

# Facts and Fiction around Ingeo™ Biopolymer

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The Pieces of Zero Waste: Compostable Bioplastics,  
certification, labeling and food service composting

Presented by:

City of Santa Monica, Office of Sustainability and the  
Environment Global Recycling Council (CRRRA) and Earth  
Resource Foundation



## Ingeo™ is NOT:

### Oxo-Biodegradable Plastics:

Plastic which degrades by a process of Oxo-degradation.

The technology is based on a very small amount of pro-degradant additive being introduced into the manufacturing process, thereby changing the behavior of the plastic.

Degradation begins when the programmed service life is over (as controlled by the additive formulation) and the product is no longer required.

### Additives with Organic Materials:

Contain biodegradable components. The additive itself will biodegrade and generate carbon dioxide. The biodegradable portion of the additive pellets can be natural materials, such as cellulose and starch or it can consist of resins, which are known to biodegrade, such as EVA or PVOH.





Carbon dioxide and water



sugar (dextrose)



ingeo™



manufacturing



Converter Partners

Further future improvements associated with:

- Production using new carbohydrate feedstock
- Further process optimization
- On site renewable energy (e.g. wind, biomass)
- Plant II

**FUTURE**  
Long term

**Implementing  
Now**  
Ingeo 2009

Ingeo 2009 represents the “Next Generation”, cradle-to-pellet Ingeo production system:

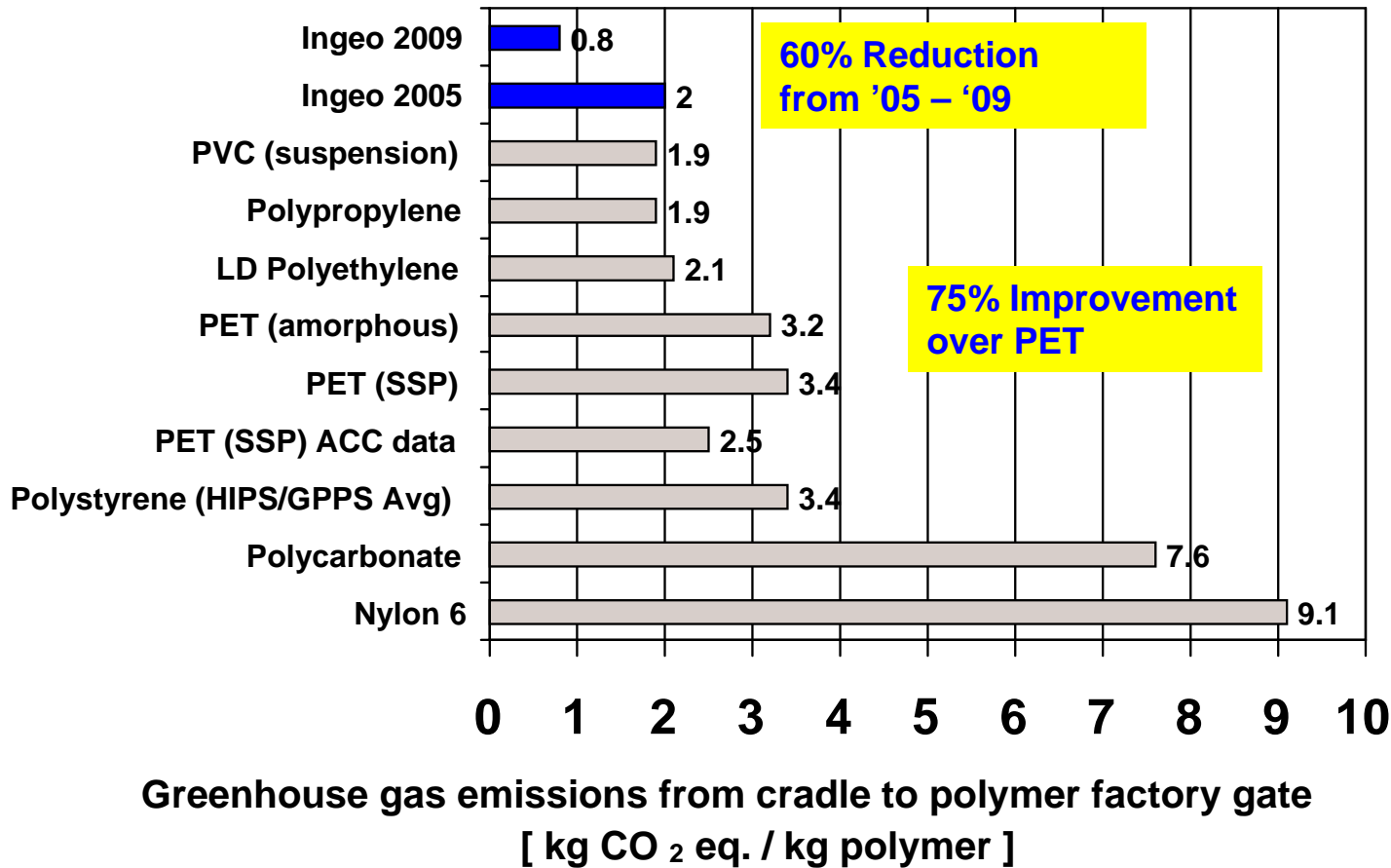
- Based on a package of technology improvements, e.g. new lactic acid technology.
- Implementation started in 2009.

