

The Opportunity for a National Electrification Skills Framework and Forum

September 2021

Transitioning the UK workforce
for the green industrial revolution
in transport and energy



FOREWORD AND ACKNOWLEDGEMENTS



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For the UK to meet its 2050 Net Zero commitments – from transport and aviation to power generation and distribution – a fresh approach to skills is required. One where the strengths of employers and educators are brought together and leveraged to the benefit of industries, businesses and their employees. To quote the published UK Innovation Strategy “it is vital that the UK’s workforce, and the education and training system that feeds it, has sufficient scale, diversity and breadth to meet the challenges and opportunities of a more innovative economy and society. Whether people are continuing education, retraining, moving from another sector, returning following a career break, or coming to the UK from abroad, our agenda must be to develop an inclusive and highly skilled workforce that meets the needs of business.” UK industry is undergoing an exciting and rapid transformation to fulfil the UK Government’s 2050 Net Zero commitments.

We are proud to launch this report which presents the opportunity for a national electrification skills framework and forum, to “re-skill, up-skill and new-skill” the UK engineering and manufacturing workforce, a major step forward to ensuring the right skills are in place at the right time. The evolution of existing sectors, along with the establishment of emerging battery cell production and power electronic and motors and drives sectors will be sustained by a skilled and increasingly agile workforce to take innovation forward into competitive production.

What follows represents a cooperative effort, catalysed by the Faraday Institution and WMG, University of Warwick, to define on first use the training and investment in people, education and skills that will allow the UK to Build Back Better and secure greener jobs in a flourishing UK electrification sector.

The need for Net Zero technologies is now. Through the delivery of an ambitious Innovation Strategy, the UK Government has signalled the desire to take this on by positioning the UK as a science superpower. Power Electronics, Machines and Drives (PEMD) are the underpinning technology to enable Net Zero to be achieved. From the generation and conditioning of electricity to its storage and use, PEMD is required.

The technology at the heart of PEMD, magnets, semiconductors and electrical steels for example are significant, and the development of robust and resilient supply chains critical. However, without people and skills technological advances alone cannot deliver the change needed, or enable the UK to significantly contribute to the global industry need for decarbonisation in the future.

The growth of people across all sectors in electrification is critical. With many cross disciplinary skills, there is an opportunity to create an upskilled workforce that is more mobile, more aspirational and better able to make a difference to the world in which we live.

This report sets out an ambitious framework that makes great steps in highlighting the need for developing electrification skills. Although initially based on the rapidly growing and early adopting automotive sector, this framework should be expanded to cover all sectors and industries involved in electrification.

Through dedicated efforts, novel approaches and outlooks to the skills agenda, people, who are so critical for success, are being returned to the heart of innovation across the UK.

The automotive sector recognises the need for electrification. Working with organisations like WMG and APC, the automotive industry has embraced the UK’s technology transformation through roadmaps, trends and forecasts. These detail the technological transformation needed to decarbonise the sector and drive improvement across propulsion systems, electrical energy storage, electric machines and power electronics. These technological transformation provide a vision of how the UK will develop in the lead up to 2040 and keep its competitive edge.

As multiple sectors transform to fully electric production, one of the key questions will be how will the workforce need to transition? We believe the answer lies in the proposed national framework for electrification skills – which will allow us to understand the development needs required to go from current skill sets to deliver the objectives outlined in the technology transformation. This focus will be essential for the sector to thrive in a highly competitive global industry and to meet Government targets for a decarbonised future.

We are proud to launch this report which presents the opportunity for a national electrification skills framework and forum, to be shaped by the wisdom, common learning and direction of our talented community of automotive technologists, educators, accrediting bodies and training providers. It provides a starting point for a national-level conversation on how to best prepare and deliver skills – at both a regional and national level – precisely when and where they are needed. This will also need to look beyond just the automotive sector, as the establishment of UK battery production facilities (gigafactories) represent a considerable industrial opportunity for the UK economy, and one where having a workforce with the required skills and capabilities will be essential for the nation to compete successfully on the European and indeed global stage. Similar to any national effort, this is only the beginning of the conversation. We look forward to including more voices and to ensure learning is shared broadly with other sectors so that they too can benefit from the methodology and outcome of this framework to inform their efforts towards electrification, developing a workforce to enable multiple industries to thrive.



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EXECUTIVE SUMMARY

Together with industrial digitalisation, Industry 4.0, the electrification revolution represents the largest shift in industrial skills for the UK in a generation. The need to move quickly, and effectively, to re-skill and up-skill the existing workforce, whilst providing newly skilled workers to fill crucial roles, emphasises the need for a unified national skills structure more than ever before. In order to achieve, this the National Electrification Skills Framework and Forum is being developed and is based on the following:



Quality

The national effort will provide a common requirement and approach. Providers can use this to ensure that wherever an employee receives their training and/or education employers can be confident that it will meet their needs, is of a high quality, and is consistent.



Re-skill, up-skill, new-skill

It is critical that the skills strategy for the electrification revolution occurs in such a way that it creates a soft landing for other industries that shrink as a result, providing new opportunities for workers to transfer from other sectors. It is also critical that it does not strip sectors of their skilled workforce and must actively seek to bring newly skilled individuals into dynamic and rewarding career paths.



A national effort

The skills framework and forum is open to all in the UK, and exists as a resource for the betterment of UK industry and society as a whole, encouraging common purpose to meet shared challenges and objectives.



Immediate and future need

Whilst serving immediate skills needs, the framework is also future looking, helping to stimulate industry growth by providing a skills base before they become critically in demand. This is a step change for UK education and represents a new approach to delivering skills.



Collaboration

Competing for resources, both physical and intellectual, is not conducive to enabling the UK to deliver quality training provision at the point of need. Cooperating partnerships among providers will enable resources to be shared to aid in delivery.

Who Should Engage

The National Electrification Skills Framework and Forum provides an opportunity for a range of stakeholders to participate in the electric revolution and drive its development.

