

# Lightweight... Every Gram Counts

Rob Mol  
Business Development Manager  
West Europe

December 6, 2016



# 3M Facts and Figures 2015

## 3M Worldwide

- Headquarters: St. Paul, Minnesota, USA
- Sales: \$ 30.3 Billion  
(65% outside USA)
- Employees: 89,500
- Researchers: 8,300
- Subsidiaries: in 70 countries
- Manufacturing: in 38 countries
- Laboratories: in 36 countries

## Diversified Technology Company

- 46 core technologies
- R&D investment: \$ 1.7 Billion  
(5.6% of sales)
- 100,000+ registered patents
- 55,000 products
- 33% of sales from products launched in the last five years



Our Vision

3M Technology Advancing Every Company

3M Products Enhancing Every Home

3M Innovation Improving Every Life

## Markets & Products



Industry &  
Skilled Crafts



Health Care  
Products



Automotive &  
Aerospace



Workplace,  
Personal and  
Traffic Safety



Home &  
Leisure



Office &  
Communication



Display &  
Graphics



Tele-  
communications,  
Electronics &  
Energy

# Lightweight Trend in Automotive (Europe)

*Global Market Growth Lightweight Materials : 8.5% CAGR (2014-2020)*

## Megatrends



Urbanization

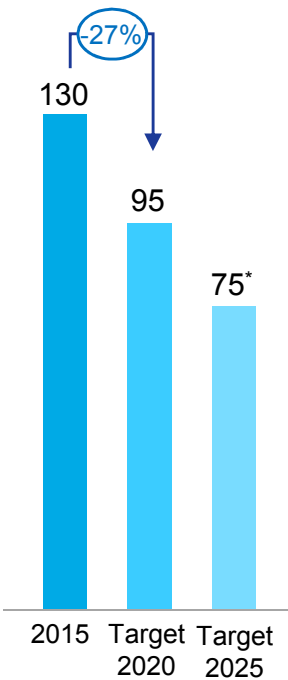


Global Warming

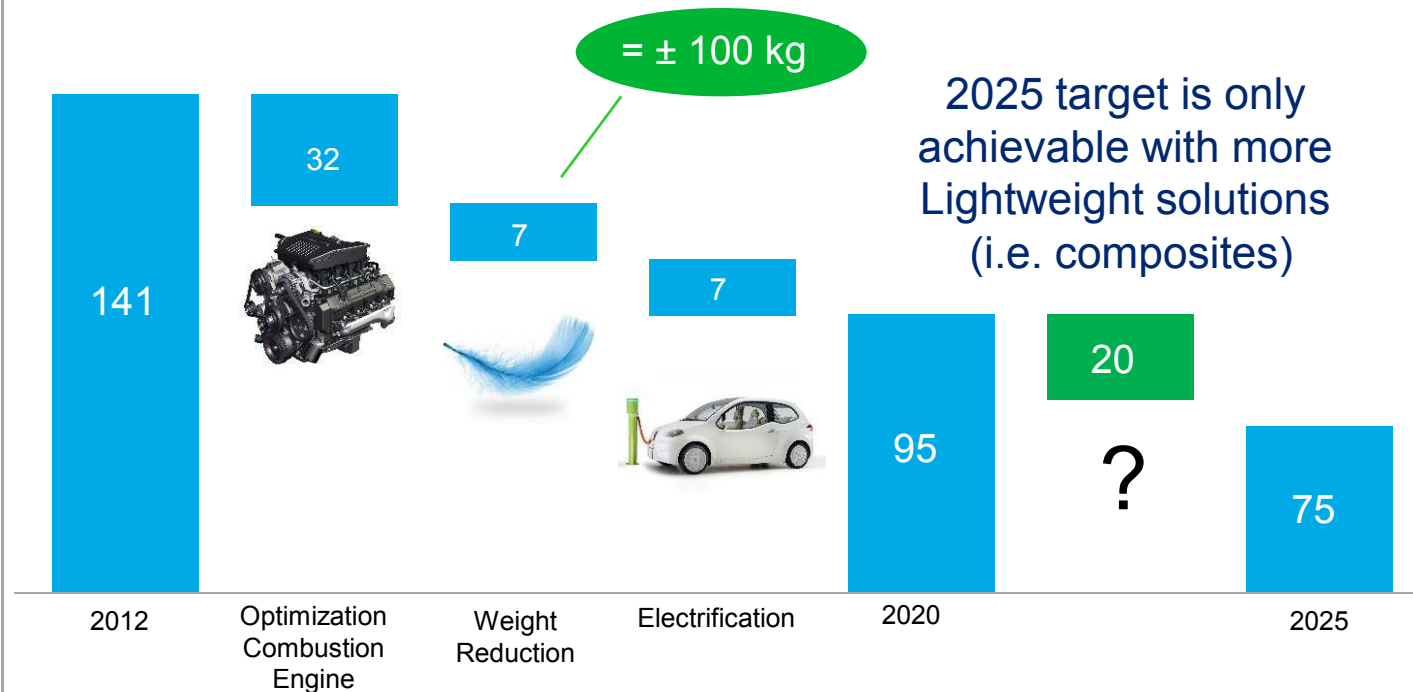


Depleting Natural Resources

## CO<sub>2</sub> Fleet Targets (g/km)



## CO<sub>2</sub> Reduction Levers Until 2020 and 2025 (g/km)



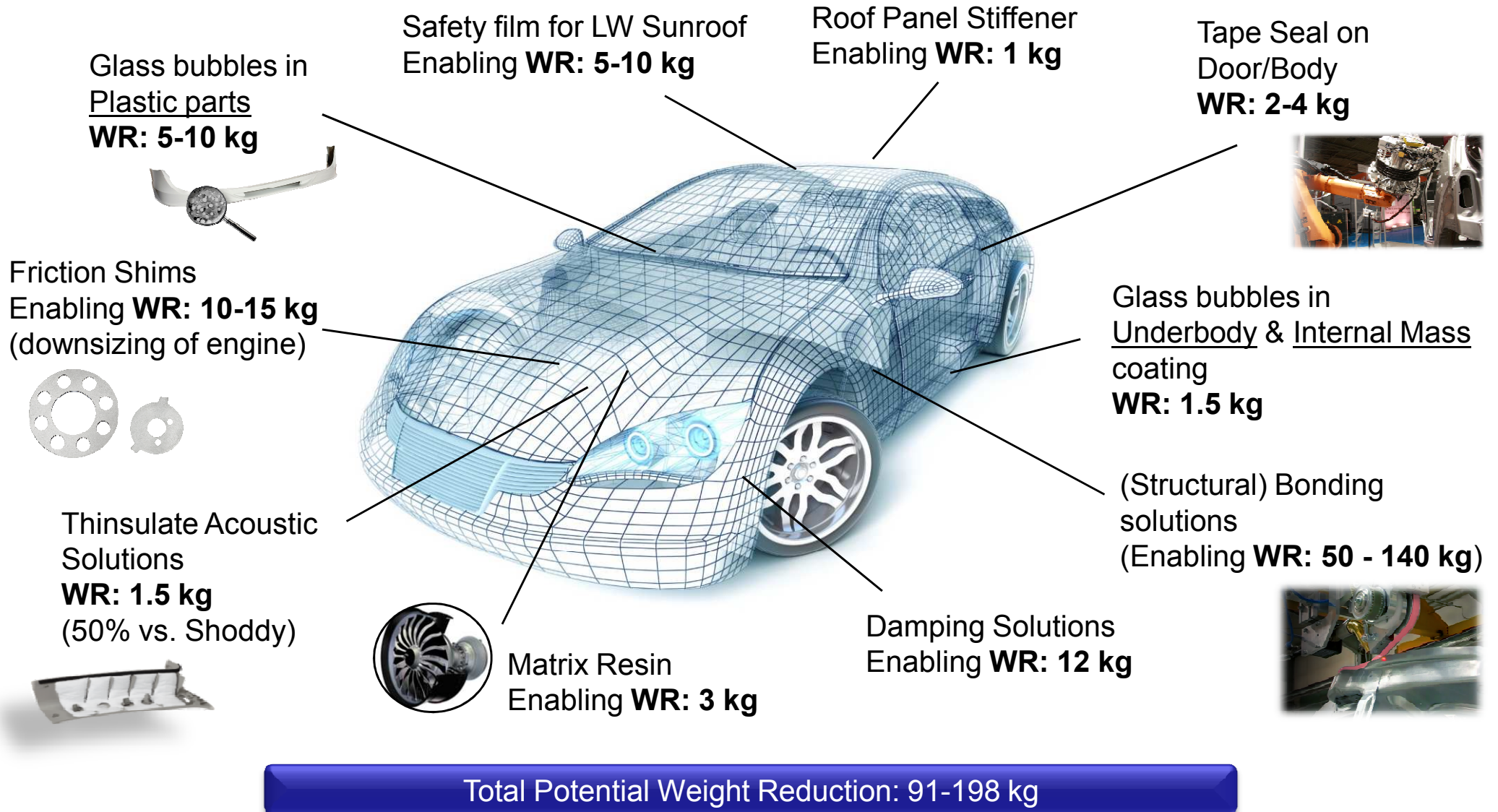
Source: BCG Automotive Study 2025

Penalties Up To EUR 95/Car Can Be Given To OEM's Who Don't Meet The Max. Emission Levels



