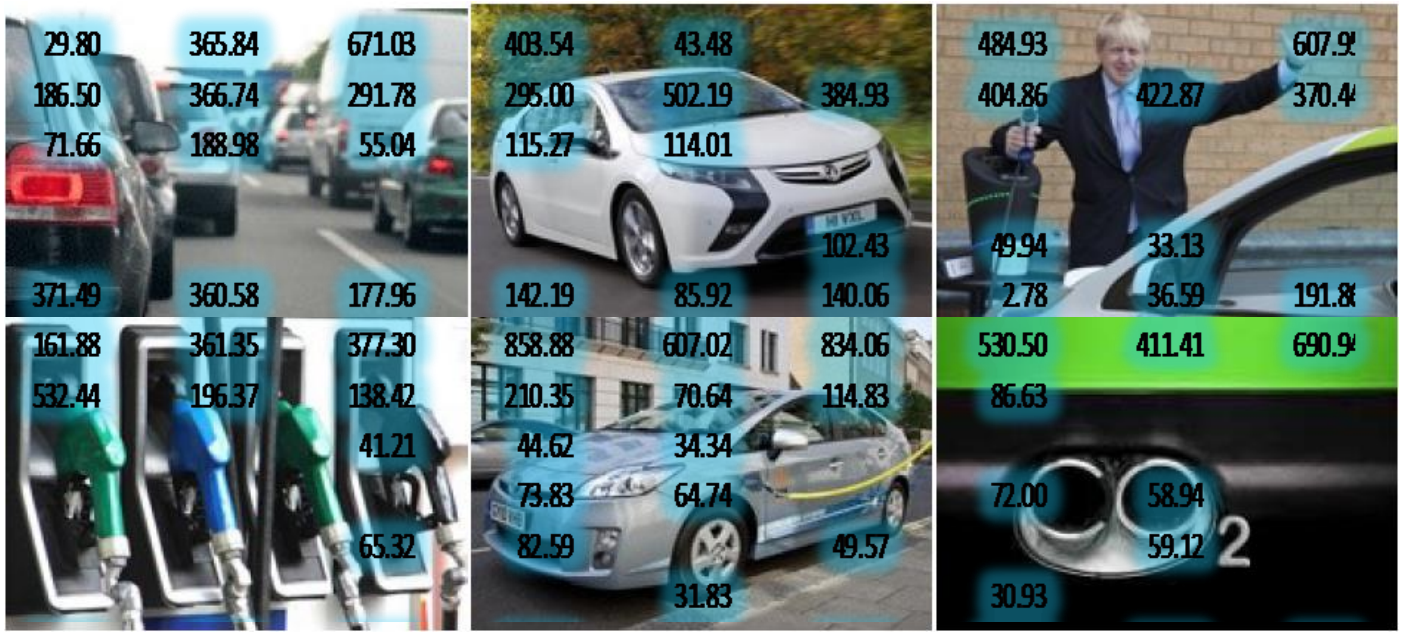
Communicating life cycle information to the consumer: challenges and opportunities



Dr Ben Lane, Ecolane & Next Green Car

LowCVP Conference 2013 – London – 11th July 2013

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Communicating life cycle information to the consumer: challenges and opportunities

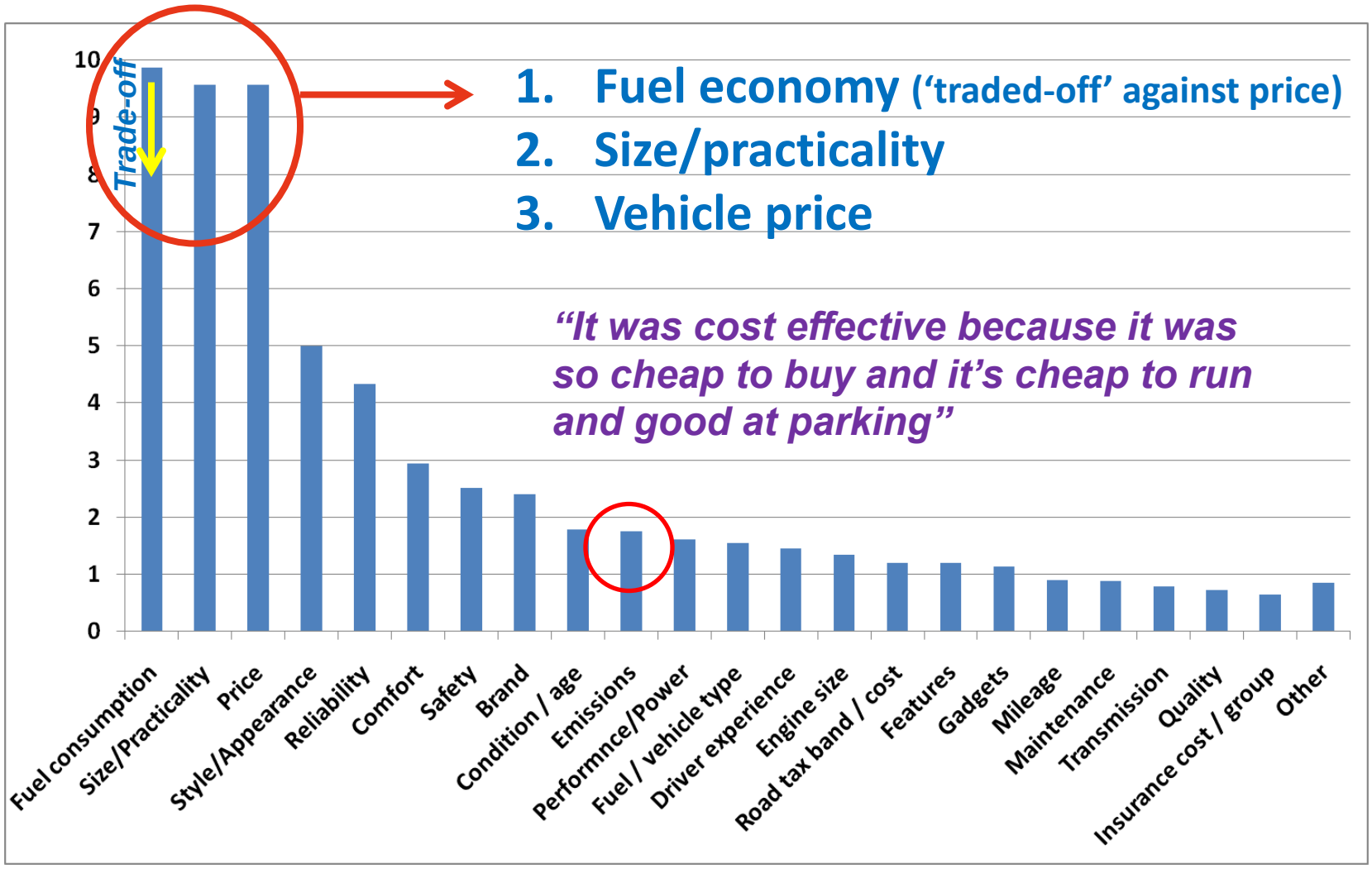
1. MAIN CAR BUYER MOTIVATIONS / TRUST
2. WHY IS LCA IMPORTANT TO CONSUMERS?
3. WHAT LCA INFORMATION IS AVAILABLE ?
4. HOW TO COMMUNICATE LCA INFORMATION?

