



AFFORDABLE COMPOSITES

23rd March 2017

Presented by
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CLF 2016 Strategy Delivery

UK SUPPLY CHAIN MANUFACTURING CLUSTERS AND PRODUCTS

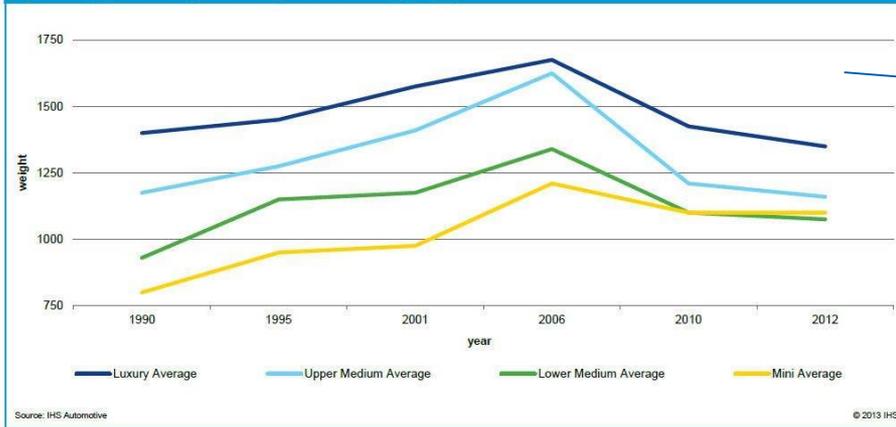
		Working Groups			
		Technology	Skills	Regulations, Codes & Standards	Sustainability
Cluster Groups	High Performance Composites	Deliver Accelerate organic growth in established sectors already using composites.			
	Affordable Composites	Develop Technologies and supply chains to capture immediate market opportunities.			
	Large Structures	Diversify Enable UK industry to take advantage of increased use of composites in other sectors.			



**Current sales potential
£2,290m
Growth to 2030 of
£10,200m**

Global emissions targets will drive the use of Automotive Composites

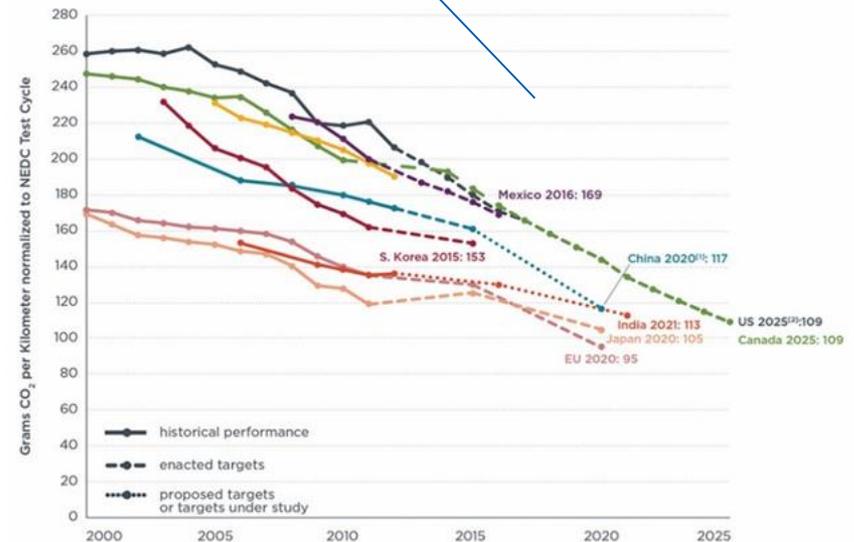
Figure 2: Segment average kerb weights 1990 - 2012 (Europe)



- Vehicle weights have increased to 2006 and have now started gradually coming down...
- ...however global emissions targets are reducing aggressively over the next 10 years

OEMs are working on programmes to significantly reduce weight in their vehicles in order to meet future emissions legislation.

Only the adoption of composites and other materials in multi-material structures, components and panels will provide the necessary level of weight reductions.



[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
 [2] US, Canada, and Mexico light-duty vehicles include light-commercial vehicles.
 [3] Supporting data can be found at: <http://www.theicct.org/info-tools/global-passenger-vehicle-standards>

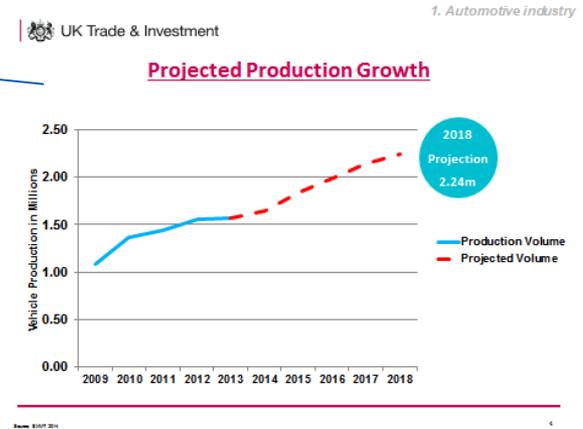
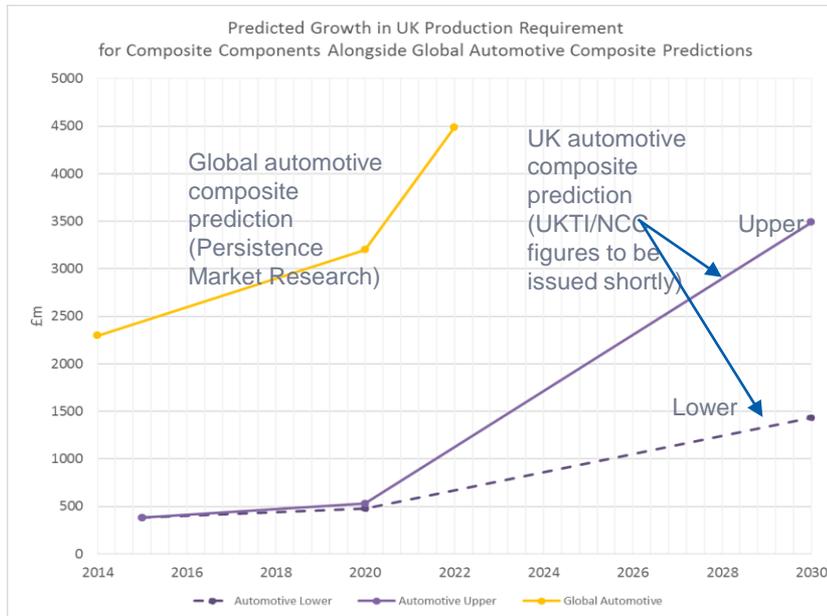
Future UK demand for automotive composite components

- The global premium automotive sector has high fleet emissions so has an urgent need to adopt lightweight materials.
- The UK has a very large premium sector globally, which is driving UK vehicle output growth to 2.24m vehicles by 2018.



