Brussels, september 2009

shecco reply to Commission consultation on "Sustainable future for transport: towards an integrated, technology led and user-friendly system"

shecco welcomes the Commission consultation on the future of transport policy as described in the Commission Communication "Sustainable future for transport: towards an integrated, technology led and user-friendly system"

This paper aims at identifying the opportunities linked to the use of electric vehicles as well as the barriers that prevent their uptake.

Shecco calls on the European Commission to take these into account and implement measures helping to address them in an effort to promote electrification of cars in the EU.

Executive summary

Air pollution due to transport is a major environmental and social challenge. Despite stringent standards to improve tailpipe emissions, the number of vehicles and kilometres traveled are increasing every year. Economic growth leads to more cars sold worldwide with an expected three billion car owners by 2050. In addition, continual exposure to internal combustion engines pollutants can cause a variety of symptoms and aggravate existing medical conditions. The elderly and the young are more susceptible to the risks imposed by air pollution.

In order to deliver on European and global environmental targets for emissions reductions and climate change prevention from the automotive industry shecco urges policy makers to encourage technologies able to satisfy those. Electric vehicles can lead the world towards more sustainable mobility so that today and future generations can make the 21st century a century of sustainability.

Shifting towards zero-emissions vehicles can be part of the solution. Electric vehicles can contribute to meeting the challenges in road transport regarding CO2 and pollutant emissions, energy efficiency and noise.

Because of their characteristics, plug-in hybrid and electric vehicles can contribute to achieving country objectives for energy independency, reducing CO2 emissions and a clean environment. Important examples are [IEA Outlook 2008]:

- For plug-in hybrid vehicles running on gasoline or diesel, improved fuel efficiency reduces oil demand and reduces CO2 emissions.

- Hybridization of vehicle drivetrains can also be combined with low CO2 emission fuels such as biofuels, to further reduce CO2 emissions from road transport and to become independent from fossil oil.

- When electricity is produced with renewable sources such as solar, hydro and wind power, hybrid (PHEV) and electric (BEV) vehicles that are recharged from the electricity grid will run on renewable and clean energy.

- PHEVs and BEVs can even serve as enablers for high shares of renewable energy in electric power production. This can be explained as follows. The electric energy that is produced by renewable sources such as solar and wind power is intermittent and the amount varies over time. In general, these variations are not synchronous with the variations in electricity demand. To overcome this mismatch in time between production and demand, electricity temporarily needs to be stored. The batteries of (a large number of) PHEVs and BEVs that are plugged into the electricity grid may serve as such a storage buffer.

- Given their low vehicular emissions and low noise production, hybrid and electric vehicles can advantageously be applied in sensitive areas such as inner city centres. When driving in electric mode, distribution trucks may even be allowed to operate during the night for example, and thus contribute to reducing congestion during daytime.

shecco is convinced that all the above mentioned factors set the stage for increased electrification of the world's automobiles. The EU has to steer the policy choices into this direction.

shecco detailed contribution to the Commission Communication "Sustainable future for transport: towards an integrated, technology led and user-friendly system"

1. Why going electric?

In considering the challenges facing the industry, including dramatically increased desire for fuel efficiency, regulatory requirements for fuel efficiency/lower CO2 emissions, and the desire to maintain many of the physical and performance attributes of today's vehicles, automotive engineers are recognizing that increased levels of electrification will be required.

- **Electrification of cars delivering on energy efficiency**

The biggest fuel efficiency gain for a hybrid vehicle comes from the differential efficiency curve of an internal combustion engine versus an electric motor. In simple terms, this means that conventional internal combustion engines are relatively inefficient at slow speeds (as low as 5-10% efficient). But at full throttle, the efficiency for gas engine could be closer to 28%. On average a gasoline engine is estimated to be 15-20% efficient. A diesel engine at full throttle can reach 33% efficiency, versus the 23% average quoted by DOE. The problem is that engines rarely function at maximum power – especially in urban environments.

