
IMI
INSTITUTE OF THE MOTOR INDUSTRY

# IMI Members & Guests Networking Conference

## 21st June 2018

INSTITUTE OF THE MOTOR INDUSTRY

# The Rapid Rise of Hybrid & Electric Cars

Steve Carter – Train4auto

ALLIANCE
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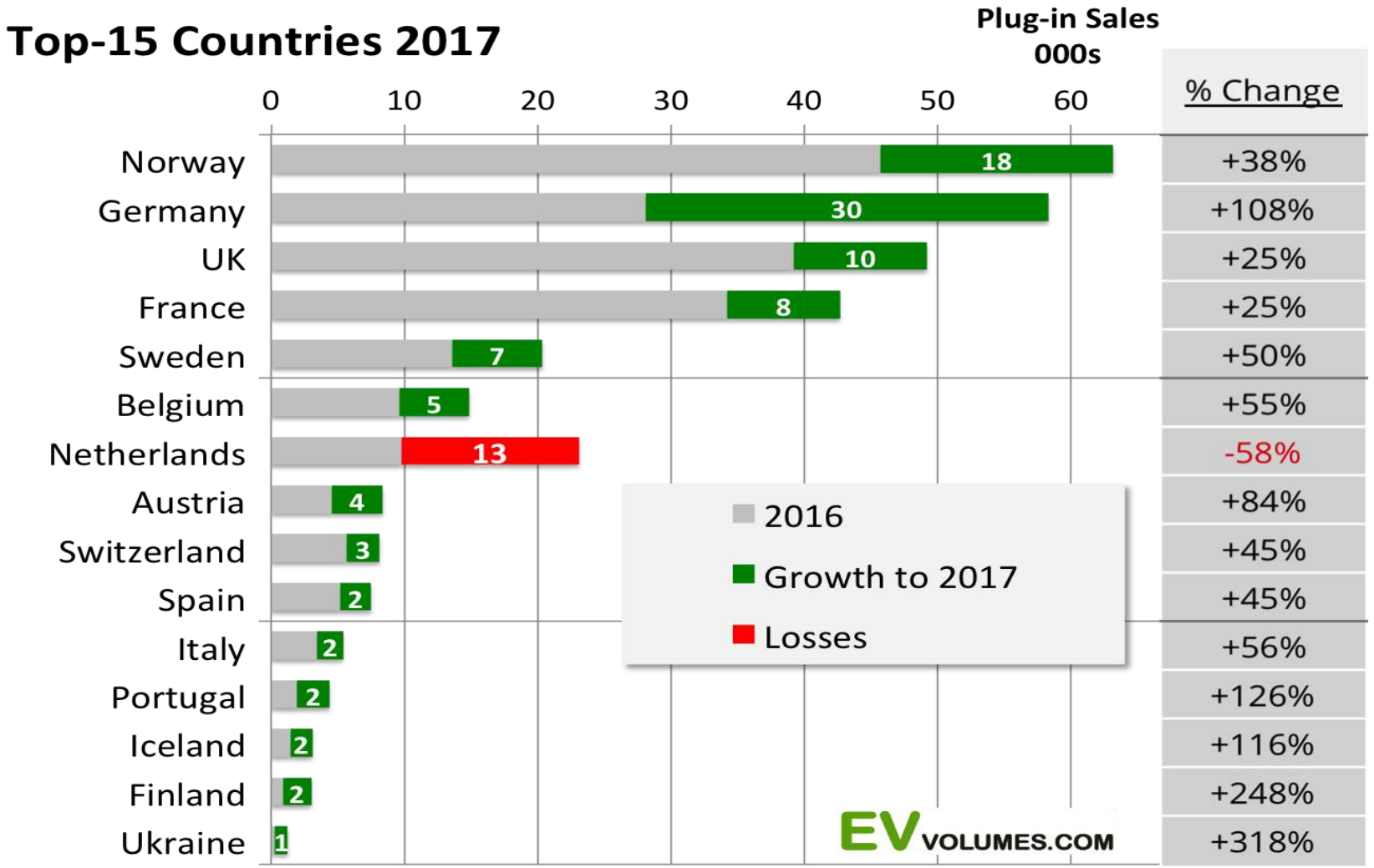
UK


# PHEV & Electric Vehicles



# Tesla Model S outsells German luxury flagships in Europe

Sales of the Model S in Europe jumped 30 percent to 16,132 last year, according to JATO. Mercedes S class sales grew 3 percent to 13,359. BMW 7 series had sales of 11,735, down 13 percent.

This is an alarm bell for the traditional automakers such as Mercedes. It says a smaller but smarter brand such as Tesla can beat them at home," said Felipe Munoz, an analyst with market researchers JATO Dynamics.

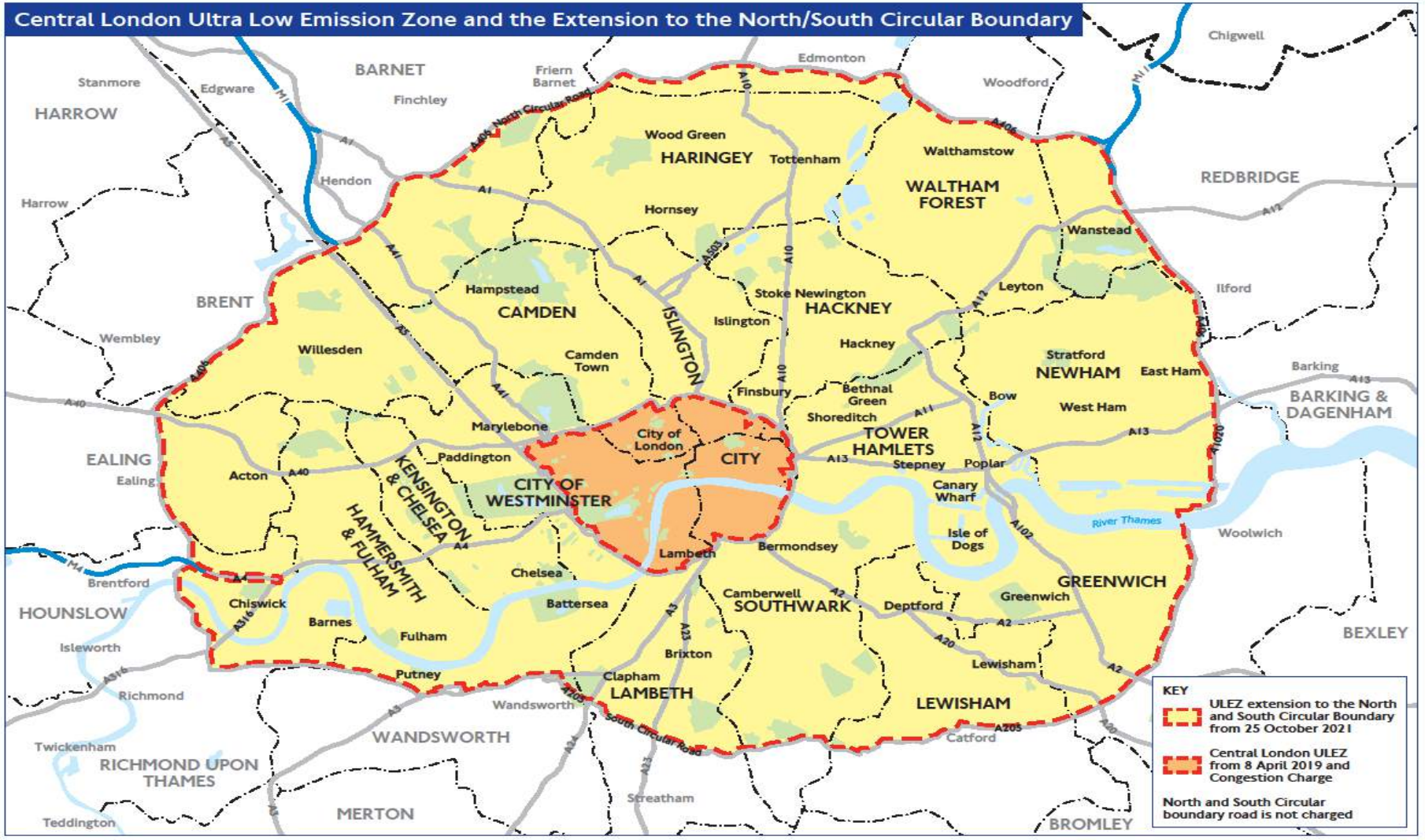
European automakers need to address the electrification faster because customers are showing more and more interest in such vehicles and it seems that the traditional industry "can't deliver on time," Munoz said.

# A sign of things to come: Hamburg puts up signposts in the city to enforce the first ban on older diesel vehicles

Hamburg has been stepping up measures to reduce air pollution by becoming the first **German** city to erect signs that will enforce a ban on older diesel vehicles on its major routes.

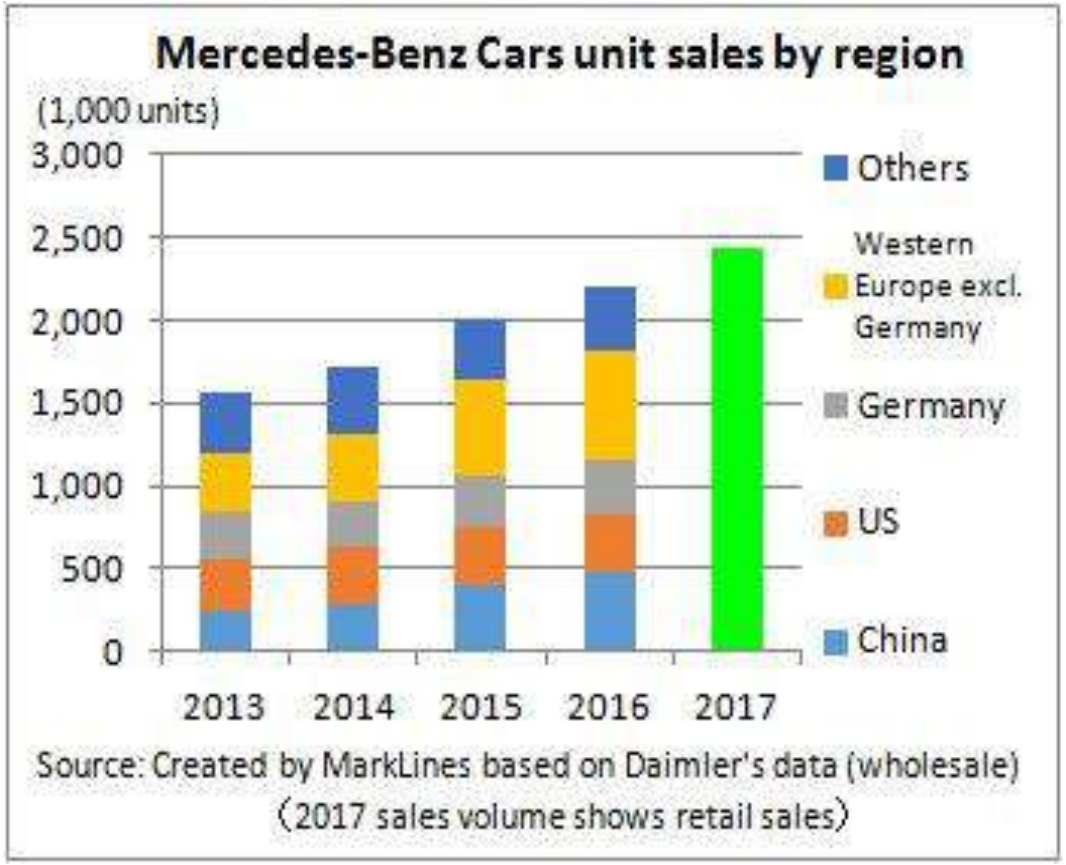
Following a ruling by Germany's top administrative court in February that gave cities the right to restrict diesel cars, vans and trucks from their streets, Hamburg looks set to become the first to impose the ban this month. Environmental authorities in the city said on Wednesday they had put up around 100 signs this week announcing the ban in 10 streets. The signs also provide directions for alternative routes for outlawed diesel vehicles.

From October 2021 the ULEZ boundary
will be extended to a larger zone bounded
by the North and South Circular Roads.



# Daimler: all-electric vehicles to account for 25-30% of total unit sales by 2025

**Plans to introduce more than 15 new all-electric vehicles by 2022**
According to its powertrain strategy announced in October 2017, Daimler is continuing to develop three powertrains for electric vehicles (EV), plug-in hybrid vehicles (PHV), and internal combustion engine (ICE)-powered vehicles. Regarding EVs, the automaker will bring more than 10 new all-electric vehicles to market by 2022. Under its new EQ sub-brand for EVs, the EQC, the first series production model, will begin production starting in 2019. Daimler expects that EVs will account for 25-30% of its total sales by 2025.



# New 2018 Nissan Leaf

Battery capacity up by 75% over old Leaf
Range now over 200 miles

# Hyundai Kona 2018
# Sells OUT in 2 days in Norway


**64kW  battery 292 miles range, drive 1 x 155 kW PMAC  motors = 210 BHP**
**0-60 7.5 seconds**

# Jaguar I Pace

90kW battery 275 Miles range 4 wheel drive 2 x 148 kW motors 296 = 400 BHP
0-60 4.3 seconds

| | Type 1 | Type 2 | Type 4 |
|---|---|---|---|
| Visual Appearance |  |  |  |
| Type | T1 | T2 | T4 |
| | YAZAKI | MENNEKES® | CHAdeMO |
| Charging Rate | Max-6.5 KW | 3.6KW to 43KW Norm 7.4KW | Up to 50KW |
| Charging Mode | Mode 3 AC | Mode 3 AC | Mode 4 DC |
| Charging Control | On-board | On-board | Off-Board |
| Own Charging Cable Require | Yes | Yes | No |

# CCS 2 Combined Charging System


**Jaguar i Pace &**
**2019 Nissan Leaf to support**
**CCS 2 Standard 100 kW**
**80% charge in 40 mins for**
**185 miles of range**

# The New Polar Ultracharge

Most charge points are access by cards.
Ecotricity now use an app.
Average cost per Kwh 0.15p
So for the cost of a gallon of fuel an EV car would travel 161 miles


# Electric vehicle to grid projects receive £30 million boost from government


“In the future you could use your car battery to power your house or earn money by selling its spare energy back into the network at peak times, and all of this whilst ensuring you have enough energy for your next day’s commute. We’re innovating to keep our customers moving at the lowest possible cost.”

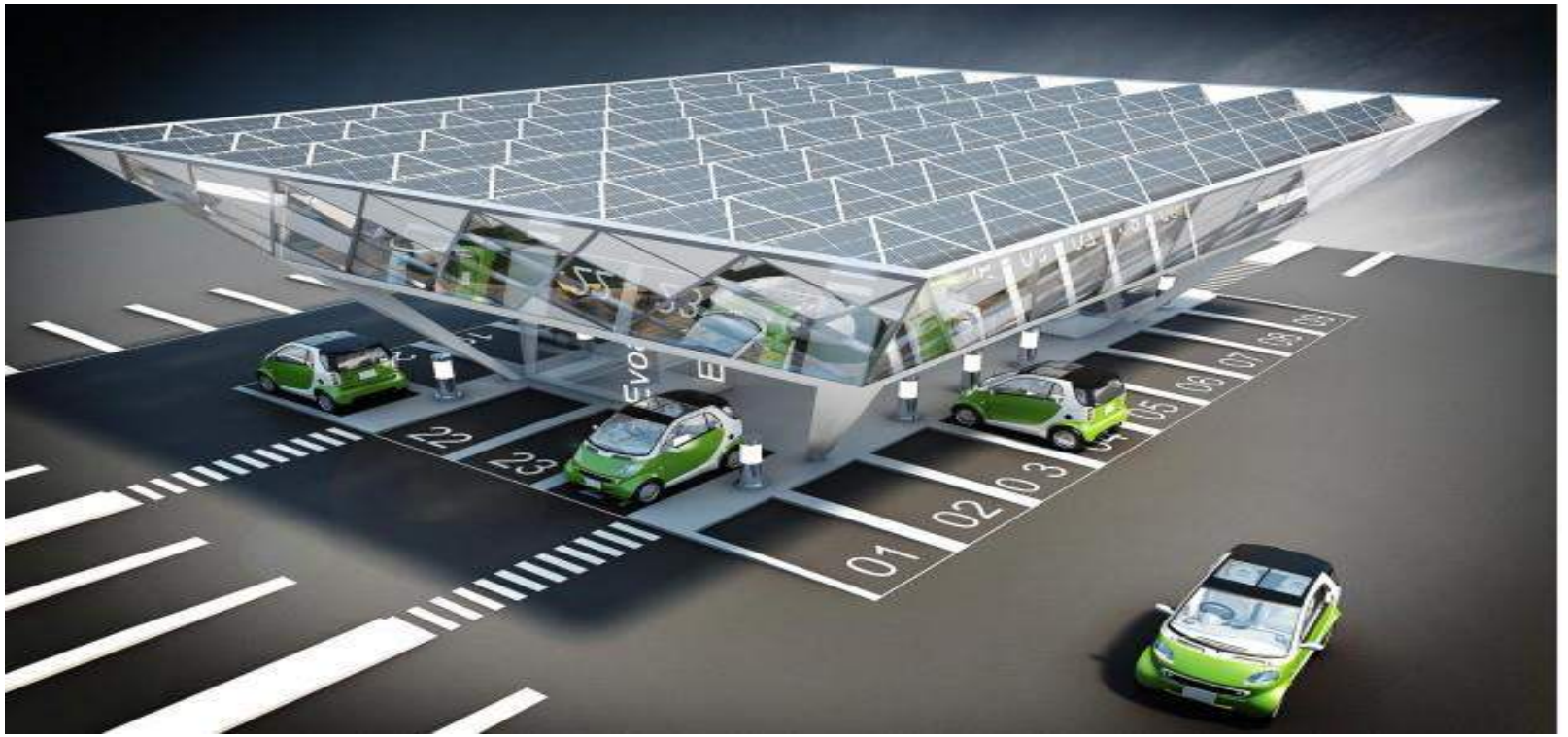
# Shell Buys EV Charging Network as It Prepares for the Future


**Shell to open electric vehicle charging points at UK petrol stations**

# BP invests 5 million in EV Charging Network as It to Prepares for the Future

# National Grid plans motorway network of superfast EV chargers

The National Grid plans to roll out a network of superfast electric vehicle (EV) chargers across Britain's motorway network, tapping directly into its transmission infrastructure to provide charging rates of up to 350kW



# National Grid backs plan for earlier petrol and diesel ban Network say's infrastructure and capacity can be in place a decade earlier by

