Changing the Way We Drive Demand for Biobased Products in Automotive

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USB Stakeholders Meeting
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We are the ONLY company in the world…

…with this legacy!

Ford Sustainability Report – 2018/2019

Our Aspirational Goals

- We support CO_2 reductions consistent with the Paris Climate Accord
- We aspire to achieve zero air emissions from our facilities
- We will use 100 percent renewable energy for all manufacturing plants globally by 2035
- We will achieve true zero waste to landfill across our operations
- We will eliminate single-use plastics from our operations by 2030
- We will make zero water withdrawals for manufacturing processes
- We aspire to use freshwater for human consumption only
- We aspire to only use recycled and renewable plastics in our vehicles globally

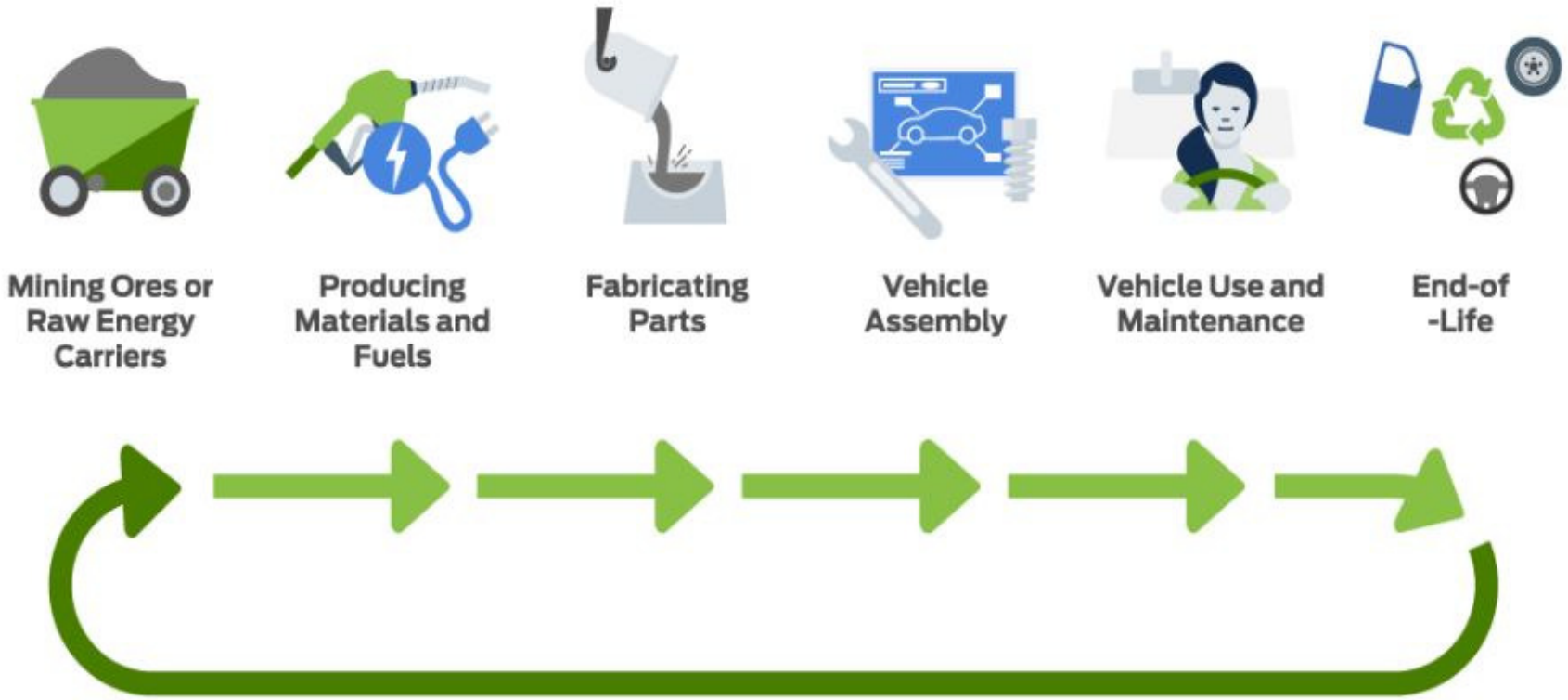
Key Points Related to Biobased Technologies;

1) Fuel economy – Sustainable Technologies and Alternative Fuels Plan
   - Ecoboost, advanced fuel injection, reduced vehicle weight
   - Biofuels – Next generation made from plant cellulose (stems, leaves)
   - Electric vehicles