In contrast to gas and diesel, electric motors have a very different efficiency curve. They are capable of producing maximum torque at launch, and they maintain a relatively flat efficiency curve until they reach a relatively higher speed. The advantage of the hybrid electric powertrain is its ability to use a combination of the two, maximizing the use of the electric powertrain at slow speed, and shifting to the internal combustion engine at speeds that give the internal combustion engine an advantage.

- **Electrification of cars delivering on the target to reduce greenhouse gases emissions intensity**

The transport sector greatly relies on fossil fuels (up to 97%) and contributes massively to greenhouse gas emissions responsible for global warming and climate change.

We now know that an increase in global temperature of even 1.5°C could lead to irreversible climate impacts, and 2°C risks triggering catastrophic climate change. We need a global plan that peaks global temperature rise as soon as possible and enables us to return to well below current levels.

While the challenge is huge, the momentum for change is now better than ever before. The European Union has set a target of 20-20-20 by 2020, whereas the international community is currently considering the update of the Kyoto Protocol on the emissions reductions of greenhouse gases globally due to be agreed in December 2009 in Copenhagen.

All in all scientific evidence shows that global greenhouse gas emissions should peak by 2015 and then decline rapidly, reaching as close to zero as possible by mid-century.

Electric vehicles with zero emissions are a major contribution to help cutting deeply rising greenhouses gases emissions from cars. Without sacrificing the continuous trend for mobility, electric vehicles can offer the much needed climate neutrality.

In a recent study, WWF [2008] provides a comparison of the CO2 intensity of motive energy at the wheels of Internal Combustion Engine Vehicles (ICEVs) and Battery Electric Vehicles (BEVs), for representative US states and EU nations, namely California, Indiana, Austria and Greece. The CO2 intensity of motive energy is depicted graphically in the following figure:

Comparison of the CO2 intensity of motive energy at the wheels of Internal Combustion Engine Vehicles (ICEVs) and Battery Electric Vehicles (BEVs)

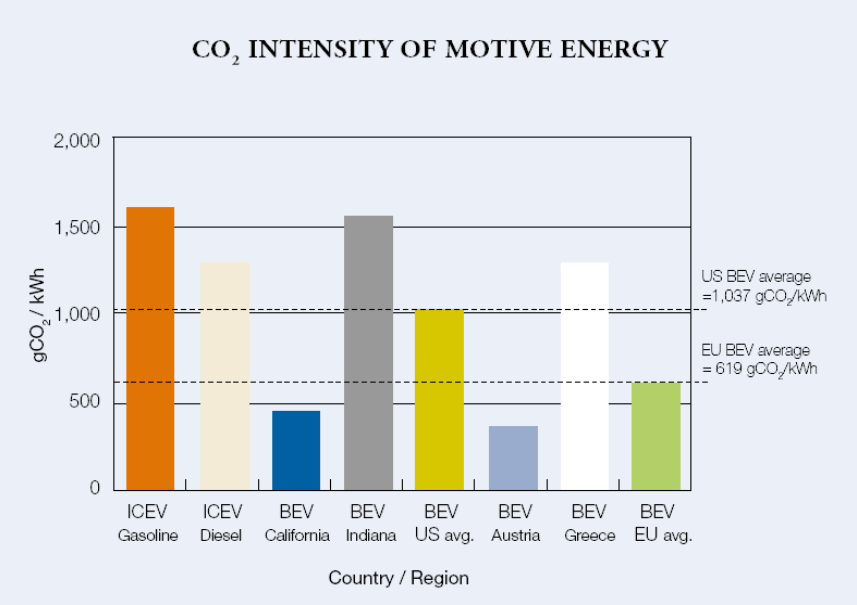

Figure 1: CO2 intensity of motive energy of ICEVs and BEVs in US and EU

Source: WWF, 2008

The calculations illustrate that, in terms of CO2 emissions, BEVs offer tremendous advantages over ICEVs where the electricity is derived from carbon-light generation sources. Even in coal rich Indiana, the BEV significantly outperforms gasoline – which dominates the US automotive market – in terms of gCO2/kWh. More importantly, based on the average power mixes of both the US and the EU, the data indicates that BEVs perform dramatically better on CO2 emissions than conventional ICEVs, whether fuelled by diesel or gasoline. This finding should lay to rest the so-called 'long tailpipe theory' which argues that the electrification of automotive transport merely transfers

