

A Sustainable Plastic Partnership



Dr. Gethin Llewelyn
Technical Customer Service & Development Manager



Agenda

- **Metal Replacement with EMS-GRIVORY**
- **Healthcare Sector**
- **Sustainability**
- **Application Development Centre (ADC)**

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- Healthcare Sector
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EMS-GRIVORY Products

Grilamid®
EMS

Grilamid L
>PA 12<

Grilamid 2D
>PA 612<

Transparent PA
Grilamid TR
>PA MACM12<
>PA 12/MACMI<
>PA 6I/X<

GRILON®
EMS

Grilon B
>PA 6<

Grilon A
>PA 66<

Grilon TS
>PA 66+PA 6<

GRIVORY®
EMS

PAPA
Grivory GV
>PA 66+PA 6I/X<

PPA (Polyphthal-amide)
Grivory HT1
>PA 6T/6I<

Grivory HT2
>PA 6T/66<

Grivory HT6
>PA 6T/8T/X<



Grilamid 1S
>PA 1010<

Grilamid 2S
>PA 610<

Grivory HT3
>PA 10T/X<

Grilamid BTR
>PA MACM10/1010<

EMS
EMS-GRIVORY

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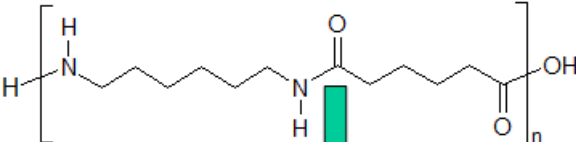
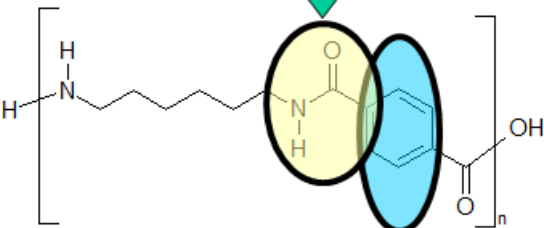
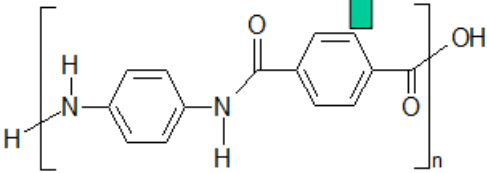
Grivory HT3
>PA 10T/X<

Grilamid BTR
>PA MACM10/1010<

EMS

EMS-GRIVORY

GRIVORY Polymer Families

Structure	Type
	Aliphatic: PA6, PA66, PA12, PA610
	Partially aromatic: PA66+PA6I/X, PA6T/6I, PA 6T/66, PA 10T/X
	Aromatic: Polyaramide, Poly-p-phenyleneterephthalamide

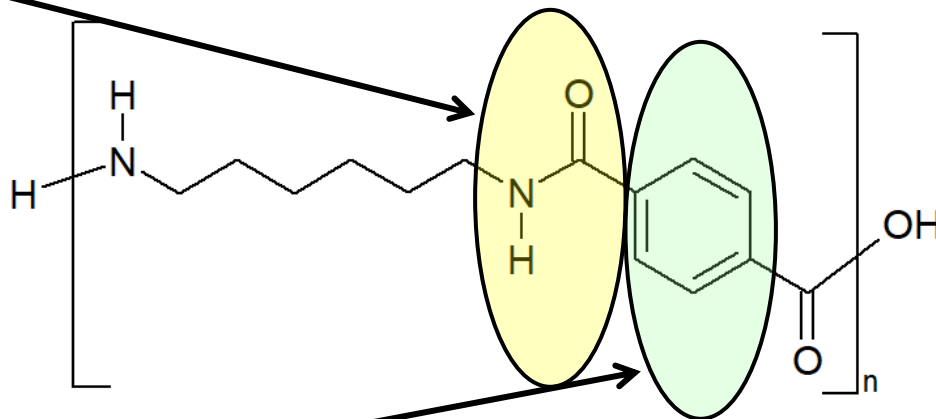
Partially Aromatic Properties

Amide bond:

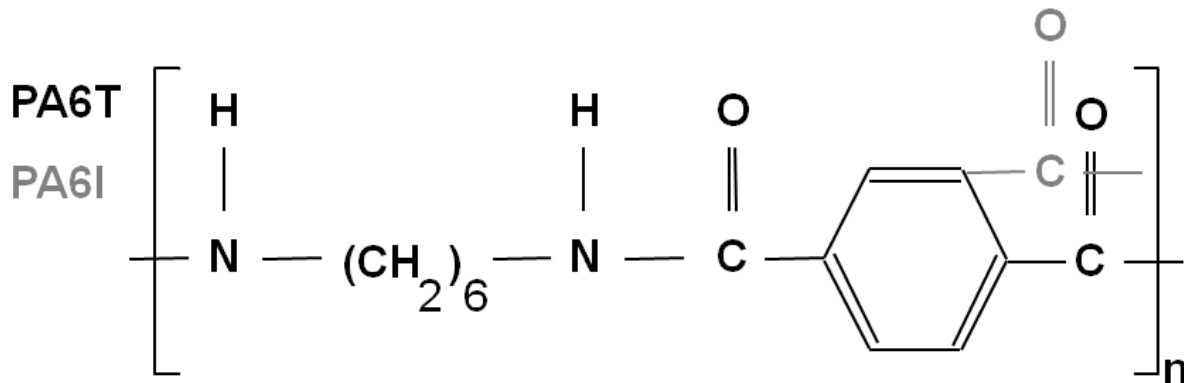
- + Strength
- + Toughness
- + Chem. Resistance
- Water absorption

Aromatic ring:

- + Higher performance at higher temperatures
- + Better chemical resistance
- + Reduced water absorption

