



High temperature
BPA-free transparent
polymers for Food
contact applications
in Consumer industry

**Part I: PC, PEI, CPET and
Sulfones for Food Contact
Applications**



Meet the presenters



Shari Axelrad

**Technical Development
Team Leader**
Solvay Specialty Polymers

Shari Axelrad is a Technical Development Team Leader for Solvay Specialty Polymers in Alpharetta, Georgia. Shari has a B.S. and M.S. in Chemical Engineering from Virginia Polytechnic Institute and Georgia Institute of Technology respectively. She joined Solvay in 1997 and has worked in the area of sulfone polymer formulation and application development for over 10 years. Shari is now supporting application development, material science and customer support for the consumer market segment.



Guru Sivakumar

**Global Marketing Manager
for Consumer Goods**
Solvay Specialty Polymers

Guru Sivakumar is currently the Global Marketing Manager for Consumer Goods with Solvay Specialty Polymers in Milan, Italy. Guru joined Solvay in 2015 and brings 10-years of experience in polymers and engineering and a deep understanding of Business Development. He holds a B.S. degree in Electrical Engineering and an MBA from SDA Bocconi respectively. His current responsibilities include driving business growth through assessing market needs and driving market adoption.

Agenda

- Overview of transparent polymers in Consumer Goods – Properties & comparative performance
- Sulfone applications case studies
- Thermal and mechanical properties
- Regulatory compliance
- Chemical resistance
- Design and processing
- Conclusion and Q&A



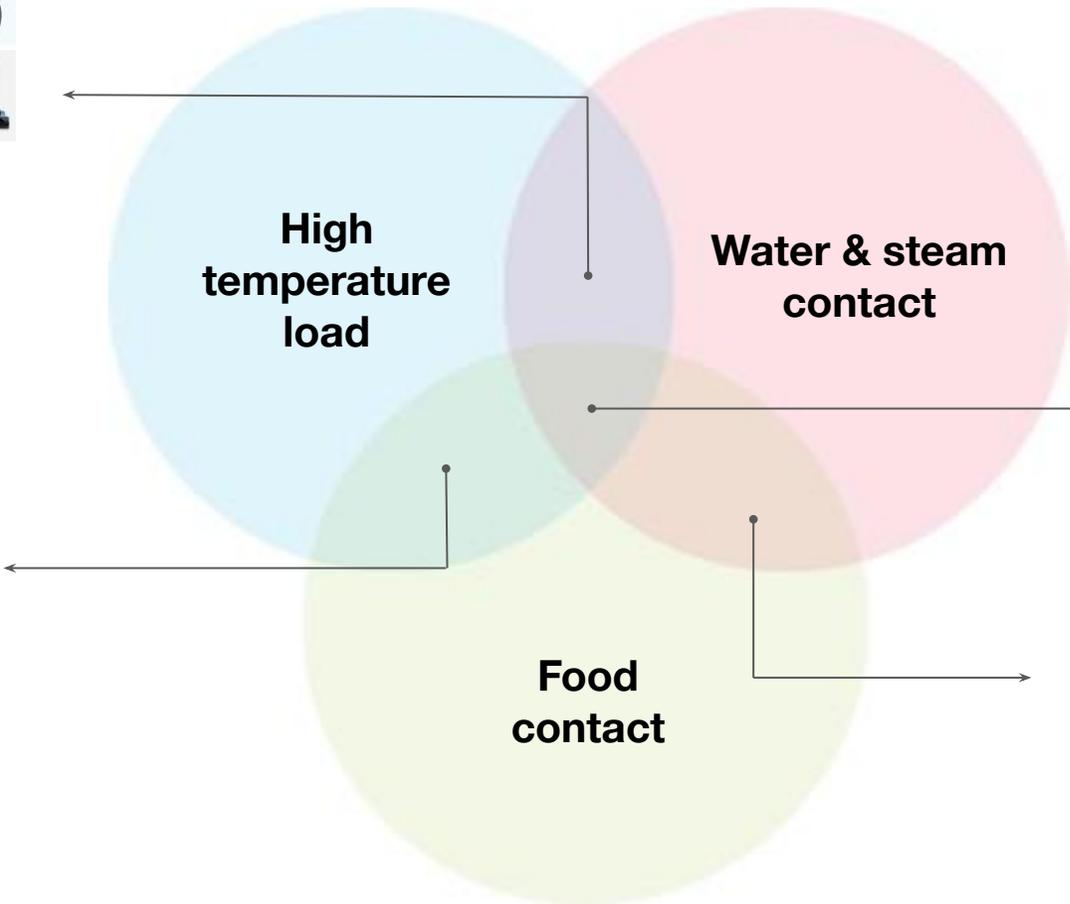
Consumer applications and functional needs driving adoption of specialty polymers



