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Establishment of the National Centre for E-Vehicle and Sustainable Technology (EVST)

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Abstract

The UK government has set ambitious targets to reduce carbon emissions and combat climate change, with a focus on the widespread adoption of electric vehicles (EVs). Alongside, the government has announced plans to phase out the sale of new petrol and diesel cars by 2030, and to invest in infrastructure such as EV charging stations to support this transition. Additionally, financial incentives, such as grants and tax breaks, are being offered to encourage individuals and businesses to switch to EVs. The adoption of EVs is seen as a key step in achieving the UK's goal of becoming a net-zero carbon economy by 2050. A recent major initiative of the University of Bolton is the establishment of the National Centre for e-Vehicle and Sustainable Technology (EVST). This Centre – established in 2022 – is a collaborative venture between the university group and key partners from industry. Its principal purpose is to provide education and training at a range of levels to support the electric, hybrid and hydrogen cell powered vehicles (both lightweight and heavy) maintenance sector. Whilst all vehicle manufacturers have developed and launched various electric and sustainable models to market, there is a well-recognised skills shortage in the maintenance of these vehicles. A market research exercise was carried out to establish the existing provision of education and training in the UK higher and further education sectors to inform the work in developing the Centre. This exercise provided valuable insight into where the opportunities and gaps existed in this important aspect of enabling widespread adoption of electric and sustainable vehicles to happen in the UK. This paper sets out how EVST will provide the educational base and industry-focussed training for a range of technician and engineer roles to address this skills shortage, initially in the North-West of England and growing to cover the rest of Great Britain.

Keywords: electric vehicles, training, education

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1. Introduction

The UK government has set an ambitious target of ending the sale of new petrol and diesel cars and vans by 2030 (DfT, 2020). This will require a significant shift to electric vehicles (EVs). To support this transition, the government is investing in several initiatives including providing grants and subsidies to accelerate the uptake of EVs, investing in charging infrastructure, enabling businesses to move to EVs fleets and supporting the provision of education and training on the design, assembly and maintenance of EVs.

The UK government has stated that education and training is essential to ensure that the transition to EVs is successful. This includes training for automotive, electrical and mechanical technicians and engineers, and other professionals who will be working with EVs. The government is also working to raise awareness of EVs among the general public. The UK government's targets for EVs and zero emissions are ambitious but are achievable. With the right investment and support, the UK can lead the world in the transition to a cleaner, more sustainable transport system.

A strength of the University of Bolton group is the educational delivery and research carried out in the fields of both automotive and motorsport engineering. Specifically, the university's National Centre for Motorsport Engineering (NCME) is recognised as a national centre of excellence in automotive performance engineering and motorsport engineering, working in collaboration with some of the leading motorsport organisations, race teams and industrial partners on many knowledge transfer projects.

The new EVST at the University of Bolton has been established to support the government's ambition by becoming the main centre for education and training in the North-West. Strategically advised by and aligned to the electric and sustainable vehicles industry, the centre is now developing a range of programmes and qualifications at different levels, to provide the education and training that industry needs urgently to support the growth of the electric and sustainable vehicles sector. Research and knowledge exchange projects are already underway alongside the programme development work.

2. Initial market analysis of EV Education/training provision

Before the EVST was launched, an extensive piece of market research was carried out by the university into the existing provision of e-vehicle related education and training across the UK. This was to establish the national picture of provision and inform the programmes portfolio to be offered by EVST.

The research was carried out by the second author, supported by a postgraduate research student from the university's business school and colleagues from the NCME. The work was carried out over a three-month period and was as extensive as was necessary to fully obtain the information required to inform the development of the new educational portfolio.

An initial web search was performed to identify the educational institutions offering EV and related courses at all levels. Identification of research active institutions was also made in this phase of the work. Geographical mapping was then performed to observe regional concentrations of the institutions which in itself identified a significant lack of provision in the North-West of England. As a second phase of the work, the web search was extended and refined to query subject databases to add a level of rigour to the emerging findings.

