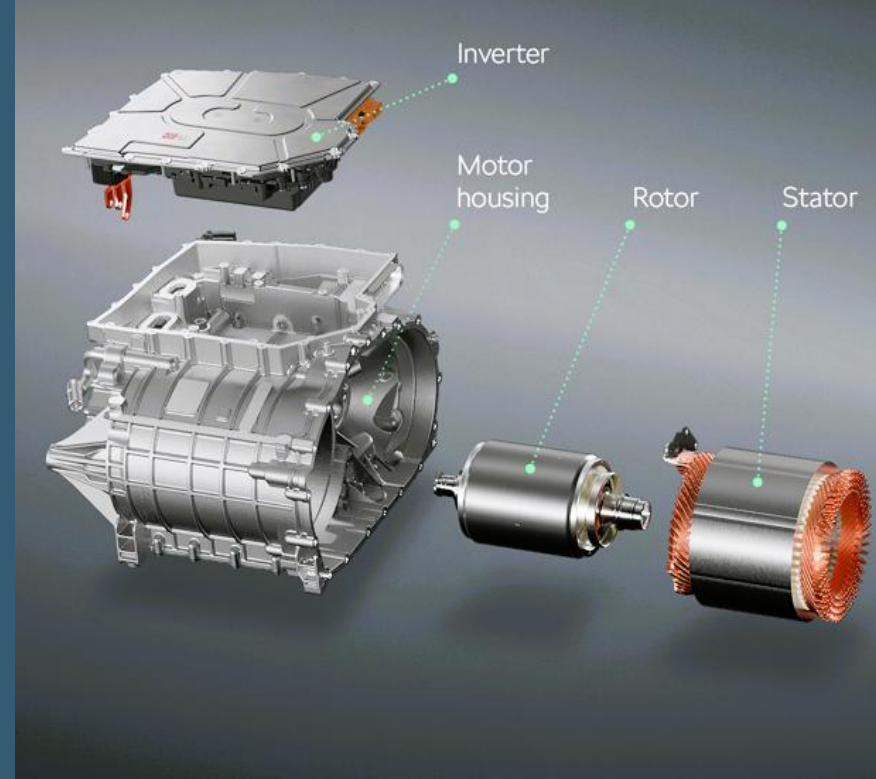


EDUCATION ACROSS THE DRIVETRAIN

RICHARD PENN

PENN ENGINEERED SOLUTIONS

SEPTEMBER 2025





WELCOME & INTRODUCTION



Winner of the UK Transport Awards.

Penn Engineered Solutions

Penn Engineered Solutions Ltd is an independent engineering and training consultancy providing transport propulsion and electrification engineering excellence for clients in a broad range of industry sectors both private and public sector. With more than thirty years' experience in transport propulsion systems we work with you to understand your skills and training requirements, map the knowledge gaps, and deliver solutions for upskilling and embedding competencies within the workforce. Our approach is to offer a mixture of on and off-site support and ensure we deliver the knowledge, skills and tools allowing you to continue your electrification journey.

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For more information, please contact info@pennengineeredolutions.co.uk



www.linkedin.com/company/penn-engineered-solutions-ltd/



TOPICS TO COVER



PENN ENGINEERED SOLUTIONS LTD



Our portfolio of training...



Units, modules, levels & courses...



Mapping to a standard...



ESN Common Sets of Skills...



Our delivery options...



Upcoming Masterclass sessions...



OUR PORTFOLIO OF TRAINING

**ELECTROCHEMISTRY
& INTRODUCTION TO
HYDROGEN**



**HYDROGEN –
FUTURE FUEL FOR
COMBUSTION
ENGINES?**



**HYDROGEN – FUEL
CELLS NOW OR
NEVER?**

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**EV CHARGING &
CHARGERS**

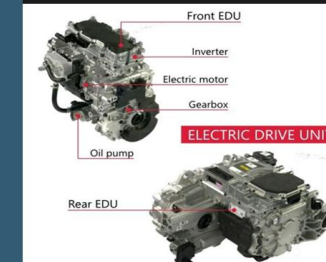
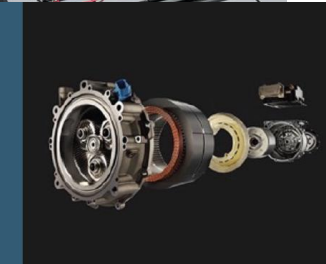


