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Book review

Green Aviation. Reduction of environmental impact through aircraft technology and alternative fuels. Emily S. Nelson & Dhanireddy R. Reddy. Leiden, The Netherlands: CRC Press. £170.00 (Hardback), £35.99 (eBook). ISBN: 978-0-415-62098-7 (Hardback), ISBN: 978-0-203-11996-9 (eBook)

This book immediately grabs the attention the reader with the green aviation title, pertinent with the topical and relevant challenge of making air transportation environmentally sustainable. It is split into two parts. The first covers the environmental impacts from aviation. The second part, aligning with the title, considers the two impacts of aircraft technology and the use of alternative fuels.

Naturally such as topic has a future-focused approach. Accordingly, the Preface has an appropriate initial starting point of three future time periods: short (around 10 years), mid (around 20 years) and long (around 30 years). A longer-term perspective is required to achieve green aviation, given the timeframe for significant environmental impacts from aircraft technology and alternative fuels. For aircraft technology, in the short-term there will not be a change in the conventional architecture. In the medium-term there may be blended-wing technology, but only in the long-term is there likely to be new propulsion body. For alternative fuels, although "drop-in" fuels may be used in existing aircraft engines, greener replacements are longer-term.

The first part of the book presents the necessary noise and emissions information. Using a Boeing 737-800 aircraft component example, Chapter 1 outlines the sources of noise –, primarily pressure disturbances from air flow interaction with various engine and airframe components during flight. More noise improvements are required given the increase in the strictness of standards and negative community reaction to noise. Chapter 2 defines gaseous and particulate emissions, introducing alternative fuels to the reader. The chapter summary demonstrates both the stricter emissions standards from the regulatory bodies required and the increasing number of emissions that need to be incorporated. The more technical Chapter 3 examines aeropropulsion fuel efficiency and historically charts NASA (National Aeronautics and Space Administration) research over the last 75 years of so. Their current effort focuses on environmental responsibility and the subsonic fixed wing.

The second part of the book initially focuses (Chapter 4) on the technical aspects of noise mitigation (e.g. engine, fan, propeller, jet & landing gear). Other valid strategies to improve noise levels, such as flight paths and continuous descent approach, are mentioned but not examined. Chapter 5 is an overview of four types of advanced material for reducing aircraft emissions: lightweight, smart, high-temperature and electric aircraft. Chapter 6 takes an aircraft engine perspective, examining the products of combustion, and how emissions can be better controlled and engine efficiency improved. Chapter 7 appropriately covers airspace systems technologies for a more environmentally efficient system that can also cope with a growth in demand. The next generation of technologies will be important to further develop surveillance, navigation, integration, communication and operations aspects.

The second part then turns to alternative fuels. Chapter 8 clarifies that only drop-in fuels are compatible with existing engines. Alternative fuels for aviation are progressing, but automotive applications are more promising and there is a need to find sustainable ways for fuel manufacture. Chapter 9 provides a descriptive overview of alternative fuel drivers. It is good to see human health and energy security aspects mentioned as well as the standard economic and environmental imperatives, although this Chapter could have been developed further. Chapter 10 provides a deeper investigation into biofuel feedstocks and supply chains, with an interesting ecological modelling approach that splits the system into three core elements: production of bioenergy crops, logistics of pre-processing and transportation, and conversion of raw feedstocks into fuel. Useful implementation scenarios are tested to show underpinning relationships at a regional level (a continental model beyond the scope of such models). Chapter 11 presents microalgae feedstock for aviation fuels, examining production scenarios for algal biofuel which has high land, water and nutrient demands. Chapter 12 documents a relevant consideration, the process of the certification of alternative fuels. Chapter 13 qualitatively covers environmental performance of alternative jet fuels using an impact matrix of the following indicators: life cycle GHG emissions, biodiversity, water quality and freshwater use. Each of these indicators does have high impacts for at least one element of the supply chain (feedstock production has the highest impact overall).

The final chapter (Chapter 14) brings the book together in a descriptive integrated forecast. Given the difficulty with predicting the future, it is appropriate to present three forecasts, the situation as now, an optimistic scenario and a pessimistic scenario. Perhaps there could have been a clearer link back to the preceding chapters and their outcomes.

Overall, the book is thorough, concise and well-referenced to academic and industry literature, particularly suited to those with a technical science or engineering background and an interest in an aviation application. Such a background helps for some of the chapters, although readers without a technical background can still follow much of the content. The inter-disciplinary aspects of a major challenge, such as green aviation, are generally handled well. Aside from the core science and engineering disciplines, techniques from ecology and environmental science are applied, although perhaps there could have been more mention of behavioural change. For instance, there could be a rebound effect whereby the efficiencies just lead to more air transport mobility instead of energy reductions. A geographical approach is represented in Chapter 11, whereby the Biomass Assessment Tool presented incorporates a Geographical Information Systems based model. Some of the other chapters contain well-presented maps and figures with underpinning spatial considerations.

Almost all authors are from the United States of America, split between academia and NASA, which gives clear credibility to the topic and strong industry alignment. The US-centric approach does provide

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much leading-edge material which clearly adds value to existing knowledge in this area. However, there could have been more international perspectives.

With a very technical-based book it is important how it is communicated to the reader. There is a good clarification of terminology throughout the book, as well as in the acronym list. The book generally has an excellent use of graphs to demonstrate appropriate relationships, and there are also some useful photos and diagrams to assist understanding of some concepts.

To conclude, Green Aviation represents a useful contribution to existing knowledge in relation to aircraft technology and alternative fuel development. The challenge is to translate the major environmental benefits from new aircraft bodies and greener alternative fuels into a shorter time horizon than the longer-term period currently predicted.

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