Plastics in Automotive Applications

Plastics in Automotive Applications

Webinar 12:00 Wednesday 14 April 2021

presented by:

Dr Trevor J. Hutley MBA

Global Polymer Industry Consultant

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Dr Trevor J. Hutley has international technical and management experience in the global plastics industry; in research [R&D], product development, technical service, and application, market and business development. He is a specialist in polymer materials, additives, formulation, structure-property relationships, and applications. Dr Trevor has been an independent polymer consultant, and Member of the PCN, for 21 years.

Outline

- ‘The Product Lifecycle’ webinar Series by the PCN

  The Plastics Consultancy Network
- Markets and Applications for Plastics
- Scope: Plastics in Cars
- Drivers and Trends for Plastics in Cars
- Examples of Plastics in Cars
- Cutting edge: Plastics in Cars

Acknowledgements

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Acknowledgements

BPF "Lunch & Learn" Webinars

The British Plastics Federation

https://bpf.co.uk/events/webinars/lunch-and-learn.aspx

"The Product Lifecycle" Series of Webinars

presented by:

pcn.org

PLASTICS CONSULTANCY NETWORK

Serving the polymer industry since 1988

The Plastics Consultancy Network *[PCN] is a professional network of some of the most experienced independent polymer consultants in the world*

BPF / PCN “The Product Lifecycle” Series

The British Plastics Federation The Plastics Consultancy Network

presented by:

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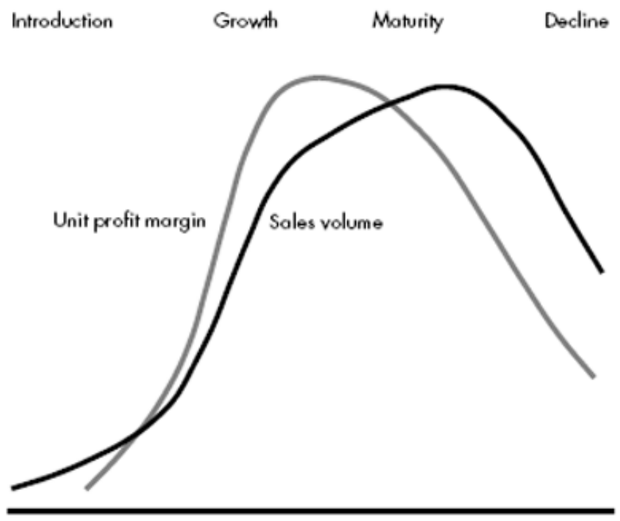
“The Product Lifecycle” Series of Webinars provides a brief introduction to many of the topics that are critical to understanding the development of plastics products;

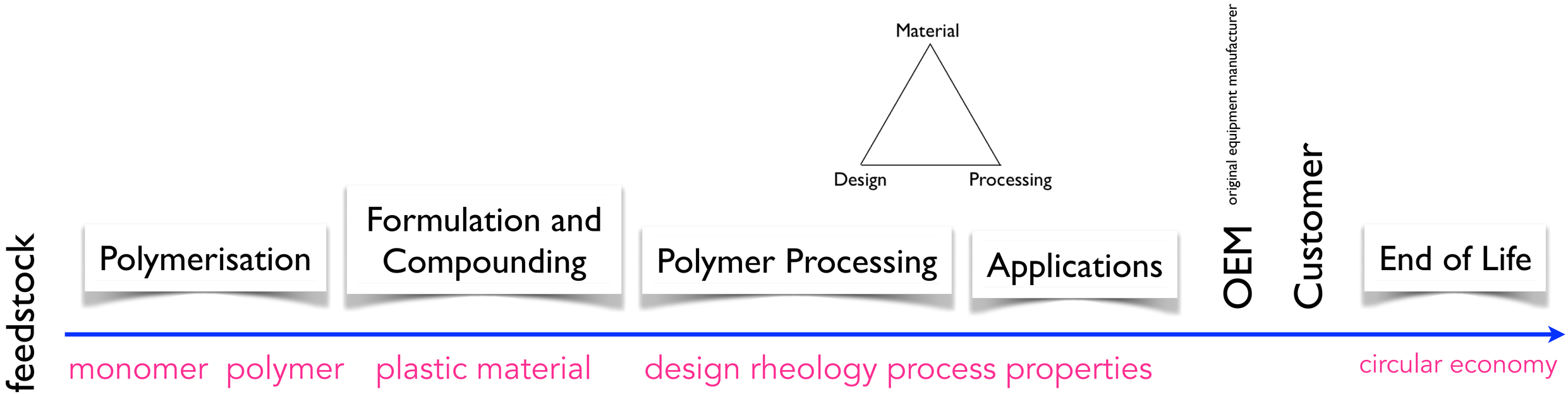
not lifecycle in these terms:



but **the life from a polymer material to a plastic product**…….

Think rather of the polymer industry value chain

Polymer Industry Value Chain



Influences on Plastic Part Performance:

Material

Polymer, Additives and Modifiers, Compounding Route, Particle size and shape

Design

Material Selection, Shape, Gating

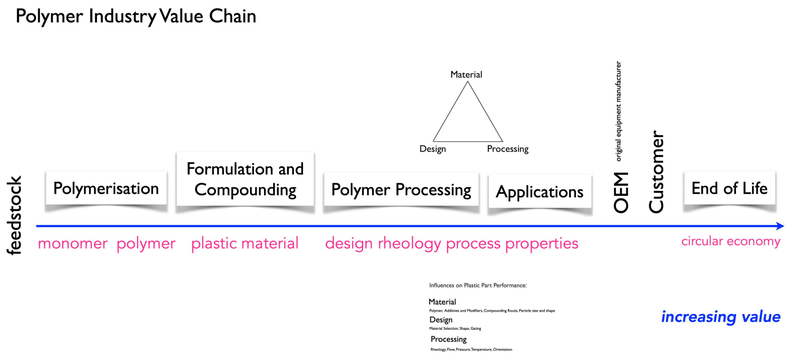
Processing

Rheology, Flow, Pressure, Temperature, Orientation

increasing value

“The Product Lifecycle” Series of Webinars

Phases of the Lifecycle of a Product:



- Materials
- Design
- Manufacturing
- Applications
- End-of-life
- Managing

Plastics in Automotive Applications

Webinar 12:00 Wednesday 14 April 2021

The automotive industry is a major growth market for polymers, with a global consumption that is forecast to soon reach 20 million tons with a value of around $50 billion.
This "Lunch & Learn" Webinar provides an introductory overview of this application sector.
The focus is on plastics materials in cars. Examples of the automotive applications of plastics provide clear demonstrations of the many benefits of plastics materials, and the value that they create.

