



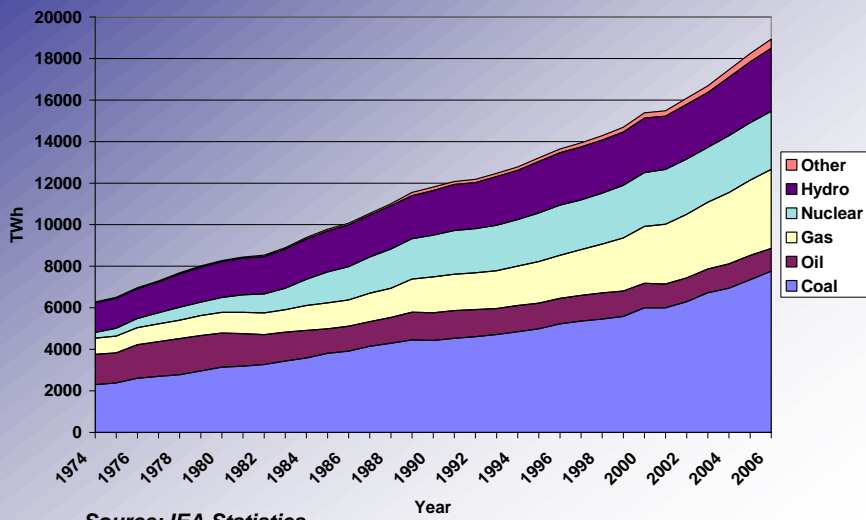
# **Coal-fired Power Generation**

## **need for common mechanism to collect and report performance**

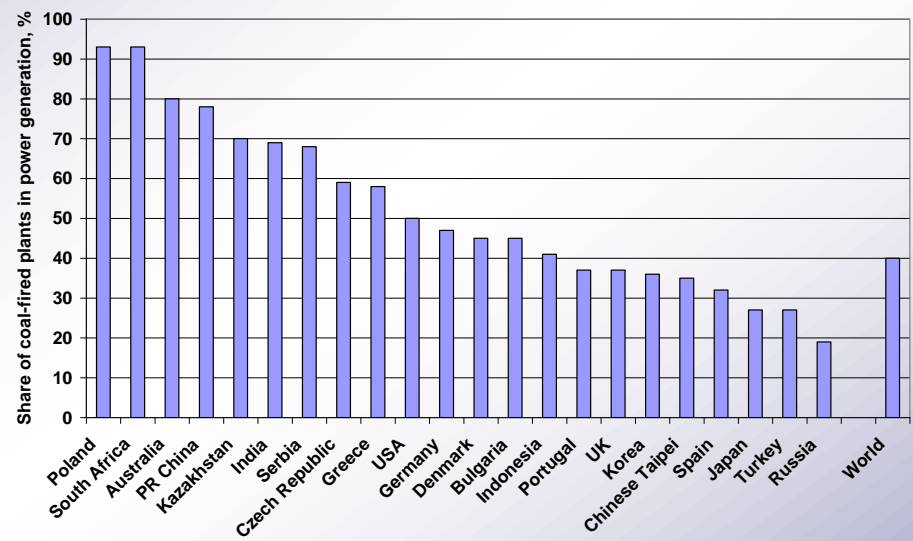
**IEA/ISO/IEC workshop on international standards to promote energy efficiency**  
**16-17 March 2009**

