Ingeo from a Cradle-to-Cradle Perspective:

NatureWorks Review for Taiwan EPA, ERI

July 23, 2013

NatureWorks LLC

Who We Are . . .

- *World's first and largest bioplastics producer*
- *World-Scale Plastics Facility*
- *2002 Winner - Presidential Green Chemistry Challenge*
- *Peer reviewed, strong eco-profile*
- *Global customer base and product adoption*
- *Ingeo applications breadth across markets, geographies, and retail applications*

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Where we are in the Market

Rigids

Food Serviceware

Films

Nonwovens / Fibers

Durables

Lactides

INGEO™ LACTIDES

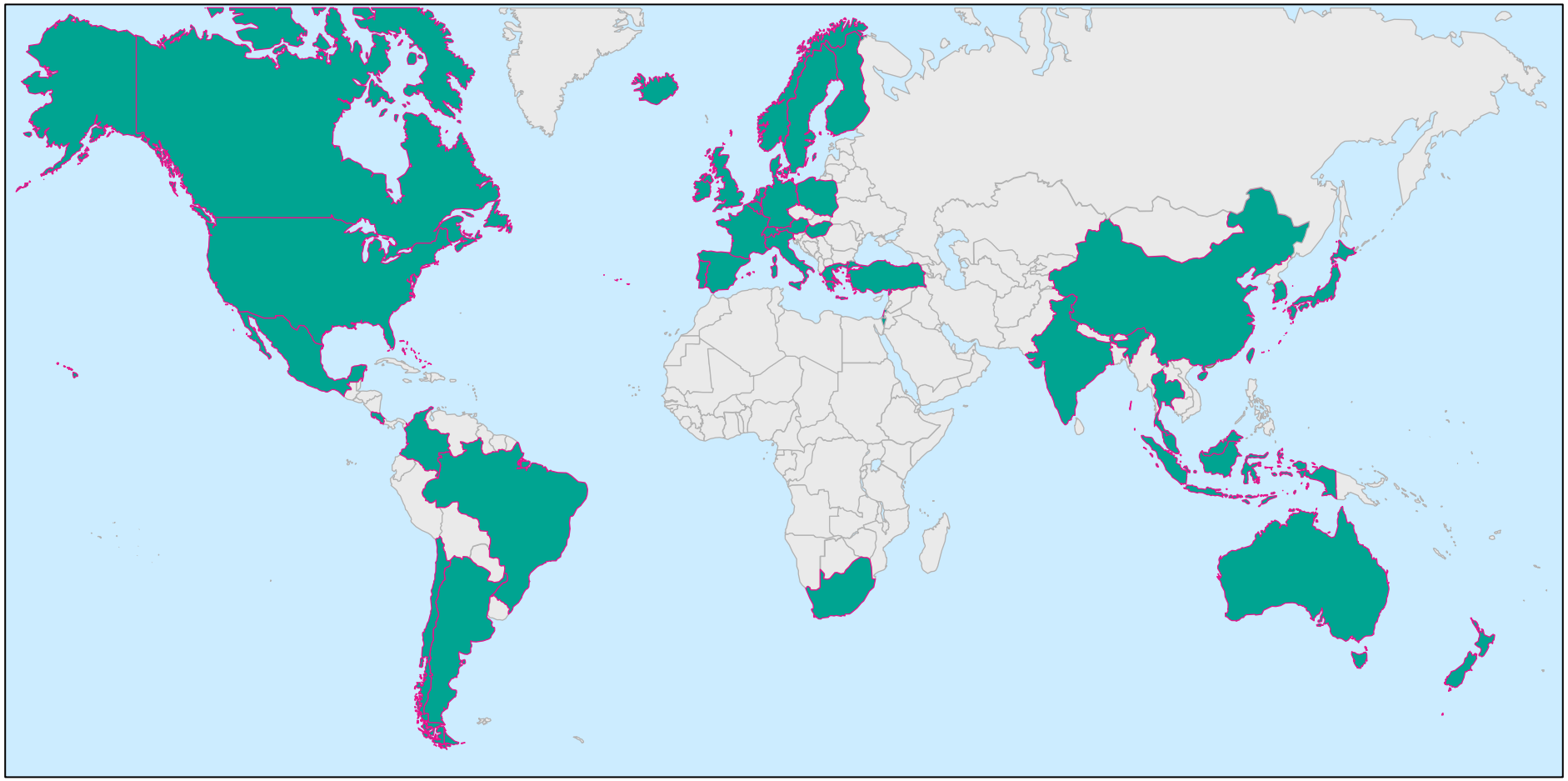
Bus. Dev.

Incubator

NatureWorks LLC

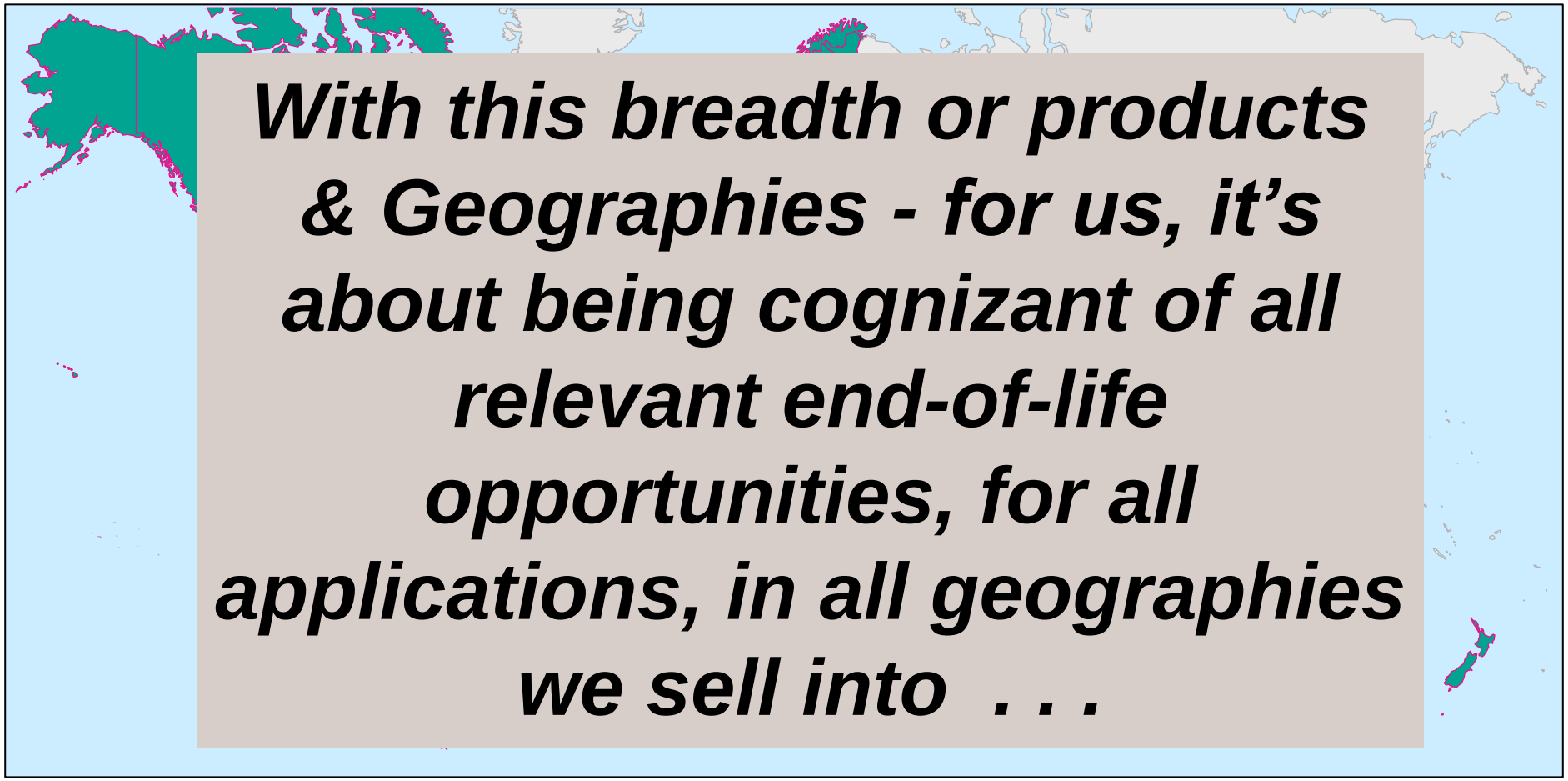
Where are we geographically

Global-scale adoption



NatureWorks LLC Where are we geographically

Global-scale adoption



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How we look at things . . .