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Introduction

A Growth Market

There about 1.35bn vehicles on the roads of the world. In 2020, 56m cars were sold.
The automotive industry has been a major growth market for polymers for about 60 years.
In 1993, the global market was over 4 million tons with a value over $7,500 million.
This global consumption is forecast to soon reach 20 million tons, with a value of around $50 billion.

Purpose:

This "Lunch & Learn" Webinar provides an introductory overview of this application sector.

Scope:

The focus is on plastics materials in cars. Examples of the automotive applications of plastics provide clear demonstrations of the many benefits of plastics materials, and the value that they create.

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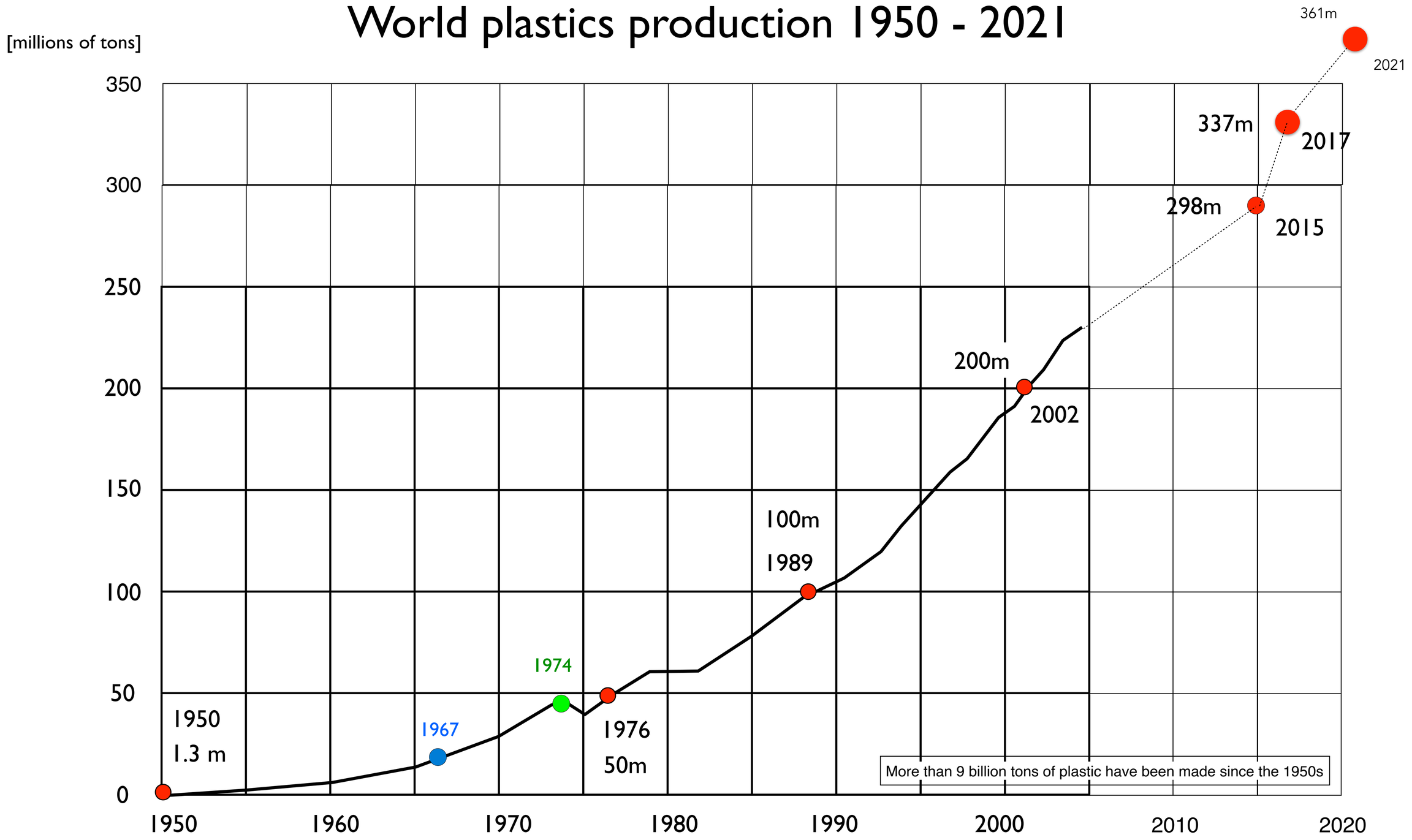
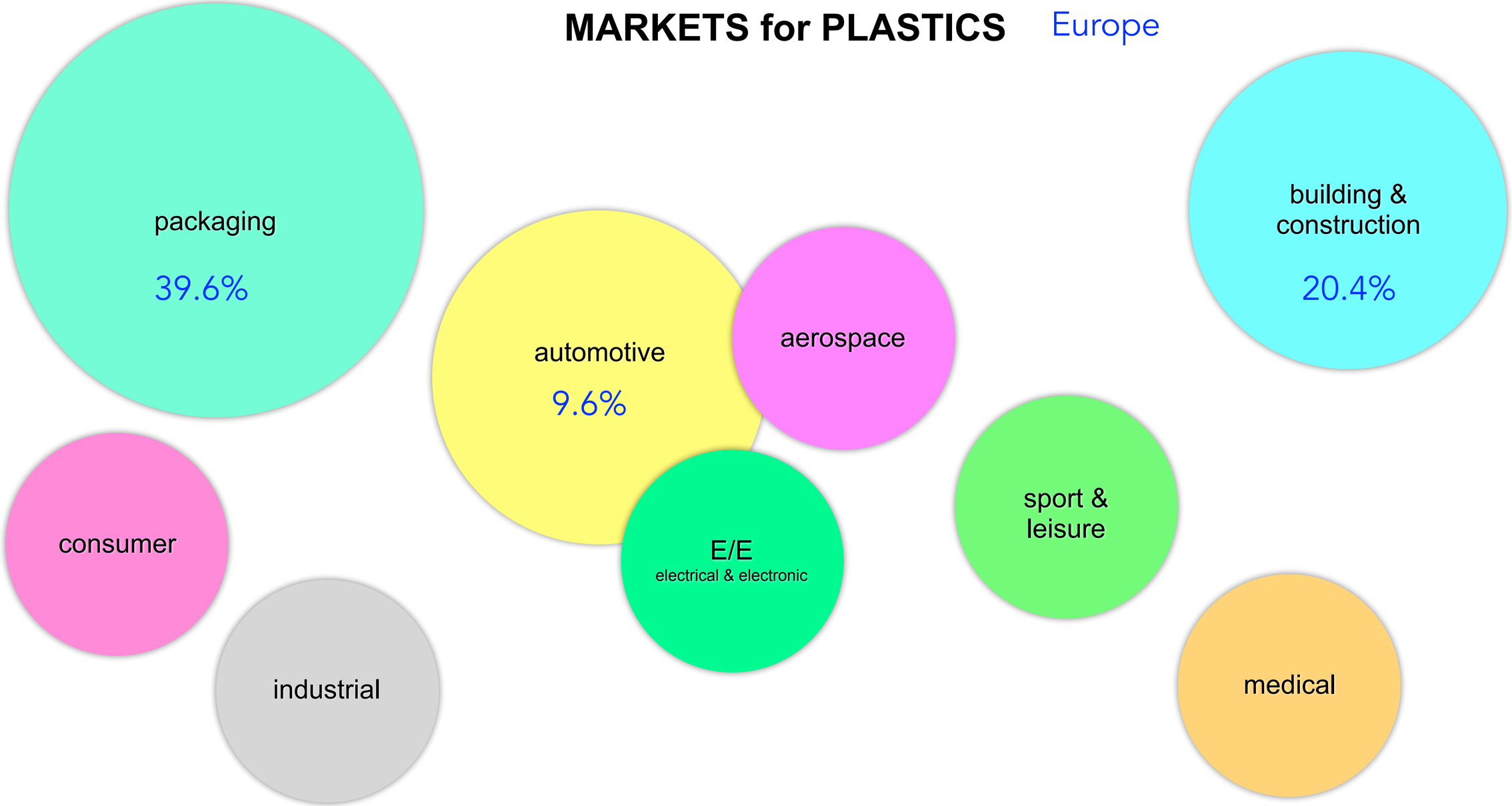
World plastics production 1950 - 2021



