A Summary of LowCVP Research on the UK Fuel Economy Label and Recommendations for Future Review of the EU Labelling Directive

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7th April 2014

1. Introduction

European Directive 1999/94/EC introduced a requirement for fuel economy and CO2 information to be displayed next to new cars in showrooms "***to ensure that information relating to the fuel economy and CO2 emissions of new passenger cars offered for sale or lease in the Community is made available to consumers in order to enable consumers to make an informed choice***".   In the UK the EU Labelling Directive is implemented by the Passenger Car (Fuel Consumption and CO2 Emissions Information) Regulations 2001, which came into force in November 2001. The Passenger Car Regulations adhere to the 1999 Directive with minor additions such as the provision of fuel economy in units of 'miles-per-gallon' or 'mpg'.

In 2005, to meet the requirements of the Labelling Directive, LowCVP brokered the design and roll-out of a UK Fuel Economy Label which included an energy efficiency style colour-coded fuel economy scale linking CO2 emissions to Vehicle Excise Duty (VED); see Appendix 1. The VED bands are colour-coded using a scale similar to the energy-efficiency rating system used for 'white goods' ranging from green for cars with the lowest CO2 emissions through the colours of the spectrum to red for the most highly polluting vehicles. Additional information presented on the UK car label includes: annual fuel cost, estimated on a distance of 12,000 miles, the combined fuel economy figure and a UK average fuel price for petrol, diesel and liquefied petroleum gas; and a 12-month VED rate[1].

On 11 February 2013 the Passenger Car (Fuel Consumption and CO_2 Emission Information) Regulations 2001 were superseded by the Passenger Car (Fuel Consumption and CO2 Emissions Information) (Amendment) Regulations 2013. The amendment enables zero CO2 tail-pipe emission vehicles, notably battery electric, plug-in and hydrogen fuel, to be covered by the fuel economy labelling scheme. LowCVP worked in partnership with DfT, SMMT and its members, and the VCA to produce new label designs for electric and plug-in hybrid vehicles. An outline of these labels is provided in Appendix 2.

Over many years LowCVP has commissioned a series of surveys to assess the roll-out and effectiveness of the UK fuel economy label with regard to its influence on car purchasing decisions, and to build an evidence base to inform future label designs. LowCVP's most recent research study on the fuel economy label (*Ecolane et al 2012*) was of significant value in informing the creation of aspects of the latest EV/PHEV labels.

This report outlines a summary of LowCVP research on the fuel economy label, and gives recommendations on how the fuel economy label could be revised in light of any future review of the EU Labelling Directive.

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[1] This has been extended to include both First Year and Standard VED Rates.

2. LowCVP Consumer Research Studies

i. LowCVP Car Buyers Surveys (GfK 2006-2009)

Car buyer surveys were undertaken on an annual basis for LowCVP between 2006 and 2009. This research was designed to assess the impact of the car fuel economy label on car buyers' awareness of the environmental performance of new cars and the extent to which this affects their purchasing behaviour. The surveys involved approximately 2,000 individuals each year – all participants had either bought a car within the last 12 months or intended to do so within the next 12 months. The following charts show a selection of the key findings of the surveys and highlight the change in consumer knowledge and preferences.

Figure 1 reveals that consumers do not appear to have a high level of awareness of the fuel economy label. However between 2006 and 2009 consumer awareness of the label increased.

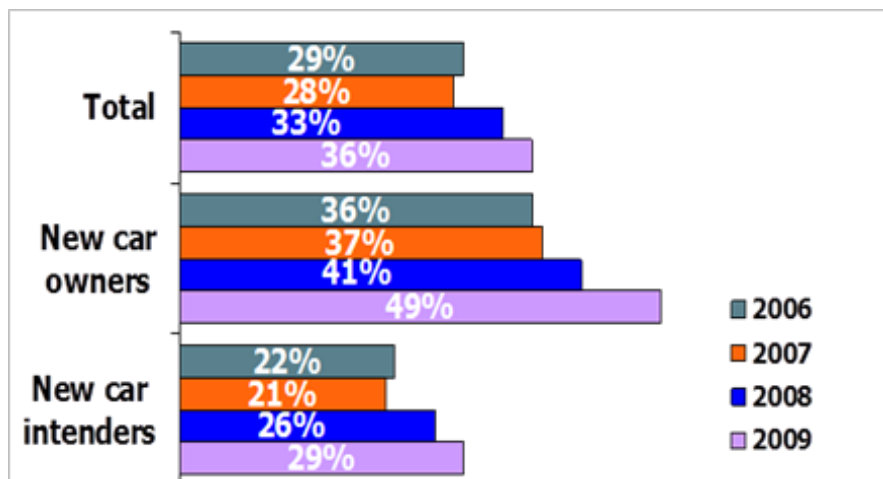*Figure 1: Consumers awareness of the fuel economy label, 2006-2009*

Figure 2 indicates that a significant majority of consumers, between 65% and 72%, state that the fuel economy label was either very important of fairly important during the car buying process, despite the fact that the individual percentages fluctuate slightly each year. These results are interesting given that Figure 1 highlights that a relatively low percentage of consumers are aware of the label. This contradiction suggests further research may be required to understand the role of the fuel economy label in the car buying process.

