Efforts to minimise the environmental impact from aviation are associated with complex inter-relationships between various disciplines. When selecting mitigation strategies, tradeoff aspects between air quality, climate change and noise impacts have to be considered, while ensuring that safety and capacity are maintained or enhanced.

Over 50 participants attended the joint X3-Noise/AERONET Symposium, co-organised with CEAS, and in the framework of “Aviation in the XX1 Century” organised by the National Aviation University, Kiev.

Dominique Collin (Snecma) chaired the Technology Session. Alain Joselzon (Airbus) gave a very thorough review starting from the context of - fuel, environmental features of noise and emissions - local air quality and climate change. Open rotors, contrarotating propellers and geared turbofans were under consideration - similar alternatives had historically received great attention, when fuel prices high and had even been historically considered for A340. For the airframer considerations would include noise, cabin comfort, aircraft integration, a broad perspective overall on safety. Airbus was pursuing ACARE goals with research participation in such as NACRE, VITAL, DREAM and Clean Sky (Integrated Technology Demonstrator). A robust and homogeneous basis was needed to help decide between turbofans, geared turbofans and open rotors.

Jim Skalecky (FAA) outlined the US proposal, CLEEN, not yet funded. CLEEN included alternative and renewable fuels; environmental issues:- noise, air quality, water, energy use, climate; and, addressing the entire national airspace system. CLEEN was to advance the US NextGen environmental goals (http://www.jpdo.gov/nextgen.asp) and take technologies to close to implementation. Goals included certifying alternative fuel, stringent Landing and Take-Off NO\textsubscript{x} and noise; considering retrofitting and re-engining.

Stephan Servaty (MTU) – presented the New Aero Engine Core Concepts (NEWAC), part of an EU Project. His speech focussed on engine core technology improvement, underlining NO\textsubscript{x} reduction and (some) CO\textsubscript{2} reduction.

Jean-Jacques Korsia (Snecma) – presented another EU Project, the envIronmenTALy Friendly Aero Engine (VITAL) explaining at the level of the engine technology the links relevant to the ACARE goals.

The four papers presented in this session had a common message: technologies need to be developed and properly demonstrated, requiring extensive efforts, resources and funding. However, the aircraft technology must not be considered in isolation, but complemented by operational aspects and supported by policy. Novel approaches beyond evolutionary progress must be explored. Environmental optimisation cannot be separated from the broader product optimisation, even if the environmental dimension has become a prime design and technology driver. Rising fuel costs will drive fundamental changes across the industry (i.e., shift in airlines costs).
The session on **Policy** was chaired by Urs Ziegler – FOCA (CH). Michael Mann (UK) presented aspects of monetisation involved in assessing noise and emissions tradeoffs. Examples of Cost Effectiveness Analysis vs. Cost Benefit Analysis were given, but various relative unknowns were also identified: e.g., how to measure health costs and climate change costs reliably.

The US view (Gregg Fleming (Volpe)) gave the considerations important to NextGen, a programme determined to achieve sustainable aviation transportation, where common environmental goals and targets will be required in all environmental management systems.

Urs Ziegler (FOCA) emphasised the ANCAT view, that a comprehensive approach is paramount. In Europe, several indicators and economic measures are still under development. The paper presented by Urs identified some gaps in policy formulated related to noise and emissions interdependencies in the aviation sector.

An airport view was presented by Christina Sares (Stockholm-Arlanda Airport) focussing on a ‘total approach needed’, a total environment view is necessary to understand the issue of tradeoffs.

The third session on **Operations**, chaired by Delia Dimitriu (MMU) outlined the impact several operational procedures have on noise and emissions tradeoffs. Operational Procedures to Reduce Noise, Emissions, Fuel Burn and Flight Time, was presented by Professor John-Paul Clarke, as part of the PARTNER group projects. The paper focussed on explaining the features - concept, design and implementation - required for aircraft to be scheduled to start Constant Descent Arrivals from top of descent.

A case study on Continuous Descent Approaches in Asia-Pacific, part of an Airbus project in the region, was presented by Delia Dimitriu. Impact of early configuration extensions on noise was underlined. The paper concluded that a CDA is only efficient, if early configuration extensions and thrust restorations are avoided. Differences up to 80kg in fuel consumption are noted from one so-called CDA procedure to another.

Assessment of Tradeoffs in operations was presented by Ivan de Lepinay from Envisa, showing methods for multicriteria assessment. Low noise departure and arrival procedures and NO\(_X\) aspects presented by Martin Schaefer (DLR) highlighted a reduction in NO\(_X\) as part of the arrival procedure, but no obvious reduction in departure was demonstrated.

The **Capacity session** was moderated by Paul Brok from NLR. Airspace and airspace capacity from the ATM perspective show safety as critical business and require an ongoing research programme. Ian Fuller from EUROCONTROL emphasised how important it is to identify how changes in the ATM system may impact airport and operational capacity.

Dick Bergmans (NLR) presented several case studies involving Schiphol airport. Assessment and questions related to future environmental capacity due to changes in air traffic patterns were given.
The impact of airport local air quality on the airport environmental capacity was presented by David Raper of Manchester Metropolitan University. He insisted on the importance of identifying all possible emissions sources through an in depth inventory process. The new EC project assessing the environmental impact for new and efficient operational practices (ERAT) was presented by Ante de Wolf (TO70).

The last session, on Tools, was moderated by Chris Eyers (QinetiQ). Assessing the impact of noise and emissions in aviation sector requires the existence of proper tools and associated knowledge. This session gave details of the present European knowledge and strategy towards an integrated tool versus the US existing tools, with some comparison of modelling activity of Europe versus the US experience. Michael Hepting (DLR) shared his experience as coordinator of the EU FP7 E-TEAM project proposal and developed some follow up steps to meet the European needs for an integrated modelling technique.

Ian Fuller (EUROCONTROL) presented a toolset for environmental sustainability assessment, emphasising the importance of (accurate) aircraft performance and noise and emissions data accessibility.

Modelling activities in North America were represented by Gregg Fleming (Volpe), who presented a Comprehensive Tool Suite incorporating: environmental challenges, environmental interrelationships, legacy/regulatory policy obligations, market scenarios, technology and operational advances.

The parallel sessions (Technology, Policy and Tools, Operations and Capacity) with a brief introduction by Paul Brok (NLR) benefitted from the wide range of interests of the symposium participants, who had the opportunity to initiate debates and ask questions related to papers presented in the previous sessions.

The Wrap up session moderated by Martin Hagström (FOI) concluded the event, emphasising that a comprehensive approach is paramount, further work is required, gaps are to be identified and clearly formulated and communicated to policymakers. However, some indicators and economic measures are already under development.