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Assessment of Fuel Economy Technologies for Light-Duty Vehicles Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles Reduced Emissions and Fuel Consumption in Automobile Engines Fuel Consumption and Consumption Optimization Fuel Economy Technological Improvements to Automobile Fuel Consumption Reduced Emissions and Fuel Consumption in Automobile Engines A Study of Technological Improvements in Automobile Fuel Consumption: Comprehensive discussion Reduced Emissions and Fuel Consumption in Automobile Engines 75 Ways to Save Gas A Study of Technological Improvements in Automobile Fuel Consumption A Study of Technological Improvements in Automobile Fuel Consumption: Comprehensive discussion A Study of Technological Improvements in Automobile Fuel Consumption: Executive summary Technological Improvements to Automobile Fuel Consumption. Volume I: Executive Summary. Final Report Driving Climate Change Technological Improvements to Automobile Fuel Consumption: Executive summary Reducing Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two Potential of Spark Ignition Engine for Increased Fuel Efficiency Concepts in Turbocharging for Improved Efficiency and Emissions Reduction Improve FUEL AVERAGE (MPG / KMPL) Automotive Spark-Ignited Direct-Injection Gasoline Engines Evaluation of Techniques for Reducing In-use Automotive Fuel Consumption Fuel Economy of the Gasoline Engine Fuel Efficiency of Passenger Cars Making Cars More Fuel Efficient Potential of Diesel Engine, Fuels and Lubrication Technology Fuel Efficient Car Technology Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles Design and Development of Heavy Duty Diesel Engines Detailed Modeling of Si Engines in Fuel Consumption Simulations for Functional Analysis Reducing Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards Decreasing Fuel Consumption and Exhaust Gas Emissions in Transportation Fuel Economy and Emissions of Lean Burn Engines Assessment of Wingtip Modifications to Increase the Fuel Efficiency of Air Force Aircraft A Study of Technological Improvements in Automobile Fuel Consumption: Executive summary Modifying Diesel Engine Operating Parameters to Reduce Emissions Improving the Efficiency of Engines for Large Nonfighter Aircraft Motor Vehicle Fuel Efficiency

Over the last several years, there has been much discussion on the interrelation of CO2 emissions with the global warming phenomenon. This in turn has increased pressure to develop and produce more fuel efficient engines and vehicles. This is the central topic of this book. It covers the underlying processes which cause pollutant emissions and the possibilities of reducing them, as well as the fuel consumption of gasoline and diesel engines, including direct injection diesel engines. As well as the engine-related causes of pollution, which is found in the raw exhaust, there is also a description of systems and methods for exhaust post treatment. The significant influence of fuels and lubricants (both conventional and alternative fuels) on emission behavior is also covered. In addition to the conventional gasoline and diesel engines, lean-burn and direct injection gasoline engines and two-stroke gasoline and diesel engines are included. The potential for reducing fuel consumption and pollution is described as well as the related reduction of CO2 emissions. Finally, a detailed summary of the most important laws and regulations pertaining to pollutant emissions and consumption limits is presented. This book is intended for practising engineers involved in research and applied sciences as well as for interested engineering students. 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. Legislative requirements to reduce CO2 emissions by 2020 have resulted in significant efforts by car manufacturers to explore various methods of pollution abatement. One of the most effective ways found so far is by shortening the cylinder stroke and downsizing the engine. This new engine then needs to be boosted, or turbocharged, to create the full and original load torque. Turbocharging has been and will continue to be a key component to the new technologies that will make a positive difference in the next-generation engines of years to come. Concepts in Turbocharging for Improved Efficiency and Emissions Reduction explores the many ways that turbocharging will deliver concrete results in meeting the new realities of sustainable, green transportation. This collection of very focused technical papers, selected by Mehrdad Zangeneh, PhD., a professor of thermo-fluids at University College in London, provides an assessment of several novel designs intended to improve fuel consumption and cap emissions, while maintaining torque at all speeds. The book is divided into four sections, each addressing the most cutting-edge technologies on the market today: o Two-Stage Turbocharging o Variable Geometry Compressors o Unconventional Compressor Configurations o Electrically Assisted Turbocharging Book Description This book gives complete quantitative analysis of fuel consumption due to various factors like rolling resistance, air resistance etc. It gives very clear picture about how exactly mileage varies under different conditions. For better understanding of the subject different method is developed. Also practical simple method is developed to measure fuel consumption accurately in just few hundred meters of running.Large amount of literature is available about factors