NON-PAPER CONCERNING PROPOSAL FOR RES-DIRECTIVE, ARTICLE 3(3): ELECTRIC VEHICLES

29 JULY 2008

Objective:

The objective of the proposed amendment is to ensure that the calculation formula used in the RES-directive fully reflects the target of replacing 10 % fossil oil with renewable energy sources. The present calculation formula does not take into account that renewable electricity used in electric transport technologies replaces 3 – 4 times more fossil oil pr. unit of final energy consumed than do bio-fuels.

The proposed amendment for Article 3 (3) below seeks to redress this imbalance.

Justification:

The European Council at the recent June meeting called for the promotion of alternatives to oil-based transport technologies singling out electric cars (Art. 39). This underlines the need to ensure that the Renewables Directive is technology neutral at the very least, as this directive will be an important part of the framework conditions for selection of new transport and energy technologies over the next decades.

The calculation formula in the present draft directive imply that 1 kWh of renewable electricity used for transport will be given the same weight as 1 kWh of bio-fuels in the calculation of the fulfilment of the 10 % renewable transport target. The explicit purpose of this target is to replace 10 % of the fossil oil used for transport. But 1 kWh of renewable electricity used in an electric vehicle replaces 3 – 4 kWh fossil oil, whereas 1 kWh biofuels will replace 1 kWh of fossil oil only. Consequently, the renewable electricity consumed in electric vehicles should be multiplied by a factor of 3-4, for the purpose of demonstrating fulfilment of the 10 % target.

Apart from substituting fossil oil electric transport technologies have a number of other benefits as compared to fuel based technologies. Seen in the context of renewables in the future EU electricity systems the storage capacity of electric car batteries can help meeting greater variability in electricity production with increasing shares of electricity from windmills and photovoltaics. The batteries can be charged during periods with high renewables production and to some extent discharged during periods with low renewable production. Similarly, electric cars can help to even out other peaks and troughs in electricity consumption and production. Batteries can be charged at night-time, when electricity consumption usually is low and may even be used to meet consumption peaks during daytime by discharging. Finally, electric cars and other electric transport technologies also reduce harmful air-pollutants and noise – not least in cities – helping Member States in their struggle to meet ever more stringent EU air-quality and noise standards.

Proposal:

The underlined addition is proposed:

Article 3(3)
Each Member State shall ensure that the share of energy from renewable sources in **all forms of** transport in 2020 is at least 10% of final consumption of energy in transport in that Member State. <u>The contribution from electricity produced by renewable sources and consumed in electric vehicles, plug-in hybrid vehicles, electric trains and other electric transport technologies shall be considered to be [three times] the energy content of</u>

the renewable electricity input. The average share of renewable electricity for EU 27 shall be used for the calculation of the renewable electricity input for electric vehicles in all Member States.

In calculating total energy consumed in transport for the purposes of the first subparagraph, petroleum products other than petrol and diesel shall not be taken into account.

Explanation
The implication of the proposal for the calculation of the contribution of electric transport technologies to the 10 % renewable transport target can be explained by the following example using the 2006 share of renewables in EU electricity production:

Example:

*An electric car running 20,000 km in 2006 used 20.000 * 0,115 kWh = 2300 kWh*

14 % of the electricity delivered in the EU 2006 was produced by renewables

The final, renewable electricity consumption of that car can be calculated as:

*(2300 kWh * 3) * (0.14) = 966 kWh*

Background

The explicit purpose of article 3(3) is to obtain substitution of the use of fossil petrol and diesel for transport by renewable energy. However, the article does not properly reflect the substitution potential of different kinds of renewable energy sources if calculated on an energy system basis.

An electric vehicle uses less energy to travel a certain distance than a comparable vehicle driven by a combustion engine. A battery-electric passenger car will approximately use 0.100 kWh electricity per km. When including loss of energy connected with battery charges and in the battery the consumption as delivered from the grid will be 0.115 kWh per km. This compares with a future, average new petrol/diesel passenger car using approximately 0.455 kWh petrol/diesel/bio-fuel per km assuming the goal of 120 g CO2/km to be achieved in 2012. That is: Electric cars at present drive about 4 times longer pr. final energy unit used. However, to remain conservative and taking into account future improvements of combustion engine technologies a factor of 3 is proposed in the amendment.

