UPMBIOCHEMICALS | UPM

UPM BioMotion™
Renewable Functional Fillers (RFF)

A SUSTAINABLE GAMECHANGER FOR AUTOMOTIVE WEATHERSTRIPS

Climate change, raw material scarcity, regulatory requirements, and consumer preference for "green products" are key drivers to replace fossil with renewable raw materials in the automotive industry. The challenge for OEMs is how to strike a balance between good technology and climate performance. UPM BioMotion™ **RFF provide an excellent solution to overcome this contradiction.**

UPM BioMotion™ Renewable Functional Fillers (RFF) offer rubber compounders and producers of mechanical rubber goods an excellent solution helping customers to meet their sustainability goals. UPM BioMotion™ RFF contain 100% biogenic carbon and have a negative carbon footprint from cradle to gate considering biogenic carbon from our feedstock and buying 100% green electricity. Compared to traditional functional fillers, the density is more than 25% lower. Like white, inorganic fillers, and unlike industrial carbon blacks, they are 100% electrically insulating and do not contain polycyclic aromatic hydrocarbons (PAHs) above the thresholds of Commission Regulation (EU) No 1272/2013.

TABLE 1: **Comparison of RFF with industrial carbon black.**

Characteristics	**UPM** BioMotion™ **RFF**	**Carbon Black**
Origin	renewable	fossil-based
GWP (carbon footprint)	negative# (reduced climate impact)	highly positive (increased climate impact)
Specific gravity	1.3 g/cm³	1.8 g/cm³
Electrical properties	non-conductive	conductive
PAHs	absent	present##

from cradle to gate based on revised third-party validated LCA according to ISO 14040 and ISO 14044 considering biogenic carbon from our feedstock and buying 100% green electricity for the production process via GOs
for standard qualities

The benefits of UPM BioMotion™ RFF can become strikingly clear when applied to a complex product such as an automotive door profile. The automotive industry has started replacing heavy steel parts with light metals to increase the driving range of vehicles and further reduce CO_2 emissions per kilometer travelled. Switching to aluminum or magnesium for car doors, for example, allows a weight reduction of 50–75 %, which can lead to an overall weight saving of more than 40 kilograms per vehicle. However, both metals suffer from electrochemical corrosion when used with steel, requiring non-conductive vehicle profiles with 10^9 ohm*cm and higher electrical volume resistances.

COMPOUNDING AND MECHANICAL PROPERTIES

The potential of UPM BioMotion™ RFF for application in automotive weatherstrips is demonstrated by four rubber compounds, which differ in the filler systems used. These allow the evaluation of fundamental compound properties and trends when replacing industrial carbon blacks with UPM BioMotion™ RFF in an EPDM model formulation. These are explicitly not final optimised blend formulations. The strategies applied show possible ways of using UPM BioMotion™ RFF, which can also be transferred to other elastomer systems. In addition, a multitude of further combinations and the adaptation and exchange of other compound components are possible. Compounds #1 and #2 each use an industrial carbon black in combination with a white filler, and each serves as a reference. In compound #3, the industrial carbon black was replaced by UPM BioMotion™ X40 in the same weight ratio. In compound #4, a combination of industrial carbon black and UPM BioMotion™ X40 was tested in a ratio of approximately 1/3, while the white filler was omitted, and the oil quantity was reduced by 33%.

TABLE 2: **Overview of the EPDM rubber compounds investigated. All figures are in phr.**

Compound	#1	#2	#3	#4
Keltan® 4455	150	150	150	150
N550	115	-	-	35
N772	-	115	-	-
UPM BioMotion™ X40	-	-	115	115
Talc	55	55	55	-
Paraffinic Oil	25	25	25	-
CaO-80	5.5	5.5	5.5	5.5
Chemicals	9	9	9	9
Sulfur + Accelerators	1.5 + 3.4	1.5 + 3.4	1.5 + 3.4	1.5 + 3.4
Mechanical Properties				
Hardness [Sh A]	71	57	62	74
Compression set [%]	19	27	28	19

FIGURE 1:
UPM BioMotion™ **RFF enables profile producers to fulfill future OEM requirements with direct and indirect benefits.**

