

DuPont Renewably Sourced (RS) Engineering Polymers



DuPont™
Renewably-sourced™
Materials



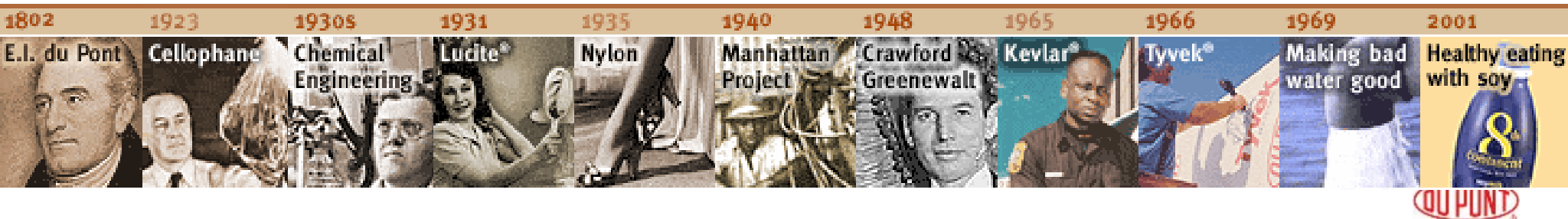
The miracles of science™



206 Years of Innovation and Success

- A Dynamic Science Company
- 60,000 employees in over 70 Countries
- \$30 Billion in global revenues
- \$6 Billion sold into the automotive segment
- \$1 Billion in bio-based revenue expected in 2015
- A World Leader in Renewable Materials

One of The Top Rated Green Companies of the World (Ceres, Business Week, Fortune)



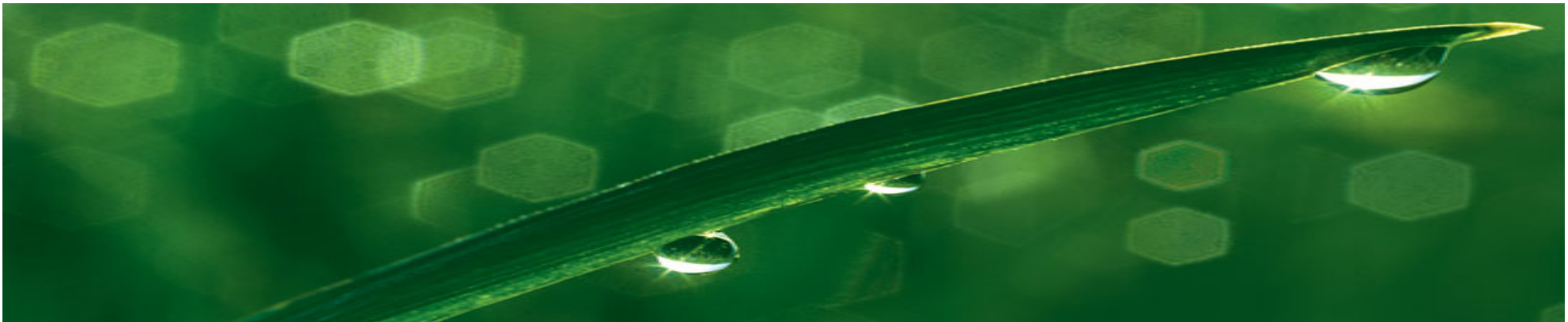
DuPont Mission: Sustainable Growth



The creation of shareholder and societal value while we reduce the environmental footprint along the value chains in which we operate.

Terminology

- **RENEWABLY SOURCED and BIO-BASED define the same thing. It refers to a material that contains carbon originating from a renewable plant source. DuPont™ Renewably Sourced™ materials contain a minimum of 20% renewably sourced ingredients by weight.**
- **RENEWABLY SOURCED can include BIODEGRADABLE products that can be broken down by living organisms like bacteria. It also includes durable goods that are designed for long life.**
- **Products discussed in this presentation are for durable good type applications and recyclable.**





responsible innovation *now*

responsible – 208 years of trusted solutions

- *renewably sourced materials*
- *light-weighting*
- *safer, sustainable world*

innovation - pushing the edge of

- *creativity in material science*
- *expert application development*
- *customer collaboration and integration*

now - sense of urgency

- *global presence, local delivery*
- *accessible: Dial DuPont, self-serve WEB content*
- *understand the “new reality”*
- *matching delivery to customer needs*

Next Generation Materials and Fuels from Biomass

Automotive OEMs around the world are developing cars to be more environmentally friendly

Biomass



Green Chemistry & Engineering

Wide range of products commercially available and under development.

...to Products



Deliver renewably sourced materials made from biomass instead of petroleum with uncompromised product performance

DuPont's 2015 Sustainability Goals

DuPont is one of the first companies to develop environmental metrics nearly 18 years ago