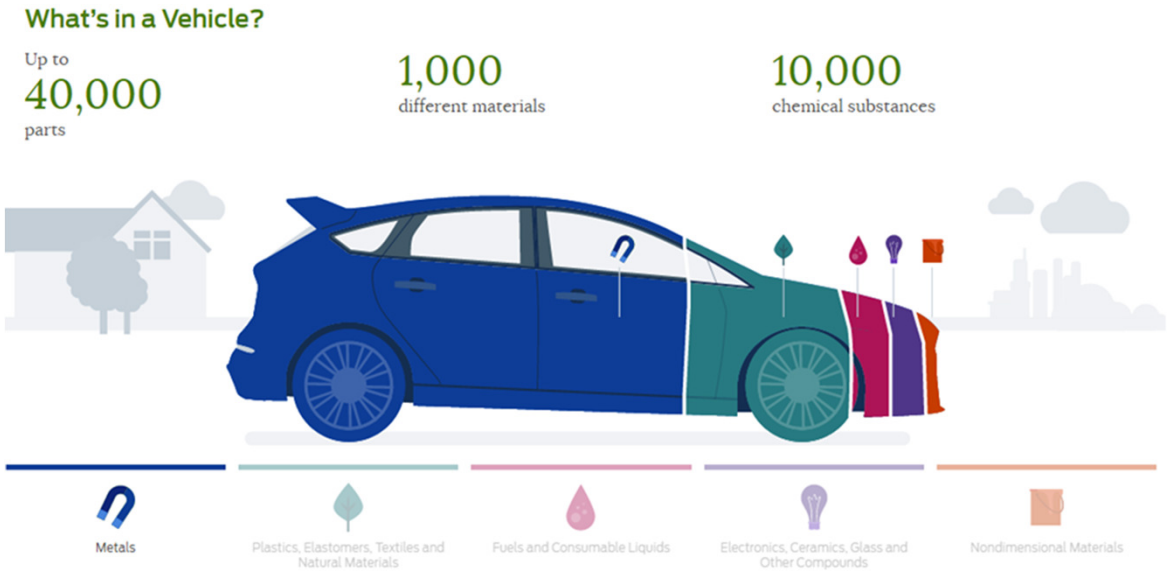
2) LCA – Analytical tools used to understand the environmental impact of our vehicles

3) Sustainable materials – Focus on recycled and renewable sourcing

Life Cycle Assessment



Ford Sustainable Materials Strategy



Renewable Material Use[10]?

- **Castor bean oil**: nylon fuel lines and soft-touch foams in instrument panels
- **Soy-based polyurethane foam**: seat backs, cushions and head restraints
- **Rice hulls**: reinforced plastic in electrical harnesses
- **Coconut husk fibers**: reinforced plastic trunk liners
- **Cellulose-reinforced plastic**: replaced fiberglass in armrests and consoles
- **Wheat straw**: reinforced plastic in storage bins
- **Kenaf** (a species of hibiscus): molded plastic door parts

Recycled Material Use[9]?

- **Rubber from post-consumer tires:** underbody covers and exterior mirror gaskets
- **Aluminum recycled at some Ford factories:** truck bodies
- **Recycled plastic bottles:** carpeting and wheel liners
- **Scrap cotton from T-shirt and denim jean production:** interior padding and sound insulation
- **Post-industrial/post-consumer PET from recycled bottles:** seat fabrics
- **Post-consumer nylon carpeting:** cylinder head covers

CAN WE MOVE SOCIETY CLOSER TO A CIRCULAR ECONOMY?

With a vehicle typically containing hundreds of different metals, plastics, fabrics and composites, manufacturers are increasingly looking to use renewable and recycled materials that have a reduced life-cycle impact, as long as they provide equivalent or superior performance.

OUR GOAL

We aspire to only use **recycled and renewable plastics** in our vehicles globally

Typical Recipes of Foams, Plastics, and Rubber

Foams: ~40lbs/vehicle
- Isocyanate
- *Polyol*
- *Fillers*

Plastics: ~ 400lbs/vehicle
- Polymer
- *Fillers*

Rubber: ~20lbs/vehicle
- Polymer
- *Fillers*
- *Oil*

Biobased Modifications
- *Polyol*
  - *Soy*
  - *Algae*
  - *CO_2*
- *Fillers*
  - *Cellulose*

Biobased Modifications
- *Fillers*
  - *Wheat Straw*
  - *Rice Hulls*
  - *Wood Fiber*
  - *Crustaceans*
  - *Biochar*
  - *Agave*

Biobased Modifications
- *Fillers*
  - *Eggshells*
  - *Cellulose*
- *Oil*
  - *Soy*

Opportunities – Use of Bio-based Materials

Light weighting

8-20% reduction in part weight

Health & Wellness

VOC & Odor
Interior Air Quality
Natural Looking Environment

Green

Reduced dependence on petroleum products

Guiding Factors;

- Customer desires a seamless, calming environment – how we get there is not as important to them.
- Targets are low cost and sustainable.

