Materials Supply Chains in the UK :-

Fossil Fired Power Plant

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Content

- Markets & Drivers
- The Global Challenge
- Materials Supply Chain
  - Key Components & Supply chain challenges
- Future Challenges
- Conclusions

Market drivers

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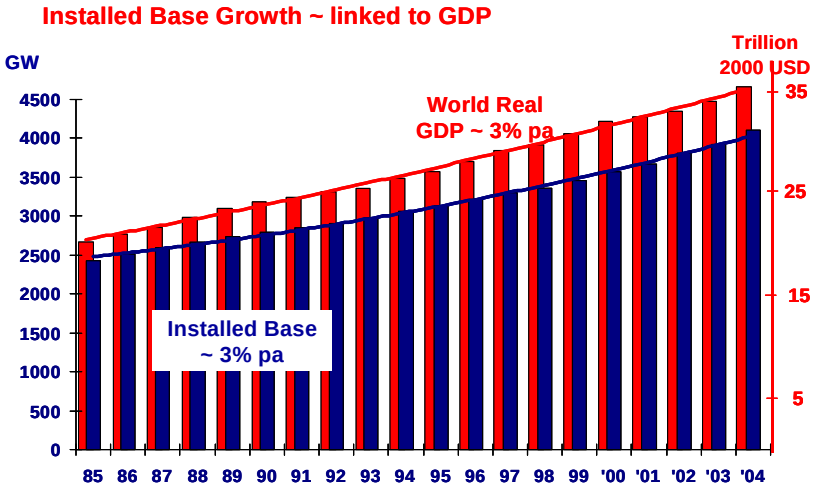
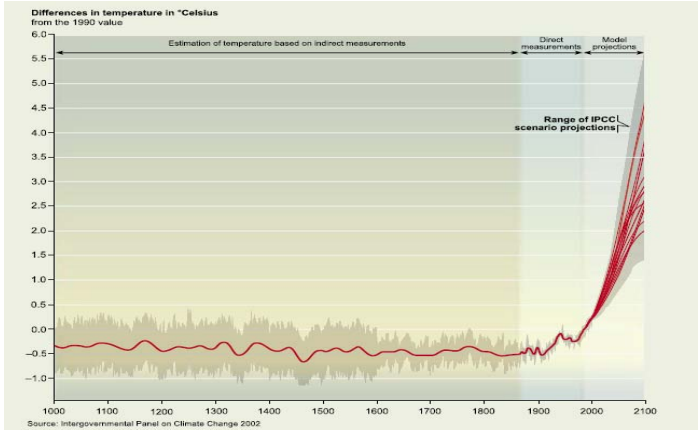
Drivers