Reduce Greenhouse Gas Emissions by another 15%

- *Reduced 72% since 1990*

Water Conservation by 30%

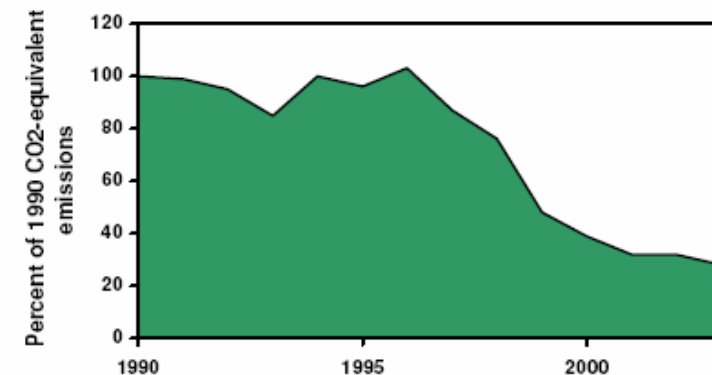
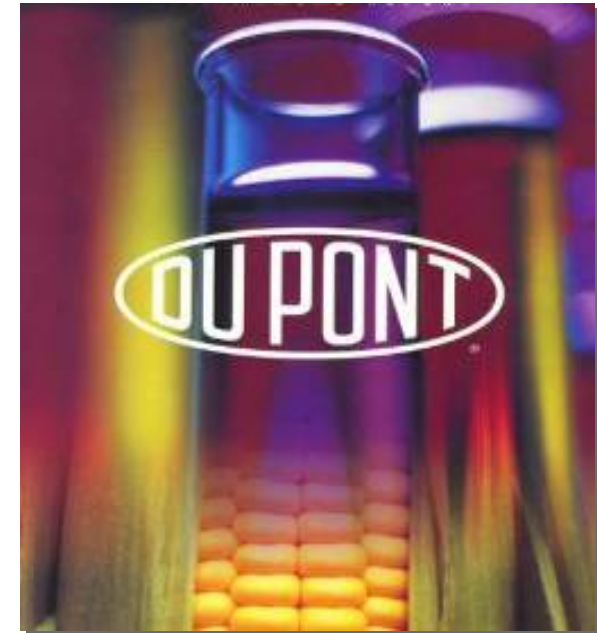
Fleet Fuel Efficiency:

- *100% fleet with better fuel efficiency*

Reduce Air Carcinogens emissions another 50%:

- *Reduced 92% air carcinogenic emissions since 1990*

Double Revenue from Non-depletable Resources to \$8 Billion



DuPont Greenhouse Gas Reductions 1990-2003

Global Greenhouse gas emissions were reduced 72% even as production volume increased 33%



What's at Stake ...

Economic, Environmental, Social Challenges

- **Global population growth**
- **Increasing global demand for energy**
- **Depleting oil reserves**
- **Rising greenhouse gas levels**
- **Need for energy independence**
- **Energy security/National security**
- **Consumer awareness of environmental options**

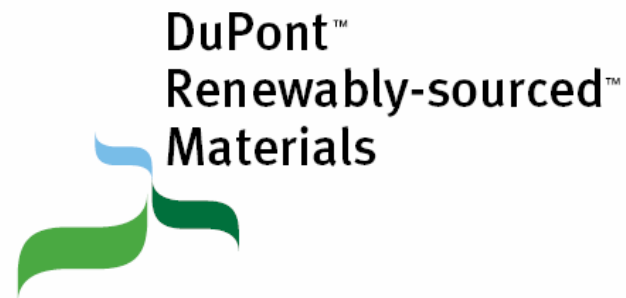


Driving the need for Renewable Energy and Materials

DuPont Renewably Sourced Materials



Our goal is to provide performance and functionality equivalent to or better than today's fully petroleum based materials while reducing the environmental footprint.



DuPont Renewably Sourced Materials

Current Portfolio for Engineering Polymers

Sorona® EP Thermoplastic Polymer

- DuPont™ Sorona® EP thermoplastic polymer is similar to the high-performance characteristics of current PBT materials.

Hytrel® RS Thermoplastic Elastomer

- DuPont™ Hytrel® RS offers the flexibility and elastic recovery of rubbers, the strength of plastics and ease of processing by conventional thermoplastic methods.

Polymers Based on Sebacic Acid made from Castor Oil

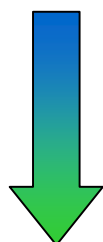
- **Zytel® RS 6,10 and 10,10 polyamides**
 - Castor oil based polyamides with high strength and toughness

DuPont™ Sorona® Polymer

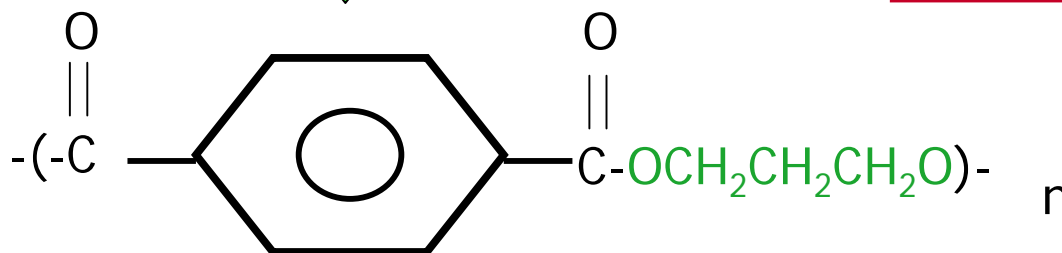
1,3-propanediol + DMT / TPA



Bio-PDO™

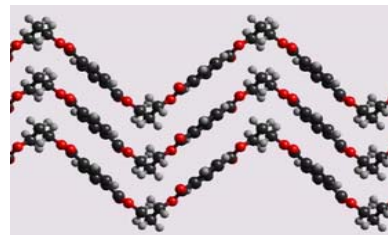


Catalyst
(Sb-free)

