Briefing 22-44 October 2022

Scottish Fleet, Waste and Grounds Seminar 2022: Report Back (Fleet)

To: All Chief Executives, Main Contacts and APSE Contacts in Scotland. For information only to England, Northern Ireland and Wales

Key Issues:

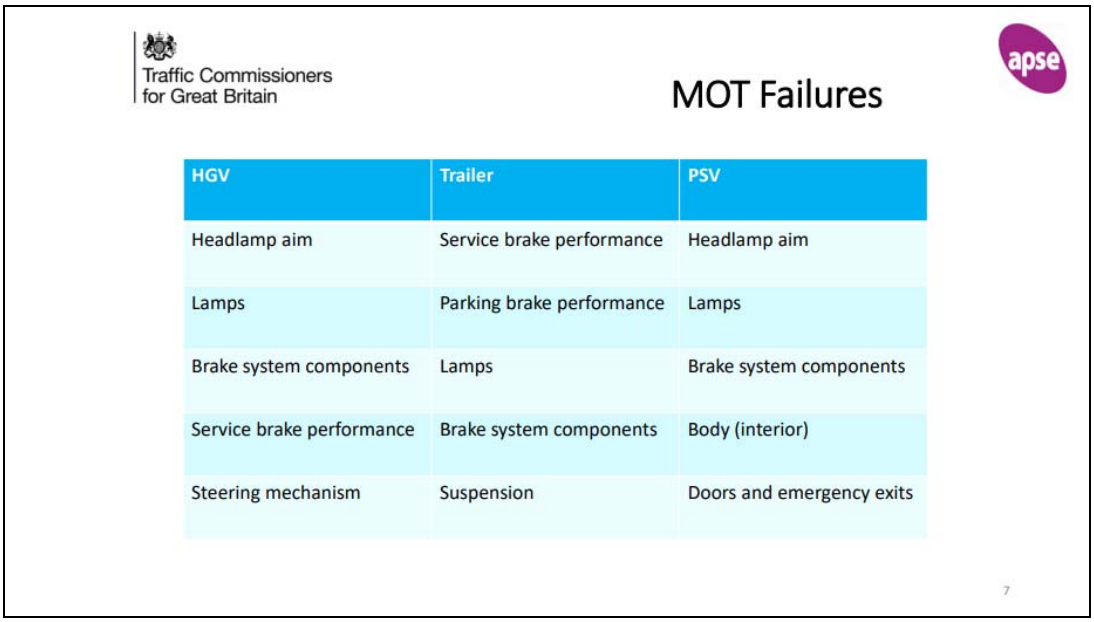
On 18th and 19th May 2022, APSE held its annual Scottish Fleet, Waste and Grounds seminar in Aviemore. This briefing provides a short summary of the seminar's fleet speakers and the topics covered at discussion forums. There are three separate briefings for the fleet, waste and grounds sections. Links to all of the presentations can be found here.

1.0 Presentations

Keynote address: Responsibilities of fleet managers and latest issues

Claire Gilmore, Traffic Commissioner for Scotland

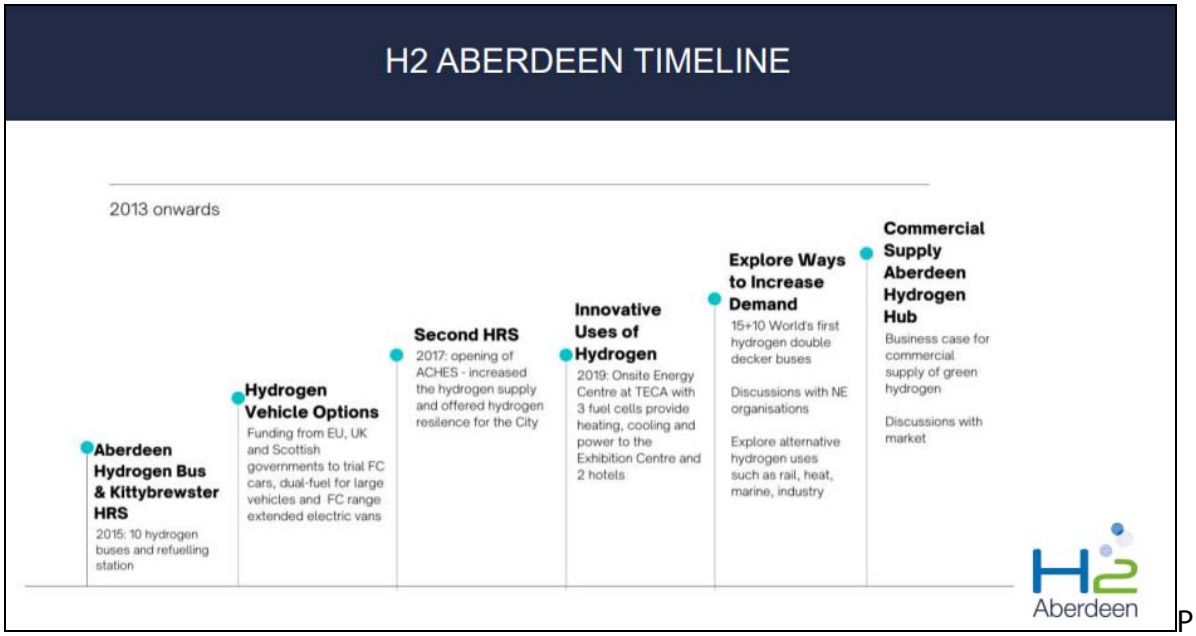
The seminar was opened with a keynote address from Claire Gilmore, Traffic Commissioner for Scotland. Claire spoke about where they are with applications, hearings and communications and education. Claire also spoke about governance and responsibilities in the public sector, risks and mitigations and the role of the transport manager. There were many lessons from last year with virtual training, remote compliance audits and adjusted maintenance schedules. Claire detailed the most common MOT failures for HGVs (headlamp aim, lamps, brake system components, service brake performance, steering mechanism), Trailer (service brake performance, parking brake performance, lamps, brake system components, suspension) and PSV (headlamp aim, lamps, brake system components, body interior, doors and emergency exits).