Ingeo From A Cradle-to-Cradle Perspective

"Nature doesn't have a design problem, people do"

William McDonough and Michael Braungart, 2002

"Technical nutrients"

- basically inorganic or synthetic materials manufactured by humans—such as plastics and metals--that can be used many times over without any loss in quality, staying in a continuous cycle.

CM
CERTIFIED
cradletocradle
SILVER

"Biological nutrients"

- Biological nutrients and materials are organic materials that can decompose into the natural environment, soil, water, etc. without affecting it in a negative way, providing food for bacteria and microbiological life

Ingeo recycle

Ingeo composting

Source: Cradle to Cradle: Remaking the Way We Make Things by William McDonough & Michael Braungart

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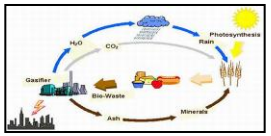
Ingeo Cradle to Cradle Options

	Incumbent Plastics	Ingeo
Mechanical Recycle 	✓	✓
Feedstock Recovery 		✓
Compost 		✓
Anaerobic Digestion 		✓
Energy Recovery 	✓	✓
Landfill 	✗	✗

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Energy Recovery

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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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Compost

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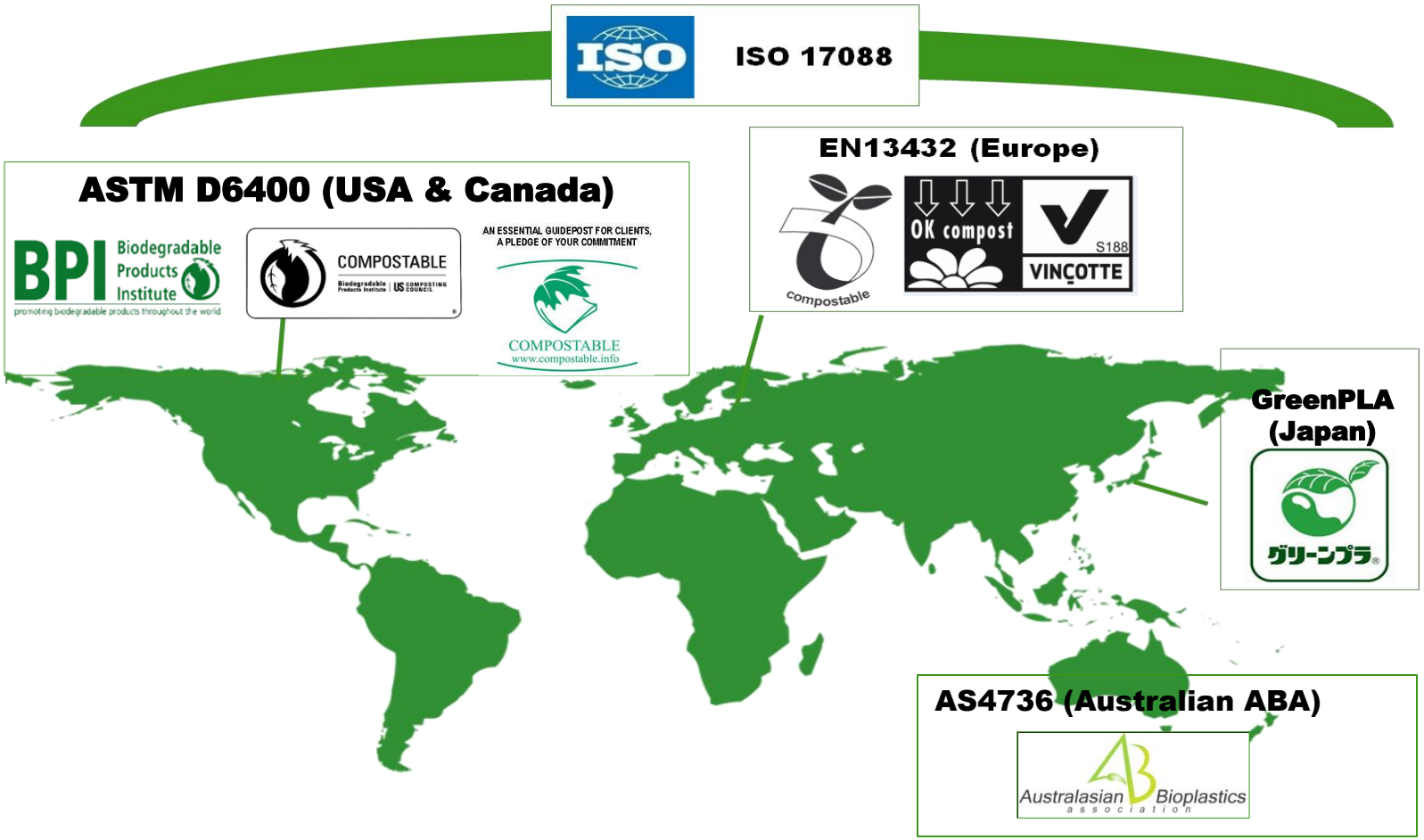
Global Standards for compostable plastics



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What's Resulted in the Global Market

Rigids

Food Serviceware

Films

Nonwovens / Fibers

Durables

Lactides

INGEO™ LACTIDES

Bus. Dev.

Incubator

NatureWorks LLC

Ingeo in Compostable Food Serviceware

Food Serviceware

NatureWorks LLC

Cradle-to-Cradle: Composting

- Composting of bio-plastics <u>as such</u> makes little sense
  - No energy recovery, no carbon storage, no re-use
- Use of compostable items <u>to divert organics from landfills</u> makes a lot of sense

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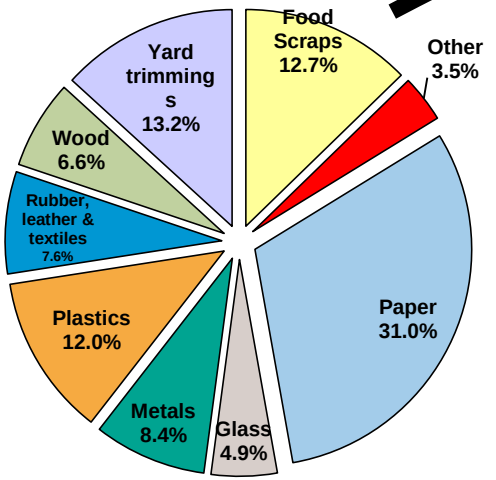
Where Compost has a role

Total US MSW Generation (by material), 2008
250 Million tons (before recycling)



Source: Municipal Solid Waste in the US: 2008 Facts & Figures

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Ingeo
Commercial Compost
Examples

