



LANXESS High Performance Materials

Addressing the trends in automotive

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National Academy of Science Webinar: Assessment of Technologies for Improving Fuel Economy of Light-Duty Vehicles – Phase 3

May 17th, 2019

Agenda

- LANXESS Overview
- Plastics & Composites for Global Fuel Efficiency Automotive Trends
 - Lightweighting
 - Powertrain
 - Aerodynamics
 - Closing Remarks

LANXESS – A globally operating specialty chemicals company



Specialty chemicals company



- Spin-off from Bayer in 2004
- Specialty chemicals portfolio: chemical intermediates, additives, specialty chemicals and plastics

Global success story



- 60 production sites worldwide
- Approximately 15,500 employees in 33 countries
- Global sales of EUR 7.2 billion in 2018






Strategy of profitability and resilience



- Strengthening of leading position in medium-sized markets
- Consolidation in Europe, expansion in USA and Asia

High Performance Materials at a glance – Leading supplier of engineering plastics



Key figures	<ul style="list-style-type: none"> ▪ Sites: 9 ▪ Employees: ~ 1,600 ▪ Customers: ~ 600
Brands	<p>  Durethan[®] PA6 and PA66  Pocan[®] PBT  Tepex[®] COMPOSITES  HiAnt[®] Engineering </p>
Applications	
Markets	<ul style="list-style-type: none"> ▪ Automotive UTH ▪ Automotive Structural ▪ Electrical / Electronics ▪ Appliances

Global Presence




- Global compounding network
- Backward integrated supply
- Product and application development

Typical Polyamide (“Nylon”) applications in Automotive

Wide range of lightweight and durable components



Functional area	Automotive Components with LANXESS contribution							
 Body/Structure	 Roof/door frame	 Front end	 Spare wheel well	 Door Systems	 Structural insert	 Cross car beam	 Module/Electronics Housings	
 Drivetrain	 Engine oil pan	 Cylinder head cover	 Fan/Shroud	 Gearbox oil pan	 Fuel Delivery System	 Pulleys	 Air Systems	
 Interior	 Airbag housing	 Bracket	 Motor Housing	 Actuator Housing	 Seat pan	 Pedal / pedal bracket	 Rear Vision (interior)	 Window Surround
 Chassis	 Steering rod	 Air Spring Systems	 Chassis Space Frame	 Steering Control System	 Steering Column	 Connectors/Housings		

Agenda

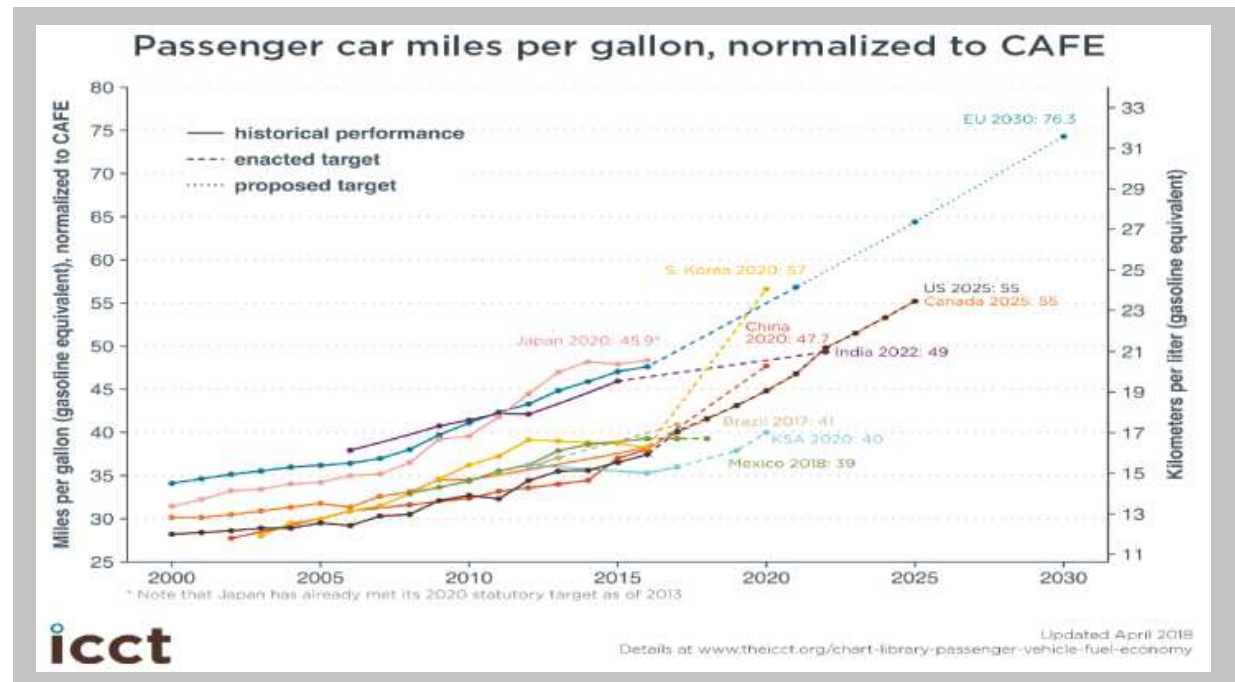
- LANXESS Overview
- **Plastics & Composites for Global Fuel Efficiency Automotive Trends**
 - Lightweighting
 - Powertrain
 - Aerodynamics
 - Plastic & Composite Innovation Highlights