Ecolane

next greencar™

Private car buyer: purchase factors

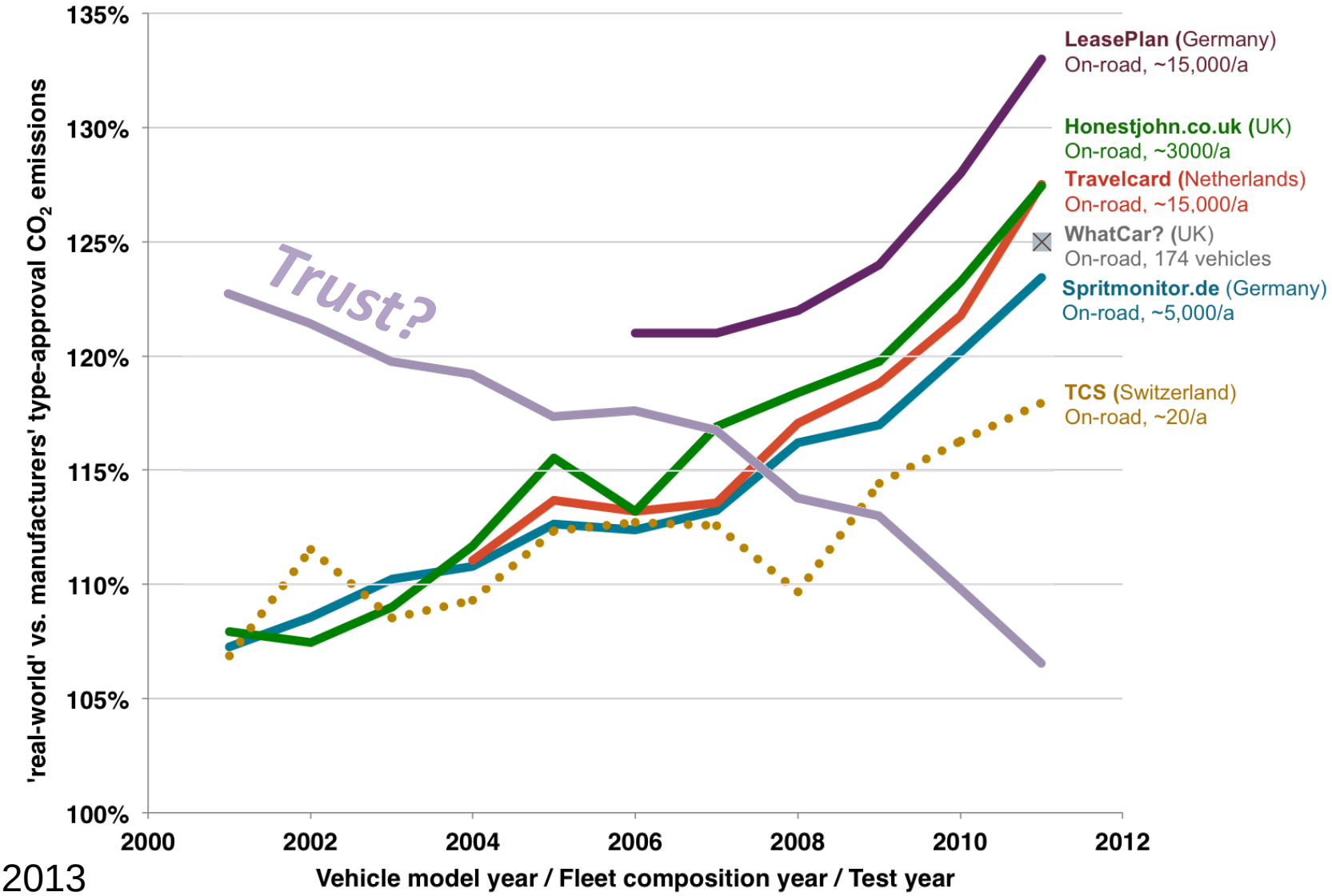
Motivation



LowCVP Car Buyer Survey 2010

Gap between ‘real-world’ and type-approval CO_2/MPG is increasing

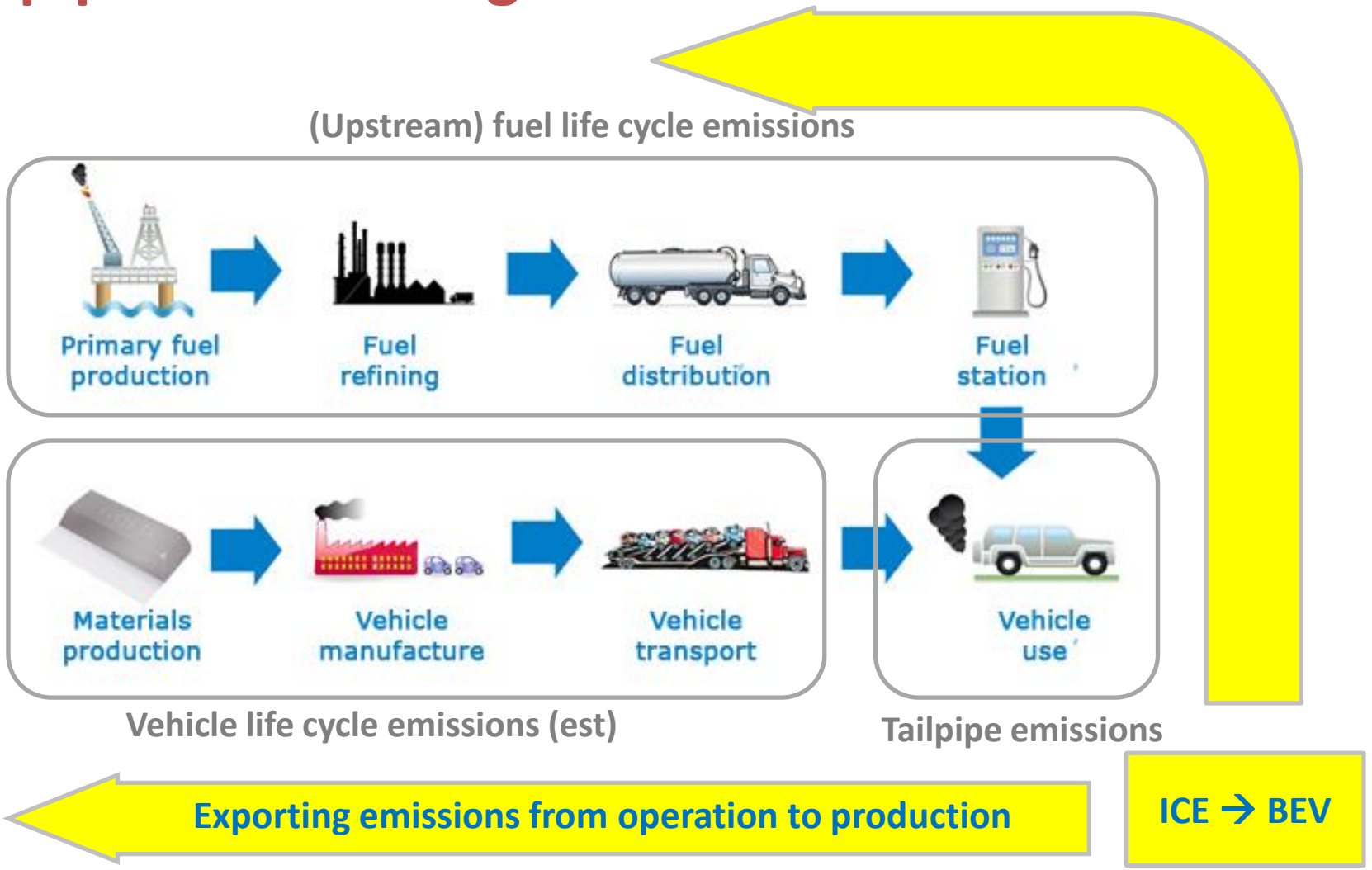
Trust



ICCT 2013

Impact beyond the tailpipe is increasing

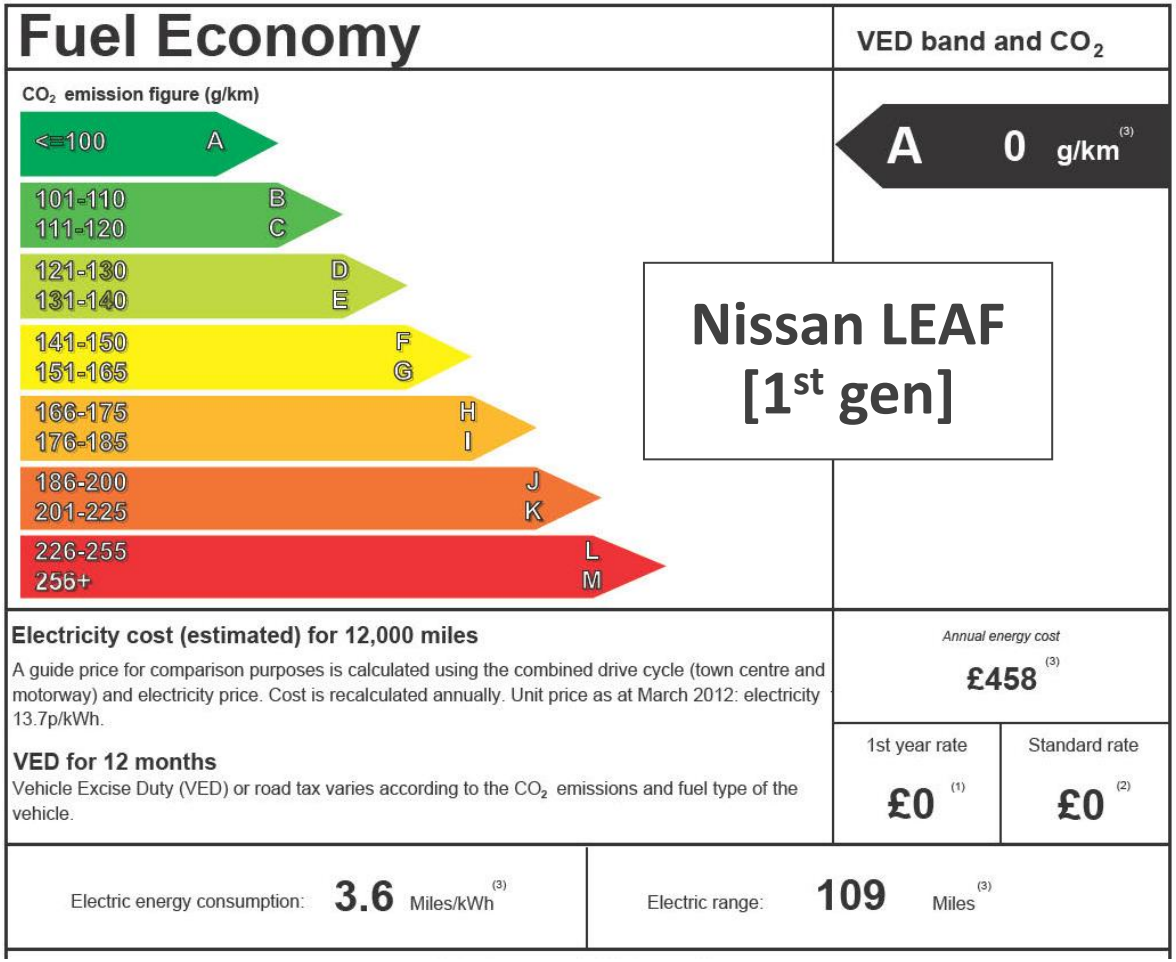
Life cycle



Next Green Car 2013

Impact beyond the tailpipe is increasing

Life cycle



- Tailpipe CO_2 emissions reducing with electrification
- Indirect ('upstream') CO_2 increasing with electrification
- Indirect CO_2 almost 50% for battery electrics
- Increasing disconnect with label information

Ricardo-AEA 2011

Vehicle specifications based on roadmap projections for 2015.
Assumed lifetime mileage 150,000 km. Fuels E10 and B7.
Electricity carbon intensity assumed to be 500 gCO_2/kWh.

What is the demand for life cycle information?

Information

- **Consumers:** Evidence that consumers aware of indirect emissions – may not know how EVs work, but conceptually understand that emissions may be generated 'elsewhere' (at power station);
- **Fleets:** Under the Companies Act 2006 (Strategic and Directors' Reports) Regulations 2013, quoted companies are required to report their annual GHG emissions in their directors' report – *advised* to include Scope 2 (indirect) emissions;
- **Policy**: Increasingly needs to be based on life cycle impacts (e.g. Embodied energy of EVs) – CO2 & AQ reduction priorities converging;
- **OEMs:** Brand, reputation, competitiveness, marketing – Combining promotion of EV with renewable electricity increased U.S. consumer interest 25%→31% among buyers of conventional vehicles

Ecolane 2009, Carbon Trust 2013, Low Emission Strategies, Axsen & Kurani 2013

What life cycle information is available?

Information

