



## **Hybrid Net-Zero Enabling Lightweight Technology for Mass Production**

**Alan Banks**, Ford Motor Company



# Composite Lightweight Automotive Suspension System



## CLASS Project

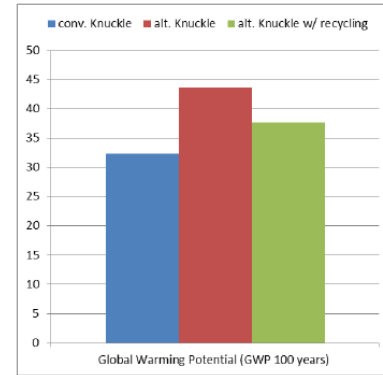
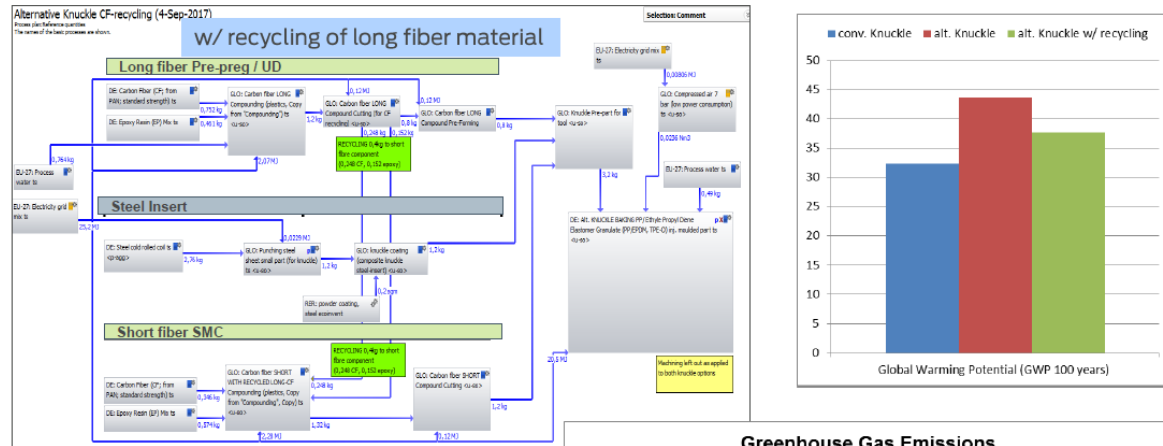
- SMC, prepreg and steel (over-moulded by SMC)



