Road Transport Carbon Impact, Time to look 'Beyond the Tailpipe'

Andy Eastlake

Low Carbon Vehicle Partnership – UK

November 2013

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LowCVP – The Low Carbon Vehicle Partnership

The LowCVP is an independent, not-for profit stakeholder partnership funded mainly through government grants and member contributions.

The LowCVP is the only organisation in the UK – or Europe – which brings stakeholders together to facilitate the development of better policy and accelerate the shift to low carbon vehicles and fuels.

"The LowCVP is a unique organisation which is effective in bringing stakeholders with widely differing perspectives together."

Prof Neville Jackson, Chief Technology and Innovation Officer, Ricardo UK Ltd and Chair of the LowCVP Board

LowCVP – Vision, Mission and Aims

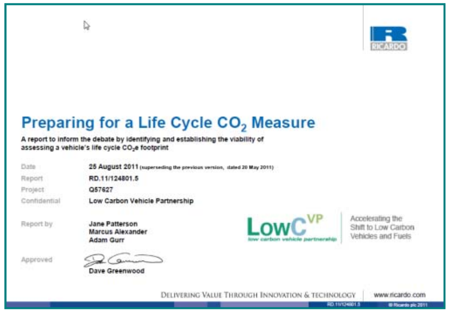
- Our aspiration is for “**Sustainable and efficient global mobility with zero life cycle impact**”
- We will work towards this by “**Accelerating a sustainable shift to low carbon vehicles and fuels and stimulating opportunities for UK businesses**”
- Through:
    - **Connecting** stakeholders to build 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.

Agenda

- UK reports on life cycle assessment
- Comparison of vehicle technologies
- UK manufacturers report
- Projection of future life cycle impacts
  - Improvements over time
  - Changing contribution of life cycle phases
  - Several options available to meet targets
- Current CO2 measurement challenges
- Precedent of urgent first steps to better assessment
- Sensitivity
  - Vehicle Life
  - Lightweight materials
  - Vehicle types
  - International implications
- The way forward

UK reports on life cycle assessment

2011 – LowCVP report “Preparing for a Life Cycle CO2 Measure” Ricardo


Preparing for a Life Cycle CO_2 Measure

A report to inform the debate by identifying and establishing the viability of assessing a vehicle's life cycle CO_2e footprint

Jane Patterson
Marcus Alexander
Adam Gurr

Dave Greenwood

2013 – Committee on Climate Change report “Current and Future Lifecycle Emissions of Key ‘Low Carbon’ Technologies and Alternatives” – Ricardo-AEA


RICARDO-AEA

Current and Future Lifecycle Emissions of Key ‘Low Carbon’ Technologies and Alternatives
Final Report

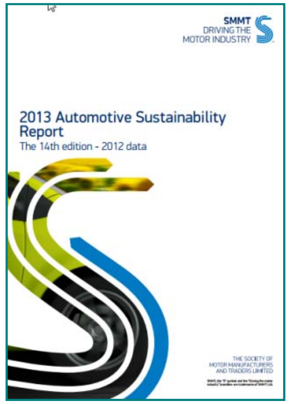
Naser Odeh
Nikolas Hill
Daniel Forster

17th April 2013

Project carried out for the Committee on Climate Change (CCC)

www.ricardo-aea.com

2013 – SMMT 14th “2013 Automotive Sustainability Report” – SMMT


SMMT DRIVING THE MOTOR INDUSTRY

2013 Automotive Sustainability Report
The 14th edition - 2012 data

2013 –LowCVP report “Life Cycle CO2e Assessment of Low Carbon Cars 2020-2030” – PE international


FINAL REPORT

Life Cycle CO_2e Assessment of Low Carbon Cars 2020 – 2030

For the Low Carbon Vehicle Partnership

PE INTERNATIONAL

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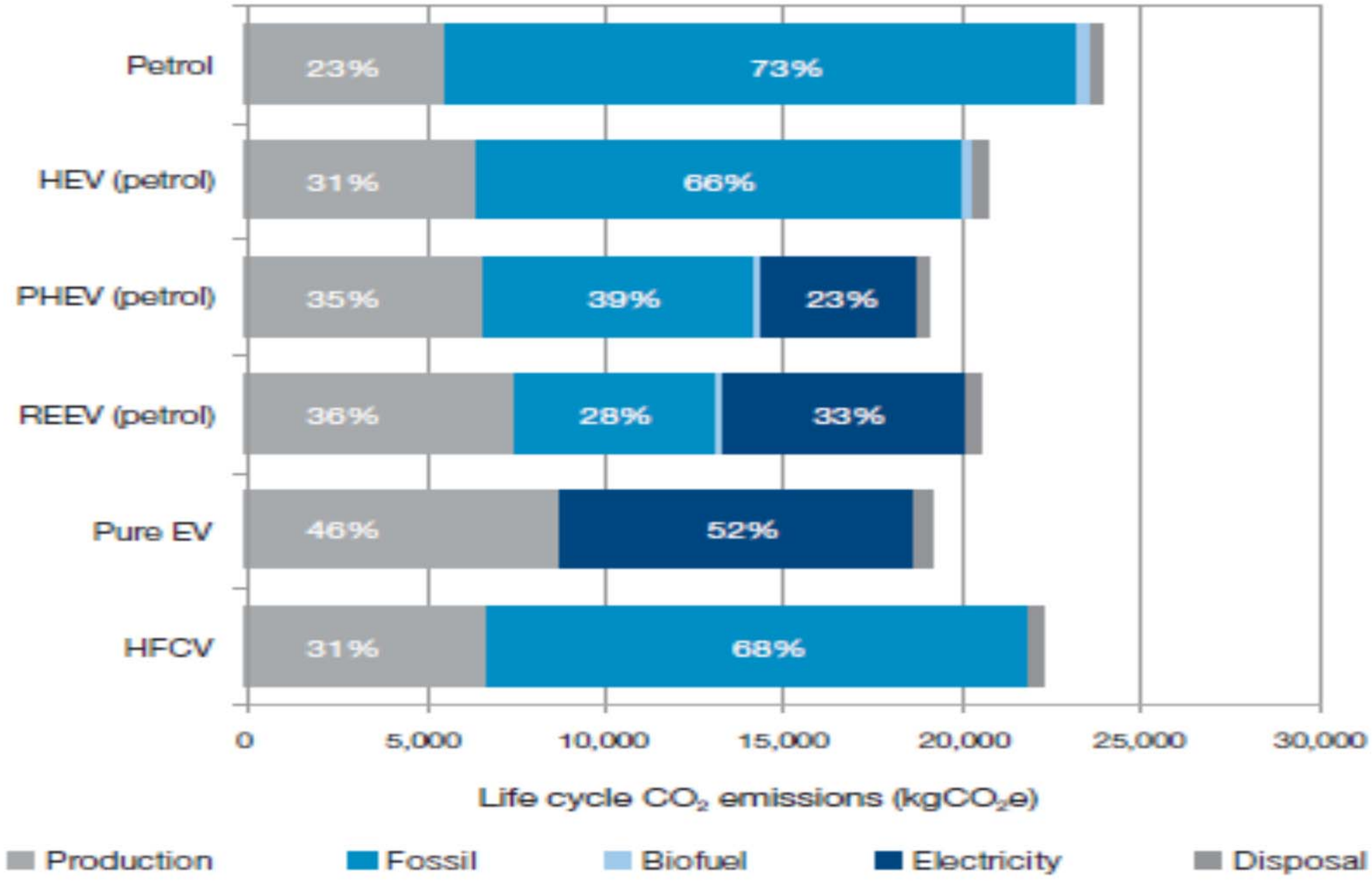
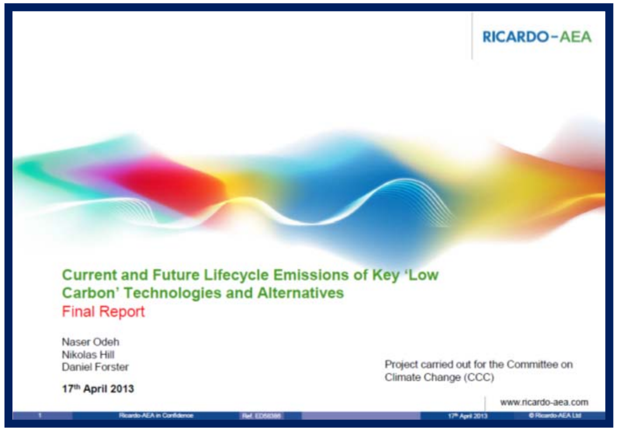
2011 – LowCVP comparison of vehicle technologies