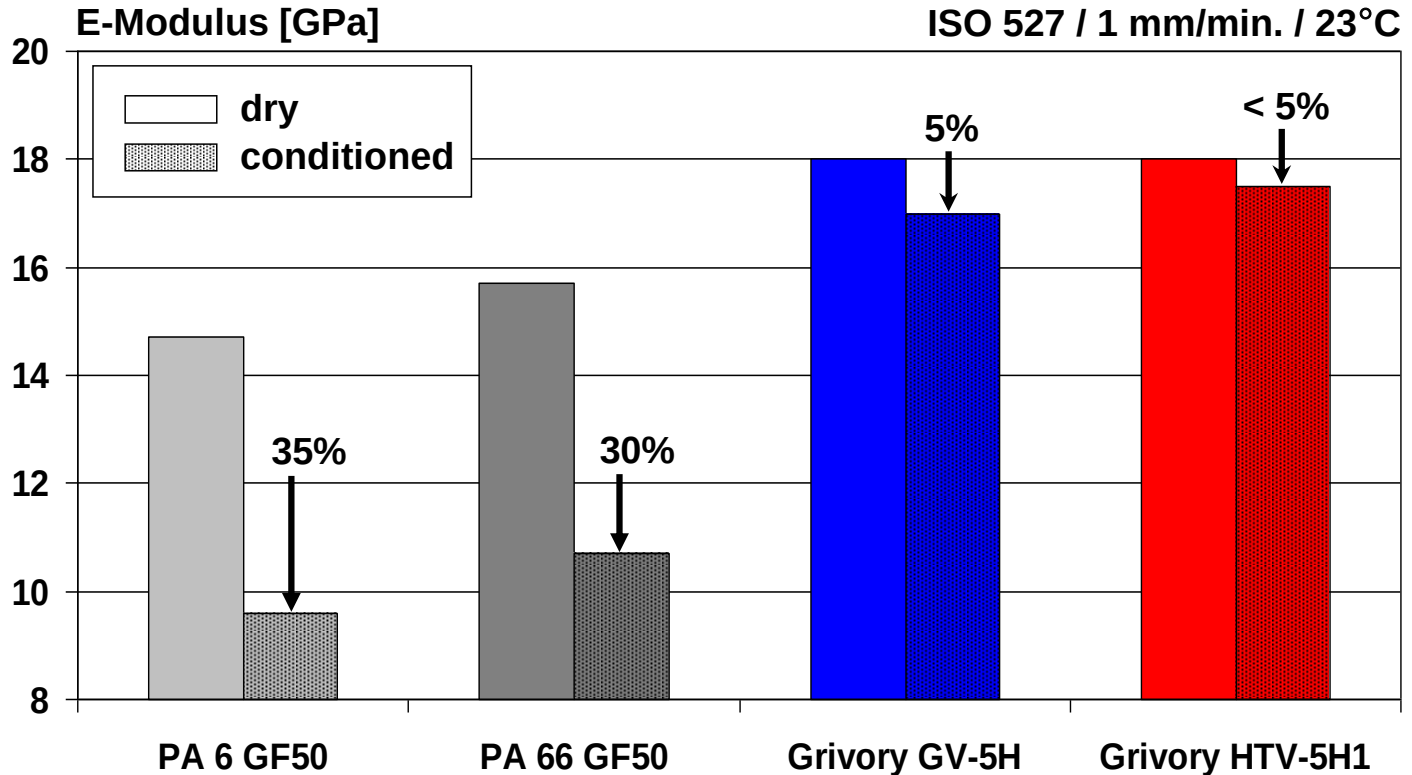


GRIVORY Product Family



ISO 1874	Type	T _m / T _g
PA66+PA6I/X	Grivory GV	260°C / 70°C
PA 6T/6I	Grivory HT1	325°C / 130°C
PA 6T/66	Grivory HT2	310°C / 95°C
PA 6T/8T/X	Grivory HT6	320°C / 145°C
PA 10T/X	Grivory HT3	295°C / 115°C

GRIVORY – Our Metal



Metal replacement with Grivory

GV – «Sports» applications

- GVN-5H + GC-4H for bike pedals



- replacement of Aluminium
- high impact strength
- high flexural fatigue strength
- high surface quality and easy coloring

Metal replacement with Grivory

GV – «Industrial» applications

- **GV-4 FWA for water filters**



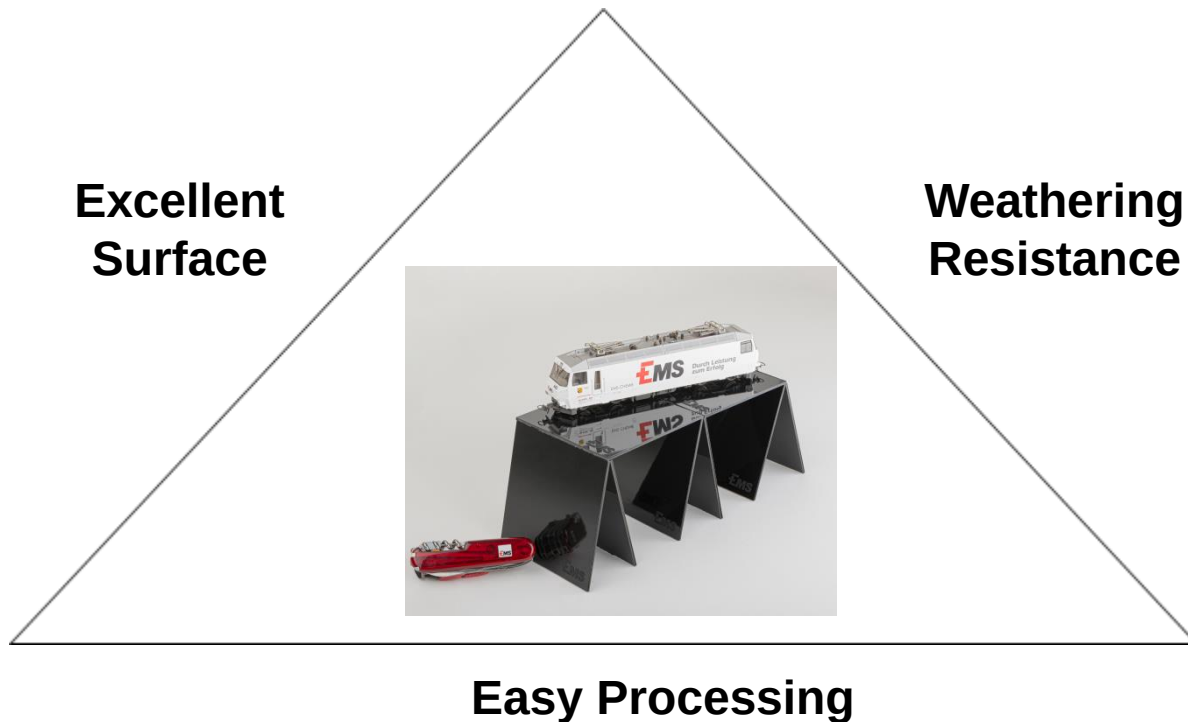
- drinking water approved
- up to 16 bar
- resistance against chemicals
- easy coloring