**PAST**  
Ingeo in 2005

We created an entirely new production system for polymers based on renewable resources. **Ingeo 2005** represents the 2005 cradle-to-pellet Ingeo production system (= the benchmark).



# Comparing Environmental Footprint: Greenhouse Gas Emissions

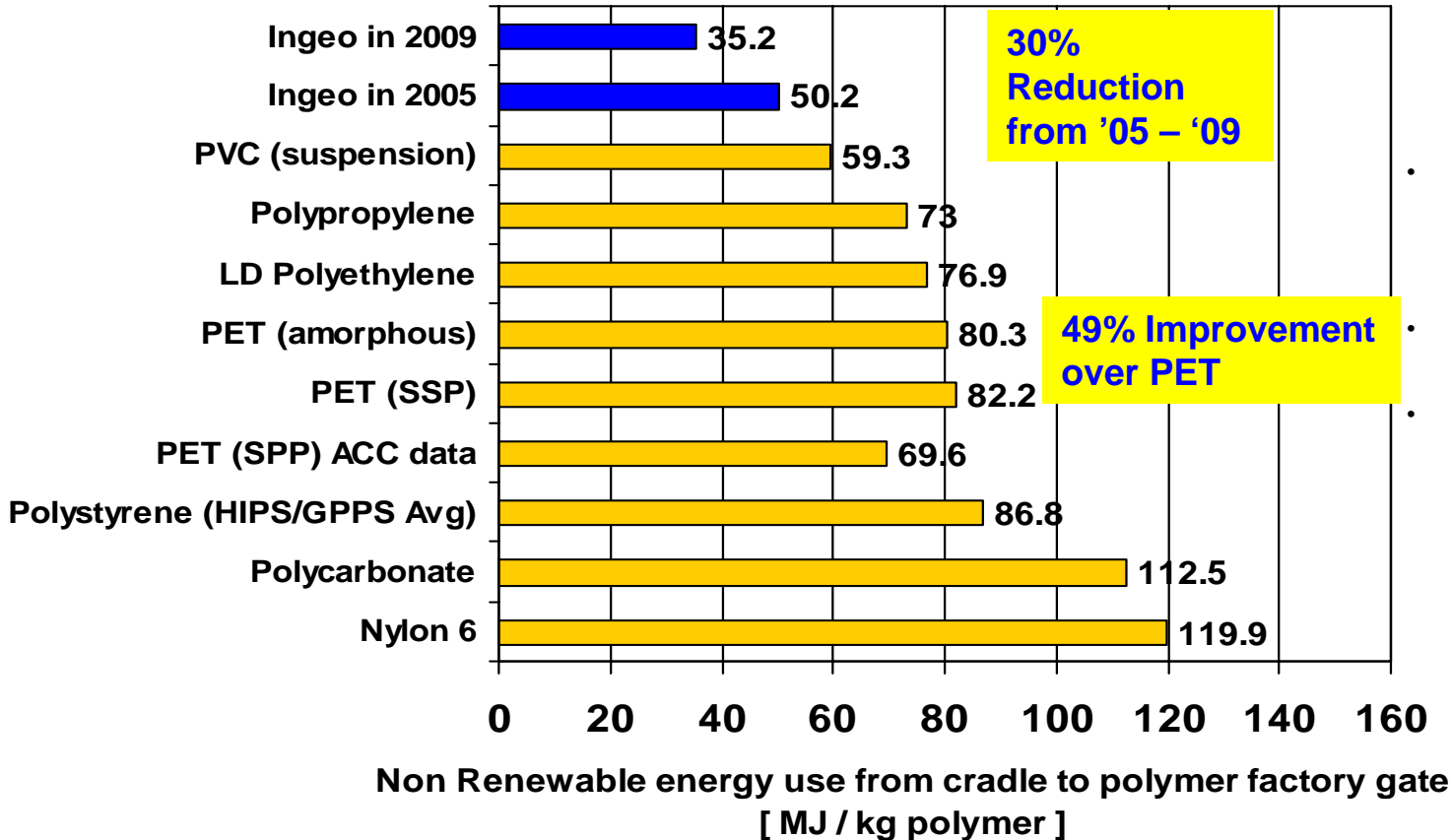


- Ingeo: Vink E.T.H. et al. The eco-profiles for current and near-future NatureWorks® polylactide (PLA) production. Industrial Biotechnology, Volume 3, Number 1, 2007, Page 58-81.
- Fossil based polymers: *PlasticsEurope*; [www.lca.plasticseurope.org](http://www.lca.plasticseurope.org)
- Classification factors used for Climate Change  
Guinee J.B., Handbook on Life Cycle Assessment, Kluwer Academic Publishers.

