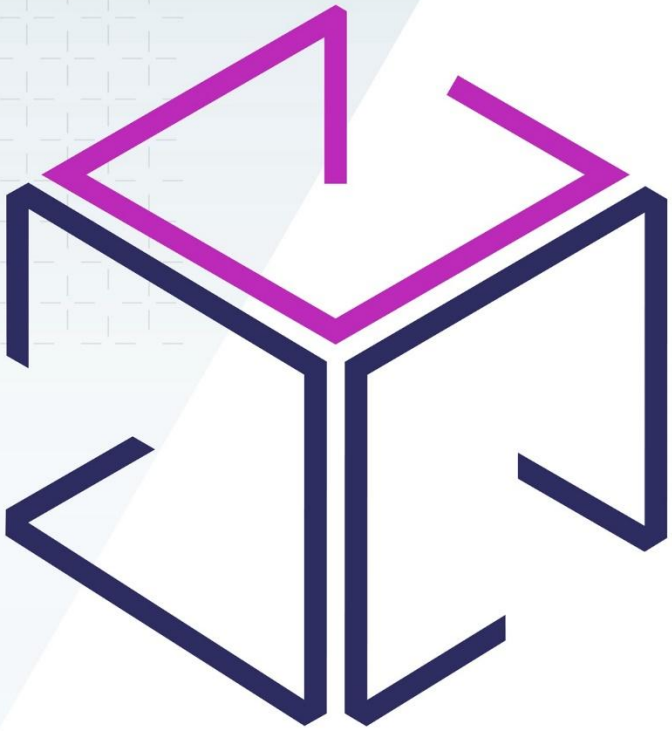
Workforce Foresighting Hub



Advanced Battery Recycling

Utilizing repair, repurposing or recycling to process manufacturing waste and end of usable life batteries to enable sustainable material reuse

Workforce Foresighting Hub findings report in collaboration with High Value Manufacturing Catapult - WMG

Date: 30/05/2026

Acknowledgements

The Workforce Foresighting process integrates data from the following international data sets:

- IfATE – Institute for Apprenticeships and Technical Education, England
- ESCO – European Skills, Competencies, Qualifications & Occupations, EU
- ONet – Occupational Networks Online, USA

In accordance with licence and publishing requirements of these organisations for the use of their data sets, the Workforce Foresighting Hub team states that –

> The IfATE data used contains public sector information licensed under the Open Government Licence v1.0.
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>
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The method and process used in the Workforce Foresighting process is under development and there may be errors and omissions in the data provided.

This report was produced following workshops undertaken Mar – June 2025 using the data set and tools available at that time.

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Executive Summary

This report presents the findings from the third domestic battery industry Foresighting cycle led by WMG, focusing on the UK's preparedness for the growing challenge of advanced battery recycling, an essential capability in meeting net zero and circular economy goals. As volumes of high-voltage traction batteries increase from electric vehicles (EVs) and grid storage systems reach the end of their serviceable life, the UK must urgently ensure that the right skills, roles and infrastructure are in place across the battery lifecycle, particularly in recovery, reuse, and recycling.

The Foresighting process has revealed significant skills mismatches across every stage of the battery recovery supply chain. Notably, 100% of the 19 future occupational profiles (FOPs) developed for this cycle were assessed as matching poorly to current IfATE apprenticeship standards showing that current provision has a low suitability when it comes to addressing this particular challenge. The skills required, ranging from high-voltage dismantling and metallurgical analysis to battery circularity compliance and reverse logistics, are currently not served by the UK's vocational education system at the required level, pace, or specificity.

Without urgent coordinated action across government, industry and the education sector, the UK risks becoming dependent on overseas providers for critical recycling services, undermining sovereign supply chain resilience and weakening our ability to meet environmental commitments.

Workforce Foresighting Topic

The UK's battery ecosystem is growing rapidly. Supported by over £2bn in public and private investment, new gigafactories are emerging to supply the automotive, aerospace and grid sectors. However, end-of-life battery management remains a significant policy and capability gap. By 2035 the UK needs to achieve 100% recovery, reuse and recycling of end of life EV batteries. Forecasts anticipate over 350,000 tonnes of battery material requiring safe disposal or reuse by 2035. Yet there is no coherent UK-wide plan to develop the technical and compliance workforce needed for this.

- No national strategy for battery recycling workforce planning – There is a lack of a coherent approach to ensuring that batteries are recovered, repaired, reused and/or recycled to ensure the robustness of the UK supply chain and energy security.
- Fragmented regulation across environmental and transport agencies – Little exists in the way of regulation beyond broad responsibilities that are not related to the specifics of achieving circularity in the battery sector.
- A lack of training provision across all stages of the recycling process, from safe battery removal to materials recovery – Nothing specific exists to address the skills needs in this area which is having an impact beyond just the sector itself.

Participants and stakeholders

Industry Participants	Skills Participants	Technology Participants
UKBIC	Institute of the Motor Industry	WMG
CarTakeBack	EAL	Altilium
Autocraft	GTA	Catapult
Connected Energy	Cogent	Bentley
VRA UK	ProMoto	Aston Martin
	ESN	Ford
	SIAS	Batri
	Better Generation Solutions	JLR
	City and Guilds	

Table 1: Participants and stakeholders

The Findings and Insights

The foresighting cycle on Advanced Battery Recycling has highlighted a profound mismatch between the future skills needed by industry and what the current education and training system is prepared to deliver. The most significant finding is that current Skills England apprenticeship standards were rated as having low suitability when mapped against many of the 19 Future Occupational Profiles (FOPs) identified during the cycle. This is not a marginal misalignment; it is a fundamental skills gap affecting all parts of the battery recycling supply chain.

How Organisational Capabilities Will Change

As the UK prepares for large-scale battery recycling, organisational capabilities will evolve rapidly in response to technological changes. Across all supply chain partners, from Gigafactories and Battery Recovery operators to Recycling Facilities and Government Regulators, there will be:

- Increased demand for capabilities in data management, environmental compliance, and circular economy strategies.
- More technical roles in battery handling, high-voltage system diagnostics, and chemical processing.
- A shift in emphasis from traditional logistics to reverse logistics and reuse-centric design processes.
- Expansion of enterprise-level capabilities (e.g. digital integration, quality compliance, workforce planning) to align with evolving regulatory frameworks.

The most significant organisational change is a greater need for capabilities in the 'Enterprise' and 'Design' functions, with a relative reduction in 'Implementation' tasks traditionally dominant in linear manufacturing.

The Next Steps

We recommend the following actions to enable UK leadership in battery recycling and avoid strategic dependence on foreign recovery infrastructure:

- Establish a National Working Group
- Convened by WMG and including Skills England, Innovate UK, DfE, and OZEV to address curriculum reform, industry demand aggregation, and qualification design.
- Validate and Publish Future Occupational Profiles (FOPs)
- Fast-track development of Level 3–5 apprenticeship standards in:
    - Battery Dismantling & Recovery
    - Metallurgical Process Operations
    - Circular Economy Compliance
    - Battery Logistics and Reverse Engineering
- Launch Targeted CPD Offerings in areas such as battery health assessment and safe handling of end-of-life batteries.
- Develop and pilot short courses aligned to high-priority capabilities in repair, reuse, and storage.
- Utilize a Professional Register for workforce continuous professional development, and recognition.

Expand current Foresighting into a robust workforce demand forecast to guide industrial policy.

If unaddressed, the UK will be ill-equipped to manage the environmental, economic and regulatory implications of battery waste. This report demonstrates that there is a clear and urgent need for skills reform. Without intervention, investment in gigafactories risks becoming a linear economy model, with waste exported abroad and no domestic value retained from recycling.

1.0 Introduction

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1.1	Background to Workforce Foresighting
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1.1 Background to Workforce Foresighting

The report “Manufacturing the Future Workforce” (Collier et al., 2020) recommended the Skills Value Chain as an approach to avoid shortfalls in workforce capabilities relating to future innovations (see Figure 1). This is the genesis of the workforce foresighting programme, which is sponsored by Innovate UK and delivered through the Innovate UK Catapult Network.

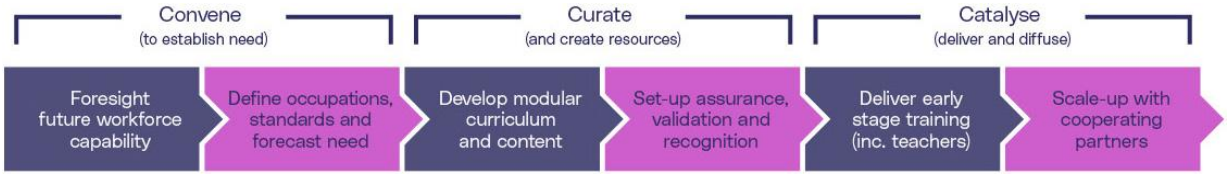

Figure 1: The Skills Value Chain

The first step of the skills value chain is to “Foresight future workforce capability”: This calls for technology, industry, education, and training partners to convene using government as a focal point, to “foresight and articulate future skills need, standards and qualifications associated with emerging technologies” (Collier et al., 2020).

1.2 Workforce Foresighting - Process Overview

The core of workforce foresighting is convening three groups of relevant specialists to conduct structured, Delphi-style, facilitated workshops to capture and discuss the set of organisational capabilities that will be required to respond to and exploit technology innovation.

Organisational capabilities are captured using a bespoke classification that has been developed by the Workforce Foresighting Hub. The classification uses a structured common language to enable cross sector and cross centre collaboration and integration of data. Additionally, the classification enables data from a number of other national and international open-source workforce datasets to be integrated through the same common language. The data is held in a cloud based “data-cube” that is dynamically growing as each workforce foresighting cycle adds to the shared data relating to future workforce capabilities.

Using cutting edge AI and Large Language Model data tools, the data-cube is used to undertake detailed analysis to ‘map’ future workforce capability requirements against the current education and training provision to identify where existing provision can be used and where new provision and qualifications are required.

As an agile development project, the Workforce Foresighting Hub team are constantly evolving and improving the detailed workshop process and workshop approach, but always consists of the following stages:

Considering – Clarifying the Challenge to be met (the ‘what’ and the ‘when’) and collating solutions (the ‘how’) as foresighting topic suggestions align with strategic priorities.

Identifying – Gain clarity and consensus about the solutions to be put forward – make the case for foresighting.

Preparing – The convening of specialists and scheduling of workshops.

Carrying out – Run foresighting workshops with experts, collate and analyse data.

Communicating – Insights, findings and recommendations gathered from all research in report.

Causing action – The driving of action based on the recommendations (promoting progress down the rest of the skills value chain) built on the findings and recommendations of foresighting.

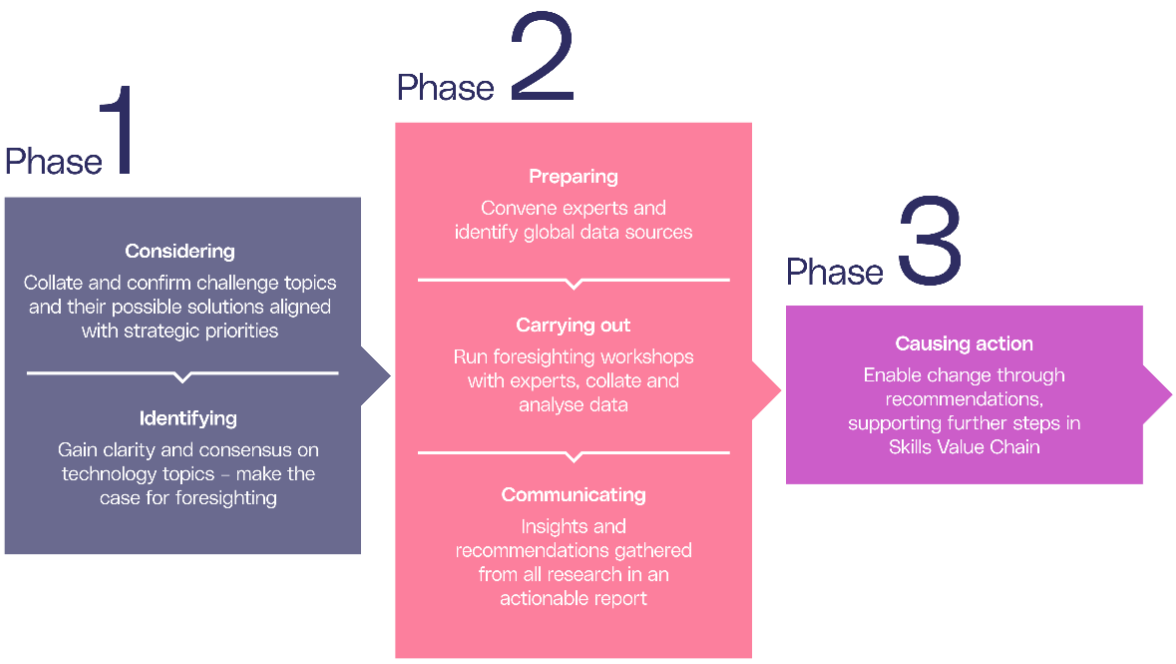

Figure 2: The workforce foresighting process

1.3 Foresighting vs Forecasting

Although this study is focussed on workforce foresighting (capabilities required) it is important to keep in mind parallel findings from forecasting (required capacities and numbers). Forecasting, alongside foresighting, provides vital input to the sector, feeding into recruitment and development targets for employers, and consideration of economic class sizes and recruitment targets for educators. However, it is beyond the scope of the foresighting study to carry out independent forecasting, and as such readers should refer to referenced studies for detail on forecasting.

1.4 Introducing the Visualisation Tool

The Workforce Foresighting Hub's Visualisation Tool is a powerful, innovative system, which will enable the reader to explore and analyse foresighting data to determine the capabilities required for future roles. Links throughout this report make it easy to identify existing standards which meet the needs of these future roles and pinpoint where new standards are necessary to develop a skilled workforce equipped to adopt new technologies.

The data is generated by the foresighting cycles, integrating the expertise of technologists/domain specialists, employers and educators. The data informs the development of future curriculums and course content as determined by the action plan. Using AI tools validated by human oversight, and by linking to external data sources, the tool identifies differences at the level of occupation/role as well as detailed changes required to help update/refresh knowledge, skills and behaviours thus delivering insights for learners, providers, creators and assurers of skills.

Detailed instructions on how to use the Visualisation Tool can be found in the appendix E (**Visualisation links and Illustrations**)

Links: Data Capture Overview [1]

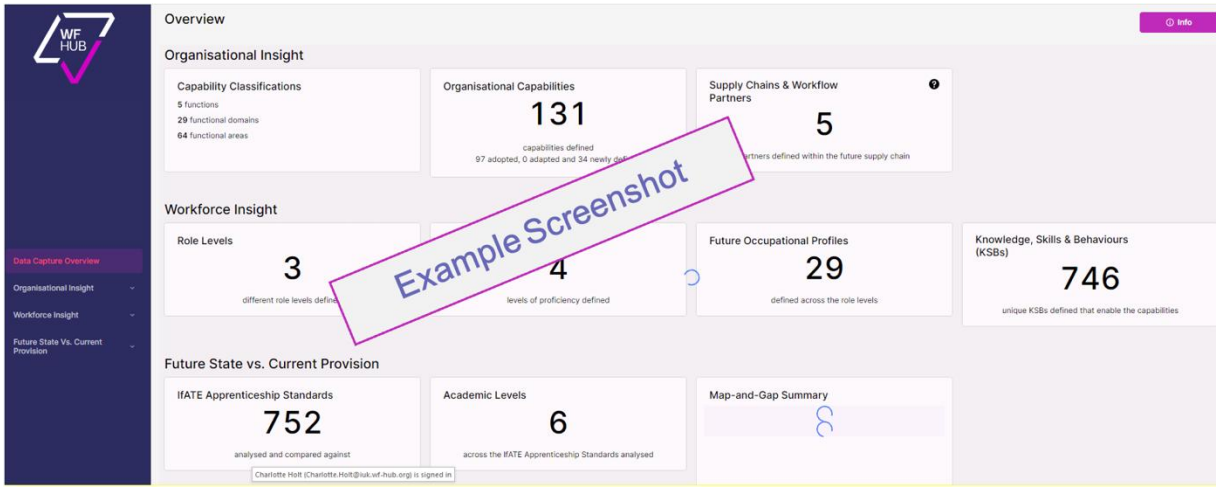

Figure 3: Data capture overview example

[1] Data capture overview https://hvmcatapultforesighting.retool.com/embedded/public/e869283b-4b8a-437c-973e-64ab292e5b87?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

2.0 Aligning the Challenge and Solutions with national priorities

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2	Aligning the Challenge and Solutions with national priorities
2.1	Positioning and context of national challenge
2.2	Potential and prioritised technology solutions to the challenge
2.3	Workforce Foresighting for Chosen Prioritised Technology Solutions
2.4	Current and predicted scale of technology deployment in UK
2.5	Key Stakeholders in industry and government

2.1 Positioning and context of national challenge

The UK's commitment to net zero, growth in electric vehicle (EV) production, and increasing reliance on lithium-ion battery systems underpin the urgent national challenge of establishing an efficient, safe, and circular battery recycling ecosystem. With a target of 2035 to achieve 100% battery repair, re-use and/or recycling there is a need to ensure that appropriate skills are available to industry to scale existing practices as well as develop new approaches. This Foresighting cycle addresses a critical gap in workforce preparedness across the emerging end-of-life battery value chain, which includes disassembly, storage, reuse, and recovery.

