Drive one.

Growing Green: Sustainability at Ford

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Global Director
Sustainability and Vehicle Environmental Matters

GC3 Conference
May 9, 2012

Ford'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

Technology Innovation Pillars

Technology Strategy

Anticipate – Innovate – Incorporate

Sustainability "GREEN"

- Improve fuel economy; reduce CO2 emissions to leadership levels
- More renewable, recycled materials
- Improved In-Vehicle Air Quality

Safety "SAFE"

- Achieve public domain targets and 3rd Party Recommended Buys
- Safety technology / feature content equal or better than competition
- Breakthrough features for family safety

Design "SMART"

- Design leadership on each new program
- Exciting interiors: leadership in comfort / convenience, infotainment technology
- Global platforms with right proportions
- Improve emotional appeal

Capabilities & Enablers – "QUALITY"

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Process to Manage Sustainability for Our Products

Product CO_2 Strategy

Deliver Vehicle Contribution to CO_2 Stabilization

Sustainable Mobility Governance Team

- Technology Plan
- Policy Positions
- Cycle Plan
- Marketing and Communications Plan

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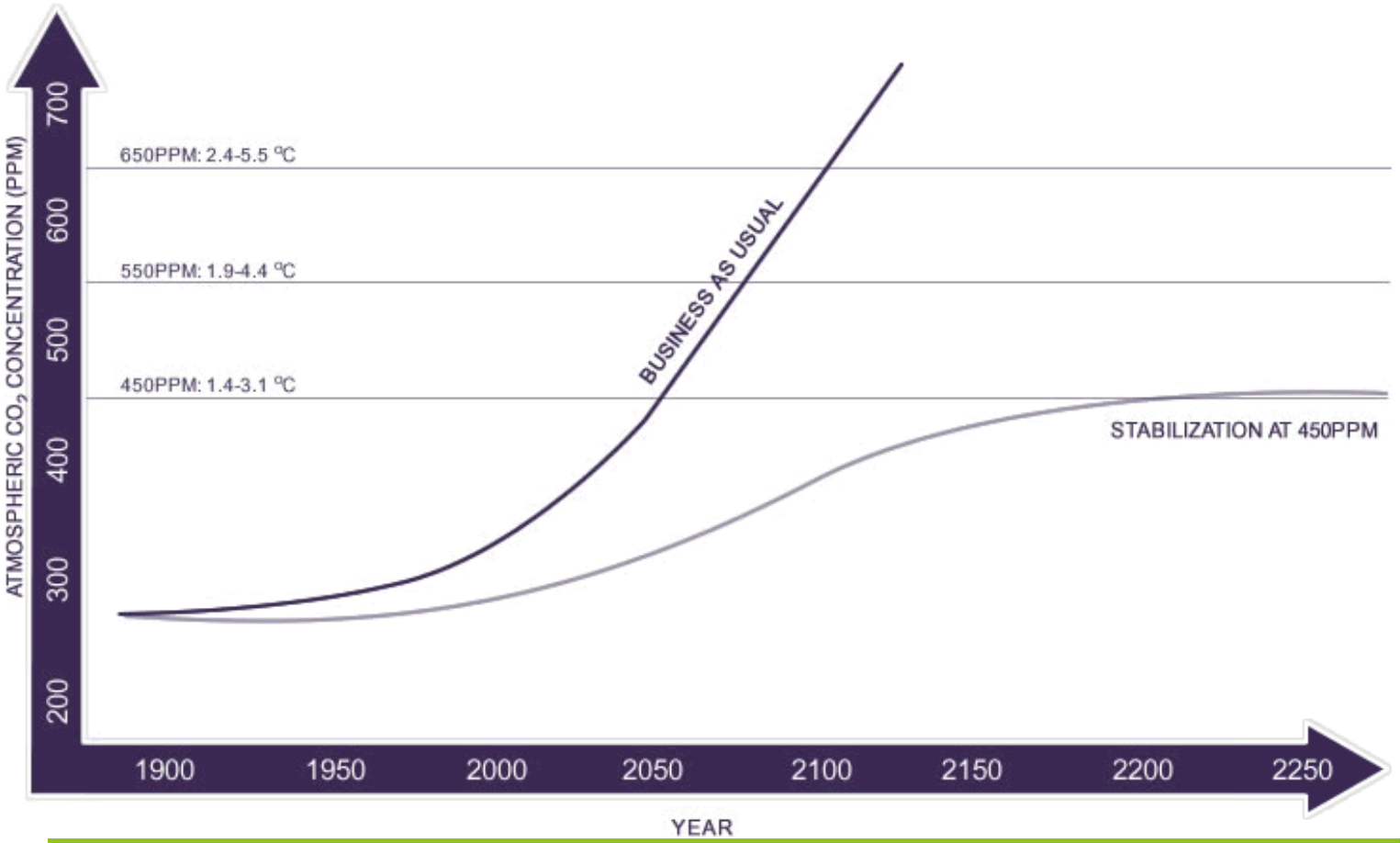
Science – Stabilizing Atmospheric CO_2 Levels