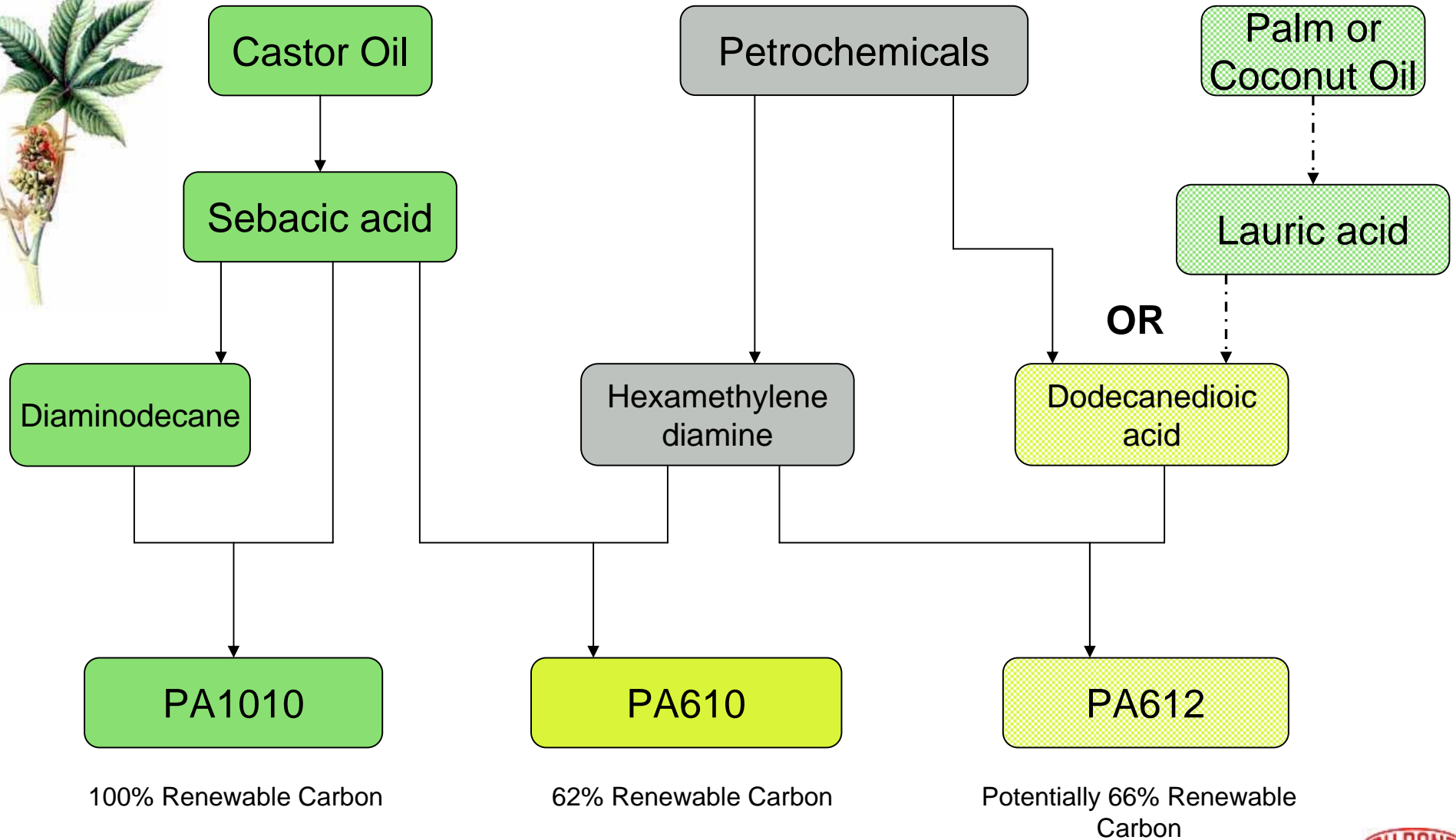


Sorona® renewably sourced polymer

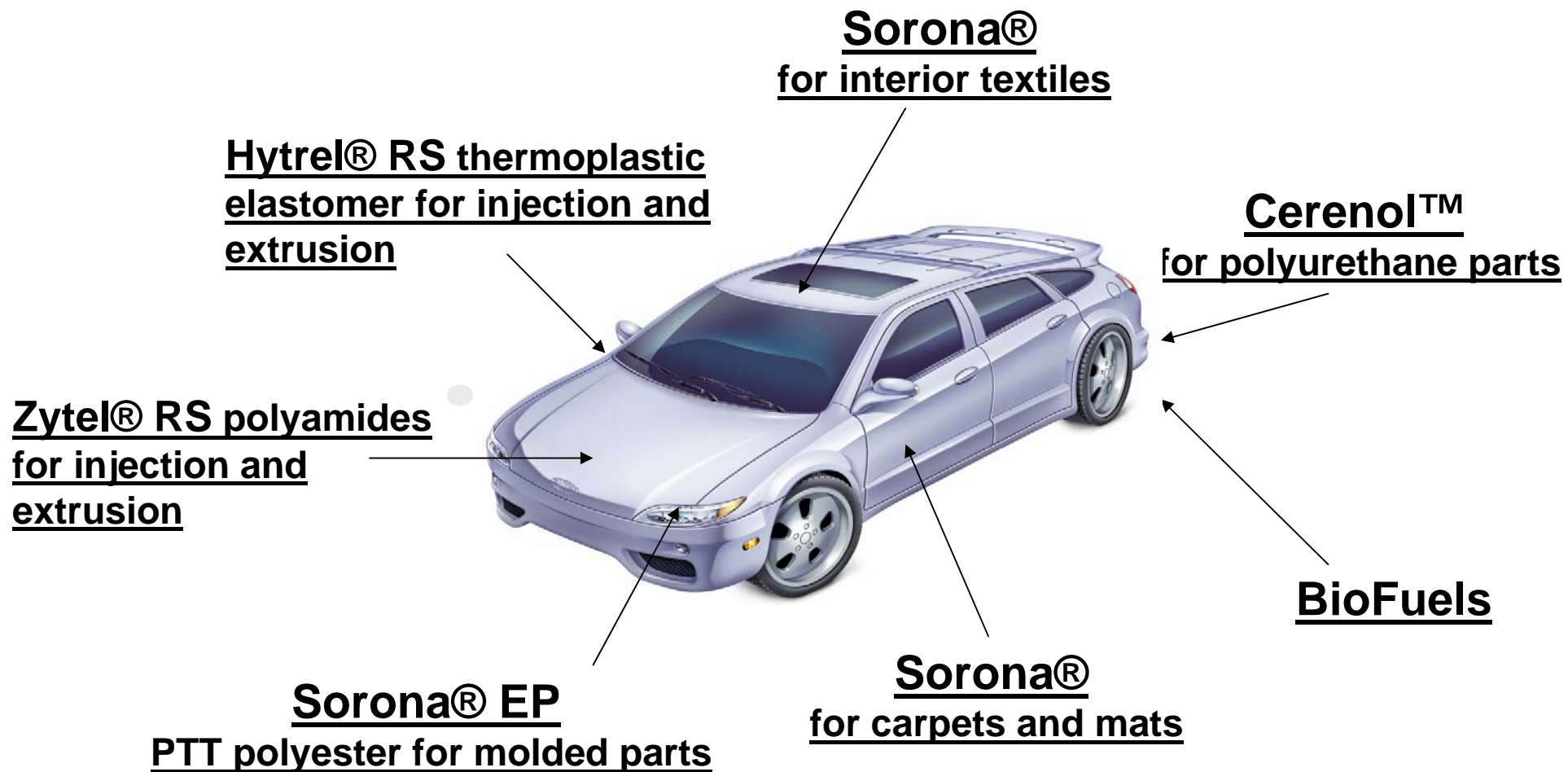
- Unique polymer with versatile properties
- **37%** renewably sourced ingredients, by weight
- Antimony free catalyst



