



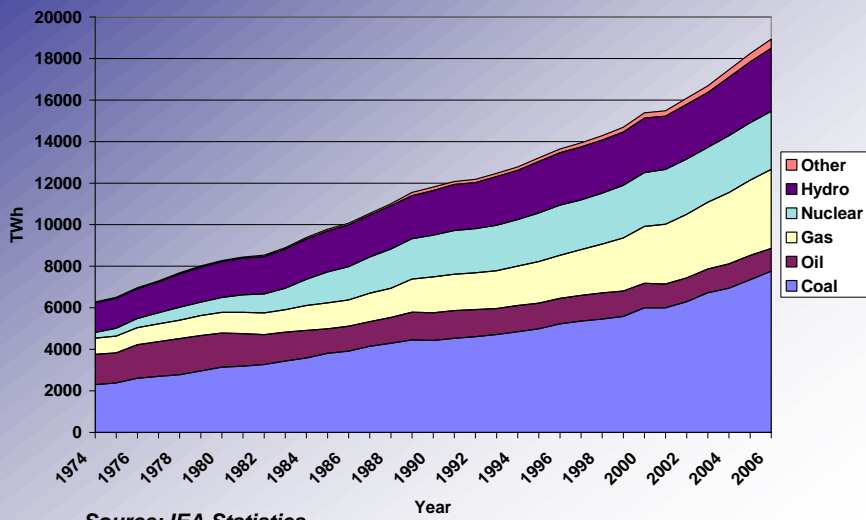
Coal-fired Power Generation

need for common mechanism to collect and report performance

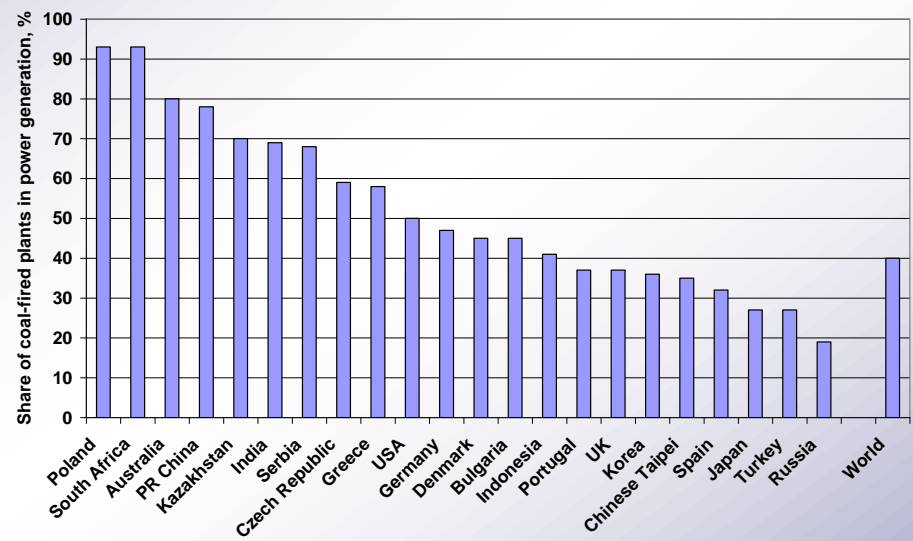
IEA/ISO/IEC workshop on international standards to promote energy efficiency
16-17 March 2009

Sankar Bhattacharya
Energy Technology Collaboration Division
International Energy Agency