affecting fuel consumption like rolling resistance, air resistance, engine efficiency etc. But unfortunately neither any text book or any other literature is available for proper understanding of overall scenario at a glance as to how mileage of any vehicle is going to change under different conditions. To fill in this gap, alternate method has been developed for calculating fuel consumption theoretically. This method makes it very easy to understand variation in mileage under different conditions. Also simple practical methods are given in the book for testing the vehicle for different parameters like rolling resistance, air resistance etc. just in few hundred meters of running. Variation in engine efficiency, particularly under part load condition is one of the major factor that affects fuel average. But unfortunately this aspect is not given its due importance.Further, due to continuously changing operating conditions such as speed, gear in which it is operated, acceleration, gradient, braking, idling etc it is

extremely difficult to visualize how fuel average changes.Normal testing method of running vehicle over longer distance & measuring fuel average therefore do not give consistent reading. Moreover, it does not help to understand behavioral pattern of fuel average.Therefore for better understanding of the subject, different method is developed. In this method, fuel consumption at constant speed in any gear is measured. For this, method has been developed to measure fuel consumption just in few seconds & in just few hundred meters of running.In each gear, 4/5 readings are taken at different speeds. Similar readings are taken for each gear. These are then shown in graphs for each gear which enable us to understand variation in fuel consumption at a glance.Also for calculating fuel consumption theoretically, alternate method is developed. Salient features of this method are -i.Fuel consumption due to engine friction is accounted separately.ii.Due to above, remaining part of fuel consumption is directly proportional to energy requirement. This simplifies accounting.iii.Calculating energy requirement for overcoming rolling resistance, air resistance etc. is easy as lot of literature is available on this.iv.Once we know the energy requirement, we can calculate fuel consumption simply by multiplying with conversion factor.v.Using above method we can easily calculate fuel consumption for running the vehicle at any given speed in any gear.vi.Also it is possible to calculate fuel consumption due to each factor e.g. rolling resistance, air resistance & engine friction separately.vii.In this method there is no need to account for fuel consumption due to acceleration or gradient.Practical testing methods are also given in the book for measurement of air resistance, rolling resistance & engine friction, just in few minutes without any instruments. Within all areas of transportation, solutions for economical and environmentally friendly technology are being examined. Fuel consumption, combustion processes, control and limitation of pollutants in the exhaust gas are technological problems, for which guidelines like 98/69/EC and 99/96 determine the processes for the reduction of fuel consumption and exhaust gas emissions. Apart from technological solutions, the consequences of international legislation and their effects on environmental and climate protection in the area of the transportation are discussed. Climate change is one of the greatest challenges facing global society. The debate over what to do is confounded by the uncertain relationship between increasing greenhouse gas emissions and climate change, and the impact of those changes on nature and human civilization. Driving Climate Change will provide professionals and students alike with the latest information regarding greenhouse emissions while presenting the most up-to-date techniques for reducing these emissions. It will investigate three broad strategies for reducing greenhouse gas emissions: 1) reducing motorized travel, 2) shifting to less energy intensive modes, and 3) changing fuel and propulsion technologies. Findings will be presented by the leaders in the field with contributions from professors, researchers, consultants and engineers at the most prominent institutions - commercial, academic and federal - dealing with environmental research and policy. Includes a comprehensive evaluation of current industrial practice Provides technologically sound and manageable techniques for engineers, scientists and designers Incorporates guidelines for a sustainable future Because of the important national defense contribution of large, non-fighter aircraft, rapidly increasing fuel costs and increasing dependence on imported oil have triggered significant interest in increased aircraft engine efficiency by the U.S. Air Force. To help address this need, the Air Force asked the National Research Council (NRC) to examine and assess technical options for improving engine efficiency of all large non-fighter aircraft under Air Force command. This report presents a review of current Air Force fuel consumption patterns; an analysis of previous programs designed to replace aircraft engines; an examination of proposed engine modifications; an assessment of the potential impact of alternative fuels and engine science and technology programs, and an analysis of costs and funding requirements. Presents measures designed to reduce fuel consumption in passenger cars. The process of