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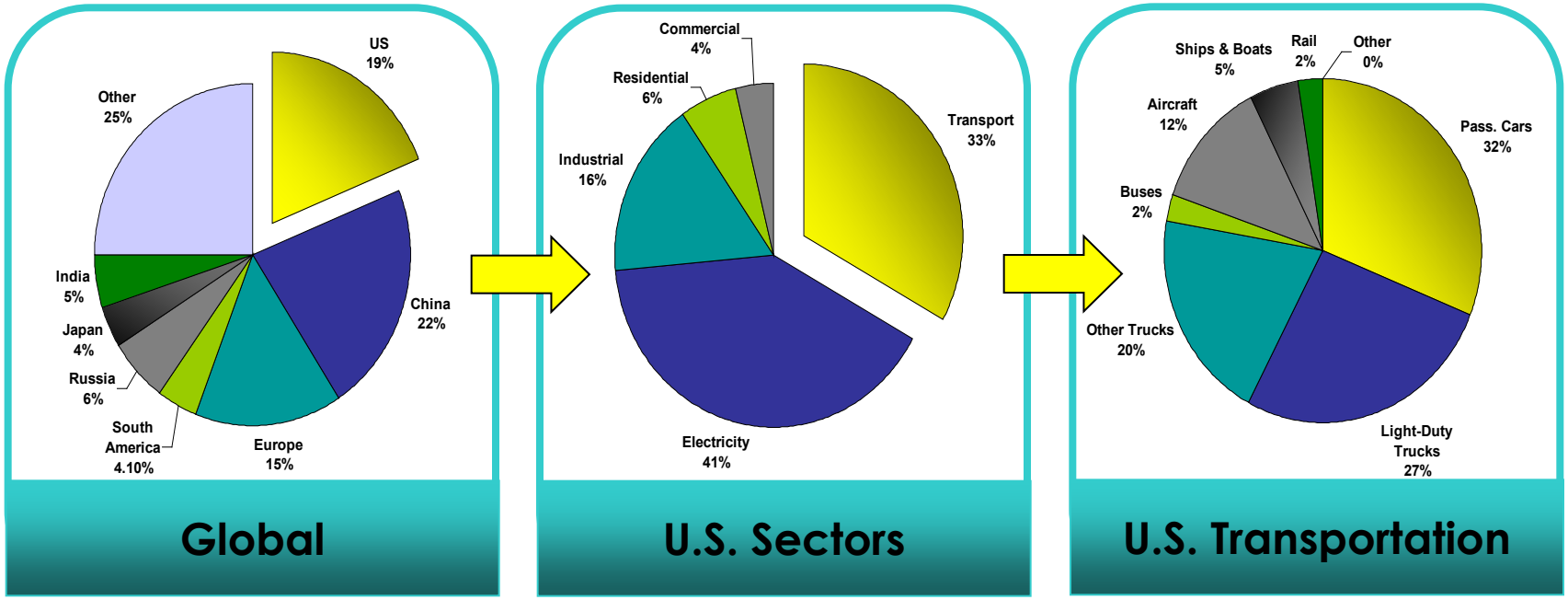
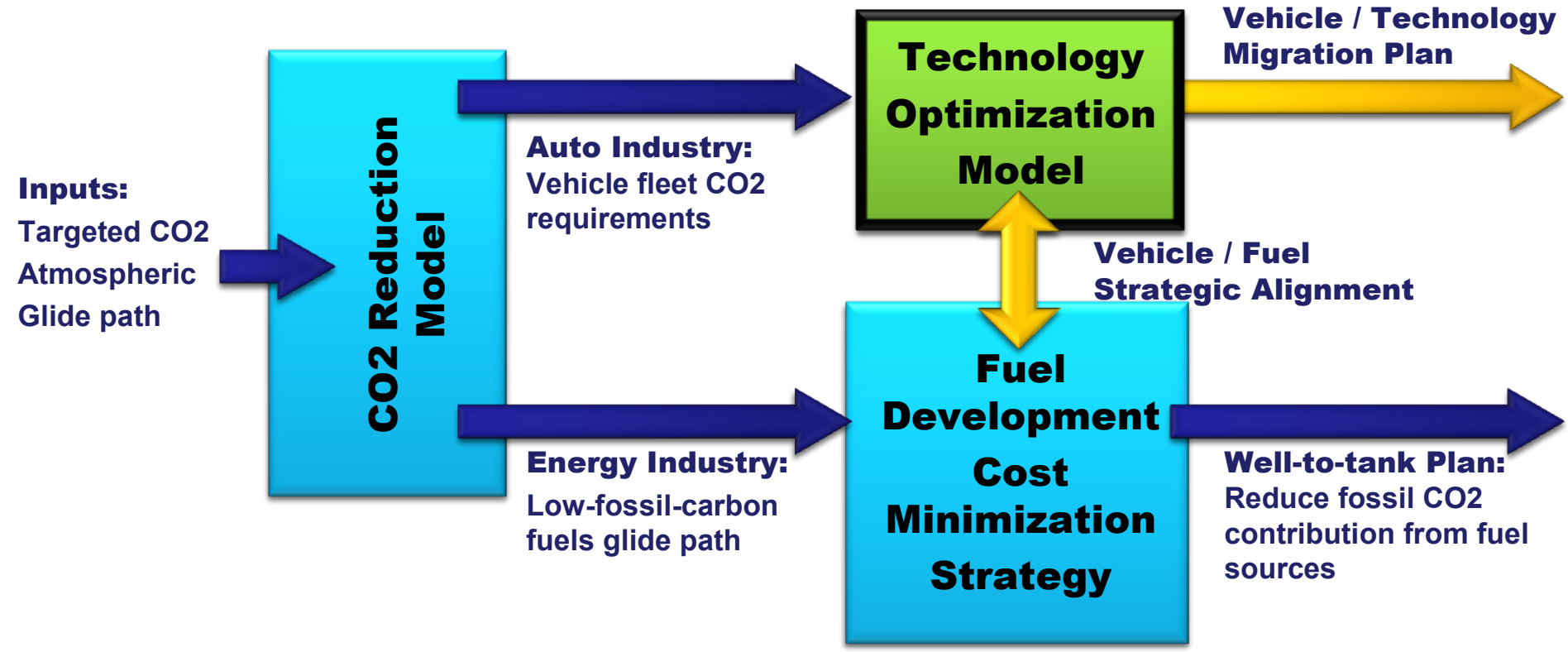
Contributions to CO_2 Emissions is Across Global Regions and Industry Sectors