PET (SSP) ACC data: M. Binder, Technical Director, PE Americas;



# Comparing Environmental Footprint: Non-renewable Energy Requirements

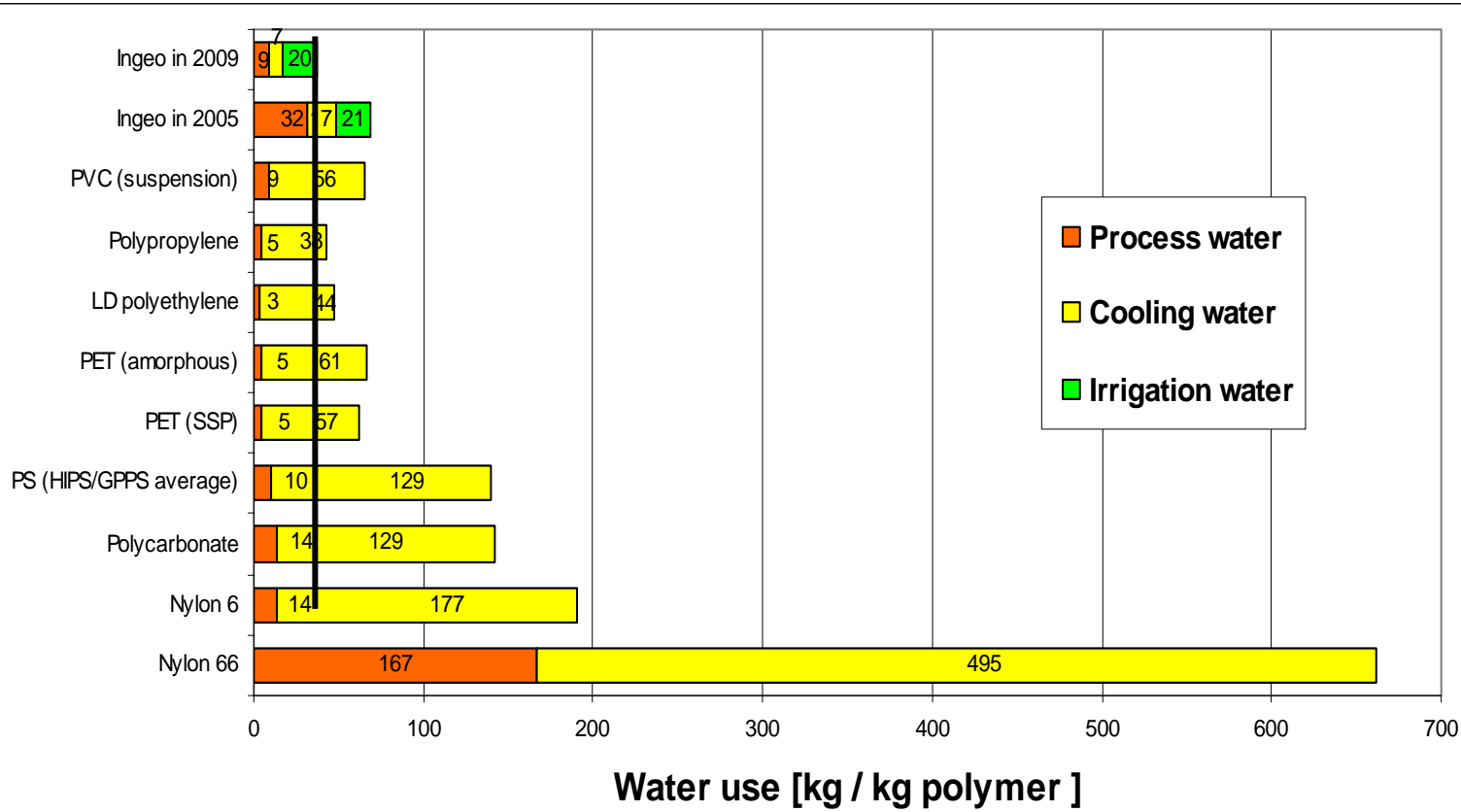


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# Comparing Environmental Footprint: Total water use



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Fossil based polymers:  
 PlasticsEurope;  
[www.lca.plastics europe.org](http://www.lca.plastics europe.org)



# Corn in North America



140,000 ton Ingeo/year



How do corn supply & Ingeo demand compare?