In Production and Targeted for Production

Soy foam – All NA seat backs, seat cushions and headrests (soy polyol)
Soy in rubber – Slap pad on F-150 (soy oil)

Cellulose – Armrest reinforcement on the MKZ
Cellulose/glass fiber hybrid - Console reinforcement on the Continental

Wheat straw - Bin on the Flex

Rice hulls – Electrical bracket on the F-150

31,251 beans/vehicle
510 M soybeans!
20+ Million vehicles
251 M lbs CO_2 reduction

Images
*aicr.org
*Bioplastics News
*haystraws.com
*ricehull.com

Soybean Oil in Natural Rubber

Slap pad purpose

Minimize metal to metal contact of the leaf springs.

Key part attributes

NVH performance and durability

Four natural rubber slap pads per vehicle.

Rassini

First application of soybean oil in an automotive natural rubber part

USB UNITED SOYBEAN BOARD
Progress Powered by U.S. Farmers

Hybrid Composites – Console Substrate

Δ Weight:	**-24%**
Δ Cost:	**-13%**
Δ Uniqueness:	**Industry first- sustainable hybrid composites**

Rice Hulls Filled Composites

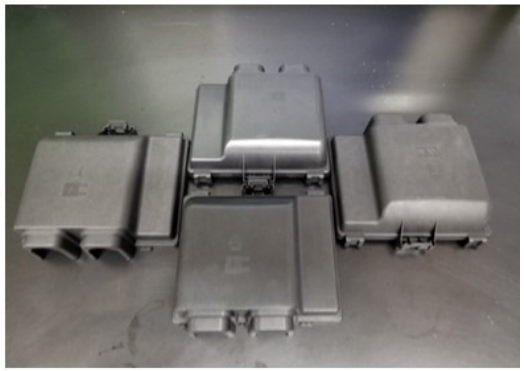
Δ Weight:	**-14%**
Δ Cost:	**-Neutral**
Δ Uniqueness:	**Green industry first and circular economy**

“Green” Under Hood Covers

SOURCE

RAW MATERIAL

END USE

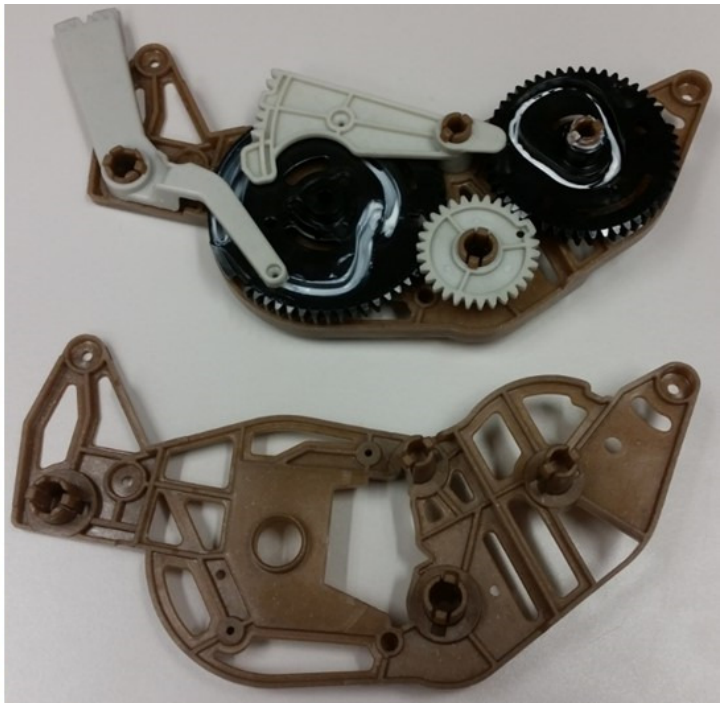


Δ Weight:	**-4%**
Δ Cost:	**Neutral**
Δ Uniqueness:	**Industry first for under-the-hood.**

Coffee Chaff - Headlamp Housings

Δ Weight:	**-17%**
Δ Cost:	**-5%**
Δ Uniqueness:	**Green industry first, circular**

Agave Fiber Filled Composites



Δ Weight:	**-14%**
Δ Cost:	**-Neutral**
Δ Uniqueness:	**Green industry first, circular economy**

