

APC support and facilitation

Meritor case study

Meritor “Epic” Case Study

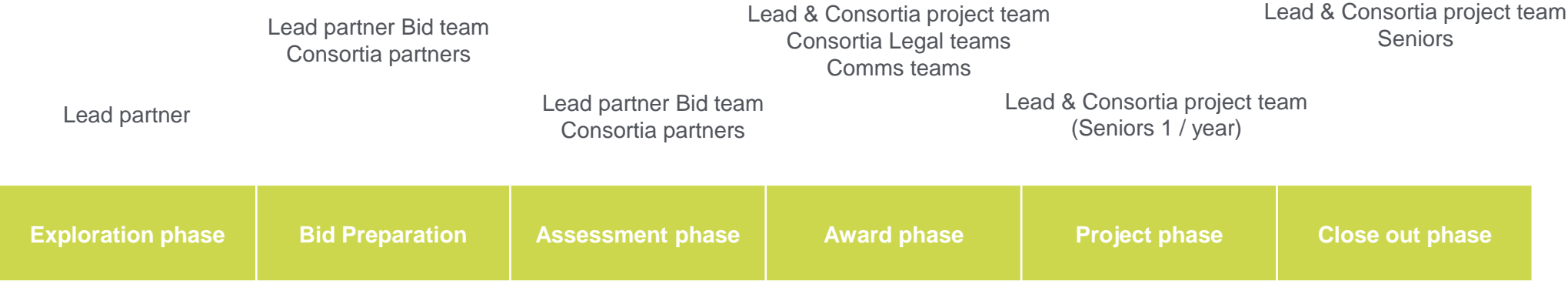
The journey:

- Meritor through DIT, reach out to explore opportunities with APC (July / Sept 2019)
- Meritor seniors meeting in London (February 2020)
- Meritor Global team explore options / understand opportunities etc (April – August+ 2020)
- Joint Meritor / APC deep dive into bid (September 2020)
- Meritor submit written bid into APC17 (October 2020)
- Meritor attend assessment interview (December 2020)
- Successful notification (January / February 2021)
- Project kick-off (April 2021)
- Project size circa £32m / £16m grant

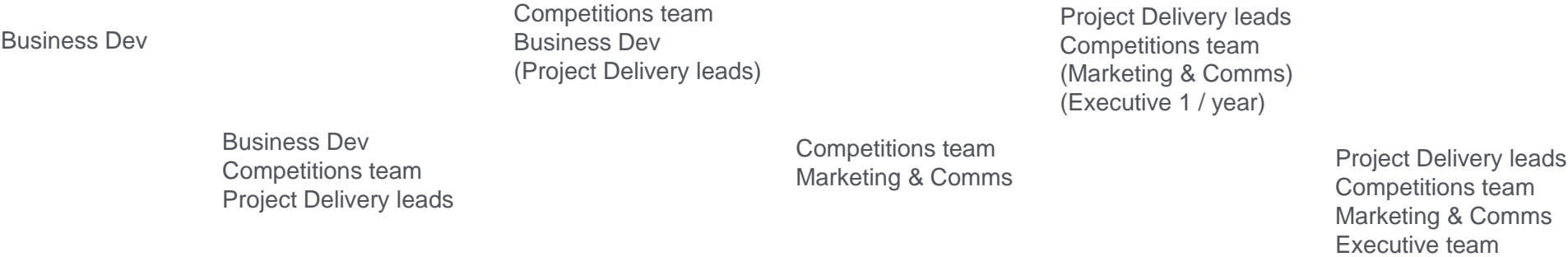
Meritor “Epic” Case Study

The team:

Consortia



APC



InnovateUK



It is a real team effort !! But the rewards are there for you to realise

Future Opportunities

Contact us:



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Chris.Harris@apcuk.co.uk



Ruby.Akhtar@apcuk.co.uk

Stay informed:



www.apcuk.co.uk

On the horizon:



APC20



Rolling Eol



Coming soon

MERITOR?