Renewable sourcing for long chain polyamides



Renewable Materials from DuPont



Sorona[®] Life Cycle Analysis

Sorona[®] vs nylon 6 Life Cycle Analysis (Cradle to gate) per ISO standards

- **37% renewable content**
- **63% less green house gas emissions**
- **30% less energy and 21% less process water.**

Major ISO 14000-series documents:

- ISO-14040 Environmental management- Life cycle assessment- Principles and framework
- ISO-14044 Environmental management- Life cycle assessment- Requirements and guidelines
- ISO-14047
ISO-14042 Environmental management- Life cycle impact assessment- Examples of application of
- ISO-14048 Environmental management- Life cycle assessment- Data documentation format
- ISO-14049 Environmental management- Life cycle assessment- Examples of application of ISO-14041 to goal and scope definition and inventory analysis

Holistic Approach:

Evaluate the impact of all upstream and downstream products and processes.

LCA data for common petroleum based polymers can be found at www.lca.plasticseurope.org as one of several public forums that use ISO.

DuPont Sorona® Fibers

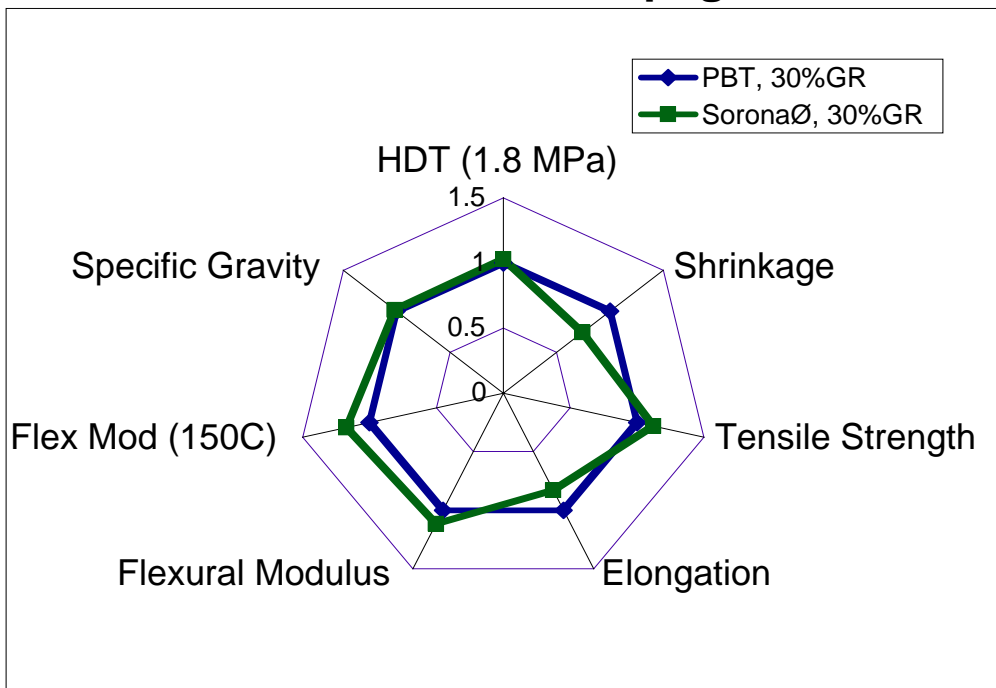
- Carpets, fabrics, automotive interiors – all commercial applications. Available at most carpet outlets.
- 37% renewable content
- 63% less green house gas emissions, 30% less energy vs nylon 6

If only 20% of the residential carpet sold in the U.S. were made from Sorona®, the energy equivalent of approximately 50 million gallons of gasoline would be saved per year.



