Rewarding renewable efficiency

The energy efficiency of charging Electric Vehicles with renewable electricity must be rewarded in the RED.

February 2022

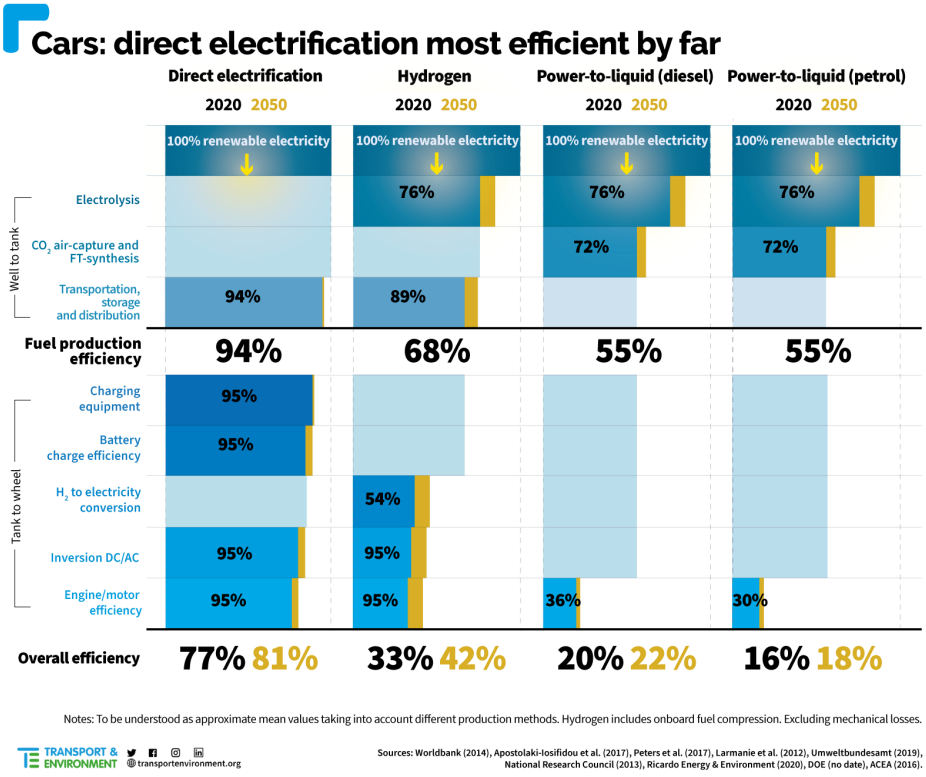
Summary

With 1 MJ of renewable electricity, Electric Vehicles (EVs) do 3.2 times more transport work and deliver 5.4 times more GHG reductions than delivering a megajoule of RED II compliant bioethanol to a combustion engine vehicle. This key finding from a review of the most recent literature should be front and center in the ongoing discussions on the review of the 2018 Renewable Energy Directive (RED). Whether or not the Commission proposal for a switch from an energy-based target to an emission intensity target for renewables in transport is approved, the RED must recognize the greater energy efficiency and resulting higher emissions savings from charging EVs with renewable electricity. Both the energy-based multiplier of 4 from the 2018 RED or the newly proposed higher fossil fuel comparator will deliver a clear signal to fuel suppliers that the supply of renewable electricity to EVs should be an important option for meeting the revised RED targets. The introduction of a fuel-neutral credit mechanism increases the importance of accurately rewarding the contribution from EVs to the RED target.

The higher efficiency of renewable electricity in EVs

It is well documented that EVs are more efficient at converting renewable electricity into transport work, when compared to fuel cell vehicles using renewable hydrogen or internal combustion engine vehicles using renewable liquid efuels (e.g. e-gasoline or e-diesel).[1] Direct electrification avoids significant conversion losses involved in the electrolysis process and the fuel cell or combustion engine.

[1] T&E (2020) Electrofuels? Yes, we can … if we're efficient



T&E commissioned a literature review on how to properly reward the higher efficiency of renewable electricity used in EVs, compared to the use of hydrogen in fuel cell vehicles and the combustion of biofuels and liquid e-fuels in internal combustion engine vehicles. The paper by Cerulogy reviews the Energy Efficiency Ratios (EERs) for cars and trucks developed by the European Commission's Joint Research Centre as well as the EERs used by the California Air Resources Board in its Low Carbon Fuel Standard[2].[3]

Considering the full Well-to-Wheel efficiency, the study finds that **delivering a megajoule of zero carbon renewable electricity to a battery electric vehicle can be expected to do 3.2 times more transport work and deliver 5.4 times more GHG reductions than delivering a megajoule of RED II compliant bioethanol to a combustion engine vehicle.** Compared to fuel cell vehicles using green hydrogen, EVs are twice as energy efficient and deliver more than double the emission savings.

[2] In addition to the Tank-to-Wheel analysis, the paper also draws on the Joint Research Centre's work on Well-to-Tank, namely the efficiency of conversion of delivery of primary energy to the vehicle.

[3] The Energy Economy Ratio refers to a value that represents the efficiency of a fuel (electricity, hydrogen, liquid efuels) as used in a powertrain (electric motor, fuel cell or internal combustion engine) as compared to the use of a reference fuel (combustion of fossil fuel like gasoline and diesel in internal combustion engine).