MERITOR OVERVIEW



MTOR
NYSE Symbol



\$4.4 Billion
Company



9,100
Employees

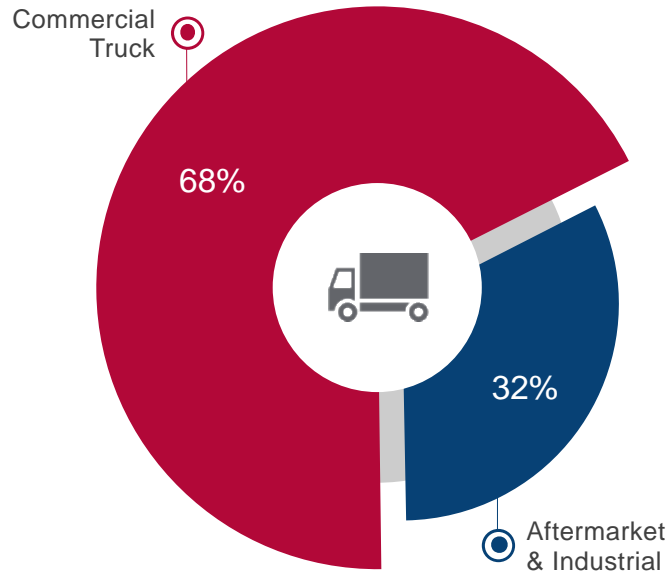


19
Countries

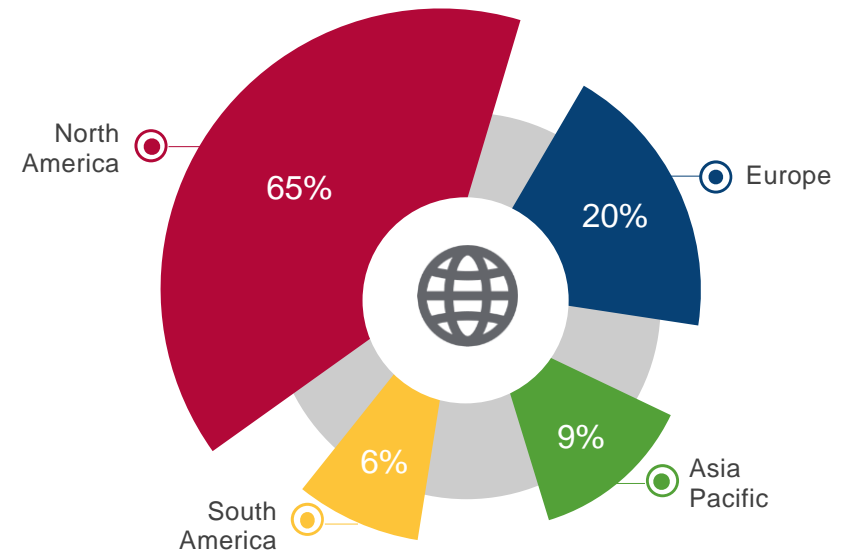


Troy, MI
Headquarters

Sales by Segment



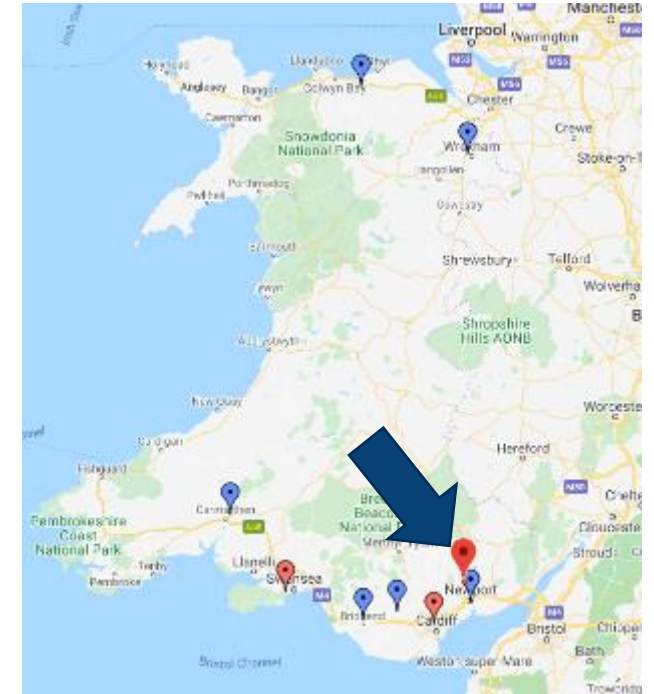
Sales by Geography



Global company focused on Commercial Vehicle drivetrains

Meritor in Cwmbran

- People may not know Meritor in Cwmbran
- Meritor acquired LucasVarity in 1999
- Today, the Cwmbran plant is still referred to as 'Girlings' by local people of a certain age
- The Cwmbran site houses the Centre of Excellence for Air Disc Brake design for the global Meritor corporation and is the largest brake manufacturing site in the group



EPIC PROJECT



- Heavy duty commercial vehicles contribute to global CO₂ production
- Global legislation demands action; trucks to reduce CO₂ emissions by 15% in 2025, 30% in 2030 in Europe, similar in United States and Asia
- Industry responding by bringing Electric Vehicles (EVs) to market, transforming the industry
- Transformation creates immense opportunity for companies that solve the unique issues EVs present
- It was vital for Meritor to be at the forefront of this change in our industry and equally important to develop a technology to specifically support our European OEM's

EPIC addresses these market needs

EPIC PROJECT

MERITOR | BLUE HORIZON™

- Encouraged by the DiT and WAF, Meritor bid and were successful in gaining APC funding to develop the right product for European Heavy trucks.
- The project is known as EPIC
- EPIC delivers:
 - Game-changing heavy duty electric powertrain
 - Establishment of European electric vehicle business for consortium members