# Composite Lightweight Automotive Suspension System

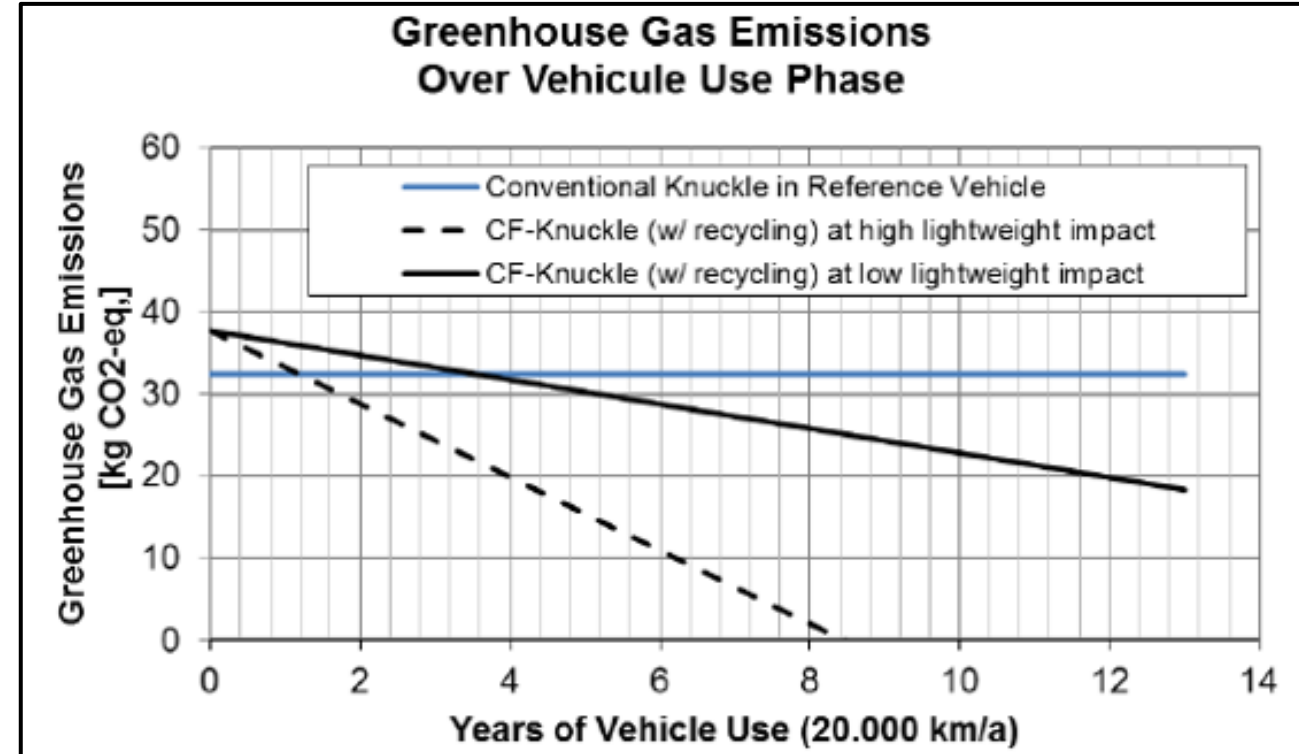
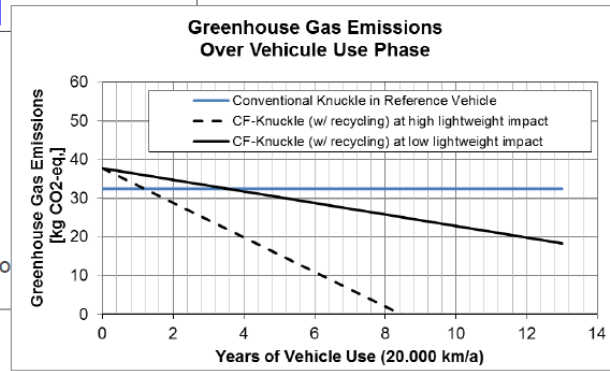


## Life Cycle Assessment of a Composite Knuckle (cont.)



### Result:

- With the current knuckle the greenhouse gas emission ( $\text{CO}_2$ ) will increase with manufacturing
- After ~ 7 years in use the break even point is reached (worst case)
- Using the car 10 years will lead to a reduction of 10kg  $\text{CO}_2$
- Recycling of long fiber material in the process will lead to a break even point after ~ 1 year of usage



When this LCA was performed, a sustainable method of re-using the long fibre waste and disassembling the different materials was unknown



