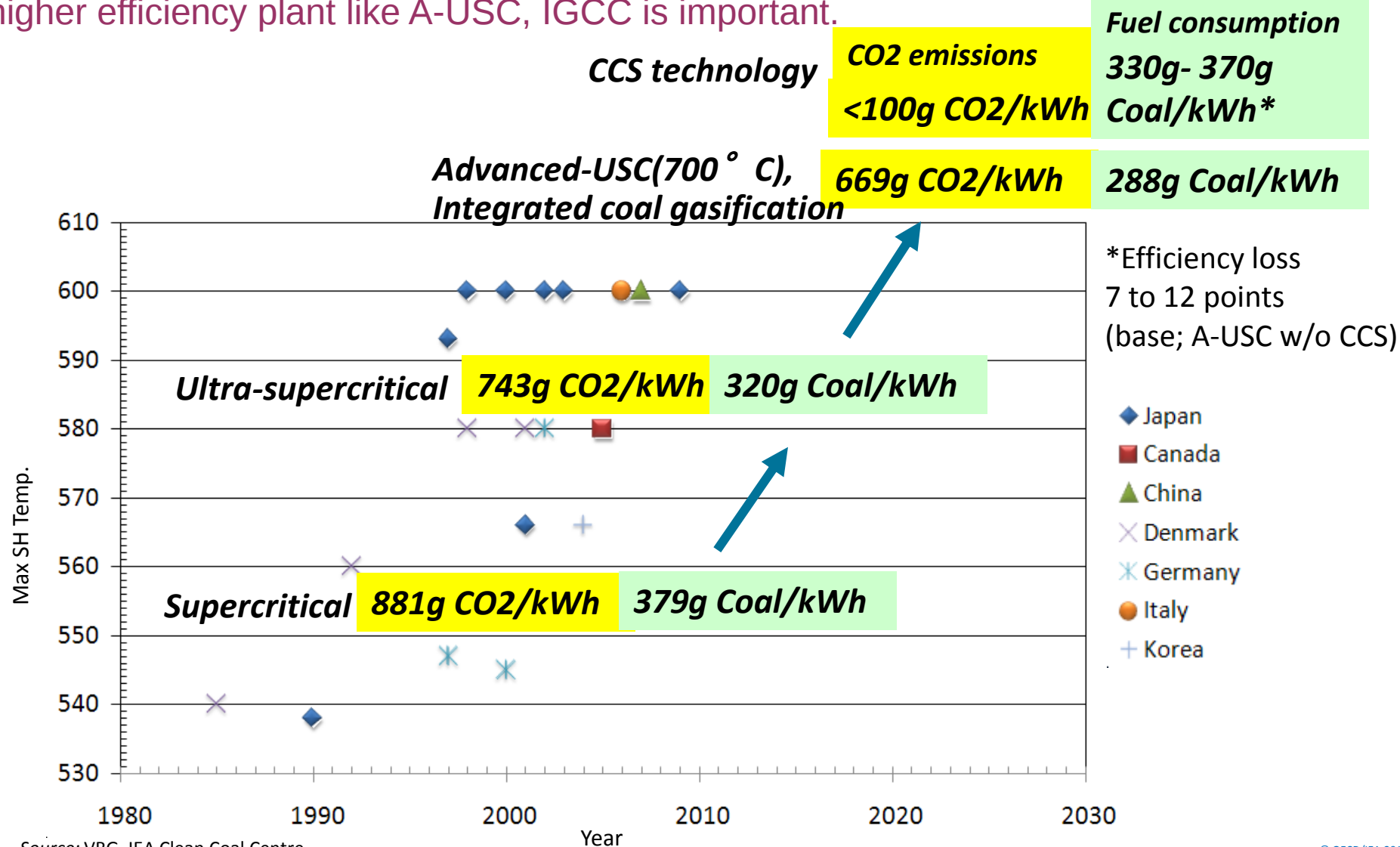


For coal generation, reducing non-GHG pollutant emissions (SO₂, NO_x, PM) is significantly important. In HELE roadmap, following three points will be focused on.



Coal-fired plant status: past and future

USC plants have been operated in Europe and Japan. Recently, most advanced plants in China have reached the same steam condition. Further R&D effort to commercialize higher efficiency plant like A-USC, IGCC is important.



High efficient coal-fires power plants

USC plants: Commercially available.