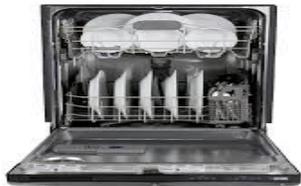
Washing machines
Dryers
Vacuum cleaners



Fryers
Ovens
Bakery Appliances
Microwave



Steam ovens
Rice cookers
Coffee

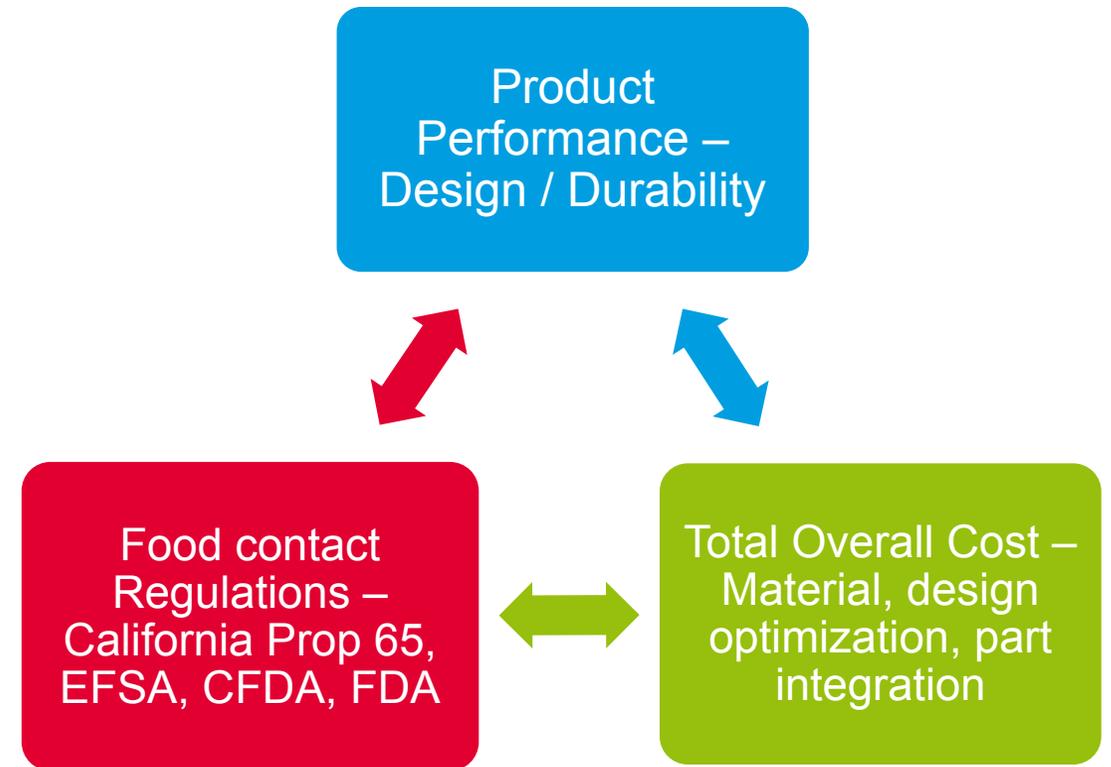


Beverages preparation
Dish washing
Juicers





Meeting the challenges in Consumer Food contact appliances



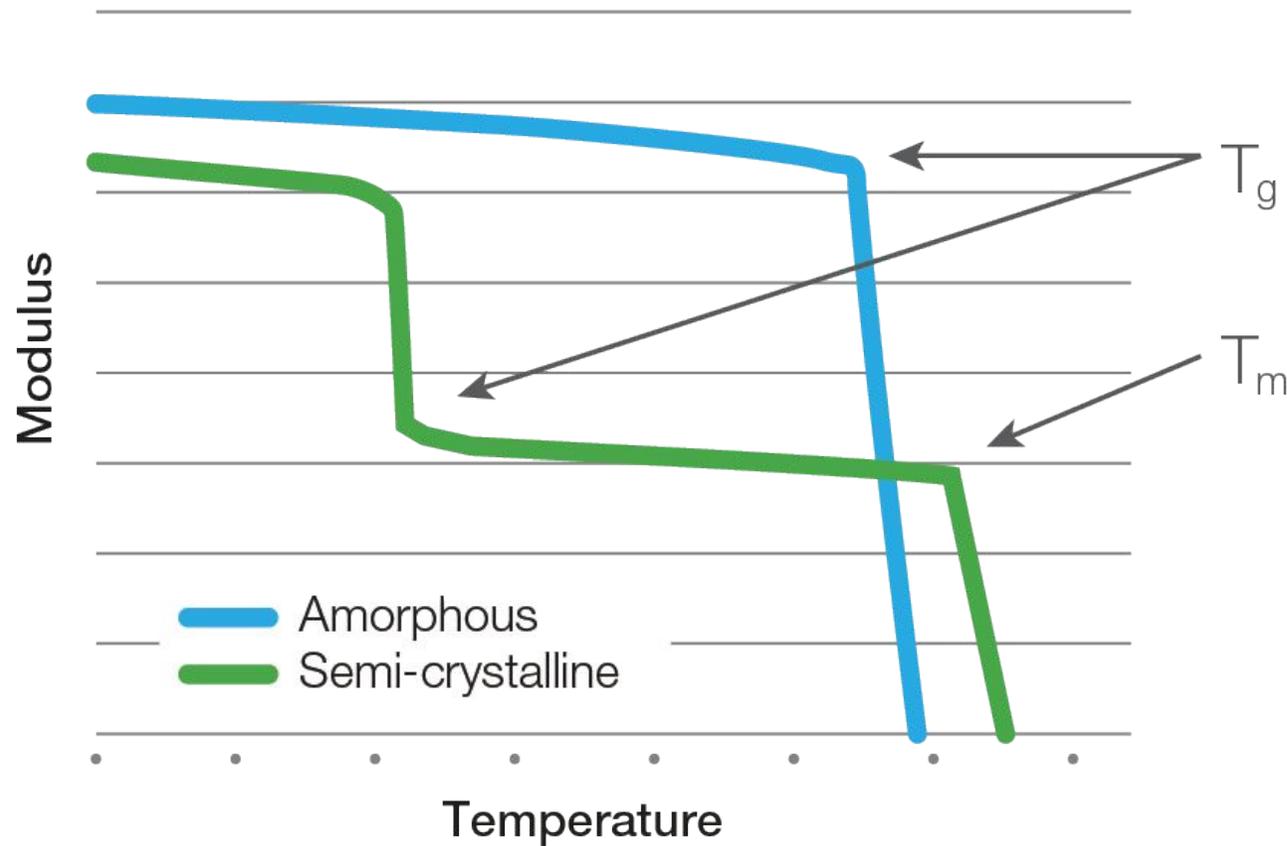
Material selection criteria in Consumer Food contact applications

Material selection criteria

- Transparency & clarity
- Strength and stiffness
- Thermal stability
- Toughness and Impact resistance
- Resistance to chemical aggression
(Dishwasher safe)
- **Sterilization** compatibility (Steam / boiling water)
- **Regulatory approvals (BPA-Free)**
- Design & processing (High flow / Molding criteria)

Thermal performance of Amorphous (Transparent) Vs Crystalline (Non-transparent) polymers

Typical change in modulus with temperature



Transparent high performance polymers (HPPs) in Consumer Goods space

Typical applications

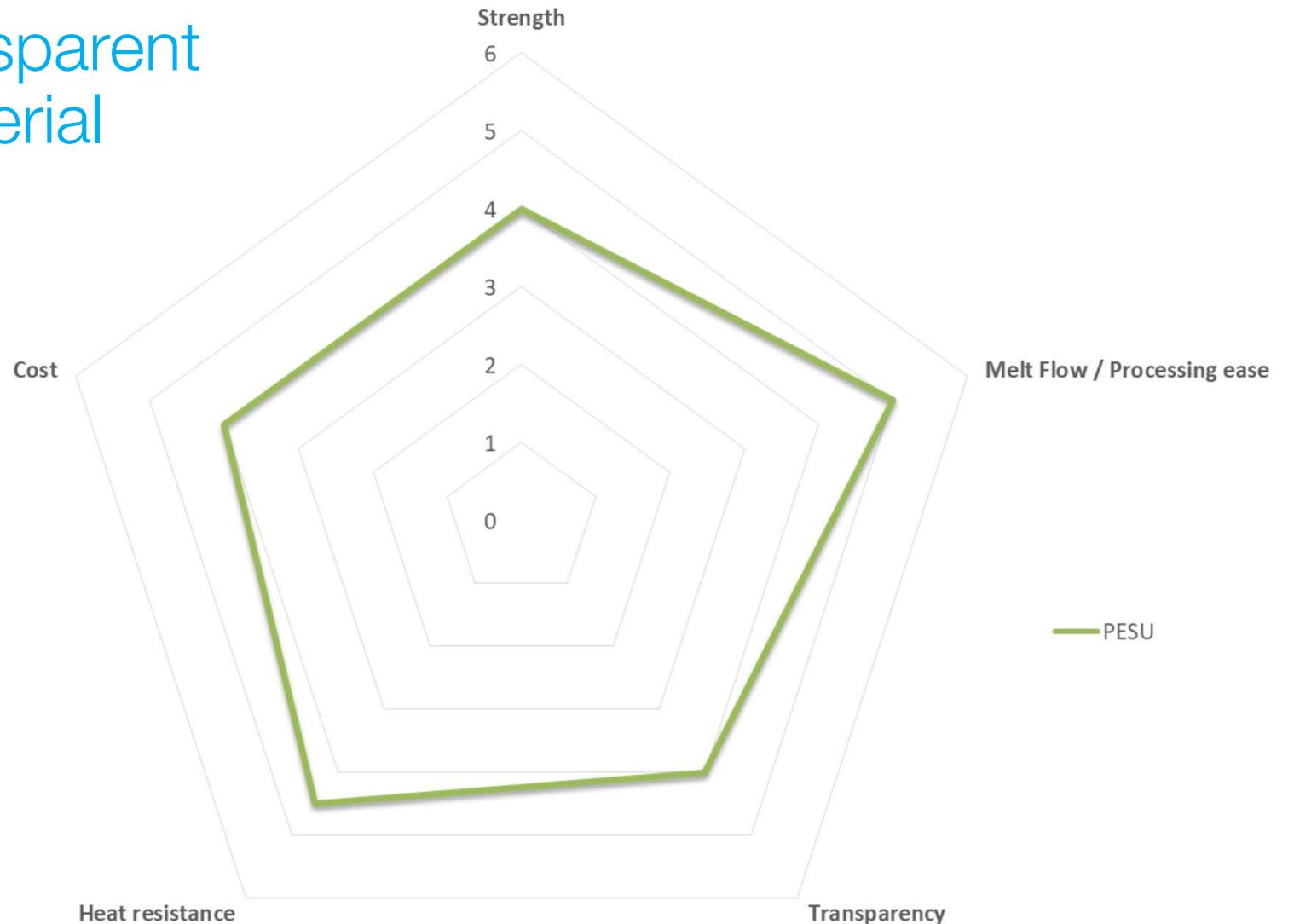
	HT Catering & Tableware	Countertop appliances*	Large vending machines	Baby products (BPA-Free)
Radel® PPSU	✓	✓	✓	✓
PEI	✓		✓	
Veradel® PESU	✓	✓	✓	✓
Udel® PSU			✓	
PC		✓	✓	
CPET	✓		✓	✓