Figure 2: How consumers rate the importance of the fuel economy label, 2006-2009
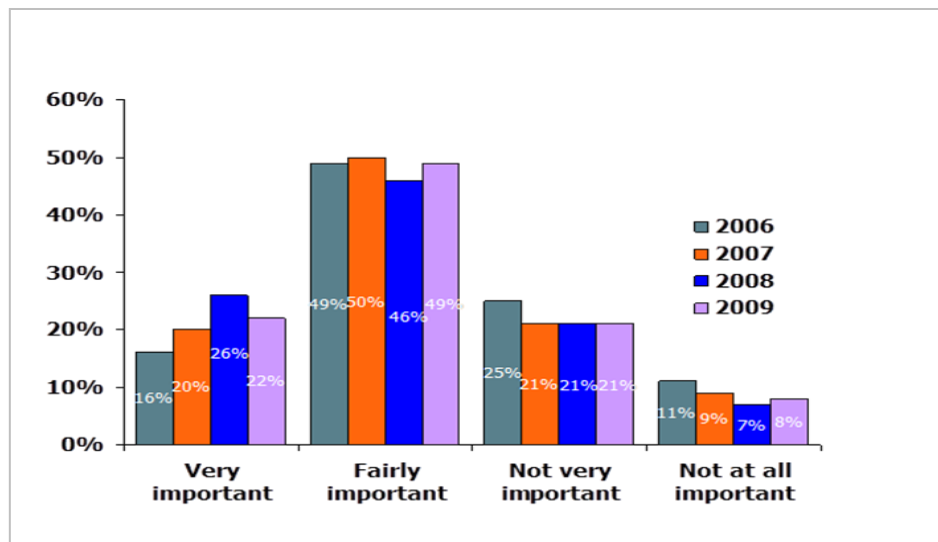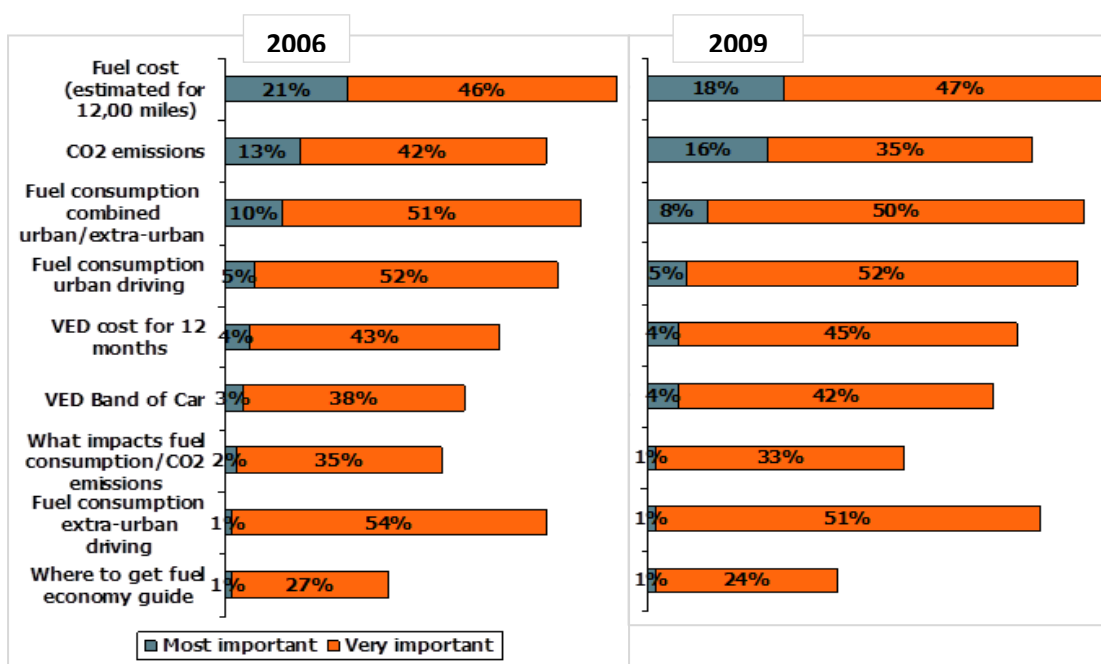

Figure 3 illustrates consumers' views on specific information presented on the fuel economy label. Consumers consider fuel costs to be the most important figures when deciding on a new car, closely followed by fuel consumption.