Fuel Economy

Fuel efficiency regulations are a global trend

OEM Strategies

- Improving Fuel Efficiency through:
 - ✓ Lightweight
 - ✓ Powertrain
 - Electrification
 - ✓ Aerodynamics



Lightweighting

Across all vehicle classes

- Entertainment, comfort & safety features all increase vehicle weight
- 10% weight reduction improves fuel efficiency by estimated 6-8%
- Polymers make up 50% vehicle volume, but only 10% vehicle weight.
- Latest CFRP further reduce part weight by 70%

Challenges:

- Weight reduction without negative effect on performance, safety and cost.
- Metal replacement, as well as density reduction and thickness optimization of existing plastic parts
- Noise-Vibration-Harshness (NVH) considerations

LANXESS
Energizing Chemistry

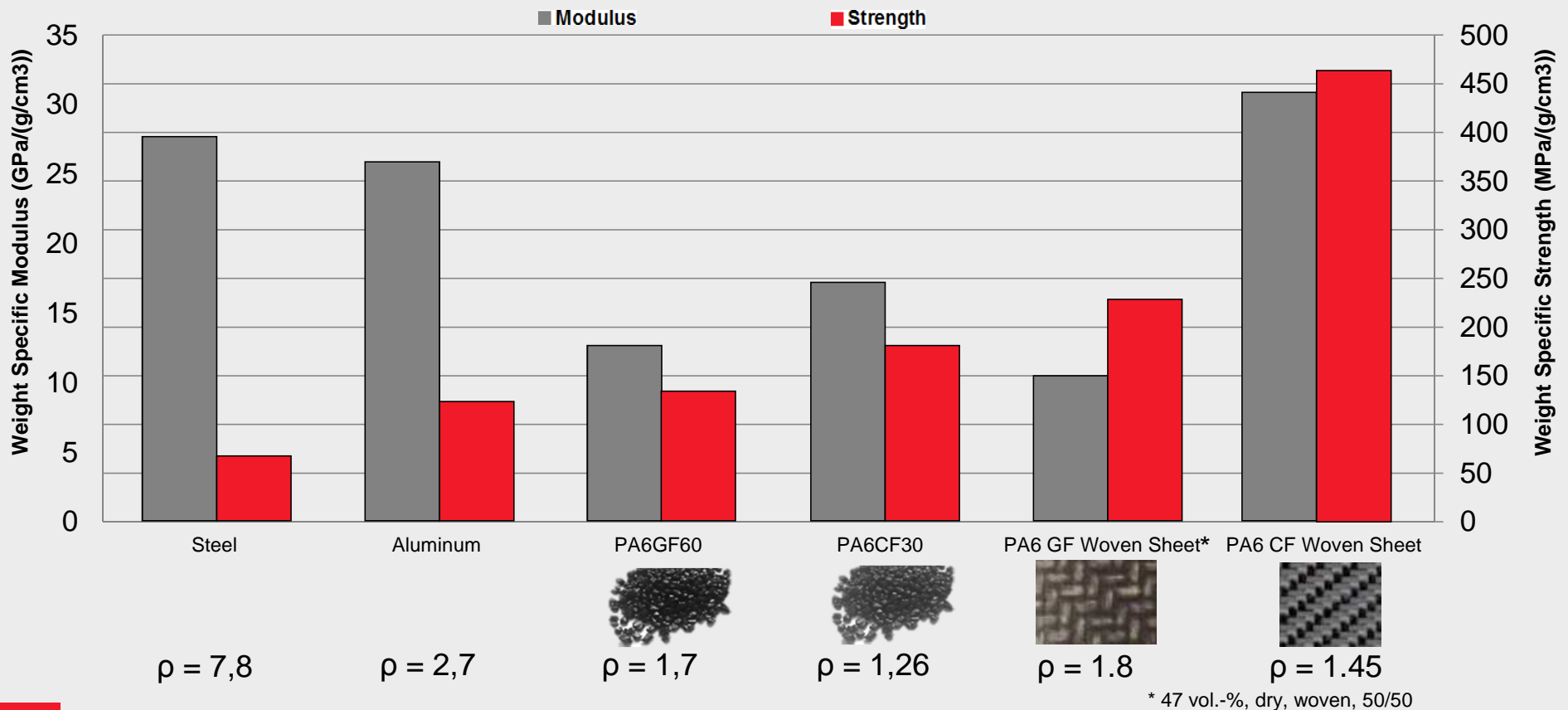


Technologies @ LANXESS

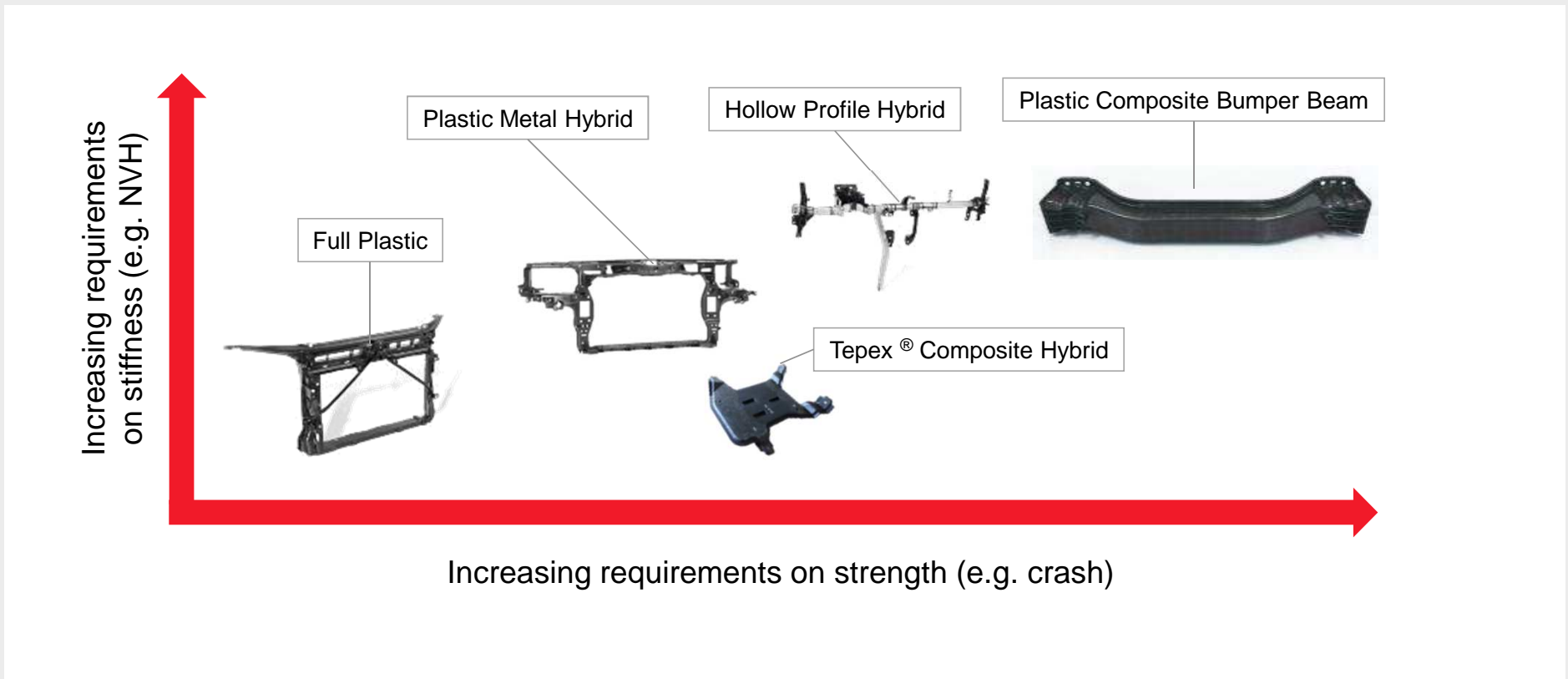
- High Modulus / High Flow materials for thinwall components, including CF Polyamide and composites
- Plastic Metal Hybrid for lighter components: Cross car beam, Front End Modules,
- All plastic composite components