Properties and comparative Cost overview for Transparent High performance Material

Selection decision factors for amorphous polymers in Food-contact

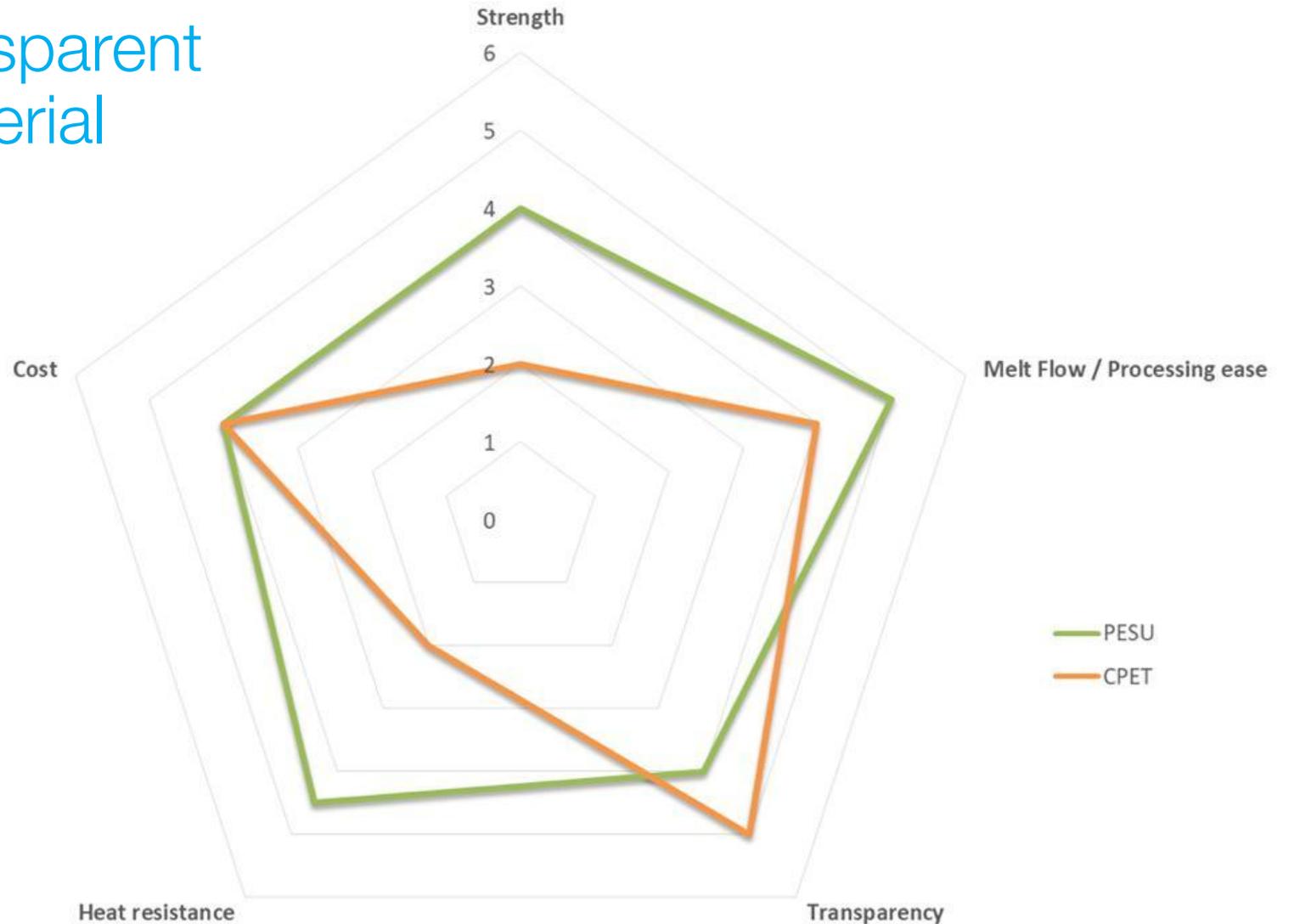
- Transparency
- Heat resistance
- Regulatory
- Cost
- Mechanical
- Processing



Properties and comparative Cost overview for Transparent High performance Material

Selection decision factors for amorphous polymers in Food-contact

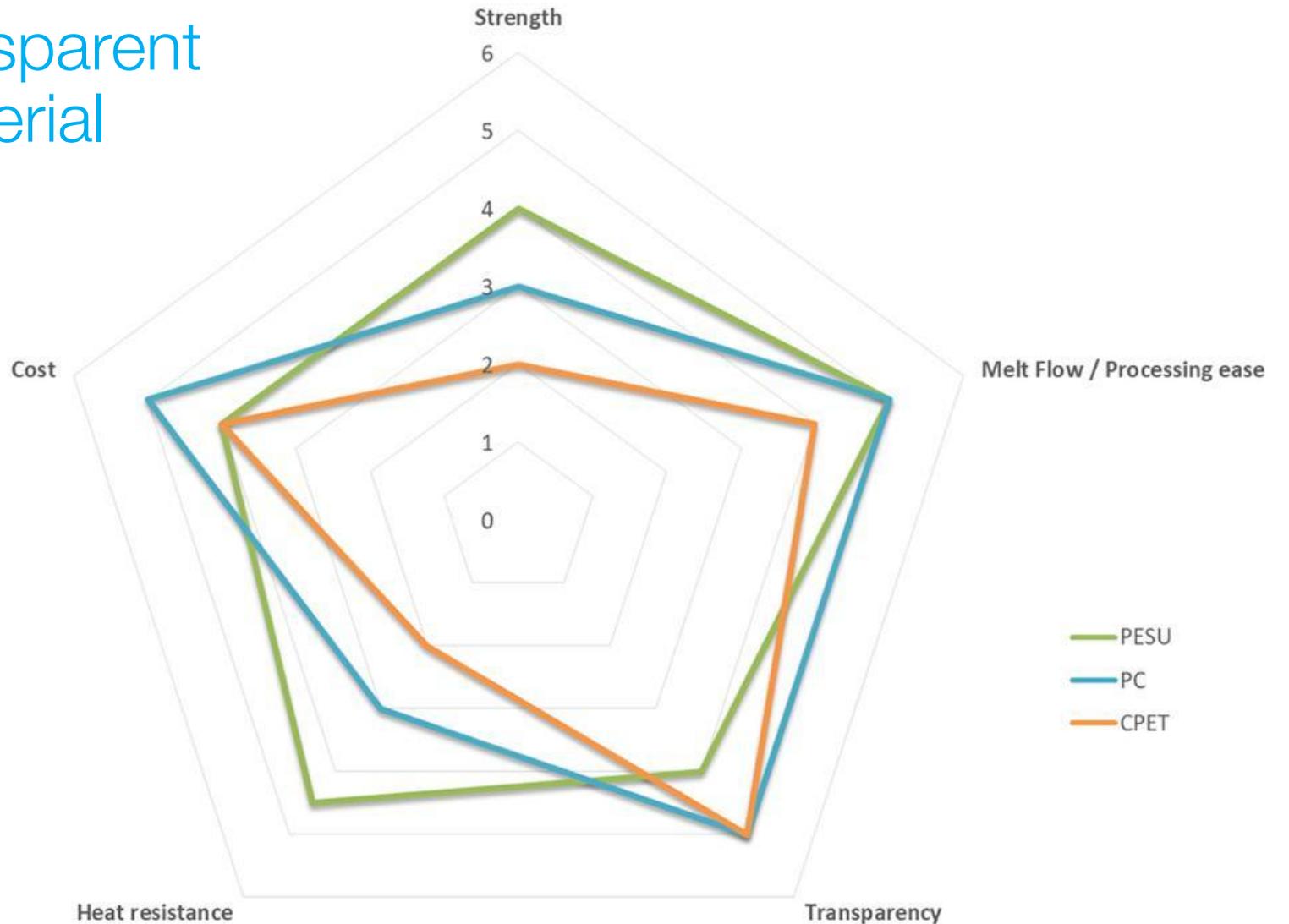
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Properties and comparative Cost overview for Transparent High performance Material