 - Electrification “Centres of Excellence” for commercial vehicles in the UK
 - Danfoss in Scotland
 - Meritor at Cwmbran, South Wales



Heavy duty electric powertrain for Commercial Vehicle

EPIC INTEGRATED ELECTRIC POWERTRAIN (IEPT)

Addresses All Deficiencies of Current Systems

EXTREME POWER-DENSITY

electric motor with 430 kW continuous power **meets all HD performance requirements**

CONVENTIONAL wheel-ends can be used **up to 44t gcw** while hub reduction wheel-ends **extend coverage to 65t+ gcw**

ULTRA-LIGHT disc brake and rotor optimized for EV duty cycles **reduces unsprung mass for better ride performance**

INTEGRATED inverter with SiC MOSFETs **maximizes efficiency and reliability** while eliminating phase cables for **lowest cost**

CONVENTIONAL housings can be used which **lowers cost and increases reliability**

INTEGRATED 3-speed transmission **meets all HD performance requirements and maximizes system efficiency** for longer vehicle range

NOVEL "straddle-style" architecture for motor and transmission enables **packaging in existing chassis** with little or no modification and **best manages added unsprung mass**

20 EPIC PATENTS

3 on motor
12 on inverter
5 on architecture

ATTRIBUTE	EPIC	Remote Motor	Other eAxes
Meets all HD performance requirements	✓	✓	✗
Enables battery packaging b/w frame rails	✓	✗	✓
Packages easily in existing chassis	✓	✓	✗
High modularity for maximum application coverage	✓	✗	✗
Maximizes vehicle range	✓	✗	✓
Maximizes vehicle payload	✓	✗	✓
Lowest cost	✓	✓	✗
High reliability	✓	✓	✗
Minimizes impact to vehicle ride and handling	✓	✓	✗
Exceeds APC's 2025/2035 targets for power density	✓	✗	unknown
Exceeds APC's 2035 target for drive cycle efficiency	✓	✗	unknown