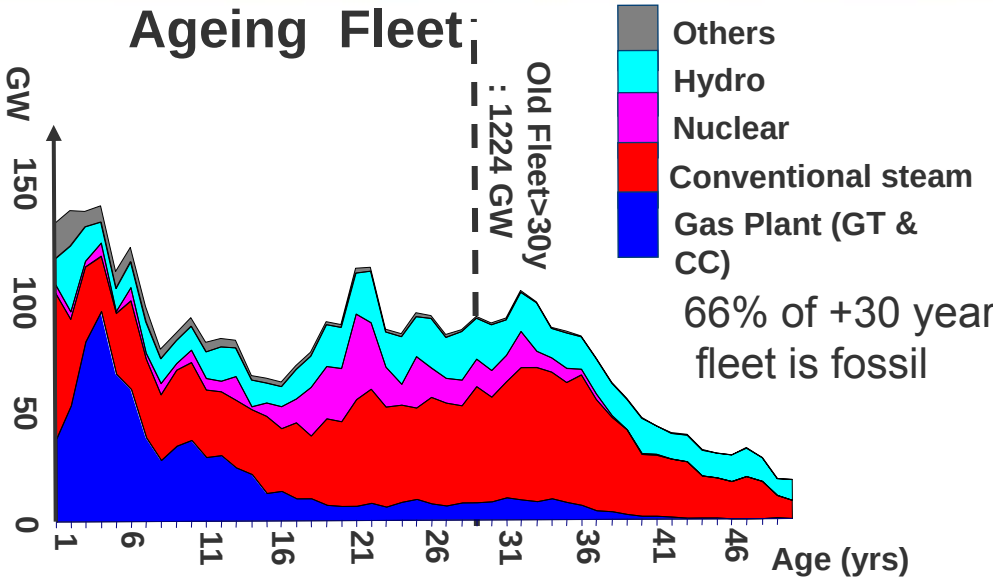
GDP Growth

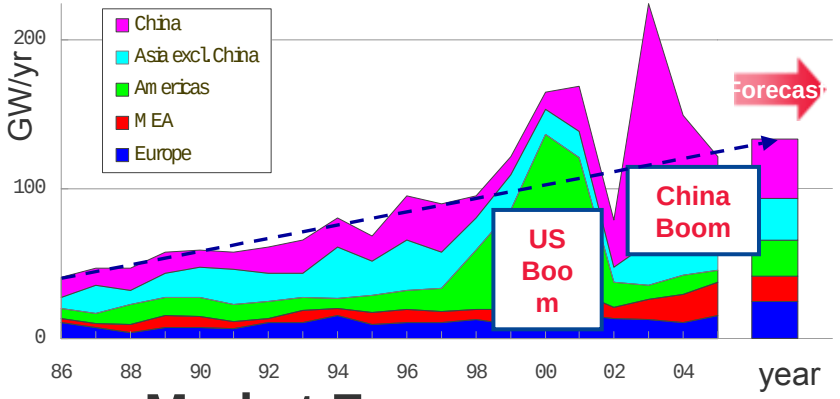




Environment

Ageing Fleet





Market Forces

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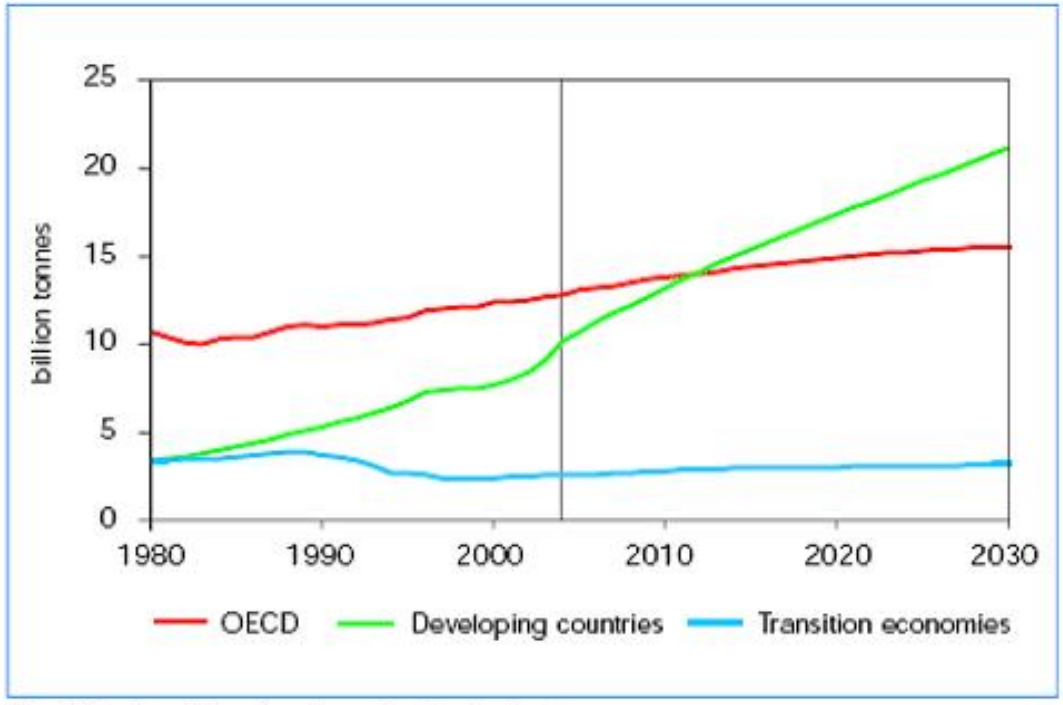
Climate Change remains a key driver

Energy-Related CO2 Emissions by Region in the Reference Scenario (IEA, WEO 2006)

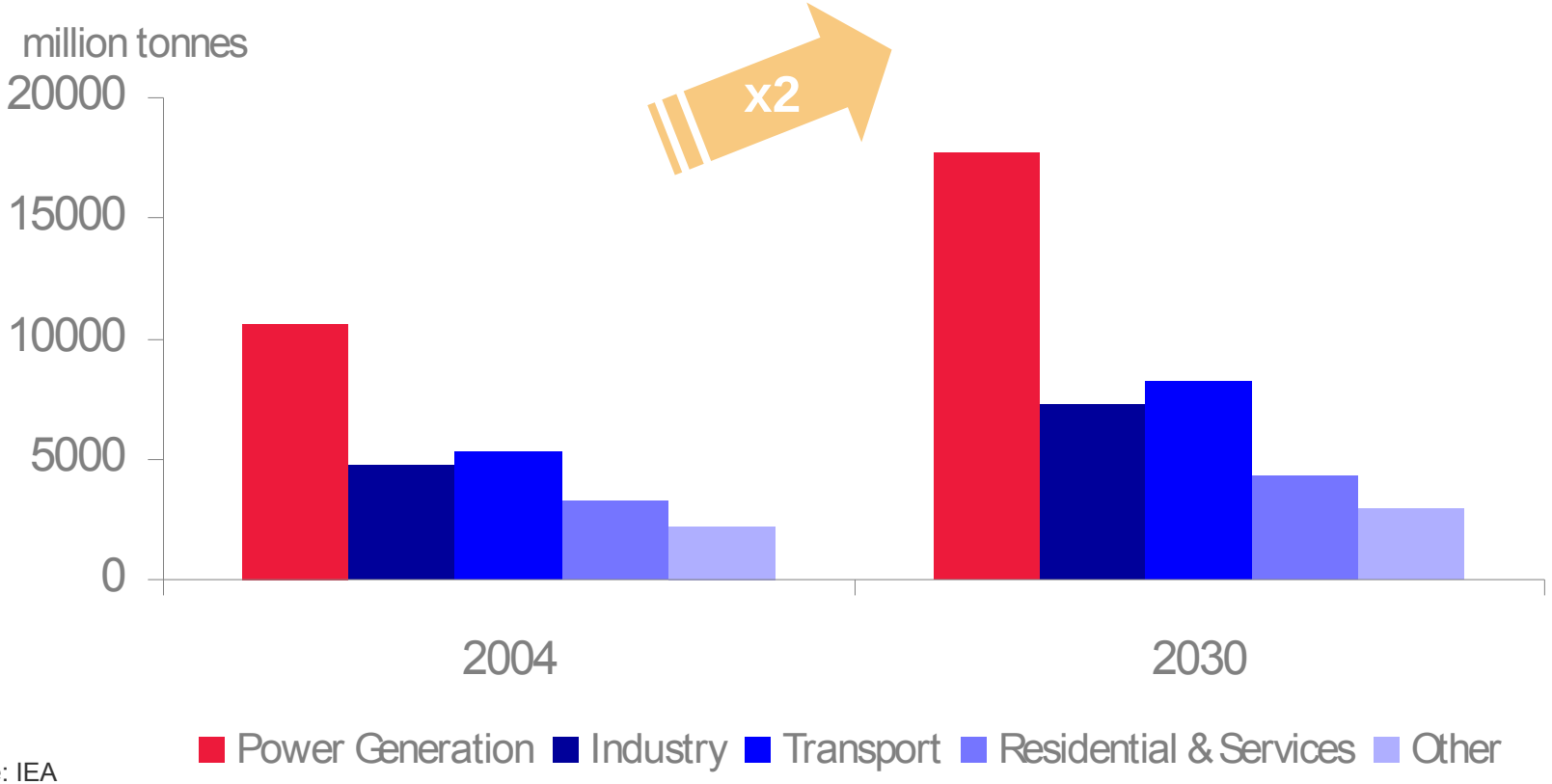


- Emissions remain a key driver and future technologies must address this.
- China has already overtaken USA as worlds major CO2 emitter

Market driver: Environment

Power generation industry: a major contributor to CO_2 emissions

CO_2 emissions from fossil fuel combustion (reference scenario)