# 2030

# Most of Britain’s electricity in 2017 is low-carbon for first time

Britain generated more electricity from renewable and nuclear energy in 2017 than from gas and coal, marking the first year that low-carbon resources have met most of the UK’s power needs.
Coal’s share of the electricity mix fell by a quarter to less than 7 per cent,

**Industrial economist predict that renewable energy is set to be cheaper than fossil fuels by 2020, according to there new report**

# UK Charging Infrastructure

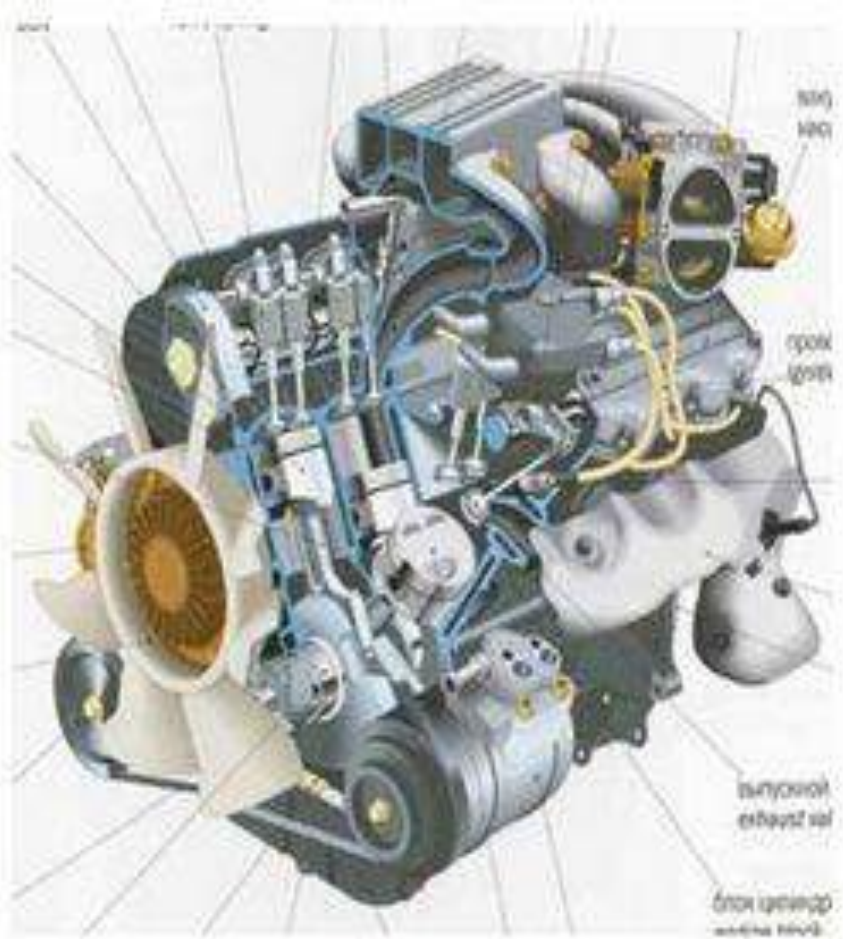
## How many EV charging points are there in the UK?

## 2010
## Just 200 Stations

## June 2018

# 16,656 Zap Map

# Out with the Old in with the New



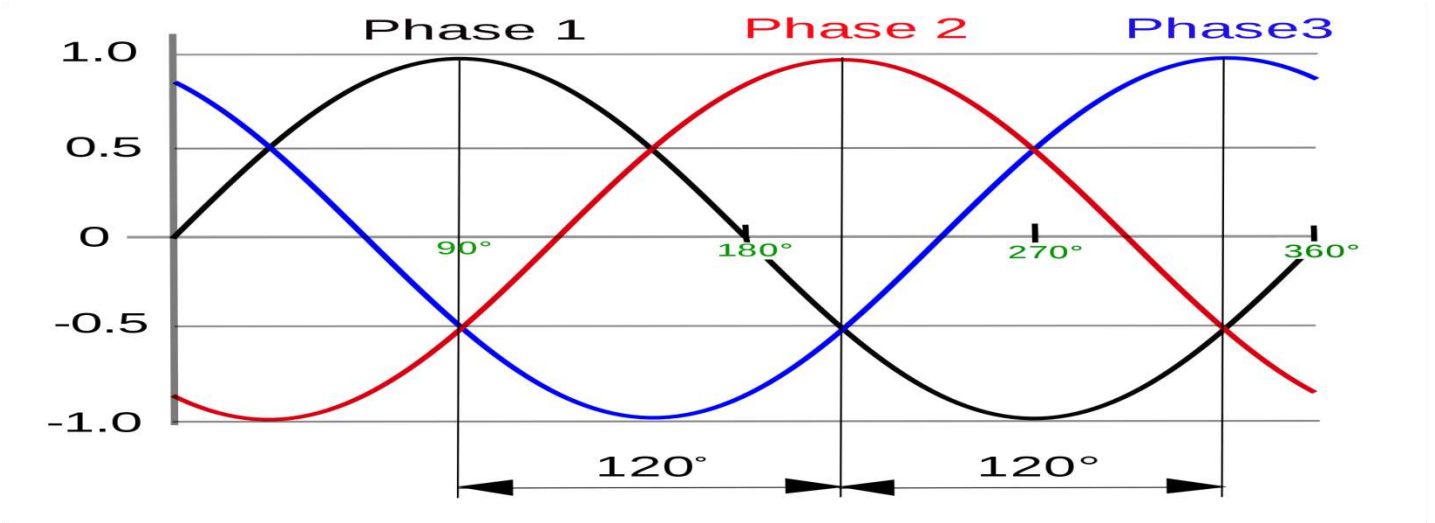
**400HP+, the Jurassic way....**

**(200+ parts, 35% efficient power)**

**400HP+, the 2013 (Tesla Model S) way**

**(no oil, 1 moving part, 88% efficient power)**

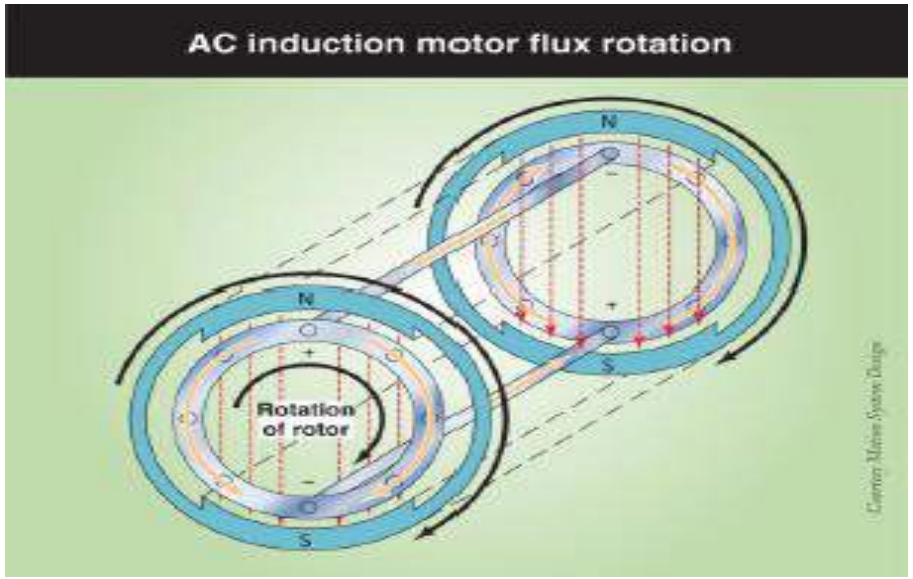
# AC & PMAC Stator Winding

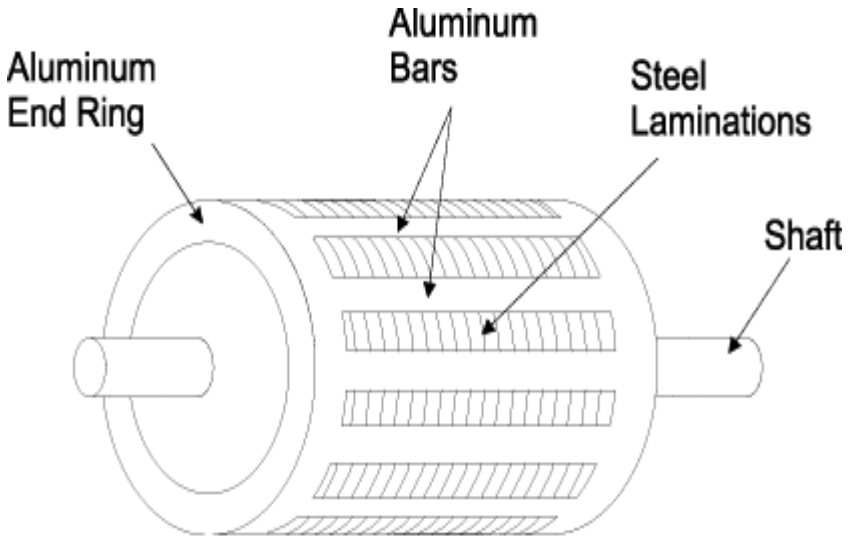



The stator consists of a stack of thin, highly permeable steel laminations with slots; the laminations are either secured in a steel or cast-iron frame that provides a mechanical support. The windings that accept the external power supply are run through the slots.

# AC induction motor’s

The AC inductor rotor assembly resembles a cage consisting of aluminium or copper conducting bars connected by short-circuiting end rings Hence the nickname squirrel cage for induction motors.

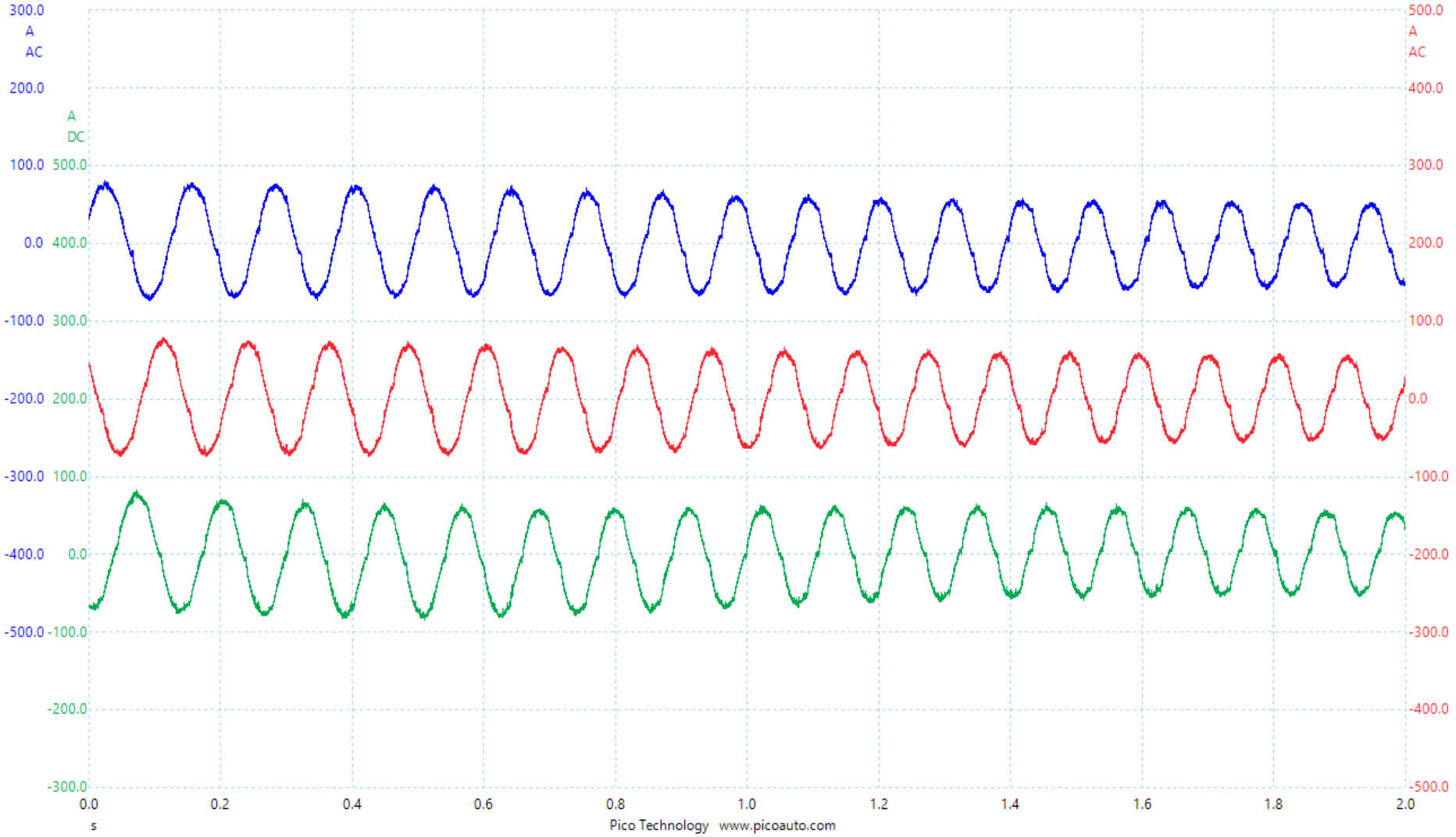


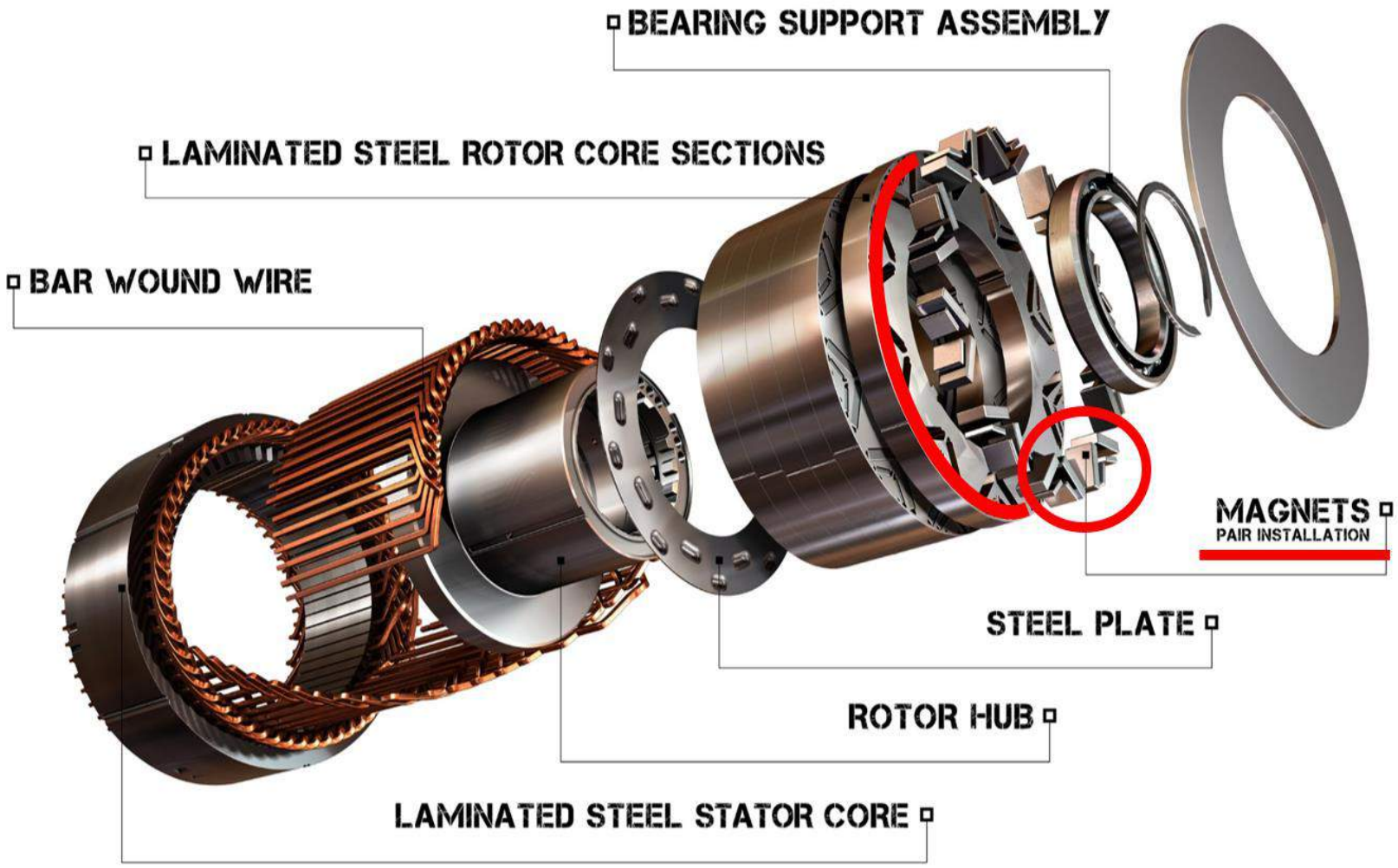

(Figure 13) AC induction motor rotor construction

The rotor also has laminations; radial slots around the laminations contain the bars. As mentioned, the rotor turns when the moving magnetic field induces current in the shorted conductors, and the rate at which it rotates is the motor’s synchronous speed — determined by power-supply frequency and the number of stator poles.