Selection decision factors for amorphous polymers in Food-contact

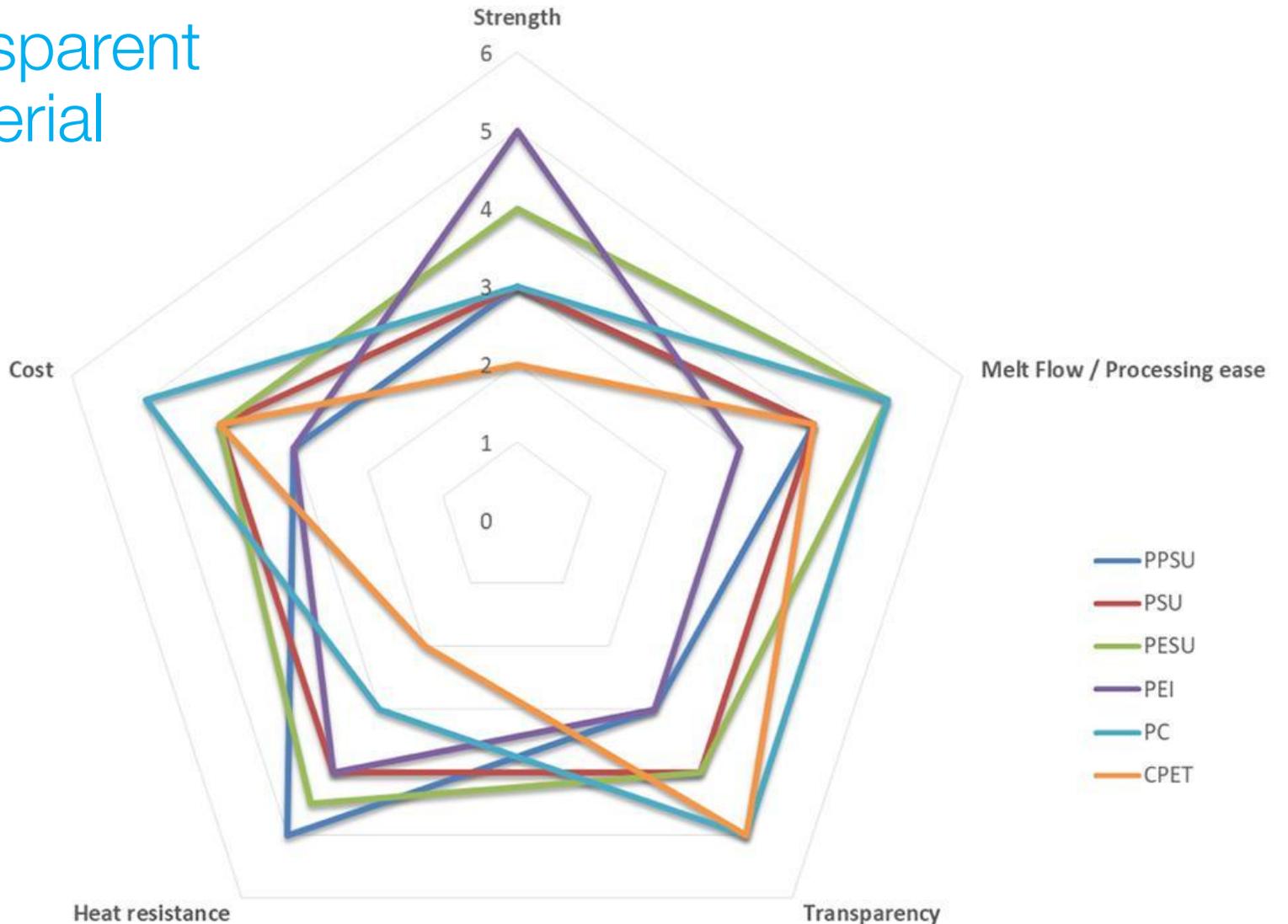
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Properties and comparative Cost overview for Transparent High performance Material

Selection decision factors for amorphous polymers in Food-contact

- Transparency
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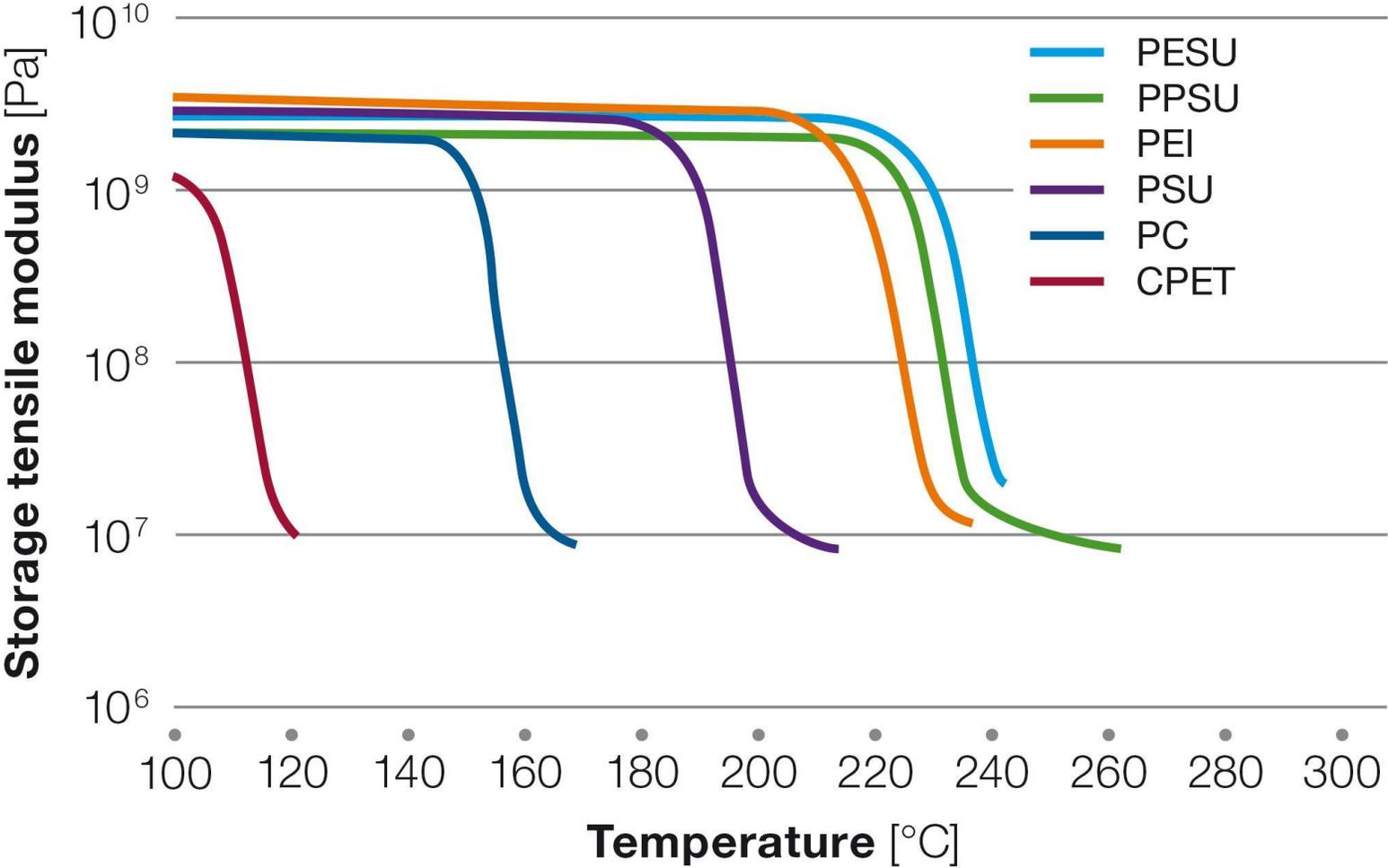