Source: IEA

* Includes agriculture and public sector
** includes international marine bunkers, other transformation and non-energy use

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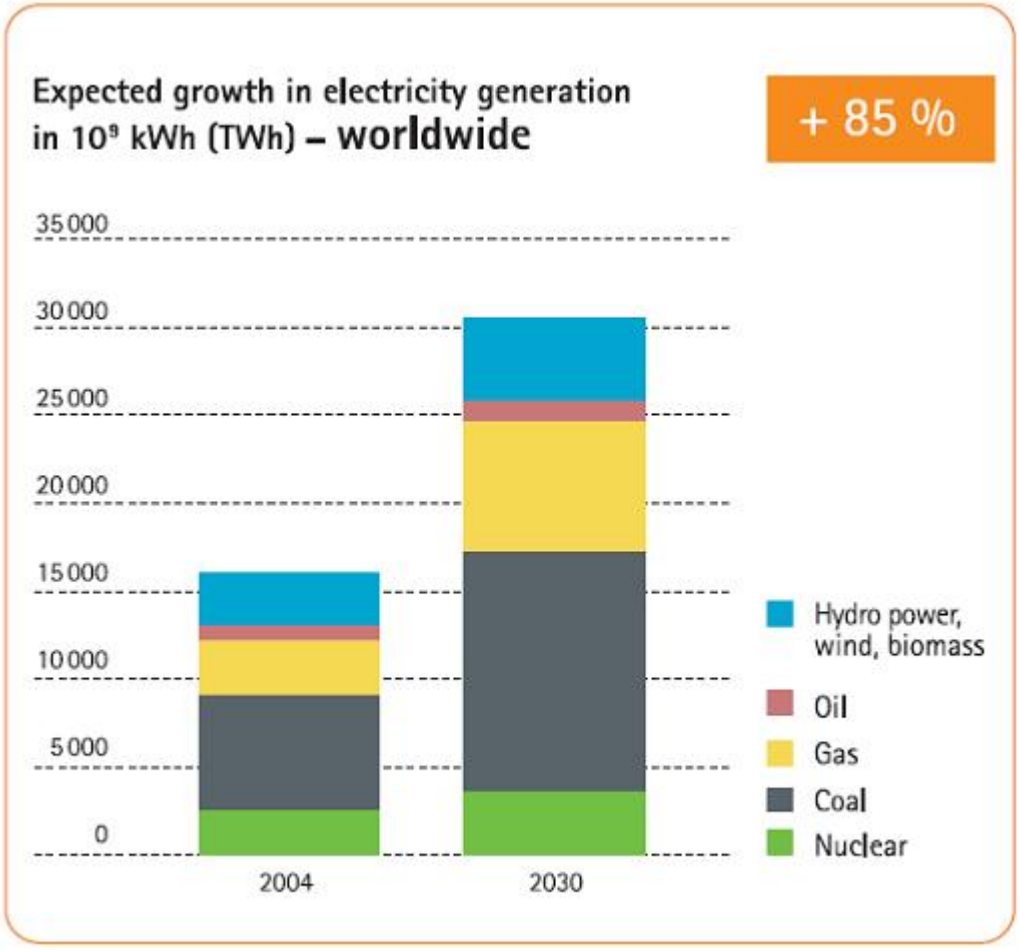
Global Market Growth



Source: IEA

- Electricity Generation is predicted to grow globally in excess of 85% by 2030
- Fossil will remain dominant

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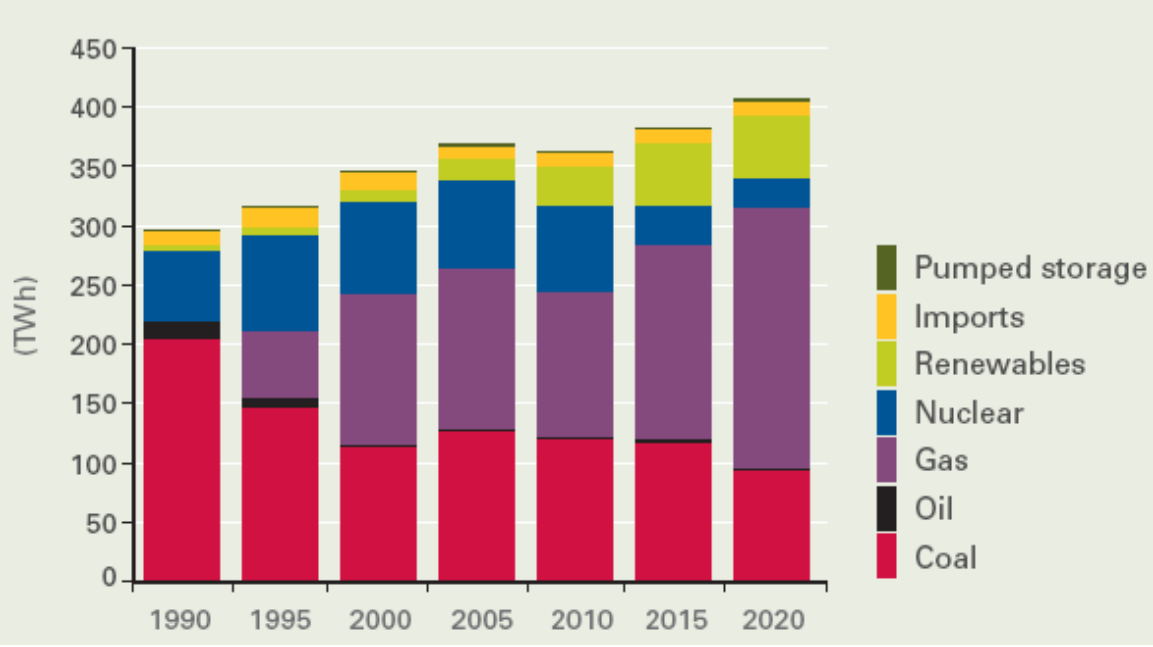
UK Perspective- the importance of fossil energy

- In 2006, electricity generation from fossil fuel combustion made up more than 75% of the UK's electricity supply, with gas-fired power stations providing 36% and coal-fired power stations providing 37.5%.