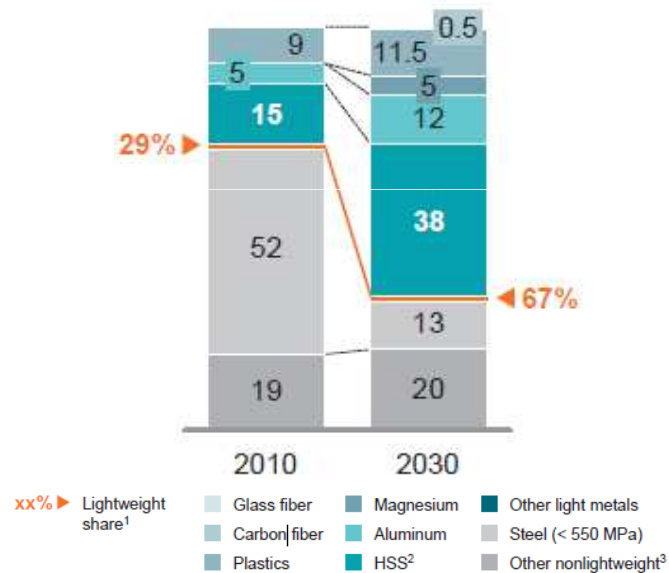
# 3M's Enabling Lightweight Solutions

*Per Car Of 1500 kg*



# 3M's (Multi-Material) Bonding Solutions

Lightweight Trend in Cars



- Common steel will be replaced by a mix of Lightweight materials
- The use of Plastics and FRP will double in next 5 years
- New joining techniques will be needed
- 5 year CAGR for Structural Adhesives in Automotive segment: +9%

3M™ Scotch-Weld™ Structural Adhesives & SAT's  
Epoxy, Acrylic, Urethane

Polyurethane Adhesives  
3M™ Scotch-Weld™ PUR

3M™ Adhesive Sealants  
Polyurethane and Hybrids

3M™ Hot Melt Adhesives

Acrylic Foam Tapes  
3M™ AFTs

3M™ Contact and Spray Adhesives

3M™ Reclosable Fasteners  
Dual Lock™ and Hook and Loop

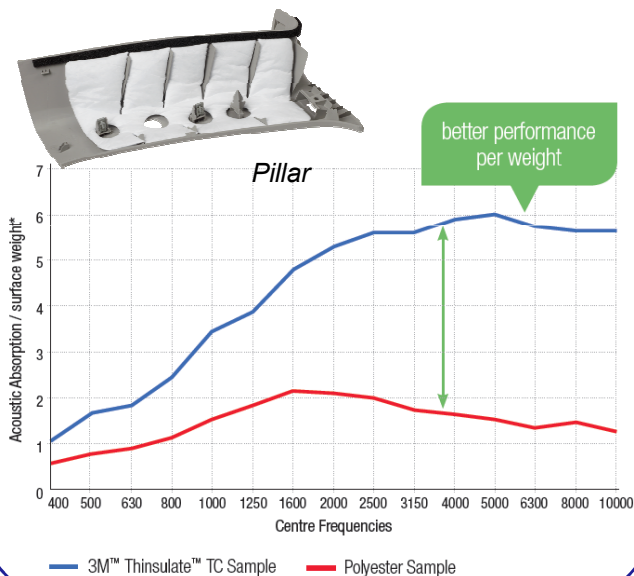
3M™ Pressure-Sensitive Adhesives  
3M™ Adhesive Transfer Tapes,  
3M™ Double-Coated Tapes

*It is important that full assessments are made of any application, materials differ.*

# Other Plastic Related 3M Solutions...

## 3M™ Thinsulate Acoustics

- Lighter structures = More NVH
- Non woven acoustic absorber
- Easily compressed to fill cavities
- No mold build-up (hydrophobic)
- Lightweight (50%-75% weight efficiency compared to alternative absorbers)



