

Automotive LPG and Natural Gas Engines

HIGHLIGHTS

- **PROCESS AND TECHNOLOGY STATUS** – Internal combustion engines running on liquid petroleum gas (LPG) are well-proven technologies and work much like gasoline-powered spark-ignition engines. Natural gas (NG) engines are also well-proven. They are typically used as spark-ignition engines for bi-fuelled (gasoline/CH₄) cars, but have also been used, for example, in compression-ignition (i.e. diesel-type) engines for heavy-duty vehicles. Both LPG and NG are not used alone, but always in bi-fuel vehicles, in combination with gasoline. In bi-fuel vehicles two fuels are stored in separate tanks and the engine runs on one fuel at a time. Bi-fuel vehicles have the capability to switch back and forth from gasoline to the other fuel, manually or automatically. In the past, most bi-fuel vehicles were derived from native gasoline vehicles by adding a tank and an electronic injection regulation system for the alternative fuel. In recent years, the offer of ‘native’ bi-fuel vehicles has increased; they have two separate tanks and two alternative injection regulation programs.
- **PERFORMANCE AND COSTS** – Bi-fuel LPG cars can reduce greenhouse gas (GHG) emissions by 15% as compared to petrol-operation. NG cars can achieve GHG reductions of up to 25%. The energy efficiency of engines running on natural gas is generally equal to that of gasoline engines, but is lower if compared with modern diesel engines. The conversion costs for LPG vehicles range from €1130 to €2740 (10-15% incremental cost). The conversion costs for light-duty NG vehicles are currently between €1640 and €2190 (10-15% incremental cost). When running on LPG or NG, CO₂ emissions are at least 10% or 20% lower, respectively, if compared to gasoline. Actual emissions depend on the share of mileage run on petrol.
- **POTENTIAL AND BARRIERS** – In 2008, more than 7 million Natural Gas Vehicles (NGVs) were on the roads, most notably in Argentina, Brazil, Pakistan, Italy, India, China, and Iran, with South America leading the global market with a 48% share. The number of LPG/NG kits sold globally is estimated to reach 8.0 million by 2012. An appropriate infrastructure, along with governmental support, may accelerate the growth of LPG and NG as global alternative fuels. Bottlenecks that may slow down the development and deployment of LPG and NG technologies are the lack of appropriate infrastructure for fuel distribution and refuelling, the higher vehicle cost, and the competition from other fuel options (e.g. biofuels).

TECHNOLOGY STATUS AND PERFORMANCE

Internal combustion engines running on liquid petroleum gas (LPG) and natural gas are well-proven technologies and work much like gasoline-powered spark-ignition engines [18]. They are normally used as spark-ignition engines for bi-fuelled (gasoline/CH₄) cars, but have also been used, for example, in compression-ignition (i.e. diesel-type) engines for heavy-duty vehicles. Both LPG and NG is not used alone, but always in bi-fuel vehicles, in combination with gasoline. In bi-fuel vehicles two fuels are stored in separate tanks and the engine runs on one fuel at a time¹. Bi-fuel vehicles have the capability to switch back and forth from gasoline to the other fuel, manually or automatically. In the past most bi-fuel vehicles were derived from native gasoline vehicles by adding a tank and an electronic injection regulation system for the alternative fuel. In recent years the availability of ‘native’ bi-fuel vehicles has increased; they have two separate tanks and two alternative injection regulation programs.

■ **LPG Vehicles** work much like gasoline-powered vehicles with a spark-ignited engines. LPG is stored as a liquid in a separate steel or composite vessel at the pressure of 10 bar, although it can stand a pressure of

20-30 bar. LPG supply to the engine is controlled by a regulator or vaporizer, which converts the LPG to a vapour. The vapour is fed to a mixer located near the intake manifold, where it is metered and mixed with filtered air before being drawn into the combustion chamber where it is burned to produce power, just like gasoline. LPG injection engines, developed over the past 15 years, do not vaporize the LPG. Instead, the LPG is injected into the combustion chamber in liquid form. These systems have proven to be reliable in terms of power, engine durability, and cold starting.