**Grivory
GV- 4 FWA**

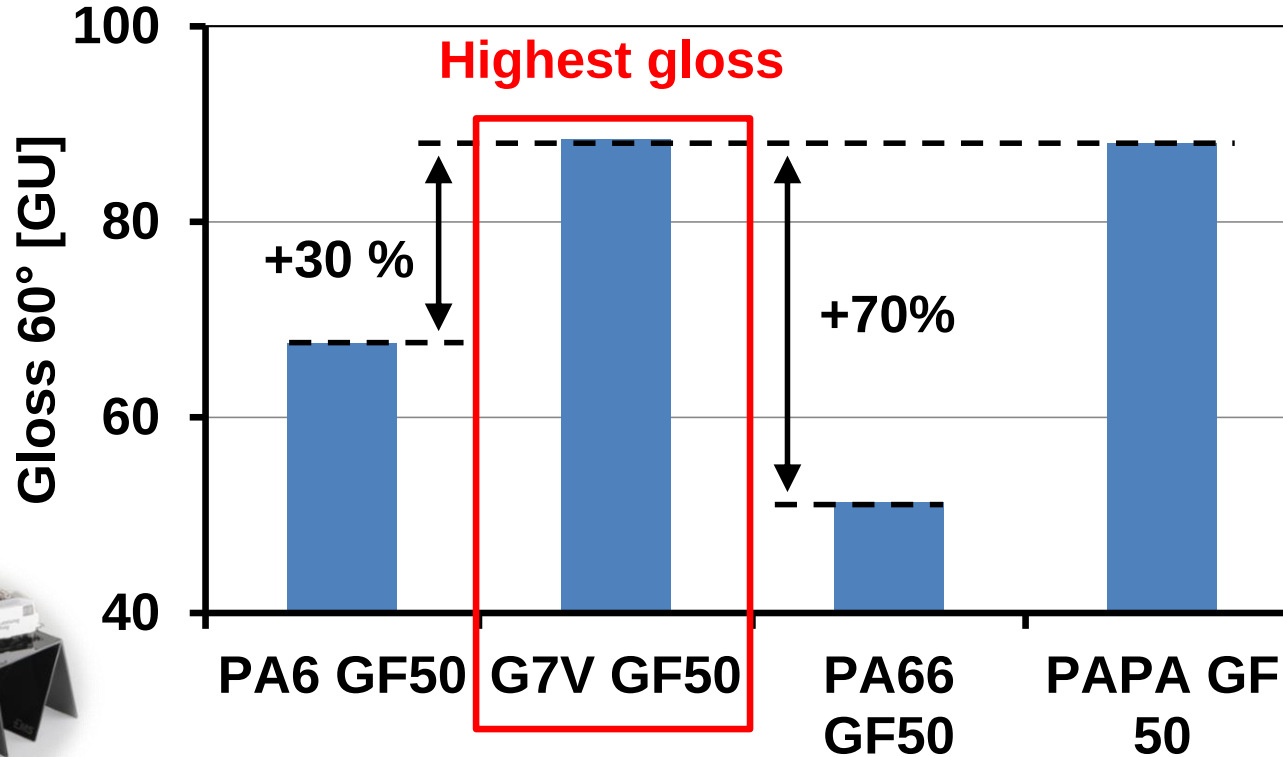
**Grilamid
TR 90 LS**

G7V – The new generation Grivory GV



Extended metal replacement without coating!

