





The role of biofuels within a fuels roadmap for Europe

Jonathan Murray Low Carbon Vehicle Partnership – UK June 2014



Connect Collaborate Influence

Introducing LowCVP

- Objectives
- Delivering low carbon vehicles
- Fuels contribution
- Meeting the RED
- Beyond 2020
- Conclusions



LowCVP – Vision, Mission and Aims



Our aspiration is for *Sustainable and efficient global mobility with zero life cycle impact*

We will work towards this by *Accelerating a sustainable shift to low carbon vehicles and fuels and stimulating opportunities for UK businesses*.

Through:

- **Connecting** stakeholders to build understanding and consensus regarding the optimal pathways to low carbon road transport.
- **Collaborating** on initiatives that develop the market for low carbon vehicles and fuels.
- **Influencing** Government and other decision-makers on future policy directions and optimal policy mechanisms.



LowCVP: Connecting, collaborating and influencing fuel policy

- LowCVP achievements regarding fuels include: Carbon & sustainability reporting, Renewable Transport Fuels Obligation, and Understanding of ILUC issues.
- Currently LowCVP's work is focused on developing consensus around future fuels.
- LowCVP commissioned Element Energy Limited to produce two reports:
 - Renewable Energy Directive Scenarios how to comply with the RED transport target
 - Fuels Roadmap road transport fuels delivering carbon reductions to 2030
- Available to LowCVP members at <u>www.lowcvp.org.uk</u> and will soon be made publicly available.





• Introducing LowCVP

• **Objectives** – reducing carbon and increasing renewables

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Objective: Cutting carbon and delivering a sustainable future

The EU has an objective of reducing greenhouse gas emissions by 80-95% 100% by 2050 compared to 1990.

Transport target for 2050 (including aviation) is to reduce greenhouse gas emissions by between 54% to 67%.

For Road Transport there are 3 main measures intended to deliver this:

- **vehicle efficiency** through new engines, materials and design;
- cleaner energy use through new fuels and propulsion systems;
- better **use of networks**.

Biofuels are seen as playing a key role in delivering carbon reductions and sustainability.





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Existing roadmaps: focus on powertrain and efficiency technologies but lack a cross-cutting view on fuels



- Efficiency improvements, driven by EU level tailpipe emissions targets and air quality regulations, underpin the roadmap.
- The 2020-2030 period is the decade when EVs (PHEVs, BEVs and/or FCEVs) become a mainstream
 offer under energy storage breakthrough condition, assuming adequate grid capacity. Development of
 these technologies driven by the need to meet the long term EU CO₂ targets¹.
- The EC transport goals are also expected to become a driver for Zero Emission Vehicles, e.g. CO₂-free city logistics in major urban centres by 2030 and phasing out conventionally fuelled cars in cities by 2050²



Slide 8 1 – A Roadmap for moving to a competitive low carbon economy in 2050, 80%-95% GHG emission reduction by 2050 compared to 1990 2 – EC Transport 2050 Strategy, Transport White Paper 2011

A fuel roadmap must align these 3 vehicle roadmaps and be consistent with the underlying drivers

Commercial & Off-Road Vehicles

Source: Auto Council

Buses

Source: LowCVP and Ricardo



- As for cars, efficiency gains are an essential part of the commercial vehicle roadmaps and the 2020-2030 decade when powertrains are increasingly hybridised, with full electric (BEV and FCEVs) expected to be adequate for some duty cycles.
- The roadmap does not include a cross-cutting liquid fuel strategy (e.g. type and blends of biofuels, diesel/gasoline balance), and there is no explicit roadmap for gas vehicles.

The role of the fuel roadmap

• The fuel roadmap must align these 3 vehicle roadmaps and be consistent with the underlying drivers, namely the EU and MS level emission targets.



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Fuel roadmap, including fuel types and blends fulfils this objective LowCVI



Source: Element Energy, Fuels Roadmap, a report for the LowCVP, 2014

Identifying the fuels, blends and feedstocks which vehicles will use

Blend	Cars	Vans	HGVs	Buses	NRMMs
E5 and E10					
E20					
E85					
B5 AND B7					
B10					
B30					
B100					
Biomethane					
Electricity					