UK market

Fossil fuelled power plant will continue to be the main source of electricity generation for foreseeable future in the UK

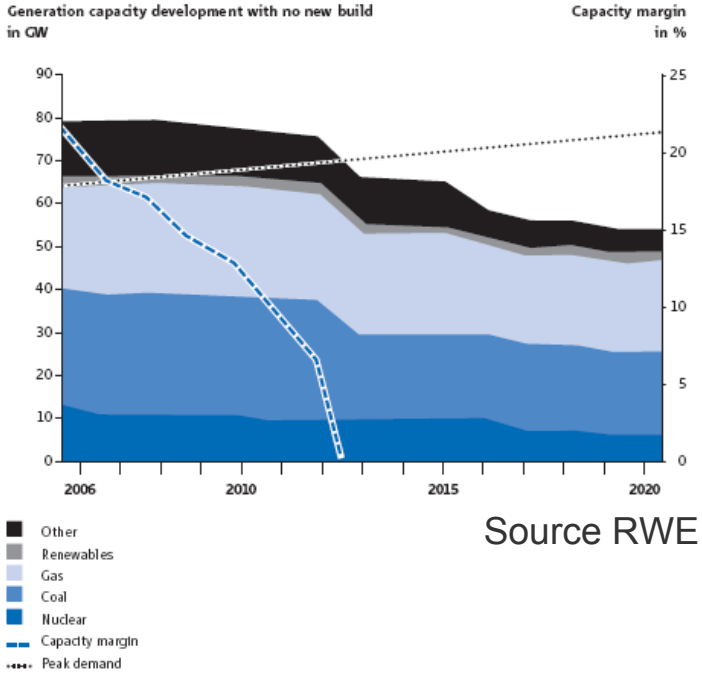


Source BERR

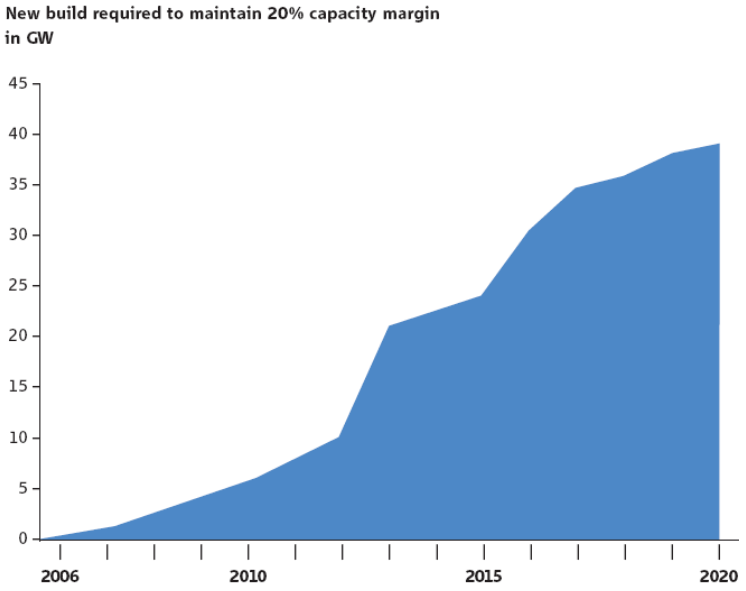
The UK market drivers

- **security of supply**
- **climate change**
- **low cost electricty**

Substantial Investment in Capacity Needed in the UK to Replace Shut-Downs and Meet Rising Demand (I)



Source RWE



35GW of new plant over the next 20 years
-mainly met by new fossil & renewables
-impact of new nuclear by 2020 likely to be small

