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ACS WEBINARS™
Green Chemistry: Innovation and Application for the New Decade

Speaker: Anne Wallin
The Dow Chemical Company

Moderator: Robert Rich
American Chemical Society

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ACS Chemistry for Life™

ACS Webinars™

Today's episode is co-produced with:

ACS Green Chemistry Institute®

Learn more at: www.acs.org/greenchemistry

Join ACS Sustainability Action Team

Learn more at: www.acs.org/sustainability

The Power of the Human Element At The Dow Chemical Company, we view chemistry as the work of humanity. We believe the most important element of all is not found on the periodic table, yet is part of every equation for the future. This element is the Human Element. With it, we are more than a chemical company, we are a difference-maker in the world.

Our Definition of Sustainability

Sustainability requires making every decision with the future in mind.

It is our relationship with the world around us – creating economic prosperity and social value while contributing to the protection of our planet.

SOLVING CHALLENGES THROUGH SUSTAINABILITY

Dow people include some of the **world's best scientists and engineers** dedicated to solving global challenges. We focus our **innovation engine** on delivering new technologies that are **good for business and good for the world**.

Energy

Climate Change

Water

Health & Nutrition

Transportation & Infrastructure

INTEGRATING SUSTAINABILITY INTO OUR CORPORATE STRATEGY

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

VALUES
Integrity
Respect for People
Protecting Our Planet

CORPORATE 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

Setting The **Standard** for Sustainability

Smart Solutions

Our technologies enable our customers, and their customers, to develop more sustainable products and services.

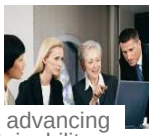
Innovations For Tomorrow

We contribute to the sustainability of society and our planet by developing innovative technologies for current and future markets.

Responsible Operations

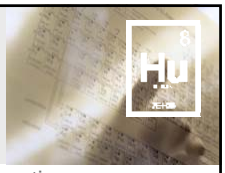
Our infrastructure has a positive impact on our company, our communities and ourselves; our operations are a model for others, wherever we operate.

Partners For Change



We are leaders in advancing all aspects of sustainability, openly collaborating with customers, suppliers, communities, civil society and governments.

A **History** of Commitment to Sustainability



HH Dow partners with Westinghouse to develop Co-Generation

First industrial use of bacteria to degrade phenolic waste

Corporate Environmental Advisory Council formed

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

Dow wins 6th Presidential Green Chemistry award – more than any company

2005 Goals Set

1897 1906 1935 1953 1967 1986 1991 1996 2005 2007 2008 *2015*

Dow Signs UN Global Compact

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

Dow's Claude Fussler writes: *Driving Eco Innovation*

Waste Reduction Always Pays (WRAP) launched

"War on BTUs" energy conservation program launched

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

2005 MILESTONES

As a result of the 2005 Goals we have:

- Saved over ***$5 billion*** with a ***$1 billion*** investment
- Reduced solid waste by ***1.6 billion pounds***
  - Enough to fill 415 football fields one meter deep
- Reduced water use by ***183 billion pounds***
  - Equal to water usage for 170,000 U.S. homes for one year
- Saved ***900 trillion BTUs*** of energy
  - Enough to power 8 million U.S. homes for one year
- Reduced personal safety and health incidents by 84%

DRIVING THE NEXT GENERATION OF CHANGE

Our 2015 Sustainability Goals

SUSTAINABLE **CHEMISTRY**

By 2015 Dow will double the percentage of sales to 10% for products which are advantaged by sustainable chemistry.

We will publicly report on our progress by:

- Reporting our overall annual assessment of our sustainable chemistry index, and performance against our % of sales having sustainable chemistry advantages
- Presenting and/or publishing life cycle assessments that are validated independently by an external stakeholder, on existing or planned Dow products.
- Providing ongoing updates on promising areas of research and investments and collaborations that spur sustainable chemistry innovation.
- Promoting sustainable chemistry internationally through student prizes and Dow employee awards under The Dow Sustainability Innovation Challenge Award program.

BREAKTHROUGHS TO WORLD CHALLENGES

We are actively working toward, and committed to achieving, at least three breakthroughs by 2015 that will significantly help solve world challenges.