G7V – Gloss properties



G7V – Target Applications

Lamella Bars



Air Vent Frames

Medical Devices



Door handles



**Sports
Accessories**

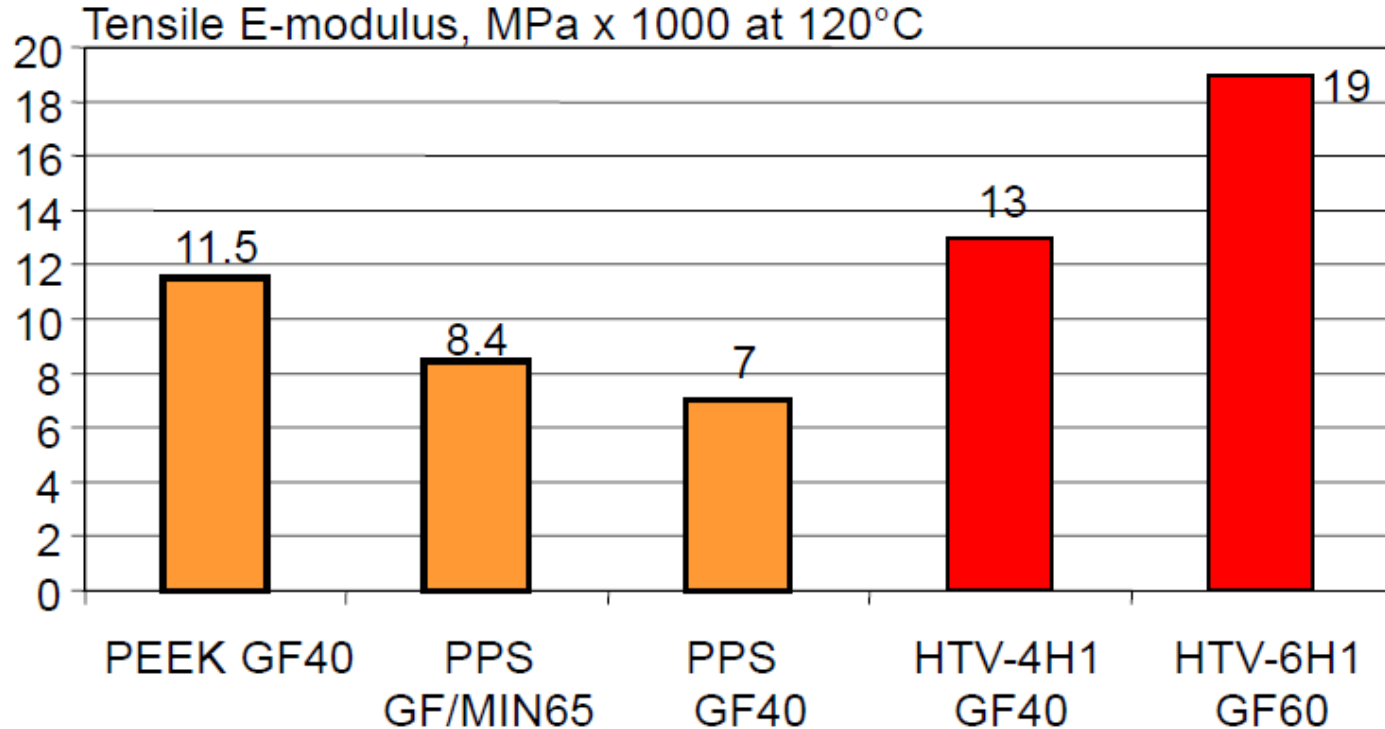


Fixings



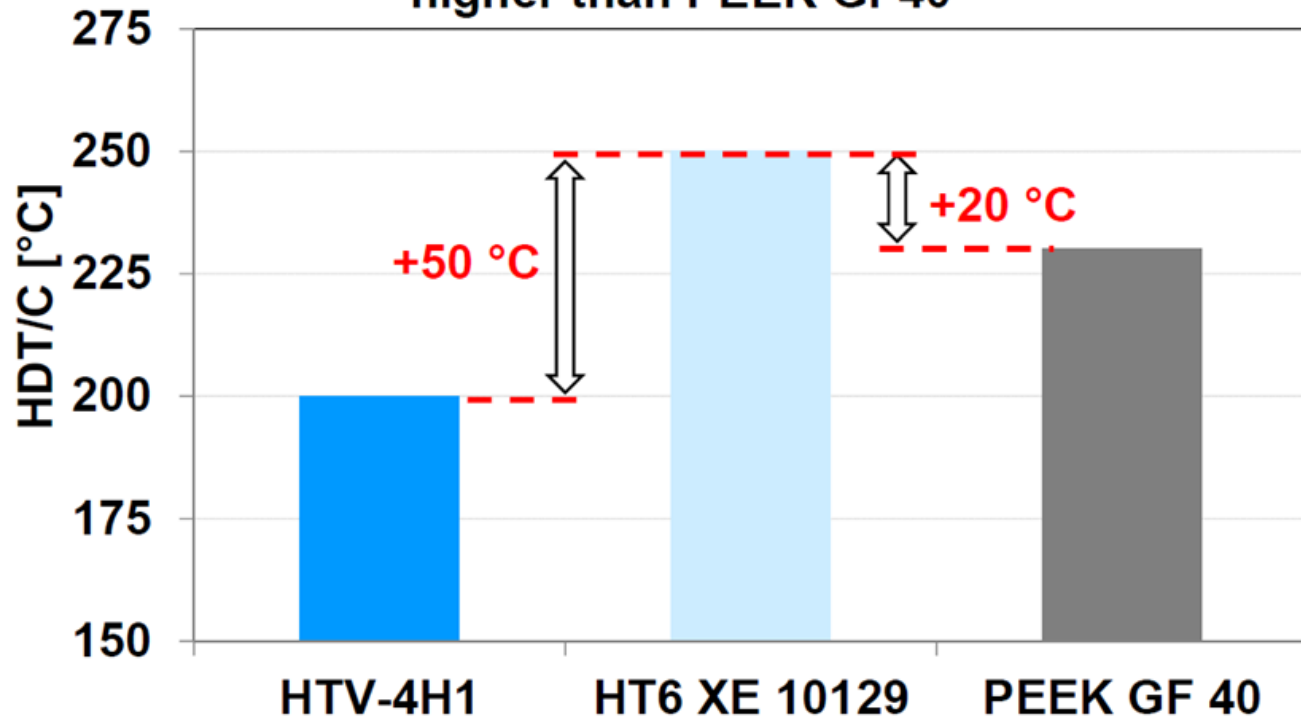
Tools

HT – Stiff and Strong even in heat



HT6 – High Heat Deformation

Highest heat deflection temperature of all PPA and 20 %
higher than PEEK GF40



HT6 – Target Applications



Actuators



Oil pumps



Bearing retainer



High performance gears



Air Mgmt. & Valves



Fixations

Grivory
HT6 XE 11627

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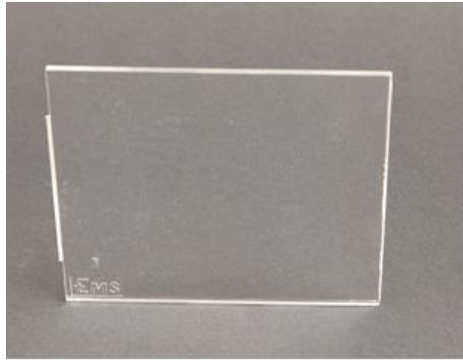
EMS-GRIVORY

Grilamid TR HT 200

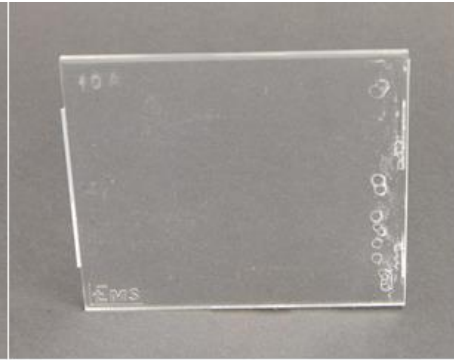


- > 500 steam sterilisation cycles at 134 °C
- High chemical resistance against disinfectants, cleaning agents, oils and fats
- High temperature resistance due to T_g of 200 °C
- Significantly easier to process in comparison to usual high T_g transparent polymers such as PSU
- Very high impact strength and ductility
- ISO 10993 und USP Class VI biocompatibility approvals

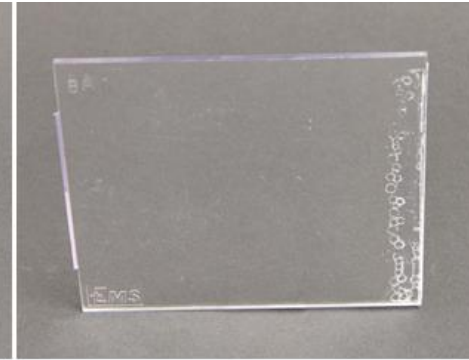
Ethanol / Alcohol Resistance



Grilamid TR HT 200



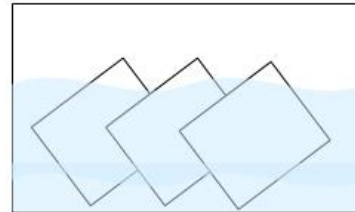
Copolyester



Polycarbonate

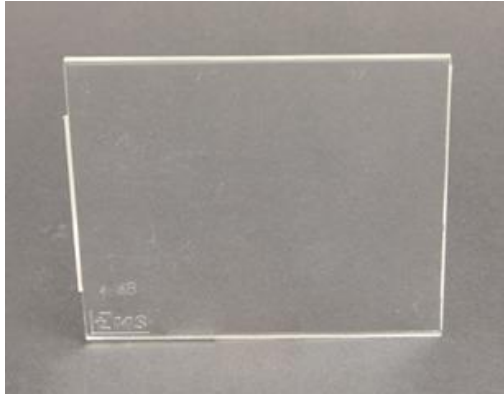


PMMA

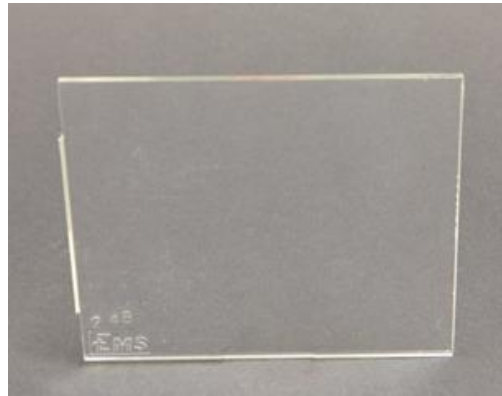


120 h storage in "sterillium virugard" (80% Ethanol)

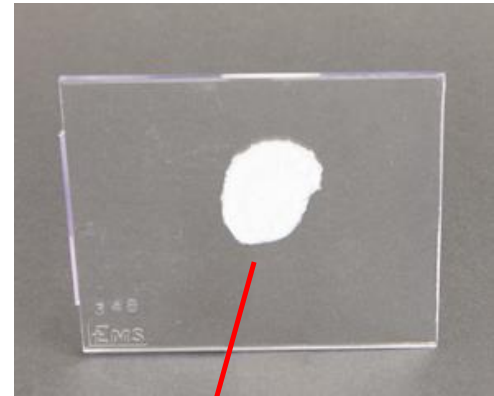
Resistance to Oncology Drugs



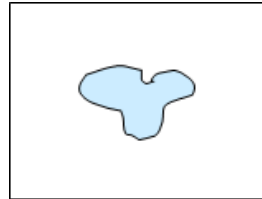
Grilamid TR HT 200



Copolyester



Polycarbonate



Some drops of a oncology drug solution
("Busilvex" + polyethyleneglycol + dimethylacetamide)
are put on a plaque for 24 h

Sterilisation Resistance

	GV-5H	LV-5H	TR 90 / ICR 12	TR HT 200
Ethylene oxide	+	+	+	+
γ -radiation* (< 40 kGy)	+	+	+	+
H ₂ O ₂ (50°C)	+	+	+	+
UV-C* (6 mW/cm ²)	+	+	-	+
Steam 121°C*	+	+	o	+
Steam 134°C*	+	+	-	+

+ High resistance

o Limited resistance

- not resistant

*Yellowing possible with light colors

Regulatory Overview

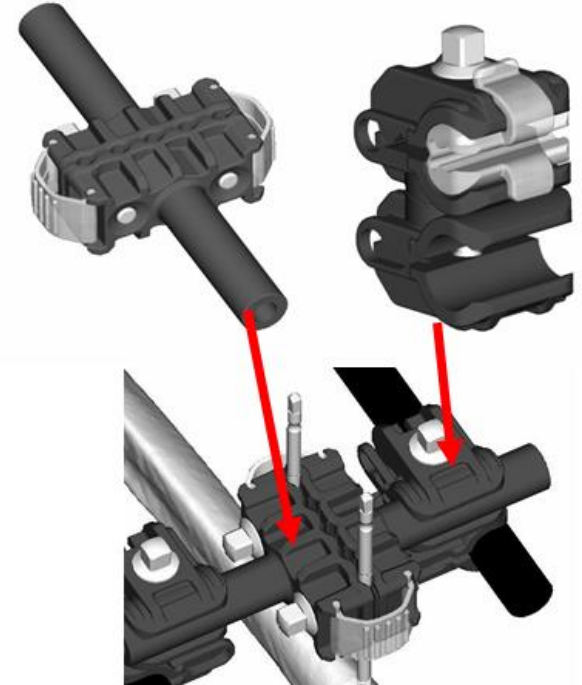
	TR HT 200	TR 90	GV-5H (FWA)	LV-3H (FWA)
ISO 10993	✓	✓	✓	
USP Class VI	✓	✓	✓	✓
EU food approved	✓	✓	✓	✓
FDA approved		✓	✓	✓
Animal-free	✓	✓	✓	✓
Phthalate-free	✓	✓	✓	✓
Bisphenol-free	✓	✓	✓	✓

