



Electromobility for a Sustainable Transport System¹

by Michael Miess and Stefan Schmelzer, Department of Economics and Finance at IHS, 27.07.2012

The transport sector is one of the largest emitters of greenhouse gases (GHGs) in Austria with about 27% of total emissions in the year 2009, second only to the sector of industrial processes that takes a share of 28%. Most important, the transport sector exhibits by far the largest increase in GHG emissions since the year 1990 with a rise of more than 54%. GHG emissions in the sector industry have expanded only by about 6% since 1990, all other sectors such as energy production, room heating and other small-scale uses, agriculture, waste, etc., tend to a reduction in GHG emissions, some of them quite substantially (e.g. -21.8% from 1990 levels for room heating and other small-scale uses).²

This clearly shows that for most sectors GHG emissions tend to stabilise or decrease, with the exception of the transport sector. This is mainly the result of an increase in individual transport systems, mostly motor cars, that has additional detrimental effects than the emission of GHG only. Rising congestion on Austria's streets despite further road construction, the occupation of public space, noise, an induced feeling of stress and the emission of fine particles are only a few examples of challenges the transport system has to face beyond the emission of GHGs.

Generally, the transport system is the physical expression of the human desire for mobility. Technical innovations during the last two centuries have allowed humanity to increase its mobility to a level that was unimaginable in pre-industrial times. Now that this system proves to be unsustainable in several aspects, we might face another technical leap. Technological innovations are happening rapidly. They are unfamiliar to most of us at this very moment yet they might provide high chances for a sustainable development.

Mobility in its current physical expression acts as a driver for growth and employment and simultaneously places a burden on our environmental and social systems that must be alleviated by making transport more sustainable.

By many, electromobility is seen as a way out of this dilemma between the desire for mobility, growth and employment on the one side, and sustainability in both ecological and human terms on the other. Electromobility opens up unknown possibilities, especially in the form of fully electric vehicles (EVs), and to varying extent for the different forms of hybrid electric vehicles (HEVs), which both are subject to intensive technological research. These possibilities include a beneficiary role for the electricity-producing system by providing a storage capacity for electricity within the batteries of EVs and HEVs. EVs, of course, will only reduce overall GHG emissions if they are fed with green electricity.

Thus, EVs are a promising direction to go for the electricity-producing industry in a twofold manner. Obviously, they will act as an additional source of demand for electric energy, which would benefit the industry by providing revenue, given the necessary power plant capacities are installed.

¹ The views expressed in this position paper are those of the authors alone.

² Source: Umweltbundesamt, Klimaschutzbericht 2011, available at <http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0334.pdf>.



Moreover, EVs might provide the key to implement a shift in electricity production away from fossil energy sources such as coal, oil and gas to renewable energy sources. Generally, renewable energy sources cause difficulties in their use because the amount of electricity they provide is subject to fluctuations. It is simply impossible to control the amount of wind blowing, the amount of sun shining, or the amount of water running. Since demand always has to match supply to prevent the grid system from breaking down, it is necessary to have balancing factors for these processes. Today, these balancing factors are mostly pump storage plants in alpine regions used to store excess electricity supply, as well as fossil fuel based power plants that can be turned off and on quite quickly during peak demand hours such as gas plants. The capacities in these plants, however, are only limited and might not suffice e.g. if a big country such as Germany shifts to electricity production from renewable energy sources on a large scale.

EVs could be part of the solution for this problem. An average vehicle is only operated for 1-2 hours a day, so that another at least 22 hours a day are available for storing or providing electricity. Excess supply could be stored in the EVs, which could release this electricity during peak hours, being recharged with cheap electricity when it is available. Intelligent charging systems considering the price of electricity, the time at which the vehicle should be available to the user, etc., can fulfil this purpose. Furthermore, peak traffic hours do not normally overlap with peak hour electricity demand, which would act in favour of such a system.