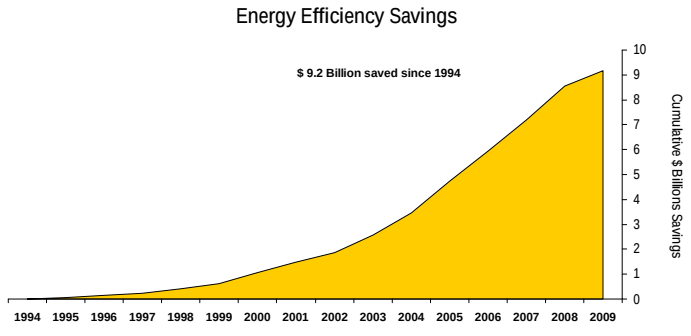
- Water
- Food
- Housing
- Energy and Climate Change
- Health

ADDRESSING **CLIMATE** CHANGE

We will reduce our greenhouse gas intensity 2.5% per year through 2015.

- Since 1990, we reduced our absolute greenhouse gas (GHG) emissions by over 20%; ***more than required by the Kyoto Protocol.***
- Our products, across our portfolio, reduce GHGs by multiples more than our own emissions on an annual basis.
- Dow is committing to using its knowledge of materials, processing, and component design to develop building integrated photovoltaic systems at a cost of less than $0.06 per watt with a manufacturing capability of 100 megawatts (a 3x reduction from 2005).

ENERGY EFFICIENCY



PRODUCT **SAFETY** LEADERSHIP

We will publish product safety assessments for all products by 2015.

- The assessments cover topics such as basic hazards, use, risk and risk management.
- We further commit to the equivalent of REACH-like testing on all our products or product families whether they are sold directly in the European Union or not.
- Summary of product safety assessments are available to the public on www.dowproductsafety.com.
- Dow will seek third-party validation of the robustness of its product safety assessment processes, including its processes for making product stewardship decisions, and will be responsive to the feedback.

R&D – OUR **INNOVATION** ENGINE

Sustainability gives Dow's world-class scientists and engineers a target for innovation.

- $1.6 billion in R&D spending annually – more than the combined budget of all U.S. university chemistry departments ($1.4 billion)
- Over 600 research projects in our innovation pipeline
- Over 6,000 R&D professionals with specialized skills
- Deep expertise in:
  - Material science
  - Polymer science
  - Separation science
  - Analytical science
  - Biotechnology
  - Ceramics
  - Catalysis

Research	Application Development	Technical Service
Invent new molecules, materials, products and processes	Create new product and solution offerings	Service customer requests and requirements

Uses for LCA

- **Spur innovation**
  - Identify the biggest opportunity for improvement
- **Inform decisions and choices**
  - Is renewable content better? Limitations?
- **Facilitate value chain improvements**
  - Customer carbon footprint goals, etc.
- **Support marketing claims**
  - Reductions in energy, water, etc.
- **Inform product differentiation**
  - Quantify differences relative to incumbents

LCA : Some Limitations

- **Does not predict absolute impacts**
  - LCA is comparative by nature – between life cycle stages, between products
  - Potential impacts assessed – often worst case scenario
- **Cannot readily account for spatial and temporal impacts**
  - Toxicity, water scarcity, varying emissions, etc.
- **Cannot define which product is "better!"**
- **Can be time consuming – use the right tool**
  - Full ISO-compliant studies
  - Scoping studies
  - Literature reviews

LCA: Part of Sustainability

One of many tools

- LCA
- Risk Assessment
- Environmental Impact Assessment
- Social Evaluations
- Economic Analysis
- **…**

CO_2 Capture

Description

Pilot plant uses proprietary advanced-amine technology jointly developed by Dow and Alstom to capture carbon dioxide from the flue gas of a coal-fired boiler at Dow West Virginia facility.

Sustainability Profile

- Carbon capture and sequestration reduces GHG emissions from coal combustion – which represents 40 percent of the world's power generation.
- Dow and Alstom's Advanced Amine Process leads the industry in carbon capture
- The pilot plant is designed to capture 1,800 tons/year of CO_2

Algae-based CO_2 to Ethanol

Description

Dow is working with Algenol Biofuels and other contributors, to build and operate a pilot-scale algae-based integrated biorefinery that will convert CO_2 into ethanol.

Sustainability Profile

- Does not require arable land, therefore does not compete with food crops
- Algenol estimates its technology will produce 5-10 times more ethanol per acre versus first generation biofuels
- Process requires saltwater (not fresh water) and a CO_2 source
- The proposed pilot plant is expected to consume about two dry tons of CO_2 from an industrial source per day, with the expectation to produce 100,000 gallons of ethanol/year on approximately 17 acres of land

Building Integrated Photovoltaics

DOW™ POWERHOUSE™ roof shingles

- BIPV design combines roofing protection and power generation in one product
- Reduces installation costs by more than 50% compared to conventional solar modules
- Proprietary electrical connections eliminate tedious and costly on-roof wiring