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The Global Challenge

- Market Drivers
- The Global Challenge for the supply chain
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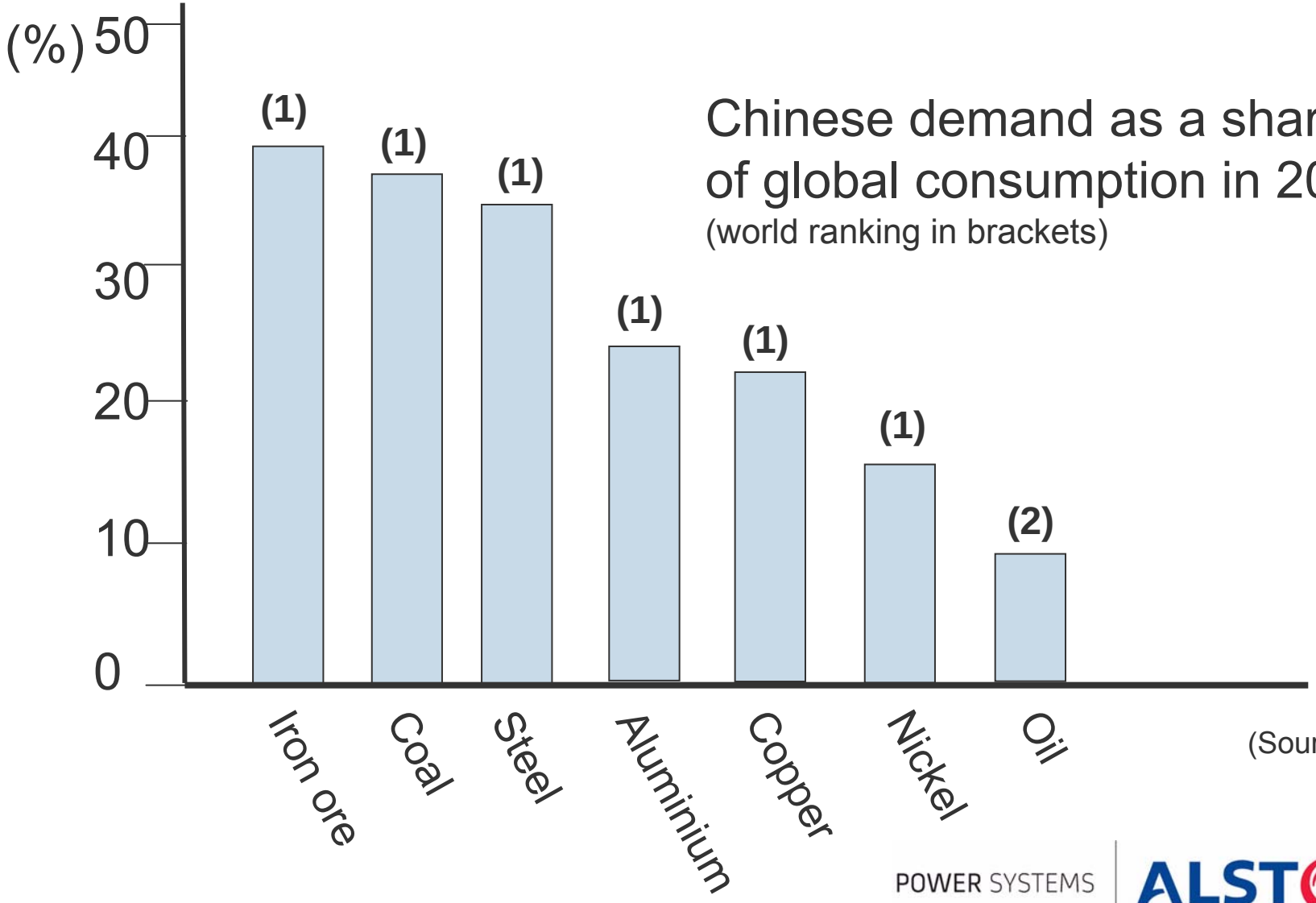
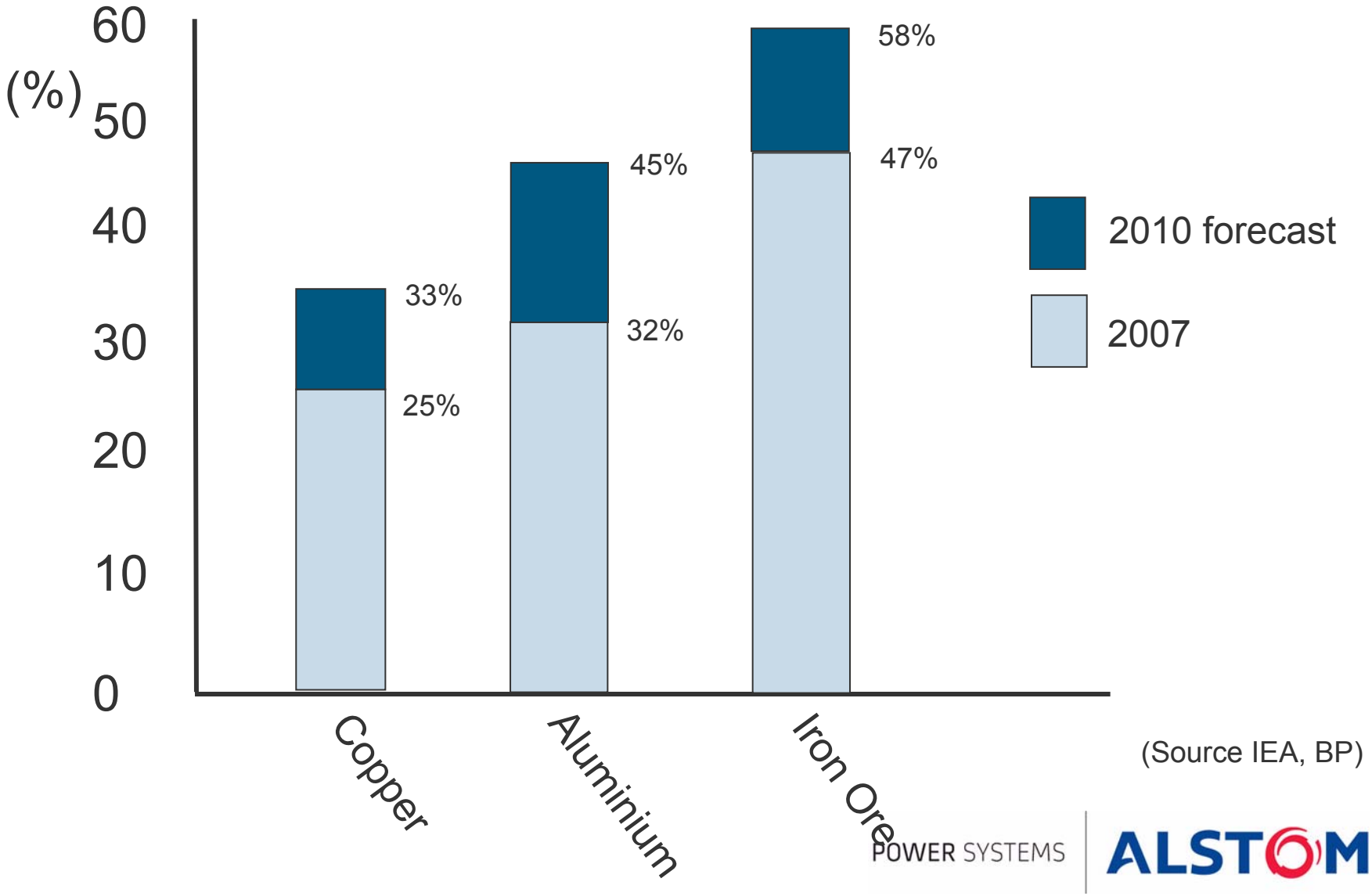
The China factor-the no. 1 global consumer of natural resources



Chinese demand as a share of global consumption in 2006
(world ranking in brackets)

(Source IEA, BP)

…and how demand is predicted to grow



(Source IEA, BP)

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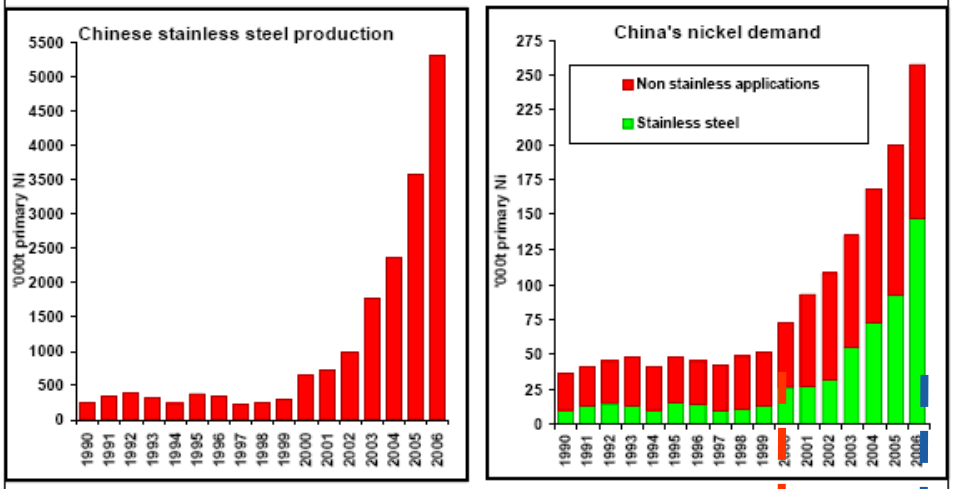
The Global Impact on Materials