- **Consumers:** No 'official' B2C model specific info other than NEDC Type Approval data – independent 3rd party online tools / websites – no national/international consumer 'brand' (such as Euro NCAP);
- **Fleets:** Multitude of corporate consultancy provided LCA services – extensive LCA datasets (ecoinvent, SimaPro, US GREET, EU JRC) – SMEs: DIY LCA supported by Defra GHG Reporting Guidance – International standards well developed: ISO 14040/44, PAS2050;
- **OEMs:** Increasing number of OEMs do produce model range LCA reports – but not distributed widely – tend to be B2B focused

European vehicle rating systems

Rating systems

LIFE CYCLE

- **Ecoscore** (Belgium, TA[1]+LCA data, 2003?-13)
  Belgian system developed by Vrije Uni. Brussels, VITO & CESSE – well supported live database
- **Green Car Rating** (UK, TA+LCA, 2006-13)
  Developed by Next Green Car, UK based on EU Cleaner Drive – well supported live database
- **Cleaner Drive** (EU, TA+LCA data, 2001-2004)
  Car life cycle ratings – EU project 2001-2004 led by Energy Saving Trust, UK – discontinued
- VCD Environmental Car List (Germany, TA data, 2002-13)
  Basic points system based on Type Approval data generated annual Top Ten list – Annual
- Ecomobiliste (Switzerland, TA data, 1997-2009-13)
  Dev by Institute Energy and Environment (IFEU), Germany – basis for Top Ten list – Annual
- CAIR Environmental Rating system (UK, TA data+, 1998-2006?)
  Centre for Automotive Industry Research (CAIR) at University of Cardiff, UK – discontinued
- ETA Car Buyer's Guide (UK, TA data, ??-2012)
  Environmental Transport Association – based on Type Approval data – Occasional updates
- EcoTest (EU, Real world tailpipe, 2003-13)
  Jointly developed by the FIA foundation and ADAC – 150+ cars tested annually real world cycle

1 – TA: Type Approval

European vehicle rating systems

Rating systems

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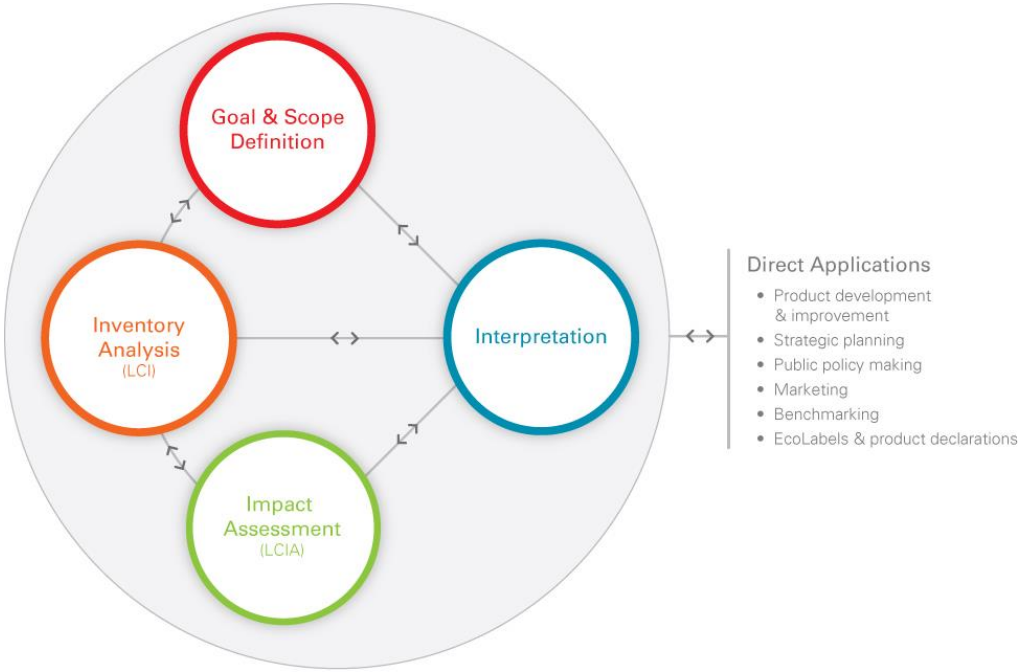
Four key LCA stages:

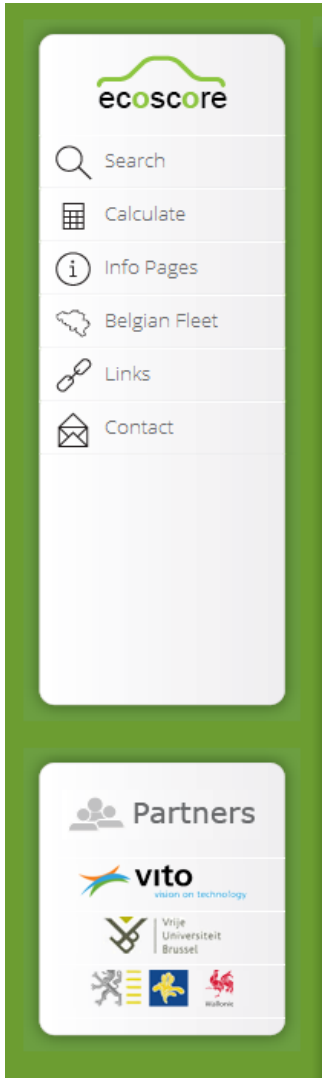
- **Scope definition**
- **Inventory analysis**
- **Impact assessment**
- **Interpretation**



www.lcanz.org.nz/introduction-lca

Ecoscore (Belgium)

Rating systems



- **ecoscore.be**[1] is a free to use consumer website developed by Vrije University Brussels, VITO & Centre of Economical and Social Studies of the Environment (CESSE) Universite Libre de Bruxelles.
- Includes **LCA methodology related to fuel cycle** and expresses car's life cycle environment impact as a score out of 100: **100 greenest** to **0 most polluting**
- Methodology includes 3x GHG emissions, 6x AQ regulated pollutants and noise – assesses impacts on climate change, air quality (human health and ecosystem).
- Website is free to use and allows users to search for specific models, provides 'Top 10' lists by vehicle class and a calculator to score any emissions dataset.

1 – http://www.ecoscore.be

Ecoscore methodology

Rating systems

- Includes CO2+noise and all regulated emissions as measured by NEDC
- Other GHG and AQ emissions considered to compare all fuel types
- '5-step' LCA methodology covers fuel life cycle (vehicle manufacture not included)

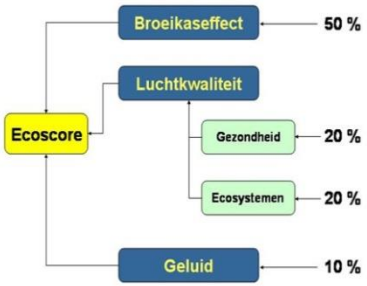
Weighting is set by methodology at:

GHG: 50%

AQ (health): 20%

AQ (ecosystem): 20%

Noise: 10%



- Tailpipe NEDC: grams/km, dB(A)
- Data: Technicar, Belgian Ministry for Transport & Febiac

Fuel cycle	In use
CO_2	CO_2
CH_4	CH_4
N_2O	N_2O
CO	CO
HCs	HCs
PM_{10}	PM_{10}
NOx	NOx
SO_2	dB(A)

Ecoscore methodology: Inventory, classification, characterisation, normalization and weighting