ON THE HORIZON

Ford Continues to Lead with Soy Foam Air Filter

- Highest bio content (30% soy-based polyol) foam formulation in the automotive industry
- Industry first bio-foam for under the hood applications requiring high heat and durability
- Producing over 3 million air filters per year for F-150, F-250, Transit and Mustang
- Continued Ford leadership in sustainable materials development
- Partners : Cargill and Mann+Hummel

Ford and Mann & Hummel teams after successful molding trial

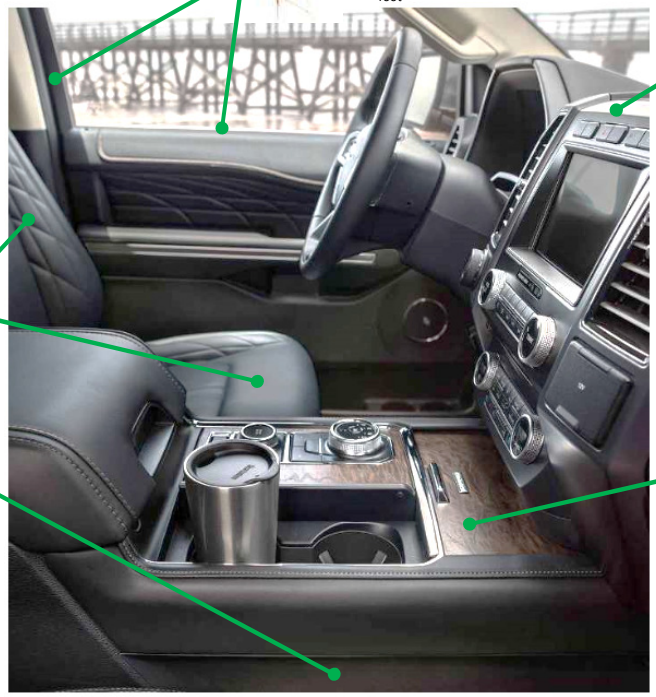
2050 Aspirational Goal: Sustainable Materials

Castor-based under-hood plastic ducts & pipes

Image Source: https://www.gardenia.net/plant/Ricinus-Communis-Carmencita-Castor-Oil-Plant

Dandelion-based seals and gaskets

Image Source: https://www.naturessunshine.com.au/blogs/health-articles/147796423-dandelion-root



Bamboo-based instrument panel substrate

Image Source: https://www.indiamart.com/salasar-alloy-steel/other-products.html

Guyale-based tires

Image Source: http://lifeofplant.blogspot.com/2011/02/plants-with-potential.html

Coffee chaff-based headlamp housings

Image Source: https://www.pinterest.co.uk/pin/640285271993883148/

Algae-based and/or Carbon Dioxide-based seats

Image Source: http://algix.com/about/history/

Tree cellulose-based floor console substrate

Image Source: https://www.researchgate.net/figure/267762389_Fig-1-Photographs-of-a-ficus-tree-b-raw-fiber-c-extracted-cellulose-microfibrils-from

Recycled-currency for coin tray

Image Source: http://contemporarybasketry.blogspot.com/2014/02/paperrecycled.html

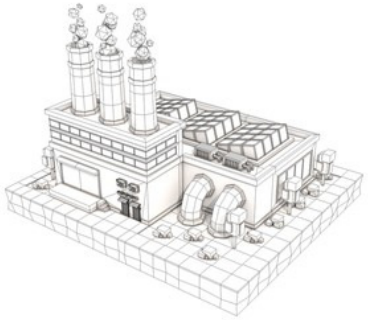
Imagine replacing 100% of the plastic components used in our vehicles with more Earth-friendly options!

Stakeholders

Raw Material Suppliers

Semi-Finished Material Suppliers

Tier 1 Suppliers



OEMs

Government Agencies

Universities

Partnerships and the sharing of experiences is key!

Partnership Example 1

- Bioplastic Feedstock Alliance, Plant-based PET Consortium

Additional Partners – Biobased Materials

And so many more….

Key Takeaways

1) Create demand & enthusiasm – everyone wants to utilize sustainable materials if the business case is positive!
2) Don’t give up if it fails the first time but recognize the limitations of the material.
3) Partnerships at all levels of development.
   - With the supply base, non-competitive industries, government agencies, and universities.
   - Common goals – singing the same tune!
4) Committed individuals at all levels to drive the technology.
5) Sharing of knowledge to drive incorporation.
   - Improves sourcing/availability.
   - Provides initiative to plant crops.

Thank you for your attention!