Polystyrene in Food Service: Problems and Alternatives

November 18, 2010

Presented by

BRENDA PLATT, INSTITUTE FOR LOCAL SELF-RELIANCE
SUSTAINABLE BIOMATERIALS COLLABORATIVE

Moderated by

Practice Greenhealth

Learning Objectives

- What's wrong with polystyrene for food service ware?
- Compostable biobased alternatives
- Understanding difference between biobased vs biodegradable vs compostable
- Benefits of composting
- Programs utilizing compostable products
- Do biobased products make sense if you can't compost?
- Compostable alone ≠ sustainable
- Criteria for environmentally preferable biobased food service ware

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Petro-Plastic Woes

- Non-renewable (geological timeframes to produce but consume in 1 to 10 years)
- Generally nonbiodegradable with devastating affects on ocean life
- Demand and production skyrocketing
- Plastics industry supports more drilling
- Recycling and reuse low
- Health impacts (polymers differ)

Agalita Marine Research Foundation

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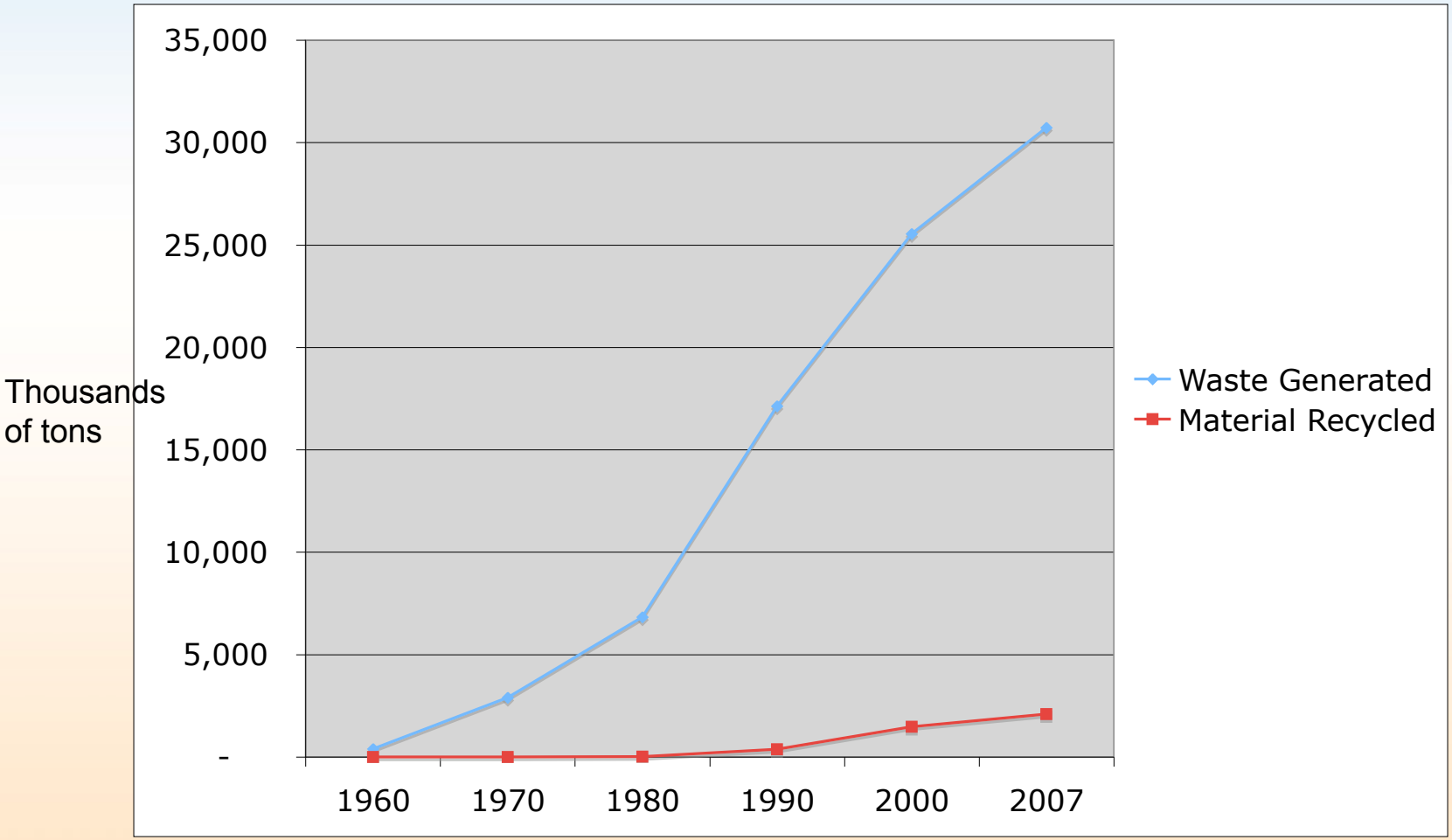
Plastics Recycling: Failure?