Employers

Reflect on existing and future skills needs in a structured way which will lead to the most appropriate training and education interventions under development. Link with providers to ensure that needs are met effectively and in-time.

Training providers

Engage with industry on a national scale and participate in a combined effort to establish and realise the UK Electrification Skills agenda.

Accrediting organisations

Engage with wider employer groups to better understand needs and to reflect these more effectively in accreditation work.

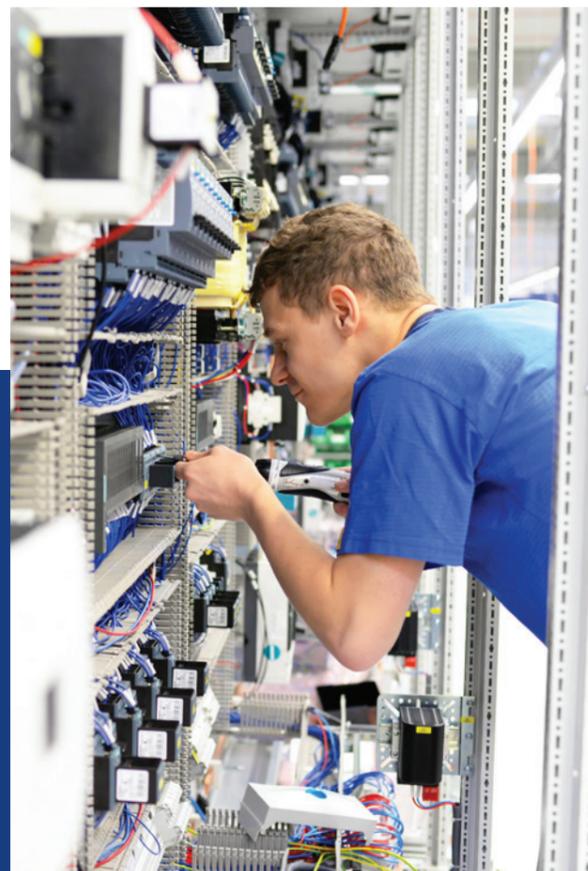
Learners

Effectively plan and access future opportunities to develop portable skills in the electrification space. Identify training and education providers that are part of this national agenda and access opportunities for development.

Opportunities and Benefits

Participants will benefit from being able to:

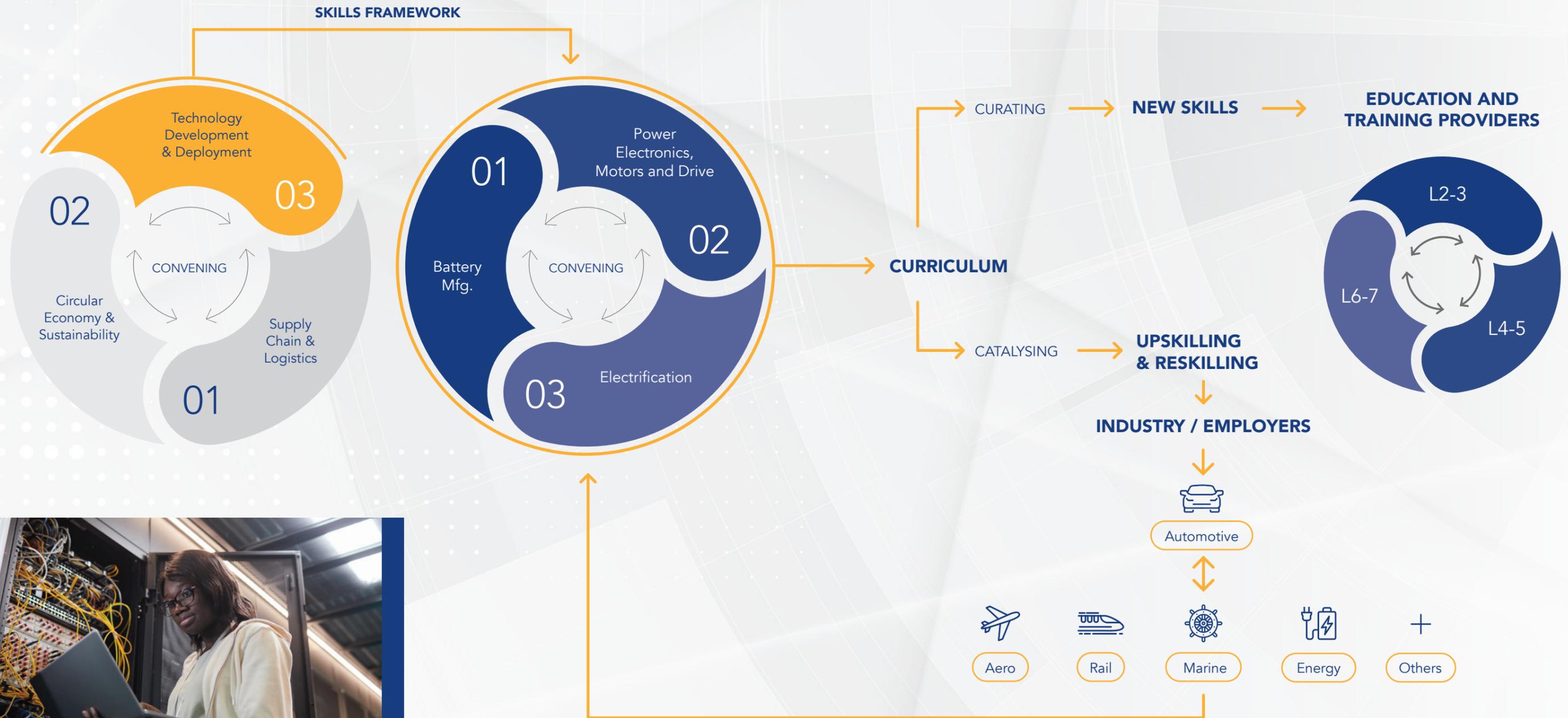
- Seek close engagement with national and regional stakeholders.
- Reach across a growing network of further and higher education and training institutions and providers.
- Take advantage of increasing on-line learning content aligned to experiential learning and assessment within the overall framework.
- Ensure that business of all sizes are able to access a skilled workforce able to meet their business needs and to compete in growing markets.
- Provide individuals with initial and lifelong learning opportunities to secure their future work opportunities in expanding green industries.



