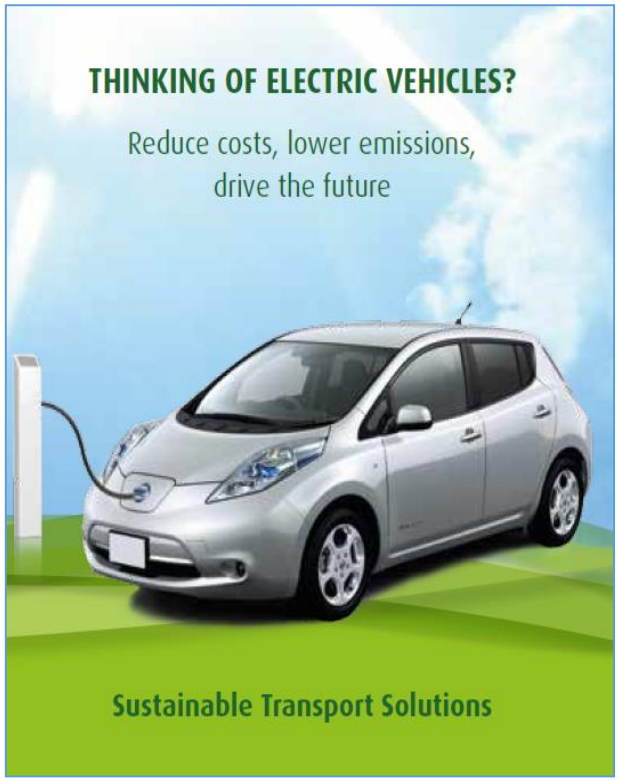
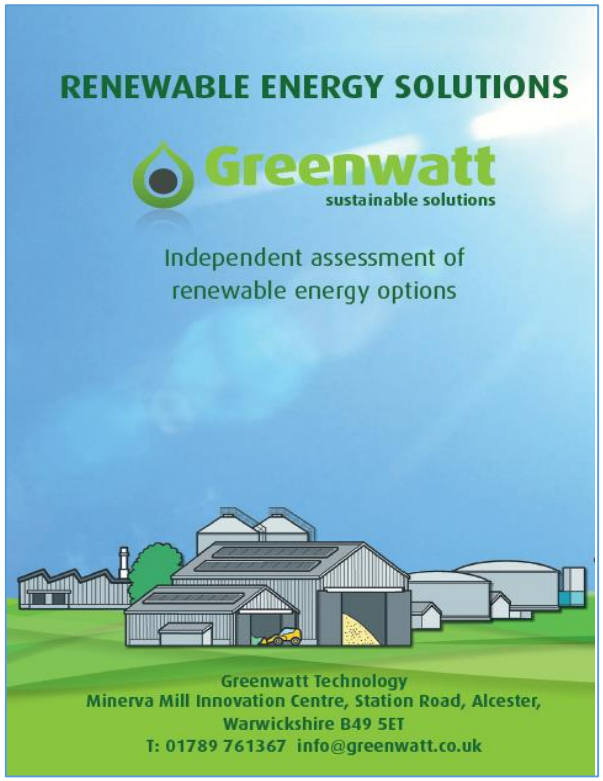
Greenwatt
sustainable transport solutions

COVENTRY & WARWICKSHIRE
GREEN BUSINESS
NETWORK

Mike Woollacott ~ Managing Director

Greenwatt Technology





Our clients include: Orbit Housing; Warwickshire County Council; Birmingham Airport; Coventry City Council; Stoneleigh Park and many SMEs.

www.greenwatt.co.uk

Why should my business invest in low emission vehicles?

- Reduce emissions from road transport CO2; NOx
- Improve air quality and public health (particulates)
- Reduce costs of fuel, service and vehicle tax
- Add to business sustainability credentials / CSR
- Provide improved driving experience
- Avoid air quality penalties

Electric Vehicles – making the news….

Renault invests over $1 billion to accelerate electric vehicle production in France

Elon Musk unveils Tesla electric truck

Jaguar Land Rover to make only electric or hybrid cars from 2020

Renault, Nissan & Mitsubishi alliance announced that it will launch 12 new all-electric vehicles within the next 5 years.

New diesel and petrol vehicles to be banned from 2040 in UK

2017

95,000
Plug-in Cars
Reg. UK April 2017
(Approx)

4,500
Plug-in Vans
Reg. UK April 2017
(Approx)

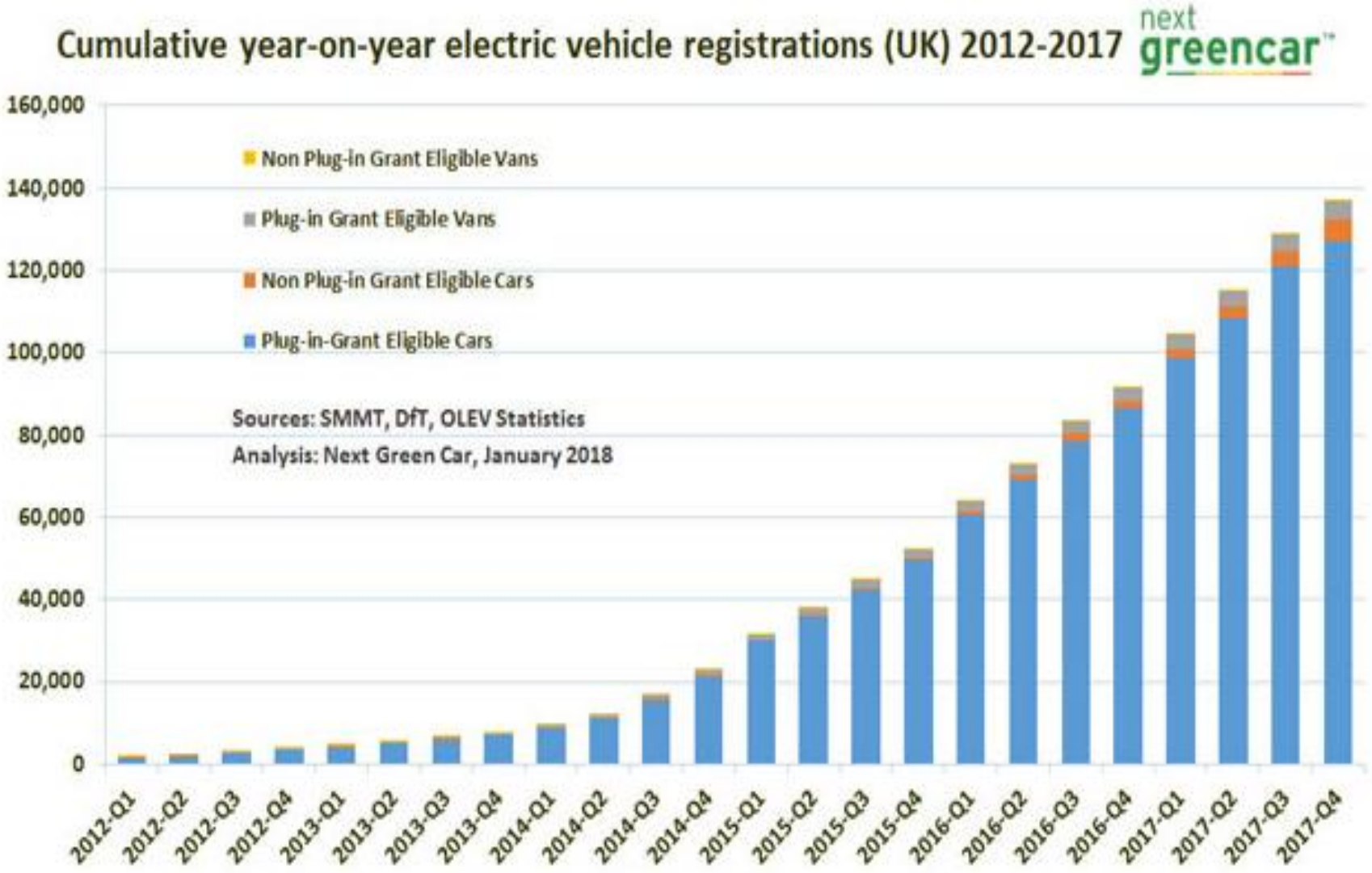
55
Plug-in Models
April 2017
(Plus variants)