**Sankar Bhattacharya**  
**Energy Technology Collaboration Division**  
**International Energy Agency**

# Role of coal in power generation



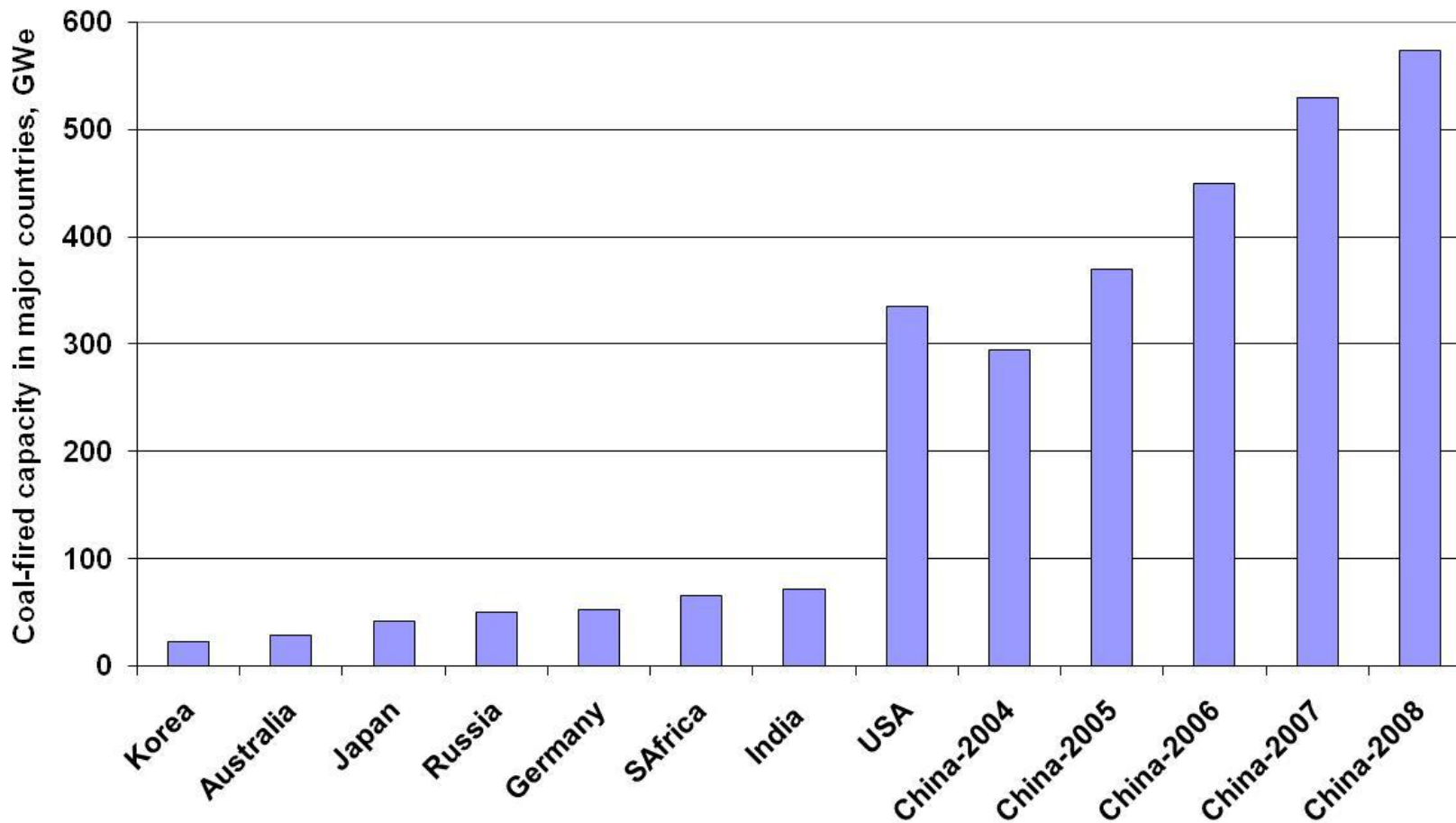
Source: IEA Statistics



- coal demand for power generation has grown over the years.
- its importance is set to continue to 2030 and beyond.