Figure 3: Importance of information presented on the fuel label

One of the salient conclusions arising from the surveys is that fuel cost is of more importance to consumers than CO_2 emissions when deciding on purchasing a new car. This suggests that running costs should be given more prominence on the fuel economy label as a means of highlighting more efficient and lower emission vehicles to consumers.

ii. Car Buyer Survey: From 'mpg paradox' to 'mpg mirage' – How purchasers are missing a trick when purchasing a new car (*Ecolane et al 2008*)

The 'mpg paradox' refers to the discord between consumers' attitudes and actions: consumers claim that fuel economy (mpg) is an important factor when choosing a car however, the prioritisation of fuel economy is not reflected in the final decision on which car to buy. This has been coined the 'attitude-action gap'. This survey aimed to ascertain whether the 'mpg paradox' continued to be prevalent amongst consumers buying new and used cars, through carrying out in-depth qualitative interviews with 21 individuals, all of whom had purchased a car in the last three months. Interviewees were asked to discuss in detail the methods and criteria used when choosing their new car. They were also questioned on their understanding of mpg, CO_2 and the link between these factors and the running costs of a vehicle. This information allowed conclusions to be drawn on the role of fuel economy (mpg) and CO_2 emissions in the car buying process.

One of the key findings of this research is that the 'mpg paradox' still exists within car purchases but it has changed in nature. Evidence suggests that consumers are now not only talking about the importance of mpg when buying a car but also making decisions which appear to be influenced by mpg. However, it appears that this change in behaviour is due to rising fuel costs and therefore it is not the mpg metric itself which is causing a switch to more fuel efficient cars, but the cost per month of purchasing fuel, hence the development of the 'mpg mirage'. It was also found that mpg was not systematically researched, understood, or used to compare cars in order to find the best-in-class models and only had a limited influence on the final decision. The following trends were highlighted through this research:

- Fuel cost per month is the main metric influencing vehicle choice
- Consumers use their previous car to benchmark fuel economy
- Car buyers are not motivated by environmental issues

The research concluded that mpg is not the best metric to employ in the promotion of smaller or lower carbon vehicles and that it would be more effective to provide up-to-date fuel costs for a particular vehicle alongside the potential savings to be made by choosing the best-in-class vehicle.

iii. Improved Environmental Information for Consumers (Ecolane and Sustain 2010)

This study collected qualitative consumer data via structured discussions with fifty-two participants, split into six focus groups, all of whom had recently bought a car or were planning to purchase one within the next 12 months. Data was also gathered through a quantitative web-based survey of around 1,000 car buyers.

Results of the web-based survey showed that the top three considerations when purchasing a new car are size and practicality, fuel consumption and price. The two categories relating most closely to the environmental performance of a vehicle, road tax band/cost and vehicle emissions were much further down the priority list. Within the focus group discussions indicated less weight was given to fuel economy as a factor in car purchases and when it was referred to, it was most commonly in connection with running costs rather than as an environmental proxy. Evidence from the focus groups did reflect the findings of the web-based survey that "factors relating most directly to environmental issues have little influence on purchasing decisions of car buyers".

Participants reported low running costs, specifically good fuel economy, as being a driver in choosing a new vehicle but only some were aware of the link between fuel economy and emissions. In addition, consumers had a tendency to believe that there were trade-offs between fuel economy and vehicle size and fuel economy and vehicle price. This demonstrates that consumers do not research cars within a certain class in order to find the most fuel efficient models as most believe there is very little difference in the fuel economy of different cars within the same class.

When asked which metrics they used to determine a vehicle's environmental impact, both the participants of the focus groups and of the web-based survey rated fuel economy, emissions and fuel type in the top three.

When presented with four different fuel economy labels, those from the UK, US, EU and an emotive 'Earth label', the colour banded A-M format used on the UK Fuel Economy label was voted as the favourite by the vast majority. Participants noted its familiarity and the fact that the same format is used on the labelling of 'white goods' stating that this made it easy to relate to.

The demand for additional environmental information to be displayed on the UK Fuel Economy Label was also assessed within the focus groups. In general there was a positive response to the possibility of adding best-in-class data to the label with this information being presented in terms of fuel economy rather than in terms of CO_2 emissions or fuel costs for 12,000 miles and annual VED cost. However, there were concerns within some of the focus groups that in adding more detail to the label it would suffer from information overload causing consumers to 'switch off' from what was being presented.

iv. Testing alternative fuel economy labels (Ecolane et al 2012)

The primary aim of this research (Appendix 3) was to test a series of fuel economy label designs to determine UK consumers' understanding of the information presented on the labels and their views on alternative layouts. The study took into account the findings of previous LowCVP research on the fuel economy label. The overarching objectives of the study were to test:

- Improving the presentation of financial information to demonstrate the benefits of choosing fuel efficient, low CO_2 vehicles
- Placing greater emphasis on mpg, less on CO_2 g/km, and how this is displayed
- Providing comparative information of the vehicle with other vehicles 'in the model range', with integration of behavioural science concepts
- Inclusion of a Quick Response (QR) code and appropriate links
- Future-proofing the label to take account of battery electric vehicles, plug-in hybrid and range-extended electric vehicles.

