Combustion in a Low Carbon World

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- **Electrical Power Generation**
- **Heating (residential, commercial and industrial)**
- **Transport**
- **Safety**

Electrical Power Generation

Globally need to shift from coal (currently 38%)

Gas-fired power generation is natural partner for renewables

<u>Requirements</u>

- **Efficiency, ultra-low pollutants (NOx, particulates, unburnt methane, etc)**
- **Balancing renewables intermittency requires:**
  - **frequent start-ups and shut-downs**
  - **ability to accommodate fast load changes**
  - **possibly part of decentralised system, e.g. small scale powerplant, micro-CHP**

    able to operate at part-load efficiently with low emissions, no flame instability or lean blowout

    modelling under non-stationary conditions, handling dynamics,

    sensors and control

    component life
- **Enable CCS**
- **Fuel flexibility**
  - **e.g. natural gas, biogas, derived products**

Heating (residential, commercial and industrial)

- Perhaps the hardest to decarbonise
- Improve efficiency of buildings and processes (more recycling)
- More efficient, lower cost boilers, heat pumps etc
- Hydrogen (from electrolysis of water as storage for renewable energy or from methane with CCS) in gas grid, biomethane, BioSNG, with requirements for burners with fuel flexibility
- Micro-CHP

Transport

- Globally, number of cars estimated to double over next 20 years, 75% estimated to run on conventional i.c. engines
- UK commitment to electric cars, optimise hybrids
- Energy density of batteries is less than 1% that of liquid fuels
- Trucks/shipping – natural gas, LNG, CNG, decarbonised gas, biofuels etc - fuel flexibility needed combined with high efficiency, low pollutants
- Aviation – biofuels, synthetic fuels from other non-conventional feedstocks (eg municipal waste)
- Should these fuels mimic kerosene or should better fuels be designed?
- Biofuels + CCS for negative CO_2

Safety

- **Fires**
  - **buildings as a system**
  - **natural/forced ventilation systems for cooling and integration with fire modelling**

- **Forest/vegetation fires will come more prevalent under the conditions expected due to climate change**