Following the web-based search, a more focussed approach of acquiring deeper insight into what aspects of education and training were required by the sector was performed. This involved the research team performing a questionnaire survey across the EVST sectors, through the research team members' professional networks. The questionnaire (MS Forms) contained nine questions, strategically chosen and written to encourage participation in the survey, which would return all relevant information around what aspects of education and training the respondents considered to be currently lacking. Returns were obtained from all relevant sectors: universities, colleges, vehicle designers, vehicle manufacturers, vehicle maintenance, vehicle sales and fleet management, charging infrastructure and professional bodies. The responses, together with the earlier review of existing provision, were compiled and analysed to enable firm findings to be drawn.

Table 1 summarises the key findings from the research.

Table 1. Market research key findings (April 2022), updated (Dec 2022)

	Finding
1	There is no industry focused, Sustainable & Electric Automotive Engineering provision (u/g & p/g) in NW England and Scotland.
2	Opportunity exists for the University of Bolton to become established as the only BEng & MSc EV provider in North-West.
3	Most universities (currently) exclude smart/autonomous vehicles from their provision.
4	No progression-focused college provision for EV exists in the NW region.

From the research it was concluded that there was an identifiable need for a national centre, such as EVST, to be established swiftly to both help to address the e-vehicle sector skills shortage and feed into the national and regional skills agenda, to increase the transition from internal combustion engine vehicles to e-vehicles. This, in turn, will help strengthen the national economic growth and positively develop social inclusion.

Following this work, the EVST was launched with financial support from the university. An Industrial Advisory Board (IAB), chaired by the Chairman of NRG Fleet Services was established and comprises key players from employers (vehicles and charging infrastructure) and professional organisations such as the Institute of the Motor Industry (IMI) and Institute of Road Transport Engineers (IRTEC).

3. The skills shortage in the sector

The UK is facing a skills shortage in the electric and sustainable vehicle (ESV) maintenance sector (DfT, 2022). The number of EVs on the road is set to grow rapidly in the coming years, but the number of technicians and mechanics trained to service and repair them is not keeping pace. This could lead to delays in repairs, higher costs, and a decrease in the attractiveness of EVs for potential buyers.

There are a number of reasons for the skills shortage in the ESV maintenance sector. One reason is that the skills required to service and repair EVs are different from those required for traditional petrol and diesel vehicles. EV mechanics need to be trained in how to work with high-voltage electricity, as well as how to diagnose and repair the specific components of EVs. Another reason for the skills shortage is that there are simply not enough training courses available.

Recognising these challenges, the authors work together with the IAB members in addressing this concerning skills shortage. Only by working cooperatively, academia with industry, can relevant and efficient programmes be developed. This transition is driven by the “Skills for Jobs: Lifelong Learning for Opportunity and Growth” (DfE, 2021) and the “Local Skills Report & Labour Market Plan” (Greater Manchester Combined Authority, 2021).

4. Programme development

The University of Bolton Group comprises three institutions: the University of Bolton, Bolton College and Alliance Learning. Programmes of study are delivered across all academic levels from T-level (Level 3) right through HNC/D (Levels 4 and 5), Bachelor and Masters degrees (Levels 6 and 7) and on to Doctoral degrees (Level 8). Higher and degree apprenticeship programmes across many vocational sectors are also offered. The portfolio of automotive and charging infrastructure related programmes available prior to the establishment of the EVST is represented by the “programmes pyramid” shown in Fig. 1.

While the offering is extensive, and across all levels, the need for top up in-house CPD training courses was readily identified by the advisory board as being necessary to satisfy the needs and requirements of employers. This was in recognition that the existing programmes didn’t map directly onto the needs of industry.

Thus, a suite of tailored, new programmes was required. The programme development work is ongoing (Spring 2023) and is being well-informed by members of the advisory panel to ensure the requirements of industry are accurately met across the programmes.

The educational portfolio under development will offer different levels of apprenticeships plus full-time diplomas and degrees in electric and sustainable vehicles maintenance and design. The benefits of a single centre offering a range of qualifications, education and training are already recognised by industry, and a network of employers and professional bodies are working cooperatively with EVST to provide input to the curriculum development plus a stream of apprentices. Alongside courses in the maintenance of light and heavy e-vehicles, EVST will also offer apprenticeships, diplomas and degrees in charging infrastructure design and installation through the university's School of Engineering.