The study entailed the use of consumer focus groups (58 participants) and a web-based survey (1005 participants) all of whom had purchased a car within the last 12 months. Participants took part in one of six focus groups which gathered qualitative data through structured discussions that were led to a large degree, by the participants themselves.

A series of prototype 'alternative' test labels was created by an information designer and used as stimulus materials during the surveys; these were grouped under the following design themes 'traditional, slider, dashboard and buyers' guide'. The first set of prototype labels developed were examined with the first focus group session (Round 1), see Figure 4 on the following page. The labels were then revised based on the feedback from the first focus groups, and a second set of label designs were used in the next round of focus groups and in the web-based survey (Round 2).

The label designs included a QR code. This was tested within the focus groups. QR codes act like 3D barcodes which can be scanned by a dedicated device or a smartphone, with a QR code application, to direct the website browser to a target URL. The QR codes used in this research linked to two different online tools which could be used to calculate the fuel cost of a specific vehicle or to compare different models within a defined range; see Figure 5 on the following page.

Plug-in hybrid, range-extended electric vehicles and battery electric vehicle labels were the most complex to design. For plug-in hybrid and range extended electric vehicles the 'weighted combined[2]' fuel consumption figure was presented; as shown on the official vehicle type approval certificate. For some label designs this was shown separately as fuel
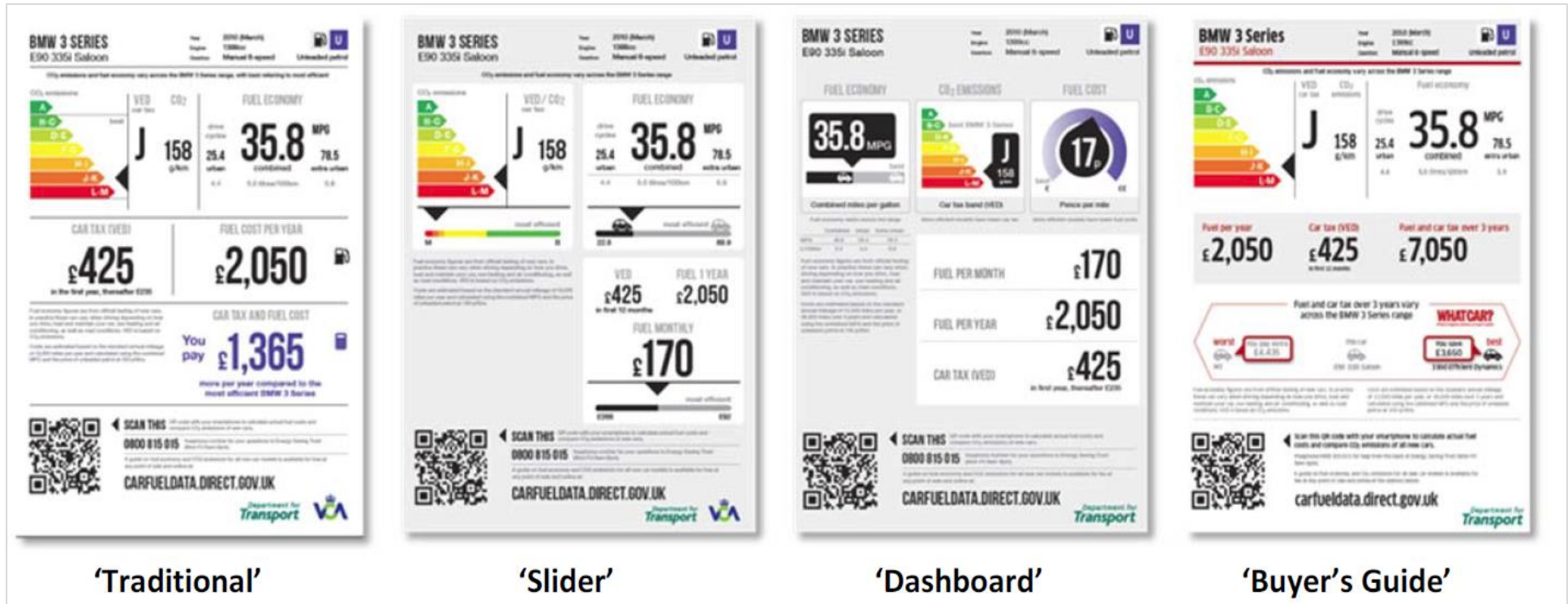
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[2] Weighted combined fuel consumption is derived from a 'weighted combined test cycle' – this entails the vehicle running over the test in two battery conditions.

and electricity consumption to assist consumer understanding of the 'weighted combined mpg' metric. For electric vehicles, electricity consumption (combined electricity consumption Wh/km) and range were presented on the labels; as shown on the official vehicle type approval certificate. The electricity consumption metric was varied on different label designs to gauge understanding. Various formats for fuel and electricity costs were shown for these powertrain technologies.