fuel injection, spray atomization and vaporization, charge cooling, mixture preparation and the control of in-cylinder air motion are all being actively researched and this work is reviewed in detail and analyzed. The new technologies such as high-pressure, common-rail, gasoline injection systems and swirl-atomizing gasoline fuel injections are discussed in detail, as these technologies, along with computer control capabilities, have enabled the current new examination of an old objective; the direct-injection, stratified-charge (DISC), gasoline engine. The prior work on DISC engines that is relevant to current GDI engine development is also reviewed and discussed. The fuel economy and emission data for actual engine configurations have been obtained and assembled for all of the available GDI literature, and are reviewed and discussed in detail. The types of GDI engines are arranged in four classifications of decreasing complexity, and the advantages and disadvantages of each class are noted and explained. Emphasis is placed upon consensus trends and conclusions that are evident when taken as a whole; thus the GDI researcher is informed regarding the degree to which engine volumetric efficiency and compression ratio can be increased under optimized conditions, and as to the extent to which unburned hydrocarbon (UBHC), NOx and particulate emissions can be minimized for specific combustion strategies. The critical area of GDI fuel injector deposits and the associated effect on spray geometry and engine performance degradation are reviewed, and important system guidelines for minimizing deposition rates and deposit effects are presented. The capabilities and limitations of emission control techniques and after treatment hardware are reviewed in depth, and a compilation and discussion of areas of consensus on attaining European, Japanese and North American emission standards presented. All known research, prototype and production GDI engines worldwide are reviewed as to performance, emissions and fuel economy advantages, and for areas requiring further development. The engine schematics, control diagrams and specifications are compiled, and the emission control strategies are illustrated and discussed. The influence of lean-NOx catalysts on the development of late-injection, stratified-charge GDI engines is reviewed, and the relative merits of lean-burn, homogeneous, direct-injection engines as an option requiring less control complexity are analyzed. Everyone is looking for ways to save money at the pump, and 75 Ways to Save Gas is an indispensable guide to doing just that. It's chock-full of simple, easy-to-follow tips to help you save fuel-and potentially hundreds, if not thousands, of dollars each year on your gas bill. The aim of this work, consisting of 9 individual, self-contained booklets, is to describe commercial vehicle technology in a way that is clear, concise and illustrative. Compact and easy to understand, it provides an overview of the technology that goes into modern commercial vehicles. Starting from the customer's fundamental requirements, the characteristics and systems that define the design of the vehicles are presented knowledgeably in a series of articles, each of which can be read and studied on their own. In this volume, Fuel Consumption and Consumption Optimization, the main focus is placed on the factors for optimizing consumption in the conventional vehicle. Fuel consumption can be optimized by four different factors: the technology of the vehicle, the conditions of its operation, the behavior of the driver and the maintenance and upkeep of the vehicle. These aspects are described in a way that is easily understood for training and practical application. Over the last several years, there has been much discussion on the interrelation of CO2 emissions with the global warming phenomenon. This in turn has increased pressure to develop and produce more fuel efficient engines and vehicles. This is the central topic of this book. It covers the underlying processes which cause pollutant emissions and the possibilities of reducing them, as well as the fuel consumption of gasoline and diesel engines, including direct injection diesel engines. As well as the engine-related causes of pollution, which is found in the raw exhaust, there is also a description of systems and methods for exhaust post treatment. The significant influence of fuels and lubricants (both conventional and alternative fuels) on emission behavior is also covered. In addition to the conventional gasoline and diesel engines, lean-burn and direct injection gasoline engines and two-stroke gasoline and diesel engines are included. The potential for reducing fuel consumption and pollution is described as well as the related reduction of CO2 emissions. Finally, a detailed summary of the most important laws and regulations pertaining to pollutant emissions and consumption limits is presented. This book is intended for practising engineers involved in research and applied sciences as well as for interested engineering students. Various combinations of commercially available technologies

