Renewable Materials in Ford Motor Company‘s Vehicles

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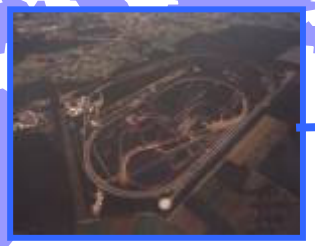
Content

- Ford Motor Company Research
- Ford Motor Company Sustainability Goals
- Renewable Materials
    - Current applications
    - On the pipeline technologies
- Conclusion

Ford Motor Company R&A Locations

RIC Dearborn

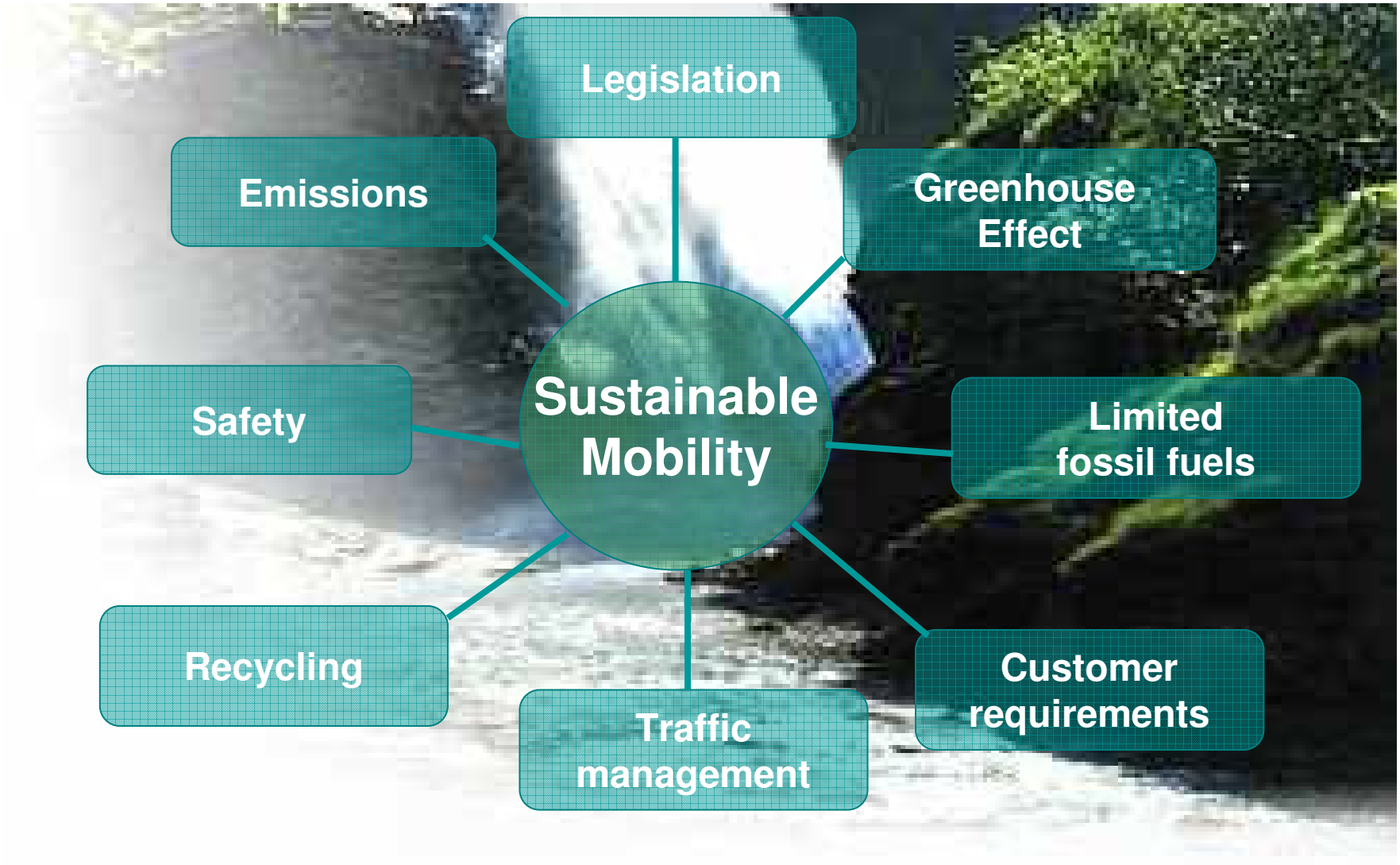


R&A Lommel

R&A at Ford Motor Company in Europe

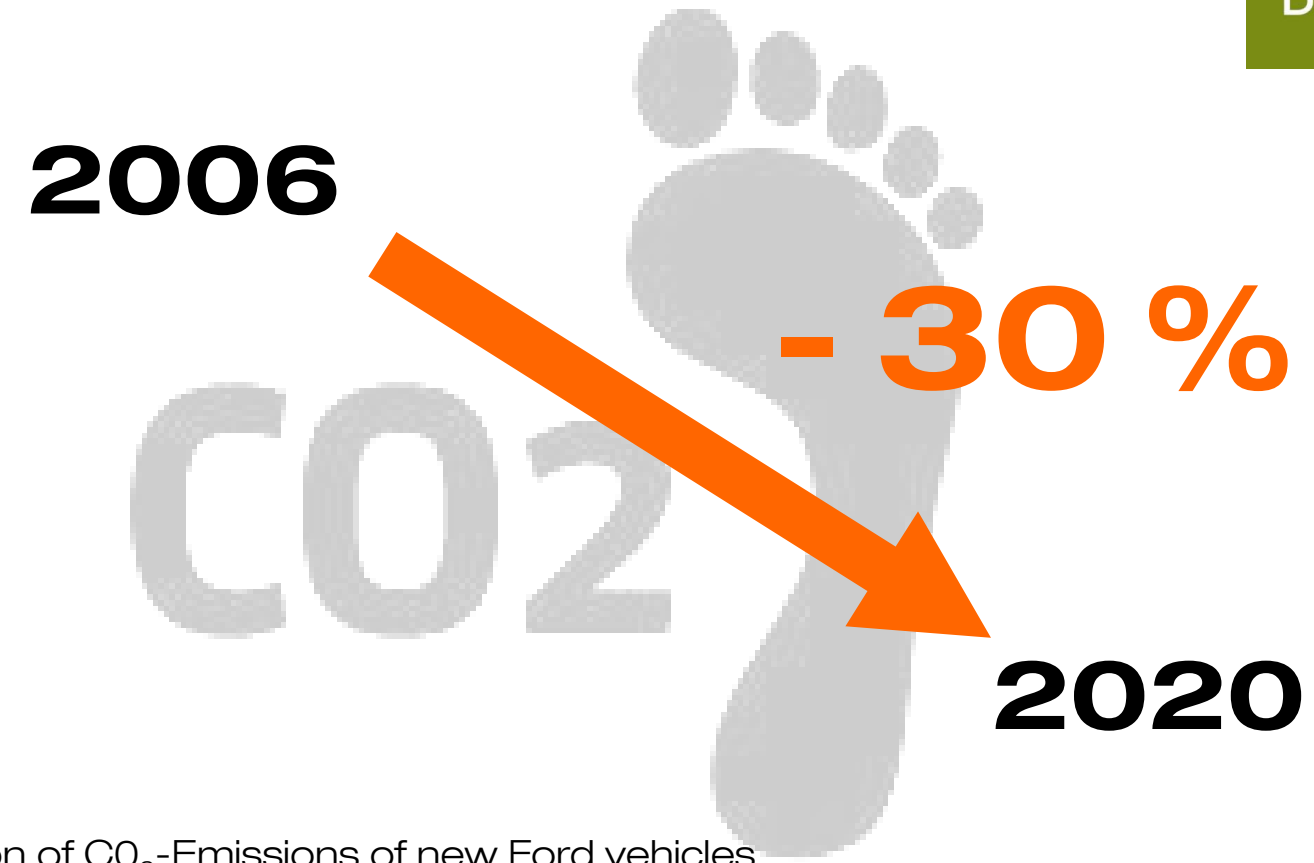
- 1994 FFA founded
- Managing Directors:
  - Dr. Andreas Schamel
  - Prof. Dr. Pim van der Jagt
- R&A FoE: 250 employees, from 25 different nations

Our Major Future Challenges



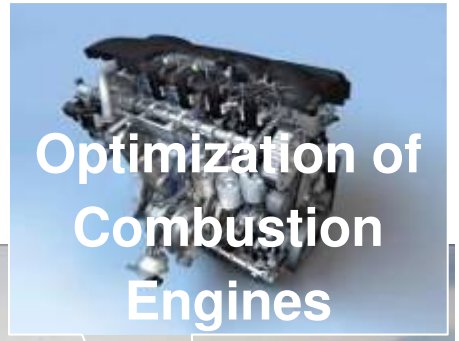
Ford Motor Company‘s Goals

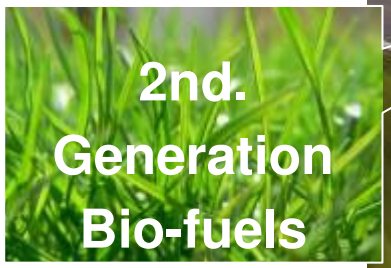
FMC Goal: Less CO_2-Emissions

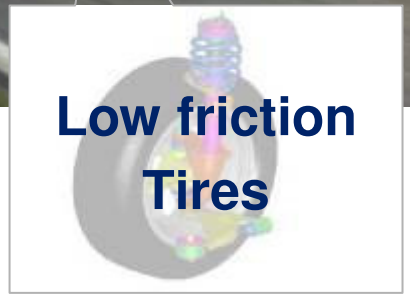


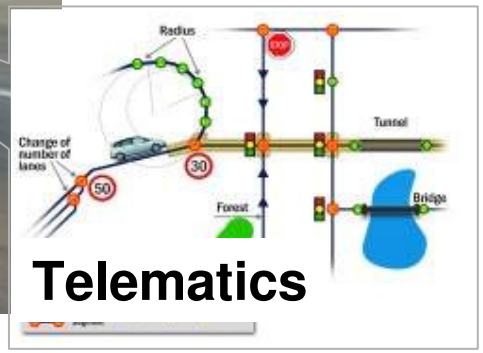
Reduction of $C0_2$-Emissions of new Ford vehicles until 2020 (Europe and USA)

Building Blocks of the CO_2 Reduction









Ford Vehicles with Alternative Fuels

Drive green.