AUTOMOTIVE

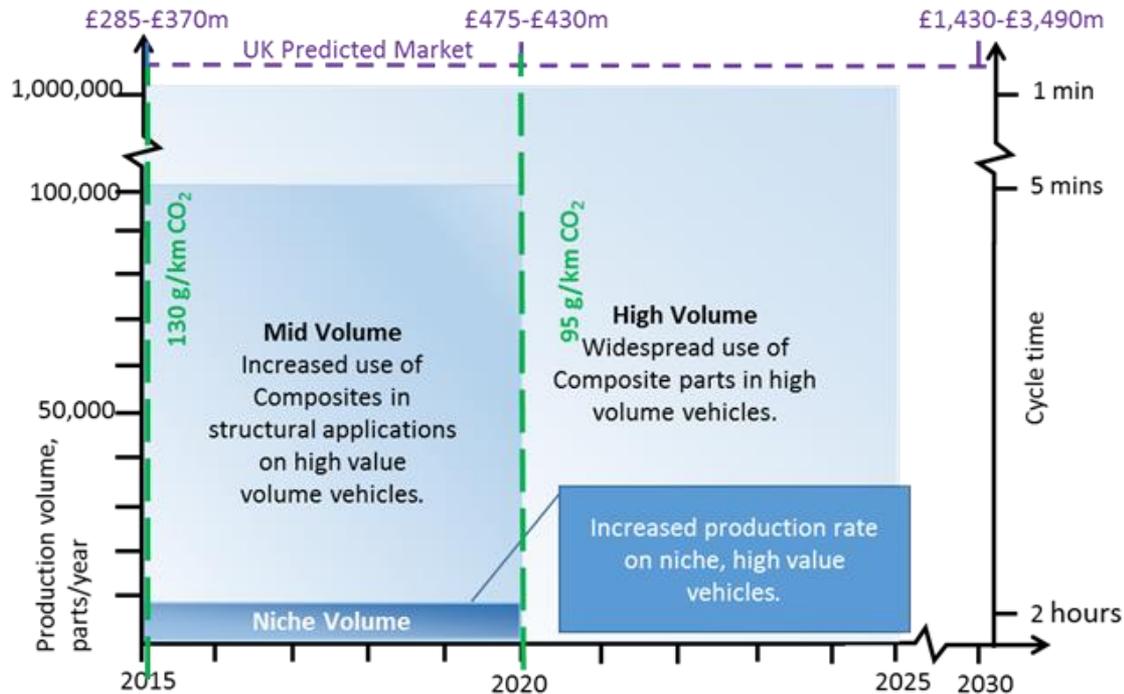
2015 £380m
2020 £490m
2030 £3.5bn



- A recent study has estimated the UK demand for automotive composites could grow from £380m in 2015 to **£3.5bn** in 2030.

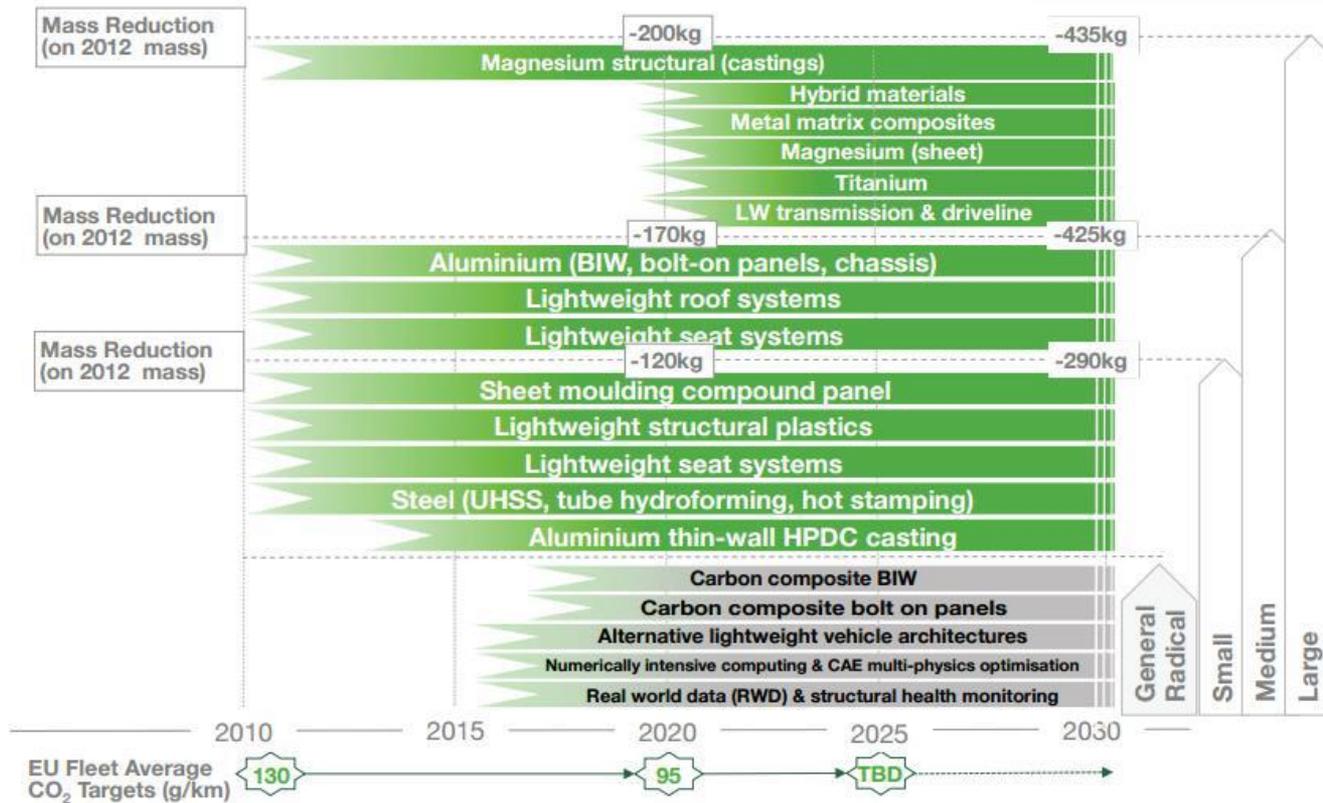
Automotive Council Technology Group view

- High demand identified for affordable composite structures from UK OEM's
- UK has world leading capabilities in production of composites for low volume, high performance applications such as Formula 1 and aerospace.



- Big opportunity to build a UK based global hub for automotive composites R&D and production

Lightweight vehicle and power train roadmap



Source:Automotive Council Technology Group 2013

Why lightweight with composites?

- **Weight saving – composites substituting for steel where appropriate**
 - Composites (thermoset, thermoplastic, CF and GF)
 - ***Hybrid multi-material structural components.***
 - 100kg weight reduction = - 6 g CO₂/km
- **Cost saving – through life compared to steel**
 - Part count reduction through component integration
 - Component cost competitive with existing benchmark plus “on cost per kg saved”
 - Use of appropriate fibre reinforcement – GF or CF?
- **Performance improvement**
 - Improved vehicle dynamics
 - Increased design freedom

Weight saving

- *reduces fuel consumption*
 - *reduces CO₂ emissions*

Where can we reduce weight in automobiles?