Mechanical Properties of Metals vs. Thermoplastics

Weight Specific Comparison



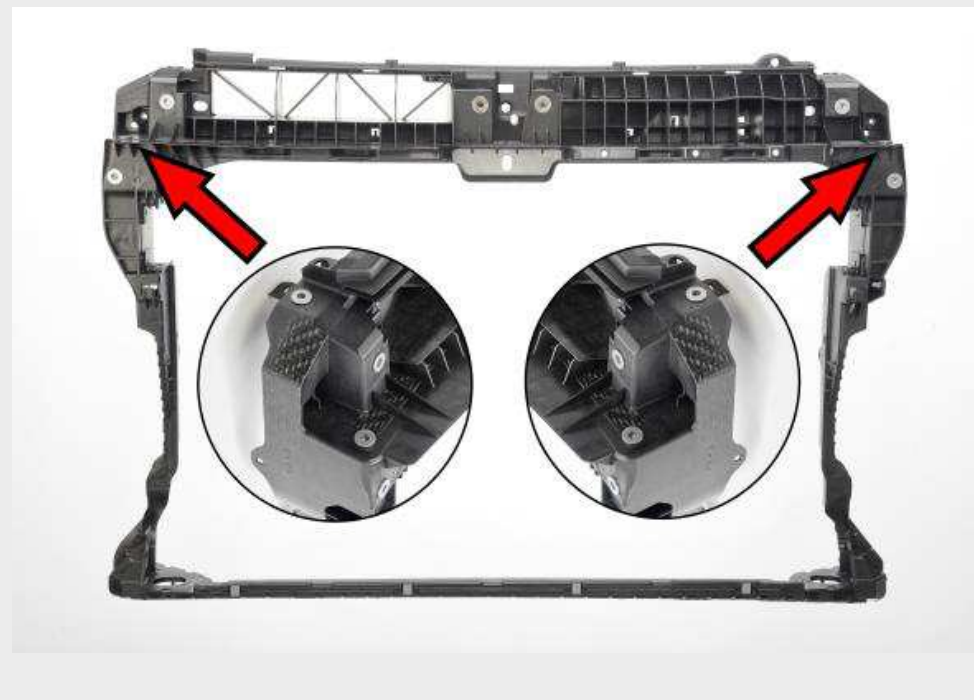
Lightweight Technology Toolbox LANXESS



Lightweight Front End

Use of localized composites

SUV Front End Module



Tepex® Composite Technology

- Free of sheet-metal – even at top cross-member extending to the fender carriers
- Withstands hood latch and head lamp loads without sheet-metal reinforcement
- 50% weight reduction vs Steel
- Wall thickness 1.8 – 4 mm
- Cost savings through smart use of composites:
 - ✓ Localized Tepex composite only used where it is needed.