2008 CO_2 Emissions from Energy Consumption



- On-road cars (32%) and light-duty trucks (27%), as a portion of the transportation sector (33%), contribute about 20% of US and ~11% of global CO_2 emissions
- Vehicles are significant source of GHGs but are often perceived to be the major source

Ford's Sustainability Framework for CO_2 and Technology Migration Development



Ford's Path to Sustainability

Near Term

Begin migration to advanced technology

Mid Term

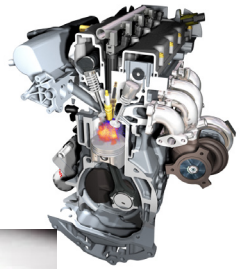
Full implementation of known technology

Long Term

Continue leverage of Hybrid technologies and deployment of alternative energy sources

Near Term

Advanced Gasoline Engines



Hybrids

FLEX FUEL

Natural Gas/LPG

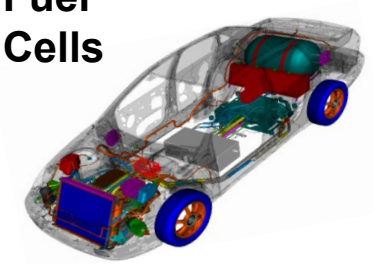
Mid Term

Electrified Vehicles

Weight Reduction

Long Term

Fuel Cells



Hydrogen Powered Engines

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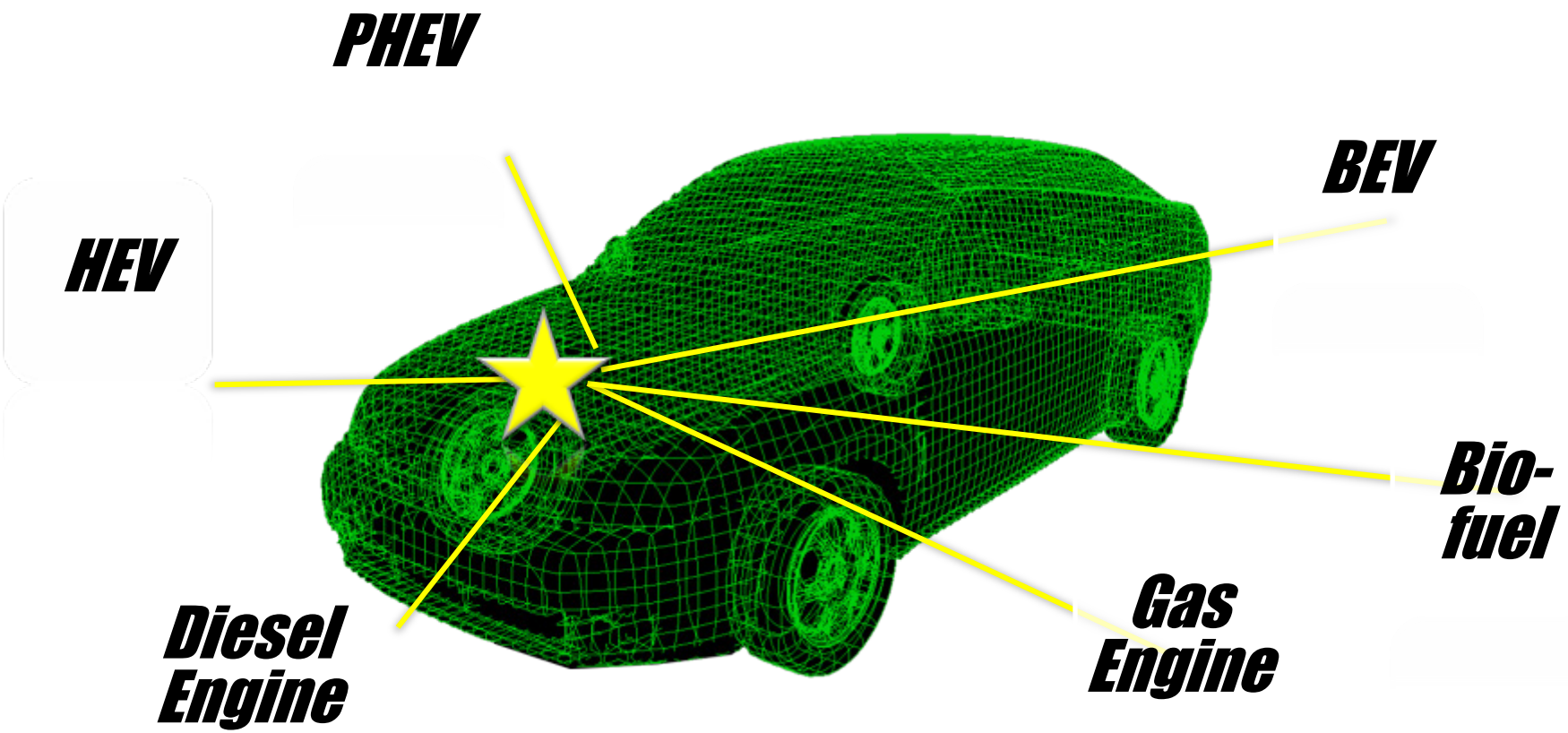
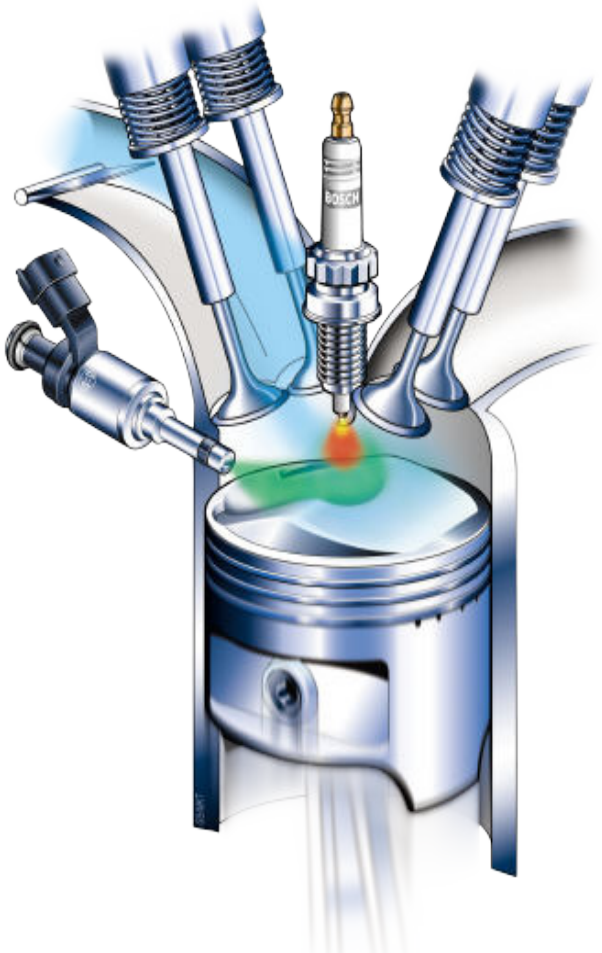
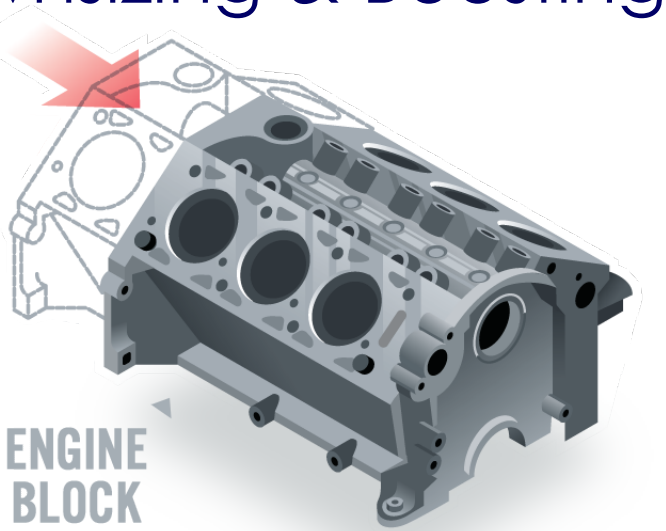
Ford Strategy: Leverage Global Platforms