CONSORTIUM MEMBERS

MERITOR

At A Glance



Customer Base



Overview

- Leading global supplier of drivetrain, mobility and braking systems
- Spent years innovating traditional products
- Introducing technology focused on efficiency and carbon footprint reduction
- Blue Horizon is Meritor's technology brand

DANFOSS



- Leading, global technology company
- Dedicated people, leading business positions, strong engine room, smart technologies and deep application knowledge
- Engineer products and solutions that deliver exceptional performance
- Electrification is core strategic pillar for Danfoss and future endeavors

ELECTRA



- Electra is making city centre delivery a 100% clean and silent operation
- Allowing minimal impact of vehicles in our environment which are essential to keep our cities running 24 hours a day
- Bringing world-class technology to commercial vehicle world, converting low-entry chassis from Mercedes and Iveco to 100% electric

Electric Powertrain Suitable for Commercial Vehicles up to 44t

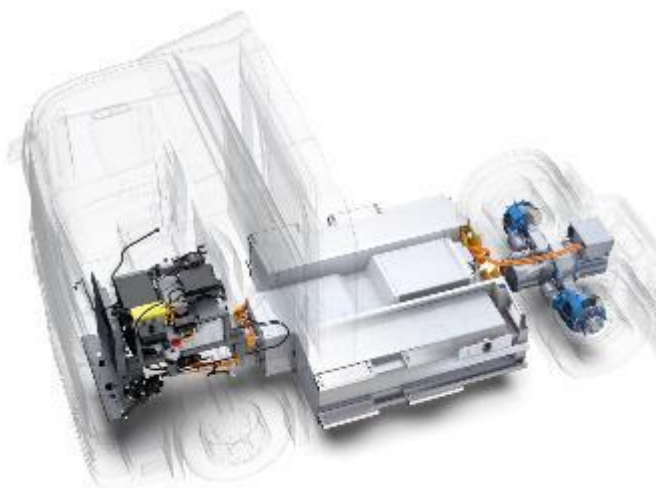


Meritor and Danfoss Centres of Excellence (CoE)



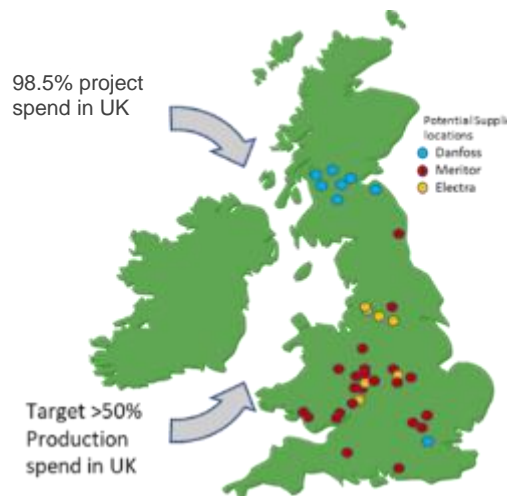
- Knowledge transfer into the UK
- Research and development roles created: 47
- Manufacturing jobs created: 142
- Safeguarded: >500

HD BEV Chassis – 4 Types

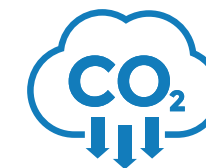


UK Supply Chain Spend 1.4B GBP

98.5% project
spend in UK



20.8 Million Tonnes CO₂ Reduction



HOW DID WE STRUCTURE THE BID?