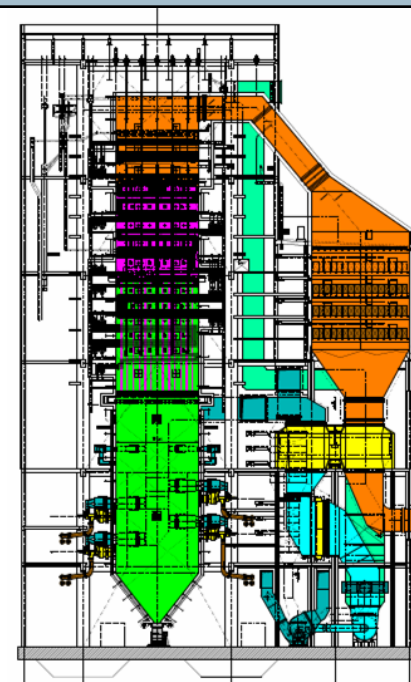
A-USC plants: R&D is intensively going on EU, Japan and US.

USC(600° C)



TEPCO Hitachinaka No.1, Japan
 (Boiler; Babcock-Hitachi)
 (600° C/600° C 25MPa 1000MW)
 (Operation; 2003/12-)

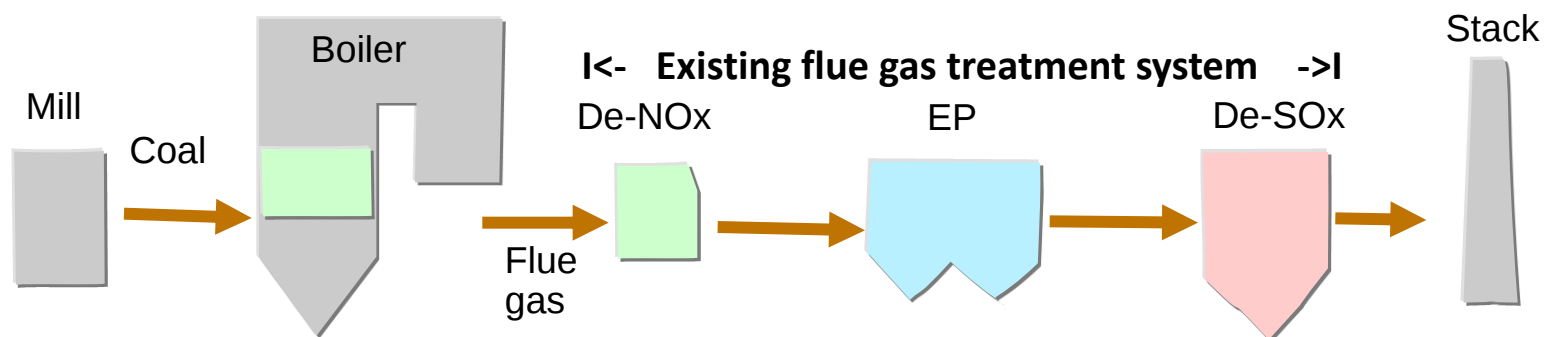
A-USC(700° C)



Basic design for
E.ON 50plus Project, Germany
 (Boiler; Hitachi Power Europe)
 (700° C/720° C 35MPa 500MW)

Low emission technology for non-GHG pollutants

Emissions of NO_x, SO₂ and PM far lower than regulated in most areas are possible, using standard systems. For NO_x minimization, flue gas treatment systems are used and low-NO_x combustion technology in boiler also helps to reduce NO_x formation . PM are removed by electrostatic precipitators or fabric filters, and SO₂ is controlled by scrubbing with limestone slurry in a flue gas desulphurisation.