## Front Subframe



Steel Component

21.1 Kg



Hybrid Concept

12.7 Kg



Hybrid Component

12.5 Kg



Flax Component

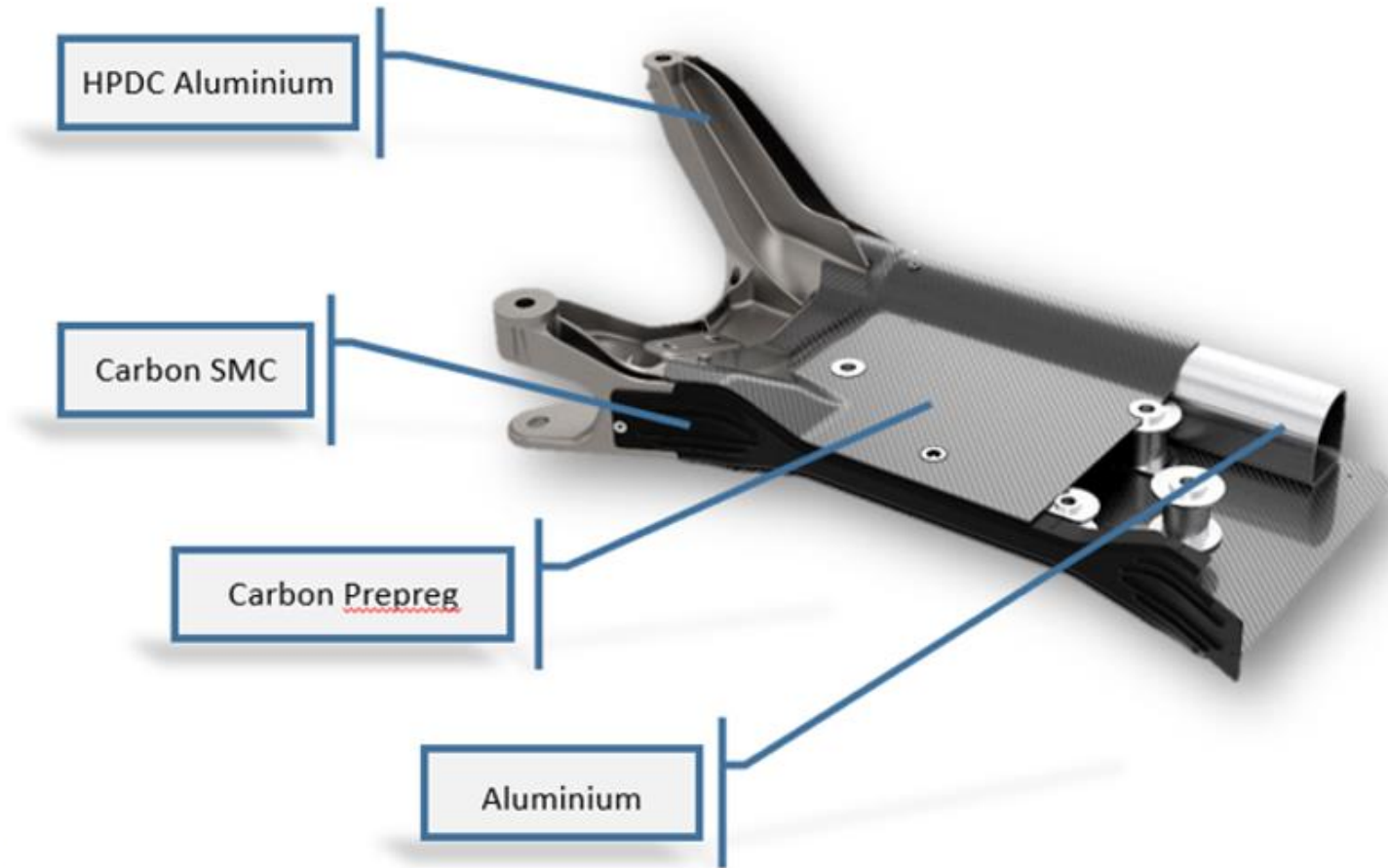
12.1kg

40.7 % weight save

42.7 % weight save

## Front Subframe

- Hybrid Material construction
- 18 fewer components in assembly
- **Innovation**
  - ❖ Right material right place
  - ❖ Alloy load paths for strength loads
  - ❖ Optimised Layups for cost / weight
  - ❖ Designed for Adhesive bonding
  - ❖ Designed for tolerance



Processes : HPDC, Extrusion, Forging, Compression moulding, Machining...