In examining behavioural science concepts, as a means of 'nudging' consumers towards more fuel efficient models, the idea of 'saving' or 'losing' money was examined. Behavioural scientists from University of East Anglia have proposed that expressing financial loss (*loss aversion theory*) can have more positive results in terms of influencing consumer behaviour towards more environmentally friendly products.

Figure 4: Round 1 Prototype Fuel Economy Label Designs

'Traditional'   'Slider'   'Dashboard'   'Buyer's Guide'

Figure 5 - QR Code links to online fuel cost calculator and vehicle comparison tools.

The overall findings of the focus groups and the web-based survey were as follows:

<u>CO_2 emissions and fuel consumption information presentation</u>

- Consumers were more interested in the fuel economy metric, expressed as mpg, than CO_2 emissions and VED and felt that it is not given enough prominence on the current UK Fuel Economy Label. This supports earlier LowCVP research which highlighted the importance of running cost in influencing consumer choice.
- The majority consumers were familiar with the A-M colour-coded bands used to indicate CO_2 emissions and VED banding, and found this simple to comprehend.
- The majority of consumers broadly understood the term 'combined fuel consumption' and had a sufficient level of trust in the reported figures to use them for comparison purposes. However, they did not believe that the figures accurately represent real-world fuel economy.
- CO_2 emissions were viewed of in terms of cost implications for the consumer, due to road tax, and not in terms of the environmental impact of the vehicle.
- Although fuel economy was the consumers' favoured metric, comparing mpg across different fuel types was inherently problematic due to the non-linear nature of the metric, there was also the problem of 'information overload' when information was displayed for each model of a large range.

<u>Running cost information presentation</u>

- For running cost information, in addition to annual fuel costs, many consumers expressed a preference for 'per month' fuel costs to be displayed along with a 'per mile' estimate. Presentation of three-year running costs was not favoured by consumers.
- Many consumers were dissatisfied with the current fuel cost estimates as the average mileage figure was not relevant for a large proportion of drivers and given current fuel price rises the displayed fuel costs were often out of date. Nearly all of the participants were impressed by the addition of a QR Code to provide up-to-date fuel cost information allowing a consumer to enter their own mileage data.

<u>Use of behaviour science concepts to influence consumer choice</u>

- 'Losing' money or 'paying more' displays to highlight the most fuel efficient model in the range was not received well by consumers and perceived very negatively. Showing money saved in relation to fuel cost was more preferable.

<u>Plug-in hybrid, range extended electric and battery electric vehicles</u>

- In terms of the information provided on the label for an electric car it was found that consumers have little understanding of watt-hours (Wh) and kilowatt-hours (kWh) and therefore could not comprehend electricity consumption figures displayed in

terms of Wh/km or kWh/100km. A preferred metric for electricity consumption was miles/kilowatt hour.

- Consumers were found to be concerned about the limitations of electric vehicles and therefore expressed an interest in displaying driving range, amount of time to recharge and the location of public recharging points on the label for electric vehicles.

- Consumers found the 'weighted combined mpg' metric challenging to comprehend for plug-in hybrids and range extended electric vehicles. There was a lack of understanding that the figure related to the vehicle being propelled by two fuels. When displaying data for plug-in hybrid vehicles separately there was a problem with presenting metric data for electricity consumption and imperial data for fuel consumption. Many consumers only noticed the mpg figure which when read alone appears improbably high and leads to a lack of trust.

Label design format

- The most popular way of displaying key metrics was the 'Dashboard' style which allows CO_2, mpg and fuel cost per mile data to be seen from a distance. The strong use of colour and larger fonts were perceived as beneficial in aiding understanding of information presented.

- The format of the 'Buyers Guide' label was found to be popular for displaying further information such as VED, fuel cost and model range comparison.