Of course, also for the functioning of an electricity-producing sector based on renewable energy sources, the grid system would have to be upgraded and renewed. Thus, increased investment in smart grids and in functional trans-regional electricity grids enabling exchange of flows e.g. between northern Europe (wind energy) and southern Europe (sun energy) will be of utmost importance. The term “smart grids” generally refers to the ability of a local grid system to be receiver (e.g. from solar panels at the roof of the building or from EV’s batteries in the garage) and dispenser (for ordinary electric devices) of electricity, and to communicate with end-use devices and the high voltage grid. This includes the possibility of controlling and monitoring electricity consumption in each household through “smart meters”, which can help to avoid system collapses.

Additionally, the increased development of EVs and HEVs in Europe could result in a position of technological leadership of its automotive sector, fostering a source of growth and employment for Europe so much desired at these times of crisis. Increasing global demand for individual transportation (e.g. in India and China), in combination with the problem of GHG emission and the finiteness of oil reserves, will most probably evoke high demand for EVs. If Europe supplies the world with EVs and the accompanying infrastructure, our current economic system would most certainly benefit strongly, and give Europe a competitive advantage in an emerging technological sector. Yet, it has to be noted that European companies will not necessarily be the main suppliers of EVs worldwide. Other economies, such as China, are improving their technological knowledge and enlarging their production capacities massively.

What has to be avoided is the possibility that an increased uptake of EVs is coupled with the construction of fossil-fuel (mostly coal) driven power plants to satisfy the increased demand for electricity. This could be a likely scenario for a rapidly developing country such as China, but also for industrialized countries with unsustainable economic policies. This prospect is of course a negative one, since the environmental burden of individual transportation is not substantially decreased (or



maybe even increased) if the electricity is produced from coal power. Electrified transport will only make sense if it is sustained by a clean input of energy and material.

However, the term sustainability with respect to transportation should be viewed in a much broader context than just in regard to electrified cars. A mode shift to public transportation, which is, among others, more efficient in public space it takes and in terms of energy use per person transported, should definitely be part of a strategy for a sustainable transport system. The result of an increased uptake of public transportation would, inter alia, increase the amount of public space available, reduce congestion times, and reduce noise levels, especially in urban areas. An extended use of bicycles and e-bikes, especially convenient transportation modes in city areas, would of course bear similar effects to a mode shift to public transportation.

Addressing these research issues, IHS has already conducted a study to elicit consumer preferences for alternative fuelled vehicles in Vienna and its surroundings (**ELMAR**). Currently IHS is coordinating the European research project **DEFINE**, co-funded by the European Commission, which aims to assess the costs and benefits of a large-scale shift to electromobility with partners from Austria, Germany and Poland. Such a shift definitely is a promising area of research now, but when thinking ahead, the changes before us might turn out to be more fundamental than we are currently able to anticipate.

Certainly, developments in the field of electromobility are subject to rapid technological progress. Technologies such as wireless electric charging³ could extend ranges that can be covered with electric vehicles quasi indefinitely and thus make the technology more sustainable, more comfortable and more efficient than conventional, fossil-fuel powered vehicles. Therefore, the change over to a mobility system almost exclusively powered by electricity could take place faster than we would imagine now.

Concluding, electromobility will most probably not be the only key to a sustainable transport system, albeit an important one. From the current perspective, the most promising road to take consists of a twofold strategy. Firstly, an increased uptake of EVs will have a positive effect on easing the exploitation of renewable energy sources for electricity production through smoothing peak demand and supply via increased storage capacities. Secondly, a shift away from a predominantly individualised transport system to electrified public transportation will restore public space and quality of living, and hence be of advantage for society. It seems necessary to take these steps now and simultaneously in order to reach at least medium-term sustainability for our transport and energy systems.

Vienna, the 27th of July, 2012

Michael Miess and Stefan Schmelzer

**Department of Economics and Finance, Applied Research Group
Vienna Institute for Advanced Studies (IHS)**

miess@ihs.ac.at,

schmelzer@ihs.ac.at

³ See <http://news.stanford.edu/news/2012/february/wireless-vehicle-charge-020112.html>