## Front Control Arm



Steel Component

4.4 Kg



Hybrid Concept

3.2 Kg



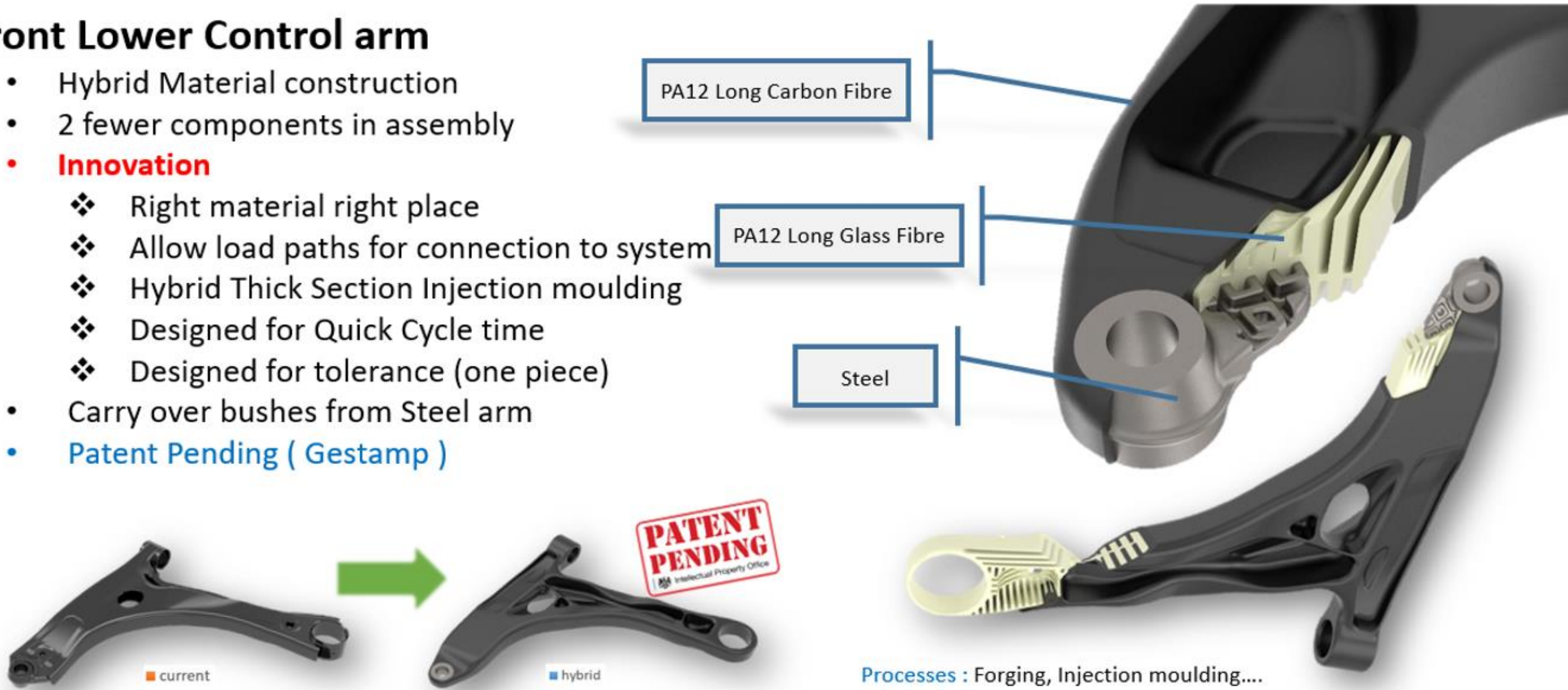
Hybrid Component

3.1 Kg

29.5 % weight save

## Front Lower Control arm

- Hybrid Material construction
- 2 fewer components in assembly
- **Innovation**
  - ❖ Right material right place
  - ❖ Allow load paths for connection to system
  - ❖ Hybrid Thick Section Injection moulding
  - ❖ Designed for Quick Cycle time
  - ❖ Designed for tolerance (one piece)
- Carry over bushes from Steel arm
- Patent Pending ( Gestamp )