Sorona® EP Polymers

- **Excellent surface appearance. Can eliminate painting even with glass reinforced grades. This provides cost savings and further environmental benefits by eliminating paint.**
- **Stronger and stiffer than PBT**
- **Lower shrink for less warpage**



Applications

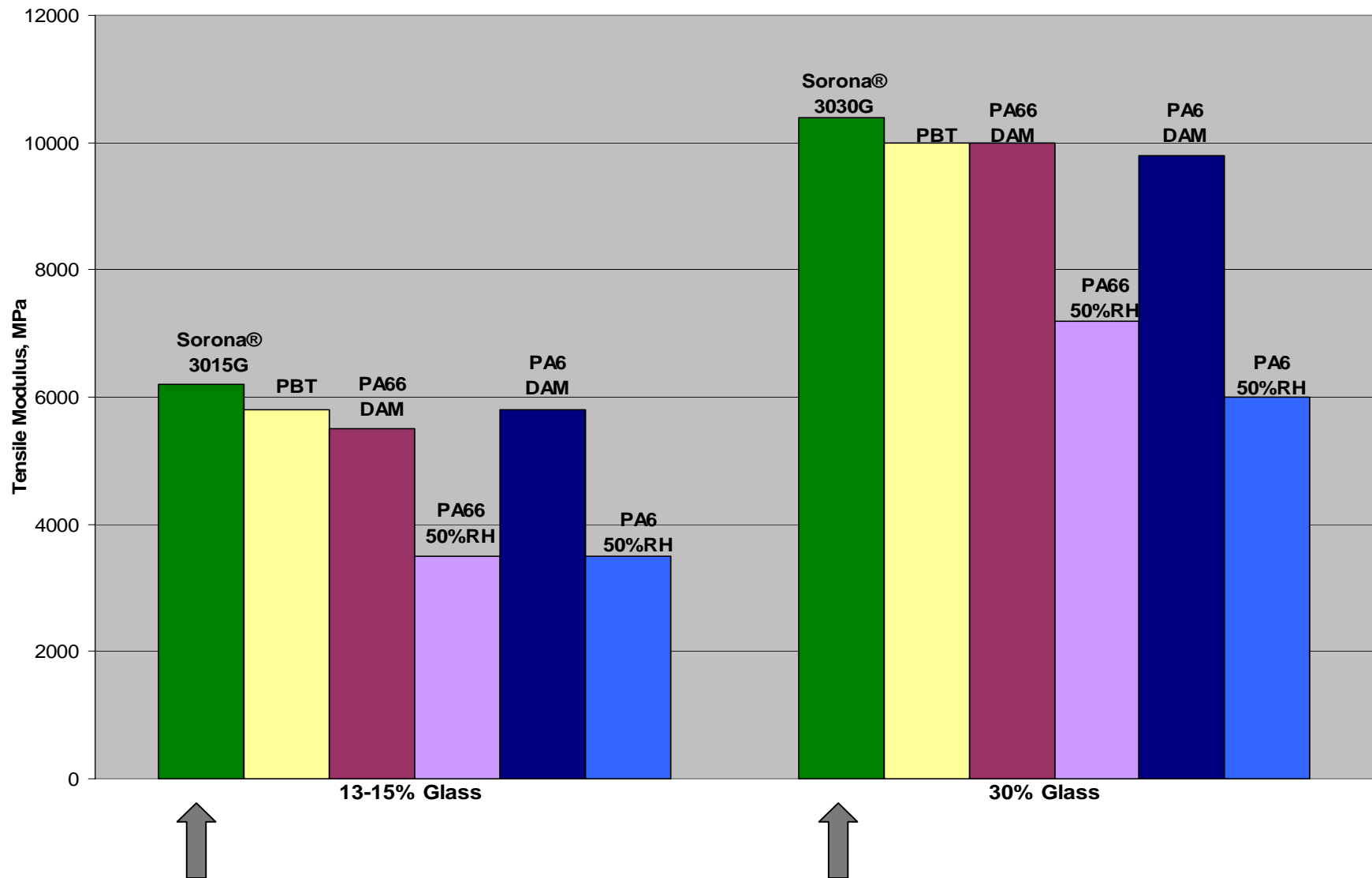
- **Electrical and electronic parts**
- **Automotive components**
- **Industrial and consumer products**
- **Appliance and power tools**
- **Office furniture & sporting goods**



ISO Recycle Designation
Compatible with PET



Comparative Properties – Glass Reinforced



Datasheets at www.plastics.dupont.com
 Contact Rick Bell for detailed product comparisons

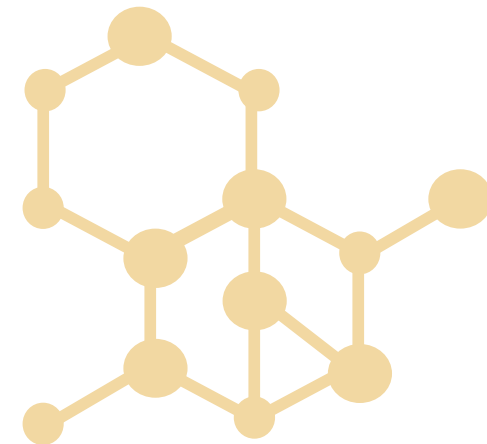


DuPont Automotive – Renewably Sourced Materials



Toyota SAI launched December Sustainable compact luxury car
60 percent of the interior fabrics use DuPont™ Sorona® renewably sourced fiber

- headliner
- sun visor
- other fabric covered surfaces
- floor mats. (Also on Prius).