12,329
UK Charge Pts
April 2017
(Zap-Map)

Growth in EVs - trends

2017	95,000 Plug-in Cars Reg. UK April 2017 (Approx)	4,500 Plug-in Vans Reg. UK April 2017 (Approx)	55 Plug-in Models April 2017 (Plus variants)	12,329 UK Charge Pts April 2017 (Zap-Map)
2018	155,000 Plug-in Cars Reg. UK June 2018 (Approx)	5,500 Plug-in Vans Reg. UK June 2018 (Approx)	75 Plug-in Models Available June 2018 (Plus variants)	16,584 UK Charge Pts June 2018 (Zap-Map)

EV registration trend




BMW 530e

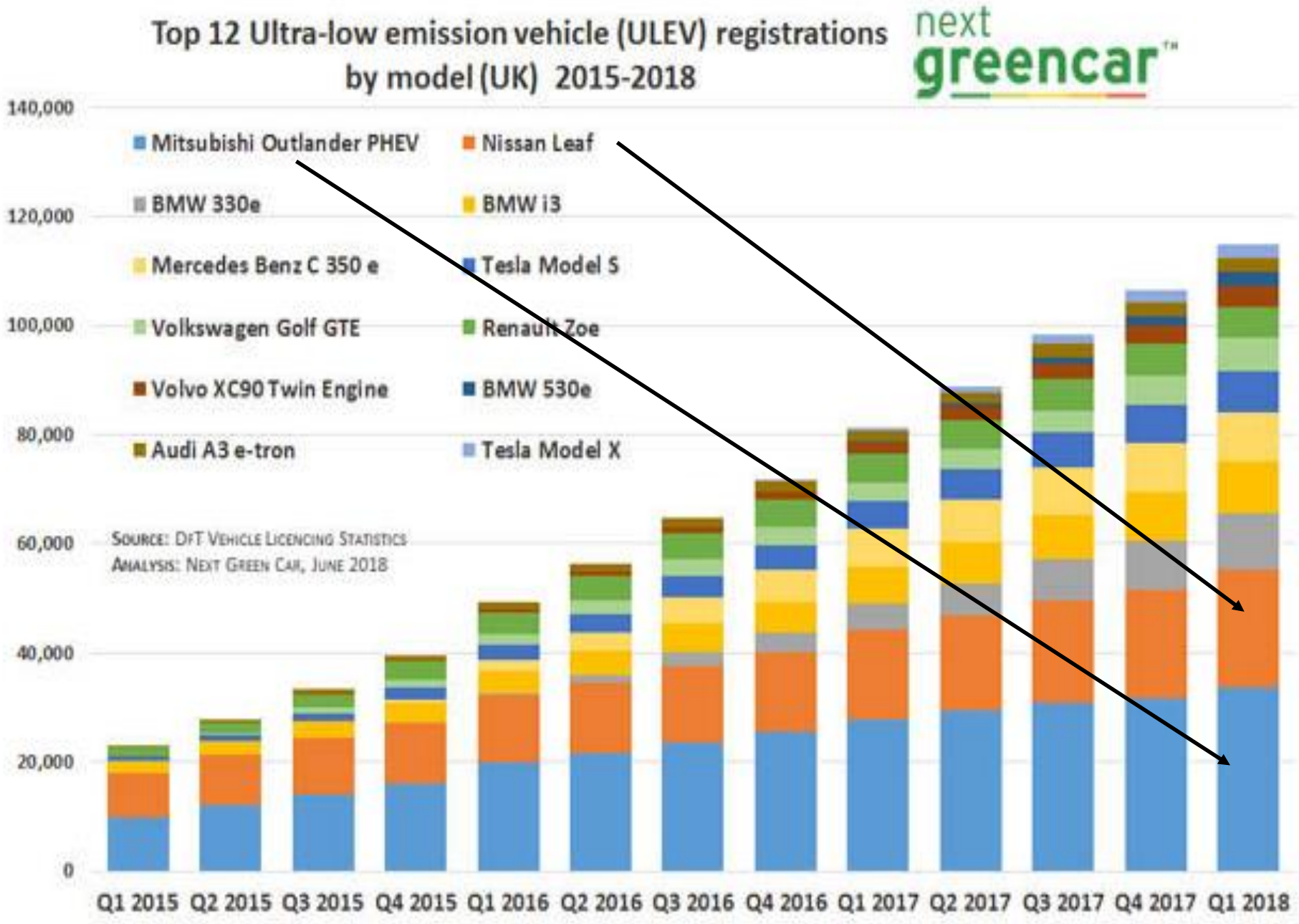

Good Energy
LJ10 KXE
Tesla

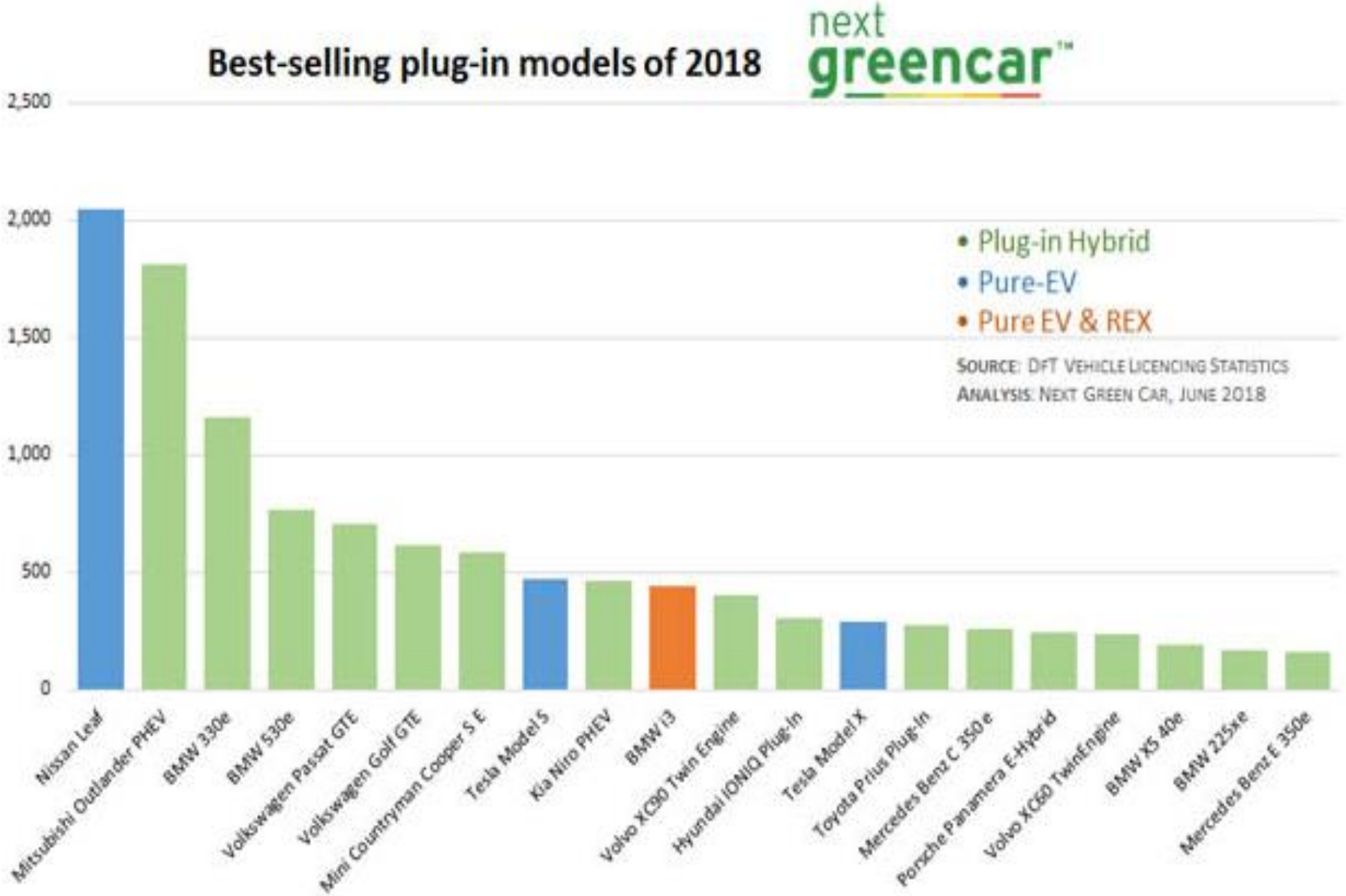

Nissan e-NV200


VW e-Golf & Golf GTE


PRIUS
Toyota Prius Plug-In


Jaguar I-PACE Concept


Top 12 Ultra-low emission vehicle (ULEV) registrations by model (UK) 2015-2018
next greencar
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Mitsubishi Outlander PHEV