Fuel	Feedstocks (New feedstocks need to be encouraged)
Ethanol	Ethanol 1G: Produced from Barley, corn, sugar beet, sugar cane, wheat. (Energy contribution factor 1) Ethanol 2G: Agricultural and forestry residues, non-food cellulosic and ligno-cellulosic material. (Energy contribution factor 2)
Drop-in Gasoline	Variety of potential fuels and feedstocks with potential to be chemically indistinguishable from gasoline.
Biodiesel	FAME food: Produced from oil seed rape, palm, soy. (Energy contribution factor 1) FAME non-food: Used cooking oil(UCO), tallow category 1. (Energy contribution factor 2)
Drop-in diesel	Biomass To Liquid (BTL) and Hydrotreated Vegetable Oil (HVO). (Energy contribution factor 2)
Gas	Biomethane: Biogas / waste. (Energy contribution factor 2)
LPG	LPG / bio LPG, the overall small share of LPG vehicles is <1% of the car and van fleet.
Ultra Low Emission Vehicle Fuels (ULEV)	Electricity: Dependent on carbon intensity of generating mix. Hydrogen: Emerging niche fuel.

Slide 12 Source: Element Energy, Fuels Roadmap, a report for the LowCVP, 2014

Fuel roadmap: Legislative drivers and policy objectives





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• Meeting the RED – a challenging target

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Analysis of the options to meet the RED transport target of 10% renewable energy by 2020 recommends E10 and B7 blends

The EE study considered four scenarios under which the RED target is met were derived:

E10 & B7: no blends higher than E10 and B7, rely on double counting fuels	E85case : E10, B7 as well as E85 at forecourts, with 6% of cars being E85 compatible by 2020		
DepotB30: E10, B7 and B30 for c. 35% of trucks & buses refuelling at depots	Depot&E85: E10, B7 as well as E85 at forecourts and B30 in depots		

Most pragmatic approach for the UK and other Member States to reach the RED target, is to pursue the **E10 & B7 approach**, namely:

- Roll out E10 and increase the biodiesel blending up to B7
- Maximise the use of double counting fuels that do not use food crop feedstock;
 - this implies a high reliance on Used Cooking Oil (UCO)
- Introduce a framework to support drop-in fuels:
 - Offer a better prospect to decrease emissions,
 - Displace / make up for supply shortfall of UCO feedstock and FAME based on food crop over time

Contribution to RED target in 2020 – E10&B7 case





Up to 20% of the FAME/HVO share could be HVO, based on the projection of 15 PJ (~450 MI) of HVO available for the UK road transport sector¹



Slide 15 Source: Element Energy, Options and recommendations to meet the RED transport target, a report for the LowCVP, 2014

1 – Assuming UK fair share (13%) of the EU potential identified in E4tech, A harmonised Auto-Fuel biofuel roadmap for the EU to 2030, Nov 2013

Fuel roadmap: Meeting the RED target in 2020

2016 - E10 becomes the certification fuel, latest introduction date for E10





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• **Beyond 2020** – achieving further carbon reductions

Conclusions



Beyond 2020, due to supply considerations regarding Biodiesel a move to E20 will be required as well as a potential for gas, depending on green pathways being identified

- Analysis by E4tech¹: results based on study of the supply of biofuels from bottom-up approach (land area, yield, plant capacity)
- Conclusions from E4tech study of biofuels supply potential at EU level:
 - Enough sustainable ethanol supply for a move to E35 (but E20 recommended when considering the needed vehicle and infrastructure modifications)
 - Not enough sustainable biodiesel supply to justify going beyond B7
 - Up to 10 Mtoe (420PJ) of biofuels not based on food crops available to the EU by 2030, with supporting policy framework in place

iseous fuels		WTW savings compared to diesel ²	Supply	Comments
	Biomethane	70 to 146%	32TWh in 2030 ³	Represents: c. 5% of the total 2030 UK gas demand; c. 5% of 2020 energy use from vans, HGVs, buses
Ö	Natural gas	-16 to 23%	>50 years of global proven reserves ⁴	There are various opportunities to reduce NG WTW emissions

- 1 E4tech, A harmonised Auto-Fuel biofuel roadmap for the EU to 2030, November 2013
- 2 Based on buses. Source: Ricardo, Preparing a low CO2 technology roadmap for buses, 2013
- 3 EU funded Green Gas Grid project, 2013 and DECC analysis (2012) for power demand range

4 – World use 2011: <40,000 TWh, world proven reserves 2012 > 2,000,000 TWh. Source: US Energy Information Administration



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A new gasoline blend beyond E10 will require an EC level decision and would be implemented in the MS in mid to late 2020s