2000 bridge strikes occur annually with 90% of those being railway bridges; this led to 1,303 cancelled train journeys as at 2019/20. Each strike delays trains by 2 hours on average with each incident costing over £13,500. The Traffic Commissioner also spoke about the risk-based approach for vehicles and drivers, reminding transport managers of what is expected of them with regards to things like infringement reporting, annual testing, brake testing and preventative maintenance inspections.

In Aberdeen - hydrogen is here!

Pam Walker, Waste & Recycling Manager, Aberdeen City Council



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am provided an overview of the hydrogen timeline for Aberdeen from the introduction of 10 hydrogen buses and a refuelling station in 2015 to having the world's first hydrogen double decker buses. Most recently they have put together a business case for the commercial supply of green hydrogen and have had discussions about this with the market.

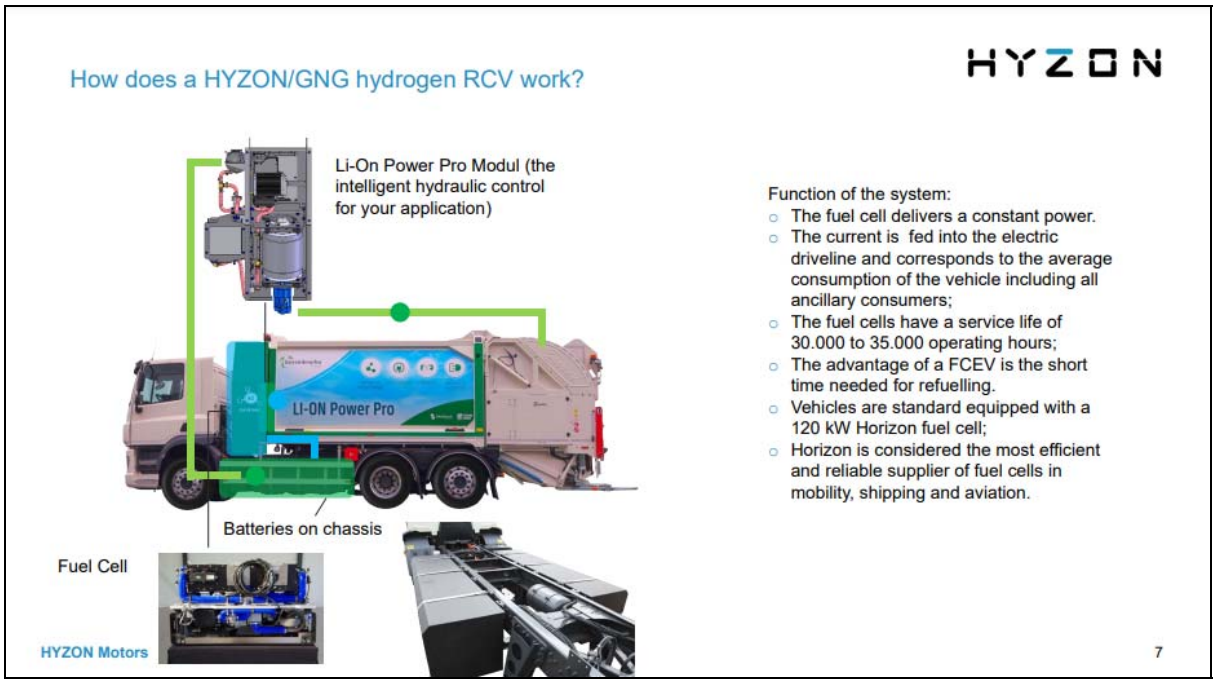
Aberdeen has two refuelling stations delivering 130kg and 360kg per day; they are 350 and 700 bar capable. They can refuel cars, vans, buses and large vehicles, and both are 'green tariff' stations. Aberdeen has one of the largest and most varied hydrogen fleets in Europe with over 85 vehicles deployed to date. This includes cars, vans, buses, refuse trucks and road sweepers. They are one of 7 cities in 5 countries involved in the HECTOR Project (Hydrogen Waste Collection Vehicles in North West Europe), which aims to demonstrate that fuel cell garbage trucks provide an effective solution to reduce emissions from road transport in the North West. Aberdeen are using the UK's first operational FCEV (fuel cell electric vehicle) waste truck provided by Geesinknorba and Hyzon with an estimated range of 150 miles. The manufacturers supplied technical training to workshop staff and familiarisation training to drivers covering fuelling and vehicle operation. Several workshop staff also underwent high voltage training. Their current workshop has modifications carried out including designated hydrogen bays with sensors to identify leakages. Their dual fuel waste trucks (H2ICED) are hydrogen and diesel

with a 9.8kg capacity, 180km range and can run on diesel if the hydrogen supply is ever an issue; they provide a CO_2 emission saving between 20-30%. The Council announced a Joint Venture company this year wholly owned by the Council and BP to deliver the Aberdeen Hydrogen Hub. The Hub will be Scotland's first scalable green hydrogen production facility with the first gas expected in the first quarter of 2024.