# Three Phase Rear Motor
# Outlander PHEV

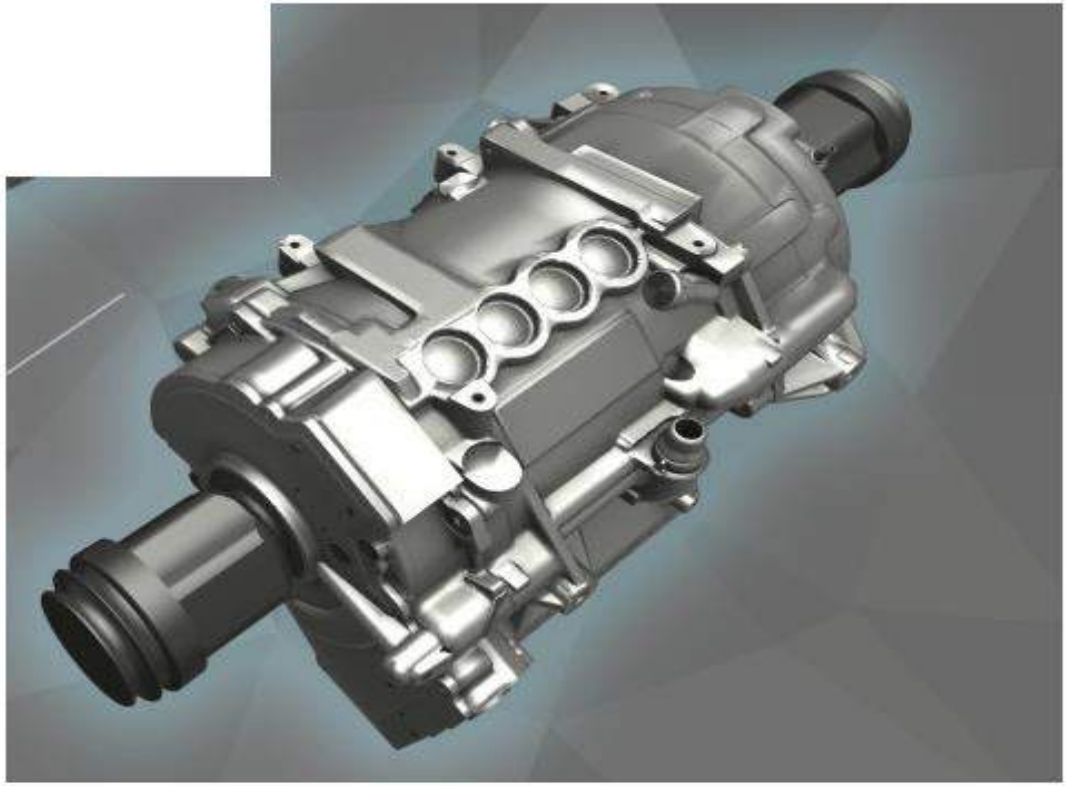


# PMAC
# 94% energy efficient



# Jaguar I Pace

## Jaguar 150 kW (200 HP) PMAC Motor



## with complete transmission

# Merger Testing of the 70Kw
# EV generator @500volts



Note how the resistance increases over time 3 to 5 seconds
How much resistance are we looking for ?

# lithium ion battery Types

## Cylindrical


- ✔ Lowest Cost Option
- ✔ Highly optimised manufacturing process
- ✔ Highest cell level volumetric efficiency
- ✘ Difficult to cool
- ✘ Packaging efficiency

**Used by:**
Tesla, Lucid, Faraday

## Prismatic

- ✔ Simple, lower cost manufacturing process
- ✔ Easier to cool
- ✘ Poor cell level energy density
- ✘ Cycle life challenges (electrode - mechanical)
- ✘ Limited available sizes - poor flexibility

**Used by:**
BMW, Volkswagen

## Pouch

- ✔ Highest module design flexibility
- ✔ Highest capacity flexibility
- ✔ Wide supplier selection
- ✘ Poor mechanical containment
- ✘ Good compression control required

**Used by:**
Chevrolet, Nissan, Renault

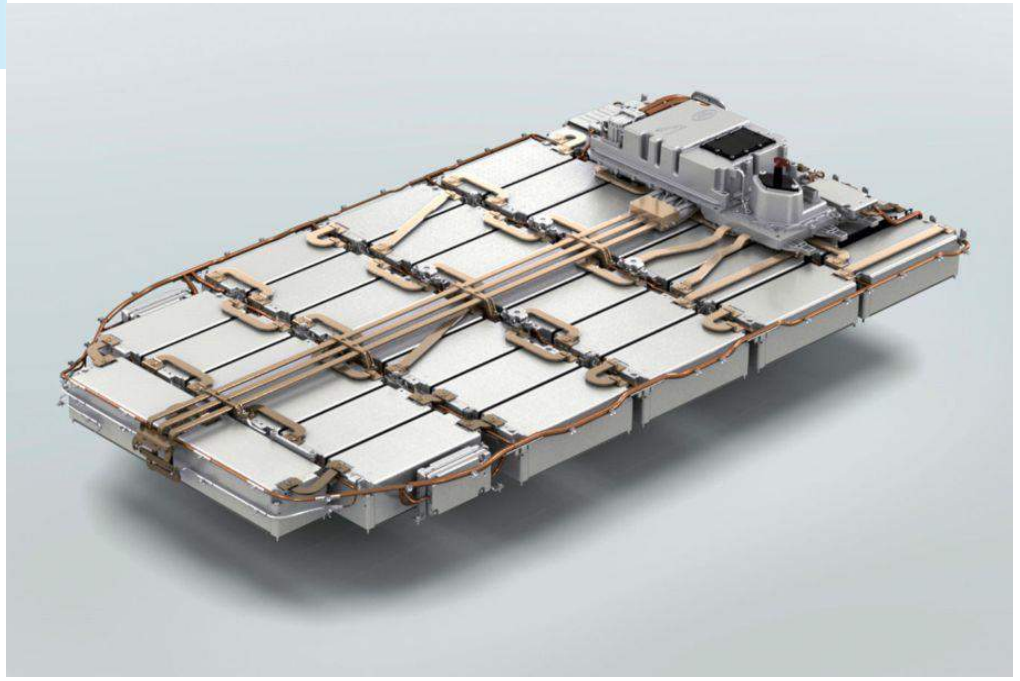
# lithium ion battery Chemistry

| Chemical Name | Material | Abbreviation | Applications |
|---|---|---|---|
| Lithium cobalt oxide | $LiCoO_2$ | LCO | Cell phones, laptops, cameras |
| Lithium manganese oxide | $LiMn_2O_4$ | LMO | Power tools, EVs, medical, hobbyist |
| Lithium iron phosphate | $LiFePO_4$ | LFP | Power tools, EVs, medical, hobbyist |
| Lithium nickel manganese cobalt oxide | $LiNiMnCo0_2$ | NMC | Power tools, EVs, medical, hobbyist |
| Lithium nickel cobalt aluminum oxide | $LiNiCoAlO_2$ | NCA | EVs, grid storage |
| Lithium titanate | $Li_4Ti_5O_{12}$ | LTO | EVs, grid storage |

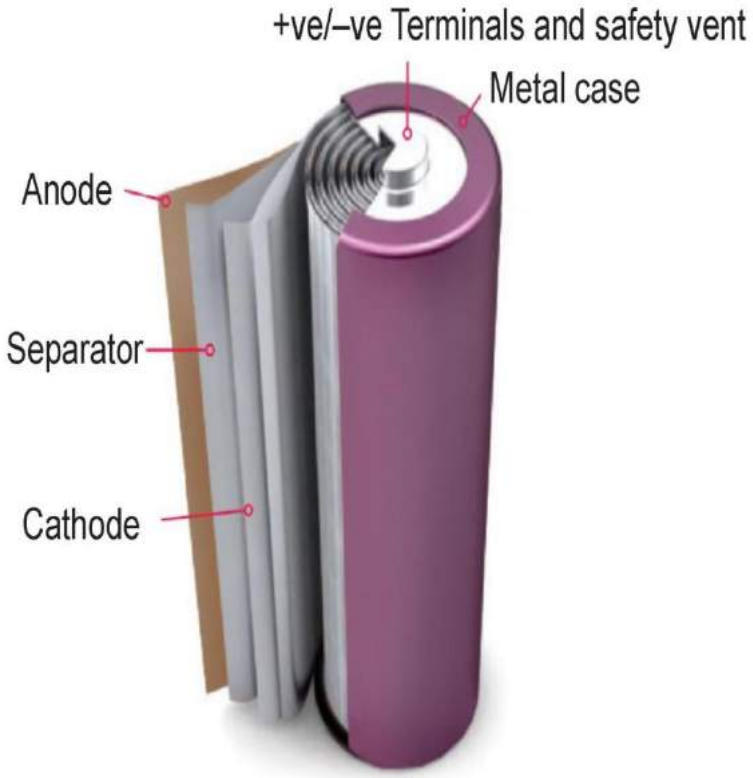
# The Drive Battery Pack

Toyota Prius 2004 to date
NiMH 201 volts
1.2Kw of power
22 Kw power output
range 1 mile

Jaguar i Pace 2018
NMC 395 volts
90 Kw of power
292 Kw power output
Range 275 miles



# Tesla Motors Battery
# 18650


3.7 Volts 3000 to 3450 mAh
C1 to C2 Discharge range

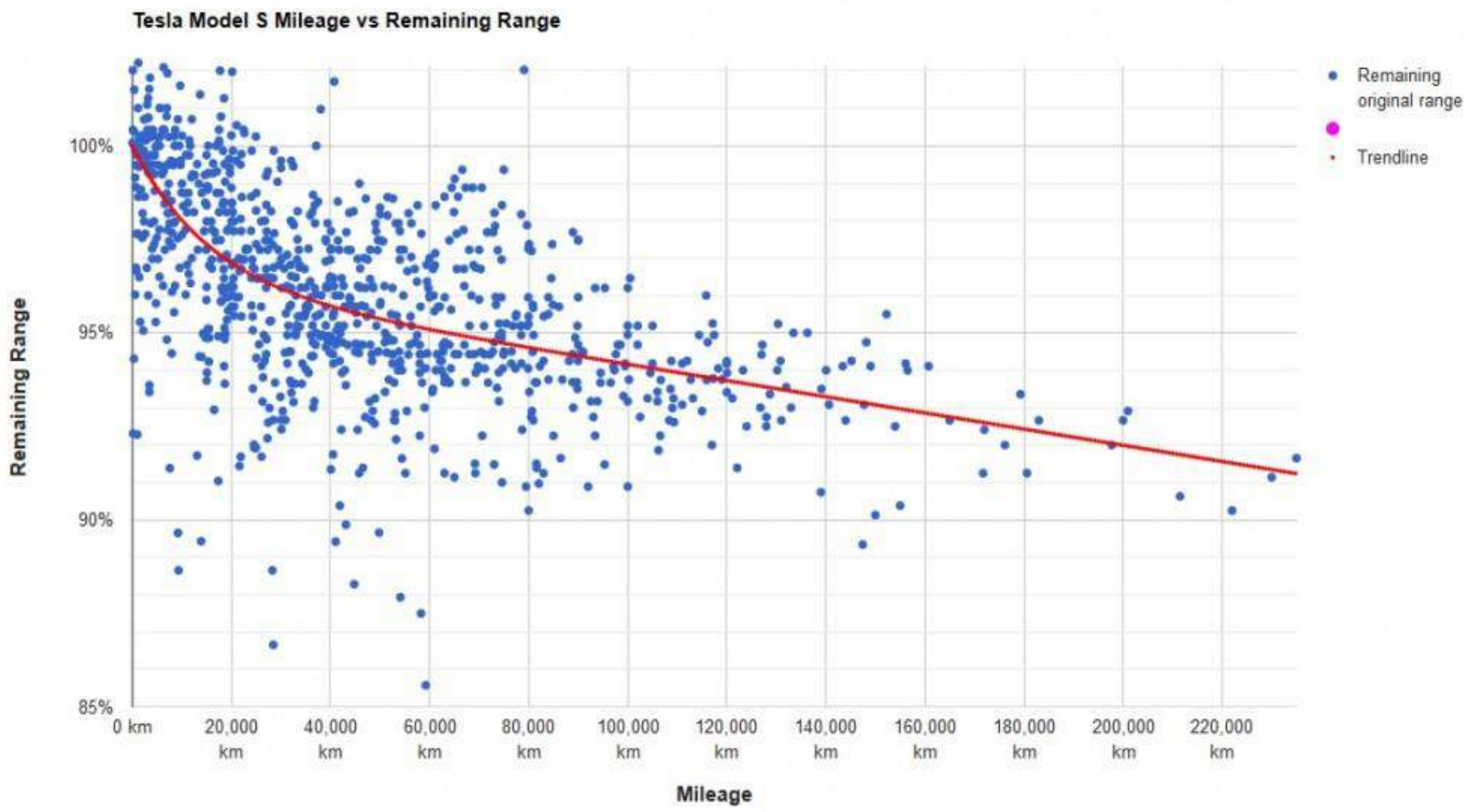
Remember if a EV battery cost £10,000 the cost of lithium for this battery would be just £100 = 1%

# Tesla S  90 KWh Battery pack

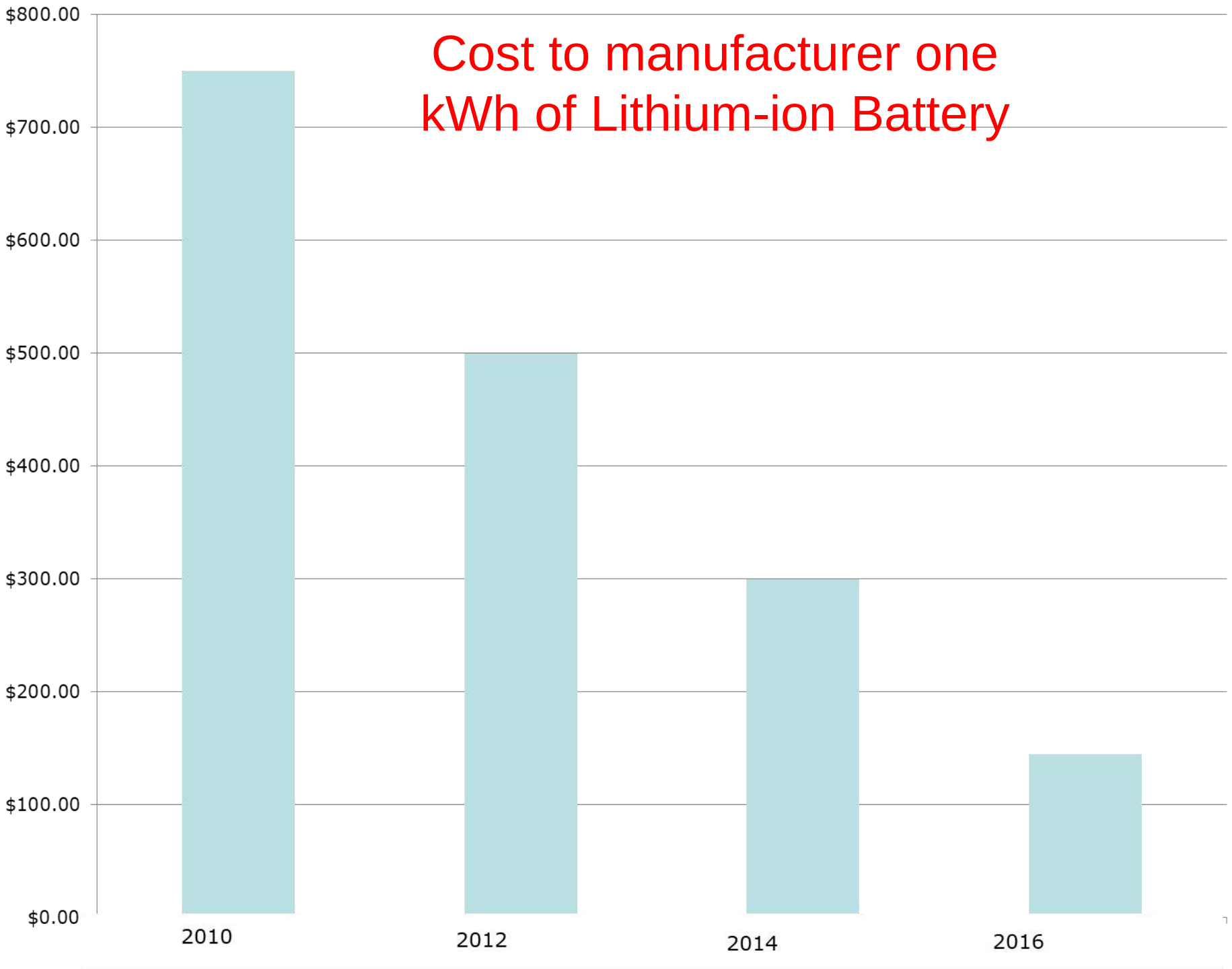
# Jaguar I Pace

432 Pouch Cells @ 58Ah NMC chemistry
12 per module 3 groups of 4 cells in parallel = 232 Ah @ 10.8 Volt
36 module @10.8 volts in series =
388 volts @ 90kW

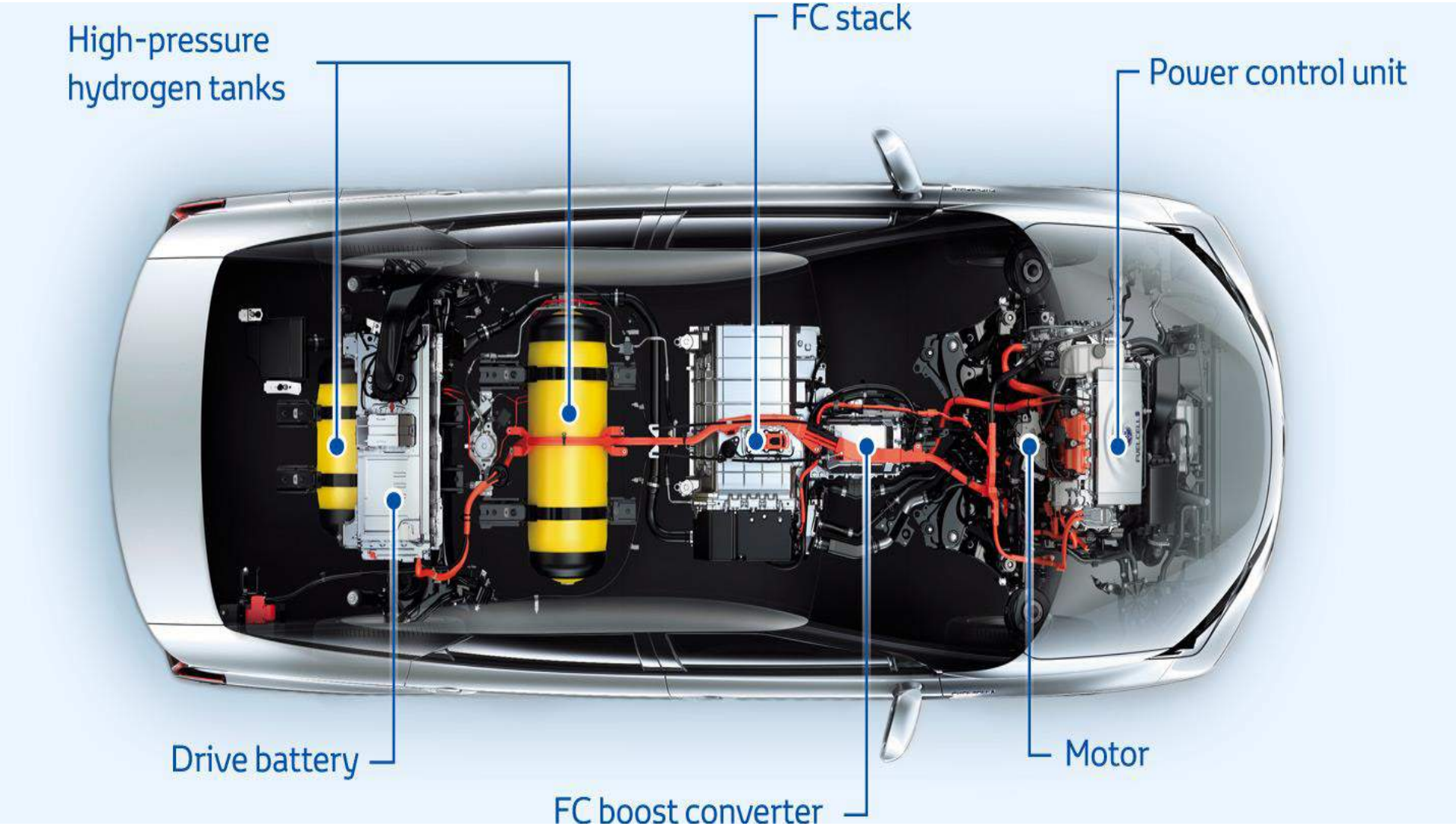
# Battery Life



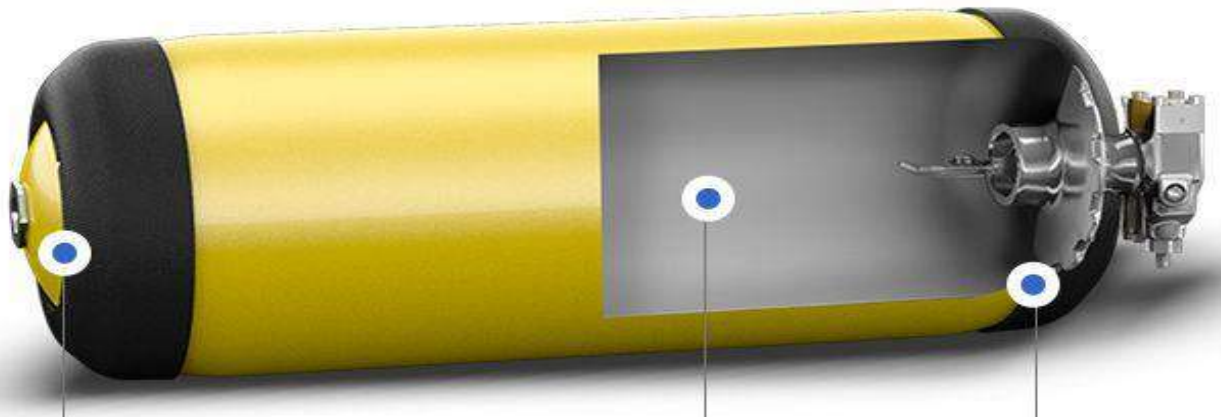
# Cost to manufacturer one kWh of Lithium-ion Battery