Sustainability Profile

1 micron of CIGS PV semi-conductor material:

- Utilizes1/100 of the material of Si solar cells
- Consumes 1/3 of the energy to produce
- Delivers up to 20% conversion efficiency

AWARD WINNER
2010 GLOBE Foundation
"Environmental Excellence in Emerging Technology

TIME Magazine: "50 Best Inventions of 2009"

AERIFY™ DIESEL PARTICULATE FILTERS

Improved emission control & diesel engine performance

- Use of fewer raw materials
- Ability to provide a smaller packaging size

Sustainability Profile

- 30 to 50 percent lower backpressure than competing filters
- 95 percent reduction in soot emissions relative to no filter
- Diesel is 25 to 35 percent more fuel efficient than gasoline

BOOSTING DIETARY FIBER

FORTEFIBER Soluble Dietary Fiber

- Virtually odorless and tasteless, made from plant fiber
  - Can be added to variety of liquid and solid foods
  - Non-allergenic and non-fermentable when used at typical formulation levels
- Clinical trials show it helps maintain normal cholesterol, blood glucose and insulin levels

Sustainability Profile

- Potential to improve health for billions of people
- Made from renewable resource

Meeting Urban Needs for Fresh Water

FILMTEC™ Reverse Osmosis Membrane Technology

- Helps make desalination more affordable and energy-efficient
- E.g. Perth, Australia experiencing shortage of drinking water

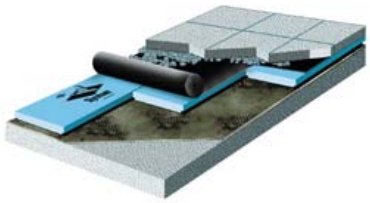
Sustainability Profile

- Technology advances have resulted in
- 3X increase in the volume of treated water
- Reduces the cost of desalination by 20 percent
- Requires 0% conventional energy sources
- Powered by wind energy: a renewable resource

Protected Membrane Roof System

Shields and protects roof's waterproof Membrane

- Uses STYROFOAM™ Insulation
  - Protects against weather, foot traffic and temperature fluctuations due to sunlight, and extreme heat and cold
  - Stays cooler than black surfaced roofs; helps reduce heat island effect



Sustainability Profile

- Energy Efficient
  - High long-term "R" Value
- Helps conserve landfill space
  - Lasts over 30 years compared to 7 to 10 for traditional; STYROFOAM™ insulation can be reused if roof is replaced

Sugar Cane to Polyethylene

Dow joint venture in Brazil

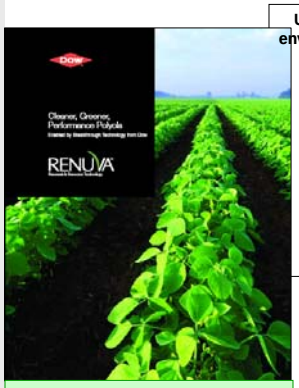
- Less fossil resources than traditional hydrocarbon processes
- Biomass (bagasse) produces heat, electricity and steam for ethanol, ethylene and polyethylene plants

Sustainability Profile

- Removes more GHGs from the atmosphere than are emitted in cradle-to-grave production of the polymer*
- Most “waste” is used in the process
- Harvesting rainwater
- Trees adjacent to fields reduce soil erosion
- Recyclable using existing infrastructure
- Contributes to economic development

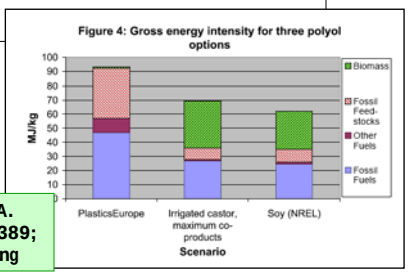
*Based on Life Cycle Assessment conducted by the Dow LCA group.

Life Cycle Assessment – Polyols from Vegetable Oils



Natural Oil Polyols Brochure

Use of life cycle assessment to characterize the environmental impacts of polyol production options



Richard K. (Rich) Helling and David A. Russell *Green* Chem., 2009, 11, 380 - 389; 2006 AIChE Presentation - Rich Helling

Industrial Stretch Film
Source Reduction & Recycling

Use 25+% less resin in last decade
- Improvements in resin design and processing
- Global market size of
  - 3 billion pounds/yr
  - This saves over 1 billion pounds per year of PE

Sustainability Profile
- Not Producing 1 billion pounds of LLDPE* saves
  - Equivalent to 293 million gallons of gasoline
  - Enough energy to heat and cool 643,000 homes for a year