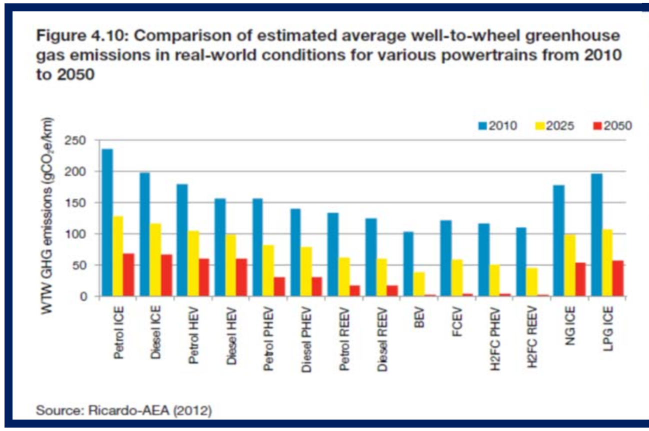
Figure 2.4: Life cycle CO_2e emissions for various medium-sized vehicle technologies in 2015

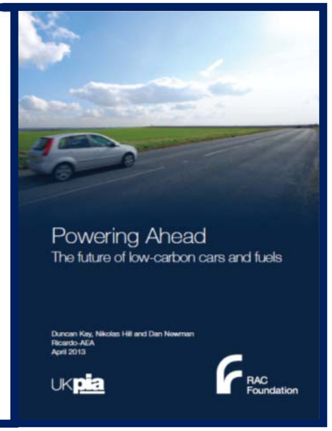


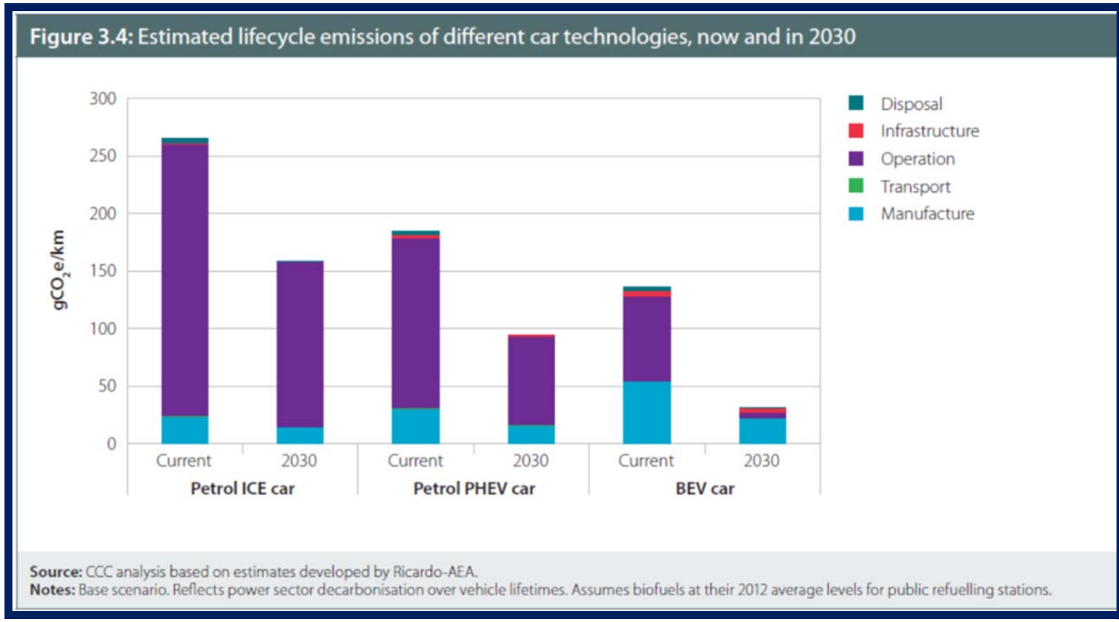
Source: Ricardo (2011) Preparing for a Life Cycle CO_2 Measure – Report for LowCVP 2011

2013 – LCA analysis gathers momentum









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UK manufacturers report – SMMT Sustainability Report

SMMT 14th year of Sustainability Report. Scorecard approach.

- Economic and market measures
- Environmental and resources
- Social impacts for sector

Shows Year-on-year changes

Covers over 95% of UK production

Includes Tier 1 suppliers

Progressively incorporates more comprehensive data on supply chain

IN SUMMARY

		2011	2012	Percentage change 2012 on 2011	
ECONOMIC PERFORMANCE					
Automotive manufacturing sector turnover*	(£ billion)	57.7	59.3	2.8	🟢
Expenditure on business R&D*	(£ billion)	1.5	1.7	9.2	🟢
Total number of cars and CVs produced	(million) (UK) (WI)	1.5	1.6	7.7	🟢
Total new cars and CV registrations	(million) (UK) (WI)	2.2	2.3	1.7	🟢
Signatories' combined turnover	(£ billion) (AS)	49.6	58.2	17.5	🟢
Total number of vehicles produced	(million) (AS)	1.4	1.5	9.4	🟢
ENVIRONMENTAL PERFORMANCE					
Production inputs					
Total combined energy use	(GWh) (AS)	5,010	4,628	-7.6	🟢
Energy used per vehicle produced	(MWh/unit) (VMs)	2.3	2.2	-4.8	🟢
Total combined water use	(000m³) (AS)	5,481	5,765	5.2	🔴
Water use per vehicle produced	(m³/unit) (VMs)	3.0	2.9	-2.1	🟢
Material output					
Total combined CO_2 equivalents	(tonnes) (AS)	1,600,148	1,420,805	-11.2	🟢
CO_2 equivalents per vehicle produced	(tonnes/unit) (VMs)	0.68	0.66	-3.2	🟢
Volatile Organic Compounds emissions (cars)	(g/m²) (VMs)	35.4	35.3	-0.2	🟢
Volatile Organic Compounds emissions (vans)	(g/m²) (VMs)	61.4	60.5	-1.4	🟢
Total combined waste to landfill	(tonnes) (AS)	14,780	11,661	-21.1	🟢
Waste to landfill per vehicle produced	(kg/unit) (VMs)	7.1	5.9	-16.7	🟢
Vehicle use					
Average new car CO_2 emissions	(g/km) (AC)	138.1	133.1	-3.6	🟢
SOCIAL PERFORMANCE					
Number of jobs dependent on the sector*	('000) (WI)	746	731	-2.0	🔴
Combined number of employees	(AS)	79,641	83,308	4.6	🟢
Number of lost-time incidents	(AS)	185	178	-3.8	🟢
Number of training days per employee	(AS)	3.2	2.7	-14.8	🔴