# Hydrogen Fuel Cell the future?



# Hydrogen fuel Tank



**Inner:** plastic-lined layer to prevent hydrogen leakage

**Middle:** structural layer of carbon-fiber-reinforced plastic

**Outer:** glass-fiber-reinforced plastic layer to protect from surface abrasions

**5.5 Kg Hydrogen Stored at 10,000 PSI**

# Hydrogen fuel station

Early stations would refill at 350 Bar
Refilling takes about 5 minutes


New stations will refill at 700 Bar the
Internationally agreed standard

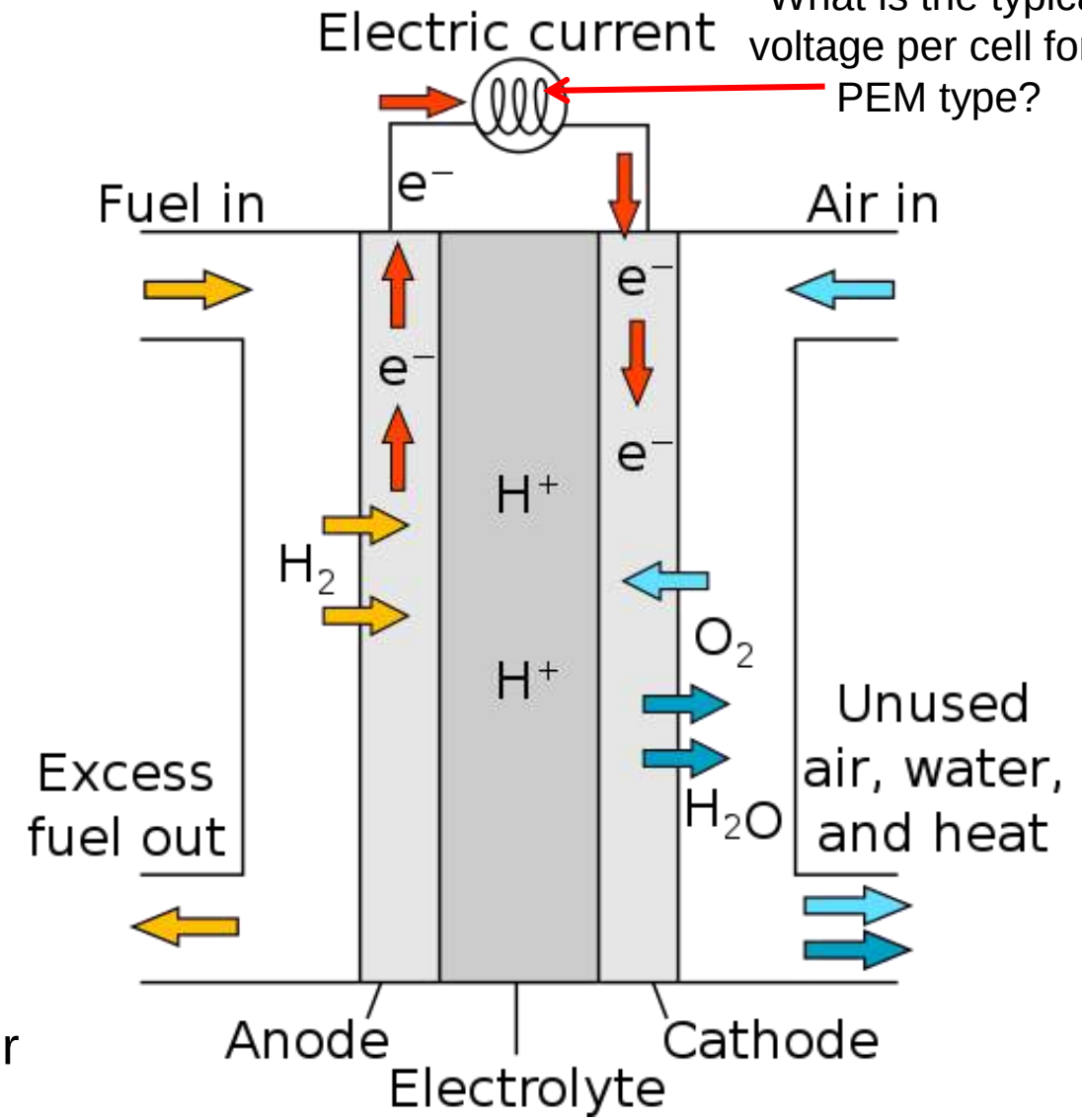
Most stations can produce 80 Kg of
Hydrogen over a 24 hour period
Enough for 16 cars

Cost per station £1.2 million
To fill a Toyota Mirai with 5Kg @ £12 per kg
is about £60 should let you cover
175 to 225 miles

# PEM Fuel Cell

**Proton Exchange Membrane Polymer Electrolyte Membrane**
(PEM) fuel cells work with a polymer electrolyte in the form of a thin, permeable sheet. Efficiency is about 40 to 50 % and operating temperature is about 80c But their fuels must be purified, and a platinum catalyst is used on both sides of the membrane, carbon-monoxide at 1 part in a million will poison the cell

What is the typical voltage per cell for a PEM type?



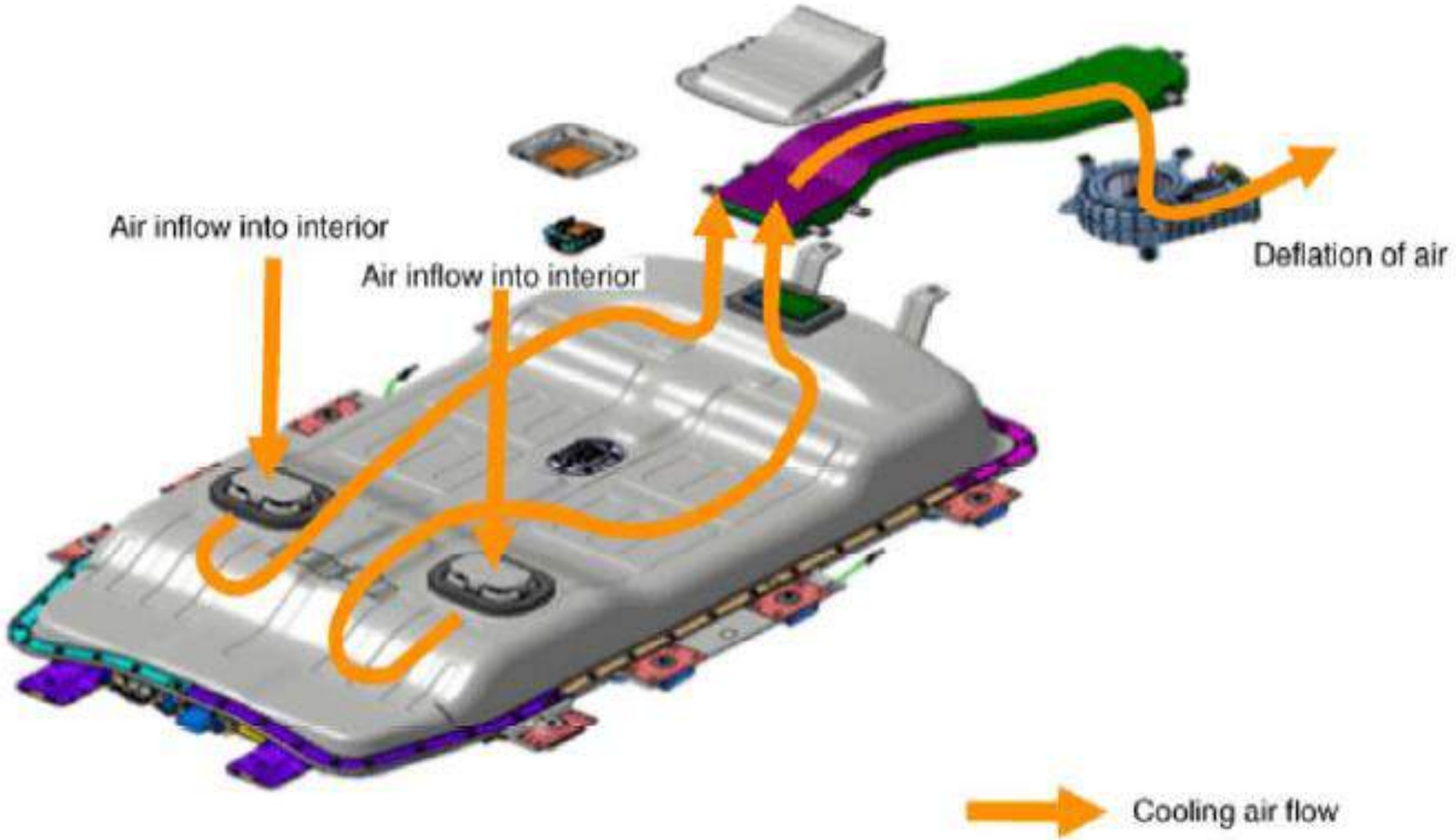

The only by–product is water but how much?

# Toyota Mirai

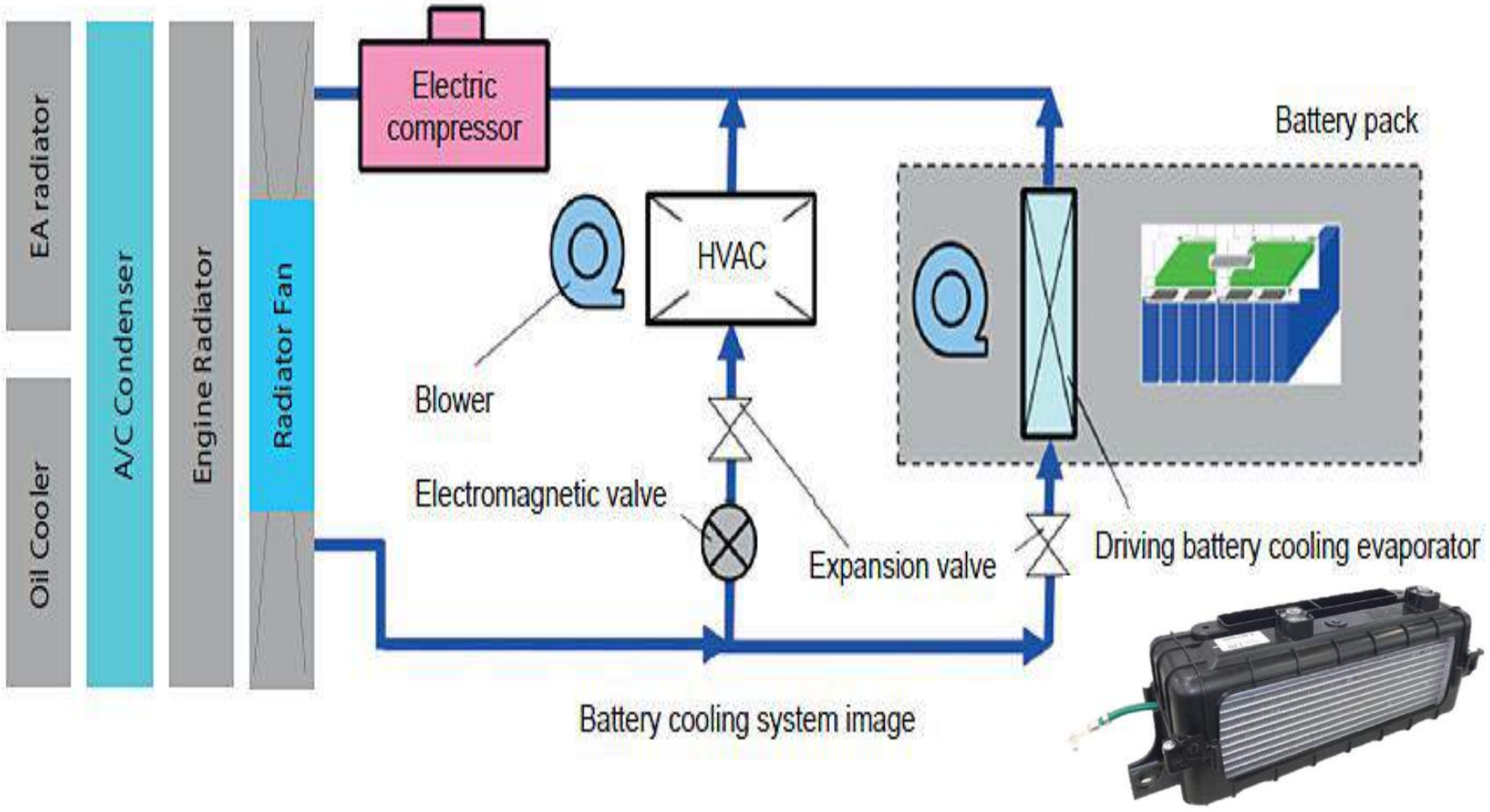


Fuel cell produce a of lot of waste heat that must be dissipate or the fuel cell will be damaged this is the reason for the large front grill

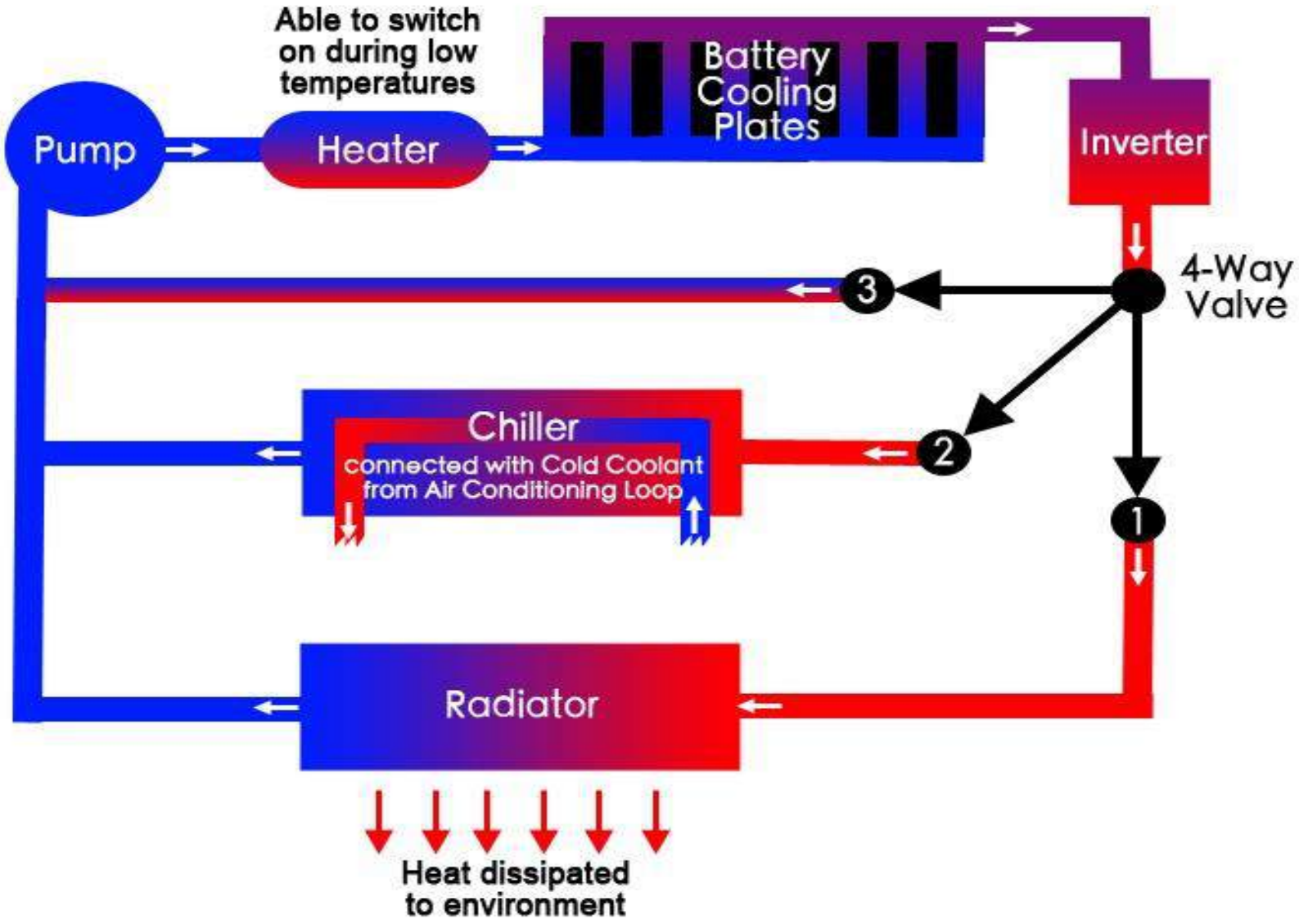
# Passive Cooling Battery Pack
# Nissan Leaf