- ExternE
- EUR/g

High score = Low impact

3 scores (x/100)
GHG
AQ
TOTAL

100 greenest to
0 most polluting

- Reference vehicle: NEDC 120 gCO2/km Petrol Euro 4

- Units: grams/GJ delivered (WTT)
- Data: MEET; VITO; Electrabel

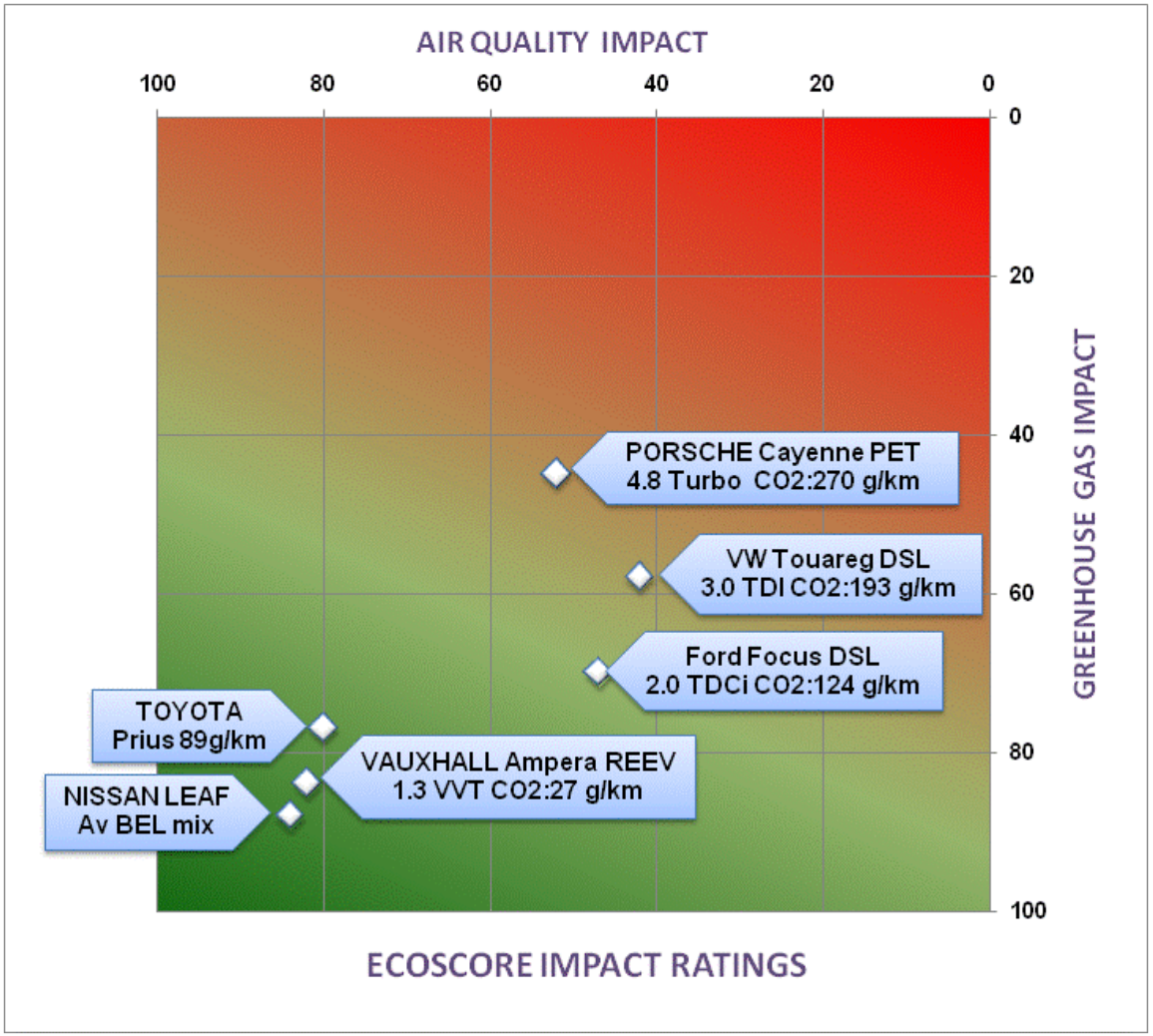
1 – CLEVER Project reports 2007, 2011

2 – http://www.ecoscore.be/en/ecoscore-information

Ecoscore results

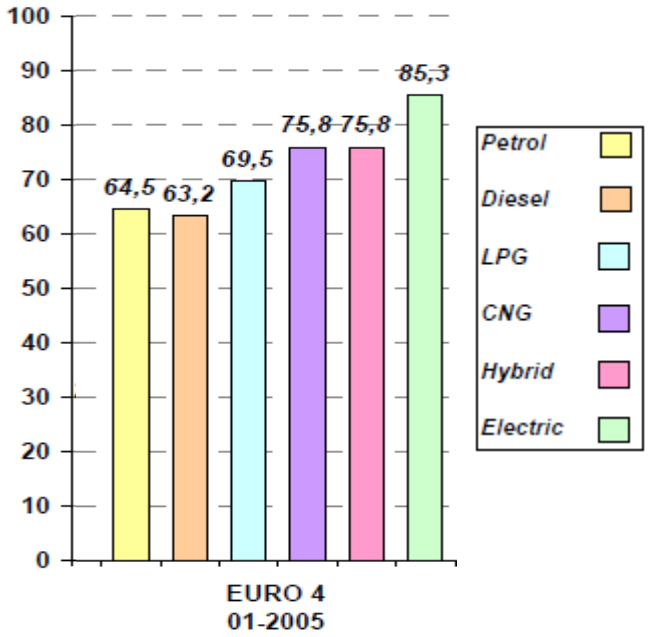
Rating systems

2012-13 models shown using reverse 2-D plot of AQ-GHG ecoscores – Belgium context



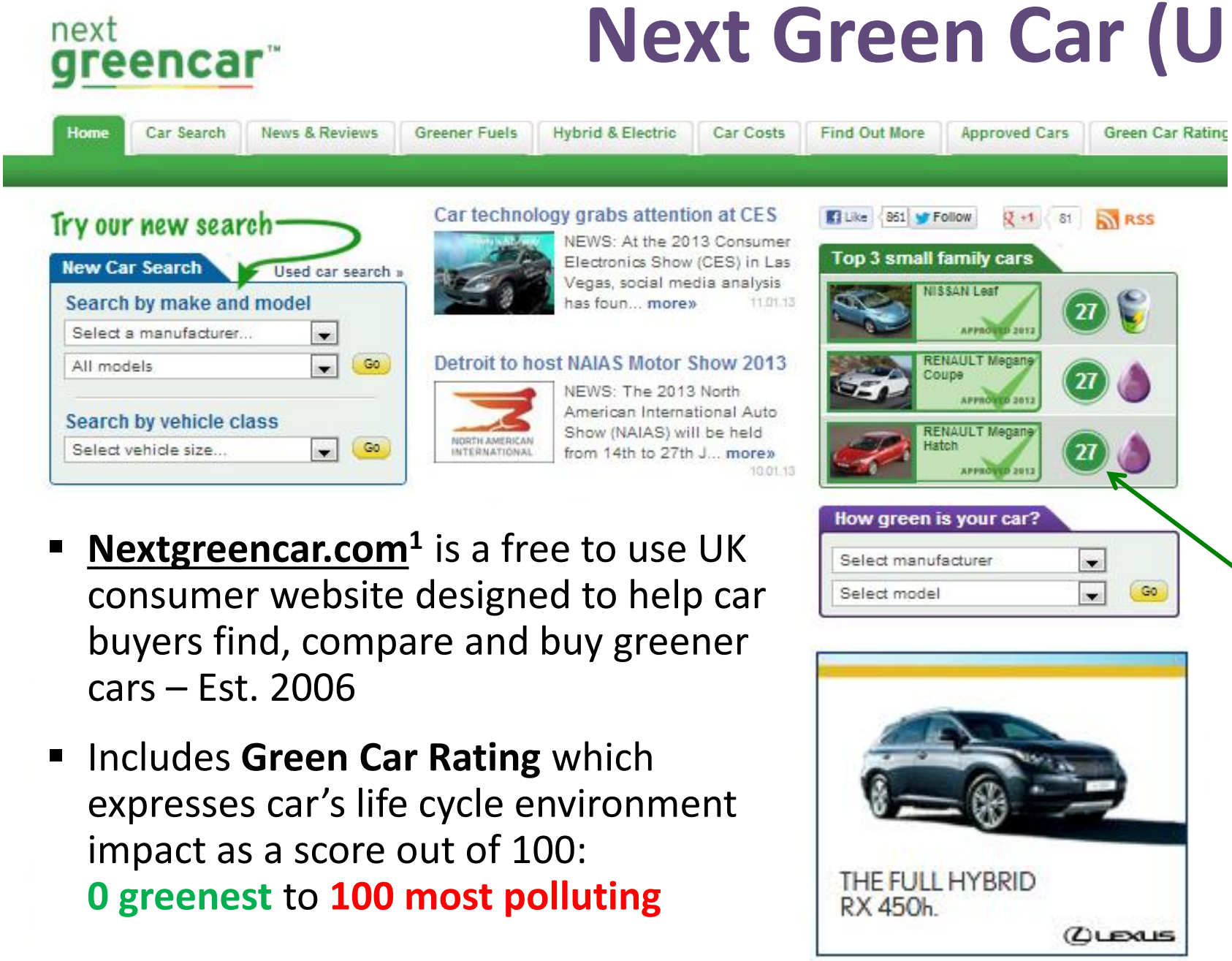
- GHG/AQ/dB weighting 50:40:10 - set by methodology
- Score is logarithmic – all +ve

- Good spread on AQ axis as ref is Euro 4 but data clustered on lower GHG axis as ref vehicle is 120 g/km (ecoscore of ref=70)



1 – ecoscore methodology applied to UK sourced Type Approval data

Next Green Car (UK)



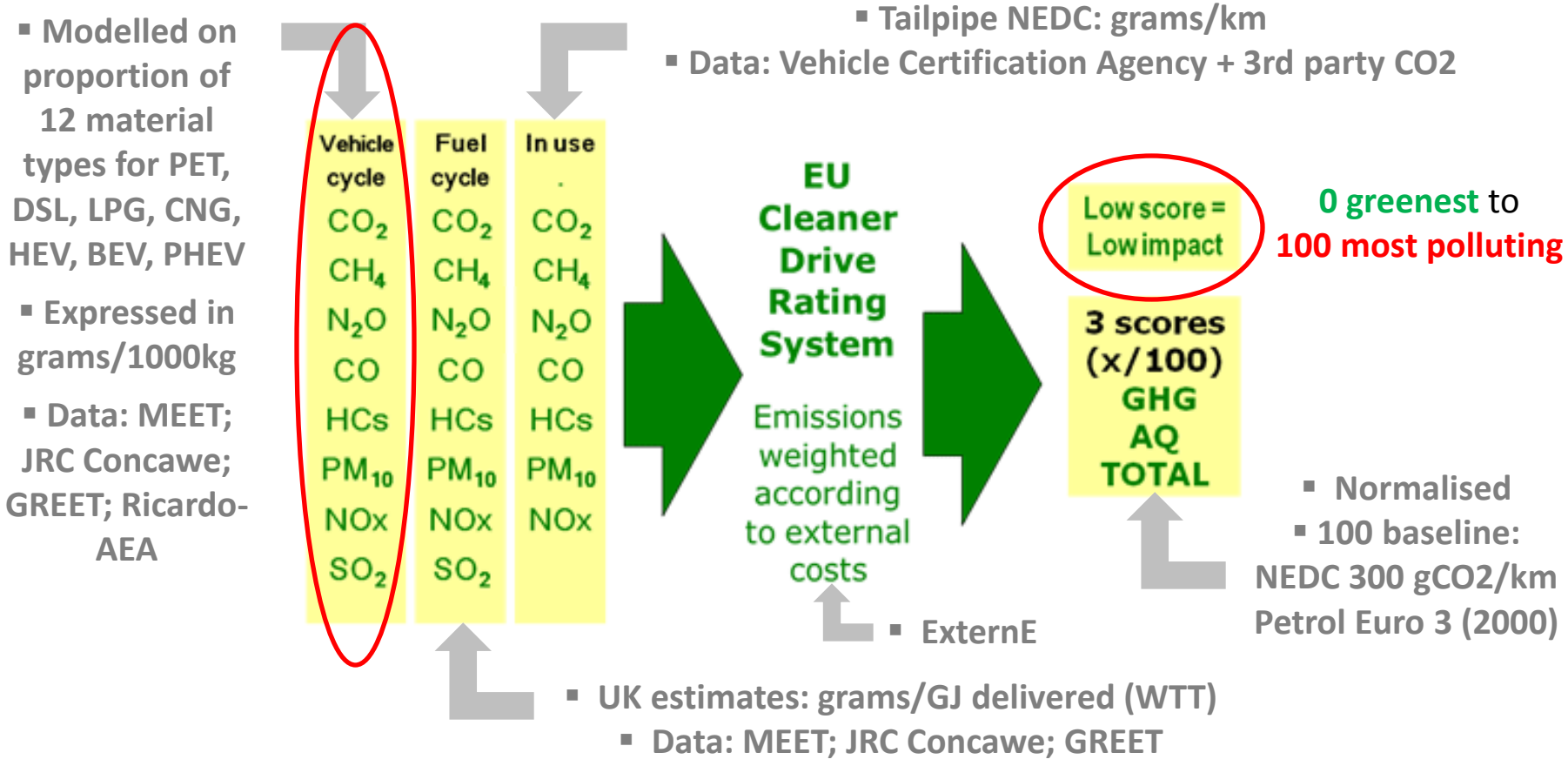
- **Nextgreencar.com**[1] is a free to use UK consumer website designed to help car buyers find, compare and buy greener cars – Est. 2006
- Includes **Green Car Rating** which expresses car's life cycle environment impact as a score out of 100:
  0 greenest to **100 most polluting**

