3rd August 2023

EQUIPMAKE HOLDINGS PLC

Initiation of Coverage

Marketing Communication (Connected Research)

Equipmake Holdings PLC#

BBG Ticker: EQIP ASE *Price: 9.5p/sh.* *Mkt Cap: £90m* **BUY**

Year to May	Revenue (£m)	EBITDA (£m)	PBT (£m)	EPS (pence)	DPS (pence)	EV/Sales (x)
2022A	3.7	-4.8	-5.2	-2.2	n/a	22.4
2023E	5.1	-3.8	-4.5	-0.5	n/a	16.4
2024E	13.4	-4.7	-5.3	-0.6	n/a	6.2
2025E	24.0	-1.9	-2.4	-0.3	n/a	3.5

***SOURCE**: Company Data, VSA Capital Research.*

Technology Driving EV Performance and Efficiency

Equipmake (EQIP) is a UK-based technology company which produces high performance electric motors, inverter, control software, battery management and pack technology. These technologies are offered as separate standalone components and are also optimised to work together for customers to develop their own Electric Vehicle (EV) powertrain systems or retrofit to existing vehicles. EQIP technologies meet the differing performance and efficiency requirements of the heavy transport, cars, aerospace, and marine markets. EQIP, on IPO in July 2022, raised £10.0m at a price of 4.25p per share. A further £6.2m was raised in February 2023 at 5p per share. We forecast FY2024 revenue of £13.4m and EBITDA loss of £4.7m and for FY2025, revenue of £24.0m and EBITDA loss reduced to £1.9m.

Leading Motor Power to Weight Performance

EQIP's Zero Emission Drive (ZED) powertrain deploys electric motors developed with the Company's patented ultra-efficient thermal management technology to maximise efficiency and vehicle range. In May 2023, at the Battery Show Europe in Stuttgart, the Company showcased its Ampere 220 eAxle. This comprises EQIP's inverter, transmission system and Ampere electric motor which has peak power of 220kW, a maximum motor speed of 30,000 rpm and weighs just under 20kg. According to EQIP, the power to weight density of just 11kW per kg, is more than twice that of a conventional electric motor. Applications are across automotive, aerospace, and marine.

International Opportunity

The Company is seeing growing international interest in its technologies. In April 2023, it announced an agreement with Switzerland based aerospace company H55 to provide lightweight power dense motors for electric aircraft development. During May 2023, EQIP announced its first technology licensing agreement with India-based Sona Comstar, a global automotive systems and components manufacturer, is for certain EQIP EV technologies for applications in electric cars, buses, commercial vehicles and off-road vehicles in the rapidly growing India market.

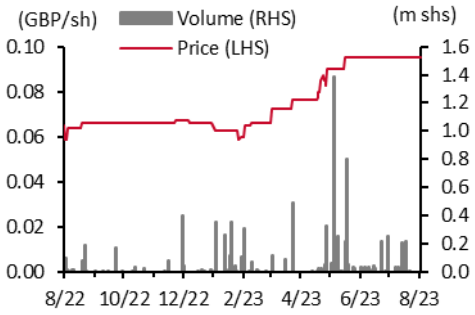
Recommendation and Target Price

We initiate research coverage of EQIP with a Buy recommendation and 12-month Target Price of 12.2 p/sh.

Group Description

An EV powertrain technology Company.

One Year Price Performance



Price % chg	1month	3month	12month
	0.0%	5.6%	61.7%
12million high/low			0.095p/0.059p

***SOURCE**: Eikon, as of 2 August 2023 close.*

Market:	London Aquis
Shares in issue	948m
Target Price (£/sh.)	12.2p
Free float:	96%
Net cash (May 2023):	£7.0m
Enterprise value:	£83.1m

Major shareholders

Ian Foley (CEO, Founder)	39.6%
ARC Co. Ltd	13.2%
Schroder Investment Mgt.	10.6%

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#VSA Capital acts as Joint Broker to Equipmake Holdings PLC.

Investment Case

Fully Integrated EV Platform

EQIP is a vertically integrated business that has designed key electric powertrain technologies and control software. The Company has also developed a complete EV powertrain platform so that existing Internal Combustion Engine (ICE) vehicles can be retrofitted for electric drives and also to provide a platform for new electric vehicles; both for road transport and also for aerospace and marine. The vertically integrated approach brings a number of advantages including the ability to design the whole electric powertrain such that the software and all the key components operate together in the most cost effective, dependable, energy efficient way, delivering the highest level of performance and range. Systems can also be designed with complete assembly in mind but also to enable next generation products to use existing manufacturing tooling and be backwards compatible for assembly. **EQIP has electric circuit boards assembled externally, whereas battery modules and motor housings are brought in.**

Licensing Technology: a Potential High Margin Revenue Stream

EQIP's EV powertrain technologies not only provide individual key components for electrification but also complete electric platforms. The automotive and transport markets are by their nature, safety critical applications. Technology has to undergo long and rigorous testing, not just to meet industry performance requirements but also safety standards and government regulatory standards for the countries into which it is sold. As such, technology development timescales for electric vehicle technologies are long and very costly for new entrants. The platforms are provided for clients to electrify existing Internal Combustion Engine (ICE) vehicles. However, EQIP owns specific EV technology IP and has full electrification platforms which offer solutions to companies seeking to enter the electric vehicle markets. EQIP also licenses its technologies enabling companies seeking to enter the EV markets to reduce development costs, engineering risk, approval timescales and product launch costs.

Technology Addressing a Broad Range of Applications

The Company is seeing strong commercial progress across a broad range of applications. In 1H 2023 (November end 2022), it delivered the first of twelve electric repowers of Optare Versa buses to **First Bus**, the UK's second largest regional bus operator, and subsequently received an LOI from the same customer the following month for a significant number of additional repowers of another bus make and model. EQIP continues to supply high-performance inverters to a European electric hyper car programme. The Company is also entering new international markets, in both South America and Indonesia, and in 1H 2023, signed a non-binding MOU with **PT Transportasi Jakarta** and **PT Vktr Teknologi Mobilitas** for an implementation plan for an electric bus retrofit trial in Jakarta, Indonesia. EQIP delivered a fully electric bus to Buenos Aires, developed in partnership with Brazilian bus manufacturer **Agrale** and Argentinian coachbuilder **Todo Bus**. EQIP has received further orders from **Emergency One (UK) Limited** to supply EV products and systems for fire trucks into the US and UK markets. In Aerospace, the Company has delivered bespoke motors and inverters to leading EVTOL Company **Vertical Aerospace Group Ltd (EVTL NYSE)**, for prototype electric aircraft build and delivered a first lightweight, high-energy-density electric motor and inverter to **Gilmour Space** for commercial rockets.

Valuation

EQIP is at an early stage of growth and the risks of forecasting revenues and earnings are higher. The Company recently reported a year-end trading update for FY2023 anticipating revenue of £5.1m. For FY2024 and FY2025 respectively, we forecast revenue to grow to £13.4m and £24.0m; from rising system sales in heavy transport and growth in revenues from electric motor, inverter, and battery pack technologies. We forecast EQIP moving into profit in FY2026 producing an EBIT of £0.2m as volumes rise into the longer-design in timescale vehicle OEM markets. Our valuation, to set a 12-month price target, is based on a blend of two valuation methods: EV/Revenue and a DCF to be able to factor the strong future growth potential. Based on our FY2024 and FY2025 estimates, we have used an EV/Revenue valuation for the Transitional Energy Technologies sector, combined with EV Technologies sector and weighted at 60%. Our DCF, based on explicit forecast cashflows, is weighted at 40%. We are, on a blended basis, valuing EQIP at an EV of £108.4m and market capitalisation of £115.4m (given reported end cash of £7.0m for May 2023 end). **Buy. Target price 12.2 p/sh.**

Overview

In the table below we have summarised our forecasts for revenues and gross margins from each EQIP business segment. As can be seen, near term we expect the largest profit driver to be from the growth in demand for repowering fossil fuel buses with the Company's electric powertrains. Equipmake is also in the early stages of growing sales from EV Technologies, including electric motors and inverters, into the automotive and aerospace sectors. Given the longer design-in timescales for these markets, we expect demand for EV Technologies to materially increase from FY2025 (year commencing June 2024).

Forecast Summary

Powertrains May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.8**	**9.4**	**16.5**	**27.3**
Gross Profit £m's	**-0.1**	**1.9**	**4.3**	**7.3**
Gross margin %	-3%	20%	32%	32%
EV Technologies May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.6**	**1.7**	**3.5**	**5.5**
Gross Profit £m's	**0.6**	**0.7**	**1.4**	**1.9**
Gross margin %	38.1%	41.6%	40.4%	35.6%
Prototype Engineering May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.3**	**1.7**	**3.0**	**3.0**
Gross Profit £m's	**0.5**	**0.8**	**1.5**	**1.5**
Gross margin %	35.1%	48.9%	50.0%	50.0%
Grants May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**0.1**	**0.6**	**0.8**	**0.1**
Gross Profit/loss £m's	**0.0**	**-0.6**	**-0.8**	**-0.1**
Licensing / royalties May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross Profit/loss £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross margin %	100%	n/m	100%	100%
Group May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Group Revenue £m's	**5.1**	**13.4**	**24.0**	**36.2**
Revenue growth %	**52%**	**166%**	**79%**	**51%**
Gross Profit £m's	**1.2**	**2.8**	**6.7**	**10.9**
Gross margin	23.9%	21.2%	27.8%	30.2%
Gross Margin excluding grant income	25.5%	26.9%	32.0%	30.6%

SOURCE: *Company Data, VSA Capital Research.*

Background

EQIP, based in Snetterton, Norfolk, UK was founded in 1997 by Ian Foley who is the CEO and major shareholder. The Company initially focused on providing engineering consultancy in the EV sector.

As the consultancy business evolved, EQIP commenced development of its own technology solutions. Early on, EQIP designed technology to control railway signalling power supplies, which was subsequently licensed to **EA Technology** who, at the time, functioned as an R&D centre for UK electricity organisations.

During 2007, EQIP identified a gap in the market for affordable high-performance electric motors and power electronics in the vehicle markets. The Company commenced development of electric flywheel energy storage technology and Formula 1 motor racing team Williams F1 became a key customer. In 2008, Williams F1 invested in the flywheel business, and it became Williams Hybrid Power. In 2009, contracts were awarded by **Porsche's (PSHG)** motor racing team who deployed the technology which then went onto to win the Le Mans 24-hour race. **Audi** also used the technology in their Le Mans 24-hour racing cars and went on to win 3 times.

Key milestones for EQIP include:

2012: EQIP began development of the first Spoke motor, developing a patented architecture which allowed the technology to be mass manufactured.

2015: EQIP began development of integrated inverter electronics to automotive safety standards.

2017: The Company is chosen by leading European electric supercar manufacturer as the supplier for its traction inverter. EQIP commenced development of an EV Powertrain project, CELEB (Cost Effective Electric Bus) with Brazil vehicle producer **Agrale**.

2019: EQIP opened a new 1,500 sqm purpose-built facility on the Snetterton Business Park located next to the famous motor racing circuit. The Company had started to make strong commercial progress with its EV technology platform and the factory was built to enable it to meet global demand for its electric bus chassis.

Nov 2021: Production deliveries of inverters to European manufacturer begins.

EQIP, prior to IPO in 2022, had raised finance through high-net-worth individuals and has benefited from £7.0m of UK Government Innovate grants.

Jul 2022: EQIP listed on the London Aquis exchange and raised gross proceeds of £10.0m through the issue of 235.3m shares at an issue price of 4.25p per share. The market capitalisation upon Admission at the issue price was £35.0m. On Admission, the Company had 823.5m Ordinary Shares in issue.

Nov 2022: Deliveries of repowered buses to First Group begins.

Feb 2023: EQIP raised a further £6.2m (before placing expenses) through the issue of 124.7m shares at an issue price of 5.0p per share. Trials of a New Routemaster bus repowered with the EQIP Zero emission powertrain for Transport for London begin.

Mar 2023: Unveiled the HPM-400, which is an ultra-lightweight, power-dense electric motor able to perform with a maximum speed of 20,000 rpm, peak power/torque of 400kW/250Nm and yet has a mass of only of 30kg. EQIP believe that it is one of the most power dense electric motors in the world and is suitable for high-performance space, aerospace, and marine applications.

Signed a lease on additional 50,000 sq. ft. capacity unit, enabling the volume re-powering of vehicles including buses, coaches and expanding the UK manufacturing capacity for their motors and battery packs.

The Drive to Electrify

The U.S. based International Energy Authority (IEA) estimated that in 2021, global CO_2 emissions increased by 6% to 36.3bn tonnes; their highest ever level. During 2021, emissions from the transport sector increased by 8% to 7.7 Gt CO_2, up from 7.1 Gt CO_2 in 2020 as pandemic restrictions were lifted and passenger and goods movements began to rebound.

Within transport emissions, road transport is the major cause of CO_2 emissions. This is a driving force behind the electrification of the transport sector. Bloomberg New Energy Finance (BNEF), in a February 2023 report, estimated that electrified transport spending reached US$466bn in 2022, up by 54% compared to 2021. Over half of this total (55%) took place in the APAC region, where China is leading the EV-transition.

BNEF estimated that of the US$1.1trn invested in the global energy transition in 2022, electrified transport accounted for 42% of investment, coming in just behind the US$495bn invested globally in renewable energy.

The electrification of transport is not only occurring to reduce global CO_2 emissions but also air pollution. The World Health Organisation (WHO) estimates that outdoor air pollution caused 4.2m premature deaths in 2019. Vehicle emissions are thought to have significant impact on urban dwellers' health. Major urban centres rely on large bus fleets to provide public transport alongside metro rail.

In 2022, Bloomberg New Energy Finance (BNEF) indicated that there were just over 3m operational buses globally.

The IEA reported that in 2021, the global electric bus stock was 670, 000 and electric heavy-duty truck stock was 66 000. Whilst Asia, specifically China, is leading growth in transport electrification, EQIP's regions of operation, Europe and South America are accelerating investment and growth.

Operations

EQIP today employs 94 full time staff of which 40 are professional engineers. The Company's HQ, based at Snetterton, Norfolk, England, is shown in the photograph below.

EQIP UK Headquarters and Main Facility

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

The 1,500sqm Snetterton facility, opened in 2019, houses:

- Software development, including optimised BMS;
- Electric motor and ASIL D certified inverter development;
- Electric motor housing machining;
- Component and ZED system assembly;
- Quality assurance and shipping;
- Client engineering interface and support;
- Central operations and marketing.

In house development expertise encompasses:

- Electromagnetic analysis;
- Mechanical design including stress analysis;
- Cooling design including computation fluid dynamic (CFD) analysis;
- Application of optimisation software (to maximise key technology performance ratios).

A Second Facility Has Been Acquired

In March 2023, EQIP announced that it had secured a flexible lease on an existing 50,000 sp. ft. unit, to provide additional capacity to accommodate fast growing demand. This development will also see EQIP bring motor winding and vacuum impregnation in house and provide the capacity to scale up its commercial vehicle retrofitting programmes with its customers.

