Aviation Transport

HIGHLIGHTS

■ **TECHNOLOGY STATUS –** This brief highlights notable technologies that are expected to contribute to energy efficiency gains and reduction of greenhouse gas emissions in civil aviation. Aviation travel currently accounts for around one-tenth of transport energy use globally, and is expected to be the fastest-growing transport mode in the future. Aviation kerosene (Jet A-1) is the fuel used in virtually all commercial aviation. Reducing fuel consumption is a key priority for the industry, both to reduce air transport's environmental impact and to keep operating costs down in the face of rising fuel prices. Energy reducing technologies can be broadly grouped into **airframe design** (mainly reducing the weight and aerodynamic drag of aircraft), **engine design** (improving the efficiency of turbofan and turboprop engines), and reducing the **life-cycle emissions from aviation fuel** (particularly through the use of biofuels). Operational measures also have a significant part to play in reducing the impact of the sector.

■ **PERFORMANCE AND COSTS –** Airframe technologies have the potential to lower fuel consumption by up to 20-25% by 2025 if fully implemented in new aircrafts. Energy savings of up to 2-5% could be realised now by retrofit. Engine technology developments have the potential to reduce fuel consumption by 15-20% by 2025. Replacing engines on existing airframes with new, more efficient versions could result in short-term savings of 5-7.5%. As technologies will be incorporated into new aircraft designs, individual costs are not publicly available. However, all technologies offer the potential for fuel cost savings, and fuel costs currently comprise around one third of operating costs. As a consequence, technology costs can be offset against these savings to an extent. A reduced exposure to oil price fluctuations is a further benefit of implementing energy efficiency technologies.

■ **POTENTIAL AND BARRIERS –** The International Air Transport Association (IATA) has set an industry goal of reducing CO_2 emissions from aviation by 50% compared with 2005 levels by the year 2050. In 2010, the International Civil Aviation Organization (ICAO) adopted a resolution on aviation and climate change which included a goal of a global 2% annual improvement in aviation energy efficiency to 2050 (per revenue tonne kilometre performed). An uncertainty over future oil prices provides an initial incentive to increase fuel economy; legislation such as the forthcoming inclusion of aviation in the EU-ETS provides further price signals. However, barriers such as proving the commercial feasibility and safety of novel technologies, the long life cycles of commercial aircraft (around 30 years) and the unproven sustainability of biofuels mean that the timescales and extent to which the environmental impact of aviation can be reduced are far from certain.

TECHNOLOGY STATUS – In 2007, aviation accounted for 11% of global transport energy consumption [1]. The International Energy Agency expects aviation to be the fastest growing transport sector in the future, with passenger-km travelled anticipated to increase by a factor of four between 2005 and 2050 in their baseline scenario [1]. This scenario also projects that aircraft efficiency will improve at a rate of 0.6% per year (or 30% between 2010 and 2050) and that load factors will also increase. The IEA's most ambitious emission reduction scenario (i.e. the BLUE Map) projects a faster rate of improvement of 1% per annum [1].

This briefing note highlights the more notable technologies which are expected to contribute to these efficiency gains along with measures such as alternative fuels, which will contribute to the reduction in greenhouse gas intensity of aviation.

A new aircraft is sourced from two companies: an airframe manufacturer and an engine manufacturer. The two largest airframe manufacturers are Boeing and Airbus, who manufacture a range of short, medium and long haul turbofan-powered aircraft, while ATR and Bombardier manufacture the airframes of short range turboprop aircraft. Airlines also usually have a choice of engine manufacturer. There are two principal types of engine used in commercial aviation: the turbofan and the turboprop. A **turbofan** engine combines a gas turbine core with a ducted fan and is primarily used on executive jets and larger, high altitude passenger aircraft. Major turbofan engine manufacturers include CFM International, Pratt & Whitney, General Electric and Rolls Royce. **Turboprop** engines combine a gas turbine with a propeller and are primarily used on short range, medium altitude executive aircraft, airliners and helicopters. Manufacturers of turboprop engines include Pratt and Whitney and Rolls Royce. Aircraft also make use of **auxiliary power units (APUs)** which are small gas turbines, usually mounted at the rear of airliners. These units supply electricity to operate the electrical, hydraulic and air conditioning systems when the main aircraft engines are switched off and are also used for main engine start up. Turbofans, turboprops and APUs all burn aviation kerosene, known as 'Jet A' in the US and 'Jet A-1' around the rest of the world.

In 2008, aviation fuel was the single largest cost item for the airline industry, representing over 30% of operating costs, up from around 12% of operating costs at the start of the decade [2]. Airlines therefore place a lot of emphasis on reducing aircraft fuel consumption. One of the main goals of airframe and engine

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