**EV SYSTEM
INTEGRATION
PART#1
- BATTERIES**



**EV SYSTEM
INTEGRATION
PART#2
- MOTORS & DRIVES**

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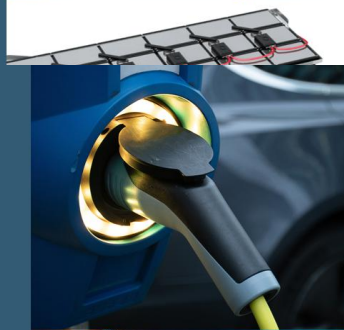


OUR PORTFOLIO OF TRAINING

**INTRODUCTION TO
BATTERY
MANAGEMENT
SYSTEMS (BMS)**



**EV SOFTWARE –
KEEPING IT SAFE &
SECURE**



**THE FUTURE OF EV
BATTERY
TECHNOLOGY**



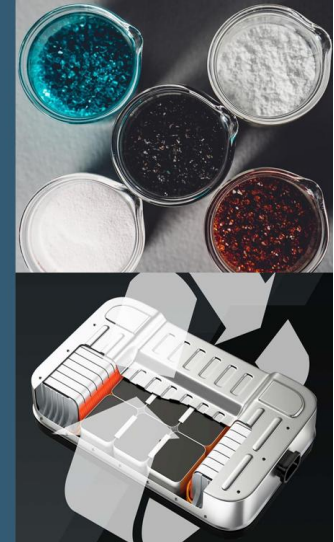
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**HIGH VOLTAGE
BATTERY**

**LITHIUM-ION
BATTERIES –
RECYCLE, REUSE OR
REPURPOSE?**

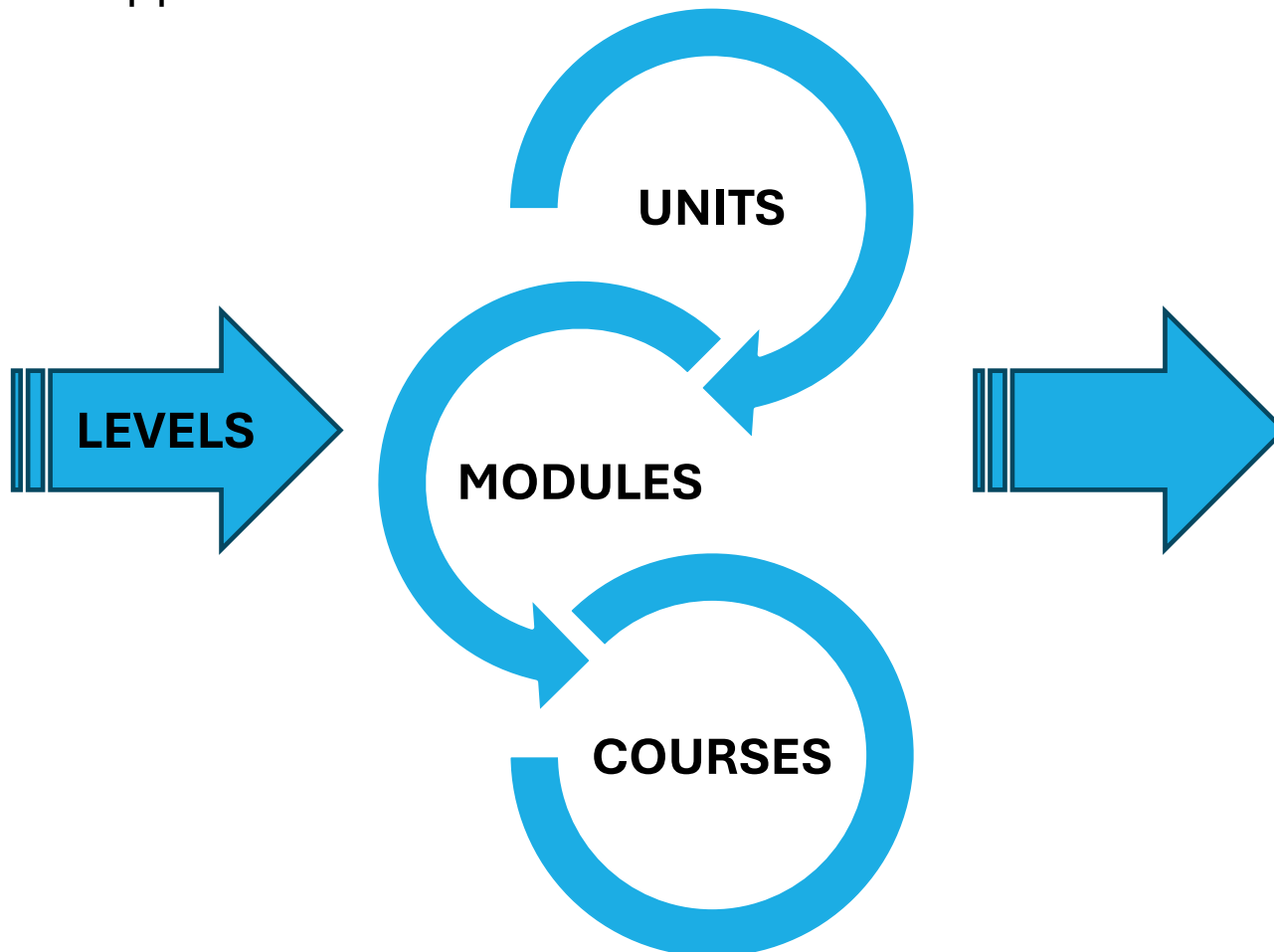
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- ✓ All units are commercially available, and more content is in development...
- ✓ In addition, we develop bespoke units to meet client requirements e.g. Software Defined Vehicles (SDV)