Integrated Platform

The Company currently delivers electrification technologies into multiple markets including low volume premium sector electric cars, commercial vehicles, marine and aerospace (incorporating electric aircraft, eVTOL and space). An electric vehicle platform has five key elements: the battery pack and batteries, Battery Management System (BMS), Vehicle Control Unit (VCU) and software, inverter technology to control the feed of battery energy to the motor and the electric motor.

EQIP has taken a vertically integrated approach and developed these core EV technologies (with the exception of battery modules where it purchases best in class product from international suppliers) so that it can offer them as separate components or able to work together integrated into a complete electric powertrain platform; this provides considerable flexibility to its customers and enables the Company to match its product offering to the exact needs of a varied customer base.

The ability to integrate these products into a complete powertrain is a significant differentiator for Equipmake.

Equipmake's integrated systems design approach produces valuable IP. This is vital, given the level of design, development engineering, testing, optimisation and certification that is required in one of the most arduous and safety critical markets, being transportation. **EV powertrains and their core components require multimillion investment and years of development.**

The Company, with a proven vehicle electrification technology, is able to address markets including:

- existing vehicle manufacturers seeking to move their product portfolios from ICE to EV;

- new vehicle manufacturers that want to enter the electric transport market and require a proven technology platform to support their time to market aspirations;
- automotive industry suppliers seeking to address EV producers;
- new applications including autonomous vehicles and robotics, for example in aerospace, industry, and military;
- existing ICE vehicles across heavy transport and passenger requiring retrofitting with an EV technology platform that can be easily installed and will provide the reliability and operating costs to support their commercial models.

Business Model

The Company has four main sources of revenues:

Powertrains: EQIP provides and fits its whole electric powertrain (the EQIP Zero Emission Drive ZED platform) to convert existing fossil fuel powered vehicles to EV's. End markets are existing vehicle fleet owners, specifically major bus operators that are seeking to fully electrify existing diesel, petrol and hybrid fleets.

EV Technologies: this comprises revenues from the sale of complete electric powertrains, control software and EQIP motor, inverter and VCU and BMS technologies. Markets addressed are across automotive, marine, and aerospace.

Technology Licensing: licensing the EQIP technologies enables clients to reduce EV platform development engineering risk, design and development costs, product approval and certification timescales and launch costs.

Engineering projects: the Company, given its expertise in electrification technologies, is requested to undertake specific design and development for customer prototypes. EQIP charges for these development services (under EQIP's Prototype Engineering activities) and retains the IP arising from its work. Given the high value add to clients of this work, EQIP secures a high gross margin, typically 50%.

EQIP Technologies

Electric transport solutions in cars, buses, and heavy transport are more costly than ICE and suffer range limitations through system weight and motor/EV powertrain system inefficiency. Early on, EQIP recognised the market need for lower cost, high performance electric motor and inverter technology, integrated and optimised with battery packs, to provide an electrification platform that:

- has been fully developed, tested, proven and qualified;
- has motor and inverter products that address the significantly different technical demands of heavy transport, public transport, supercars, and aerospace;
- that could be licensed for different applications and in different market, enabling licensees to provide their customers with electric solutions, far more quickly than developing their own products.

An **electric platform** has four main elements the battery pack, BMS, VCU including control software, inverter, and the electric motor.

- **Batteries:** lithium-ion battery cells and increasingly LFP (lithium-iron). In April 2022, Tesla confirmed that almost half of all its vehicles produced in the prior quarter were already using cobalt-free iron-phosphate (LFP) batteries. EQIP sources batteries from global battery manufacturers and has developed its own battery packs.
- **Battery Management System (BMS):** EQIP is developing its own BMS. Control over the charging and internal balancing of individual battery cells is crucial to ensure reliability, longevity, and safety. Having control over the hardware and software of the BMS enables EQIP to better manage the packs, and also ensures access to the data.

- **Vehicle Control Unit (VCU):** the inverter interfaces with the vehicle VCU to receive driver torque commands which are then processed by the inverter to provide highly controlled power feed from the battery into the motor and to continually monitor motor response. EQIP fully develops the system control software in house.

- **Inverters:** technology that converts battery DC to the AC required by the electric vehicle motor. The inverter can be required to switch the electrical charge thousands of times per second. The inverter software controls power electronics that can change the speed at which the motor rotates by adjusting the frequency of the alternating current. It can also increase or decrease the power or torque of the motor by adjusting the amplitude of the signal. The EQIP inverter has been developed to the highest automotive safety level (ISO26262 ASIL D)

- **Electric Motors:** EQIP has developed multiple permanent magnet architectures, including patented Spoke electric motor technology. These are being sold into the bus, car, and aerospace markets.

Electric motors are either DC based or more commonly AC (see Appendix for principles of operation and types). Electric motors are designed in different physical formats but comprise a rotor surrounded by magnetic coils in the stator that are powered to create a magnetic field that "rotates" around the rotor and causes it to revolve.

The Company's complete vehicle electrification platform is called the Zero Emission Drive (ZED).

Zero Emission Drive (ZED)

EQIP offers the ZED in 3 commercial formats:

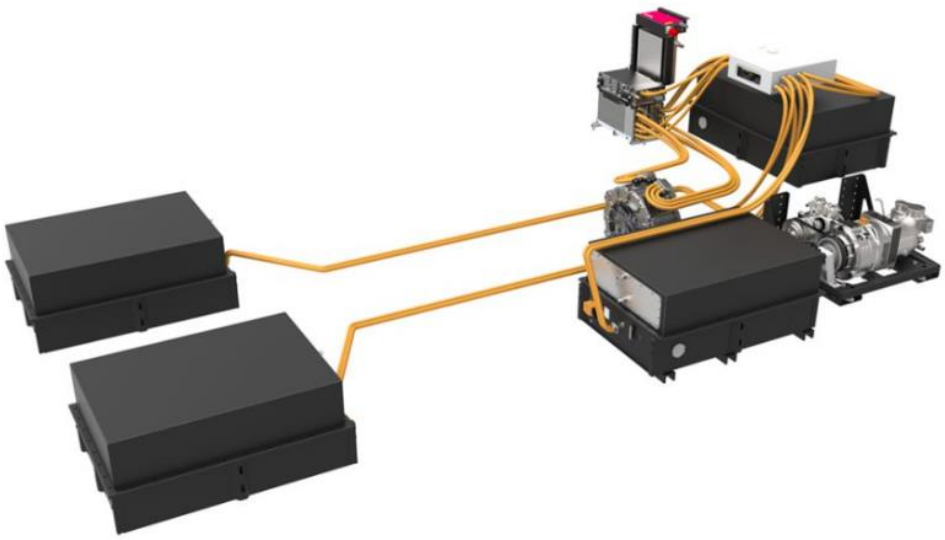
- As a complete retrofit powertrain solution for existing ICE vehicles. This is shown in the diagram below and offers owners of vehicle significant cost savings vs. purchasing a complete new electric vehicle to an existing ICE powered vehicle.

- As a kit of parts for vehicle OEMS to assemble into vehicles.

- As a licensed technology portfolio for manufactures to produce and quickly gain access electric vehicle markets without the significant design time and cost associated with design electric motor technologies for demanding application in transport.

An example of an EQIP ZED is shown below.

ZED Zero Emission Drive



SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

Patented Technology to achieve Performance and Range

A key feature of the EQIP ZED is the Company's novel (patent applied for) ultra-efficient thermal management system. This has been designed to maintain all four of the ZED's main components: the battery pack, motor, inverter and control, all at an optimum operating temperature, maximising the vehicle range. The ZED uses an advanced water-glycol cooling circuit. The system has an added benefit in that it can provide vehicle interior heating during wintry conditions with captured thermal energy.

The Company describes the retrofitting of a ZED into an existing ICE vehicle to convert it to an EV as "repowering."

In November 2022, at the Euro Bus Expo in Birmingham, UK, EQIP showcased a clean, green London New Routemaster bus that had been repowered by EQIP. The repowering process saw EQIP replace its hybrid powertrain with EQIP's ZED. The Company note that the ZED which features in the New Routemaster can be applied to any existing hybrid or diesel bus, quickly upgrading the vehicle with a state-of-the art battery powertrain.

This powertrain featured EQIP's HTM 3500 electric motor integrated into the bus prop shaft without the need for a separate transmission. The HTM 3500 motor is specifically designed for heavy transport applications and meets the stop-start drive requirements of a fully laden double-decker bus by producing 3,500Nm torque at a motor speed of just 1,000rpm and delivering 400kW maximum power. This ZED has energy stored in a configurable lithium-ion battery pack, 434kWh in this case, enough for a range of up to 200 miles on a single charge, meeting the requirements of a regular daily operating mileage.

- The ZED is offered in configurations that can provide up to 300 miles of range on one charge.

EQIP has just announced a £1.5m contract with a new customer, **Newport Transport**, to repower 8 double decker buses utilising the EQIP ZED system with the first vehicle to enter service in early 2024. Five diesel ADL E400s and three hybrid Volvo B5LHs are to be converted to fully electric. Each B5LH vehicle will have a 218kWh battery system, providing a c.90-mile daily range suitable for school routes, and the E400 buses will be repowered with a 382kWh battery system, providing a c.150-mile range, suitable for a combination of school and city routes.

When EQIP offers a complete powertrain, it is agnostic as to the motor technology used, its own or other providers, as different performance requirements can be required for different applications. Trucks and buses need higher torque than power as they must start and stop regularly and need the torque to get them moving their heavy loads from stationary. Conversely, cars need more power than torque as they require more continuous speed.

The Company sees largest market opportunities as those that use its own patented electric motor technology.

EQIP has developed patented electric motor technology based on a Permanent Magnet Synchronous Motor (PMSM) using a number of configurations, including a Spoke configuration. Patented and developed over several years, the Company has designed electric motors that are able to achieve industry leading power to weight performance.

EQIP Motor Technology: World Class Power to Weight Performance

The EQIP electric motor, given the highly demanding requirements of the EV transport sector, has taken a number of years to develop, refine and qualify for application. The level of development required, significant costs and the time it takes, in our view, provides high barriers to entry. EQIP has also created significant value by having fully developed and proven automotive technology able to provide access to international markets.

The Company has designed, developed, and commercialised an AC **synchronous** motor called a Permanent Magnet Synchronous Motor (PMSM).

PMSM motors are used for high-performance and high efficiency; this is because such motors offer control that enables smooth control over the entire speed range of the motor, high torque and fast acceleration and deceleration.

The PMSM is a cross between an induction motor and brushless DC motor; like a brushless DC motor, it has a permanent magnet rotor and windings on the stator. However, as a synchronous motor, the PMSM is based on the interaction of the *rotating magnetic field* of the stator and the constant magnetic field of magnets that are on the rotor structure.

PMSMs have the magnets located on the surface of the rotor; there are three types of PMSM electric motors have been developed for Electric Vehicles: **Surface, Spoke and Interior**.

In a Spoke motor the magnets are arranged at a 90-degree angle to the hub. There are also laminations between each of the spokes which enable more efficient use of the magnetic material offering cost reduction. EQIP chose to design a Spoke motor as it believed this configuration would offer the greatest opportunity to achieve the following properties:

- Low cost;
- High torque at low-end and high power at speed;
- Reliability and robustness;
- Low weight;
- High efficiency.

EQIP Motor Cooling Technology Plays a Key Role, driving down cost and stepping up performance.

The Company fundamentally designs its motors with a focus on cooling to maximise efficiency through minimising energy consumption by reducing the heat generation that can degrade motors' magnetic fields.

Electric motors have two power figures: how much they can generate flat out **(peak power)** and how much they can sustain without eventually overheating and needing to shut down **(continuous power).** When electric motors start to overheat, the vehicle engine management system will start to limit the electric motor power output, referred to as **thermal cut off**.

With the magnets in a standard arrangement on the motor rotor, it can be difficult to get coolant close enough to them to keep them in their operating zone under constant high-power operation.

EQIP recognised early on in its design work that if it were to reduce the size and weight of the motor whilst maximising efficiency and output, cooling technology would play a critical role. In motor design, the impact of thermal cut off can be reduced by designing the motor to use expensive magnet materials such as neodymium, however the Company developed alternative solutions to keep costs low and use of such metals low.

EQIP took a design approach that would provide a lower cost solution; improving cooling by focusing on the configuration of magnets on the rotor structure. This requires complex engineering as it involves the interaction of high frequency magnetic fields from the rotor magnetics and the fields of the surrounding coils.

The Spoke motor architecture was already well known to provide the best combination of high power and torque, whilst making the best use of the available magnet flux (resulting in lower magnet cost). This was highlighted in a paper by General Electric (Advanced High Power-Density Interior Permanent Magnet Motor for Traction applications in 2013, and in an EU funded project Motorbrain, which included ZF and Infineon in the consortium. These projects verified the performance advantages, but, according to the Company, did not provide a design which could be manufactured cost effectively. EQIP has solved this problem with its patented technology and the core motor structure that it developed and now supplies, is shown below.

The EQIP Spoke Permanent Magnet Synchronous Motor (PMSM)

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

In the EQIP Spoke motor design, the magnets (the dark rectangle structures in the first picture on the previous page) sit right on top of the hub and the cooling fluid (indicated by the blue channels in the first picture) cools the magnets.

Independent modelling has shown that replacing the conventional Interior Permanent Magnet (IPM) rotor in an existing automotive application (Honda Accord hybrid motor) with an EQIP motor would achieve certain torque profiles using 25% less magnet material in the motor design or, alternatively, using the same amount of magnetic material and increase the available torque by 25%. This provides competitive edge through either reduced cost or enhanced performance.

The Torque produced by an electric motor is a result of 1) the interaction of the magnetic field produced by the permanent magnets with the magnetic field produced by the stator current (electromagnetic torque) and 2) the result of the magnetic steel of the rotor trying to align with the magnetic field produced the stator (reluctance torque). A conventional IPM motor has a high reluctance torque, however this also results in lower powers at high speeds, resulting in lower power density than the spoke motor. Conversely, the Spoke motor has lower reluctance torque, and therefore lower overall torque density than the conventional IPM motor, but a much higher power density.

Both the Spoke and conventional IPM motors use less magnets to produce torque than a Surface Permanent Magnet (SPM) motor. However, the SPM motor can produce higher torque density, but at the cost of much greater magnet mass. An SPM motor is therefore used where low weight is more important than cost, such as aerospace.

The Spoke motor provides significant advantages for many automotive applications where high torque and high-power density are required at low volume manufacturing cost. Equipmake has also developed optimised solutions for other applications such as bus, where high torque density is required but specific the specific power requirement is low or aerospace where overall mass is critical.

HTM3500

The Company developed its HTM 3500 electric motor specifically around the heavy-duty bus drive cycle. It was designed from the outset for the highest cycle efficiency at the lowest manufacturing cost. These requirements resulted in a more conventional IPM motor to meet the high torque density, low power density requirement. The high torque requires a large diameter rotor. EQIP has developed a novel patented method of rotor manufacture which significantly reduces the material wastage in the rotor stamping process. The EQIP HTM 3500, according to the Company, is significantly smaller and lower mass than comparable motors in this space.