Bivalente **Natural gas** vehicle



Bivalente **LPG** vehicle





Flexifuel-vehicles with **Bio-Ethanol-** engine




Trivalente vehicles **Bio-Ethanol/LPG/Super**

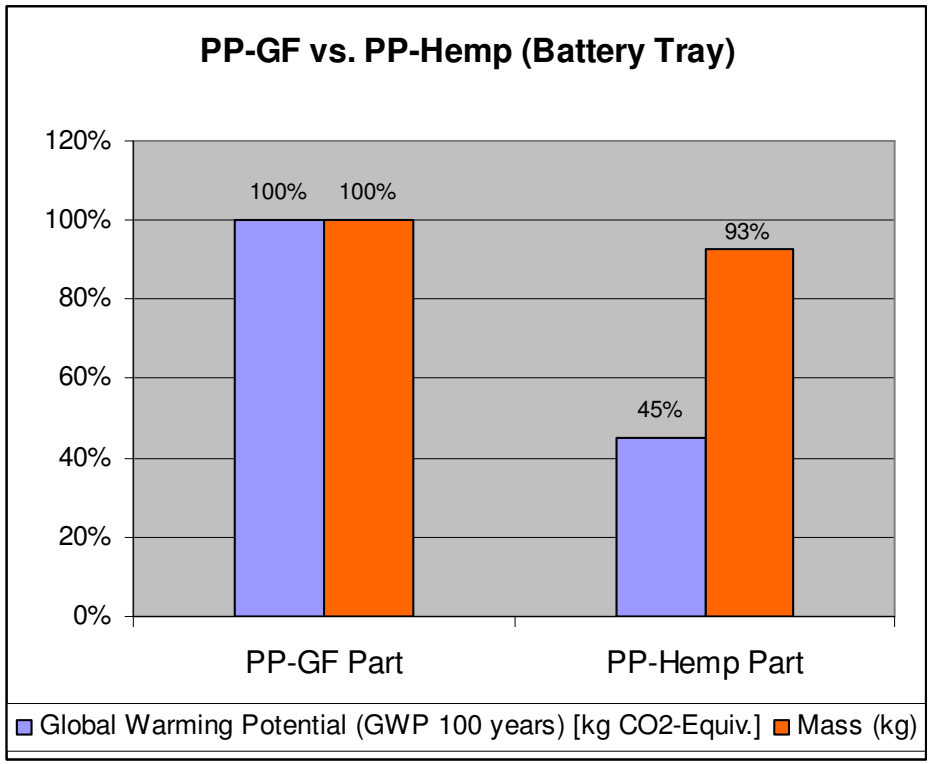
ECOnetic **Diesel-** vehicles

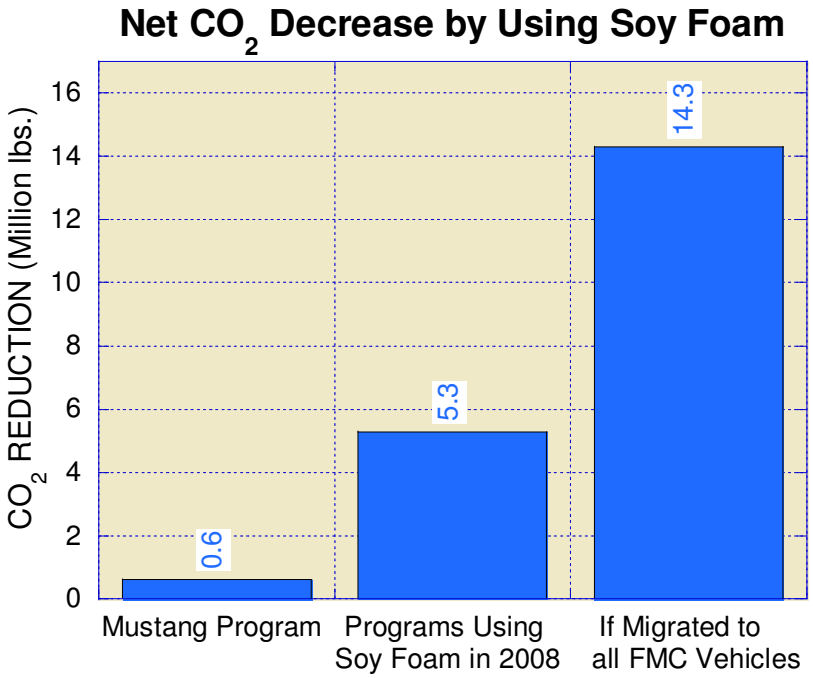


98 g/km | 114→99 g/km | 139 g/km

CO2 Reduction by Using Renewable Materials

- PP-GF vs. PP-NF
- Soy-based polyurethane foam





Renewable Materials:
Examples of Current Vehicle Applications

Ford Vehicles with Biomaterials – Soy-Based Foam

Soy-Based Foam

- Use of soy polyol in formulating flexible polyurethane foam for seat cushion and seat back applications
- Soy content: 12% polyol replacement
- United Soybean Board support on development from 2004-2007