Lightweight examples

In production today – Future developments ongoing



Rear Bumper

- Part weight ~3.6 kg
- Weight reduction ~50 % vs aluminum/steel
- ✓ One shot process
- ✓ Meets all US standards for rear crash performance



Cross Car Beam

- High stiffness
- Functional integration
- Lightweight
- Cost reduction
- ✓ Meets all US standards for crash performance

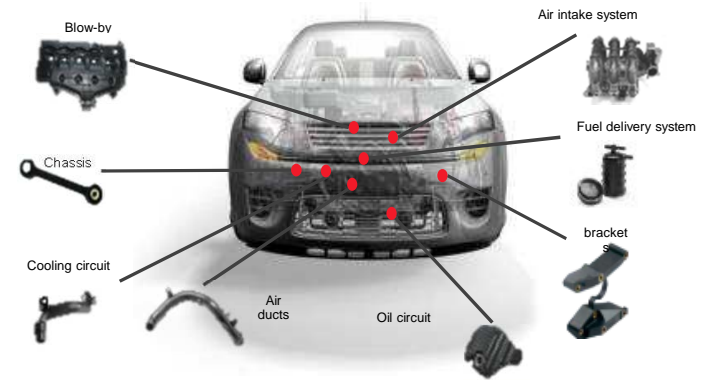
Powertrain

Turbo is here, Electrification is coming

- Powertrain know-how is main focus for fuel efficiency
 - Accounts for \approx 25% of vehicle mass
- ✓ Turbo charged and EGR (Exhaust Gas Recovery)
- ✓ Powertrain electrification
- ✓ Global Platforms

Challenges:

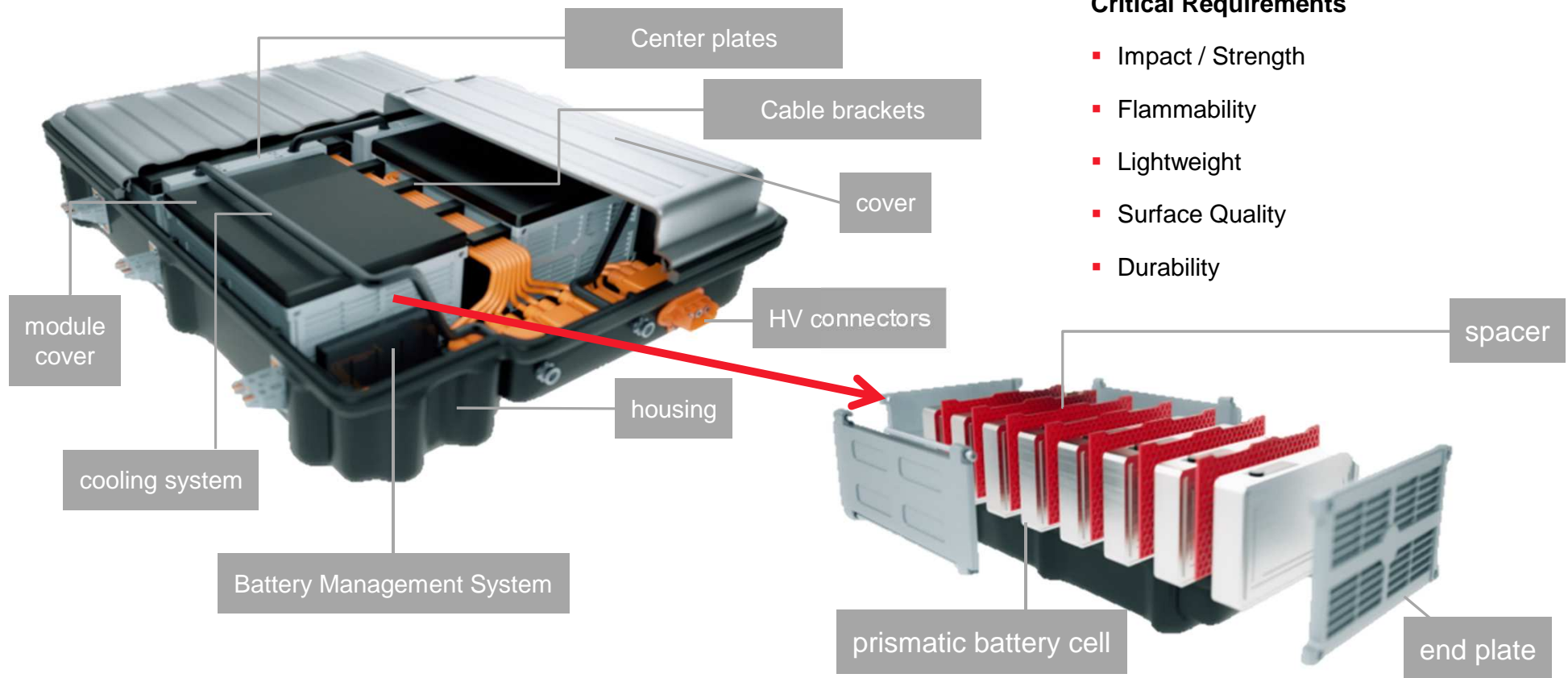
- Increased engine temperatures
- Compact engine design
- Lightweight electric systems with new requirements:
 - ✓ Cooling, flame resistant, EMS ...