	BODY IN WHITE	CHASSIS	STEERING and SUSPENSION	CLOSURES	INTERIOR
Mid – Volume (3k – 100k parts pa)	 <p>% of car weight 35%</p>	 <p>20%</p>	 <p>17%</p>	 <p>10%</p>	 <p>18%</p>
Market factors	<p>Most OEMs develop in-house</p> <p>High barriers for change – BIW line investment</p> <p>Safety critical</p>	<p>Tier 1 sourced</p> <p>Incremental change opportunities -</p>	<p>Tier 1 sourced</p> <p>Incremental change opportunities</p>	<p>In-house and outsourced</p> <p>CF panels luxury/sports</p> <p>Move towards structural composite modules and systems</p>	<p>Tier 1 sourced</p> <p>High existing use of polymers</p>
Composite Technologies	<p>CF Thermoset GF Thermoplastic</p>	<p>Hybrid multi-material Including Thermoplastics</p>	<p>Hybrid multi-material</p>	<p>Hybrid multi-material</p> <ul style="list-style-type: none"> • Pressing • HP-RTM 	<p>Fibre reinforced thermoplastics</p>

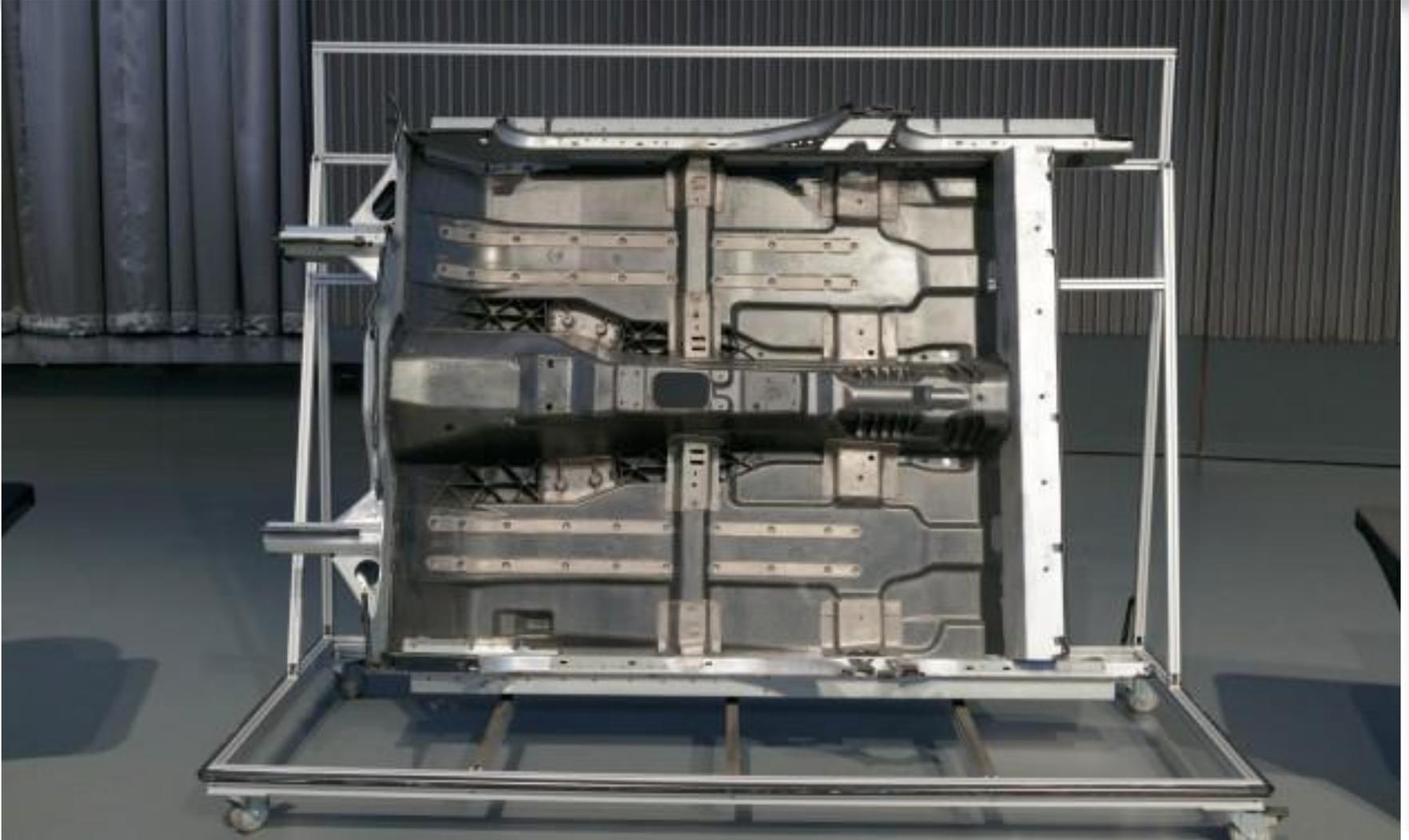




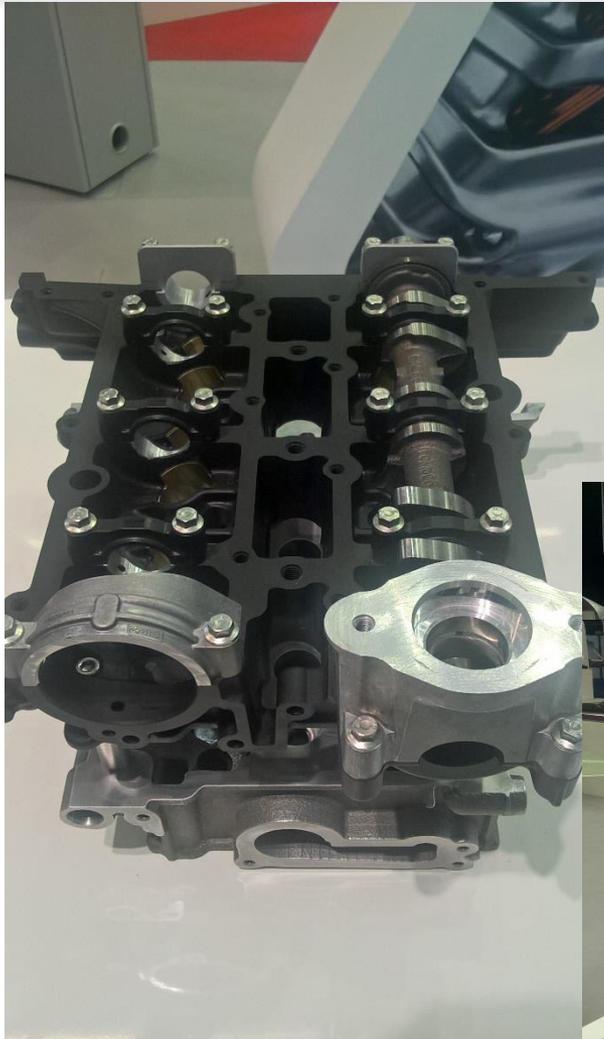




Pictures: Mondial de L'Automobile Paris 1 - 16 Oct 2016 M. Remp



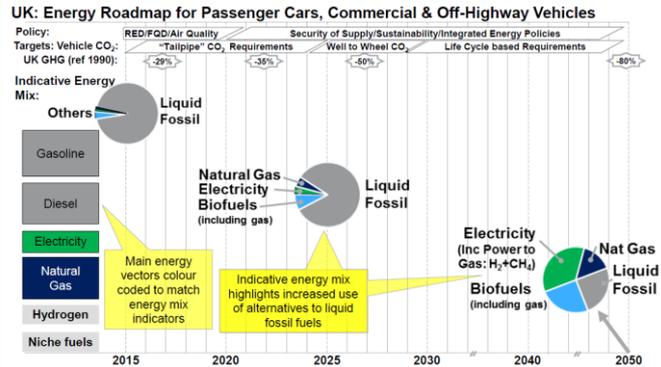
JEC



Powertrain Opportunities

Electric vehicle battery cases and LNG/CNG gas tanks are significant opportunities for UK

Spillover benefits in establishing UK capability and capacity in manufacturing will maximise future UK share of value chain.



Ricardo Background IP. All rights reserved.