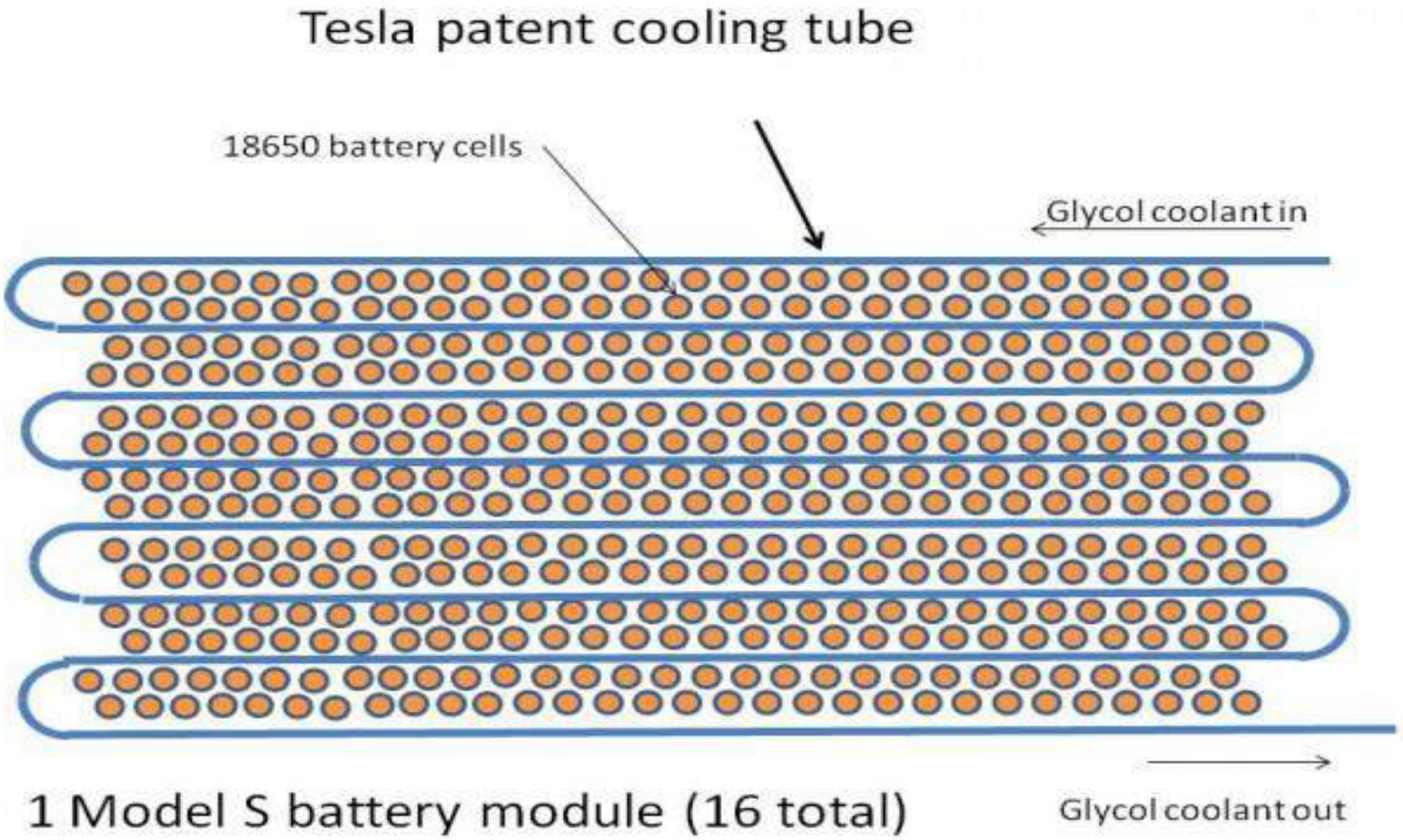
# Mitsubishi Outlander PHEV Battery Active Cooling

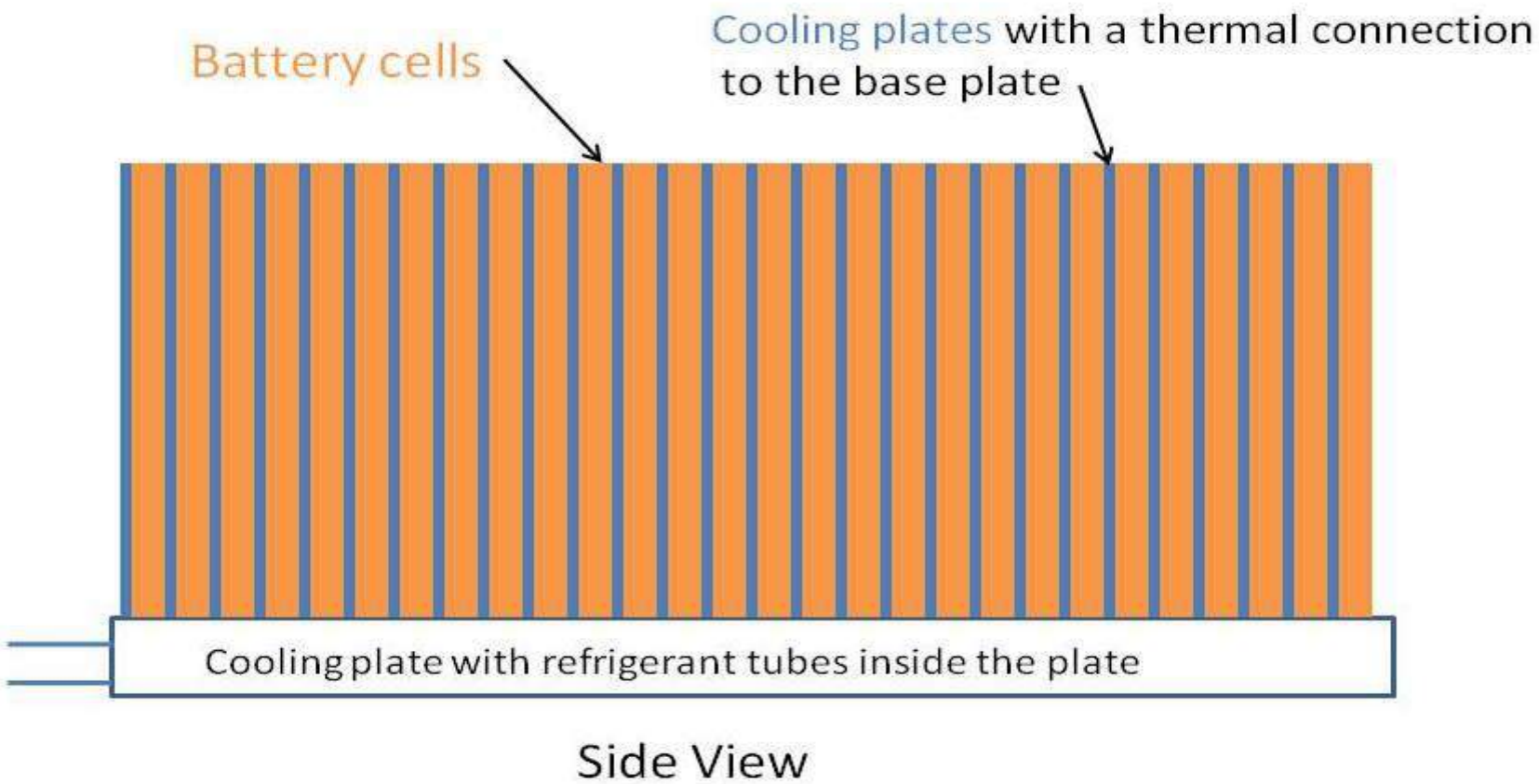


# Tesla Model S Battery Cooling



# Tesla Model S Battery Cooling





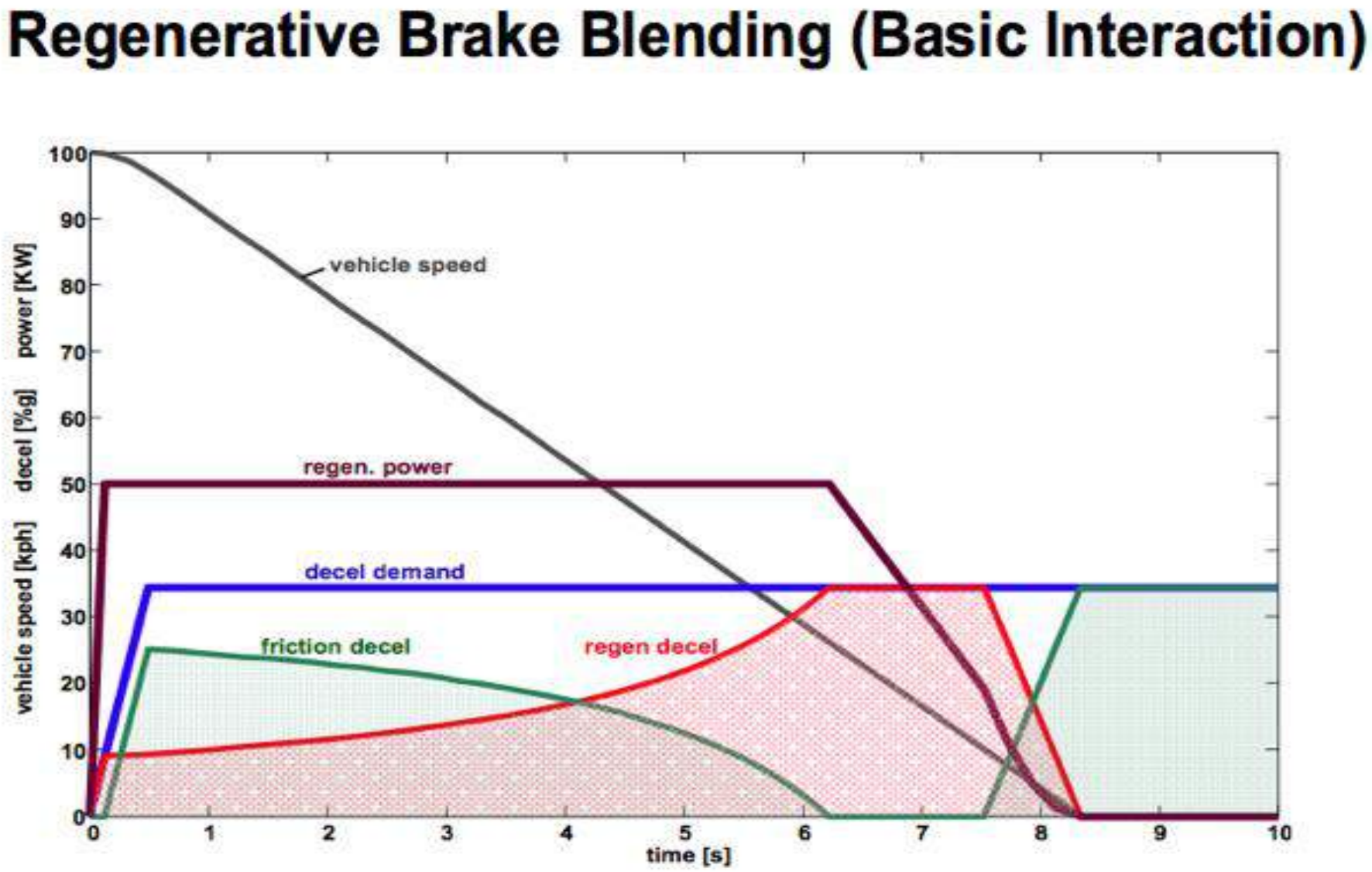

# Direct Expansion cooling

There is no glycol liquid- just refrigerant

# Jaguar I Pace


A triple heat pump thermal scavenging system can increase range by 50kM

# Regenerative breaking



# Optimising regenerative breaking

In order to optimise efficiency most manufacturers are fitting some form of manually controlled regenerative breaking, this can often referred to as one pedal driving.

The idea beaning as you approach a situation which requires you to slow down you select the amount of retardation by flicking a paddle on the back of the steering wheel to progressively slow the car down. All of the vehicles kinetic energy is transformed into electricity rather then heat.


Remember the deceleration is a consequence of the discharge state of the battery, therefore the load applied across the MG units will be less, if the battery is not discharged or only partly discharge, the amount of deceleration will be reduced. **<u>This is not a fault, it is how the system works</u>**

# Controlling the amount of Regenerative Braking

Lenz’s law and back EMF work hand-in-hand. In electric motor operation, as the armature rotates inside the magnetic field, a voltage is produced. This voltage is commonly referred to as back EMF (electromotive force), since it acts against the voltage driving the motor.

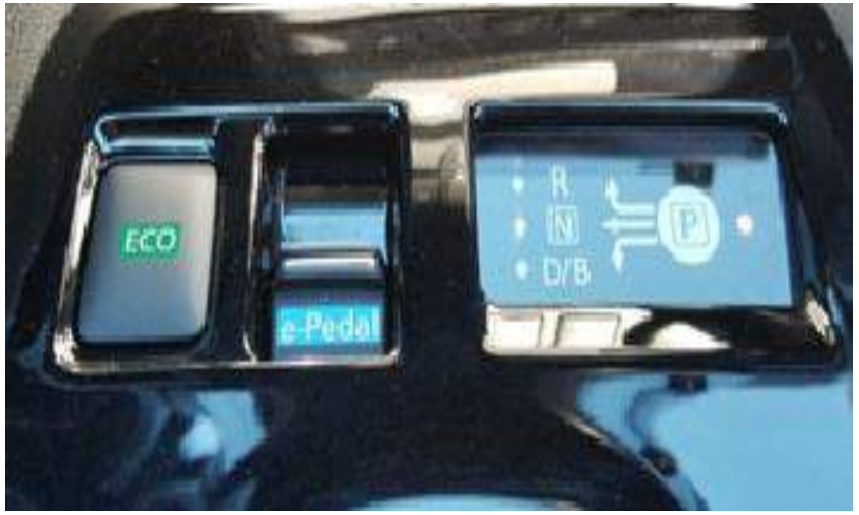
Because of the back EMF, for any supply voltage there is a speed at which the motor will draw no current at all. The ratio of BEMF/RPM is a constant, It can also be easily be measured by spinning the unconnected motor at a known speed and measure the voltage at its leads.
Then, provided that the motor speed can be measured, the PDM controller can compute the motor's back EMF and can be made to do any of the following:

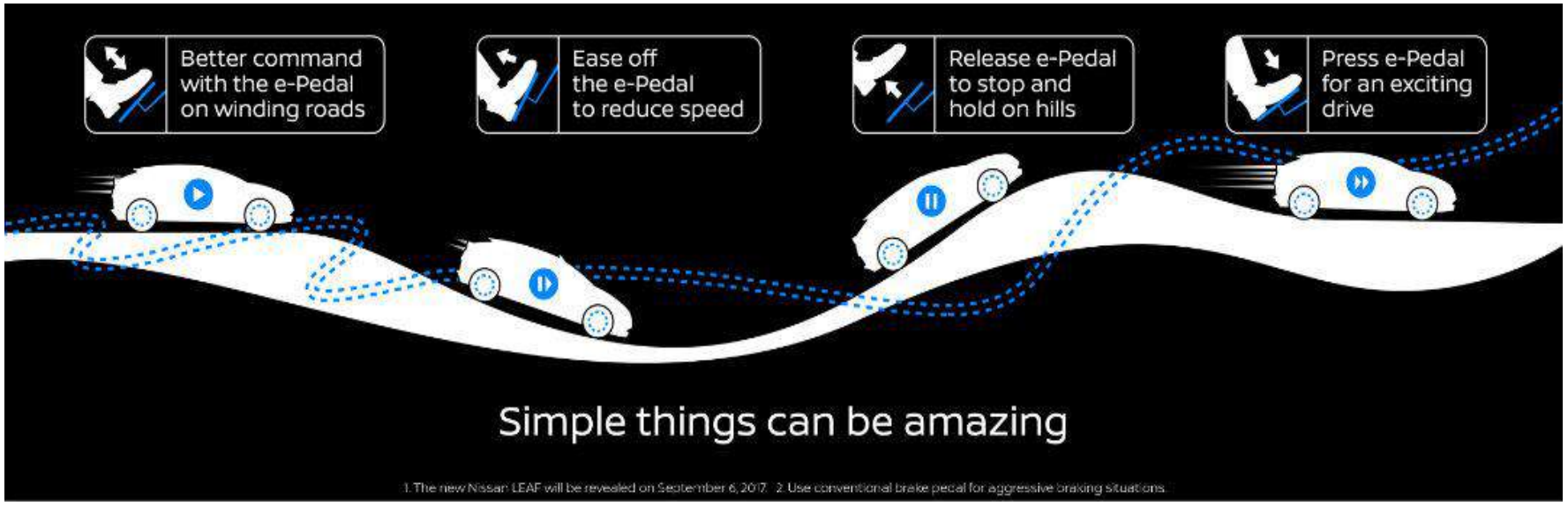
1-Match the motor's back EMF, in which case the motor neither accelerates nor brakes. If it is stopped is stays stopped. If already moving, it maintains that speed.