Opportunity for a range of stakeholders to participate in the electric revolution and drive its development



ELECTRIFICATION ROADMAPS / RESEARCH AND DEVELOPMENT / TECHNOLOGY STRATEGY



THE ELECTRIFICATION SKILLS FRAMEWORK

To meet the needs for up-skilling, re-skilling and new-skilling, workers require an integrated approach.

Developing Skills at the Point of Need

When looking back from 2030, we will see a revolutionary change to a greener industry. Yet despite the rapid pace of this change, it will be incremental year on year, building on and changing the skills base of our current workforce. This leads us to build solutions in a modular and therefore flexible way, seeking common solutions that suit multiple learning models and enables the introduction of appropriate assessment and credentialling of critical competencies as the workforce develops and new technologies take over. And change won't stop in 2030.

Therefore, to meet the needs for **up-skilling, re-skilling and new-skilling** workers require an integrated approach that will enable the sharing of key learning across different delivery models as well as enabling individuals to earn transferrable credit for their learning and gain recognition of their skills and industrial credentials. The following delivery approach has a number of strands to meet industry need:

STEM

Engaging young people through STEM activities is critical in broadening exposure to the opportunities available in electrification. Employers, professional bodies, local authorities, charities and educational organisations will be engaged to curate existing STEM opportunities and to broaden the provision to create a national engagement programme to support existing initiatives. The importance of this activity cannot be underestimated and it sits at the heart of all future activities providing a strong foundation upon which the framework will be built.



Long Courses

Longer courses typically make use of apprenticeships to support development in key areas of electrification. Existing at levels from 2 to 7 these programmes offer identifiable career progression pathways and are linked to qualifications. Relevant to up-skilling, re-skilling and new-skilling, long-course programmes encompass the knowledge, skills and behaviours required to perform key roles. The learning assets used in the longer course provision can be broken down to provide learning opportunities for those who are either not eligible for apprenticeship funding or whose life circumstances do not allow prolonged training periods as well as those whose current skills base does not require longer courses of learning in order to up-skill or re-skill.



Short Courses

A wide range of short courses will be available for ongoing professional development, up-skilling and re-skilling. These will be responsive to industry need as well as linking to long course provision. Where industry demands short courses in critical emerging areas these will be integrated with the structure of long course provision to ensure wide coverage for all learners. A key approach to meeting the vision is that individuals accessing short courses should have the opportunity to accumulate that learning and use it towards longer programmes of study if they wish to at the same time as achieving industry valued credentials.

Credit Accumulation

Short courses will be designed to enable credit accumulation towards qualifications and awards, where the course is suitable to do so. This will allow learners, and companies, flexibility in creating bespoke learning journeys to help meet their emerging needs. As new courses are developed to meet new needs there will be flexibility to add these into the longer learning journey meaning that qualifications will be entirely reflective of the needs, both of individuals and their employers, at the point of completion. The ultimate aim will be that the community of providers will recognise credit drawn from those within the community, allowing learners to make use of the specialist delivery available within the community.

Accreditation

All courses, whether short or long, will be designed with accreditation from relevant professional bodies in mind. Working closely with these bodies from the outset will ensure that the learning meets their accreditation needs and is recognised for its quality and rigor by industry and professional bodies alike.

Framework Approach

- Levels 2 - 8 (or equivalent)
- Informed by industry partners from a wide range of sectors
- Sector agnostic** – electrification is considered as a whole rather than as separate industry sectors
- Common and less common curriculum** – makes use of cross cutting electrification themes that are the same regardless of sector, level or role to ensure consistency and efficiency. Sector specific elements are then attached
- Modular** – Long course programmes, such as apprenticeships, are deconstructed into short course offerings in order to allow employers to select aspects that are required to allow for up-skilling and re-skilling of workers where a full development programme is not required
- Current** – Incremental changes to short course portfolios will be readily reflected into long course programmes
- Consistency** – Regardless of the mode of delivery the content, competencies and assessments are the same which gives parity
- Credit accumulation** - Individuals will be able to accumulate credit from the courses that they attend and use it against larger qualifications
- No dead ends** - Individuals will always have opportunity to further their careers through training and education with progression routes clearly articulated and made available
- Widening participation** - multiple entry points and opportunities for experience based achievements will help to engage learners more widely through an inclusive and accessible approach to accessing education and careers in electrification



THE ELECTRIFICATION SKILLS FORUM: A CALL TO ACTION

The transition to an electrified and Net Zero future requires a **strong collaborative approach** that emphasises the needs of UK industry as a whole over commercial gain. Competing for the same physical and intellectual resources, rather than collaborating to make the best use of that which is available, detracts from the key focus of delivering high quality training and education to enable the UK to both meet its internal goals and become a global leader in future technologies.

Collaborating to elevate achievement is critical at this time and will drive confidence in the UK's ability to deliver.

The Provider Network

Convening providers on a level playing field where expertise, material and facilities are shared allows the sector to most effectively, efficiently and competitively ensure the highest quality of training provision to best impact the competencies of employees across the UK at scale. This plan emphasises blended learning approaches to address the growing importance of on-line learning to provide key knowledge at scale, supported by opportunities for experiential and work-based learning to transfer safe and effective skills and behaviours. The provider network co-develops curriculum whilst members support one another to develop and deliver against the National Electrification Framework.

The provider network is growing and there is an opportunity for more providers to join and actively engage in the work being undertaken. There is an opportunity to shape the framework and the curriculum that underpins it to best allow industry to realise its potential.