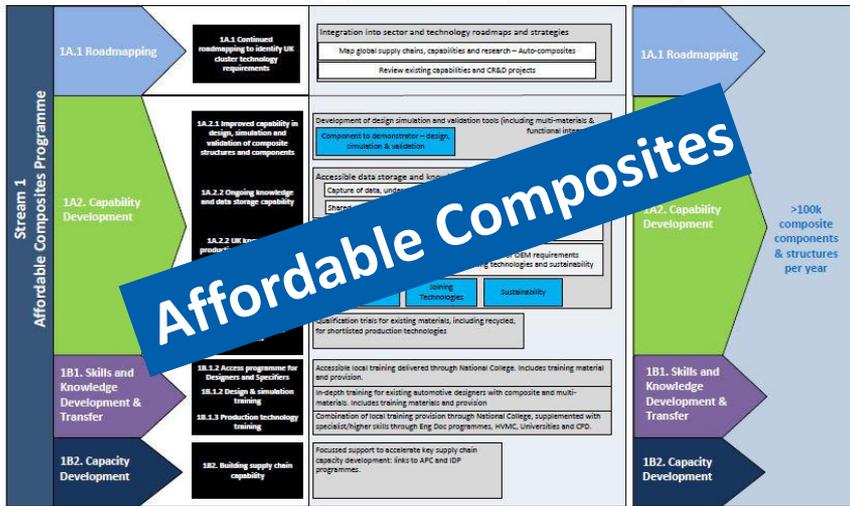


Composites (including CMC and MMCs) and advanced multi-material solutions can improve efficiency of Internal Combustion Engines

Affordable Composites Group

- The ACG was set up by the Automotive Council (Manufacturing Group) and the Composites Leadership Forum with the purpose:
 - **“to facilitate development of UK technology capability and supply chain capacity to deliver high productivity manufacturing of globally competitive, higher volume composite structures and components”.**
- It is chaired by Philip Bruce and contains representatives from supply chain and funding bodies.
- ACG has mapped out the supply chain development required and is identifying, and seeking to fill, gaps that could restrict future development.
- It is working with Government and funding bodies to identify funding mechanisms to facilitate all of this.

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
STREAM 1 "Affordable Composites Programme" 2016 to 2026										
PHASE 1: 2016 to 2021 → to 100k components & structures per year						PHASE 2: 2021 to 2026 → >100k components & structures per year				
STREAM 2 "Innovative Materials & Modelling" 2016 to 2026										



Programme

Stream 1- "Affordable Composites Programme"

- Supply chain producing high volume parts cost effectively by 2021. Focus on current materials and manufacturing technologies.
- Post 2021, ramp up capability above this, potentially using new materials.

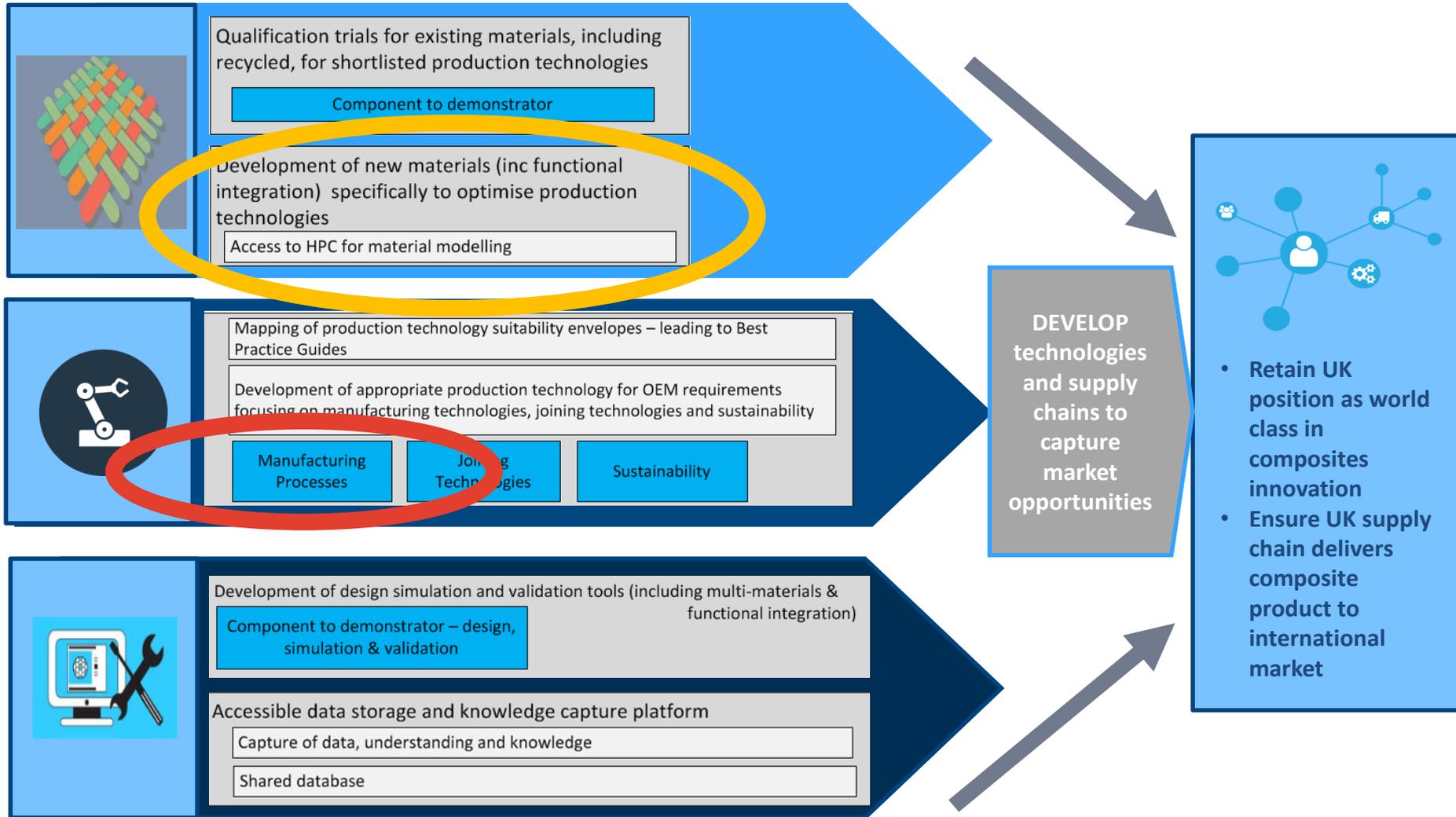
Stream 2 – Innovative Materials and Modelling

"National Composites Material Centre"

- Develop UK composite materials development and manufacturing capability to bring about the step change in cost and production technology to deliver higher rate affordable production.

Both cover Technology, Supply Chain and Skills development.