Grivory GV-5H

Bone Fixing Element

Success Factors

- High stiffness and strength (Al die cast replacement)
- Gamma ray sterilisable
- ISO 10993 approval



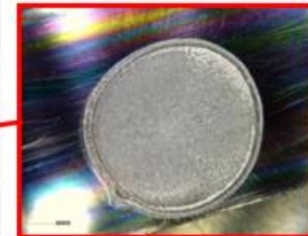
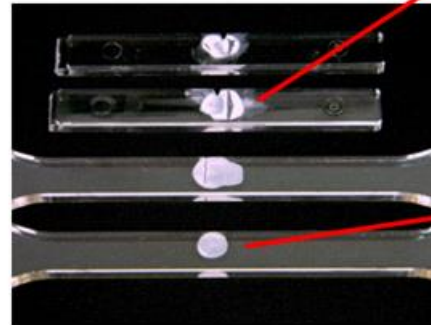
Grilamid TR 90 / Grivory GVN-35H

Bone Cement Delivery System

Success Factors

- High chemical resistance vs bone cement hardener
- ISO 10993 & USP Class VI Approvals
- Mechanical strength and toughness

PC failed testing

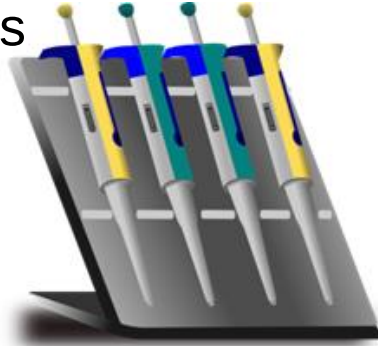


Grilamid LKN-3H / 5H

Precision Pipette Housing

Success Factors

- Excellent chemical resistance
- Resilient and abrasion-resistant
- Steam sterilisable at 121 °C
- High dimension stability and surface finish due to glass bead reinforcement



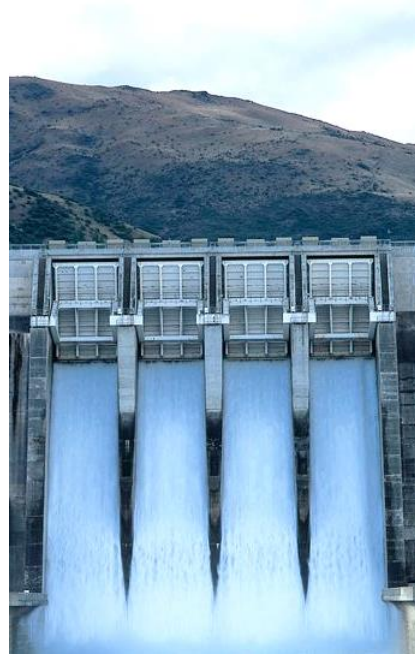
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EMS-GROUP: CO₂ Negative



Biomass steam



Hydroelectricity



**> 100,000 flights
Zurich - New York!**

**Customer
Development Projects**

EMS - Best Performance in CO₂ - Reduction

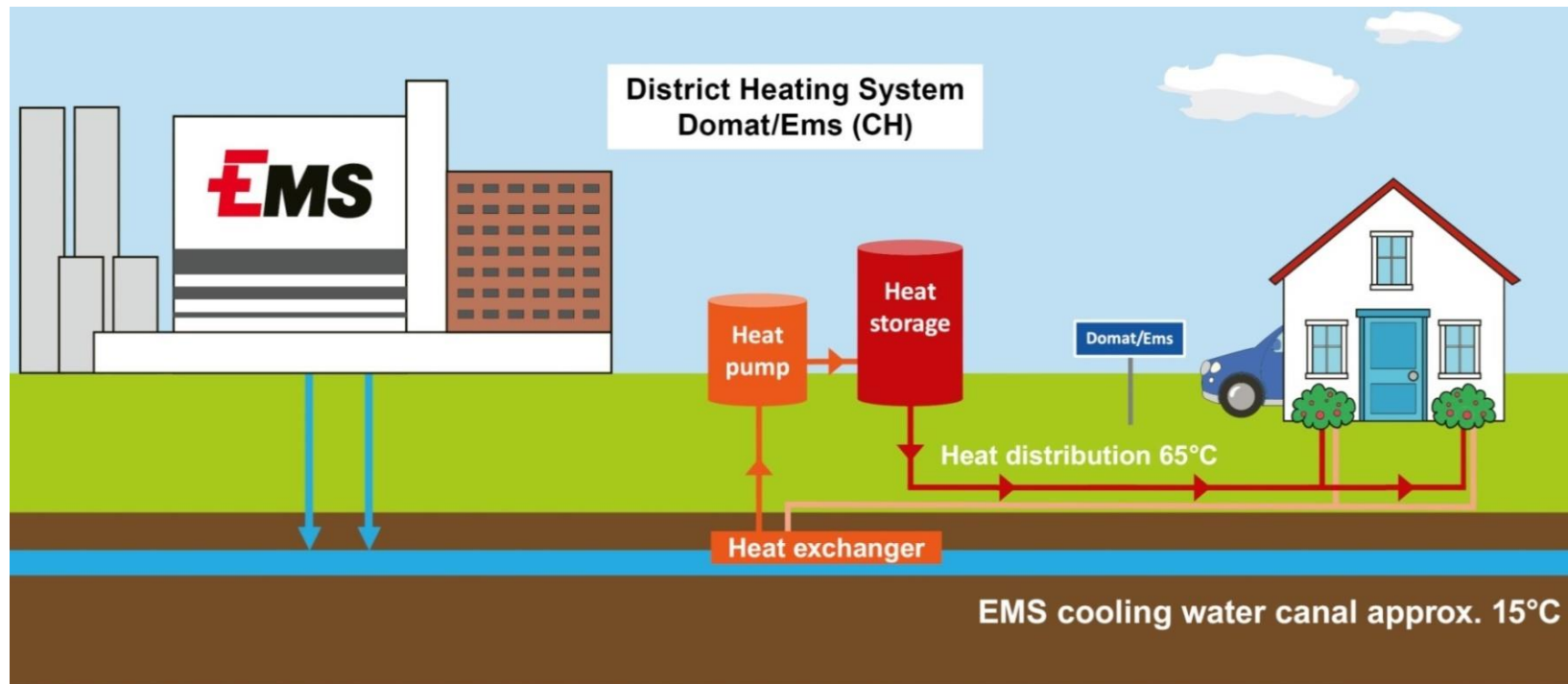
Largest Biomass Power Station in Western Europe

- 140,000 t process steam per year
- Local waste timber
- - 85% CO₂ - Reduction!
- Energy award 2008