1 – http://www.nextgreencar.com

Next Green Car method

Rating systems

- Includes CO2 and all regulated emissions as measured by NEDC
- Other GHG and AQ emissions considered to compare all fuel types (excl. dB(A))
- External costing method – GHG/AQ weighting determined by costs and ref. vehicle

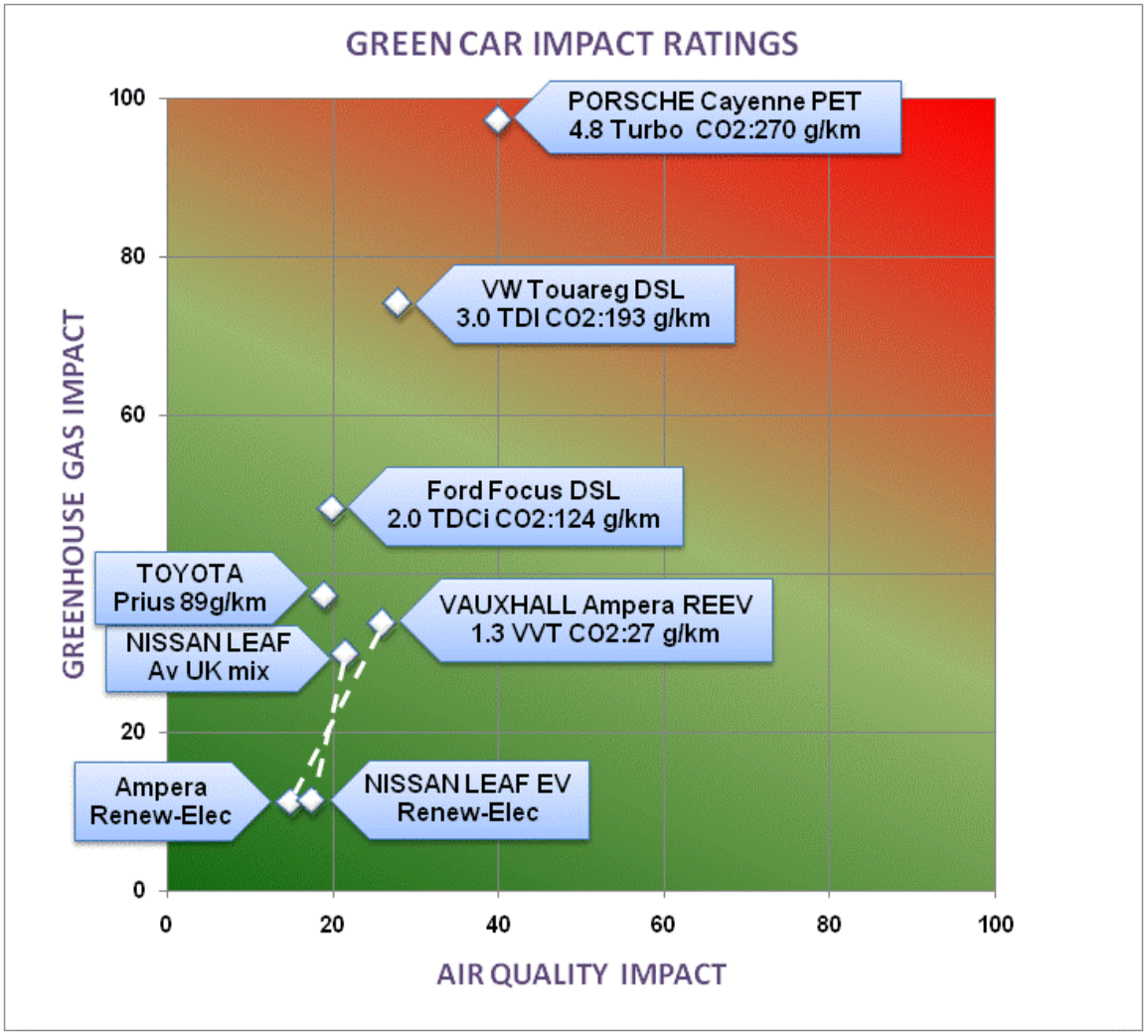


1 – www.nextgreencar.com/ratings.php

Next Green Car results

Rating systems

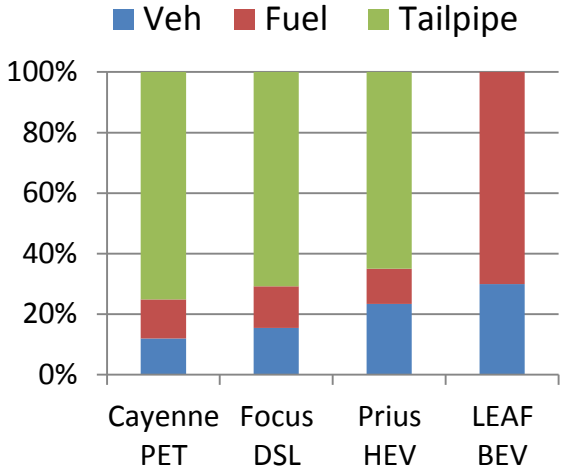
2012-13 models shown using 2-D plot of AQ-GHG ratings coordinates – UK context



- GHG/AQ weighting 60:40 approx. – arises purely out of relative value of external costs and emissions of baseline veh.

- Good spread of data points on GHG axis as ref is 300 g/km
- <u>But</u> data points tend to cluster on lower AQ axis as ref is Euro 3

Life cycle CO_2



1 – Next Green Car dataset 2013

Providing consumer and fleet LCA information

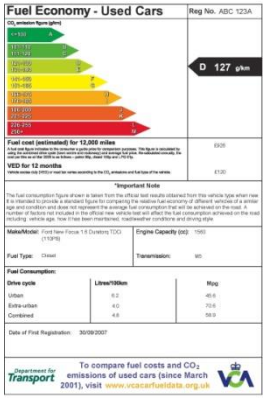
The challenge

- **Include life cycle emissions (beyond tailpipe)** – enables a fair comparison of all vehicle types – and means that zero-emission vehicles can be fairly compared
- **Include all measured air-based emissions (not just CO2)** – allows a realistic comparison between different vehicle and fuel types (PET vs DSL)
- **Incorporate an impact assessment** – accounts for impacts of different emissions and enables: (a) comparison between emissions (b) emission vectors to be aggregated
- **Include vehicle manufacturing cycle (as well as fuel cycle)** – while manufacturer of ICEs only contributes 10-15% of life cycle CO2, this is set to dramatically increase
- **Be simple for non-experts** – common approach is to use a score out of 100 – but also be able to provide all relevant reporting data (fleet)
- **Be a trusted source of information** – common standards available include ISO 14040-14044 standards and PAS2050 accreditation
- **Branded**: instantly recognisable by mass audience