Automotive Carpet made with DuPont Sorona®

Commercial Automotive Applications Rapidly Growing



- **Greater design flexibility without fear of staining lighter colors**
- **Reduction in warranty claims for stain damaged carpet**
- **No surface treatments required for soil resistance**
- **Superior softness while delivering wear resistance comparable to nylon**
- **Dries faster than nylon and is therefore more resistant to mold and mildew.**

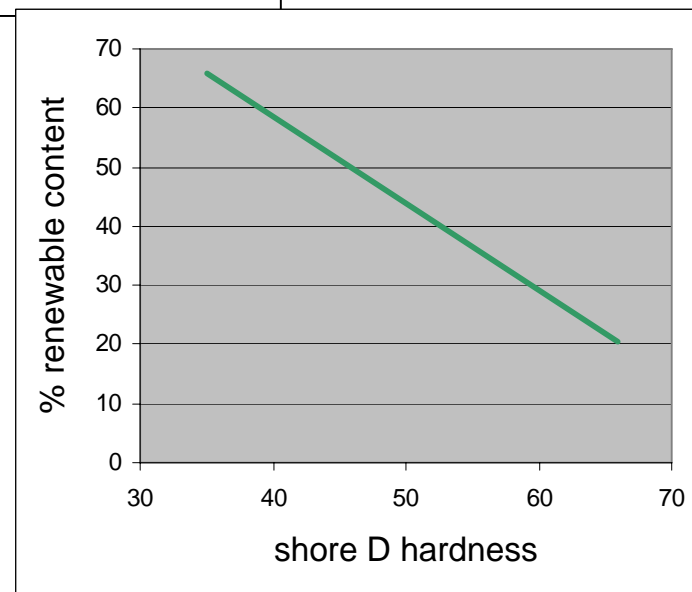
Hytrel® RS



Properties identical to standard Hytrel®

In Hytrel® RS, petroleum sourced polyether glycols in the soft segments are replaced by Renewably Sourced polyether glycols made from non-food biomass.

- Excellent elasticity & low temperature flexibility
- Excellent flex fatigue and cut growth life
- Good chemical & oil resistance
- High tear strength, toughness, resilience, impact resistance



The renewably sourced content of Hytrel® RS varies with the hardness of the grade

Hytrel® RS – Potential Applications

Properties similar as regular Hytrel® TPE



ABD Covers
(Driver)



Overmolded parts
(Door latches)



CVJ, shifter boot, seat shift
dust covers

Any
thermoplastic
elastomer, soft
touch
application



Air duct



Hose & tubing
(vacuum hoses)



Air brake hose

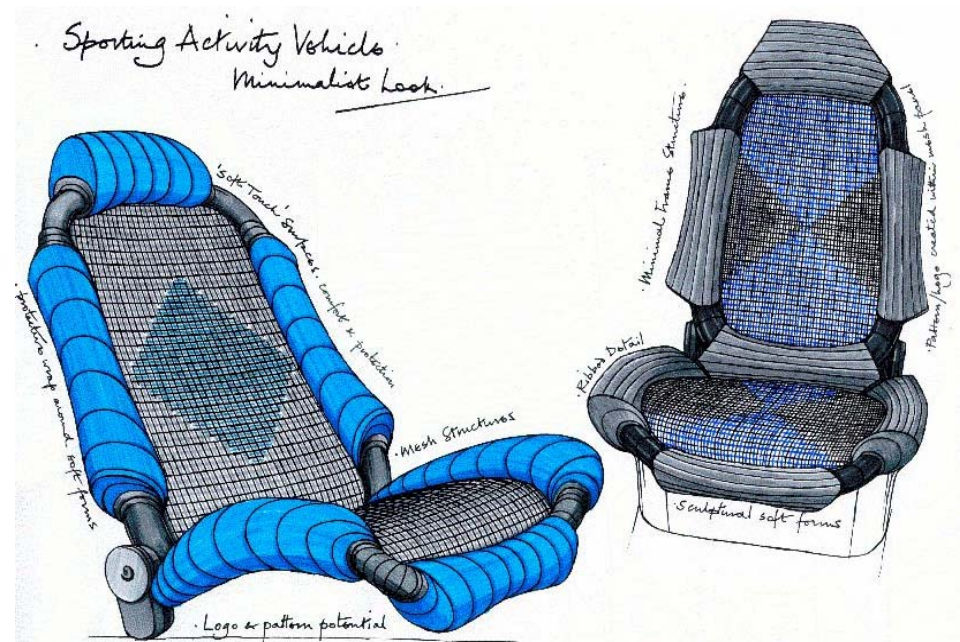
DuPont™ Hytrel® RS Concept

Elastomeric Suspension Fabric For Automotive Seating

Weight, space, design, comfort, utility, durability



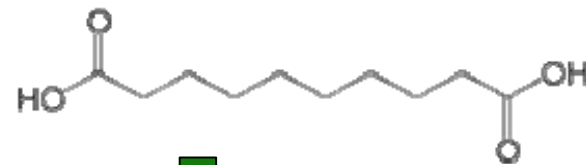
Examples of woven filament design



Specialty Polyamides Based on Renewable Feedstock

Developing specialty polyamides from renewable feed stocks.

Sebacic acid, is derived from a renewable resource and is used in preparing PA 6,10 & PA10,10.