GREEN SPORTS ALLIANCE SUMMIT

September 5-7, 2012
Seattle, Washington

US Sports Venues & Arenas – Zero Waste Initiatives

- **The Portland Trail Blazers and the Rose Garden**
- **Minnesota Wild / Excel Energy Center**
- **The Pittsburgh Pirates and AgRecycle**

TRAIL BLAZERS

ASSIST LEADER

#4 **JERRYD BAYLESS** with

DELL O'NEAL
POSITION:
Housekeeping Manager

HEIGHT: 5'10"

ASSIST:
Composting more than 150 tons of food waste annually

JAMES JEDIBUDIAH
POSITION:
Ovations - Sustainability Coordinator

HEIGHT: 6'

ASSIST:
Sourcing our compostable food service wares from Portland-based Stalk Market

make it better

PORTLAND TRAIL BLAZERS

"I'd like to introduce you to…Dell O'Neal and James Jedibudiah. It's a dirty job, but somebodys got to do it. You see, Dell oversees recycling efforts at the Rose Garden and James ensures we compost as much as possible. They both deserve a standing ovation for diverting more than 60% of arena waste out of our city's landfills each year."

To learn more about how you can help make it better with the Trail Blazers visit trailblazers.com/**makeitbetter**.

PACIFIC POWER
A DIVISION OF PACIFICORP

Stalk Market
COMPOSTABLE PRODUCTS

AgRecycle was founded in 1991 and operates multiple composting sites in western Pennsylvania

Pennsylvania's Composting General Permit allows us to accept source-separated:

- Yard Debris
- Clean Wood Waste
- Manures (and bedding)
- Paper
- All food residuals (including proteins and bones)
- Non-biosolid liquids
- Green building materials
- Corrugated/wax corrugated
- Approved compostable products

We have been accepting food scraps since 1998 and began our own collection routes in 2006.

AGRECYCLE
FROM FORGOTTEN TO FERTILE

AgRecycle's food scrap customers are from these commercial sectors:

- Serving
  - Food processors
  - Supermarkets
  - Restaurants
  - Universities/Schools
  - Professional sports stadiums
  - Pittsburgh Convention Center
  - Corporate cafeterias
  - Public venues
  - Special events
  - Museums

Pennsylvania's Regulations

- There are no landfill bans in place for any organic materials within the state, nor are there any local ordinances regulating the flow of organic waste materials away from landfills.
- Every client of AgRecycle's diverts voluntarily.
- No subsidies have ever existed for private sector composting entities.

FOOD COLLECTION CONTAINERS


AGRECYCLE

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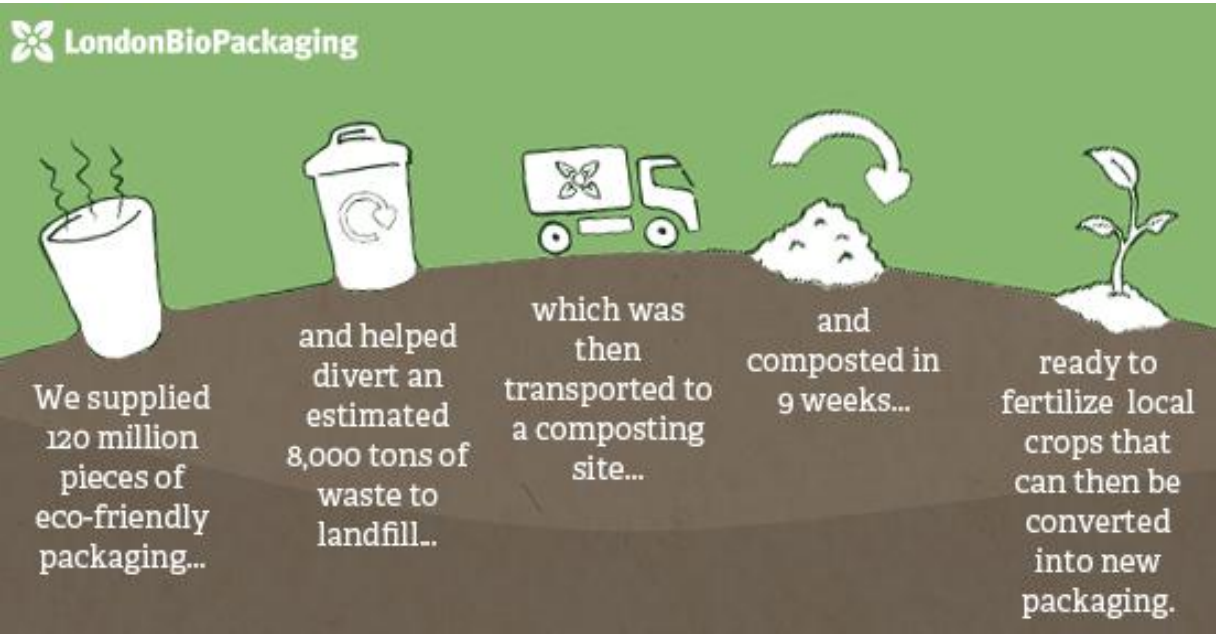
Ingeo in use at London 2012 Olympic Games



- 14.3 million Ingeo lined paper cups
- 7.5 million heat resistant Ingeo lids

LondonBioPackaging

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Recycle Options

	Incumbent Plastics	Ingeo
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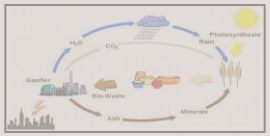
Anaerobic Digestion 		✓
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Landfill 	✗	✗

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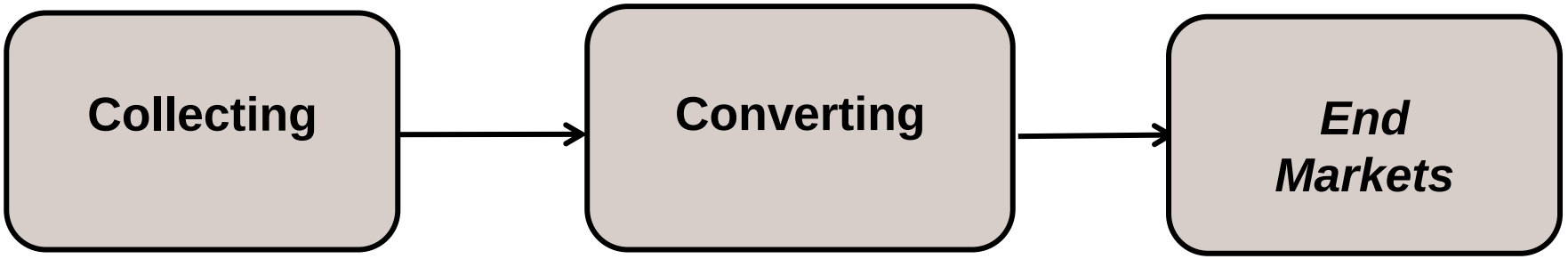
Recycling Post Consumer Ingeo
Three Challenges



- Sortation

- Final Plastics Sort
- Grinding/Size Reduce
- Cleaning/Washing
- Repelletizing (?)

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MRF Sortation Demonstrations & Pilots

- Equipment/Technology Assessment

- USA:
  - California Funded Bioplastics Grant ------
  - Titus LA MRF

- Italy:
  - “COREPLA” (COnsortium for REcycling PLAstic) Study

- UK: Waste Resources Action Programme (WRAP)

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Equipment/Technology Assessment - “NIR”

- Titech

TITECH
INNOVATION IN GLOBAL RECYCLING

- Unisensor

UNISENSOR
Sensorsysteme GmbH

- MS

MSS OPTICAL SORTERS
A DIVISION OF THE CP GROUP

- Pellenc

PELLENC
selective technologies

Equipment/Technology Assessment

- Titech (www.titech.com)

  Titech has demonstrated the ability of its near-infrared sorting systems to eject concentrated amounts of PLA in a PET sorting operation. Sorting efficiency in a single pass was found to be a minimum of 97.5% accurate. Titech's near-infrared sorting is perhaps the most dominant technology used worldwide.