Affordable Composites – High level roadmap

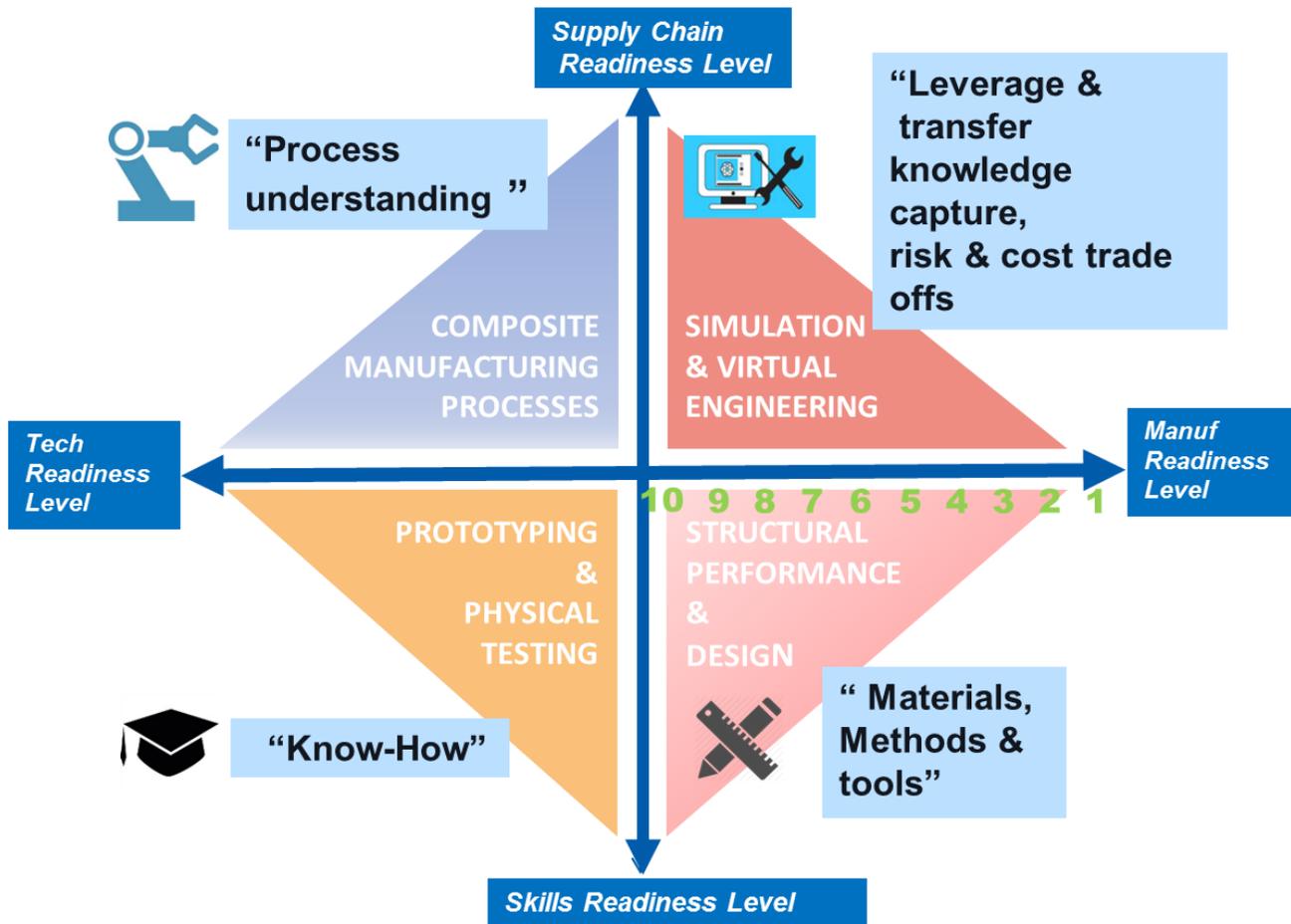


Why is automation the solution?

- Protects and expands existing UK composites capabilities
- Expands UK manufacturing capacity with economies of scale
 - Accelerated adoption of automated high rate manufacturing processes
 - Improved material utilisation
 - Increased productivity
 - Repeatable processes – higher quality & improved optimisation
- Secures future value
- “**Aggregate** demand – to develop investment cases”
 - “**Standardise** processes – to accelerate understanding and acceptance”
 - “**Commoditise** knowledge – through CAE tools and training”

Accelerating Investment Cases

Hitting the target for Investment Readiness: Application of Knowledge



Collaboration, co-ordination and standardisation?

Combine cross sector volume
Shared knowledge/data
Platform?

Accelerate material
characterisation?