Introduction of EcoBoost Technology

- Gasoline Direct Injection
- Turbocharging
- "Downsizing & Boosting"





Electrified Vehicles

THE POWER OF CHOICE

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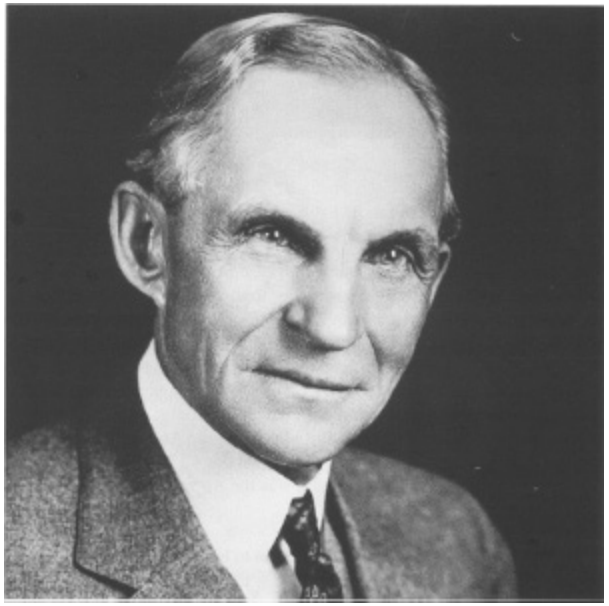
Ford's Strategy Is To Electrify Global Platforms With All 3 Electric Solutions – To Drive Choice Of Top Hats, Scale And Affordability.

Weight Management has Been a Design Consideration for a Long Time

"Saving even a few pounds of a vehicle's weight . . . could mean that they would also go faster and consume less fuel. Reducing weight involves reducing materials, which , in turn, means reducing cost as well."