Chinese stainless steel production and nickel demand explodes



Source: INSG, CRU, CSSC, Macquarie Research, May 2007

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4x demand in China 2000-06

Supply and demand….
The price explosion

~4x increase in price 2000-06

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The Materials Supply Chain

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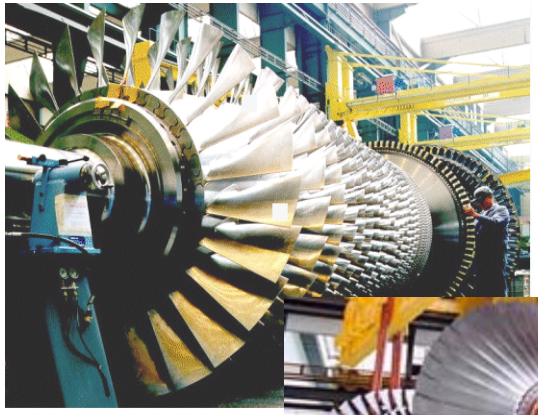
The Materials Supply Chain

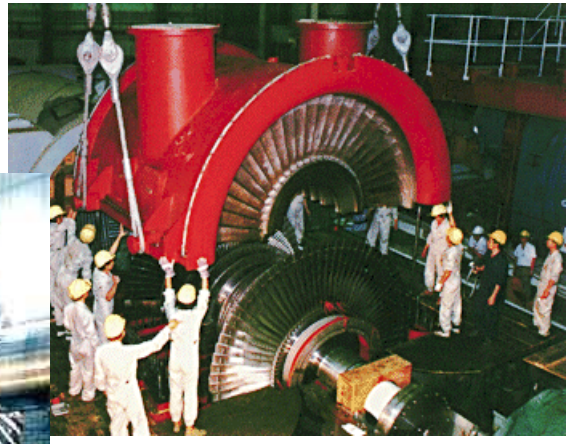
- For fossil (and nuclear) power plant, the main supply chain risk is that of availability of global processing and manufacturing facilities and capabilities….

The Materials Supply Chain
-Steam Turbine & Gas Turbine....key components

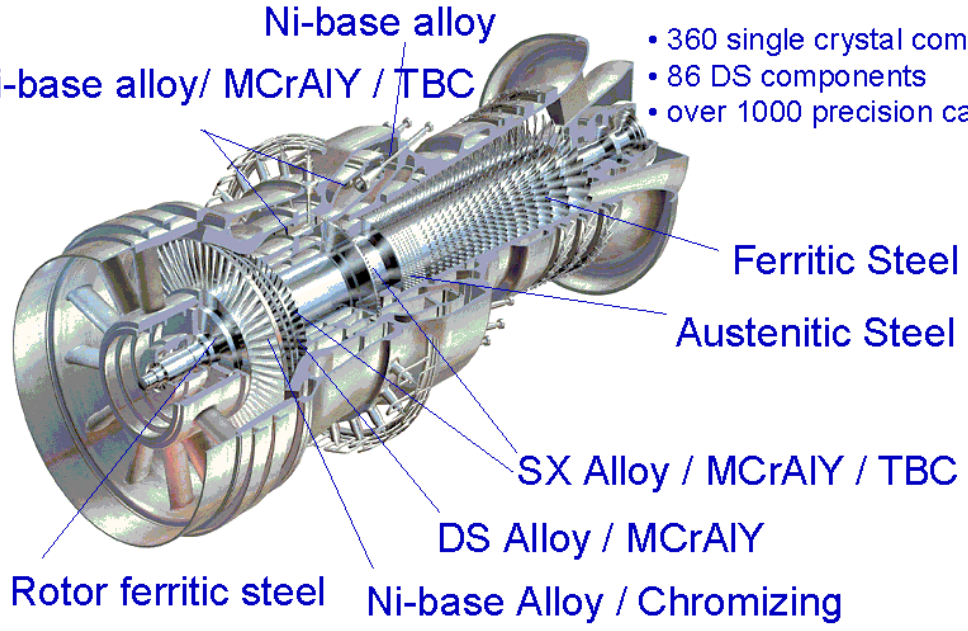


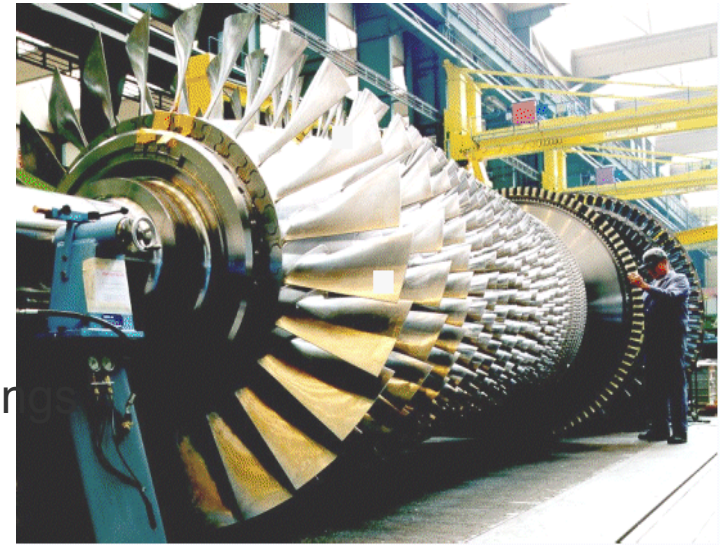
Most issues revolve around the ability to source the larger components

- Forgings-rotors, discs
- Castings-casings



The Materials Supply Chain -GT26 Gas Turbine materials





Supply Chain includes;