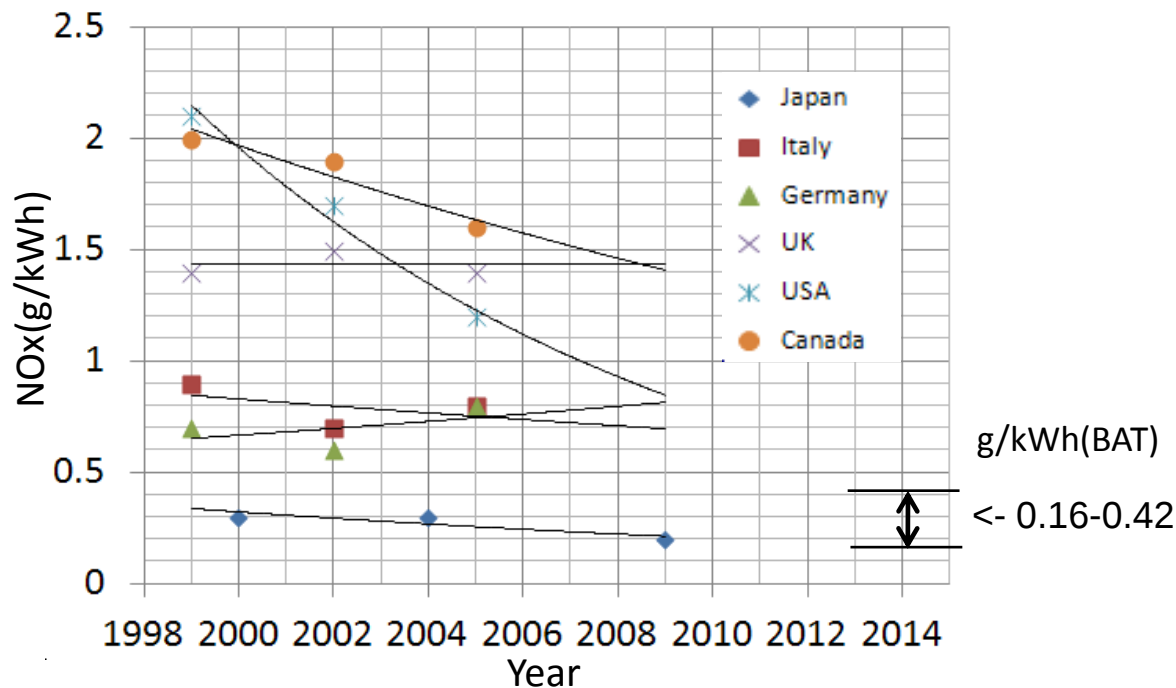
Current best available technology(BAT)

					g/kWh base
NO _x (mg/m ³ N)	< 500-1000 → < 50-100			< 50-100	< 0.16-0.42
SO ₂ (mg/m ³ N)	<5000		→ < 20	< 20	< 0.06-0.08
PM (mg/m ³ N)	< 20,000	→ < 30-50	→ < 5-10	< 5-10	< 0.016-0.042

SCR: Selective Catalytic Reduction Wet-FGD :Wet-Flue Gas Desulfurization EP: Electrostatic Precipitator

Reducing NOx and SO2 has been major technical change over the decades and in some OECD countries like Japan and Germany, air pollutant has been drastically reduced by employing the flue gas treatment system. A certain policy action and regulation is needed to deploy currently available technologies.