## Deadbeam



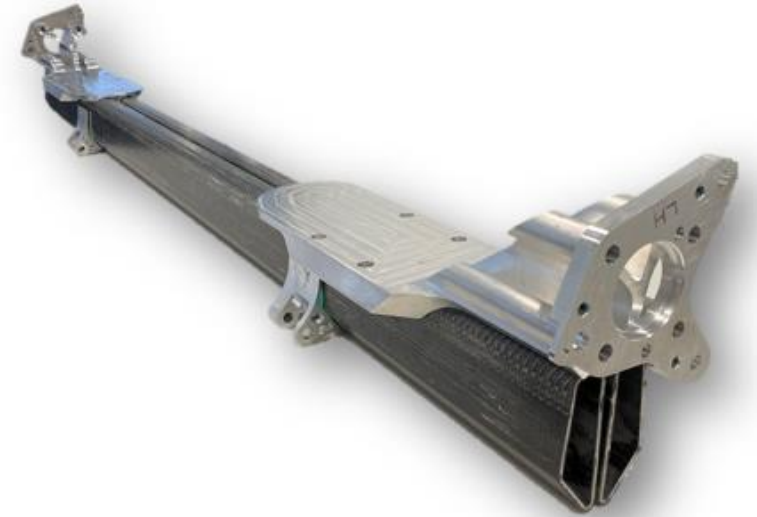
■ Steel Component

39.75 Kg



■ Hybrid Concept

19.7 Kg



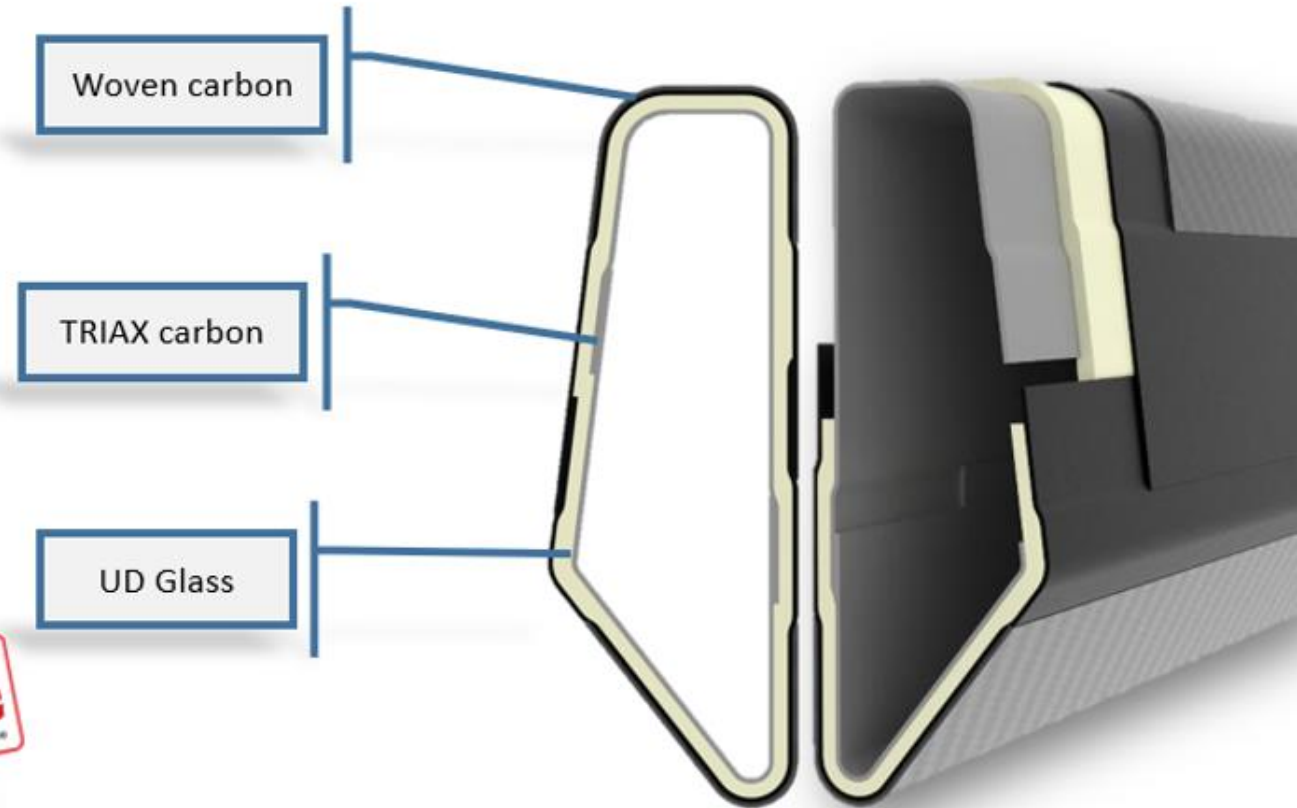
■ Hybrid Component

**18.7 Kg**

*53.2 % weight save*

## Rear Dead Beam

- Hybrid Material construction
- 8 fewer components in assembly
- **Innovation**
  - ❖ Right material right place
  - ❖ Alloy load paths for strength loads
  - ❖ Optimised Hybrid Pultruded beam
  - ❖ Part integration
  - ❖ Designed for Adhesive bonding
  - ❖ Designed for tolerance
- Patent Pending ( Gestamp )