Government and Sector Targets

The UK government's Net Zero Strategy, the Critical Minerals Strategy, and the UK Battery Strategy highlight the need for a resilient battery supply chain, circularity of materials, and decarbonisation of manufacturing. With the rapid scaling of Gigafactories and EV adoption, the capacity to handle waste batteries, recover critical materials, and safely reintegrate components into the economy is a strategic necessity. Furthermore, the Faraday Institution and Innovate UK have prioritised battery reuse and recycling in their innovation programmes.

Sector Context

The battery manufacturing and recycling sector is emerging as a cornerstone of UK industrial growth. Significant public and private investments are flowing into Gigafactories, expected to produce hundreds of thousands of battery packs annually. However, the recycling and reuse end of the value chain remains underdeveloped. Current workforce capabilities are misaligned with future roles such as Battery Recovery Technician, High Voltage Battery Repair Technician, and Circularity Compliance Lead.

The UK risks falling behind international competitors unless rapid progress is made in standardising roles, developing training provision, and enabling safe and compliant reuse and recycling operations. Crucially a failure to address this skills need will impact on the UK's ability to create a circular economy around battery manufacturing which will increase reliance on the import of virgin materials and negatively impact on domestic energy security.

Technology Landscape and Outlook

Advances in battery chemistry, automation, AI-driven diagnostics, and hydrometallurgical processing are reshaping the sector. With EVs approaching mass-market maturity, large volumes of end-of-life batteries are expected by the late 2020s. The battery recycling challenge is not just technical, it is systemic, involving regulation, logistics, safety, materials science, and digital tracking of assets.

Workforce development must keep pace with these technological advances to avoid bottlenecks in implementation. Current roles and standards are inadequate for what is to come, and immediate action is needed to build out the human infrastructure.

2.2 Potential and prioritised technology solutions to the challenge

Evaluation of Technology Solutions

The foresighting workshops evaluated a broad range of technologies related to battery end-of-life processing. Participants considered current and emerging practices across the supply chain, including recovery, disassembly, testing, storage, reuse, and materials reclamation.

Technology Options Considered

Technology Area	Description	Supply Chain Impacted	Relevance to Challenge
Automated battery pack disassembly	Robotics and automation to safely disassemble packs	Gigafactories, recovery, reuse	Increases safety, throughput, cost-effectiveness
Battery State of Health (SOH) diagnostics	Digital tools and sensors to assess battery reuse potential	Repair, reuse, storage	Enables second-life use, prevents early disposal
High-voltage safety systems	Infrastructure for safe handling and storage of high-voltage units	All sectors	Critical to safety and compliance
Hydro- and pyro-metallurgy processes	Chemical processes to recover critical minerals	Recycling & materials recovery	Core to achieving material circularity
Digital tracking and traceability	Battery passports and digital asset tracking	Government, logistics, all supply chain actors	Enables compliance, traceability, policy alignment

Table 2: Technology options considered

Relevance and Timing

All solutions have immediate and long-term relevance. However, digital SOH diagnostics and automated disassembly were considered high priority for early deployment, as they reduce manual labour, improve safety, and facilitate reuse pathways. Hydrometallurgical processes are essential but require more capital investment and technical expertise, placing them on a medium to long-term implementation horizon.

The greatest short-term workforce need lies in enabling safe, skilled disassembly, handling, and assessment of used battery systems, **roles not currently supported by existing standards**. Further to this, for the workforce to be agile and responsive, a professional register is recommended to record qualifications, continuous professional development, and to enable agility across the sector by demonstrating acquired skills and competencies.

2.3 Workforce Foresighting for Chosen Prioritised Technology Solutions

Chosen Technology: Battery Recycling and Reuse Systems

The prioritised technology in this foresighting cycle is the **end-of-life battery processing ecosystem**, including reuse, repurposing, and materials recovery. This reflects the urgent national need for safe handling and recovery of lithium-ion batteries and alignment with environmental and industrial strategy objectives.

Cycle Title

Workforce Foresighting Cycle: Advanced Battery Recycling – WMG. Utilizing repair, repurposing or recycling to process manufacturing waste and end of usable life batteries to enable sustainable material reuse.

Horizon, Impact and Supply Chain

The horizon for impact is immediate (0–5 years), with scale increasing rapidly as EV uptake grows. The foresighting identifies required workforce capabilities across six interconnected supply chain groups:

1. Gigafactory waste producers.
2. Battery recovery and removal.
3. Battery storage and logistics.
4. Repair and reuse.
5. Discharge/recycling and materials recovery.
6. Government and regulatory bodies.

The foresighting exercise generated **Future Occupational Profiles (FOPs)** for each supply chain group and role level (Technician, Supervisor, Graduate Engineer, Senior Engineer), defining the proficiencies, capabilities, and training requirements that are currently unmet by education provision.

2.4 Current and predicted scale of technology deployment in UK

The UK has invested significantly in upstream battery production, with Gigafactories in Sunderland and further investment in Somerset supported by government funding and industry partners. However, the downstream capability, particularly recycling infrastructure, is lagging.

Forecasts indicate that by 2035:

- Over **350,000 tonnes of battery waste** will be processed annually in the UK.
- Recovering critical minerals could reduce dependence on foreign imports and support sovereign supply chains.
- Battery reuse (second life applications in energy storage, micromobility) could unlock new revenue streams but depends on scalable diagnostic and refurbishment systems.

Reports from the **Faraday Institution**, and the **UK Battery Strategy** emphasise the importance of battery circularity and the need to develop regulatory and skills infrastructure to support deployment.

The foresighting process confirms that without intervention, a lack of trained personnel and recognised roles will become a critical bottleneck.

2.5 Key Stakeholders in industry and government

The foresighting cycle brought together stakeholders from across the sector. Their insights formed the basis of the data used to define future capabilities and occupational needs.

Stakeholder Categories

Category	Organisations Represented (examples)
Industry Participants	Gigafactories, battery recyclers, EV OEMs, logistics firms, second life battery specialists
Skills Participants	Further and higher education providers, apprenticeship bodies, professional bodies
Technology Participants	Battery specialists, automation companies, vehicle manufacturers

Table 3: Stakeholder categories

Cycle Participants

Industry Participants	Skills Participants	Technology Participants
UKBIC	Institute of the Motor Industry	WMG
CarTakeBack	EAL	Altilium
Autocraft	GTA	Catapult
Connected Energy	Cogent	Bentley
VRA UK	ProMoto	Aston Martin
	ESN	Ford
	SIAS	Batri
	Better Generation Solutions	JLR
	City and Guilds	

Figure 4: Cycle Participants

3.0 Findings and Results

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3	Findings and Results
3.1	Methodology and Findings
3.2	Step One – How will the Supply chain change - Organisational Changes
3.3	Table 4: Visualisation Instructions organisational capabilities Step Two – How will the Workforce change - Occupational Change Insight
3.4	Step Three – How the current Education provision meets the future need - Highlighted Changes for Future Provision

3.1 Methodology and Findings

Summary information is provided with a narrative based on the underlying data which is also provided using bespoke visualisations to enable greater insight and access to detail. The report is aligned to the needs of those responsible for workforce planning – employers, educators, and skills providers.

Step One – How will the Supply chain change - Organisational Changes

Exploration of organisational changes provides insights into how organisations will need to adapt their current capabilities to implement the solutions that respond to the challenge addressed by the foresighting project.

Typically, organisational changes will also require the adoption of new capabilities and a change in the distribution of these capabilities across supply chain partners. The change in capabilities within an organisation as well as their supply chain partners will determine the changes knowledge and skill changes required by the role groups within the workforce of each Supply Chain partner.

Step Two – How will the Workforce change - Occupational Changes

A set of 'Future Occupational Profiles' (FOPs) is produced by the foresight process that demonstrates how current occupations may need to change in the future. FOPs are generated using a combination of attributes from the underlying capability classification and from data collected in the workshops. The FOP generation algorithm works to group capabilities into logical sets reflecting role levels, function, proficiency and capability similarity. As part of the foresight process the generated FOPs are reviewed, revised and distilled by the Employer group. The agreed set of FOPs are then compared with selected current education provision; the default reference is the set of Institute for Apprenticeships and Technical Education (IfATE) apprenticeship standards; to assess which current training and education provision could be used in the future. Two bespoke metrics - match and surplus - are used to evaluate the alignment of current provision with the set of FOPs proposed. Summaries are presented of the key findings related to each Supply Chain partner.

Findings are aimed at both Employers, and Education and Training Providers, and identify matches and gaps in future training needs compared with current provision to guide further detailed investigation.

Step Three – How the current Education provision meets the future need - Highlighted Changes to Future Provision

The report identifies suggested changes to education and training provision – principally apprenticeship standards that will deliver the knowledge, skills and behaviours required by future occupations. In some cases, this will include the development of short courses and continued professional development (CPD) to upskill the current workforce to meet future needs. Additionally, foresighting outputs can be used to develop programmes, qualifications, and apprenticeship standards for new entrants to the workforce joining via apprenticeship, taught qualification, or other training programme.

The insight and data in this part of the report are primarily aimed at educators training providers, apprenticeship standards bodies and awarding organisations. Combined with insight arising from the Supply Chain capability changes, the provision insight offers an effective way for employers to identify training opportunities that align to their future needs.

3.2 Step One – How will the Supply Chain change - Organisational Changes Insight

Organisation functions

The Workforce Foresighting process uses an information architecture built on five functional areas which are common to any business:

Design	The function of an organisation that focuses on activities relating to product, service or solution design.
Implement	The function of an organisation that focuses on activities relating to producing / making / providing its products or services.
Logistics	The function of an organisation that focuses on activities relating to procurement, delivery, materials, or services necessary for operations – service / manufacturing, etc.
Support	The function of an organisation that focuses on activities relating to users, in-service support, repair / maintenance, recycling, end of life disposal.
Enterprise	Core functions of an organisation - e.g., strategic planning, leadership and management, human resources, digital backbone and data systems, integration of relevant statutory / regulatory requirements and compliance.

The functional structure is developed to levels of detail that enable the foresight process to reference external data sets including ONET (US) Occupational Information Network [[2]], ESCO – European Skills, Competences, Qualifications and Occupations[[3]], IfATE (UK) Institute for Apprenticeships and Technical Education[[4]] .

The five root functions comprise around 40 domains which are broken down to around 140 functional areas. The architecture is used to position ~ 25,000 capability statements which are the building blocks used in the workforce foresight process. Each capability statement has several attributes - some are static and reflect the position of the capability statement in the architecture, whilst others are dynamic and are assigned values through a cycle and set of workshops.

The data architecture is implemented in a bespoke ‘data-cube’ which underpins the foresight process, workshops, and enables extensive use of LLM and AI tools. Additionally, a key feature of the data-cube is that the data from each foresight topic cycle is added into the data set and can then be used, where relevant, in future cycles. This ensures that the capabilities of the system are dynamic and up to date.

[2] ONET - Occupational Information Network - https://www.onetcenter.org/
[3] ESCO - European Skills, Competences, Qualifications and Occupations - https://esco.ec.europa.eu/en
[4] IfATE – Institute for Apprenticeships and Technical Education - https://www.instituteforapprenticeships.org/

Identifying the Future Supply Chain Capabilities

The following charts and graphs summarise the changes in the set of capabilities that will be required by the supply chain (Supply Chain involved in production) in the future. The pie-charts reflect the distribution of capabilities across the five functions of the capability classification. The future state data is captured in three technology focused workshops. The current state data is derived from information collected on apprenticeship standards used across current supply chain partners. sector. This latter information is not as detailed as that produced by the workshops but is indicative and used to provide a point of comparison.

These initial pie charts summarise the changes that will be required by the whole supply chain, across the five functions. As noted earlier in the report the very low match to existing standards means that the current state chart is not particularly accurate and does not provide a good basis for comparison. However, the future state does show a balanced need to address roles across all five function areas. A notable change, as seen in the other battery manufacturing Foresighting cycles, is the increase in logistics related profiles.

- Indicates an overall relative increase in 'Design' and 'Enterprise'
- Indicates an overall relative **decrease in 'Implementation'**, with the 'Enterprise' function taking 24% share.

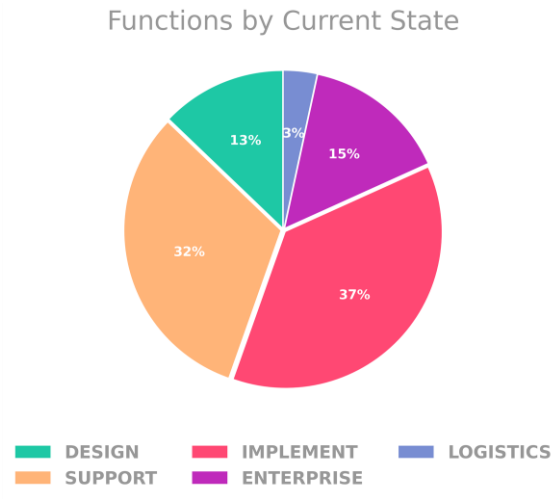


Figure 6a: Existing Supply Chain - Capability Function Distribution %

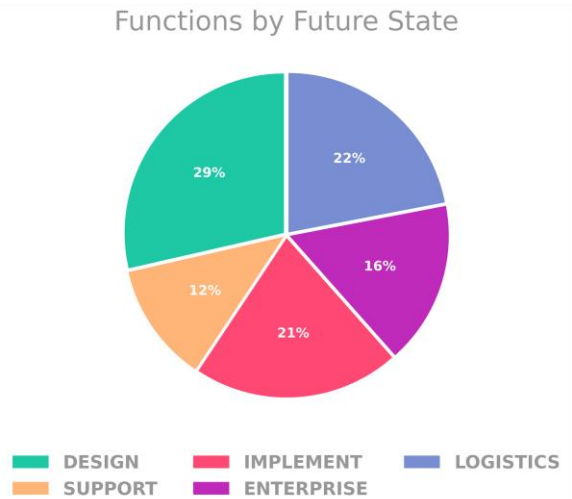


Figure 6b: Future – Whole Supply Chain - Capability Function Distribution %

Whilst the information on current and future Supply Chain capabilities is useful to indicate relative changes, factors such as volume of activity will also determine which functions may have greater future significance.

The graphs below show the distribution of capabilities assigned at domain level within the five main functions for this cycle. These graphs provide insight into the relative importance of each domain for the advanced battery recycling sector in the future.

