Aviation Infrastructure

HIGHLIGHTS

■ **TECHNOLOGY STATUS –** This brief covers energy consumption and greenhouse gas emissions of aviation infrastructure, including runways and taxiways, airport buildings and services, and ground support equipment. Runways are tarmac or asphalt-paved surfaces for aircraft take-off and landing; taxiways are non-runway paved surfaces for aircraft taxiing, loading and storage, with lower specification than runways. In cold conditions, airport surfaces and aircraft require de-icing, currently achieved using de-icing fluid that is a major airport consumable for airports above certain latitudes. Airport terminals have similar construction and operational needs to offices and shopping centres. Ground support equipment (GSE) provides power, mobility and loading/unloading to aircraft at the terminal, and is a significant source of airport operational energy consumption. Current GSE is mainly fuelled by gasoline or diesel internal combustion engines. Moving to alternative fuels and powertrains is a major option to improve GSE efficiency.

■ **PERFORMANCE AND COSTS –** Aviation infrastructure contributes a modest proportion of the total GHG emissions from aviation, estimated at around 3.2% of the total emissions per passenger-km. Around two-thirds of these emissions arise from operation of the infrastructure, with the remaining third mainly originating from its construction. The largest single source of aviation infrastructure emissions is the ground support equipment (GSE), which account for 51% of the life cycle infrastructure emissions per passenger-km travelled. These emissions primarily occur because GSE are powered by fossil fuel combustion engines; moving to GSE powered by low emission fuels or electricity is therefore a key mitigation measure. Construction of runways and tarmacs (taxiways) is also a major contributor to infrastructure life cycle emissions, with 8% and 22% respectively. Improving the airport traffic management has the potential to reduce emissions by 6-12% per trip. Connecting aircraft to the terminal providing centrally generated electricity ("fixed gate" energy supplies) during service operation and maintenance - in place of using aircraft's auxiliary power unit or mobile generators - is another measure to improve energy efficiency, reduce emissions and costs.

■ **POTENTIAL AND BARRIERS –** There is significant potential to improve energy efficiency of aviation infrastructure, but investment costs and the physical layout of existing airports can be a barrier to changes and improvements. In addition, in developed countries, expansion projects for airport infrastructure have often to face public opposition. For example, replacing mobile power units (typically diesel) and/or the aircraft's auxiliary power unit with fixed gate supply offers a significant efficiency potential, but in many airports the physical layout is a barrier as the transmission over distance of the 115/200V, 400 Hz electricity needed for commercial aircraft involves relatively high losses, and more generation capacity would be needed to provide power to a number of aircraft docked at any time.

TECHNOLOGY STATUS

This briefing note highlights the more notable technologies which could increase the efficiency of aviation infrastructure and will contribute to the reduction in greenhouse gas intensity of aviation as a whole. The International Energy Agency in its baseline scenario [1] projects aviation to be the fastest growing transport sector in the future, with the number of *passenger-km* travelled anticipated to increase by a factor of four between 2005 and 2050. This future increase in aviation demand will involve a considerable increase in energy consumption and place a burden on aviation infrastructure, including communications, navigation, surveillance, air traffic management and related infrastructure, such as airport terminals and runways. In 2008, aviation fuel was the single largest cost item for the airline industry, representing over 30% of operating costs, up from around 12% at the start of the decade [3]. Therefore, a lot of emphasis is placed on measures for reducing aircraft fuel consumption and greenhouse gas emissions (airframe and engine improvements and radical innovation, alternative fuels, novel air traffic management approaches, see ETSAP T12). The aviation Infrastructure is responsible for only a small proportion of overall aviation GHG emissions (3.2% per passenger-km, see Figure 1), but emissions of air pollutants from airports are a major concern, particularly for airports located in urban areas, and provide an additional motivation to improve energy efficiency in aviation infrastructure. The Intergovernmental Panel on Climate Change (IPCC) estimated in 1999 that there was 12% inefficiency in air transport infrastructure. Since then, the IATA estimates that efficiency has improved by 4% in aviation infrastructure, but there is still scope for significant improvement [2]. The following sections provide an overview of technologies, performance and costs of aviation infrastructure.

■ **Components of the Aviation Infrastructure –** **Airport terminal buildings** can be likened to office buildings and shopping centres as far as design specifications and construction are concerned. The types of flights and airlines served at an airport determine the design features of a terminal, including

Please send comments to Gena.Gibson@aeat.co.uk, Robert.Milnes@aeat.co.uk, Matthew.Morris@aeat.co.uk, Nikolas.Hill@aeat.co.uk (Authors), and to Giorgio.Simbolotti@enea.it and Giancarlo Tosato (gct@etsap.org), Project Coordinators