Applications of Green Chemistry and Engineering for a Sustainable World

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About Dow

• A science and technology leader with annual sales of $54 billion
• Founded in 1897 by Herbert H. Dow in Midland, Michigan
• Supplies plastics and chemical products to customers in 160 countries
• From 188 manufacturing sites in 35 countries
• Employs ~50,000 people globally

“If you can’t do it better, why do it?”
– Herbert H. Dow
What is Sustainable Development?

It is sustained competitive advantage from excellent TRIPLE BOTTOM LINE performance:

Profit - People - Planet

sustainable development (n) is development that meets the needs of today’s generation without compromising the ability of future generations to meet their needs.
A History of Dow's Commitment to Sustainability

- 1897
- 1906
- 1935
- 1953
- 1967
- 1986
- 1991
- 1996
- 2005
- 2007
- 2010
- 2015

1906 1935
HH Dow partners with Westinghouse to develop Co-Generation

First industrial use of bacteria to degrade phenolic waste

1953
Developed water-based, acrylic technology that revolutionized the paint industry

1967
Waste Reduction Always Pays (WRAP) launched

1986
Corporate Environmental Advisory Council formed

1991 1996
Dow's Claude Fussler writes: Driving Eco Innovation

2005
2005 Goals saved company $5 billion on $1 Billion Investment, 2015 Sustainability Goals Set

2005 Goals Set

2007
Dow signs UN Global Compact

2010
Dow wins 7th Presidential Green Chemistry award – more than any company

2015
2005 Goals Set

Dow's Frank Popoff pens Eco-Efficiency: The Business Link to Sustainable Development

1897
Sustainability is part of Corporate Strategy

**VALUES**
- Integrity
- Respect for People
- Protecting Our Planet

**MISSION**
To passionately innovate what is essential to human progress by providing sustainable solutions to our customers

**VISION**
To be the most profitable and respected science-driven chemical company in the world

**STRATEGY**
Preferentially invest in a portfolio of technology-integrated, market-driven performance businesses that create value for our shareholders and growth for our customers

**Financial Discipline**  **Sustainability**  **Strategic Growth**  **Performance Culture**
Dow’s 2015 Sustainability Goals

- By 2015 Dow will double the percentage of sales to 10% for products which are advantaged by sustainable chemistry.
- We are actively working toward, and committed to achieving, at least three breakthroughs by 2015 that will significantly help solve world challenges.
- We will publish product safety assessments for all products by 2015.
- By 2015, Dow will achieve on average a 75% improvement of key indicators for EH&S operating excellence from 2005 baseline.
- We will reduce our energy intensity 25% by 2015.
- We will reduce our greenhouse gas intensity 2.5% per year through 2015.
- By 2015, 100% of Dow sites where we have a major presence will have achieved their individual community acceptance ratings.

...and we measure our progress
1. Waste Prevention
2. Atom Economy
3. Safe Raw Materials
4. Safe Product
5. Safe Solvents
6. Energy Efficiency
7. Renewables
8. Process Complexity
9. Catalysis
10. Biodegradability
11. Process Control
12. Safe Process

Color Codes:
- Economic drivers
- Personal safety
- Feedstock choice
- Product properties

Note: A great “green chemistry” does not need to hit ALL of these!
Some Examples
Low-VOC Architectural Coatings

Description
• Dow’s development of low- or no-volatile organic compound (VOC) solutions for architectural paints and coatings protect the environment and human health while helping customers meet more stringent environmental regulations.

Sustainability Profile
• VOC reduction enables better indoor and outdoor air quality, and decreases human exposure to pollutants
• Dow’s low- or no-VOC solutions cost less than more traditional compounds
• Dow’s low or no-VOC solutions meet sustainability requirements without compromising the quality of the product

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Bio-Based Plasticizers

Description

DOW ECOLIBRIUM™ Bio-Based Plasticizers offer flame-resistant protection and performance using a renewable material alternative to traditional PVC plasticizer wire insulation and jacketing.

Sustainability Profile

- Reduces GHG emissions by up to 40 percent compared to production of traditional plasticizers
- Made from nearly 100 percent renewable feedstocks, which minimizes carbon footprint and reduces crude oil use
- Composed of phthalate- and lead-free material
- Provide opportunities for cable-makers and building end-users to earn carbon credits and LEED certification

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AQUASET™ Thermoset Technology

Description
Water-based AQUASET acrylic technology, often used in home insulation, is a sustainable chemistry that manufacturers can use to dramatically reduce or even eliminate exposure to emissions and volatile organic compounds (VOCs).

Sustainability Profile
• Water is the only byproduct emitted (in contrast to traditional binders that emit compounds such as formaldehyde, methanol, phenol and ammonia during the curing process)
• The technology has several sustainability, health and safety attributes, including being non-combustible, non-hazardous, recyclable and non-flammable

AWARD WINNER
2006 American Chemistry Council "Heroes of Chemistry Award"

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Innovative Propylene Oxide Process

Description
Dow and BASF jointly developed the hydrogen peroxide to propylene oxide (HPPO) technology, which significantly reduces waste water, energy and capital over competing technologies.

Sustainability Profile
- Uses hydrogen peroxide and propylene as raw materials
- Produces only propylene oxide and water
- Waste water reduced by 70% to 80%
- Energy use reduced by 35%
- Reduced physical footprint requires up to 25% less capital
- Avoids need for co-product infrastructure and markets

2010 AWARD WINNER
U.S. Presidential Green Chemistry Challenge “Greener Synthetic Pathways”

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Addressing the Global Water Challenge

Description
Dow’s FILMTEC™ Reverse Osmosis technologies provide safe drinking water through desalination in coastal areas that have limited fresh water resources.

Sustainability Profile
- Reverse Osmosis Elements help make desalination more energy-efficient
- Decreases use of chemicals, protecting local marine habitats with high biological or organic fouling
- Reduces use of materials and GHG emissions
- Committed to reducing the cost of desalination and water reuse 35 percent between 2005 and 2015.

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Description

Innovative insect control technology derived from a biological organism that provides control of a broad spectrum of insect pests in a variety of crops.

Sustainability Profile

- Applied at lower rates than conventional insecticides
- Low impact on beneficial insects
- Naturally degrades through UV light and soil microbes
- Low solubility in water
- Favorable mammalian and ecotoxicological profile
- Carries lowest human hazard label

2009 AWARD WINNER
Michigan Green Chemistry Governor’s Award

2008 AWARD WINNER
U.S. Presidential Green Chemistry Challenge
“Designing Greener Chemicals”

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Description
Building integrated photovoltaic (BIPV) design combines roofing protection and power generation in one product.

Sustainability Profile
• Aesthetically pleasing and neighborhood-friendly, it’s the best looking solar option available for asphalt rooftops
• Installed by a roofer along with standard asphalt roofing materials which eliminates additional steps and costs
• Interconnected system design allows for a single power connection
• Launched in October 2009, the POWERHOUSE™ Solar Shingle is expected to be commercially available in 2011

TIME Magazine: “50 Best Inventions of 2009”
Thank You