Accelerating the energy transition

André Lagendijk, Sales Manager Europe, Hyzon Motors

Hyzon is a leading global supplier of zero emission hydrogen fuel cell powered commercial vehicles with manufacturing locations in USA, Netherlands, China and Australia. André Lagendijk from Hyzon Motors provided an overview of the HYMAX range of vehicles (HYMAX-160 4x2 RIGID, HYMAX-250 6x2 PULLER, HYMAX-250 4x2 PULLER, HYMAX-250 LE (low entry) 6x2 RIGID) and spoke about the collaboration between Geesinknorba and Kyzon to significantly improve the local and global environmental impacts of waste collection activities.

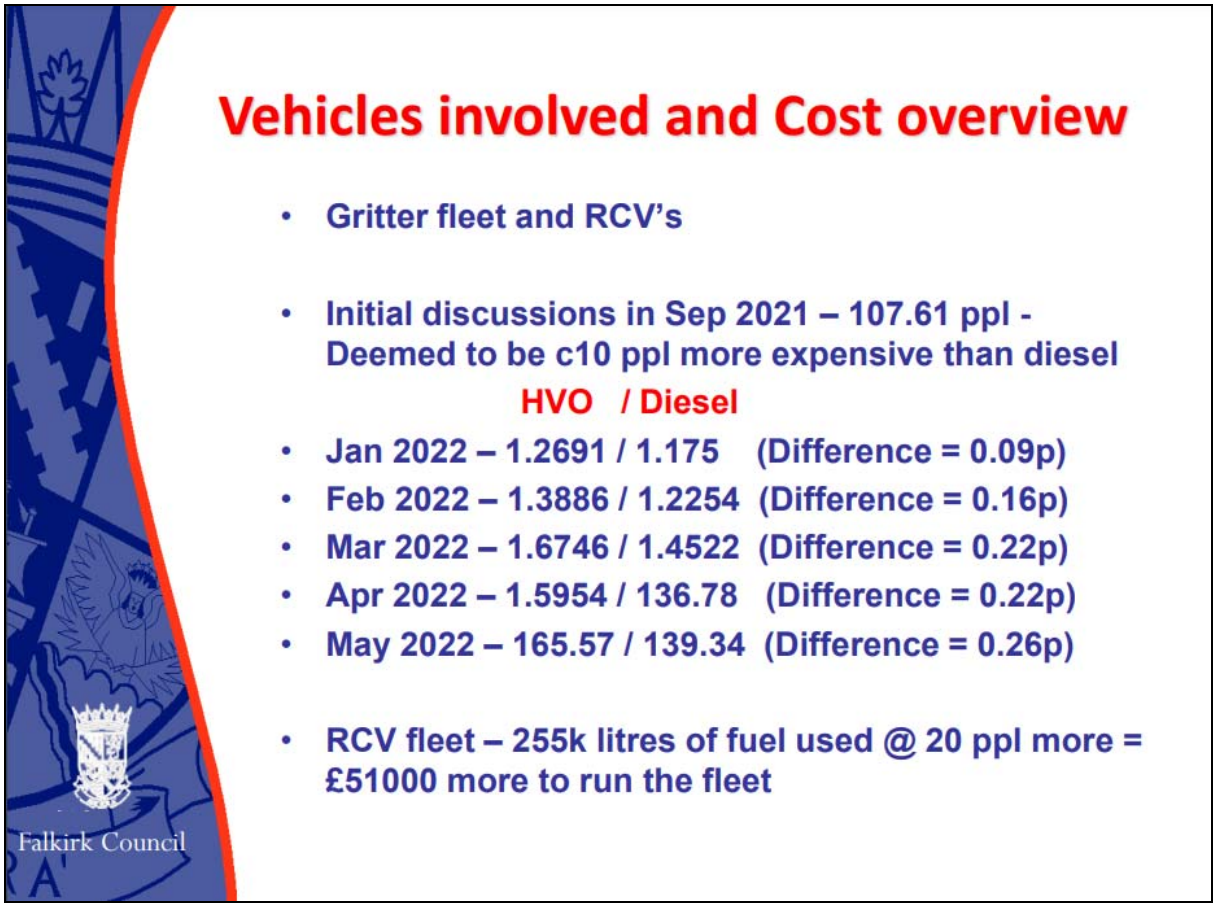


André explained how hydrogen works, how the HYZON/GNG hydrogen RCV works and the advantages of hydrogen in general. The hydrogen tanks in the vehicle hold the fuel which is pumped into the vehicle, hydrogen and air are funnelled into the fuel cell system which generates electricity, and the electric motor turns the wheels. The system functions where the current is fed into the electric driveline and corresponds to the average

consumption of the vehicles including all ancillary consumers, fuel cells have a service life of 30,000 to 35,000 operating hours; the advantage of a fuel cell electric vehicle is the short time needed for refuelling. Vehicles are standard equipped with a 120kW Horizon fuel cell; Horizon is considered the most efficient and reliable supplier of fuel cells in mobility, shipping and aviation. The advantages of hydrogen included driving and operating with low noise emissions, no exhaust emissions from the vehicle, a long range of up to 600km and 100% emission-free operation when using emission-free energy sources. He also explained the process of converting a Mercedes Econic to hydrogen and showed some examples of Hyzon vehicles in operation.

Hydrogenated Vegetable Oil (HVO): Can it be a stepping stone before going fully electric?