Henry Ford, 1923



Emerging Lightweight Material Opportunities

Body Structures
Near Term - Increase AHSS, Aluminum
Future – Magnesium, Carbon Fiber Composites, Natural Fiber Plastics

Interiors
Al,Mg,
BioBased
Plastics

Powertrain Materials
Near Term – Aluminum
Future –Magnesium,
High Temp Plastics

Closures
Near Term – AHSS, Aluminum,
Future – Magnesium & Reinforced Plastics

Chassis Systems
Near –AHSS, Al
Future – Mg, CF

Ford's Sustainable Materials Strategy

- **Vision**
  - **Ford Motor Company will ensure that our products are engineered to enable sustainable materials leadership without compromise to Product Quality, Durability, Performance or Economics.**

- **Key Positions**
  - **Recycled** and **renewable** materials must be selected whenever technically and economically feasible. We will encourage the best green technologies to meet the increasing demand for these materials.
  - When we use **recycled** and **renewable** materials, there will be no compromise to Product Quality, Durability & Performance or Economics.
  - We will enhance technologies, tools and enablers to help validate, select and track the use of these materials in our products.
  - The use of **recycled** and **renewable** content is increased year by year, model by model where possible.

Eliminate Undesirable Substances and Materials

- Ford was the first in Auto industry developed the Restricted Substance Management Standard (1984) which has been used to manage substances used in Ford vehicles and plants for nearly 30 years

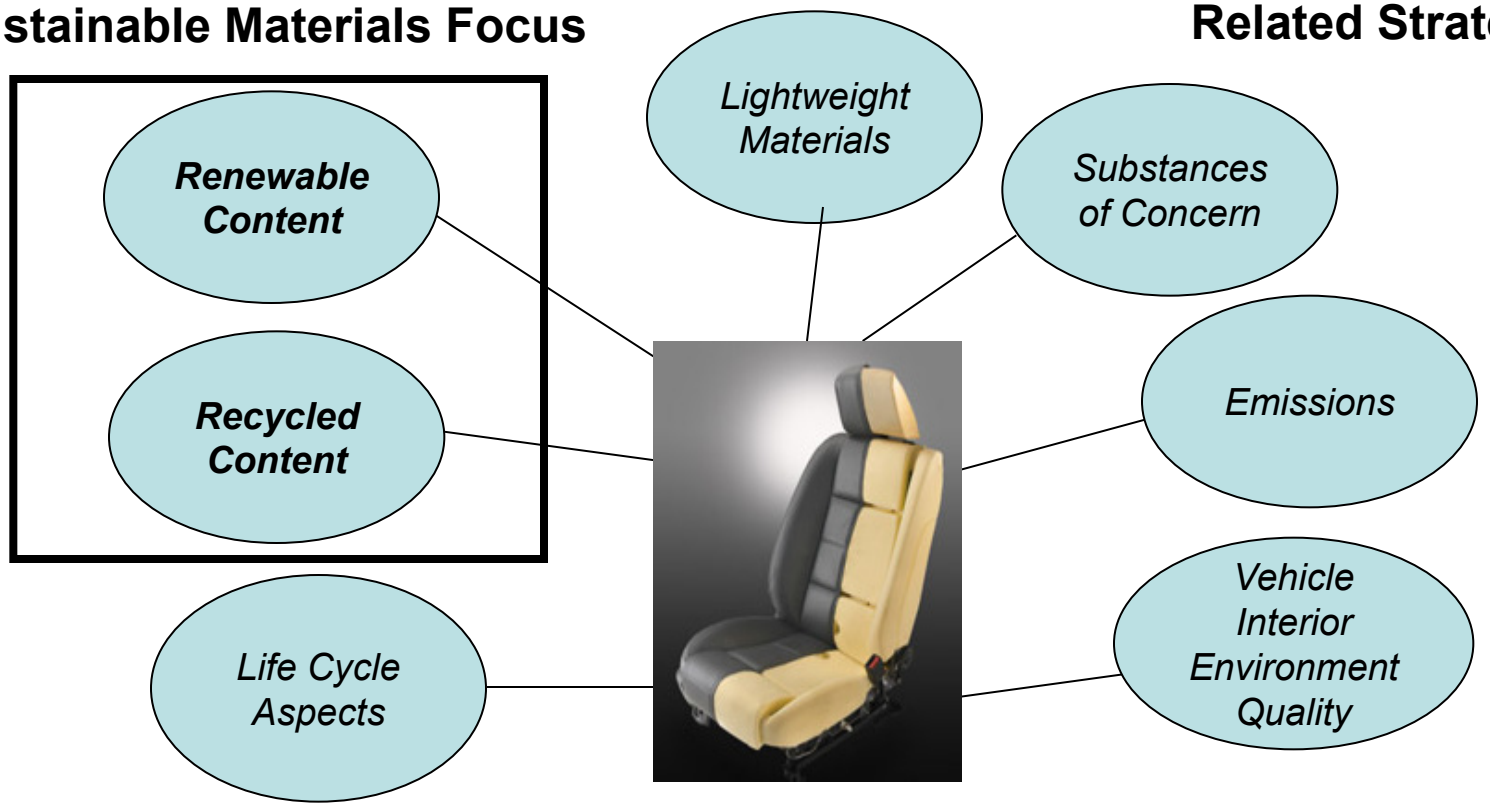
- Ford was among the 7 OEMs who developed the International Material Data System to collect all substance/material/part info for our vehicle

- Ford have been leading/supporting industrial efforts in developing Global Automotive Declarable Substance List, Registration, Evaluation, Authorization and Restriction of CHemicals (REACH, EU new low) Automotive Industry Guidelines, etc.