~25%  
for  
ethanol



< 0.2% for  
Ingeo

– Our footprint is small: At full capacity, Ingeo represents:

- < 0.2 % of 2007 US corn production (< .05 % of global corn production)

## Perspective on GM Feedstocks

- ***NatureWorks does not need GM raw materials (plants) to make Ingeo™ and there is no genetic material in the finished product.***
- ***NatureWorks is committed to innovation***
  - We're working with the industry today to explore various options for future feedstock sources
- ***NatureWorks gives consumers choices today***

### ***Three tiered customer source option program:***

- 1. Certification***
- 2. Source Offset***
- 3. Identity Preserved Option***



## Alternative (Biomass) Feedstocks

- Current feedstock is corn starch from a wet mill.
- Next Generation, non-feed/food, feedstocks are already being driven by biofuels
- US Biofuels mandates call for alternative feedstocks with reduced GHG
- NatureWorks is positioned to take advantage of these new feedstocks

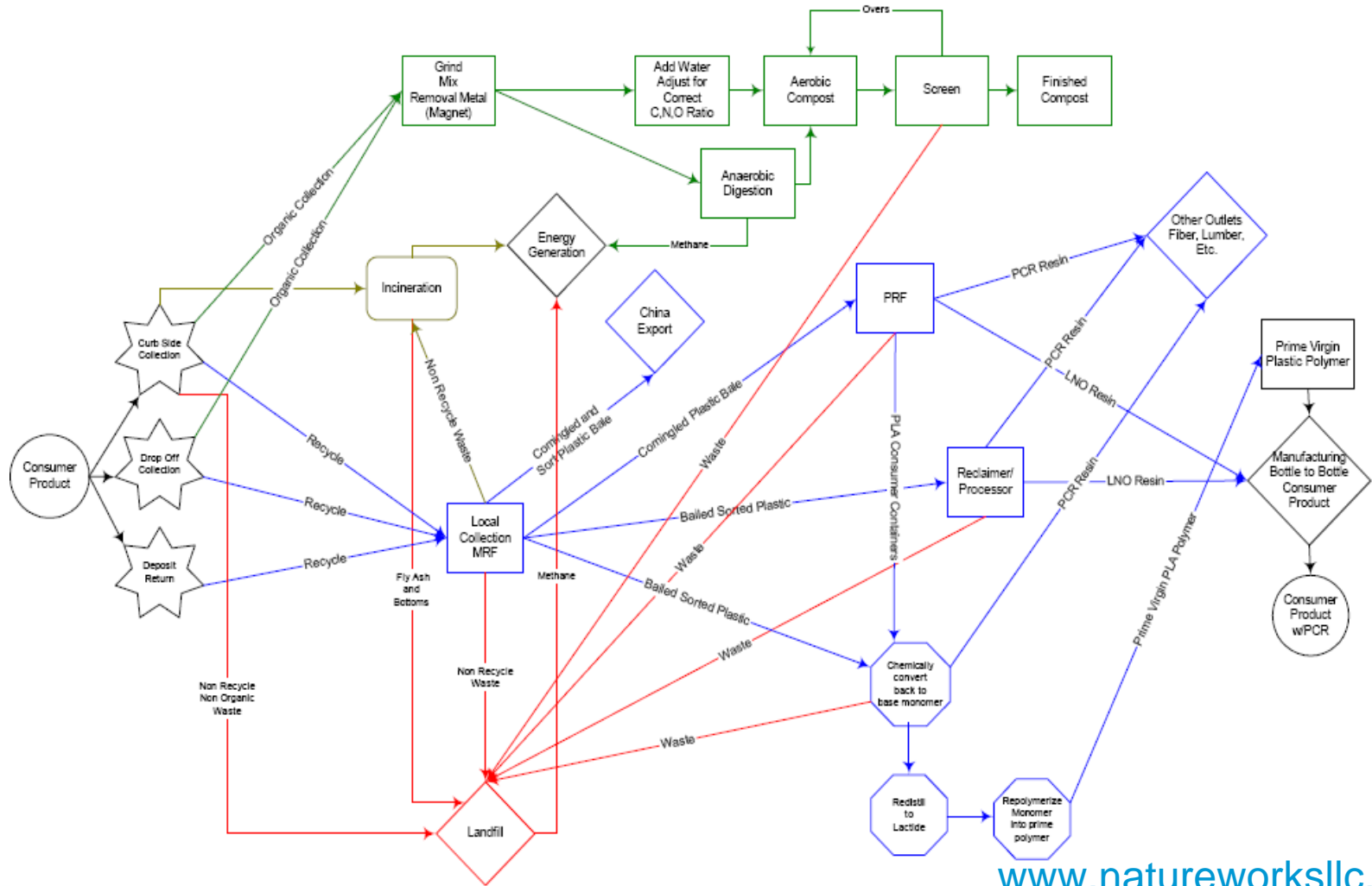


## Ingeo End of Life Vision

- Maintain a journey to **zero-waste**.
- Keep Ingeo in any form **out of landfills**.