BUILDING A CONSORTIUM



Jay Craig

Chief Executive
Officer and President



John Bennett

VP and Chief
Technology Officer



Tony Williams

Director, eMobility and
Adv Technologies



Angie Bellos

Director, Global PMO



Brandon Sykora

Senior Manager,
Electrification Finance



Jeff Herrin

VP of Research and
Development



Adrian Schaffer

Director of Global
Sales



Josh Ley

Director of Research
and Development



Sid Sadique

Chief Executive
Officer and President

*Senior executive buy in
was a must!*

COLLABORATION AGREEMENT

COLLABORATION AGREEMENT

THIS COLLABORATION AGREEMENT ("Agreement") is made and entered into as of March 24, 2021 (the "Effective Date") between:

(1) MERITOR ELECTRIC VEHICLES, LLC, a Delaware limited liability company ("Meritor US"), and MERITOR HEAVY VEHICLE BRAKING SYSTEMS (UK) LTD, a United Kingdom company ("Meritor UK," and, together with Meritor US, hereinafter referred to as "MERITOR");

(2) DANFOSS SCOTLAND LIMITED, a United Kingdom company ("Danfoss UK") and DANFOSS POWER SOLUTIONS (US) COMPANY, a Delaware company ("Danfoss US," and, together with Danfoss UK, hereinafter collectively referred to as "DANFOSS"), and

(3) ELECTRA COMMERCIAL VEHICLES LTD, a United Kingdom company ("ELECTRA").

MERITOR, DANFOSS, and ELECTRA are sometimes referred to herein individually as a "Party" and collectively as the "Parties."

RECITALS

WHEREAS, the Parties intend to collaborate in the development, by DANFOSS, of certain motors, motor controllers and inverters for integration into MERITOR's L-Series electronically driven powertrains, which in turn will be integrated by ELECTRA, along with other components, into heavy-duty vehicles (the "E-Vehicles") as more fully described in the SOW, and

WHEREAS, the Parties have submitted a proposal on October 12, 2020 (the "Proposal") to the Advanced Propulsion Centre ("APC") under the APC's Core Competition Program (the "Opportunity") which, if selected for award by the APC, would result in a grant from the United Kingdom that would partially fund the design and development of the components and systems resulting from this collaboration between the Parties substantially within the United Kingdom (the "Grant"); and

WHEREAS, if the Proposal is selected for award by APC, this Agreement will cover the collaboration of the Parties in executing the Proposal (the "Project"); and

WHEREAS, the purpose of this Agreement is to specify each Party's obligations, responsibilities, and rights with respect to the Project;

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein set forth, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

6

intended to create any interest in any third Party.

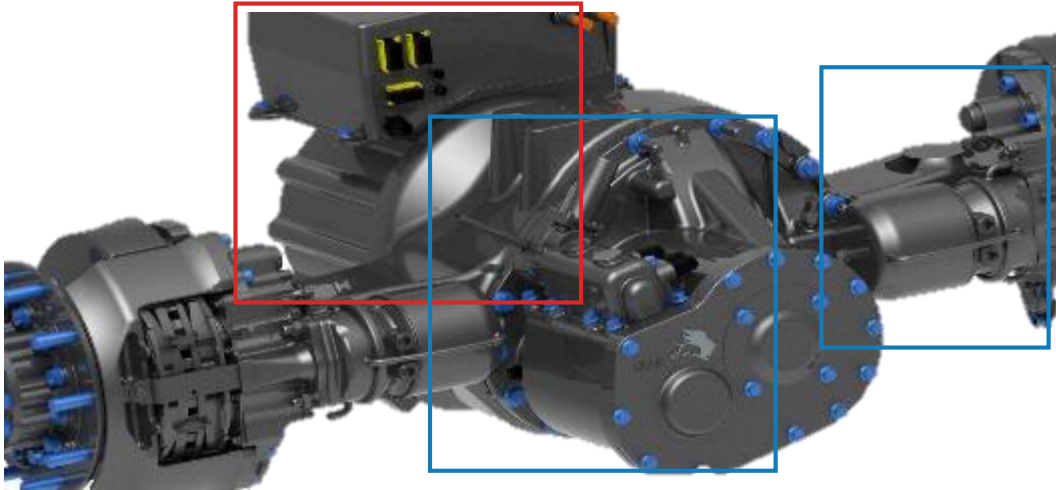
- Although not required in final form until late in the process, starting the discussion around the way the consortium plan to work together (the Collaboration Agreement) brings out issues and drives resolution.