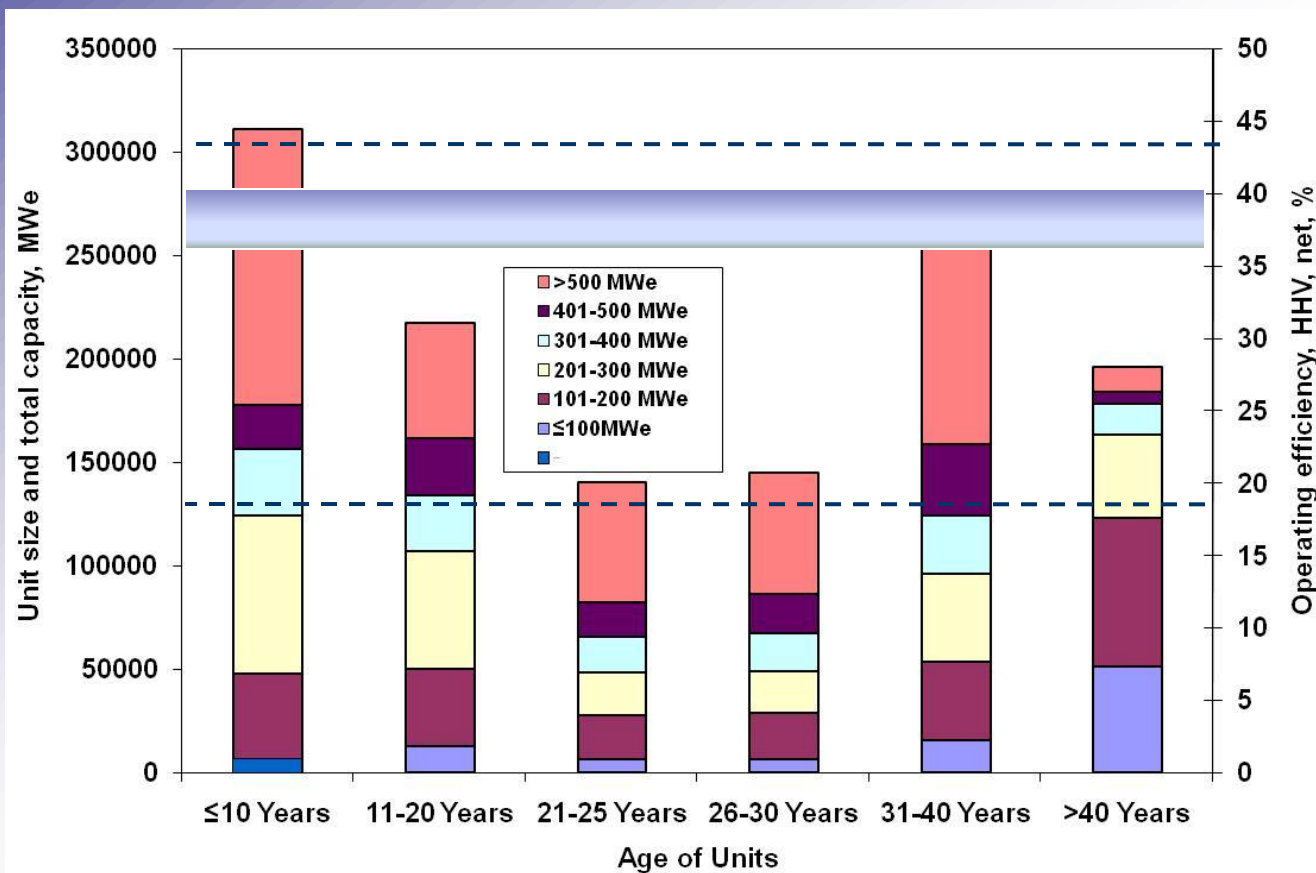
- significant proportion of power generation in several countries