Some critics of electric cars argue that the superior energy efficiency of electric cars measured in terms of *final energy* units disappears when measured in terms of total *gross energy consumption*- that is: When taking a total energy system approach. The reason given is that thermal production of electricity entails significant losses – with 50-65 % of gross energy inputs being lost. However, this critique is invalid in this context for two reasons:

Firstly, according to Article 3 (3) bio-fuels are also to be measured in terms of their *final energy* content – not as the gross energy input used to produce them. The production of biofuels in many cases lead to significant energy conversion losses as well – for some bio-fuels up to 45 % of gross energy input is lost in the conversion process.

Secondly, the production of *renewable* electricity has much lower conversion losses than EU thermal electricity production in general. In 2006 80 % of EU 27 renewable electricity production was based on hydro and wind[1], which carry no conversion losses at all. Much of the remaining thermally based production

[1] Energy and Transport in Figures, DG TREN 2007

came from high-efficiency industrial combined heat and power stations, notably in paper and pulp mills or in district heating applications. Forecasts in the Commissions Renewable Energy Road Map (2007) indicate that the share of renewable electricity production without conversion losses will stay above 75 % till 2020. Conversion losses in renewable electricity production in the EU are and will probably remain small – and no higher than for most bio-fuel production.

In conclusion, electric vehicles retain their superior efficiency compared to combustion engine vehicles run on bio-fuels even when measured in terms of *gross energy* inputs using a total energy systems approach.

No double-counting as regards 20 % target

Using the multiplier of 3 when calculating the final energy consumption of electric transport technologies as regards the fulfilment of the 10 % renewable transport target will not result in any double-counting as regards the 20 % renewables target. The proposed amendment does not affect the calculation of the 20 % renewables target at all, as the multiplier will not be used for this calculation. See Annex 1 for further detail.

As for the 10 % renewable transport target the triple-counting of renewable electricity used in electric transport is only made to correctly reflect the related replacement of fossil fuels and hence the real contribution to the fulfilment of that target.

Setting the share of renewable electricity

The amendment suggests that the average share of renewable electricity for EU 27 shall be used for the calculation of the renewable electricity input in all Member States. That is: If 1/3 of EU electricity production comes from renewables this should be the factor used for calculating the final, renewable energy input to electric transport technologies in all Member States. In 2006 around 14 % of gross EU electricity production was based on renewables. This is expected to grow to around 1/3 of EU electricity production in 2020.

The background for this part of the proposal is the following:

The EU 27 electricity grid may – for practical purposes – be seen as one, single grid, as almost all major national and regional grids are physically connected today. Taking a one-grid approach greatly simplifies the calculation of how much renewable electricity is used in electric vehicles in the EU.

Taking this approach also creates one, single market with similar incentives for electric transport technologies in the whole of the EU. This will help to ensure a large and attractive market for car-producers, which need large scale production to make the production of electric cars cheaper. Secondly, it ensures that electric vehicles will also be used in large population centres in Central and Southern Europe with little local renewable electricity production but with extensive air-quality problems.

Finally, a one-grid approach avoids difficult discussion on potential differentiation of national renewable transport targets. The draft directive justifies the common 10 % renewable transport target for all member states with the ease of trading and transport of bio-fuels. Conversely, the natural endowment of renewable electricity resources varies greatly between Member States (notably hydro and wind-resources). If country specific shares of renewable electricity were to be used this could spark requests that richly endowed countries should have higher renewable transport targets.

Measuring the electricity consumption of electric vehicles

Reliable reporting of electricity consumption of electric vehicles must be ensured, if electric vehicles are to count against the 10 % renewable transport target – irrespective of whether the proposed amendment is accepted or not. Electricity use for trains is normally measured and reported with great accuracy. But

electricity use for charging of electric cars will be much more decentralised and potentially difficult to single out from other electricity use.