Source: US EPA, 2007 data (http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm)

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Plastics Recycling Low

	Generation (thousand tons)	Recycling (thousand tons)	Recycling Level (percent by weight)
PET	2,860	540	18.9%
HDPE	5,890	520	8.8%
PVC	1,640		0.0%
LDPE/LLDPE	6,450	190	2.9%
PP	4,000	10	0.3%
PS	2,590		0.0%
Other resins	5,480	390	7.1%
Total Plastics in MSW	**28,910**	**1,650**	**5.7%**

Source: US EPA, 2005 data

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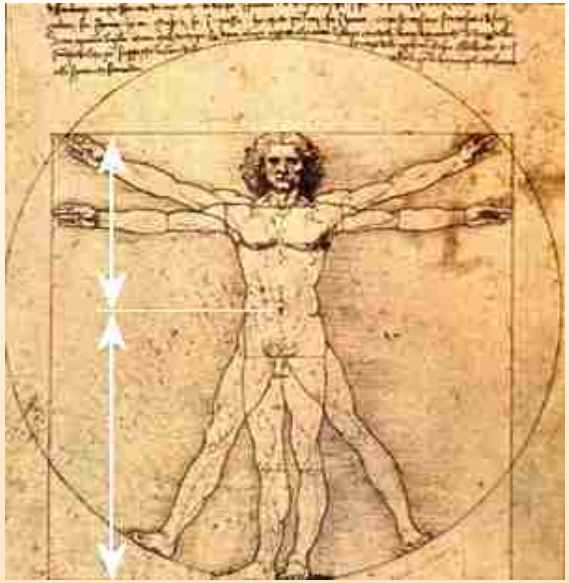
How Exposure to Polystyrene Affects the Human Body



- Polystyrene in made from the monomer styrene (vinyl benzene)
- Styrene remains present in polystyrene (no polymerization process is 100% efficient)
- Styrene = a neurotoxin and suspected human carcinogen
- Styrene impairs the central and peripheral nervous systems.
- Exposure to styrene in the workplace has also been associated with chromosomal aberrations, thus is considered a mutagen.
- Carcinogenic Effects: Proven that it causes cancer in animals, but there are no long-term studies showing that PS causes cancer in humans.

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Styrene Leaches into Food

"The ability of styrene monomer to migrate from polystyrene packaging to food has been reported in a number of publications and probably accounts for the greatest contamination of foods by styrene monomer."

World Health Organization

Styrene Chapter, *Air Quality Guidelines-2nd Edition*, WHO Regional Office for Europe, Copenhagen, Denmark, 2000

http://www.euro.who.int (search "Chapter 5.12 Styrene")

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Reference Sites on Health Impacts

World Health Organization information on styrene: http://www.euro.who.int
(search "Chapter 5.12 styrene")

OSHA web site on styrene: http://www.osha.gov/SLTC/styrene/index.html

EPA's Air Toxics web site on styrene: http://www.epa.gov/ttn/atw/hlthef/styrene.html

Toxipedia web site on styrene: http://toxipedia.org/display/toxipedia/Styrene

Healthy Child web site on styrene: http://healthychild.org/issues/chemical-pop/styrene/

J.R. Whithey, "Quantitative Analysis of Styrene Monomer in Polystyrene and Foods," Environmental Health Perspectives, Vol. 17, pp. 125-1.53, 1976:
http://www.mindfully.org/Plastic/Polystyrene/Polystyrene-Foods-Styrene-Monomer.htm

Firefighters With Parkinsons:
http://www.firefighterswithparkinsons.net/index.cfm?section=10&pagenum=208.

Toxicity information on polystyrene leaching:
www.ourstolenfuture.org/NewScience/oncompounds/styrene/2001ohyamaetal.htm

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More resources

Health Effects of Styrene and Benzene on Humans:
http://search.ca.gov/search?q=polystyrene%2C+health+effects&btnG=Search+OEHHA&entqr=0&output=xml_no_dtd&sort=date%3AD%3AL%3Ad1&client=ca_oehha&ud=1&spell=1&oe=UTF-8&ie=UTF-8&proxystylesheet=ca_oehha&site=ca_oehha

Chemical & Carcinogen Breakdown of Styrene:
http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s165styr.pdf

Extensive Scientific Studies on Mice/Rats, and Human Case Studies in regards to inhalation and exposure:
U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances & Disease Registry:
(http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=421&tid=74)

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Benefits of Biobased Alternatives

- Can replace many harmful conventional plastics
- Can be fully biodegradable (capable of being utilized by living matter)
- Can be made from a variety of renewable resources
- Can be composted locally into a soil amendment
- Can help capture food discards
- Can contribute to healthier rural economies
- Can complement zero waste goals

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Degradable Vs. Biodegradable

Degradable

- May be invisible to naked eye
- Fragment into smaller pieces
- No data to document biodegradability within one growing season
- Migrate into water table
- Not completely assimilated by microbial populations in a short time period