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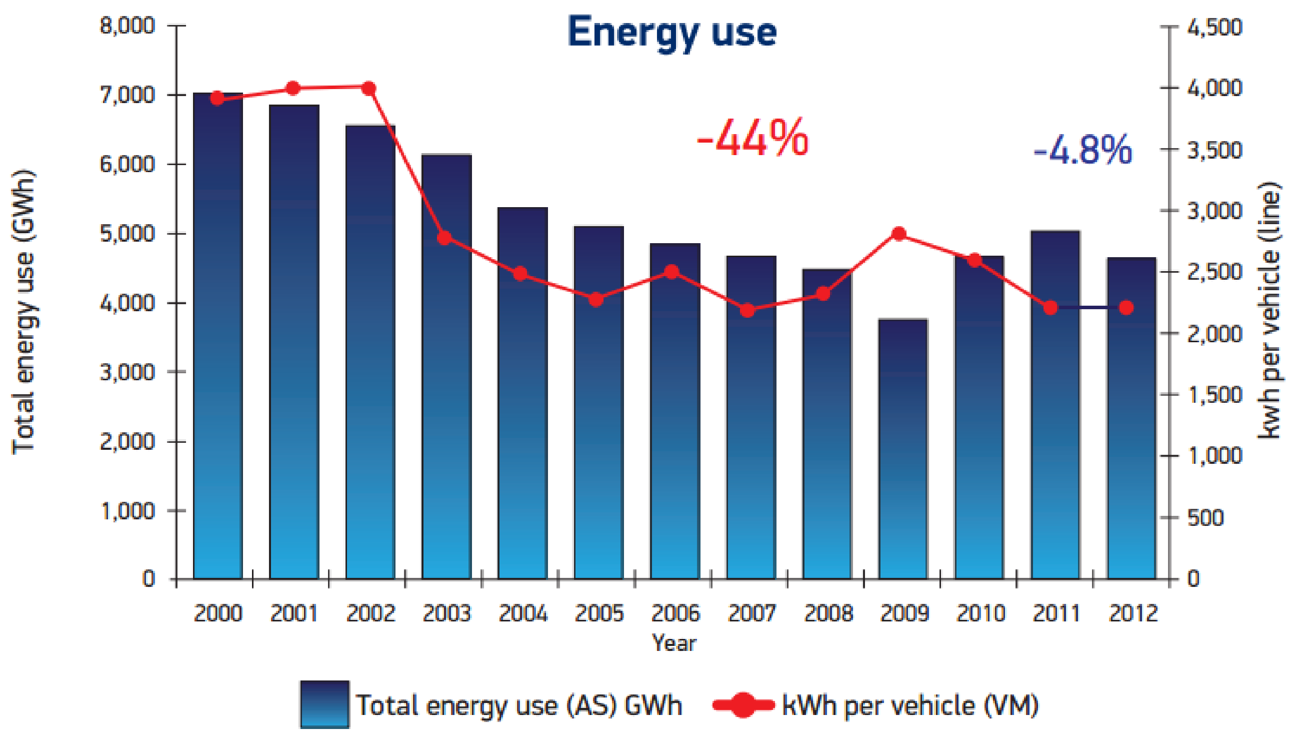
Example of progress in manufacturing impact

Energy and CO_2

- Energy consumption for all signatories dropped by 7.6%. Energy per vehicle manufactured reduced by 4.8%
- CO_2 emissions showed a similar trend, down 11.2% for all signatories and 3.2% per vehicle.
- Since 2000, energy consumption per vehicle has fallen 44% and CO_2 emissions have declined 40.3%.

The 2011 and 2012 figures have been adjusted to take into account new signatories.



Individual manufacturers are increasingly publishing reports on Life Cycle assessment using a wide variety of methods, assumptions and boundaries.

LowCVP Report 2013 –

- Building on the previous LowCVP work:-
- To study how the change in technology will affect the life-cycle impact
- To identify the most carbon intensive phases of a vehicle life now and in the future
- To review key areas of sensitivity in input assumptions

- Considers four technology options on a mid size
- passenger car
- (Petrol only) ICEV, HEV, PHEV, BEV
- From 2012, forecast for 2020, 2030
- Identifies potential of ‘best’ case options
- Includes Biofuel consideration
- Using GaBi database and using ISO 14040 outline

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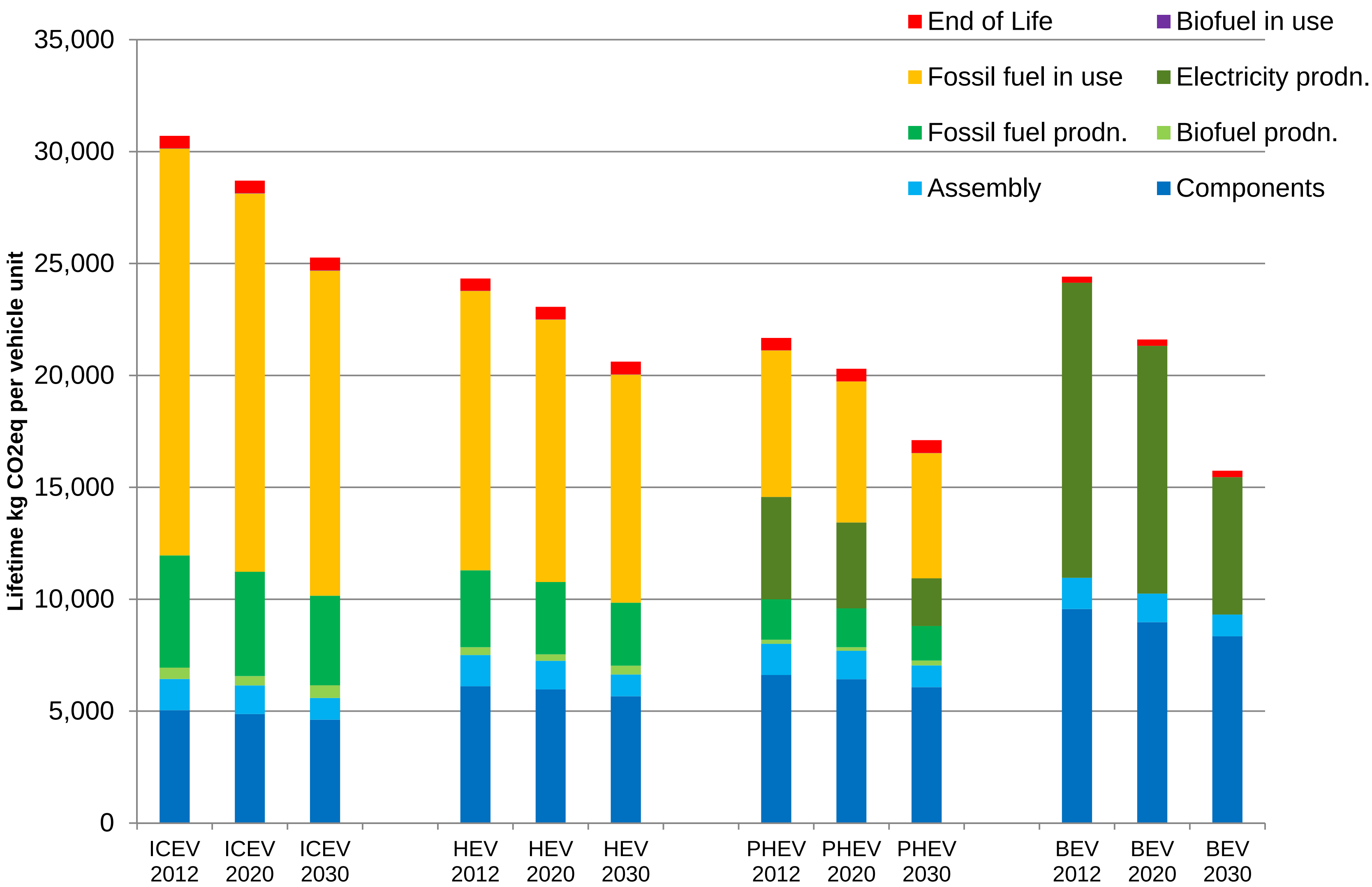
Assumptions are critical in any report/analysis

- Key assumptions used in this report
- GaBi 5 system developed by PE International, used by major OEMs with specified emission factors for each material
- Reducing carbon intensity of grid electricity for production and use
- Bioethanol blended in gasoline (E10 baseline)
- Driving cycle is NEDC
- Vehicle life 150,000km
- Progressive improvements in fuel consumption due to technology and light-weighting

- Sensitivity analysis
- Vehicle life to 300,000km (With battery replacement assumption)
- Light-weighting via aluminium or high strength steel
- Potential recycling benefit of traction battery packs

Life-cycle impact improves with time – for all technologies.