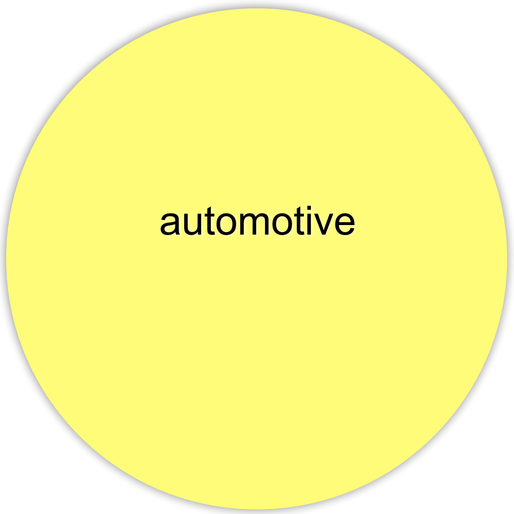
DRIVERS for growth:

- demographics
- progress of society
- geographical shift
- material substitution & technological progress
- market & application opportunities
- carbohydrate versus hydrocarbon

MARKETS for PLASTICS Europe



AUTOMOTIVE MARKET for PLASTICS



- Exterior

  door panels, roofs, sun-roof frames, floors, wings, back panels, bonnets, mud flaps, bumpers, door handles, mirror housings, underbody shields

- Interior

  primarily in decorative, safety, noise, vibration, and harshness applications for the interior parts of the vehicle, including the cockpit systems (instrument panels [IPs], structural portions of IPs, and dashmats), headliners, seat systems, soft and hard trim (door trim and pillars), interior door handles, gloveboxes, and packaging trays, steering wheels, door handles, and mirror housings, airbags, airbag doors (covers)

- Powertrain

  Under the bonnet (AIM, thermostat housing, charge air coolers, engine covers), fuel systems, fuel tank