problematic emissions from the vehicle exhaust to the power plant. […] The conclusion is clear: despite the variation in today's power generation mix across states and nations, electrons beat liquids in terms of life-cycle CO2 emissions.

So if BEVs beat ICEVs in terms of life-cycle CO2 emissions *with the energy source mix as it is today*, it is safe to say that the gulf will only widen if sustainable renewable energy options become a greater part of that mix. And that is destined to happen: as CO2 emissions attract increasing financial penalties through climate change policies such as the European Emissions Trading Scheme (EU−ETS) and similar state-level instruments in the US and elsewhere, renewable energy options will steadily become more and more competitive versus fossil fuels.

- **Electrification of cars answer end-user needs**

Electric vehicles are perfectly reliable means of transport and are virtually maintenance-free because they never need oil changes, air filters, tune-ups, mufflers, timing belts, or emission tests. This only adds to the list of features that can make electric vehicles a success.

2. Drivers of electrification - How?

The trend towards electric vehicles is currently mainly driven by four developments: rising oil prices, increased societal concern about climate change, advances in battery technology, and a barrage of regulations focusing on fuel economy, energy efficiency, and CO2 emissions.

Experts estimate that market share, mix, competitive advantages, vehicle content levels, used vehicle values, the frequency of consumer purchases, and powertrain technology could all change more dramatically over the next five years than they have in the past 50.

- **Policy measures promoting electrification**

The influence of political measures to promote electric and hybrid vehicles is crucial. As a recent example, the drop in sales of some hybrid models in the USA can directly be linked to the limits of subsidies.

In addition, there are still several countries where hybrid vehicles meet barriers. Often an inappropriate tax system is in place, e.g. in Denmark or Finland. (IEA AR 2006)
Governments have means to influence – slow down or accelerate – the trend towards electric vehicles.
They have many different options to encourage the demand and deployment for electric vehicles, including the following:

• Demonstration projects to promote innovation;

• Fiscal measures such as tax incentives for clean vehicles, “feebate” systems to encourage the purchase of small and hybrid vehicles, tax exemption; taxation of CO2 emissions, charges for less fuel-efficient vehicles to enter the city;

• Subsidies that may help overcome the price premium of hybrid and electric vehicles;

• Non-monetary measures such as parking lots with free recharge for electric vehicles, or entry rules for certain areas such as “car free” zones only accessible for zero emission cars;

• Raising public awareness, e.g. through promotion programmes;

• Stimulation of fleet renewal programmes to remove old vehicles from the in-use population;

• Directives & other laws (IEA Outlook 2008) Directives and laws play a key role in the support for electric vehicles. Policy makers have acknowledged electric powertrains as an efficient means to meet the challenges in road transport regarding GHG and pollutant emissions, energy efficiency, noise and even congestion. With ever more demanding fuel efficiency targets and emission limits established around the world, automotive engineers are recognizing that it may not be possible to meet the onerous targets through upgrades to conventional powertrains. In addition to legal prosecution arising from non-compliance, they are aware of the direct and indirect costs arising from not meeting the targets (penalties, fees, market barriers, lost market competitiveness). However, this has to be weighed against the rising costs of compliance with fuel economy standards. A growing number of industry executives predict that increased levels of electrification will be required to meet these challenges. (Deutsche Bank 2008).

- **EU Policy and Legislative Drivers in detail**

This section provides an overview of those EU policy initiatives having a major impact in driving the market uptake for electric vehicles.