> 50%

WEIGHT REDUCTION when shifting from steel to Aluminum or Magnesium in car doors

> 40 kg

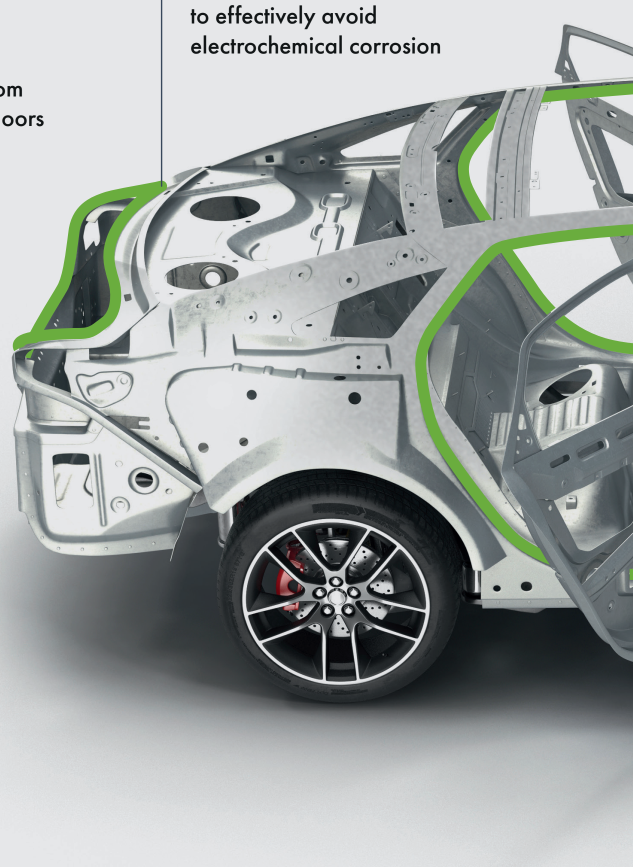
WEIGHT SAVINGS per car

~ 40%

REPLACEMENT LEVEL of steel doors by 2025

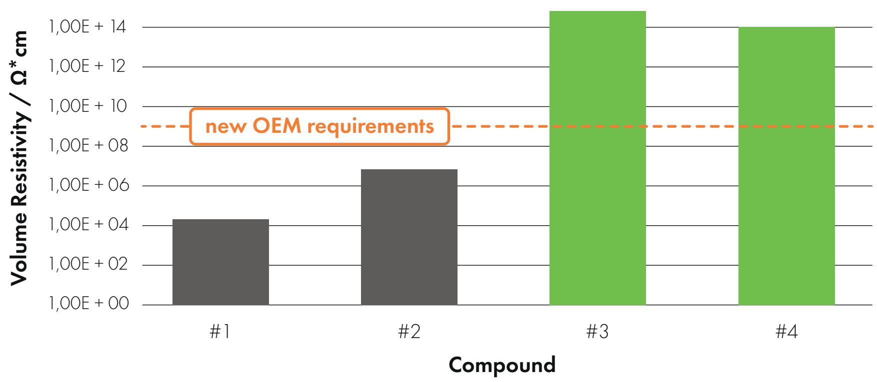
> 10⁹ Ω * cm

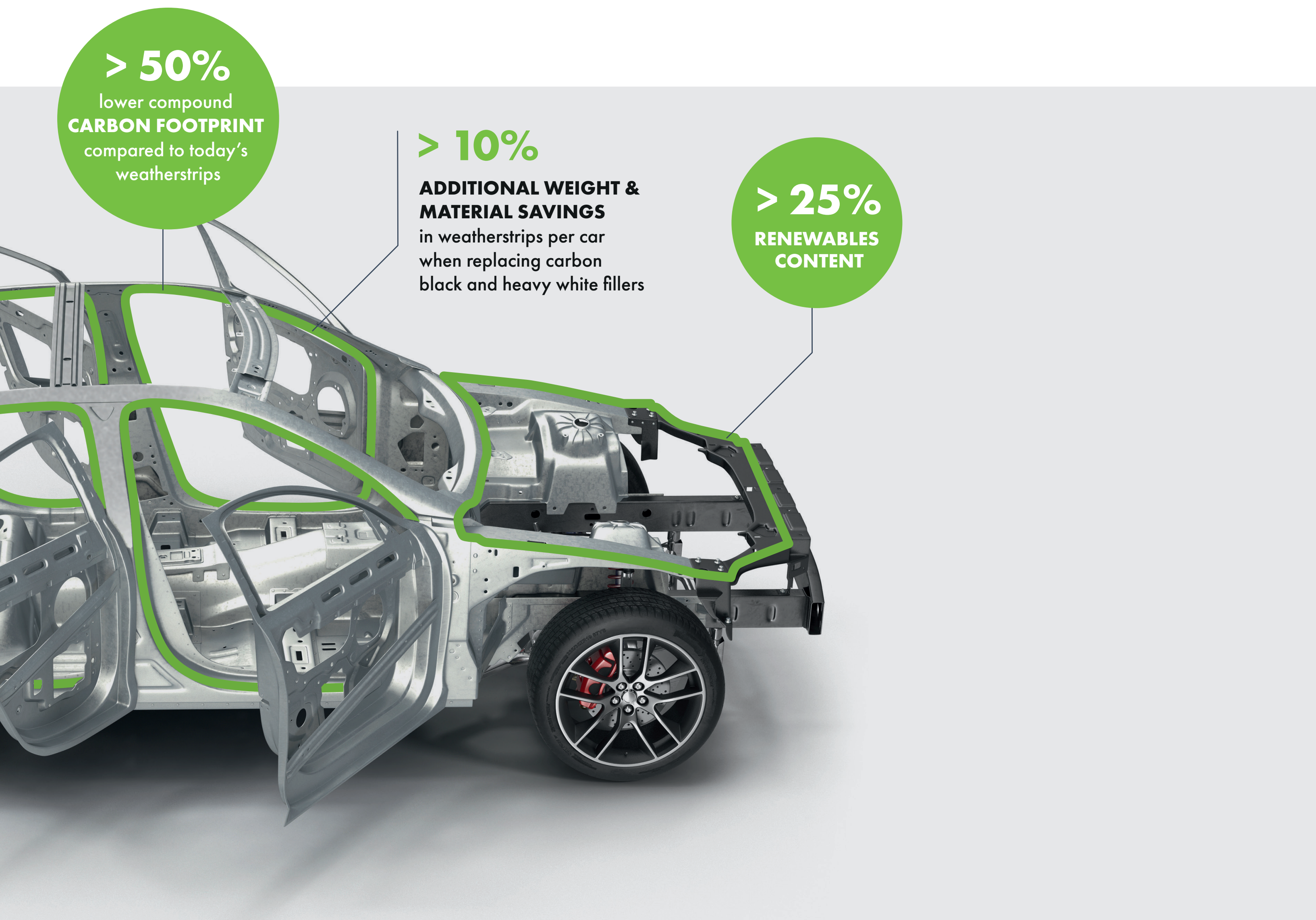
VOLUME RESISTIVITY required for next generation weatherstrips to effectively avoid electrochemical corrosion