- external and internal lighting systems
- glazing

Features of Plastics

low cost

self-coloured

insulating

can be tailored

tough

durable

ease of assembly

transparent

integration: part & function consolidation

low density

corrosion resistance

easily shaped

recyclable

chemical resistance

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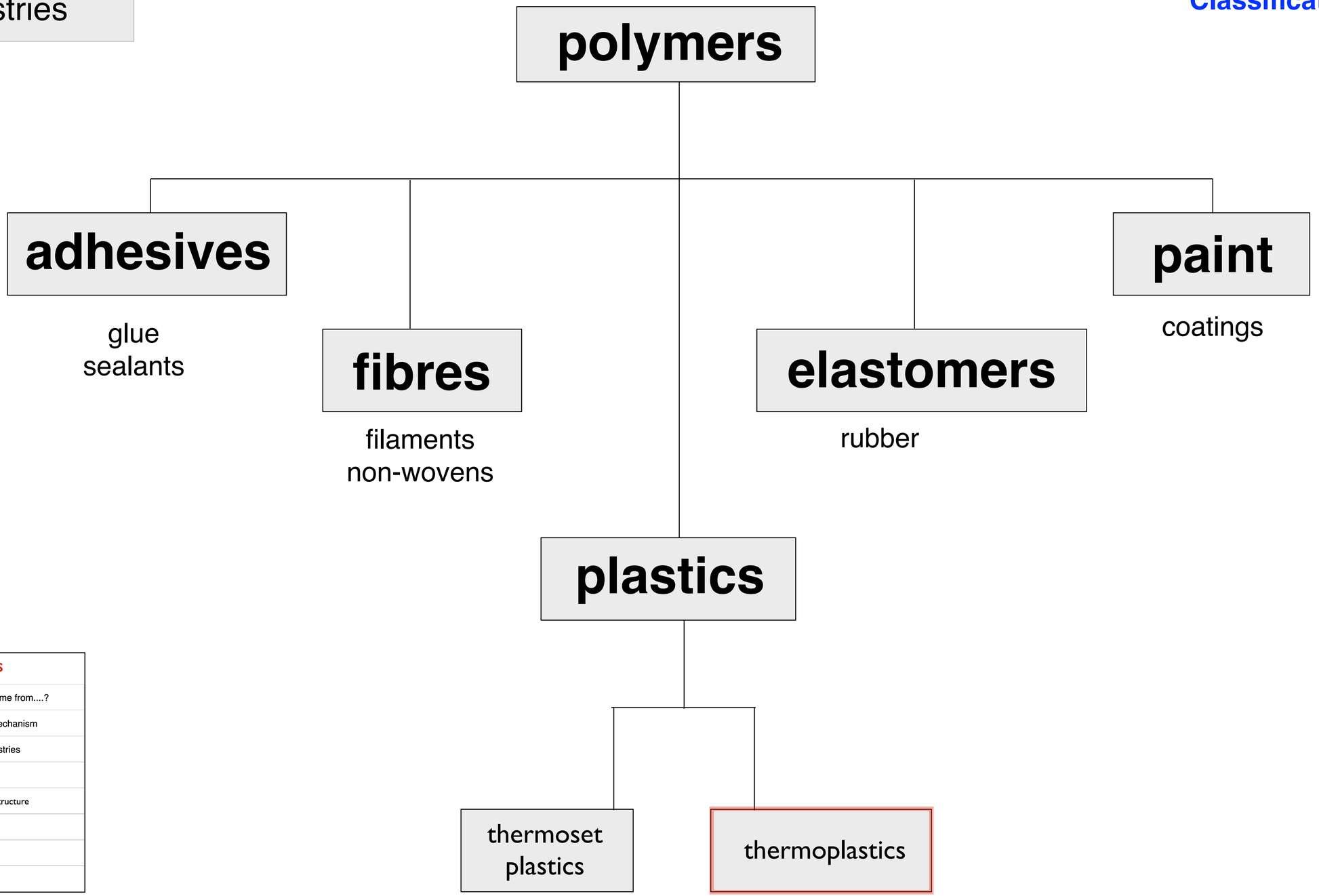
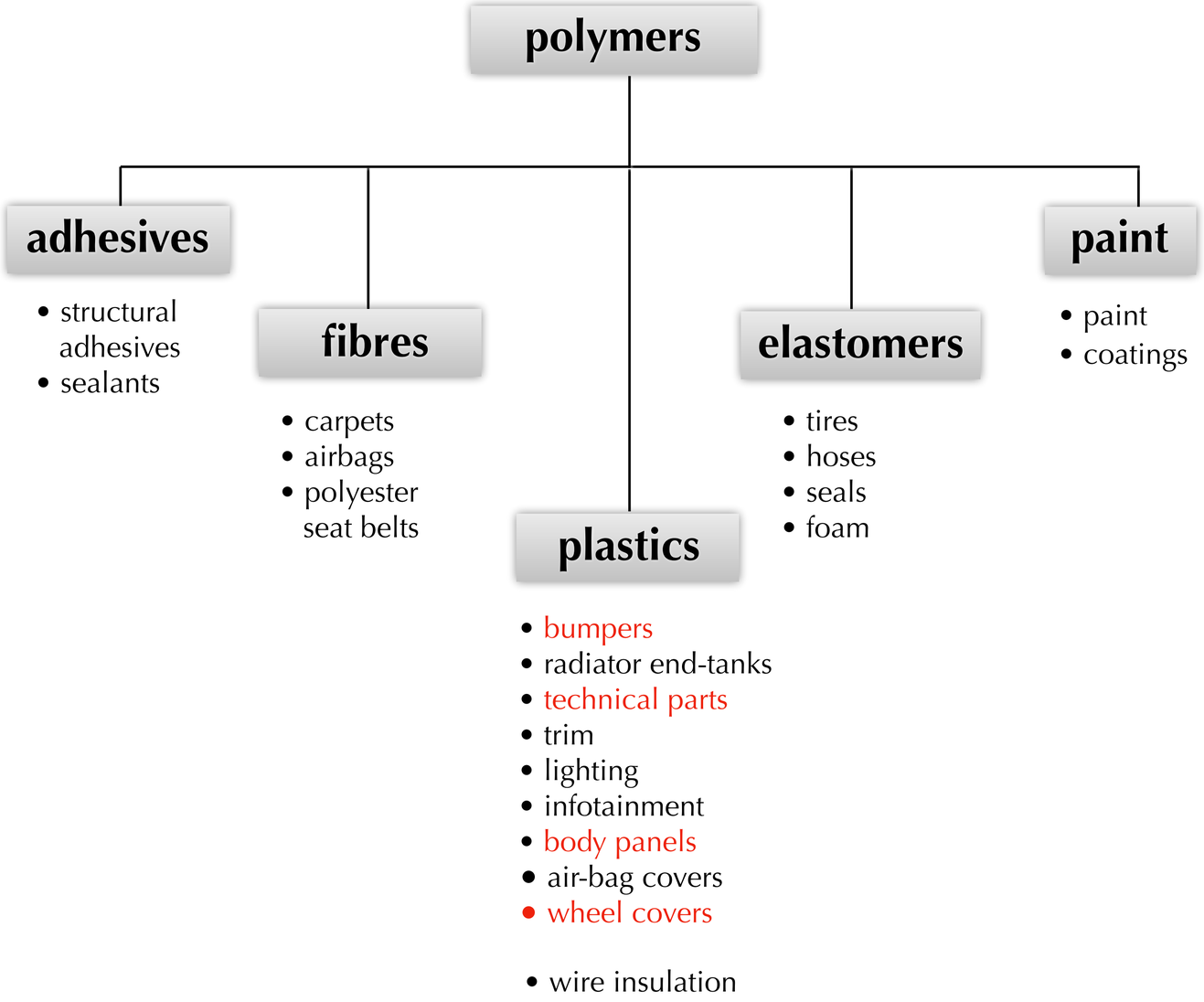
The Polymer Industries