Role of coal in power generation



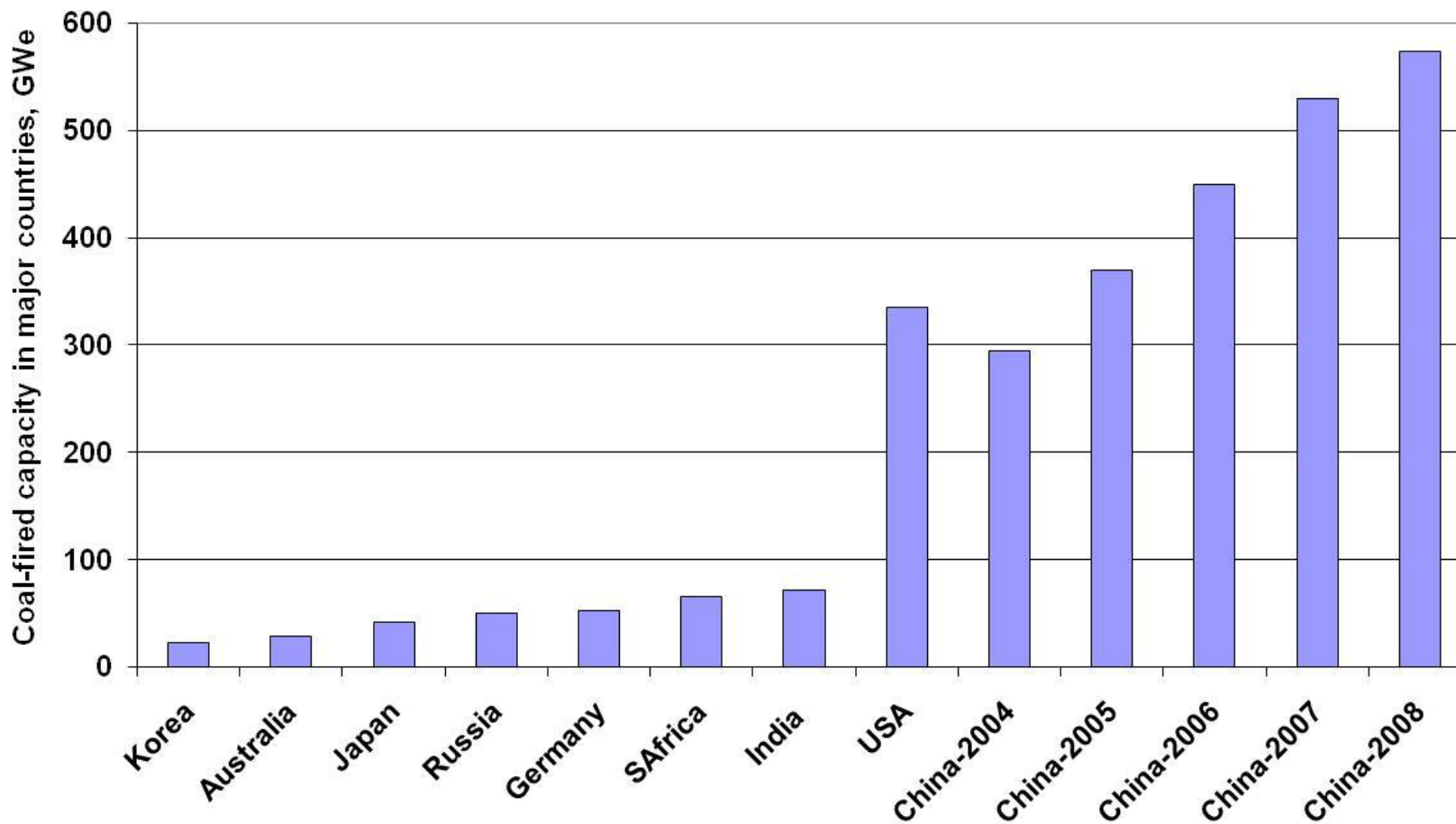
Source: IEA Statistics



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

