

Building a business model for Low Carbon Vehicles

Corby, 30th January 2018

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GROWING THE RENEWABLE ENERGY & CLEAN TECHNOLOGY ECONOMY

Introduction

- Driving EV since 1999.
- EV consultant since 2005.
- Infrastructure project (OLEV)
- Training/support OEM brands.
- EV fleet design.

















Why EV? Low carbon AND cleaner air



- De-carbonisation should be hand-in-hand with improvements
- UK aim for (nearly) all new vehicles to be zero emission by 2040.
- Nowhere more important than in our major cities and other proposed Clean Air Zones (CAZs)
- Transport is now the UK's biggest emitter of carbon (CCC)
- T-charge introduced in London on top of Congestion Charge.
- Are we just displacing the carbon/emissions problem...





2017 energy milestones in UK

- 21st April: "No coal day" first time in 130 years.
- 26th May: Record solar PV output: 24.3% of grid (8.7GW) at 1pm.
- 7th June: First time ever where >50% of UK energy is renewable: wind, solar, hydro and biomass. (50.7%)

Increasingly de-centralised grid. Increasingly variable generation.





Renewable Transport Fuels Group

Dealing with the existing fleet / hard-to-change vehicles:

- Bioethanol (E5, E10...)
- CNG / Biomethane
- Alternative liquid fuels (e.g. advanced biodiesels)









Back to the future...







EV market





















PHEV (Plug-in Hybrid Electric Vehicle) market













Limited electric range (circa 30 miles).

Benefit-in-Kind savings.

Possibly good fuel economy, depending on duty cycle.





PHEV (Plug-in Hybrid Electric Vehicle) market



Plug-in hybrid vehicles among the 'highestpolluting' company cars

CALENDAR

20/09/2017 in Fleet Industry News



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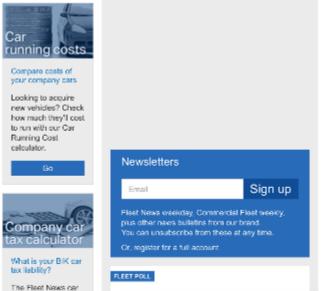
Newly-released data from TMC highlights worryingly-high fuel consumption and emissions in real-world driving for hybrid vehicles.

The data has been released as official. car registration figures for August show a 47% rise in hybrid car sales compared. to last year, and some leasing companies report a 300% increase in

orders for plug-in hybrids.

TMC's real-world driving data shows plug-in hybrid vehicles (PHEVs) to be among the highest-polluting company cars in terms of greenhouse gas emissions during real-world use by corporate fleets.

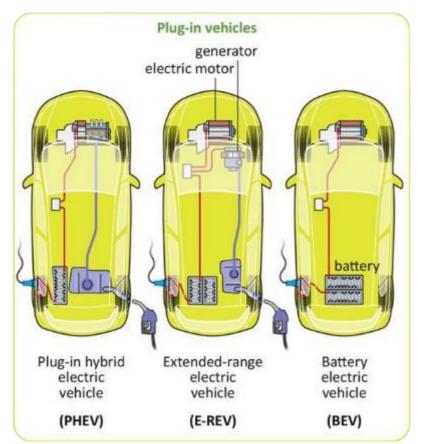
The analysis has shown that their average CO2 autout is 188 often in day to day.







Differences in technology – 'ULEV'









Future ULEV improvement – BIK from 2020?

Car	Appropriate percentage 2%	
Car with CO2 emissions figure of 0		
Car with CO2 emissions figure of 1 - 50	10000	
Car with electric range figure of 130 miles or more	2%	
Car with electric range figure of 70 - 129	5% 8%	
Car with electric range figure of 40 - 69 Car with electric range figure of 30 - 39	12%	
Car with electric range figure of less than 30	14%	
Car with CO ₂ emissions figure of 51 - 54	15%	
Car with CO2 emissions figure of 55 - 59	16%	
Car with CO2 emissions figure of 60 - 64	17%	
Car with CO2 emissions figure of 65 - 69	18%	
Car with CO ₂ emissions figure of 70 - 74	19%	





Case Study 1: NHS – Renault ZOE fleet







Charging EVs –

Strategic network of Rapid Charging

Currently: 50kW

Near-term: 150kW

Longer-term: 350kW



Referenced in Automated & Electric Vehicles Bill Local grid issues to support multiple high power connections: requiring energy storage and/or on-site renewables?