Pat Taggart, Fleet Service Manager, Falkirk Council



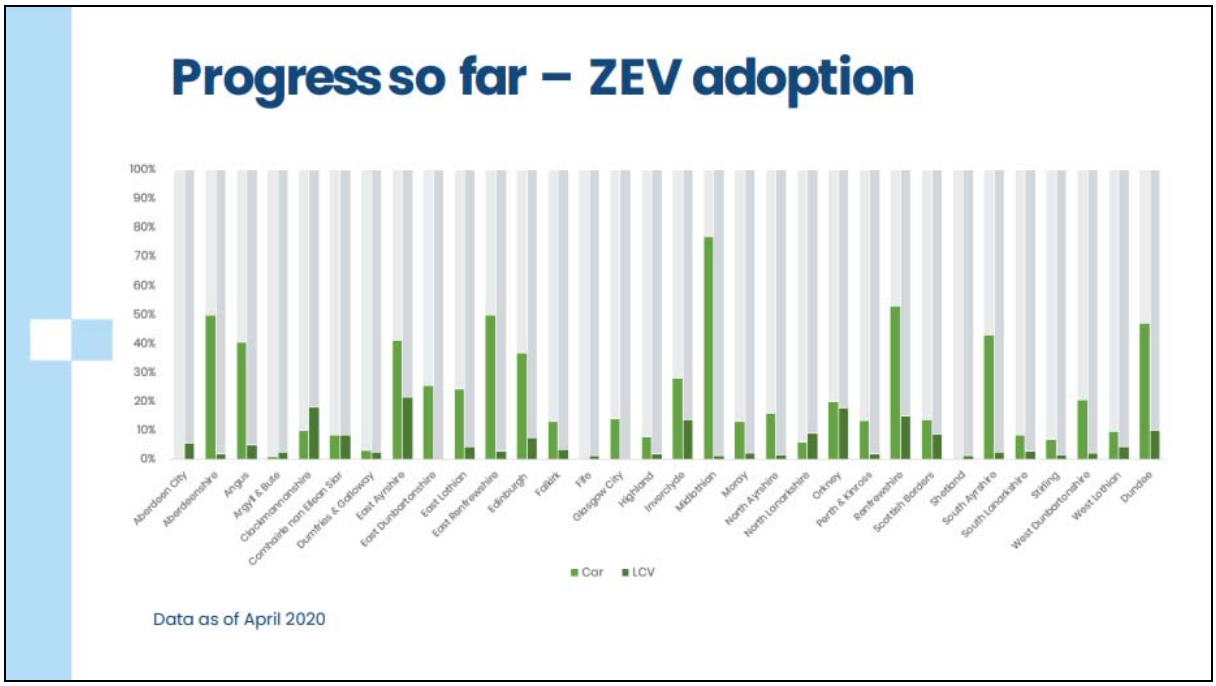
Pat Taggart from Falkirk Council presented on using hydrogenated vegetable oil (HVO) in the fleet service. Falkirk are the 16th largest authority in Scotland covering an area of approximately 112 square miles. It has a mix of urban and rural communities with 640 council vehicles, 120 of which are pool cars. The service areas covered include Building Maintenance, Grounds Maintenance, Roads, Street Cleansing and Waste.

The benefits of using hydrogenated vegetable oil fuel are that it is made from sustainable and raw materials, it reduces carbon emissions by as much as 90%, it has a longer shelf life meaning you can store it for longer, it is suitable for fleet, plant, machinery, generators and industrial power systems, and it is suitable for use up to temperatures of negative 40 degrees. There were many safety considerations provided by Certas – potential issues include that it could be fatal if swallowed, repeated exposure may cause dryness or

cracking of skin, water jets should not be used to extinguish fuel and there is a risk of soil or water contamination if leaks occur. Falkirk identified a spare tank with 22,500 litre capacity and ordered an initial 10,000 litres; they increased stock to prevent business continuity issues and have had absolutely no issues to date. The vehicles involved were their gritter fleet and RCVs. Their analysis of the cost of the fuel compared to diesel between January and May 2022 showed that HVO cost between £0.09 and £0.26 more expensive per litre. Currently vehicles are still using hydrogenated vegetable oil with no fuelling or supply issues. There have been a lot of CO2 savings realised but there are cost implications involved and a decision is required on future use of hydrogenated vegetable oil by the Council. Pat rounded up by talking about what the future might hold for the Council, this included: electrification of the council fleet, the council's climate change commitments and the Scottish Government deadlines which need to be considered, the need for further funding and the potential use of hydrogen fuel.

Support with decarbonising your transport

Gordon Manson, Programme Manager - Technical Projects, Energy Saving Trust



Gordon Manson from the Energy Saving Trust presented on the support available to decarbonising your transport. The Energy Saving Trust are an independent organisation dedicated to promoting energy efficiency, low carbon transport and sustainable energy use. They aim to address the climate emergency and deliver the wider benefits of clean

energy as we transition to net zero. They empower householders to make better choices, deliver transformative programmes for governments and support businesses with strategy, research and assurance – enabling everyone to play their part in building a sustainable future.

Gordon promoted the Fleet Decarbonisation Forum which is a bi-monthly forum that has been running for the last 2 years and is open to all public sector fleet managers. 50 to 60 attendees are at each session with peer-to-peer knowledge sharing and industry specialist guest speakers. Topics covered so far include vehicle selection, charging infrastructure, zero emission HDVs, grey fleet replacement, hydrogen transport, and digital tools. It aims to be to a useful platform for sharing knowledge and new ideas. The Energy Saving Trust's transport support package includes fleet decarbonisation reports which have bespoke analysis of existing fleet and depot energy supplies to inform fleet decarbonisation plans. They have already engaged with 32 local authorities, 14 NHS trusts and multiple public sector organisations. The fleet decarbonisation guide is a central resource of fleet decarbonisation guidance with the Energy Saving Trust's accumulated knowledge on all thing's fleet decarbonisation; the resource will evolve and develop over time.

