

# Sustainability at Teijin:

## Customer Benefit Model and case study tires

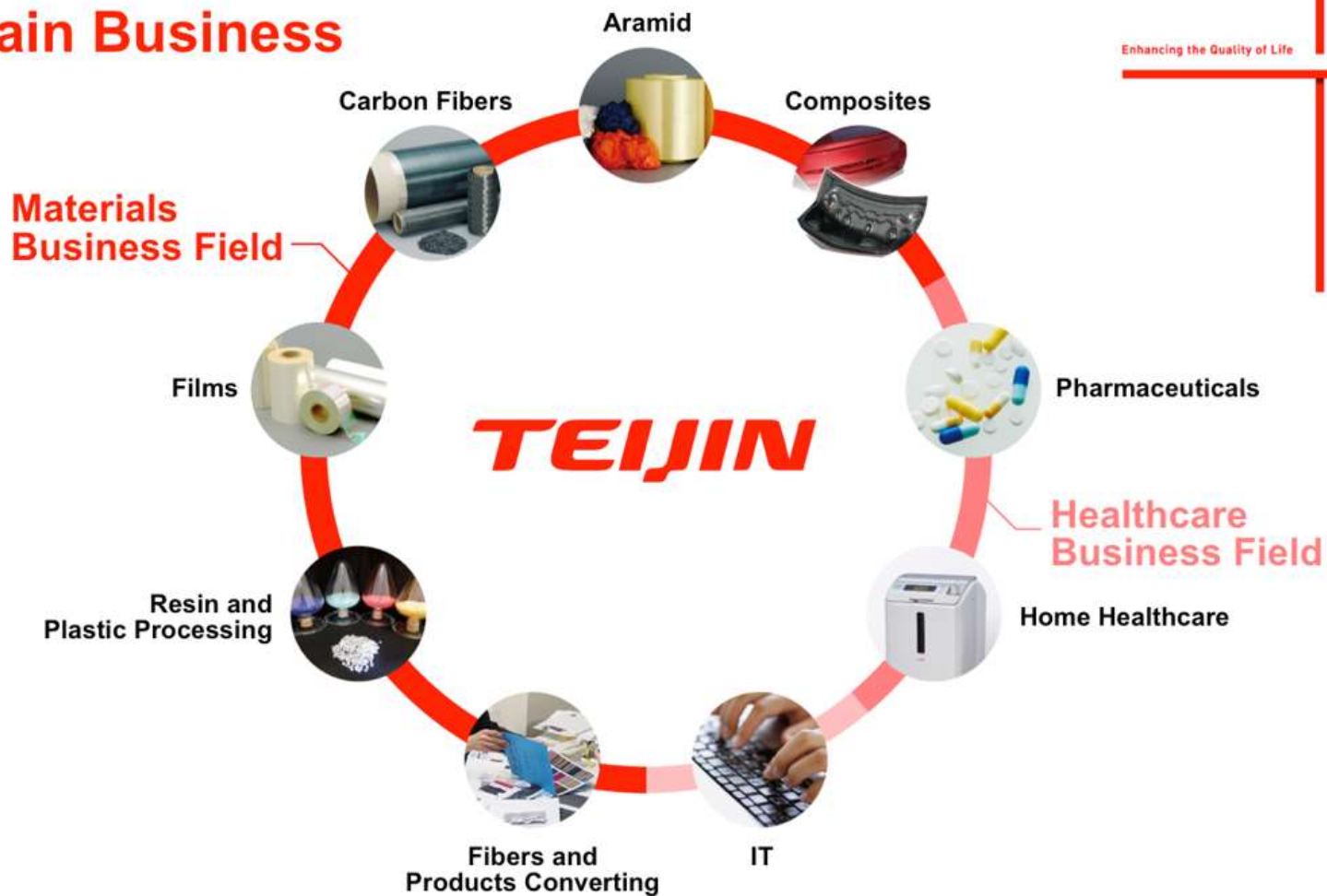
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Enhancing the Quality of Life

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# Main Business

Enhancing the Quality of Life



# Materials Business Field



Enhancing the Quality of Life



## Composites

- Carbon fiber reinforced composites
- Glass fiber reinforced composites
- Plastic glazing



## Aramid

- Para-aramid fibers
- Meta-aramid fibers
- High-performance polyethylene



## Carbon Fibers

- Carbon fibers
- Intermediate materials (prepreg, fabrics)
- Flame-resistant fibers