At the EU level various debates are currently being held concerning the impact of the financial crisis on the automobile industry. EU legislators refer to Community instruments that can help the development of clean cars and explore the full potential of innovative and environmentally sustainable propulsion technologies such as fuel cells, hybrid, electric, solar power. At the same time, existing instruments, such as scrapping schemes for old cars, combined with demand for new ones that could generate additional benefits such as improved transport safety and reduced emissions are also discussed. Despite these indicative areas of potential future proposals that could affect the market for EVs, existing EU initiatives that are expected to drive the market include:

- **EU Renewables Energy Directive**

The new EU Renewables Directive require a target of at least 10% of renewable energy in the EU's total fuel consumption in all forms of transport by 2020, as part of the overall

target of 20% renewable energy in the EU's energy mix by 2020. Each Member State will thus have to increase its share of renewable energy in transport to 10%. Co-operation to achieve renewables targets jointly between Member States will be possible through for example running joint projects on green electricity production, heating or cooling, or to transfer renewable energy "statistically" between each other.

Member States may also join or partly coordinate their national support schemes so that renewable energy produced in one Member State counts towards the national target of another Member State.

- **EU Regulation on CO2 emissions from light-duty vehicles**

The idea is that an electric "zero emissions" model could help carmakers bring down the average carbon dioxide emissions of their entire fleet to the 130g/km limit that the EU is seeking to establish by 2012.

A new regulation will set emission performance standards for new passenger cars registered in the EU. The final text of the regulation backs the European Commission's proposed target of an average of 120g of CO2/km for the whole car industry by 2012, compared to the current levels of 160g/km. The regulation sets an average target of 130g CO2/km for new passenger cars to be reached by improvements in vehicle motor technology. It will be supplemented by additional measures to achieve a further 10g/km reduction, so as to reach the 120g/km target, through other technical improvements. The regulation introduces a long term target for 2020 for the new car fleet of average emissions of 95 g CO2/km.

However, manufacturers will be given interim targets to ensure average CO2 emissions of 65% of their fleets in January 2012, 75% in January 2013, 80% in January 2014 and 100% from 2015, to comply with each manufacturer's specific CO2 emissions target. This in effect delays the effective entry into force of the regulation until 2015. In case the average emissions of CO2 exceed the targets, manufacturers will have to pay fines, the so called "excess emissions premiums" according to the level of noncompliance. The level of fines between 2012 and 2018 are set to:

€ 5 for the first gram of CO2

€ 15 for the second gram of CO2

€ 25 for the third gram of CO2

€ 95 from the fourth gram of CO2 onwards.

Supercredits – As proposed by the European Parliament’s Environment Committee, a multiplier will be introduced for ultra low-carbon vehicles, so as to give car manufacturers incentives and reduce to the maximum possible their average CO2 emissions. Under this deal, each new passenger car with CO2 emissions of less than 50 g CO2/km shall count as: 3.5 cars in 2012 and 2013, 2.5 cars in 2014, 1.5 cars in 2015 and

one car (like any other) from 2016. Hybrid and electric vehicles may fall under the category of ultra low-carbon vehicles. The provision of supercredits, therefore, rewards manufacturers that produce zero-emissions full-electric vehicles or low emission hybrid-electric vehicles by making it much easier to meet their car fleet emission targets.

- **EU Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles**

In October 2008, the European Council and the Parliament adopted the new Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles. This Directive will introduce, for the first time, energy consumption, CO2 and pollutant emissions as mandatory award criteria into public procurement of vehicles.

The Directive is expected, over the long term, to result in a considerably faster and broader market introduction of clean and energy efficient vehicles and in a reduction of their costs through economies of scale. This will then contribute to improving energy efficiency and reducing CO2 and pollutant emissions of the whole vehicle fleet in Europe.

The approach is based on the internalising lifetime operational costs of vehicles in the procurement award process. Common rules are defined for calculating lifetime costs for energy consumption, CO2 emissions, and pollutant emissions linked to the operation of vehicles. These lifetime operational costs should be included as award criteria for all procurement of vehicles or transport services by public authorities. The application of these criteria will be optional in a first phase and mandatory from 2012.