Gordon also spoke about funding support from Transport Scotland for 2022-23 which is yet to be confirmed, with the funding model shifting more towards private sector investment in public sector charging infrastructure and vehicles. Transport Scotland are working with Scottish Futures Trust to investigate alternative financial and operational models. Gordon provided an overview of the current makeup of the Scottish local authority fleet, profile, their progress so far towards Zero Emission Vehicle adoption and their capacity to support electric fleet; he also provided the same information for the NHS and other public sector bodies. Gordon outlined a number of key challenges including the high capital cost of vans / HDVs and charging infrastructure, the limited viable vehicle options, the lack of staff resource and skills, uncertainty over charging infrastructure strategy and limitations to depot power supplies. Other key challenges included working in partnership with other internal departments, uncertainty over strategy, long vehicle supply lead times for zero emissions vehicles and staff mindset issues such as range anxiety.

Gordon spoke about the many opportunities with the rapidly increasing choice of vehicle models, good quality data collection supporting fleet decisions, focus on rationalising both fleet and charge points, 'home start' charging solutions, and innovative funding solutions. He concluded his presentation by saying that the public sector are already setting a great example for the rest of society, that there are some significant challenges that will be overcome, that the Energy Saving Trust is here to support as best they can, and that he is really looking forward to seeing a fully clean, green public sector fleet improving air quality and reducing emissions.

Electric fleets: how good are they?

Dr Euan McTurk, Consultant Battery Electrochemist, Plug Life Consulting

Dr Euan McTurk was unable to attend the event in person as he was filming a series of electric vehicle reviews for the Faster Project which is installing 73 much needed DC Rapid chargers across the Republic of Ireland, Northern Ireland and the West of Scotland including the Highlands. He provided a video presentation instead that has been transcribed below.

We're here to talk about fleet EVs, so first of all, are they reliable? The answer is very. Here is a prime example, this is Wizzy the Nissan Leaf taxi from Cornwall. This is one of the earlier Nissan Leaf's, only a 60-to-80-mile range, smaller 24kW hour battery, no thermal management system and despite this, after 100,000 miles it still had all 12 of its State of Health bars, that means the battery is still in excellent health despite being repeatedly rapid charged in constant use as a taxi. That vehicle would go on to do 174,000 miles in four years on the original battery which admittedly had degraded a little by that time but was still in daily use. In terms of the total repairs in that time, the only mechanical failure was one ball bearing.

So why are electric vehicles so reliable? As I have just mentioned, electric vehicles are the most reliable vehicles on the road. They have far less moving components and a lot less to break. An electric vehicle motor only has a handful of components to it, whereas an internal combustion engine has hundreds of moving components. An electric vehicle

doesn't need things that are expensive to replace like a clutch, a gear box, an exhaust gas regulator or timing belt. There is also far less heat and vibration, electric motors are smooth and efficient and very little energy is wasted on heat. The round-trip efficiency, the source to wheel efficiency is about 70%, whereas an internal combustion is about 20% of the energy of the fuel you put into it.

So why do electric vehicle batteries last longer than phone or laptop batteries? There was this misconception that EV batteries would last between 3 and 5 years. There is much better battery management in electric vehicles and control electronics that keep the voltage and currents in their optimum condition. There is active thermal management. Typically, it's a liquid-based cooling system that keeps batteries at their optimum temperature. EVs typically operate between -10 to 30 degrees in the UK environment, whereas phones are between 37 and 50 degrees (they live in your pocket, are always warm and cause the cell to degrade quicker), and laptop CPUs get up to 90 degrees, they are exposed to very hot temperatures and a temperature gradient. Looking next at mechanical components, you'll need to do your suspension but there is hardly any brake wear in an electric vehicle because of regenerative braking. The brake pad lifespan on an EV is typically upwards of 100,000 miles compared to 40,000 on a petrol or diesel car. You don't have an exhaust, gearbox, clutch or anything like that. Less components equal less failures which equal cheaper running costs and more reliability.

What about the materials used to make batteries? Progress is being made very rapidly, but we need to understand what is in a lithium-ion battery first. In your electric vehicle you'll have a battery pack made up of a series of modules, these are the building blocks of the battery pack in which you'll find the cells that contain the electrochemistry that stores and releases that energy. There are different types of cells – you get cylindrical ones like you find in a Tesla, you get prismatic ones which you'll find in some Volkswagen electric vehicles, and pouch cells which are found in the vast majority of vehicles today, it's basically a laminated aluminium foil which the electrode stacks are vacuum squeezed into. There are no rare-earth elements in lithium-ion batteries. There are 14 million tons of lithium on land in brines or rocks, enough for 1.14 billion 40kWh Nissan LEAF batteries, as well as 230 billion tons of lithium in the ocean, enough for 18.7 trillion 40kWh Nissan LEAF

batteries. We are not going to run out. Cornwall has some of the most lithium-rich brines in the world, those are being extracted by two companies at the moment. Direct Lithium Extraction is a new technique which is being used on brines with a 3 times higher yield and vastly reduced water consumption. Basically, whenever someone says there is a problem with lithium-ion batteries or electric vehicles, someone has already gone a long way to commercialising a solution for that. As for cobalt, are we going to run out? Tesla in 2009 were using 11kg of cobalt per car, in 2020 they were using 4.5kg of cobalt per car despite the fact the battery had even more range in it. Over in China, Tesla's factory has started using CATL which is the biggest cell manufacturer in the world, they have lithium iron phosphate cells (LFP) that they have managed to improve the energy density of to the extent you can get over 200 miles range out of a chemistry that was previously deemed not very energy dense or good for long range. What is interesting about lithium iron phosphate is there is no cobalt so no nickel. Incredibly cheap to make, incredibly sustainable. Ford, Volkswagen and Mercedes are planning to use LFP soon. For the long-range vehicles, you've got NMC811. A research group closely affiliated with Tesla prove that the NCA batteries we were talking about in the previous slide can be cobalt free, we as electrochemists had previously thought we needed cobalt in there for stability.