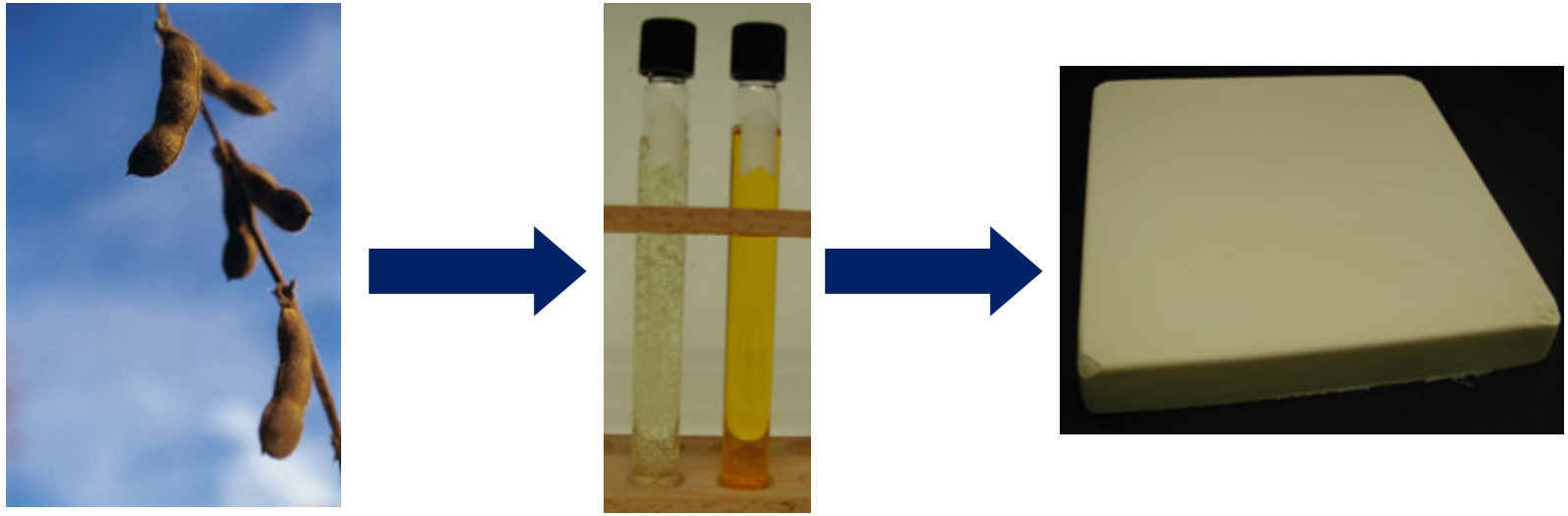


Photo by Lynn Betts, USDA Natural Resources Conservation Service.

Ford Vehicles with Biomaterials – Soy-Based Foam

Ford leader in technology and 1st OEM to launch it in production

-Ford Mustang

-Ford Expedition

-Lincoln Navigator

-Ford F-150

-Ford Escape

-Mercury Mariner

-Ford Focus

-Lincoln MKS

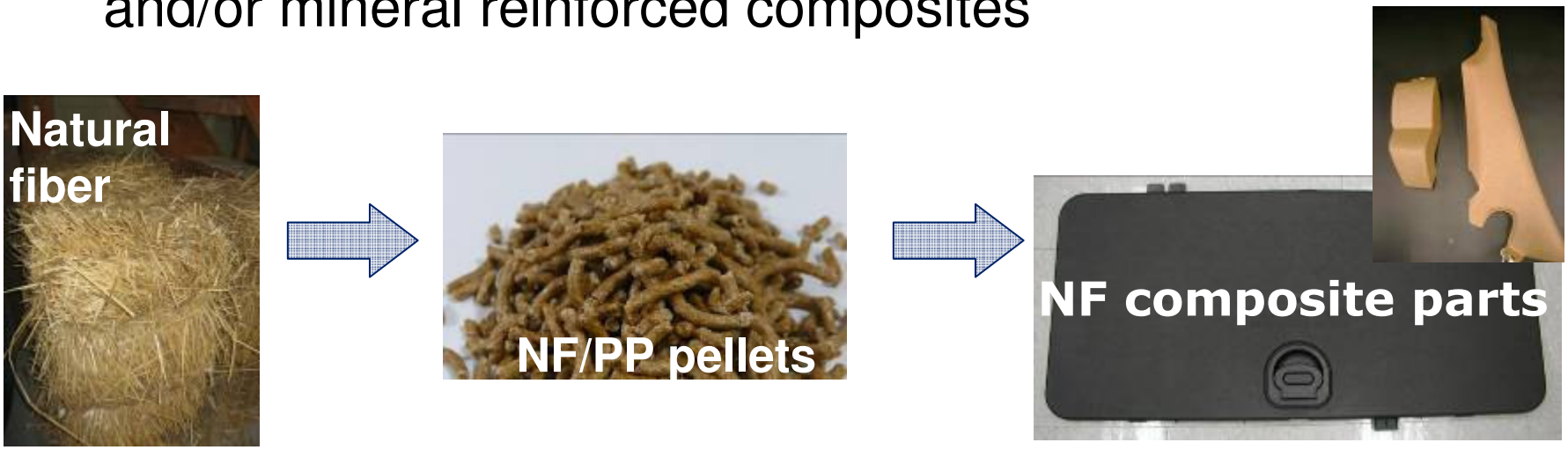
Ford Vehicles with Biomaterials – PP-NF (inj.)

PP-Wheat Straw: industry-first usage in quarter trim bins: Ford Flex, 2010

Ford Vehicles with Biomaterials – PP-NF (inj.)

PP-Wheat Straw

- Use of agricultural fiber **co-products** for reinforcement of composites.
- Reduced density and reduced CO_2 emissions over glass and/or mineral reinforced composites



Ford Vehicles with Biomaterials – PP-NF

- PP-Natural Fibers (compression mold)
- Ford Mondeo (50PP-50Kenaf)
- Ford Focus
- Ford Fiesta

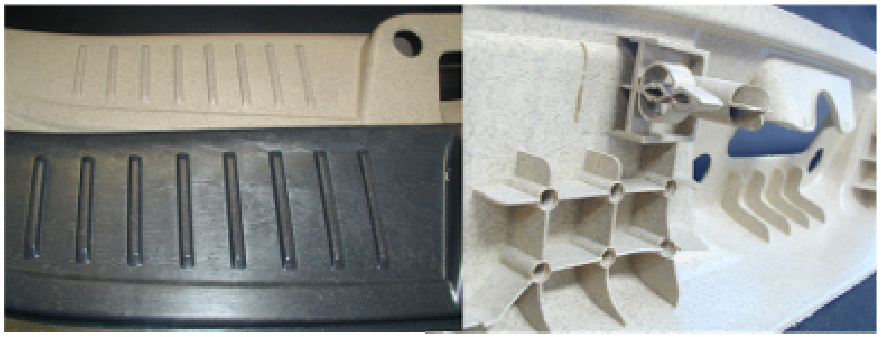
Renewable Materials:
On the Pipeline Technologies

Sisal Reinforced PP (Injection Mold)