While the mechanical properties in terms of rubber hardness and compression set are comparable for the different rubber compositions, compounds #1 and #2 demonstrate the dilemma of the automotive profile industry today. The specific volume resistivities of 10^9 Ohm*cm required to prevent electrochemical corrosion effectively are not achieved in either case. This requires either a reduction in industrial carbon black or an increase in the white filler content. While the former approach typically has a negative effect on processing behaviour, the latter strategy leads to a significant increase in the compound density and thus the final component weight, which contradicts car manufacturers' ambitions striving for light-weight.

FIGURE 2: **Specific volume resistivities measured for compounds #1–#4.**



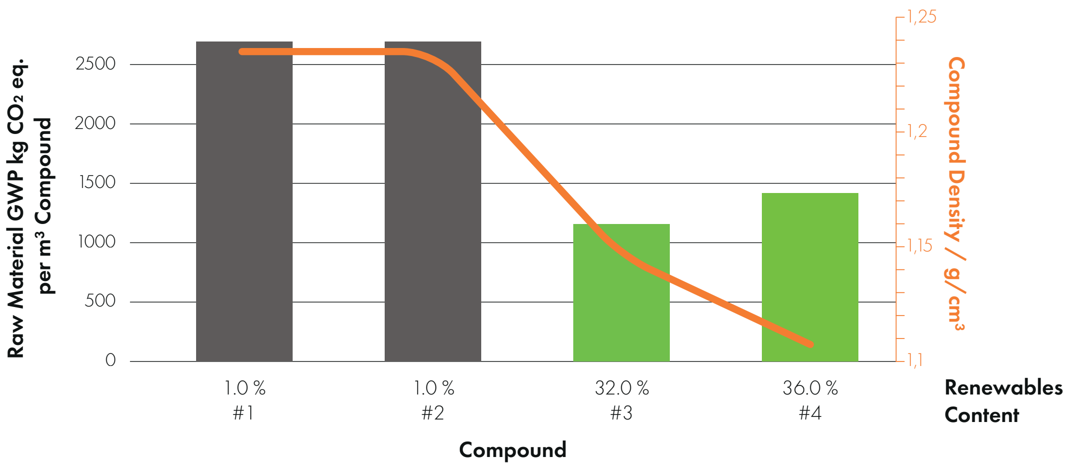


CLIMATE BENEFITS REPLACING CARBON BLACK WITH UPM BioMotion™ **RFF**

This is not the case when UPM BioMotion™ RFF are used. Each of the compounds #3 and #4 exceeds the required electrical conductivity targets by orders of magnitude, with an additional reduction in material density of 7–15% compared to the references. In addition, the UPM BioMotion™ RFF compounds are characterised by a very high share of renewable material in the range of 32–36%, which is also reflected in their carbon footprints. The examples shown have 48–58% lower global warming potentials (GWP) compared to the state of the art.

The examples of the UPM BioMotion™ RFF compounds shown have 48–58% lower global warming potentials (GWP) compared to the state of the art.

FIGURE 3: **Comparison of GWP, rubber densities, and shares of renewable materials for compounds #1-#4. The carbon footprints are based on reference GWPs for the different compound raw materials** (source: GaBi database).



LEARN MORE ABOUT US

We encourage you to be in touch to learn more about our business and our products, explore possibilities for collaboration, and discuss how we can jointly transform the rubber and plastics industry.

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