Sustainable Materials

Sustainable Materials Focus

Related Strategies



***Sustainable Materials* – - Materials with lower environmental impact, which provide performance equivalent to existing materials. This includes materials manufactured with recycled content and/or renewable feed stocks.**

Ford's Sustainable Materials Strategy

What goes in

A key goal in Ford's sustainable materials strategy is to identify opportunities to use recycled or renewable material – in place of nonrenewable virgin material – in its vehicles. Here are some of the green materials Ford is using:

Recycled materials (non-metal)

- Post-consumer plastics made into:
  - Underbody shields
  - Battery tray
  - Carpets
  - Heater and air conditioning housing
  - Fan shroud
  - Replacement bumpers
  - Wheel arch liners
  - Air cleaner assembly
  - Roof lining
  - Instrument panel
  - Parcel shelf
  - Soundproofing
  - Insulation
  - Seat fabrics

- Post-industrial yarns made into seat fabrics
- Post-industrial cotton from blue jeans made into interior padding
- Post-consumer nylon carpeting made into resin for cylinder head covers

Renewable materials

- Soy-based polyurethane foams used for seat cushions, seatbacks and headliners
- Wheat straw and other plant fiber-reinforced plastic used for vehicle storage bins and interior door panels

- Engineering wood technology (recycled and renewable) used for interior trim
- Sugars made from corn, beet and cane under consideration for biodegradable plastic parts

Reduce, Reuse and Recycle

What goes into a vehicle at the beginning of its lifecycle and what comes out of it at the end contribute greatly to its environmental friendliness. That's why Ford is committed to maximizing the use of recycled, renewable and recyclable content in its vehicles, while enabling maximum end-of-life vehicle recycling.

This Reduce, Reuse and Recycle commitment is part of Ford's broader global sustainability strategy to reduce its environmental footprint and accelerate the global development of advanced fuel-efficient vehicle technologies.

The end-of-life process

Once all of the salvageable material is removed from a vehicle at the end of its useful life, the remaining structure is flattened and pulverized into fist-sized pieces at the rate of one car every 45 seconds.

Industrial-strength magnets are used to separate the ferrous (iron and steel) from non-ferrous (aluminum) metals and the recovered ferrous metals are recycled to produce new steel. The steel industry recycles more than 14 million tons of steel from end-of-life vehicles each year.

Following the removal of all recyclable materials, the remaining non-recyclable ASR (auto shredder residue), which includes plastics, rubber, foam, fabric and glass, is disposed of in landfills.

What comes out

About 85 percent of the materials used on Ford vehicles are recyclable. Approximately 95 percent of the materials from all vehicles retired from use annually are recoverable, according to International Organization for Standardization guidelines.

- Dismantled, reconditioned and sold on the used auto parts market when possible:

  - Starter
  - Alternator
  - Engine
  - Transmission
  - Steering wheel column
  - Fuel tank
  - Seats
  - Stereo
  - Fenders
  - Doors

- Drained for reuse when possible:
  - Fuel
  - Coolant
  - Windshield fluid
- Batteries recycled or sold on the used auto parts market when possible

- Tires reused when possible, or shredded, cleaned and processed into playground surfaces and garden mulch

Opportunities for Recycled Materials

100% Recycled carpets & fabrics

Post Industrial recycled bumpers

Recycled Polyurethane foam components

Laundry & Milk Bottles into:
-Windshield washer bottles
-Climate Control Air Ducts

Tires into:
-aero deflectors
-under hood covers

Battery casings into:
-splash shields
-rocker moldings

History of Biomaterials at Ford

- 1937 Ford was producing 300,000 gallons of soy oil a year for use in car enamels (*Soybean Digest* 1947).
- 1939 the Ford Motor Company was harvesting about 100,000 bushels of its own soybeans
- The "Soybean Car" was unveiled by Henry Ford on August 13, 1941
- 'Fordite' material used in steering wheels contained wheat straw

Robert Boyer and Henry Ford with the Soybean Car.

Soybean Car assembly image showing production of plastic panels.

"Someday you and I will see the day when auto bodies will be grown down on the farm."

– Henry Ford

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Supply Chain: Farm to Fender

Famous Ford "Firsts"

TRANSFORMING CROPS INTO MOTOR CAR MATERIALS, TO BENEFIT CAR OWNER AND FARMER ALIKE

1st to "grow" automobile parts on the farm

It has always been a Ford conviction that agriculture and industry are natural partners. That is why Ford has pioneered the use of farm products as automobile materials.

Ford was the first car manufacturer to start growing its own timber. This was in 1919, when Ford purchased a large tract in Northern Michigan, to provide a dependable source of both hard and soft woods.

Ford was the first car manufacturer to acquire its own rubber plantations.

Ford was the first car manufacturer to provide its own tung oil for paints and enamels, by planting tung tree groves.

And perhaps the most striking example of this partnership of farm and factory is the Ford development of the soya bean. Ford was first to sow, harvest and use the "miracle bean" as a basic industrial material. The soya bean has long been an ingredient of synthetic resin enamels and plastic parts for Ford-built cars. This Ford "first" brought impetus to the plastics industry. It gave farmers a new "money crop".

Today many products go from farm to Ford, to contribute to the beauty, performance and economy of Ford-built cars and trucks. And these products benefit owners and farmers alike, because they bring new values on the one hand . . . new income on the other. Here is another of the Ford advances that mean so much to America.

Tune in . . . THE FORD SHOW . . . CBS, Tuesdays, 10-10:30 P. M., E.S.T. THE FORD SUNDAY EVENING HOUR . . . ABC, Sundays, 8-9 P.M., E.S.T.

Ford

EXPECT THE "FIRSTS" FROM FORD!

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Why Sustainable Materials? Why Now?