To get involved please contact
electrification-skills@hvm.catapult.org.uk

The Employer Network

For the UK Electrification Framework to develop with industry need as it evolves, employers across all sectors with an interest in electrification skills have an opportunity to participate in an active employer network. The network is supported and convened by Centres of Innovation such as WMG, University of Warwick and sector skills groups will continue to guide and input, discuss existing and future training and education offerings. The employer network also exists to stimulate cross sector collaboration and learning enabling employers from a wide range of industries to establish common skills needs and to support one another. The employer network works hand in hand with the provider network to ensure that skills needs are communicated and that courses meet need.

The employer network is growing and there is an opportunity for more employers to join and actively engage in the work being undertaken. There is an opportunity to shape the framework and the curriculum that underpins it as well as engaging with employers from a range of different sectors to establish and address common skills needs.



To get involved please contact
electrification-skills@hvm.catapult.org.uk

THE CASE FOR AUTOMOTIVE MANUFACTURING SKILLS

Demand for Electrification Skills is Accelerating

The UK automotive industry is a large employer, with 168,000 direct employees working in the sector, which is undergoing a massive transformation. The rapid transition of the automotive sector to the production of fully electric vehicles, creates competency gaps at all levels with particular emphasis on engineering and manufacturing roles that would need to be filled with core and specified training.

Specialist skills for electrification do not currently exist at scale in the industry and there is an unmet need for design engineers, development engineers, systems engineers, electronics technicians, vehicle technicians, specialist skills in batteries, power electronics and electric machines, as well as key roles in procurement, cost estimating and supplier quality.

A 2020 review* reveals the scale of the challenge:

- Across automotive manufacturing roles related to batteries, power electronics and electric machines, 63% of current jobs roles will be subject to significant change. For electric machines, this is expected to be as high as 84%.
- A number of new roles will exist in power electronics, motors and drives across a range of sectors.
- For roles related to purchasing of electric machines, as many as 61% of current powertrain jobs may see significant gap in competencies.
- Material planning and logistics powertrain specialists will need training to obtain appropriate skill level required related to batteries.
- Quality engineers and technicians with knowledge of power electronics represent the job roles expected to see the biggest change (91%), and therefore require significant training / re-training. Quality Engineers and Technicians for batteries are also critical.

* WMG, University of Warwick survey of OEMs in the sector, literature reviews and studies



Beyond Manufacture

Outside of the volume auto manufacturing part of sector, electrification brings additional competency and skills challenges:

- Potentially 182,000 mechanics will be in need of reskilling by 2030. This date is market driven by number of EVs on road in need of service over time.
- Around 175,000 independent dealerships, assuming franchise dealers will be trained by OEMs, will need training.
- In emergency response roles, 61,000 visible police, 28,500 specialist police, 26,000 specialist advanced paramedic and paramedic, 44,000 firefighters (L2-L4 or equivalent), 500+ independent recovery operators (L1-L4 or equivalent) will need specialised training, with additional awareness training for 1,375 fire control, and 18,000 emergency care assistants (ambulance).

Electrification is a combination of technologies bringing together electrical energy storage, electric machines and power electronics.



The Case for Automotive Manufacturing Skills



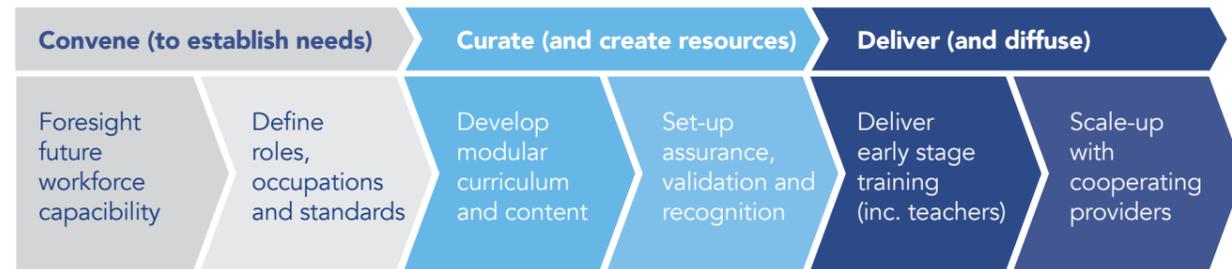
Genesis

In 2019, the Auto Council's Skills Working Group identified a common need to better anticipate the transformation of the sector to electric vehicle production across employers, employees, professional accrediting organisations and training providers. To scope this skills challenge, the government-backed Faraday Institution initiated a project with WMG, University of Warwick to better understand automotive sector demand for electrification skilled workers over time; determine the requisite competencies needed by job family, type and role; and evaluate the existing training landscape and available offers.

The aim of the project is help to secure the competitiveness of the sector by creating a clear and common path that would enable the transformation of the workforce by closely relating their future skills to the demands of technologies yet to be widely adopted.



Skills Value Chain



The Foresighting Method and the Skills Value Chain



In its second phase, in 2020/21, the project team utilised the Foresighting and Skills Value Chain approach demonstrated by the HVM Catapult and Gatsby Foundation in the 2020 report “Manufacturing the Future Workforce”.

Based on international good practice, this makes the case that the transformation of engineering and manufacturing professions to address a growing competency gap related to emerging technologies requires a connected and systematic response if the UK is to leverage its public investment in innovation.

This stepped approach connects employers, government investment, innovating bodies, and education and training systems using a consistent rigorous process. It generates clarity around the required capabilities, competencies and course provision starting from input from businesses in a specific sector. In simple terms the three stages enable the sector to:

- Convene** technologists, industry, education and training partners, and government as a focal point for the shift to battery electric vehicle production to foresight and articulate emerging skills needs, standards and qualifications associated with emerging technologies.
- Work with others to **curate** suitable existing education and training provision and **create** further content where necessary in a form suitable for a range of learner groups, putting in place the required competence assurance and accreditation systems.
- Deliver** early-stage training, with specialist technology centres acting as a primary point of initial transmission of this knowledge to early industry adopters as well as to teachers who will educate others, then on an on-going basis support diffusion through wider teaching and training networks of specialist emerging technologies.