UNITS, MODULES, LEVELS OR COURSES?

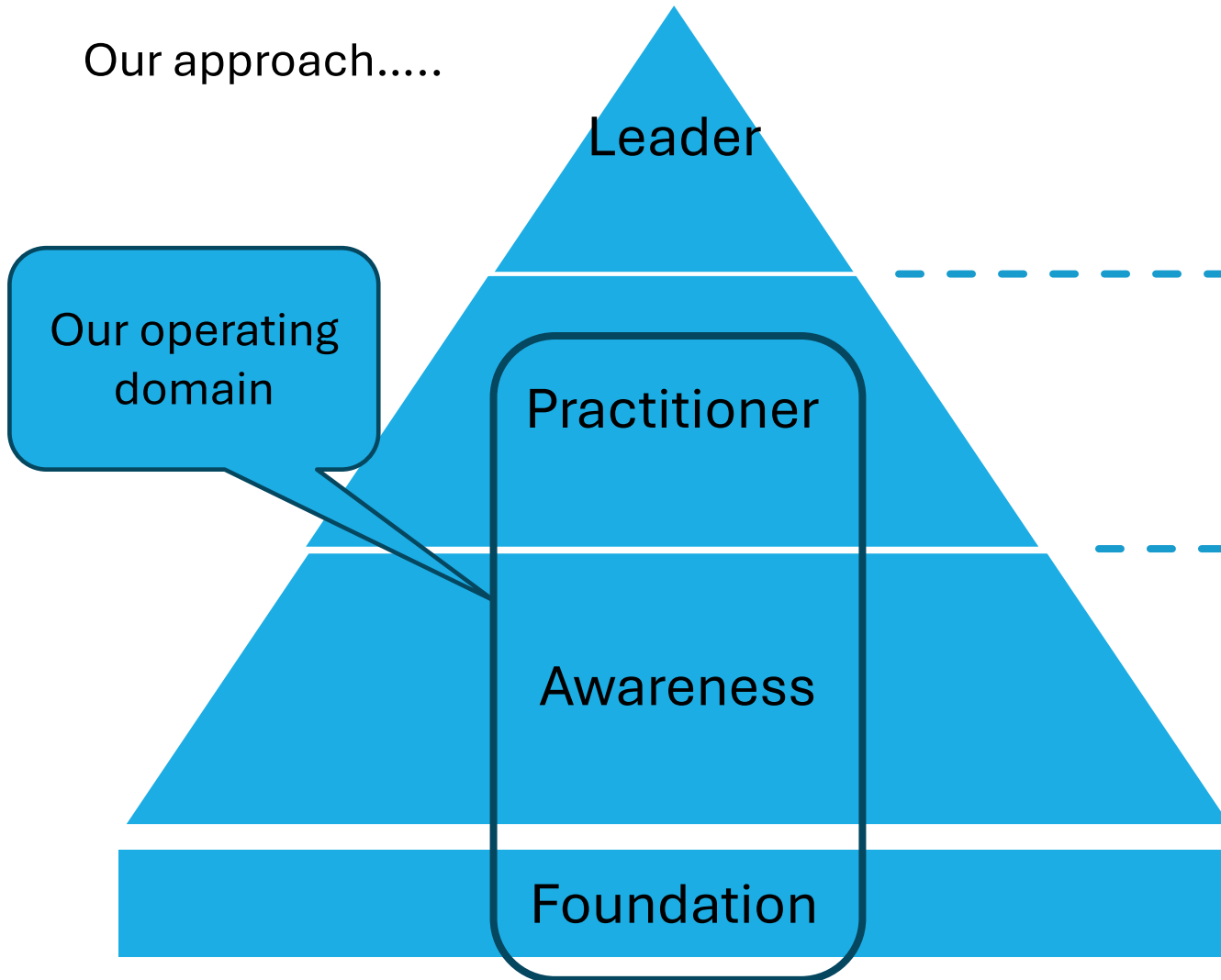
Our approach.....