Biodegradable

- Completely assimilated into food and energy source by microbial populations in a short time period
- Meet biodegradability standards

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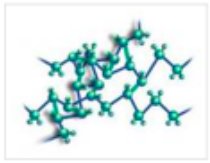
Biodegradable vs. Biobased

MONDAY, JUNE 25, 2007

The bioeconomy at work: Braskem develops polyethylene from sugarcane ethanol



Braskem, the leading company in Latin America's thermoplastic resins segment and Brazil's second largest privately owned industrial company, announces it has produced the first internationally certified polyethylene made from sugarcane ethanol. Given the fact that petroleum-derived polyethylene is so widely used in our daily lives, this may be called an important breakthrough for the bioeconomy. 60 million tonnes per year of the polymer end up in hundreds of plastic products. We now have a bio-based, renewable alternative with a low carbon footprint.

Brazil has been ahead of most other countries in the development of a genuine bioeconomy in which oil-based products are replaced by renewable carbohydrate and vegetable oil based substitutes. Government initiative (with a fund of almost US$5 billion for the bioeconomy) as well as an innovative private sector that is being supported by a growing number of

Dow and Crystalsev Announce Plans to Make Polyethylene from Sugar Cane in Brazil

Renewable Resource Used in Production Process Will Significantly Re Footprint

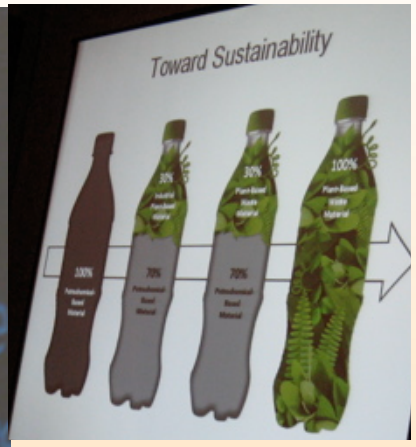
(CSRwire) SAO PAULO, BRAZIL - July 24, 2007- The Dow Chemical Company, the world's large polyethylene, and Crystalsev, one of Brazil's largest ethanol players have announced plans for a wo manufacture polyethylene from sugar cane.

Under the terms of a memorandum of understanding agreed by the two companies, Dow and Crysta venture in Brazil to design and build the first integrated facility of its scale in the world. It is expecte in 2011 and will have a capacity of 350,000 metric tons. The venture will combine Dow's leading po with Crystalsev's know-how and experience in ethanol to meet the needs of Dow's customers in Brai be international interest.

"We are excited to partner with a great company like Crystalsev to build the first world-scale polyet will use a renewable feedstock," said Andrew Liveris, chairman and CEO of Dow. "This project is how Dow's innovation and industry leadership are creating outstanding opportunities to drive forwa agenda in a way that fully supports our 2015 Sustainability Goals commitments."

The new facility will use ethanol derived from sugar cane, an annually renewable resource, to prod raw material required to make polyethylene, the world's most widely-used plastic. Ethylene is traditi either naphtha or natural gas liquids, both of which are petroleum products. It is estimated that the n produce significantly less CO2 compared to the traditional polyethylene manufacturing proces

"This joint venture will provide Crystalsev with an excellent opportunity to diversify its busine development of value-added products made from ethanol as part of an environmentally sustai Lacerda Ferraz, president of Crystalsev. "This project will bring the optimization of synergies and professional growth opportunities. For such an important enterprise, we could not have fo Dow, the global leader in the polyethylene market and a company that works with state-of-the