Developing Modular CPD Units

1. Assessing Industry Capabilities

UK vehicle electrification design and manufacturing strategies, roadmaps and plans were assessed by technical specialists to identify future capabilities required by UK manufacturing to enable their adoption of battery powered automotive solutions.

2. Defining Workforce Competencies

Expert educators defined appropriate competency sets for three role groups: technical operator, junior engineer and senior engineer. In total about 450 competence statements – knowledge or skill – were developed and linked to specific capability requirements for each role group. These can be used to inform future reviews of apprenticeship standards and qualifications.

3. Curating Existing CPD Course Provision

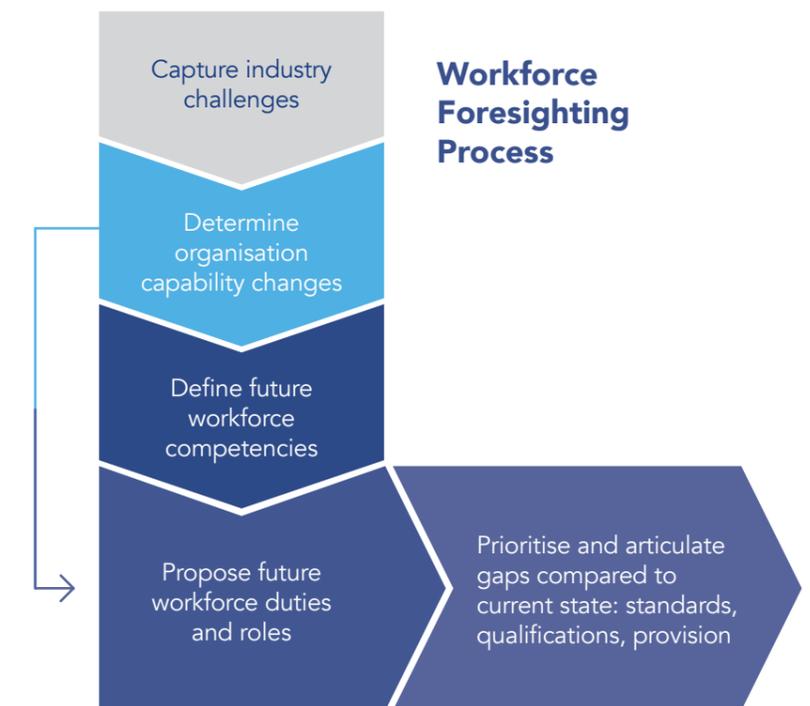
The expert educators also mapped these competency needs using a range of existing qualifications and sector training providers to develop over 20 unit definitions ranging from fundamental electrical, battery, engineering science and health and safety topics to advanced domain specific requirements.

4. Identify Further CPD Courses to Create

Where there is no current suitable CPD offer, the Department for Education-funded Emerging Skills Project led by the HVM Catapult will create pilot courses and train the trainer content available for roll out to meet demand from 2022, with WMG, University of Warwick coordinating electrification content across Institutes of Technology.

Next Steps

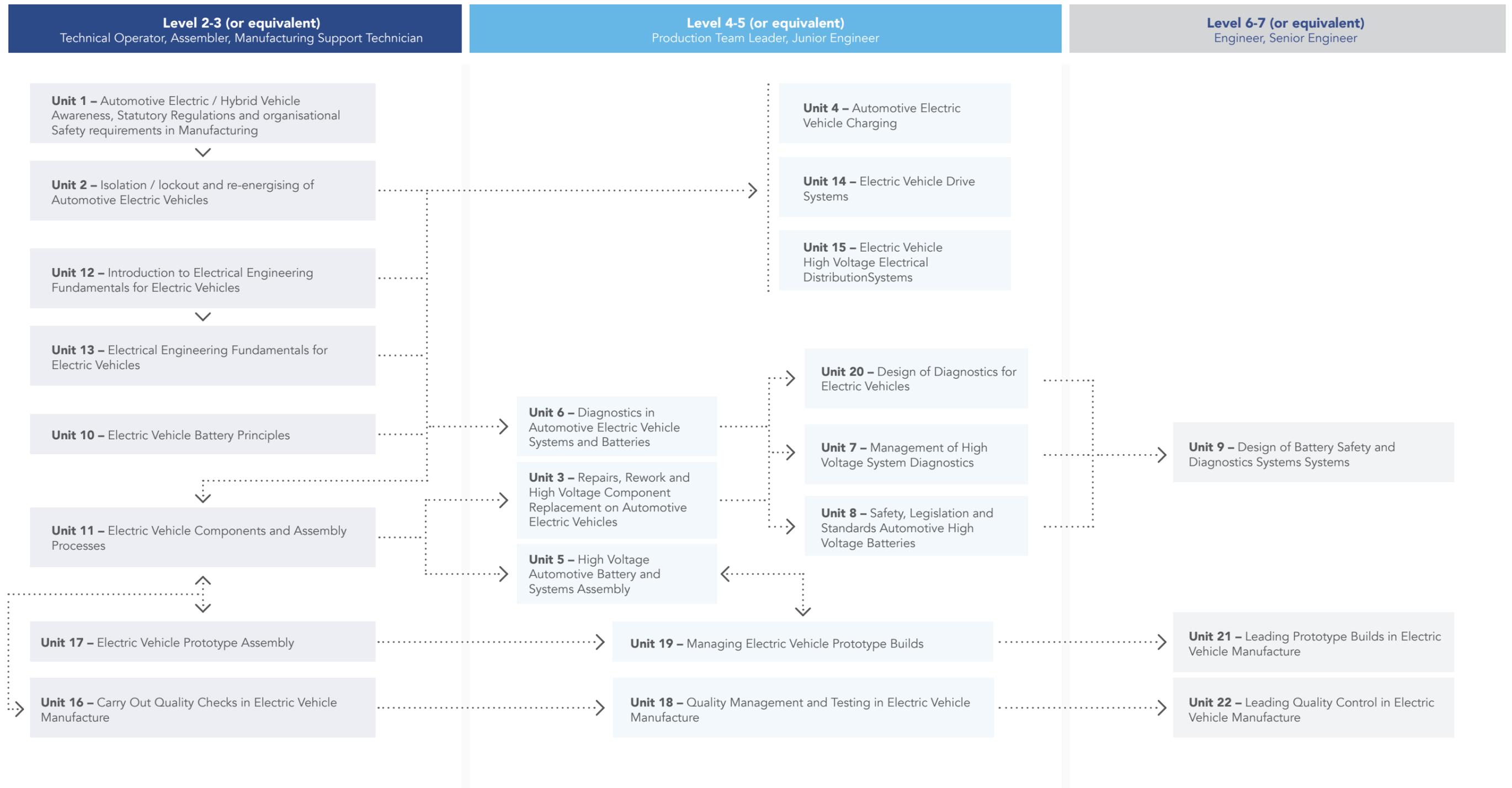
Providing “line of sight” from technology roadmaps to related workforce development activities, the overall aim of the project is to secure the competitiveness of the sector. A clear and common path will enable the transformation of the workforce by closely connecting their future skills and opportunities to the demands of technologies yet to be widely adopted. A forum among key stakeholders has been established for further identification and development of CPD.



