Fun & Facts on the impact of power electronics

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Why Electric outperforms Bio

Germany alone has about 40 Million passenger cars doing 50 km daily in average.

Summed up:
2 Billion km/day
700 Billion km/year

The - renewable – energy [kWh] necessary could come from:
- 10 Million hectares of corn for Biomethane or
- 17 Million hectares of canola for Biodiesel or
- 19 Million hectares of corn for ethanol fuel

But only 140,000 hectares of solar panels

Total agricultural area in Germany: 17 Mio. hectares
19 Mio. hectares to create ethanol fuel
17 Mio. hectares to create biodiesel
10 Mio. hectares to create Biomethane

200km
Mechanical conversion vs. electronic conversion

› Growian 1983
  - 3MW, Leonard-Converter
  - $\eta \sim 80\%$
  - 600kW losses

› State of the art, 2018
  - 6MW, Power Electronics
  - $\eta > 95\%$
  - <300kW losses
Wind-driven mobility?

- 3 MW Windmill
- Typically 2000 full-power hours equivalent per year → 6 Million kWh/year
- Assuming 20 kWh/100 km → Energy to go 30,000,000 km
- Average use of fossil fuel in Germany 2015 was 7L/100 km and 120 gCO₂/km → 2,100,000 liters of gasoline saved
- 3000 tons of CO₂ saved in generation, ~0.5 kg/kWh
- 3600 tons of CO₂ saved in traffic
A side note...

An electric vehicle that needs 20kWh/100km consumes an equivalent of only 1.67L Diesel/100km

(1L Diesel ~12kWh)
Renewable hydrogen and the efficiency trap

Renewables → Electrolysis → H₂ → Battery electric vehicles

1 p.u.

Battery electric vehicles outperform H₂-fuel cells by factor 3, H₂-powered ICEs by factor 10

ICE* → <10 km
Fuel-cell → 36 km
EV charger → 100 km

* ICE = Internal Combustion Engine
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