Non-biodegradable biobased plastics are here

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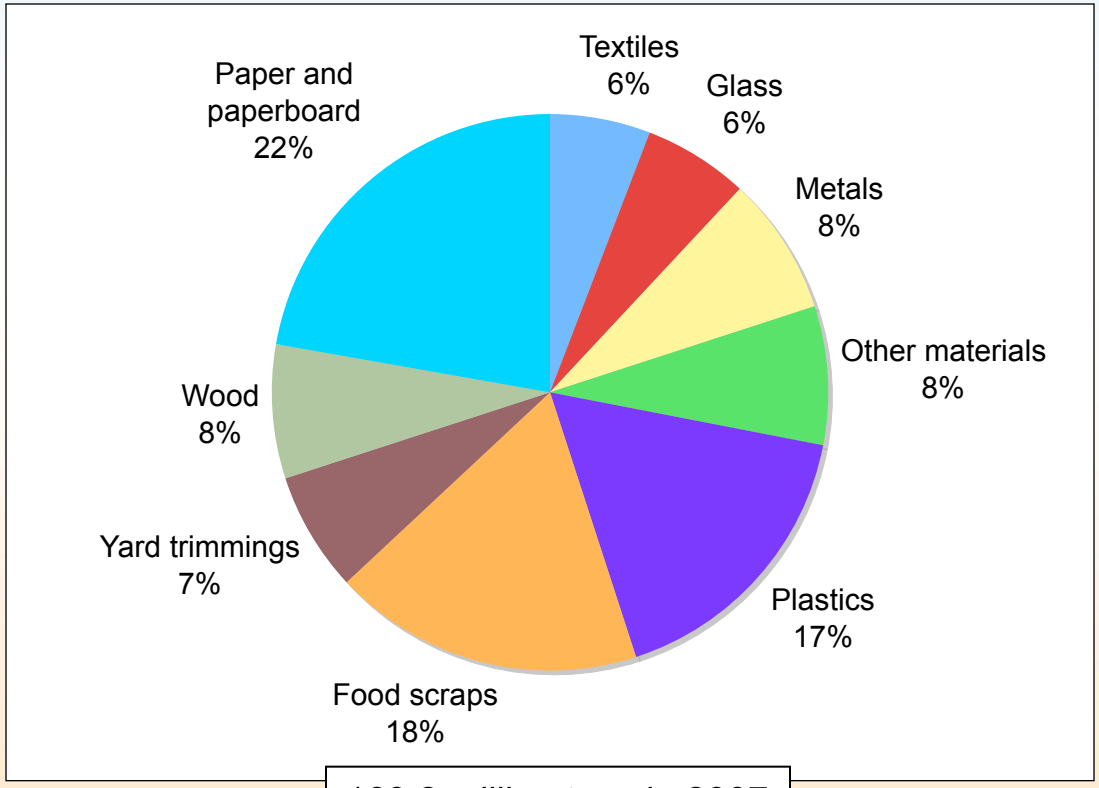
U.S. municipal waste disposed



169.2 million tons in 2007

Source: US EPA, 2007 data (http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm)

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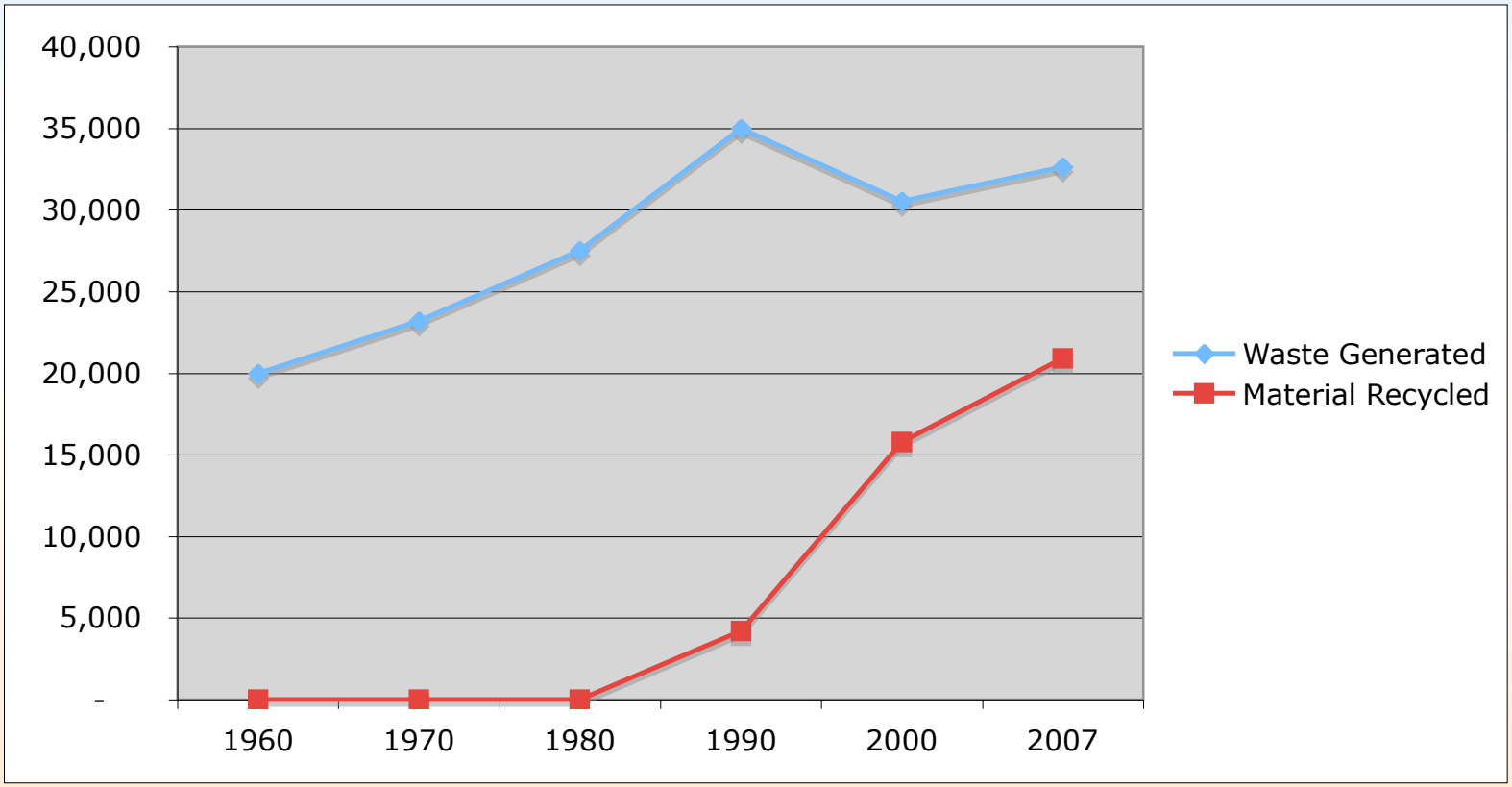
Creates a rich nutrient-filled material, humus,
Increases the nutrient content in soils,
Helps soils retain moisture,
Reduces or eliminate the need for chemical fertilizers,
Suppresses plant diseases and pests,
Promotes higher yields of agricultural crops,
Helps regenerate poor soils,
Has the ability to cleanup (remediate) contaminated soil,
Can help prevent pollution and manage erosion problems.
BLACK GOLD