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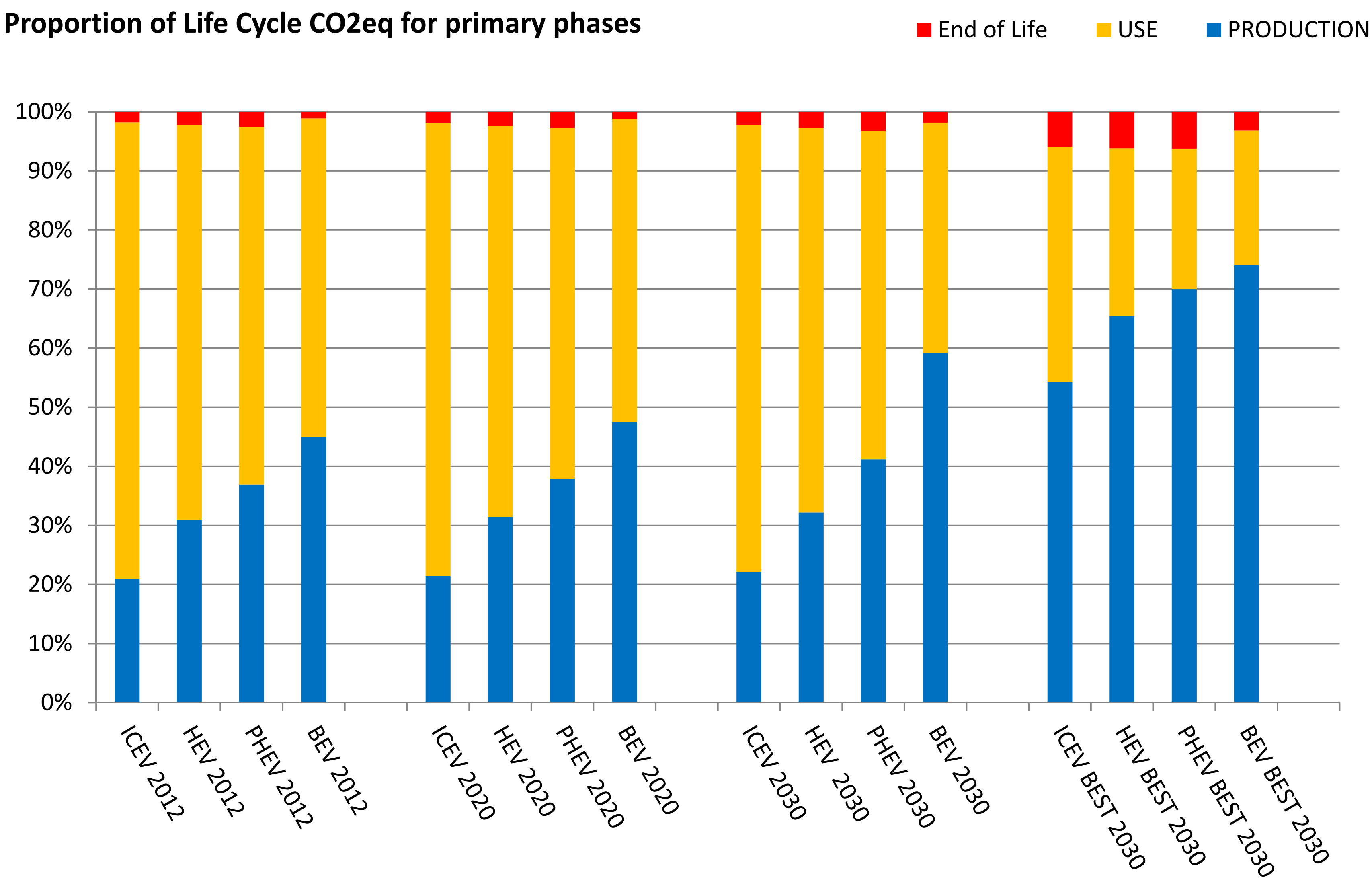
In-use phase still dominates before 2030



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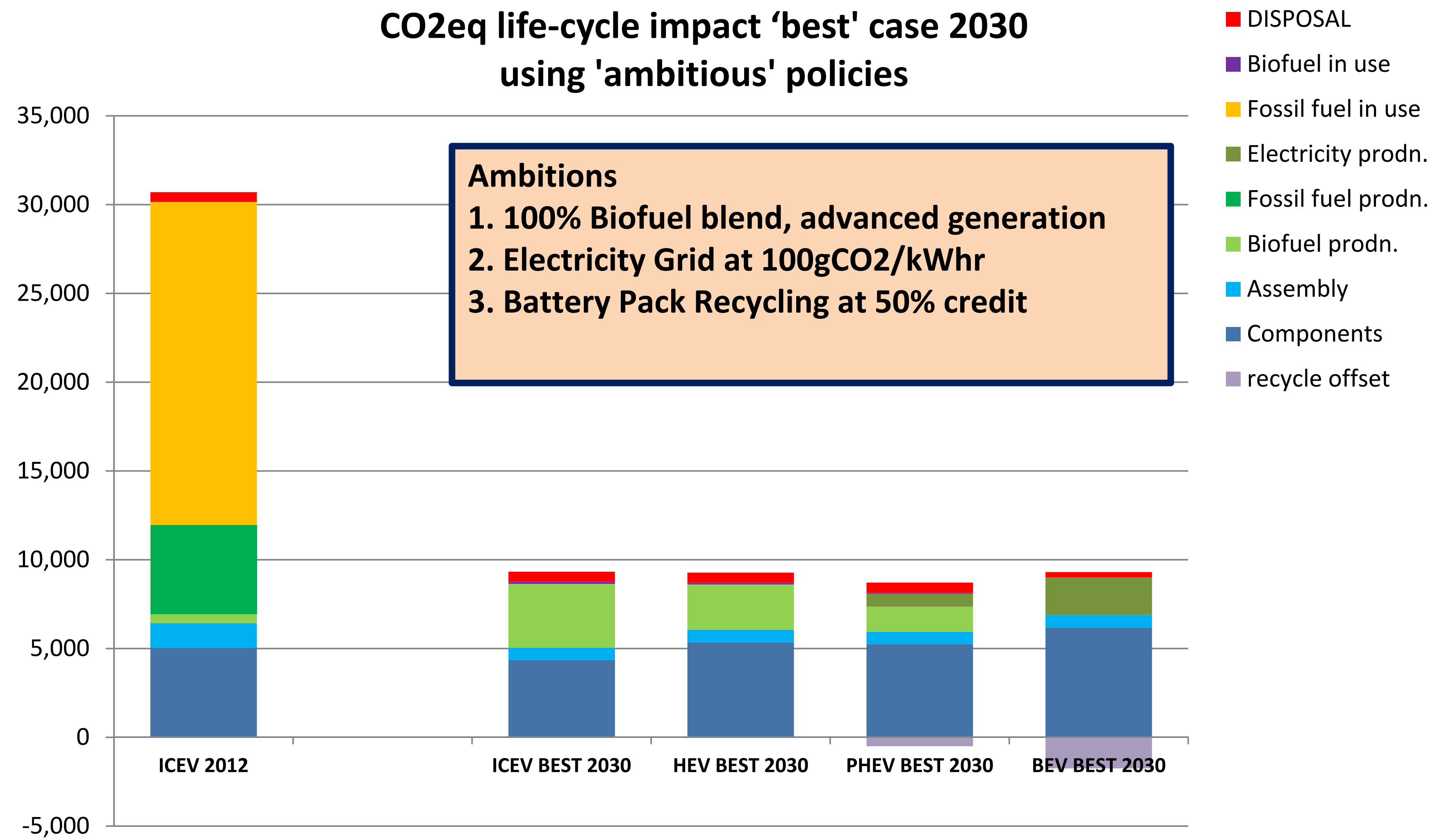
Ambitious policies could deliver >65% reductions by 2030 for all technologies



*100g/CO2/kWr relates to electricity generation at the point of consumption

BUT … real world fuel use higher than NEDC

- Recent reports have noted that consumers fuel consumption typically exceeds test cycle results by an average of 25%

- ICCT report May 2013 –25% average increase based on users own data input
- Additionally UK data from Emissions Analytics/What Car? True mpg – corroborates 25% higher on average than NEDC

- Very limited data exists on electric energy consumption but indications are similar discrepancy in real world use

- Interestingly the results are very consistent even though some data are from a large dataset of users own fuel measurements and other from on-road testing using Portable Emissions Measurement System (PEMS)

BUT … Well-to-Wheel assessment is needed

- No current options completely eradicate carbon from the fuel use chain, however all have significant opportunities to reduce carbon on a WTW basis