- Raw materials
- Cast blades SX/DS, casings to large steel forgings
- Heat treatment
- Machining
- Coatings

The Materials Supply Chain -Overcoming challenges by design

Welded rotor

Technology/know how
Available since 1929

Advantages:

- controlled material properties
- designed for low internal stresses
- flexibility in materials supplier and reduced lead time

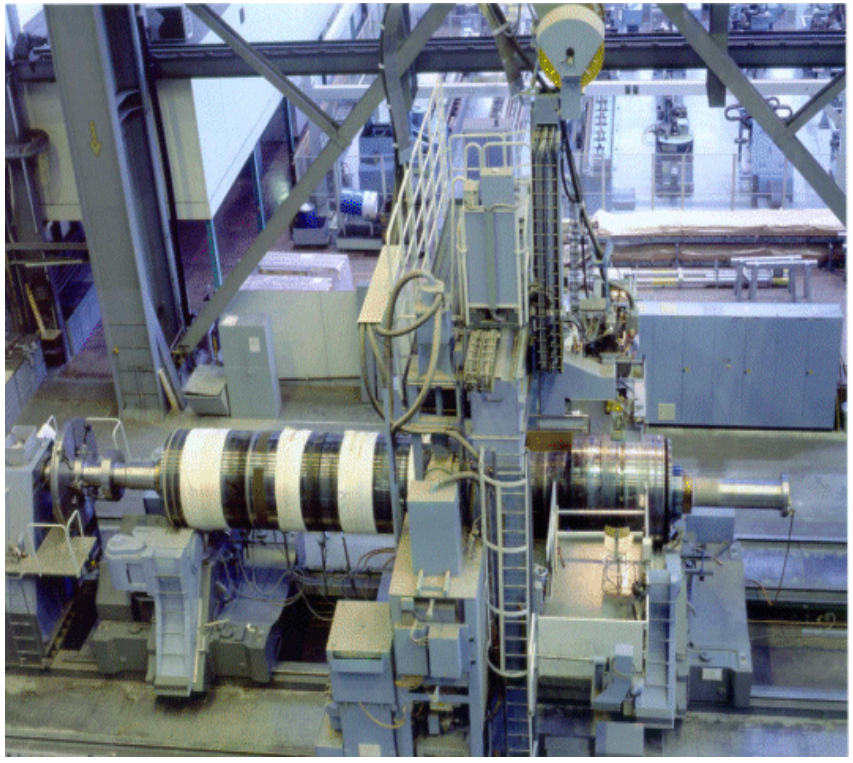
Rotor parts

The Materials Supply Chain -Overcoming challenges by

Submerged arc welding (SAW)

Automatic SAW-Tandem Welding process

Submerged arc welding Unit 1 + 2



Future Challenges

- Market Drivers
- The Global Challenge
- Materials Supply Chain
  - Key Components & Supply chain issues
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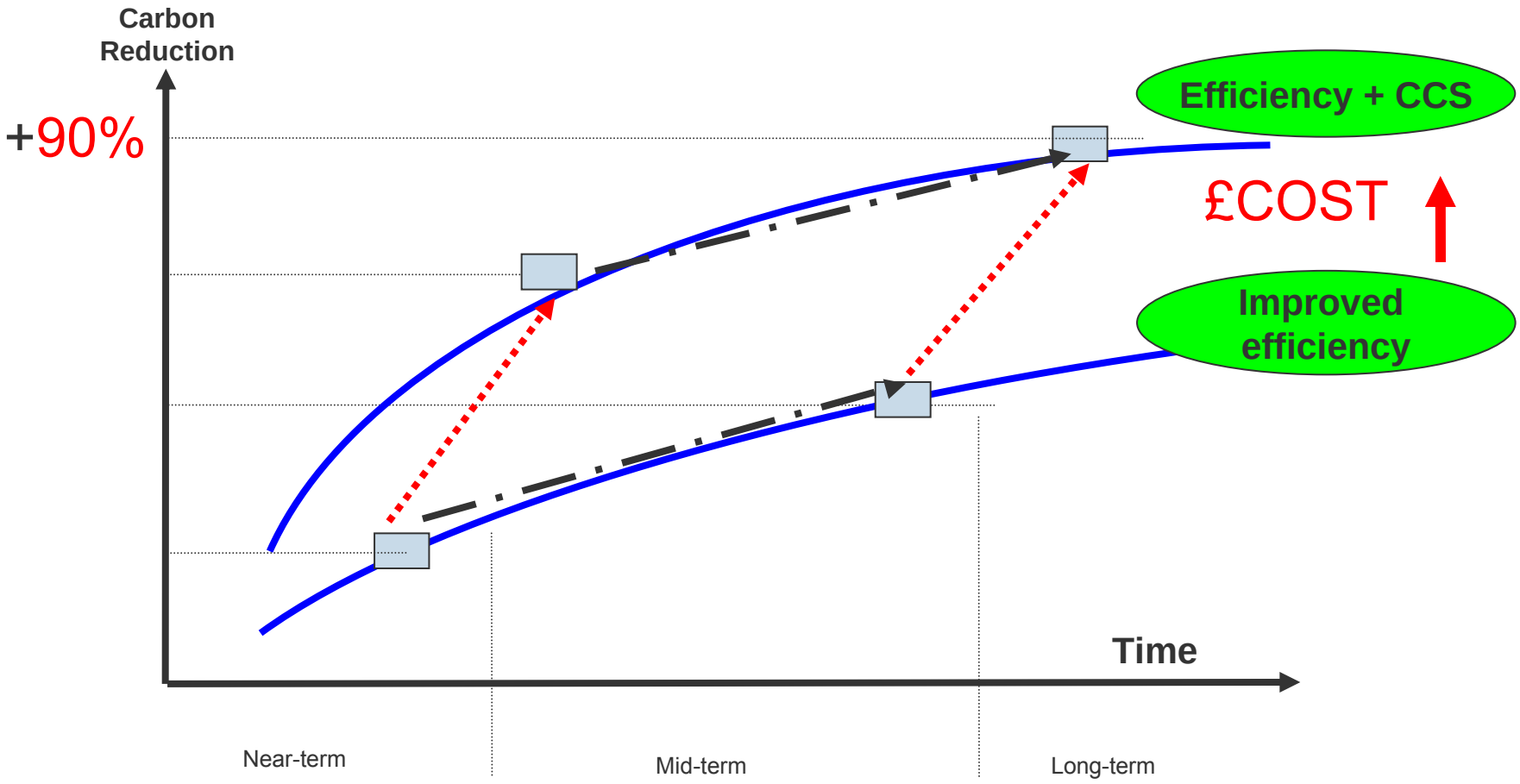
Future Challenges
Fossil power plant -Striving for Zero