EVTOL Motor

Equipmake has developed an SPM motor for EVTOL and single engine aircraft applications. This motor uses Halbach array technology to maximise the surface permanent magnet usage. It is also designed to meet the latest safety requirements from the EASA (European Union Aviation Safety Agency).

Inverters: Si Carbide Technology for Optimum Performance

In an EV, the inverter interfaces with the vehicle VCU to receive torque commands which require processing by the inverter to provide highly controlled power feed into the motor and to continually monitor motor response. The EQIP inverter incorporates the latest IGBT Power Electronic technology. It is also available with a Silicon Carbide option combined with IGBT's to improve the power capability and enable the inverter to run at high switching frequencies. The inverter has been designed to run at a DC voltage of 750V, with a peak current rating of 450A rms.

Traditionally, the building blocks of inverters are silicon power transistors called Insulated-Gate Bipolar Transistors (IGBTs), which switch the current up to around 20,000 times per second (20kHz). Silicon Carbide (SiC) transistors are gaining increased traction as they offer improved thermal performance, high switching speeds, reduced switching losses, higher efficiency, and ruggedness.

Software: the inverter software manages transitions between lower currents to manage torque. The inverter feedback, electronics, and software continually monitor electric motor speed and temperature such that efficiency is continually maximised. The software is developed and tailored per motor type and customer powertrain requirements. Accurate transient response is becoming more important in many applications, and accurate control of current is essential to maximise efficiency. Compliance with highly stringent functional safety requirements is also becoming mandatory. EQIP has developed its software to full production level for the most demanding functional safety level (ISO 26262 ASIL D), and for applications with high performance requirements such as a production electric supercar and rocket fuel motors.

Integral Epicycle Gearbox

Some of EQIP's motors are designed with an integral 5.5: 1 epicycle gearbox which means that that the output shaft of the gearbox can be connected directly to the wheel hub. This provides the most efficient connection of transmission of power from the motor through the gearbox to provide torque and speed combinations to the wheels.

The Company offers a broad portfolio of motor technology designed for applications ranging from heavy transport to super cars.

The AMPERE (AMP) family of motors and eAxles

EQIP has designed its AMPERE electric motor range to have applications across many sectors, from automotive to aerospace and marine.

The APM 120 has peak power of 125kW at 12,000rpm, continuous power of 75kW and peak torque of 130Nm. This motor weighs only 14kg, an has a power density of just under 9kW per kg. This, according to Company, is 'world class.' The AMP 120 has an integrated gearbox and yet it measures just 200mm in length and 170mm in diameter.

The APM 200 Next Generation Spoke Motor delivers peak power of 220kW at 10,000rpm, continuous power of 110kW and peak torque of 450Nm. The spoke architecture enables the rotor to be liquid cooled increasing the motors continuous power output capability. The AMP 200 weighs 40kg and has a power density of over 5kW per kg.

With an integrated gearbox, it measures 247mm in length and 318mm in diameter. Both the AMP 120 and AMP 200 motors can be specified with or without an integrated gearbox and can be mounted horizontally or vertically.

The AMPERE 220 eAxle: For High performance Automotive. During September 2022, EQIP unveiled the Ampere-220 electric axle drive (eAxle). This motor has been designed for manufacturers of high-performance electric vehicles, marine and aerospace applications. The technology combines either one or two 220-kW motors with all power electronics, including silicon carbide inverters and gearboxes, in a single unit. The AMPERE 220 electric axle drive, shown in the illustration below, is an off-the-shelf electric solution for high performance cars.

The EQIP AMPERE 220

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

The AMPERE 220 has been developed using advanced motor design and additive manufacturing to allow its structure to be 3D printed, rather than milled from a solid billet. This, states EQIP, brings a number of key competitive advantages in terms of light weighting, cooling ability and cost effectiveness. EQIP has designed the motor for high-speed applications, such as super cars, and this in reflected in the weight, dimensions and performance that the AMPERE 220 achieves:

- Motor Mass 20kg, Reduction Gearbox Mass 14kg;
- Motor and Gearbox Width 290mm Motor and Gearbox Length 340 mm, Motor and Gearbox Height 280 mm;
- Maximum Power 220kW, Continuous Power 165kW;
- Maximum Speed (motor) 30,000rpm;
- Maximum Torque (driveshaft) 2,475Nm.

The AMPERE 220 weighs 20 kg and offers a power density of 11kW per kg. **This, notes EQIP, is world class, leading, Power to Weight ratio performance in electric motors.**

The eAxle is not just extremely powerful, compact, and light but has been designed to achieve high quality and safety standards. The AMPERE 220 is ISO 26262-compliant and Automotive Safety Integrity (ASIL-D) ready.

HMP-400 Ultra-lightweight, Power-Dense Electric Motor for Space, Aerospace and Marine

In March 2023, the Company announced the HPM-400, an advanced high power, short duration motor designed for high-performance space, aerospace, and marine applications. The motor was originally specified as a high-performance rocket fuel pump for Australian Company, Gilmour Space Technologies, for use in its Eris rocket programme. The HTM-400 motor includes several technological and packaging innovations from the need to withstand extreme acceleration while also operating at atmospheric pressure and in space. EQIP believe that the HPM-400 has multiple applications in high-performance environments. According to the Company, the maximum motor speed is 20,000rpm and the peak power/torque 400kW/250Nm**.** The electric motor mass is 30kg is integrated with a silicon carbide inverter which weighs only 10kg, and the entire system weighs just 40kg. Given the high power and low weight, **EQIP believes that the HPM-400 is the most power dense electric motor in the world.**

The EQIP HMP - 400 With integrated SiC Inverter

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

The HPM-400 needs to operate in outer space and therefore in a vacuum. The design of the inverter keeps air pressure inside and EQIP has undertaken the design to mechanically withstand the pressure from within when it goes from atmosphere into the vacuum. The Company states that this has resulted in a super compact cylindrical package, conventional inverters being square, with a carbon fibre shell to keep pressure in and weight down. This has seen EQIP develop an advanced high power, low weight motor/inverter that is able to operate in space applications, aerospace or in the water.

HTM-3500: Designed for Heavy Transport, HGV and Buses

EQIP launched the HTM-3500 in 2020. This is a direct drive, high torque and low speed electric motor specifically developed for applications needing heavy loads to be moved on a high start / stop duty cycle. The HTM-3500 targets the electrification of heavy transport from electric buses to HGVs and mining trucks.

The EQIP HTM-3500

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

The HTM-3500 has been designed so that it can fit directly onto the prop-shaft of an electric vehicle, and this removes the requirement for separate gearbox. The HTM-3500 can achieve torque of 3,500Nm at only 1,000rpm.

Markets

The Company sells system components including electric motors, inverters, software, and battery packs. The components are available integrated together in a complete electric vehicle platform (powertrain). EQIP also provides retrofitting of platforms. EQIP more recently offers IP licensing. EQIP's main markets are heavy transport (eBuses), fire engines, marine, cars and aerospace.

Powertrains: for Heavy Vehicles

This market sector primarily covers buses and trucks.

EQIP is initially focused on the burgeoning electric bus (eBus) market as an international, scalable opportunity. The IEA estimated that "sales of electric buses increased by 40% in 2021. China accounted for over 90% of these, although registrations in Europe and the United States also increased." The leading global electric bus manufacturers are China based **BYD***, and **Yutong**. BYD (Hong Kong listed BYD Co. Ltd. is the largest global manufacturer of electric buses. In 2021, BYD sold 70,000 electric buses globally. Of these, 2.5% were sold in Europe. *Note BYD mentioned above is China-based, electrical vehicle producer, BYD Co. Ltd, a Company quoted in Hong Kong (1211.HK) and in the U.S. (depository receipt BYDDY).

European-based electric bus and electric chassis producers include **BAE Systems PLC (BA LN), BYD-Alexander Dennis, Ltd, Daimler Benz (MBG GE), MAN Truck & Bus, Solaris Bus & Coach sp., AB Volvo (VOLV ST) and Wrightbus (a division of Bamford Bus Company Holdings Limited).**

Significant eBus Growth Potential

- Research from MarketsandMarkets cites the global electric bus market as 112,041 units sold in 2022 and estimated to grow to 671,285 units by 2027, a CAGR of 43.1%.
- Electric bus volumes are increasing as urban areas seek to reduce transport pollution and operators look to provide a "clean transport" solution and reduce overall operating costs.

The electric bus market potential is significant. Germany-based vehicle manufacturer MAN estimates that by 2040, just 17 years' time, electric buses will be 80% of the market.

Costs of New eBus Can Be Prohibitive

A new electric bus and the cost of its associated charging infrastructure is a much higher upfront capital cost than a diesel bus. EQIP estimate that a new electric bus costs £300k to £400k, this without any charging infrastructure. A new diesel equivalent costs between £230k and £260k.

There are specific benefits electric buses including:

- Near Zero Emission;
- Lower maintenance costs through less mechanical parts;
- Lower running costs through leasing batteries and due to the higher energy equivalent i.e., 25 mpg equivalent for an electric bus vs. 8-10mpg for a diesel bus;
- Longer vehicle life due to lower temperatures when running and reduced vibration;
- Government subsidies.

The IEA estimated that by the end of 2021, the global electric bus fleet totalled 670,000 vehicles. However, this represented just 4% of the overall number of buses in operation globally. 96% of the existing global bus fleet are ICE vehicles.

EQIP Repower Programme: Electrifying the existing bus fleet.

Global bus operators are seeking to convert their fleets to electric through either buying all new electric buses, moving to ICE/electric hybrid solutions, hydrogen-powered or through retrofitting existing ICE fleets with an all-electric eBus chassis such as the EQIP Zero Emission Drive (ZED) system. EQIP refers to this part of the business as its repower technology programme for the eBus market.

Research from Interact Analysis estimates that in 2022, ahead of the cancellation of subsidies that had been in place for a decade, 138,000 electric buses were registered in China. Other global markets are now starting to follow China's lead and look to electrifying their bus fleets. Whilst China is dominated by domestic eBus manufacturers, EQIP is focused on India, The Americas, and Europe.

During October 2019, EQIP announced a "Low Floor" version of its eBus electric chassis targeting double decker applications. The new electric chassis uses two EQIP APM200 spoke motors, latest-generation lithium-ion battery pack and an advanced power control system. It is designed to have enough range for one day's running without the need for charging and can use smaller batteries through optimised on bus heating and cooling to improve energy efficiency.

- The solution is made available as a completely integrated chassis to enable coachbuilders with no EV knowledge to become an electric bus manufacturer.

EQIP estimate that repowering an existing ICE bus, using its electrification platform, is a compelling proposition for fleet operators given that each conversion comes in at **less than half the price of a new electric bus.** The Company also believes that with most buses expected to remain in service for 14 years or beyond, operators can still make significant efficiencies by repowering a bus halfway through its working life.

Asia: India and Indonesia

India is the world's third largest automotive market. The Government of India states that the automotive sector contributes 49% to India's manufacturing GDP. India has high oil imports and is seeking to reduce emissions. Vehicle electrification helps to potentially reduce dependency on external oil supplies and reduce pollution.

- India's government is targeting that 30% of *all* automotive sales should be electric by 2030.

This target is seeing investment by India companies in EV technology and investment into the country.

The electric vehicle market in India is dominated by two-wheeled rather than four-wheeled vehicles with significant growth sales of electric scooters, mopeds, and motorbikes. Two-wheeled vehicles are seeing the strongest growth in the region given their affordability. In 2022, according to data from India VAHAN Database, just under 1m EV's were sold in India. Of the vehicles sold, 62% were two-wheeled vehicles. In terms of electric buses, in 2022, 1,939 were sold.

Equipmake Licenses its Technology to a Major India manufacturer.

In May 2023, EQIP announced that it had signed a licensing agreement with Sona BLW Precision Forging Limited (Sona Comstar) an India based, global automotive systems and components manufacturer, with annual revenue more than US$325m and a market cap more than US$3.5Bn. The Licensing Agreement will see EQIP license certain products from its range of drive motors, inverter, and electric powertrain technology to Sona Comstar for applications in electric cars, buses, commercial vehicles and off-road vehicles in India, Thailand and other select South Asian countries.

In August 2022, the Company a signed non-binding MOU with PT Transportasi Jakarta and PT Vktr Teknologi Mobilitas for an implementation plan for an electric bus retrofit trial in Jakarta, Indonesia. Development of the first trial vehicle is under way, with trials in Jakarta expected to start during calendar year 2023.

The Americas

North America is seen as a future opportunity for the Company. EQIP is currently focused on the Latin America eBus market which is growing as large cities in South America seek to cut pollution. In Argentina, EQIP has already entered final phase testing of a low-entry chassis for single decker buses with Brazilian commercial vehicle maker, Agrale. The Company has a framework agreement with Agrale that gives Agrale the right to sell the electric chassis in North and South America (including Argentina) and Africa, with EQIP selling in the Rest Of the World (ROW). Buenos Aires has around 16,000 buses and Agrale has 50% market share through their partnership with Argentine coach builder Todo Bus. Since 2019, EQIP has been developing a bus electric chassis in partnership with Todo Bus.

- In August 2022, the Company, in partnership with Agrale and Todo Bus, delivered a fully electric bus to Buenos Aires.

- Agrale launched the vehicle to the South American press during the C40 World Mayors Summit in Buenos Aires in October 2022. The vehicle, reports EQIP, has completed more than 25,000 kilometres of testing without any technical problems and will commence in-service trials (carrying passengers) once homologation has been finalised.

- Agrale is now marketing the vehicle to potential customers within South America.

Europe

The European Automobile Manufacturers' Association, or ACEA, represents Europe's 14 major car, truck, van, and bus makers. Members include AB Volvo, **BMW (BMWG DE), DAF Trucks A.G.,** Daimler Benz, **Renault**, **SAAB Scania**, and **Volkswagen A.G. (VOWG DE).** Data from the ACEA provides an excellent overview of the European bus sector:

- 684,285 buses are in circulation in Europe and 1.0% of the fleet is all electric.

- 29,941 were new buses and coaches were registered in 2021. 68.8% of all new buses sold are powered by diesel and 10.6% were hybrid or all electric buses.

- The average age of the European bus fleet is 12.8 years.

In October 2022, 11 European cities (Barcelona, Cluj-Napoca, Copenhagen, Hamburg, Malaga, Milan, Palma, Paris, Rotterdam, Seville, and Valencia) in a letter to the EU, asked to make the purchase of zero-emission buses for public transport mandatory from 2027. In February 2023, The European Commission proposed ambitious new CO2 emissions targets for new heavy-duty vehicles (HDVs) from 2030 onwards: 45% emissions reductions from 2030; 65% emission reductions from 2035; and 90% emissions reduction from 2040.

The targets are to help to reduce CO2 emissions in the transport sector, particularly from trucks, city buses, and long-distance buses which, state the EU, are responsible for over 6% of total EU greenhouse gas (GHG) emissions and more than 25% of GHG emissions from road transport.

The EU proposal includes plans to make all new city buses zero-emission by 2030.

According to February 2023 data from Chatrou CME Solutions consultancy, the European electric bus market grew by 26% in 2022 with 4,152 units registered. Yutong was the biggest supplier followed by BYD -Alexander Dennis and then Daimler Benz. Mainland Europe is a future market opportunity for Equipmake.