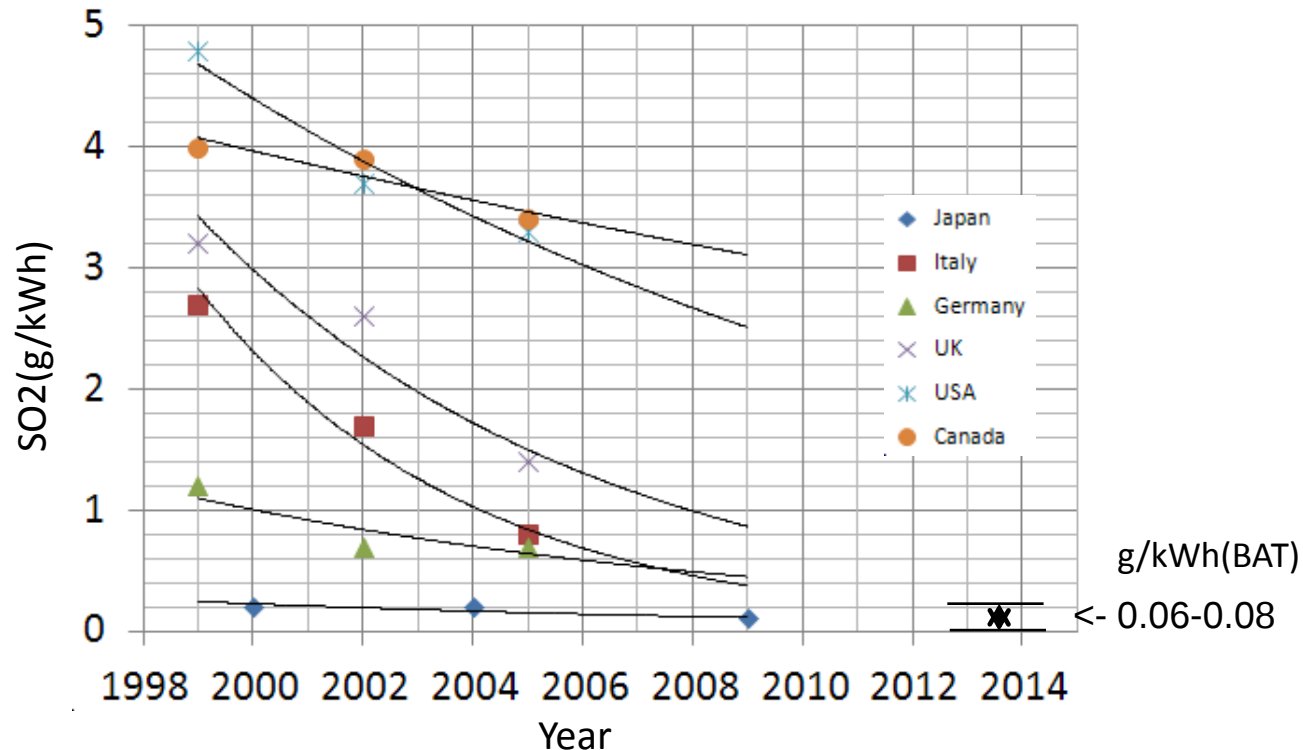
Figure: Trend of average NOx emission from thermal power plants



BAT :Best Available Technology

Reducing NO_x and SO₂ have been major technical change over the decades and in some OECD countries like Japan and Germany, air pollutant has been drastically reduced by employing the flue gas treatment system. A certain policy action and regulation is needed to deploy currently available technologies.

Figure: Trend of average SO₂ emission from thermal power plants



