TODAY’S SPEAKERS

John Cooper, United Soybean Board Director and Member of the Domestic Marketing Committee. John is a soybean farmer from Wynne, Arkansas

James W. Pollack, Omni Tech International, Ltd Environmental Business Manager

Don Scott, National Biodiesel Board Director of Sustainability

Bob Moffit, Ashland Performance Materials Product Manager

Shelly West, BioBased Technologies® Sales Manager, Polyols
Key Findings on Soybean Production and Processing

As soybeans grow, they remove greenhouse gases from the atmosphere. The **3.36 billion bushels of soybeans grown in the United States in 2009** removed the carbon equivalent of taking **21 million cars off the road** when the figures are computed using the Environmental Protection Agency’s Greenhouse Gas Equivalencies Calculator.
The average soybean yield for 2004-2007 was 42.3 bushels per acre – a 12 percent increase over the data (1998-2000 average) used in the current U.S. Life Cycle Inventory database.

This is consistent with other analysis that found plant breeders have succeeded in increasing the yield potential of soybeans by an average of 0.41 bushels/acre per year for the past 35 years. Meanwhile, plant breeding companies anticipate new soybean varieties will allow farmers to increase soybean yields by 40 percent in the next decade.
Key Findings Continued

The calculated release of nitrous oxide (N2O), a greenhouse gas, is 85% less than the data contained in the current U.S. Life Cycle Inventory Database due to a corrected emission factor issued by the International Panel on Climate Change (IPCC) in 2006.
Key Findings Continued

The updated data show approximately 20% less direct energy used in soybean farming due to reduced diesel and gasoline usage.
Key Findings Continued

Soybean processing facilities reduced their energy consumption by 45% compared to 1998 data.
Soy Polyol
Insulation, Foam for Cars, Furniture Cushions, Carpet Backing
Soy Lubes
Lubricants for Heavy Equipment, Two-cycle Engines and more
Peer Review

The entire project was peer reviewed in accordance with International Organization for Standardization (ISO) 14040/44 Life Cycle Requirements.

Peer Reviewers included:
- Dr. Martin Patel of Utrecht University
- Michael Levy of the American Chemistry Council
- Dow Chemical
- BASF
- Bayer
- Center for Polyurethane Industry (ACC)

Omni Tech International, Ltd conducted the study for the United Soybean Board. Four Elements Consulting, LLC performed the life cycle assessment modeling.
Sources of Information

• U.S. Department of Agriculture and Ag Research Service Lab—agriculture and process data

• National Oilseed Processors Association (NOPA) mass balance for soybean crushing (50/60 plants-83%)

• National Biodiesel Board (NBB) mass balance for biodiesel production (37% plants reporting)
Boundary Conditions and Methodology

• Cradle-to-Gate

• Transportation Included

• Packaging Excluded

• Functional Unit of 1,000 kg of product

• Mass allocation for baseline analysis

• Economic allocation to assess sensitivity
Boundary Conditions and Methodology (cont.)

• LCA model built in Sima Pro 7
• Material data from U.S. Life Cycle Inventory Database, EcolInvent and SimaPro
• Building for Environmental and Economic Sustainability (BEES) impacts used for Life Cycle Impact Assessment
• Carbon sequestration included
Product Impact Results

- Shows environmental and energy benefits of soybean-derived feedstocks
- Reduced greenhouse gas emissions
- Lower fossil fuel depletion
Current Activities

Continue to monitor soy agriculture practices

- Conservation Technology Information Center
- U.S. Department of Agriculture – Agricultural Research Service
- Discussions with farmers
Sound Benefits

- Renewable
- Domestic
- Energy Efficient
- Clean
- Safe

- Better than ever
- Continues to improve

Photo courtesy of 1998 USDA/DOE Lifecycle Inventory
Production Locations (9/17/08)

Production Capacity 2.55 billion gallons per year

175 Plants

BQ-9000 Accredited Producers
## Lowers Tailpipe Emissions

<table>
<thead>
<tr>
<th>Emission Type</th>
<th>B100</th>
<th>B20</th>
<th>B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Unburned Hydrocarbons</td>
<td>-67%</td>
<td>-20%</td>
<td>-2.2%</td>
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<tr>
<td>Carbon Monoxide</td>
<td>-48%</td>
<td>-12%</td>
<td>-1.3%</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>-47%</td>
<td>-12%</td>
<td>-1.3%</td>
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</table>

vs.

![Field Image](image1.jpg) vs. ![Factory Image](image2.jpg)
<table>
<thead>
<tr>
<th></th>
<th>Energy Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity</strong> (Kwh/gal)</td>
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</tr>
<tr>
<td><strong>Natural Gas</strong> (SCF/gal)</td>
<td>2.69</td>
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</tbody>
</table>
Sound Benefits

• Renewable
• Domestic
• Energy Efficient
• Clean
• Safe

• Better than ever
• Continues to improve

Photo courtesy of 1998 USDA/DOE Lifecycle Inventory
ENVIREZ® Resins

- Ashland developed the first commercially available biobased unsaturated polyester resin in 2003
  - ENVIREZ 1807 was developed at the request of the United Soybean Board and John Deere
  - The initial applications were tractor and combine side panels

- Ashland continues to invest in the research and development of green resins
  - Commercial products using biobased materials are now available for most composite fabrication processes
  - Ashland designates resins formulated with recyclable and/or renewable raw materials with the ENVIREZ brand
Value Proposition for Green Products

• Stewardship
  - Individuals and some organizations transition to “greener” products and processes because of the environmental, social and sustainable benefits of these products.