## Films

- PET (polyethylene terephthalate) film
- PEN (polyethylene naphthalate) film
- PC (polycarbonate) resin sheet/film
- Processed film



## Resin and Plastic Processing

- PC resin
- PC/ABS, PC/AS polymer alloy
- PEN resin
- Special PPS compound resin



## Fibers and Products Converting

- High-performance polyester fibers
- PEN fibers
- High-grade artificial leather
- Sales and trading of fibrous raw material, apparel, industrial materials and performance polymer products

# Teijin: global presence

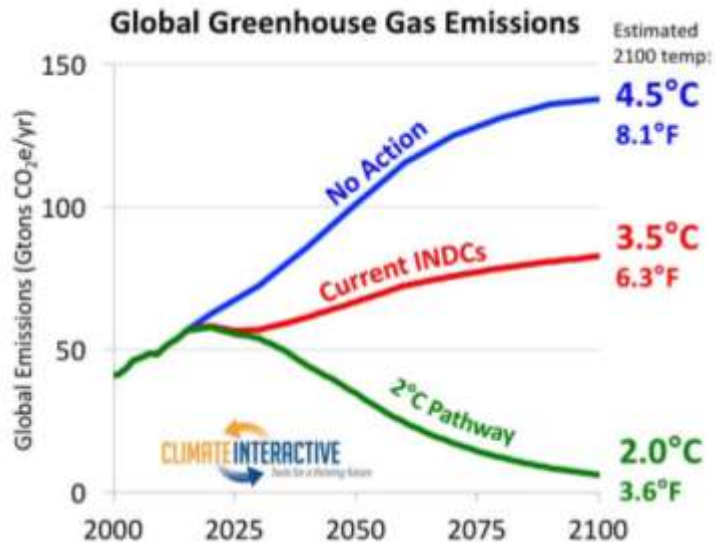
**Teijin Aramid: based in  
The Netherlands**



Always business with Eco-Economics:



Business Opportunities from  
*Climate adaptation (Curative)*



**Always Business  
with Eco-Economics!!**



Business Opportunities from  
*Climate mitigation (Preventive)*



# Tool: Customer Benefit Model (CBM)

Developed in cooperation with



TüV certified model



**Eco-Efficiency based calculations:**

**Financial and ecological results**

**Comparison based on function  
over the total value chain**

# Measuring eco-performance across the value chain

## Value Chain Thinking

Total eco-performance comparison:  
Eco-performance over the total value chain and costs over the total value chain.



## Calculation makes it green

The Customer Benefit Model (CBM) can be used to calculate total eco-performance and cost performance. This TÜV-certified model compares solutions according to their function over the total value chain, both ecologically and financially. This is what we call Value-Chain Thinking.



TÜV-certified  
Customer Benefit Model  
(ISO 14040, 14044)

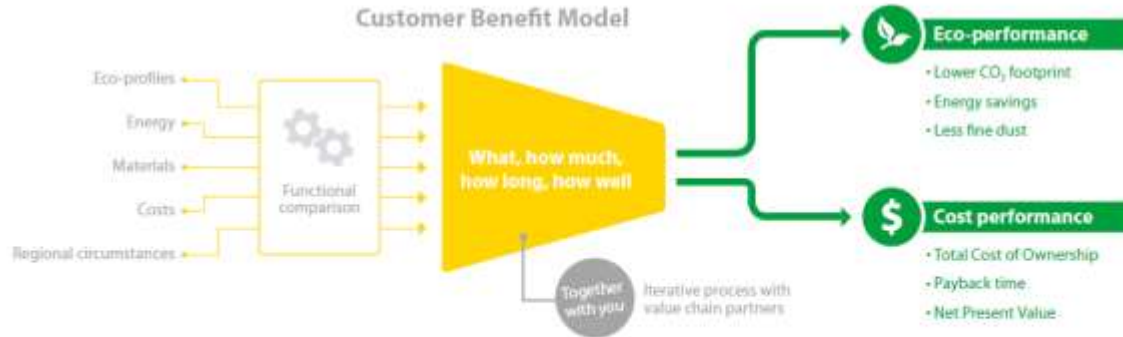
## Customer Benefit Model



CBM available for different applications, for example:

- Conveyor belts
- Tires
- Water-blocking yarn
- Soft-ballistic vests
- Flexible composite pipes
- Gas cylinders

