EU Transport GHG: Routes to 2050?

Alternative energy carriers and power trains for cars and vans

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Meeting 1b

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www.eutransportghg2050.eu

Partners

AEA CE Delft TNO ISIS milieu

Scope of Presentation

- Alternative energy carriers and powertrains
  - Liquid biofuels and biogas
  - CNG, LNG and LPG
  - Pure Electric and Plug-in hybrids
  - Hydrogen and Fuel Cells

- Summary

Points to note

- Presentation based on:
  - Paper 2: ‘Alternative Energy Carriers and Powertrains to Reduce GHG from Transport’
- Lead Author was Nik Hill (AEA)
  - Tom Hazeldine wrote chapters on EVs and hydrogen fuel cells

Biofuels

- Covers range of fuels:
  - Vegetable oil, biogas/biomethane, bioethanol and biodiesel
  - First generation: from food crops
  - Second generation: from ligno-cellulosic materials (i.e. ‘woody’ or ‘grassy’ biomass)
    - Thought of as more sustainable
- 10% blend will be mandated by EU Renewable Energy Directive by 2020
  - Consensus that 5% biofuel blend will not damage engines
  - Concern regarding the impact a >5% blend would have on engines
- Potentially, very significant GHG reductions
  - 38% to 64% GHG savings for biodiesel from oilseed rape
  - 73% to 85% for second generation biofuels

Biofuels (2)

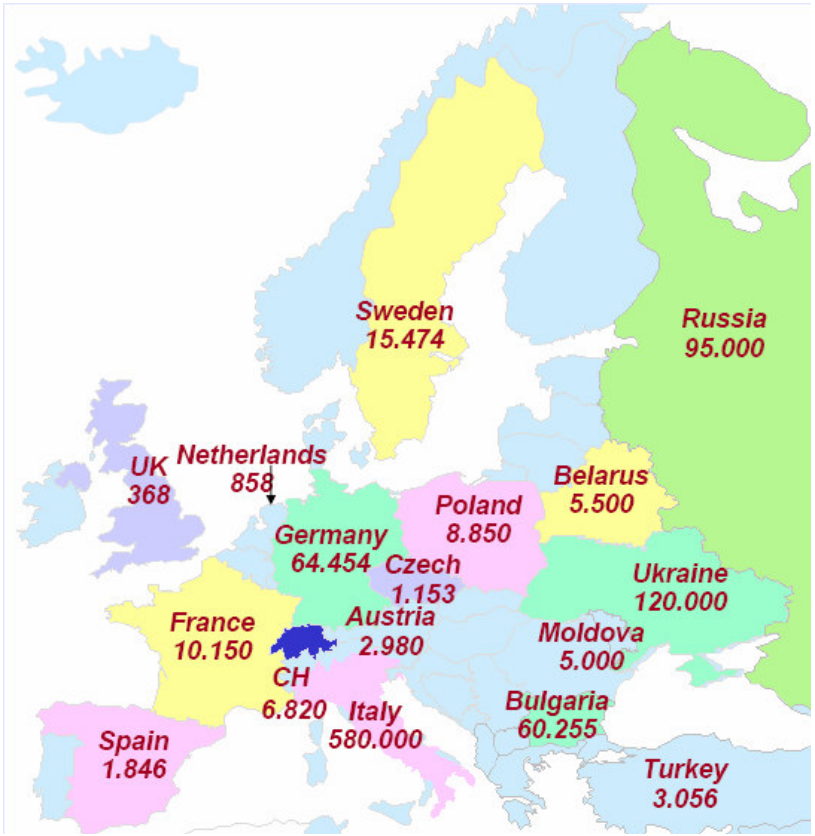
- Sensitivity analysis by AEA/North Energy showed LCA assumptions can have a big impact on GHG reductions:
  - Country specific influences (variations in yield, fertiliser application rates, energy mix)
  - Source of process heat or electricity
  - Transport distance for feedstock
  - Allocation methods (by price, substitution, energy content or mass)
  - NO2 soil emissions assumption
  - Land use change
- Price varies according to feedstock and country of origin
  - However, bioethanol from sugar cane in Brazil and corn in US are competitive with gasoline
- Barriers
  - Sustainability issues
    - Competition with food crops
    - Cause land use change elsewhere
  - Impact on comodity prices
  - Studies suggest lower lifecycle emissions if used for heating or co-firing