- Introduction of E20 would bring further carbon savings from ICE fleet but first requires action at EC level, with the definition of a E20 fuel standard (for which work has started).
- OEMs and fuel producers need to agree on the E20 fuel octane number, a decision that balances higher WTW emission savings (through better fuel efficiency, high octane) and refinery costs (cheaper with lower octane).
- E20 compatible vehicles must be deployed ahead of the introduction of E20 optimised vehicles and the E20 fuel rollout must be timed to minimise the use of E20 optimised vehicles with lower blends¹.
- 2-grade gasoline markets requires a greater proportion of E20 vehicles in fleet. Adoption in UK is estimated to start in late 2020s at best, while multi-grade MS may be earlier.
- For E2G¹ to ramp up from early commercial, policy clarity (accounting, waste categorisation, post-2020 vision) and certainty is required at EC level, and support mechanisms set up at MS level



2 - Ethanol (or butanol) made from waste or lignocellulosic material that deliver high WTW emission savings

Fuel roadmap: Gasoline move to E20 and drop-in fuels



2016 - E10 becomes the certification fuel, latest introduction date for E10



The limitation in sustainable FAME means the roll-out of renewable diesel based on non-food crops, low ILUC feedstock must be supported

- The current blend limit (B7) does not need to be increased as:
 - · the access to sustainable FAME will be constrained and
 - increase in the share of drop-in fuel (which avoids B7 blend wall).
 - The use of biodiesel might however require refined fuel standards to ensure fuel quality.1
- For **drop-in fuels to ramp up** from early commercial, policy clarity and certainty is required at EC level, and support mechanisms set up at MS level.
- The overall use of biomass feedstock and biofuels dedicated to diesel vehicles must take into account:
 - · The need from the aviation sector

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- The other energy sectors (heat, power, other uses)
- There are potential conflicting uses for bioenergy and competing incentives need to be avoided. Member State incentives will need to account for the desired best use of biomass.



1 – The Options and recommendations to meet the RED transport target report (EE, 2014) recommends refined biodiesel standards to ensure FAME quality level that does not compromise engine behaviour under winter conditions and a possible revision of the diesel standard e.g. for cold flow properties. 2 – DECC/DfT/Defra 2012 UK Bioenergy Strategy

Fuel roadmap: Diesel B7 with increase in drop-in fuels.





Ultra Low Emission Vehicles: decarbonisation of pathways for electricity & hydrogen will require investment in upgrade or new technologies

Electricity

- In the UK projected baseline reduction of grid carbon intensity from c.500gCO₂/kWh today to 100gCO₂/kWh in 2030
- Requires more renewable generation. This, along with the integration of new demands (heat pumps, EVs) will require investments in networks and 'smart' systems
- Investment needed in power transmission and distribution are estimated at £42-49 billion¹ in UK
- New commercial arrangements e.g. to allow Demand Side Response are currently being investigated and trialled across EU.

Hydrogen

- Hydrogen currently mostly an industrial by-product or made from Steam Methane Reforming, i.e. high carbon pathway
- Water Electrolysis, due to decarbonisation of the grid, is the most promising option for the early 2020s and offer network storage benefits.
- In the longer term, additional green pathways include waste gasification, Carbon Capture and Storage (with SMR) and biomass gasification
- WTW emissions to be 35g CO₂/km for mid-sized Fuel Cell Electric car by 2030 based on projected UK hydrogen mix³



The deployment of gas vehicles requires a dedicated gas pathway strategy to ensure WTW emission benefits

- Deployment of gas vehicles varies across Member States. However methane has potential in the road transport sector to reduce carbon emissions and can be deployed with increased methane use across Member States.
- Bio-methane supply is limited and may not be possible to 'earmark' for transport, instead gas vehicles must be fuelled by gas produced and delivered through a pathway consistent with MS strategy.
- The fuel roadmap implies:
 - A certification procedure for gas fuelled vehicles and a gas specification (e.g. energy content and sulphur content) is agreed at EC level
 - The MS defines a strategy to incentivise the uptake of gas vehicles (commercial vehicles and buses) as well as incentivise the best gas pathway in terms of WTW emission reductions, consistency with carbon budgets and feedstock/gas supply potential
 - Supply of gas vehicles to the EU market is improved as OEMs develop Euro 6 gas vans, trucks, buses

Roadmap for the deployment of gas vehicles in the UK



plants nor initiatives in the UK, other countries are considering its use in transport, e.g. the US and Sweden, where the first bioDME pilot plant was opened in 2010

Fuel roadmap: Green pathways and low carbon electricity generation key to alternative fuels.