Nissan Leaf
BMW 330e
BMW i3
Mercedes Benz C 350 e
Tesla Model S
Volkswagen Golf GTE
Renault Zoe
Volvo XC90 Twin Engine
BMW 530e
Audi A3 e-tron
Tesla Model X
SOURCE: DFT VEHICLE LICENCING STATISTICS
ANALYSIS: NEXT GREEN CAR, JUNE 2018
Q1 2015
Q2 2015
Q3 2015
Q4 2015
Q1 2016
Q2 2016
Q3 2016
Q4 2016
Q1 2017
Q2 2017
Q3 2017
Q4 2017
Q1 2018



Source: DfT Vehicle Licensing Statistics. Analysis Next Green Car, June 2018.

ICE, PHEV or BEV?

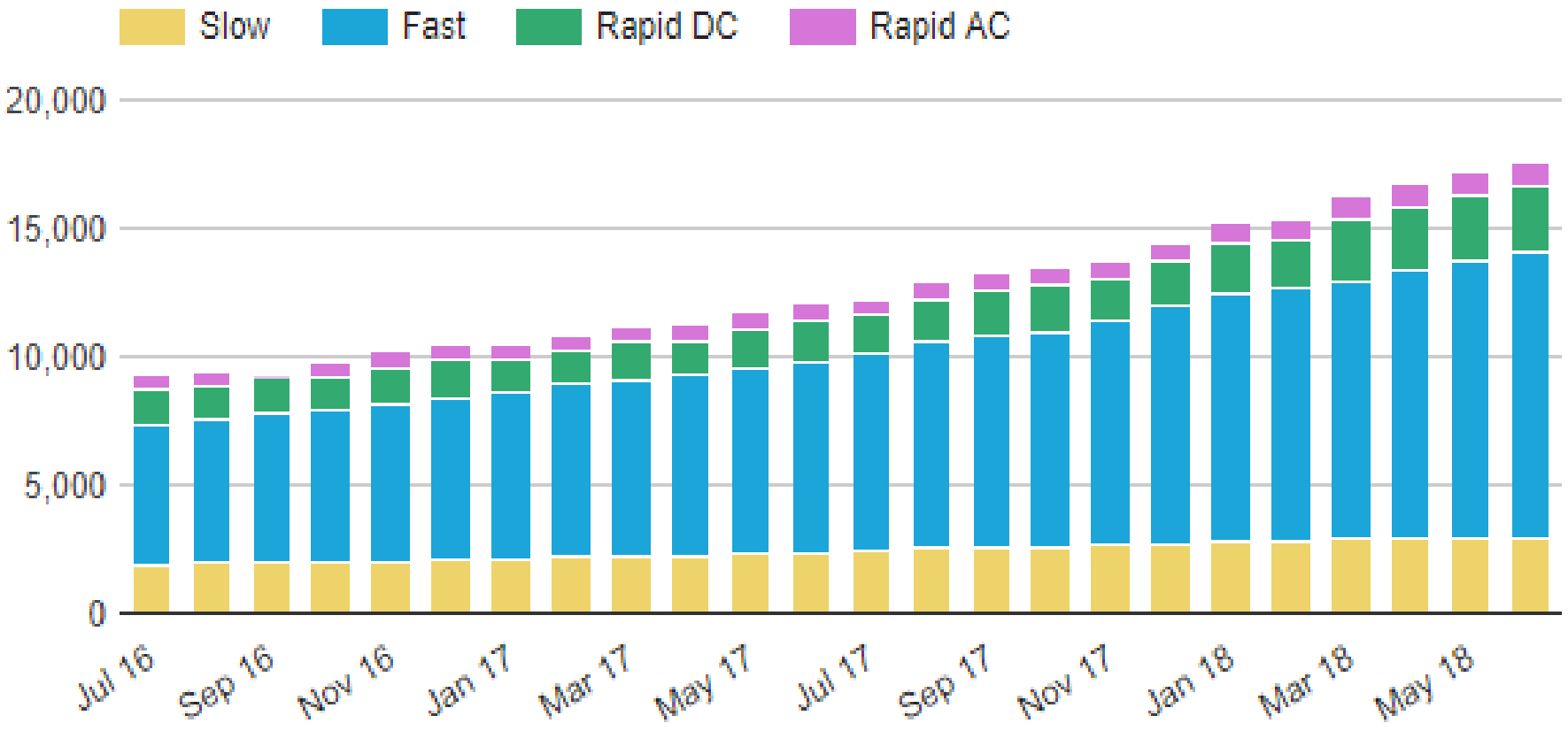
	ICE	PHEV	BEV
Internal Combustion Engine (ICE)	✓	✓	✗
Motor	✗	✓	✓
Drive battery and range	✗	✓ 15-30 miles	✓ 150+ miles
CO2 emissions	✓	✓	✗
Particulates	✓	✗	✗
Regenerative braking	✗	✓	✓
Grant towards purchase	✗	✓	✓
Low Emission Zone free access	✗	✓	✓
Lower service and maintenance costs	✗	✗	✓
Heavy duty vehicle use	✓	✓	✗