## Customer Benefit Model



For more information, please visit [www.teijinamid.com/eco-efficiency](http://www.teijinamid.com/eco-efficiency)

<https://www.youtube.com/watch?v=7OYsLWMqxnA>



# Intrinsic sustainability of Twaron *in applications*

Human Chemistry. Human Solutions **TEIJIN**



**Requirements for tire developments: lower weight of tires**  
**Leads to better fuel efficiency and less CO<sub>2</sub> emissions**

# What is a “green” tire?



## A

a tire made 100%  
from **natural**  
materials

## B

a tire with **better eco**  
**performance over the whole life**  
**cycle**

Environmental impact in the value chain of a tire:

|                                             | RAW MATERIALS | MANUFACTURING | DISTRIBUTION | USE PHASE | END OF LIFE |
|---------------------------------------------|---------------|---------------|--------------|-----------|-------------|
| Percentage of life cycle environment impact | 5%            | 5%            | < 1%         | 90%       |             |

(sources: reports from Pirelli, Continental, Bridgestone)

# Rayon replacement in carcass

reinforcement materials :

*p*-aramid: rayon = 1:3

*p*-aramid: PET = 1:2



**RAYON CORDS**  
300 gr rayon  
600 gr rubber compound

or

**ARAMID/PET**  
67 gr Twaron  
67 gr PET  
270 gr rubber compound

or

**FULL ARAMID**  
100 gr Twaron  
200 gr rubber compound

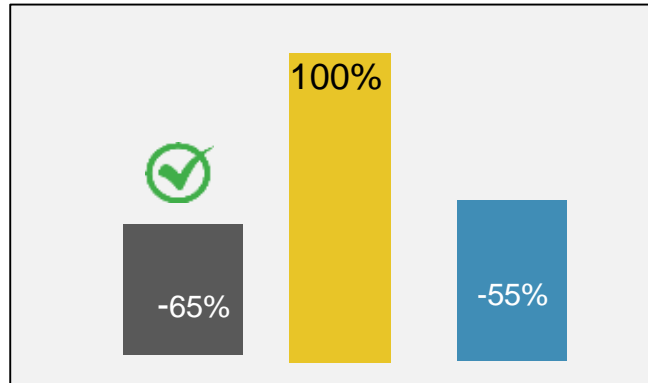
| REINFORCEMENT MATERIAL: | RAYON | HYBRID ARAMID/PET | FULL ARAMID |
|-------------------------|-------|-------------------|-------------|
| Lower weight            | -     | +                 | ++          |
| Less rolling resistance | -     | +                 | ++          |
| Dynamic stiffness       | +     | +                 | ++          |
| Comfort                 | 0     | 0                 | -           |

# Results for raw materials (tire producers):



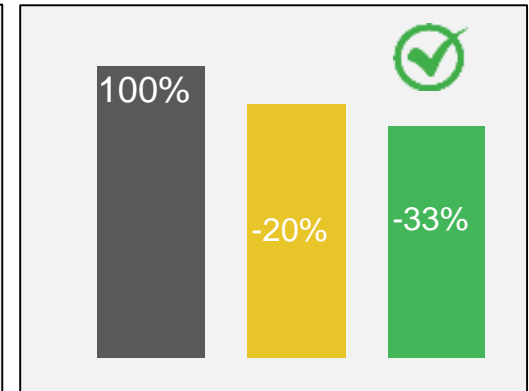
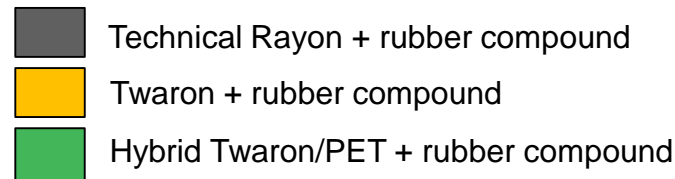
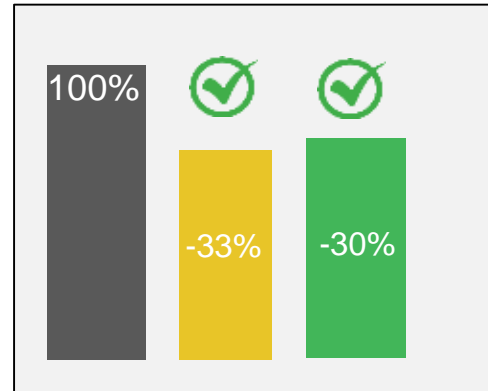
Per kg dipped and twisted reinforcement material only:

CO<sub>2</sub>-eq emissions per kg



CO<sub>2</sub>-eq emissions per carcass

Costs per carcass



# Overview value chain effects:



Benefits for  
**Tire manufacturers:**

- Better CO<sub>2</sub> footprint
- Lower costs of raw materials



Benefits for  
**Drivers:**



- Lighter tire = Lower fuel use
- Better CO<sub>2</sub> footprint
- lower costs in use



- **Function-based analysis gives the right answer**
- **Value chain cooperation is key**

For this case study:

- Bio-based materials are **not always** more eco-friendly
- Sustainable business is often **more profitable**

# Thank you for your attention

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**Any  
questions?**

# EXTRA SLIDES



# Differences in the value chain:



WHAT AND HOW MUCH



HOW LONG, HOW WELL



|                   | RAW MATERIALS                            | MANU-FACTURING                 | DISTRIBUTION                                             | USE PHASE                                                                                         | END OF LIFE                             |
|-------------------|------------------------------------------|--------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------|
| <b>Twaron/PET</b> | <b>33% less material, 33% less costs</b> | 10% extra throughput possible* | <b>Less</b> material less transport ecoburden and costs  | <b>1% Fuel savings</b><br>10% lighter tire, 10% less rolling resistance* leads to 1% fuel savings | 10% less weight per tire to dispose of. |
| <b>Rayon</b>      | More material, more costs                |                                | <b>More</b> material, more transport ecoburden and costs |                                                                                                   |                                         |

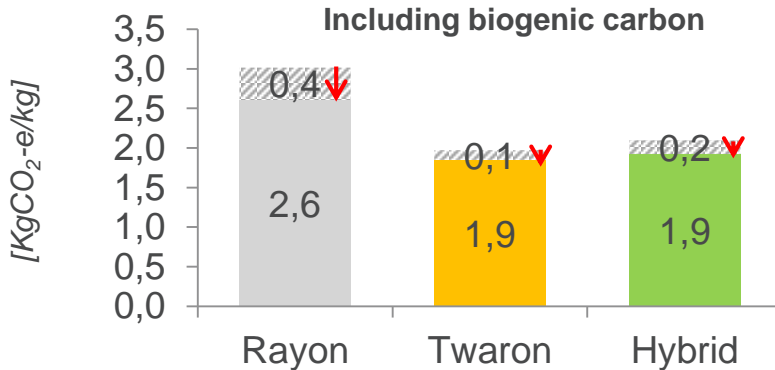
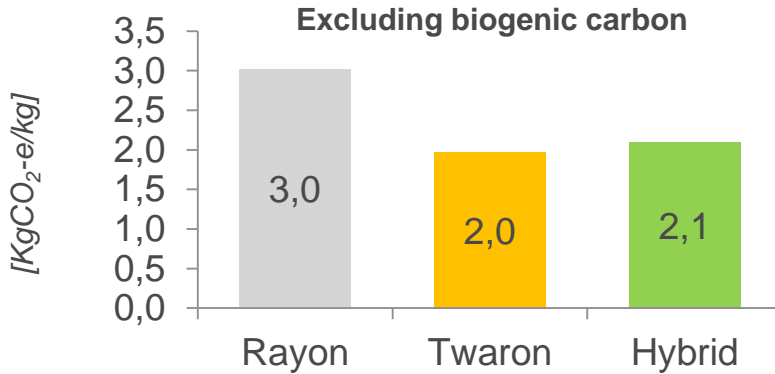
## Benefits for tire manufacturers

Better CO<sub>2</sub> footprint  
Less costs  
for raw materials

## Benefits for car producers and consumers (drivers, fleet owners)

Lower fuel use  
Better CO<sub>2</sub> footprint, less costs!

# Example: Carcass tires, cradle to gate [KgCO<sub>2</sub>-e/kg]



- When biomass is used to produce bio-based materials, CO<sub>2</sub> is removed from atmosphere. This is known as **biogenic carbon**.
- Credits (negative emissions) are given due to the capture of biogenic carbon.
- The credits might be returned when the carbon is released back at the end-of-life.

## Business case

- All alternatives benefit from biogenic carbon capture (Rayon and natural rubber in rubber compound)
- The business case is valid excluding and including biogenic carbon