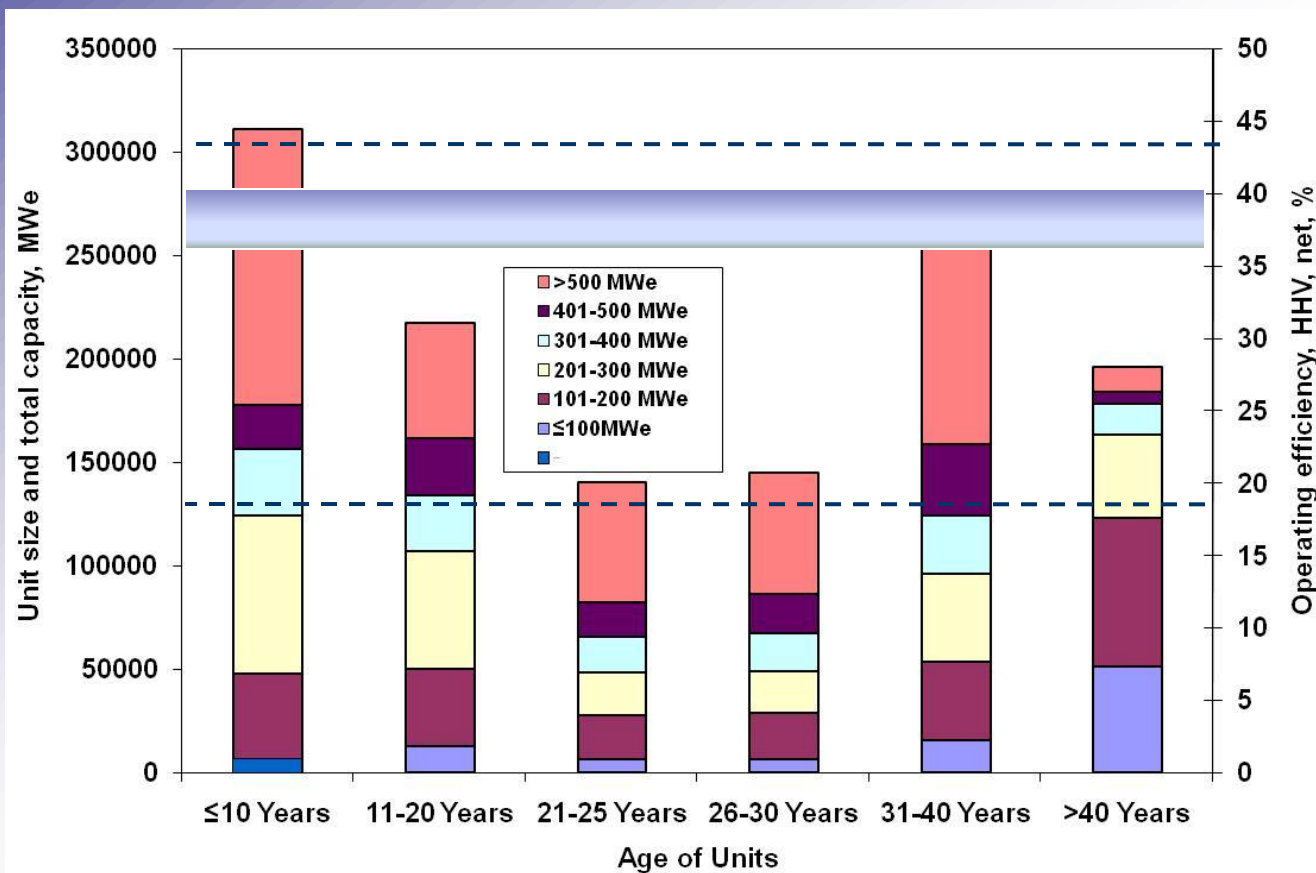
- significant proportion of power generation in several countries