Case Study 1: Catering and Tableware



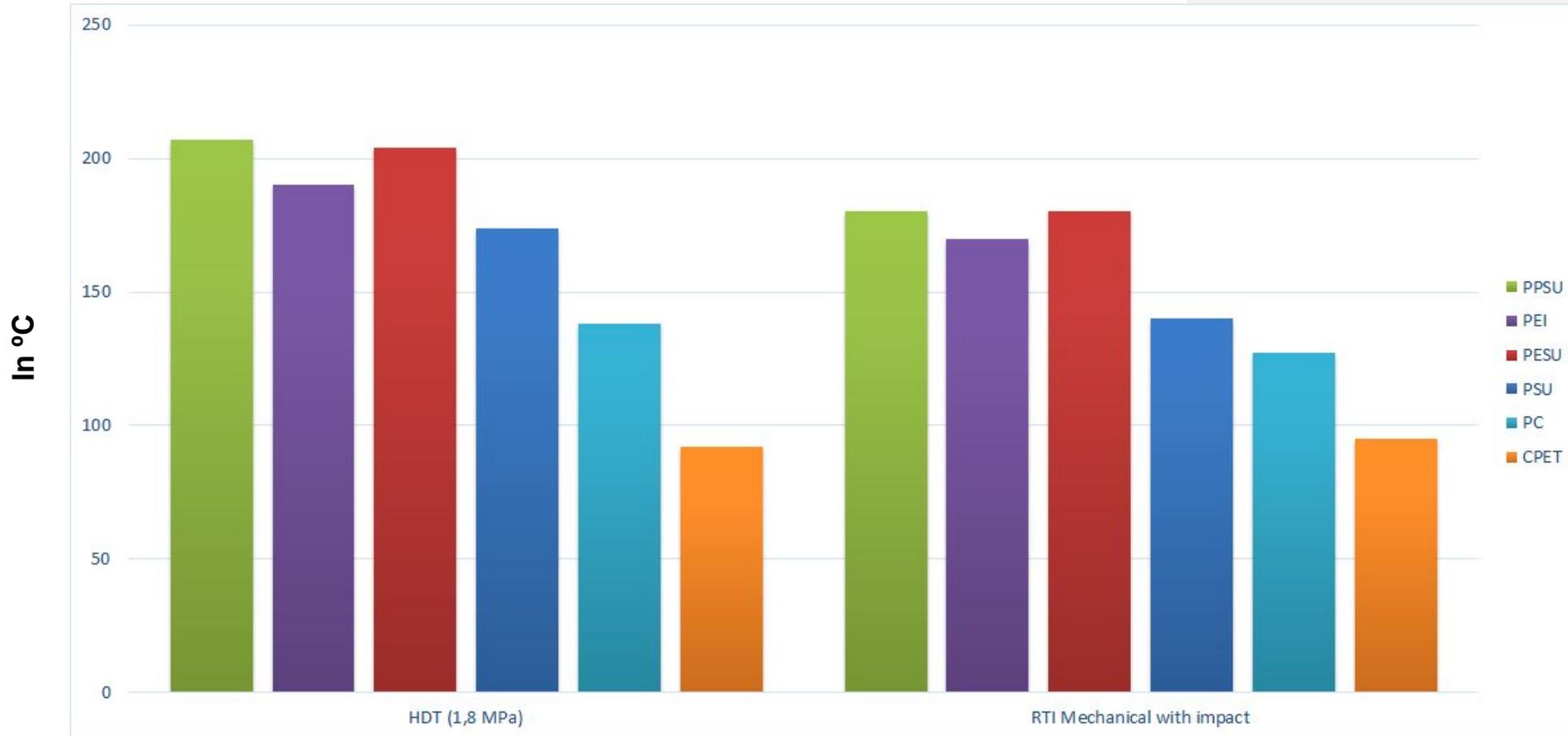
- Application: High temperature microwaveable trays for application in Home / Restaurants and Aerospace food heating
- Material: Veradel® PESU A301 NT / Radel® PPSU R-5000 NT
- Processing method: Injection molding
- Main Value Proposition:
 - **High temperature resistance of >150C (Microwave temp exposure)**
 - **Food contact approvals globally (BPA-free)**
 - **Transparency**
 - Lightweight and shatter proof vs Glass
 - Exceptional toughness
 - Hydrolytic stability at high temperatures
 - No Smell & Taste migration in final food
 - Dishwasher safe