Equipment/Technology Assessment

- **Unisensor**

  (http://unisensor.luveno-net.de)

  Unisensor has shown its laser flake technology is fully capable of sorting PLA flakes from desired PET recycle streams at efficiencies as high as 96-99%. This is consistent with other plastics considered contaminants in the PET flake sorting technology.

Equipment/Technology Assessment

- MSS (www.magsep.com)

MSS tested **Ingeo™** in its Aladdin near-infrared system. The test confirmed that **Ingeo™** emits a unique polymeric "signature." The test demonstrated that **Ingeo™** comes up as "other plastics" in a system specifically designed to identify PET, PE, and other plastics. Its unique signature means that the equipment could be programmed to identify **Ingeo™** as **Ingeo™** or simply as "other plastics."

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MRF Sortation Demonstrations & Pilots

- Global: Equipment/Technology Assessment
- UK: Waste Resources Action Programme (WRAP)
- Italy:
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- USA:
  - California Funded Bioplastics Grant
  - Titus LA MRF

CalRecycle

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UK Sortation Study

"NIR (near-infrared) systems can effectively remove PLA and carton board from a mixed packaging stream."

WRAP is an internationally recognized not-for-profit company that helps individuals, businesses, and local authorities reduce waste.

Waste Resources Action Program (WRAP) report published, June 2008, "Domestic Mixed Plastics Packaging Waste Option".

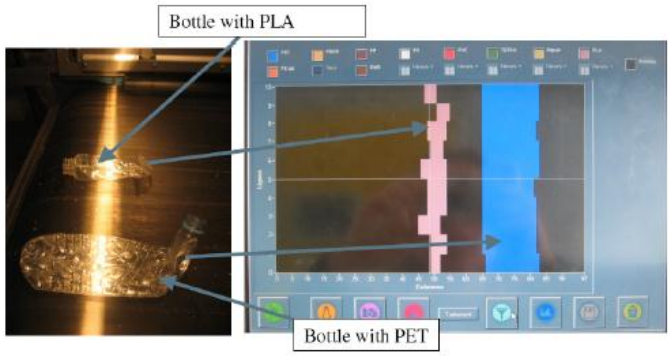
wrap Material change for a better environment

Final Project Report

Domestic Mixed Plastics Packaging Waste Management Options

An assessment of the technical, environmental and economic viability of recycling domestic mixed plastics packaging waste in the UK.

UK WRAP Project



PP output

PVC output

PET output

PLA output

Whole Item Separation Trials Results

Polymer	PP	PE	PET	PS	PVC	PLA	Throughput
Purity Achieved*	96%	94%	94%	87%	93%	97%	3 tph

*Representative output purity for NIR Sorting

" the systems are capable of being trained to identify new polymers or variations of polymers. This function was utilised to identify PLA bioplastic within the streams and successfully eject them from the mixed plastics fraction (…) "

WRAP (Waste & Resources Action Programme) – UK June 2008

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Sortation in Italy

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MRF Sortation Demonstrations & Pilots

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- USA:
  - California Funded Bioplastics Grant
  - Titus LA MRF

CalRecycle

Project Sponsors

Future 500 Bioplastics Project received funds from CalRecycle to construct, test and prove that an optical sorter can separate PLA bioplastics from other plastics to work toward a clean PLA stream, and guard against unacceptable PLA in the PET stream.

THE FUTURE 500

CalRecycle

PELLENC

Primary Project Goals

1. Demonstrate the ability of optical scanners to separate PLA from PET and other plastics
2. Identify products made from PLA as well as other bioplastics that are in the sorted recyclables
3. Measure volume of PLA products that are separated by the sorting machinery, and the volume that remains in the sort residue
4. Educate MRF operators about best practices in PLA separation and recycling
5. Demonstrate to the materials recycling industry that state of the art technology can deliver marketable PLA and other uncontaminated bioplastics into the marketplace

Findings

- When PLA is present in the feedstock materials, the Pellenc optical sorting system is capable of identifying it and separating it from other materials.
- The optical sorting system is capable of separating PLA bottles only or bottles, cups, and clamshells from all other mixed materials at a MRF.
- The optical sorter most effectively separated the greatest amount of PLA material (up to 99.6%) from other plastics when it was set to positively sort only for PLA

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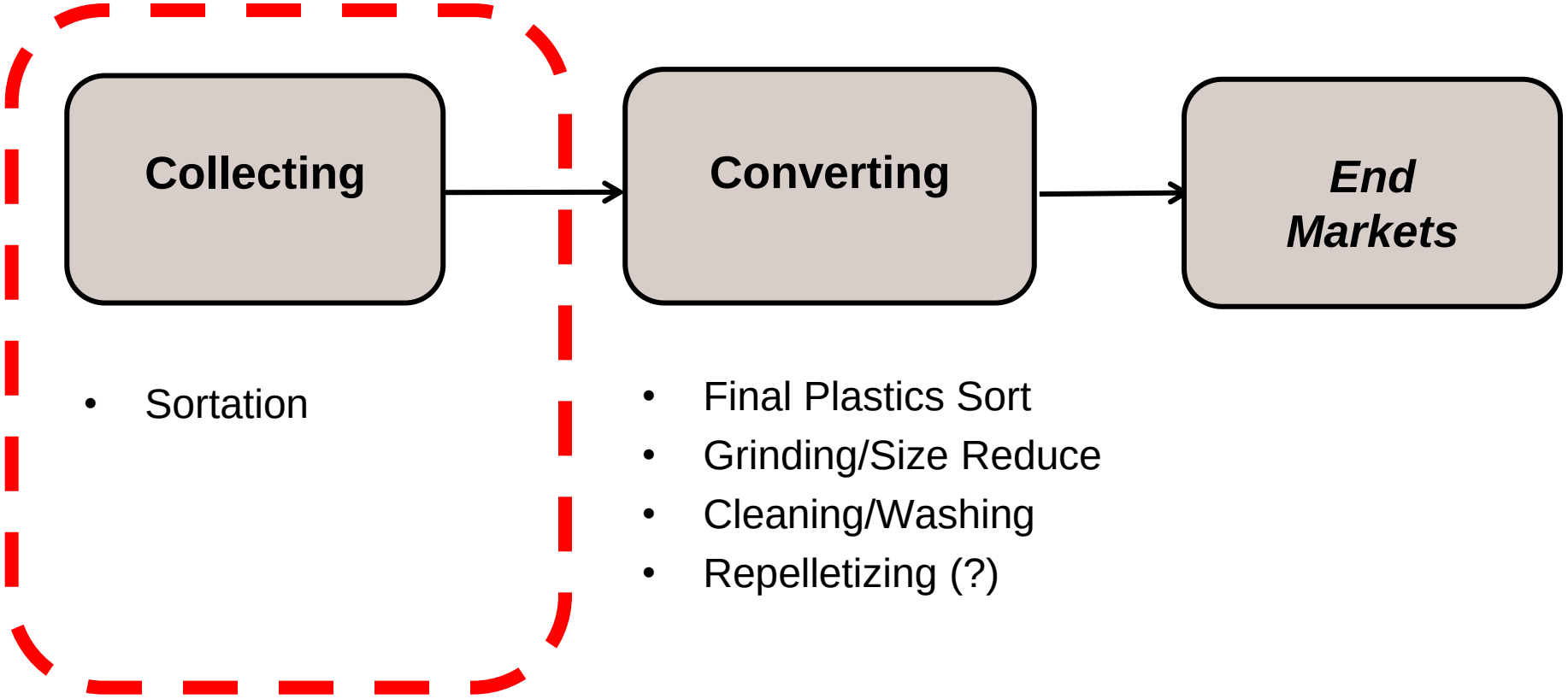
Recycling Post Consumer Ingeo
Three Challenges