Design Domains

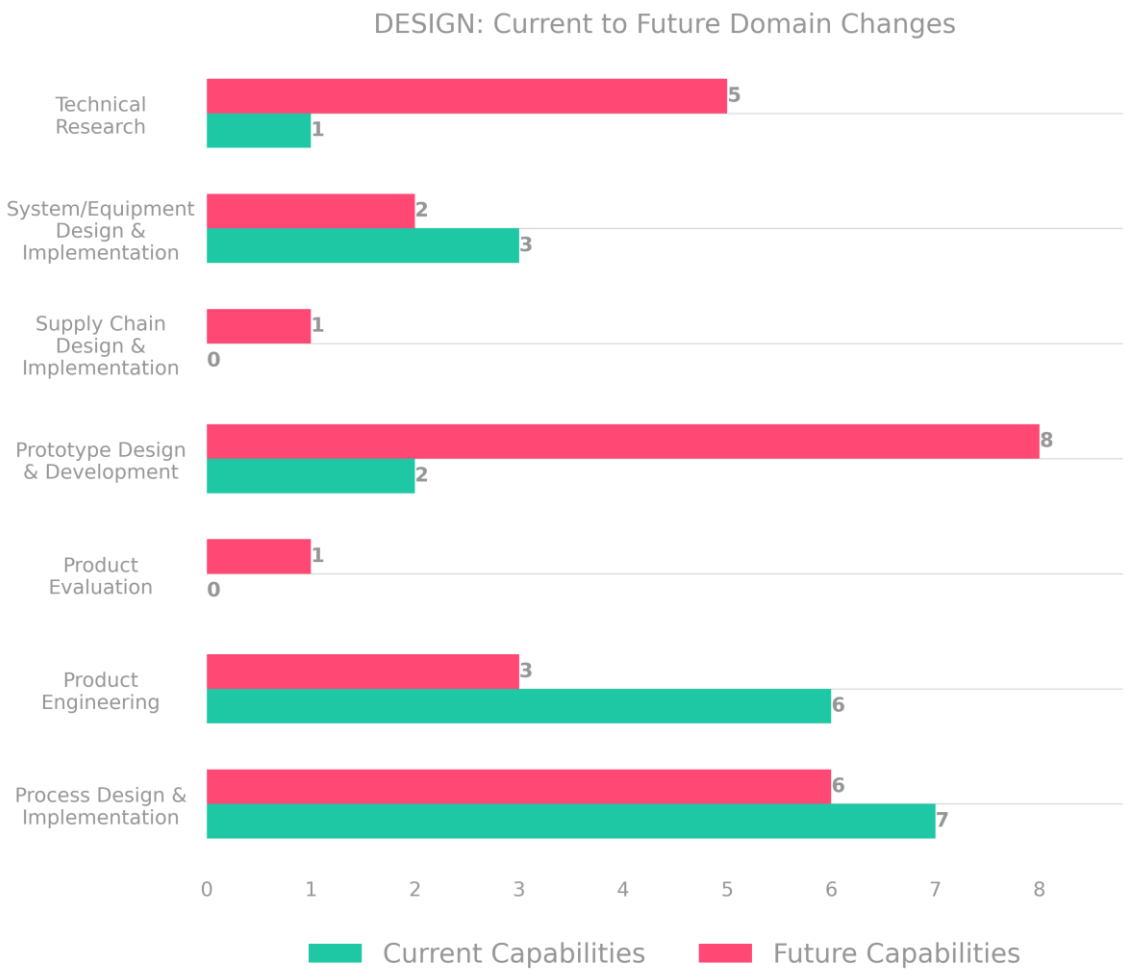


Figure 7: Design Future Domain Spread of Capabilities

A before the current state is not a true reflection of where the sector currently is given the poor match to existing profiles both in terms of curriculum and roles. However, it is worth noting the increase relative importance of technical research and design & development associated with battery repair, re-use and recycling. As well as growing capabilities there is scope to innovate in processes in order to scale the UK's ability to address challenges in repairing, re-using and recycling batteries. The inclusion of supply chain design reflects the need to integrate this activity into the wider battery ecosystem.

Enterprise Domains:

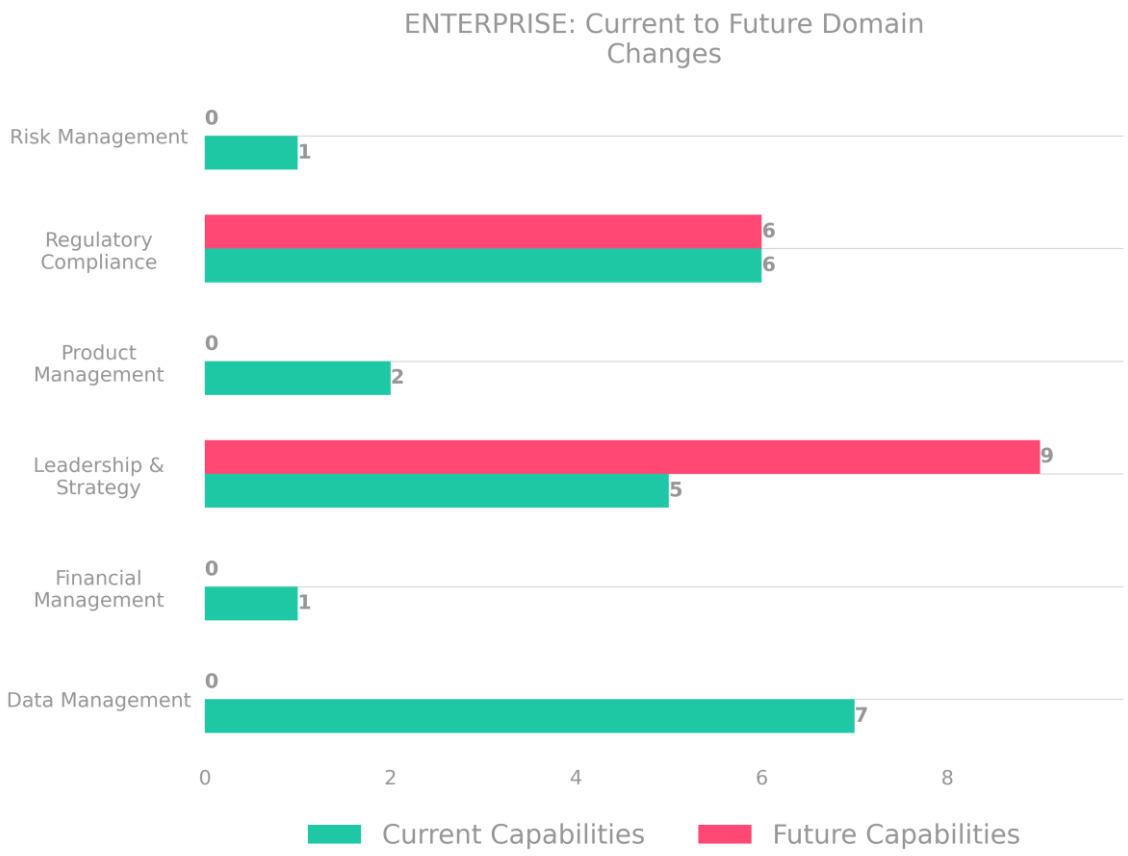


Figure 8: Enterprise Future Domain Spread of Capabilities

Comparison with the existing state is, again, less valuable given poor matching. The growth of the leadership and strategy domain demonstrate a need to grow the capability and capacity of the sector. Regulatory and compliance remain very important which reflects the need to generate regulation and to operate within it effectively. Data management will remain important but as an integrated capability rather than a standalone one. The growth of leadership and strategy capabilities reflects the need to successfully navigate the growth of the sector in areas that are entirely new in many cases such as the assessment of battery health.

The current / future comparisons in the Enterprise area show the increased need associated with a maturing and competitive regulated market and the need to increase human resources.

Implementation Domains

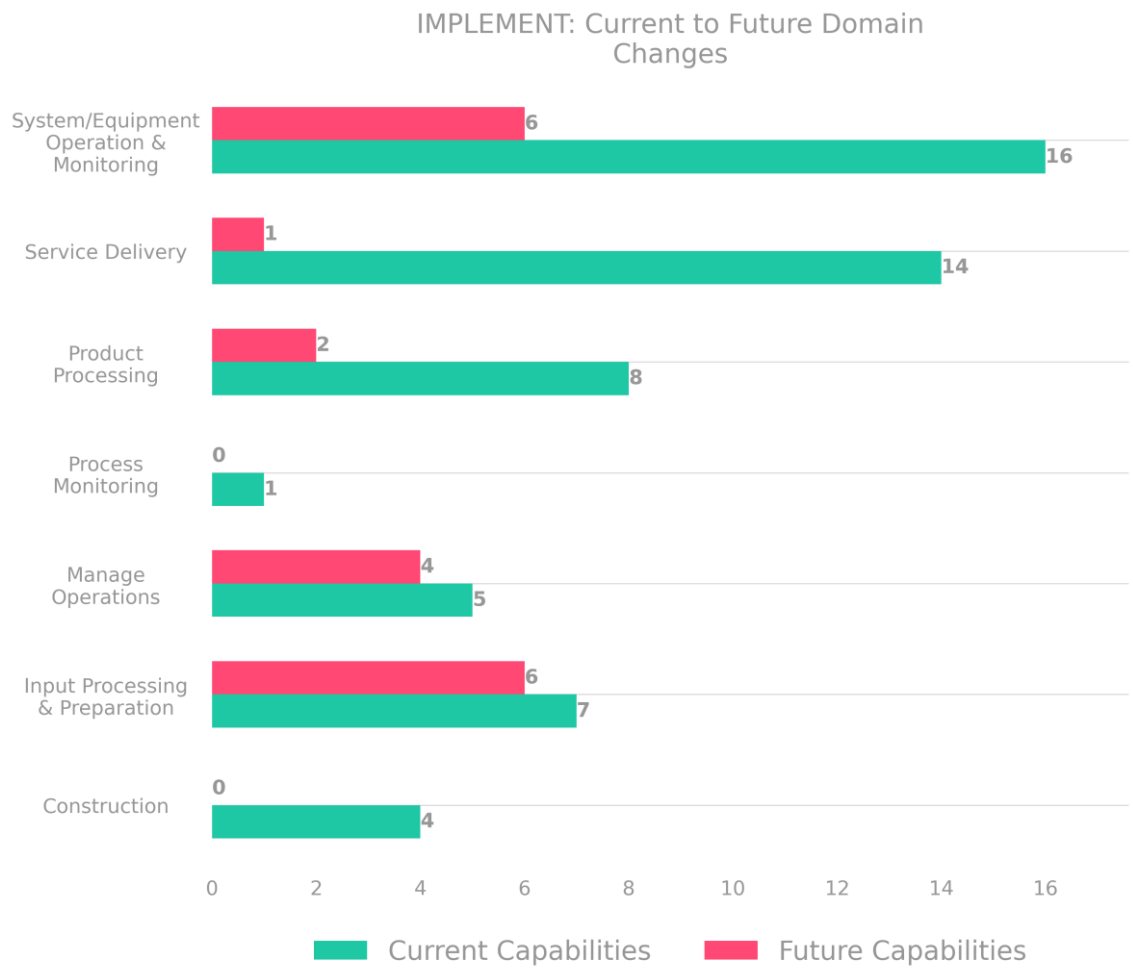


Figure 9: Implementation Future Domains Spread of Capabilities

The spread of capabilities within each of the domains in implementation show that new capabilities are not needed in many of the areas in order to actually undertake the processes associated with battery recycling. New capabilities are added to operations and processing domains reflecting the new nature of the processes that will need to be implemented to achieve workforce transformation for this sector.

Logistics Domains

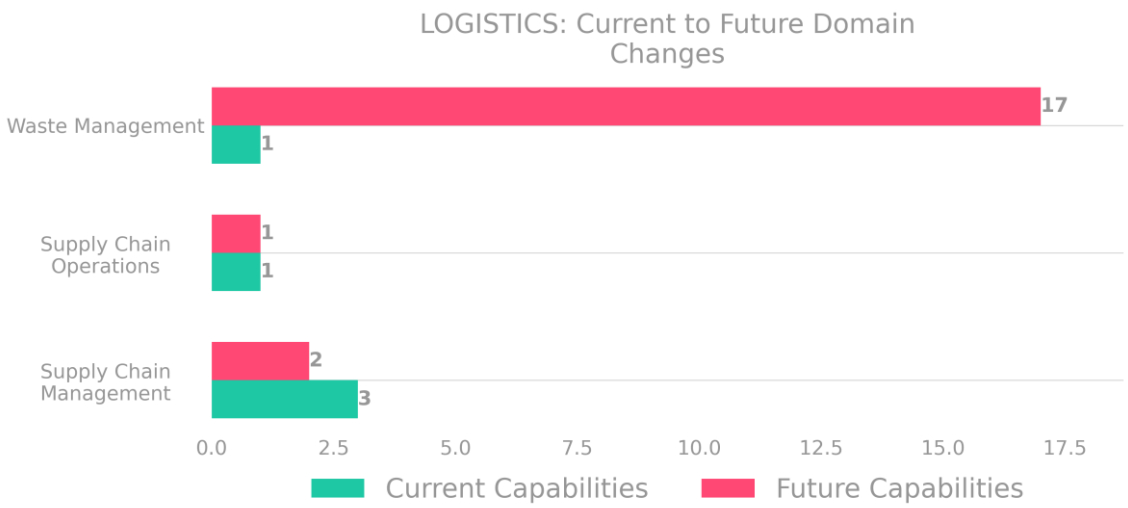


Figure 10: Logistics Future Domains- Future Spread of Capabilities

There are few existing capabilities in this domain focusing primarily on supply chain operations management. This is a trend that was observed across all battery Foresighting cycles. However, the future capability state will rely heavily on the logistics domain. A significant number of capabilities that relate to waste management have been added reflecting the nature of the work that will be undertaken. In terms of this topic waste management includes the safe handling and assessment of traction batteries to ensure that they are safe for repair, re-use and/or recycling. It also considers safe transport and storage which are critical as the volume of activity grows.

The current and future comparison for logistics is as expected for organisations gearing up to work at a higher scale of production.

Support Domains

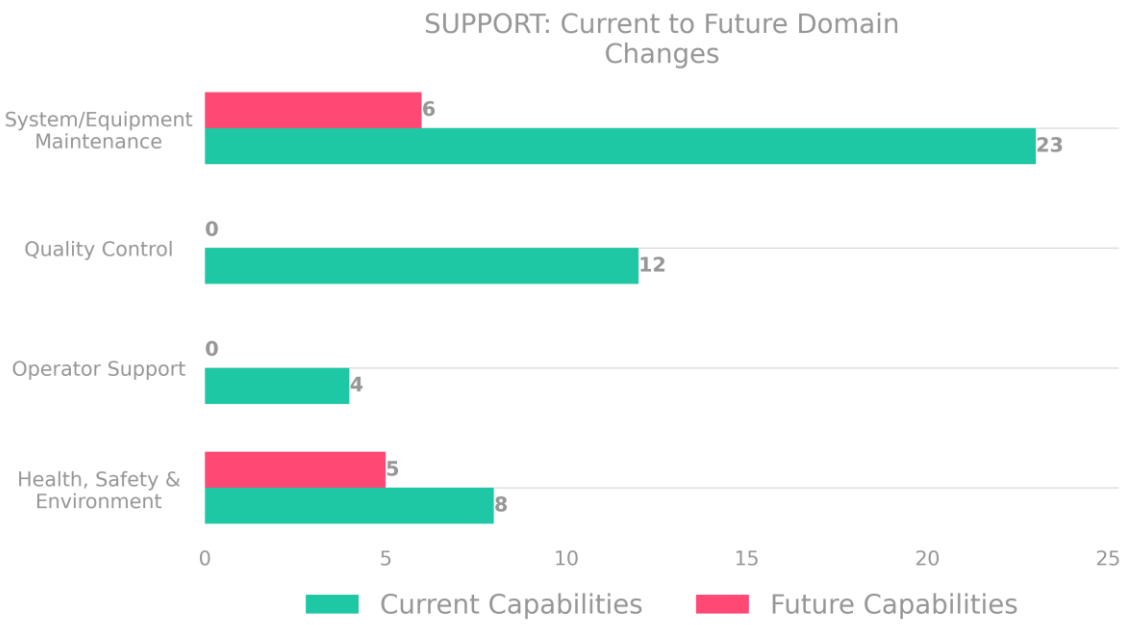


Figure 11: Support Future Domains - Future Spread of Capabilities

The Support function accounts for 21 of the 131 capabilities identified in this cycle. Operator Support is the most prominent domain, reflecting the need to design, configure and operate support systems for safe battery handling, condition assessment, triage, storage, repair and end-of-life processing. These capabilities matter because battery recycling relies on decisions being made before material reaches a recycling facility: batteries must be isolated, tested, classified, stored and routed appropriately for repair, reuse, discharge or material recovery. The prominence of Operator Support also signals that support functions can no longer be treated as peripheral; they are integral to safety, compliance and circularity across the full lifecycle.