- Increased use of renewable feedstocks and agricultural products
- Increased use of recycled or waste bi-products
- Reduce dependence on foreign petroleum
- Improved material life cycle
- Improved performance in select functions
- Increased consumer awareness

Success of Soy-based Foam

Applications: Use of functionalized soy oil in urethane foam for automotive seating and headliner applications

Status: Ford is leader in technology and first OEM to launch in production; migration to other non-automotive applications

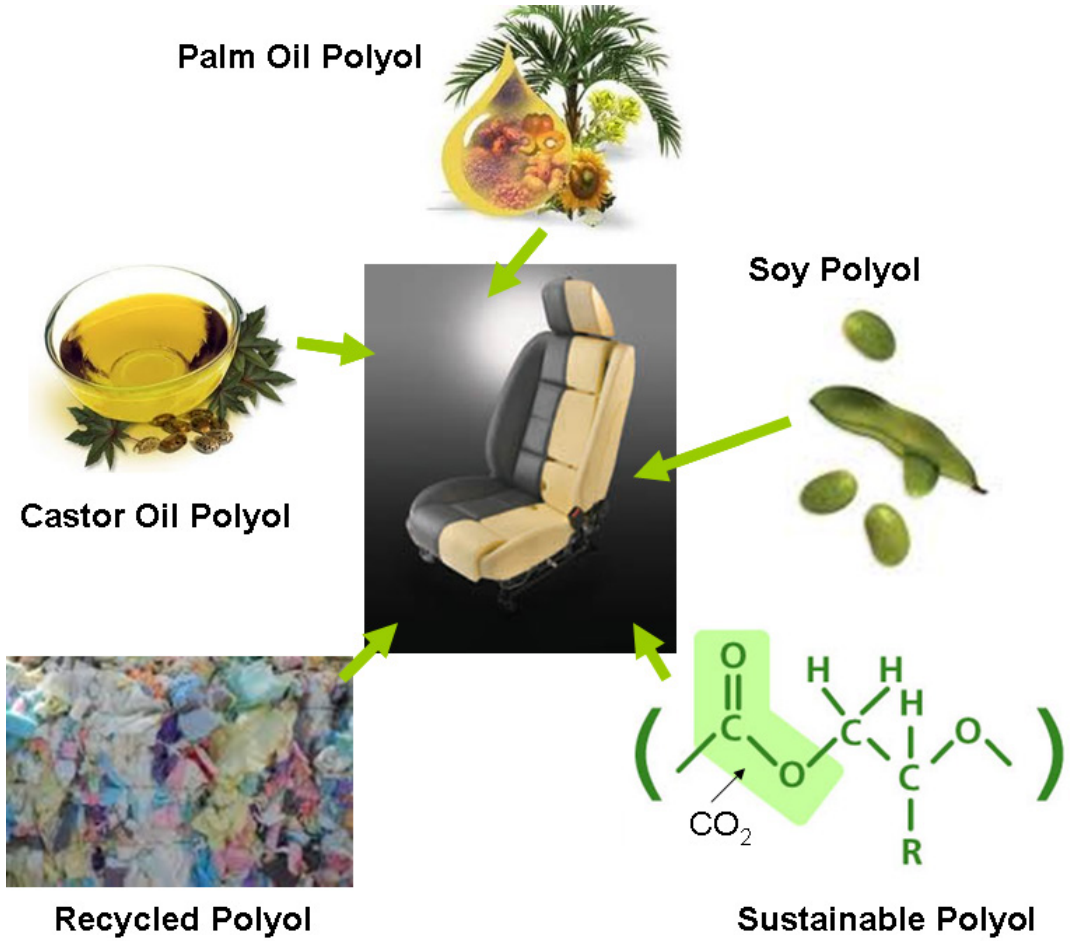
Soy foam headliner

Soy foam seats

- Soy foam seats on all vehicle platforms in North America!!
- Over 5 million Ford vehicles on the road today have soy foam seats
- Escape has soy foam headliner
- 75% headrests contain soy foam
- Reduces petroleum usage by 4 million lbs annually & CO_2 by 17 million lbs

Future Green Chemistry Ideas for Foam

- Sustainable sources other than soy must be considered for regions where soy is not as plentiful
- Recycling soy foams to keep them out of landfills at end of life



Natural Fiber Reinforced Plastics

Description: Use of natural fibers such as hemp, coconut coir and cellulose in place of glass fibers for plastic reinforcement.

Benefit: Up to 30% weight reduction of part.

Natural Fibers:


purified cellulose


flax fiber


jute fiber


hemp twine

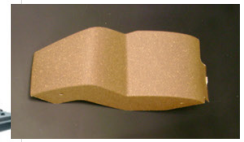

coconut coir


Indian Grass

Injection molding
compression molding

Components:


Box inner


Edge end cap


F-150 fender reinforcement


B-pillar


Fusion tow impact shield

Wheat Straw Bio-Filled Polypropylene

Industry and World-First Usage in Quarter Trim Bins on 2010 Ford Flex

Wheat Straw

Extrusion Compounding

Wheat Straw / Polypropylene Resin

Injection Molding

Wheat Straw Bio-Filled Polypropylene Quarter Trim Bin

reduces petroleum usage by some 20,000 pounds per year and reduces CO2 emissions by 30,000 pounds per year