- ✓ **UNITS** are the building blocks
- ✓ **MODULES** bring together a number of **UNITS** based around a skills family
- ✓ **COURSES** bring together a number of **MODULES** based around a technology or sector
- ✓ **LEVELS** allow us to flex how deeply we go into a skills family, technology or sector

MAPPING TO A “STANDARD”

Our approach.....



LEVEL

DESCRIPTOR

3	<ul style="list-style-type: none"> ✓ Recognised expert in their field ✓ Trainer / mentor for Level 2 ✓ PT / FT formal study (MSc, MEng)
2	<ul style="list-style-type: none"> ✓ Regular on the job exposure ✓ Formal specialised training course ✓ Opportunity to train / mentor Level 1
1	<ul style="list-style-type: none"> ✓ Limited on the job exposure ✓ Introductory training modules ✓ Opportunity to support Level 0
0	<ul style="list-style-type: none"> ✓ Base training units and modules ✓ Foundation principles

ESN COMMON SETS OF SKILLS

Battery Fundamentals

In the area "Battery Manufacturing"

Level: Introduction

Focus: Theory

Activity: Populated

Battery Management Systems (BMS)

In the area "Battery Manufacturing"

Level: Technical

Focus: Theory

Activity: Populated

INTRODUCTION TO ELECTROCHEMISTRY

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INTRODUCTION TO EV PROPULSION - BATTERIES

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INTRODUCTION TO BATTERY MANAGEMENT SYSTEMS (BMS)

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Understand battery cell chemistry advantages and disadvantages