  Liquid fuels (petrol/diesel) – higher biofuel blends and substitution

  Electricity - renewables and the low carbon grid

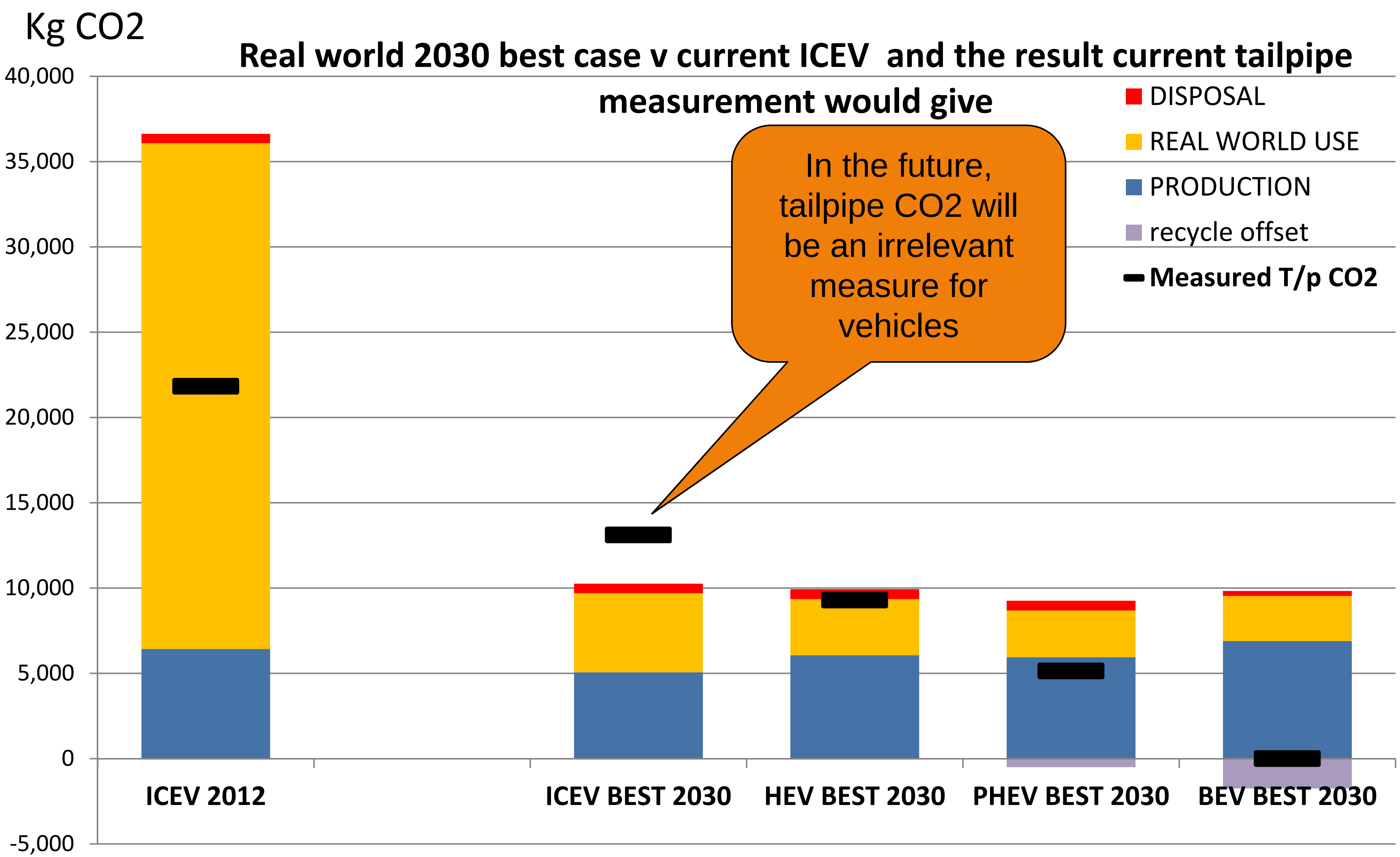
  Gas – Biomethane

  Hydrogen – production from renewable power sources.

- Only by combining a WTW approach **together** with in-use vehicle energy efficiency will the lowest carbon pathway for the use phase become apparent.

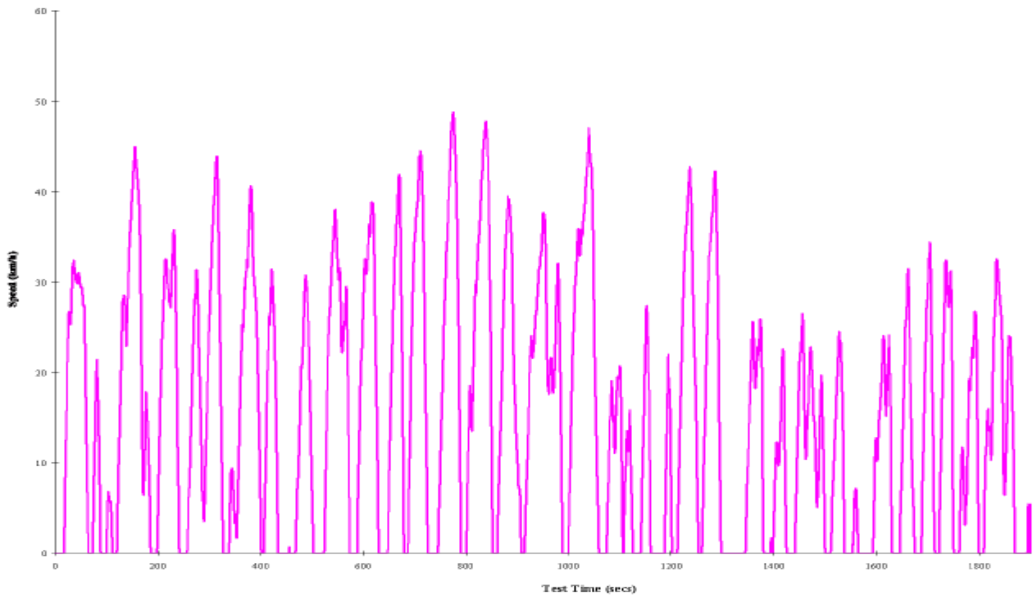
- There is no single solution so keeping our options open allows optimum combinations and applications of transport energy pathways

Tailpipe CO_2 is no longer representative



Example precedent – UK Low Carbon Emission Bus certificate

- Whole Vehicle Test on Chassis dynamometer
- **Real-world test cycle** for an Urban Bus
- **Well to wheel** assessment of emissions
- Full **Green House Gas** (Co2, CH4, N2O) measurement
- Target based on passenger capacity – 30% reduction compared to std. Euro3
- Procedures established for **all vehicle powertrain types**



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Sensitivity to vehicle life -

As vehicle life increases impact also increases through in uses and maintenance…..

However, it may still be more sustainable to use an ICEV followed by a PHEV for shorter times than one ICEV for example!