- **Aggregate**

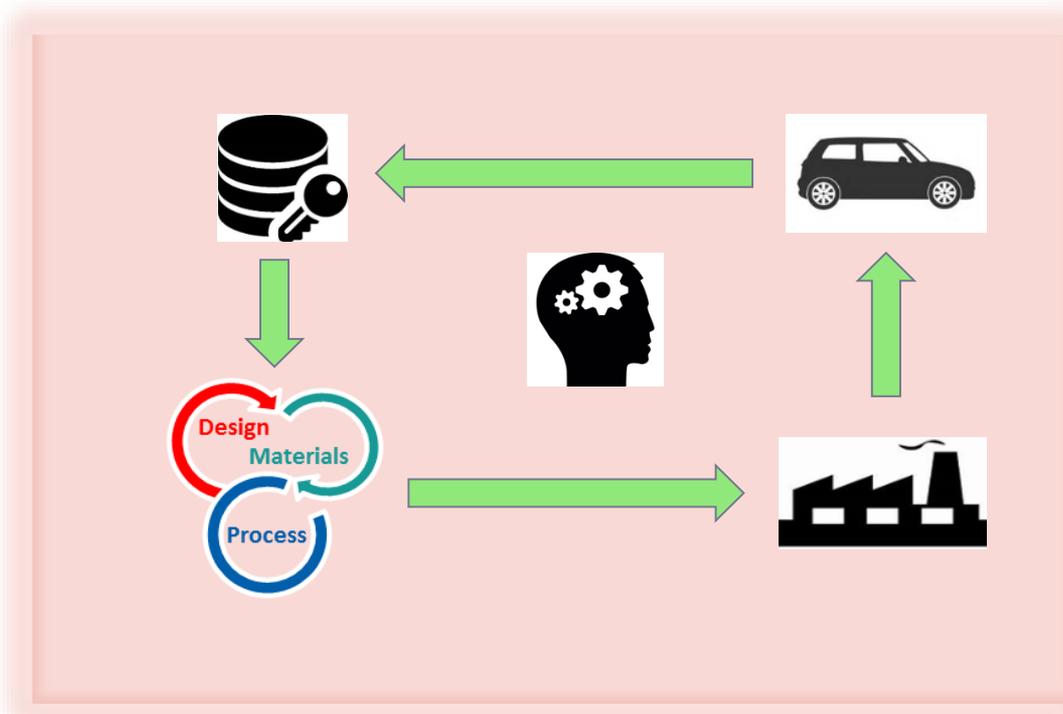
Best practice
Pre-standards
Standards

Training
- **Standardise**

Make it easier to specify
composites

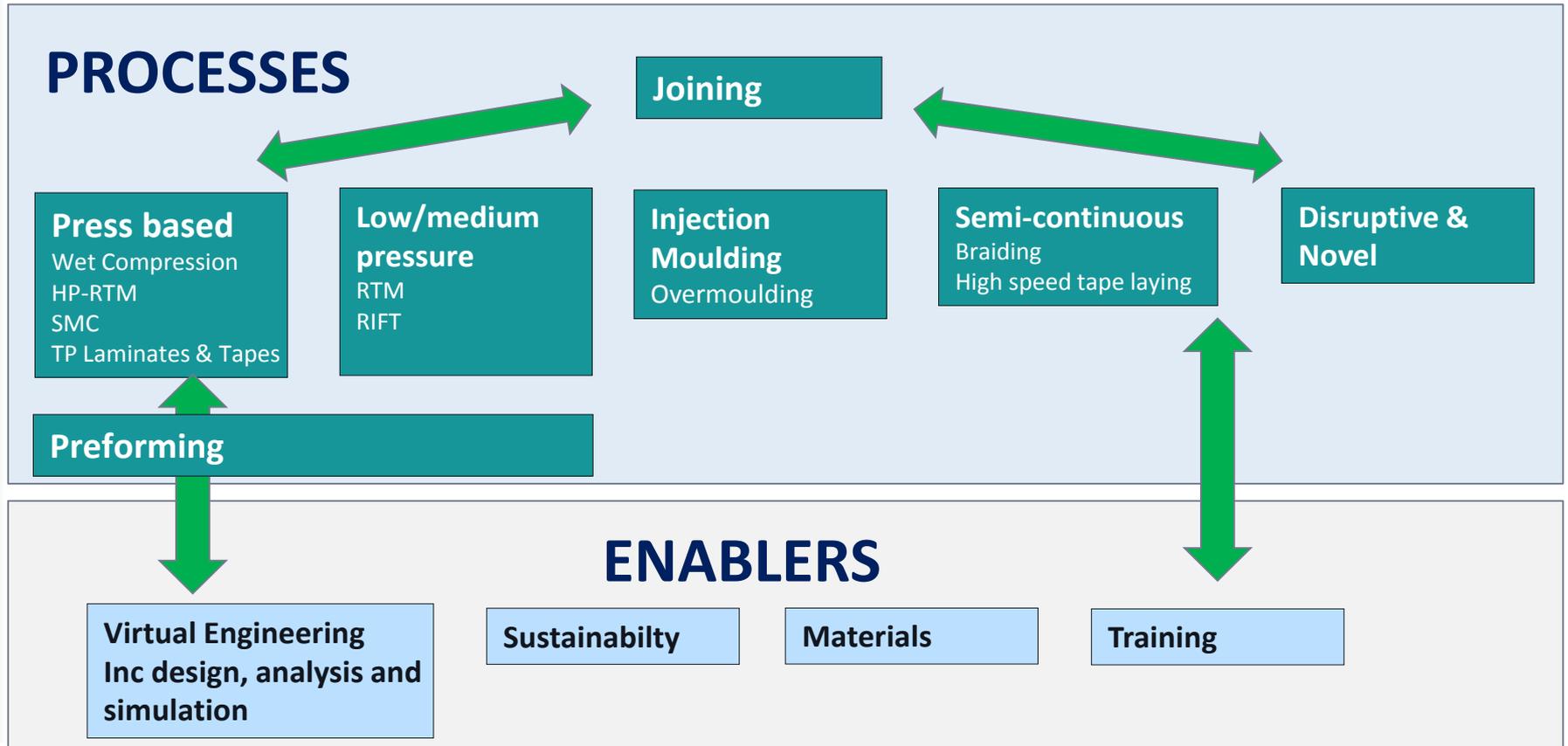
Creating functional market
For Affordable Composites

- **Commoditise**



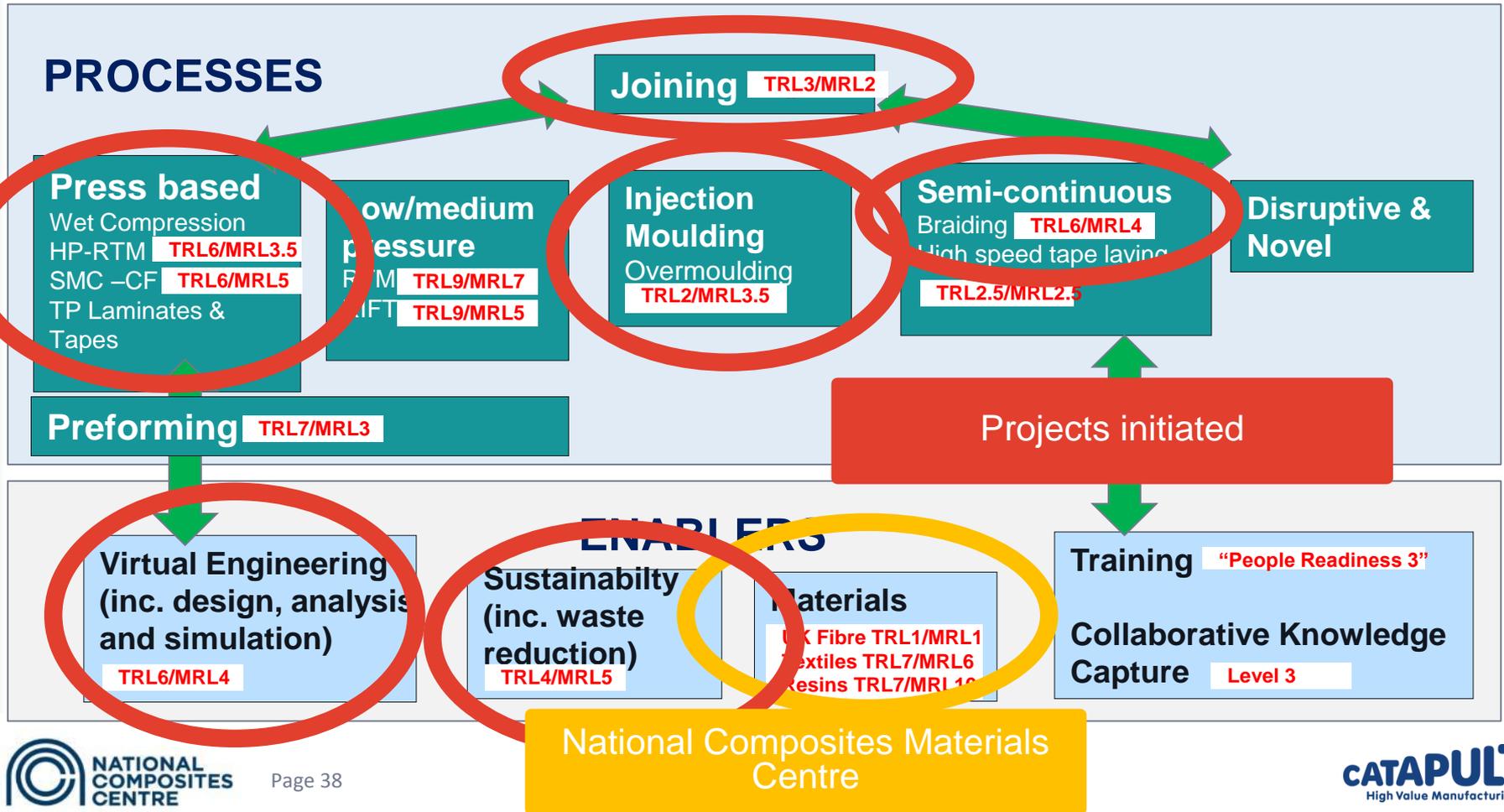
Stream 1 – Affordable Composites

Aggregate demand around manufacturing processes, suitable for up to 100k components per year and maturing quickly to achieve SOP in 2021



Stream 1 – Affordable Composites – Current Status Q3 2016

Aggregate demand around manufacturing processes, suitable for up to 100k components per year and maturing quickly to achieve SOP in 2021