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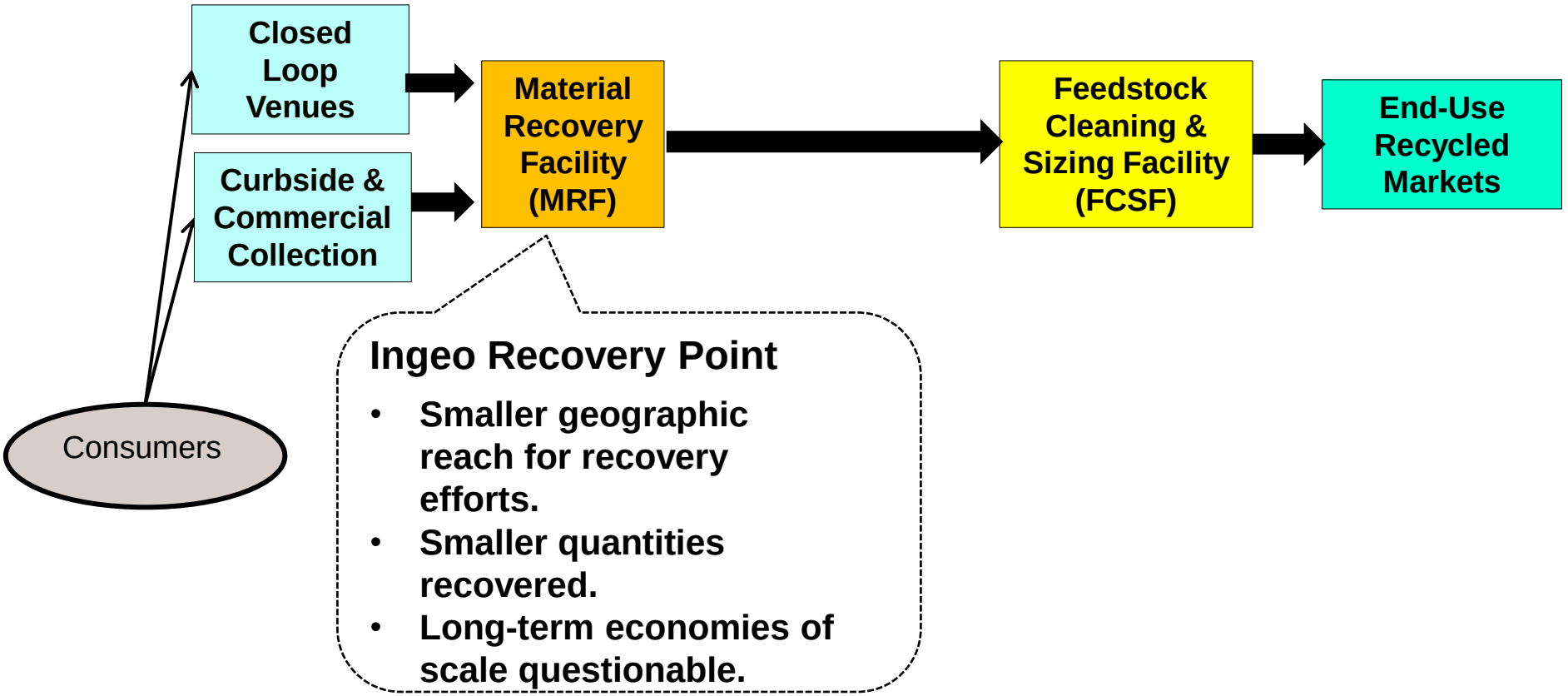
MRFs & PRFs
(Material & Plastics Recovery Facilities)

Post Consumer Ingeo Recycling Value Chain in the MRF Centric Model



Ingeo Recovery Point

- Smaller geographic reach for recovery efforts.
- Smaller quantities recovered.
- Long-term economies of scale questionable.

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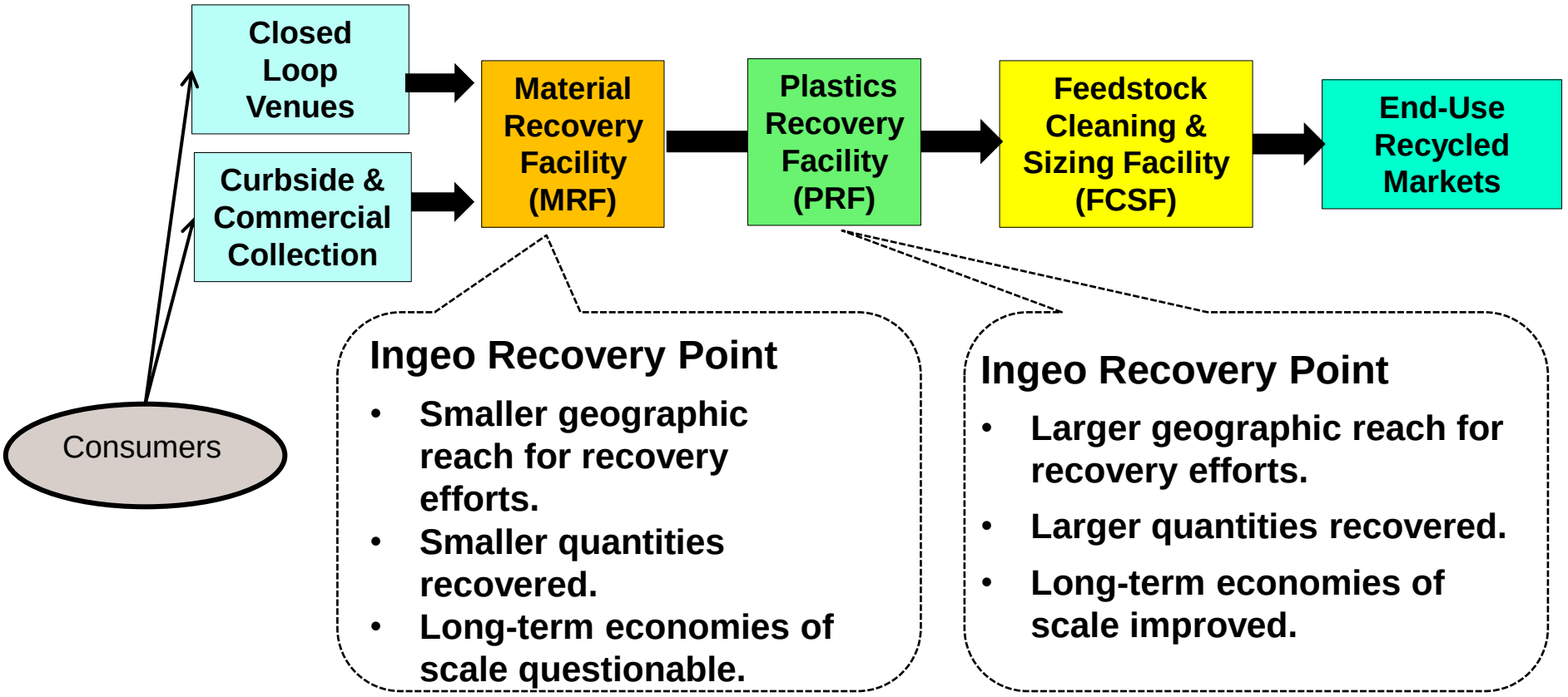
MRFs & PRFs
(Material & Plastics Recovery Facilities)