The current and future support comparison reflects the current prominent levels of Health and Safety – the reduction in proportions may be due to omissions during the data gathering and analysis.

Visualisation Instructions

Visualisation Data Link	What is it and what can it be used for?
Organisational Capabilities [5]	The page provides details of the capabilities required by each supply chain partner and the supply chain as whole. The information is presented using the Capability Classification Framework, Design / Implement / Logistics / Support / Enterprise and can be interrogated and then exported to suit specific user requirements and interest. The information provided also identifies capabilities supported by existing provision, and also where there may be gaps that require new development to support to equip the future workforce.

Table 4: Visualisation Instructions organisational capabilities

[5] Organisational capabilities https://hvmcatapultforesighting.retool.com/embedded/public/f56f84e9-8ab8-414f-aa1a-0b42ab5c71df?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

3.3 Step Two – How will the Workforce change - Occupational Change Insight

Insight into occupational change uses the understanding of how capabilities will change across business functions section 3.2 (**Step One – How will the Supply Chain change - Organisational Changes Insight**) to inform proposals for how occupations and their associated skills set for each supply chain partner may need be revised to reflect change for each role level within that partner.

Supply Chain partner organisation types

The workforce foresighting process recognises that different partners in a Supply Chain will require appropriate capabilities, and these are determined and agreed in the initial workshops. In this cycle, the following Supply Chain partners were identified and then used during participant workshops and data analysis to determine the organisational needs:

Table Key: Supply chain partners

1. Manufacturing waste producers (Gigafactories and Module and Pack Assemblers).
2. Recovery & Battery Removal.
3. Battery Storage.
4. Repair and Reuse.
5. Discharge / Recycling & Material Recovery.
6. Government and Regulatory Bodies.

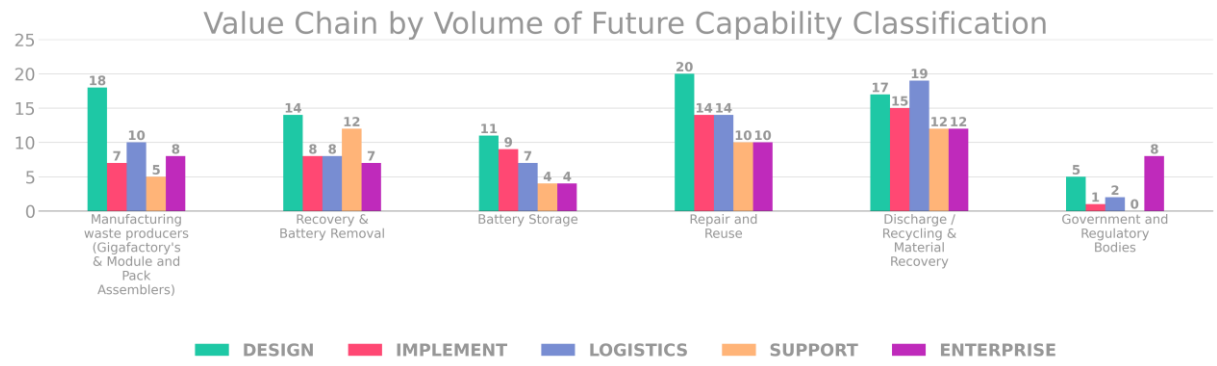


Figure 12: Distribution of Functions across each Supply chain partner

The graph illustrates the distribution of capabilities by function across the Supply Chain Partners. These capability sets are used to form the set of Future Occupational Profiles within each role level. It is clear that across all of the supply chain partners “design” domain competencies will be required as the volume of activity in battery recycling grows. Across all partners new processes and approaches to waste reduction will be required as well as the storage, repair and ultimate recycling of battery active materials.

Beyond design the implementation of these processes is more embedded within manufacturing as reflected by the lower number of new capabilities. However, there is a steady requirement to ensure that new processes are implemented across all supply chain partners with those in newer areas, such as repair and re-use as well as recycling and material recover having the most to do to embed new processes.

As identified, logistics competencies will grow, and this is reflected strongly in repair and reuse and in recycling and material recovery supply chain partners. The logistics of managing battery waste from identification, recovery and storage through to transit are all new areas that will require new approaches and training activities.

Subsequently, in many of the emerging supply chain partners, support competencies have also emerged. Those within the more established activities of manufacturing and assembly reflect the need to incorporate sustainability into existing processes and the leadership required to achieve this. The same pattern can be seen in the enterprise competencies as well.

Visualisation Instructions

Detailed instructions can be found in the appendix

Visualisation Data Link	What is it and what can it be used for?
Supply Chain Capabilities [6]	This page provides an overview of the identified capabilities at a Supply Chain Partner level. By selecting/deselecting each Supply Chain Partner you can review the capabilities identified as required in that area of the Supply Chain. This can be used to generate organisational capability profiles for each area of the Supply Chain to help prioritise and focus the acquisition of new capabilities that will be required in the future. It can also be used to generate combined organisational profiles, where an organisation may be involved in more than one area of the Supply Chain.

Table 5: Visualisation Instructions supply chain partners

[6] Supply chain capabilities https://hvmcatapultforesighting.retool.com/embedded/public/3573002a-ab48-4fad-9765-bee00876a42e?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

Role Levels

The foresighting process uses the concept of Role Levels to represent future occupations. Utilising this approach acknowledges that the workforce is not homogeneous, there will be varying levels of proficiency required across a workforce and qualifications and training may be aligned/require different types of vocational or academic qualifications. Additionally, the role level approach seeks to avoid presuming that the future workforce will be operating at a different level to the current state.
For this cycle, the following role levels were determined through the workshops reflecting the same structure identified throughout the battery Foresighting activities.

1. Technicians
2. Supervisors / First Line Managers
3. Graduate Engineer
4. Senior Engineer

Proficiencies

Each of these role levels will require proficiency that reflects their role and the needs of each Supply Chain Partner. The foresight process uses a three-point scale to capture and differentiate the proficiencies required. This information is used both in the generation of the Future Occupational Profiles, and to assist the definition of training needs identified. Within the workforce foresight process proficiency is defined as:

> **Awareness (A)** - Has a foundational knowledge of tools, technology, techniques relevant to sector, industry, or organisation. Sufficient comprehension to know where to seek further information/details as necessary for a particular issue.
> **Practitioner (P)** - Has the ability to apply and use independently a tool, system, or process. Understands the implications, consequences, and impact for their role/function. A Practitioner knows what key actions are required and in what context.
> **Expert (E)** - Has detailed knowledge of process, system, tool, or technology. Can support others and identify improvements required for a process, system, or tool. An Expert can implement improvements personally or direct and guide others.

During the workshops participants applied their insight to assign proficiency for each role group to each capability. Individual responses were aggregated by the system to arrive at a consensus.

A summary of the distribution of required proficiency for the role levels in this cycle is shown below. The balance of proficiency across the different role levels demonstrates a progression route from a heavily practitioner based through to an expert based level of competency.

Technicians are a practitioner focused role group with expertise in specific areas of the process. This has been deliberately positioned to enable the development of highly trained and skilled technicians.

First line managers further incorporate expertise with awareness of wider business objectives to enable them to effectively lead teams. They remain skilled practitioners in order to support teams but also develop expertise in processes in order to lead others, deliver effective training and engage effectively with regulators and other external agencies.

Graduate engineers have an awareness of manufacturing processes along with practitioner capabilities in areas that senior engineers would be expert. They are able to support first line

managers in certain aspects of their work and develop an expertise in competencies related to the design and delivery of processes.

Senior Engineers develop an expertise in the areas that first line managers have an awareness in, especially the wider aspects of the business and engagement with regulators and other outside agencies. They are less engaged with the hands-on processes that technicians are leading.

Proficiency	Technicians	Supervisors / First Line Managers	Graduate Engineer	Senior Engineer
Awareness	0	13	15	0
Practitioner	38	32	32	2
Expert	15	25	16	25

Table 6: Proficiency Profile by Role Levels

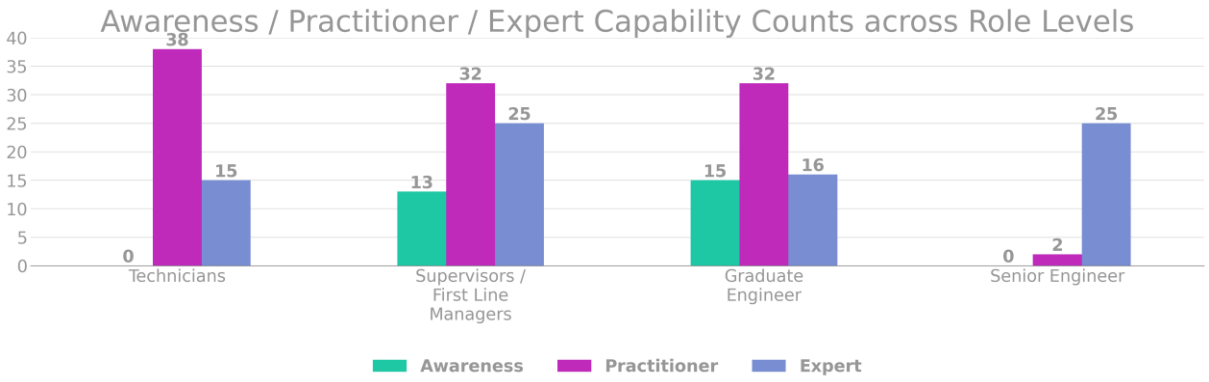


Figure 13: Proficiency details by Role Level

Future Occupational Profiles

FOPs are used to describe and suggest occupations, or roles, that may be required in the future and provide a framework to indicate capabilities and related duties. They can be used to review the impact on current roles and the adaptation that may be required in the future. **Educators** can review current apprenticeship standards against the requirements of the FOPs and interpret which need to be changed to fill the gaps between the current and future state. **Employers** can consider existing apprenticeship standards and make a judgement on adapting an existing apprenticeship standard to upskill their workforce to meet the requirements of a particular FOP.

FOPs and indicative skills need

Combining proficiency with the identified FOPs, the following graphs indicate the priority needs across the supply chain for each Role Group to deliver future capabilities.
The education levels associated with each role generally reflect current vocational and academic practices. Technicians are generally level 3 qualified, with some qualified at level 4 for specialist processes and quality assurance. This is viewed as a highly skilled role. Figure 9 shows the spread of practitioner and expert competencies amongst the technician types identified in the cycle. Operations technicians are generally the most experienced and will hold the higher number of expert competencies.

First line managers will generally undertake further training at level 4/5 which will focus on leadership capabilities and possibly additional technical training. First line management is more about the leadership of people and processes rather than an increase in technical competencies. Reflecting the changing approaches identified in the cycle first line managers will typically hold greater levels of expertise in role such as health and safety, environment management and logistics and compliance. This reflects their critical role in leading operational functions on a day-to-day basis as well as their expertise in processes and operations.

Graduate engineers will generally hold a level 6 qualification, such as an undergraduate degree. Those who undertake operations management roles will hold higher numbers of expert competencies in the production process and will have a broader role overall.

Senior Engineers will typically undergo further training at level 7. This additional training may be technical, or leadership based but increasingly will combine the two to enable better integration of technology solutions.

Technicians Role Level FOPs:

In this cycle the Technicians role level was defined as occupations and roles generally requiring Level 3 qualifications or apprenticeships.

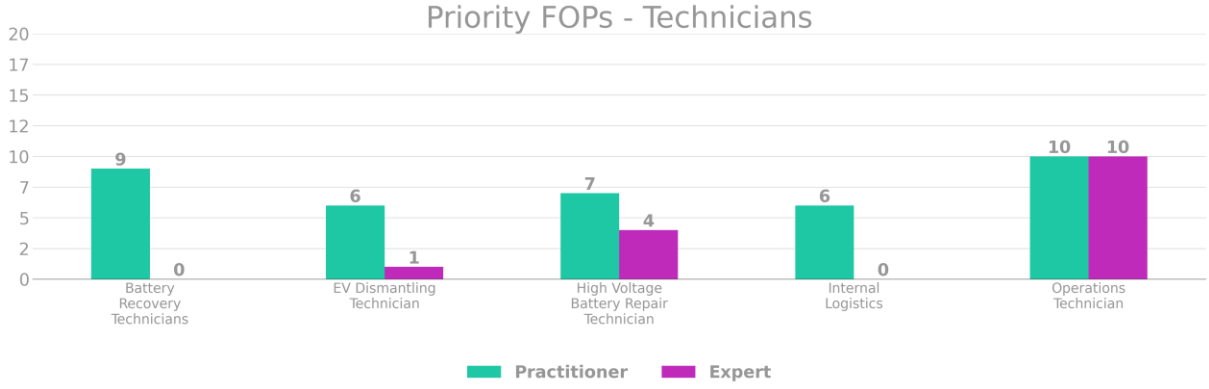


Figure 14: Priority FOPs - Technicians Role Level

Supervisors / First Line Managers Role Level FOPs:

In this cycle the Supervisors / First Line Managers role level was defined as occupations and roles typically requiring Level 4/5 qualifications or apprenticeships.

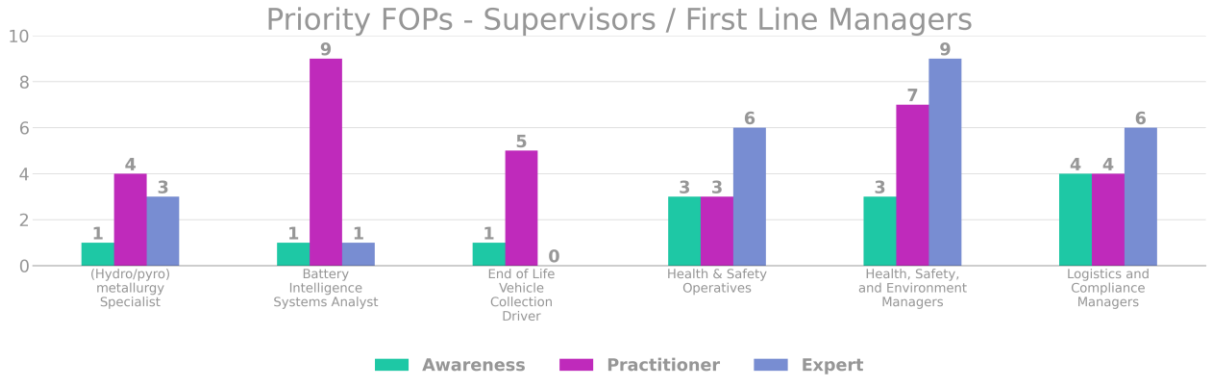


Figure 15: Priority FOPs - Supervisors / First Line Managers Role Level

Graduate Engineer Role Level FOPs:

In this cycle the Graduate Engineer role level was defined as occupations and roles typically requiring Level 6 qualifications or apprenticeships.