In the 1970s Toyota made a number of LPG-only engines for cars. Today, most LPG vehicles are conversions from petrol vehicles. Many car makers offer conversion/bi-mode vehicles. LPG technology is rather popular in the European Union, Australia, Hong Kong, India, South Korea, Serbia, the Philippines, Turkey and Armenia. The world leader is probably Armenia where about 20-30% of vehicles run on LPG which offers a cheap alternative to diesel and petrol. LPG engines and fuelling systems are also available for medium- and heavy-duty vehicles such as school buses and street sweepers. For example, the school districts in Dallas, Denton, Texas, Portland and Oregon rely on LPG-fuelled school buses. [8].

¹ unlike flexible-fuel vehicles (‘dual-fuel’), that store the two different fuels mixed together in the same tank, and the resulting blend is burned in the unique combustion chamber.

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Renewable Fuels for Sustainable Mobility Pravesh Chandra Shukla,Giacomo Belgiorno,Gabriele Di Blasio,Avinash Kumar Agarwal,2023-05-06 This volume discusses the use of renewable fuels for clean transportation and its applications on internal combustion engines The contents focus on the key aspects of fuel production processes and its impact on various segments of the transportation sector and for sustainable mobility Several kinds of fuels are assessed such as biofuels alcohols and hydrogen and their effects on the combustion process are characterized by application This volume will be of use to those working in academia and industry as well as energy experts and policy makers Energy Storage Systems and Power Conversion Electronics for E-Transportation and Smart Grid Sergio Saponara,Lucian Mihet-Popa,2020-12-02 This is a reprint in book form of the Energies MDPI Journal Special Issue entitled Energy Storage Systems and Power Conversion Electronics for E Transportation and Smart Grid The Special Issue was managed by two Guest Editors from Italy and Norway Professor Sergio Saponara from the University of Pisa and Professor Lucian MIHET POPA from stfold University College in close cooperation with the Editors from Energies The papers published in this SI are related to the emerging trends in energy storage and power conversion electronic circuits and systems with a specific focus on transportation electrification and on the evolution from the electric grid to a smart grid An extensive exploitation of renewable energy sources is foreseen for the smart grid as well as a close integration with the energy storage and recharging systems of the electrified transportation era Innovations at the levels of both algorithmic and hardware i e power converters electric drives electronic control units ECU energy storage modules and charging stations are proposed Research and technology transfer activities in energy storage systems such as batteries and super ultra capacitors are essential for the success of electric transportation and to foster the use of renewable energy sources Energy storage systems are the key technology to solve these issues and to increase the adoption of renewable energy sources in the smart grid **Automotive Fuels for the Future** International Energy Agency Implementing Agreement on Advanced Motor Fuels. Automotive Fuels Information Service,1999 Which alternative motor fuels will be in common use tomorrow Which criteria should be used to assess them No simple answers exist Complex trade offs are involved in the decision making process But the most important ingredient for making informed choices is sound information produced by a transparent methodology Automotive Fuels for the Future offers a digest of basic data on the critical fuel choices for the future It is a well balanced compendium of concise technical information as well as an overview of the essential issues in deciding among alternative fuels Fuels such as natural gas LPG or alcohols and biodiesel derived from different feedstocks are considered over the entire cycle from production to use They are analysed in terms of environmental effects safety availability and cost Their weaknesses and strengths are judged against the yardsticks of established gasoline and diesel technologies This publication from IEA AFIS the information service of the IEA Implementing Agreement on Advanced Motor Fuels makes this information accessible to the general reader **Alternative Fuels and**