UK

In total there are around 32,000 buses in operation around the UK. The largest national operators are Arriva UK (5,900 buses), First Bus/FirstGroup plc (4,900 buses), Go-Ahead Group plc (2,400 buses), Stagecoach Group plc (8,500 buses) and National Express with 10,000 vehicles in its fleet as well as through its contracted operators.

In 2020, the UK government outlined its £3.0bn National Bus Strategy and ambition to deliver 4,000 zero emission buses over four years. During March 2022, the UK government announced £198.3m of funding to provide 943 zero emission buses.

- At the time of IPO in July 2022, EQIP noted that it was in active discussions with UK major bus operators and had generated a potential pipeline of £80m.

FirstGroup plc: in Q1 2022, EQIP commenced a contract for First Bus (owned by FirstGroup plc) to fully convert 12 Optare Versa buses run by First Bus York from existing EV Generation One systems to EQIP's ZED. This contract is worth £2.2m.

In January 2023, in a trading update for the 6 months ending 30th November 2022 (1H 2023), EQIP reported that it had delivered the first vehicle under its contract with FirstGroup to repower its York fleet of 12 Optare Versa buses, this meeting all the criteria from the original scoping document. The Company has also commenced delivery of the remaining vehicles, with five planned for delivery in the 2H 2023 and the remainder to be delivered in FY 2024.

- Following the success of the Optare Versa project, FirstGroup awarded EQIP a follow-on contract for the repower of a Double Deck diesel vehicle. Under this agreement, FirstGroup has entered a letter of intent that following a successful trial period, it may engage the Company ***for the conversion of several hundreds of vehicles.***

- The trial period is expected to be completed in the third quarter of the calendar year 2023. If the trial period is successful, the Company anticipates initial production on this project starting before the end of the calendar year.

London Bus Operators: London bus routes are franchised to operators on 7-year contracts with the average number of buses per route being 20. EQIP is currently engaging with all the London operators and is entering into tender processes.

EQIP has an electric bus collaboration with Spanish Bus Coachbuilder, Beulas SAU (Beulas). EQIP and Beulas have together partnered with London's largest bus operator, Go-Ahead, who will undertake service trials of the Beulas in its Jewel E double decker electric bus. The Jewel E bus is powered by EQIP's Zero Emission Powertrain (ZED). The version being used offers the following configuration options: three (324kWh), four (432kWh) or five (540kWh) battery packs. According to Company data, the 540kWh option is the largest available for any UK specification double deck bus, resulting in the longest range currently on the market.

- The London bus operators represent a significant opportunity given that London has around 8,000 buses and, according to the Company, replaces them at a rate of approximately 700 per annum.

- The Jewel E double decker bus is also being evaluated by other UK operators. Beulas is marketing the vehicle in left-hand-drive form in Europe.

Transport for London (TfL): EQIP has an agreement with TfL to demonstrate a retrofit of a Routemaster vehicle. In November 2022, EQIP showcased a New Routemaster London bus which had been repowered by the Company replacing its hybrid powertrain with a zero-exhaust-emission powertrain (ZED) comprising 95% British-built components. This electric version of the London bus is undergoing 6 months of pre-service trials operated by Metroline in London. There are approximately 1,000 of these vehicles in London.

The Company estimates that if it won a contract to retrofit 500 TfL Routemaster buses, this could be worth £100m.

Fire Engines: Working With The Biggest U.S. Fire Truck Producers

EQIP has an agreement with UK based Emergency One Group Ltd, the largest provider of fire trucks in the UK with a market share of over 80%. The Company's first project with Emergency One is to provide a fully integrated system to one of the largest U.S. fire truck manufacturers.

The first vehicle, using the EQIP electrification platform, was delivered by Emergency One to U.S. based **REV Group (NYSE REVG),** in February 2022. REV Group, with 2022 annual revenue of US$2.3bn, manufactures speciality vehicles and related aftermarket parts and services for three segments: Fire & Emergency, Commercial and Recreation. REV Group is the biggest U.S. producer of fire trucks. EQIP expects to deliver five systems to Emergency One during FY2023. The Company at Interims published in February 2023, noted that it had continued to receive orders from Emergency One to supply electric powertrains to this and other clients.

REV Group is only just launching its all-electric fire engine. However, there is scope for upside given REV Group's production capability and the size of the U.S. market for emergency vehicles. The U.S. National Fire Department Registry covers 91% of all U.S. fire departments and notes that it has 1.2m firefighters operating out of 52,028 fire stations. Market research Mordor Intelligence estimate the U.S. fire truck market was worth US$5.5bn in 2021.

Powertrain Segment Forecasts

From our discussions with management, we believe that for first volumes a higher price of £0.19m per bus is achievable and as volume increases that this will reduce to £0.16m.

The FirstGroup refit of 12 buses covers our projections for 5 retrofits in 2023 and for 7 within our 2024 projection of 50 units.

In calendar 2023, the Company will undergo further trials with FirstGroup and, if it successfully concludes at the end of calendar 3rd quarter, orders are anticipated by 2023 end. We believe that these orders will support fiscal 2024 (year-end May 2024) estimates. The EQIP ZED is, as already noted undergoing trials with TFL on the Routemaster and this retrofit opportunity, for up to 500 buses, could also support our volume estimates for 2024 and 2025.

EQIP expects to deliver 5 systems to Emergency One during FY 2023 and has stated that it has received further orders without noting specific numbers. We, conservatively estimate 8 units for FY 2024 and 12 for FY 2025. From discussion with management, we believe that circa £0.2m of revenue per unit is achievable. Given the significant scale of the U.S fire services with over 52,000 fire stations and opportunity to convert to electric vehicles, we could see far higher volumes as REV Group drive sales.

Factoring in inflationary costs for core components such as motors, inverters, and batteries, we forecast an FY2024 gross margin of 20%. For FY2025 we see the gross margin rising to 32% as EQIP scales its retrofitting operations, increasing efficiency and productivity.

Powertrain Estimates

Powertrains May y/e	2023E	2024E	2025E	2026E
Revenue £m's	**1.8**	**9.4**	**16.5**	**27.3**
Gross Profit £m's	**-0.1**	**1.9**	**4.3**	**7.3**
Gross margin %	-3%	20%	32%	32%

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

EV Technologies

The Company provides core technologies for electric transport including motors, software control, battery packs and inverters.

Performance Vehicles

The Company has a £4.5m contract to supply front inverters for one of the major European automotive OEM's high-performance electric vehicles.

The inverter is fully automotive qualified and been developed to integrate into the vehicle having the highest automotive safety rating (ASIL D). We understand from the Company that the vehicle is one of the fastest accelerating production cars in the world. Delivery of the remaining units ordered in 2022 is expected by the end of FY 2023.

According to EQIP, under the supply agreement, further orders will be issued annually, with the final order being issued no later than January 2026. The Company could secure further interest for its EV technologies for application in the automotive sector and it is actively marketing to a number of OEM's and major Tier 1 suppliers.

Aerospace

Future Air Mobility (FAM): is a movement to transform flight, passenger, and cargo transport, to become more sustainable, autonomous (unmanned drones), supersonic and use advanced technologies. Looking to sustainability, the IEA reported that in 2021 that flight accounted for over 2% of global energy-related CO2 emissions and those emissions had grown faster in recent decades than road, rail or shipping.

Most aircraft today are powered by kerosene. Low-carbon Sustainable Aviation Fuel provides a near term solution to reduce emissions. As is the case for road transport, hybrid engines are also being seen a solution to reduce emissions. However, to achieve zero emissions, hydrogen and battery-powered flight is required.

Aviation fuel has significantly higher energy density than batteries. Typically for aviation fuel, the energy density is 43-48 MJ/kg whereas for a lithium-ion battery it is 1 MJ/kg. For long haul flights, given an aircraft's size and weight, many batteries would be required. Additionally, as fossil fuel is consumed in flight the aircraft loses weight. However, batteries do not lose weight as their charge depletes whilst powering the plane. Given the above challenges, electric powered flight is being looked at for hybrid systems and for pure electric powered flight over short distances.

Global consultancy McKinsey in July 2022 estimated that existing aerospace companies and more than 500 new industry participants are currently developing new FAM products. McKinsey also estimated that the largest proportion of investment was going into passenger electric vertical take-off and landing (eVTOL) aircraft and surveillance or cargo drones.

H55: In June 2023, the Company announced that it had agreed to a production technology partnership with Switzerland based H55, a leading electric aerospace propulsion company. This new agreement with EQIP builds on a collaboration already in place, which has seen EQIP supply advanced electric motors to support H55 Electric Propulsion System (EPS) development. EQIP and H55 have been partnering on production-ready, certified EPS, with the Company supplying its lightweight, power dense, high-performance state-of-the art electric motors for use in electric aircraft.

EQIP will support H55 on its customer program with aircraft manufacturer BRM AERO, on the Bristell B23 Energic aircraft, a two-seater electric trainer designed for flight schools and pilot training, as the project advances from prototype development to full manufacturing. Certification is planned for end of 2024 with revenue from sales for EQIP expected from H1 2025. The Company and H55 will also expand the range of motors available, with the next version already under development.

Gilmour Space Technologies Pty Ltd: During 1H 2022, the Company delivered a lightweight, high-energy-density electric motor and inverter unit to leading Australian space Company, Gilmour Space Technologies. The EQIP motor and inverter have been designed to provide the power and weight requirements to facilitate performance in the vacuum of space. Gilmour's first commercial rocket, Eris, is scheduled for launch in April 2023 and will carry a lightweight satellite. This

will mark Australia's entry into the space market. EQIP is having ongoing discussions with Gilmour for initial production supply in 2024.

Vertical Aerospace Ltd (NYSE EVTL): EQIP is working with Vertical Aerospace Ltd (VA), a Bristol, UK-based Company which was founded in 2016 with the vision of decarbonising air travel. In 2020, VA unveiled the VX4 electric aircraft and VA joined the UK government's Future Flight Challenge. The VX4 is an electric Vertical Take-off and Landing (eVTOL) aircraft, has a 1MW powertrain, an ability to cruise at around 150mph, range of over 100 miles and produces zero emissions. The plane, pictured below, has capacity for a pilot and 4 passengers.

The Vertical Aerospace VX 4

SOURCE: *Vertical Aerospace, VSA Capital Research.*

In March 2021 **Rolls Royce Holdings PLC (RR LN)** announced its partnership with VA and that it was to design the system architecture *of the whole electrical propulsion system*, the electric power system that including Rolls Royce's latest 100kW-class lift and push electrical propulsion units, the power distribution and the monitoring system that will support operations.

During 2021, VA announced conditional pre-orders for up to 1,350 aircraft from **American Airlines, Avolon, Virgin Atlantic, Marubeni Corp, Iberojet and Bristow Group** for estimated US$5.4bn. VA listed on the NYSE in December 2021 and raised US$300m. In 2023, further conditional pre-orders for 1,400 aircraft brought the total pre-orders to 2,750 VX4 aircraft.

EQIP has supplied its advanced electric propulsion unit (EPU) to VA for use on its VX4 prototype aircraft. This EPU combines a lightweight, power dense electric motor with a high-performance inverter, which was designed, developed, and manufactured by Equipmake at its base in Snetterton, UK.

In October 2022, VA successfully performed its first test flight, with the aircraft tethered. The test took place following the Company receiving its "Permit to Fly" from the UK's Civil Aviation Authority (CAA). **VA has stated that it hopes to have the VX4 aircraft fully certified in 2025.**

In July 2023, EQIP announced that VA had reported the completion of its first-ever full-scale untethered (eVTOL) flight in the UK with its VX4 prototype. EQIP noted at the time that this was, "a significant milestone of the first thrust borne flights, meaning the prototype eVTOL aircraft has been held up by the thrust of its vertical propulsion system, allows VA to continue in its objective to certify the VX4 by the end of 2026."

The project with VA is the first time EQIP's electrification products and expertise have been applied to the rapidly growing eVTOL market, which, according to estimates from Research and Markets, is forecast to grow to $30.8bn by 2030.

EQIP could, potentially, become more deeply involved in the VA programme. VA, at some stage, will need to finalise all components, including motors and inverters to be used on the production aircraft. It will need to submit the aircraft for full aviation authority new aircraft type approval and, to be achieved, VA hopes in 2025, and then to commence volume build.

Marine

The electric boat industry is in the initial stages of development and the Company anticipates its high power, compact and lightweight electric motors being used in multiple marine applications, from hybrid luxury yachts, allowing silent, emission-free cruising whether at sea or for inland navigation, to hybrid tugs and fully electrified RIBs. EQIP cites market research estimates for the electric marine market to grow to $16.6bn by 2030.

EQIP has developed a marine version of its HPM-400 motor and inverter for use in fully electric boats and it is also able to work with marine businesses to tailormade electric powertrains. Given the early nature of the market opportunity, we are not anticipating material revenue with our explicit forecast period.

BAR Technologies; In July 2023, Equipmake announced that it had supplied an advanced e-powertrain system for a world-first electric hydrofoil boat. The project is a collaboration between modern classic yacht design and build experts, Spirit Yachts, and UK based advanced marine engineering company, BAR Technologies. The purpose-built 35ft electric hydrofoil boat, called the SpiritBARTech35EF (pictured overleaf), features a trio of active retractable foils to help minimise drag. The boat has been designed to have a fast-cruising range of 100 nautical miles and a top speed of 28 knots or 52 kph.

The SpiritBARTech35EF Electric Hydrofoil Boat

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

For this project, EQIP designed, developed, and manufactured a bespoke fully electric powertrain, featuring a specially adapted version of its lightweight, power dense, high-performance HPM-400 motor, producing peak power of 80kW, complete with an integrated gearbox. The powertrain also features Equipmake's own HPI-450 IGBT inverter and a 120kWh custom battery pack.

EV Technologies Forecasts

As noted, the Company has a £4.5m contract to supply front inverters for one of the major European automotive OEM's high-performance vehicles, although volumes are small, the technically demanding nature of the application means that the inverter technology commands relatively high price. Further orders under the contract are to be issued annually, with the final order being issued no later than January 2026. This contract underpins a proportion of our forecasts overleaf.

EV Technologies Estimates

EV Technologies May y/e	2023E	2024E	2025E	2026E
Revenue £m's	**1.6**	**1.7**	**3.5**	**5.5**
Gross Profit £m's	**0.6**	**0.7**	**1.4**	**1.9**
Gross margin %	38.1%	41.6%	40.4%	35.6%

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

Looking to 2025 and 2026 revenues, as already noted, the Company could secure interest from another transport producer for motors, inverters, or both. We understand from EQIP that it is actively marketing to a number of OEM's and major Tier 1 suppliers. As we have also seen, the Company is attracting interest from electric aerospace, again, demanding applications for the technology and likely to command premium pricing and higher margins. Our gross margin estimates for FY2024 and FY2025 are mainly supported by the existing (high performance car) inverter contract. Looking ahead, we see higher volume opportunities and revenue from road/off road vehicles. Albeit at a lower gross margin, these see the business start to achieve real scale.