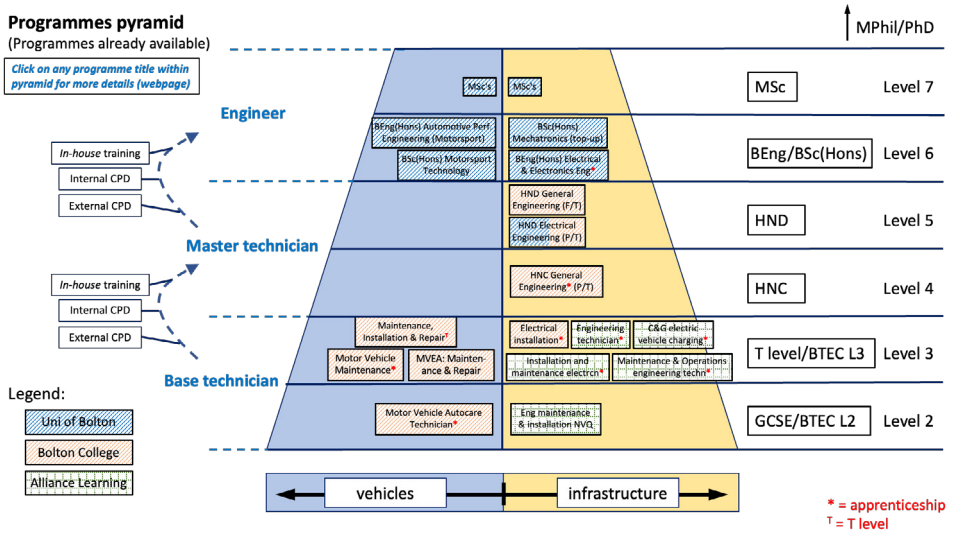

Fig. 1. Programmes pyramid of relevant, existing programmes.

Combining the findings from the earlier market research and the views and advice from the advisory board members, it was clear that employers currently prioritised a need for HNC programme to be developed, aligned to a Level 4 apprenticeship standard.

EV Technology at both the university and the college present state-of-the-art manufacturing, measurement and test equipment to embed learning. The university group educational ethos focusses on process excellence and experience, meaning that students are given the opportunity to get up close and personal with advanced manufacturing technology such as metallic 3d printing, composite structures, and testing.

Alongside the in-house experience, students will have the opportunity to experience industrial practice, live examples, site visits, and practical skills in conjunction with our partner employer organisations. In addition, a year-long industrial placement option between Years 2 and 3 of the degree programme allows students to take an internship in industry.

The courses, designed with input from industry partners, ensure that the curricula meet industrial requirements and focus on the existing skills gaps in the region. Further, the courses ensure graduates will be technologically ready for the application of advanced techniques and production methods on entering the industry. The degree course meets professional standards and supports students' professional development by addressing all competences as set by the Engineering Council and UK Spec.

4.1. HNC Sustainable and Electric Vehicle Engineering

The IAB has highlighted that EV sector training is currently available for level 3 apprenticeship, however once that apprenticeship has been achieved, a significant barrier remains towards progression. The resolution to this comes in the way of a licensed University of Bolton Higher National Certificate in Sustainable and Electric Vehicle Engineering

that is being developed in line with key sector stakeholders. Further, for future proofing, the development of a Higher Technical Qualification (HTQ) is also under way.

Furthermore, within the specialist HNC, a multi-disciplinary pathway to serve various forms of engineers will also be available. Each pathway will be fully supported by the Institute for Apprenticeships, which allows for the use of the apprenticeship levy to finance this training need. To accompany this offer, a series of bolt-on units such as specialist training in battery and fuel cell testing and analysis, management and legislation will be available.

4.2. BEng (Hons) Sustainable and Electric Vehicle Engineering

The north-west of England is currently home to multiple major automotive vehicle manufacturers. As manufacturers transition to electric and hydrogen-based propulsion systems, growing the local and national talent pool is essential. With a major skills gap in the design, engineering, research and development of vehicles utilising this technology, education providers need to develop provisions to address this to enable both economic growth and the transition to sustainable transport.