Effect of temperature on material modulus



Data based on datasheets
Solvay & Sabic
Measurements Solvay R&D

Thermal properties comparison for high temperature transparent polymers



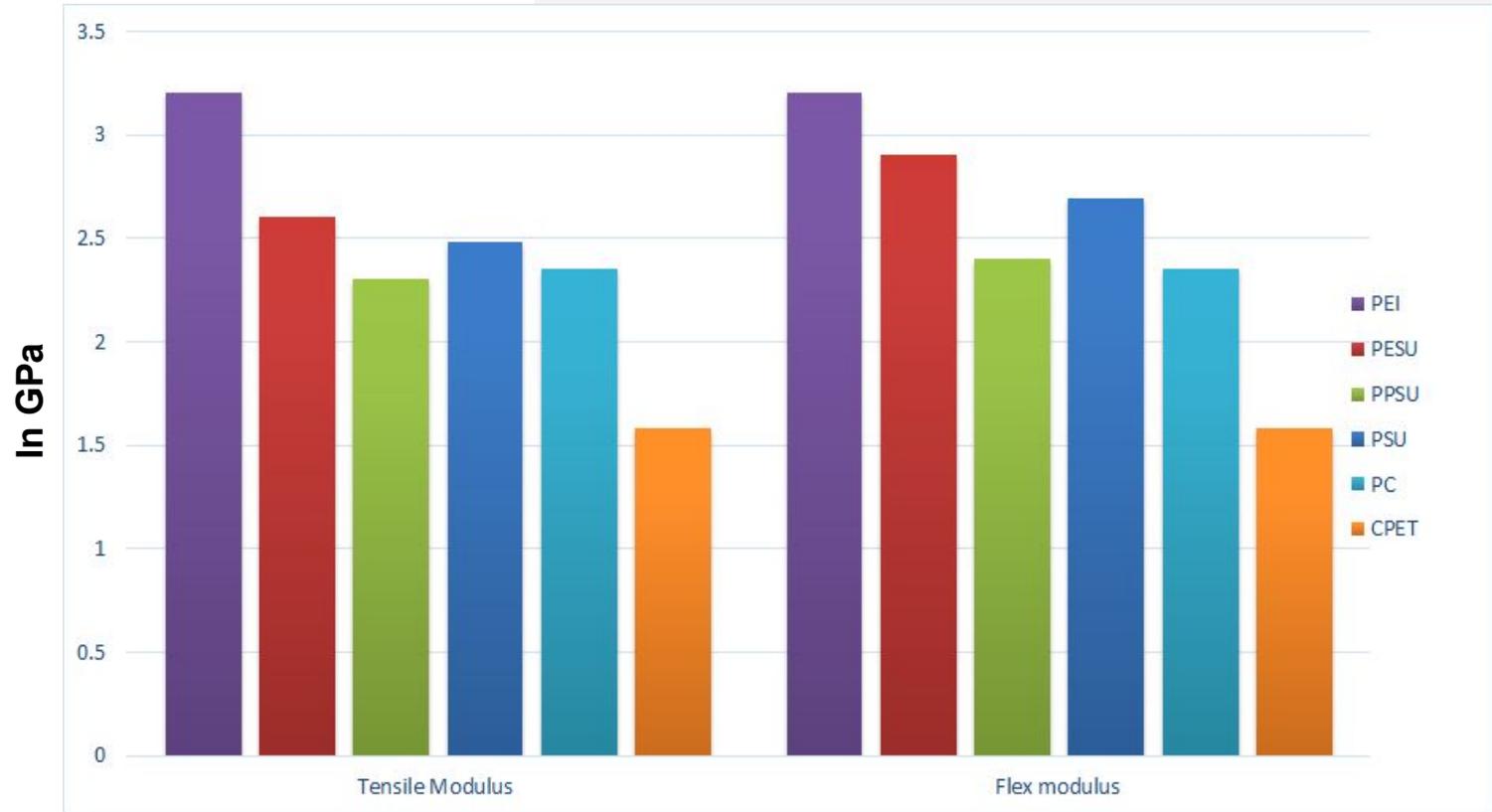
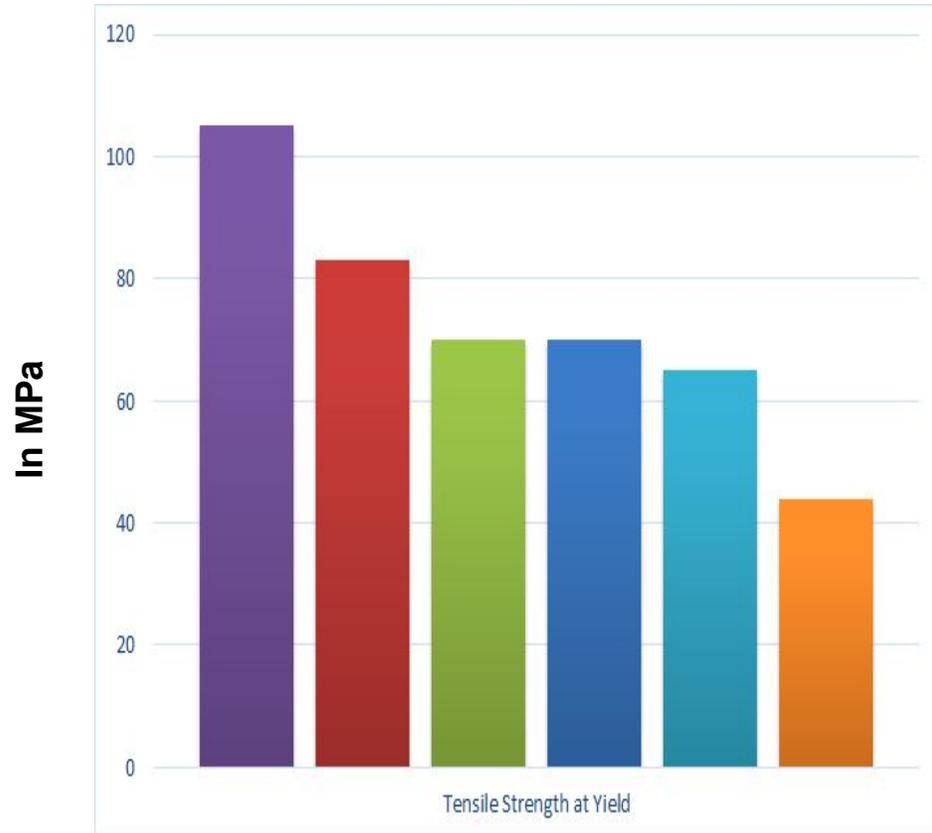
Data based on datasheets Solvay, Sabic (PEI) & public available data for PC & CPET

Case Study 2: Countertop appliances



- Application: Transparent food / water contact parts for coffee machines (carafes), food processors and juicers
- Material: Veradel[®] PESU A-301 NT / Radel[®] PPSU R-5000 NT
- Processing method: Injection molding
- Main Value Proposition:
 - Chemical resistance to aggressive food material (Coffee...)
 - High temperature resistance of >180C for processors
 - Food contact approvals globally (BPA-free)
 - Shatterproof vs Glass
 - Transparency
 - Dishwasher safe