Saving fuel costs

Example - comparison between EV and diesel on cost (200 miles/week avg)	**Weekly Average**	**Year Prediction**
Cost of Diesel (£) to miles travelled	£25.70	£1,336.24
Cost of Electricity (£) used by EV	£4.89	£254.49
Cost of Fuel Saved (£)	**£20.07**	**£1,043.65**
Comparison on emissions		
CO2 Emissions (g/mile) diesel	27,182	1,413,467
CO2 Emissions (g/mile) EV well-to-wheel	83	4,339
CO2 Emissions (g/mile) EV at point of use	0	0
CO2 Emissions Saved (g/mile)	**27,099**	**1,409,128**


P
Electric vehicle
recharging point
only

EV charge point trend – by speed of charge



SLOW CHARGERS (UP TO 3KW)

2586
SLOW CONNECTORS
25 APRIL 2017

FAST CHARGERS (7-22KW)

6671
FAST CONNECTORS
25 APRIL 2017

RAPID AC CHARGERS (UP TO 43KW)

658
RAPID AC CONNECTORS
25 APRIL 2017

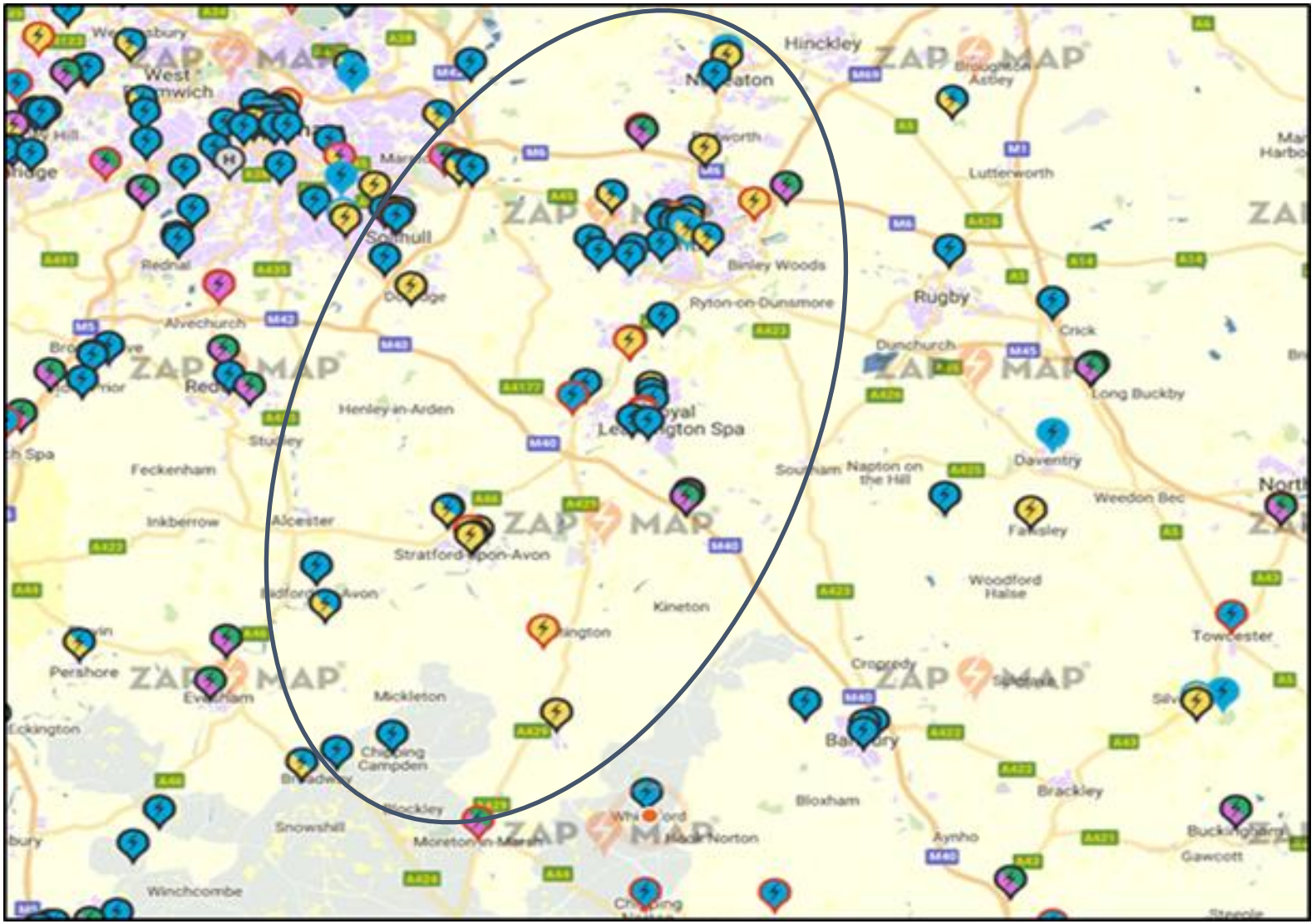
RAPID DC CHARGERS (UP TO 50KW)

1385
RAPID DC CONNECTORS
25 APRIL 2017

ZAP MAP®


WALES
Calais
ZAP MAP

EV charge point network Warwickshire



Where are EV drivers charging?

- Home charging
- On-street charging
- Workplace charging
- Destination charging
- Opportunity charging (top up)

Electric bike charging

EV Plug-In Grant Scheme (new vehicles only)

- 35% of the cost of a car, max £2,500 PHEV or £4,500 BEV
- 20% of cost of E-van, up to a maximum of £8k (taxis £7.5k)
- 20% of the cost of a motorcycle, up to a maximum of £1,500
- Plug-In Van grant scheme - £4 million 2017 extending the eligibility to larger electric vehicles >3.5tonnes.

Office for Low Emission Vehicles

Grants for EV charging infrastructure

Office for Low Emission Vehicles

- **Electric Vehicle Homecharge Scheme -** 75% (capped at £500, inc VAT) off the total capital costs of domestic chargepoint and associated installation costs.
- **Workplace Charging Scheme** - £7.5 million for eligible private and public sector workplaces in the UK to support the installation of charging infrastructure for their staff and fleet use. (£300 per socket max 20)
- **On Street Charging** - £2.5 million available to councils who commit to installing charge points on streets near homes without private off-street parking. IR 75% costs.
- **Plug-in taxis** - £20 million competition for councils to roll-out charge points for plug-in taxis.