Sebacic acid



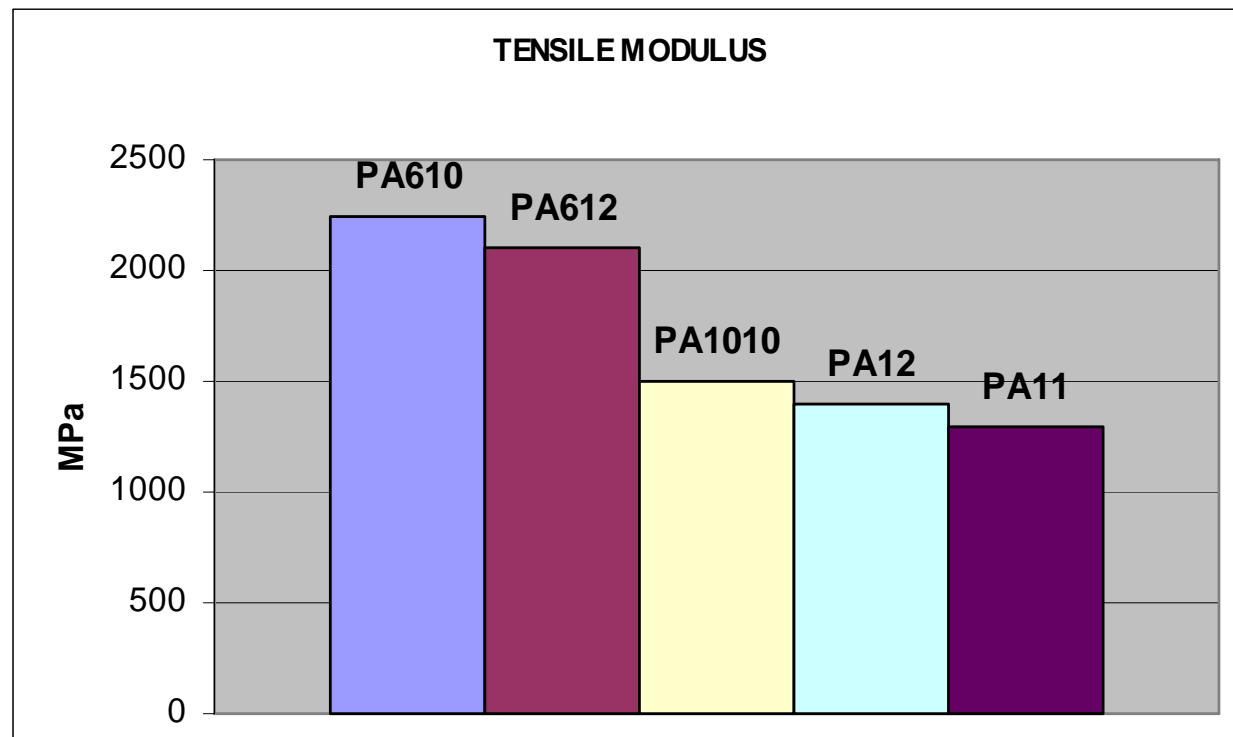
PA10,10
PA 6,10

- Good mechanical, RF & Impact
- Resistance to polar fluids
- Low moisture absorption
- Good paintability, extrudability
- Up to 100% bio-sourced
- Non-food crop sourced

- Fuel lines
- Pneumatic tubes
- Air brake tubes
- Handheld device



Comparative properties of base polymers



Mechanical Properties (dry as moulded)	PA610	PA612	PA1010	PA11	PA12
Yield Stress (Mpa)	62	61	50	43	45
Yield Strain (%)		4.3	4.6	5	5.2
Strain at Break (%)	>50	>50	>50	>50	>50
Tensile Modulus (MPa)	2250	2100	1550	1350	1400
Unnotched Charpy Impact Strength -50C (kJ/m2)	NB	NB	NB	NB	NB
Notched Charpy Impact Strength -50C (kJ/m2)	2.4	3.5	6.3		5.2

Zytel® RS Long Chain Polyamides

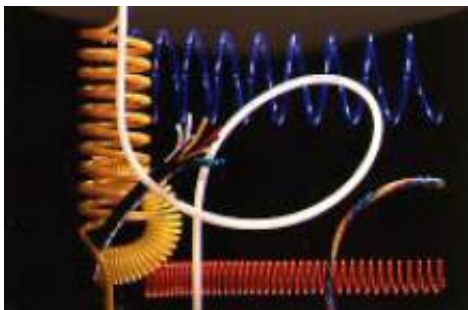
- Based on biofeedstock derived from castor plant. Includes various grades of PA10,10 (100% biobased) and PA6,10 (60% biobased).
- Commercial in monofilaments, consumer products, sporting goods, hand held devices, automotive.
- High performance polyamides that provide high flexibility, toughness and thermal properties with superior chemical and hydrolysis resistance
- Provides competitive cost options vs nylon 11 and 12.



Radiator end-tanks



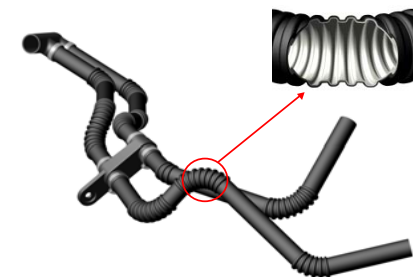
Fuel lines and tubing



Pneumatic tubes



Fuel Connectors



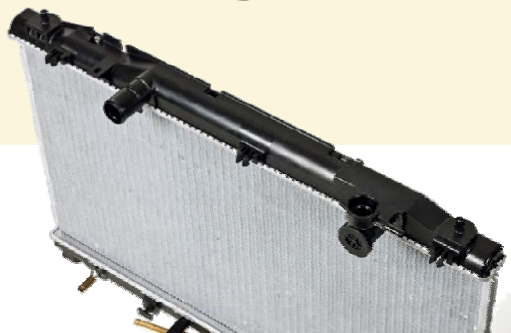
Coolant pipes

Radiator End-Tanks - Denso

Commercial example of better performance at lower cost while reducing carbon footprint