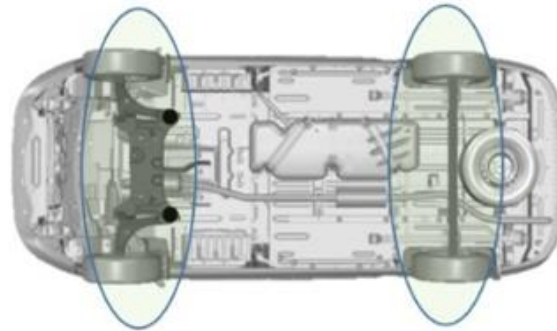
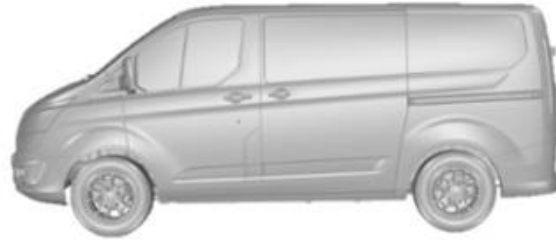
Processes : Extrusion, Pultrusion, Fine Blanking, Machining...

## Conclusions

All Steel Chassis



69.3kg



Hybrid Material Chassis



37.4kg



31.9kg Weight Save \*

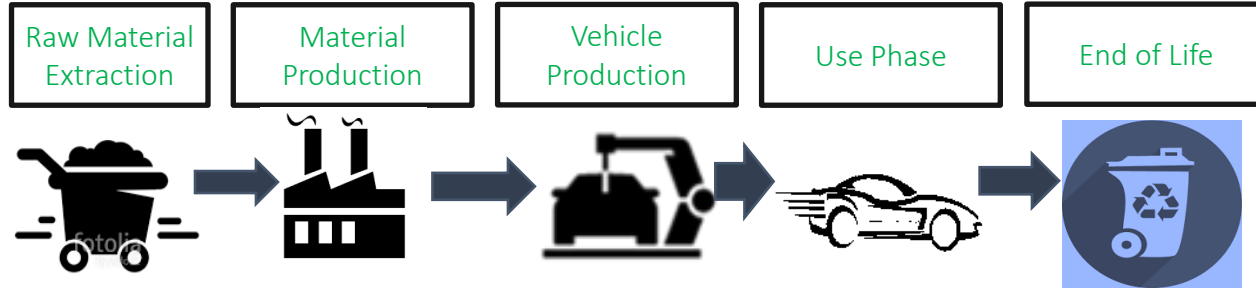
\*NOTE : Project Target was 25Kg weight save across platform