Kick off the collaboration agreement and clear SOW early

SHARE THE LOAD

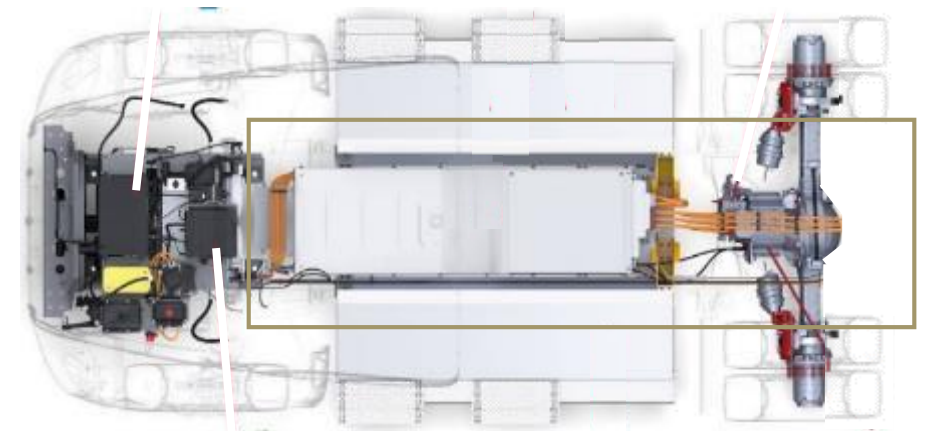
Danfoss

WP1	WP2	WP5
Motor development	Motor controller and software development	Inverter development and integration
Time: Months 1 to 28	Time: Months 1 to 42	Time: Months 1 to 42
Cost: £	Cost: £	Cost: £
Dependency: WP3, WP7	Dependency: WP4	Dependency: WP4



WP3	WP4	WP6
Trans and geared carrier development and integration	Transmission controller and software development	Lightweight brake development
Time: Months 1 to 35	Time: Months 1 to 42	Time: Months 6 to 13
Cost: £	Cost: £	Cost: £
Dependency: WP1, WP7	Dependency: WP2, WP8	Dependency: WP7

WP7	WP8
Mechanical integration of battery-electric chassis	Controls integration of battery-electric chassis
Time: Months 3 to 22	Time: Month 8 to month 42
Cost: £	Cost: £
Dependency: WP1, WP3	Dependency: WP4



ELECTRA
COMMERCIAL VEHICLES

WP9	WP10
System validation	Supply chain selection and develop
Time: Months 5 to 42	Time: Months 1 to 29
Cost: £	Cost: £
Dependency: All except WP10	Dependency: none

BLUE HORIZON

Danfoss

ELECTRA
COMMERCIAL VEHICLES

- To construct the bid in APC 17, we formed a multi national team
 - Members supporting our bid construction came from
 - Cwmbran, Blackburn and Edinburgh in UK
 - Colorado, Michigan and California in US
 - Finland, Italy and Austria.
 - We also engaged an extra set of external eyes
- Plus the APC and DiT teams
- Covid restrictions gave us a few headaches with communication but we formed an effective team, all with something to gain. We had a purpose and focus.