## 3M™ Matrix Resins

- Improved fracture toughness
- High modulus
- High hardness
- Enables composites with
  - Increased pressure resistance
  - Increased flexural modulus and shear modulus
  - Improved interlaminar shear strength
- Improved scratch resistance
- Reduced curing shrinkage

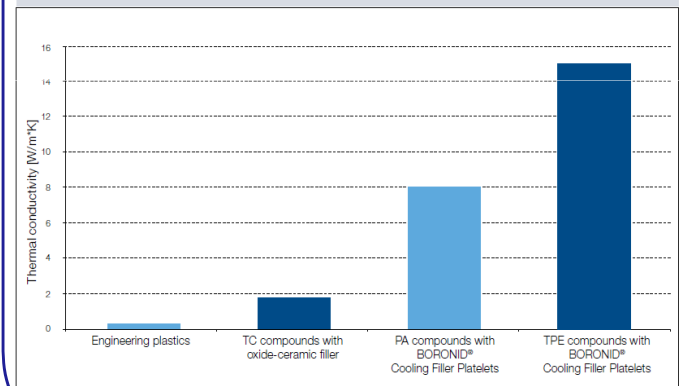


CNG Tank for Heavy Trucks

## 3M™ Boron Nitride Cooling Fillers

- BORONID® Cooling Fillers for highly thermal conductive thermoplastics and thermosets
- Thermal conductivity up to 15 W/m\*K
- Electrical insulation
- Enables substitution of metal parts that require thermal conductivity

Comparison of thermally conductive plastics





## 3M™ Glass Bubbles

For  
Thermoplastic &  
Thermoset  
Applications

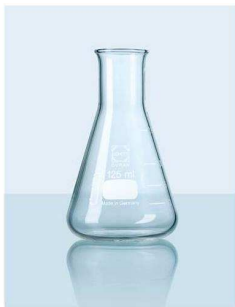


# 3M™ Glass Bubbles - Microsphere Filler

*5 To 25 Times Lower Density Compared To Minerals*

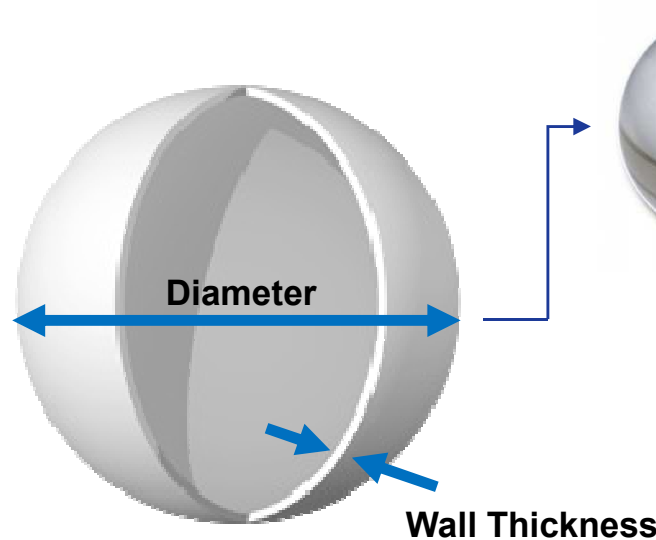
## 1. Hollow

- Low Density
- Low Thermal Conductivity
- Low Acoustic Transmittance
- Low Heat Capacity