Composting: A Success Story

Yard Debris,

Thousands of tons



Source: US EPA, 2007 data (http://www.epa.gov/epaoswer/non-hw/muncpl/msw99.htm)

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Composting, lots of models

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The Good News on Biobased Alternatives

- Variety of resins available
- Performance improving
- Experience and R&D growing
- Growth expected
- Programs such as the federal biobased procurement will open up new markets
- Standards in place
- Price competitiveness improving
- Demand increasing

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Boulder Farmers' Market

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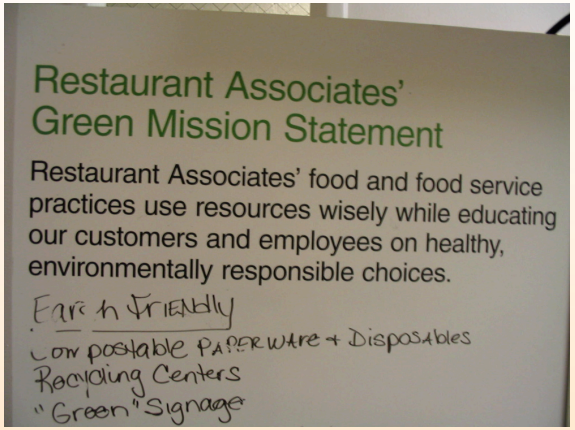
Green the Capitol Initiative



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Whole Foods

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Communities with Polystyrene Restrictions

California:

- Berkeley
- City of Calabasas
- City of Capitola
- Emeryville
- Huntington Beach
- City of Laguna Woods
- Malibu
- Monterey
- Mill Valley
- Millbrae
- Newport Beach
- Oakland
- Pacific Grove
- Palo Alto
- Richmond
- City of San Clemente
- San Francisco
- San Mateo County
- Santa Cruz County
- Santa Monica
- Sonoma County
- Ventura County

Other:

- Freeport, Maine
- Portland, Oregon
- Seattle, Washington
- Takoma Park, Maryland

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San Francisco: Aiming for Zero Waste

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Color-coded compostable design for 400k at SF Festival

Photos courtesy of City of San Francisco

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Seattle: Compostable Food Service Ware

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Biomaterial – Wonder Material?

- "renewable"
- "green
- "eco-friendly"
- "sustainable"
- "environmentally neutral"
- "safe and better"
- "easy on the environment"
- "return to nature without a trace"

Compostability alone ≠ sustainable

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Not All Bioproducts Created Equal

- Biobased content
- Material feedstock type
- Feedstock location
- Biodegradability
  - Commercial compost sites
  - Home composting
  - Marine environment
  - Anaerobic digestion
- Additives and blends
- Recyclability
- Performance
- Products

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Challenges with Biobased Products

- Concern over genetically modified organisms (GMOs)
- Desire for sustainably grown biomass
- Need to develop adequate composting programs
- Concern with nanocomposites and fossil-fuel-plastic blends
- Lack of adequate labeling
- Concern over contamination of recycling systems