Advanced Vehicle Technologies for Improved Environmental Performance Richard Folkson, 2014-03-19 Most vehicles run on fossil fuels and this presents a major emissions problem as demand for fuel continues to increase *Alternative Fuels and Advanced Vehicle Technologies* gives an overview of key developments in advanced fuels and vehicle technologies to improve the energy efficiency and environmental impact of the automotive sector Part I considers the role of alternative fuels such as electricity alcohol and hydrogen fuel cells as well as advanced additives and oils in environmentally sustainable transport Part II explores methods of revising engine and vehicle design to improve environmental performance and fuel economy It contains chapters on improvements in design aerodynamics combustion and transmission Finally Part III outlines developments in electric and hybrid vehicle technologies and provides an overview of the benefits and limitations of these vehicles in terms of their environmental impact safety cost and design practicalities *Alternative Fuels and Advanced Vehicle Technologies* is a standard reference for professionals engineers and researchers in the automotive sector as well as vehicle manufacturers fuel system developers and academics with an interest in this field Provides a broad ranging review of recent research into advanced fuels and vehicle technologies that will be instrumental in improving the energy efficiency and environmental impact of the automotive sector Reviews the development of alternative fuels more efficient engines and powertrain technologies as well as hybrid and electric vehicle technologies

Sustainable Automobile Transport L. Ryan, Hal Turton, 2008-01-01 Transport and in particular road transport represents a significant global threat to long term sustainable development and is one of the fastest growing consumers of final energy and sources of greenhouse gas emissions In this book long term energy economy environment scenarios are used to identify the key technological developments required to address the challenges passenger car transport poses to climate change mitigation and energy security It also considers possible targets for policy support and examines some of the elements that contribute to the significant levels of uncertainty particularly social and political conditions The book then builds on this long term scenario analysis with a broad review of recent empirical examples of relevant policy implementation to identify near term options for the passenger transportation sector which may promote a shift towards a more sustainable transport system over the longer term *Sustainable Automobile Transport* will be of particular interest to those in the policy process who are striving to address the automobile derived challenges associated with climate change a growing rather than declining problem It will have a worldwide audience as every developed and rapidly growing society struggles to address the dynamic growth in greenhouse gas emissions from automobiles

Advances in Compression Ignition Natural Gas - Diesel Dual Fuel Engines Hongsheng Guo, Hailin Li, Lino Guzzella, Masahiro Shioji, 2021-03-23

[Compendium of Hydrogen Energy](#) Michael Ball, Angelo Basile, T. Nejat Veziroglu, 2015-08-28 *Compendium of Hydrogen Energy* Volume 4 Hydrogen Use Safety and the Hydrogen Economy focuses on the uses of hydrogen As many experts believe the hydrogen economy will at some point replace the fossil fuel economy as the primary source of the world's energy this book investigates the uses of this energy from transport to

stationary and portable applications with final sections discussing the difficulties and possibilities of the widespread adoption of the hydrogen economy Written by both leading academics in the fields of sustainable energy and experts from the world of industry Part of a very comprehensive compendium which across four volumes looks at the entirety of the hydrogen energy economy Covers a wide array of hydrogen uses and details safety tactics hydrogen applications in transport and the hydrogen economy as a whole

Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles National Research Council, Transportation Research Board, Division on Engineering and Physical Sciences, Board on Energy and Environmental Systems, Committee to Assess Fuel Economy Technologies for Medium- and Heavy-Duty Vehicles, 2010-08-30 Technologies and Approaches to Reducing the Fuel Consumption of Medium and Heavy Duty Vehicles evaluates various technologies and methods that could improve the fuel economy of medium and heavy duty vehicles such as tractor trailers transit buses and work trucks The book also recommends approaches that federal agencies could use to regulate these vehicles fuel consumption Currently there are no fuel consumption standards for such vehicles which account for about 26 percent of the transportation fuel used in the U S The miles per gallon measure used to regulate the fuel economy of passenger cars is not appropriate for medium and heavy duty vehicles which are designed above all to carry loads efficiently Instead any regulation of medium and heavy duty vehicles should use a metric that reflects the efficiency with which a vehicle moves goods or passengers such as gallons per ton mile a unit that reflects the amount of fuel a vehicle would use to carry a ton of goods one mile This is called load specific fuel consumption LSFC The book estimates the improvements that various technologies could achieve over the next decade in seven vehicle types For example using advanced diesel engines in tractor trailers could lower their fuel consumption by up to 20 percent by 2020 and improved aerodynamics could yield an 11 percent reduction Hybrid powertrains could lower the fuel consumption of vehicles that stop frequently such as garbage trucks and transit buses by as much 35 percent in the same time frame Pathways for a transition to a sustainable hydrogen transportation fuel infrastructure in California Marlene Hilkert, 2004-02-20

