Technology Options for Decarbonizing Road Freight

JRC/IEA Workshop:
Future Role of Trucks for Energy and the Environment

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11 July 2013

The Centre for Sustainable Road Freight:
A Unique Collaboration...

Cambridge University Engineering Department
Internationally leading capability in heavy vehicle engineering

Heriot-Watt University
A world leader in logistics

* Advisory Committee Member
Useful Transport Energy from Renewable Electricity
(U. Bossel, 2006)

Renewable AC Electricity
100 kWh

AC-DC Conversion
(95%) \(\rightarrow\) 95 kWh

Electrolysis
(75%) \(\rightarrow\) 71 kWh

H₂ Compression
(90%) \(\rightarrow\) 64 kWh

H₂ Transport/Transfer
(80%) \(\rightarrow\) 51 kWh

Fuel Cell
(50%) \(\rightarrow\) 26 kWh

Electric vehicle
(90%) \(\rightarrow\) 23 kWh

* Ignores boil-off: 3-4% per day; 50% in 2 weeks
* Ignores leakage

H₂ Liquefaction
(65%) \(\rightarrow\) 46 kWh

H₂ Transport/Transfer
(90%) \(\rightarrow\) 42 kWh

Fuel Cell
(50%) \(\rightarrow\) 21 kWh

Electric vehicle
(90%) \(\rightarrow\) 19 kWh

Tank to Wheel efficiency looks good \(\approx 45\%\)

AC via grid transmission
(90%) \(\rightarrow\) 90 kWh

AC-DC conversion and battery charging
(85%) \(\rightarrow\) 77 kWh

Electric vehicle with regenerative braking
(90%) \(\rightarrow\) 69 kWh

H₂ Compression
(90%) \(\rightarrow\) 64 kWh

H₂ Transport/Transfer
(90%) \(\rightarrow\) 42 kWh

Fuel Cell
(50%) \(\rightarrow\) 21 kWh

Electric vehicle
(90%) \(\rightarrow\) 19 kWh

* Ignores boil-off: 3-4% per day; 50% in 2 weeks
* Ignores leakage
Useful Transport Energy from Biofuel

Bio Methane 100 kWh

Steam Methane Reforming (90%) ➔ 90 kWh (HCV)

- H₂ Compression (90%) ➔ 81 kWh
- H₂ Transport/Transfer (80%) ➔ 65 kWh
- Fuel Cell (50%) ➔ 32 kWh
- Electric vehicle (90%) ➔ 29 kWh

CH₄ Compress & Transport (95%) ➔ 95 kWh

Hybrid vehicle with gas engine (45%) ➔ 43 kWh

CO₂ CCS?

Cancelled by George Osborne Nov 2015

(10% EU target for biofuels 2020+)