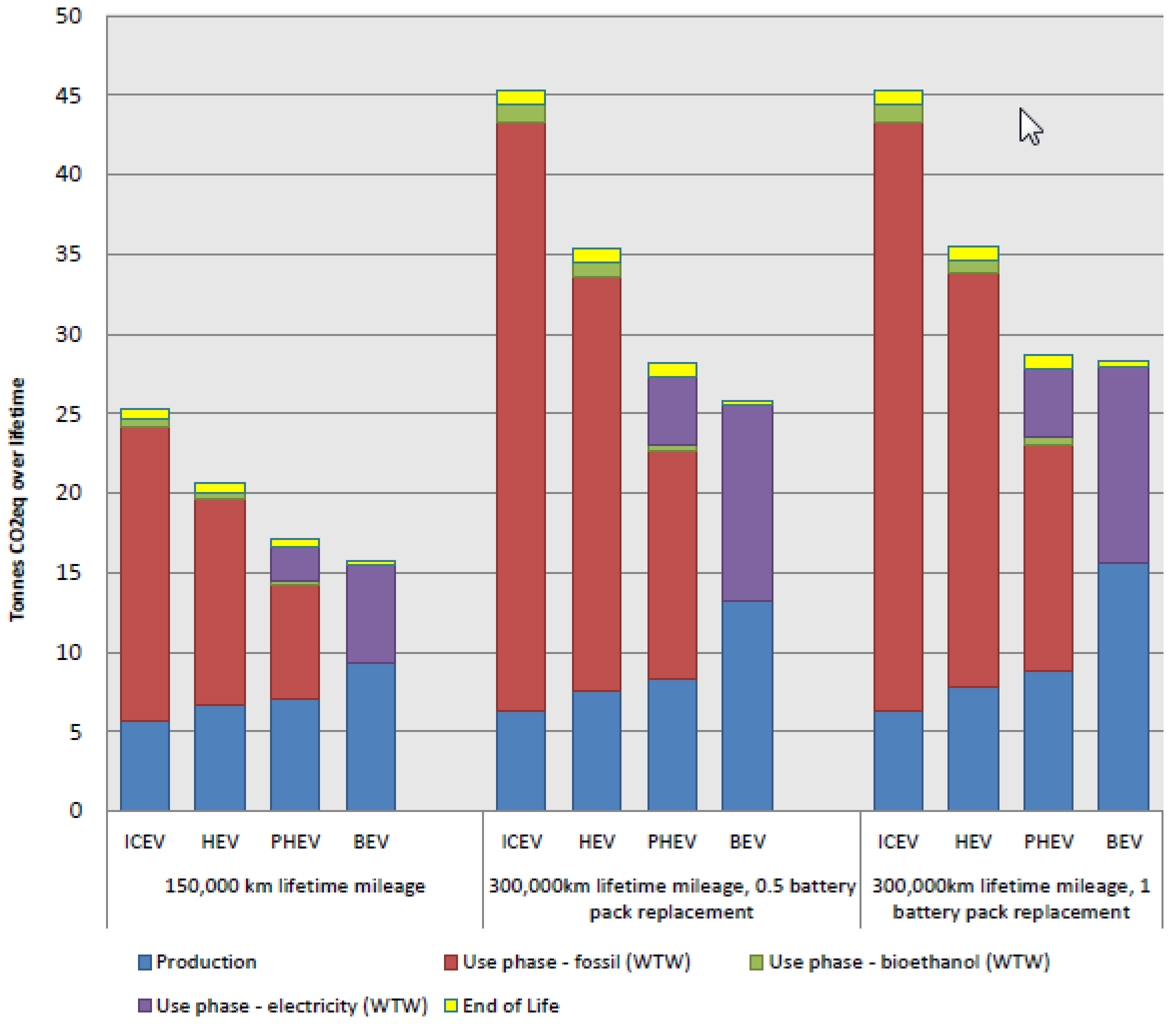
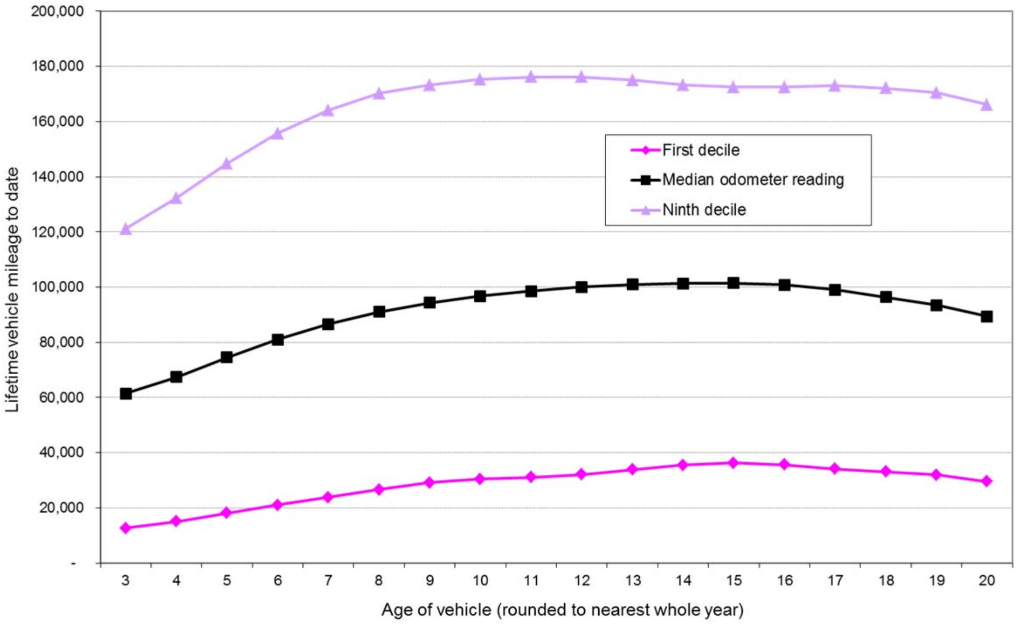


Figure 5-2: Impacts over 1 vehicle life cycle for Lifetime sensitivity "Typical 2030" – Detailed view

Vehicle types lifetime mileage – UK vehicles average

On average UK car life is 100k miles (160,000 km), with average annual mileage of 15,000 miles in first 5 years.

Electric vehicles selling with battery rental 7,500 miles to 12,000 miles pa and battery warranty 60-80,000miles



Smaller (L category) vehicles will have lower mileages, hence life cycle balance will change

Commercial vehicles are dominated by operational impact.

Any life cycle methodology should consider the likely mileage and life of each vehicle and technology type. This may encourage more informed purchase decisions

True impact of new materials

Analysis of light-weighting approach showed small gains in fuel efficiency may be outweighed by increased carbon intensity of material in production.

Only a robust life cycle approach will establish the optimum solutions for each vehicle type.