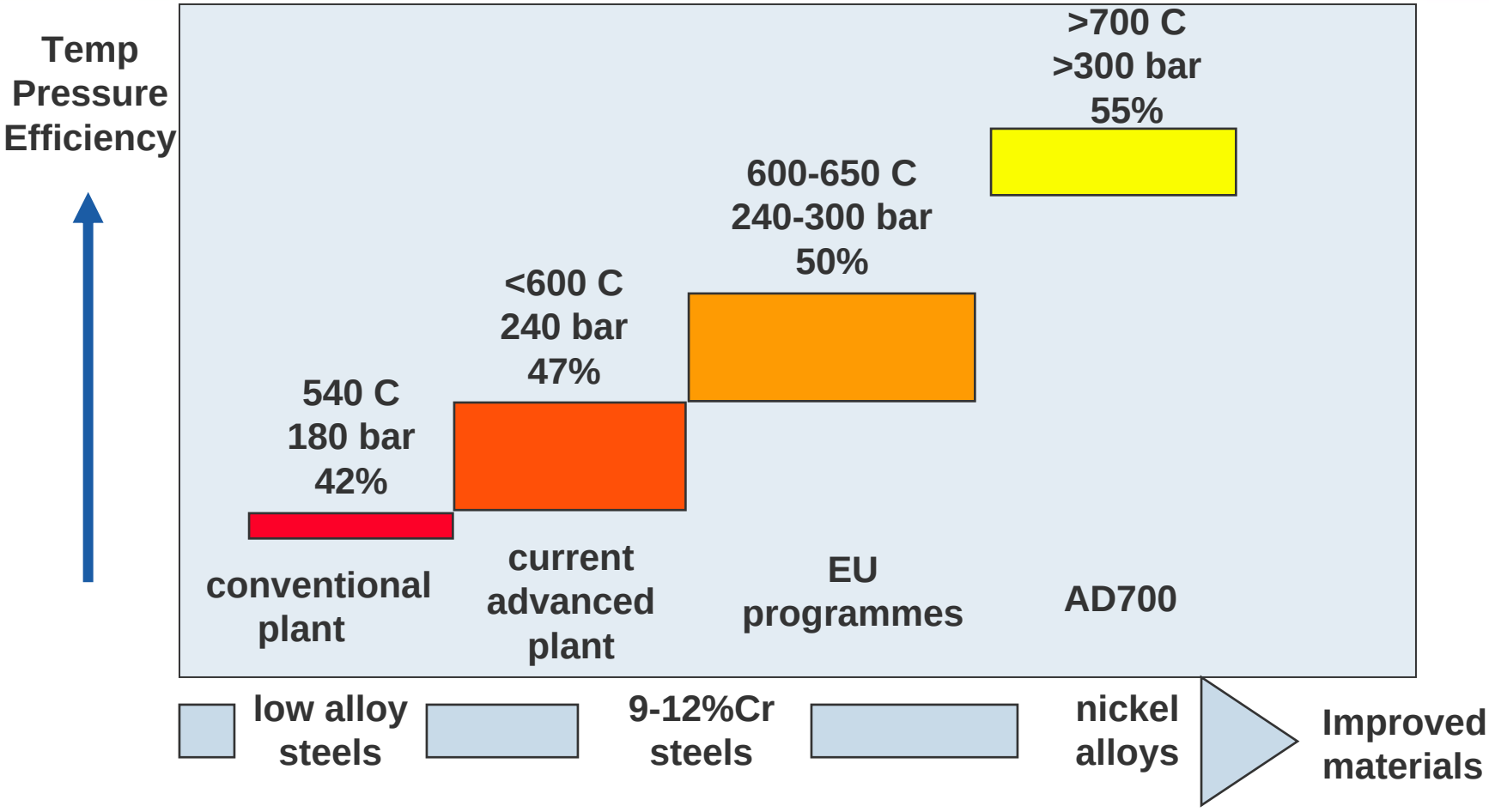


Future Challenges -Coal can be clean

	NOW	TOMORROW
Installed base	• Improve efficiency • Integrated retrofits • Conventional emissions reductions to 95-99%	• Post combustion CO_2 scrubbing to achieve emission reduction
New base		• Post-combustion capture • Oxyfiring • Pre-combustion capture?

Clean Power = limiting emissions while maintaining plant economics

Future Challenges
-Steam power plant trends



Future Challenges -The way forward

The new advanced technologies for GT & ST plant will generally

- Higher temperatures
- Higher stresses
- Harsher environments

- Supply of large steel forgings and castings will continue to be crucial
- Large Ni forgings and castings are potentially needed should the demonstration of 700C steam plant be successful
- Welding/joining technologies for dissimilar metals
- Coatings technologies/surface engineering
- NDT/inspection methods

Future Challenges -Skills

Skills

Engineering Construction Industry Training Board (ECITB) Review

- In order to stand still in the power sector, ~700 people are needed annually and a further 600 to meet expansion at 5% per annum, giving a total of 1,300 annually across the skills mix.

Conclusions

- Markets & Drivers
- The Global Challenge for the Supply Chain
- Materials Resources
  - Materials at risk?
  - Key Components & Supply chain issues
- Future Challenges
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Conclusions

- The Energy/Power generation market is buoyant and growing. Major opportunities exist in conventional fossil and in Carbon Capture & Storage
- Fossil energy will remain major UK & global source for foreseeable future
- Raw materials supply is not seen as the major risk in fossil plant
  - However, lack of sufficient world-class processing and manufacturing facilities is a major issue
- Large components (forgings and castings) are currently the main bottleneck
- Future technologies may potentially include large Ni base castings and forgings
- Operating conditions will only get more arduous, hence new technologies in
  - Coatings, modelling, lifetime prediction & NDE

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