Classification 3

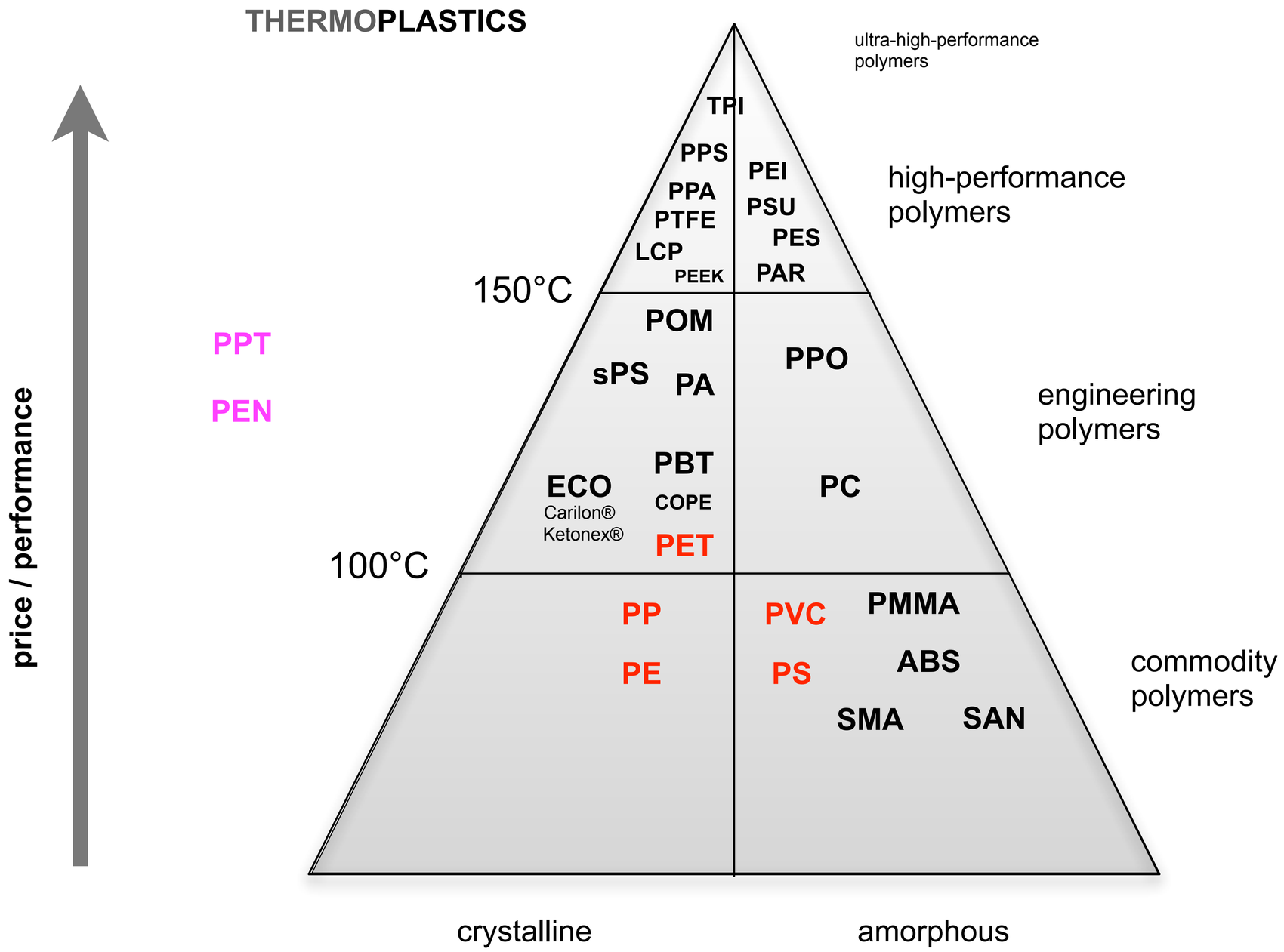


Classifications of Polymers		
1	SOURCE [origin]	Where do they come from....?
2	type of POLYMERIZATION	Polymerization mechanism
3	TECHNOLOGICAL USE	The polymer industries
4	MICROSTRUCTURE	Morphology
5	ARCHITECTURE	Topology, skeletal structure
6	PROCESSING CHARACTERISTICS	
7	CHEMISTRY of COMPOSITION	
8	ENGINEERING PERFORMANCE	

- **Polymers in Cars**



8. CLASSIFICATION BY ENGINEERING PERFORMANCE



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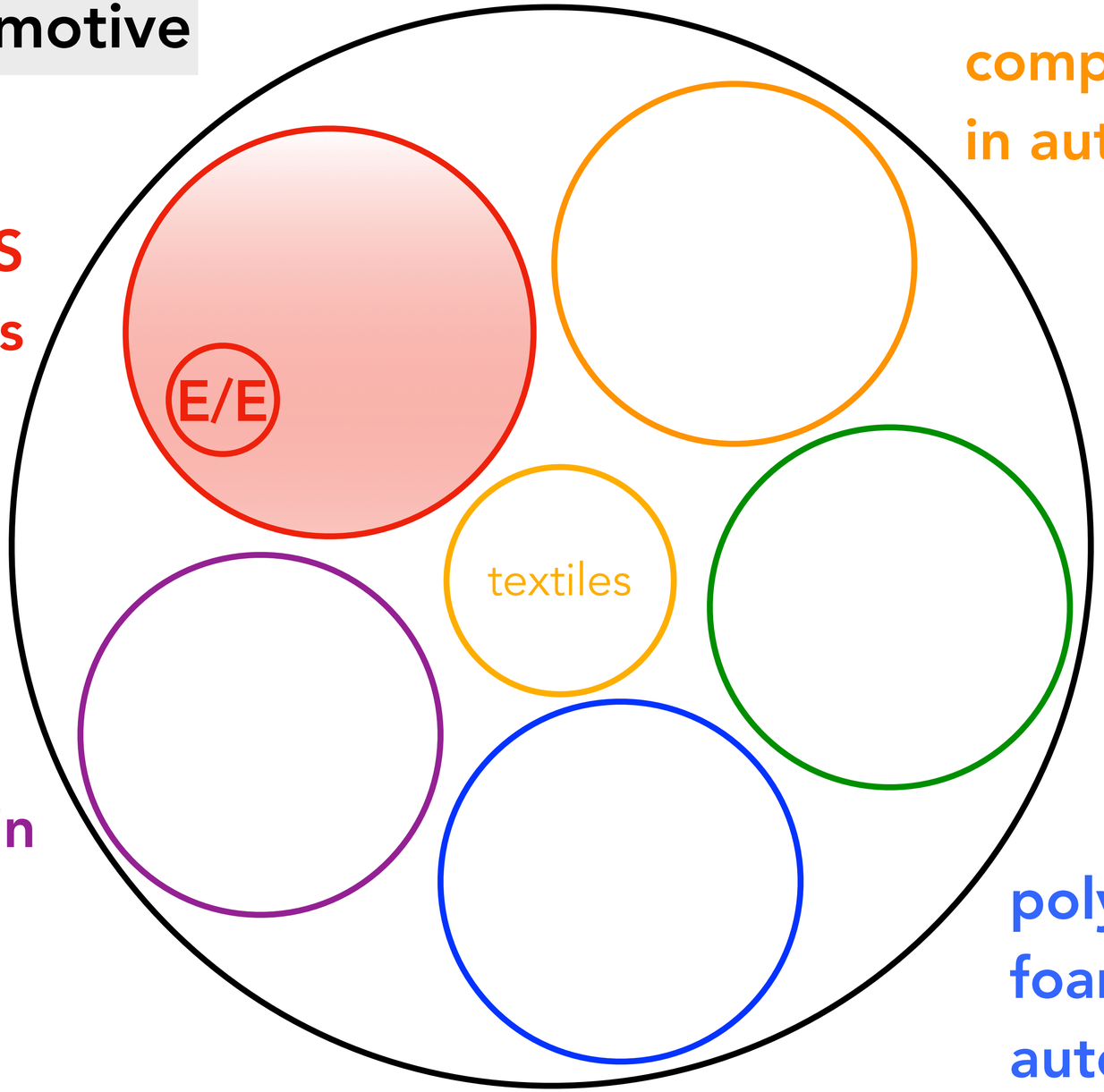
2000+ parts in plastics

Polymers in automotive



composite materials in automotive

ThermoPLASTICS in cars

a plastic that can be:

melt processed to a certain shape, and can later be re-melted

adhesives in automotive

elastomers in automotive

polyurethane foams in automotive


ELISE

polyurethane foam

Fabrizio Rizzato and Petra Mickova

car tires

complex!