2-Exceed the motor's back EMF, in which case the motor will accelerate

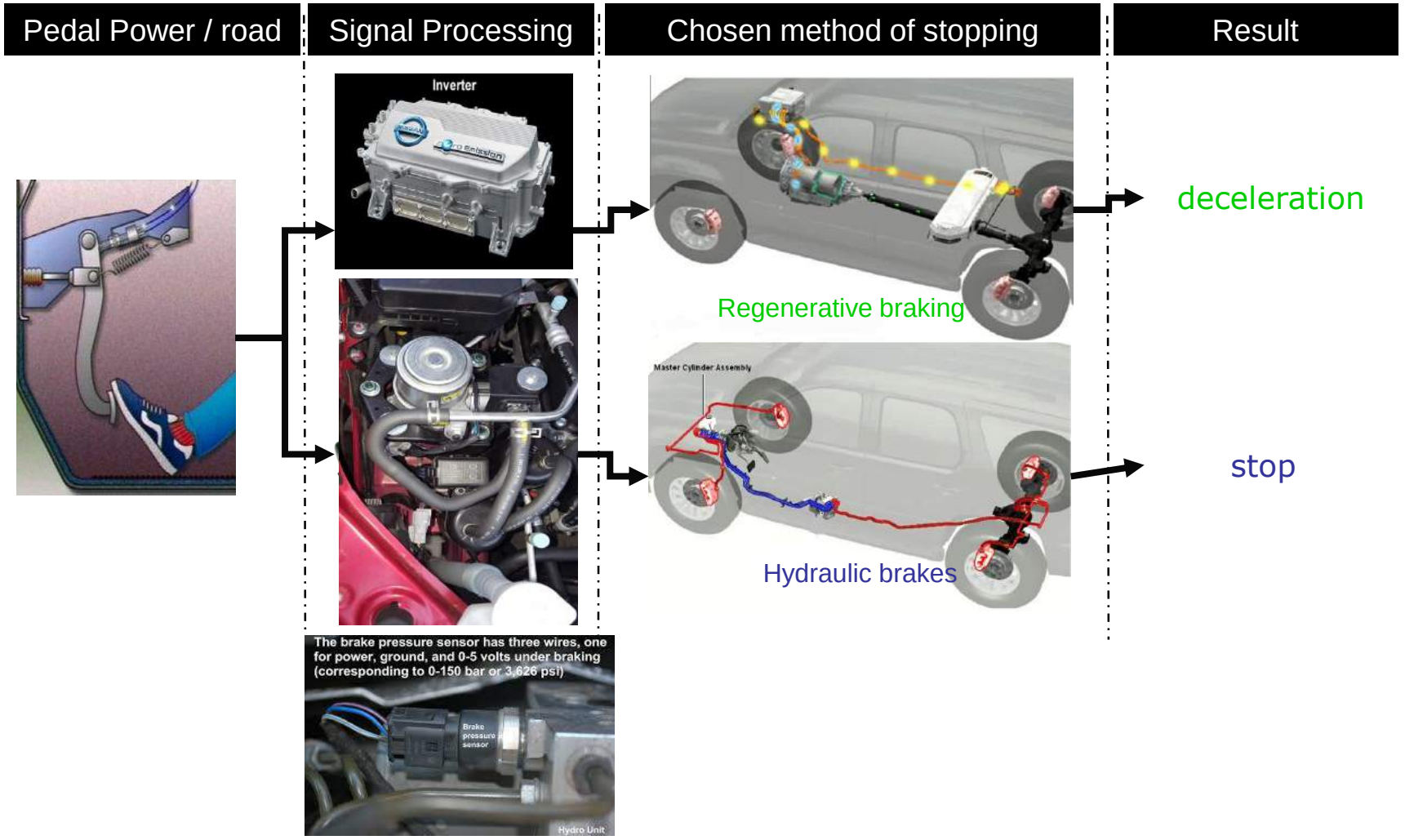
3-Be lower than the motor's back EMF, in which case the motor will brake and regenerate current. The greater the difference between the motor's BEMF and the controller's output voltage, the stronger the regeneration and braking will be.

# Regenerative breaking using the E-pedal know as one pedal driving



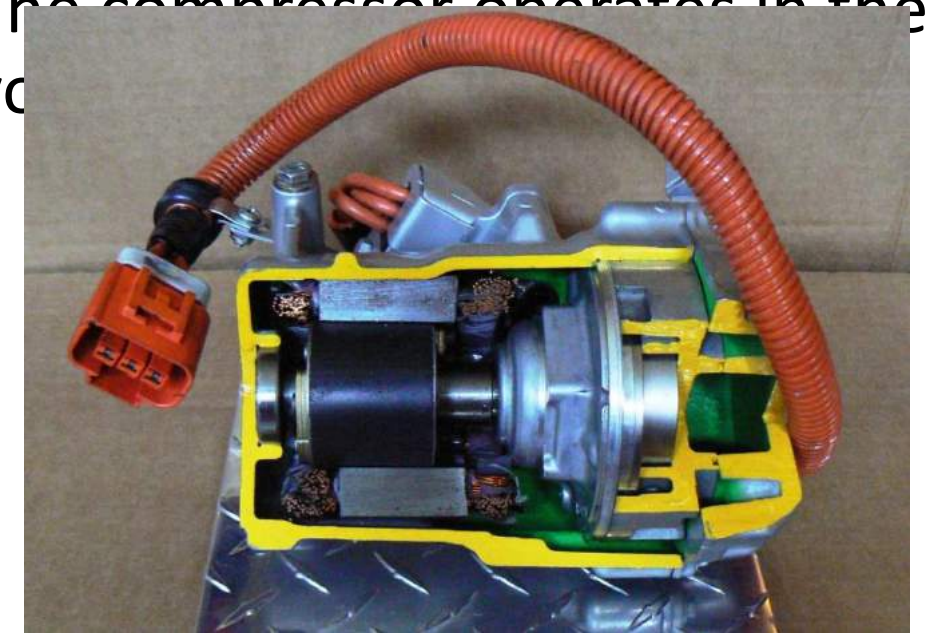
# Braking System Control

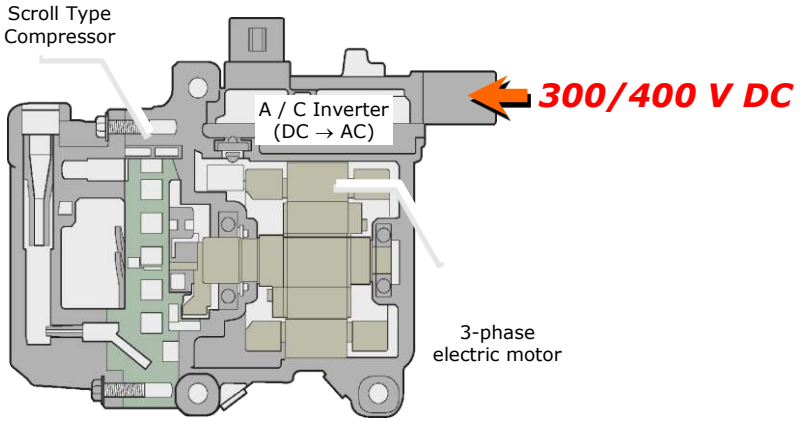


# EV and PHEVs Features
# Air Conditioning & Heating

# Electric Air Conditioning Compressor

- The air conditioning must able to operate **independently** from the engine.
- For this reason the compressor is **electrically** powered.
- The compressor operates in the high voltage

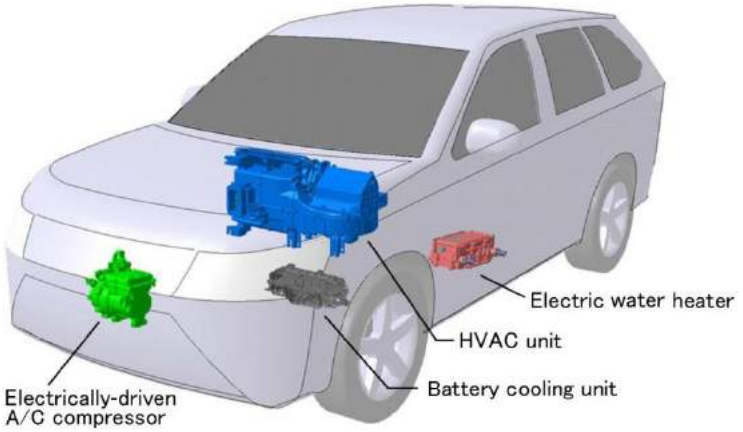




# PHEV Supplementary Heating Systems

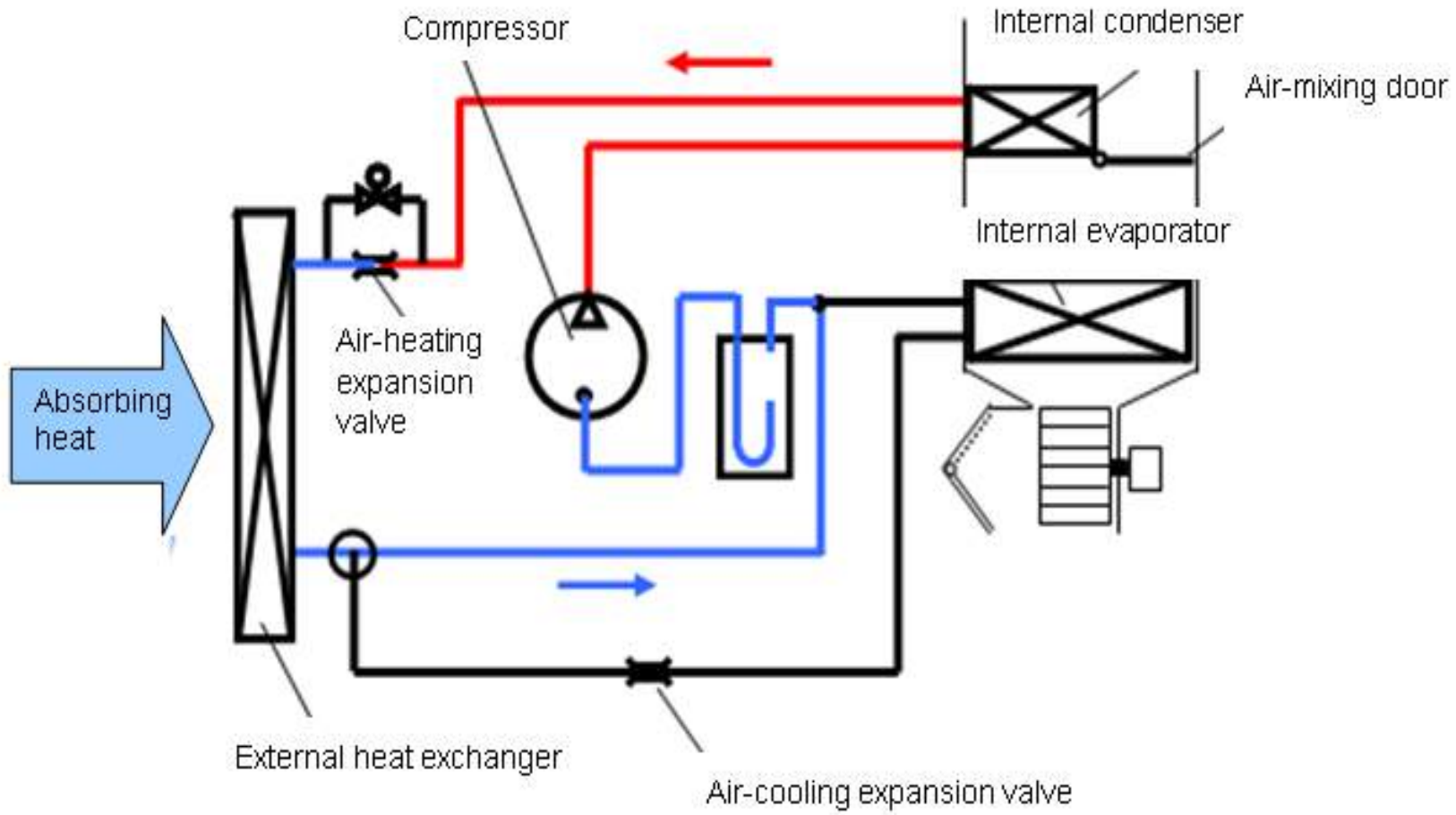
40Amp @300 volts fuses for supplementary Heating system

4,000 Watt PTC Heater

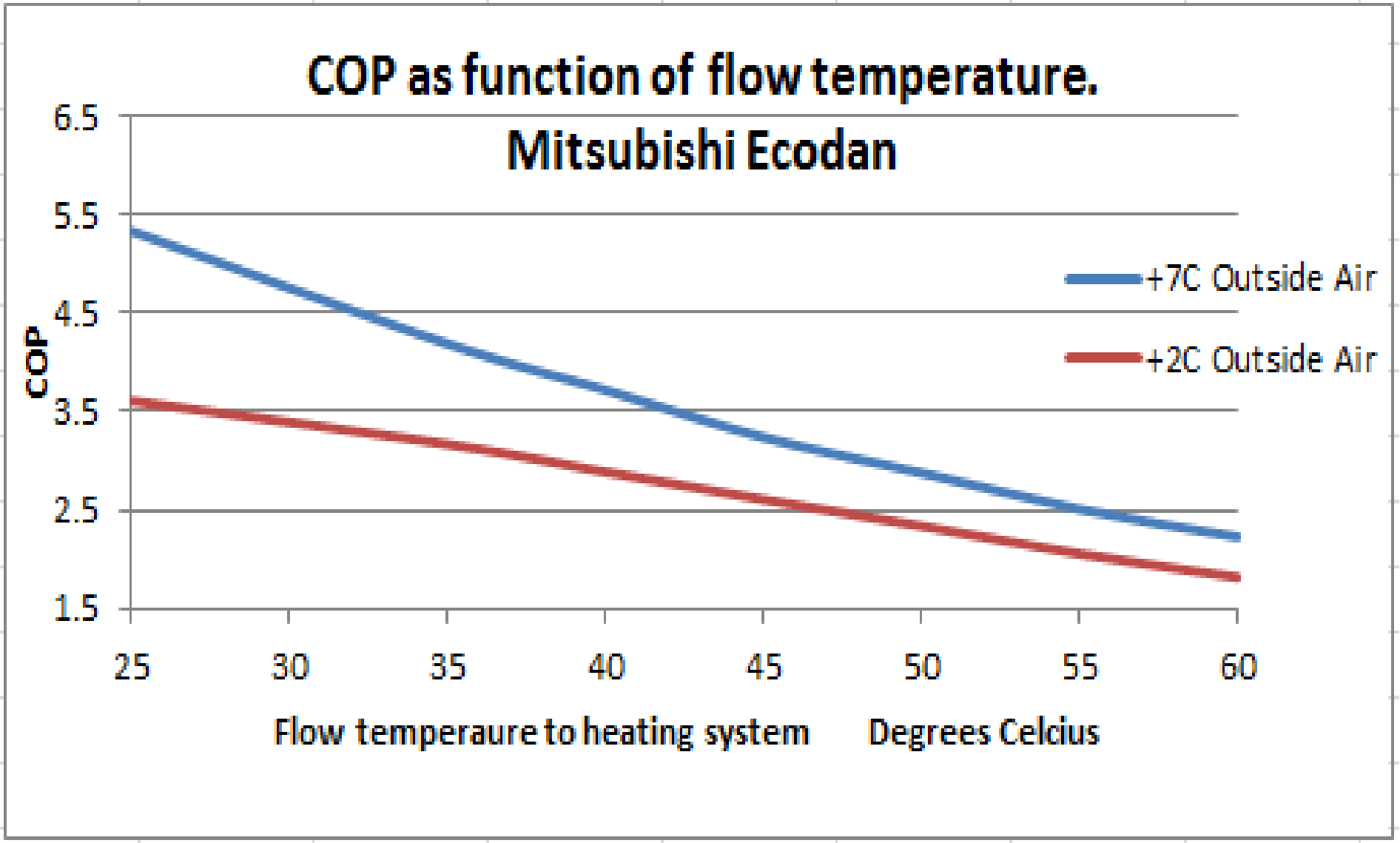


# What is a Heat Pump

A heat pump is a device that transfers heat energy from a source of heat to a destination called a "heat sink". Heat pumps are designed to move thermal energy in the opposite direction of spontaneous heat flow by absorbing heat from a cold space and releasing it to a warmer one. A heat pump uses a small amount of external power to accomplish the work of transferring energy from the heat source to the heat sink.



# Heat Pump COP of efficiency



# Air Conditioning System Maintenance

- Because the air conditioning compressor is connected to the high voltage system, no conductive fluid should be used in the air conditioning system. Common compressor oil also should not be used.
- This means:
  - Use special compressor oil (Poly-Ester Oil). This is called POE.
    No PAG or mineral (R12) oil.
  - Use appropriate leak detection/dye.
  - Install required gaskets and hoses. Be careful with universal seals and hoses.


# Air Conditioning System Maintenance

- The filter/dryer is used for absorbing larger amounts of moisture from the refrigerant which is very hygroscopic this will need replacing on a regular basis
- Nissan Leaf servicing is every 3 years.
- With the AC system now used to cool the battery and heat the car, it will require more servicing. With no air-con you will not be able to rapid DC charging, and just a 20% loss will reduce the heat pump output by up to 50%
- Refrigerant R134A is still used but HFO1234YF will start to replace it
- If the compressor needs to be replaced, the high voltage system must be switched off according to regulations.

ALLIANCE
AUTOMOTIVE GROUP
UK



**Thank you for your attention and enjoyed your day**

*Steve Carter*

INSTITUTE OF THE MOTOR INDUSTRY

# Why is the Automotive Sector Always Short on Talent?

## Guy Liddall – Motor Trade Selection

# Talent

Why are we always short of it?

# We’ve never had enough Automotive Talent

And we’ve never been very good at keeping it

# £0.5m more in every dealer

By actively managing your talent

# We are not the only ones

**Estate agency industry suffers 'worst staff shortages' in a generation – despite branch closures**

MARCH 22, 2017 | ROSALIND RENSHAW

**The long and short of the UK teacher crisis**

Training

**Low-skilled sectors 'could face huge talent shortages after Brexit'**

Annie Makoff 30 Mar 2017 1 comments

**Food manufacturing likely to be worst affected, as CIPD urges flexible immigration system**

A cap on post-Brexit EU migration could result in significant labour shortages within certain sectors that are reliant on EU migrants, new research has warned.

**Brexit could lead to talent shortages in the professional sector**

Posted on 3rd October 2016 from Changeboard

Analysis of Linkedin profiles has revealed that 40% of professional migrant workers in the UK come from EU states. Will businesses be able to cope with this talent gap?