* US EPA

Household Waste Water Use

Dow's Terneuzen, The Netherlands, site uses municipal household waste water
- Re-use of water previously discharged directly to the river
- Used twice at Dow

Sustainability Profile
- Almost 10 million liters of water per day
- 65% less energy than desalinating sea water with the same membrane technology
  - Equal to lowering CO2 emissions by 5,000 tons per year
  - Reduced need of chemical cleaning of membranes

Concept can be leveraged at other locations around the world

HPPO: Dow & BASF's New Propylene Oxide Process

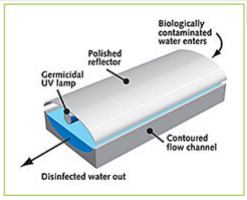
Simpler raw material integration

- Uses hydrogen peroxide and propylene
- Produces PO and water
- Avoids need for co-product markets
- Reduced physical footprint

Sustainability Profile

- Waste water reduced by 70 to 80%
- Energy use reduced by 35%
- Requires up to 25% less capital

WaterHealth International



Unique Business Model

- Total service, turn key system
- System finance/operation
- Ownership passes to village in 8 years
- Patented, low cost UV technology
- Modular systems serving 2-10 thousand people
- Close working relationship with local NGO & village government

Sustainability Profile

- Affordable water for those earning $2 per day
- Revenue stream sufficient for long term viability
- Innovative use of Dow capital to enable clean drinking water in rural areas

Broad Range of **Collaboration**

Academic

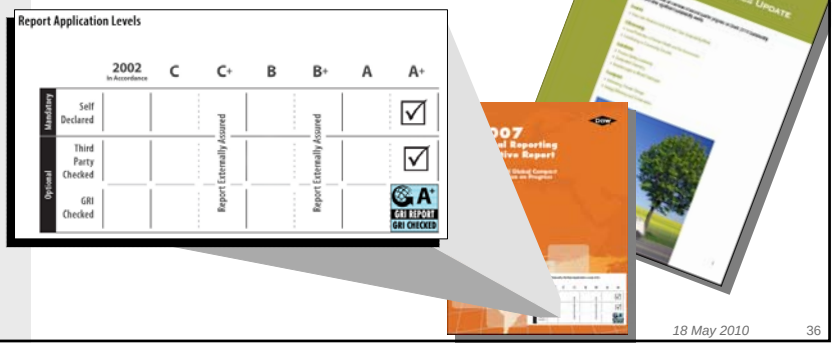
Industry

NGOs

Government

Rigorous **Reporting** Discipline

- Financial 10K
- Community
- GRI
- Sustainability Goals



SUSTAINABILITY LEADERSHIP **RECOGNITION**

6 Presidential Green Chemistry Awards - more than any other company

Named Nine Times

Dow Jones Sustainability Indexes
Member 2009/10

China's "Most Innovative Corporation" Award

MOST INNOVATIVE CORPORATION AWARD
中国杰出创新企业评选

for sustainable innovation of corporate ecosystem, CEO CIO Magazine and the Research Center for Technological Innovation

Most Innovative Corporate Social Responsibility Project

ICIS INNOVATION AWARDS2008

100 Most Technologically Significant New Products of the Year for IMPAXX™

R&D 100

Dow POWERHOUSE™ Solar Shingle #13 on TIME Magazine's **"50 Best Inventions of 2009"**

TIME

TRACK OUR **PROGRESS**

At Dow, we have always believed that the role of chemistry is to do more good in the world.

- We are committed – through chemistry – to the betterment of global humanity. And it is this commitment that drives all of our strategy for growth and profitability.
- We've set aggressive 2015 Sustainability Goals in each area of our sustainability program.
- Seen this way, the work of chemistry moves from focusing on the basics of business – products and bottom lines – to life itself.
- Track our progress at www.dow.com/commitments

RESPONSIBILITY BEGINS HERE

"**Sustainability** begins at home, but its destiny is to engage the problems of the world. We will build on our company's rich legacy of leadership in solving the world's most pressing problems."

- Andrew Liveris,
Chairman & CEO
The Dow Chemical Company

THANK YOU.

References to "Dow" mean The Dow Chemical Company and its consolidated subsidiaries unless otherwise expressly noted

ACS Chemistry for Life™

Q&A SESSION
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Please submit your questions for the speaker via the Questions Panel in GoToWebinar

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ACS Chemistry for Life™

Upcoming Event:
May 27, 2010. 2-3pm ET

"*Knowing Your Worth: Strategies to Negotiate for Salary or Pay for Chemical Professionals*" with Meredith Dow, PROVEN Inc.

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