The Directive covers all road vehicles (such as police cars, buses, waste collection vehicles, etc.) procured/purchased by public authorities and by operators providing public transport services. Life time costs will have to be calculated according to a methodology proposed by the European Commission.

- **Oil Prices**

There is no doubt that over the next decades the pressure from ever decreasing oil reserves and a simultaneously rising demand for fuel will mount, given the increase in population and standard of living in different world regions.

This will put tremendous pressure on the auto industry to bring forward fuel-saving technologies.

Increasing gasoline prices are, besides political support, the major driver for a transition to electric vehicles. In a recent report by Deutsche Bank, it was estimated that the world is currently consuming 87 million barrels of oil per day. Trend demand growth is roughly one million barrels per day per year. With shortages in supply in the future, due to internal instability in major oil producing nations, sabotage of oil fields, pipelines and refineries, this trend will continue. A predicted $150/bbl oil in the intermediate term would bring the automotive industry to a halt, experts estimate.

Since diesel prices have been rising faster than petrol prices, the interest in diesel vehicles as a long term viable alternative has gone down. For several countries, including the U.S., Belgium, France, and Austria, the movement of petrol prices clearly favours plug-in hybrids, as residential electricity prices have not followed the rapid increase seen in petrol prices.

- **Technology**

In a recent evaluation of the battery market potential for electric vehicles, Deutsche Bank Research estimates the efficiency improvement potential for internal combustion engines (ICE) to be limited.

Only 15-20% of the energy contained in gasoline is used to propel the vehicle, the rest being lost primarily as waste heat. In contrast, electric motors are able to convert roughly 86% of available electric energy into motive power. At lower average speed they become more efficient still – a level at which internal combustion engines are relatively less efficient. (Deutsche Bank 2008)

As a result, advances in battery technology are likely to spur a sharp electrification of the automobile.

High energy, cost effective, long lasting, and abuse tolerant batteries will be the key technical enablers for this shift, and there have been recent breakthroughs in meeting these requirements. Once the price and availability of batteries provides for an economically sensible move towards electric vehicles in the light-duty and heavy-duty vehicles sector, manufacturers can target vehicles for military or defense, space applications, marine equipment, and others, thereby unlocking potential in markets different from the automotive sector.

Overall, analysts see the prospects for investments in the electric vehicles battery market at an all time high. In 2004, the revenues generated by the World electric vehicles battery market were approximately $348.5 million. Revenues are expected to become $1867.3 million in 2011, growing at a compound annual growth rate of 27.1 percent.

- **Consumer Behaviour & Public Perception**

Another driving fact is the public perception of hybrid vehicles. The discussions about climate change and communication activities like Al Gore's movie ‘An inconvenient truth’ reach new people.

After Hollywood stars switched to hybrid vehicles, this movement is now expanding into broader market segments. It is well noticed when a car driver switches to a hybrid vehicle, pushing his image as a progressive and responsible citizen, especially in business.

Insurance companies have started to pay a remarkable contribution to those employees that buy a hybrid vehicle instead of a gas-guzzler.

Hybrids have arrived in TV series, in public relations campaigns - a major indication of their breakthrough on the mass market.

Overall, environmental concerns have gained greatly in influence when deciding for a car. Executives from the automotive sector asked in the KPMG Annual Global Auto Executive Survey 2009 for the expected predominating consumer purchase criterion over the next five years named "Fuel Efficiency" as the most important criterion by far. With 96% it is now well ahead of all other purchase criteria, including quality, safety, and affordability.