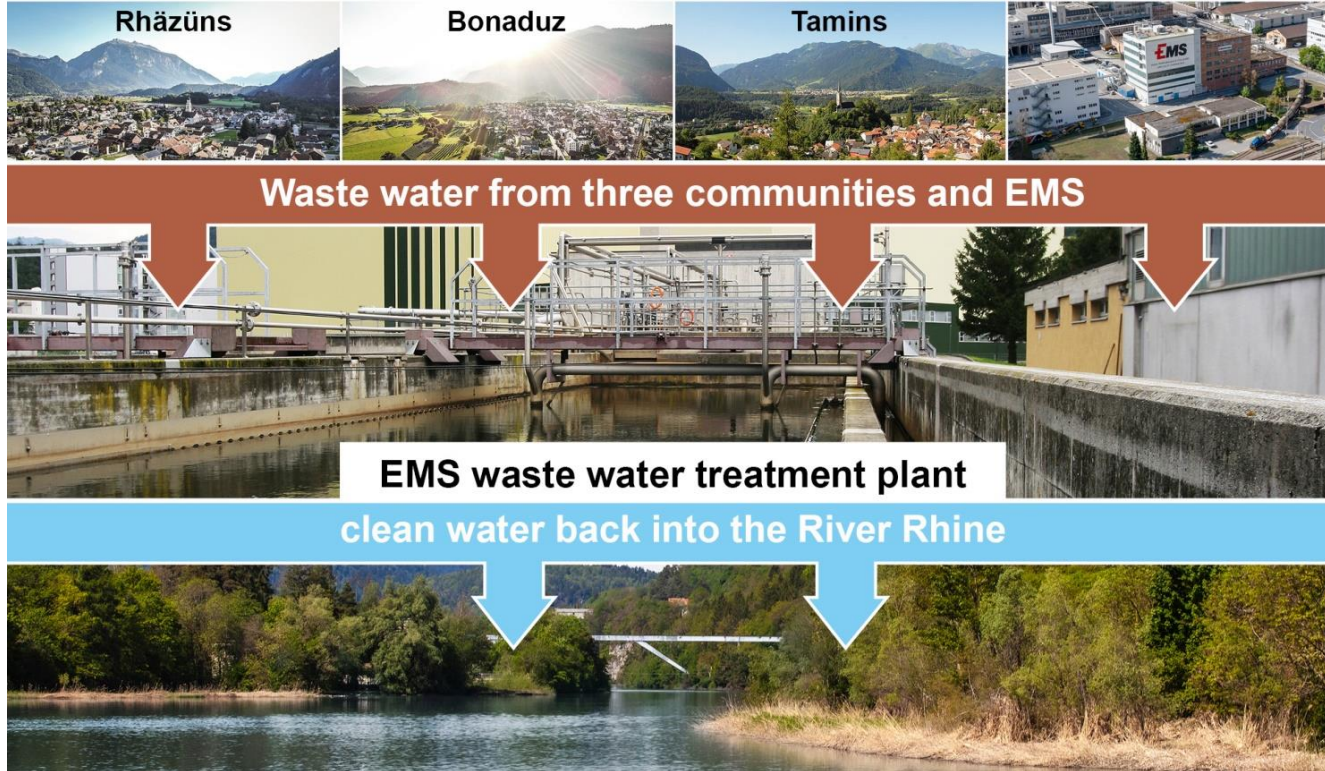
District Heating System for > 20,000 Households

Energy Reduction since 2000: - 46%!

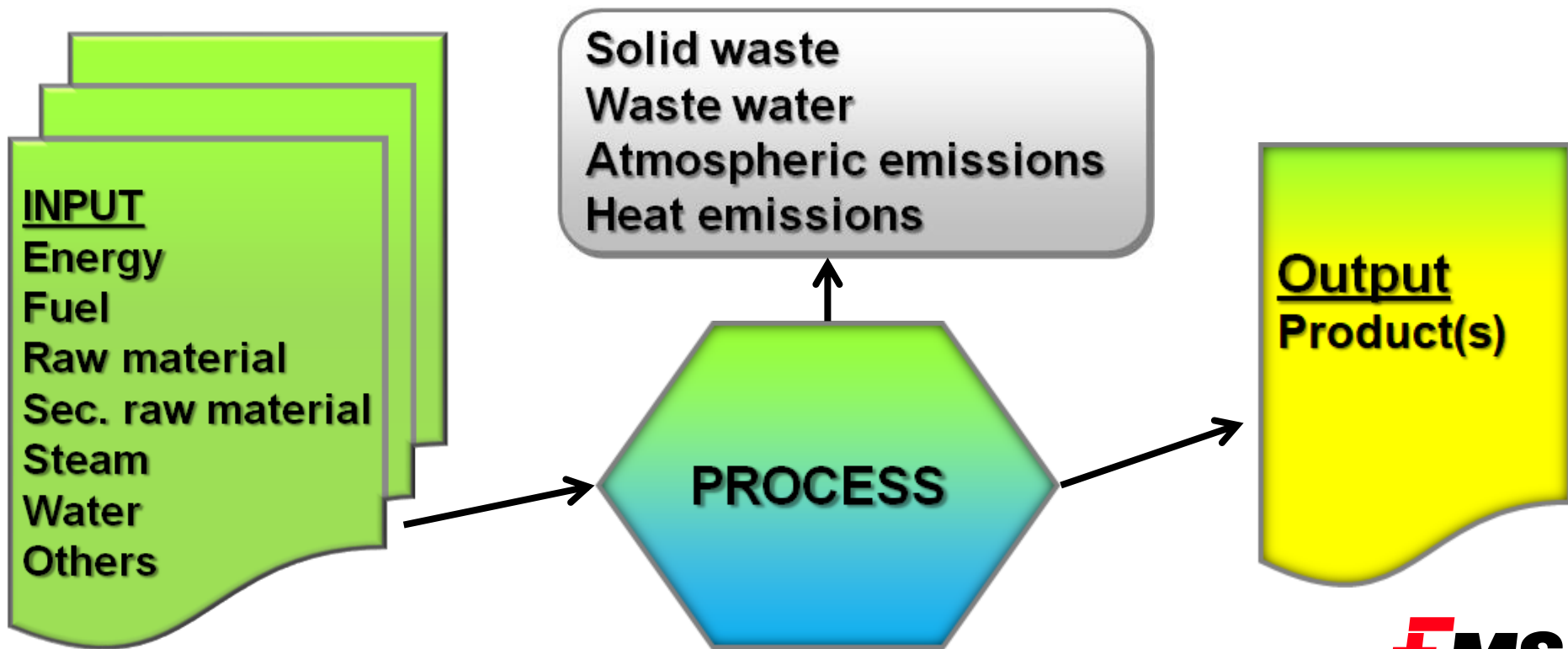


EMS Waste Water Treatment

Water Reduction since 2000: - 61%!