- 200 raw materials

- natural rubber
- synthetic rubber
- carbon black
- polyester fibre

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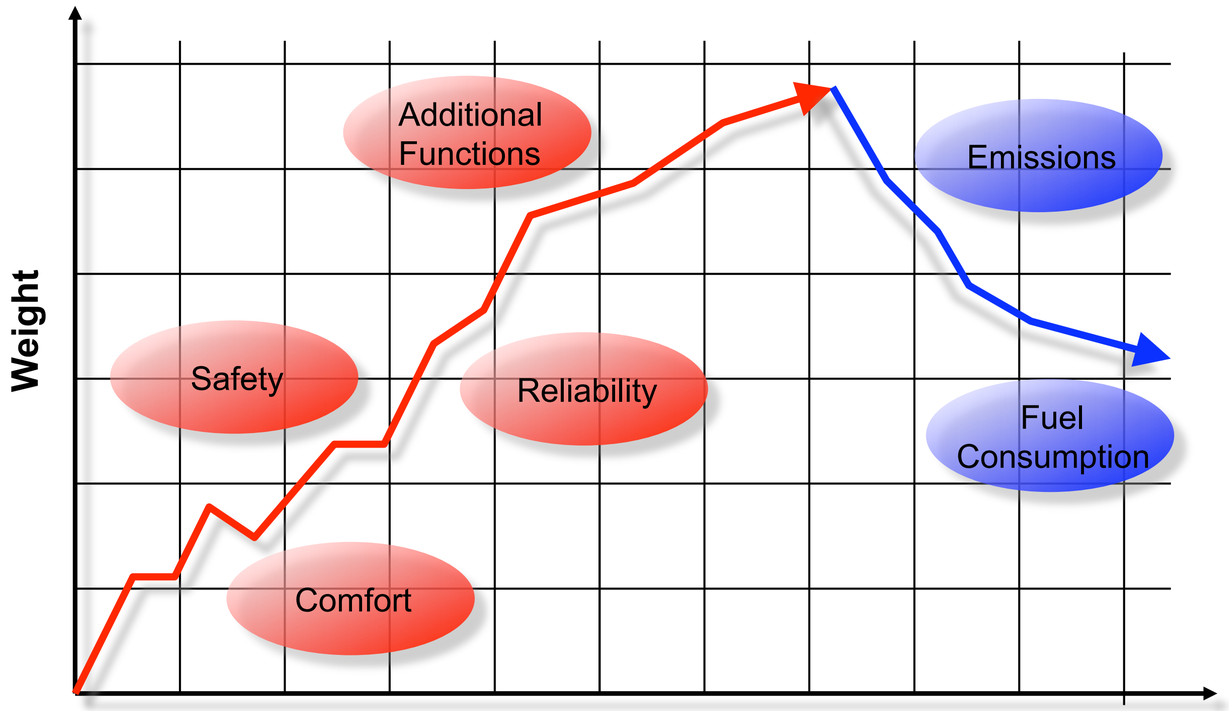


factors influencing vehicle weight ...

For every 10% reduction in vehicle mass, an increase in fuel economy of 6-7% may be achieved

The TENSION between functionality and the environment & economy

Dynamics of the Automotive Space

ACCESS

A
C
C
E
S
S

AUTONOMY
Advanced driver-assist safety technologies and other technological breakthroughs are helping to gradually relieve human drivers from controlling passenger vehicles.

CONNECTIVITY
Future vehicles will offer greater levels of connectivity and communications, driven not only by in-vehicle comfort and convenience but also by safety considerations.

CIRCULARITY
Principles of a circular economy emphasize recovering materials at the end of their usable life, refurbishing and repairing materials to extend product lifecycles, and remanufacturing and reusing them in new products.

ELECTRIFICATION
Electric vehicle (EV) sales are accelerating and projected to represent between 30% and 50% of worldwide vehicle sales by 2040, up from just 1% of worldwide vehicle sales in 2016.

SHARED MOBILITY
Adoption of ridesharing has grown from 15% of U.S. consumers having used ridesharing in 2015 to as many as 43% of U.S. consumers in 2018, helping to reduce travel costs and environmental impact of passenger vehicles.

SUSTAINABILITY
Automakers are working to achieve sustainable automotive design that reduces environmental impacts and improves the efficiency of products throughout their lifecycle.

SAV
shared autonomous vehicles

Dynamics of the Automotive Space

- Convergence of IT & Auto Industries
- Improved Battery Technology
- Proliferation of Artificial Intelligence
- Growing Global Environmental Concerns
- Rise in Automotive- Buying Populations in Growing Economies
- Increasingly Urban Populations
- Emergence of Alternatives to Personal Vehicles
- Implementation of Fuel Economy Standards Encouraging Automotive Lightweighting
- Modernization of Regulations and Standards to Enable Self-Driving Cars

Milburn Wagon Company 1918

top speed of 30 mph and a range of 100 miles on a charge

Transformative technological, cultural, economic and environmental megatrends are converging to reshape "personal mobility," creating a demand for new material solutions that plastics and polymer materials can provide

Automotive plastics - a roadmap

ACCESS

Advanced plastics and polymer composites offer an unparalleled combination of properties that are essential to achieving the opportunities outlined in the ACCESS framework.

The ways these materials can already help the automotive industry capture the opportunities in the ACCESS framework and shape the personal mobility revolution:

- Safely add sensors, electronics, and batteries to vehicles
- Offset added weight from additional features
- Enable design and seamless integration of high-value electronic content
- Support a re-imagination of vehicle interiors
- Help modernize transportation infrastructure
- Promote sustainable design and supply chain

plastronics, a technology used to integrate electronic circuits into moulded plastic parts right from the design phase

all manufacturers' efforts are focused on developing increasingly connected vehicles and making all their models electric

there is still so much to be invented

electroactive polymers

polymers that can change shape when subjected to a stimulus, most often an electrical stimulus. This is the principle of piezoelectricity. Various families of polymers fall under this category: ionic electroactive polymers, liquid-crystal polymers, ferroelectric polymers such as polyvinylidene fluoride (PVDF).
Use these materials to Revolutionise acoustic speaker systems in vehicles by doing away with traditional speakers. The aim is to both improve sound quality and reduce their weight. In high-end vehicles, sound systems can weigh up to several dozen kilograms.