ELECTRIFICATION CPD MAP

Automotive Role Groups and Competency Sets

Each column represents an automotive role group and the competency sets identified to aid in the transition to electric vehicle production. Each set recommends CPD units which build from fundamentals to more advanced units, to provide appropriate coverage of the required topics. The three role groups are aligned to the Engineering Council descriptors for Engineering Technician, Incorporated Engineer and Chartered Engineer. They are also mapped to academic descriptors and levels – 2/3 (or equivalent) Eng Tech, 4/5 (or equivalent) IEng and 6/7 (or equivalent) C.Eng. Generic role types in the sector are reflected.



This unit is an example of those currently in development.

Electrification Skills Plan 2021

Automotive Manufacture

Unit 1: Automotive Electric / Hybrid Vehicle Awareness, Statutory Regulations and Organisational Safety Requirements in Manufacturing

Level: L2/3 (Ofqual) (or equivalent)	Credit Size	TBC
Suitable for: Vehicle assembly operators, uniformed services, valeters, general garage staff	Indicative Learning Hrs	30
Prerequisites: None	Indicative Contact Hrs	8
	Indicative Self-Directed Study Hrs	20

Learning Outcomes:

On completion of unit learners will:

1. Know about the types of electric/hybrid vehicles available (K)
2. Know and understand the hazards/risks around motor vehicle high energy electrical systems (K)
3. Know how to work safely around electric/hybrid vehicles (K)
4. Know how to comply with the statutory regulations and organisational safety requirements for vehicles with electric drive systems or energy storage devices (derived from 60 & 62) (K) (MF)
5. Be able to identify different types of electric vehicle charging systems and connections (K)
6. Be able to plug into a vehicle charging point and ensure the vehicle is accepting charge (S)
7. Demonstrate compliance with statutory regulations and organisational safety requirements for vehicles with electric drive systems or energy storage devices in their work environment (derived from 60 & 62) (S) (MF)

Assessment:

Knowledge and skills, with a workplace observation

Suggested format:

The knowledge should be assessed via multiple choice e-assessment and skills assessment (charging the vehicle) via assessor observation. Observation of competency in the workplace against LO7.

Version: 1.6

Created: 01/02/2021

Revised:

Core Subjects	Potential Curriculum Coverage (initial mapping shows some matches to high level statements)	Currently Delivered By
	IMI - L1 Award in Electric / Hybrid Vehicle Awareness	IMI Centres
Identifying an electrically propelled vehicle and understand associated risk	ABC - Level 1 Award in Automotive Electric / Hybrid Vehicle Awareness	IMI Centres
	Nissan Training Course	Nissan
Complying with statutory regulations and organisational safety requirements for vehicles with electric drive systems or energy storage devices	Retired EAL unit QMVEDS2/001 , which is contained within Level 2 Diploma in Manufacture of vehicles with electric drive systems	New required
Identifying charger types and charging the vehicle	Lucas Nuelle offer charging training as part of the Hybrid and Electric Vehicle Specialist - Charging the Vehicle unit	Delivered globally as part of the LN electric vehicle offer
	Manufacturer specific training systems	Various manufacturers

Additional information and recommendations

Many of the LO within this programme can easily be delivered through online learning, with limited face-to-face learning. As suggested with the Nissan course, it's likely that manufacturers would combine this programme with brand awareness training. LO 1-3 have qualifications available via two Accrediting Organisations (AO): IMI and ABC. It's worth noting that this is offered vehicle type specific for ABC Awards (Bus / Coach, Heavy Vehicle and Light Vehicle). There is some variation in delivery time through AO.

This unit is an example of those currently in development.

Electrification Skills Plan 2021

Automotive Manufacture

Unit 6: Diagnostics in Automotive Electric Vehicle Systems and Batteries

Level: L3/4 (Ofqual) (or equivalent)

Credit Size TBC

Suitable for: Individuals who work on electric vehicles and would be responsible for identifying faults within high voltage electrical systems and components following production, or when in service.