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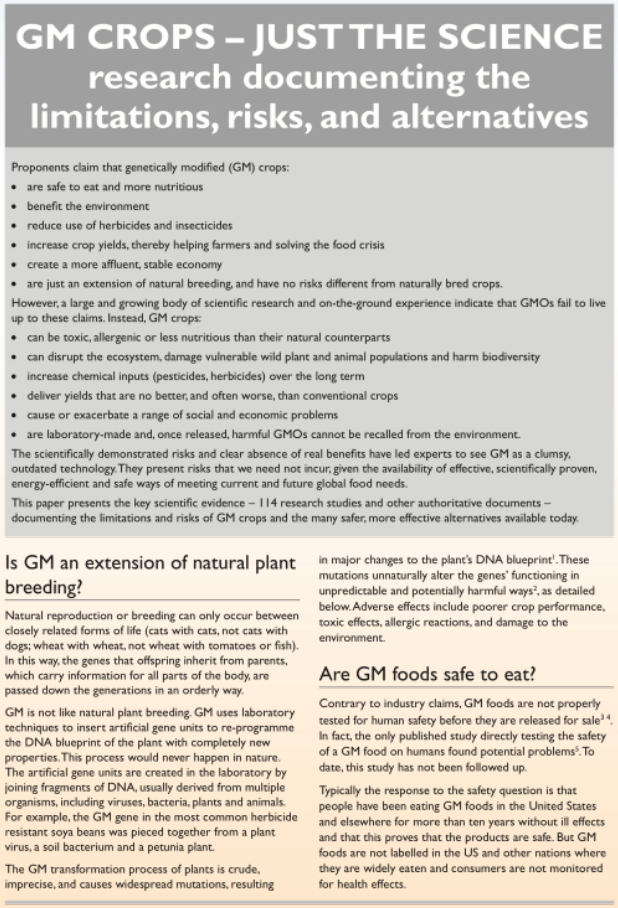
Genetically Modified Crops



GM CROPS – JUST THE SCIENCE
research documenting the limitations, risks, and alternatives

Proponents claim that genetically modified (GM) crops:

- are safe to eat and more nutritious
- benefit the environment
- reduce use of herbicides and insecticides
- increase crop yields, thereby helping farmers and solving the food crisis
- create a more affluent, stable economy
- are just an extension of natural breeding, and have no risks different from naturally bred crops.

However, a large and growing body of scientific research and on-the-ground experience indicate that GMOs fail to live up to these claims. Instead, GM crops:

- can be toxic, allergenic or less nutritious than their natural counterparts
- can disrupt the ecosystem, damage vulnerable wild plant and animal populations and harm biodiversity
- increase chemical inputs (pesticides, herbicides) over the long term
- deliver yields that are no better, and often worse, than conventional crops
- cause or exacerbate a range of social and economic problems
- are laboratory-made and, once released, harmful GMOs cannot be recalled from the environment.

The scientifically demonstrated risks and clear absence of real benefits have led experts to see GM as a clumsy, outdated technology. They present risks that we need not incur, given the availability of effective, scientifically proven, energy-efficient and safe ways of meeting current and future global food needs.

This paper presents the key scientific evidence – 114 research studies and other authoritative documents – documenting the limitations and risks of GM crops and the many safer, more effective alternatives available today.

Is GM an extension of natural plant breeding?

Natural reproduction or breeding can only occur between closely related forms of life (cats with cats, not cats with dogs; wheat with wheat, not wheat with tomatoes or fish). In this way, the genes that offspring inherit from parents, which carry information for all parts of the body, are passed down the generations in an orderly way.

GM is not like natural plant breeding. GM uses laboratory techniques to insert artificial gene units to re-programme the DNA blueprint of the plant with completely new properties. This process would never happen in nature. The artificial gene units are created in the laboratory by joining fragments of DNA, usually derived from multiple organisms, including viruses, bacteria, plants and animals. For example, the GM gene in the most common herbicide resistant soya beans was pieced together from a plant virus, a soil bacterium and a petunia plant.

The GM transformation process of plants is crude, imprecise, and causes widespread mutations, resulting in major changes to the plant's DNA blueprint[1]. These mutations unnaturally alter the genes' functioning in unpredictable and potentially harmful ways[2], as detailed below. Adverse effects include poorer crop performance, toxic effects, allergic reactions, and damage to the environment.

Are GM foods safe to eat?

Contrary to industry claims, GM foods are not properly tested for human safety before they are released for sale[3,4]. In fact, the only published study directly testing the safety of a GM food on humans found potential problems[5]. To date, this study has not been followed up.

Typically the response to the safety question is that people have been eating GM foods in the United States and elsewhere for more than ten years without ill effects and that this proves that the products are safe. But GM foods are not labelled in the US and other nations where they are widely eaten and consumers are not monitored for health effects.

- Can be toxic, allergenic or less nutritious than their natural counterparts
- Can disrupt the ecosystem, damage vulnerable wild plant and animal populations and harm biodiversity
- Increase chemical inputs (pesticides, herbicides) over the long term
- Deliver yields that are no better, and often worse, than conventional crops
- Cause or exacerbate a range of social and economic problems
- Are laboratory-made and, once released, harmful GMOs cannot be recalled from the environment.

Source: http://www.nongmoproject.org/

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What We Put Into Corn…

- Average of over 120 lbs. nitrogen fertilizer per acre
- Among the highest levels of herbicide and pesticide use for conventional crops
- Irrigation water
- Proprietary hybrids

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Institute for Agriculture and Trade Policy

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Sustainable Biomaterials Collaborative

The Sustainable Biomaterials Collaborative is a network of organizations working together to spur the introduction and use of biomaterials that are sustainable from cradle to cradle. The Collaborative is creating sustainability guidelines, engaging markets, and promoting policy initiatives.