Business EV fleet and infrastructure

ACTION:

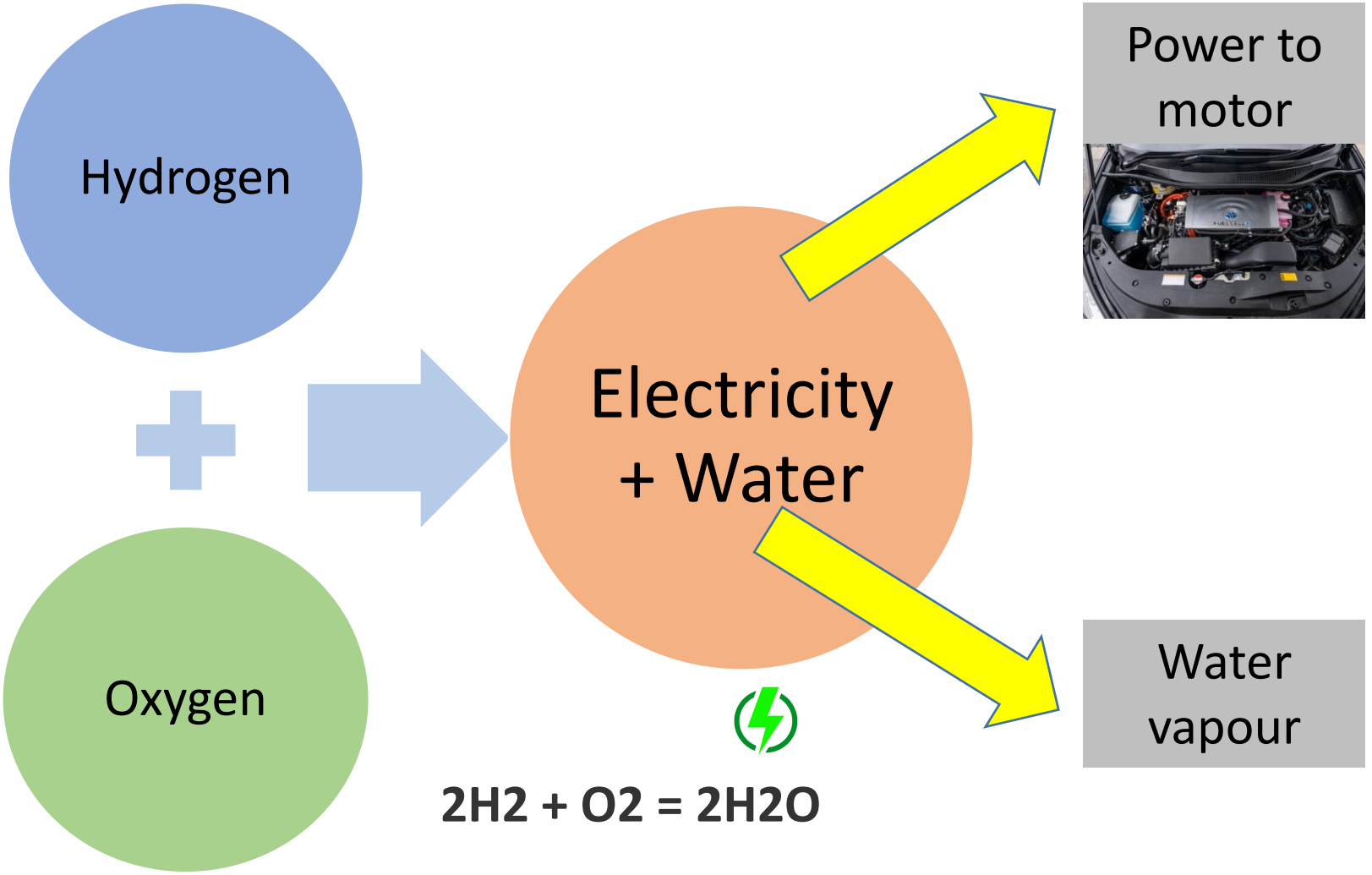
- Review business fleet to confirm where EV / PHEV transfer is appropriate
- Carry out feasibility study to ascertain business case
- Install charge point infrastructure to suit business fleet and staff EV user profile (slow, fast, rapid EVCPs)
- Introduce staff EV incentive scheme

What about Hydrogen?

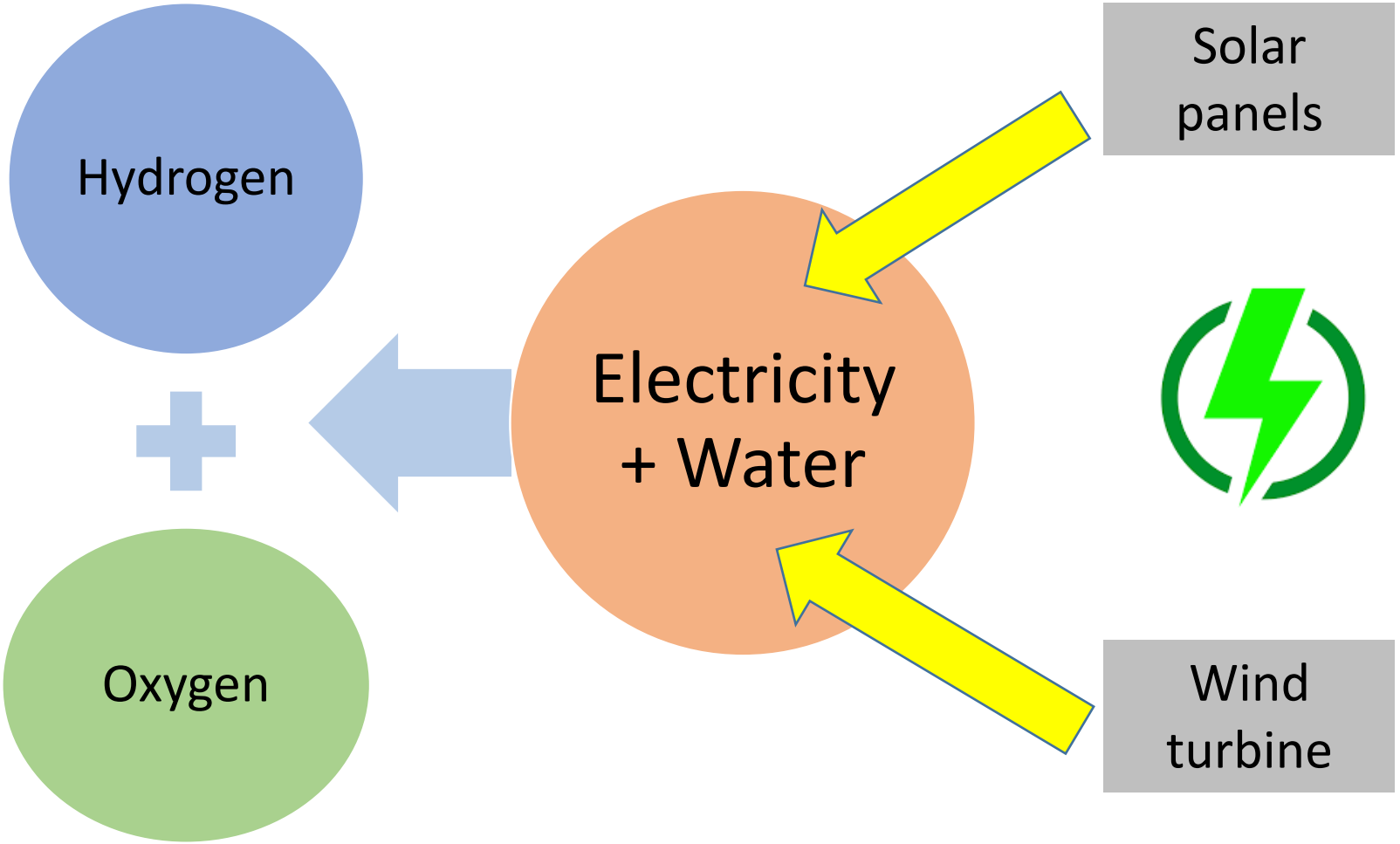
“Microsoft and Toyota are revving up interest in hydrogen fuel-cell energy tech 25.6.18” [CleanTech Innovation Showcase](),