Post Consumer Ingeo Recycling Value Chain in the MRF Centric Model



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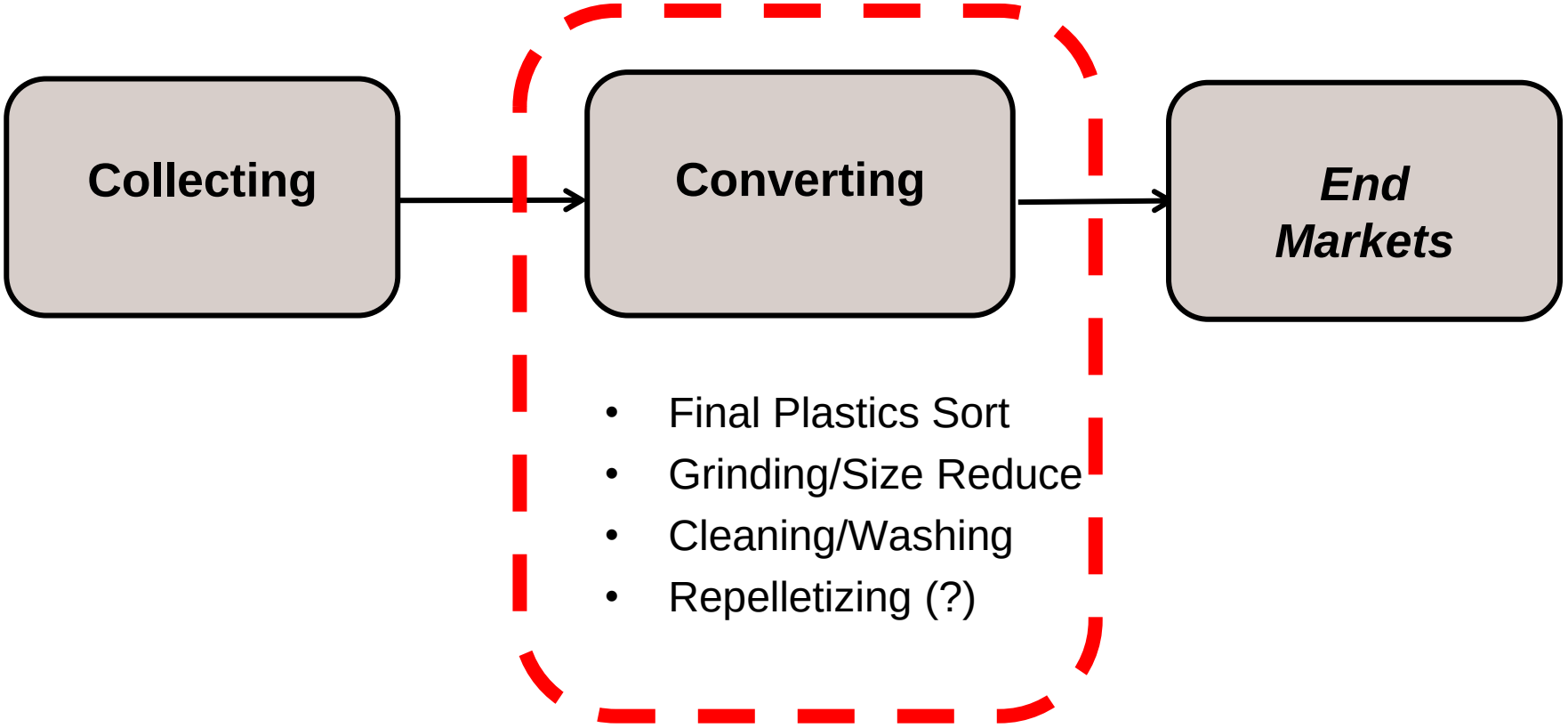
Recycling Post Consumer Ingeo
Three Challenges



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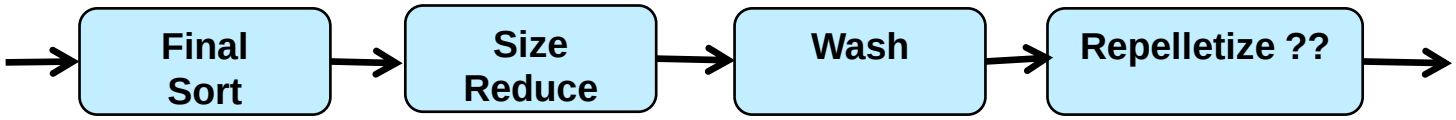
Post Consumer Recyclate - Conversion



- US
  - **Plastics Forming Enterprises**: Bench/Pilot washline process development
- EU
  - **Sorema**: Italian Turnkey Equipment Supplier to the recycling industry (lab & pilot facilities)
  - **LoopLife**
- Taiwan

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Post Consumer from California Venue Collection

Washline Key Process Input Variables

- Time, Temperature, Caustic %, Surfactant %

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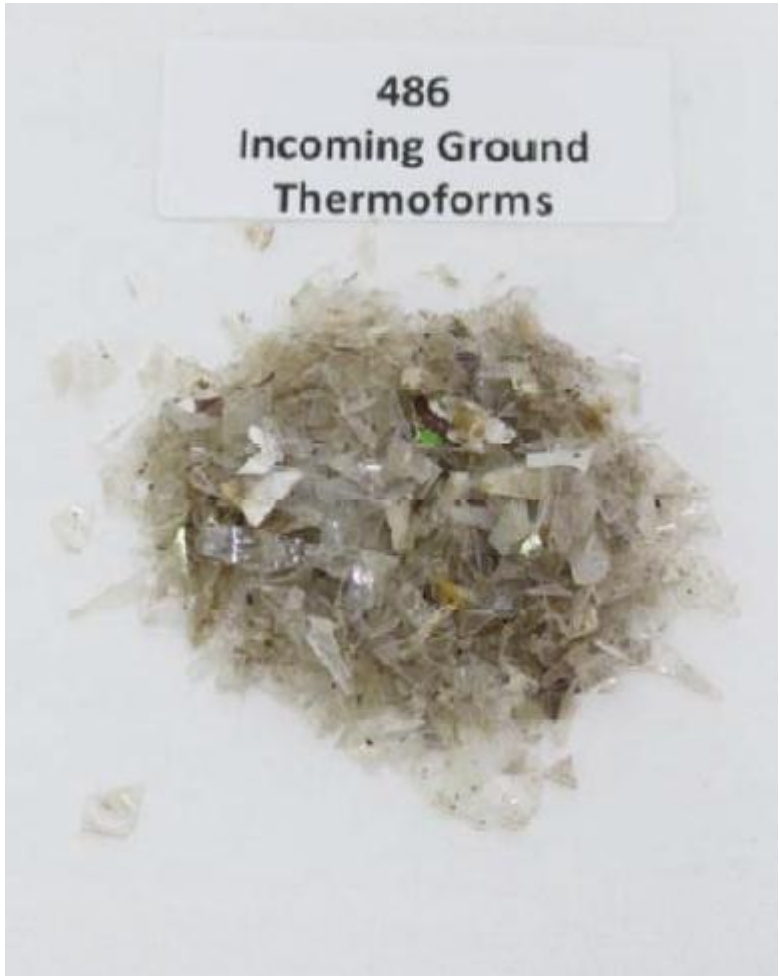