Inhaltsangabe Abstract As society enters the 21st century there is a growing awareness of the burdens being placed on the planet as its ability to keep up with the demands of modern society are strained One of the major contributors to this burden happens to be a main resource required for sustained development Energy has always been and will always be a necessary resource for existence Since the industrial revolution fossil fuels such as coal and oil have been the main stay fuel to accommodate society s appetite As the demand for this resource increases the climatic and socio economic costs of this fuel become more acute and it is well documented that the supply of this fuel is not endless One of the major consumers of this fuel as a society is the transportation sector The processes in place which take it from the ground to its combustion as a fuel are some of the main culprits which adversely affect the planet This thesis explores the issues associated with the introduction of another energy resource Hydrogen as a replacement fuel for the transportation industry It is argued that for

the transportation sector Hydrogen offers the most promising alternative as a fuel Making Hydrogen readily available and affordable through the retail infrastructure is of paramount importance if its widespread use is to be achieved The logistics of this are explored and it is believed that the introduction of small Hydrogen fuelers at existing retail outlets is the preferred method to instantiate the transition in the short to medium term Those fueling stations can utilize grid electricity to produce Hydrogen by the means of water electrolysis or take advantage of the existing Natural Gas distribution infrastructure to produce Hydrogen via steam reformation This thesis examines the Well to Wheels impacts and economic feasibility of those options and compares them to existing vehicle and fuel technologies The state of California was chosen as a target market due to its high automobile density the resulting pollution issues and its clear mandate on promoting alternative energy sources

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Enriched Methane Marcello De Falco,Angelo Basile,2015-10-28 This book brings together recent research from across the world on enriched methane and examines the production distribution and use of this resource in internal combustion engines and gas turbines It aims to provide readers with an extensive account of potential technological breakthroughs which have the capacity to revolutionize energy systems Enriched methane a gas mixture composed by methane and hydrogen 10 30%vol constitutes the first realistic step towards the application of hydrogen as an energy vector It provides strong benefits in terms of emissions reduction that is 11% of CO₂ eq emission with the combustion of a 30%vol H₂ mixture if hydrogen is produced from renewable energy sources Enriched methane offers the following advantages it can be produced at competitive costs it can be distributed by means of the medium pressure natural gas grid it can be stored in traditional natural gas storage systems it can feed natural gas internal combustion engine improving conversion efficiency

This book is intended for academics in chemical engineering and energy production distribution and storage It is also intended for energy producers engineering companies and R D organizations

Ammonia Energy Technologies Ibrahim Dincer,Dogan Erdemir,Muhammed Iberia Aydin,Huseyin Karasu,Greg Vezina,2023-02-08 This book is the first to cover all aspects of using ammonia for energy from production to last use The book explains the fundamentals and basic concepts about hydrogen and ammonia before examining their production methods Then it covers ammonia production and storage techniques Furthermore the book contains case studies that demonstrate the use of ammonia technology Ammonia energy systems are explained and the technologies and methods used with them are explained with illustrative examples Finally the book lays out future directions in the development of ammonia energy systems It is expected that the book will be of interest to all researchers and professionals interested in new energy sources

Transport Revolutions Richard Gilbert,Anthony Perl,2018-10-24 First released in 2007 the bestselling Transport Revolutions argued that land transport in the first half of the

21st century will feature at least two revolutions One will involve the use of electric drives rather than internal combustion engines Another will involve powering many of these drives directly from the electric grid as trains and trolley buses are powered today rather than from on board fuel Now available for the first time in paperback and updated with the most recent data it sets out the challenges to our growing dependence on transport fuelled by low priced oil These challenges include an early peak in world oil production and profound climate change resulting in part from oil use It proposes responses to ensure effective secure movement of people and goods in ways that make the best use of renewable sources of energy while minimizing environmental impacts Synthesizing engineering economics environment organization policy and technology in a detailed yet highly readable style Transport Revolutions is essential reading for anyone working studying or interested in transport and the environment The Replacement of Petroleum-based Fuels by Alternative Sources of Energy Australia. Parliament. Senate. Standing Committee on National Resources,1980 **Energy Policies of IEA Countries** ,2004