"Hydrogen is like money - it is all around us, but it doesn't necessarily belong to you."

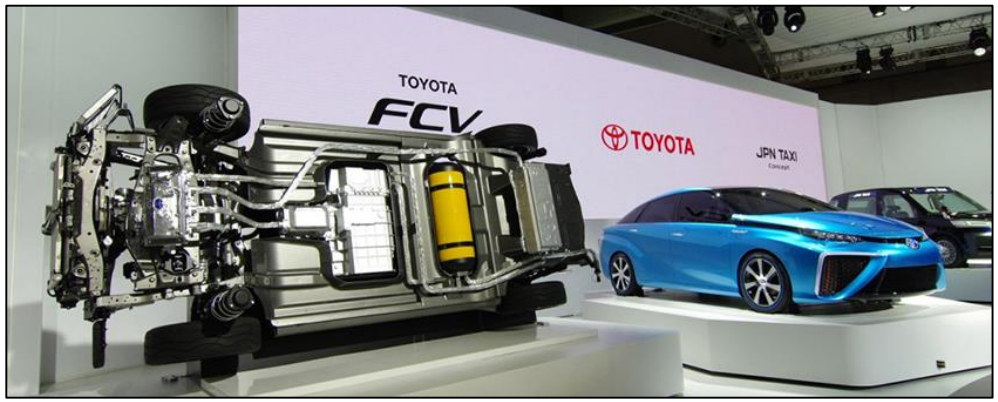
The fuel cell process



Hydrogen from renewables



Hydrogen Fuel Cells



Advantages

- Carbon-emission free
- Accessible and clean – only emission is H2O
- Not subject to corrosion or high temperature damage
- Can be from renewable energy source (electrolysis)
- High fuel efficiency

Disadvantages

- Nitrogen Dioxide emission
- Storage issues
- High cost of production
- Highly flammable
- Climate change aggravation
- Production infrastructure undeveloped

How fuel cell cars work

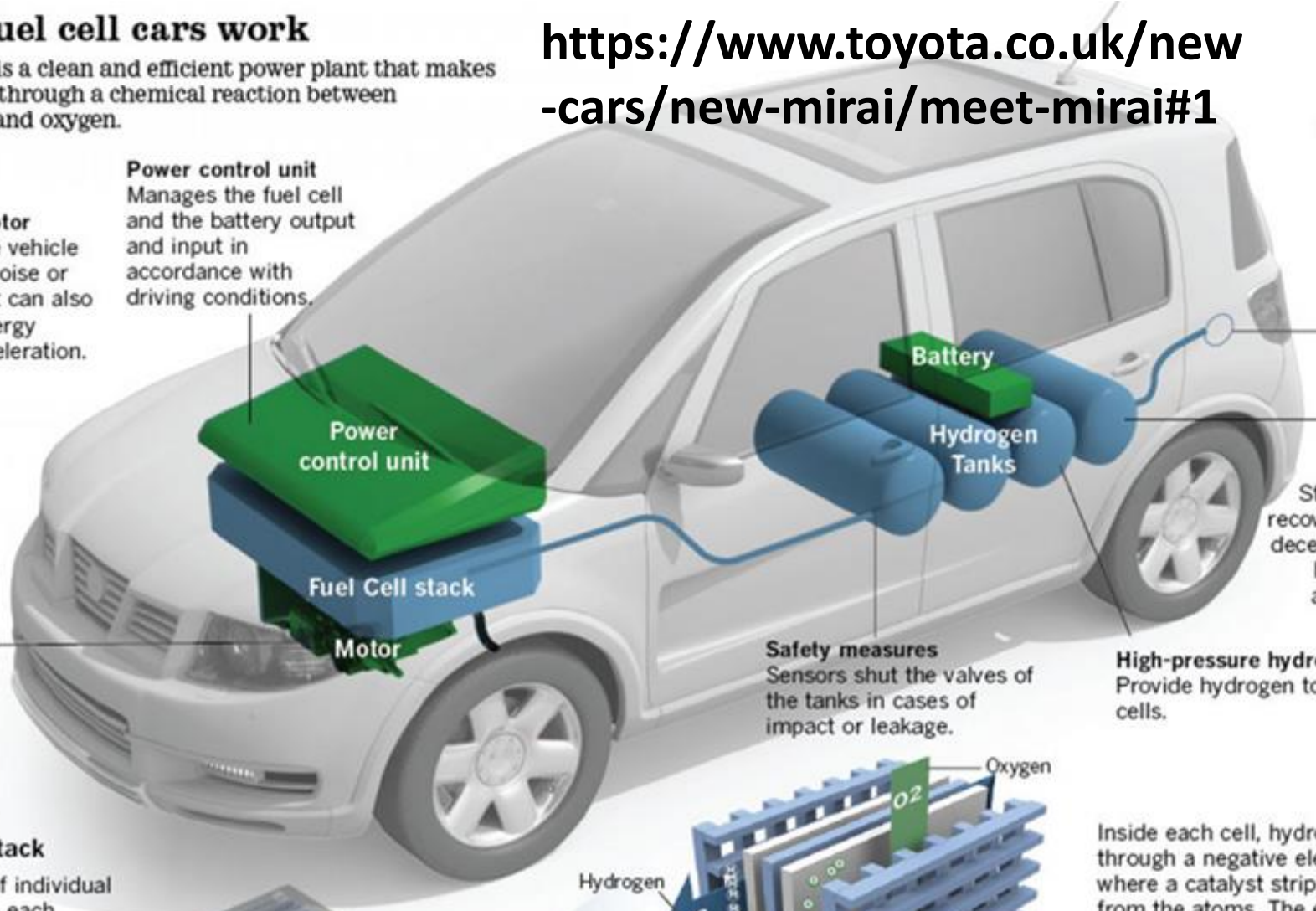
A fuel cell is a clean and efficient power plant that makes electricity through a chemical reaction between hydrogen and oxygen.

https://www.toyota.co.uk/new-cars/new-mirai/meet-mirai#1

Fuel port
The tanks are refilled at hydrogen fueling stations.