"Polymers remain the materials of the future for our industry"
Gérard Liraut, Polymer Expert Leader for the GROUP RENAULT

Automotive plastics - a roadmap [CONTINUED]

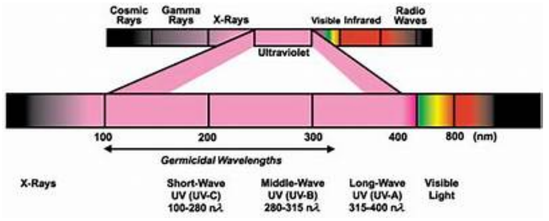
there is still so much to be invented

2020 TREND: Hygiene and Health

anti-microbial plastic surfaces self-cleaning fragrances anti-odour

54% of consumers are interested in having their next personal vehicle equipped with an antimicrobial coating

- UV-C lights could be embedded inside air-filtration systems to clean air while cars are in use
- they could also be installed in dome fixtures or headliners to clean steering wheels, seats, and controls when the vehicle is unoccupied



UV-C 100-280nm


iCar

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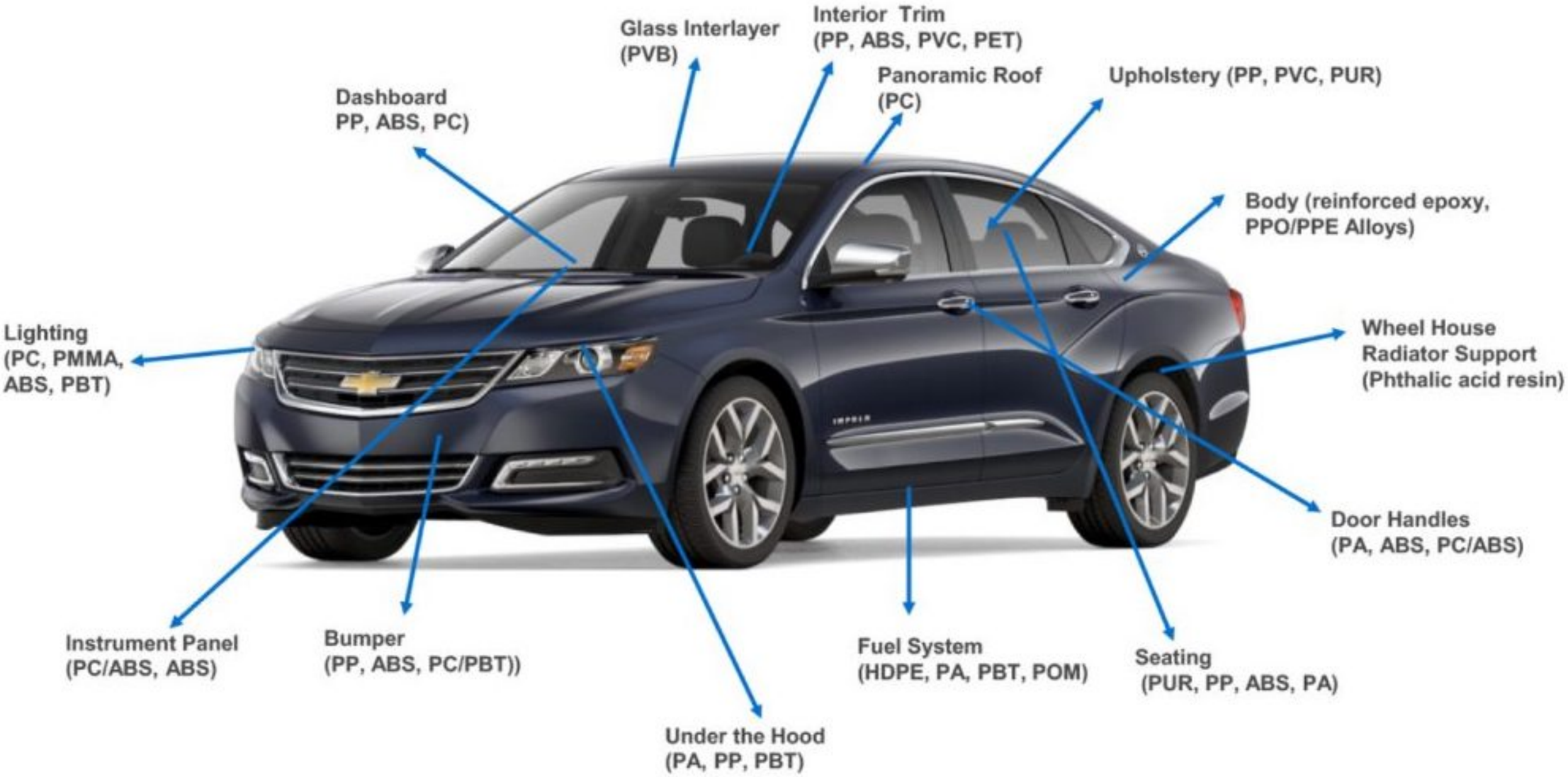

Glass Interlayer
(PVB)
Interior Trim
(PP, ABS, PVC, PET)
Panoramic Roof
(PC)
Upholstery (PP, PVC, PUR)
Dashboard
PP, ABS, PC)
Body (reinforced epoxy,
PPO/PPE Alloys)
Lighting
(PC, PMMA,
ABS, PBT)
Wheel House
Radiator Support
(Phthalic acid resin)
Door Handles
(PA, ABS, PC/ABS)
Instrument Panel
(PC/ABS, ABS)
Bumper
(PP, ABS, PC/PBT))
Fuel System
(HDPE, PA, PBT, POM)
Seating
(PUR, PP, ABS, PA)
Under the Hood
(PA, PP, PBT)

(car) radiator end tanks in nylon

parts integration and cost reduction, weight reduction, and equal or better performance

nylon 6:6

nylon 6:10

(self-locking) cable ties in nylon 66

- an established $250m application but still growing at 8% per annum
- rapidly injection-moulded in up to 100-cavity moulds

bumpers & body panels

Porsche Carrera 4 [1988]

Material Substitution

RRIM thermoset →
Bexloy V *polyester*

- **toughness**
- **CLTE**
- **flow**
- **surface**

→ PP polypropylene


EVORA
LOTUS

air intake manifolds

another Material Substitution story …..