As You Sow
Center for Health, Environment and Justice
Clean Production Action *
Environmental Health Fund *
Green Harvest Technologies
Health Care Without Harm
Healthy Building Network
Institute for Agriculture and Trade Policy *
Institute for Local Self-Reliance*
Lowell Center for Sustainable Production *
Sustainable Research Group
Pure Strategies
RecycleWorld Consulting
Science & Environmental Health Network
Seventh Generation
National Campaign for Sustainable Ag.

* Steering committee

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Survey Data: feedstock types and sources

- China
  - Bulrush
  - Bagasse
  - PSM (Plastarch Material)
  - Corn
  - Chinese PLA
  - PHBV*
  - PBS**
  - Cornstarch
- India
  - Fallen palm leaves
- Thailand/Vietnam
  - Tapioca starch
  - Grass fiber
  - Bagasse
- Malaysia
  - Palm fiber
- USA
  - NatureWorks PLA
  - "Natural total chlorine-free pulp"
  - Recycled wood fiber

*polyhydroxybutyrate-polyhydroxyvalerate

**polybutylene succinate (petrochemical + succinic acid)

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Path from Field to Producer

"The source product is from Brazil,
then turned into cornstarch in China,
then the starch is used in
our manufacturer's facility."

Feedstocks grown in Midwestern US.
Manufacture the resin
in Hawthorne, CA today,
but plan to manufacture
in Seymour, IN shortly."

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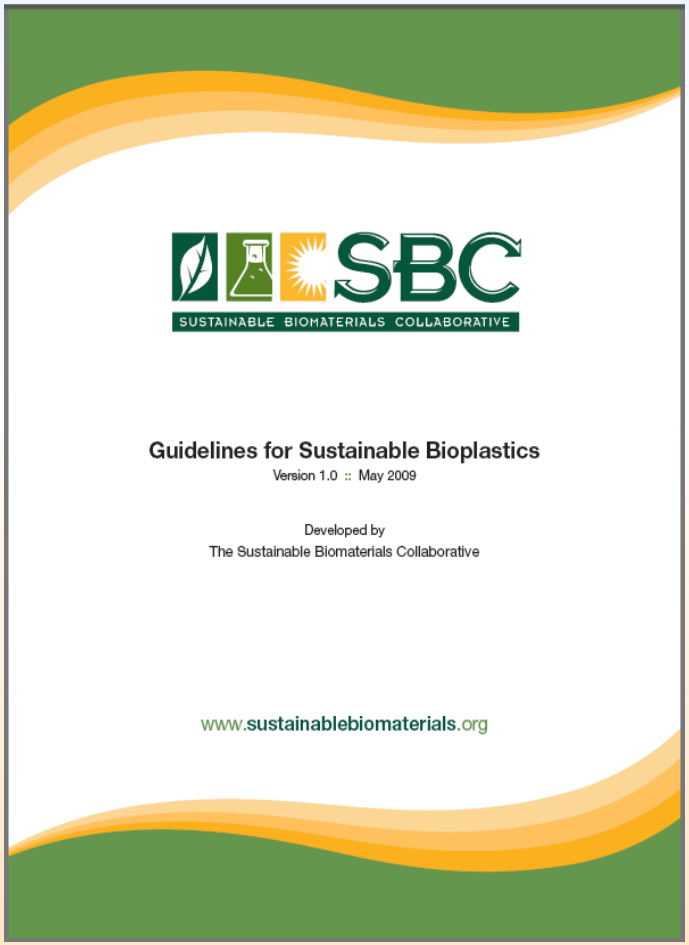
Defining Sustainable Life Cycles by Principles

- Sustainable feedstocks / Sustainable agriculture
- Green Chemistry / Clean Production
- Closed Loop Systems / Cradle to Cradle / Zero Waste



"Just because it's biobased, doesn't make it green"

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Biomass Feedstock

- Avoid hazardous chemicals
- Avoid GMOs
- Conserve soil & nutrients
- Biological diversity
- Sustainable agriculture plan
- Protect workers

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Manufacturing

- Support sustainable feedstock
- Reduce fossil energy use
- Avoid problematic blends & additives
- Avoid untested chemicals and engineered nano particles
- Design for recycling & composting
- Maximize process safety/reduce emissions
- Green chemistry
- Protect workers

End of Life

COMPOSTABLE
Biodegradable Products Institute | US COMPOSTING COUNCIL

- Compostable or recyclable
- Biodegradable in aquatic systems
- Adequate product labeling
- Adequate recovery infrastructure

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Development of Specifications

BioSpecs for Food Service Ware

Environmentally Preferable Purchasing Specifications for Compostable Biobased Food Service Ware