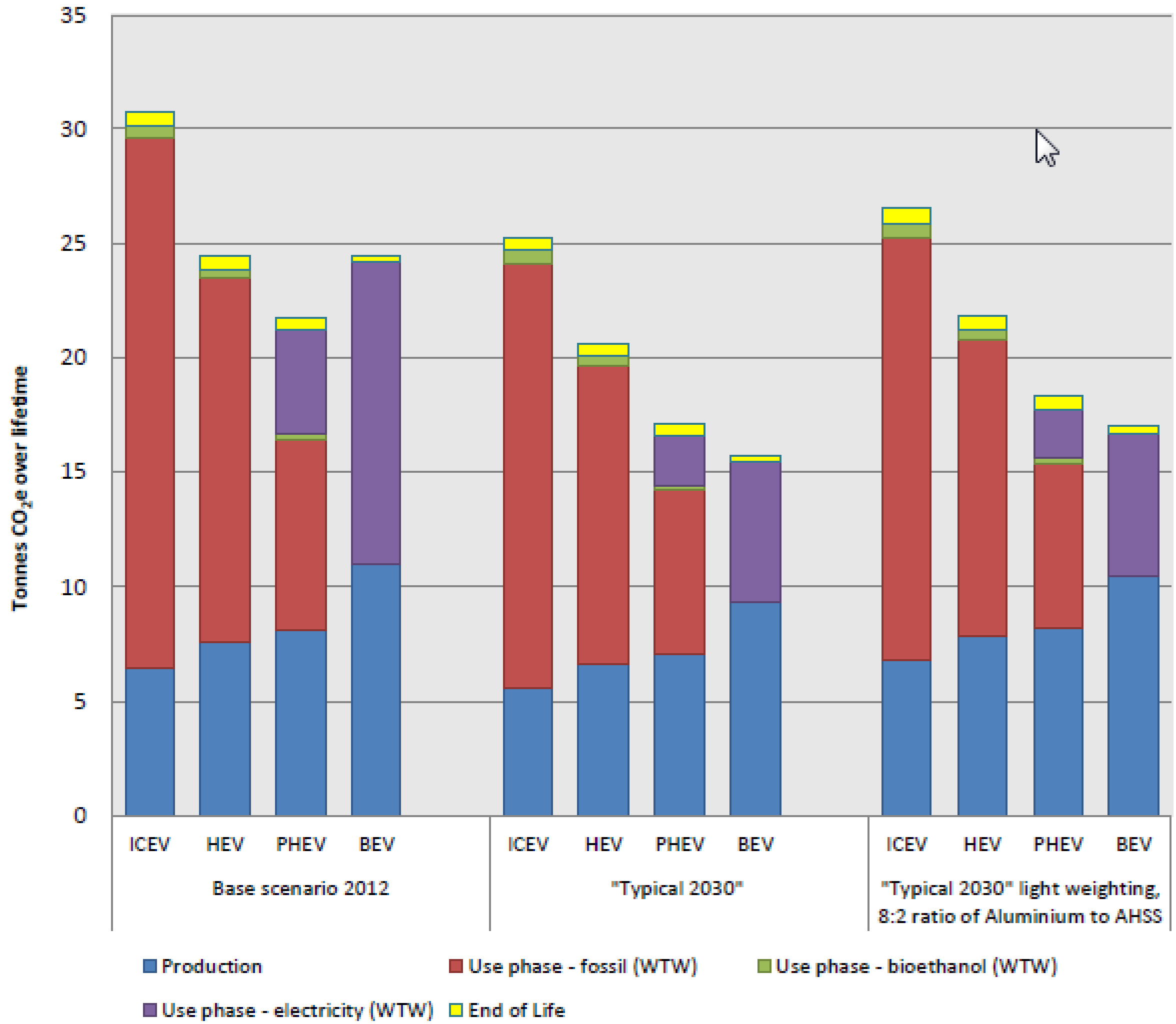


Figure 5-7: Light-weighting sensitivity "Typical 2030" – Detailed view

Other vehicle types may vary significantly – HGV operation

Base case and sensitivities for artic HGVs

Breakdown by lifecycle stage, best and worst cases

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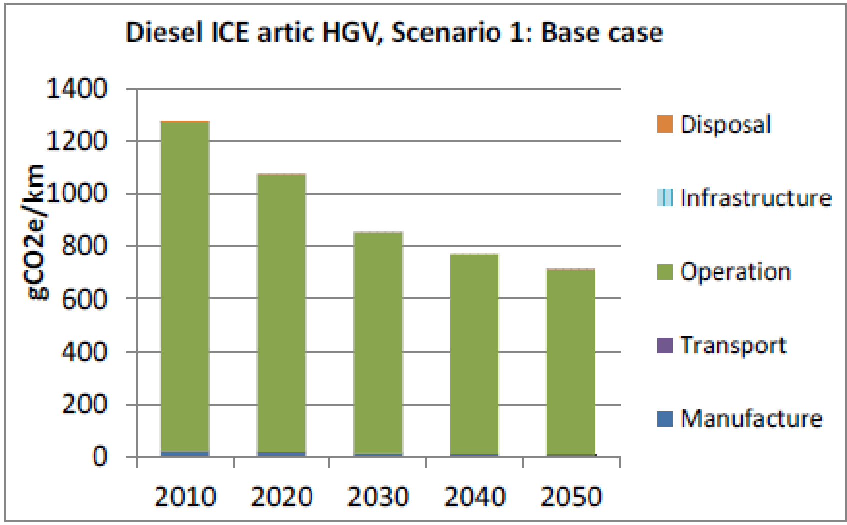
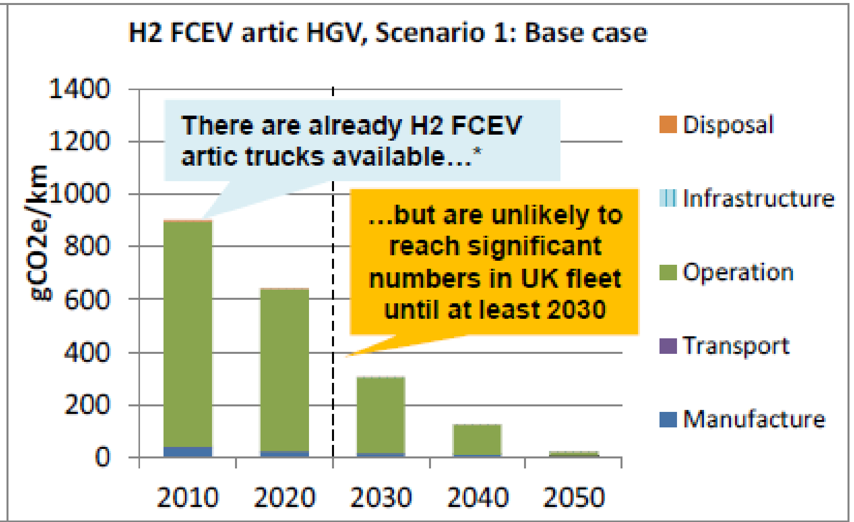
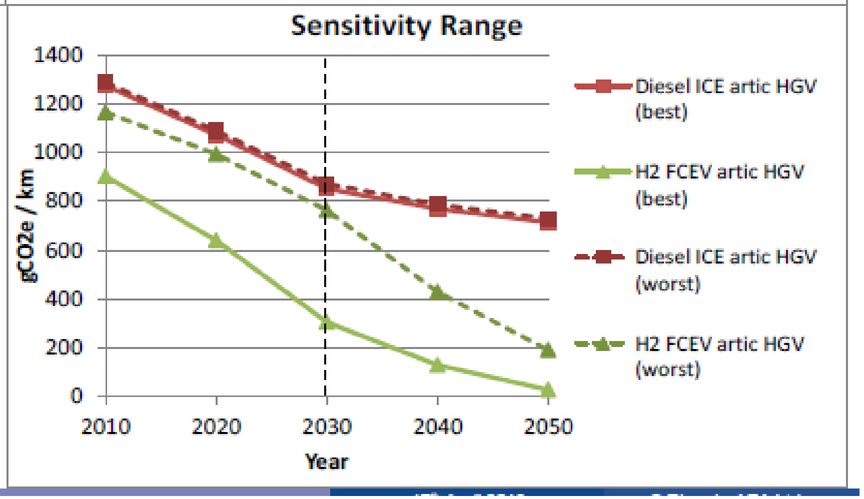




- Operational emissions dominate for both technologies
- Hydrogen production GHG and FCEV efficiency are the key to savings compared to base ICE
- The impacts of additional emissions from manufacturing and hydrogen refuelling infrastructure may be relatively minimal components except in the very long term (further work is needed to better quantify these)



* For example: www.visionmotorcorp.com/tyrano.asp

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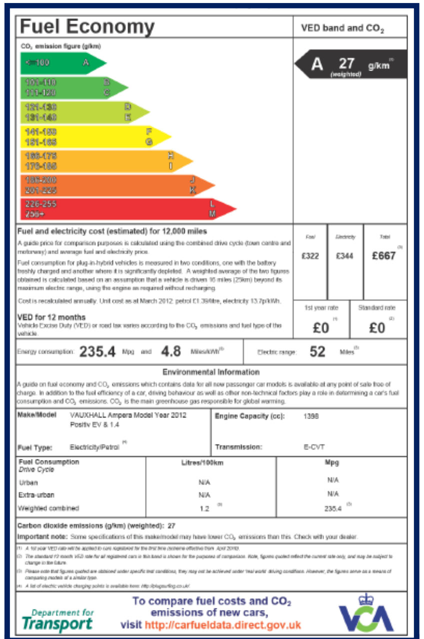
What we are doing now?

The LowCVP **work programme** is taking on the challenge

- Consumer label revised for new technology, further research on-going into how to influence consumers
- Buses already use WTW, GHG, real world – focus now is growing the market
- Fuels roadmap pathways to lower carbon fuels both for the current fleet and the future vehicles.
- HGV technology and gas fuel strategies and incentives
- Van and minibus market research and support
- Encouraging innovative vehicle solutions
- Investigation into "L" category options



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International displacement of emissions needs good data

New technologies and the shift from in-use emissions may displace the majority to another country. This will present an international challenge.