**Two thirds of employers expect to face skills shortages in 2018**

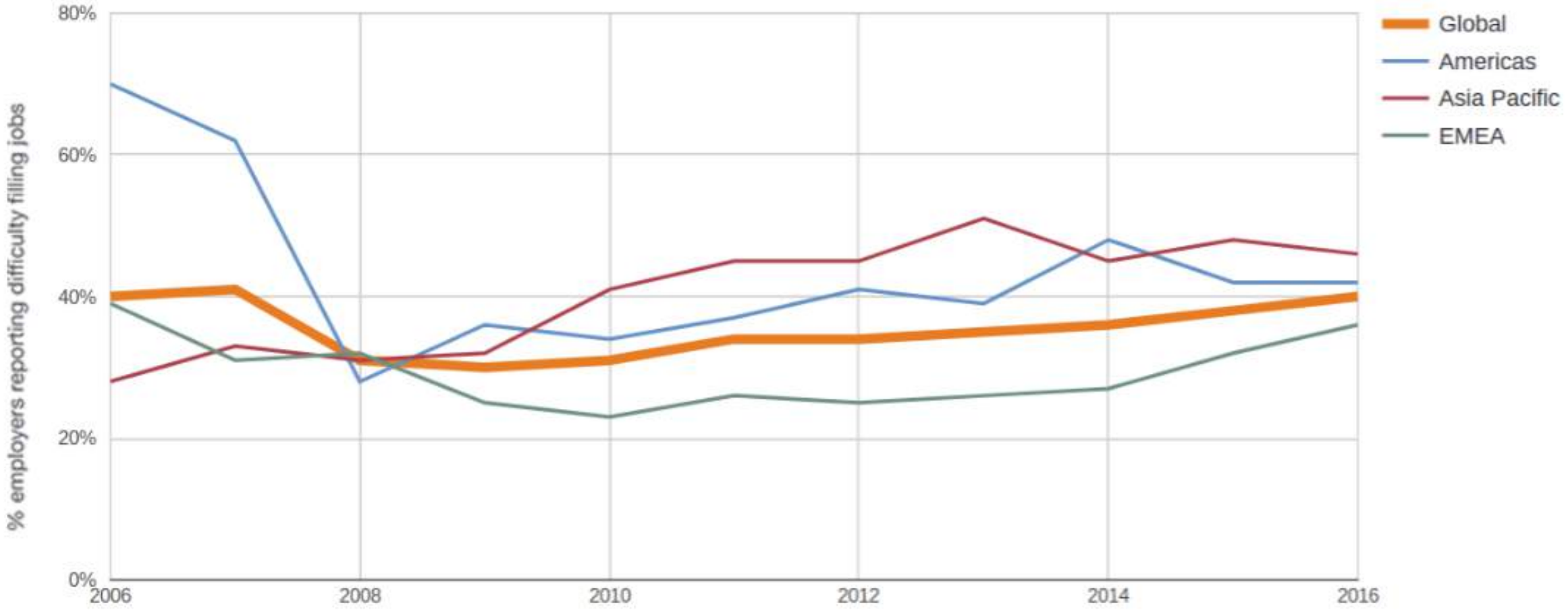
Posted by Steve Warnham on March 19, 2018

**Brexit could lead to talent shortages in the professional sector**

Posted on 3rd October 2016 from Changeboard

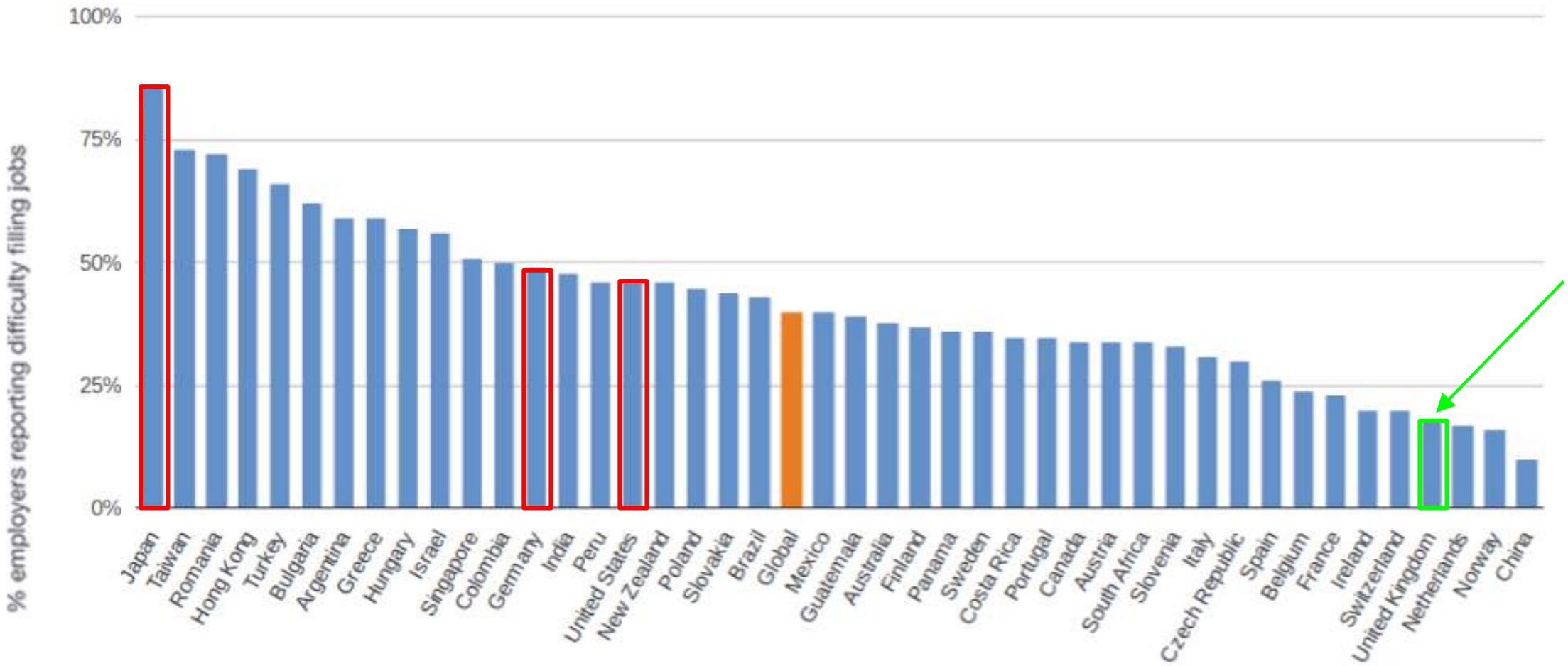
# We are not the only ones

*Manpower Group - 2016/2017 Talent Shortage Survey*



# And we are not the worst (by a long way)

*Manpower Group - 2016/2017 Talent Shortage Survey*



# Top 10 Global Recruitment Problems

Skilled Trades

**IT Personnel**

**Sales Representatives**

Engineers

**Technicians**

**Drivers**

**Accounting & Finance**

**Management / Executive**

Production/Machine Operators

**Secretaries, PAs, Receptionists, Admin & Office support staff**

# That’s Automotive

# Talent

Teams

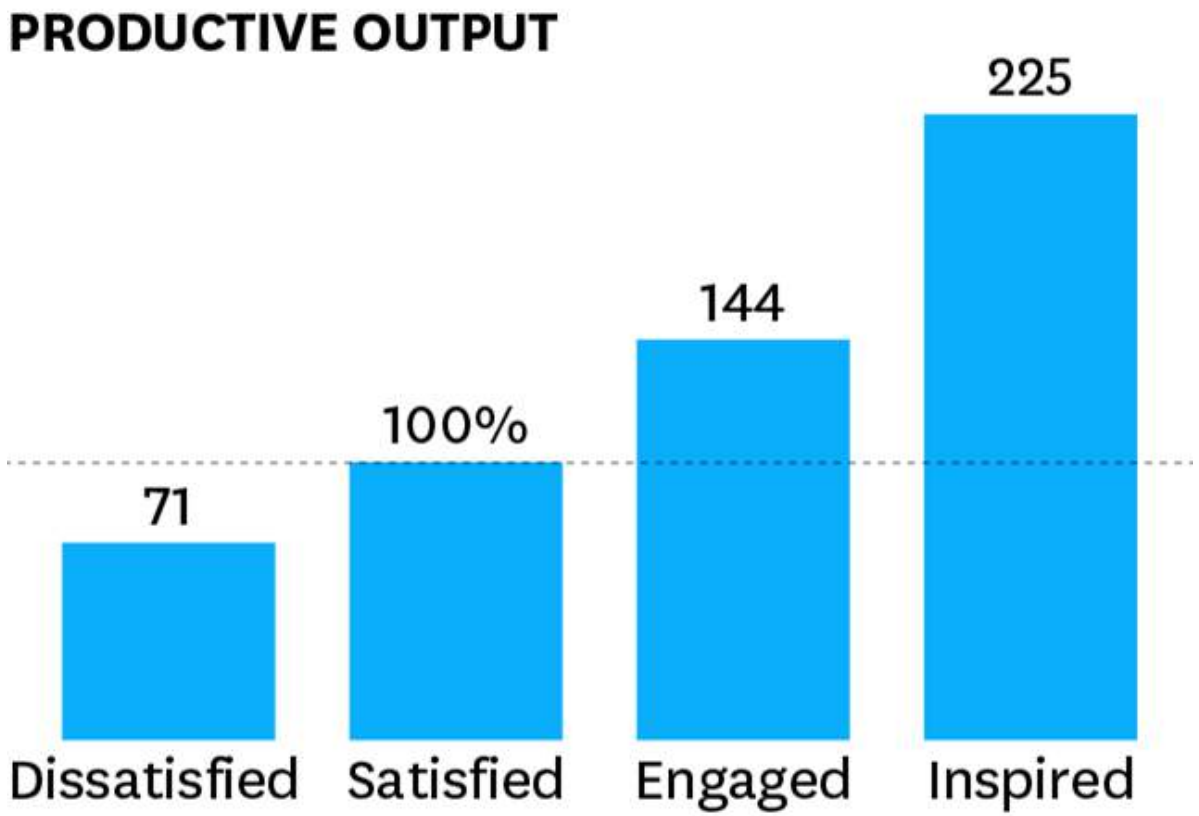
Organisations

Jobs

People

And takes them from Satisfied, through Engaged to Inspired

# Talent makes Money



# Case Study 1 - Service Manager

- Improved Labour Sales by 34%
- Workshop productivity up from below 70% to over 83%
- Took CS from bottom 10% UK to only Group Dealer above National Average
- Most improved NPS score in the whole Group

**Direct Profit up by £284k year on year**.

# Case Study 2 - Sales Manager

- Increased New sales from 350 to over 550
- Doubled Used Cars ppu to £1250
- Dealer up from below 190 to 35 on Franchise's UK ranking
- Won a number of Group and Franchise awards

**Took department from a small loss to £220k direct profit**

# Case Study 2 - General Manager

- First GM role
- Increased New sales from 650 to over 1,000
- Doubled Used Cars to 550
- Increased Labour Sales by 27%
- CS scores in top 20% for Franchise

**Increased Dealer Profit from £260k to over £1m in just over 18 months**

# At least £0.5m more

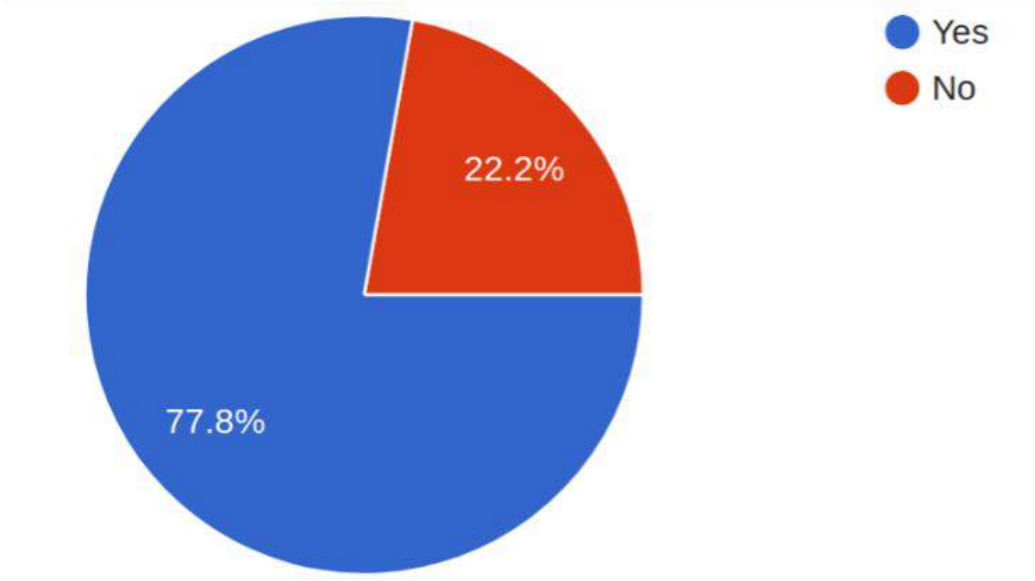
By employing the right talent

# Why can’t you find Talent?

We asked our people

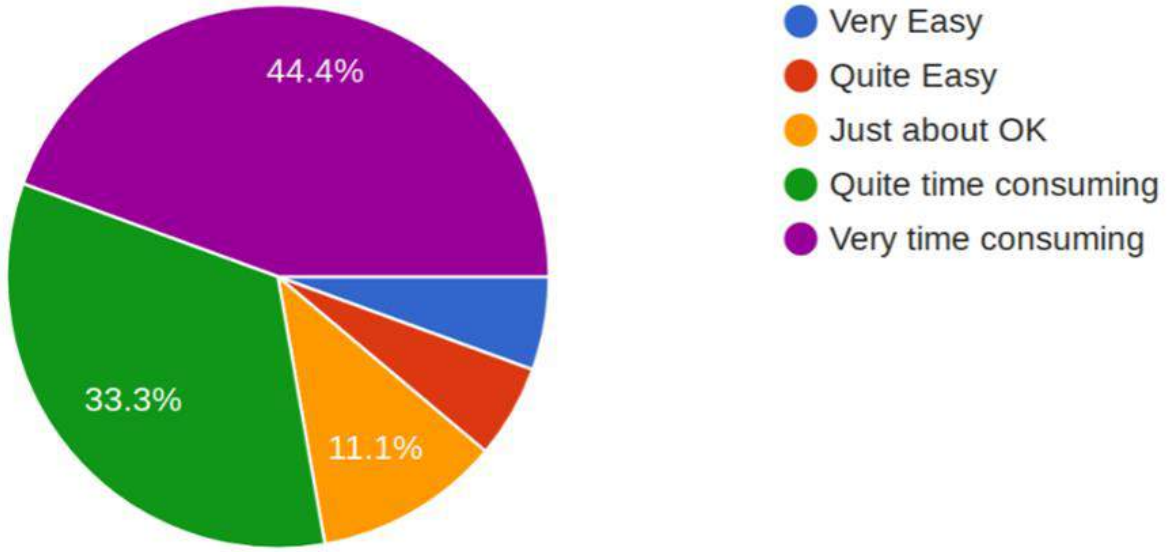
# We spoke to 55 candidates

Have you applied for a job in the past 24 months?



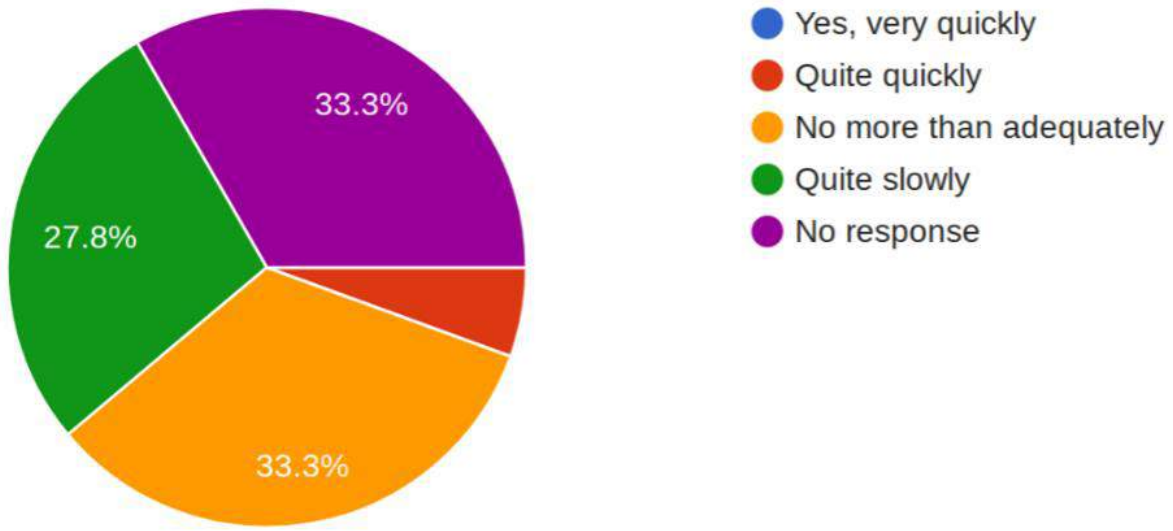
# We spoke to 55 candidates

## How did you find the process?



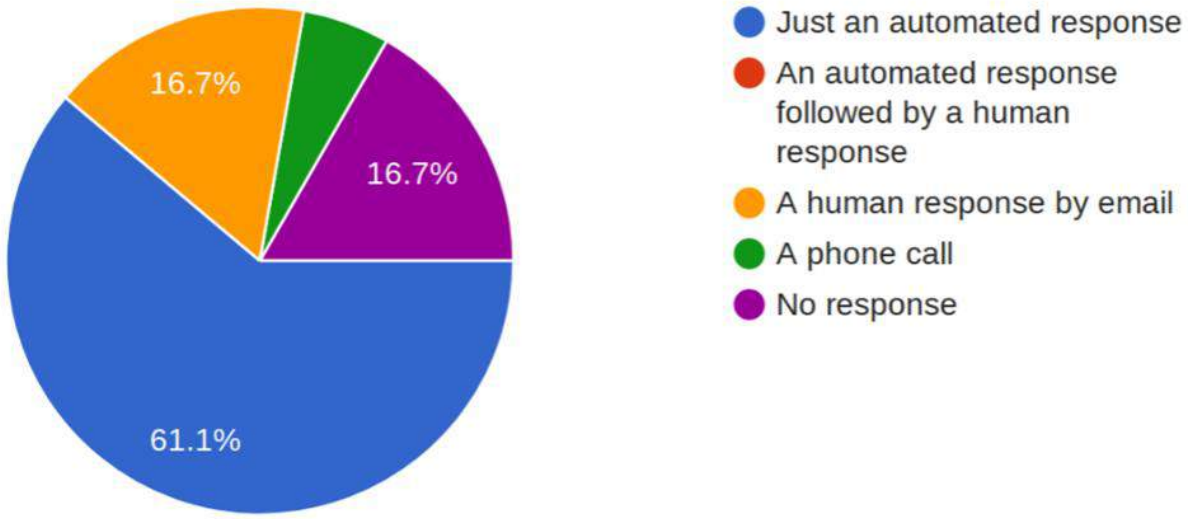
# We spoke to 55 candidates

## How quickly did they respond?



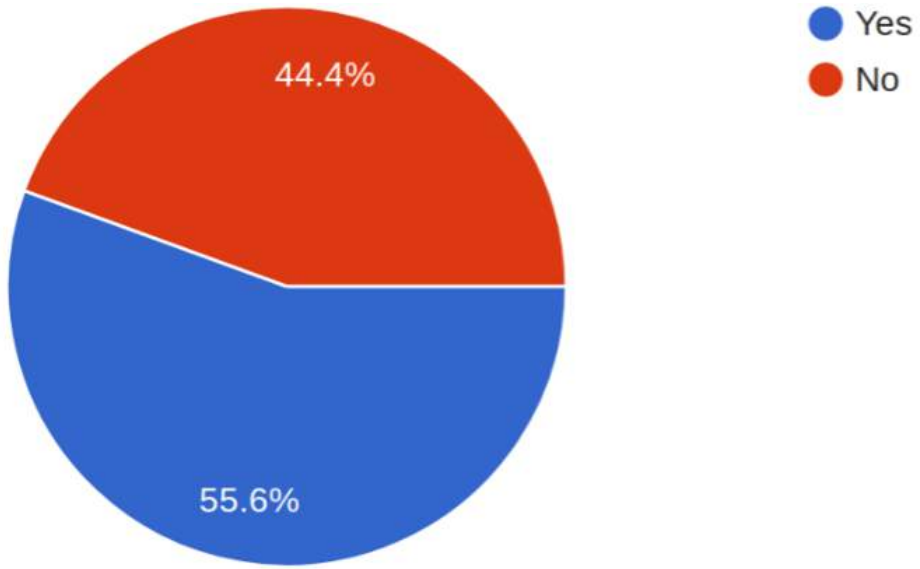
# We spoke to 55 candidates

## How did they respond?



# We spoke to 55 candidates

## Have you attended an Assessment Centre?



# 30 Assessment Centre Candidates

- 40% enjoyed the day
- 70% found it quite or very demanding
- 23% said it was professionally handled
- 50% worried about confidentiality
- 93% had to take a day off
- 90% did not get proper feedback
- 33% got the job

