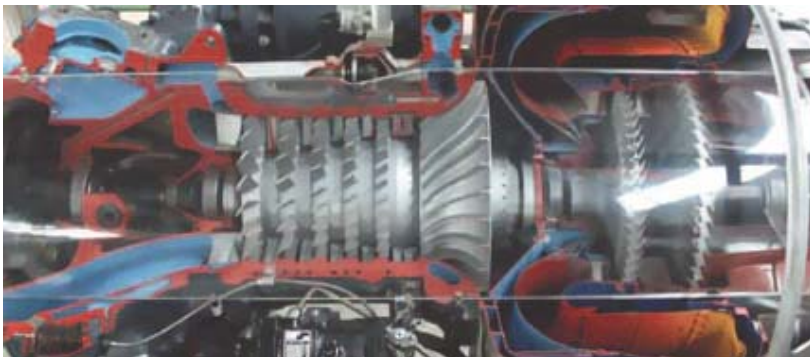


National Research Council Canada & Industrial Applications for Gas Turbines Committee

Collaborative Forum on:

Challenges and Opportunities in Future Gas Turbine Development and Operation



October 20th & 21st, 2008

The forum will be a two day event, aimed at bringing together experts and stakeholders from government, industry, academia and users sectors to identify and address the future challenges and opportunities in gas turbine technology development and operation. The event will also give the attendees an opportunity to visit some of the globally unique NRC facilities. The event will follow a panel format where invited experts from Government, OEM, Academia and Users Group will present their view on the following designated topics:

- 1. Fuel flexibility and alternative fuels for gas turbines**
- 2. Gas turbine performance and health monitoring**
- 3. Gas turbine material and component lifing**

The panel presentations and open discussions on the topics will target solutions, gaps and ways forward for reducing environmental emissions, and increasing system efficiency, engine reliability and energy security.

Session 1

Fuel Flexibility and Alternative Fuels

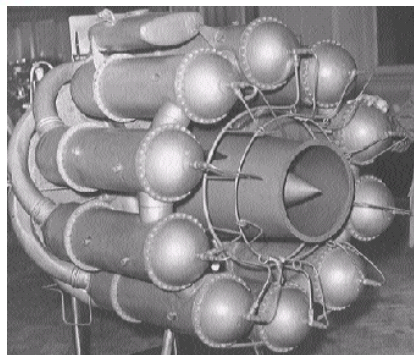
Moderator: Wajid Ali Chishty

Gas Turbine Laboratory, NRC-Institute for Aerospace Research

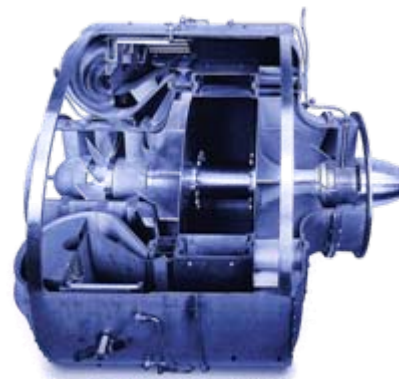
October 20, 2008



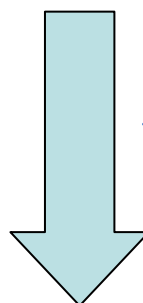
Progress in Gas Turbine Technologies



Whittle 1 (3.8kN)



He S 3B (4.4kN)



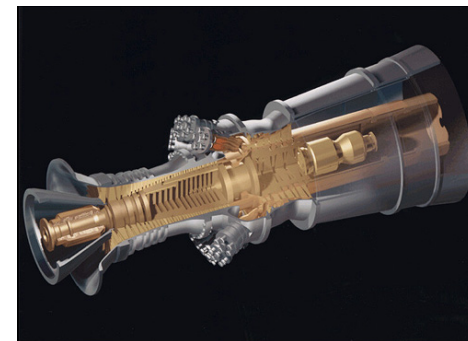
~ 70 years



Trent 1000 (333kN)

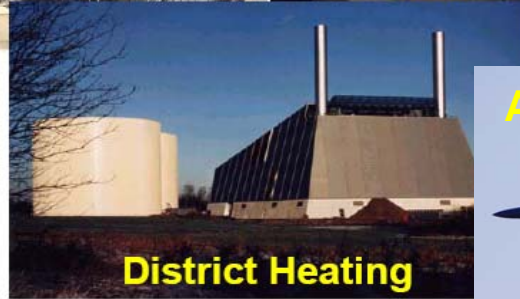
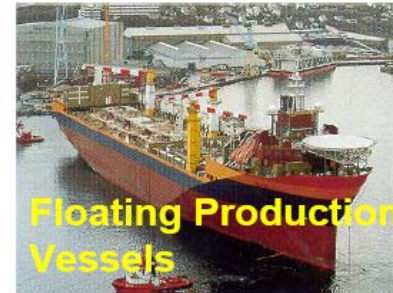


F135 (156kN)



H-Series (400MW)

Present Utilization



- Meets 19% of world's installed electric generation capacity
→ 39% by 2020
- New electric power demand in the U.S. by 2010
→ 81% will be met by gas turbines

- World energy demand growth
→ 47% electrical generation & 20% transportation

(Ref: Lipton, 2005)