Power control unit
Manages the fuel cell and the battery output and input in accordance with driving conditions.

Electric motor
Propels the vehicle with little noise or vibration. It can also recover energy during deceleration.



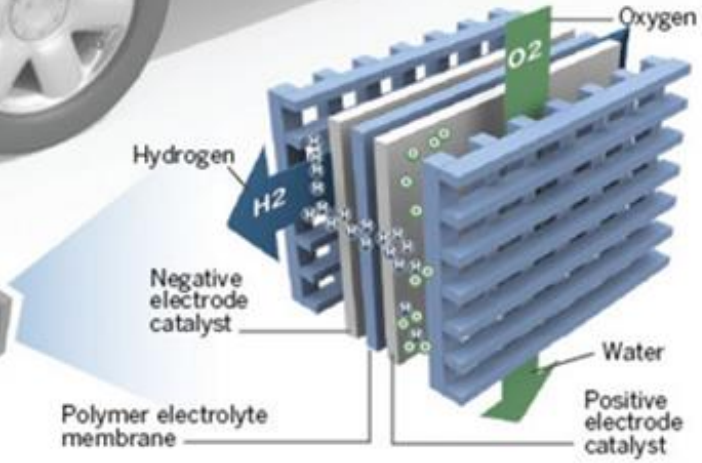
Battery
Stores energy recovered during deceleration and helps during acceleration.

Safety measures
Sensors shut the valves of the tanks in cases of impact or leakage.

High-pressure hydrogen tanks
Provide hydrogen to the fuel cells.

Inside the fuel cell stack

Hundreds of individual fuel cells — each producing less than one volt — are assembled inside the stack to produce enough voltage for the motor.



Inside each cell, hydrogen passes through a negative electrode where a catalyst strips electrons from the atoms. The electrons flow from the negative to the positive electrode, generating electricity. Electrons and hydrogen atoms travel through an electrolyte membrane to reach the positive side, where they join with oxygen to become water.

Source: Toyota Motor Corp.

Hydrogen Vehicles

Range
around 300
miles per fill
from empty

Cost per tank
refuelling £50
/ £75 = 15p
/25p per mile

Refuelling
time down
to 5-6mins

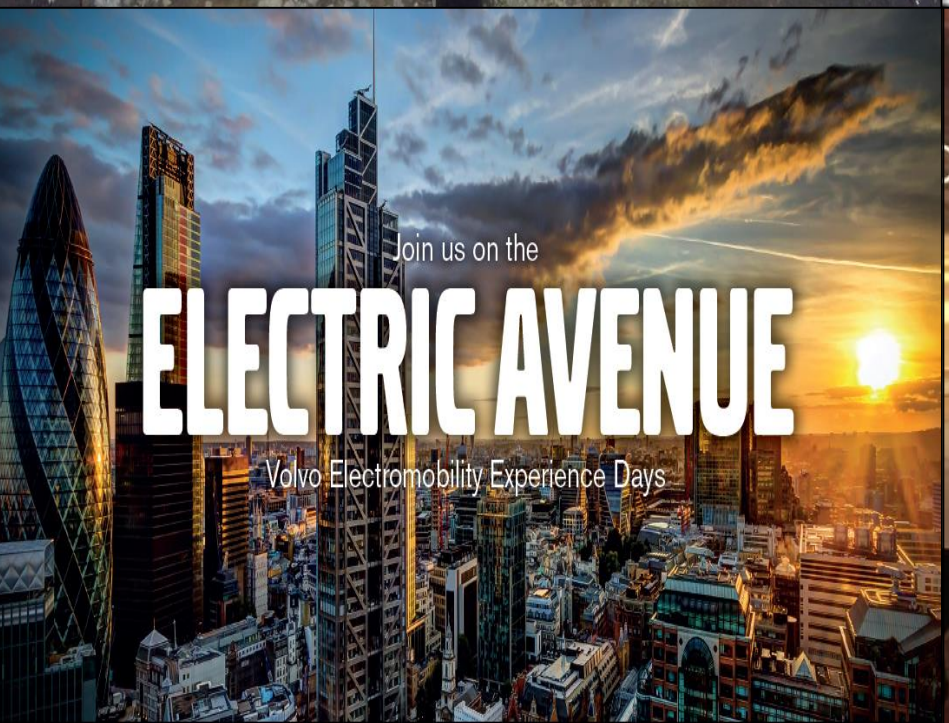
No VED; no congestion charge or T-tax;
lower service costs; less wear and tear costs
e.g brake pads