- **Composting** is desirable for **food contaminated** Ingeo packaging, thus facilitating green waste diversion from a landfill.
- **Recovery** as a **bottle** for use in the same application or higher use applications whenever possible.
- The ideal for an Ingeo bottle is **recycling** through **hydrolysis** back to lactic acid, with further processing back to virgin Ingeo resin.
- Leveraging future **innovation, technology** and **education** to build a bridge to a better choice for our planet, our business and a better way of life.



# The Complexity of Waste Management



[www.natureworksllc.com](http://www.natureworksllc.com)



## Scenarios for Ingeo™ products

1. Landfill: Throwing away raw materials and energy.
2. Anaerobic digestion: Advanced biodegradation with energy recovery.
3. Incineration w/ heat recovery: Mixed plastics fraction used as a fuel.
4. Mechanical recycling: bottles: reuse of materials.
5. Feedstock recovery: All packaging/applications recycled back to lactic acid.
6. Composting: Food and green diversion from a landfill

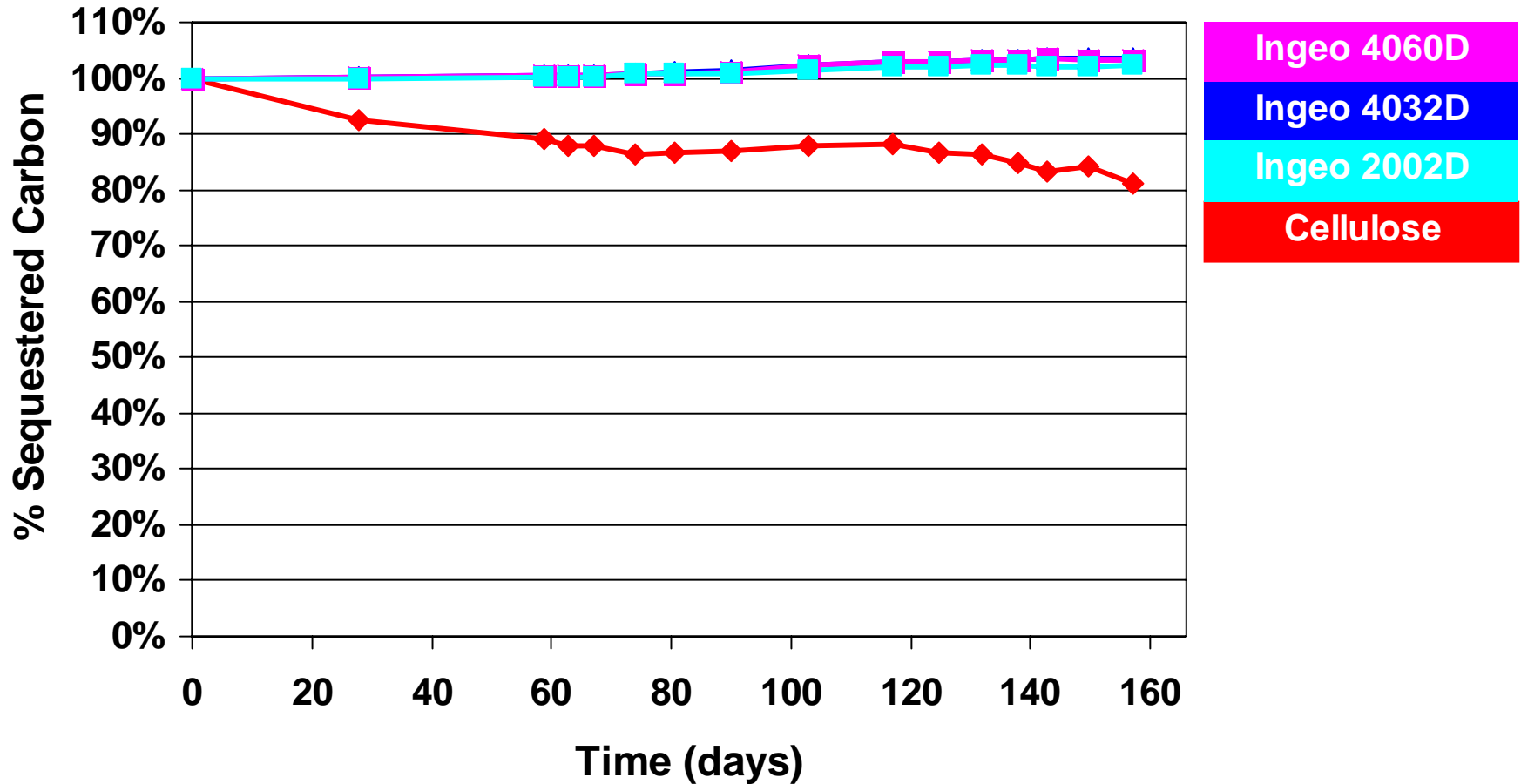


•Landfill practices in the US: regulation by the EPA.