FMC Patent Material

PP+30% Sisal

Interior Applications



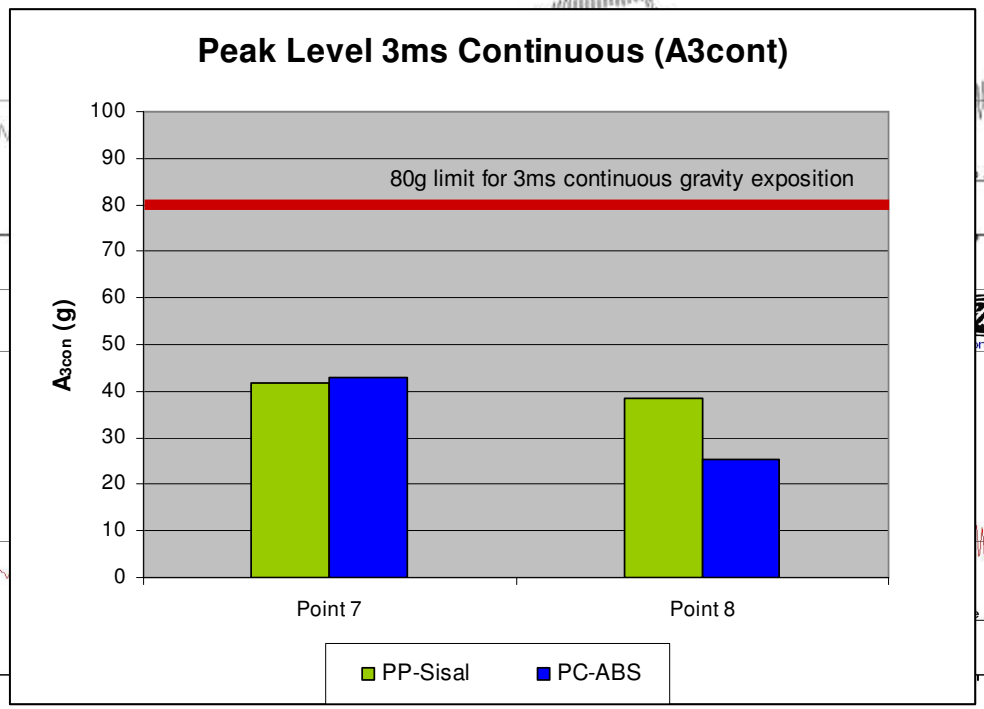
- Good mechanical properties (high impact resistance)
- Good final appearance
- Social responsible material

Component test

- Crash test: PASSED!
  - Front impact, 40% overlap, 64km/h
    - Prototypes manufactured with series production tools (PP-EPDM)
    - Despite of different shrinkage ratio, PP-Sisal parts could be assembled without problems

Component test

- Head impact test: PASSED!
  - Impact points & angles as determined by homologation engineering



Production Tests

- 8h continuous production (Center Console)

PP-Sisal30 Production Process Advantages			
	PP-Sisal	PP-TD20	Dif. (%)
Weight (kg)	0.608	0.656	**-7.32**
Cycle Time (s)	53	59	**-10.17**

Temperature set up:
PP-Sisal30: **140~170ºC**
PP-TD20: 180~210ºC

Equipment:
Injection Machine ROMI 450 ton

Concept cars – full PP-Sisal Interior Trim

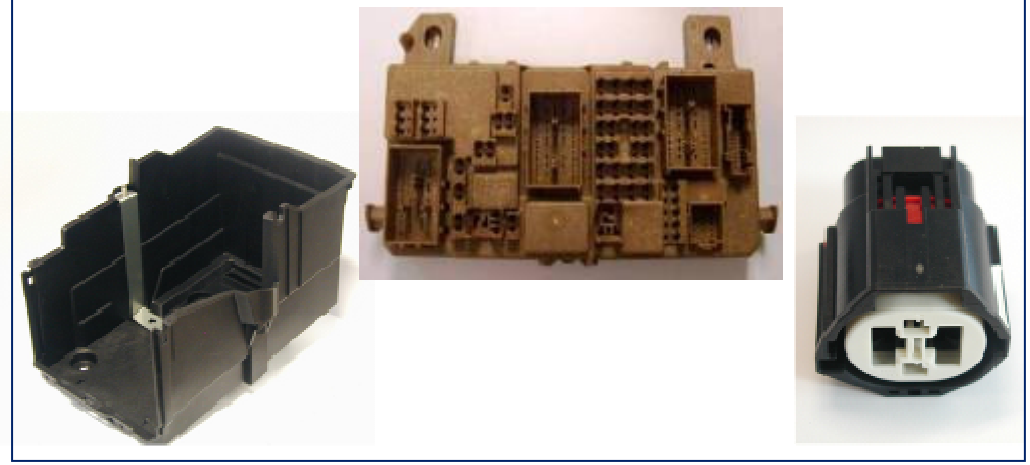
The Beauty

Hemp Reinforced PP

FMC External Material

PP+30% Hemp

EESE + Eng. Compartment



- Competitive mechanical and thermal properties
- Heat aging performance proved
- Very competitive price