Retired U.S. Currency

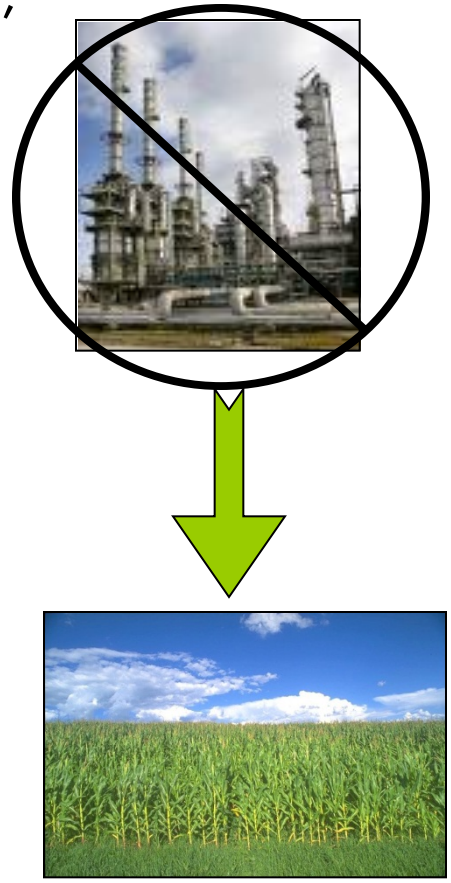
- Benefits
  - Use of waste stream
    - 10,000 lb of retired paper currency shredded daily
    - Currently landfilled or burned
  - Weight / density reduction
  - Cycle time reduction
- Shredded currency fibers
  - Blend of linen and cotton
  - Good impact performance
- Implementation targets
  - Coin tray
  - Interior trim

Unique Technical Challenges

- **Automotive Interior** – challenging environment
  - high heat, humidity and sun load
  - performance maintained over lifetime of vehicle – 10 years/ 100,000 miles
- Some bio-polymers will degrade with exposure to heat & moisture
  - balance between durability & compostability
- Solutions Ford is Researching
  - Overcome performance and durability issues of biopolymers like PLA through the use of additives and blends with other plastics
  - Develop traditional polymers from renewable monomers and chemical feedstocks

Bio-based Monomer Technologies

- Producing traditional plastics (PP, PE, PA, PET, PBT) from bio-based feedstocks rather than petroleum
  - Utilize bio-chemical reactions
  - Good long term durability
  - Material can be used in existing processes
  - Known performance and attributes
  - Reduce dependence on foreign petroleum
    - Local supply
    - Multiple material sourcing possible
  - Improved carbon footprint



The Need for Domestic Rubber Crops

- The U.S. is totally dependent upon NR imports from tropical countries – and consumes about 1.2 million MT/yr (of 10 million MT total NR)

- NR production is dependent upon one genetically-narrow plant species, *Hevea brasiliensis* (clones) – we need biodiversity

- Synthetic rubber is derived from petroleum with escalating costs

*Data courtesy of OARDC

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Possibilities for Sustainable Rubber?

- Partnering with OSU – OARDC to develop **Russian Dandelion** and **Guayule** as a domestic, sustainable source for rubber
- Potential use as a rubber modifier in TPO or bio-based plastic materials for interior trim applications

Recycled Content

Recycled materials:

- Reduce the use of petroleum based virgin plastics
- Improve environmental footprint
- Divert waste from landfills

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Recycled Fabrics and Carpet

- In 2009, Ford required all fabrics have a min of 25% recycled content
- Explorer uses 25% recycled PET fiber in all interior fabrics
- Focus Electric uses 100% recycled PET fabric (REPREVE)

Post consumer recycled bottles and industrial scarp materials

Melted and re-spun into fibers and yarns

Fibers woven into fabrics or needled into carpets

Recycled Bottles to Make Carpet

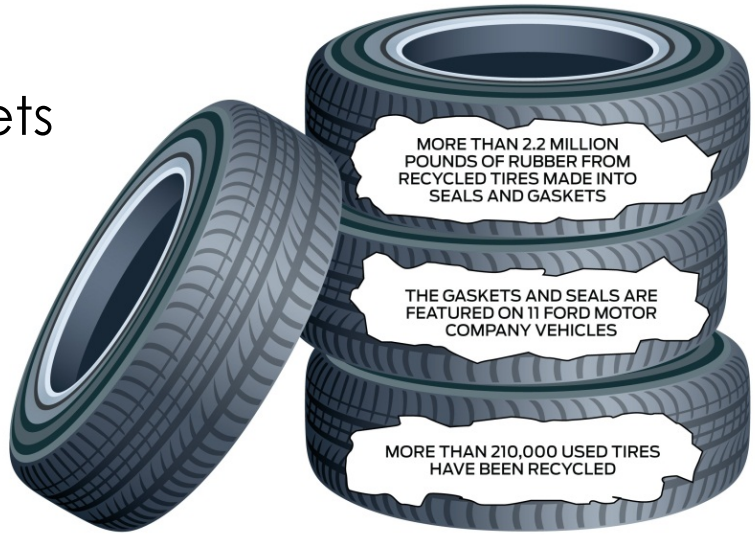
2012 Escape

Recycled Clothing for Sound Absorption Materials

- Vehicles contain ~ 2 pairs of blue jeans as sound-dampening material to eliminate road, wind and powertrain noise
- Diverting scrap from the textile industry from landfills
  - The textile scrap gets shredded and processed into the backing of interior panels and carpeting

Recycled and Renewable – Together!

- Gaskets and Seals compounded from recycled tires and soy
- Used 2.2 million pounds of rubber from recycling 210,000 tires, and 150,000 pounds of soy.
- Lighter weight than the prior gaskets



Driving Green Solutions For **All**

Farmers

Research

Universities

Resin Producer

Chemical Companies

Compounder

OEM

Tier 1