

Preface

The extensive use of fossil fuel in railway transportation is a high concern in North America and other world regions where diesel and/or diesel-electric locomotives represent the majority of prime movers. Besides rail transport, a major emission source of greenhouse gases is road transportation, which relates practically to gasoline and diesel fuels. As an example, in Canada, the transportation sector is the largest contributor to greenhouse gas emissions with over 25 % of the total emissions. Reduction of these emissions for the benefit of better and clean air and environment requires, among others, a strong encouragement of public transit, especially of rail transport. This obviously implies development and implementation of a clean rail transportation infrastructure.

This book discusses the current status and historical overview of rail transport and rail transport systems and applications and the development of alternative system and fuel options for a clean rail sector, which relates to sustainable energy sources and fuels, and thus produces substantially less pollution than the conventional railway which is in place today. Various cleaner fuels were considered in the past, among which one notes natural gas (in compressed or liquefied forms), methanol and biodiesel or other diesel fuel blends, hydrogen, and more recently ammonia. Purely electric rail transport remains a major option, which although being expensive, may be the preferred solution for some jurisdictions relating on clean power generation (e.g., hydro, wind, nuclear).

This book comprises nine chapters. After the introductory chapter, the rail transportation outlook is provided in Chap. 2, with emphasis on rail transport, rail status, and railway environmental impact. The conventional locomotive prime movers are presented in Chap. 3, with a historical perspective aimed at presenting the evolution of technical concepts and economic drivers from the beginning of the railways (in the 1700s) until the present. Chapter 4 presents the existing clean fuels options for railways, analyzing their main properties and mentioning the fuel fabrication pathways in a sustainable manner. The worldwide initiatives on the Clean Rail development are summarized in Chap. 5. Some relevant emerging locomotive systems for clean rail applications are reviewed in Chap. 6, with a focus on hydrogen,

natural gas, and ammonia locomotives as the main three pillars. Chapter 7 presents the methods of locomotive assessment based on multiple criteria including thermodynamic analyses and assessment with energy and energy methods, as well as the economic, environmental, and sustainability assessment. The book comprises a number of case studies for actual systems with focus on a multi-criteria comparative assessment with a baseline case of diesel-electric locomotive as presented in Chap. 8. The main concluding remarks are summarized and some recommendations are made in Chap. 9. The book comprises a comprehensive list of references and technical appendices with relevant data for analyses.

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