# Composite Hybrid Automotive Suspension System Innovative Structures

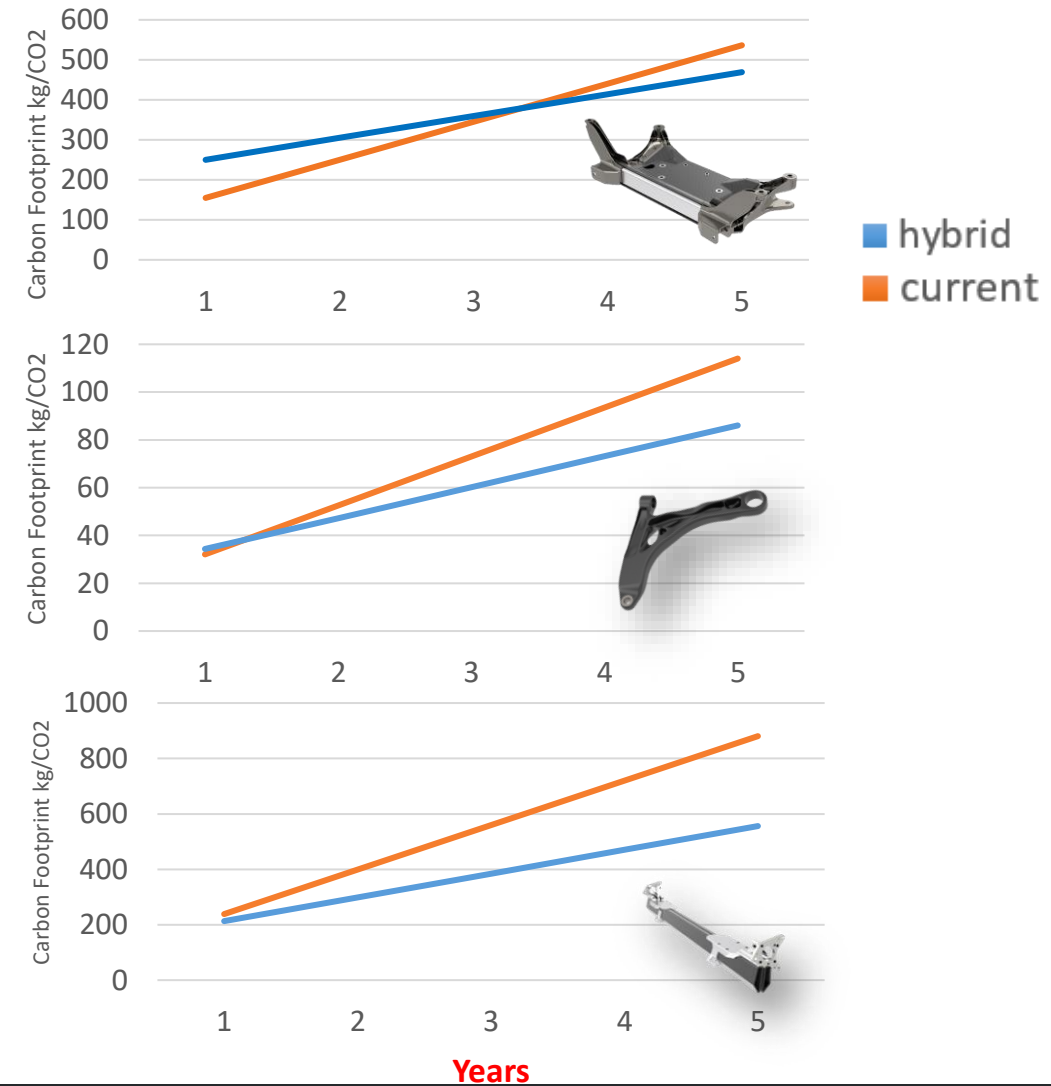
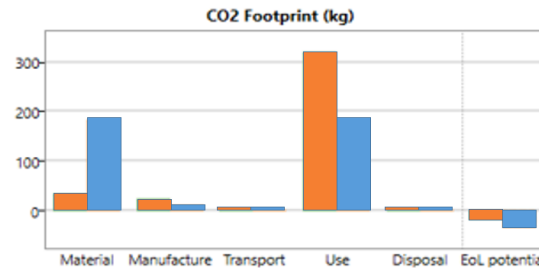


## Life Cycle Analysis (LCA) on Lower Control Arm



An Initial life cycle analysis was assessed for each component over a 5 year period based on 17K miles a year. Each component has different CO<sub>2</sub> breakeven points due to the weight, material selection and manufacturing process

- **Front Subframe:-**
  - Breakeven time will be **3.35 years** for CO<sub>2</sub> output
- **Lower Control Arm:-**
  - Breakeven time will be **1.3 years** for CO<sub>2</sub> output
- **Dead beam:-**
  - Breakeven time will be **0.65 years** for CO<sub>2</sub> output



# Disassembly and Recycling

Using the B&M Longworth DEECOM<sup>®</sup> (steam decomposition) process of sustainable fibre separation – First iteration