Base case scenario for cars:
Emissions in the UK vs overseas

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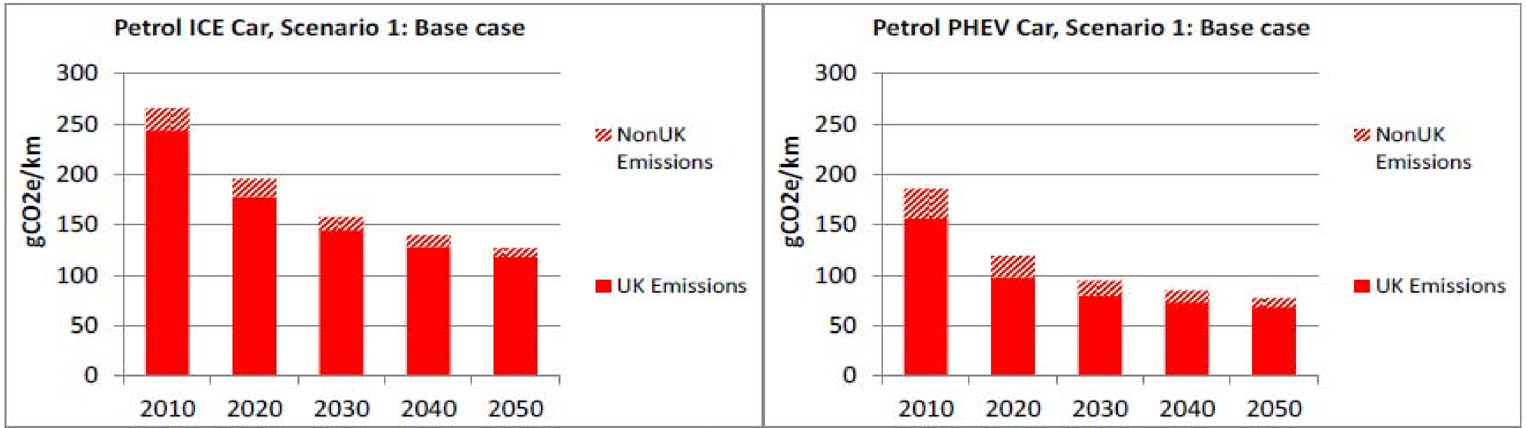
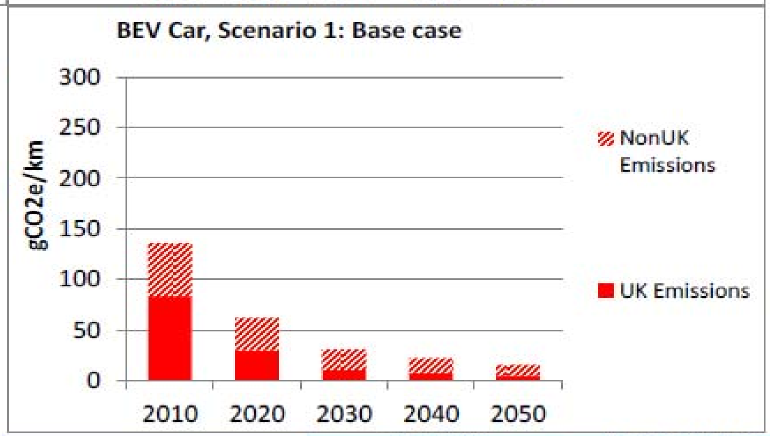


- Proportion of emissions outside UK doesn't change much over time for ICE (2010: ~8%) and PHEV (2010: ~16%) technologies
- >40% of BEV emissions are outside of the UK in 2010, potentially rising to 66% by 2050 (due to vehicle and battery production)
- In the Worst Case scenario (with very high emissions due mainly to the batteries) over 86% of BEV LCE could occur outside of the UK by 2050 (also due to reduction in operational LCE)



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Why we must change

- The use phase of vehicles dominates carbon impact so is the obvious place to start with robust regulation and information, But……………
- Tailpipe test results are increasingly unrepresentative, **consumers are losing confidence** and need more consistent information
- We must focus on lower carbon fuel/energy in **combination** with vehicle efficiency improvement
- **Awareness of life-cycle** considerations is rapidly increasing
- Full life-cycle analysis is highly complex and needs further development so we should **commence the discussion** as soon as possible
- The range of fuels and technologies available in the future need an appropriate **common metric** which reflects **their true impact**
- For commercial vehicles the use phase is even more dominant, but Urban vehicles production may dominate sooner.
- **Geographical boundaries** for material, production and energy sources can have significant effect
- **Information** is an urgent need, but **Regulation** will happen!

The view from one UK manufacturer! (JLR)

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The way forward is to look
“Beyond the Tailpipe”

Thank you

Andy Eastlake - LowCVP

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 170 members with a stake in the low carbon road transport agenda.
www.lowcvp.org.uk

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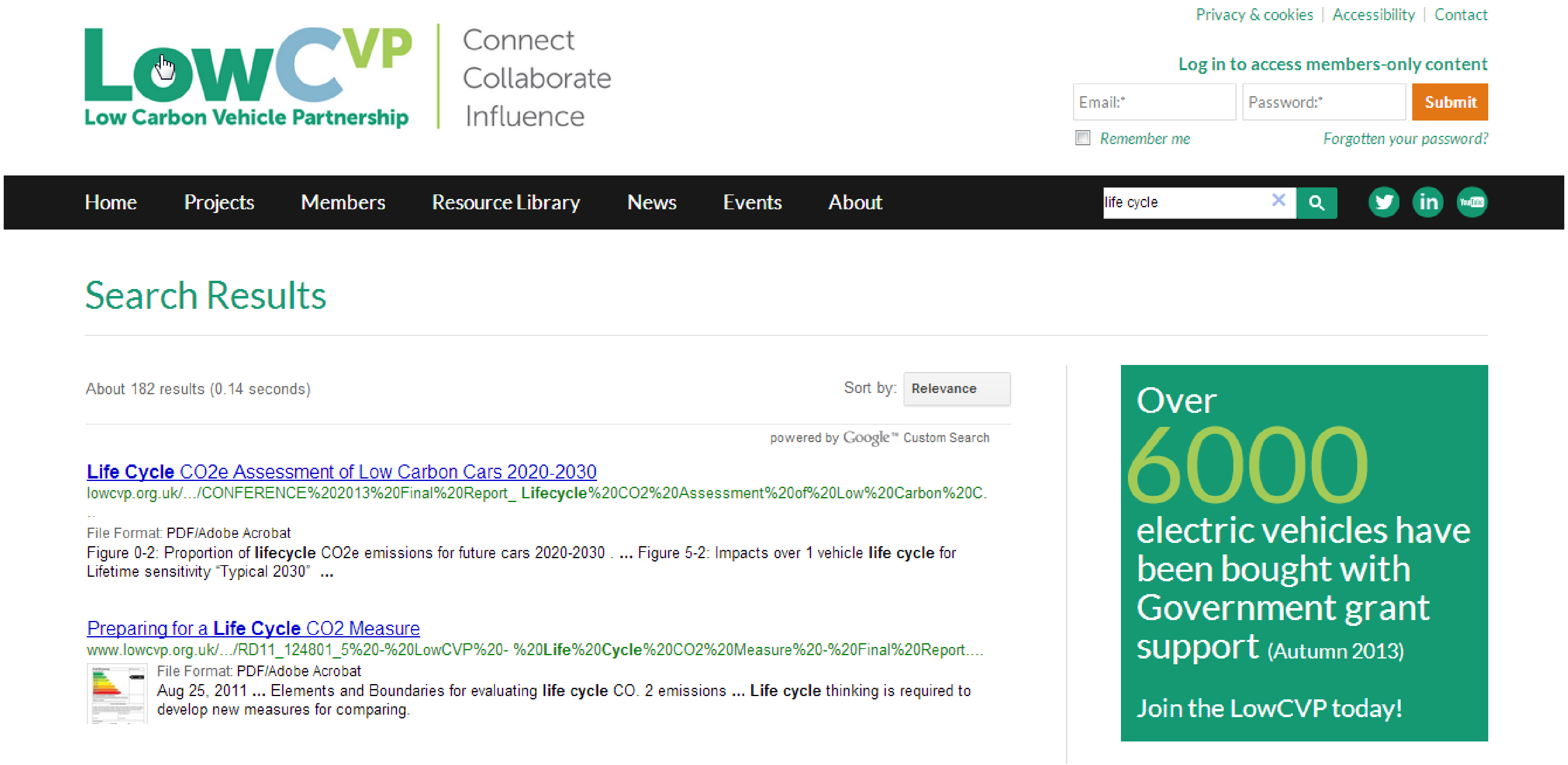
Further resources available on LowCVP website

www.lowcvp.org.uk



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