could greatly reduce fuel consumption in passenger cars, sport-utility vehicles, minivans, and other light-duty vehicles without compromising vehicle performance or safety. Assessment of Technologies for Improving Light Duty Vehicle Fuel Economy estimates the potential fuel savings and costs to consumers of available technology combinations for three types of engines: spark-ignition gasoline, compression-ignition diesel, and hybrid. According to its estimates, adopting the full combination of improved technologies in medium and large cars and pickup trucks with spark-ignition engines could reduce fuel consumption by 29 percent at an additional cost of $2,200 to the consumer. Replacing spark-ignition engines with diesel engines and components would yield fuel savings of about 37 percent at an added cost of approximately $5,900 per vehicle, and replacing spark-ignition engines with hybrid engines and components would reduce fuel consumption by 43 percent at an increase of $6,000 per vehicle. The book focuses on fuel consumption--the amount of fuel consumed in a given driving distance--because energy savings are directly related to the amount of fuel used. In contrast, fuel economy measures how far a vehicle will travel with a gallon of fuel. Because fuel consumption data indicate money saved on fuel purchases and reductions in carbon dioxide emissions, the book finds that vehicle stickers should provide consumers with fuel consumption data in addition to fuel economy information. Since CAFE standards were established 25 years ago, there have been significant changes in motor vehicle technology, globalization of the industry, the mix and characteristics of vehicle sales, production capacity, and other factors. This volume evaluates the implications of these changes as well as changes anticipated in the next few years, on the need for CAFE, as well as the stringency and/or structure of the CAFE program in future years. This book is intended to serve as a comprehensive reference on the design and development of diesel engines. It talks about combustion and gas exchange processes with important references to emissions and fuel consumption and descriptions of the design of various parts of an engine, its coolants and lubricants, and emission control and optimization techniques. Some of the topics covered are turbocharging and supercharging, noise and vibrational control, emission and combustion control, and the future of heavy duty diesel engines. This volume will be of interest to researchers and professionals working in this area. Over the last several years, there has been much discussion on the interrelation of CO2 emissions with the global warming phenomenon. This in turn has increased pressure to develop and produce more fuel efficient engines and vehicles. This is the central topic of this book. It covers the underlying processes which cause pollutant emissions and the possibilities of reducing them, as well as the fuel consumption of gasoline and diesel engines, including direct injection diesel engines. As well as the engine-related causes of pollution, which is found in the raw exhaust, there is also a description of systems and methods for exhaust post treatment. The significant influence of fuels and lubricants (both conventional and alternative fuels) on emission behavior is also covered. In addition to the conventional gasoline and diesel engines, lean-burn and direct injection gasoline engines and two-stroke gasoline and diesel engines are included. The potential for reducing fuel consumption and pollution is described as well as the related reduction of CO2 emissions. Finally, a detailed summary of the most important laws and regulations pertaining to pollutant emissions and consumption limits is presented. This book is intended for practising engineers involved in research and applied sciences as well as for interested engineering students. The high cost of aviation fuel has resulted in increased attention by Congress and the Air Force on improving military aircraft fuel efficiency. One action considered is modification of the aircraftâ€™s wingtip by installing, for example, winglets to reduce drag. While common on commercial aircraft, such modifications have been less so on military aircraft. In an attempt to encourage greater Air Force use in this area, Congress, in H. Rept. 109-452, directed the Air Force to provide a report examining the feasibility of modifying its aircraft with winglets. To assist in this effort, the Air Force asked the NRC to evaluate its aircraft inventory and identify those aircraft that may be good candidates for winglet modifications. This reportâ€"which considers other wingtip modifications in addition to wingletsâ€"presents a review of wingtip modifications; an examination of previous analyses and experience with such modifications; and an assessment of wingtip modifications for various Air Force aircraft and potential investment strategies. Medium- and heavy-duty trucks, motor coaches, and transit buses - collectively, "medium- and heavy-duty vehicles", or MHDVs - are used in every sector of the economy. The fuel consumption and greenhouse gas emissions of MHDVs have become a focus of legislative and regulatory action in the past few years. This study is a follow-on to the National Research Council's 2010 report, Technologies and Approaches to Reducing the Fuel Consumption of Medium-and Heavy-Duty Vehicles. That report provided a series of findings and recommendations on the development of regulations for reducing fuel consumption of MHDVs. On September 15, 2011, NHTSA and EPA finalized joint Phase I rules to establish a comprehensive Heavy-Duty National Program to reduce greenhouse gas emissions and fuel consumption for on-road medium- and heavy-duty vehicles. As NHTSA and EPA began working on a second round of standards, the National Academies issued another report, Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two: First Report, providing recommendations for the Phase II standards. This third and final report focuses on a possible third phase of regulations to be promulgated by these agencies in the next decade. 