To accelerate growth in the local and national sustainable vehicle sector, automotive engineers need to obtain skills in:

- battery and Fuel Cell materials, electrochemical performance, design and engineering
- modelling, simulation and integration of energy storage systems into sustainable powertrains
- design for EV and Fuel Cell EVs (FCEV) vehicle safety

The course will provide students with a holistic understanding of the integration of these sustainable propulsion sources into vehicles. After developing skills into battery and fuel cell system design, modelling and simulation, local industry will be able to draw upon a talent pool which will accelerate their product engineering and innovation.

5. Response to technical education reform

As the United Kingdom is implementing its latest reforms for technical and vocational education, the University of Bolton has fully embraced the opportunity for reform by developing the EVST. Transformation in education must be mirrored by the progressive transition of educational organisations to ensure that they remain responsive to the nation's needs. As educational institutions recognise this need for change, this directly improves the social and economic wellbeing of the region.

Shaw (2020) highlighted that from the 2022-23 academic session, the education sector is commencing the introduction of T Levels and more apprenticeships at higher levels. This will enable more opportunities for learners to progress to a positive destination. A positive destination is indicated as either full-time employment, an apprenticeship, progression into higher education or a combination of all three. The three positive destinations have been decided and driven by the 2016 Sainsbury Review (Crown, 2016) and are at the focus of the development within our organisation.

DfE *et al.* (2022) identified several shortcomings in the existing vocational education system in England, including:

- too many overlapping and low-value qualifications at levels 2 and 3 and a lack of technical provision at level 4 and above,
- a complex market of qualifications which young people struggled to navigate,
- a lack of high-quality alternatives to the academic (A level) route at level 3,
- too many young people not in education, employment or training (NEET) while employers faced growing skills gaps, and
- lack of employer voice in shaping the content of vocational qualifications

It has been stated that curriculum pathways will change from the conventional NVQ (National Vocational Qualification) or BTEC (Business and Technology Education Council) Level 3 courses which historically have poor progression destinations. These changes are currently being implemented by the University of Bolton Group to develop curriculum sequencing and ensure positive progression opportunities exist.

Lewis and Bolton (2022) stated that '*T Levels will become the main qualification option for the technical route and are intended to support progression into skilled employment (requiring specialist training or expertise), further technical study or apprenticeships, and potentially higher education courses*'.

In the 2023-24 academic session, a continuation or "next stage" of the technical reform will occur, which will focus on the Higher Education programs within the Further Education sector. The focus will be on forming a progression route from T levels into HTQ, Higher Apprenticeships, Degree Apprenticeships, and or employment. The reforms are employer and skills driven to meet regional and economic needs.

As further iterated by the Department for Education (2021), '*We must ensure that technical skills provision is supporting the economy and responsive to local labour market needs' and, 'These plans will be created by employers and providers' with a justification stated within 'Our intention is for Local Skills Improvement Plans to provide a framework to help colleges and other providers reshape what they offer*'.

As these changes and reforms occur, The University of Bolton will be the pioneering organisation that embraces technological developments. This will ensure a fruitful and inspired educational experience is available to everyone.

6. Conclusions

The new EVST at the University of Bolton has been established to support the government's ambition to improve education and training in the field of electric and sustainable vehicles. Strategically advised by, and aligned to, the electric and sustainable vehicles industry, the centre is developing a range of programmes and qualifications at different levels, to provide the education and training that industry needs urgently to support the growth of the electric and sustainable vehicles sector. Research and knowledge exchange projects are already underway alongside the programme development work.

The programmes offered will allow students to be the first to be fully trained and skilled across major areas to add value and change the landscape of the automotive industry. Manufacturers and technology already exist in the field, but no formal educational programme exists to support the development of this industry in the North-West until now. The courses (BEng, HND and HNC) are designed, with input from the advisory board, to satisfy the needs of industry and will provide the knowledge, skills, behaviours and practical experience for graduates to allow them to succeed in their graduate engineer or technician roles.

With the development of the centre and associated programs being at the heart of the commercial sector's needs, it also contributes to other objectives. Hence, the EVST satisfies the university's strategic objective to serve and support the social and economic needs of the region, whilst simultaneously supporting the development of the UK educational reform.

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