Indicative Learning Hrs 20 (estimate)

Indicative Contact Hrs 8 (estimate)

Indicative Self-Directed Study Hrs 12 (estimate)

Prerequisites: Individuals will already have appropriate vehicle assembly and repair knowledge and skills at level 2 and must have first completed the programme carry out the isolation / lockout and re-energising of Automotive Electric Vehicles

Learning Outcomes:

Assessment:

On completion of unit learners will:

Knowledge and skills

1. Use high voltage diagnostic tools to identify errors/faults in vehicle power/battery systems (19) (S) (MF)
2. Use battery/systems diagnostics for fault finding and trouble shooting (15) (S) (MF)
3. Demonstrate awareness of the characteristics of power electronics, installation, cooling, interface, connection, grounding and handling requirements (53) (K) (MF)
4. Use diagnostic in controlled environment to gauge whether a system or component meets the required criteria and resolve simple faults (18) (S) (MF)

Suggested format:

The skills assessment would be completed in a controlled environment. The knowledge would be assessed through e-assessment multiple choice questions, with some consideration given to whether contextualisation is needed to ensure specific safety requirements manufacturer. If this is the case, this could be included via oral questioning as part of the skills assessment on component / system assembly as this is likely to be completed on manufacturer specific product)

Version: 1.4

Created: 01/02/2021

Revised:

Core Subjects	Potential Curriculum Coverage (initial mapping shows some matches to high level statements)	Currently Delivered By
Identifying an electrically propelled vehicle and understand associated risk	IMI - L1 Award in Electric / Hybrid Vehicle Awareness	IMI Centres
	ABC - Level 1 Award in Automotive Electric / Hybrid Vehicle Awareness	IMI Centres
	Nissan Training Course	Nissan
Complying with statutory regulations and organisational safety requirements for vehicles with electric drive systems or energy storage devices	Retired EAL unit QMVEDS2/001 , which is contained within Level 2 Diploma in Manufacture of vehicles with electric drive systems	New required
Identifying charger types and charging the vehicle	Lucas Nuelle offer charging training as part of the Hybrid and Electric Vehicle Specialist - Charging the Vehicle unit	Delivered globally as part of the LN electric vehicle offer
	Manufacturer specific training systems	Various manufacturers

THE CASE FOR BATTERY MANUFACTURING

The 2050 Road to Zero

As a key part of its 2050 Road to Zero strategy, the UK Government has committed to tackling climate change by reducing carbon emissions through transport electrification.

As such, the UK is in a position to set itself apart as a world leader in battery technology.

Analysis from the Faraday Institution suggests that the UK could be producing as many as 1.4 million electric vehicles by 2040, which would elicit requirements for around 140GWh/year of battery production capacity, the equivalent of seven 'gigafactories' producing 20GWh/year. To meet this need, an additional 70,000 employees will need to be hired in the sector - 20,000 in gigafactories and 50,000 in the associated material supply chain.

This can be achieved via re-skilling existing workforces to transition from traditional powertrain methods; up-skilling those who are already involved in the sector and, crucially, providing newly skilled workers through education and training. With gigafactory sites already planned in the North East and Midlands, it is vital to commence skill development now. In order to do this effectively, there is a need for a robust and forward-looking plan.



The UK Battery Skills Framework

WMG, University of Warwick, along with the UK Battery Industrialisation Centre (UKBIC), has researched the skills that the sector will require in order to fulfill market demands and potential.

Through engagement with industry partners the project team identified the core needs of the sector to facilitate growth. This highlighted requirements for skills that support the whole lifecycle of a battery, from cell production and pack design through to recycling and re-use.

The outcome of this work is the 'UK Battery Skills Framework'. Supported by the Faraday Battery Challenge, the Framework is based on a set of key principles, including social responsibility, flexibility, industry engagement and the opportunity to progress.

It is critical that the UK Battery Skills Framework supports workers to re-skill, up-skill and develop new skills to work effectively within the battery sector and explore progression opportunities in their chosen career. Where other manufacturing sectors are contracting this will provide opportunities to move across into growth areas. The flexibility of the Framework means that development opportunities can be offered as short course programmes, apprenticeships and contain embedded qualifications.

This approach means that immediate skills needs can be met effectively and longer term planning can be facilitated, allowing for the pace of training and development to match that of technological progress. The Framework has been designed as a through-career pathway. For individuals, this gives the opportunity to develop themselves and further their careers. For companies, it provides a viable way of managing and developing the skills of their workforce in alignment with their business objectives.

The aim is that this UK Battery Skills Framework is used nationwide to provide consistency and to allow the skills in the emerging battery sector to keep pace with policy and technological change.



EXAMPLE ROLE



**APPRENTICESHIP STANDARD
- LONG COURSE**



**EXAMPLE PROGRAMME
- LONG COURSE**



**EXAMPLE PROGRAMME
- SHORT COURSES**

**LEVEL
(OR EQUIVALENT)**

7	<ul style="list-style-type: none"> > Smart Connected and Autonomous Vehicle Engineer > Sustainable Automotive Electrification Engineer > Engineering Business Manager 	<p>ST0456 Postgraduate Engineer</p>	<ul style="list-style-type: none"> > PGDip Smart Connected Autonomous Vehicles > PGDip Sustainable Automotive Electrification > PGDip Engineering Business Management 	<ul style="list-style-type: none"> > Battery technologies and applications > Fundamental chemical and electrochemical principles for batteries > Battery materials and characterization > Battery sustainability > Battery manufacturing and testing > Battery management systems
6	<ul style="list-style-type: none"> > Sustainable Battery Engineer > Software Engineer > Network Engineer > Data Analyst > Cyber Security Specialist 	<p>ST0023 Product Design and Development Engineer</p> <p>ST0119 Digital and Technology Solutions Professional</p>	<ul style="list-style-type: none"> > BEng (Hons) Applied Professional Engineer - Sustainable Battery Engineer > BSc (Hons) Digital and Technology Solutions 	
5				
4	<p>Battery Manufacturing:</p> <ul style="list-style-type: none"> > Team Leader > Quality Manager 	<p>ST0685 Process Leader</p> <p>ST0853 Quality Practitioner</p>	<ul style="list-style-type: none"> > Certificate in HE First Line Management > Unit Credit 	
3	<p>Manufacturing / Maintenance Technicians:</p> <ul style="list-style-type: none"> > Battery Electrode and Cell Assembly Technician > Battery Formation, Aging and Testing (FA&T) Control Room Technician > Maintenance Technician > Battery Module and Pack Technician 	<p>ST0250 Science Manufacturing Technician</p> <p>ST0154 Maintenance and Operations Engineering Technician</p>	<p>Either:</p> <ul style="list-style-type: none"> > BTEC L3 Certificate in Applied Science > BTEC L3 Diploma in Engineering > Non-qualification option 	<ul style="list-style-type: none"> > Battery Health and Safety > Battery Environmental Concerns > Battery Fundamentals > Battery Manufacturing > Clean and Dry Rooms
2	<p>Battery Assembly Operative</p>	<p>ST0420 Lean Manufacturing Operative</p>	<ul style="list-style-type: none"> > BTEC L2 Diploma in Manufacturing > Non-qualification option 	
1	Basic awareness level			

