Importance of Energy Materials: an Industrial Perspective

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4th December 2007
Energy Materials in the UK
Launch of Strategic Research Agenda
Tate Britain, Millbank, London
Alstom Power: present in all markets

Materials technologies adapted to all major energy sources

- Gas
- Coal
- Hydro
- Nuclear (conventional and conventional part)
- Wind
Agenda

1st topic  Energy Market Drivers and Issues

2nd topic  Energy Technologies and Materials

3rd topic  Concluding Remarks
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Market Driver: GDP Growth
Increasing demand for electricity

Increase in demand for energy, especially electricity and in developing countries

29% of installed capacity older than 30 years
Market Driver: Global CO₂ Emissions

Goal: A long term moderate stable CO₂ concentration in the atmosphere

IPCC AR4 Nov07

Need to peak at 2015 to have any chance of meeting desired 2°C rise target

50-80% reductions required at 2050

IPCC* Scenarios

- Business-as-usual
- Required reduction
- Desirable reduction

- 1000 ppm
- 550 ppm
- 450 ppm

~40% caused by power generation

Goal: A long term moderate stable CO₂ concentration in the atmosphere

Source: WBCSD 2005* Intergovernmental Panel on Climate Change

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Key `take-away` messages

- All technologies will be needed: a full portfolio approach
  - `Clean` Use of Fossil Fuel
  - `Economic` Renewable Energy
  - `Safe` Nuclear
- Substantial increase in take-up of energy efficiency
Key `take-away` messages

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- Need to accelerate deployment
- Need to address issue worldwide
Key `take-away` messages

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- Importance of continued technology development
  - subsequent generations of technology
  - importance of underpinning technologies

- Critical role of materials
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Clean Fossil Fuel: pathway to `zero emission`
Advanced Power Plant Cycles

Stairway to high efficiency and performance

Process Optimization
- Once Through Technology
- LowNox FGD
- Flue Gas Waste Heat Utilization
- Pre-dried Lignite (WTA)

Material Development (SH)
- X20
- T91 Austenitic Materials
- Ni-Based Materials

Cycle Improvement Milestones
- 1960
- 1980
- 2000
- 2020
Carbon Capture Technologies

- Accepted need for a portfolio approach
- All technologies need to be addressed
- Retrofit and new plant application

Main goal: Cost of CO₂ avoided: < 20 €/t CO₂

All of the options require materials to operate in more aggressive environments
Rotating Machinery

- high temperature
- high pressure
- harsher environments
- new alloys, coatings
- sealing systems
- reliability, life prediction
Renewable Energy: Hydro

- weight and strength
  - composites

- reliability
  - corrosion, coatings, monitoring
Renewable Energy: Wind

- **Cost**
  - Cheaper materials & processing

- **Efficiency**
  - Larger advanced composite blades, joining technologies

- **Reliability**
  - Coatings, remote condition monitoring, NDE, sensors, life prediction
Nuclear Power

➢ Conventional ‘island’ plant shares many similar generic materials challenges with ‘nuclear’ components:
  • high temperatures
  • harsh environments
  • lifetime prediction models
  • environmental degradation
  • safety & reliability - NDE
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Concluding remarks

- all energy systems reliant upon aspects of materials engineering

- materials a vital underpinning and enabling technology

- future generation energy technologies will depend upon material developments

- Alstom fully supports the initiative