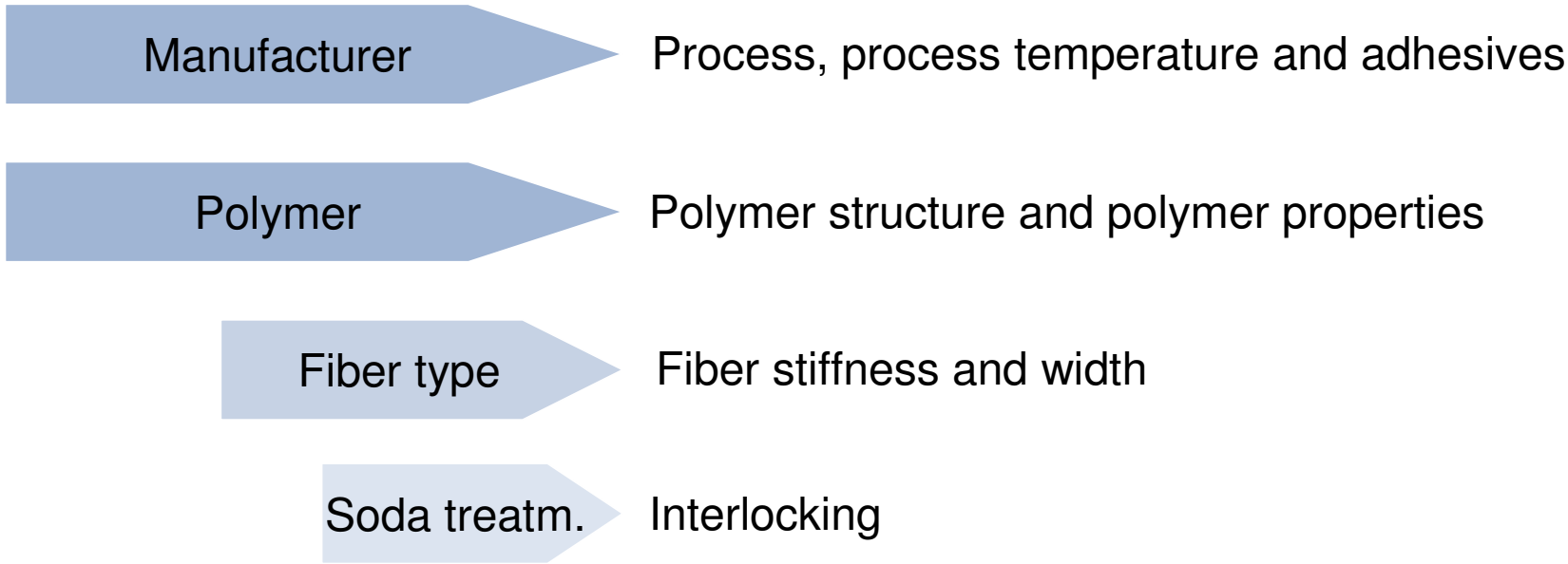
PP-Hemp: Component Test

- Crash test
  - RHS and LHS offset, 64km/h: PASSED!

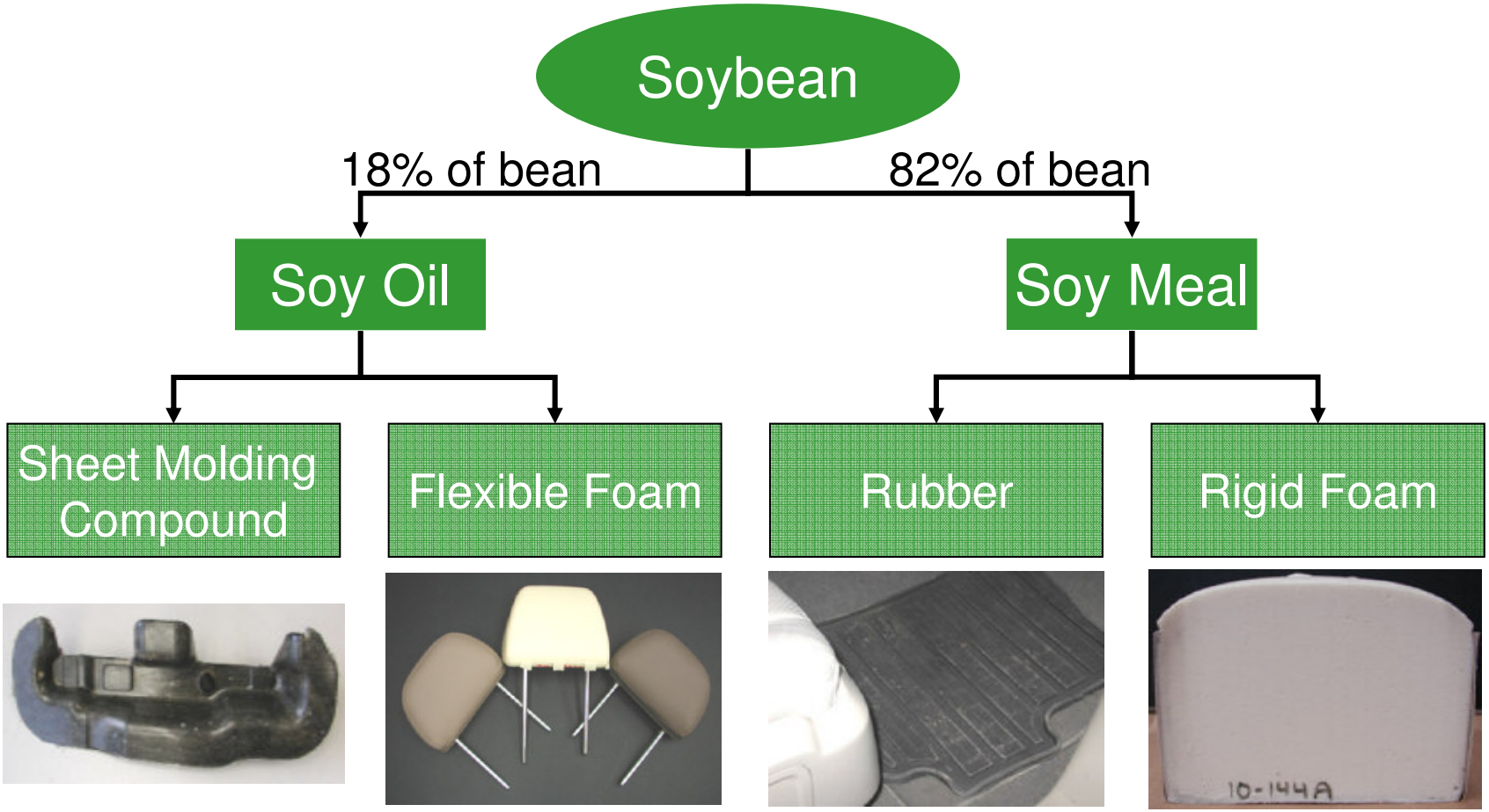
- Durability test: successfully completed!
  - Test ran over 65.000 km
- Share of tool with PP-GF component: dimension of component kept under tolerance
- Production trial proved cycle time is the same (potential to further reduction due to lower injection temperature)