POWER ELECTRONICS, MACHINES AND DRIVES (PEMD)

Based on the initial Scoping Project
– Identifying opportunities for manufacturing



Automotive

- 1,558,493 vehicles produced in the UK in 2019. Levels are predicted to return to this by 2025
- By 2030 demand will be for a commensurate number of motors and inverters as well as charging systems for both AC and DC applications
- Significant numbers of ICE engine engineers will need to be re-skilled as a result of a decline in demand
- Training is largely in house due to a lack of expertise at technician and engineer level in the UK (electrical and electronic engineering).
- Apprenticeships will be key in driving skill activities



Aerospace

- UK is the second largest manufacturer of aviation PEMD products
- Low volume, high quality/safety manufacturing environment
- Manufacturing technician skills are critical as production is not automated
- Skills needs tend to be filled by existing recruitment but a large volume of skilled workers come from overseas
- Future shift in the industry will see a move towards more automated manufacture which will increase the demand in skills related to robotics, industrialisation, software engineering and automated manufacture
- Larger aviation companies appear to command a shorter timeframe from design to market than smaller companies which could impact on innovation



Rail

- Rolling stock manufacturers import power electronics for assembly in the UK
- Skills are consolidated in the OEMs as they handle servicing as well as manufacture
- Electrification of the lines will require investment in material and workforce with appropriate skills to install power electronics
- Skillset has commonalities with other sectors
- Growth is likely to be low
- National Skills Academy for Rail (NSAR) estimate an average need for 480 new electric trains between 2019 and 2028, however, this figure is likely to be low



Energy

- The energy sector will need to replace or retrain 48% of the workforce, equating to 277,000 in the next 10 years
- Based on industry estimations there are approximately 530,400 inverter devices on solar power installations, 48,200 on wind installations and 4,433 on the EV charging infrastructure
- The trend is for an increase in renewables and a reduction in traditional power generation
- Skills for energy and distribution are currently under review but will require more technician and engineer qualified workers to meet demand
- Energy generation through renewables will require a set of "competent persons" qualifications to meet growing demand
- The UK has the potential to be a global leader in the design, manufacture and maintenance of wind turbines which will require a greater number of skilled workers, initially around 2,000, to staff a new facility
- Committing to 30GW of onshore wind energy production could provide up to 31,000 skilled jobs all of whom would need some form of PEMD skills training



PARTICIPATION (TO DATE SEPTEMBER 2021)

A
 Advanced Propulsion Centre (APC) 
 Aerospace Growth Partnership 
 Aerospace Technology Institute (ATI) 
 Auto Consultancy & Training Limited 
 Automotive Council Skills Working Group 

B
 Bentley Motors Limited 
 Birmingham City University 
 BMW 
 Bosch 
 Britishvolt 

C
 Charpak Ltd 
 Civil Aviation Authority 
 Compound Semiconductor Application (CSA) Catapult 
 Coventry and Warwickshire Local Enterprise Partnership (CWLEP) 
 CPI 

D
 Driving the Electric Revolution Challenge 
 Driving the Electric Revolution - Industrialisation Centre - Midlands 
 Duplex Business Services Ltd 

E
 Education Partnership North East 
 European Metals Recycling 
 Energy and Utility Skills 
 Energy Systems Catapult 
 Energy UK 
 Enginuity 
 Envision – AESC 
 EVera Recruitment 

F
 Faraday Battery Challenge 
 Faraday Institution 
 Ford 

G
 Gatsby Foundation 
 GTG Training Ltd 

H
 Hexcel 
 High Value Manufacturing Catapult 
 Honda 
 Hyperdrive 

I
 Innovate UK 



J
 Jaguar Land Rover 
 JCB 

L
 Lancaster University 
 Lincoln College 
 Lotus Cars 

M
 Macclesfield College 
 Mahle 
 Manchester Innovation Activities Hub 
 McLaren Automotive 

N
 National Grid 
 National Express 
 National Skills Academy for Rail 
 New College Durham 
 Newcastle University 
 Nissan Motor Manufacturing UK 
 North East IoT 
 Nottingham University 

O
 Offshore Renewable Energy (ORE) Catapult 

-  Automotive Electrification
-  Battery Manufacture
-  PEMD scoping

R
 Revamp Training 
 Rugby Borough Council 

S
 Safran 
 Silverstone Green Energy 
 Solihull IoT 
 Solihull and Birmingham College 
 Swindon College 

T
 Tevva 
 Toyota Manufacturing UK 

U
 UK Battery Industrialisation Centre (UKBIC) 
 UK Research and Innovation (UKRI) 
 University College Birmingham (UCB) 
 University of Nottingham 
 University of Salford 
 University of the West of England 

W
 Weston College 
 WMCA Automotive Taskforce 
 WMG, University of Warwick 
 WMG Academies for Young Engineers 

Z
 Zero Carbon Futures 
 ZPN Energy 

The Opportunity for a National Electrification Skills Framework and Forum

September 2021 Transitioning the workforce for the green industrial revolution in transport and energy



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High Value Manufacturing

hvm.catapult.org.uk

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THE UNIVERSITY OF WARWICK

wmg.warwick.ac.uk

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