Vol ume 1

Energy and Environment

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The European Commission (DG-MOVE and DG-RTD), the Conference of European Road Directors (CEDR), the European Road Transport Research Advisory Council (ERTRAC), the European Rail Research Advisory Council (ERRAC) and the European Technology Platform WATERBORNE-TP are acknowledged for their support and active contribution to the Programme Committee of TRA2014, in charge of reviewing and selecting the papers presented at the conference, which forms the main input of this volume.

The French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR) is acknowledged for having organized the TRA2014, in which 600 high-quality papers were presented successfully.

Yves Amsler, Gianfranco Burzio, Panos Papaioannou and Mark Robinson, the coordinators of the topics on Mobility and Safety, all the other members of the Programme Committee, the reviewers who actively contributed to the review and selection of the papers, and the authors who wrote them are acknowledged for their great job that produced the material for this volume.

Joëlle Labarrère, Secretary of the Programme Committee of TRA2014, is acknowledged for her valuable help to the editors and for her support to this volume production.
The transport sector is very much concerned about environmental adaptation and mitigation issues. Most of these are related to the objective of curbing GHG emission by 20% by 2020, alternative energy and energy savings, sustainable mobility and infrastructures, safety and security, etc. These objectives require the implementation of advanced research work to develop new policies, and to adjust education and industrial innovations.

The theme and slogan of the Transport Research Arena held in Paris (TRA2014) were respectively: “Transport Solutions: From Research to Deployment” and “Innovate Mobility, Mobilise Innovation”. Top researchers and engineers, as well as private and public policy and decision-makers, were mobilized to identify and take the relevant steps to implement innovative solutions in transport. All surface modes were included, including walking and cycling, as well as cross modal aspects.

Policies, technologies and behaviors must be continually adapted to new constraints, such as climate change, the diminishing supply of fossil fuels, the economic crisis, the increased demand for mobility, safety and security, i.e. all the societal issues of the 21st Century. Transport infrastructures and materials, modal share, co-modality, urban planning, public transportation and mobility, safety and security, freight, logistics, ITS, energy and environment issues are the subject of extensive studies, research work and industrial innovations that are reported in this series of books.

This book is a part of a set of six volumes called the Research for Innovative Transports set. This collection presents an update of the latest academic and applied research, case studies, best practices and user perspectives on transport carried out in Europe and worldwide. The presentations made during TRA2014 reflect on them. The TRAs are supported by the European Commission (DG-MOVE and DG-RTD),
the Conference of European Road Directors (CEDR) and the modal European platforms, ERRAC (rail), ERTRAC (road), WATERBORNE, and ALICE (freight), and also by the European Construction Technology Platform (ECTP) and the European Transport Research Alliance (ETRA).

The volumes are made up of a selection of the best papers presented at the TRA2014. All papers were peer reviewed before being accepted at the conference, and they were then selected by the editors for the purpose of the present collection. Each volume contains complementary academic and applied inputs provided by highly qualified researchers, experts and professionals from all around the world.

Each volume of the series covers a strategic theme of TRA2014.

Volume 1, *Energy and Environment*, presents recent research work around the triptych “transports, energy and environment” that demonstrate that vehicle technologies and fuels can still improve, but it is necessary to prepare their implementation (electromobility), think about new services and involve enterprises. Mitigation strategies and policies are examined under different prospective scenarios, to develop and promote alternative fuels and technologies, multi-modality and services, and optimized transport chains while preserving climate and the environment. Evaluation and certification methodologies are key elements for assessing air pollution, noise and vibration from road, rail and maritime transports, and their impacts on the environment. Different depollution technologies and mitigation strategies are also presented.

Volume 2, *Towards Innovative Freight and Logistics*, analyzes how to optimize freight movements and logistics; it introduces new vehicle concepts, points out the governance and organization issues, and proposes an assessment framework.

Volumes 3 and 4 are complementary books covering the topic of traffic management and safety.

Volume 3, *Traffic Management*, starts with a survey of data collection processes and policies and then shows how traffic modeling and simulation may resolve major problems. Traffic management, monitoring and routing tools and experience are reported and the role of traffic information is highlighted. Impact assessments are presented.