Technologies @ LANXESS

- Next Generation High Heat PA grades (“XTS”) for AIM.
- Hot Side air ducts with improved heat stability
- High temperature Hydrolysis Resistant (HR) grades for cooling systems.
- Metal replacements in Engine and Transmission components

Battery System – Various applications for Engineering Plastics



Critical Requirements

- Impact / Strength
- Flammability
- Lightweight
- Surface Quality
- Durability

Improved Aerodynamics

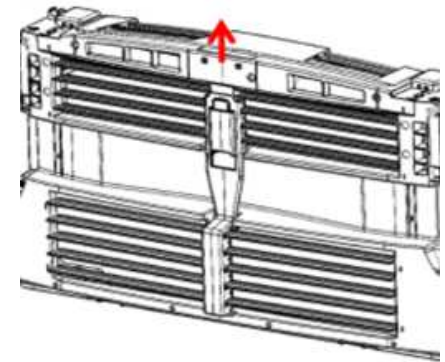
Active Grille Shutters (AGS) and Underbody Protection



- Aerodynamics essential, even for EVs
- Just removing roof rack improves fuel economy by 5%
- AGS not implemented “across the board”
 - Depends on engine size, fuel efficiency strategy
 - Improves FE by 2g CO₂/km = 1.1 MPG (0.4 km/l)

Challenges:

- Optimization of AGS (weight / flatness / strength)
- Underbody components with unique requirements:
 - Impact resistance, engine accessibility, heat management



Technologies @ LANXESS

- New Extreme Flow PA grades for reduced warpage (BKV30XF) and improved cycle times
- Next generation of UV-stable PA grades with improved surface quality
- Tepex® composite sheet for underbody protection

Tepex[®] compression molding (LWRT) Under body protection

Direct Compounded Long Fiber Thermoplastic

- Compression molding Low Weight Reinforced Thermoplastic **LWRT**
- Tepex[®] composite surface and metal inserts
- 3 times higher strength and energy absorption in comparison to other non-composite solution
- Improved acoustics / sound absorption
- Impact Resistant: excellent durability on rough roads
- Fast cycle times for mass production (<1 min)



Polymer Materials Improving Fuel Economy

- Safely Reducing Weight
- Reducing Cost & Consolidating Parts
- Improving Aerodynamics
- Enabling Electrification & More

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Energizing Chemistry