Role of coal in energy

- In the near term, coal will be dominant in electricity generation.

Future perspectives

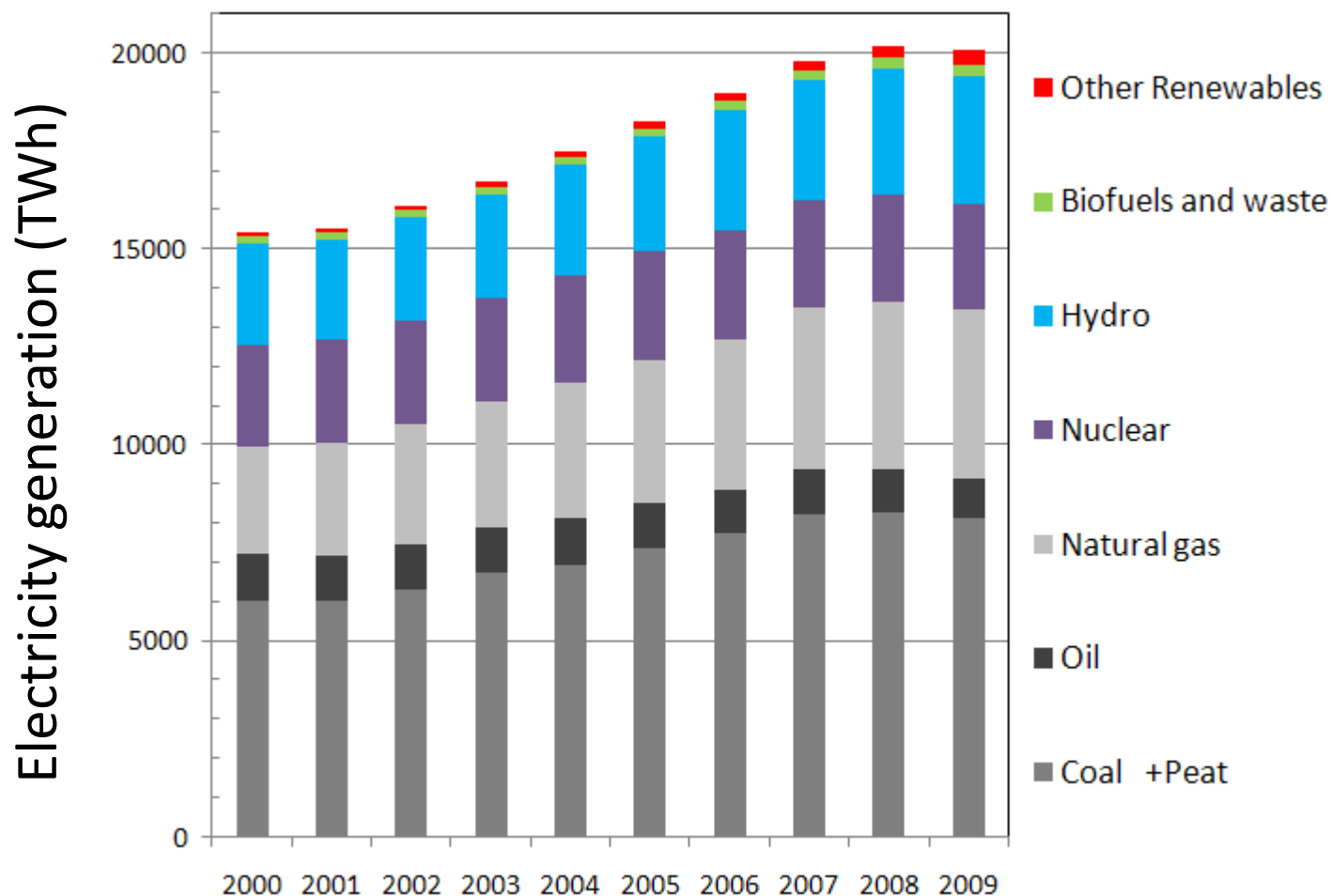
- To achieve Blue Map scenario, both technology development and strong policy actions are indispensable.
- USC for new installation and retrofit will be largely deployed and RD&D of higher efficiency plants (A-USC, IGCC) will be intensively promoted.
- Policies enacted to lead to closing of old existing plants. Replacing coal plants by gas and renewables to be promoted.