## 3. Glass

- Water & Chemical Resistant



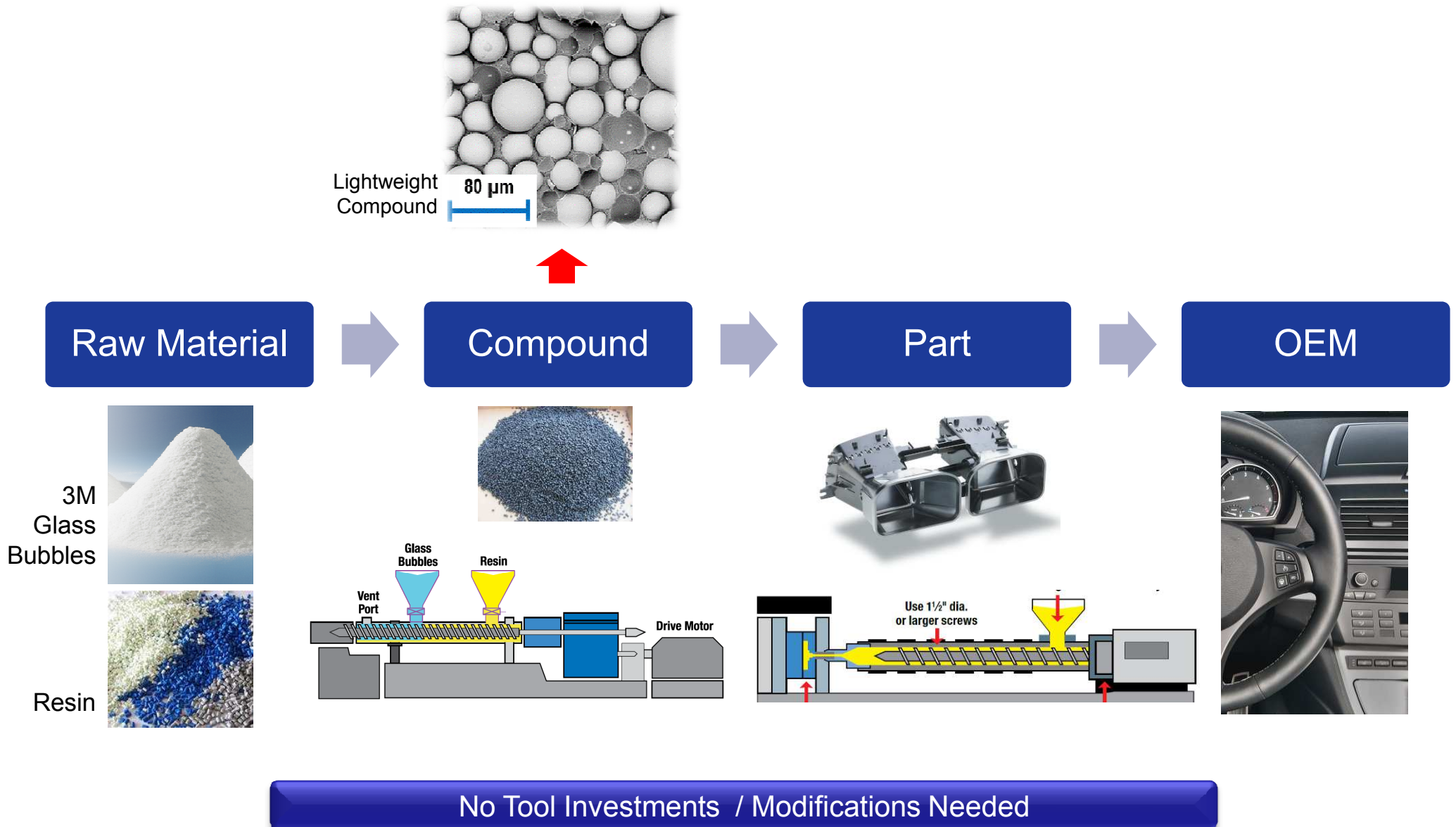
## 2. Spherical

- Isotropic Properties/no Reinforcement
- Low Surface to Volume Ratio

Property	All 3M™ Glass Bubble Grades	iM16k
Shape	Hollow; thin walled; single-cellular spheres	
Composition	Borosilicate glass; Chemical and water resistant	
Color	White	
Hardness	Mohs Scale 5	
Softening temperature	600° C	<b><u>iM16K</u></b>
Density	0.12 – 0.6 g/cm <sup>3</sup>	0.46 g/cm <sup>3</sup>
Isostatic pressure resistance	1.7 – 190 MPa (250 – 28,000 psi)	110 MPa
Average particle diameter	65 – 16 µm	20 µm



# Injection Molding Applications



# Injection Molded Applications - Automotive

## *Current Applications of 3M™ Glass Bubbles in Thermoplastics*

- Weight reduction up to 13%
- Cost neutral because increase in material cost was compensated by higher productivity (cycle time reduction)
- Reduced shrinkage & warpage



Glass Bubble used: S60HS  
Recommendation for new projects: iM16k

# Injection Molded Dashboard – Automotive

## *Current Applications of 3M™ Glass Bubbles in Thermoplastics*

- Weight reduction ~ 33%
- Final material density 0.88
- Material: Polypropylene
- Reinforcement: Glassfiber

Full Production: Q1 2017



*Dashboard with 3M Glass Bubbles*



*Alfa Romeo Stelvio*

Glass Bubble used:  
iM16k



# Extrusion Applications - Aerospace

## *Current Applications of 3M™ Glass Bubbles in Thermosets*

- Weight reduction ~ 12%
- Mat surface, „soft touch“
- ➔ Serial application in Airbus A350



Low-density polymer systems specifically for the aircraft industry have been developed using 3M™ Glass Bubbles in high temperature high performance polymers.