CNG/LNG/LPG

- CNG and LNG
  - Limited GHG emissions benefits
    - ~25% lower GHG emissions than gasoline but similar to diesel and less than EVs and FCVs
    - Greater GHG savings are available from biogas/biomethane
      - Although limited supply will consign it to niche markets
    - Could play a role in weaning the public off oil
  - Big benefit is significantly lower air quality emissions than gasoline or diesel. Compared to gasoline:
    - 90% to 97% lower CO
    - 35% to 60% lower NOx
    - Potentially 50% to 75% lower HC
    - Little or no PM
  - Across Europe there already almost a million NGVs on the road
    - Uptake varies significantly from country to country

CNG/LNG/LPG (2)

- Uptake of NGVs in Europe (International Association of NGVs)



CNG/LNG (3)

- Costs
  - Infrastructure costs for CNG and LNG are high
    - CNG fuel pump: 375,000 Euro to 750,000 Euro
    - LNG fuel pump: 150,00 Euro to 450,00 Euro
- Barriers
  - Technical bottlenecks
    - Durability of some components (natural gas regulators and on-board LNG tanks)
  - Infrastructure
    - Shell estimate that 20,000 refuelling sites costing US$7billion needed to meet potential demand
  - Storage
    - Most NGVs are dual fuelled. Some consumers dislike reduced gasoline range.

Pure Electric and Plug-in Hybrids

- EVs have the greatest potential for carbon savings
  - WWF study
    - Petrol = 1,619g CO2 per kWh of motive energy
    - Diesel = 1,300g CO2 per kWh of motive energy
    - Electric = 619g CO2 per kWh of motive energy (current EU grid mix)
  - Will lock in carbon savings as grid is decarbonised
- Li-ion batteries have provided step change in energy density
- However, no significant uptake until early 2020's
  - Volume manufactured EVs will continue to become available in small numbers over the next couple of years
- PHEVs could act as a bridging technology
  - No range issues
  - Lower battery cost

Pure Electric and Plug-in Hybrids (2)

- High marginal capital cost
  - £6,500 to £20,000 for small EVs
  - £8,500 to £14,000 for medium PHEVs
  - Although often a v.tenuous link between cost and price
    - Loss leaders…
- Cheaper to run
  - Fuel savings heavily discounted by consumers
  - Lower maintenance costs

Pure Electric and Plug-in Hybrids (3)

- Various significant barriers
  - Very high li-ion battery costs (around $800/kWh to 1,000$/kWh)
    - $250/kWh to $300/kWh once reach production volumes of 100,00 per annum
    - Different li-ion chemistries may help reduce cost
  - Reduced range
    - Battery swapping?
    - Project Better Place
  - Lack of charging infrastructure
  - Charging time for slow charging
  - Behavioural change
  - Competition from advanced diesels which will be cheaper
  - Impact on grid
    - Not thought to be significant until sizeable uptake (15% to 20%) of vehicles
    - Smart Grids

Hydrogen and fuel cells

- Hydrogen fuel cells used to be *the* future low-C technology for transport

- Support is fading
  - US administration "will not play a role in next 10 – 15 years"
  - European Transport Ministers "may play a role in the long term"
  - Inherently less energy efficient than EVs and hence lower C savings
    - WWF estimate the FCV pathway has energy efficiency of 28% compared to 34% and 69% for PHEV pathways running on Grid electricity and renewables respectively
    - Ease of energy storage is only advantage over EVs

- May play a role post 20-30 but by no means guaranteed

- Cost
  - IEA estimate that fuel cell costs need to reduce 10 to 50 times to become competitive
  - Infrastructure is very expensive
    - IEA estimates (ball park figure) that it would cost US$2.5trillion to develop worldwide hydrogen infrastructure

Summary

- In the short term 1st generation biofuels will only play a very limited role in reducing GHG from transport
- In the medium term 2nd generation biofuels may play a greater role
- No significant role for CNG/LNG/LPG (in terms of cutting GHG emissions)
- Greatest potential for GHG savings from EV but not available in significant number until early 2020's
- PHEVs will act as a bridging technology
- No significant role for hydrogen fuel cells for the forseeable future

Discussion points

- Do you agree with the conclusions?
  - Are we right to write off 1st generation biofuels, CNG/LNG/LPG and hydrogen?
  - Is the early 2020's realistic for EVs?
- Do you agree with the costs and carbon savings?

Any Questions?

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