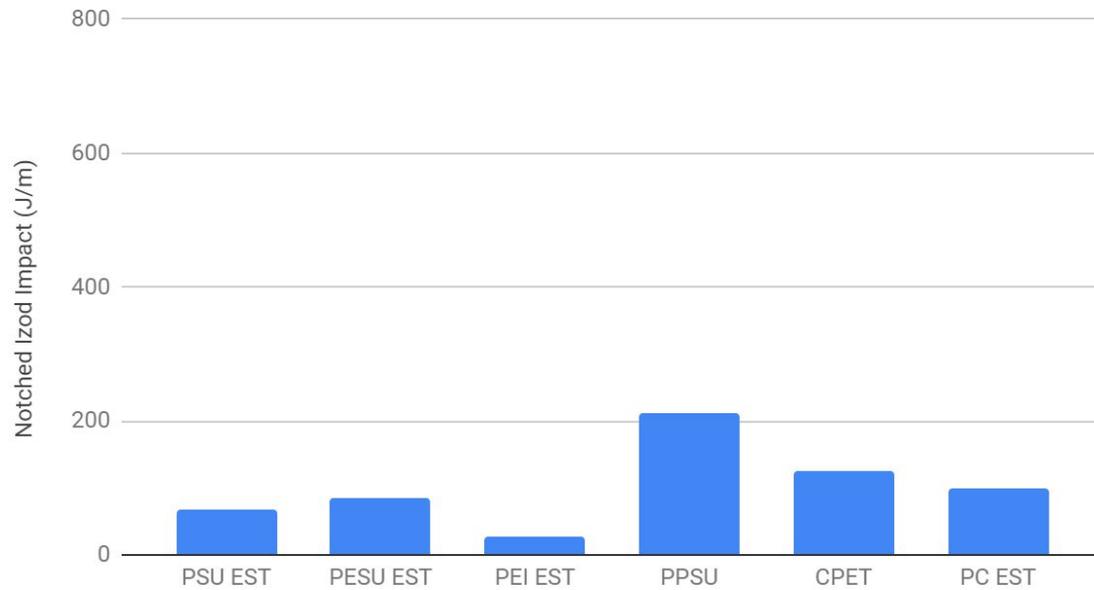
Tensile strength and modulus data



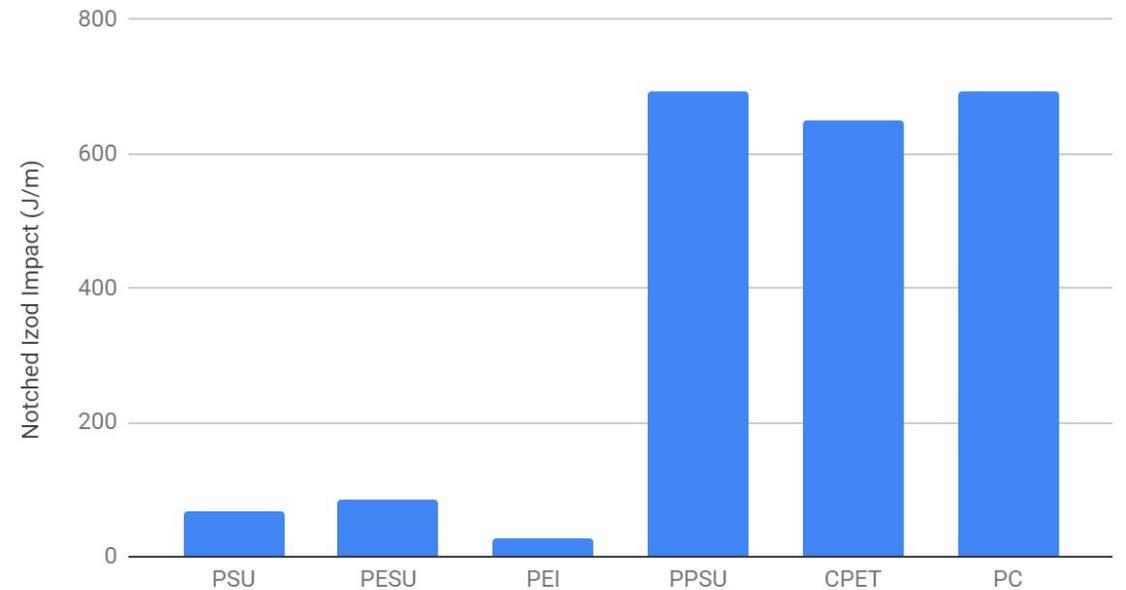
Data based on datasheets Solvay & Sabic and public data available for CPET and PC

Impact property comparison

Notched Izod Impact Performance at -40C



Notched Izod Impact Performance at Room Temperature



Although PPSU, CPET and PC provide the best impact performance, almost all the amorphous high performance polymers will surpass the requirements of impact in consumer goods and appliances industry

Case Study 3: Baby products



- Application: Transparent food contact approved / BPA free baby bottles
- Material: Radel® PPSU R-5000 NT / Veradel® PESU A-101 / 201 / 301 NT
- Processing method: Blow molding
- Main Value Proposition:
 - Food contact approvals globally (BPA-free)
 - Resistance to hot water sterilization
 - Shatterproof vs Glass
 - Exceptional toughness
 - Transparency
 - Significantly lower deformations at high temperatures Vs other polymers such as CPET

Source: Press release

Case Study 4: Beverage vending



- Application: Valves / Coffee pressure drip-heads / connectors in Beverage vending machines
- Material: Radel[®] PPSU R-5000 / Veradel[®] PESU A301 NT / Udel[®] PSU P1700
- Processing method: Injection Molding
- Main Value Proposition:
 - Food contact approvals globally
 - Functional part integration Vs Metals
 - Resistance to hot water contact and dimensional stability
 - High temperature resistance of >150C for professional hot beverage makers (possibility of thinner wall molding for high temperature applications)
 - Lightweight and shatter proof

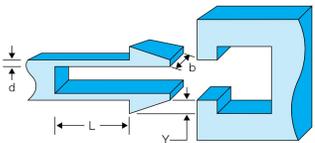


Don't specialty polymers cost more than the materials I currently use?

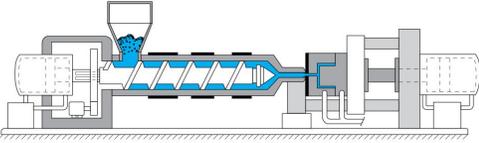
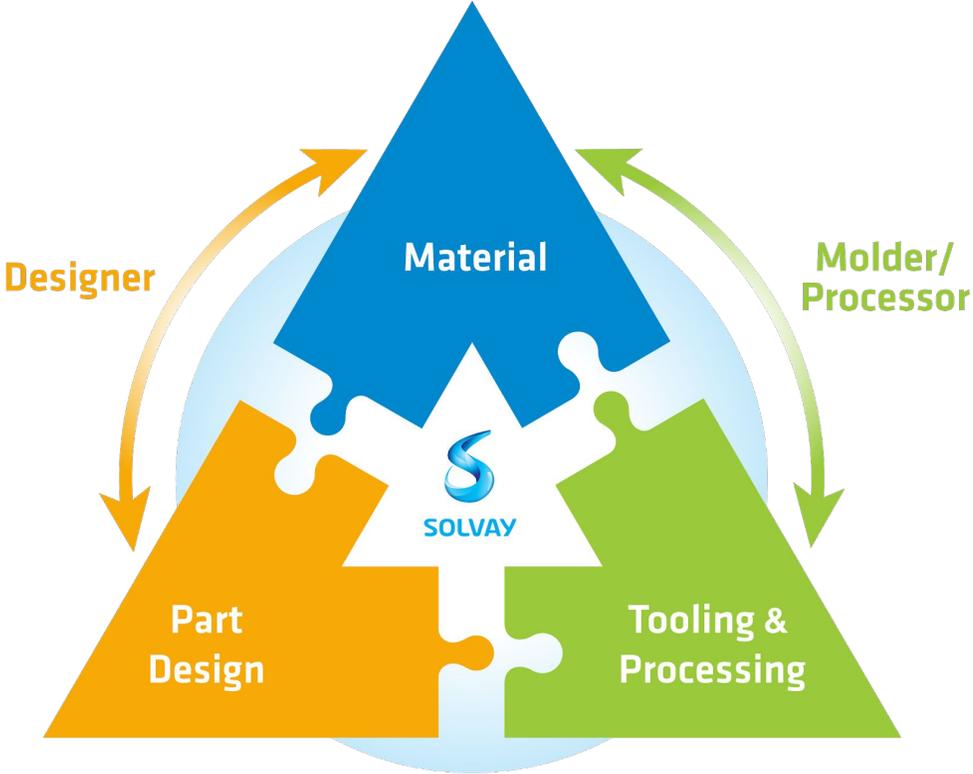
In selecting polymers always consider the total cost of production which is impacted by following factors

- ❑ Material cost: Price/Kg, Density
- ❑ Molding costs: Melt & Mold temperatures
- ❑ Design: Thinner walled parts / functional integration
- ❑ Capex: Mold / Tool investment Vs operating life (Eg: 100k parts / tool for metal Vs 1Mn parts / tool for polymers)
- ❑ Post processing: Curing, Annealing

Collaboration hold the key to design the most effective part and select the best material for an application