https://www.toyota.co.uk/new-cars/new-mirai/landing#/youtube/tL6guqDQkvI

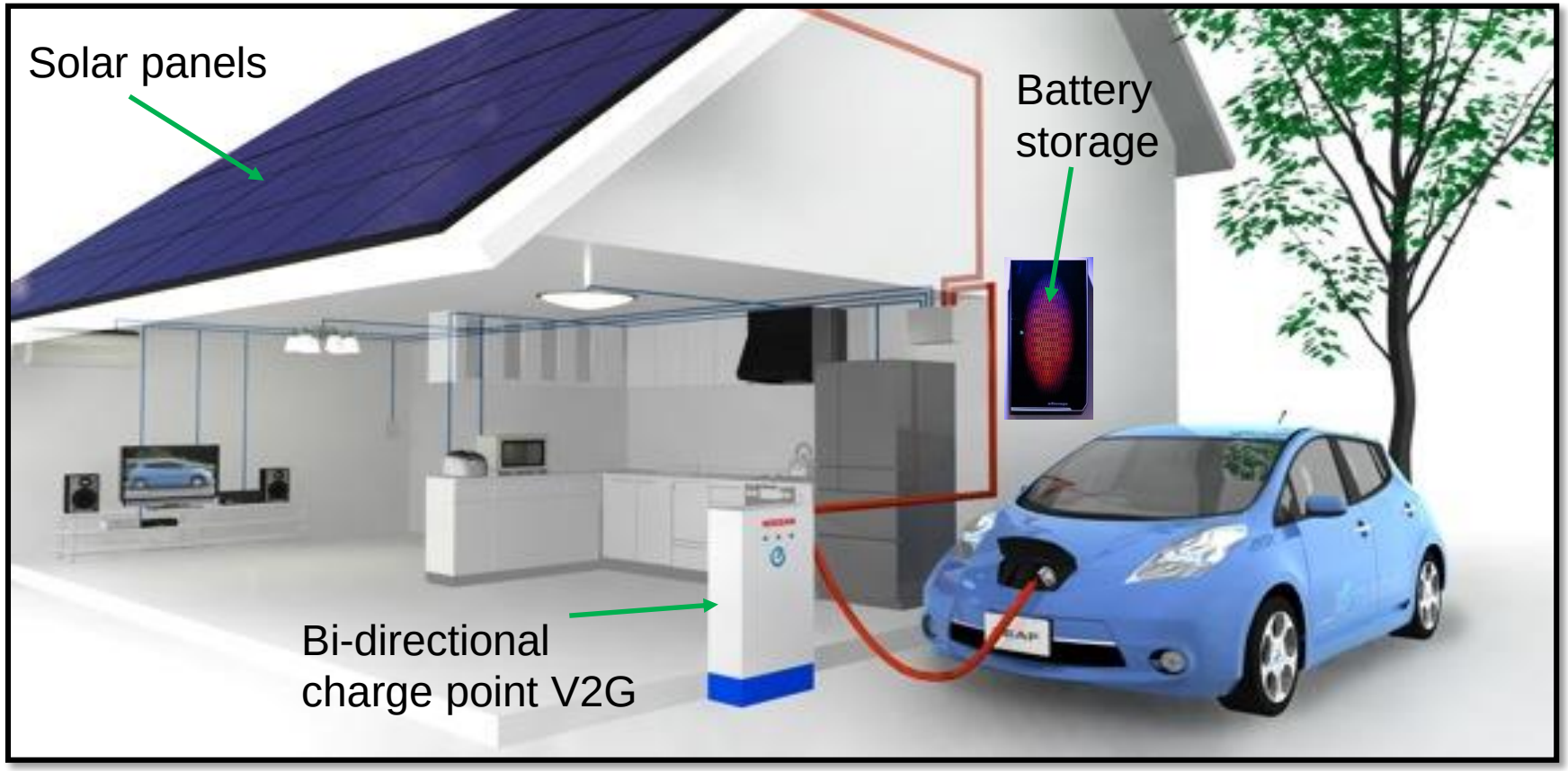
Hydrogen Refuelling Stations Jan 2018

Electric Vehicles – How fast is technology moving?


ELECTRIC AVENUE


Join us on the
ELECTRIC AVENUE
Volvo Electromobility Experience Days

Integrated solar PV, storage and Vehicle-to-Grid systems



EVs for grid balancing at peak load.

Storage – EV is a (big) battery on wheels!

Nissan Leaf – 30kW battery enough power for a 3-bed house for 2 days!

Solar energy – storage potential

https://youtu.be/yxc2y1mcwEM

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sustainable solutions

EV technologies - Rapid charge point with storage (grid buffer)

‘Off-grid’ rapid charging (50kW CHAdeMO) and a fast charging (11kW) AC charger, allowing a site with limited grid capacity to charge vehicles without upgrading grid infrastructure.

EV technologies - Solar Car Roofs

http://www.fleetcarma.com/electric-vehicle-charging-future/

EV technologies - Inductive (wireless) Charging Pads

http://www.fleetcarma.com/electric-vehicle-charging-future/

EV technologies - Wireless Road Charging

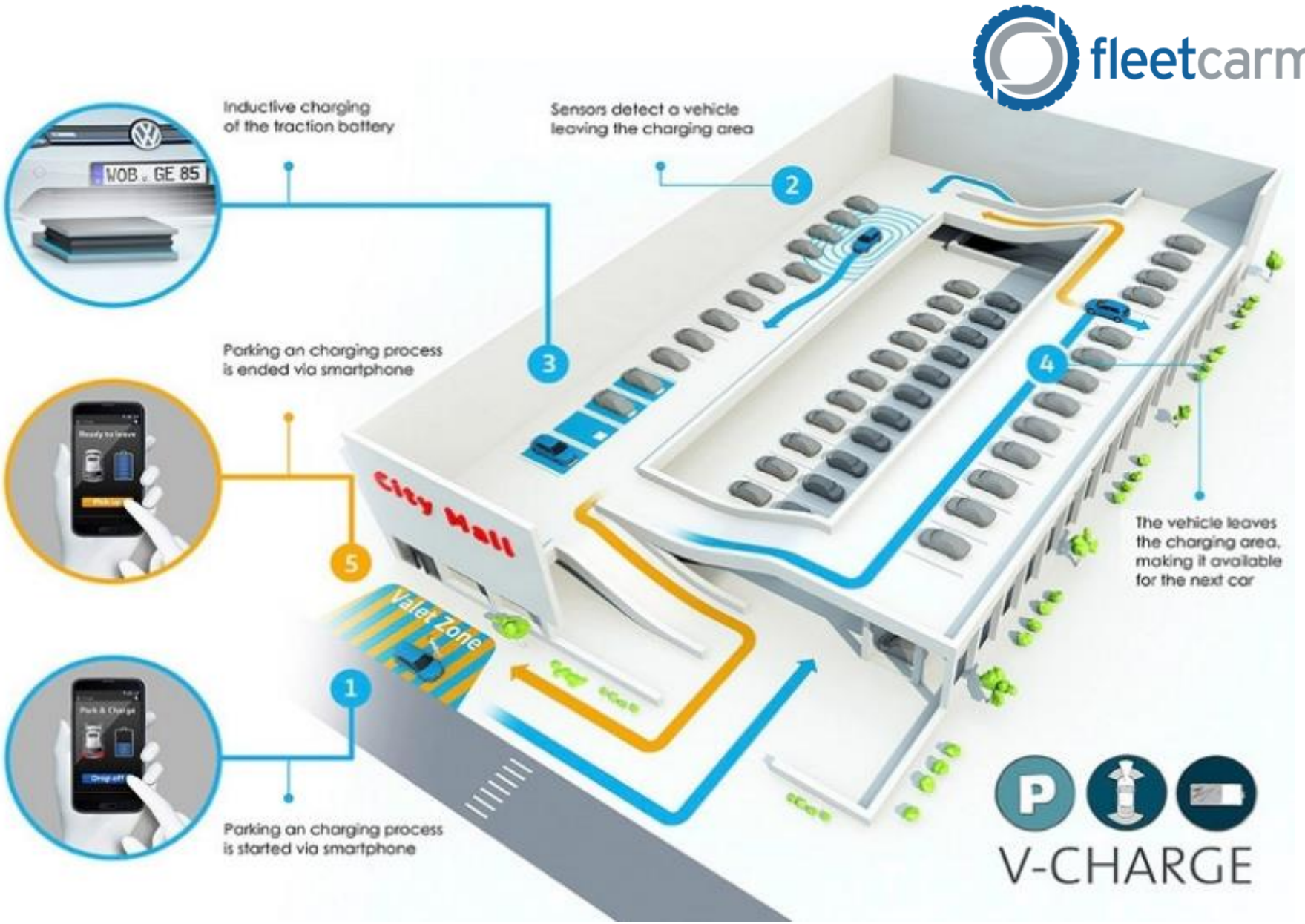
http://www.fleetcarma.com/electric-vehicle-charging-future/

EV technologies Ultra-fast Charging

60 miles charge in 4 minutes!

http://www.fleetcarma.com/electric-vehicle-charging-future/

EV technologies - Autonomous Park & Charge



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Questions, thoughts and views

Open discussion




www.greenwatt.co.uk