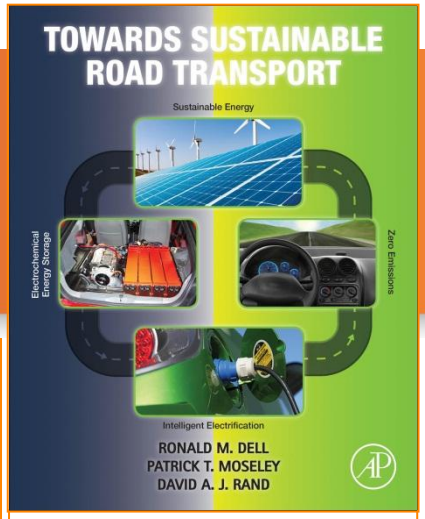

Towards Sustainable Road Transport

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AUDIENCE

Renewable Energy Professionals; Automotive Engineers, including Electrical, Mechanical and Chemical Engineers working with Hybrid, Electric and Next-Gen Green Vehicles.

Explore the green future of road transport, from power sources to infrastructure!

KEY FEATURES

- Drivers of technological change in road transport and the infrastructure requirements
- Discussion of alternative fuels for internal combustion engines and fuel conversion technologies
- Detailed exploration of current and emerging options for vehicle propulsion, with emphasis on hybrid/battery electric traction, hydrogen, and fuel cells
- Comparative analysis of vehicle design requirements, primary power source efficiency, and energy storage systems

DESCRIPTION

Increasing pressure on global reserves of petroleum at a time of growing demand for personal transport in developing countries, together with concerns over atmospheric pollution and carbon dioxide emissions, are leading to a requirement for more sustainable forms of road transport. Major improvements in the efficiency of all types of road vehicles are called for, along with the use of fuels derived from alternative sources, or entirely new fuels. ***Towards Sustainable Road Transport*** first describes the evolution of vehicle designs and propulsion technologies over the past two centuries, before looking forward to possible new forms of energy to substitute for petroleum. The book also discusses the political and socio-economic drivers for change, investigates barriers to their broad implementation, and outlines the state-of-the-art of candidate power sources, advanced vehicle design, and associated infrastructure. The comprehensive technical information supplied by an expert author team ensures that ***Towards Sustainable Road Transport*** will provide readers with a clear understanding of the ongoing progress in this field and the challenges still to be faced.

CONTENTS

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Chapter 1 The Evolution of Unsustainable Road Transport
There is a consensus that the present status of road transport in the developed world is unsustainable in the long term for a variety of reasons — urban congestion, pollution, petroleum depletion, and greenhouse gas emissions.This introductory chapter outlines the emergence of the present precarious situation over the course of the 20th century.

Chapter 2 Drivers for Change
The road transport scene is changing rapidly under the stimulus of new vehicle and engine technology, as well as being driven by political and socio-economic pressures in the world at large. The latter include the growth in world population, the spread of car ownership from the developed to the developing world, environmental legislation, and concerns over the availability of transport fuels in sufficient quantities to meet projected global demand. These issues are discussed in this Chapter.

Chapter 3 Unconventional Fuels
There are various alternatives to conventional petrol and diesel fuels for the propulsion of road vehicles with internal combustion engines. Attention is first given to raw materials other than crude oil that can either be used with very little processing (natural gas) or can be refined into useable fuels. The latter include other fossil deposits (oil sands and bitumen, oil and gas shales, coal), as well as various types of renewable bio-crops. The second part of the chapter examines the different fuels that can be derived from these raw materials.

Chapter 4 Development of Road Vehicles with Internal Combustion Engines
The construction and operation of conventional road vehicles is outlined in this chapter, with the emphasis on cars. The principal engineering advances of the 20th and early 21st centuries are described, including developments in body design and assembly, improvements in engine performance, transmissions, suspensions, steering, brakes, safety and all the components and accessories that make the modern automobile so reliable, comfortable and affordable.

Chapter 5 Progressive Electrification of Road Vehicles
Battery electric vehicles (BEVs) in the form of off-road vehicles have been employed for a long time, but electric cars for on-road use have never enjoyed great success on account of their capital cost, range-per-charge and time-to-recharge limitations. Similarly, the disadvantages of vehicles with internal combustion engines (ICEVs) are well-known, notably: low fuel efficiency and the fact that the engines are oversized for steady cruising in order to have sufficient power for hill climbing and overtaking. It is now recognized that the individual limitations of BEVs and ICEVs can be overcome by means of a hybrid system. Various stages in the electrification of road vehicles are possible; designs range from stop–start vehicles (SSVs), through mild- and full-hybrids to BEVs. Engineering implementation of these concepts is on-going and the status of such work is reviewed, together with the new challenges that hybrid electric vehicles (HEVs) place on the batteries that provide on-board energy storage.

Chapter 6 Mains Electricity Supply for Charging Vehicle Batteries
Two classes of electric vehicle, the plug-in hybrid (PHEV) and the battery electric (BEV), obtain electricity from the mains. It is therefore appropriate to enquire whether the generating and distribution systems installed in various countries are adequate to cope with large fleets of such vehicles. After reviewing the different means of electricity production and their significance for greenhouse gas emissions, the chapter describes the electricity supply situation in some representative, but different countries. It appears that most of these should be capable of delivering adequate power to accommodate the substantial numbers of PHEVs and BEVs that can reasonably be envisaged on the roads in the next few decades.

Chapter 7 Batteries and Supercapacitors for Use in Road Vehicles
The characteristics of the various battery chemistries that are being considered for road vehicles are reviewed, together with details of the required duty schedules. As the number of electrical functions that have to be supported in a vehicle continues to grow, it may be necessary to advance from 12 V to 48-V electrical systems and batteries with correspondingly higher voltages. Hybrid electric vehicles of all types impose challenging demands on the battery that include operation at partial state-of-charge and acceptance of charge at very high rates. Battery electric vehicles need high specific energy and long deep-cycle-life. Supercapacitors are also of interest for electric vehicles on account of their fast rates of charge and discharge. They are complementary to batteries inasmuch as their prime attribute lies in the provision of power rather than in energy storage.

Chapter 8 Hydrogen, Fuel Cells and Fuel-Cell Vehicles
Hydrogen has long been advocated as the ultra-clean fuel because its combustion produces pure water and no pollutants. As long ago as the 1930s, a German engineer demonstrated that an internal combustion engine could be made to run on hydrogen. An alternative approach to utilizing hydrogen is in an electrochemical fuel cell to generate electricity to drive an electric motor. Fuel cell vehicles provide greater driving range and faster refuelling than BEVs and are therefore clearly a desirable way forward for electric traction. Unfortunately, there remain problems with the generation, the distribution and the storage of hydrogen, as well as with the cost of the fuel cells themselves. This chapter discusses these matters and concludes that, with the possible exception of fleets of buses, it will be some while yet before fuel cell vehicles become commonplace.

Chapter 9 The Shape of Things to Come
Earlier chapters have covered the rise of a road transport system based on the internal combustion engine. This technology is considered to be unsustainable in the long term because it requires fuel that is in limited supply and is responsible for damage to the environment, both locally and globally. Current efforts to mitigate that damage by electrification of the drive train have also been reviewed. This final chapter is an attempt to foresee the possible development of road transport over the next 30 or so years.