# There Is No 'Talent Shortage'

Only Employers Who Fail At Recruiting

# Talent does not need you

So make it

Easy

Professional

Confidential

Give them feedback

# Assessment Centres

They help but they’re not the only answer

Studies show they are unreliable

Great at filtering “incapable” candidates

# Artificial Intelligence

Reduces repetitive tasks

Can make you look more responsive

Ethical issues

Unconscious bias

Developing technology

But there is real hope

# The biggest groups

- They recognise Talent is crucial
- They grow their own
- Recruitment is uncertain, often ineffective and disappointing
- Career management is important
- Diversity essential

# Three responses

Daksh Gupta, CEO Marshalls Group

Stuart Foulds, CEO and Chairman, Trust Ford

Melvin Rogers, Group HR Director, Sytners Group

# Stuart Foulds

# Melvin Rogers

# Sytners

- Rarely recruit outside the group at senior level
- No lack of Talent
- Long term vision
- Rarely use assessment centres

# Sytners

- Entry to the group
  - Much greater use of apprenticeships across every area
  - Every dealer link with at least one school
  - Closer links with Careers Offices at schools and universities
- Result
  - Higher proportion of women and other minorities
- Change to Processes
  - Induction much more detailed
  - Exit interviews for every leaver
  - Intervention where necessary

# Daksh Gupta

# Daksh Gupta, CEO, Marshalls Group

Talent crucial

Sales great starting point

Changed approach

# Essential for Entry?

- Aftersales
  - Technical Knowledge
  - Colleges and Schools
- Sales
  - Low basic - high commission

# Marshalls £25K deal

- Clear offering
- Overcomes barriers
- Invests in people
  - 2 week Induction Programme
  - Residential training
  - Senior Directors in attendance
- 1, 2 and 3 year loyalty reward

# The Result?

- 20% of new sales recruits came from outside industry
- Now that figure is 80%
- Greater stability of new recruits
- Greater commitment to the group
- No shortage of talent

# A couple of thoughts to finish

# You’re wasting half the talent out there

36% of our workforce is female
14/150 on LinkedIn

Diverse workforces are more successful
35% more (2015 Mckinsey study)

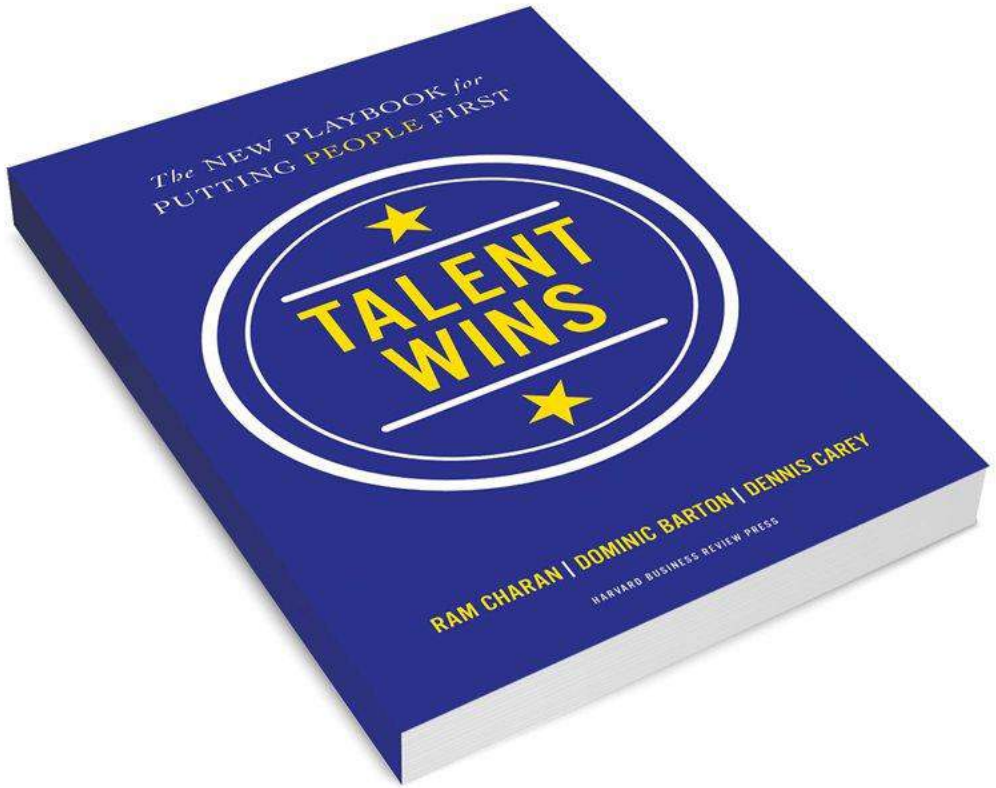
But the best?

# They left 20 years ago

**The Lex Group**

- Talent recruitment was independent and permanent
- Training and induction best in industry
- Career Management
  - Independent
  - Non-negotiable
  - Talent focused
- Exit Management
- They did alright

# Talent Wins




*ng*


Lisa Davies

Director - Get the Edge


# 01 What's your dream & purpose?

Navigating change
Leading success

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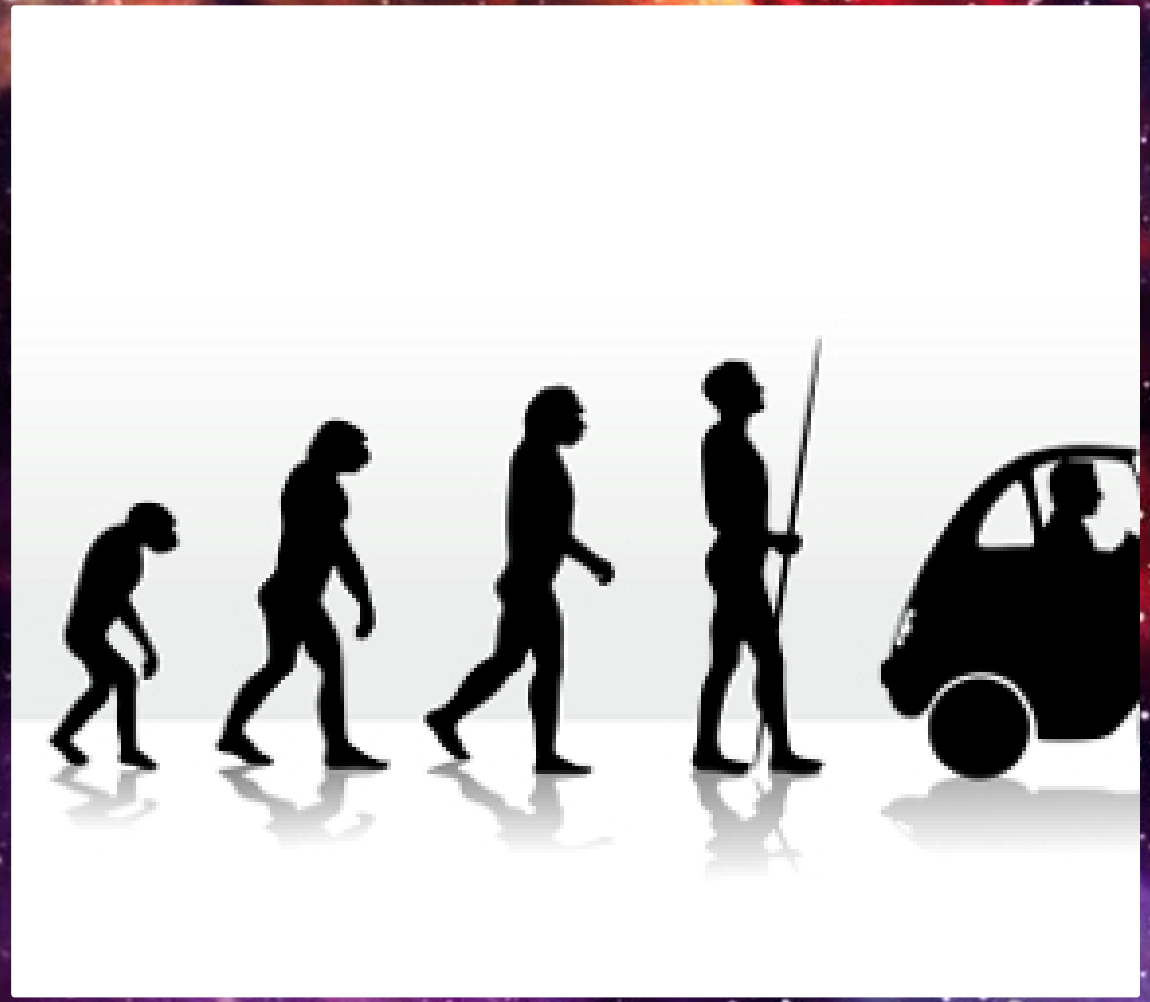

It is often said that the only things that are inevitable in life is death and taxes.

Well, you can add a third item to that list of things that are inevitable and that's CHANGE

And that change is happening faster than any time in history

"Nothing endures but change." – Heraclitus

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Leadership

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change." – **Charles Darwin**

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# Navigating change
# Leading success

Marketplace

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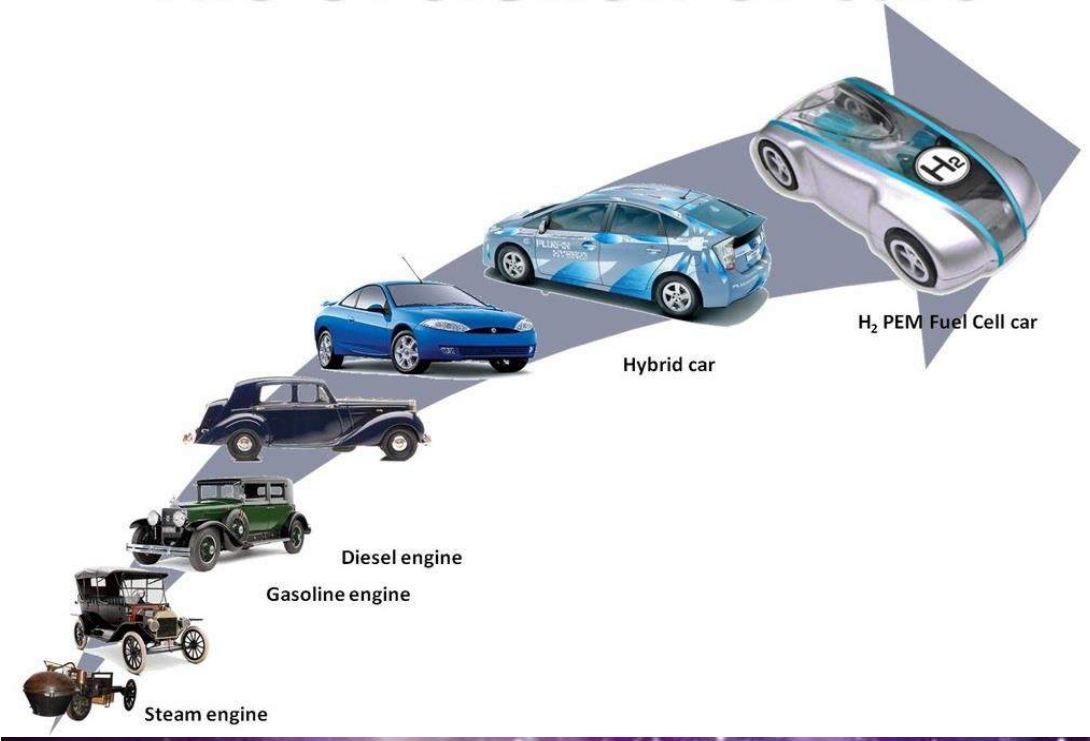


# Marketplace

"Without accepting the fact that everything changes, we cannot find perfect composure. But unfortunately, although it is true, it is difficult for us to accept it. Because we cannot accept the truth of transience, we suffer." – **Shunryu Suzuki**


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# Technology

"The rate of change is not going to slow down anytime soon. If anything, competition in most industries will probably speed up even more in the next few decades." – **John Kotter**

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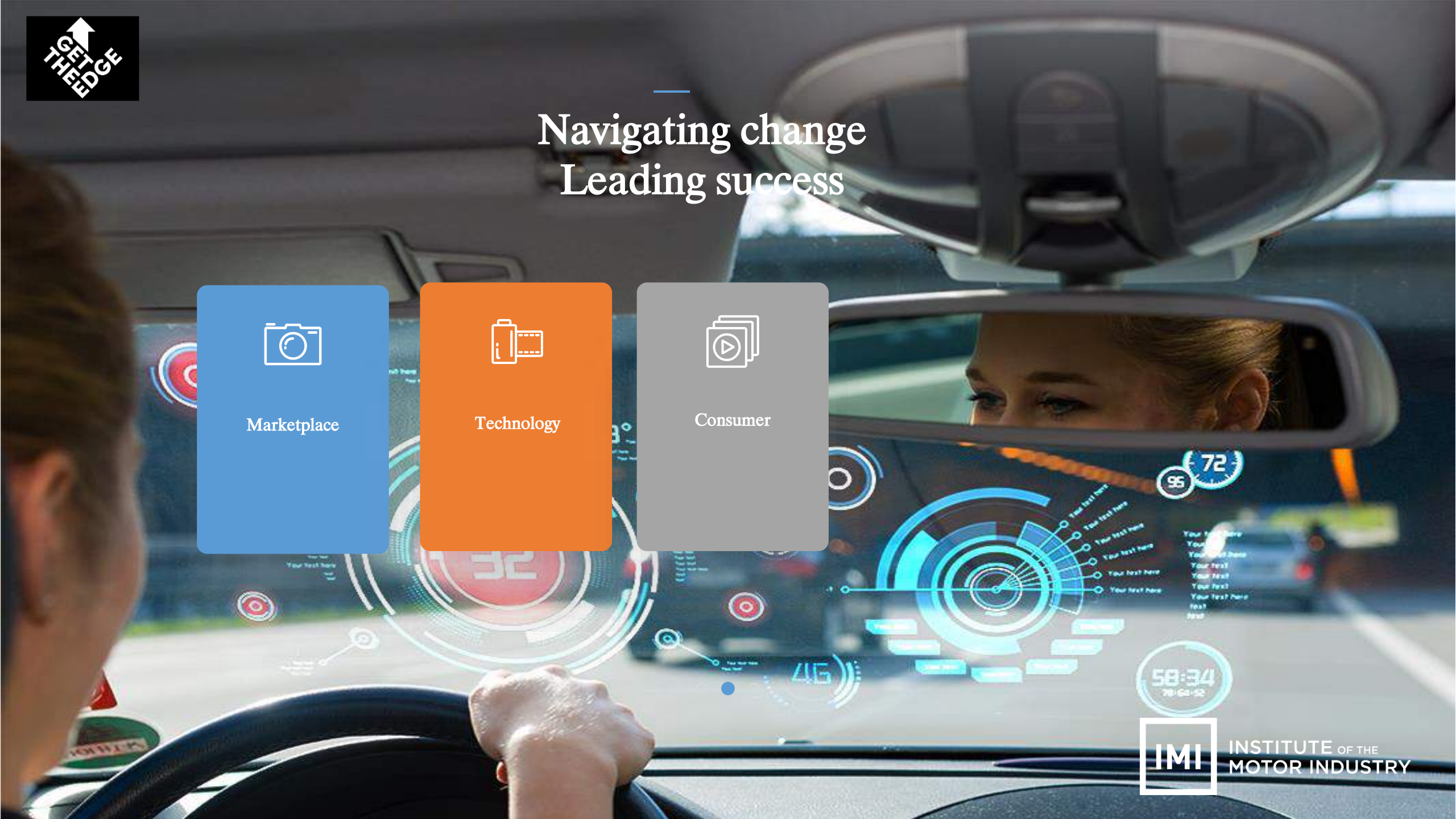
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# Consumer

"The only way to make sense of change is to plunge into it, move with it, and join the dance." – **Alan Watts**

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# A Snapshot of Differences

| | Traditionalists | Boomers | Gen X | Millennials |
|---|---|---|---|---|
| **Education is…** | A dream | A birthright | A way to get there | An incredible expense |
| **Work Ethic** | Dedicated, pay your dues | Driven, workaholic | Balance, work smarter with greater output | Ambitious, done at 5:00, entrepreneurial |
| **Technology** | Adapted | Acquired | Assimilated | Integral |
| **Preferred Work Environment** | Conservative, hierarchal, top-down management | "Flat" hierarchy, democratic, warm and friendly | Functional, positive, efficient, fast-paced and flexible | Collaborative, creative, diverse, continuous feedback |
| **Interactive Style** | One-on-one | Team player – lots of meetings | Entrepreneur, cut to the chase | Collaborative , lots of feedback |

Employee

"People don't resist change. They resist being changed!" – **Peter Senge**


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Engage To Change

# Leadership

"In times of rapid change, experience could be your worst enemy." – **J. Paul Getty**

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#1 Inspire a shared vision
#2 Model the way
#3 Challenge the process
NEWS
#4 Enable others to act
#5 Encourage the heart
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Lisa Davies, Director
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