Providing consumer and fleet LCA information

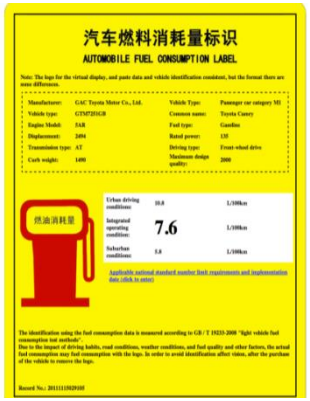
The challenge

None of the global fuel economy labels include LCA data:

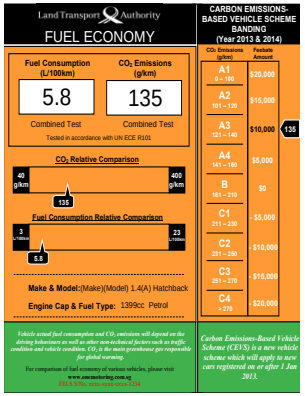


UK

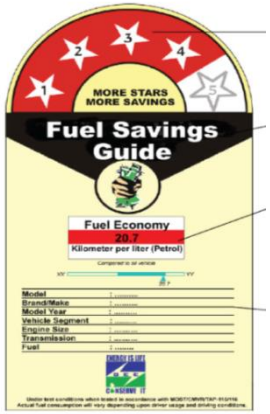
Brazil



China

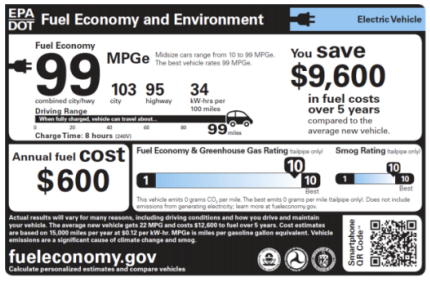


Singapore



India

Chile



US

South Korea

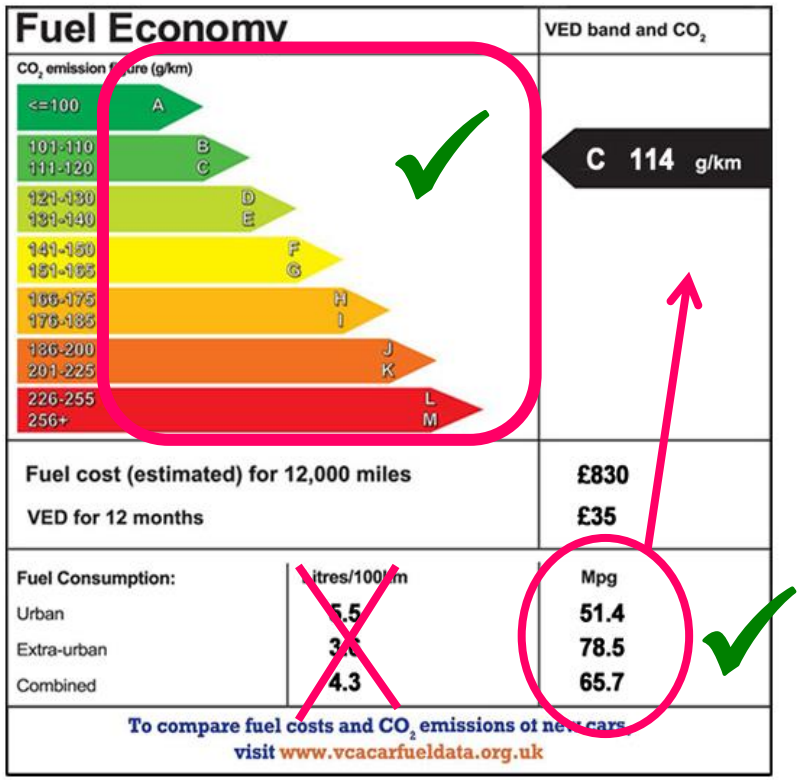
NZ

ICCT 2013

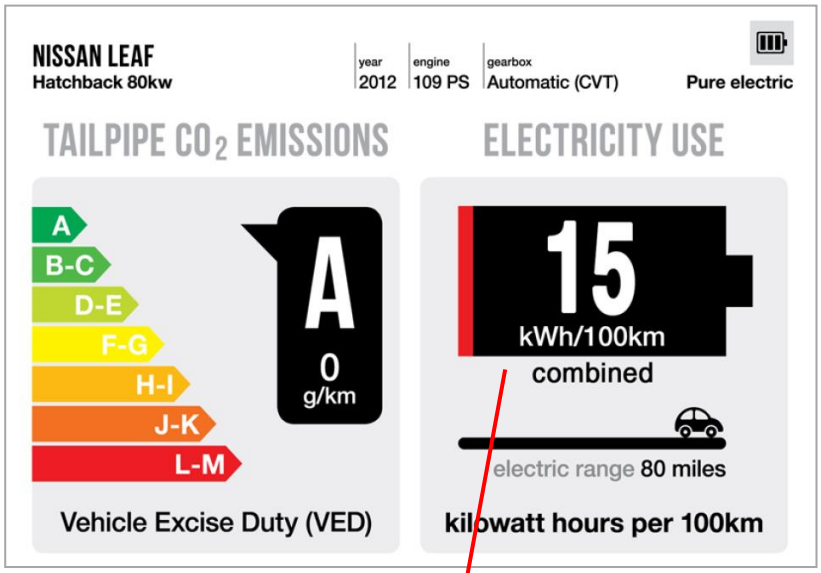
Providing consumer and fleet LCA information

The challenge

Designing consumer metrics can be a challenge in itself:



Test label based on current UK label



Test label for battery electric vehicle

Very low level of understanding of 'Wh/km' and 'kWh/100km'

LowCVP Car Buyer Survey 2012

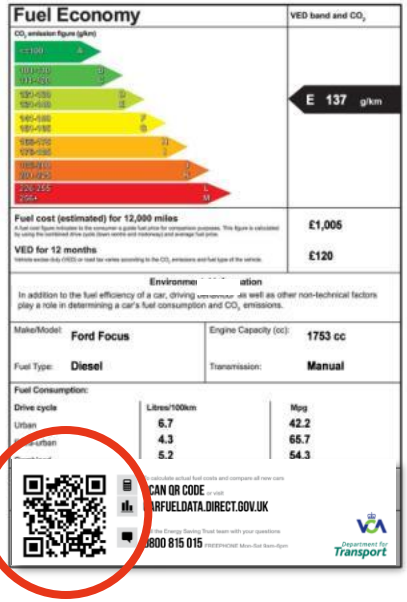
Life cycle information provision and marketing

The opportunity

- **Consumers:** able to make simple but informed choices (eg ICE vs EV) – retain trust in industry and brand loyalty;
- **Fleets:** able to report and audit GHG + AQ emissions simply, accurately and to agreed common standards;
- **Policy**: able to make informed technology choices based on balanced approach to CO_2 & AQ – better company reporting → better national emissions auditing;
- **OEMs:** Brand strength, maintain reputation, increase competitiveness → new marketing opportunities (e.g. EV sales, data for fleets)

Life cycle information provision and marketing

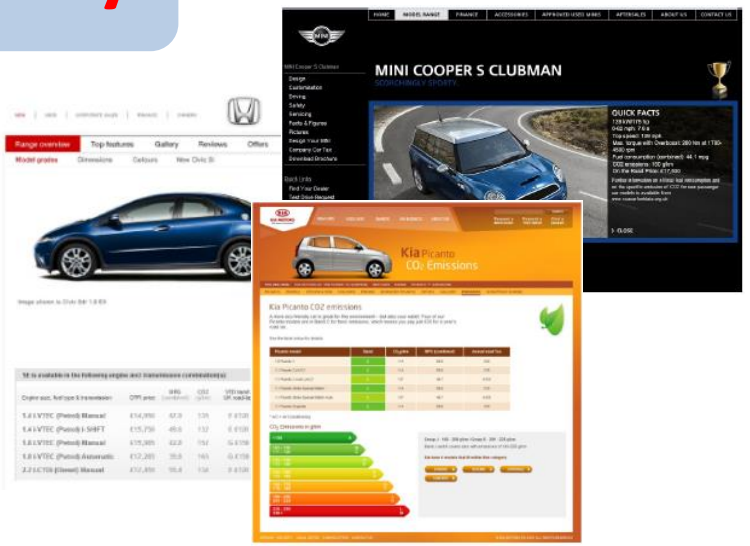
The opportunity



"If you're in the showroom... rather than ask the dealer, you've got the information to hand – it's great"