What happens to EV batteries when they die? They get reused, then recycled. This whole idea of them ending up in landfills isn't true. When your electric vehicle battery reaches end of life you will take it out of the vehicle. End of life for an electric vehicle battery is deemed as 70% of its original capacity. If you look at the KIA e-Niro, that still translates to 190 miles of range, that is perfectly usable for a lot of cases, so you could actually continue to run it even if your battery has gone beyond its 8-year 100,000-mile warranty which is typical for electric vehicles. Once you've eventually found there is not enough capacity left you can drop out the EV modules from the battery pack and put them into energy storage systems, you can reuse them in domestic or grid scale energy storage. There are examples of this that use old lithium-ion batteries in Scotland, including the flagship charging hub of Dundee City Council at Princes Street which has 3 old Renault Zoe battery packs stacked on top of each other in a shipping container.

Energy storage is an easy life for old EV batteries. In a car it has a very dynamic duty cycle with a constantly changing power demand, there's sharp acceleration, sharp regenerative braking, rapid charging. It's rare it has a constant load. It's a hard life for batteries, but modern EV batteries are still likely to last as long as the chassis. In grid storage, it's far more constant loads and far lower loads, it's far more predictable, it's a very easy life for an old battery which reduces its rate of degradation and gives it many more years of useful life. When batteries die completely, battery recycling is very much on the up. It is increasingly efficient, there are new techniques being developed in 100 research groups around the world working on this. We've also found batteries that have been made from recycled materials have shown better performance than the original batteries they were made from. There are also mandates across the world particularly in Europe that amounts of recycled batteries need to be incorporated. The big problem is that EV battery recycling hasn't been done in large volumes yet because there aren't large volumes of batteries to recycle yet because they're all still going strong in EVs. We are starting to see recycling facilities being built, the Britishvolt and Glencore EV battery recycling facility in the UK is one of several I am aware of.

How much do EVs cost to run? Let's compare typical diesel and electric taxis.

Kia e-Niro (250-270 mile range)	Model	Skoda Octavia diesel
4.5 miles/kWh	Fuel economy	50 mpg
£0.20/kWh	Fuel cost	£1.66/litre
£0	Tax	£160
£1,333.33	Annual fuel and tax costs (30,000 miles/year)	£4,691.80

These are both popular taxis in use in Dundee. Looking at electricity prices today I've tried to take an average of people on tariffs from before times and people who are on tariffs now the prices have fluctuated. You've not got car tax to worry about, you are saving

roughly £3,358 per year in fuel and tax versus a typical diesel saloon with the Kia e-Niro, that is not even looking at maintenance costs. If you are able to use the off-peak home tariff of £0.075kWh, you would instead be saving £4,192 per year. If you only have access to public rapid charging infrastructure Instavolt is one of the more expensive out there at £0.50kWh, but you would still save £1,358 per year.

What about your maintenance costs? New brake pads will be required about every 40,000 miles for a diesel vehicle versus 100,000 miles or more for an electric vehicle. Your dealer service costs will also typically be cheaper for an electric vehicle because there is less to service, companies like Nissan do this. An electric vehicle motor and battery will both last hundreds of thousands of miles, we have not really seen many major battery failures even out with the warranty period. Compare that to a diesel vehicle with a timing belt, gearbox, clutch, exhaust, head gasket etc and it can get very expensive. You will also have access to low emission zones or zero emission zones.

What about niche Local Authority vehicles where electric options are limited or expensive? Lorna McAteer from the National Grid who is respected in this field quite wisely said just do what you can at the moment. There is a Scottish solution to this coming soon. If you look at options for Hackney Cab drivers who have a diesel vehicle, you can get an LPG retrofit that has no real savings in running costs and won't be granted access to Zero Emission Zones and won't be worth it. There's the e-NV200 Hackney cab retrofit, it is fully electric but doesn't look like a hackney cab, doesn't have permission to run in many Scottish cities because of the wheelchair accessibility setup and there is no liquid thermal management. There is the LEVC TX Taxi which is partly electric (it is a petrol range-extended EV), you have very limited electric-only range of about 50 miles per charge and it is very expensive to buy. What the Electron Garage has done in conjunction with others is develop a retrofit for the TX4 which is completely reversible. It is fully electric with almost 3 times the electric range of the LEVC TX for about half the price. You are saving between 5.5 and 11 tonnes of CO2 by reusing a chassis versus building a new one, you are using locally made components with Scottish-made battery modules, BMS and high voltage junction box which is a key internal component of the vehicle. The battery pack is liquid cooled with greater than 50kW CCS rapid charging capability with a powerful motor and

no alterations to the chassis. They are applying for the Clean Vehicle Retrofit Accreditation Scheme (CVRAS) which would give £10,000 off the retrofit to the prospective customers. They hope to provide test drives starting in Q2 2022, you can get in touch with the consortium if you're interested.