IP and Patents

EQIP is a technology led business, with skills and expertise that have seen it develop globally leading electric motor performance, which in itself generates IP. The Company, through its Prototype Engineering business, sees its expertise in electrification technologies called upon by customers to undertake bespoke, technology development work. This also generates IP for the Company. EQIP registers and applies for patents associated with its technologies:

- EQIP has 26 patents of which 17 have been granted.

The patents that EQIP develops create their own inherent value and increase the Company's attractiveness as an acquisition target.

Licensing and Royalties

EQIP, in late 2022, noted that it was exploring opportunities to license its IP. The licence agreement with Sona Comstar in India, announced in May 2023, is the first announced technology licence agreement. Under this agreement, Sona Comstar will pay EQIP a fixed one-time licence fee together with running royalties on the licensed products manufactured and sold by Sona Comstar.

The terms of this agreement were not disclosed and given the early stage of the licensing and royalty business model, we have only forecast nominal estimates for our 2023, 2024 and 2025 forecast periods. Licencing and Royalties, given the global growth in the transport electrification markets, could become a significant future opportunity.

Licensing and Royalties Estimates

Licensing / royalties May y/e	2023E	2024E	2025E	2026E
Revenue £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross Profit/loss £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross margin %	100%	n/m	100%	100%

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

Prototype Engineering

Given the nature of the transport markets with major differences in vehicle performance between manufactures, EQIP undertakes varying degrees of customisation to tailor achievable torque and power profiles by applications. This may entail additional work on top of that to support standard design in, such as additional software development for the

control systems. The Company also undertakes bespoke transport electrification development work. This all comes under EQIP's Prototype Engineering activities. EQIP charges clients program costs comprising Non-Recurring Expense (NRE) charges. Our forecasts below assume small scale NRE charges initially until design in activity with customers accelerates.

Prototype Engineering Estimates

Prototype Engineering May y/e	2023E	2024E	2025E	2026E
Revenue £m's	**1.3**	**1.7**	**3.0**	**3.0**
Gross Profit £m's	**0.5**	**0.8**	**1.5**	**1.5**
Gross margin %	35.1%	48.9%	50.0%	50.0%

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

EQIP expends engineering costs for technology development that are part funded by Grant income.

Grants

In April 2023, the Company was awarded grant funding up to £1.6m, on a matched funding basis, to participate in a UK consortium that is developing an integrated fuel cell battery hybrid system suitable for the bus and other goods and passenger vehicle markets. The grant funding was awarded by Innovate UK in conjunction with the Advanced Propulsion Centre ("APC"). The UK consortium is to demonstrate the use of a novel printed circuit board ("PCB") hydrogen fuel cell in electric vehicles.

EQIP will develop an innovative DC-DC converter for integration into an 800V fuel cell system and battery system. This will include the development of the BMS and thermal management system to integrate the fuel cell, battery, and powertrain with the cabin heating/cooling requirements. EQIP will also integrate the system onto its Jewel E double-decker bus platform before trialling it.

Grant income helps EQIP to part fund engineering costs for specific projects. It therefore produces a negative gross margin as can be seen in from our estimates shown in the table below. Despite the negative margin, it is important to note that grant income helps to fund work that will broaden and strengthen EQIP's technology portfolio.

Grants Estimates

Grants May y/e	2023E	2024E	2025E	2026E
Revenue £m's	**0.1**	**0.6**	**0.8**	**0.1**
Gross Profit/loss £m's	**0.0**	**-0.6**	**-0.8**	**-0.1**

SOURCE: *EQIP Holdings PLC, VSA Capital Research.*

Competition

Electric Buses

In Europe, the electric bus market is in the preliminary stages of growth. According to data from consultancy Chatrou CME solutions, in 2022 electric bus sales rose by 26% to 4,152 units. China based Yutong, with 479 e-bus registrations, had 11.5% market share followed by BYD-Alexander Dennis Ltd with 11.2% share and Daimler with 9.8% share. Others with material sales share were **Iveco VDL**, Solaris and Volvo. All these companies also operate in international markets outside Europe.

Chinese bus manufacturers, such as the two largest global electric bus producers BYD and Yutong Group Co. are gaining a growing share of the EU market. Both BYD's and Yutong's electric bus development and volume growth has been helped by China's rapid electrification of transport and domination of global battery supply chains. Both companies are now rapidly expanding overseas.

BYD & Alexander Dennis Limited (ADL). ADL, a subsidiary of global bus manufacturer NFI Group Inc. is the UK's largest bus and coach manufacturer. BYD and ADL have been working together since 2015, combining UK based ADL's bus building capability and market position with China based BYD's EV technology (rolling chassis with electric powertrain and batteries). The main joint products are the BYD ADL Enviro100EV minibus, Enviro 200EV single decker and the Enviro 400EV double decker buses. Outside the UK, BYD operates under its own brand.

In May 2022, BYD-ADL announced the delivery of their 1,000th zero-emission bus in the UK.

During January 2023, BYD and Alexander Dennis jointly announced that they were to supply 130 zero emission double deck buses to bus operator **National Express**. This, part of a plan to make Coventry the UK's first all-electric bus city. The project, according to ADL, is financed partly through the partnership between Zenobē and National Express, with some investment also coming from a £50m grant from the UK Department of Transport.

In April 2023, Alexander Dennis and BYD UK jointly announced that they had taken a firm order from National Express West Midlands for a further 170 double deck electric buses, to be delivered by the end of 2024. The new order bringing the number of BYD ADL Enviro400EV buses operated by National Express in the West Midlands to 329.

Yutong Group Co. is the world's largest bus manufacturer by sales volume, since 2013. Yutong has been building electric buses since 1999 and has 133,000 zero emission vehicles in service in 100 different countries.

UK Company Pelican Bus & Coach is a UK and Ireland importer and distributor for Yutong Buses and Coaches. In 2021, it was announced that Pelican was to be recognised as an official UK "knock-down" plant for Yutong and that vehicles would in future arrive in the UK for final assembly at a new facility in Castleford, West Yorkshire. In November 2022, Pelican secured a £60m green funding package from HSBC to support the distribution of 250 new electric buses.

In November 2022, it was announced that 78 new electric buses were to be ordered by Nottingham City Transport as part of a £34m project. UK based EV fleet and battery storage specialist Zenobē Energy is supplying the charging infrastructure. This project is being supported with £15.2m from the UK Department for Transport's Zero Emission Bus Regional Areas (ZEBRA) Fund.

Volvo Buses is a subsidiary of Sweden based Volvo Group which are wholly owned by China based **Geely Holding Group**.

In September 2021, Volvo launched its all-new Volvo BZL Electric bus chassis which is designed for both single decker and double-decker buses. The chassis can accommodate three to five battery packs giving options of 282kWh, 376 kWh and 470kWh depending on the bus size and requirements. The chassis electric motor is coupled to a two-stage automated transmission which has 167kW continuous and 200kW peak power and 425Nm of torque.

The Volvo BZL Electric Chassis

SOURCE: *Volvo Group, VSA Capital Research.*

In May 2023, Volvo Buses secured orders for 189 Volvo BZL Electric single deck buses from Stagecoach for service in Stockport UK, Delivery is to commence in summer 2024. The total order comprised £37.2m investment by Stagecoach, £35.7m by Greater Manchester Council and £12.5m from TFGM/GMCA; a total order value of £85.4m equating to £502k per bus.

Wrightbus

In August 2022, an £81m order comprising £43m from First Bus and £38m in UK government grants was placed with UK based Wrightbus for 193 electric buses. The total order equated to £420k per bus. First Bus worked with five local authorities to secure funding. The grants were to help bridge the gap between the cost of a diesel bus and an EV equivalent bus alongside the supporting charging infrastructure.

- In November 2022, EQIP announced that it had repowered a Wrightbus New Routemaster with a battery-electric driveline, with the vehicle making its debut at Euro Bus Expo. The zero-emission package, which includes 400kW/h of battery storage and the supplier's HTM 3500 400kW electric motor, is expected to deliver a range of 150 miles. It is fitted to a New Routemaster that is part of the Metroline fleet.

eAxle and Drive Technologies

EQIP, outside of the electric bus market and retrofit systems, separately sells its own developed motors, invertors, battery pack, BMS and software into the wider automotive and off road, aerospace, and marine markets. As EQIP grows, it will face broader competition from the international producers of these individual technologies or sold as a complete eAxle system.

EQIP has developed electric drive technologies to not only meet the demanding torque and power requirements of heavy transport but also the high-performance requirements of super cars, rockets, and aerospace. With technologies to meet such a range of end applications, **EQIP could see itself as an acquisition target.**

The leading manufacturers offer some or all the following EV solutions: electric motors, inverters, complete eAxles (incorporating motor inverter and gears), BMS, battery pack and software include ABB, Allison Transmissions, BorgWarner, Dana, Dowlais PLC, Linamar Corp. Nidec, Robert Bosch and ZF. These are highlighted below. However, other leading producers also include Continental AG, Cummins/Meritor and Dana Inc.

ABB (NYSE) reported 2022 revenue of $29.4bn. ABB produces technology for Electrification, Robotics and Motion, Industrial Automation and Power Grids. Looking to vehicle electrification, ABB provides charging infrastructure and has developed electric motors, inverters and controllers for **trains, buses, and industrial vehicles** used in mining, construction, materials handling, marine and public transportation. In June 2022, ABB reported that it had supplied electric motor systems for 100 buses.

Allison Transmission Holdings Inc. (ALSN) operates in 150 countries and is the largest manufacturer of automatic transmission systems for medium and heavy transport in the commercial and defence sectors. 2022 revenue was $2.8bn and Allison generated an EBIT margin of 28%, high for a sector that typically generates EBIT margins of 5-10%. This may reflect its defence business exposure. Allison has developed a new series of fully integrated electric axle, called eGen Power® that are designed to fit between the wheels of **medium and heavy-duty trucks and buses**, replacing the vehicle's traditional powertrain. The eGen Power is sold as a bolt-in solution compatible and customisable to current vehicle frames, suspension and wheel ends, and, quotes Allison, is well suited to most OEM vehicle assembly processes.

BorgWarner Inc. (NYSE BWA) in December 2022 announced the spin-off of its Fuel Systems and Aftermarket segments into a separate, publicly traded company. BorgWarner will in future comprise the Company's current e-Propulsion & Powertrain and Air Management segments. BorgWarner reported 2022 global revenues of $15.8bn split $12.5bn from its EV and ICE propulsion related business and $3.3bn from Fuel Systems and Aftermarket. The Company produces electric motors, inverters, dc-dc convertors, battery packs and complete eAxles, which it calls them Integrated Drive Modules (iDM's). In 2021, BorgWarner booked eMotor volumes of 0.3m and for 2025, forecasts volumes of 2.0m. In May 2023, BorgWarner announced that it had been selected to supply battery packs for an electric bus manufacturer in Georgia USA.

Robert Bosch GmbH is a private company based in Stuttgart, Germany. In 2022, it generated revenue of €88.2bn and €3.5bn EBIT, a margin of 3.9%. This during a period in which the Chairman, in the Annual Report noted, "we were confronted with massive price hikes for energy and raw materials." Robert Bosch operates across four business sectors: Mobility, Industrial Technology, Consumer Goods, and Energy and Building Technology. The Mobility division, for EV's, produces electric motors, inverters, DC-DC convertors, VCU, BMS and E-Axles.

Dowlais Group PLC (DWL L) recently spun out from UK-quoted Melrose PLC. The Company's GKN Automotive division reported 2022 annual revenue of £4.2bn. It is, states Dowlais, the #1 global drive system supplier, serving 90% of global OEMs. It supplies drive systems for ICE vehicles though is also focussed on the growth opportunity from EV's. GKN Automotive eDrives can be supplied as 3-in-1 with inverter, motor, transmission, software, and controls fully integrated, sourced as 2-in-1 systems, or as single modules or components. It has supplied electric drive systems into 2,000,000 vehicles globally and it reports and EV order book; accounting for over 40% of £5.0bn of new orders in 2022. Dowlais is targeting an EBIT margin of 11%.

Linamar Corp. (LNR TRO) is Canada-based and a global Tier 1 automotive components manufacturer. In 2022, the Company produced revenue of $5.9bn. Linamar's products include mobile industrial (aerial platforms), harvesting equipment, precision metallic components, modules and systems for powertrain, driveline, and body. Linamar has developed eAxle systems for the medium and heavy-duty EV markets.

Nidec (NYSE) China-based Nidec is a leading global producer of eAxle systems for EV's. The Nidec eAxle incorporates the electric motor, inverter, and gears. Nidec, in reporting its results for 2021 stated that of 2.91m BEV's sold in China, it has 27% share of the eAxles supplied., Nidec produces eAxles ranging from 50kw to 200kw.

ZF Friedrichshafen AG is a privately owned, Germany-based, technology company, with reported sales of €43.8bn in 2022. ZF supplies systems for passenger car, commercial vehicle and industrial markets. As an e-motor supplier, ZF is currently involved in around 50 different projects with 12 automotive manufacturers, including premium and volume manufacturers. UK-based Lotus cars is owned by Geely. The Lotus Eletre car uses a ZF 800v silicon carbide inverter, PSM motor technology and software can deliver up to 675kW and maximum torque of 985nm. ZF electric motors are used in the Mercedes EQ. Two ZF motors are used deliver over 600hp (440kW) in the Porsche Taycan. The Company's AxTrax2 system for buses integrates the e-motor, 800v inverter, power electronics and transmission. The systems deliver 210 kW continuous power and 26,000 Nm of peak output torque.

Segment Forecasts

Note: We readily acknowledge that our forecasts, given that the business is moving to scale, are highly subjective. Our estimates on volumes, pricing and ramp up are based on a combination of discussions, with management, our observations of market data and judgement.

Our financial forecasts for EQIP are summarised as shown in the table below:

Summary Table

Powertrains May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.8**	**9.4**	**16.5**	**27.3**
Gross Profit £m's	**-0.1**	**1.9**	**4.3**	**7.3**
Gross margin %	-3%	20%	32%	32%
EV Technologies May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.6**	**1.7**	**3.5**	**5.5**
Gross Profit £m's	**0.6**	**0.7**	**1.4**	**1.9**
Gross margin %	38.1%	41.6%	40.4%	35.6%
Prototype Engineering May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**1.3**	**1.7**	**3.0**	**3.0**
Gross Profit £m's	**0.5**	**0.8**	**1.5**	**1.5**
Gross margin %	35.1%	48.9%	50.0%	50.0%
Grants May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**0.1**	**0.6**	**0.8**	**0.1**
Gross Profit/loss £m's	**0.0**	**-0.6**	**-0.8**	**-0.1**
Licensing / royalties May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Revenue £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross Profit/loss £m's	**0.3**	**0.0**	**0.2**	**0.3**
Gross margin %	35.1%	48.9%	50.0%	50.0%
Group May y/e	**2023E**	**2024E**	**2025E**	**2026E**
Group Revenue £m's	**5.1**	**13.4**	**24.0**	**36.2**
Revenue growth %	**52%**	**166%**	**79%**	**51%**
Gross Profit £m's	**1.2**	**2.8**	**6.7**	**10.9**
Gross margin	23.9%	21.2%	27.8%	30.2%
Gross Margin excluding grant income	25.5%	26.9%	32.0%	30.6%

SOURCE: *Company Data, VSA Capital Research.*

Financials

Revenue: For FY2023 (year-end May 2023), we are estimating revenue of £5.1m which is based on the July 2023 Trading update from EQIP outlining Full Year revenue of £5.1m comprising £4.8m from existing order books and £0.3m from the new licencing agreement with Sona Comstar. EQIP, also in its July 2023 trading update, reported a contracted order book of £5.5m as at July 10th, 2023. We see this order book supporting our estimated revenue for FY2024 of £13.4m, which comprises £9.4m from powertrains, £1.7m from EV technologies including motors and inverters, £1.7m of electrification developments for clients and £0.6m of grant income.