•Where do Ingeo™ products fit in?

•The OWS modeling studies.

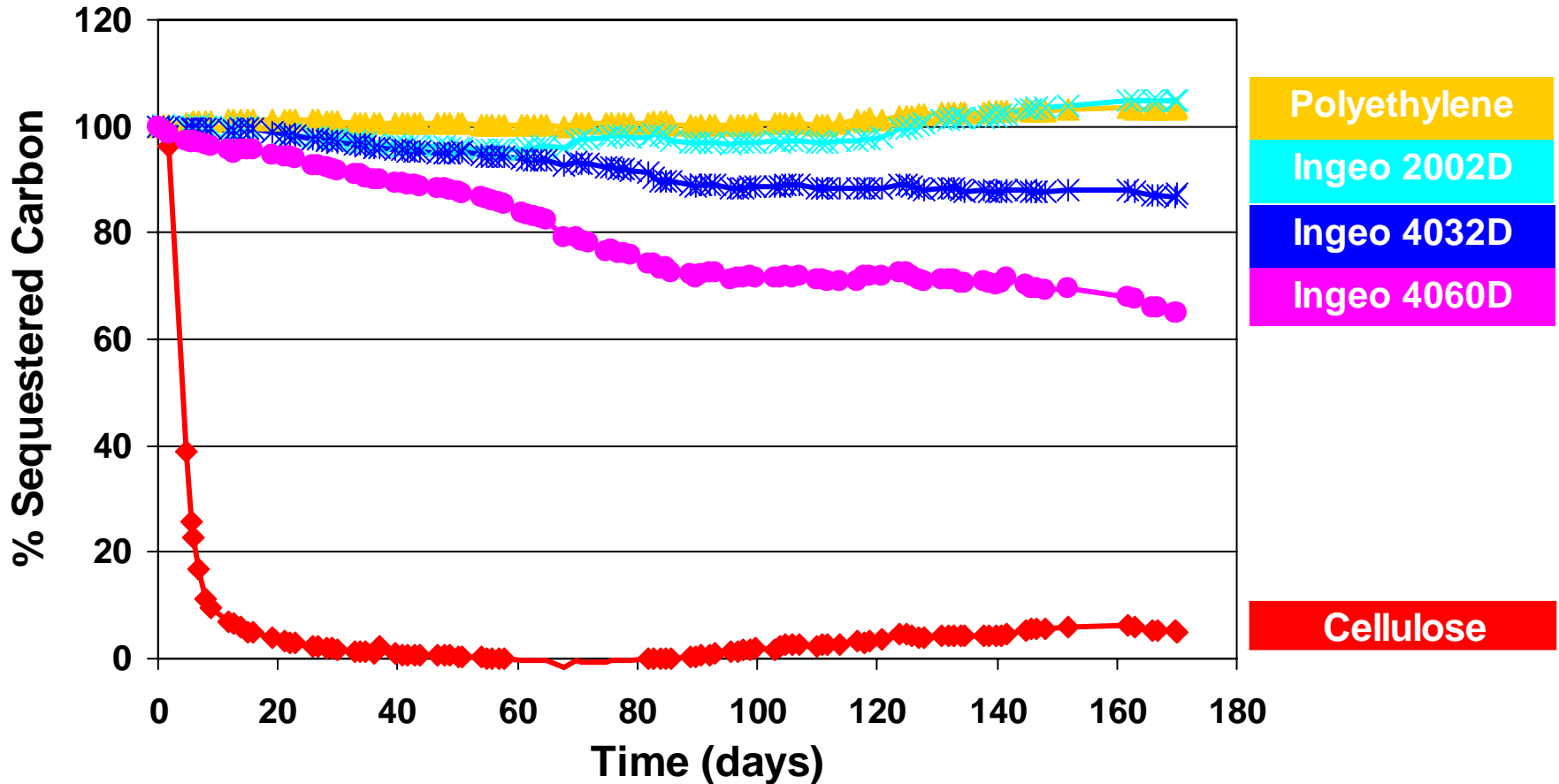
# ASTM D5526: Accelerated Landfill Simulation



OWS:

- *“Biodegradation has not started for any of the Ingeo test samples”*

**ASTM D5511: Mesophilic Anaerobic Digester Simulation**



**OWS:**

- *“The Ingeo grades tested would be poor feedstocks for a mesophilic biogasification facility”*

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# Test Results

NatureWorks LLC conducted testing at an optimum incineration temperature of 1000°C.