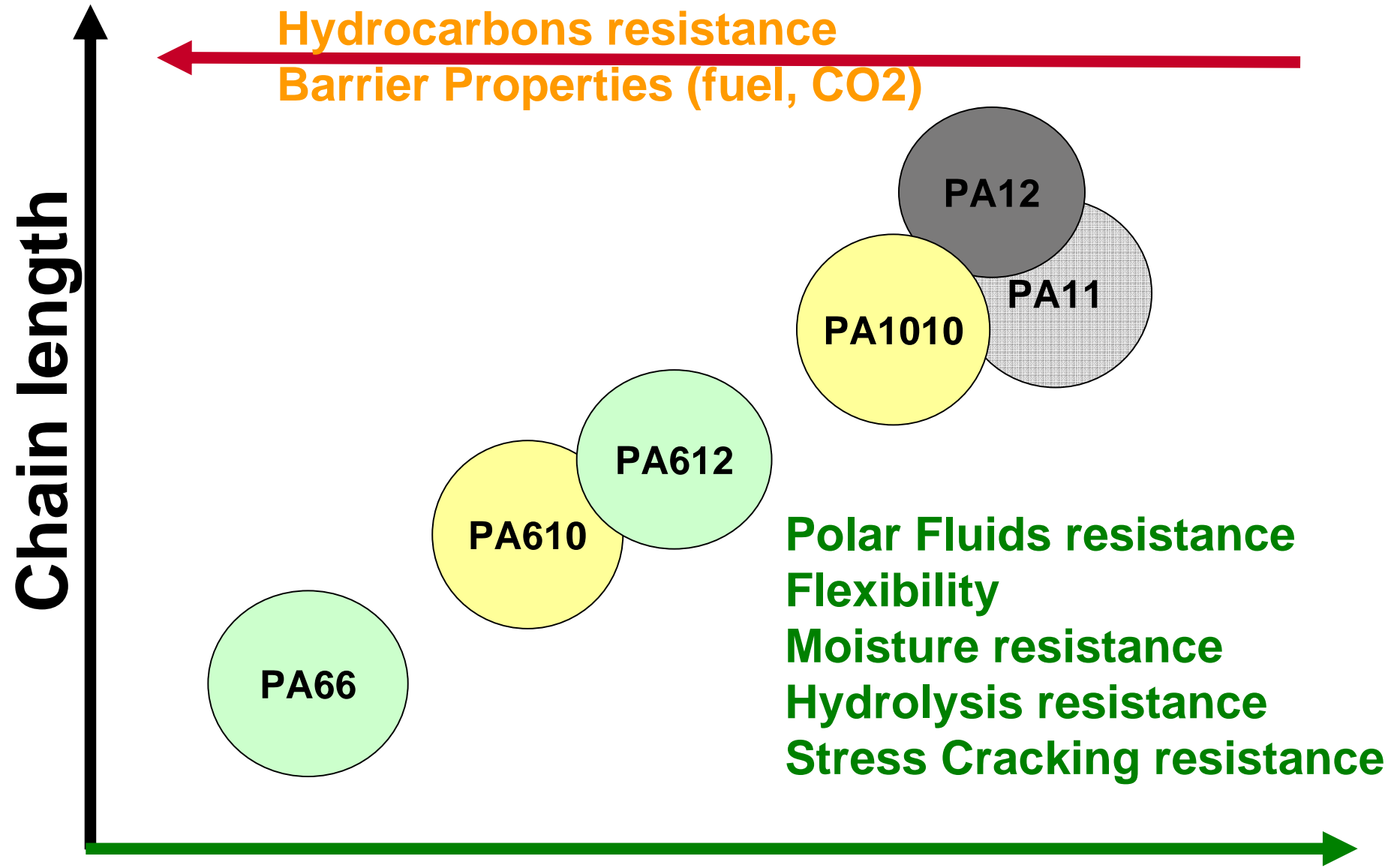


- **Zytel® RS (PA 610) commercial in radiator end tanks**
- **First use of this renewably sourced plastic in a mechanical component exposed to the hot, chemically aggressive underhood environment**
- **DuPont won Denso's "Innovative Technology of the Year" award and SPE 2009 automotive award "Most Innovative Use of Plastics for the Environment"**



Lower cost vs PA11, PA12 or PA6,12

Positioning of Various Polyamides



responsible
innovation
now



**New, renewably-sourced DuPont™ Hytrel® RS
for airbag systems**



Hytrel® RS...

responsible innovation *now!*

Does not reduce our food stocks

Supports the planet for future generations

Better carbon footprint than petrochemical-based products

Equivalent product performance to traditional materials

From DuPont a name that you can trust for more than 200 years and has delivered and is continuing to deliver sustainable solutions



responsible
innovation
now



DU PONT®



Sorona® RS...

responsible innovation *now!*

Made with renewable plant materials

Supports the planet for future generations

Better carbon footprint than petrochemical-based products

Equivalent or better product performance to traditional materials

Excellent surface quality, lower warpage, better laser weldability, and better strength and stiffness than PBT.

From DuPont a name that you can trust for more than 200 years and has delivered and is continuing to deliver sustainable solutions

DU PONT®

Summary

- **DuPont Renewably Sourced Materials supports corporate transformation and sustainability goals.**
- **DuPont is leading the way towards the creation of a renewable economy. We have the broadest product portfolio for engineering polymers.**
- **Renewably Sourced Materials offer uncompromised product performance and a reduced environmental footprint.**
- **Product data sheets and commercially sourced products are available for engineering resins applications in Auto, EE, Industrial, and Consumer markets.**

DuPont Renewably Sourced Materials

visit www.renewable.dupont.com

[Home](#) | [Renewability](#) | [Video](#) | [Science](#) | [Products](#) | [Applications](#) | [Connect](#)

Embracing the Era of Renewability

Where sun, soil and suitable climate come together, there are now alternative sources for materials and fuels. Scientific breakthroughs have made the promise of carbon neutrality, renewability and independence from petroleum a real possibility. It's a science that has grown beyond what was previously imagined. Now, some of the basic materials and fuels we use every day can be derived from renewable, farmgrown sources, including corn, molasses, sugar cane, wheat and other renewable sources.

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The miracles of science™

