Hydrogen Working Group

Objectives of the ETN Hydrogen Working Group

Enable and optimise the use of hydrogen in gas turbines by:

- **Highlighting potential use, applications** and benefits
- **Pave the way for funding opportunities** by highlighting the research needs on gas turbines to burn hydrogen, in order to contribute to the deployment of those gases in future energy systems.
- **Address operational issues/effects** on gas turbines components related to the use of hydrogen.
- **Explore market opportunities** and retrofit solutions for existing and future gas turbines fleets operating with renewable gases (containing hydrogen).
- Assess and **address operational safety aspects** of hydrogen in gas turbines plants (and pipelines).
- To **foster the use of hydrogen and hydrogen carriers** (such as ammonia) as complementary energy vectors to decarbonise the energy systems.

Research Needs (1/2)

Hydrogen Combustion

- The combustion of hydrogen without dilution and with low emissions is still on an early development stage.
  - **High burner inlet temperatures** increase the **risk for flash back** in the premixing zone compared to natural gas.
  - The high reactivity of hydrogen inherently increases the **auto ignition risk** in the premixing section which needs to be addressed in future combustor development
  - The targeted **high TITs do not allow for higher air to fuel ratios** which would help to reduce the reactivity of H2 flames
  - Hydrogen flames exhibit a **different thermo acoustic behaviour** and therefore require different measures to avoid high pressure pulsations
- In the transition to a hydrogen based energy system **fuel flexible gas turbines** are needed to utilise blends of hydrogen and other gaseous fuels e.g. natural gas

Research Needs (2/2)

Retrofit of existing gas turbines

- While new gas turbines will be developed to be operated with higher hydrogen concentrations, the **hydrogen capability** of existing combustion systems **has to be evaluated**. As small changes to the combustion system can increase the risk of flash back and flame anchoring inside the burner, **each gas turbine has to be rated separately**.
- **Strategies to** test and **evaluate the maximum possible hydrogen content** in the fuel for existing gas turbines have to be developed
- **Cost effective retrofit solutions** have to be developed to allow for a fast transit to a technology capable of higher hydrogen fuel contents and to fulfil customer's needs
- **Safety related topics** of the overall system have to be investigated

Objectives of ETN regarding ammonia

- We need to know the **key enablers for the introduction of ammonia in gas turbines**, searching for novel implementation opportunities
- Topics that require consideration for the progression of the technology are the understanding and development/improvement of:
  - Impacts of hot ammonia/alkaline-acid streams to materials and lubricant/oils
  - Compressor, turbines and pumps performance under new cycle, industrial conditions
  - Fundamental combustion issues: radicals formation/control, stability, NOx, designs