- Inclusion of a QR code linked to an online calculator and comparison tool was given much support.
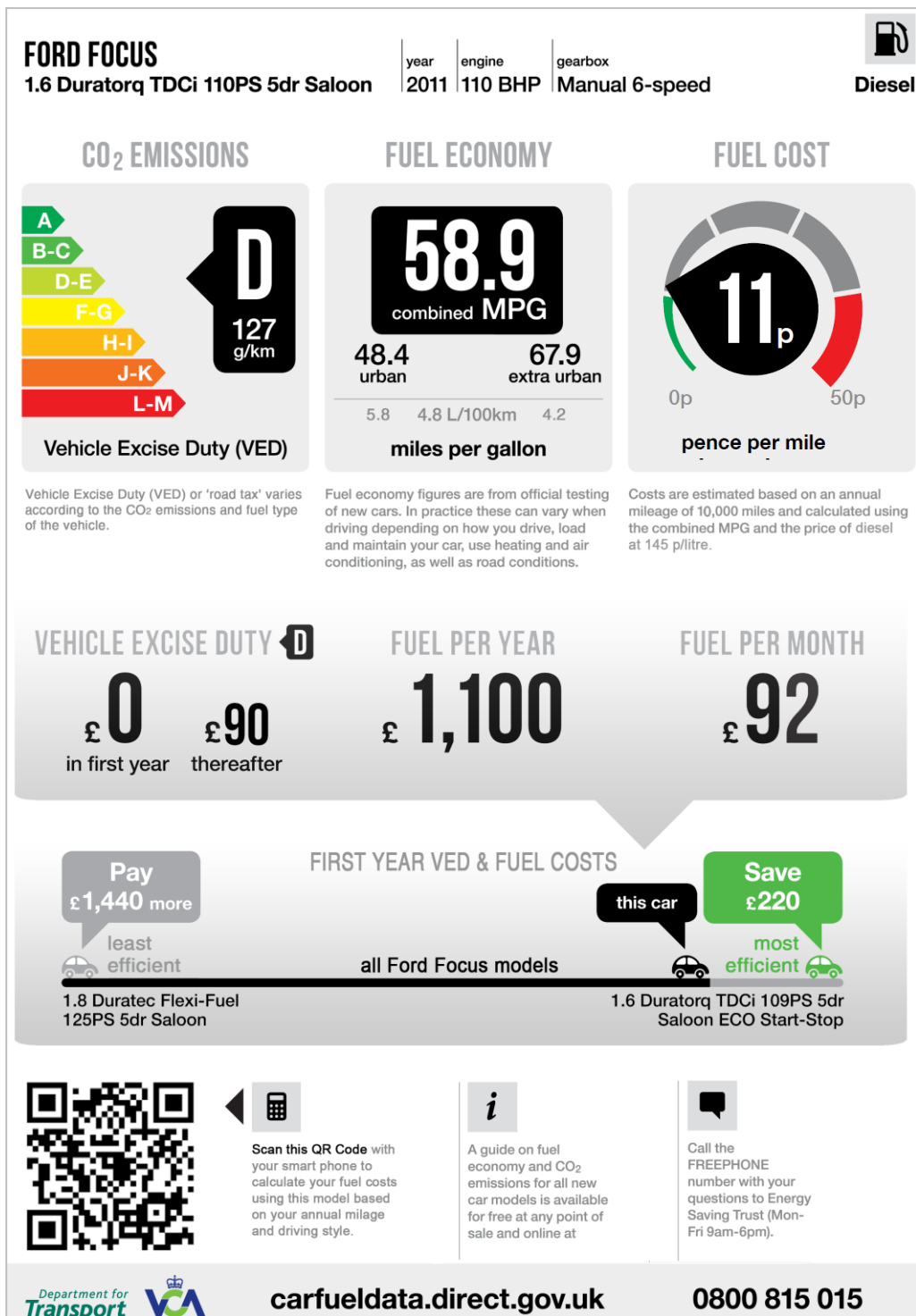
3. Recommendations for Future Review of the EU Labelling Directive

a) The label design should be kept simple and avoid information overload. It is essential that consumers comprehend the information presented. Making use of colour and visual icons assists consumer understanding.

b) The A-M colour-coded CO_2 bandings are well recognised by consumers in the UK and Europe and enable comparison with other cars to be easily carried out.

c) Given the importance of fuel consumption information when purchasing a new car and its association with running costs, the fuel economy data should be made more prominent by improving the position and using a larger font size on the label. The space and prominence given to information on tailpipe CO_2 emissions should be reduced.

d) In member states where CO_2 emissions banding is linked with taxation (e.g. UK), this should be made more explicit through better visual clues.

e) Fuel cost is a key piece of information for consumers when purchasing a new car and should therefore be displayed on the label in larger font. Comparing the fuel cost of different cars can serve to guide consumers towards more efficient models. In addition to annual fuel cost an estimate of fuel costs expressed in terms of 'pence per mile' and 'per month' should be displayed. The different fuel and electricity consumption metrics for ICE, EV and PHEV are likely to present challenges for the consumer; a cost based metric resolves this issue.

f) The application of behavioural science (nudging) to influence purchase decisions should focus on financial information (fuel costs) rather than environmental information. Positive messages associated with 'saving' money are more favourable than 'losing' money to draw attention to more fuel efficient cars.