Scottish TX4 electric retrofit from the Electron Garage

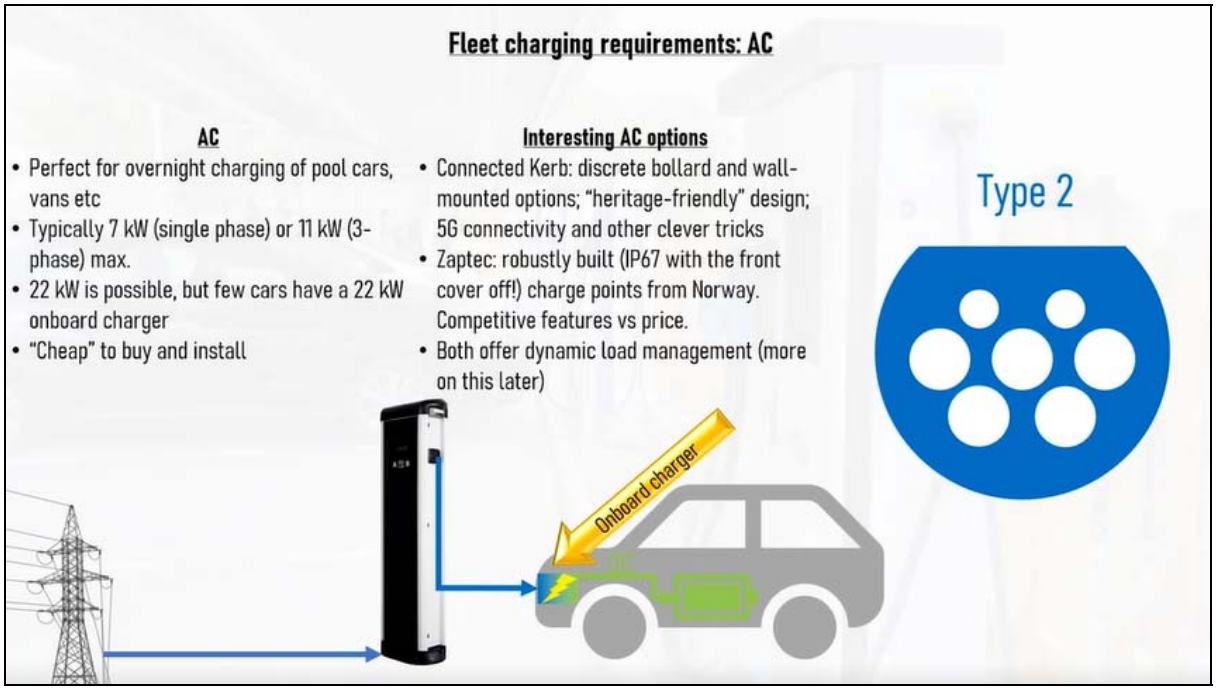
Taxi option	Fully electric?	Cost to customer	Real-world electric-only range?	Liquid cooling?	Rapid charging max power	Able to rapidly integrate new chemistries?	Notes
TX4 retrofit	**Yes**	**£30-£35k approx**	**140+ miles**	**Yes**	**>50 kW CCS**	**Yes**	**Compatible with all charging networks; 22 kW AC onboard charging optional; the only taxi with multiple cell supply chain options (resilient against factory shutdowns etc).**
Vehicle Repowering Solutions LPG retrofit	No (no electric propulsion)	£12,600	N/A	N/A	N/A	N/A	Soon to be ineligible for ULEZ access as still produces exhaust and CO2 emissions; not a zero-emission vehicle.
LEVC TX	No (36.7 mpg petrol range extender)	£55,599	50	Yes	50 kW CCS	No	Compatible with all charging networks; 22 kW AC onboard charging optional.
Dynamo e-NV200	Yes	£48,995	120	No	50 kW CHAdeMO	No	No CCS rapid charging (not future-proof); slower Type 2 charging speeds; likely to overheat if rapid charged repeatedly.

A summary of how it compared against the competition, it's the only one with modern rapid charging speeds, modern range, has liquid cooling so the battery should do the distance, and would be very affordable. That price does not include the CVRAS grant that would knock £10,000 off it, while reusing a perfectly usable chassis. Electric retrofitting can easily be applied to local authority fleet vehicles like minibuses and RCVs. The stuff done above with taxis could easily be done with local authority vehicles. Something to consider if you own your vehicles outright and are looking for a low-cost way of electrifying them.