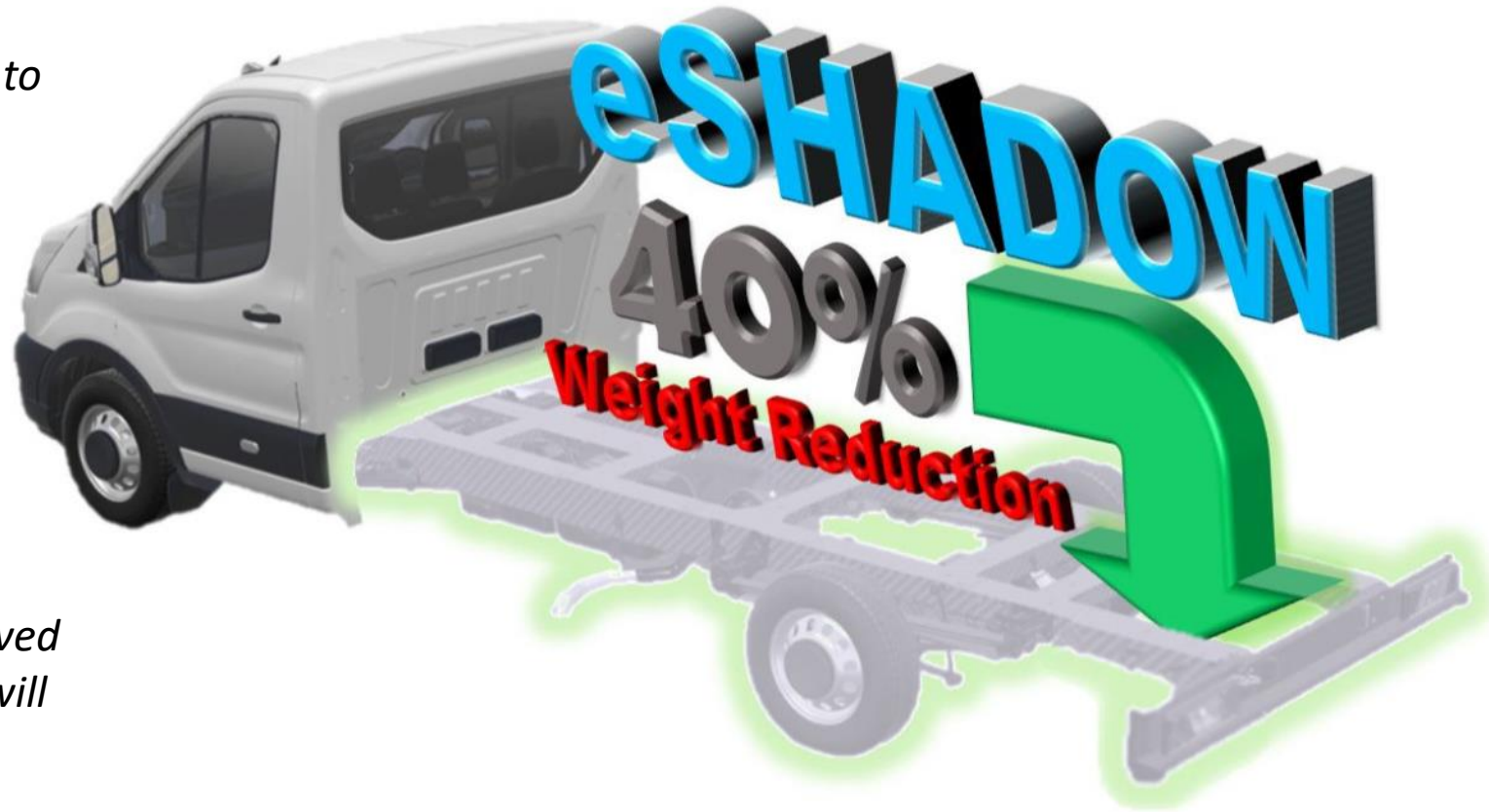
All reclamation pictures courtesy of B&M Longworth



# Electrified Structural Hybrid Automotive Designs for Optimised Weight

*The eSHADOW project will develop lightweight multi-material solutions for chassis ladder frames for commercial vehicle conversions to improve vehicle efficiency and enable the adoption of zero emission vehicle architectures.*

*Specifically, using a hybrid material combination of carbon and glass fibre reinforced polymer composite and metallic alloys in volume manufacturing process, weight savings of 40% as compared to conventional all steel systems will be achieved and these step reductions in vehicle mass will promote the adoption of EV technologies.*



# Thank you

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