• Initiatives
  - Government and Industry Initiatives are developed to capture the stewardship benefits from a larger population segment. These initiatives often have economic benefit to one or more members within the supply chain.
# Stewardship
## ENVIREZ Resins

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>Fabrication Process</th>
<th>Product Example</th>
<th>Bio Content</th>
<th>CO₂</th>
<th>Energy</th>
<th>Reference</th>
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<tbody>
<tr>
<td>ENVIREZ 1807</td>
<td>SMC/BMC</td>
<td>Combine Panel</td>
<td>18</td>
<td>-0.91</td>
<td>-2600</td>
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<td>ENVIREZ 70301</td>
<td>Pultrusion</td>
<td>Window Frame</td>
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<td>-3800</td>
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<td>ENVIREZ L 86300</td>
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<td>Boat Hull</td>
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<td>-0.19</td>
<td>-2100</td>
<td>(2)</td>
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<td>ENVIREZ LF 80630</td>
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<td>Shower Unit</td>
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<td>-0.62</td>
<td>-5300</td>
<td>(1,3)</td>
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<td>ENVIREZ 86400 INF</td>
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<td>Furniture</td>
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<td>-0.19</td>
<td>-2100</td>
<td>(2)</td>
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<td>ENVIREZ Q 11500 INF</td>
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<td>Surface Parts</td>
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<td>-800</td>
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<tr>
<td>ENVIREZ SS 70419</td>
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<td>Counter Top</td>
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<td>-3100</td>
<td>(2)</td>
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<tr>
<td>ENVIREZ MR 80220</td>
<td>Casting</td>
<td>Sinks</td>
<td>20</td>
<td>-0.31</td>
<td>-3400</td>
<td>(2)</td>
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</tbody>
</table>

- **Bio Content**: The percent, by weight, of the total raw material charge
- **CO₂**: The CO₂ contribution, in pounds per pound of resin, vs a standard petrochemical based equivalent
- **Energy**: The energy consumption, in BTU/Lb resin, vs a standard petrochemical based equivalent.

References apply to CO₂ and ENERGY:

(1) Based on product life cycle assessments by Omnitech International
(2) Based on cradle to gate life cycle assessment of raw material component(s) on a design basis provided by DuPont Tate & Lyle.
(3) Based on energy and CO2 data provided by raw material supplier
Stewardship
Examples from above table

Compared to similar use petroleum based polyester resin:

ENVIREZ® 1807 Resin
**CO₂:** A 40,000 lb tank wagon
Reduces 36,400 Pounds of CO₂

ENVIREZ® 1807 Resin
**Energy:** A 40,000 lb tank wagon
Saves 104 Million BTU
Equal to 17 Barrels of Crude Petroleum
Initiatives

• Fabricated composites can be preferentially selected when they meet requirements of government and industry initiatives, such as:
  - USDA Biopreference
  - Green Globes
  - LEED

• Ashland is helping our Customers understand how their products meet the requirements of these programs.
• Using a unique chemical process, BioBased Technologies® manufactures a polyol for use in polyurethane applications:

• Range of functionalities allows for a unique application flexibility

• Qualities such as low acid number, mild odor, and light color make it ideal for replacement of petroleum-based polyols
Environmental Benefits of Agrol® Polyols

High Biobased Content
Biobased content = 96% (ASTM D6866)

Low VOC Emissions
Total VOC emission factor = <40 (µg/kg)/hr
Formaldehyde emission factor = BQL (below quantifiable level)
ASTM D5116
Environmental Benefits of Agrol® Polyols

Agrol® polyols help lower your Carbon Footprint

5.5 pounds of carbon dioxide equivalents are removed or prevented from entering the atmosphere for every pound of Agrol® that replaces a pound of petroleum-based polyether polyol*

Agrol® polyols have lower GWP

Agrol® has a Global Warming Potential of -1,400 gm CO2 eq/kg compared to petroleum-based polyols resulting in 4,100 gm CO2 eq/kg*

*This data is from a 3rd party, cradle to gate Life Cycle Analysis (LCA) of Agrol® Polyols by Omni Tech International.
Market Drivers for Agrol® Polyols

• Agrol® is a value-added portion to final products

• Quantifiable environmental, social & economic impact:
  • Qualification for USDA Biopreferred purchasing program
  • Lower carbon footprint for the customer and manufacturer
  • Reduced dependence on petroleum-based products
  • Sustainable feedstock, made in U.S.A.
  • Improved air quality emissions
U.S. SOY DELIVERS ENERGY AND ENVIRONMENTAL BENEFITS

FOR MORE INFORMATION
Go to www.soybiobased.org to download documents related to the New Life Cycle Profile for Soy Products or contact Karen Coble Edwards karen@kcegroup.com 703-281-7600