
Preface

*One day they will come to grief
(Unknown origin)*

Humanity's energy needs are continuing to grow. However, fossil fuel resources are limited. Economy and ecology are engaged in a clinch. The search for alternatives has therefore begun.

Although power is available from solar energy, wind and water, biological raw materials and geothermal energy, it will take decades of research and development together with considerable social and political changes to become independent on fossil fuels. To help us bridge the gap, natural gas, which consists of a high percentage of methane, is available.

Natural gas is second only to coal as the most prevalent fossil energy carrier and has the best H/C ratio for energy exploitation and thus has the lowest CO₂ burden for the atmosphere when combusted. It is also relatively low-cost on the global market. Above all, it can be produced from a variety of biological and synthetic means from sustainable sources, something that is being increasingly practiced today, and together with the utilization of existing infrastructure facilitates the previously noted transition to a non-fossil energy system.

If in the future more and more regenerative energy carriers in the form of chemically stored energy will be available—for example as gaseous or liquid hydrocarbons, there will be no necessity to replace the combustion engine with the electric motor, since the combustion is then CO₂ neutral—which is not the case with the electric motor—and its energy consumption (well-to-wheel) is identical to or lower than that of an electric motor, depending on the electricity mix.

In contrast to the electric motor and with an appropriate design and exhaust aftertreatment, it is even able to reduce the pollution in megacities (sub-zero emission vehicle). This secures “eternal life” for the piston engine. Policy-makers can be criticized for the one-sided sponsoring of electro-mobility despite this insight. Instead of this, lawmakers should only determine limits. Only scientific and engineering (R&D) solutions can show the technological way forwards due to the complex interdependencies.

I was inspired by the automotive manufacturer Audi to develop this book. Audi, who not only produce natural gas vehicles, are also the first automotive manufacturer worldwide to offer their customers artificially produced methane from their own “power-to-gas” plant.

More than 50 authors and co-authors from the scientific community, from industry and from politics have participated in this work. Redundancy was thus not always avoidable, but has been preserved to render the individual chapters easier to understand for the readers, since there is no necessity to cross-reference with other chapters. There are also several places where inconsistencies occur, for example the question of what percentage of hydrogen is acceptable in the natural gas pipeline network. Such cases require further research and development work in order to obtain definitive answers.

The book is aimed primarily at product developers for natural gas and methane applications, and at production management in the automotive and supplier industry. It is intended to be an important source of advice for science, research, teaching and politics. It is designed to fill a gap in the book market.

I would like to thank the highly competent authors from the automotive industry, universities, scientific institutes, associations and politics. I am grateful to Professor Michael Bargende from the University of Stuttgart, Dr Michael Specht from the Centre for Solar Energy and Hydrogen Research (ZSW), Reiner Mangold and Reinhard Otten from Audi and Professor Helmut Eichsleder from the Technical University of Graz, who contributed the lion’s share of the content of this book. Almost 300 diagrams and graphics illustrate the content and 572 references to external literature provide the opportunity for further study.

Thank you also to AVL, who helped with the design of the book’s content and who made the publication of this book possible in the series “The Vehicle Powertrain” whose editor is Helmut List. Thanks also to Gisela Großmann from the University of Stuttgart for the comprehensive support.

Finally, I wish this work its deserved attention.

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