# Size of coal-fired fleet major coal using countries



1 GW = 1000 MW

# Age and size of coal fleet worldwide



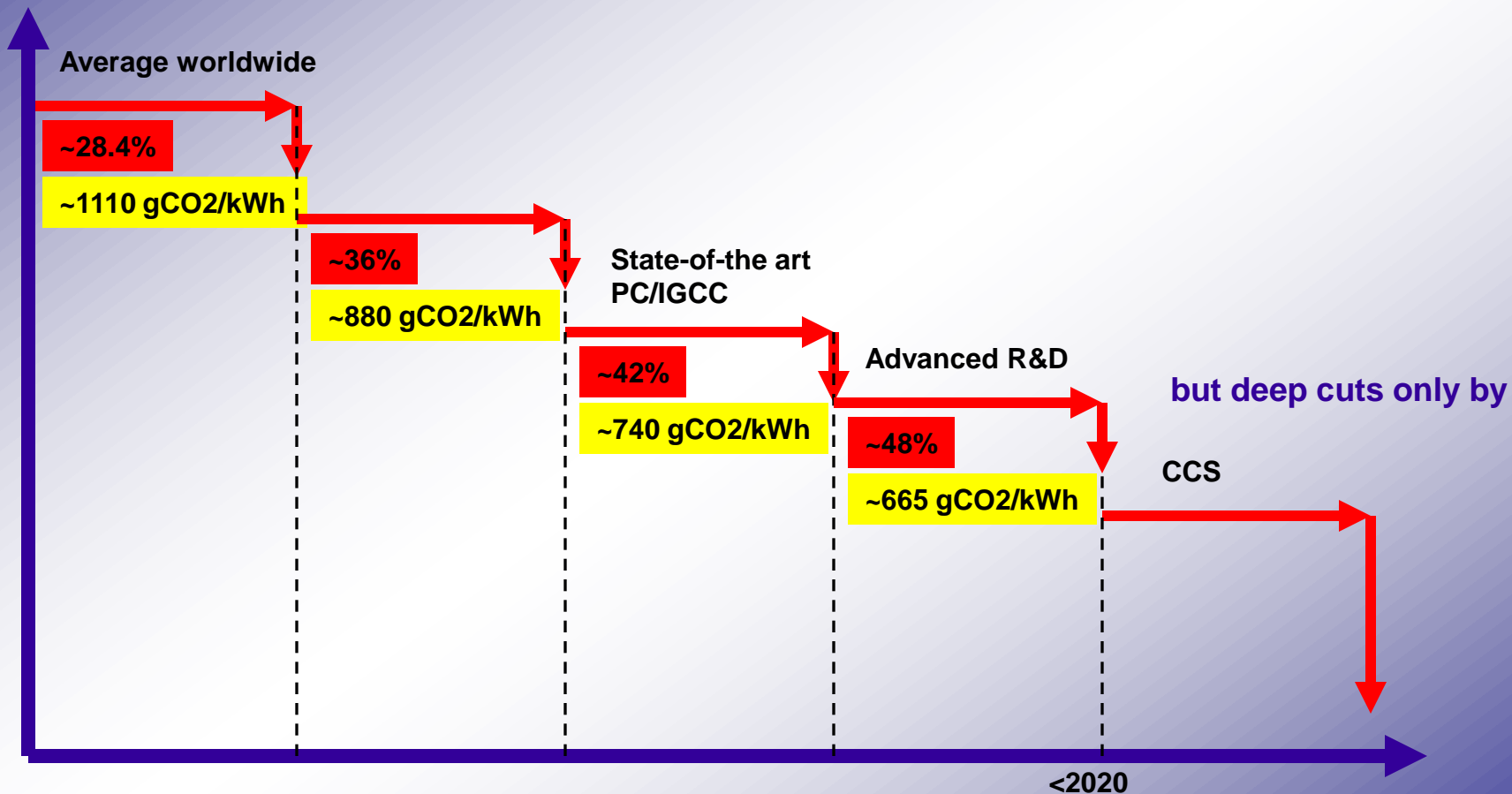
## As of 2004...

- ~50% of the operating fleet : >25 years age, ≤300MWe unit size
- >80% of the operating fleet : sub-critical units
- average operating efficiency ~28.4%, HHV, net

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Current best technology operates around 40% efficiency depending on coal quality and ambient conditions

# Outlook.....



adapted from VGB 2007; efficiency – HHV,net  
for hard coals  
For lignites: 2-4%-point lower

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# Carbon Dioxide capture and storage (CCS)

- large efficiency penalty at present : 7-12 percentage point
- R&D in progress
  - Pulverised coal (PC) fired, IGCC, Oxy-firing (PC and CFB)
- Partial capture
- Integrated demonstration – urgently needed!