Looking to the periods ending May 2025 (FY2025) and May 2026 (FY2026), we see revenue accelerating to £24.0m and £36.2m.

These estimates represent material increases on our expectations for the coming FY2024 fiscal year. For FY2025, we estimate that of the £24.0m revenue, £16.5m will come from supplying full systems, including retrofitting, for 74 buses and 12 fire engines. This, specifically from FirstGroup, TFL, and REV Group as earlier outlined. EQIP has secured a flexible lease on a 50,000 sq. ft. unit to accommodate growing demand.

We also anticipate revenues from EV Technologies to rise from £3.5m in FY2025 to £5.5m in FY2026 with volumes shipped rising from 146 units to 245 units.

Gross margins: the gross margin in any financial period is going to depend upon revenue mix. Our cost of goods sold estimates primarily include materials, manufacturing, assembly, and engineering costs; the cost intensity depending on the business segment. We anticipate the gross margin falling in FY2024 to 21.2% from 23.9% in FY2023 as the Company expends costs that are funded by grant income. Excluding grant income, the FY2024 margin would be 26.9%. On rising volume, we forecast the gross margin to increase 27.8% in FY2025 and 32.0% in FY2026.

EQIP's technology requires semiconductors, batteries, and more general electronic components. There have been, and still are, supply issues across the electronics industry, which not only creates manufacturing challenges when components are short but also pricing pressure. However, we understand from the Company that for several types of components this situation is now easing. We have sought to allow for supply pressures in our anticipated volume ramp up and achievable gross margins near term. A number of components sourced by EQIP are priced in US dollars and the exchange rate vs. the British pound (USD/GBP rate) has, in recent months, moved in the Company's favour providing more dollars per pound. This could provide upside to our estimates.

Operating costs: by the close of FY2023 the Company's headcount had grown to 94 full time staff (FY2022: 73) of which 40 are professional engineers. We estimate Sales, General and Administration (SG&A) costs rising from £5.9m in FY2023 to £8.1m in FY2024, £8.6m in FY2025 and, in FY2026 £9.5m to represent 26% of revenue.

The Company is supplying the transport markets and must provide for and support warranty including parts and repairs under warranty terms. We understand from management that it is prudent at this stage to allow for a P&L warranty expense of 4.5% of revenue in FY2024, 4.2% in FY2025 and 4.8% in FY2026, mainly in relation to buses. This is an initial estimate and as EQIP's volume ramps up, we will start to get a better feel for the warranty costs.

We have also included an operating income line that relates to UK Government's Research and Development Credit (RDEC) scheme. Companies who claim under the RDEC scheme, receive 13% of qualifying R&D expenditure from April 1st, 2020, up to and including March 31st, 2023, and will receive 20% from April 1st, 2023. In FY2022, EQIP had £0.6m operating income from RDEC, and expects this ahead near term.

Given the early-stage nature of EQIP's revenues and investment for growth, we are not estimating the Company to generate a positive EBIT until FY2026.

We are being conservative and forecast for FY2023, FY2024, FY2025 and FY2026 respectively EBIT losses of -£4.4m, -£5.3m and -£2.4m moving to a profit of £0.3m. Leading industry EV technology suppliers into the automotive and wider transport markets in 2022 achieved average EBIT margins of 7% under conditions of high inflationary costs. Within this

Allison Transmission (mentioned in our Competition section) achieved a 28.3% EBIT margin and BorgWarner 8.7%. Longer term and given scale, EQIP should be able to achieve a low double digit EBIT margin.

Tax: our forecasts are for EQIP to move to net profit in FY2026 and be charged at a UK corporate tax rate of 25%.

Net profit/loss: we estimate respectively net losses for FY2023, FY2024, FY2025 of -£4.6m, -£5.4m, -£2.5m. For FY2026, we forecast a maiden net profit of £0.2m. This equates to a respective EPS net loss per share for FY2023, FY2024, FY2025 of -0.5p, -0.6p and -0.3p. For FY2026, when we forecast the Company to move into profit, we estimate an EPS of 0.02p per share.

Cashflow: FY2023 saw the business raise £20.0m inclusive of costs. This comprised £3.8m from a loan note which later converted, £10.0m on IPO in September 2022, and a subsequent £6.2m equity raise in January 2023. For FY2023, we forecast a net operating cash outflow of £8.4m, capital expenditure of £0.8m and R&D capitalisation of £1.1m, this to result in an overall free cash outflow of £10.3m. Post overall £15.4m of cash income from financing, including the £3.8m negative on note conversion, will, we estimate, see FY2023 end cash increase from £2.0m to £7.0m.

As revenues rise and losses reduce, we estimate a £4.9m cash outflow in FY2024, £1.2m outflow in FY2025 and £1.9m inflow in FY 2026 to close with end cash of £2.8m.

Future Expansion to meet Growth Opportunity

During the financial period commencing June 2025 (FY2026), we anticipate EQIP starting to accelerate revenues from inverters, motor, and battery pack technologies into the automotive and aerospace markets. This, we forecast, will see units sold increase from 146 in FY2025 to 245 in FY2026 from sales into the automotive markets, not just high-performance cars, but also from larger motors into the off road, construction, and mining vehicle markets. There are also, as we have already noted, growing opportunities in aerospace and marine.

245 is a small volume, particularly in ground transport, however producing this volume will require a step up in EQIP's manufacturing capacity. EQIP currently undertakes final unit, full systems assembly, and testing in-house at Snetterton. Motor coil windings, all circuit boards, batteries and motor housings and battery packs are sourced externally. Software for specific control systems to maximise EV platform performance is developed internally and is a key part of the Company's' Intellectual Property.

EQIP may need to build its own production facilities to meet anticipated future growth, and this will require additional capital (not in our forecasts). Alternatively, EQIP could fully outsource full component assembly and test. We have initially allowed for this, hence our estimated gross margin of 35.6% for the EV Technologies segment in FY2026. Logically, given electrification opportunity in transport, existing customer relationships and that the products have already been used in advanced automotive and aerospace applications, EQIP should be able to achieve volumes in the 1,000's of units.

Valuation

We are initiating coverage with a Buy recommendation setting a valuation of £121m and 12-month share price target of 12.2p/sh.

Our valuation is based on a blend of EV/Revenue and is supported by a Discounted Cash Flow (DCF) which highlights the value potential as growth is realised.

We have % weighted our valuation EV/Revenue 60% and DCF 40%. This a balance between:

1. Selecting the appropriate peer group EV/Revenue multiple given our two peer groups produce respective multiples of **7.2x and 2.8x**
2. DCF longer-term forecast risk.

Our blended valuation is shown in the table below:

Sum Of The Parts (SOTP) Valuation

	EV/ Revenue FY1	Revenue £m's FY1	Implied EV £m's FY1	EV/ Revenue FY2	Revenue £m's FY2	Implied EV £m's FY2	Average implied EV (FY1 & FY2)	Valuation Weighting	Valuation Contribution £m's
Transitional Energy technology	7.2	13.4	96	4.0	24.0	95	96	30.0%	28.7
EV technologies and eAxles	2.8	13.4	38	2.6	24.0	63	51	30.0%	15.2
DCF implied EV							161	40.0%	64.5
12-month implied EV									108.4
Net Cash £m's									7.0
12-month Market Capitalisation target £m's									**115.4**
Basic number of shares in issue									948
12 months share price target pence									**12.2**
Current share price pence									9.5
Upside/(Downside)									**28.1%**

Source: Eikon, VSA Capital Research.

Peer Group Valuations: EV/Revenue multiples

To derive relevant peer group EV/Revenue multiples, we have looked at two peer groups: Transitional Energy technologies and EV technologies & eAxle. Given that a number of our peer comparison companies are loss making, as is EQIP currently, we have not considered comparisons of earnings multiples such as EV/EBITDA.

Comparison periods: the Company year-end is May. FY2023 is about to complete and so we have applied sector 1 year ahead (FY1) and two years ahead (FY2) EV/Revenue multiples (sourced from Refinitiv Eikon) to our FY2024 and FY2025 revenue estimates (year-end May). The Peer Group forecast multiples, sourced from Refinitiv Eikon, cover calendar year 2023 and 2024 financial estimates.

Transitional Energy technologies: includes technologies for the transition including those for vehicles but also the electricity grid including fuel cells, electrolysers, batteries, and EV charging.

Electric Vehicle technologies and eAxles: suppliers of electric vehicle technologies such as electric motors, inverters, BMS, battery packs, control software and complete eAxles integrating such technologies.

Transitional Energy technology peers

EQIP is developing technology that has a key role to play in a structural move to Transitional Energy and reducing emissions; that of vehicle electrification.

Within our Transitional Energy technology peer group, we have included battery technology companies and fuel cell developers. Fuel cells are being evaluated to extend range, particularly in heavy electric vehicles. EQIP recently won grant funding to help to develop a hydrogen/battery electric hybrid vehicle.

Transitional Energy Technology Peer Group Valuations

Company Ticker	Company Name	Market Cap (USD m)	EV/Revenue (FY1)	EV/ Revenue (FY2)
BLDP.TO	Ballard Power Systems Inc	1,424	6.4	3.8
CWR.L	Ceres Power Holdings PLC	887	11.8	9.3
FCEL.O	FuelCell Energy Inc	866	5.2	3.7
IES.L	Invinity Energy Systems PLC	116	3.5	1.8
ITM.L	ITM Power PLC	720	17.9	9.0
M6P.F	McPhy Energy SAS	235	5.1	2.4
PLUG.O	Plug Power Inc	7,663	5.3	3.4
PCELL.ST	Powercell Sweden AB (publ)	476	15.3	10.5
Sector Average (exc. CWR and PCEL)			**7.2**	**4.0**

SOURCE: *Eikon, VSA Capital Research.*

We can see that valuation is skewed by several hydrogen-related technology companies such as **Powercell and Ceres Power** which already have commercial relationships, market opportunities, are revenue generating though loss making as they are moving strongly into volume. Fuel cell developers, which have been around for many years, are now finding real opportunity as the market recognises the urgent need for viable technologies to increase sustainability.

For our Transitional Energy technology peer group, the average EV/Revenue multiple is **7.2x for FY1, falling to 4.0x for FY2.**

Electric Vehicle technologies and eAxle peers

Most of these companies are well established, advanced technology multinationals with mature revenue streams and producing EBITDA profits from multiple technologies into the transportation sector. Given maturity, this peer group does not trade on the larger multiples exhibited by the potentially high growth, earlier stage, Transitional Energy technology peer group.

EV Technologies and eAxle Peer Group Valuations

Company Ticker	Company Name	Market Cap (USD m)	EV/Revenue (FY1)	EV/ Revenue (FY2)
6902.T	Denso Corp.	54,060	1.1	1.1
6594.T	Nidec Corp.	33,975	2.3	2.1
ABB	ABB	75,254	2.5	2.4
ALSN.K	Allison Transmission	5,343	2.5	2.5
AME	AMETEK Inc.	36,749	5.8	5.5
BWA	BorgWarner Inc.	10,891	0.9	0.8
DHR	Danaher Corp.	188,280	7.0	6.6
DWL.L	Dowlais Group Plc	2,214	0.7	0.7
FELE.O	Franklin Electric Co Inc	4,516	2.2	2.1
MOD.N	Modine Manufacturing Co.	1,988	0.9	0.9
WEGE3.SA	WEG SA	34,920	4.8	4.2
Sector Average			**2.8**	**2.6**

SOURCE: *Eikon, VSA Capital Research.*

For our Electric Vehicle technologies and eAxle peer group, the average EV/Revenue multiple is **2.8x for FY1, falling to 2.6x for FY2.**

Discounted Cash Flow (DCF) Valuation

EQIP, in our view is more than capable of achieving strong double digit top line growth. Given levels of commercial interest and factoring in customer design in timescales, we expect the Company to materially grow motor, inverter and battery pack volumes from FY2025 and we estimate double digit % revenue growth, even at the end of our 10-year forecast period. However, the growth rates see the DCF terminal value overly weigh on overall value from core cashflow generation. We believe that a WACC of 11.8% is appropriate given that the business is at an early stage of growth.

Discounted Cash Flow Valuation

Discounted cashflow £m's	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E
Sales	**5.1**	**13.4**	**24.0**	**36.2**	**46.4**	**61.7**	**84.5**	**148.5**	**177.1**	**208.6**
% Change	36.4%	165.5%	78.6%	50.9%	28.4%	32.8%	37.0%	75.8%	19.3%	17.8%
EBIT	-4.4	-5.3	-2.4	0.3	2.7	4.3	9.1	14.4	19.1	26.0
EBIT Margin	n/m	n/m	-9.8%	0.9%	5.8%	6.9%	10.7%	9.7%	10.8%	12.5%
D&A	0.7	0.6	0.4	0.6	2.2	2.3	3.1	5.3	6.3	7.4
Change in working capital	-4.9	0.9	0.8	0.3	-0.5	-2.3	-3.4	-9.8	-4.4	-4.8
Warranty provision	0.2	0.6	1.0	1.8	3.3	4.2	5.5	8.9	10.4	12.1
Warranty - cash paid	0.0	-0.1	-0.2	-0.4	-0.7	-0.8	-1.1	-1.8	-2.1	-2.4
Capital Expenditure	-1.9	-2.0	-0.2	-0.2	-3.0	-3.1	-4.2	-7.4	-8.9	-10.4
RDEC tax credits	0.3	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cash tax	0.0	0.0	-0.1	-0.1	-0.7	-1.1	-2.3	-3.6	-4.8	-6.5
FCFF to Equity	**-10.1**	**-4.9**	**-0.1**	**2.9**	**4.0**	**4.0**	**7.2**	**6.6**	**16.3**	**22.0**
WACC	11.8%									
Discount factor	0.89	0.80	0.71	0.64	0.57	0.51	0.46	0.41	0.37	0.33
Discounted cash flow	**-9.0**	**-3.9**	**-0.1**	**1.8**	**2.3**	**2.0**	**3.3**	**2.7**	**6.0**	**7.2**
10-year NPV £m's	12.2									
Terminal value (TV) £m's	148.9									
EV £m's	161.1									
2023 May end cash £m's	7.0									
Equity value £ m's	**168.1**									
Number of shares m's	948.2									
DCF price per share (p)	**17.7**									

Source: Company Data, VSA Capital Research.