	Battery Electric Vehicles	Fuel Cell Electric Vehicles	Efuels in Internal Combustion Engine (ICE) Vehicles	Ethanol in spark ICE (60% GHG reduction)
Equivalence by distance travelled per unit of energy delivered to vehicle	**3.2**	1.5	1	1
Equivalence by GHG saving delivered per unit of energy delivered to vehicle (electricity at 0 gCO2e/MJ)	**5.4**	2.4	1.7	1

Multipliers for renewable electricity existed in previous RED

Back in 2009, when the Renewable Energy Directive (RED) first started promoting renewable energy in transport, EVs were not considered a credible decarbonisation option for road transport. This is why the Member States implemented the RED by means of biofuel blending mandates, aiming to gradually blend an increasing share of biofuels with fossil gasoline or diesel for use in internal combustion vehicles. Much has changed over the last decade. EVs sales are rapidly growing and the question of how to value and incentivise the use of renewable electricity by EVs has become a hotly debated topic. This is especially the case, as the Commission proposal requires Member States to implement a fuel-neutral credit mechanism "allowing fuel suppliers in their territory to exchange credits for supplying renewable energy to the transport sector". Operators of public recharging stations shall receive credit for the renewable electricity supplied to EVs, which they can sell to fuel suppliers.

In 2018, a multiplier of 4 was already introduced in the RED (Art. 27.2.b): For every 1 MJ of renewable electricity charged by EVs, 4 MJ must be counted towards the achievement of the target for renewables in transport. The Commission proposal for a 13% greenhouse gas intensity reduction target raises the question of how to value the contribution of direct electrification by EVs toward this new type of target.

Multiplier for renewable electricity in the new RED proposal

The current Commission proposal states that renewable electricity "should be considered to have zero emissions, meaning it saves 100% emissions compared to electricity produced from fossil fuels". In other words, instead of linking the emission savings to the carbon footprint of gasoline and diesel, the Commission puts forward the innovative idea of valuing the emissions savings from renewable electricity in transport based on the emission reductions realised by replacing a carbon-intensive electricity mix with renewable electricity sources. According to the EC , this will "create an incentive for the use of renewable electricity since renewable fuels and recycled carbon fuels are unlikely to achieve such a high percentage of savings."[4]

Concretely, the Commission proposes to distinguish between the emission savings from direct use of renewable electricity on the one hand and all types of liquid fuels on the other hand. It achieves this by introducing two fossil fuel comparators:

- For renewable electricity, the fossil fuel comparator $EC_{F(e)}$ from Annex V is used, namely 183 g CO2eq/MJ.[5]
- For liquid fuels such as biofuels, green hydrogen, e-gasoline and e-diesel, the fossil fuel comparator $E_{F(t)}$ of 94 g CO2eq/MJ, is used.

What does this mean in practice? A higher emissions comparator of 183 gCOe2/MJ allows the greater efficiency of battery electric vehicles to be recognised, albeit only partly. Under the proposed system, a megajoule of zero carbon renewable electricity supplied to an electric vehicle would receive 3.2 times as much credit as a megajoule of bioethanol delivering a 60% carbon intensity reduction, compared to the $E_{F(t)}$ of 94 g CO2eq/MJ (183gCOe2/MJ vs 56.4 gCOe2/MJ). This is still significantly less than the 5.4 times difference in GHG emissions reductions that are delivered in reality.

Conclusion

Whichever approach is chosen - be it an energy-based or a GHG-based target for renewables in transport -, the Parliament and Council must deliver a clear signal to fuel suppliers that the supply of renewable electricity to EVs should be an important option for meeting the revised RED targets. The introduction of a fuel-neutral credit mechanism increases the importance of accurately rewarding the contribution from EVs. For T&E, the 4x energy-based multiplier from the 2018 RED or the higher $EC_{F(e)}$ fossil fuel comparator deliver a similar effect. Both approaches find a middle ground between the 3.2 EER and the 5.4 times more GHG reductions from renewable electricity compared to crop-based biofuels. It also finds an appropriate compromise between the different EERs for a range of vehicles: cars, vans, smaller and bigger trucks. The upcoming review of the RED cannot offer a pretext for reducing the contribution that electric

[4] European Commission (2021) *Proposal for a Directive amending Directive (EU) 2018/2001, [...] as regards the promotion of energy from renewable sources (COM(2021) 557 final)*, p. 24, retrieved amendment-renewable-energy-directive-2030-climate-target-with-annexes_en.pdf

[5] This value is based on the carbon savings from using bioliquids used for the production of electricity, whereby renewable electricity replaces a fossil fuel-intensive electricity mix on the grid. The emission savings from renewable electricity are based on a weighted average EU fossil power mix (46% coal, 53% gas, 2% oil). More details in Table 1, page 16 of this JRC (2017) publication

vehicles can make to the target for renewables in transport, in particular at a time when EV sales are rapidly increasing. Downgrading the contribution of renewable electricity will only make the achievement of higher ambition more challenging, as other options are more scarce/expensive (e.g. Part A biofuels) or not able to expand (given the cap on crop-based biofuels and the phase-out of palm oil).

Further information

Geert Decock
Electricity & Energy Manager
Transport & Environment
geert.dc@transportenvironment.org
Mobile: +32(0) 484 629 491