Denmark remains open as to how reliable reporting should be ensured, but it seems appropriate to link the accuracy of reporting of consumption to the share of electricity based car-transport:

At a share of the overall transport demand for electric cars below 1 - 2 % such calculations could be limited to statistical estimates. The estimates could be based on the number of cars, their specific electricity consumption pr. km and the average number of km driven (based on surveys). At higher penetration rates only electricity supplied via dedicated charging terminals with separate measurement and reporting of consumption should be taken into account. These terminals should at the same time be part of an integrated grid management system enabling the use of car-batteries in overall grid-management.

Other environmental aspects

Some critics fear that electric cars will lead to higher energy consumption and higher overall CO2-emissions. However, this critique does not seem justified for two reasons:

Energy consumption: In a well-to-wheels perspective electric cars have much higher energy efficiency than other alternatives. A recent Danish study put the overall efficiency of electric cars at 30 % today and 37 % expected for 2025 – that is: 30 – 37 % of the gross energy input to electricity production is transformed to useful, mechanical energy. The second highest energy efficiency is achieved by conventional diesel cars at app. 18 % today and 23 % efficiency expected for 2025. So, replacing oil-based transport with electric transport will lead to a reduction in total gross energy consumption for transport. Total electricity production, though, will have to increase to meet increased electricity demand. The likely increase in total electricity demand for transport is expected to be much smaller than the increase in renewable electricity production, though.

CO2: At present the average EU emission pr. kWh electricity produced stands at around 420 g/kWh. This translates into an average emission of less than 50 g CO2/km for electric cars charged from the grid. For comparison the present, average EU emission of new cars based on fossil oil is around 160 g CO2/km and the target for 2012 is 120 g/km.

Even if it was assumed that electric cars were to be charged exclusively from new, coal-fired power stations without CCS the specific emission pr. km will be less than 100 g/km. In addition, the EU Emissions Trading System has established a cap over total CO2-emissions from a.o. electricity production. This implies that increased electricity consumption and production can not lead to higher CO2-emissions overall.

Renewable electricity production carries negligible CO2-emissions only. As most renewable electricity will be produced inside the EU this production will be covered by comprehensive environmental legislation ensuring environmental sustainability.

Security of supply

The security of supply of renewable electricity production is expected to be very high, as almost all of this production will take place within the EU. Annual production of renewable electricity varies, but for the EU as a whole such variations tend to be small. In general, security of supply of all electricity production in the EU is deemed higher than for oil-supply, as the sources of primary energy used for this production are more diversified than for oil-imports.

Possible scenario for the role of electric transport in fulfilling the renewable transport obligation

It is very difficult to predict the possible effect of the proposal on the actual take-up of electric vehicles. Electric passenger cars and plug-in hybrids – which are expected to be the main, new source of electric transport – are only marketed on a very limited scale today. It remains unknown whether recent technological advances - especially batteries - will be sufficient to make such cars attractive for consumers.

In order to provide some oversight of the numbers involved as regards oil-substitution, total electricity consumption, number of electric cars a.o., a possible scenario for the fulfilment of the EU Renewable Transport Obligation is provided in Annex 2. The most crucial estimates – on total use of electricity for transport in 2015 and 2020 – are purely speculative. Still, the table indicates the challenge of meeting a major share of the Renewable Transport Obligation by means of electric transport – in Annex 2 illustrated by the significant share of electric cars of new car registrations needed if electric transport is to meet around half of the 10 % obligation: In the period 2010-15 no less than 11% of new car registrations must be electric cars and 2015-20 no less than 22 %. Annex 2 also indicates that total oil-substitution attributable to the introduction of electric cars will be 3 times higher than the figure for renewable electricity, as the non-renewable part of the electricity used also replaces fossil oil. Yet, total extra electricity demand for transport in this scenario – 100 TWh - is only a fraction of the expected increase in renewable electricity production at 886 TWh.