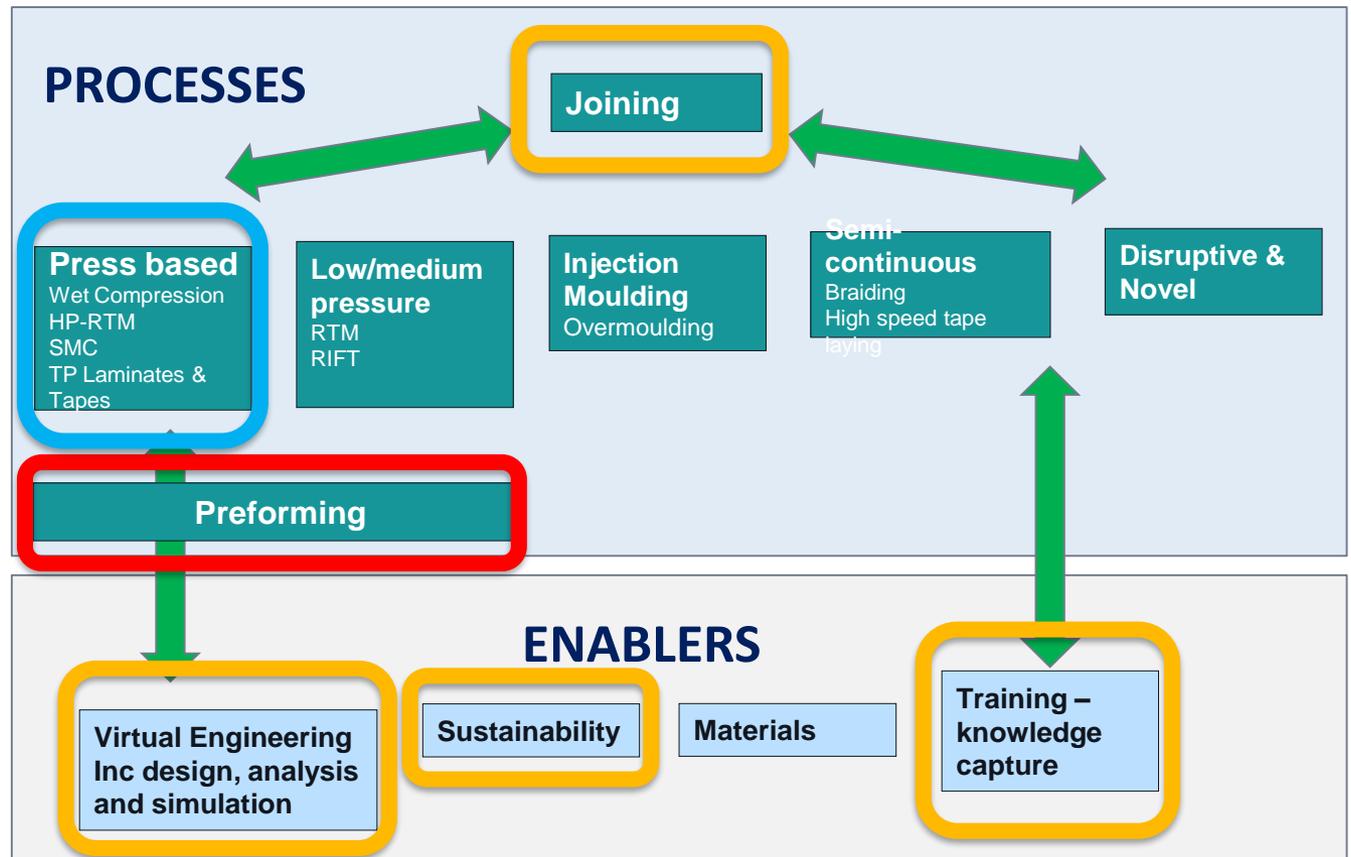
High Efficiency Preforming – an enabling step

Key technology previously not covered by funded projects

Additional critical technologies/capabilities

Critical press-based impregnation technologies

Aggregate demand around manufacturing processes, suitable for up to **100,000 components per year** and “mature by 2017”



Affordable Composites and allied initiatives

2016

2021

2025

Affordable Composites



Greater shared knowledge and understanding of composites design and manufacture leading to significant adoption of composites in the automotive supply chain by 2021 and widespread use in new products by 2025.



NCMC



NCMC will deliver the right composite materials capabilities to be able to anchor the composite products supply chain in UK and increase GVA impact of composite products in UK.

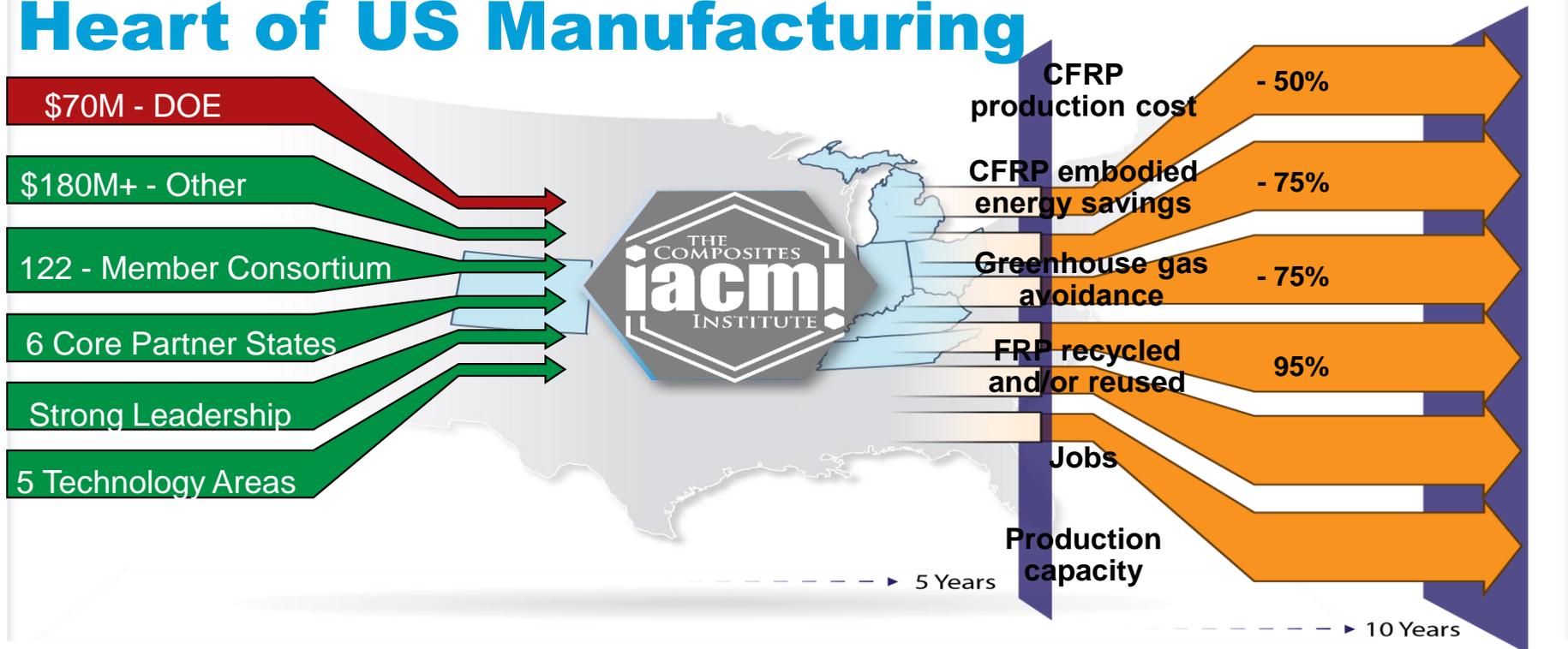


High Efficiency Preforming



“To develop a range of technologies suitable for the production of affordable composite preforms for application to the automotive sector by 2019 in line with sector requirements.”