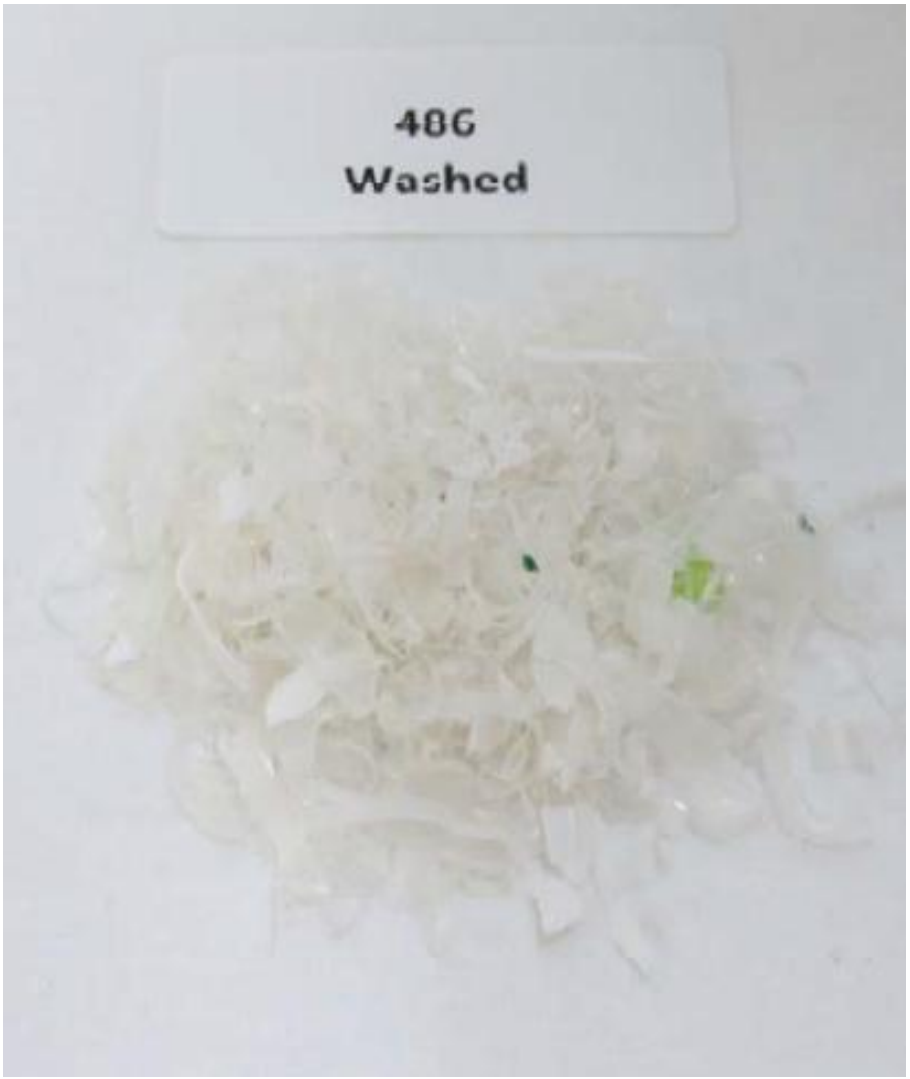

- Key Take-Aways
  - "Standard" PET type wash condition produces reasonable visual appearance
  - Ink removal appears straightforward
- Need to check MW post washing
- Next: Exploratory DOE

  MW, Color = f (T, pH, t)

EU Washline Process Development

- Founded in 1976 with over 250 recycling lines currently in operation, around the world,
- Specializes in turnkey recycling lines.

- Market leader for washing lines for PET recycling plants and for all post consumer plastics.

- Lab (kg scale) and pilot (tonne scale) trials arranged with Sorema Sept-Nov
  - Sant'Anna Bottle Bale
  - Looplife cups from closed loop collection
  - Cups from Taiwan ?

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Taiwan

Introduction

國內生分解塑膠回收量與法規發展歷程

公告PLA生分解塑膠為回收廢棄物

召開專家小組會議

PLA生分解塑膠容器使用量為1,500公噸

PLA生分解塑膠容器使用量為1,876公噸

2010年3月1日起強制回收

PLA生分解塑膠容器使用量為2,194公噸

PLA生分解塑膠容器使用量為2,350公噸

PLA回收率低於10%

公告回收清除處理補貼費率及其實施日期

Nature Work 回收PLA產品

2008年 2009年 2010年 2011年 2012年

資料整理：塑膠中心

The Impurity Ratio of R-PLA

- Result

batch	NaCl density＝1.17 g/cm^3	1.17<PLA density<1.27	H2SO4＝1.27 g/cm^3	Impurity ratio %
A(偉盟)	3.65%	88.5%	4.67%	11.5
B(大豐)	6.83%	94.67%	1.68%	5.33
C(協昌)	2.48%	95.81%	1.71%	4.19
D(尚穩)	1.72%	97.8%	0.48%	2.2
E(根福)	6.13%	92.81%	1.06%	7.19

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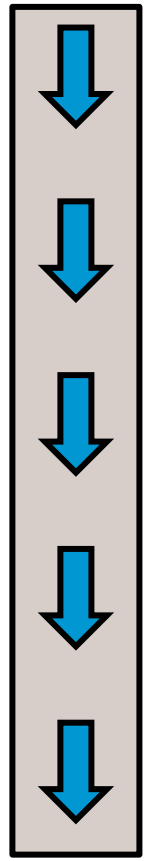
Taiwan Plastics Sortation Recycling Facility (Da Fon Environmental Technologies)

Sort Line

(Manual Picking Staions)

Material take-off in order of decreasing amount present



1. # 2 HDPE “white tank”
2. # 2 HDPE “Yogurt”
3. # 2 HDPE “Detergent”
4. # 2 HDPE “Milk Bottles”
5. # 1 PET “PET Bottles”
6. # 5 PP “Juice Bottles”
7. # 6 PS “Yakult”
8. # 5 PP “Disposable Dishware”
9. # 3 PVC
10. # 1 PET “Bottles (Other)”
11. # 1 PET “Bottles/?”
12. # 1 PET, # 3 PVC, “Packing Box”
13. # 7 Other “Miscellaneous plastic”
14. # 2 HDPE “Silicone Bottles”
15. # 6 PS “Packing Box”
16. # 7 PLA “PLA”

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Taiwan Plastics Sortation Recycling Facility (Da Fon Environmental Technologies)

Sort Line

(Manual Picking Staions)

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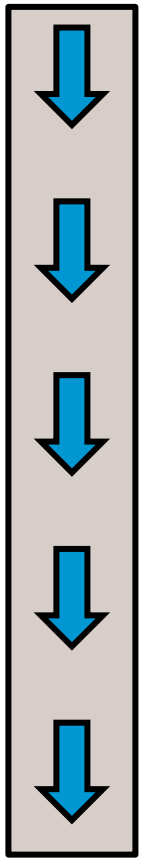