Charging EVs –







Charging EVs – MSA/TRSA







World class exemplars in UK











Commercial Electric Vehicles

December 2017: ~125,000 ULEV registrations. Currently <5% Light Commercials (LCVs)

Ford Transit 'Range Extender' trial (20 vehicles)

'Full EV' is improving with better batteries:

- Better range: 100+ real-world miles.
- Larger EV vans (factory produced models)
- Good option for vans and smaller trucks if duty cycle known.
- Rapid Charge capability to extend daily range.







Commercial Electric Vehicles



24kWh -> 40kWh

NEDC: 106 miles -> 174 miles



22kWh -> 33kWh

NEDC: 106 miles -> 170 miles TRA





Commercial Electric Vehicles

- Peugeot Partner Electric
- Citroën Berlingo Electric







Case Study 2: Peugeot parts delivery







Total Cost of Ownership

- Longer operating lifetime on fleet vehicles anyway
- Strong warranties
- e.g. 8 year lifetime
 ICE: fuel+servicing+RFL
 same as purchase cost
 EV: lower TCO overall.



 Potentially lower project cost <u>including</u> charging infrastructure



Total Cost of Ownership



Servicing:	Σ 197	£ 197	£ 517	Σ 384	Σ 380	50k/4yr
Residual Value:	10%	10%	20%	20%	20%	
Residual Value:	€ 2,130	Σ 2,130	£ 2,609	Σ 2,883	Σ 2,749	
Congestion Charge:			£ -	£	£ -	
				-		
Total Cost of Ownership:	Σ 15,057	Σ 14,515	£ 21,524	£ 18,907	Σ 19,037	per vehicle
Total Cost of Ownership:	Σ 15,057	14,010	£ 21,524	€ 18,907	Σ 19,037	per verticie
Fleet size:	5	5				
	٤ 75,286	٤ 72,575	£ 107,618	٤ 94,533	£ 95,186	Total cost for

Н		1	J	K
Duty cycle				
Daily Mileage		29	5	days/week
Annual Mileage		7,540		
Operating term		8	years	
Total mileage		60320		
Congestion Charge		£10.50	per day	Select
Energy costs				
Energy cost		7.5	p/kWh	e.g. 7.6p
Energy efficiency		2.8	miles/kWh	Spread: e.g. 2.0-5.
(Range		70	miles)	circa 70-90 miles
Cost per mile		2.7	p/mile	
Petrol costs (Officia	al: 34.0mp	g Urban /	43.5mpg Co	ombined)
Fuel price	£	1.10	/litre	
Fuel efficiency		30	mpg	real world
Cost per mile		16.6	p/mile	
Coet ratio		6.2	:1 cheaper	as Electric
Diesel costs (Officia		g Urban /	51.4mpg C	
Diesel costs (Officia Fuel price	al: 44.8mp	g Urban / 1.10	51.4mpg Co	ombined)
Diesel costs (Officia Fuel price Fuel efficiency		g Urban / 1.10 40	51.4mpg Co	
Diesel costs (Officia Fuel price		g Urban / 1.10 40 12.5	51.4mpg Co	ombined) real world



Long-range EVs

A new generation of EVs is coming:





40-60 kWh will be the norm on new vehicles: 200+ mile range will appeal to more motorists than ever.

Daily use maybe less than 20% of total capability?





EVs, Renewables & Energy Storage

Energy Storage sector developing quickly (all scales)

EVs as the storage:

- Micro/embedded systems: homes and businesses
- *Demand Side Reduction / *Demand Turn Up / time-shifting
- Vehicle-to-X (X=Home | Building | Grid)

National Grid and DNOs increasingly interested.





EVs, Renewables & Energy Storage





V2G - Vehicle 2 Grid





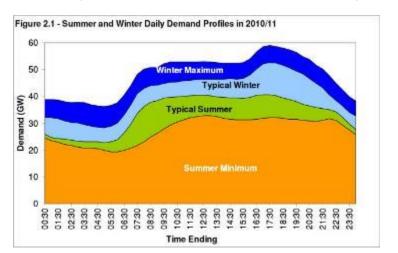


Charging EVs

Issues with local grid (customer side of transformer)

Electric Avenue / Electric Nation projects

DNO's grid in an area of clustering (11kV/33kV) Overall energy supply and demand nationally











THANK YOU

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