Size of coal-fired fleet major coal using countries



1 GW = 1000 MW

Age and size of coal fleet worldwide



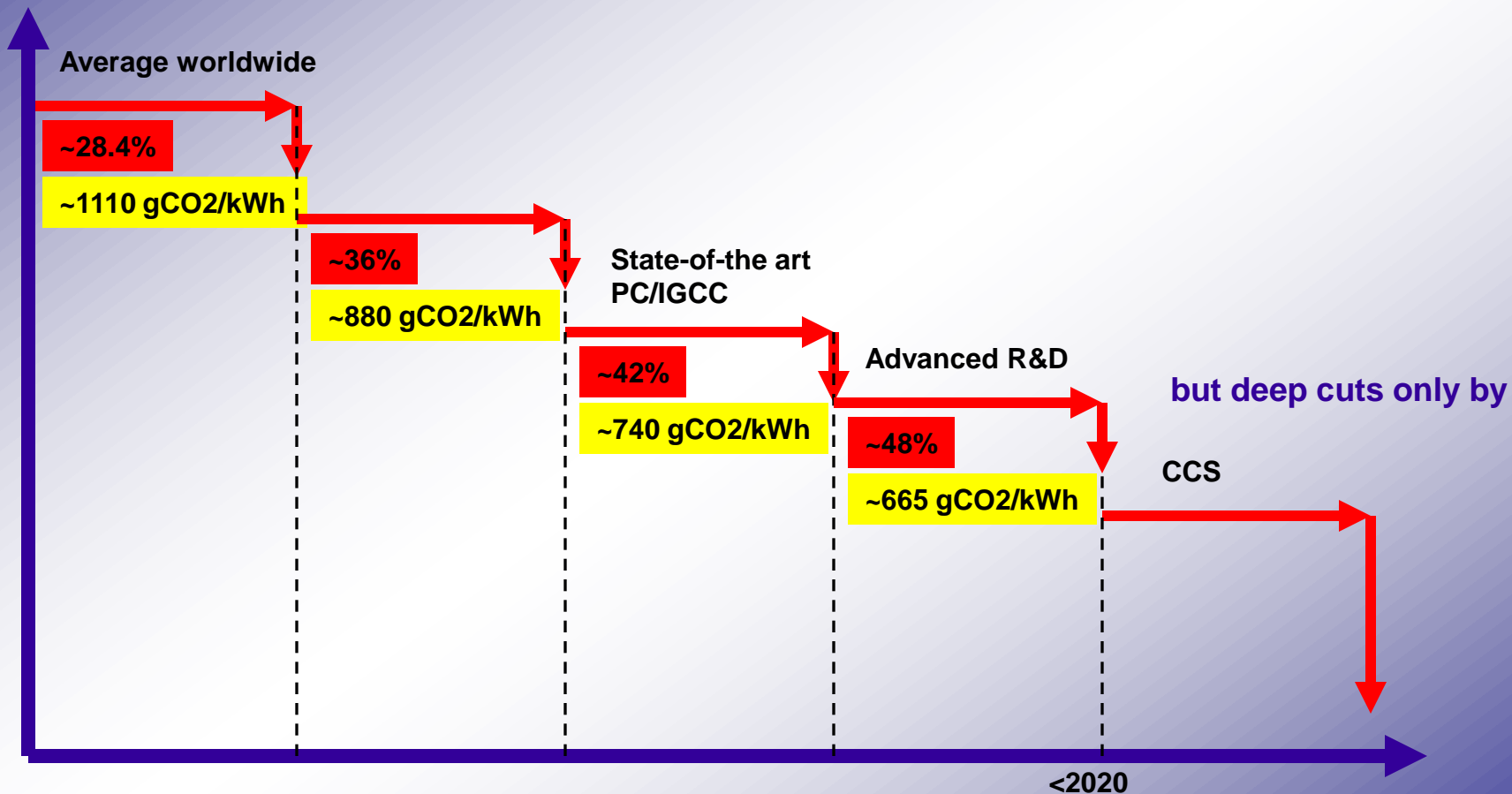
As of 2004...

- ~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 CO₂ 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_x, NO_x, 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 CO₂ is stored
- risk assessment guidelines

Methodologies are given:

MMV - IPCC GHG Guidelines
EU ETS MRG draft in preparation

EU ETS BERR report on MRG

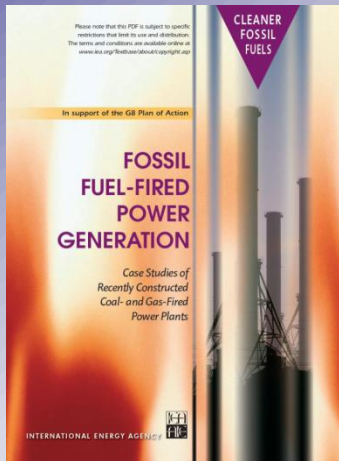
Risk assessment

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.