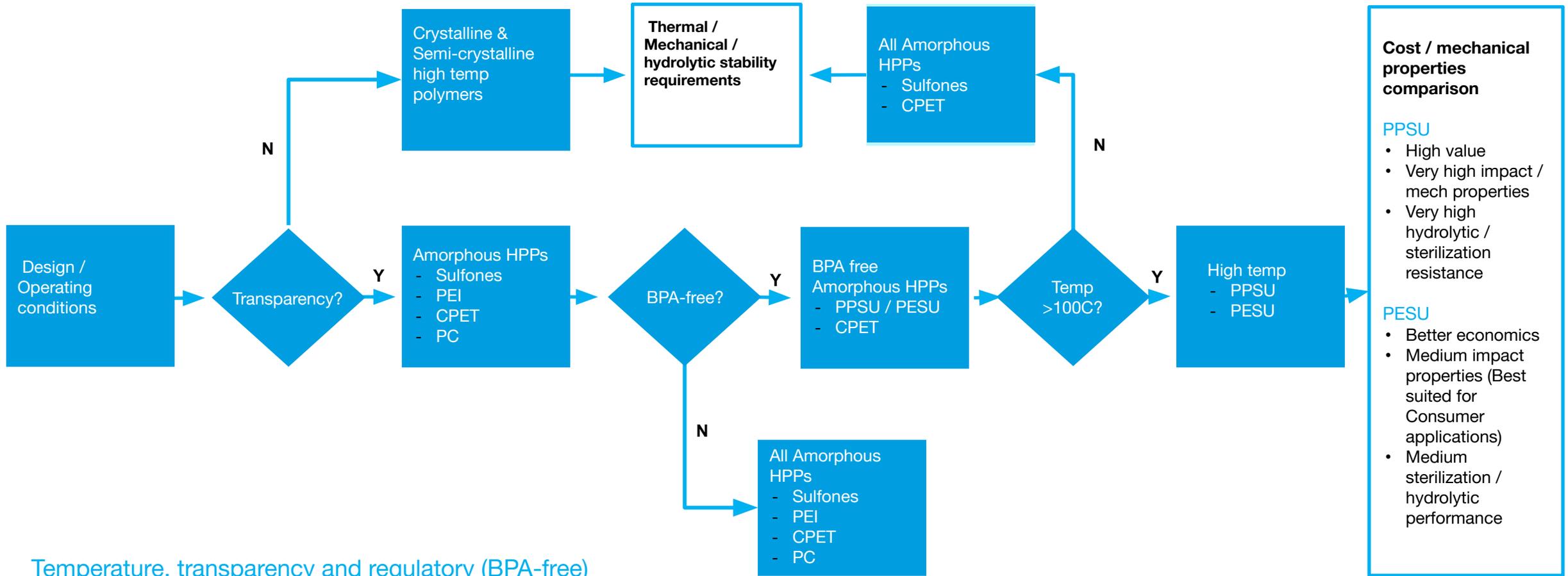
Performance
Geometry
Lifecycle
Regulations
Cost
Etc.



Processing
Tooling
Moldability
Cycle time
Yield, margin
Etc.

Leverage the Solvay CAE and mold support capabilities to arrive at the best possible design enabling cost optimization, compliance and performance enhancement

Polymer selection decision map



Temperature, transparency and regulatory (BPA-free)
Strength, impact and hydrolytic stability and cost

Cost / mechanical properties comparison

PPSU

- High value
- Very high impact / mech properties
- Very high hydrolytic / sterilization resistance

PESU

- Better economics
- Medium impact properties (Best suited for Consumer applications)
- Medium sterilization / hydrolytic performance

2018 Key Figures



~24,500
Employees



61
Countries



115
Industrial sites



21
Major R&I centers



TOP 3
Market position in
~ 90% of portfolio



€10.3 billion
Underlying net sales



€2.2 billion
Underlying EBITDA

Figures take in account the
planned divestment of the
polyamide business



50%
Net sales generated
by sustainable
solutions



**We are an advanced materials
and specialty chemicals company,
committed to addressing
key societal challenges**

GLOBAL PRESENCE Close to our Customers

1



Headquarters

14



Production sites

9

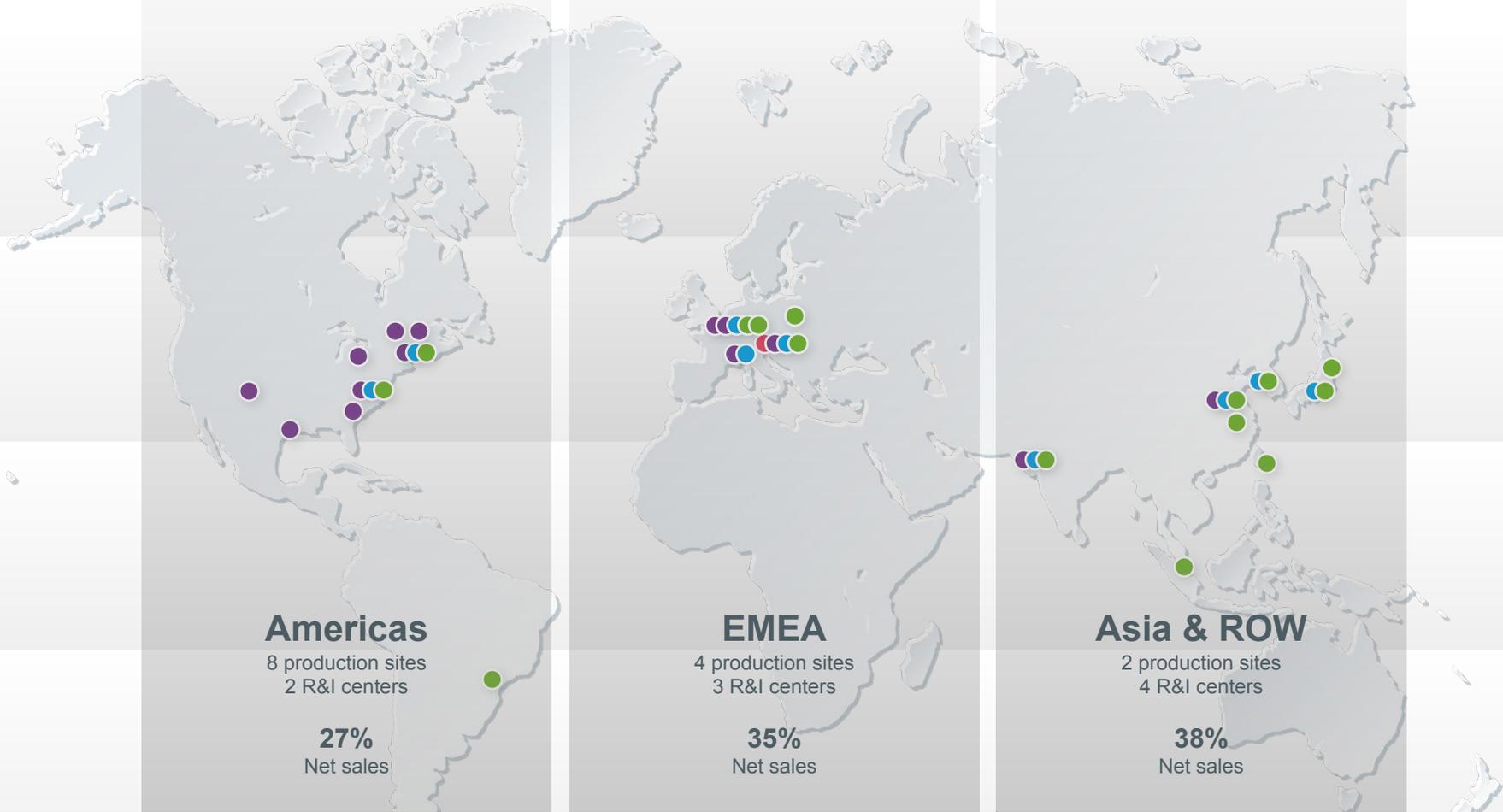


Research & Innovation Centers

15



Sales & Marketing Offices



Americas

8 production sites
2 R&I centers

27%
Net sales

EMEA

4 production sites
3 R&I centers

35%
Net sales

Asia & ROW

2 production sites
4 R&I centers

38%
Net sales

€ 2.0 bn
Net sales 2018



~3,600
Employees



~ 600
Researchers



40-44
Average Age



80%
Engagement Index

2018 Data



Q&A

Contact



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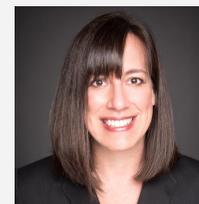
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