Power generation

- High efficient technology (A-USC, IGCC) can contribute to reduce CO₂ up to 670g/kWh. For further CO₂ abatement, CCS is the only measure.
- In clean coal technology, reduction of non-GHG pollutant emissions (SO₂, NO_x, PM) is indispensable and deployment of best available flue gas treatment technologies should be intensively promoted.

Supplements

Global Electricity generation by resources in the world, 2000-2009

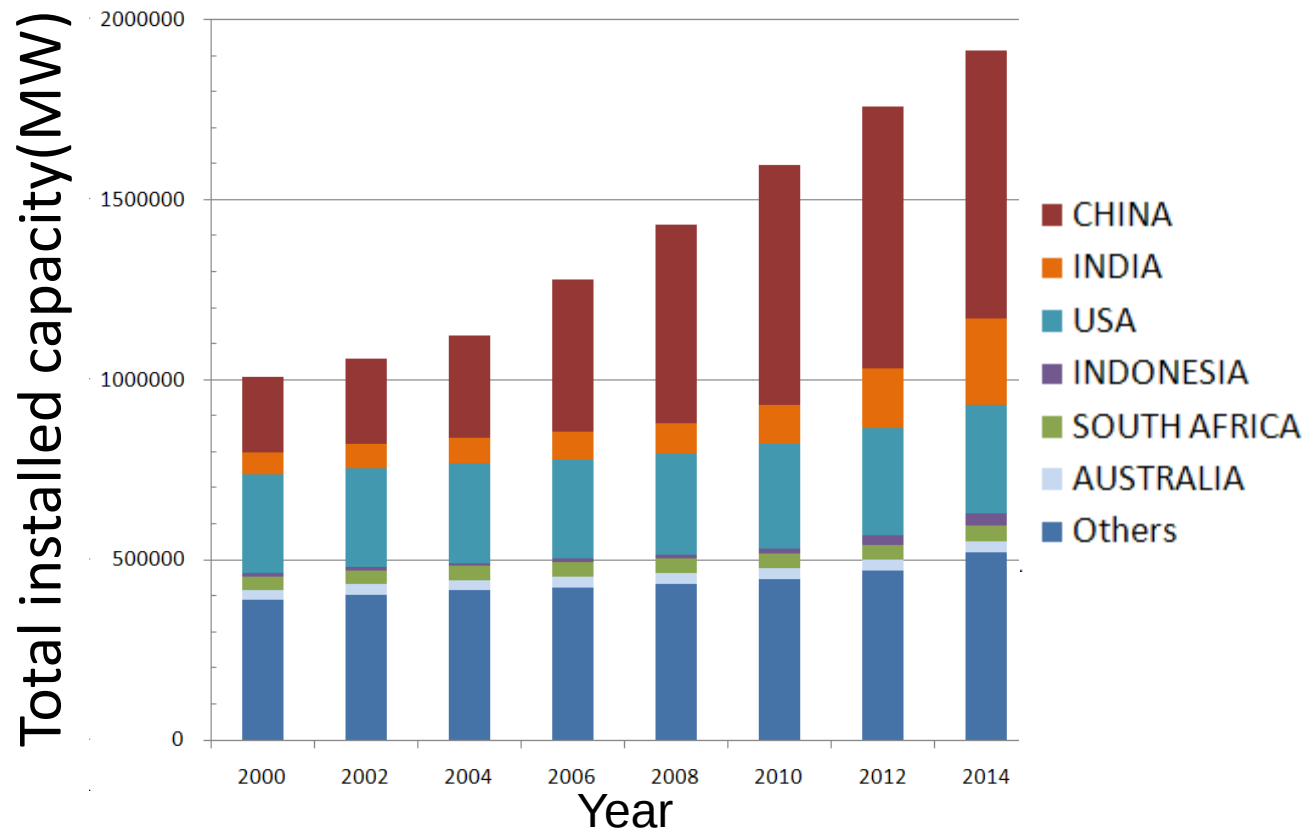


Source: IEA Statistics

Key point: Although non-fossil electricity generations increased contributed to CO₂ reduction, growth of generation from fossil fuel continues over the decade.

Trend of installed capacity in coal generation

A large amount of new capacity is due to be added over the decade in China & India.