Volume 4, *Traffic Safety*, describes the main road safety policies, accident analysis and modeling. Special focus is placed on the safety of vulnerable road users. The roles of infrastructure and ITS in safety are analyzed. Finally railway safety is focused upon.
Volume 5, *Materials and Infrastructures*, is split into two sub-volumes, investigating geotechnical issues and pavement materials’ characterization, innovative materials, technologies and processes and introducing new techniques and approaches for auscultation and monitoring. Solutions to increase the durability of infrastructures and to improve maintenance and repair are presented, for recycling as well as for ensuring the sustainability of the infrastructures. Specific railways and inland navigation issues are addressed. A focus is put on climate resilient roads.

Volume 6, *Urban Mobility and Public Transport*, highlights possible innovations in order to improve transports and the quality of life in urban areas. Buses and two-wheelers could be a viable alternative in cities if they are safe and reliable. New methodologies are needed to assess urban mobility through new survey protocols, a better knowledge of user behavior or taking into account the value of travel for public transport. The interactions between urban transport and land planning are a key issue. However, these interactions have to be better assessed in order to propose scenarios for new policies.

Bernard JACOB, Chair of the TRA2014 Programme Committee
Jean-Bernard KOVARIK, Chair of the TRA2014 Management Committee
March 2016
I.1. Introduction

Transport systems are facing an impossible dilemma today: on one hand they must satisfy an increasing demand of mobility for a growing world population and an intensification of the goods exchanges, while on the other hand, they are also supposed to decrease their energy requirements and shift to non-fossil fuels (rarefaction and climatic impacts), while preserving or even improving the environment, decreasing the impacts of noise and air pollution on living beings, fauna and flora, to be precise. Besides that, transports have a unique opportunity to evolve in a changing world, with new services (vehicle sharing or in self-service), technologies like intelligent transportation systems (ITS), communication, etc., and also requirements including fast delivery, reliability, improved accessibility, etc.

In this book, recent research and application works – that were presented during the 5th Conference of Transport Research Arena, Paris, France, held on 14–17 April 2014 – are reported around the triptych: “transports, energy and environment”.

Successively, works will be reported on the progress and potential of electromobility and the conditions of its implementation (Part 1), the recent developments of vehicle and engine technologies for optimizing their operation while decreasing their energy needs and their environmental impacts (Part 2). Renewable and alternative energies are studied from both their technological and implementation points of view in Part 3.

Introduction written by Michel André and Zissis Samaras.
The next three parts adopt rather an environmental perspective, with respect to climate change and of the mitigation of transportation-related greenhouse gases (Part 4) and the issues of air and noise pollution due to transports in Parts 5 and 6.

As a prelude to this scientific and technical reporting, we propose a brief contextual overview, regarding the energy, environment and transport sectors, and their connections taking into account appropriate and coherent policies, towards the development of sustainable transport systems. This overview will be followed by a brief summary of the research works reported in the following chapters.

I.2. Context

I.2.1. Consistent and coordinated energy and environmental policies are needed in Europe

One of the major European concerns is increased oil and gas prices due to geopolitical instability that may endanger EU economic performance [BER 14]. This requires the development of sound energy policy which should take into account environmental issues such as climate change, air quality, noise and other related impacts. As underlined in the Green Paper on a European strategy for sustainable, competitive and secure energy by the European Commission in 2006, Europe has to put energy policy high on the EU agenda if it is to achieve its economic, social and environmental objectives. The EU must exploit its position as the world’s second largest energy market and as a world leader in demand management and the promotion of renewable energy sources. Improving energy efficiency and focusing on regionally sourced renewables will also benefit energy security by leading to lower imports of fuel, making countries less reliant on foreign supplies. Moreover, it will result in a more diverse energy mix and improve the resilience of national or regional energy systems.

I.2.2. Co-benefits between energy and environment can be achieved

It is important to note that significant co-benefits can be produced for health, quality of life, or even ecosystems and the economy by linking energy policies with those for climate change and environmental protection (on that subject, see for instance [WES 13, MCC 13, RAO 13, RAF 13, ALG 13]). Switching to clean energy would pay for itself, almost immediately, because actions to reduce greenhouse gas emissions reduce co-emitted air pollutants too, thus bringing co-benefits for air quality and human health, as well as for natural environment and ecosystems.