Parameters Influencing PP-NF Compound

- Manufacturer and polymer were the process parameters with the most influence to NFC properties



R&A Projects Using Soy in Plastics

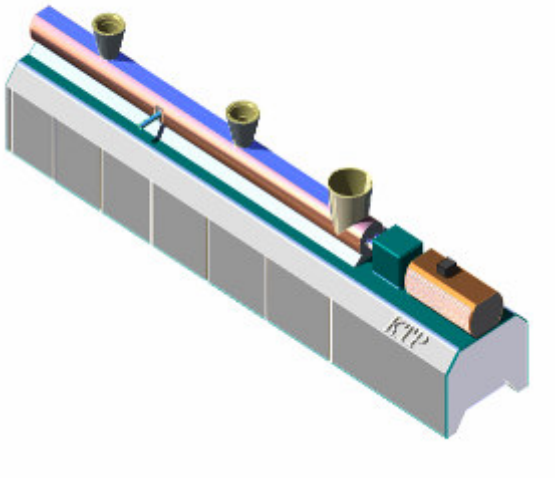


R&A Soybean Projects Summary

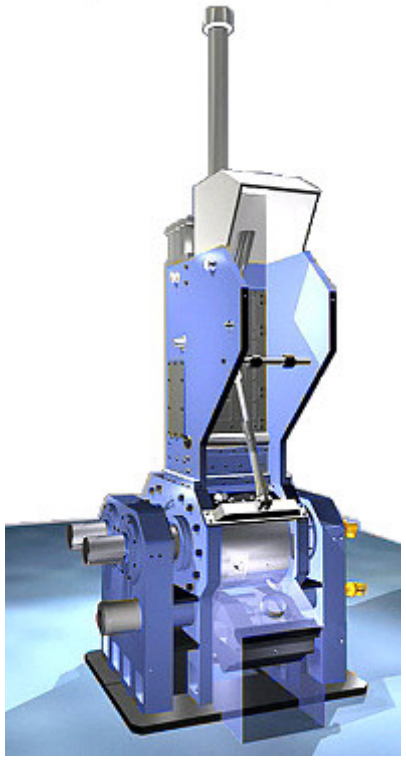
- Soy Oil in Flexible PU Foam
  - In production
- Soy Fillers in Rigid PU Foam
  - Able to incorporate up to 24% filler, but moisture absorption a concern
- Soy Fillers in Natural Rubber
  - Positive results using up to 30% soy flour
- Soy Fillers in EPDM
  - Obtained promising physical results; collaborating with supplier on parts
- Soy Fillers in Polyolefins
  - New project to use soy fillers in PP, TPO, TPE

Liquid Wood – Project Description

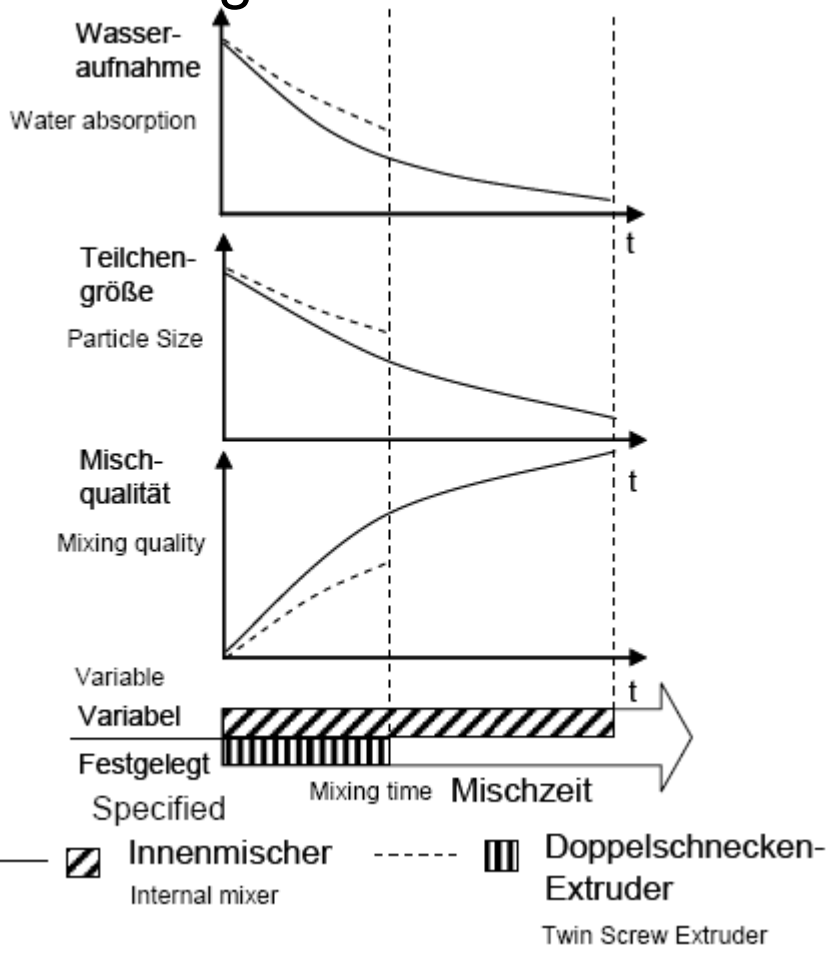
- Improving Quality of Wood-Plastic-Composites (WPC) through Innovative Compounding Technique in a *Internal Mixer*.