g) The label should include a QR code to hard-link the label with online information including: model specific information, a fuel cost calculator and comparisons with other cars in the model range or vehicle class. The comparison tool could include a visual marker to identify the best in model range and class to consumers.

h) The format of the label should be consistent for ICE, EVs, PHEVs and range extended vehicles.

i) Plug-in hybrid and range extended electric vehicles should present fuel consumption data as 'weighted combined mpg' plus the electricity consumption figure (derived from the vehicle type approval certificate). Electric vehicle range should be presented as well.

j) For plug-in hybrid vehicles annual fuel cost could be split between 'combined' vehicle operation and 'electric' only to demonstrate the benefit of driving more miles in electric mode.

k) Electric vehicle labels should display electricity consumption in miles/kilowatt hour and the electric range.

l) Displaying comparative information for 'best-in-model' range requires further investigation both in terms of consumer comprehension and ability to present this on the label data by manufacturers. In order to avoid information overload on the label, comparative information may be more effective if communicated through the QR code.

m) A future label could be designed with elements of the 'Dashboard Plus' format, see Figure 6. This consists of:

- Dashboard design at the top displaying CO_2, mpg and fuel per mile data

- Buyers' guide design in the middle displaying VED, fuel cost and model range comparison (*only if further consumer testing warrants that comparison information is useful and does not risk information overload*)

- Sources of further information and tools at the bottom including QR code, website and phone number.

n) Before implementation a fuel economy label based on revised design such as 'Dashboard Plus' design, it should undergo further rounds of testing at the household level in order to assess the impact of the design on consumer behaviour in addition to comprehension of the labels associated with ICE, EV and PHEV.

o) Various market-based research has highlighted the importance of the internet in the car buying process, suggesting that over 80% of consumers do most of their research on the internet. Consideration could be given to the role of the internet and the provision of fuel consumption and CO_2 emissions data. Displaying the fuel economy label online could be a more effective way of communicating fuel consumption and CO_2 emission information to consumers and influencing their purchasing decision.

Note: pence/mile and miles/kilowatt hour would be presented in kilometre metrics, and l/100km in place of MPG for EU Member States.

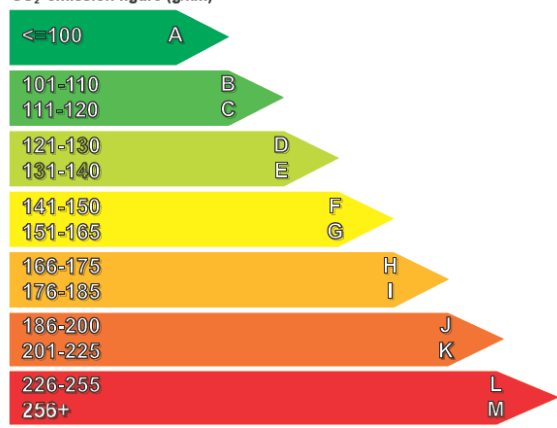*Figure 6: 'Dashboard plus' suggested design for a diesel car*

Appendix 1 – UK car fuel economy label

Fuel Economy | VED band and CO₂

CO_2 emission figure (g/km)

Range	Band
<=100	A
101-110	B
111-130	C
121-130	D
131-140	E
141-150	F
151-165	G
166-175	H
176-185	I
186-200	J
201-225	K
226-255	L
256+	M

Fuel cost (estimated) for 12,000 miles

A fuel cost figure indicates to the consumer a guide price for comparison purposes. This figure is calculated by using the combined drive cycle (town centre and motorway) and average fuel price. Re-calculated annually, the cost per litre as at Mar 2012 is as follows - petrol 139p, diesel 147p, LPG 74p.

VED for 12 months | 1ˢᵗ Year rate' | Standard rate"

Vehicle excise duty (VED) or road tax varies according to the CO_2 emissions and fuel type of the vehicle.

Environmental Information

A guide on fuel economy and CO_2 emissions which contains data for all new passenger car models is available at any point of sale free of charge. In addition to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car's fuel consumption and CO_2 emissions. CO_2 is the main greenhouse gas responsible for global warming.

Make/Model: | Engine Capacity (cc):

Fuel Type: | Transmission:

Fuel Consumption:

Drive cycle	Litres/100km	Mpg
Urban		
Extra-urban		
Combined		

Carbon dioxide emissions (g/km):
Important note: Some specifications of this make/model may have lower CO_2 emissions than this. Check with your dealer.

Department for **Transport**

To compare fuel costs and CO₂ emissions of new cars, visit http://carfueldata.direct.gov.uk/

VCA

Appendix 2 – Example of the UK plug-in hybrid car fuel economy label

Fuel Economy

VED band and CO₂

CO₂ emission figure (g/km)

<100	A
101-110	B
111-120	C
121-130	D
131-140	E
141-150	F
151-165	G
166-175	H
176-185	I
186-200	J
201-225	K
226-255	L
256+	M

A 49 g/km [3]
(weighted)

Fuel and electricity cost (estimated) for 12,000 miles

A guide price for comparison purposes is calculated using the combined drive cycle (town centre and motorway) and average fuel and electricity price.