- large number of PC plants – now and to 2030
  - may not be retrofittable with CO<sub>2</sub> capture plant
  - technical reasons
  - storage issues
- If not replaceable, efficiency improvement is the key for these plants



# Factors affecting power station efficiency and emissions

*Need to know operational efficiency figures accurately...*

- **constrained efficiency differences**
  - use of different cooling systems
  - fuel quality – moisture, ash, sulfur
  - flue gas cleaning technologies used in the plant
  - ambient conditions
  
- **efficiency differences due to operation**
  - average operating load, capacity factor, transient operation, start-ups
  
- **efficiency differences due to design and maintenance**
  - SC/ USC, component availability



# Factors affecting power station efficiency and emissions

*a plant with steam conditions and cooling system suitable for bituminous coals will give lower efficiency when operated with sub-bituminous coals, and even lower efficiencies with lignite*

**In addition.....**

*efficiencies reported in different countries on different bases*



# Power station efficiency standards - 1

- **boiler performance standards**

- BS 2885 1974
- DIN 1942
- PTC 4 1998
- ISO 12953-15 2003, similar to DIN 1942

- standards relate to test conditions, not operating conditions
- wide range of system boundaries
- exceptions and amendments to be made by agreement between the client and vendor
- tests on the same plant using two different standards will yield different results

- **steam turbine performance standards**

- DIN 1943. Steam Turbines - Acceptance Tests
- ANSI PTC 6S. Procedures for Routine Performance Tests of Steam Turbines

*up to 0.8%-point difference in overall unit efficiency*



## Power station efficiency standards - 2

- performance standards for entire plant
  - PTC 46 – widely used for new gas-fired plants
  - VDI 3986 – somewhat less detailed than PTC
- both provide a framework for short-term tests – verification that contract requirements are met
- Generator efficiency standards – Australian Greenhouse Office
- ASME PTC PM – performance monitoring guidelines
- other countries have different methodologies
  - examples



## Power station efficiency standards - 3

- **No common mechanism exist**
  - to collect, compile and compare coal-fired plant efficiencies from different parts of the world
  - efficiency reporting on different bases – HHV/LHV/gross/net
- **IEA CIAB initiated report to rationalise the different reporting methodologies**



## Power station efficiency standards - 4

- Standards for IGCC plants?
- Standards for Oxy-fuel plants?

### Emission performance standards for SO<sub>x</sub>, NO<sub>x</sub>, dust, and mercury

- USEPA
- Californian EPS
- LCPD limits

## Performance standards for entire plant retrofitted with CCS

- system boundary, what measurements?
- capture, transportation and storage – type of capture
- measurement, monitoring and verification – once CO<sub>2</sub> is stored
- risk assessment guidelines

## Methodologies are given:

MMV - IPCC GHG Guidelines  
EU ETS MRG draft in preparation

EU ETS BERR report on MRG

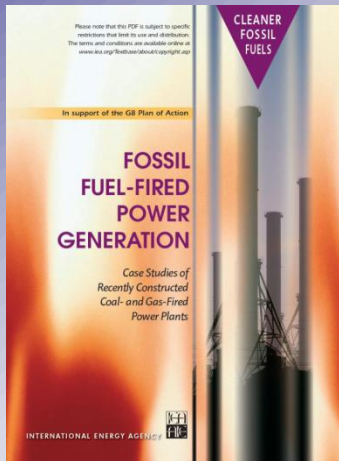
## Risk assessment

London and OSPAR Risk Assessment Guidelines  
EU CCS Directive

*Significant work in progress within the IEA and other organizations...*

# IEA Work in Cleaner Fossil Fuels

## Recent Publications



## Forthcoming Reports

- Potential of upgrade and replacement of older coal-fired power plants in major coal using economies.
- Developments in coal-fired power generation and its potential for higher efficiency.
- Case studies on recently constructed supercritical or ultra-supercritical coal-fired units.
- Assessment of full coal process chain for efficiency improvement in power generation.