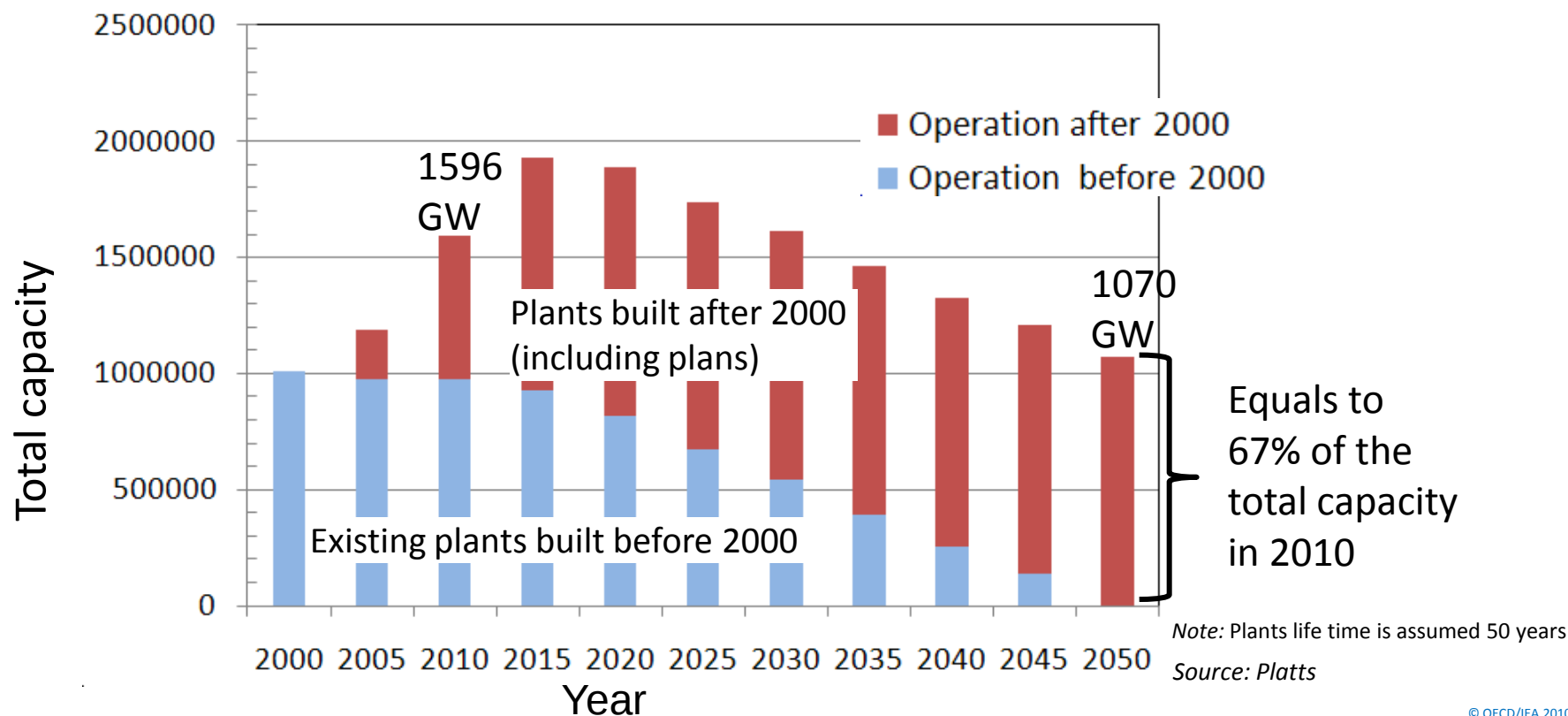


Source: Platts database

Case of carbon Lock in

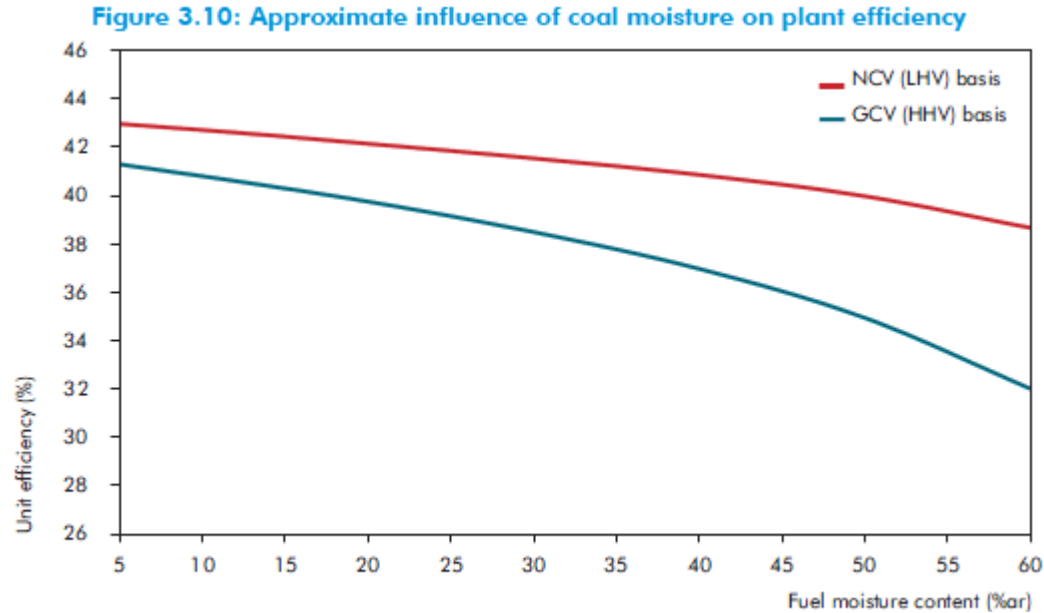
Newly install power stations, in the absence of policies to encourage their early retirement, will continue to operate and emit large quantities of CO₂ until 2050. Thus, even if no coal plants are built after 2015, total emissions from all coal-fired plants would be almost equivalent to 2000 level. Without no CCS, total CO₂ emission from these plants would definitely exceed the level of BLUE Map target.

Figure D.x: Projection of carbon lock in from coal generation



Approximate influence of coal moisture on plant efficiency

Removing moisture from lignite is an important to improve efficiency in lignite power plant. Lignite drying can increase efficiency and reduce CO₂ emissions substantially if the technology used employs low grade heat and recovers as much energy from the drying as possible.



Source: IEA Power Generation from Coal

Key point: Removing moisture from lignite is an important technology to improve efficiency in lignite power plant.

Figure : Trend of efficiency improvement in coal-fired power plants