Fuel consumption for plug-in-hybrid vehicles is measured in two conditions, one with the battery freshly charged and another where it is significantly depleted. A weighted average of the two figures obtained is calculated based on an assumption that a vehicle is driven 16 miles (25km) beyond its maximum electric range, using the engine as required without recharging.

Cost is recalculated annually. Unit cost as at March 2012: petrol £1.39/litre, electricity 13.7p/kWh.

	Fuel	Electricity	Total
	£564	£138	£702 [3]

VED for 12 months
Vehicle Excise Duty (VED) or road tax varies according to the CO₂ emissions and fuel type of the vehicle.

1st year rate	Standard rate
£0 [1]	£0 [2]

Energy consumption: **134.5** Mpg and **11.9** Miles/kWh [3]   Electric range: **16** Miles [3]

Environmental Information

A guide on fuel economy and CO₂ emissions which contains data for all new passenger car models is available at any point of sale free of charge. In addition to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car's fuel consumption and CO₂ emissions. CO₂ is the main greenhouse gas responsible for global warming.

Make/Model	TOYOTA Prius plug-in hybrid	Engine Capacity (cc):	1798
Fuel Type:	Electricity/Petrol [4]	Transmission:	N/A

Fuel Consumption *Drive Cycle*	Litres/100km	Mpg
Urban	N/A	N/A
Extra-urban	N/A	N/A
Weighted combined	2.1 [3]	134.5 [3]

Carbon dioxide emissions (g/km) (weighted): 49

Important note: Some specifications of this make/model may have lower CO₂ emissions than this. Check with your dealer.

[1] A 1st year VED rate will be applied to cars registered for the first time (scheme effective from April 2010).

[2] The standard 12 month VED rate for all registered cars in this band is shown for the purposes of comparison. Note, figures quoted reflect the current rate only, and may be subject to change in the future.

[3] Please note that figures quoted are obtained under specific test conditions, they may not be achieved under 'real world driving conditions. However, the figures serve as a means of comparing models of a similar type.

[4] A list of electric vehicle charging points is available here: http://plugsurfing.co.uk/.

Department for Transport

To compare fuel costs and CO₂ emissions of new cars, visit http://carfueldata.direct.gov.uk

VCA

New information presented in the UK plug-in hybrid and range extended electric vehicle labels

The UK plug-in hybrid and range-extended electric vehicle labels include several pieces of new information. The presentation of this information has been informed by LowCVP's 'testing alternative label design study'. The new data and information displayed on the fuel economy label for plug-in and range-extended electric vehicles is as follows:

- 'Weighted combined' fuel consumption and CO_2 emissions figures are presented in accordance with the official test cycle measurements for plug-in hybrid and range extended electric vehicles (This is based on a 'combined weighted' drive cycle. Urban and extra urban fuel consumption figures are now defunct for plug-in hybrid, range extended and electric powertrain technologies.)

- A description of how 'weighted combined' fuel consumptions determined to assist car buyers' understanding of this new metric.

- Annual fuel and electricity cost in addition to total running cost to highlight to consumers the benefit of running the vehicles on more miles in electric operation.

- Energy consumption shown as 'weighted combined mpg' and electricity consumption. The purpose of this is to assist car buyers in understanding that 'weighted combined' fuel consumption relates to a test cycle where the vehicle is operated on petrol and electricity.

- Electric range to assist consumers in understanding the electric mileage capability of the vehicle.

- The 'combined' drive cycle has been amended to 'combined cycle' as defined in the certificate of conformity.

- Inclusion of a website showing the location of electric vehicle charging points in the UK.

Appendix 3 – LowCVP Research Reports

1. LowCVP Car buyer survey, GfK 2006 (*LowCVP members only*)

2. LowCVP Car buyer survey, GfK 2007 (*LowCVP members only*)

3. LowCVP Car buyer survey, GfK 2008 (*LowCVP members only*)

4. LowCVP Car buyer survey, GfK 2009 (*LowCVP members only*)

5. From 'mpg paradox' to 'mpg mirage': How car purchasers are missing a trick when choosing new cars. Robert Gordon University, Ecolane and Sustain, 2008.

6. LowCVP Car Buyer Survey: Improved environmental information for consumers. Conducted by Ecolane, Sustain, and Robert Gordon University, 2010.

7. Testing alternative fuel economy labels. Ecolane, Centre for Sustainable Energy, University of Aberdeen, 2012

   http://www.lowcvp.org.uk/resource-library/reports-and-studies.htm