The explicit forecast period provides a Net Present Value (NPV) of £12.2m and a terminal value of £148.9m. However, the GDP growth rate assumed for the perpetuity factor for the terminal value calculation can be very subjective; we have used 2.0% (7.0% nominal including inflation expectation), which is conservative given expectations longer term for global electric transportation growth. We also assume that the Company over time achieves the low double percentage digit EBIT margin seen in the wider automotive technologies sector. Our overall DCF valuation, using moderate assumptions for the Weighted Average Cost of Capital (WACC) and growth rates, clearly demonstrates the value proposition.

Our DCF produces a market capitalisation of £168.1m and DCF price per share of 17.7 p/sh.

Key Risks

- **Earlier stage business:** EQIP is also in the initial stages of producing and retrofitting full electrification systems and could incur delays, increased costs while key components may not be supplied on time. This could see production volumes and financial forecasts not achieved as we envisage. Given competition and time to complete tenders, there is no guarantee that any of the opportunities for which the Company is in the process of tendering, or in respect of which it is in early discussions, will result in the award of a contract to the Company. EQIP, given that it is currently loss making, may require further equity capital in future to support growth and this could dilute shareholdings.

- **Technology Development:** To compete, EQIP needs to invest in R&D to develop additional products. EQIP's products are used in applications that require exacting standards of safety and are subject to regulations. If any of the Company's products fail to achieve regulatory certification or pass testing processes, it could impact commercialisation timescales. Target end markets involve rapidly changing technologies and the ability to compete successfully depends on the technological and creative skill of the Company's personnel, consultants and contractors and their ability to design, develop, manufacture, assemble, test, market and support new products and enhancements on a timely and cost-effective basis to satisfy the demands and expectations of customers. EQIP needs to ensure that it can recruit, incentivise, and retain skilled engineers to achieve its development roadmaps.

- **Electronic component shortages:** our forecasts call for an increase in system volumes produced and shipped. The Company's products use complex electronic components such as semiconductors which are provided by third party manufacturers. The Company is subject to the risk of shortages and long lead times in its supply chain. This could impact its ability to produce product, provide satisfactory supply to customers and achieve our financial estimates. EQIP may be required to incur additional costs and expenses in managing supply chain disruptions, in particular a further semiconductor chip shortage. Costs could include additional R&D expenditure, engineering design and development costs if the Company were to be required to onboard alternate suppliers on an expedited basis.

- **IP Infringement:** EQIP has patents both approved and pending. The Company's success depends in part on its ability to protect its rights in its intellectual property and proprietary expertise. EQIP relies upon various intellectual property protections, including trade secrets, license agreements, patents, trademarks, and contractual provisions, including with current and former employees and contractors, to preserve its intellectual property rights and proprietary expertise. Despite these precautions, it may be possible for third parties to obtain and use the Company's intellectual property and proprietary expertise without its authorisation.

- **The Company is exposed to potential product liability:** some of the Company's activities may expose it to potential product liability and professional indemnity risks, as well as litigation and reputational risks, which are inherent in the development and manufacture of its products and future products. Any product liability claim brought against the Company, with or without merit, could result in the increase of the Company's product liability insurance premiums or the inability to secure coverage in the future. There can be no assurance that the necessary insurance cover will be available to the Company at a commercially acceptable cost or that, in the event of any claim, the level or extent of insurance carried by the Company now or in the future will be adequate, or that a product liability or other claim would not materially and/or adversely affect the business of the Company.

- **Planned manufacturing expansion:** EQIP intends to further expand its manufacturing capacity to scale up the business and meet anticipated future demand. This includes the opening of a new, larger manufacturing facility, adjacent to the Company's current operations in the UK. There is a risk that this expansion takes longer than expected. Delays could arise in the installation of the equipment, its commissioning could take longer than expected and equipment may not work as expected, while delays could also cause the new facility not to open on time and cause the anticipated scale-up in manufacturing capacity not to be achieved within the timeline expected.

- **Entry into new geographic territories:** the strategy is to enter new geographic markets. The Company's operating results could be materially adversely affected by a variety of uncontrollable and changing factors linked to expansion challenges, including distance, language, and cultural differences; legal or regulatory restrictions; potential adverse tax consequences; and higher costs associated with doing business internationally. Adverse exchange rates could also present risk.

Appendices

Board of Directors

Clive Scrivener, Independent Non-Executive Chairman

Clive has significant automotive and clean technology industry experience, having previously held senior executive roles including CFO, COO and CEO at engineering technology company Prodrive Holdings Ltd. He is currently a non-executive Chairman at a number of high growth, technology companies in the clean energy and new mobility sectors, including full stack autonomous software developer Oxbotica and Hydrogen fuel cell developer Bramble Energy. Clive is also Non-Executive Chairman of the Vehicle Certification Agency.

Ian Foley, Founder & CEO

An engineer by profession, Ian moved to Norfolk in 1988 working for the leading automotive engineering consultancy Lotus Engineering. In 1991, Ian moved to the Lotus Formula 1 Team and was soon promoted to Head of Research & Development. In this capacity, Ian led the development of the ground-breaking computer controlled Active Suspension system which the team raced in 1992 & 1993. Following this Ian set up EQIP, initially as a vehicle from his own engineering consultancy.

In 2007, Ian identified the importance of the move to electrification, and upon the introduction of hybrid systems in Formula 1, he began the development of an electric hybrid system based around a novel electrically driven carbon fibre flywheel. This technology had originally been developed by nuclear centrifuge producer Urenco Group. As it became clear that this technology would have applications in the mainstream, as well as Formula One, Ian spun the project out and formed a new Company Automotive Hybrid Power ("AHP"), together with 2 ex-Urenco Group employees. This Company acquired the patents and knowledge for the technology. AHP contracted Williams Grand Prix Engineering Ltd ("WF1") initially as a customer, then WF1 became an investor and the Company was renamed Williams Hybrid Power ("WHP"), with Ian as its CEO. WHP successfully developed the technology, winning the Le Mans 24 Hour race 3 times with the Works Audi racing team and the technology was commercialised as an energy storage system for buses. Following successful bus trials, significant orders were placed for the technology and because of this success, Williams F1 who were by now the majority shareholder, decided to exit, selling the business to the largest engineering Company in the UK, GKN Automotive. Ian then focused on the development of EV technology at EQIP.

Steven McGillivray, Chief Financial Officer

Steven is a fellow with the ACCA having qualified in 2008. Prior to joining EQIP, he spent six years working as the Financial Controller for Aquaterra Energy, an upstream oil and gas service group with an international footprint, where he was responsible for the day-to-day management of the finance function. This included responsibility for adherence with overseas tax and financial reporting legislation for overseas branches in Australia, Norway and Azerbaijan, foreign subsidiaries in Egypt and Malaysia and tax presences in a number of other countries. He was integral to the due diligence process that led to a private-equity investment in 2017 and held the senior finance position during the change of ownership. Prior to this, he was the Head of Finance for Retail Operations at Anglian Home Improvements where he played a key role in numerous business improvement initiatives alongside the management of the Operations Finance team.

James Bishop, Chief Operating Officer

James started his professional career as a mechanical engineer in the automotive technology space at Active Technologies before branching into project design and management. Between 2012 to 2018, he took on more leadership positions across of a range of engineering systems, delivering technical and challenging projects for client such as AP Moeller Maersk, Rolls Royce Holding PLC and BAE Systems PLC. James is now serving as the Chief Operating Officer of the Company, where he is focusing on delivering the plan to expand the business whilst managing day-to-day business operations.

Dena Bellamy, Independent Non-Executive Director

Dena has over 20 years' experience as a corporate finance adviser at distinguished investment banks including Rothschild, Merrill Lynch, and Commerzbank. She has advised both corporate clients and public sector entities on a broad range of transactions from multi-billion-pound public transactions to private financing for growth companies. Her experience, spanning M&A, privatisations, debt and equity capital markets and private fundraising has covered, inter alia, transport & logistics, aerospace & defence, infrastructure, and real estate.

Jonathan Beasley, Independent Non-Executive Director

Following a 5-year tenure as Group Technology Officer for GKN Ltd, Jonathan became a lead member of the Advanced Propulsion Centre upon its founding in 2014, as Director of Competition and Programmes. Under his direction, the Advanced Propulsion Centre has funded programmes to the value of c.£1.1bn. Jonathan is also a long-standing member of the UK Automotive Council and as such has helped shape the thinking regarding the transition of the automotive industry to a zero-carbon future.

Torque-to-Weight and Power-to-Weight

Two key principles require understanding when evaluating motor performance: Torque and Power.

Torque in physics, this is also called a called a moment of a force. This is the tendency of a force to rotate the body to which it is applied. The torque, specified regarding the axis of rotation, is equal to the magnitude of the component of the force vector lying in the plane perpendicular to the axis, multiplied by the shortest distance between the axis and the direction of the force component.

Force is measured in Newtons (N), distance in metres (m) and therefore Torque is measured in Newton metres (Nm).

An example of the application of torque can be illustrated using a wheel brace (long spanner like tool) to remove a wheel nut off a car wheel. If the wheel brace is parallel to the ground, the torque you apply is the combined downward force on the wheel brace (i.e., your mass multiplied by gravitational acceleration) measured in Newtons multiplied by the length of the wheel brace in metres. Torque is a measure of *work done* and is therefore applied whether the wheel nut moves or not. Once the wheel nut starts to rotate, measured in revolutions per minute (rpm) you are increasing Power. There is therefore a direct link between torque and power.

Power is the rate at which *work is done* (or energy transferred). Power is measured in Watts whereby 1 Watt = 1 Joule (the measure of Energy) per second. For every extra Joule transferred in a second, the power increases by 1 Watt. For motors, the equation linking Power and Torque is:

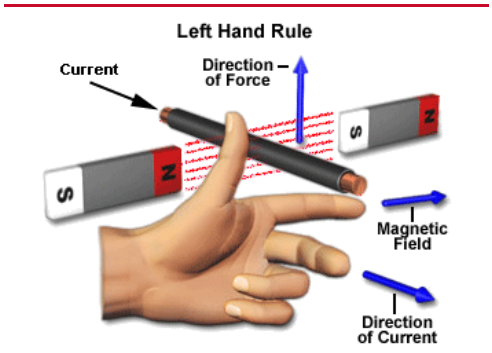
Power produced (in kW) = Engine speed (rpm) x Torque (Nm), divided by 9,549.

Types of Electric Motors

Electromagnetic Principles and Electric Motors

When a current carrying conductor meets a magnetic field, a force will act on the conductor. Sir John Ambrose Fleming, an English physicist, in the late 19th century, developed a memorable and yet accurate way to find the direction of force/motion of the conductor in an electric motor when both the direction of the magnetic field and electric current are known. This is called Fleming's Left-Hand Rule and is illustrated in the diagram below:

Fleming's Left-Hand Rule



SOURCE: Wikimedia Commons, VSA *Capital Research.*

The magnetic fields produced by opposite magnetic poles attract - North and South attract each other. The magnetic fields produced by like magnetic poles repel – South and South repel.

The alternate attraction and repulsing forces, created by magnetic fields produced in electric motors, cause the rotor to rotate.

Electrical current occurs in two forms:

Direct Current (DC): the electrical current (the flow of electrons through a conductor) is in one direction only. The electrical current produced by from solar panels and batteries is Direct Current. It flows from one terminal directly to another terminal. If we reverse battery connections, electrons flow in the opposite direction.

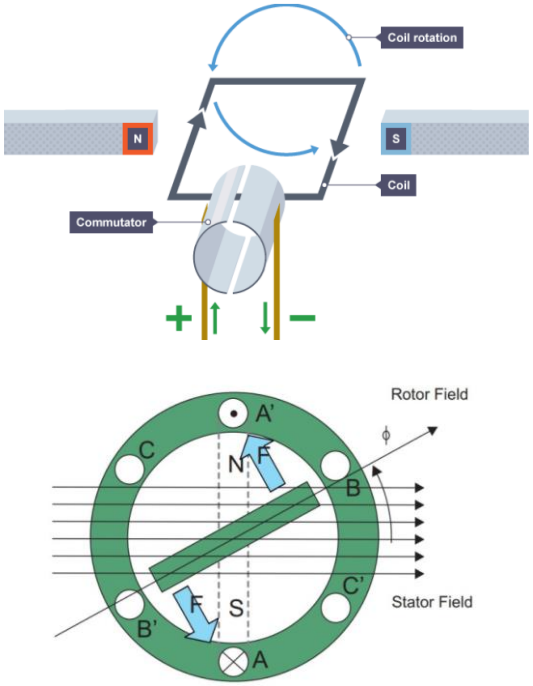
Alternating Current (AC): electrons move backwards and forwards as the voltage and so current reverse polarity. Most power distribution systems around the world carry AC. The reason is that over long distances from power stations, AC loses less power than DC.

There are two types of electric motors: DC and AC.

Electric Motors: DC and AC

The diagram below shows the basic principles of a DC electric motor and how Flemings Left Hand Rule describes the force causing rotation of the central armature.

DC Motor Fundamentals



SOURCE: Texas Instruments Inc. (Stator and Rotor Field) BBC Bitesize, VSA Capital Research.

Looking to the diagram above, the current in the left-hand part of the coil, according to Fleming's Left Hand Rule, causes a downward force. The current in the right-hand part of the coil causes an upward force and the coil rotates anti-clockwise. In the vertical position, moves parallel to the magnetic field and no force is produced. Normally that would make the motor stop, however, there are two features allow the coil to continue rotating:

1. The momentum of the motor causes it to continue to rotate a little
2. A split-ring commutator which changes the current direction every half turn. This means that the current in the left-hand part of the coil still causes a downward force and the right-hand part an upward force.

The second diagram shown above (in green) shows the magnetic fields within a hypothetical electric motor. A current flowing through stator wire coil windings produces the stator magnetic fields which interact with the rotor fields as their North and South repel and attract.

DC electric motors are not seen as the ideal solution for EVs as they can be hard to control precisely for speed and torque.

DC Motors: Brushed and Brushless

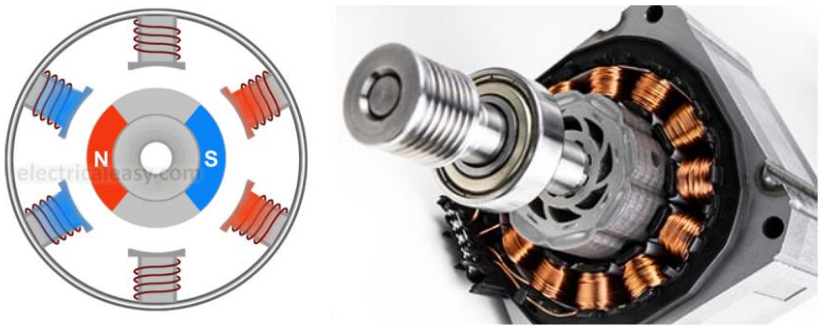
DC electric motors are designed as either Brushed or Brushless DC (BLDC) and are fundamental elements of DC motor construction, some of which we have already mentioned:

- Armature, the rotating part of the motor (sometimes called the rotor);
- Stator, the field windings or the stationary part of the motor;
- Commutator, an electrical switch that periodically reverses the current direction between the rotor and the external circuit; it can be brushed or brushless; and
- Field magnets provide the magnetic field that turns an axle connected to the motor; these magnets can either be permanent or electromagnets.