## Summary

- BTU value higher than cellulosic based materials
- Low residue
- No volatiles

Ingeo™ Heat Content	
8368	Btu/lb

Elemental Analysis	
Element	% Avg.
Carbon	50.05
Hydrogen	5.71
Oxygen	45.07
Nitrogen	0.04
Sulfur	0.30
Phosphorus	ND (<0.10)
Chlorine	ND (<0.05)

Decomposition Products	
Compounds	mg/g
Carbon Monoxide	ND (<0.1)
Carbon Dioxide	2020
Water	>260
Volatiles	ND (<0.001)
Semivolatiles	ND (<0.01)
Residue	0.01

Other Energy Values	
Material	Btu/pound
Fuel Oil	20,900
HDPE	18,700
Rubber and Leather	12,800
PET	10,900
Wyoming Coal	9,600
Textiles	9,400
Newspaper	8,000
Wood	7,300
Corrugated Boxes (paper)	7,000
Average MSW	5,900
Yard Waste	2,900
Food Waste	2,900



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# NatureWorks LLC Efforts in Recycling

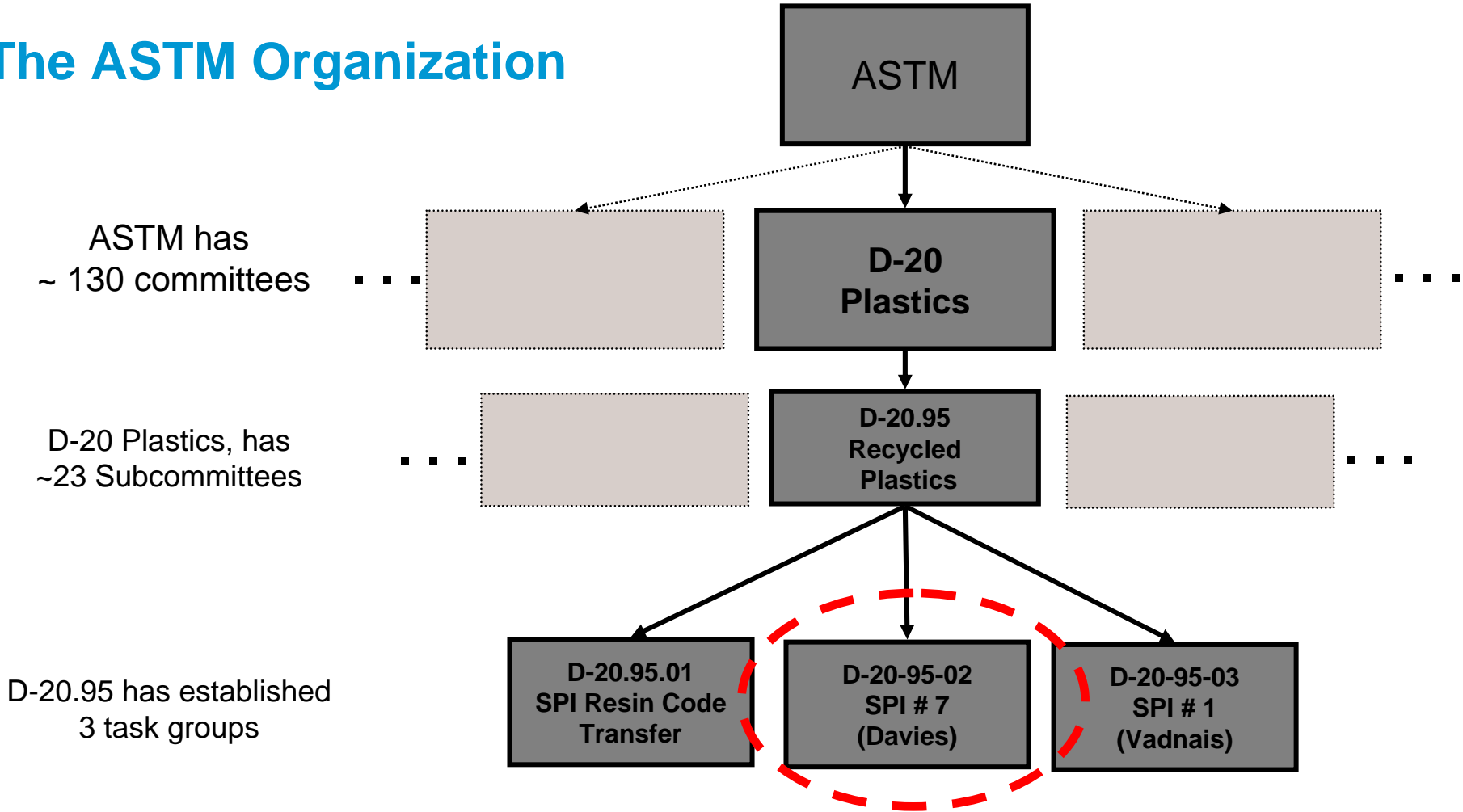
- Various group membership.
  - Association of Postconsumer Plastic Recyclers (APR)
  - National Recycling Coalition (NRC)
  - Sustainable Packaging Coalition (SPC)
  - Bioplastics Recycling Consortium member
  - Biodegradable Products Institute (BPI)
  - European Bioplastics Association (EuPA)
- NIR sorting at plant scale
  - PET stream purity
  - PLA stream isolation
- Manual sorting technology development
- Website materials
  - End of Life vision
  - Education for end of life
- ASTM member and participation
  - Unique material code for PLA
  - ASTM D20, D20.95, D20.95.01
- End market development
  - Polymer grade lactic acid
  - Other applications