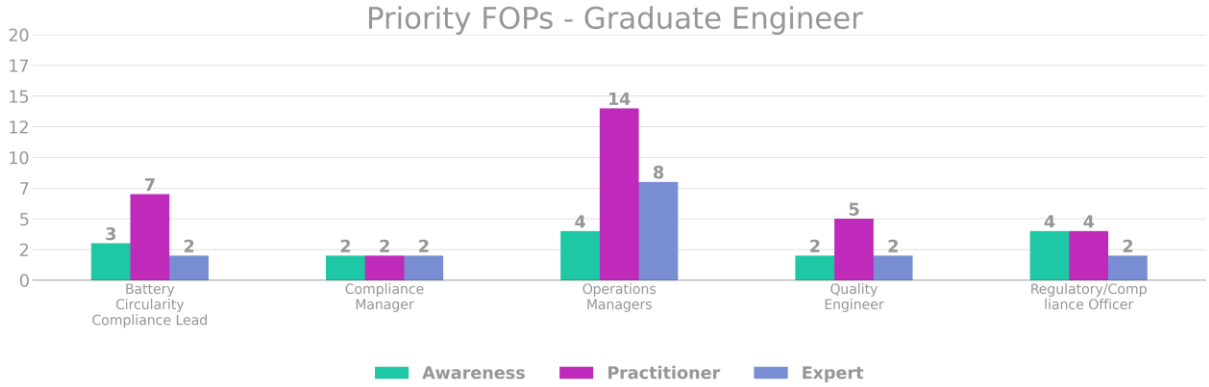


Figure 16: Priority FOPs - Graduate Engineer Role Level

Senior Engineer Role Level FOPs:
In this cycle the Senior Engineer role level was defined as occupations and roles typically requiring Level 7 qualifications or apprenticeships.

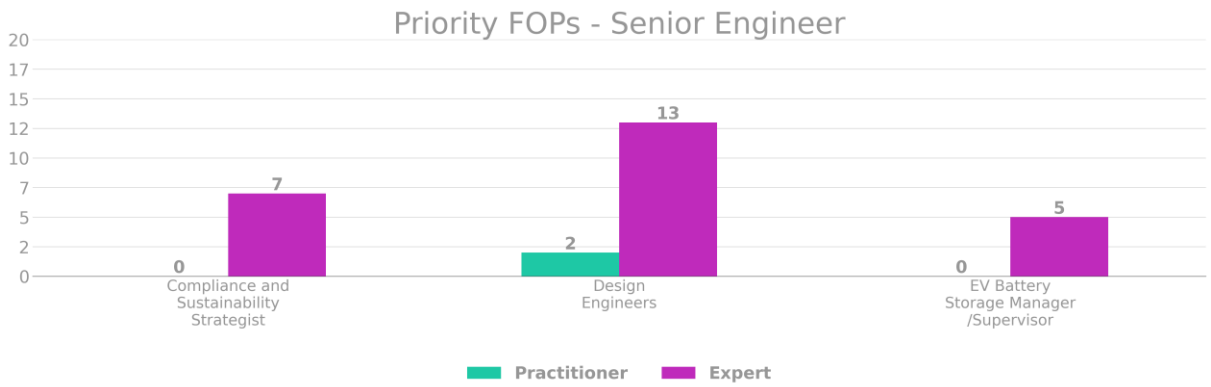


Figure 17: Priority FOPs - Senior Engineer Role Level

Visualisation Instructions

Detailed instructions can be found in the appendix E (**Visualisation links and Illustrations)**	
Visualisation Data Link	What is it and what can it be used for?
FOP Matrix [7]	This page provides a detailed breakdown of future occupational profiles that could be required in the future workforce. These were generated using a combination of attributes collected through the workshops and an algorithm. These suggested profiles were then reviewed and ratified by small groups of employers who were able to add/remove capabilities and uprate/downrate proficiency levels required. You can view all the FOPs in a role level by selecting one (or more) of these from the drop down. This will then allow you to select the FOPs aligned to that role level. The populated table allows you review and compares different FOPs within or across role levels. You can view the capabilities in each FOP and the assigned proficiency levels.

Table 7: Visualisation Instructions FOP Matrix

[7] FOP Matrix https://hvmcatapultforesighting.retool.com/embedded/public/f99a913f-8827-4730-8893-d618d489bc84?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

3.4 Step Three – How the current Education provision meets the future need - Highlighted Changes for Future Provision

The Workforce Foresighting process has developed two metrics to quantify the alignment between a FOP and a current standard or qualification:

Fit – expressed as a %, it is a measure of the proportion of a FOP that is covered by an existing standard or qualification.
Surplus – expressed as a %, it is a measure of the not relevant material in an existing standard that is not required for a FOP.

An ideal existing qualification or standard would have a high fit and low surplus – this implies good coverage of the FOP but with little material that is not relevant to the FOP. Conversely a poor candidate would have a low fit and high surplus. Using these two metrics it is possible to quantitively evaluate, rank, and compare a range of existing provisions against a set of FOPs describing future needs.

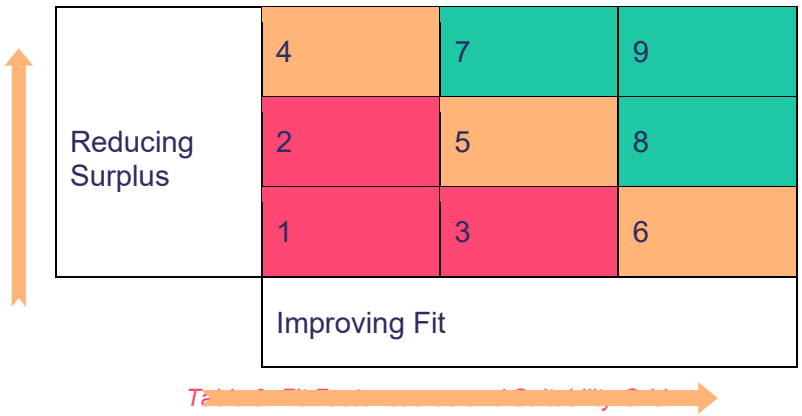
Our interpretation is represented by a simple nine-box model to position the suitability of a given current occupational standard to a future occupational profile:

Factor scores

Fit Factor	Fit score	Surplus Factor	Surplus score
0 - 32%	1	81-100%	1
33-65%	2	51-80%	2
66-100%	3	0 - 50%	3

Table 8: Suitability Grid

(Multiplying the Fit score by the Surplus score gives a Suitability Grid score of 1-9 as below)



Using this score and indicated 'RAG status' the following interpretations can be made:

High Suitability – 7,8,9 – for standards that have good coverage of FOPs.
Represents good candidates from current apprenticeship standards used as the basis of development to meet FOP requirements and inform elements of short course and CPD provision.

Some Suitability– 4,5,6 – for standards that have only partial coverage of FOPs.
These are likely to require extended work to meet FOP requirements, further review of the data may be necessary. They are likely to contain some useful information to inform elements of short course and CPD provision.

Low Suitability – 1,2,3 – for standards that have poor coverage of FOPs.
These are unlikely to be adaptable to meet future needs but may contain some useful information to inform elements of short course and CPD provision, which can be assessed using the data visualisation tools.

FOP findings compared with current standards

Using the approach described above and applying the 'RAG' scores to each FOP indicating the suitability of current apprenticeship standards selected from the IfATE set, the following table begins to identify areas of action and concern for the provision of future skills for each Supply Chain Partner to respond to the challenge.

Across the range of roles identified the fit to existing qualification identified within the Skills England portfolio is uniformly poor. Figures 14 to 19 show that training roles in battery repair, re-use and recycling using existing technical education offerings would not enable them to develop the competencies required. However, this does not mean that the existing standards do not contain competencies that are required for the new roles identified. Careful examination of existing provision is required to pin point underpinning competencies and where additional ones are needed to fully enable the identified roles. Short courses can be used to close gaps where qualified members of a parallel workforce wish to transfer into this area. Similarly, provision for new entrants must also be considered.

Supply Chain Partners

- Battery Storage
- Repair and Re use
- Discharge / Recycling and Material Recovery
- Government and Regulatory Bodies
- Manufacturing Waste Producers (Gigafactories and Module and Pack Assemblers)
- Recovery and Battery Removal

Supply Chain Partner - Manufacturing waste producers (Gigafactories and Module and Pack Assemblers)

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Technicians	Operations Technician	Low
Supervisors / First Line Managers	Health & Safety Operatives	Low
Supervisors / First Line Managers	Health, Safety, and Environment Managers	Low
Graduate Engineer	Operations Managers	Low
Graduate Engineer	Quality Engineer	Low
Senior Engineer	Design Engineers	Low

Table 10: Supply Chain Partner - Manufacturing waste producers (Gigafactories and Module and Pack Assemblers)

Detailed breakdown:

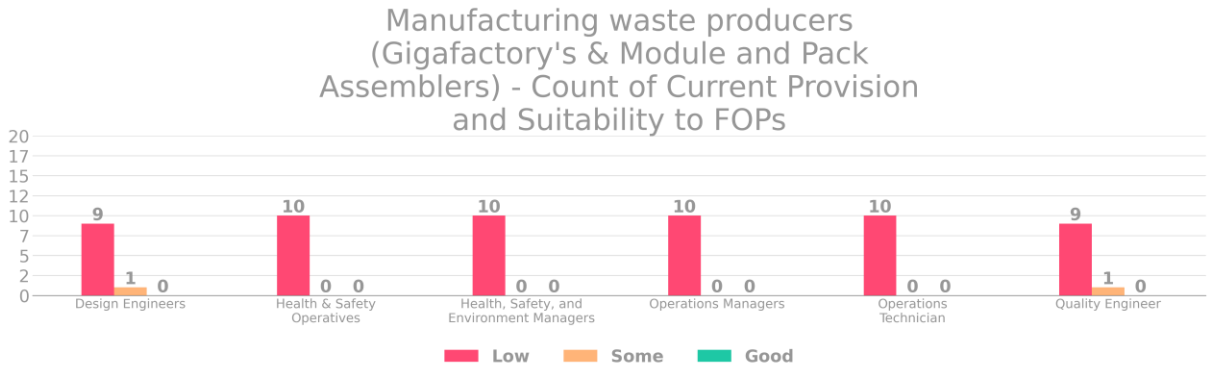


Figure 18: Figure 14: Suitability Summary - Manufacturing waste producers (Gigafactories and Module and Pack Assemblers)

Supply Chain Partner - Recovery & Battery Removal

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Technicians	EV Dismantling Technician	Low
Technicians	Operations Technician	Low
Supervisors / First Line Managers	Health, Safety, and Environment Managers	Low
Supervisors / First Line Managers	End of Life Vehicle Collection Driver	Low
Graduate Engineer	Operations Managers	Low

Table 11: Supply Chain Partner - Recovery & Battery Removal

Detailed breakdown:

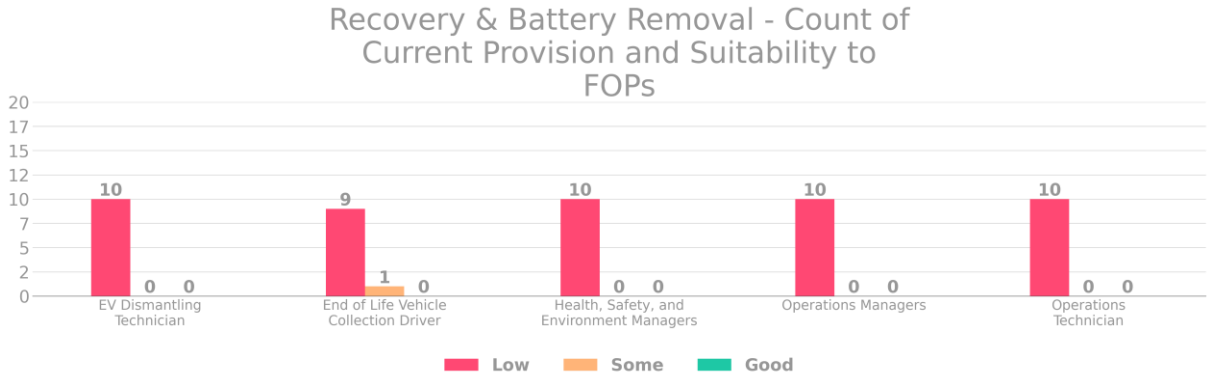


Figure 19: Suitability Summary - Recovery & Battery Removal

Supply Chain Partner - Battery Storage

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Technicians	Internal Logistics	Low
Technicians	Operations Technician	Low
Supervisors / First Line Managers	Health, Safety, and Environment Managers	Low
Graduate Engineer	Operations Managers	Low
Senior Engineer	EV Battery Storage Manager/Supervisor	Low

Table 12: Supply Chain Partner - Battery Storage

Detailed breakdown:

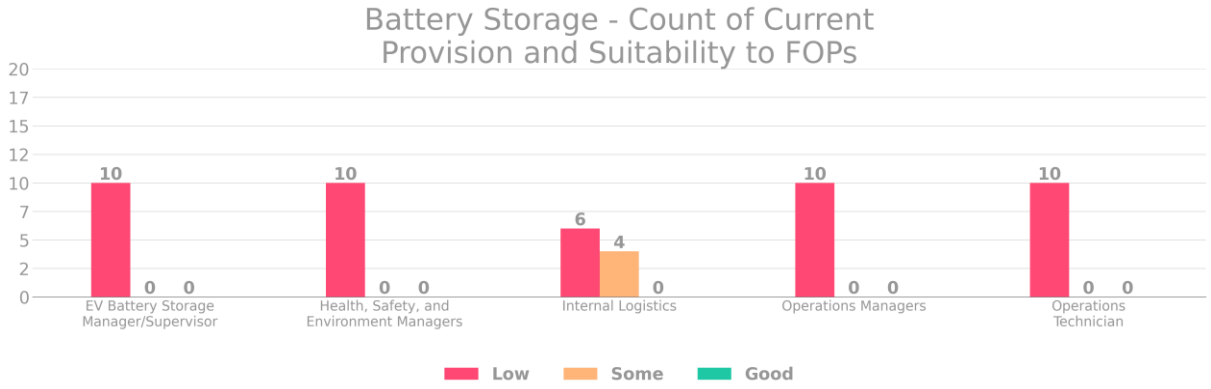


Figure 20: Figure 16: Suitability Summary - Battery Storage

Supply Chain Partner - Repair and Reuse

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Technicians	Battery Recovery Technicians	Low
Technicians	High Voltage Battery Repair Technician	Low
Technicians	Operations Technician	Low
Supervisors / First Line Managers	Health & Safety Operatives	Low
Supervisors / First Line Managers	Logistics and Compliance Managers	Low
Supervisors / First Line Managers	Health, Safety, and Environment Managers	Low
Supervisors / First Line Managers	Battery Intelligence Systems Analyst	Low
Graduate Engineer	Operations Managers	Low
Senior Engineer	Design Engineers	Low

Table 13: Supply Chain Partner - Repair and Reuse

Detailed breakdown:

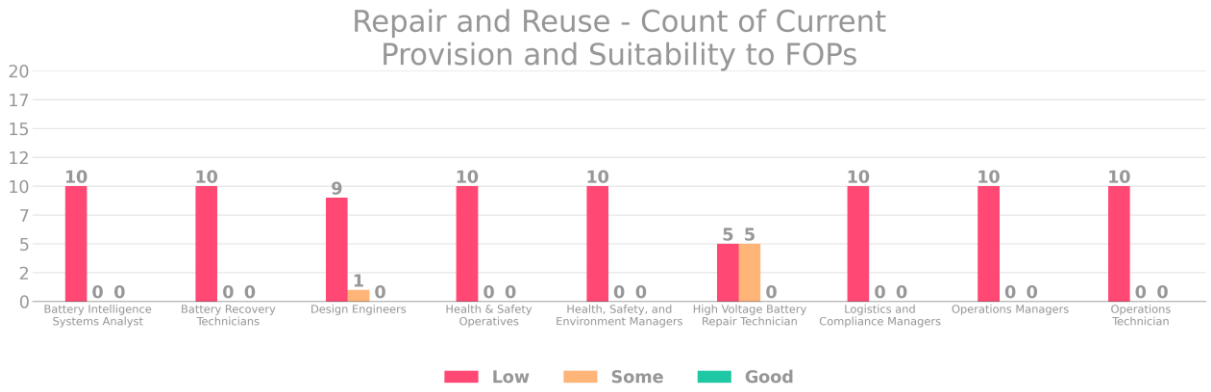


Figure 21: Suitability Summary - Repair and Reuse

Supply Chain Partner - Discharge / Recycling & Material Recovery

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Technicians	Operations Technician	Low
Supervisors / First Line Managers	(Hydro/pyro) metallurgy Specialist	Low
Supervisors / First Line Managers	Battery Intelligence Systems Analyst	Low
Supervisors / First Line Managers	Health & Safety Operatives	Low
Supervisors / First Line Managers	Health, Safety, and Environment Managers	Low
Graduate Engineer	Regulatory/Compliance Officer	Low
Graduate Engineer	Battery Circularity Compliance Lead	Low
Graduate Engineer	Operations Managers	Low

Table 14: Supply Chain Partner - Discharge / Recycling & Material Recovery

Detailed breakdown:

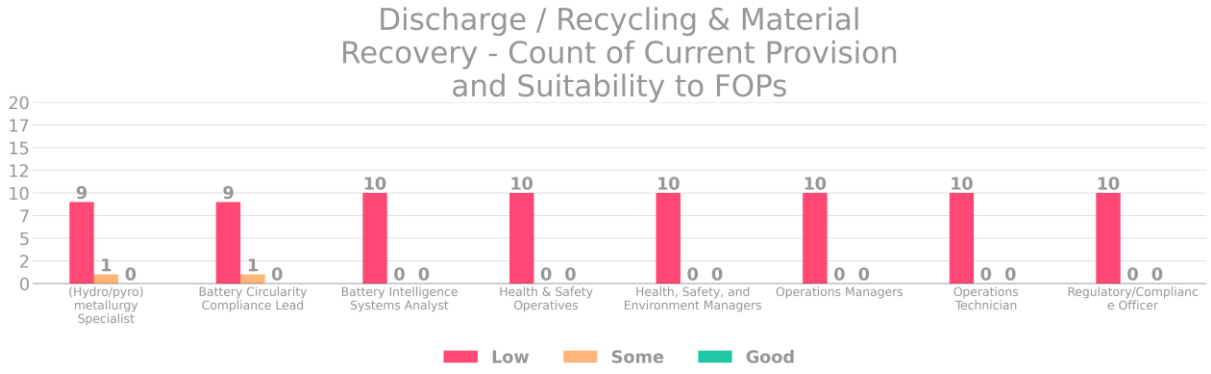


Figure 18: Suitability Summary - Discharge / Recycling & Material Recovery

Supply Chain Partner - Government and Regulatory Bodies

Role Level	Selected Future Occupational Profiles	Current Suitability Summary
Graduate Engineer	Compliance Manager	Low
Senior Engineer	Compliance and Sustainability Strategist	Low

Table 15: Supply Chain Partner - Government and Regulatory Bodies

Detailed breakdown:

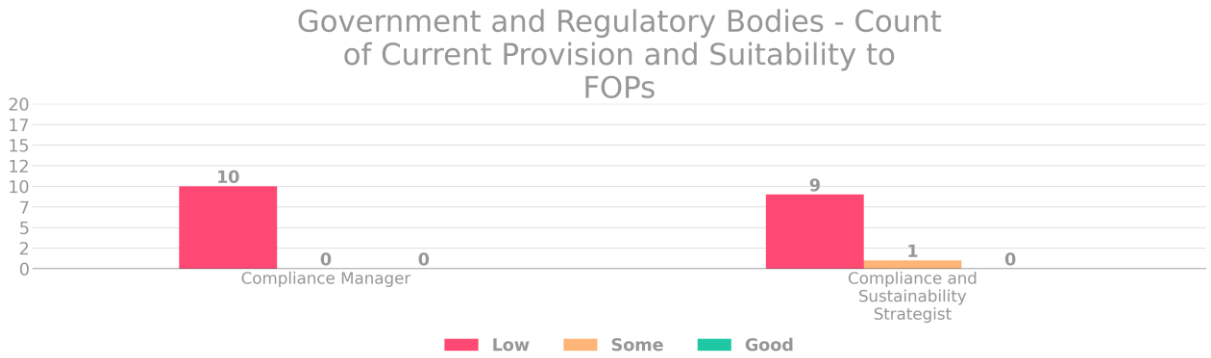


Figure 19: Suitability Summary - Government and Regulatory Bodies

Link to full data set - Visualisation Instructions

Visualisation Data Link	What is it and what can it be used for?
FOP Detail	This page allows you to review a specific Occupational Profile, including the capabilities contained within it and the Knowledge, Skills & Behaviour (KSB) tags associated with the capability. You can select an individual Role Level and linked FOP in the two available dropdowns. The table in the lower section of the page will then be populated with all relevant capabilities. The search control above the table allows you to filter content of any of the columns of data. A key piece of functionality in this table is the presence of the KSB tags associated with the capabilities. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/81d272f0-ad80-421c-8926-86655913acdf?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410
Future KSBs Summary	This page provides a view of the complete set of capabilities within the cycle along with all of the associated KSB tags which are linked to them. It is, essentially, the superset of all details displayed on the Fop_detail page. This is used to: • To review the identified Knowledge, Skill and Behaviour tags for a given capability, to support development of future education and learning material. • To review the requirements from a capability level, rather than a role level/occupational profile grouping. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/8634650f-9700-4627-8431-068b4b764222?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410
Capabilities Matched to Current Provision	This page allows you to review and compare individual capabilities against 'Duty' statements in an Apprenticeship / Occupational Standard. You can select individual capabilities to review their specific matches. These matches are shown in the bottom panel, including the Standard, the Level and the Duty Statement this is matched to. You can filter in several ways to focus your review: • By the Capability Classification Framework (left-hand panel). • By capabilities that **are** served by the reference mapping framework – the default is Institute for Apprenticeships and Technical Education (IfATE) provision. • By capabilities that **are not** served by the reference mapping framework, e.g., IfATE provision – these are capabilities required in the future that may require new/bespoke training and CPD materials to be developed to upskill/re-skill the workforce. This page can be used to identify where existing provision may exist across the broad spectrum of Apprenticeship standards, and not just within a narrow range of sector-specific Standards. The data also allows you to identify where provision may already exist to support specific capabilities. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/219ff6af-36ea-4b5e-bda1-b0b989c0e3f0?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

Visualisation Data Link	What is it and what can it be used for?
Fit & Surplus Factors	This page allows you to review the 'Fit' and 'Surplus' of Prototype Future Occupation Profiles (FOP) against existing training provision e.g. Institute for Apprenticeships and Technical Education (IfATE). It is possible for the 'Fit' and 'Surplus' comparison to total over 100%, as they are two separate calculations based on a two-way comparison. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/c699e504-3f64-45a0-b52e-ad44a95f9aa4?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410
Fit & Surplus Matrix	This page is a visual representation of the 'Fit and Surplus Factor' insight. You can visually review 'Fit' and 'Surplus' of Prototype Future Occupation Profiles (FOP) against existing training provision e.g. Institute for Apprenticeships and Technical Education (IfATE). This can help you identify which provision may align strongest, or which may require adaptation, to provide the suitable provision fit for each future role. It will help you focus in on which provision to focus your attention for analysis. Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/1c4e204b-3927-4226-9f8e-2f62ce0643c5?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410
FOP Capability Matches	This page allows you to view the matches between Capabilities and Institute for Apprenticeships and Technical Education (IfATE) Duty Statements. Clicking the arrow next to a number in the 'Matches' column will open a popup with more detail for each Capability. Each capability also includes Knowledge, Skill and Behaviour Tags, to support with scaffolding future education provision. You can review individual Prototype Future Occupational Profiles (FOPs) or review all FOPs under a Role Level, to give a more holistic view of Capabilities and Matches Where a future capability has been matched to existing provision (currently, by default, IfATE apprenticeship standards) it is possible to interrogate the data and identify specific statements in standards that align to enable identification of existing training materials and activities that could be used or adapted to meet future requirements. This can be used to review the capability requirements for Role Levels and FOPs, from Job / Occupation level through to Knowledge, Skill and Behaviour level Full URL: https://hvmcatapultforesighting.retool.com/embedded/public/6a205e7e-8f33-4765-b39b-82f1f549217a?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

4.0 Conclusion and Next Steps

4.0 Conclusion and Next Steps

4	Conclusions and Next Steps
4.1	Summary of Key Insights
4.2	What this means for Industry and the Workforce
4.3	What this means for Education
4.4	Recommended next steps

4.1 Summary of Key Insights

The below table counts the number of IfATE standards by suitability score for each FOP. For the purpose of this report, we've utilised the suitability grid to highlight the top IfATE standards that support each FOP. The table identifies if they have low, some or high suitability and colour-coded their overall suitability.

FOP by suitability to existing IfATE (Skills England) provision

Role Level	Primary Supply Chain / Supply Chain Partner	Future Occupation Profile	Low Suitability	Some Suitability	High Suitability	Overall Suitability RAG
Technicians	Recovery Battery Removal	EV Dismantling Technician	10	0	0	Low
Technicians	Battery Storage	Internal Logistics	6	4	0	Low
Technicians	Repair and Reuse	Battery Recovery Technicians	10	0	0	Low
Technicians	Repair and Reuse	High Voltage Battery Repair Technician	5	5	0	Low
Technicians	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers), Recovery Battery Removal, Battery Storage, Repair and Reuse, Discharge / Recycling Material Recovery	Operations Technician	10	0	0	Low
Supervisors / First Line Managers	Recovery Battery Removal	End of Life Vehicle Collection Driver	9	1	0	Low
Supervisors / First Line Managers	Repair and Reuse	Logistics and Compliance Managers	10	0	0	Low
Supervisors / First Line Managers	Discharge / Recycling Material Recovery	(Hydro/pyro) metallurgy Specialist	9	1	0	Low
Supervisors / First Line Managers	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers), Recovery Battery Removal, Battery Storage, Repair and Reuse, Discharge / Recycling Material Recovery	Health, Safety, and Environment Managers	10	0	0	Low

Role Level	Primary Supply Chain / Supply Chain Partner	Future Occupation Profile	Low Suitability	Some Suitability	High Suitability	Overall Suitability RAG
Supervisors / First Line Managers	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers), Repair and Reuse, Discharge / Recycling Material Recovery	Health Safety Operatives	10	0	0	Low
Supervisors / First Line Managers	Repair and Reuse, Discharge / Recycling Material Recovery	Battery Intelligence Systems Analyst	10	0	0	Low
Graduate Engineer	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers)	Quality Engineer	9	1	0	Low
Graduate Engineer	Discharge / Recycling Material Recovery	Battery Circularity Compliance Lead	9	1	0	Low
Graduate Engineer	Discharge / Recycling Material Recovery	Regulatory/Compliance Officer	10	0	0	Low
Graduate Engineer	Government and Regulatory Bodies	Compliance Manager	10	0	0	Low
Graduate Engineer	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers), Recovery Battery Removal, Battery Storage, Repair and Reuse, Discharge / Recycling Material Recovery	Operations Managers	10	0	0	Low
Senior Engineer	Battery Storage	EV Battery Storage Manager/Supervisor	10	0	0	Low
Senior Engineer	Government and Regulatory Bodies	Compliance and Sustainability Strategist	9	1	0	Low
Senior Engineer	Manufacturing waste producers (Gigafactory's Module and Pack Assemblers), Repair and Reuse	Design Engineers	9	1	0	Low

Table 16: No. of IfATE standards by suitability score for each FOP

Top Fits

By reviewing the FOPs against the suitability grid, we can determine which of the groups of current apprenticeship standards are more applicable than others. There are currently no applicable standards currently in use that can be fit to the FOPs identified in this cycle. The two FOPs with the highest level of "some suitability" are:

- Internal Logistics
- High Voltage Battery Repair Technician

The **Internal Logistics role**, as with the other battery manufacturing sector Foresighting cycles has the most in common with existing logistics activities and therefore the closest possible match. The **HV Battery Repair Technician role** has similar capabilities to those addressed in the Battery Manufacturing Technician apprenticeship standard which was specifically written with aspects of end of life in mind.

FOPs with the lowest scores are:

The vast majority of FOPs do not match to existing provision within the Skills England portfolio. As noted, a poor fit does not mean that there is nothing of value within existing provision, but it will take more work to fit these to future needs. It also suggests that Apprenticeship Units, as they currently stand, would not be appropriate for enabling reskill opportunities in this area. The ultimate conclusion, therefore, is that additional development will be required to ensure that FOPs can be addressed.

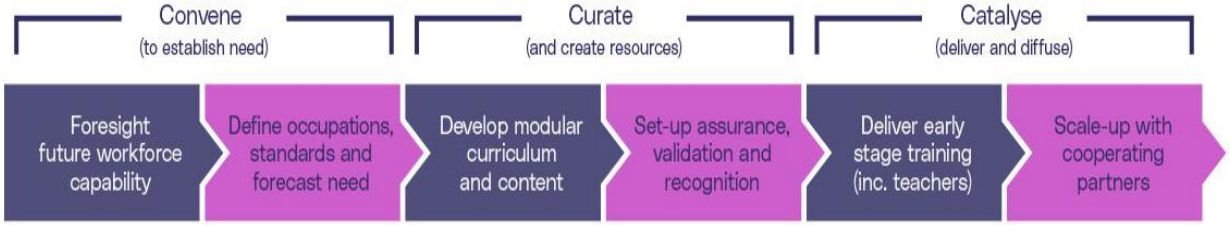
1. EV Dismantling Technician
2. Internal Logistics
3. Battery Recovery Technicians
4. High Voltage Battery Repair Technician
5. Operations Technician
6. End of Life Vehicle Collection Driver
7. Logistics and Compliance Managers
8. (Hydro/pyro) metallurgy Specialist
9. Health, Safety, and Environment Managers
10. Health, Safety Operatives
11. Battery Intelligence Systems Analyst
12. Quality Engineer
13. Battery Circularity Compliance Lead
14. Regulatory/Compliance Officer
15. Compliance Manager
16. Operations Managers
17. EV Battery Storage Manager/Supervisor
18. Compliance and Sustainability Strategist
19. Design Engineers

4.2 What this means for Industry and the Workforce

Collective Action

Foresighting has been developed to provide insight and the detailed information required to enable action by relevant stakeholders but is the first step of the Skills Value Chain. Collective action will be required by all stakeholders to ensure that the changes identified by foresighting – to the supply chain, the workforce and education provision are implemented.

Figure 1: The Skills Value Chain



This section summarises the actions required as a result of this foresight cycle.

There are no ready training solutions that employers can access that will provide industry ready technicians and engineers at scale. Currently employers are drawing from a diverse range of technical, engineering and science backgrounds and providing additional training on an ad-hoc basis to ensure they are able to undertake operations. Some employers are doing so quite successfully but this does not represent a scalable and sustainable solution.

Having undertaken this cycle with employer input it is clear that employers must ensure that they engage with government bodies, such as Skills England, as well as providers and regulators to clearly articulate their needs in line with the findings of this report. The report has shown that a significant volume of new provision is going to be needed to address a wide range of emerging roles in battery repair, re-use and recycling and so this work must start as a matter of urgency.