3. Electric vehicles – Why not? The Barriers

- **Availability and Price of Batteries**

A major setback for an early and widespread market penetration of electric vehicles is that battery technology is unable to keep pace with the growing demand for energy by the vehicles. Greater power leads to greater instability in the batteries thereby limiting the kilometres covered. In the case of electric vehicles, the battery technology is not advanced enough to cover long distances on one charge. Increasing the number of cells to augment the energy capacity and density of the batteries, however, increases the vehicle's weight, rendering it incapable of covering greater distances. This also increases the battery cost, thereby discouraging demand. Other factors contributing to the high battery cost are expensive raw materials and lack of economies of scale. (Frost & Sullivan 2005)

At present, the market for advanced rechargeable batteries for hybrids is relatively small – roughly $900 MM –and mainly dominated by makers of nickel metal hydride batteries. However, there is no doubt among automakers and suppliers that lithium-ion batteries offer the highest future potential.

Incremental costs only from the battery range from $100 (micro hybrid) up to $11,000 (full electric vehicle) per vehicle (see Annex I-3). Although this has to be offset against fuel efficiency gains, a significant price premium for electric vehicles due to the battery remains. On average, the battery can account for up to 75% of the incremental cost of electric vehicles.

- **Vehicle Purchase Price**

For a large proportion of the vehicle-buying public, purchase price is still the most important criterion when choosing a vehicle. The general public is not aware of the vehicle life cycle costs and how these costs compare among different propulsion alternatives. Up to now, because of the higher price of hybrid and electric vehicles, most buyers chose a conventional vehicle.

Research shows that in Europe, fuel savings from electric vehicles technology could approach $2100 per year, and the payback would be approximately 3.9 years.

Given higher up-front cost, penetration levels for full electric vehicles will largely depend on government incentives for zero-emission and zeropetroleum- consuming vehicles, or new business models offered by service oriented companies to take the upfront cost away from the consumer.

The most established one, Project Better Place, is running a business model in which it will own the battery and sell the consumer "miles" at a lower cost than the equivalent cost of gasoline in each country. A direct relationship between Project Better Place and electric utilities means that the cost of electricity will be absorbed by Better Place. Preferential tax treatment for electric vehicles will also provide an additional cost advantage for consumers purchasing electric vehicles.

- **Other Barriers**

In addition to the barriers mentioned earlier, there are three major setbacks for an early adoption of electric vehicles: public awareness, standardisation, market demands, and lack of consistency.

  - **Public Awareness**

There is still a lack of public awareness regarding alternatives to conventional gasoline and diesel cars. Besides the high purchase price and the limited driving range, there is a lack of confidence in electric powered vehicles in some markets. The latter is the result of battery problems in the past, and despite the fact that these problems have been successfully eliminated.

  - **Standardisation and Regulatory level playing field**

As for any new technology, standardisation of electric vehicles components and test methods are not as mature as for conventional vehicles. This is a barrier for industry to build up an efficient profit chain.

Non-existing consistency among different countries with respect to regulations create market disruptions and impede a cost-effective export of electric vehicle technology. Larger vehicle markets with similar requirements can help manufacturers develop products that meet all regulatory requirements.

  - **Market Demands**

Because it takes time to develop new vehicles and to build up the production and maintenance infrastructure, manufacturers are not yet always able to supply sufficient numbers of vehicles to meet the demand of surging markets.

4. Expected growth in electrification

Shecco believes that electric vehicles are destined for much more growth than is widely perceived.
This includes hybrid electric vehicles, plug-in hybrid electric vehicles, and even fully electric vehicles.

In the U.S. alone, 13 hybrid electric vehicle models were available in 2007, 17 are expected by the end of 2008, and at least 75 will be available within by 2011. NHTSA's April 2008 report on proposed Corporate Average Fuel Economy Standards projected that hybrid vehicles could rise to 20% of the U.S. market by 2015, from just 2% of the market in 2007. Global Insight projects 47% hybridization of the U.S. market by 2020.

In Europe, where fuel economy requirements are on an even steeper trajectory, Roland Berger and J.D. Power estimated that the market for hybrids/electric vehicles could rise to 50% by 2015 (mostly micro hybrids), from approximately 2% in 2007.

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