# Intent of the SPI-to-ASTM Resin Code Transfer

- ASTM International News Releases - July 2008
  - ASTM International Working to Adapt SPI Resin Identification Codes as New Standard
    - “ASTM WK20632 will expand on the original SPI system by providing for additional codes for resin types not covered in codes 1-6, potentially adding to the list of materials currently available for recycling. In addition to expanding the range of material covered, the proposed ASTM standard will allow for containers to be coded with numbers as they stand in the original SPI code and/or the "zero plus number" (for example, 01) system that is used in similar coding systems in the United Kingdom and China  
[\[http://www.astmnewsroom.org/default.aspx?pageid=1449&year=2008&category=Standards%2FTechnical+Committee+News\]](http://www.astmnewsroom.org/default.aspx?pageid=1449&year=2008&category=Standards%2FTechnical+Committee+News)
- SPI Resin Identification Code - Guide to Correct Use
  - “In 2008, SPI began work with ASTM International, as well as industry and government experts, to develop a new standard that will expand the current system by providing for additional codes for resin types not covered in codes 1-6”  
[\[http://www.plasticsindustry.org/AboutPlastics/content.cfm?ItemNumber=823\]](http://www.plasticsindustry.org/AboutPlastics/content.cfm?ItemNumber=823)



# The ASTM Organization



## Specific Objectives of the # 7 Task Group

- Develop, and recommend to the D20.95 subcommittee, a revision to the currently proposed “standard practice for marking plastics items” which defines how any plastic **other than those already defined by existing resin identification codes #1-6** will be marked with a unique resin identification code.
- Remain consistent with the philosophy underlying the original SPI code, where **each number designates a specific plastic type, not a disposal option.**
- Work product will be recommended draft language which will **NOT combine compostable plastics under one code number** – recognizes that although a plastic may be compostable, depending on it’s use, composting may not be the preferred treatment.



## Feedstock Recycling Today

- WRR Environmental in the US
  - Recycling off grade production resin
  - Recycling post industrial resin
  - Understanding post consumer sources
- Galactic in the EU
  - Building a 1500MT plant
  - Operational in 2009
- NatureWorks LLC
  - Recovered +20MM lbs of off grade resin
  - Tested pilot scale post consumer sourced



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# Ingeo and Composting

- Standard guidelines for composting revolve around four basic criteria:
  - Biodegradation
  - Material characteristics
  - Disintegration
  - Ecotoxicity
- Ingeo has been certified by BPI as compostable under the ASTM D6400-04 standard
- Japan:
  - Ingeo has received certification under ISO 16929 through the Biodegradable Plastics Society of Japan
- Europe
  - Ingeo has received DIN CERTO EN 13432 certification in Europe



**Ingeo™ biopolymer is certified, however specific packaging articles also need to be certified.**

# Appendix Materials



# Environmental Marketing Claims

Laura DeMartino

Assistant Director, Division of Enforcement  
Bureau of Consumer Protection



# Types of Marketing Claims

- General environmental benefits
- Degradable and biodegradable
- Compostable
- Recyclable
- Recycled content



# General Environmental Claims

Our gift cards are environmentally-friendly



- General claims may be confusing
- Identify specific “green” attributes



# Biodegradable



Difficult for products to biodegrade in a landfill



# Compostable Claims



- Will the product break down in home compost piles?
- Qualify if compostable only in a municipal facility & disclose limited availability of municipal facilities



# Recyclable

- Do recycling facilities exist for your product?
- Use disclosures to qualify claims