It is critical that once industry receive the signals that demonstrate how the shape of the organisational capability will change that they are able to start to identify the routes to achieving this. Therefore, the signals to the education system need to be timely and effective. Signals to awarding organisations need to demonstrate where gaps are in provision so that they are able to undertake work with providers and industry to create solutions to those gaps. Signals to government need to illustrate how support should be provided to enable training to take place and signals to providers need to illustrate the gaps that industry are facing and the short-term solutions that could be implemented.

Employer-led workforce action

Employers across the battery recovery, repair, reuse and recycling ecosystem must take proactive steps, both individually and collectively, to ensure that workforce development keeps pace with the expected growth in end-of-life battery volumes. The findings show that there are currently no ready-made training solutions that can deliver industry-ready technicians, supervisors and engineers at scale. Employers should therefore use the Future Occupational Profiles (FOPs) and capability sets as a practical workforce planning tool: to identify at-risk roles, map transferable skills, specify short-course provision, and support the development of new standards and qualifications.

As the battery lifecycle becomes more interconnected, technical collaboration among gigafactories, vehicle manufacturers, recovery operators, dismantlers, storage providers, recyclers, regulators and education providers will be crucial. This collaboration should begin early in the design and process-planning stages so that battery packs, diagnostic systems, storage processes and recovery routes are aligned with safe circularity. Working groups and interface design teams should be established around high-priority issues such as state-of-health assessment, reverse logistics, high-voltage safety, digital traceability and environmental compliance.

To tackle the anticipated skills gap, the sector should work with government and the education system to develop realistic workforce demand forecasts. This should include the volume and location of batteries expected to enter repair, reuse and recycling routes, the number of technicians and engineers required at each role level, and the timeline for training interventions. Without this coordinated approach, individual employers may be able to train small numbers of specialists, but the UK will not build the scalable capability required to retain value from battery materials domestically.

4.3 What this means for Education

Education will need to respond in short-, medium- and longer-term contexts, each of which will impact different parts of the system. The cycle highlighted a significant gap in existing provision: roles such as battery health technicians and those associated directly with “waste” will need provision that currently does not exist. The whole education system needs to be mindful of the need to skill its own workforce as part of short-term development, as failure to do so will mean that industry will not have opportunities to take advantage of new curriculum and awards when they are created.

Short term – Meeting more immediate needs can be done through immediate responses from education providers working closely with industry partners. Development of short courses that address gaps that have been identified will help industry partners to make rapid gains. Flexibilities in adult skills funds, and potentially through the Growth and Skills Levy, may provide funding routes for this activity. Education providers can also look at how small additionalities to existing provision may help support capabilities for emerging roles. Over a longer period of time changes to awards will be needed to fully support the sector.

Medium term – Awarding Organisations (AOs) will need to respond to the identified gaps to produce qualifications that can be funded through existing means. This will include the development of new apprenticeship standards as well as the potential re-design of other vocational awards to enable progression into battery repair, re-use and recycling roles. Universities will also need to look at their provision to provide undergraduate routes that enable engineers to join the sector and then postgraduate and short course provision that will allow for up-skilling and re-skilling of existing engineers.

Longer term – A longer term view needs to be taken to ensure that the core competencies that are required in this context, many of which are very similar to those required in other contexts, are embedded within the whole of the education system. Sustainability and data literacy are considered to be core competencies across the entirety of the battery lifecycle and should be embedded.

Implications for curriculum and provider capability

The findings indicate that future needs cannot be met through minor amendments alone. Some capabilities can be integrated into existing engineering, automotive, logistics, manufacturing and environmental programmes, but the low suitability scores across the FOPs show that new and significantly revised provision will be required. A modular approach is still the most achievable short-term route because it allows providers to address immediate gaps in areas such as high-voltage battery assessment, safe handling, discharge, storage, repair, reverse logistics and material recovery while longer apprenticeships, qualifications and degree pathways are developed.

Educators should treat the FOPs, and capability sets as design inputs for FE, HE, apprenticeship and CPD provision. The cycle demonstrates that battery recycling is not solely an electrical engineering challenge; it combines electrical and mechanical engineering, chemical and metallurgical processing, logistics, data, environmental compliance, quality assurance and health and safety. This means modules should be designed across disciplines rather than held within a single curriculum area.

At FE and apprenticeship levels, priority should be given to occupationally focused provision for EV dismantling, battery recovery, high-voltage repair, internal logistics, storage and battery state-of-health assessment. At HE and higher technical levels, provision should address circularity design, hydrometallurgical and pyrometallurgical process operations, quality assurance, data analytics, environmental compliance and systems integration. Existing standards in engineering, manufacturing, maintenance, production, logistics and quality assurance may provide building blocks, but they will require targeted updates to reflect battery-specific risks and circular economy outcomes.

Specialist capability development should also be supported through RTO and university partnerships, including industry-led research, PhD projects and demonstrators in battery state-of-health, second-life deployment, automation, discharge, metallurgical recovery and traceability. These projects should be shaped with industry so that research outputs can be translated into scalable training and operational practice.

Academia and providers should engage proactively with employers and professional bodies to keep the curriculum current. The pace of change in battery chemistry, recycling technologies and regulatory requirements means that provision will need regular review, with CPD and professional registration used to recognise incremental development as new technologies and processes are adopted.

4.4 Recommended next steps

We recommend the following actions to enable UK leadership in battery recycling and avoid strategic dependence on overseas recovery infrastructure:

Establish a coordinated battery recycling skills action group.
WMG should convene this through, or in close partnership with, the Electrification Skills Network (ESN), with representation from Skills England, Innovate UK, DfE, OZEV, employers, awarding organisations, professional bodies, FE and HE providers. The group should own the transition from foresighting insight to implementation.

Validate and publish the Future Occupational Profiles (FOPs).
The 19 FOPs should be tested with employers across gigafactory waste production, recovery and removal, storage and logistics, repair and reuse, discharge/recycling and material recovery, and government/regulatory functions. Validation should clarify which roles need immediate CPD, which require revised standards, and which require new qualifications.

Commission a workforce demand and capacity forecast.
Foresighting has identified the capabilities required; forecasting is now needed to estimate the number of workers required, where they will be needed, and when. This should include projected battery volumes entering repair, reuse, storage and recycling routes, and the implications for technician, supervisor, graduate engineer and senior engineer pipelines.

Fast-track Level 3 to Level 5 pathways and short-course provision.
Priority areas should include battery dismantling and recovery, high-voltage repair, battery state-of-health assessment, internal logistics, safe storage and transport, discharge, metallurgical process operations and circular economy compliance. Short courses should be developed first to support immediate reskilling, with the same modules then feeding into apprenticeships, technical qualifications and degree pathways.

Use a professional register to recognise ongoing competence.
A professional register should record qualifications, CPD and recognised competence across the battery lifecycle. This would support workforce mobility between manufacturing, service, repair, recovery and recycling, while giving employers and regulators a clearer view of capability without creating unnecessary barriers to entry.

Embed circularity, data and compliance as cross-cutting capabilities.
Education providers and employers should ensure that battery circularity, digital traceability, environmental compliance, quality assurance, safety and data literacy are embedded across relevant programmes rather than treated as isolated topics.

Taken together, these actions will move the findings into the next stages of the Skills Value Chain. Failure to act will leave employers reliant on ad hoc training, limit the development of a safe reuse market, and increase the risk that valuable battery materials are exported rather than recovered within the UK.

Recommended workforce development actions

Timeframe	Topic	Actions	Who	When	Intended Outcome
Short Term	Reskilling and Upskilling Current Workforce	Develop course content to address the capability gaps identified in the Foresighting work to enable those migrating from other sector areas or furthering their engineering competence. Tailor course content to match new capabilities with existing occupational standards, focusing on design and other lifecycle activities. New courses will be required, and providers will need to develop additional skills	Educators, Awarding Bodies, Employers	Immediately, scope will need creating to match projected industry need. Start preparing immediately	Availability of short-term training for the current workforce to meet immediate technology demands.
	Recruitment from Other Industries	Identify and reskill individuals with transferable skills from other sectors, A broad view of transferable skills needs to be taken. Action should be undertaken alongside identified draw-down of parallel sectors so as not to impact the workforce in those areas. This action parallels that which can be undertaken in manufacturing areas of the battery lifecycle.	Employers, Training Providers	Immediate	Mitigation of workforce shortages in high-demand areas through targeted recruitment and training initiatives.

Timeframe	Topic	Actions	Who	When	Intended Outcome
	Up-skilling of providers to meet need	A significant gap in provision is the competency level of providers themselves. Short courses can be used to ensure that providers have the capability to deliver against growing need. The lack of alignment with existing vocational provision means that expert support will need to be given to providers to ensure they are able to meet needs.	Providers, industry partners and technology specialists	Immediate – technology specialists and industry will need to support providers	Training providers will have the capabilities required to meet future needs as demand grows.
Medium term	Integration of Future Skills Training	Formalise changes to occupational standards and training programs for new entrants, integrating future skills requirements defined by the Future Occupational Profiles (FOPs). New provision may be created for a range of vocational routes including apprenticeships, fulltime vocational courses and short course programmes fundable under GSL and potentially LLE.	Educators, Awarding Bodies, Employers	As soon as possible for prioritised FOPs	Development of training programs that meet both current and future skills needs, reducing lead time for new workforce entrants
	Modular Approach to Course Updates	Implement modular changes to existing courses rather than complete redesigns, facilitating quicker adaptation to evolving skills requirements. Short courses designed as immediate actions can be used to create larger modular adaptations to longer courses such as technical	Educators, Training Providers	Ongoing	Flexibility in educational programs, enabling rapid response to industry needs.

Timeframe	Topic	Actions	Who	When	Intended Outcome
		and vocational qualifications as well as degrees.			
	Integration with organisations with access to the workforce	A significant challenge will be accessing sufficient numbers to manage growth in the sector. By engaging with organisations that work with those who may be considered “non-traditional” in the workforce it will support growth.	Employers, Skills Frame-works	Ongoing	A wider pool of available workforce to meet employment needs.
	Development of provision for graduate engineers and ongoing training	New provision for graduate engineers will be required. This is likely an adjustment of existing provision rather than all new courses.	Educators (HE), Employers.	Ongoing	Engineers with the appropriate capabilities and an ongoing training pipeline for graduate skills
General Actions for Educators	Assessment and Feedback	Review apprenticeship standards and relevant qualifications with employers, providing feedback and identifying gaps. Role for employers and educators in shaping standards and qualifications through engagement groups.	Educators, Employers	Ongoing	Comprehensive understanding of current training provisions and identification of areas for improvement.
	Commissioning New Continuing Professional Development (CPD) Courses	Evaluate existing CPD provisions, commission new courses where necessary, and facilitate collaboration to maintain a unified approach.	Educators, Training Providers	Short-term	Enhanced CPD offerings to upskill current workforce members across all role families.
Additional Recommendations	Dissemination of Findings	Set up a working group to create an action plan, share findings widely among stakeholders to	Convener, Sponsor, Stakeholders, Industry Groups	Following Publication	Broad access to insights and strategic direction

Timeframe	Topic	Actions	Who	When	Intended Outcome
		influence workforce development initiatives.			for workforce initiatives
	Ongoing Review and Adaptation	Regularly review findings with stakeholders and adapt Future Occupational Profiles to better fit emerging roles	Stake-holders, Sponsor Leads, Partici-pants	Before Formal Publication	Robust and validated actions.

Table 17: Recommended workforce development actions

Appendix

Appendices

	Appendices
A	List of Participants
B	Cycle timeline
C	Access to output data - link and authorisation
D	Glossary - common language
E	Visualisation links and Illustrations

A List of Participants

Industry Participants	Skills Participants	Technology Participants
UKBIC	Institute of the Motor Industry	WMG
CarTakeBack	EAL	Altilium
Autocraft	GTA	Catapult
Connected Energy	Cogent	Bentley
VRA UK	ProMoto	Aston Martin
	ESN	Ford
	SIAS	Batri
	Better Generation Solutions	JLR
	City and Guilds	

B Cycle timeline

The Workforce Foresighting cycle started the Carry Out phase in June 2025. The Carry Out phase concluded in August 2025. The findings report was prepared following the data validation period using the data set and tools available at that time.

C Access to output data - link and authorisation

Data Capture Overview [8]

[8] Data capture overview https://hvmcatapultforesighting.retool.com/embedded/public/e869283b-4b8a-437c-973e-64ab292e5b87?_environment=production&token=720b30240536c97ba7e73e6d1ecc5410

D Glossary - common language

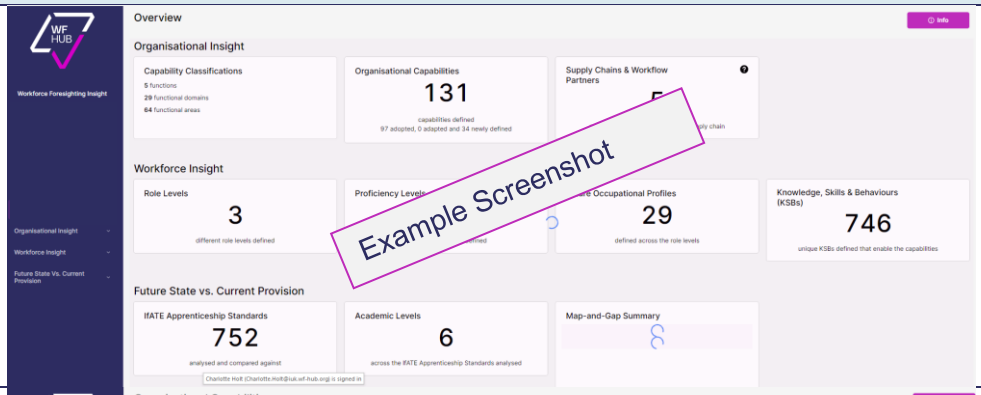
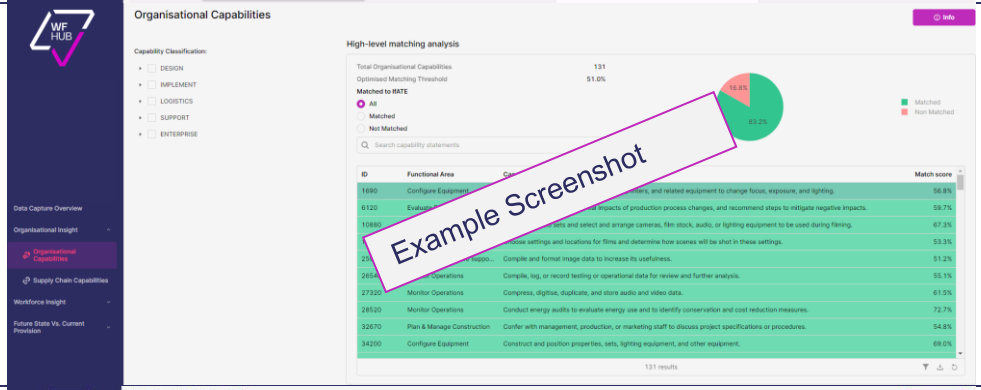
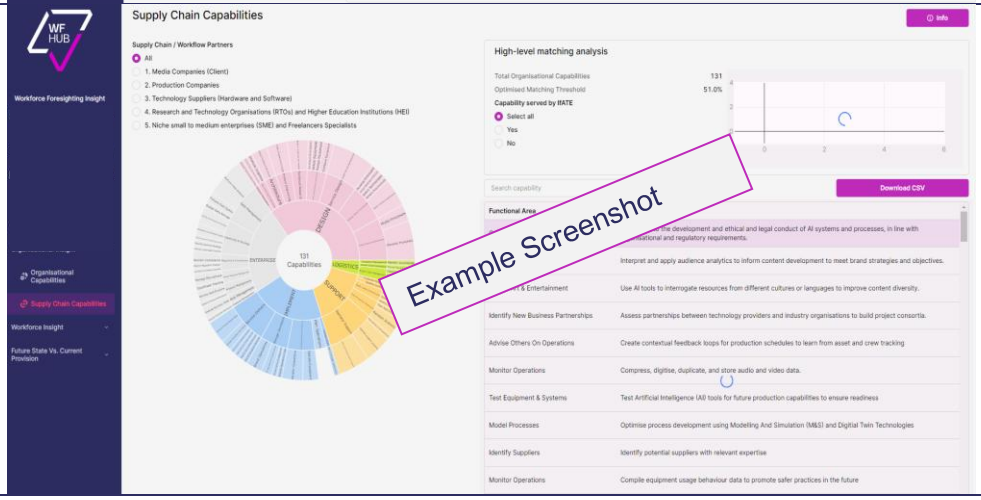
Term	Definition
Impact Domains	Innovate UK domains used as Strategic Categories to assist setting and monitoring priorities
National Challenge (Industry / Sector / Region)	A recognised technological or socio-political threat or opportunity for which there is consensus that workforce action is necessary
Challenge Response	Specific intervention aimed at the challenge
Capability (Organisation)	The collective abilities, and expertise of an organisation to carry out a function, because provision and preparation have been made by the organisation
Capability Classification	Classification provides a common, structured vocabulary to define capability
Capability Statements	Description of the depth and nature of each capability within an organisation
Capability Syntax	Common language to describe each capability application within organisation type
Competencies (Workforce / Individual)	'Proficiency, aptitude, capacity, skill, technique, experience, expertise, facility, fitness related to capability
Competency definition 'KSBs' (Knowledge, Skills and Behaviours)	Knowledge, Skills, and Behaviours are the elements used to express the required competencies for each Role Group
Competency Domain	Used during foresighting analysis to provide focus on existing and emerging competency needs
Delphi Process	Foresighting takes a Delphi approach which has come to represent consulting expert opinion. (Harking back to the Delphic Oracle of ancient Greece)
Foresight Cycle	Set of workshops, analysis and reporting that implements the Foresight Process for each subject
Foresight Process	A series of activities which are convened to understand future competence needs, the opportunities available and actions required to deliver the right skills at the right time and place
Foresighting Champion	An individual nominated within a new user organisation of foresighting to facilitate and lead the use of foresighting processes and tools with the support of the Project Team
Foresighting Subject	The application of specific technologies in the context of a given challenge and which are candidates for foresighting
Future Competency Set	The KBS output from the Educator workshop for each Role Group
Map and Gap Analysis	A combined expert and automated process that maps the Future Competency Set against a selected reference framework
Organisation Type	Simple description of nature of organisation for which capability is required
Proficiencies	Proficiencies differentiate the degree of competencies required from differing Role Groups to support capabilities
Project Sponsor	Typically, a stakeholder in the challenge being successfully met who requires information to under-write plans to act