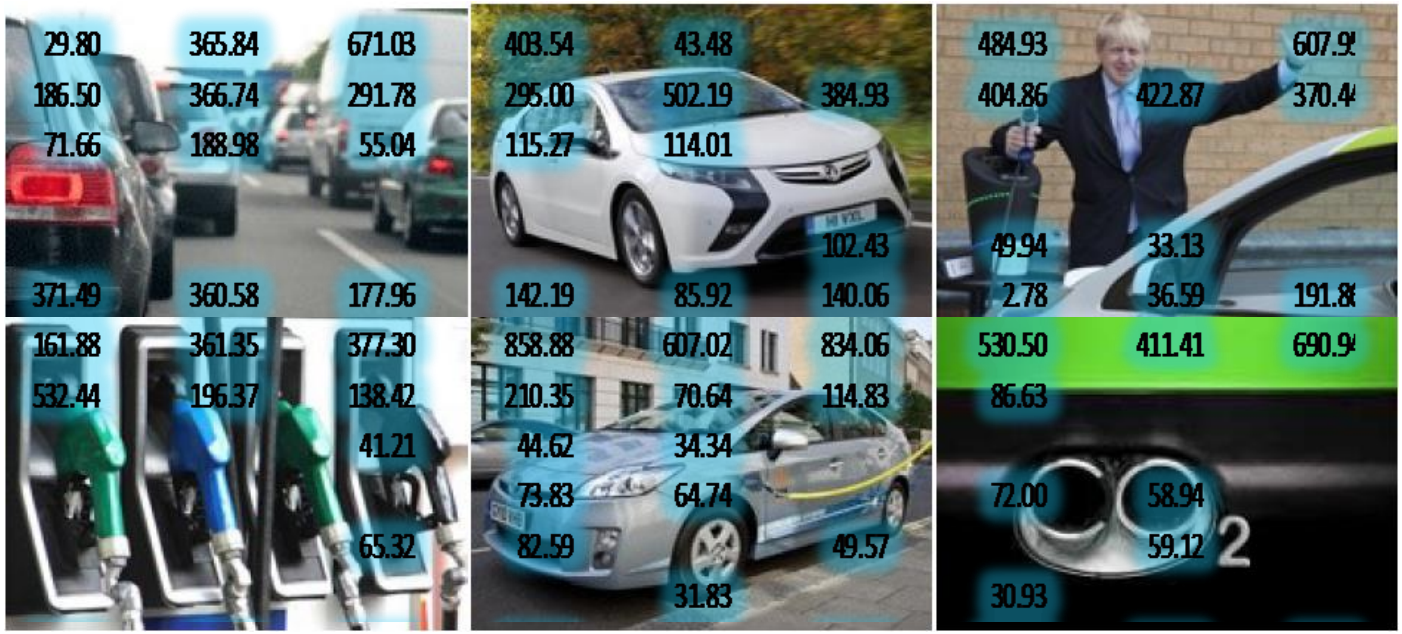
Digital delivery

QR CODE



LowCVP Car Buyer Survey 2012

Communicating life cycle information to the consumer: challenges and opportunities



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Additional slides for reference only

(if required for discussion)

Green Car Rating calculation (UK)

- **External cost $Q_{GHG/AQ}$ (EUR/km) = $\sum_i p_i.c_i$**

p_i = emission of pollutant *i* in grams/km
c_i = external cost of emission of pollutant *i* in EUR/grams

- **GHG Rating = 100 × Q_{GHG} (vehicle) / Q_{GHG}(maximum)**
- **AQ Rating = 100 × Q_{AQ} (vehicle) / Q_{AQ} (maximum)**
- **Green Car Rating = 100 × Q_{TOTAL} (vehicle) / Q_{TOTAL} (maximum)**

Example: Toyota Prius 1.8 VVT-i T3 HEV MY2013 89gCO2/km[2]

GHG external costs	CO_2	CH_4	N_2O	TOTAL
Tailpipe emissions (g/km)	89	0.012 (est)	0.005 (est)	-
Tailpipe ext costs (EUR/km)	0.00409	0.00001	0.00007	-
Indirect ext costs (EUR/km)	0.00221	0.00004	0.00000	-
GHG external costs	**0.00630**	**0.00005**	**0.00007**	**0.00642**
Max GHG ext cost				**0.01718**

AQ external costs	CO	HC	NO_x	PM	SO_2	TOTAL
Tailpipe emissions (g/km)	0.258	0.058	0.006	-	-	-
Tailpipe ext costs (EUR/km)	0.00000	0.00000	0.00000	0.00000	0.00000	-
Indirect ext costs (EUR/km)	0.00000	0.00069	0.00031	0.00012	0.00095	-
AQ external costs	**0.00000**	**0.00069**	**0.00031**	**0.00012**	**0.00095**	**0.00208**
Max AQ ext cost						**0.01165**

GHG Rating = 100 × 0.00642 / 0.01718 = 37.0 (1 dec pl.)

AQ Rating = 100 × 0.00208 / 0.01165 = 19.0 (1 dec pl.)

Green Car Rating = 100 × 0.00959 / 0.02883 = 30.0 (1 dec pl.)

1 – http://www.ecoscore.be/en/ecoscore-information 2 – VCA (UK) NEDC data

Ecoscore methodology

Rating systems

- **Ecoscore = 100*exp[-0.00357*(A*CO2 + B*HC + C*NOx + D*CO + E*PM + F*BV + G*dB(A) + H)]**
- **Ecoscore GHG = 100*exp[-0.00357*2*(A*CO2 + f1*BV + h1)]**
- **Ecoscore AQ = 100*exp[-0.00357*2.5*(B*HC + C*NOx + D*CO + E*PM + f2*BV)]**

BV = fuel economy in lit/100km, m3/100km or kWh/100km
Coefficients A, B, C, D, E, F, f1, f2, G and the constants H, h1, h2 correspond to fuel type and Euro standard

Example: Toyota Prius 1.8 VVT-i T3 HEV MY2013 89gCO2/km[2]

GHG calculation	CO_2	BV	constant	TOTAL
CO2 (g/km) & FC (l/100km)	89	3.9	-	-
Coefficients	0.36	1.12	0.71	-
Exponent **GHG ecoscore**	**32.04**	**4.368**	**0.71**	**37.118** **76.7**

AQ calculation	CO	HC	NO_x	PM	BV	TOTAL
Emm (g/km) & FC (l/100km)	0.258	0.058	0.006	-	3.9	-
Coefficients	0.011	23.17	101.88	1407.75	5.89	
Exponent **AQ ecoscore**	**0.0028**	**1.3439**	**0.6113**	**0.0000**	**22.971**	**24.929** **80.0**

AQ calculation	CO2	CO	HC	NO_x	PM	BV	dB(A)	constant	TOTAL
Emm (g/km) & FC (l/100km)	89	0.258	0.058	0.006	-	3.9	69.0		-
Coefficients	0.36	0.011	23.17	101.88	1407.75	7.01	**0.333**	**-12.63**	
Exponent **AQ ecoscore**	**32.04**	**0.0028**	**1.3439**	**0.6113**	**0.0000**	**27.339**	**22.977**	**-12.63**	**71.684** **77.4**

GHG ecoscore = 76.7 (1 dec pl.)

AQ ecoscore = 80.0 (1 dec pl.)

TOTAL ecoscore = 77.4 (1 dec pl.)

1 – http://www.ecoscore.be/en/ecoscore-information 2 – VCA (UK) NEDC data