Clear and Present Challenges

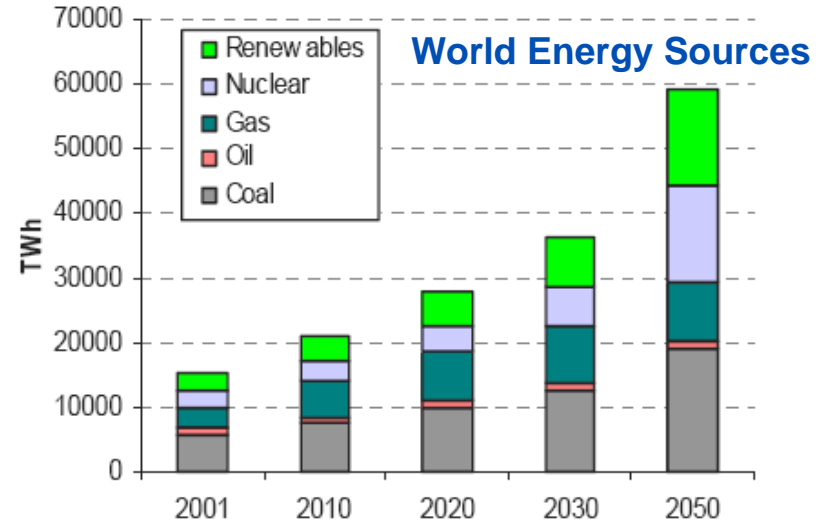
- Pollutant emissions and GHG contamination
- Energy security
- Depleting fossil fuel reserves
- Fuel price



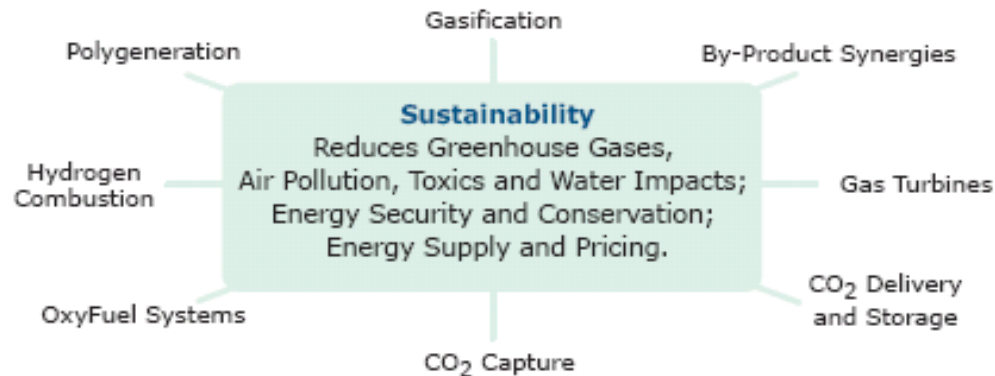
Clear and present need for low emission energy

Energy Outlook

- Long term (>50 years):
 - Carbon free energy sources: Renewables
 - H₂ -economy
- Short term (< 50 years)
 - Alternative fuels
 - Integrated energy solution



(EC Report : "World Energy Outlook-2050", Brussels, 8 January 2007)



Alternative Fuels

- Hydrogen enriched syngas (gasification of coal, biomass, solid waste)
- Bio-fuels (ethanol, butanol)
- Synthesized liquid fuels (BTL, CTL, GTL)
- Biojets
- Unconventional petroleum resources (tar sand, oil shale)
- Biodiesel
- Microalgae based

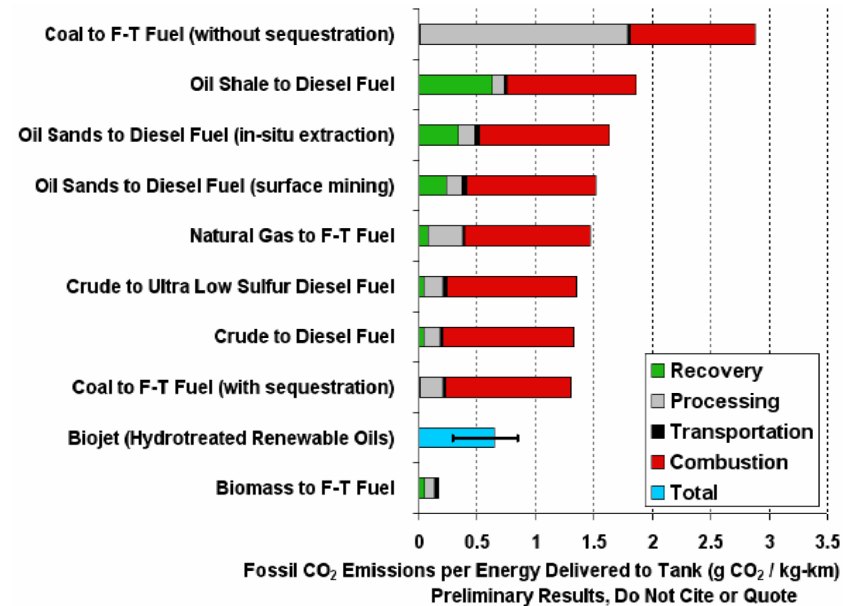


Alternative Fuels Issues

- Food vs. fuel
- Fuel flexibility
- Lubrication and fuel system elastomer leakage
- Thermal stability at low and elevated temperatures
- Operability
- Production capacity
- Effects on turbomachinery
- Are these novel fuels really green ?



(Daggett et al., 2007)



(Hileman et al., 2008)

What does this mean for the future gas turbine research, technology development, operation and maintenance ?

The “Omnivorous” Gas Turbine



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LAND, BY AIR, BY SEA**

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