Clean Energy R M Dell,D A J Rand,2007-10-31 Clean Energy presents a broad survey of the energy problems facing society over the coming decades and the prospects for their solution The book emphasizes the importance of developing a strategy for the world s future energy supply The strategy must take into account the finite supplies of natural gas and petroleum the increased consumption of fuel by developing economies the concern over greenhouse gas emissions the pollution caused by burning coal especially coal with a high sulphur content the difficulties and costs of extracting unconventional fossil fuels and the technical sociological and cost barriers that restrict the use of renewable forms of energy Clean Energy sets the various renewable energies wind waves solar etc in the context of present and projected world production of energy and its use in the time frame until 2020 and looks speculatively beyond that It looks at the possibilities for reducing pollution from fossil fuels and tackles the serious problem of how to store energy in order to smooth out fluctuations in supply and demand Clean Energy is well illustrated with diagrams and photographs It is accessible to anyone who has studied science to A level and will appeal to anyone with a serious interest in environmental matters and the interaction between energy usage and the environment Introduction to Energy Analysis Kornelis Blok,Evert Nieuwlaar,2020-11-17 This textbook provides an introduction to energy analysis for those students who want to specialise in this challenging field In comparison to other textbooks this book provides a balanced treatment of complete energy systems covering the demand side the supply side and the energy markets that connect these The emphasis is very much on presenting a range of tools and methodologies that will help students find their way in analysing real world problems in energy systems This new edition has been updated throughout and contains additional content on energy transitions and improvements in the treatment of several energy systems analysis approaches Featuring learning objectives further readings and practical exercises in each chapter Introduction to Energy Analysis will be essential reading for upper level undergraduate and postgraduate students with a background in the natural sciences and engineering This book may also be

useful for professionals dealing with energy issues as a first introduction into the field *Sugarcane Bioenergy for Sustainable Development* Luis A. B. Cortez, Manoel Regis L. V. Leal, Luiz A. Horta Nogueira, 2018-10-25 In recent years there has been a rapid expansion of the growing of crops for use in bioenergy production rather than for food This has been particularly the case for sugarcane in Latin America and Africa This book examines the further potential in the context of the food versus fuel debate and as a strategy for sustainable development Detailed case studies of two countries Colombia and Mozambique are presented These address the key issues such as the balance between food security and energy security rural and land development policies and feasibility and production models for expanding bioenergy The authors then assess these issues in the context of broader sustainable development strategies including implications for economics employment generation and the environment The book will be of great interest to researchers and professionals in energy and agricultural development *Environmental Technology Development in Liberal and Coordinated Market Economies* S. Wong, 2006-11-27 This book explores the role of institutions in policy making and the states role in promotion of technology focusing on environmental technology development Case studies include wind power diffusion in the UK and Germany waste recycling in a variety of countries and green automobile technology in the US and Japan **The IEA Natural Gas Security Study** International Energy Agency, Organisation for Economic Co-operation and Development, 1995 Clean Fuels for Mobility Gabriele Di Blasio, Avinash Kumar Agarwal, Giacomo Belgiorno, Pravesh Chandra Shukla, 2022-01-01 This book provides an overview of clean fuels for sustainable mobility by highlighting on world energy outlook technic economic assessment and the key aspects of the fuel production processes and their possible large impact on various transportation sector segments The content initially deals with different types of alternative fuels for example ethanol methanol butanol hydrogen biogas biodiesel etc It also focuses on current trends in the automotive sector Various aspects of the clean fuels production process and formulation to improve the combustion characteristics and efficiency toward sustainability are considered Some of the important fuels like hydrogen ammonia natural gas etc are discussed in detail This volume will be useful for the industrial and research community involved in fuels combustion engines and environmental research

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