Annex 1:

No double counting of renewable electricity used in electric vehicles as regards 20 % overall renewables target

Concern has been raised that the Danish proposal would lead to double-counting as regards the 20 % renewables target. The table below seeks to illustrate that this is not the case. Two extreme scenarios for 2020 and a half biofuels/half renewable electricity-scenario are presented to make it easier to understand:

- Biofuels Scenario: The 10 % renewable transport target is fulfilled exclusively with biofuels
- Electricity Scenario: The 10 % renewable transport target is fulfilled exclusively with renewable electricity

Contribution of renewable energy sources to total Final Energy consumption 2005 & 2020 (Mtoe)

Mtoe[1]	**2005**	**Fulfilment of the 10 % renewable transport target**		**Fulfilment of 20 % renewables target**	
		Biofuels Scenario	Electricity Scenario	Biofuels scenario	Electricity scenario
Renewable electricity	40	0	35 (=11,67*3)	135	146,67
Renewable heat	56	0	0	100	123,33
Bio-fuels	3	35	0	35	0
Total	99	35	35	270	270

[1] Figures for the total expected EU 27 final energy consumption and transport energy demand are derived from the PRIMES base-case for 2020.

Calculation of the 10 % renewable transport target: In the electricity scenario the 35 Mtoe biofuels is replaced by11,67 Mtoe renewable electricity. This amount of renewable electricity will replace around 35 Mtoe of fossil oil – the same replacement as achieved by 35 Mtoe of bio-fuels

Calculation of the overall 20 % renewables target: In the Electricity Scenario the 35 Mtoe of bio-fuels expected in the Bio-fuels scenario is assumed to be replaced by an additional 11,67 Mtoe renewable electricity and 23.33 Mtoe renewable heat. This specific distribution of the 35 Mtoe being replaced is just for illustration purposes and could be different. **The decisive point is that the total amount of renewable energy in 2020 stays the same with the Danish proposal – only the breakdown on renewable sources will differ compared to a scenario where bio-fuels are used to fulfil all of the renewable transport target.**

Annex 2: Possible scenario for phasing in the EU renewables transport obligation

	2010	2015	2020	
EU 27 Transport, diesel & petrol consumption, Mtoe	317	336	350	PRIMES basecase (public road transport, cars, trucks)
Renewable Transport obligation, share of total petrol & diesel transport	0,04	0,07	0,1	2010 Biofuels Directive target of 5,75% not achieved, 2015 & 2020 own estimates
Renewable Transport obligation, Mtoe	12,68	23,52	35	
Electricity for transport, TWh	96,336	130	200	2010= EEA figure for 2005(http://themes.eea.europa.eu, 2015 & 2020 own estimates
Oil-substitution by electricity in transport, Mtoe	24,9	33,5	51,6	Electricity used for transport multiplied by 3
EU electricity production, TWh	3568	3839	4078	PRIMES basecase
Renewable share of EU electricity production	0,14	0,24	0,34	2010 PRIMES basecase, 2015 & 2020 Own estimates
Renewable electricity, TWh	500,10	921,36	1386,52	
Renewable electricity based oil-substitution, Mtoe	3,48	8,05	17,54	Renewable electricity multiplied by 3
Residual = biofuels & others, Mtoe	9,20	15,47	17,46	(Renewable transport obligation) minus (oilsubstitution by renewable electricity)
Total number of electric cars, mill.	0	14.6	45.1	Electric cars: Annual mileage 20.000 km, annual electricity use 2300 kWh, electric trains consta
EU Stock of passenger cars, mill.	247.7	271.9	298.4	2010-20: Statistical figure for 2005+ 1.88% annual growth
Electric cars share of stock	-	0,05	0,15	
Average share of new car registrations		**0,11**	**0,22**	2015 = Average 2010-15, 2020 = av. 2015-20, New registrations = Growth in stock + 8 % annual replacement of stock