Version 1.0 :: September 2010

Developed by

Sustainable Biomaterials Collaborative

The Business-NGO Working Group

www.sustainablebiomaterials.org

Recognition Levels

- Bronze
  - → Baseline Criteria
  - → Easily Verifiable Criteria
- Silver
- Gold
  - → Highest Level
  - → More challenges to Verify Criteria

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Criteria: Biomass Production

Criteria	Recognition Level
Biobased (organic) carbon content	
Product must be >90%	Bronze
Product must be >99%	Silver
Genetically Modified Plants	
No plastics may be made directly in plants	Bronze
GM crops allowed in field with offsets	Bronze
No GM biomass allowed in field	Silver
Sustainably grown biomass	
Forest and brushland-derived biomass	Bronze
Agricultural crop biomass	Gold
Protection of biomass production workers	Gold

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FSC

OK biobased VINÇOTTE

WLC WORKING LANDSCAPES CERTIFICATE

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Criteria: Manufacturing

Criteria	Recognition Level
Wood- or fiber-based products	
Non-food-contact products: 100% recycled, 40% PCR	Bronze
Cups: 10% PCR content	Silver
Other food-contact products: 45% recycled content	Bronze
No organohalogens added	Bronze
Additives and Contaminants of High Concern	
Declare whether nanomaterials present	Bronze
No additives that are chemicals of high concern	Bronze
No engineered nano without health risk assessment	Silver
All additives must be tested	Gold
No chlorine or chlorine compounds	Silver
Protection of biomass production workers	Gold
Local ownership and production	Gold

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Criteria: End of Life

Criteria	Recognition Level
Product must be 100% commercially compostable	Bronze
Product labeled for compostability	
"Commercially Compostable" if facility exists	Bronze
Verification logo on product	Bronze
Clearly compostable	Bronze
Additional labeling if facility does not exist	Bronze
100% backyard or home compostable	Silver
100% biodegradable in aquatic environment	
Marine biodegradable	Gold
Freshwater biodegradable	Gold

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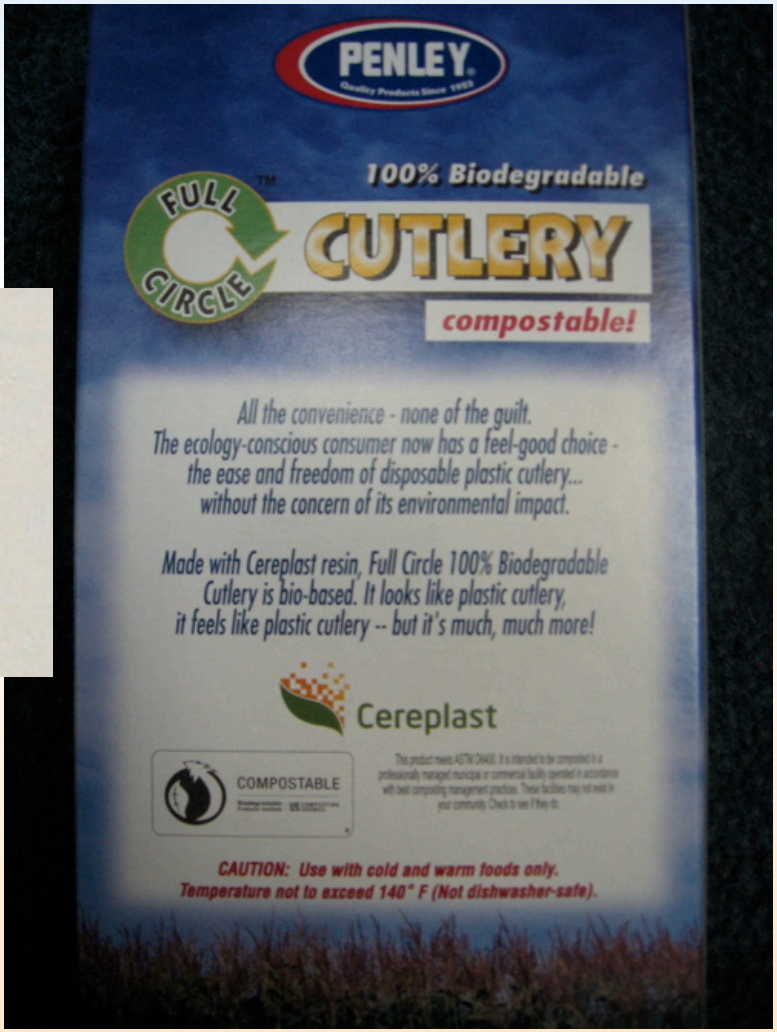
What if you don't have access to composting?

This product meets ASTM D6400. It is intended to be composted in a professionally managed municipal or commercial facility operated in accordance with best composting management practices. These facilities may not exist in your community. Check to see if they do.



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Next Steps

- Vetting Products
  - → Manufacturers submit products for review
  - → Beta-test Products
- Work with purchasers to beta-test bid specs
- Expand working landscape certificates

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Questions?

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