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As NHTSA and EPA began working on a second round of standards, the National Academies issued another report, Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase Two: First Report, providing recommendations for the Phase II standards. This third and final report focuses on a possible third phase of regulations to be promulgated by these agencies in the next decade. The light-duty vehicle fleet is expected to undergo substantial technological changes over the next several decades. New powertrain designs, alternative fuels, advanced materials and significant changes to the vehicle body are being driven by increasingly stringent fuel economy and greenhouse gas emission standards. By the end of the next decade, cars and light-duty trucks will be more fuel efficient, weigh less, emit less air pollutants, have more safety features, and will be more expensive to purchase relative to current vehicles. Though the gasoline-powered spark ignition engine will continue to be the dominant powertrain configuration even through 2030, such vehicles will be equipped with advanced technologies, materials, electronics and controls, and aerodynamics. And by 2030, the deployment of alternative methods to propel and fuel vehicles and alternative modes of transportation, including autonomous vehicles, will be well underway. What are these new technologies - how will they work, and will some technologies be more effective than others? Written to inform The United States Department of Transportation's National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) emission standards, this new report from the National Research Council is a technical evaluation of costs, benefits, and implementation issues of fuel reduction technologies for next-generation light-duty vehicles. Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles estimates the cost, potential efficiency improvements, and barriers to commercial deployment of technologies that might be employed from 2020 to 2030. This report describes these promising technologies and makes recommendations for their inclusion on the list of technologies applicable for the 2017-2025 CAFE standards. Concern about the reduced availability and the increased cost of petroleum fuels prompted great efforts in

recent years to reduce the fuel consumption of auto mobiles. The ongoing efforts to reduce fuel consumption have addressed many relevant factors, including increased engine performance, reduced friction, use of lightweight materials, and reduced aerodynamic drag. The results of the investigations assessing the various factors affecting fuel economy have been published in journals, conference proceedings, and in company and government reports. This proliferation of technical information makes it difficult for workers to keep abreast of aU developments. The material presented in this book brings together in a single volume much of the relevant materials, summarizes many of the state-of-the-art theories and data, and provides extensive lists of references. Thus, it is hoped that this book will be a useful reference for specialists and practicing engineers interested in the fuel economy of automobiles. J. C. HILLIARD o. S. SPRINGER vii CONTENTS 1. AUTOMOTIVE FUEL ECONOMY David Cole I. Introduction and Background. . . . . 1 . . . . . n. Fuel Economy Factors . . . . . 9 A. Engine..... 11 B. Drive Train. . . . . 20 . . . . . C. Vehicle Factors. . . . . 22 . . . . . D. Operating Factors. . . . . 28 . . . . . E. Test Cycles . . . . . 32 . . . . . References . . . . . 33 . . . . . 2. FUEL ECONOMY AND EMISSIONS J. T. Kummer I. Introduction ..... . 35 n. Emission Regulations ..... . 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. The aim of this thesis is to establish a coupled modeling approach to simulate fuel consumption and in-cylinder gas emissions of a passenger car in various driving cycles (NEDC, RDE, WLTP). Combining models of the engine control unit and the mechanical vehicle powertrain with a crank-angle based combustion engine simulation opens up the possibility to support the development and calibration of future engines, demonstrated here for a turbo-charged spark ignited engine with direct injection and a fully-variable valvetrain. Thermodynamic processes are implemented within a 1D gas exchange model which allows to consider not only steady-state but also transient engine operation. The coupled system is extended by calculations of engine-out emissions considering the formation of nitrogen oxide (NOx), carbon monoxide (CO), and hydrocarbons (HC). Furthermore, tailpipe emissions are determined in an additional simulation model. The successful validation of this complex coupling technique is presented with exemplary results from all stages of the validation process. Finally, the advantage of this simulation methodology is shown by several application examples demonstrating the attained capabilities. "The European Conference of Ministers of Transport has released a report that analyzes the gap between fuel efficiency certification test ratings and the actual on-road fuel efficiency of automobiles. The report also examines technologies available that c