Source: Element Energy, Fuels Roadmap, a report for the LowCVP, 2014

Roadmaps show potential to reduce GHG emissions by 20% WTW between 2020 and 2030, and double renewable energy share



Illustrative impact of the fuel roadmap in UK¹



- The combination of powertrain roadmaps and fuel roadmap will deliver a reduction of emissions through:
 - An improvement in the fleet energy efficiency to the extent that total energy use decreases by 4%-10% between 2020 and 2030 (depending on powertrain technology uptake)
 - An increasing use of biofuels, gas and grid decarbonisation
- By 2030, FAME, drop-in diesel and ethanol are still providing most of the renewable energy due to dominance of petrol and diesel vehicles
- The rise of diesel ICE among cars is assumed to stop as emission requirements are becoming more difficult to meet by diesel ICE

2030 sales share assumptions

Powertrain scenario	Base	High AFV
ULEV [cars]	30%	60%
ULEV + gas [vans]	10%	20%
Gas [HGVs]	7%	26%
ULEV + gas [buses]	7%	15%

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Source: Element Energy. Fuel Roadmap, a report for LowCVP, 2014. 1 – Based on emissions, vehicle efficiency, fleet and travel assumptions in consistence with approach developed in *Options and recommendations to meet the RED transport target*, Element Energy for the LowCVP, 2014

Ambitious policies to introduce renewables could deliver >65% reductions in GHGs for road transport



Source: PE International. Life cycle CO2e assessment of low carbon cars 2020-2030. A report for LowCVP. 2013



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• **Conclusions** – the opportunities, risks and challenges



Conclusion & what needs to happen to meet the RED

The LowCVP believes the most pragmatic strategy to comply with the RED target is to use the **E10 & B7 approach**.

- Roll out E10 and increase the biodiesel blending up to B7 blend wall
- Maximise the use of double counting fuels that do not use food crop feedstock
- Feedstocks need to be sustainable and minimise risk of ILUC
- This will be reliant on high utilisation of Used Cooking Oil (UCO) as a feedstock for B7 biodiesel.
 - There are potential other non-food waste streams which could provide an alternative to UCO but these are constrained by poor waste collection, costs and processing/refining plant capacity currently.
- Encouraging the development and deployment of advanced and drop-in fuels as early as possible to alleviate reliance on UCO.
- Encouraging the deployment of electric and biomethane vehicles could help alleviate reliance on E10 and B7.

In all cases, the implied take-up of new fuel blends and deployment of vehicles suggest an ambitious implementation programme which will require incentives.

The supply of double counting fuels is critical to the success of this approach.



Conclusion & what needs to happen beyond 2020

Beyond 2020 there is potential to significantly reduce carbon emissions and increase the use of renewable energy in road transport. With respect to liquid fuels;

- There is sufficient sustainable ethanol supply to move to a higher blend than E10 gasoline i.e. E20.
- The level of octane in E20 has implications for both vehicle and refining efficiencies. The agreed level should offer significant WTW emission savings.
- 2 grade gasoline infrastructure will delay deployment of E20.
- Early development and deployment of E20 compatible vehicles will aid deployment of E20.
- Limitations on sustainable biodiesel supply and development of drop-in diesel preclude the need to go beyond B7 (EN590) specification.
- The development and commercialisation of drop-in gasoline and diesel fuels will require policy clarity at EC level and support mechanisms at Member State level.



Conclusion & what needs to happen post-2020 for alternative fuels

During the period 2020-2030 alternatives to liquid fuels will start to main stream alternatives to liquid fuels. With respect to alternatives fuels:

- Significant investment in renewable generation, networks and smart systems will be required for continued electric vehicle deployment.
- Development of additional green pathways for hydrogen are required to lower carbon content of hydrogen to 2030.
- Biomethane and methane have a role to play in road transport in the time horizon to 2030. This will require a strategy to ensure WTW emission benefits.
- LPG offers a lower carbon flexible bridging fuel which can be used in older vehicles. The development of bio-LPG offers a potential role for LPG as a road fuel to 2030.
- Need to encourage continued innovation to develop new renewable energy solutions for road transport in the future.



The Low Carbon Vehicle Partnership

Connect |Collaborate | Influence

- Connect: With privileged access to information, you'll gain insight into low carbon vehicle policy development and be introduced to key stakeholders.
- Collaborate: You'll benefit from many opportunities to work – and network - with key UK and EU government, industry, NGO and other stakeholders.
- Influence: You'll be able to initiate proposals and help to shape future low carbon vehicle policy, programmes and regulations.



LowCVP is a partnership organisation with over c180 members with a stake in the low carbon road transport agenda.



Thank you for your attention.

Jonathan Murray Policy and Operations Director Low Carbon Vehicle Partnership



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