Photo provided by REHAU as portrayed at NPE 2012.



Glass Bubble used: iM30k-N  
Recommendation for new projects: iM16k

- 5 kg weight savings per aircraft
- 1000 liters fuel saving/year
- Reduction in carbon emissions

# Automotive RRIM Parts

## *Current Applications of 3M™ Glass Bubbles in Thermosets*

- Resin: Polyurethane (Covestro / Bayflex Lightweight)
- Reinforced with recycled carbon fibers
- 23% reduction in density (1.2 kg reduction)
- Density = 0.9 g/cm<sup>3</sup>
- No impact of mechanical properties vs. previous model



Glass Bubble used: K42HS  
All new applications: iM16k

# SMC Application

## *Current Applications of 3M™ Glass Bubbles in Thermosets*

- Material: low density-SMC Class A
- Density: 1.4 g/cm<sup>3</sup>
- Deck Lid DaimlerChrysler CL-Model
- Deck Lid BMW 3-Series M2
- Underbody capsule multiple Daimler Nameplates



Glass Bubble used: K37, S38, VS5500 (S38HS)  
New projects: iM16k, iM16k-MAS-1



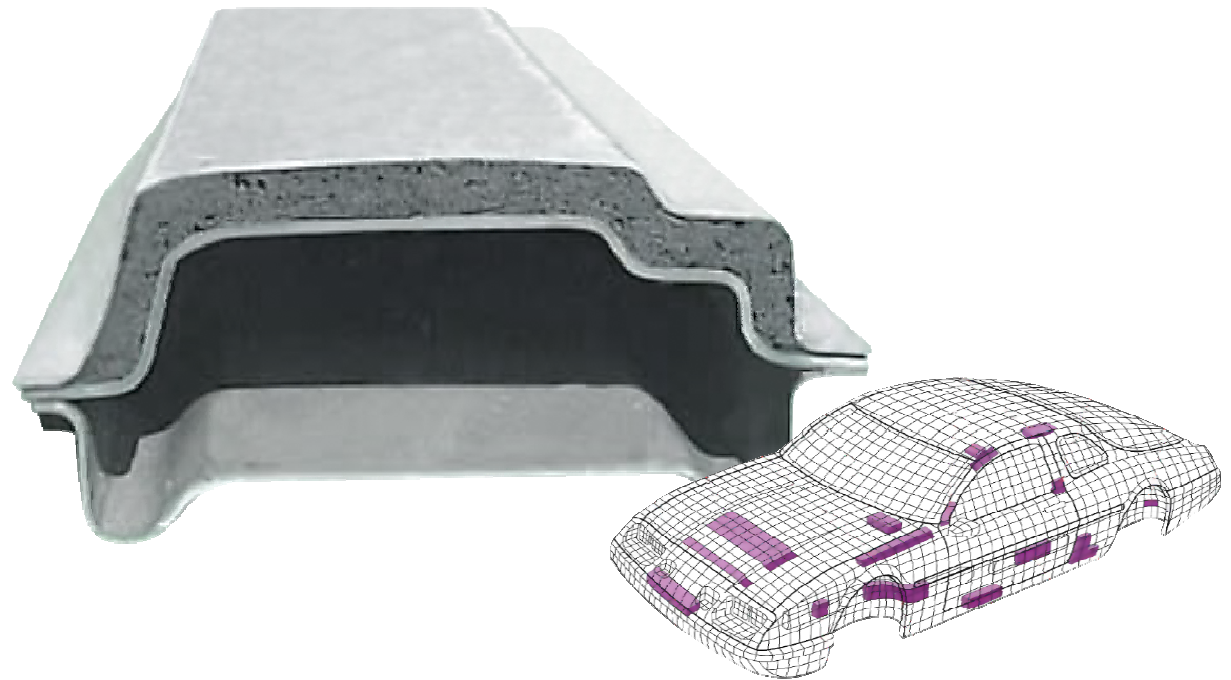


# Structural Foam

## *Current Applications of 3M™ Glass Bubbles in Thermosets*

Used as reinforcement and stiffeners to improve:

- Impact resistance
- Reduced vibration, noise, harshness (NVH)
- Crash performance



Glass Bubble used:  
VS5500 (S38HS)

**3M** Science.  
Applied to Life.™