*We never physically met as a team
– we became experts in ‘Teams’ meetings.....*

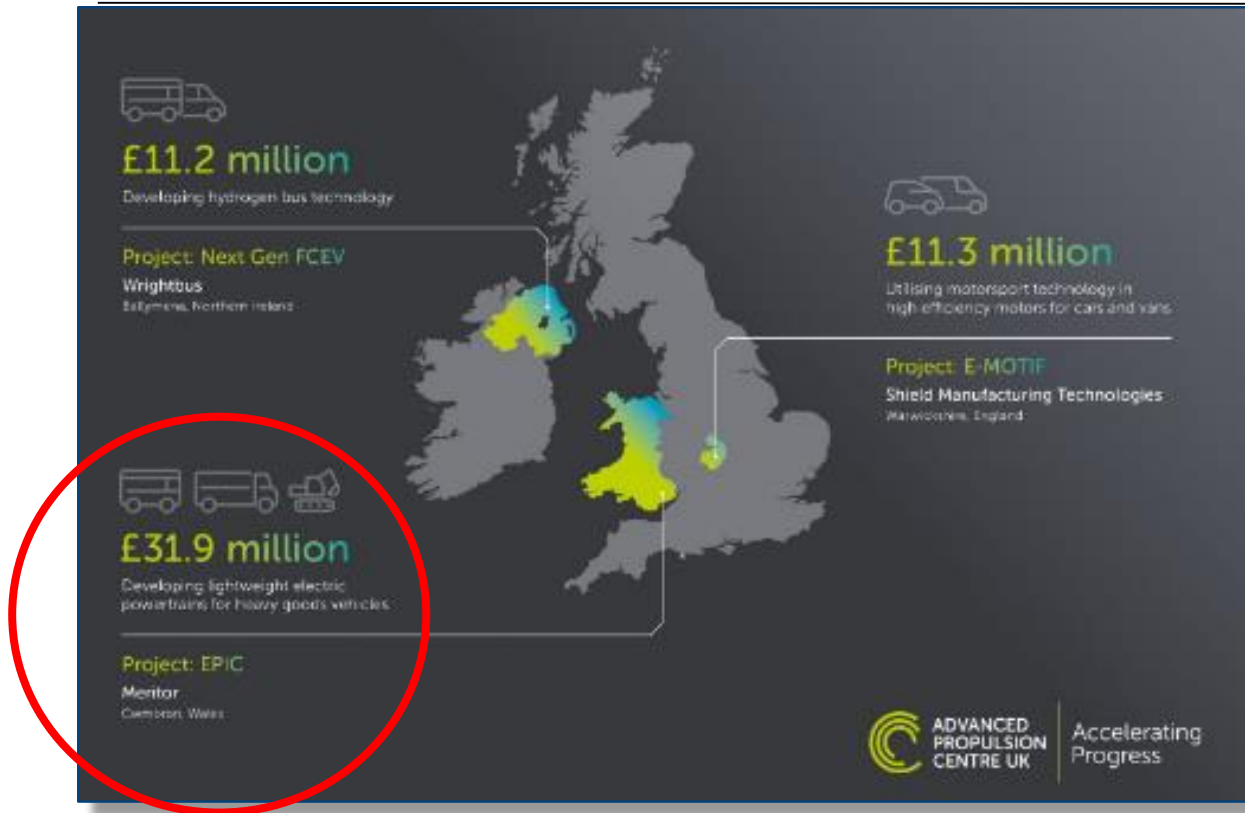
IT WASN'T ALL WORK.....

Thanks for all the support
with APC.....
Have a great holiday



.... but we did manage to hold a virtual Christmas party.....

APC grant award



■ Core team

- 5 Meritor
- 4 Danfoss
- 3 Electra

■ Manhours

- Weekly meetings at team level
- Regular reviews with Senior execs
- 37 Financial iterations at Meritor alone!
- Around 6 man years of effort!

- The Advanced Propulsion Centre (APC) welcomes £54 million commitment across three innovative automotive projects in the latest round of R&D funding
- Investment in hydrogen fuel cells for buses, lightweight electric vehicle powertrains for heavy goods vehicles and motorsport technology built into high efficiency motors for cars and vans
- Transformational programmes across England, Northern Ireland, Scotland and Wales forecast to create and safeguard nearly 10,000 jobs

The reward is worth the effort

- **Attend the APC launch events**
 - Good advice
 - Good networking
- **Talk to APC and DiT teams**
 - Incredible support
 - Don't be afraid to ask questions
 - Make sure to answer all the facets of the questions
- **Be innovative**
 - Outline your innovation and then talk to the APC team
- **Think about the potential routes to Market**
 - Seek letters of support from your potential customers
- **Talk to other successful bidders**

Good luck!

Thank you

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