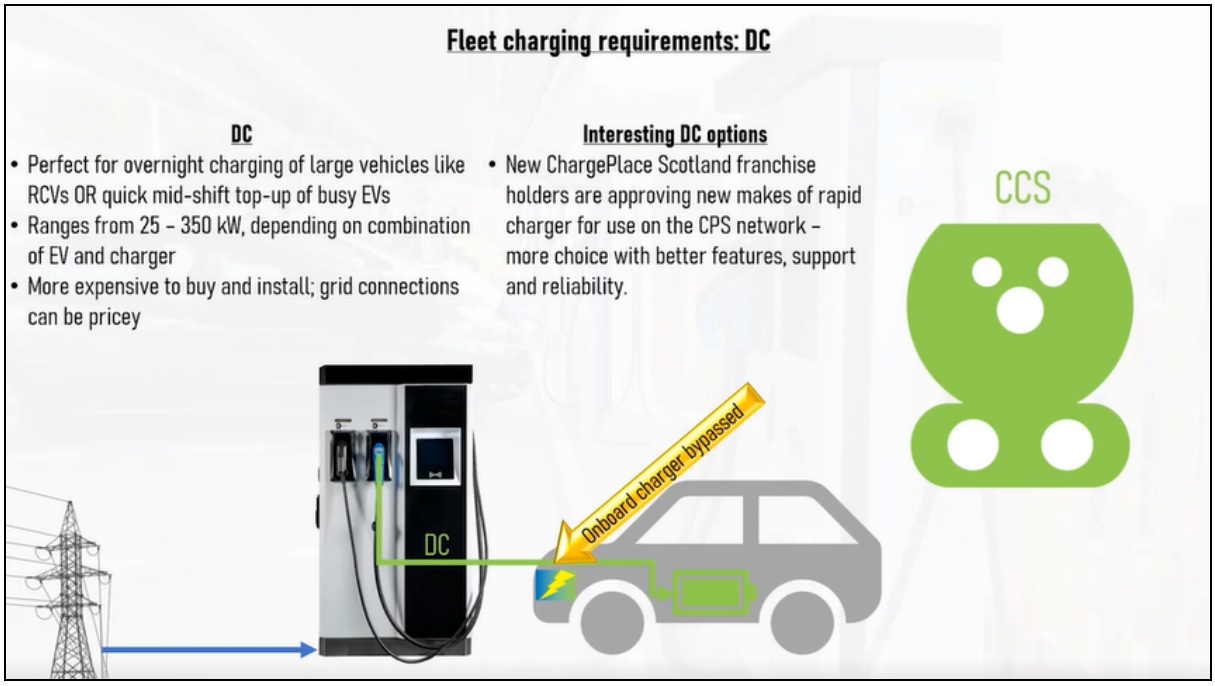
What about charging? ChargePlace Scotland has taught us the good, the bad and the ugly. It is quite lucky we've had this, as it is a hardware-agnostic testing ground of hardware reliability and aftermarket support. ChargePlace Scotland is just a back office, they don't actually own the charging infrastructure. They merely administer the charging sessions and the billing. Good charging infrastructure has good reliability and excellent customer support, fast lead times on repair (especially in rural areas), technicians and parts stockpiles based in Scotland to respond to issues quickly. Learn from other local

authorities, some have made mistakes on hardware choices and had to rip them out and replace them. Other local authorities have made good hardware choices, and enjoy excellent reliability, service and lead times on repairs. Crucially, if it's public facing infrastructure, they get an excellent reputation amongst EV drivers. East Lothian Council are an exemplary local authority in the provision of quality charging infrastructure for public and council fleets, they went from one of the worst in Scotland to one of the best in under a year. It is important to never, ever weight price above quality in tenders, you will end up paying twice. Connect with East Lothian Council and other leading local authorities and see what technology they are using.

In terms of your fleet charging requirements, AC, which is explained below.



There is also DC charging which is explained in the slide below.



If you have a red commando socket (63 amp round red socket) in your industrial premises you can get an instant rapid charger. You can get a Kempower T-Series, this is used by a number of Welsh local authorities for charging their refuse vehicles. It provides up to 40kW of charging power from a portable, wheelable charger. There is comparatively low cost with this option as there is no need for foundations or hardwiring of a new electricity supply. It can be wheeled into position to charge specific EVs, and if you are moving premises, you can easily take your charger with you. It is used by Newport and Cardiff City Councils in Wales to charge their eRCVs.

I'm going to speak next about dynamic load management, you can do this with AC but I'm going to describe how it works with DC. If you're charging multiple EVs from a limited grid supply, most DC rapid chargers today are either standalone with no power sharing, or only capable of sharing power in pairs. Both lead to underutilisation of capacity and slower charging of fleet or a bigger, more expensive grid supply to install enough DC chargers for your fleet. So how do you rapid charge multiple EVs from a limited grid supply? Kempower C Series power cabinets and S Series dispensers: multiple slim dispensers fed from a central power cabinet containing many 25kW power modules. Power modules can be connected in any combination to any EV on charge. You can max out your available grid supply with power modules, and let the charging system do the rest. You can have power modules allocated to EVs in 25kW segments, faster charging EVs get more modules, as EVs

reach a higher State of Charge and reduce their charging power, power modules are automatically reassigned to other EVs that can use them. The ChargEye software that comes with this lets you delay the start of DC charging until the off-peak electricity tariff kicks in (typically when grid demand and fossil fuel power generation is lower), making charging cheaper and cleaner as well as faster.

2.0 Transport advisory discussion forum

During the event, there was also a transport advisory discussion forum to debate the latest challenges and opportunities for the sector. Discussions included fleshing out a briefing on the roles and responsibilities of Vehicle Operator's Licence holders, hydrogen vehicle trials, hydrogenated vegetable oil as fuel, difficulty recruiting and filling vacancies, and CCTV van specifications for safer communities.

3.0 APSE Comment

APSE encourages our membership to engage with the best practice lessons shared by our membership at this event. The presentation slides are available online here.

Discussions are continued at APSE Scotland's Transport and Mechanical advisory group which is free to attend for APSE members. Previous presentations and discussion topics can be found on the APSE website. As well as the Importance of the Vehicle Operator Licence briefing, we have also recently produced our Transport and fleet Trend Analysis using our 2020-21 Performance Networks data.

Through our training suite, advisory groups, research programmes and benchmarking service, membership of APSE can bring significant benefits to those who work in local government – from officers to directors to elected members to chief executives – by helping them comprehensively get to grips with the latest policy and technological developments. Not a member? Sign up today!

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