Life Cycle Assessment



GreenLine range

Family	Polymer	Bio-content [1]
Grilamid 1S	PA1010	up to 99%
Grilamid 2S	PA610	up to 62%
Grivory HT3	PPA	up to 48%
Grilamid BTR	amorphous PA	up to 54%

[1] According to ASTM D 6866-08, expressed in % of bio based carbon in the polymer

GreenLine is a Biosource

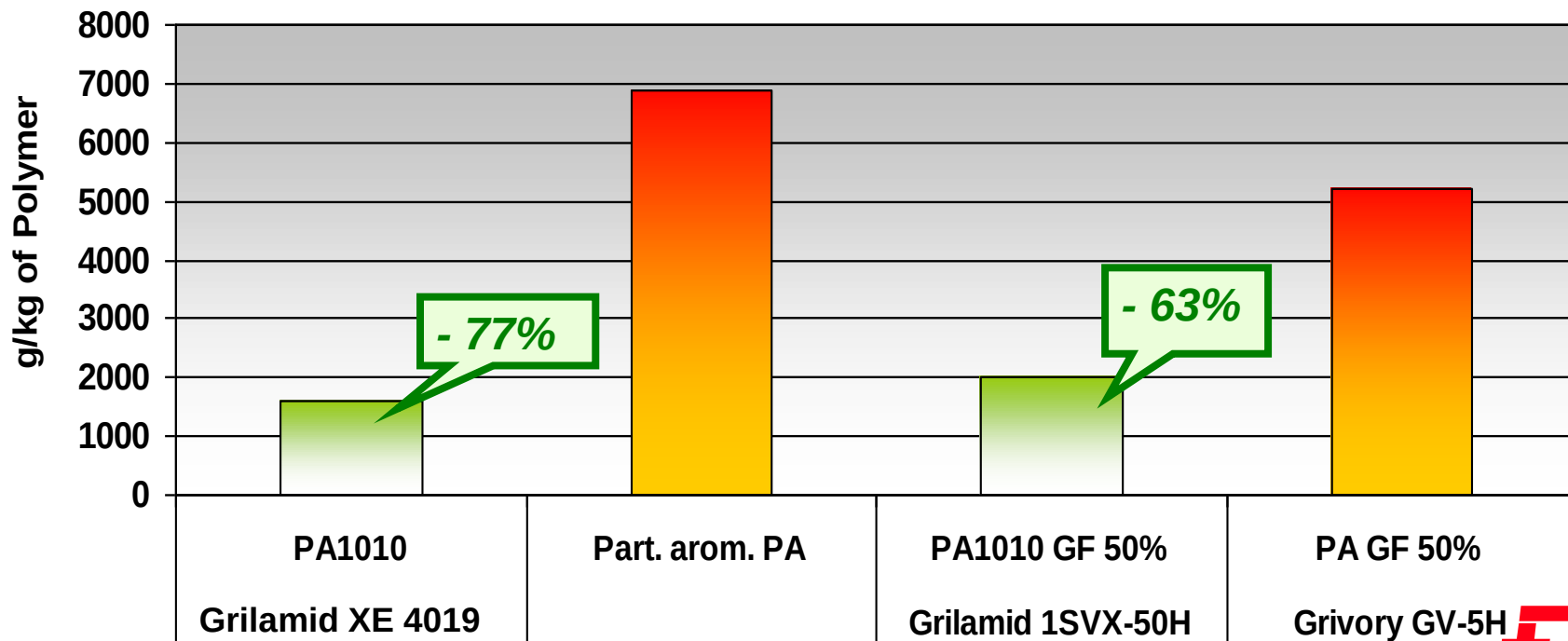
Castor Plant (*Ricinus communis*)

- High content of Castor Oil
- Robust annual plant
- Not a food plant
- Not competing with food crops for land
- Grown in semi arid areas (India, China, Brazil)