Lead acid, Nickel Cadmium, Nickel Metal Hydride

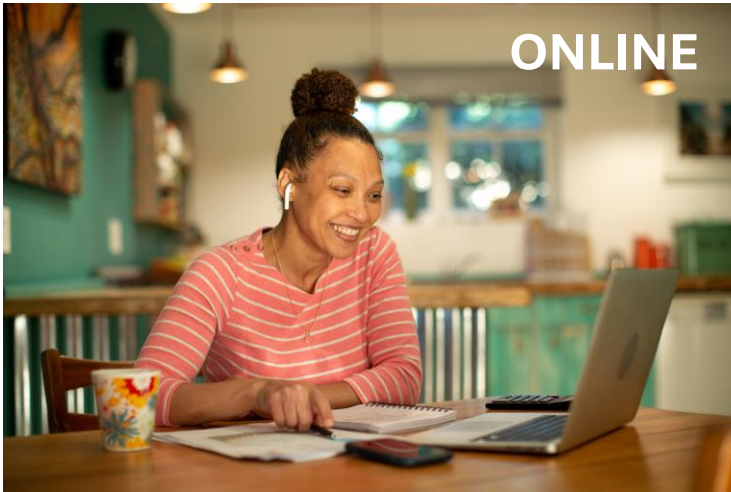
Understand different types of cells and their assemblies

Cylindrical, prismatic and pouch cells and new trends. Application specific

guard data driven and model based predictions. Limitations of each method. Mechanisms of degradation of battery capacity (loss of active material, increase of internal resistance).

Relevance of thermal control for battery performance and safety. Thermal sensors and BMS integration. Thermal management systems and design (air, liquid and refrigerant cooling, heat sinks)

OUR DELIVERY OPTIONS



- ✓ Delivered by an instructor real time or available as pre recorded content
- ✓ Most of our Level 0 and Level 1 content is delivered online
- ✓ We always offer (and recommend) access to the instructor for follow up questions and to explore further learning opportunities
- ✓ We don't offer stand alone eLearning units



- ✓ Delivered at your site or at an agreed training venue
- ✓ Most of our Level 2 content is delivered in person
- ✓ We always offer (and recommend) access to the instructor for follow up questions and to explore further learning opportunities
- ✓ We have delivered projects in multi mode format, some content online, some in person – we are flexible.



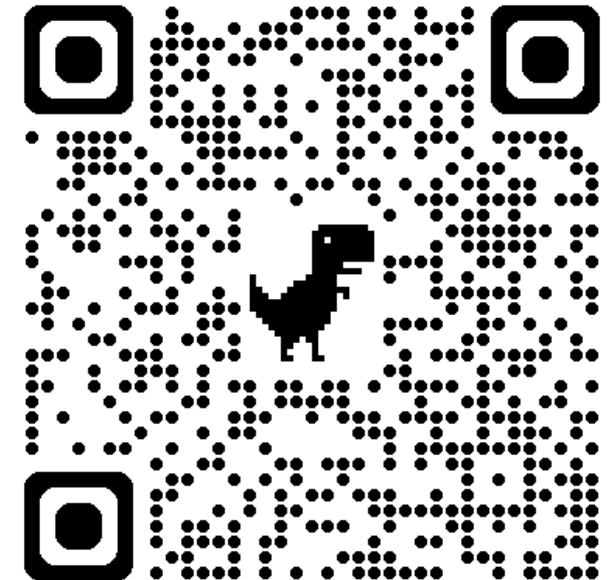
GET INVOLVED - UPCOMING MASTERCLASS SESSIONS ✓ Sign up and join for free

Running from **September to October 2025**, this highly anticipated series features **8 expert-led sessions**, including a brand-new module:

“Batteries – Recycle, Reuse, or Repurpose?” — a hot topic for anyone passionate about sustainable electrification.

- **Tues 23 Sept** – Electrochemistry and Introduction to Hydrogen
- **Fri 26 Sept** – Hydrogen PEM Fuel Cells – Now or Never?
- **Tues 30 Sept** – EV System Integration Part #1 – Batteries
- **Tues 7 Oct** – Introduction to Battery Management Systems (BMS)
- **Mon 13 Oct** – EV System Integration Part #2 – Motors and Drive Units
- **Fri 17 Oct** – EV Software – Keeping It Safe and Secure
- **Mon 20 Oct** – Batteries – Recycle, Reuse, or Repurpose? (*New Session*)
- **Fri 24 Oct** – The Future of EV Battery Technology

- ✓ Interactive style webinars with Paul Whiteside moderating the sessions
- ✓ You will get a handout of the presented material after attendance





ELECTRIFICATION SKILLS NETWORK



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THANKS FOR LISTENING

For more information, please contact
info@pennengineeredolutions.co.uk