- aluminium

→ • plastic (glass fibre reinforced nylon 66) air-intake manifold

  - 25% weight savings
  - 15% cost savings
  - 3-5% improvement in power

processes: lost-core moulding; welded components; die slide injection (DSI)

→ • plastic (glass fibre reinforced polypropylene) air-intake manifold

  - 15% weight savings
  - better acoustics
  - less energy in moulding (no drying, lower T_{melt})

oil pan

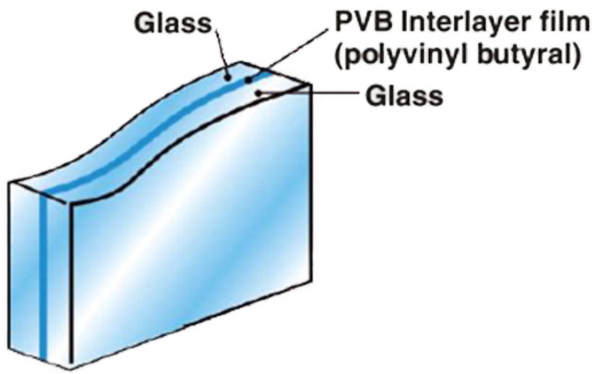
door mirror

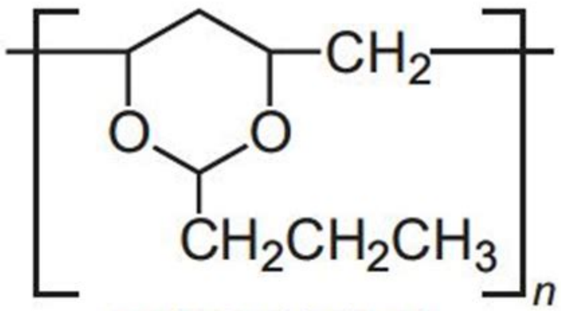
pedal block

thermostat housing

laminated windscreens SAFETY

In 1981, laminated glass with a total thickness of 6 mm superseded tempered glass for windscreen applications.





polyvinyl butyral

Now, a 4 mm wind- screen is configured with a 1.8 mm outer pane and a 1.4 mm inner pane with a 0.76 mm PVB interlayer.

4.5 → 4mm asymmetric glass windscreen is tougher,
with acoustic PVB reducing road noise by 5dB (class difference)
and a weight saving of 1.3kg

Lighting

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Printing a car in 3D

Local Motors was one of the first to 3-D print - in about 40h - an electric car, called Strati, which is made with carbon-fiber-reinforced plastics (CFRP)

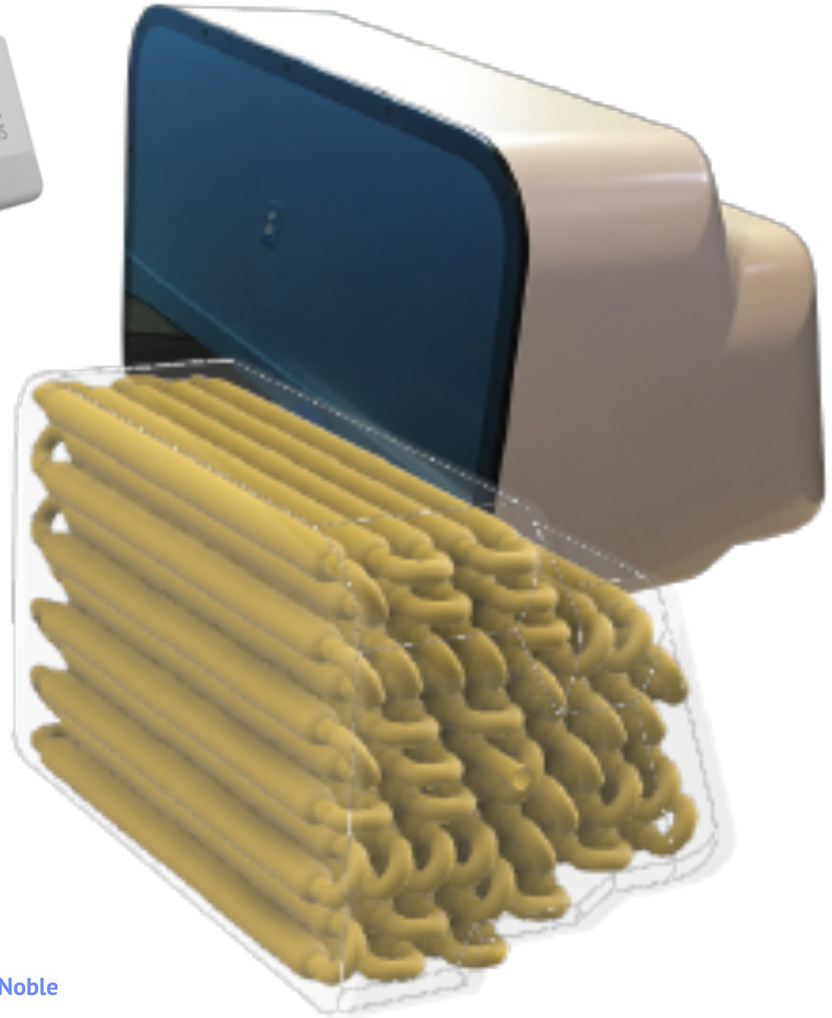
350-bar conformable hydrogen tank technology

thermoplastic elastomer tube - flexiblity, permeation barrier

CONFORMABLE TANK TECHNOLOGY

Liner — Thermoplastic elastomer for flexibility and permeation barrier

Reinforcement — Woven synthetic fiber for pressure containment



Noble Gas Systems

The future of gas storage and delivery is Noble

Acknowledgements

This presentation has used data, insights, images, graphics, infographics from a variety of sources, and I am grateful to all of the original authors for the availability of this valuable information on the world-wide web, which I have used freely for these educational purposes, without any permission ….

plasticsmakeitpossible.com

plastics.americanchemistry.com/Automotive/

www.automotiveplastics.com

book: 2009 Engineering Plastics and Plastic Composites in Automotive Applications - Dr Kalyan Sehanobish

book: 1994 Plastics in the Automotive Industry - James Maxwell

Summary

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Plastics in Automotive Applications

Webinar 12:00 Wednesday 14 April 2021

After this "Lunch & Learn" Webinar, delegates will understand where polymer materials are used in cars. With a focus on plastics applications, delegates will learn about how the intrinsic properties of plastics materials create value-in-use. Examples will show how plastics replace earlier materials; how lighter cars are achieved; how plastics enable greater functionality, how plastics simplify construction and assembly, and thereby reduce cost, how their processability provides optimum use of space. Suggestions are given of how this sector might change due to the fast growth of electric vehicles, autonomous driving, and the call for sustainability.

coming soon!

Polymers in Wire & Cable Applications

Webinar 12:00 Thursday 29 April 2021

After this "Lunch & Learn" Webinar, delegates will have the big-picture of the E/E [electrical and electronic] and wire and cable sectors; how it is sub-divided, the drivers, the polymer materials and the required properties, and the terminology used in this industry. They will understand the key polymer materials used for insulation, and how these polymers are typically formulated and modified to achieve certain properties and performance for wire and cable construction.