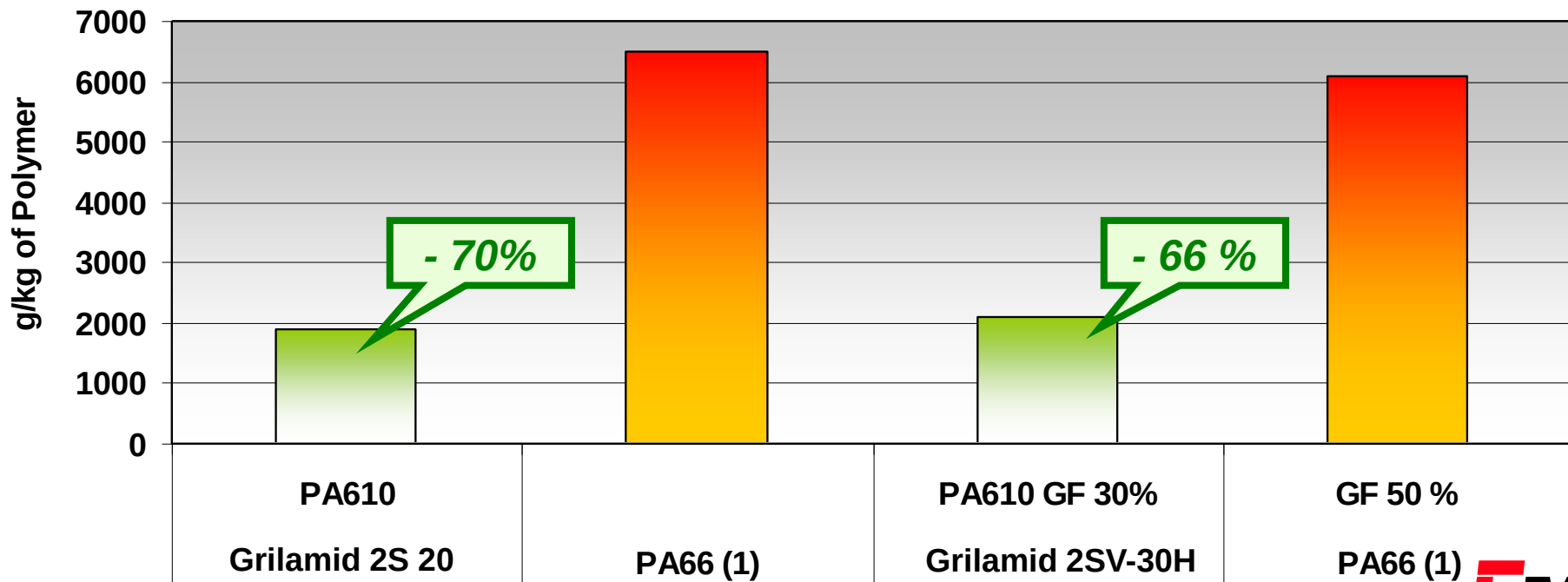
LCA Results

CO₂ Balance



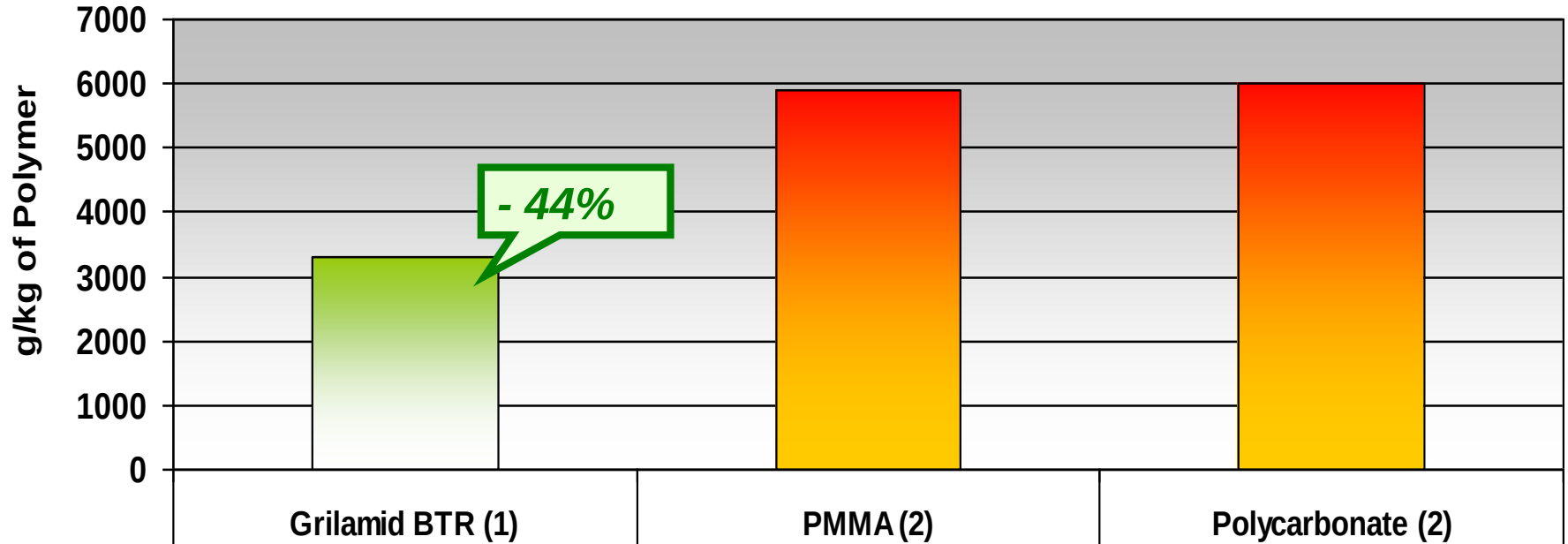
LCA Results

CO₂ Balance



LCA Results

CO₂ Balance



Valid for XE 4069, XE 4010

Summary – Energy, CO₂ GWP, Bio-Content

		Product		
		Grilamid 1SVX-50H PA1010 50% GF	Grilamid 1SVX-65H PA1010 65% GF	Grilamid 2SV-30H PA610 30% GF
Total Energy	<i>MJ/kg</i>	114	94	110
	<i>kg oil/kg equiv.</i>	2.3	1.9	2.2
CO ₂ -Balance	<i>g/kg</i>	2000	2100	2100
GWP*	<i>CO₂ equiv.</i>			
20 years		2600	2800	2700
100 years		2300	2400	2400
500 years		2200	2300	2200
Organic content	<i>bio %</i>	49.2	34.4	44
	<i>non bio %</i>	0.8	0.6	26
Inorganic content (glass)	<i>%</i>	50	65	30

*Global Warming Potential

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Application Development Centre (ADC)



Cooperation in Product Development

Converter



OEM



EMS
EMS-GRIVORY



EMS
EMS-GRIVORY

SPE Automotive Awards 2021

International Society of Plastics Engineers

2nd Place
**Electronical/
Optical Part**



**Fast Charging Plug
(Various OEM)**

2nd Place
Powertrain



**Gear Shift Module
(Hyundai)**

3rd Place
**Chassis Unit/
Structural Component**



**Headlight Bracket
(Jaguar Land Rover)**

3rd Place
New Mobility



**Cooling Valve
(Various OEM)**

EMS Support

DESIGN CONCEPT

- Design proposals (variants)
- Part cost calculations

MATERIAL SELECTION

- Determination of material data
- Material comparisons

DESIGN EVALUATION

- Design recommendations
- Moldflow calculations
- Finite Element Analysis (FEA)



EMS Support

PROTOTYPES

- Production of prototypes
- Modifications on die cast tools for trials

APPLICATION RELATED TESTS

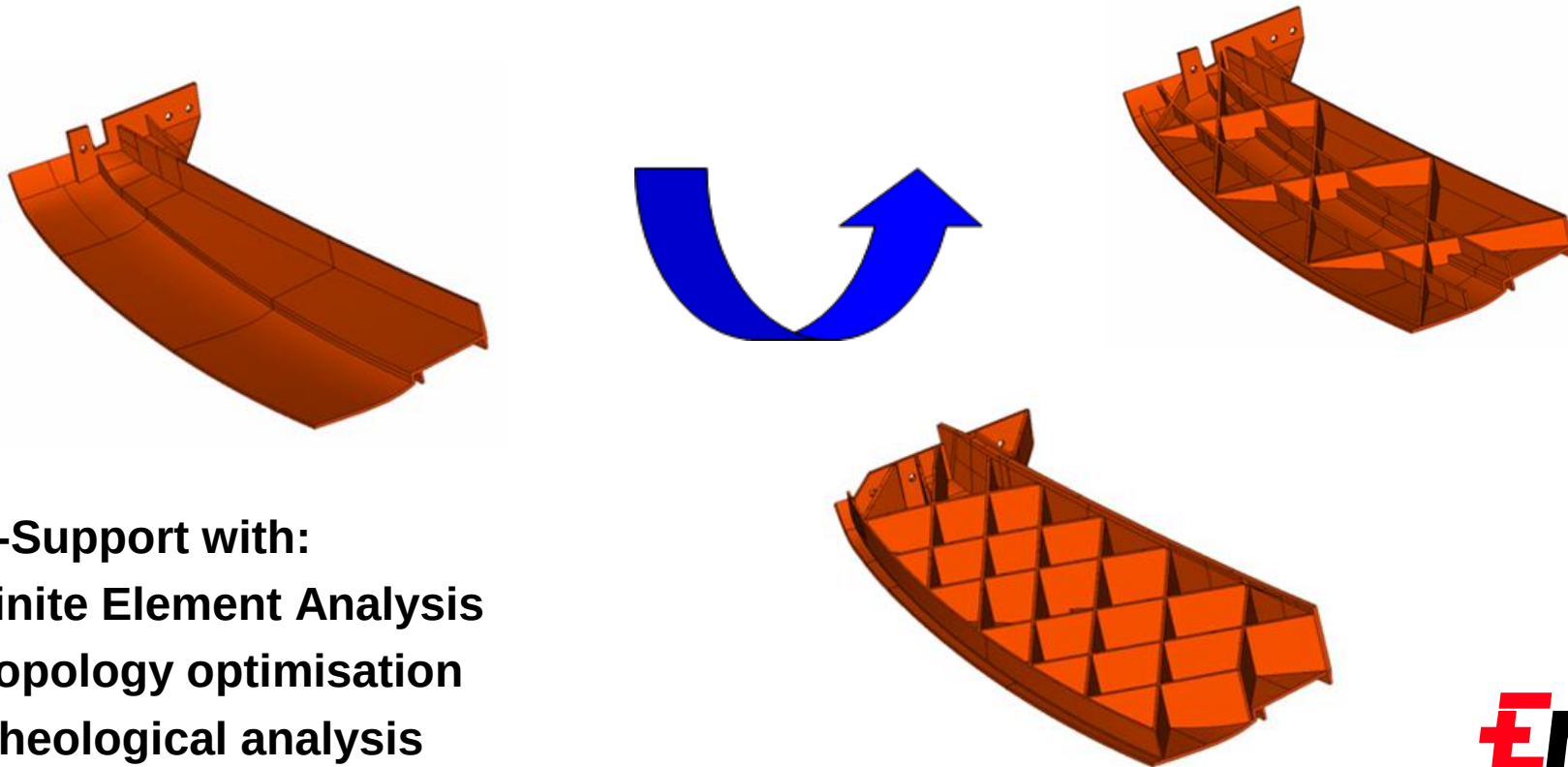
- Development of test methods
- Chemical and hydrolysis resistance
- Mechanical properties

SAMPLING / PRODUCTION RAMP-UP

- Processing and tool optimisation



Optimisation of Structural Stiffness



EMS-Support with:

- Finite Element Analysis
- Topology optimisation
- Rheological analysis

Thank you for listening!



Any questions?

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