

Energy Systems in Transport Systems and the Role of ITS

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Guest Editorial

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Transport systems around the world would quickly grind to a halt without adequate energy supplies. Not only is energy an essential input to our transport systems, but their scale means that transport energy use is a major component of the overall energy demand. Transport accounts for about 20 per cent of the global energy use, but it can account for as much as *one third of the energy consumption* in industrialised countries, sometimes even more. The International Energy Agency expects the total transport energy consumption to double by 2050, given the present trends.

To date, the transport system has almost totally been reliant on energy from fossil fuels. Not only does transport account for about *half of all oil consumption*, but, in many industrialised economies, oil provides in excess of 93 per cent of the energy required for their transport systems to function. While questions have been emerging for some years about what confidence we can have long term in oil supplies and prices, the consumption of fossil fuels is also making transport a *major contributor to pollution* and, possibly, to climate change. In some jurisdictions or areas, transport can account for up to a third of all greenhouse gas emissions, provided that these are in some way dispersed throughout the atmosphere. *Diversification* of energy sources, and in particular, besides energy carriers, the increasing role of electrification has the potential of addressing the challenges associated with the impact of both supply and emissions, but has to be compliant with user needs and daily scheduling. The emergence of hybrid, plug-in-hybrid, electric battery and electric fuel cell vehicles reflects the important transformation that is underway which is challenging the central role played by the internal combustion engine (ICE) in current transport systems.

Although the development of reliable, low carbon fuels is important, *energy efficiency* is emerging as a critical transport issue of both short and long term significance. To date, much of the emphasis on vehicle energy efficiency has focussed on fuel and engine technologies. However, the complementary role that Intelligent Transport Systems can play in improving transport energy efficiency is now being recognised.

As a result of the great response to the call for papers, we are delighted to contribute to the comprehension of future transport systems by publishing a range of papers in this Special Issue which shines the spotlight on the contribution that ITS can make to enhancing the energy efficiency of our transport systems. These papers explore the interaction between ITS and energy efficiency for both conventional vehicles and emerging types of vehicles, such as hybrids and fully electric vehicles. Although most of the papers are focussed on road transport applications, one of the selected papers focuses on rail transport.

Given that ITS basically relies on the transmission of information in order to collect, analyse and assist the mobility of people and the movement of freight, communication is a common thread in many of the papers. This includes the role of vehicle-to-infrastructure and infrastructure-to-vehicle communication in optimising how a vehicle might approach an intersection as well as in promoting driving styles that reduce energy consumption and emissions. These driving styles are generically known as eco-driving. Concentrating on eco-driving, another paper draws on realistic driving styles to examine how eco-driving habits need to change

in response to enhancements in engine technology, and covers both ICE and hybrid ICE/electric vehicle engine architectures. The evolution of vehicles towards greater reliance on battery-electric technology presents new challenges in terms of 'refuelling' the vehicle. One of the papers in this Special Issue assesses the performance of a charge-while-driving system that would enable vehicles to be charged during still phases, such as while in a queue at intersections or elsewhere.

As is well known, transport is a major producer of greenhouse gases, particularly CO₂. Assessing the contribution that ITS can make by reducing CO₂ emissions is a challenging task. One of the papers proposes a systematic assessment methodology to assist developers, public authorities and investors in ITS solutions to make sound decisions based on comparable and transparent impact estimates.

It should be recalled that vehicle routing problems do not usually consider energy consumption, but rather time and space: one selected paper proposes a solution that considers the minimisation of fuel consumption, which might have a relevant effect on navigators, especially if entrance into a city centre will one day only be allowed to vehicles with electric traction and that an optimised routing might consider the state of charge of an electric vehicle, besides the time and energy requested to reach a destination, with or without charging possibilities.

In contrast to the focus of most of the papers in this Special Issue, one paper deals with rail transport. It draws on a micro-simulation approach to assess the energy performance of rail services and considers the effects of regenerative braking on energy consumption.

We would like to thank all of the contributors who submitted their scientific results for this Special Issue and the authors of the published papers, we particularly appreciate the care they have taken to respond to the constructive feedback provided by the reviewers. We would also like to extend special thanks to the anonymous reviewers, since it is only through the combined efforts of the authors and the reviewers that we have obtained papers of such high quality to make up this Special Issue.

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GEOFF ROSE



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Bruno Dalla Chiara has been an Associate Professor at the Politecnico di Torino (I) in the Transport systems academic field since 2005. He holds a degree in Mechanical Engineering, in which he specialised in transport systems, engineering and economics (1993), and a Ph.D. in Transport Engineering, in which he specialised in ITS (1997). He holds the chair, at the Politecnico di Torino, in "Engineering and operation of Transport Systems". He is the author of a number of publications, mainly concerning the engineering and design of transport systems, rail and intermodal transport and intelligent transports systems (ITS).



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Geoff Rose is Professor of Education for Sustainability at Monash University, but his activities are split between the Institute of Transport Studies, at the Department of Civil

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