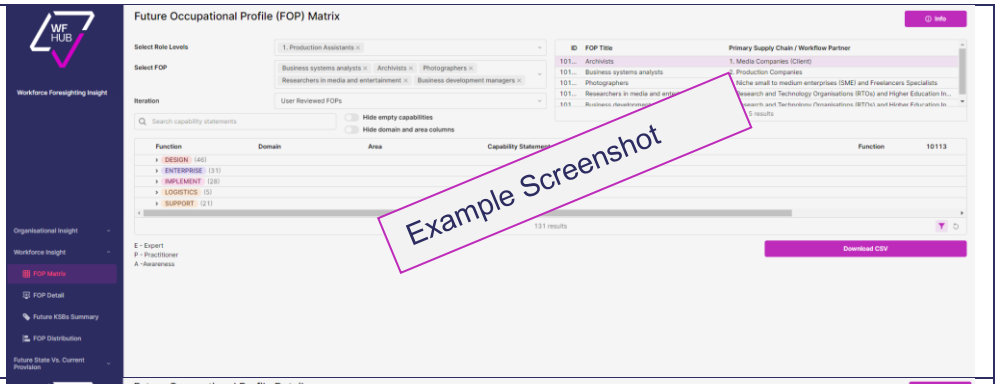
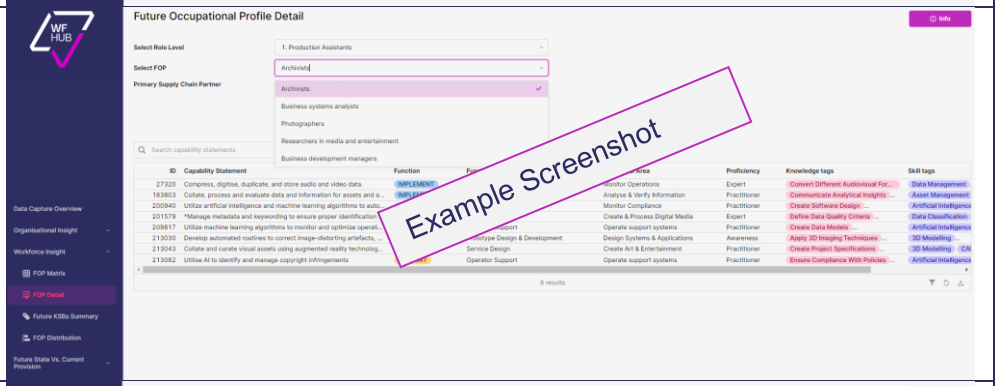
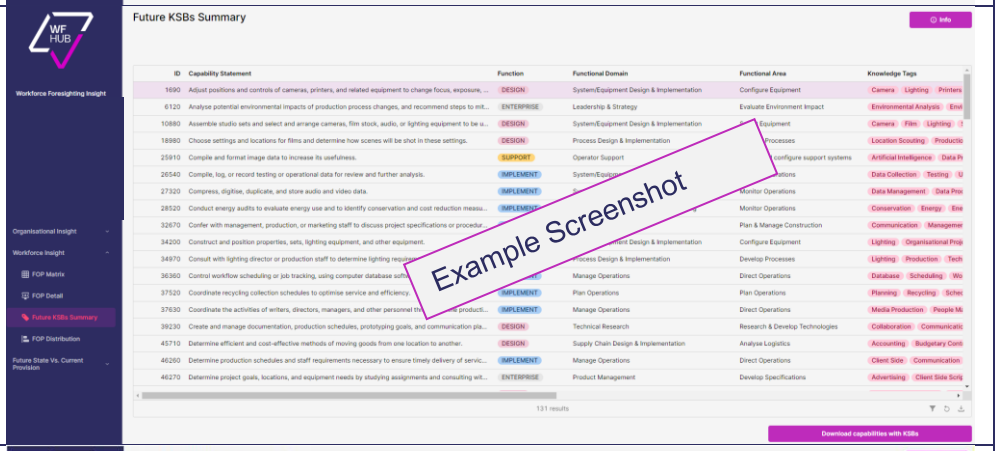
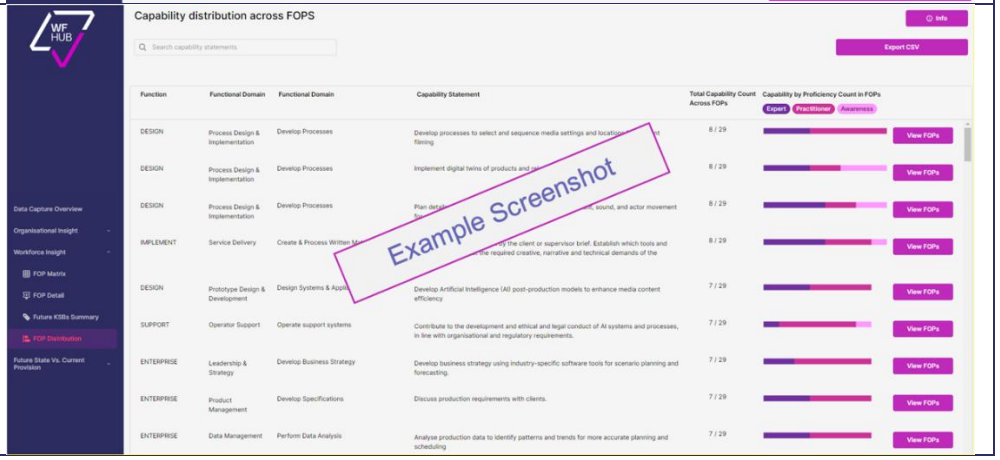
Role Group	Role groups are a collective of roles that exist in a typical manufacturing business / industrial sector
Syntax	The way in which a statement is phrased to ensure reliable, repeatable and meaningful interpretation
Technologies	The technology that could be used to address the challenge
Working Scenario	To provide further context in relation to the subjects and used to position participants thinking during the detailed identification of future capabilities
Workshops	Online sessions used to undertake each step in the foresight process
Roadmaps	Sector, Industry, Regional view of emerging opportunities and their market entry
Participants	Technologists, Educators, Employers

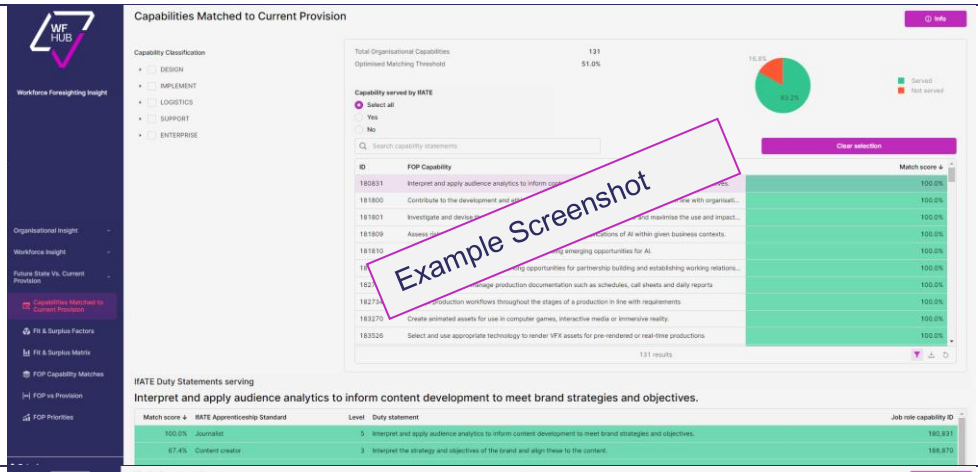
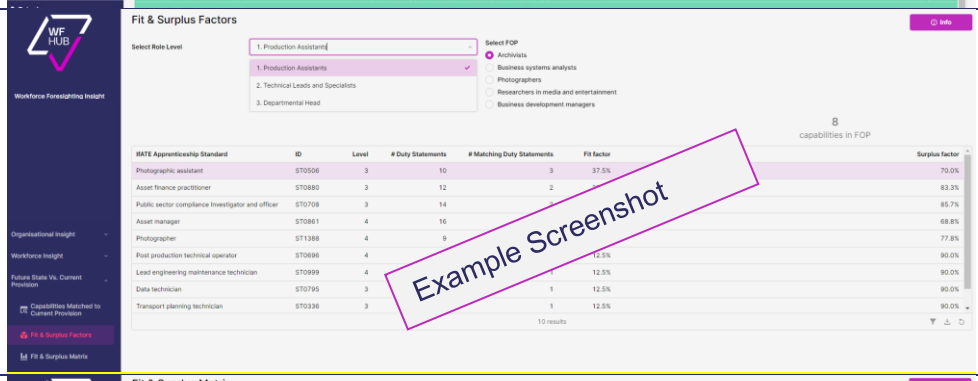
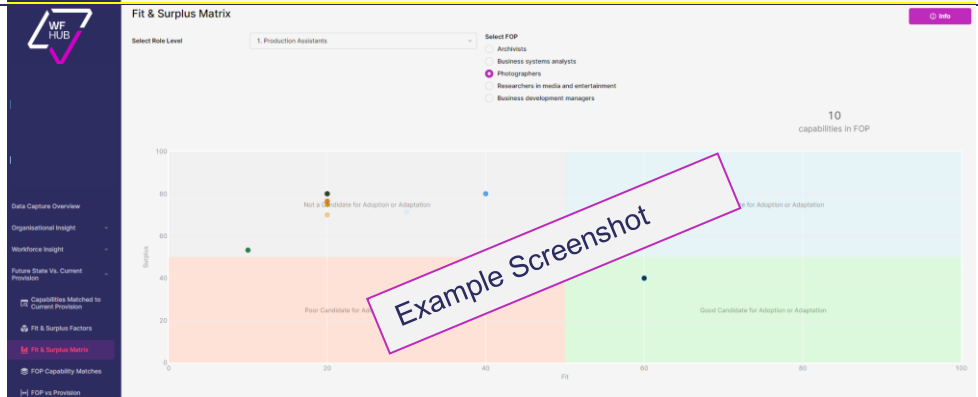
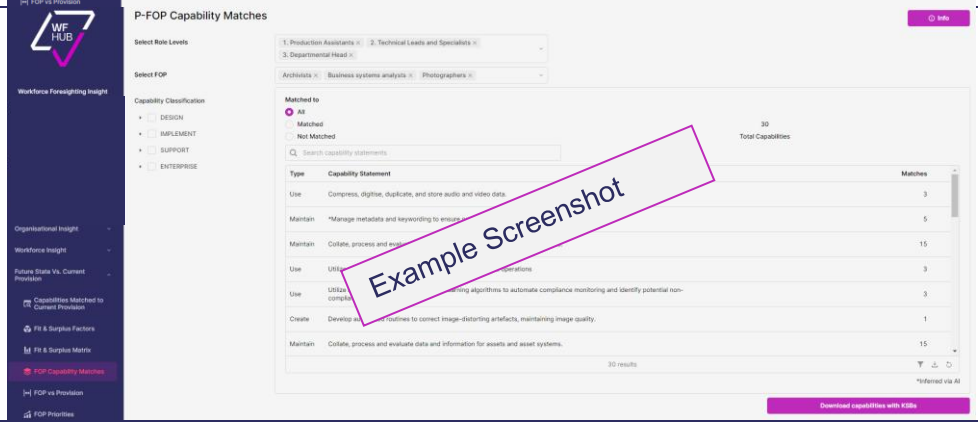
Table 18: Glossary of terms

E Visualisation links and Illustrations

The following visualisation links and illustrations are provided to support interpretation of the cycle outputs.

Link to Visualisation	View of data
Data Capture Overview	
Organisational Capabilities	
Supply Chain Capabilities	

[FOP Matrix]	
	
[Future KSBs Summary]	
[FOP Distribution]	

[Capabilities Matched to Current Provision]	
[Fit Surplus Factors]	
[Fit Surplus Matrix]	
[FOP Capability Matches]	

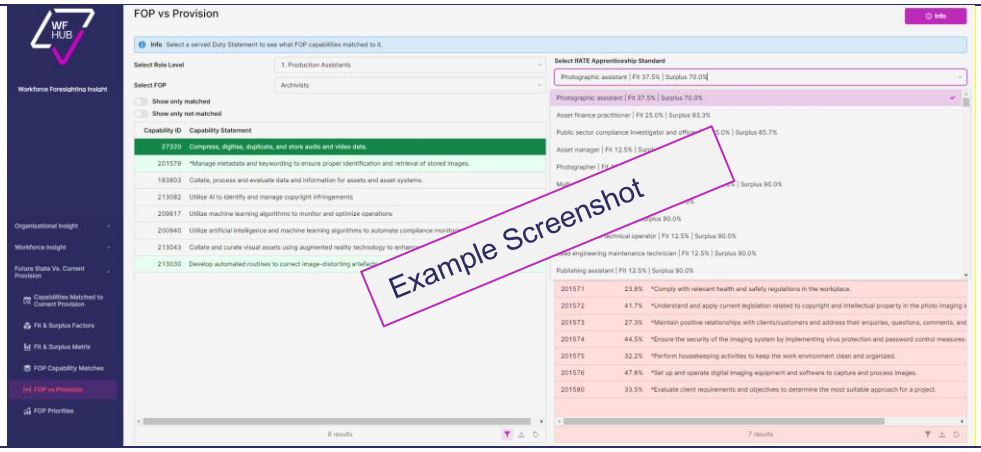
FOP vs Provision	
FOP Priorities	

Table 19: Visualisation links and Illustrations