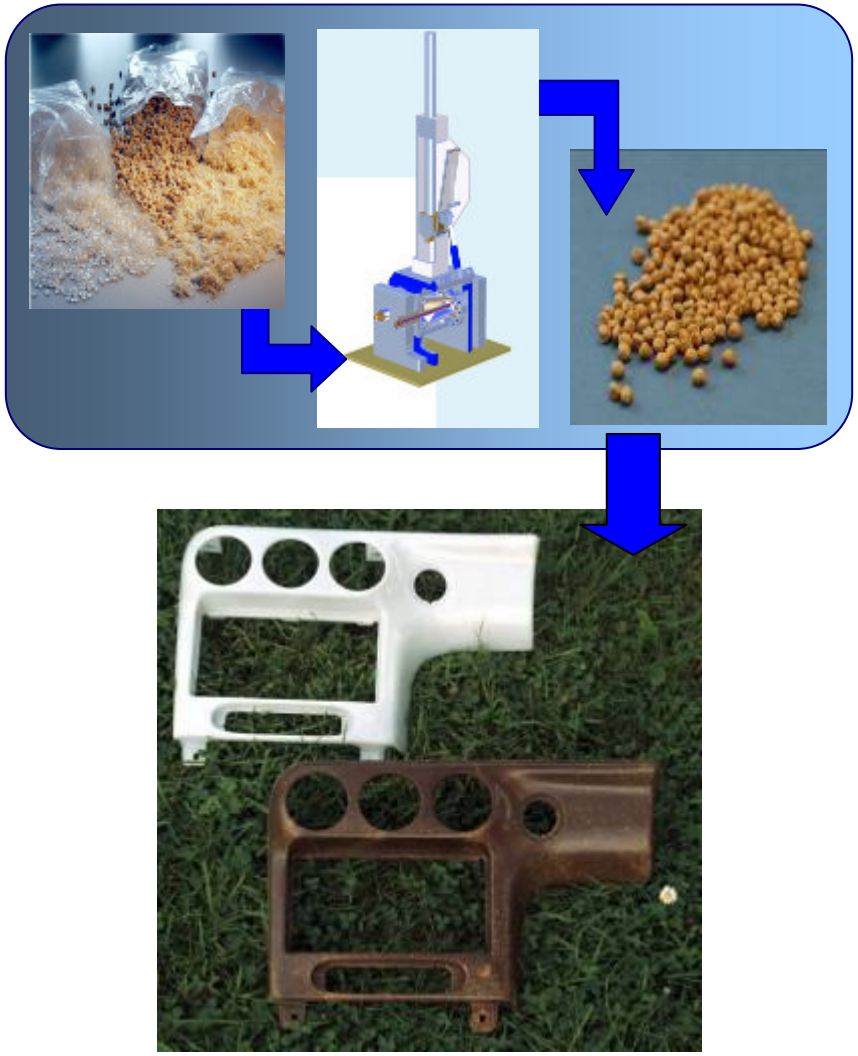
Extrusion Line



Internal Mixer



Liquid Wood Pilot Test – Production of a Ford Interior Trim Part



- Old tool used due to anticipated processing difficulties of the low viscosity
  - Only minor modifications necessary (temperatures, etc.)
  - Complicated shape including weld lines & cut-outs possible
  - Draft angles should be adjusted due to low shrinkage, but could also be advantage for tool design

Remaining Challenges

- Optimization of industrial production and cost
- Stable supply
- Color Management
- Simulation input data & models

Ford Motor Company‘s Commitment

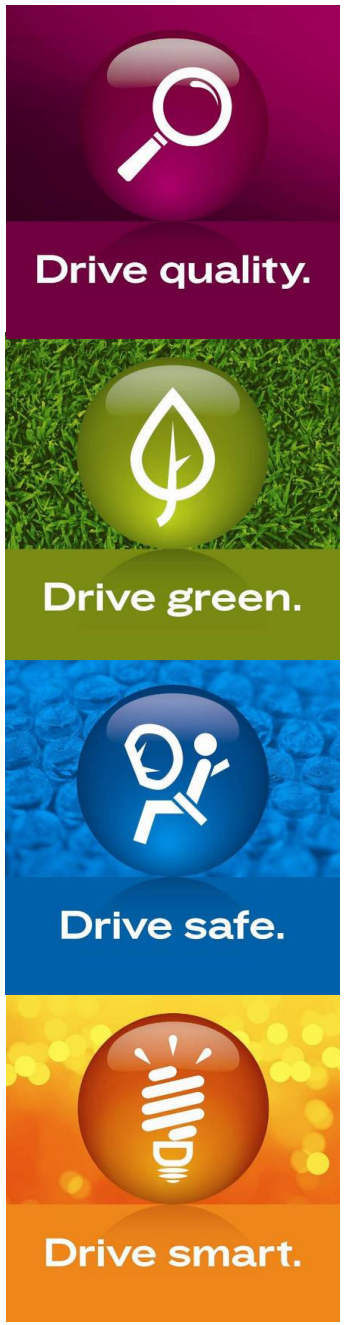
- 1915 (Model T): wheat based glue, soybean wool, soybean plastics
- Henry Ford spent $1.25 Million from 1932-1933 to research soy crops

- 1940: soybean plastic trunk lid
- 1941 - “Annual community festival of Dearborn”: Besides soybean plastics: wheat, hemp, flax, ramie & cork

Ford Motor Company‘s Commitment

“Ford is committed to offering customers affordable, environmentally friendly technologies in vehicles they really want. We are focused on providing solutions that can be used not for hundreds or thousands of cars, but for millions of cars because that is how Ford can truly make a difference.”

-Alan Mulally, President & CEO Ford Motor Company



Thank you very much for your attention!

Questions?