Preface

I had the pleasure to be one of the speakers at the 2010 World Forum on Enterprise and the Environment, held by the Smith School of the University of Oxford. The participants, drawn from academia, industry, government and NGOs, were asked to explore the challenges and offer pathways to a sustainable, low carbon transportation future. To continue that spirited set of discussions and focus groups, a number of the participants have contributed to this volume on *Energy, Transport and the Environment*.

The topic of the forum is part of the larger energy and environmental challenge we face today. The Industrial Revolution and all that followed over the past 250 years liberated us from the constraints of human and animal power. In this brief instant in the history of human existence, we achieved remarkable advances in prosperity, but our success has brought challenges as well as opportunities. This revolution has sustained an approximately tenfold increase in the world population, from 700 million to an estimated 7 billion people by the end of 2011. It elevated the living conditions of an ever increasing fraction of humanity to heights that were unimaginable to the kings, queens, and emperors of earlier times. Our homes are warm in winter, cool in summer, and lit at night. The mobility of information, goods, and people has been fueled and transformed by our use of energy. We travel to a local market under the pull of more than a hundred horses to buy produce grown halfway around the world. We fly across continents and oceans using engines that have the power of a hundred thousand horses.

Our present path is not sustainable. We are becoming increasingly adept in our ability to find and extract fossil energy, but there is no debate that the supply of these fuels is finite. As discussed in the first section of this book, new discoveries of conventional oil, the dominant source of transportation energy, are peaking. There is a growing strain between projected demand and future supplies. The demand for oil will increase, driven in large part by rising prosperity in the developing world. On the supply side, more than 70% by volume of major discoveries since 2007 have been in deep offshore reservoirs, and oil companies are about to embark on greatly expanded exploration of northern arctic regions. “Unconventional” sources such as bituminous oils may play an increasingly

important role as higher oil prices and improved technology make their extraction economically feasible.

Even if technology advances were able to accommodate increases in demand with only modest increases in the cost of extraction, we will still need dramatically to de-carbonize our use of energy. The scientific evidence that the climate is changing, largely due to human greenhouse gas emissions, grows more compelling with each passing year. In order to mitigate the most dire risks, we will need to make substantial and timely changes in an arena where established technologies are naturally favored and the timescale of change is often slow. Despite the inherent advantages of liquid fuel, it took several decades to transition to an oil-based transportation economy. Sustained and creative actions will be needed to replace the embedded infrastructure, especially when full current and future costs of business are not yet included.

Transport consumes roughly 19% of the world energy supply and produces 23% of the carbon dioxide emissions. An IEA report predicts that the quantity of transport emissions will double by 2050 in the absence of new government policies.[1] Furthermore, we know of no practical technology that can be used to capture greenhouse gas emissions from mobile platforms. Thus, to achieve economic prosperity, energy security, and environmental responsibility, we will need to make fundamental changes. These changes will require significant technological advances, serious commercial investments, and wise government policies to guide this transition. The articles on the various transportation sectors—road, aviation, sea, rail and cargo—indicate that solutions to sustainable mobility may be *the* most challenging aspect of our energy and climate challenge.

This volume considers transportation in the urban environment. The vast majority of the future infrastructure of the world will be built in locations where we have the greatest opportunity to transition to sustainable mobility. What set of acceptable, effective, and affordable government policies, tailored in each country, will most effectively assist this transition? A variety of policies are discussed: they span the gamut from financial incentives and disincentives to extensive and heavily supported public transportation systems to new businesses such as shared "personal" vehicles. All of these ideas are aimed at mitigating the growth of vehicles in cities. In this section, I would have liked to have seen more emphasis on urban planning in developing countries. By 2030, China and India alone are projected to expand or build cities for roughly 600 million people. Developing countries have an enormous opportunity to design urban infrastructure where thoughtful "system" approaches can be used to integrate living, working, and shopping areas with urban transport and recreational spaces. There are enormous opportunities here—the creation of sustainable cites and surrounding areas can greatly improve the quality of life of its inhabitants while reducing costs, congestion, and carbon emissions. One can also learn from innovative master plans of urban renewal projects and university campus expansions.

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[1] *Transport, Energy and CO_2, Moving Towards Sustainablilty*, IEA Report, (2009).

Many of the articles in the book describe technical solutions. The de-carbonization of transportation would greatly benefit from technical breakthroughs in a number of areas. I personally believe that the fastest gains in reducing the cost and carbon footprint of road transport will come from fuel efficiency standards. More radical approaches such as improved batteries for plug-in hybrids and electric vehicles coupled with clean generation of electrical power, the development of affordable fuel cells and low-carbon sources of hydrogen, and alternative low-carbon fuels all have potential and should be explored. No one can predict which technologies will prevail, and it is therefore prudent to support a diverse research and development portfolio rather than down-select prematurely. Similarly, we should not deploy nascent technologies prematurely at great public cost. Technologies where substantial new infrastructure would have to be established can be field-tested in cost effective ways. For example, hydrogen fuel cell vehicles should be first piloted in situations where centralized refueling is possible and where hydrogen is readily available. What is clear is that the standard for technologies that can compete in price and performance with the internal combustion engine and liquid fossil fuel is high. We either must improve our low-carbon technology choices, change market demand, or both.

Finally, I want to return to the importance of finding solutions to sustainable mobility. Mobility is considered an integral part of the world's increasing standard of living. Ownership of a cell phone, a television, a refrigerator, and an automobile are often seen as important symbols of an improving standard of living. Furthermore, indigenous automobile production is seen as an important driver of the economic engine of developed and developing countries. When coupled with the fact that the population is projected to grow to approximately 9 billion by 2050 and 10 billion by the end of this century,[2] it is easy to see we face a stark challenge: meeting the world's rising energy needs with clean, sustainable sources. Countries with the highest per capita standard of living are beginning to decouple economic prosperity from carbon emissions, but we need to accelerate this trend. The developing world is following a proven path to prosperity; it is in the best interests of the developed *and* developing world to find a better path. The Red Queen in *Alice in Wonderland* describes our dilemma: "It takes all the running you can do to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

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U.S. Secretary of Energy
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[2] See, for example, *Science* 333, Special Section on Population, pp 562–594, (2011).

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