Federal Investment Will Catalyze a Composites Ecosystem in the Heart of US Manufacturing



Germany – MAI Carbon

+ Leading Edge Cluster MAI Carbon



Page 16 Erber, Hauke - LCC Symposium - 2014-09-11

Goals

- 90% Process cost reduction
- 50% Material cost reduction
- 60% - 80% added value in Germany

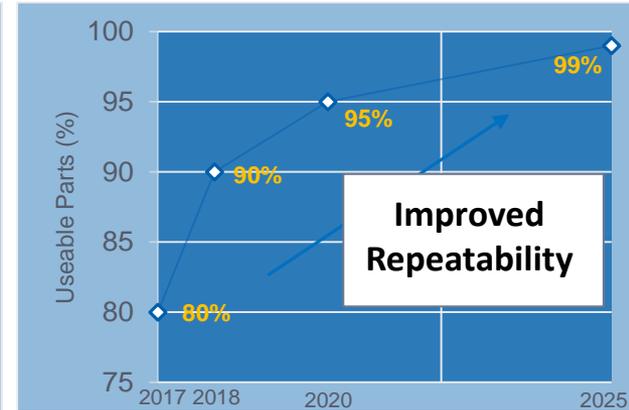
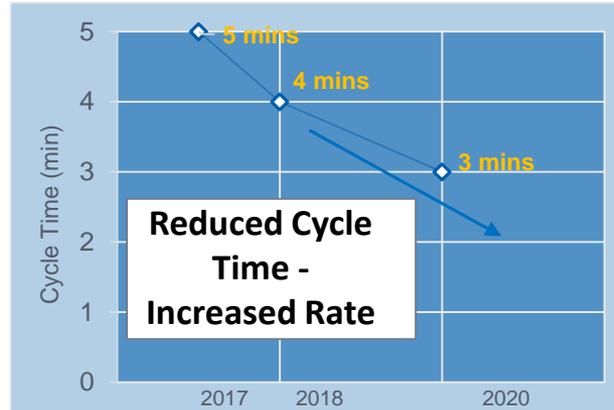
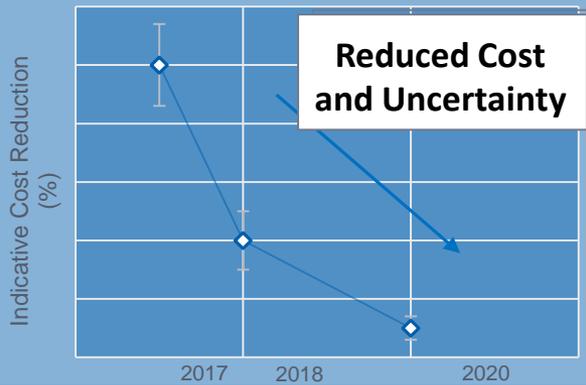
M-A-I
CARBON
Munich – Augsburg - Ingolstadt



ACG Roadmap Objectives – Under Discussion

	US (IACMI)	Germany (MAI Carbon)	UK (Affordable Composites)
Baseline	2015	2010	2017 (Manual processing Benchmark)
Production Cost of finished CF components	Reduce by 25% (2020) Reduce by 50% (2025)	Reduce by 90% (2020) ("processing costs only")	Reduce by 40% (2020) Reduce by 75% (2025) (including material cost reduction)
Demonstrate technologies for recyclability	>80% (2020) >95% (2025)	80% (2020)	>80% (2020)
Cycle (takt) time	90s (Thermoplastic 2020) 180s (Thermoset 2020)	60s (2020)	60s Thermoplastic (2020) 180s Thermoset (2020)
Reduction of process steps		60% (2020)	
Material cost reduction in finished CF parts (includes waste reduction)	Reduce by 25% (2020) Reduce by 50% (2025)	50% (2020)	50% (2025)
Reduction in CFRP embodied energy	>50% (2020) >75% (2025)		>50% (2025)
Local added value % of finished CF component		60-80% (2020)	50% (2020) 80% (2030)

ACG Roadmap Objectives – Implications



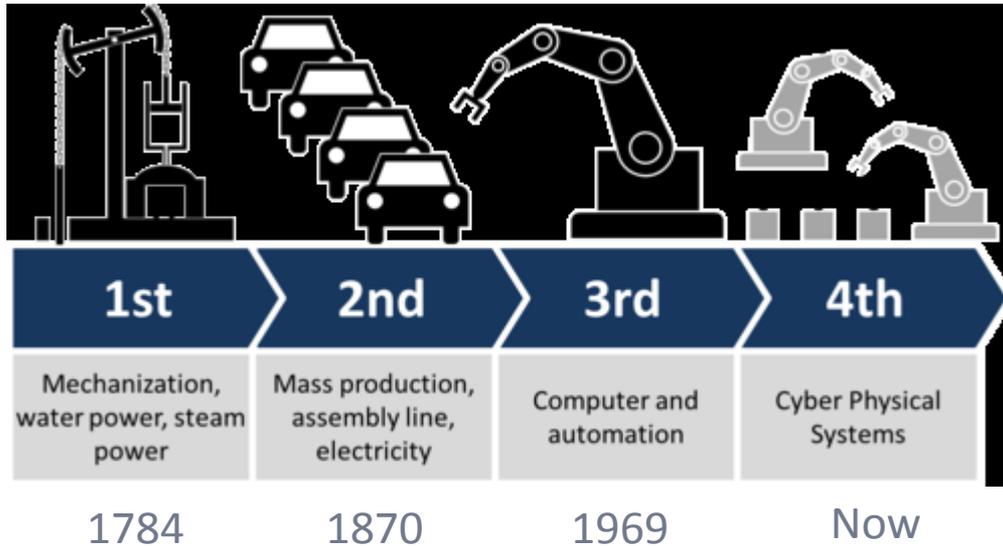
Sustainability – Data to capture typical embodied energy in processes

Knowledge management – socialise status of process envelopes, collaborate on solutions

Increasing focus on keeping processes in control to drive repeatability and yield

Data driven closed loop quality assurance

Industry 4.0 – SMART Manufacturing



Intelligent, connected,
manufacturing systems

Going beyond condition
monitoring (SPC) and fault
diagnosis

Self aware and self diagnosing
systems

Need for range of online multiple NDT/SPC datasets to assure process is in control

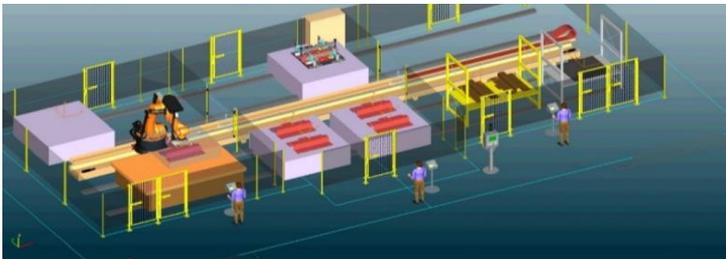
- Rapid sensing
- Multiple criteria
- Decision making

Industry 4.0 - Initiatives



Highly efficient composites preforming enabled through manufacturing informatics and in-process verification, truly realising data driven automation in composites manufacturing.

The end-effector houses an embedded heated tool, various grippers, and sensors. The core idea is to load-balance the complexity of forming, using grippers, tooling, and sensors – verifying key characterises in-process.



Automated Preforming Cell & Composites Integrity & Verification Cell – coming soon

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