Permanent Magnet Brushless DC (PM BLDC)

The Permanent Magnet Brushless DC (PM BLDC) motor has been used in early EV models. This type of motor has a higher efficiency than Brushed DC, using an electronic commutator/inverter instead of the brushes. The motors use coils wound round magnets and spaced apart all around the stator. As current is applied to the coils, magnetic fields are produced that interact with the magnetic fields of the permanent magnets built into the rotor. This interaction causes the rotor to rotate.

A PM BLDC Motor



SOURCE: electricaleasy.com owerelectronictips.com motioncontrolonline.org, VSA Capital Research.

The PM BLDC motor offers a number of advantages:

- High efficiency and high output power to size ratio;
- Less overall maintenance due to lack of brushes;
- Constant torque up to base speed, constant power up to max speed;
- Reduced size with superior thermal characteristics;
- Higher speed range and lower electric noise generation; and
- Windings on stator help to eliminate heat. Magnets on the rotor have low-moderate eddy current-induced heating.

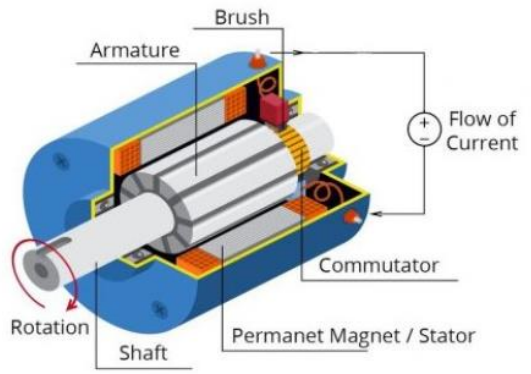
There are disadvantages:

- Cost can be higher as PM BLDC motors use high power permanent magnets that are expensive;
- PM BLDC motors have a short constant power operation region because of their permanent magnet field weakened by a stator field. The permanent magnets also limit the motor torque to be high; and

- The increased centrifugal forces caused by higher motor rotation speed can cause safety issues due to the possible breaking of the magnets. Temperature can be an issue as the magnets are significantly influenced by the elevated temperature which reduces the magnetic field flux density and so the motor torque capacity.

The diagram overleaf shows an expanded view of a Brushed DC motor.

A Brushed DC Motor



SOURCE: Powerelectronictips.com, VSA Capital Research.

The Brushed D motor is a very mature technology and provides:

- Low cost;
- High torque at low speed; and
- Speed control.

Given their low cost, Brushed motors are universally used, however, not for EVs due to a number of disadvantages, namely:

- Large size;
- Maintenance requirements due to the brush and collector structure;
- Lower electrical efficiency compared with alternatives;
- The windings on rotor can make heat removal from both rotor and commutator challenging;
- At high voltages, commutator arcing (sparking across) can be a problem; and
- Regenerative braking can be difficult and require a complex speed controller.

AC Motors

The EV motor must operate smoothly and predictably from zero RPM to thousands of RPM when driving at higher speed. This level of control is best achieved with an AC Induction motor.

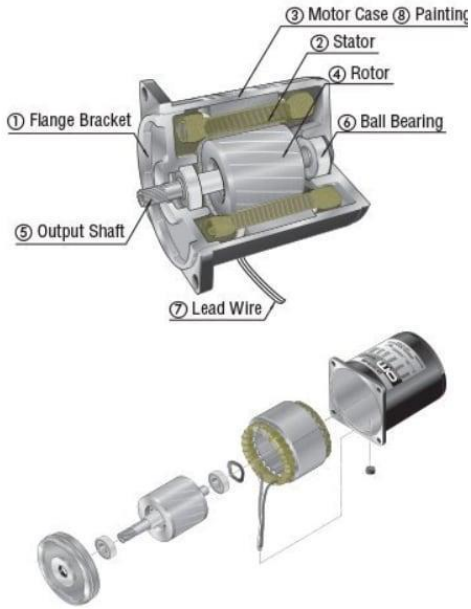
AC induction motors have a simple construction comprising:

- A stator containing the coil windings; and
- A rotor composed of conductors shorted together at each end and arranged as “squirrel cage".

The type of AC motor used in transport applications is typically a “3 phase” motor. This means that that the motor operates with three separate AC electrical currents which are offset from each other in time i.e. phase 2 achieves its positive peak after phase 1 does and phase 3 after phase 2. A typical 3 phase AC induction motor has 3 separated coils, each connected to a different phase of the AC supply and physically spaced 120 degrees apart around the stator which surrounds the “squirrel cage” rotor.

The motor stator coils create a set of magnetic fields which effectively rotate. The motor works on the principle of electromagnetic induction whereby magnetic fields created by the stator coils induce a current inside the rotor's conductors, which in turns produces rotor's magnetic field that tries to follow stator's magnetic field, pulling the rotor into rotation.

An AC Induction Motor



SOURCE: *Orientalmotor.com, VSA Capital Research.*

Since the speed of an AC induction motor depends on the frequency of the alternating current that drives it, the motor turns at a constant speed unless you use a Variable Frequency Drive (VFD). The speed of DC motors is much easier to control simply by turning the supply voltage up or down.

Unlike DC motors, an AC induction motor cannot be driven from batteries or any other source of DC power (solar panels, for example) without using an inverter (a device that turns DC into AC). This is because an AC induction motor works on the principle of alternating direction current changing magnetic field to turn the rotor: DC flows in one direction. Compared to DC motors, the advantages of AC motors are:

- High efficiency;
- Less overall maintenance;
- Constant torque up to base speed, constant power up to maximum speed, whilst automotive applications are clearly viable with a single ratio gearbox, it can take hundreds of ms for torque to build after application of current, limited on either the low or high end depending on powertrain configuration;
- Higher reliability;
- Regenerative capability that enables braking energy to be returned to the batteries.

Permanent Magnet Synchronous Motor (PMSM)

The PMSM is an AC **synchronous** motor the field excitation of which is provided by permanent magnets. The PMSM is a cross between an induction motor and brushless DC motor. Like a brushless DC motor, it has a permanent magnet rotor and windings on the stator.

As a synchronous motor, the PMSM is based on the interaction of the *rotating magnetic field* of the stator and the constant magnetic field of the rotor. However, the stator structure with windings constructed to produce a sinusoidal flux density in the air gap of the machine resembles that of an induction motor.

The power density of a PMSM is higher than induction motors with the same ratings since there is no stator power dedicated to magnetic field production.

The PMSM offers a number of advantages:

- Simpler construction;
- Higher efficiency and high-power density;
- With permanent magnets the motor can generate torque at zero speed;
- Smooth rotation over the entire speed range of the motor, full torque control at zero speed, and fast acceleration and deceleration.

Disadvantages are:

- Cost can be higher as this type of motor uses high power permanent magnets;
- PMSM motors require a digitally controlled inverter for operations;
- High-performance motor control requires vector control techniques are usually also referred to as **field-oriented control (FOC).** A vector control algorithm is to decompose a stator current into a magnetic field-generating part and a torque-generating part. Both components can be controlled separately after decomposition;
- The increased centrifugal forces caused by higher motor rotation speed can cause safety issues due to the possible breaking of the magnets. Temperature can be an issue as the magnets are significantly influenced by the high temperature which reduces the magnetic field flux density and so the motor torque capacity.

PMSMs have the magnets located on the surface of the rotor. This can prevent the motor from operating at high speed. With the internal allocation of the magnets, the mechanical strength of the rotor increases, and the motor can operate at exceedingly high speed.

EQIP's patented electric motor control technology is agnostic to motor type and works with SynRM, Axial Flux and SPM motors in automotive applications.

Financial Forecasts

Profit & Loss (£m)

Profit & Loss £m's May year end	2022A	2023E	2024E	2025E	2026E
Revenue	**3.7**	**5.1**	**13.4**	**24.0**	**36.2**
Cost of Sales	-6.1	-3.8	-10.6	-17.3	-25.2
Gross Profit	**-2.4**	**1.2**	**2.8**	**6.7**	**10.9**
Gross Profit Margin	-64.2%	23.9%	21.2%	27.8%	30.2%
Selling General and Administration	-2.5	-5.9	-8.1	-8.6	-9.5
Warranty provision	0.0	-0.2	-0.6	-1.0	-1.8
Other operating income (RDEC)	0.6	0.5	0.6	0.6	0.6
Fair value adjustment - convertible loan note	-0.8	0.0	0.0	0.0	0.0
Operating costs	**-2.7**	**-5.6**	**-8.1**	**-9.0**	**-10.6**
EBIT	**-5.1**	**-4.4**	**-5.3**	**-2.4**	**0.3**
EBIT Margin %	n/m	n/m	n/m	n/m	0.9%
Adjusted EBITDA	**-4.8**	**-3.8**	**-4.7**	**-1.9**	**0.9**
EBITDA Margin %	n/m	n/m	n/m	n/m	2.6%
Finance Income	0.0	0.0	0.0	0.0	0.0
Finance Expense	-0.1	-0.1	0.0	0.0	0.0
Interest	**-0.1**	**-0.1**	**0.0**	**0.0**	**0.0**
PBT reported	**-5.2**	**-4.5**	**-5.3**	**-2.4**	**0.3**
Tax Expense	-0.1	-0.1	-0.1	-0.1	-0.1
Net profit (loss)	**-5.3**	**-4.6**	**-5.4**	**-2.5**	**0.2**
Non-controlling interest	-0.7	0.0	0.0	0.0	0.0
Owners of the parent	-4.6	-4.6	-5.4	-2.5	0.2
Basic number of shares	208.3	864.5	948.2	948.2	948.2
Weighted average number of shares (m)	208.3	864.5	948.2	948.2	948.2
Basic EPS (pence)	-2.2	-0.5	-0.6	-0.3	0.0
EPS Weighted Average (pence)	**-2.2**	**-0.5**	**-0.6**	**-0.3**	**0.0**
EV/Sales	22.4	16.4	6.2	3.5	2.3

SOURCE: *Company data, VSA Capital Research.*

Cash Flow (£m)

Cash flow £m's May year end	2022A	2023E	2024E	2025E	2026E
Net profit	**-5.3**	**-4.6**	**-5.4**	**-2.5**	**0.2**
Depreciation	0.2	0.6	0.5	0.3	0.5
Amortisation	0.0	0.1	0.1	0.1	0.1
Net interest	0.1	0.1	0.0	0.0	0.0
RDEC Tax credit	-0.4	-0.5	-0.6	-0.6	-0.6
P&L tax charge	0.1	0.1	0.1	0.1	0.1
Share based payment charge	0.6	0.2	0.0	0.0	0.0
Fair value losses on convertible note	0.8	0.0	0.0	0.0	0.0
(Increase)/Decrease Inventories	-0.8	-2.2	-1.1	0.1	0.0
(Increase)/Decrease Trade and Other Receivables	-0.4	-2.5	0.6	-0.2	-0.7
(Decrease)/ Increase Trade and Other Payables	0.6	-0.2	1.4	0.9	1.0
Change in working capital	**-0.6**	**-4.9**	**0.9**	**0.8**	**0.3**
Warranty provision charged	0.0	0.2	0.6	1.0	1.8
Warranty provision used	0.0	0.0	-0.1	-0.2	-0.4
Cash From Operations	**-4.6**	**-8.7**	**-3.9**	**-1.0**	**2.0**
RDEC tax received	0.4	0.3	0.4	0.6	0.6
Cash tax paid	0.0	0.0	0.0	-0.1	-0.1
Interest Paid	0.0	0.0	0.0	0.0	0.0
Interest Received	0.0	0.0	0.0	0.0	0.0
Net Cash From Operations	**-4.2**	**-8.4**	**-3.5**	**-0.5**	**2.5**
Capital expenditure	-0.1	-0.8	-2.0	-0.2	-0.2
Capitalisation of development costs	0.0	-1.1	0.0	0.0	0.0
Disposals	0.0	0.0	0.0	0.0	0.0
Cash From Investment	**-0.1**	**-1.9**	**-2.0**	**-0.2**	**-0.2**
Proceeds from share placing	0.0	20.0	0.0	0.0	0.0
Commission on raise	0.0	-0.8	0.0	0.0	0.0
New convertible loan	3.0	0.0	0.0	0.0	0.0
Conversion of convertible loan	0.0	-3.8	0.0	0.0	0.0
New finance leases	0.0	0.2	1.0	0.0	0.0
Repayment of finance leases	-0.1	-0.1	-0.3	-0.4	-0.4
Repayment of HP	0.0	-0.1	-0.1	-0.1	0.0
Dividends paid	-0.4	0.0	0.0	0.0	0.0
Interest paid	0.0	-0.1	0.0	0.0	0.0
Cash From Financing	**2.5**	**15.4**	**0.6**	**-0.5**	**-0.4**
Change in Cash	**-1.9**	**5.0**	**-4.9**	**-1.2**	**1.9**
Cash and cash equivalents at start of period	3.8	2.0	7.0	2.1	0.9
FX Adjustments	0.0	0.0	0.0	0.0	0.0
Cash and cash equivalents at the end of period	**2.0**	**7.0**	**2.1**	**0.9**	**2.8**

SOURCE: *Company data, VSA Capital Research.*

Balance Sheet (£m)

Balance sheet £m's May year end	2022A	2023E	2024E	2025E	2026E
Property and plant	0.5	0.8	2.3	2.2	1.9
Intangible/Goodwill assets	0.0	1.0	0.9	0.8	0.7
Assets	**0.5**	**1.8**	**3.1**	**2.9**	**2.5**
Inventories	0.8	3.0	4.1	4.0	4.0
Trade receivables and Prepayments	1.9	4.4	3.8	4.0	4.7
Cash & Equivalents	2.0	7.0	2.1	0.9	2.8
Current Assets	**4.7**	**14.4**	**10.0**	**8.9**	**11.5**
Trade Payables	-0.8	-0.5	-0.9	-1.4	-2.1
Lease liabilities	-0.1	-0.2	-0.9	-0.5	-0.1
Accruals and deferred income	-1.1	-1.2	-2.2	-2.5	-2.8
Convertible loan	-3.8	0.0	0.0	0.0	0.0
Current Liabilities	**-5.8**	**-1.9**	**-4.0**	**-4.5**	**-5.0**
Existing HP liabilities	-0.3	-0.2	-0.1	0.0	0.0
Warranty provision	0.0	-0.2	-0.8	-1.8	-3.6
Warranty provision used	0.0	0.0	0.2	0.4	0.7
Liabilities	**-0.4**	**-0.4**	**-0.8**	**-1.5**	**-2.9**
Net assets	**-0.9**	**13.8**	**8.3**	**5.9**	**6.1**

SOURCE: *Company Data, VSA Capital Research.*

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Equities breakdown: 03/08/23	BUY	SPEC BUY	HOLD	SELL
Overall equities coverage	86%	14%	0%	0%
Companies to which VSA has supplied investment banking services	100%	100%	n/a	n/a

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Valuation basis

Our valuation, to set a 12-month price target, is based on a blend of two valuation methods: EV/Revenue and a DCF.

Risks to that valuation

Component pricing and supply risk, execution risk, financing risk, regulatory risk, product liability risk, IP infringement risk and new territory entry risk.

This recommendation was first published on 03/08/23.