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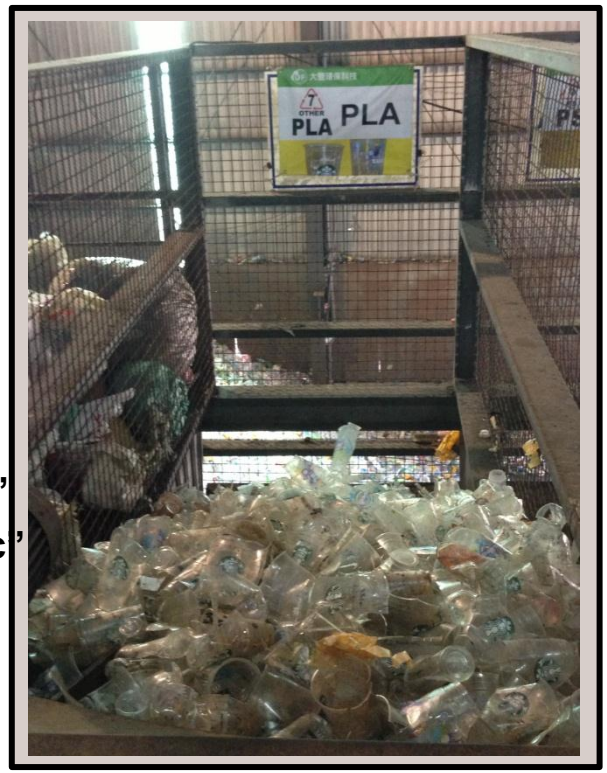

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Da Fon Post Consumer PLA Bales

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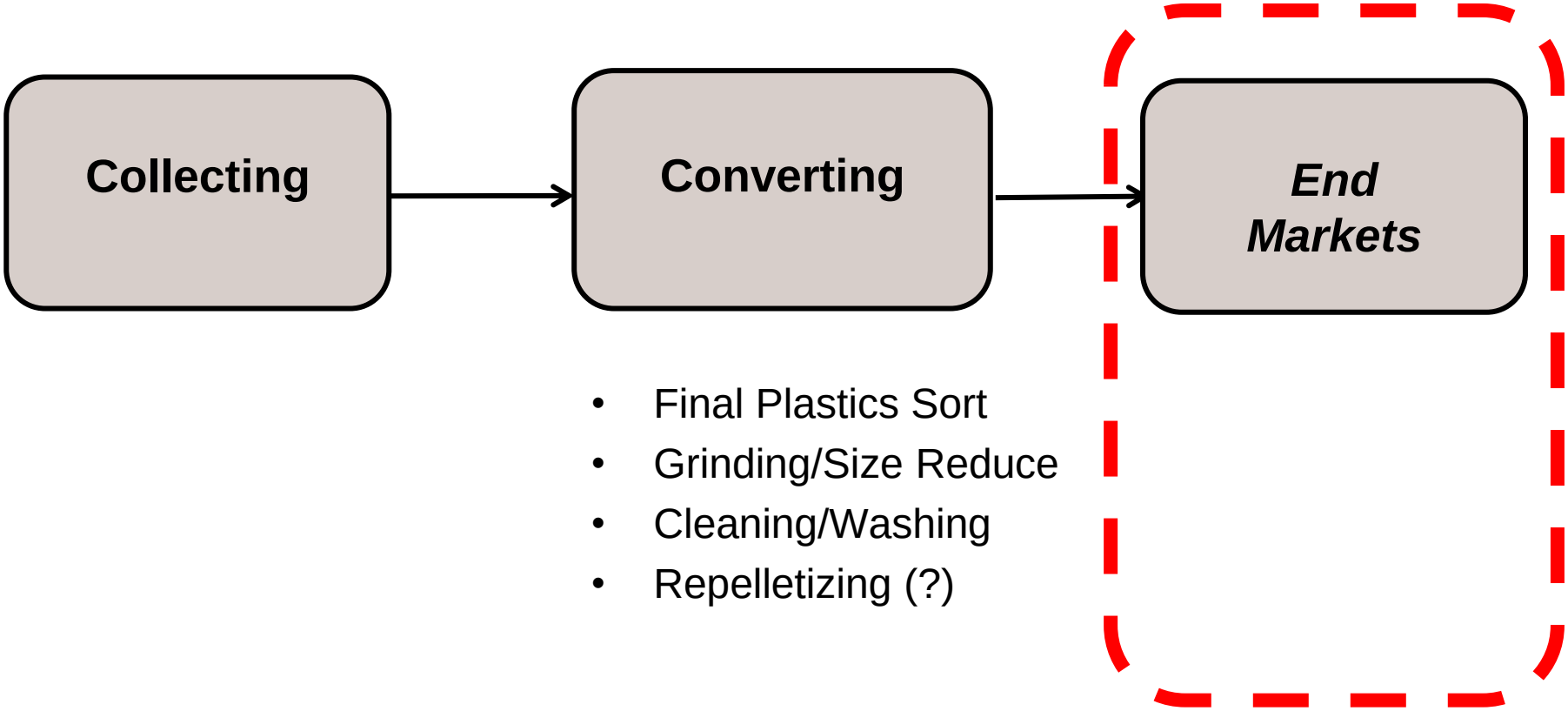
Recycling Post Consumer Ingeo
Three Challenges



- Final Plastics Sort
- Grinding/Size Reduce
- Cleaning/Washing
- Repelletizing (?)

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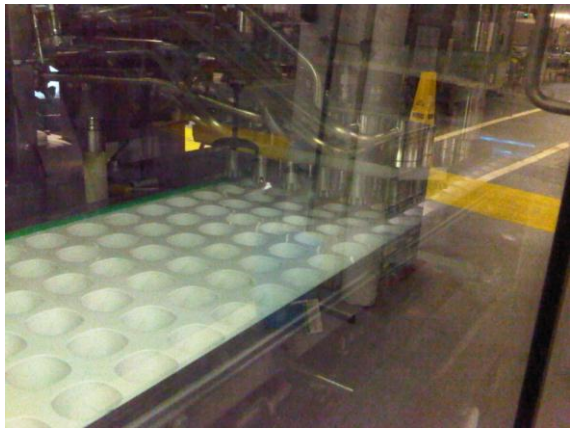
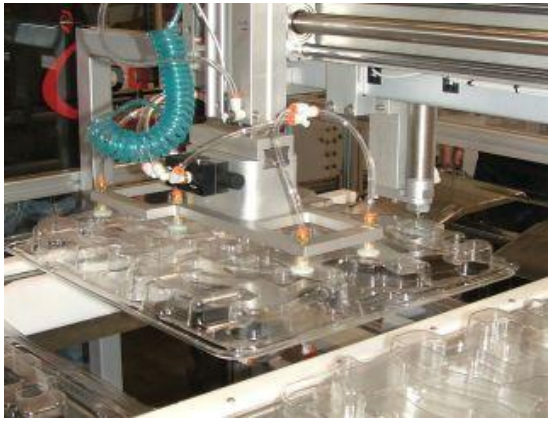
Sampling market with post industrial scrap (as “proxy” for clean post consumer flake)





Questions/Discussion

NatureWorks Review for Taiwan EPA, ERI

July 23, 2013

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Aspen Materials
a division of Aspen Research Corporation

RPLA Series

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Trend 1: Single Stream Collection

Type of Recycling Program for Each State's Largest Municipality[1]

	2009	2010	2011	2012
Single Stream	31	34	35	40
Dual Stream	8	7	7	5
Source Separated	1	1	1	1
Pilot Program(s)	2	1	1	0
Drop Off Only	1	3	3	2
Subscription	5	5	4	3
Total	**48**	**51**	**51**	**51**

[1] **Includes Washington D.C.**

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Trend 2: Collection of #1 – 7 Containers

No. of Each State's Largest Municipality[1] Having #1 – 7 Plastic Container Recycling Programs

	2009	2010	2011	2012
All #1 – 7 Containers	16	24	27	32
#1-7 Bottles Only	8	7	6	3
#1 – 7 Containers With Some Exceptions	6	4	5	10
Total	30	35	38	45

[1] **Includes Washington D.C.**

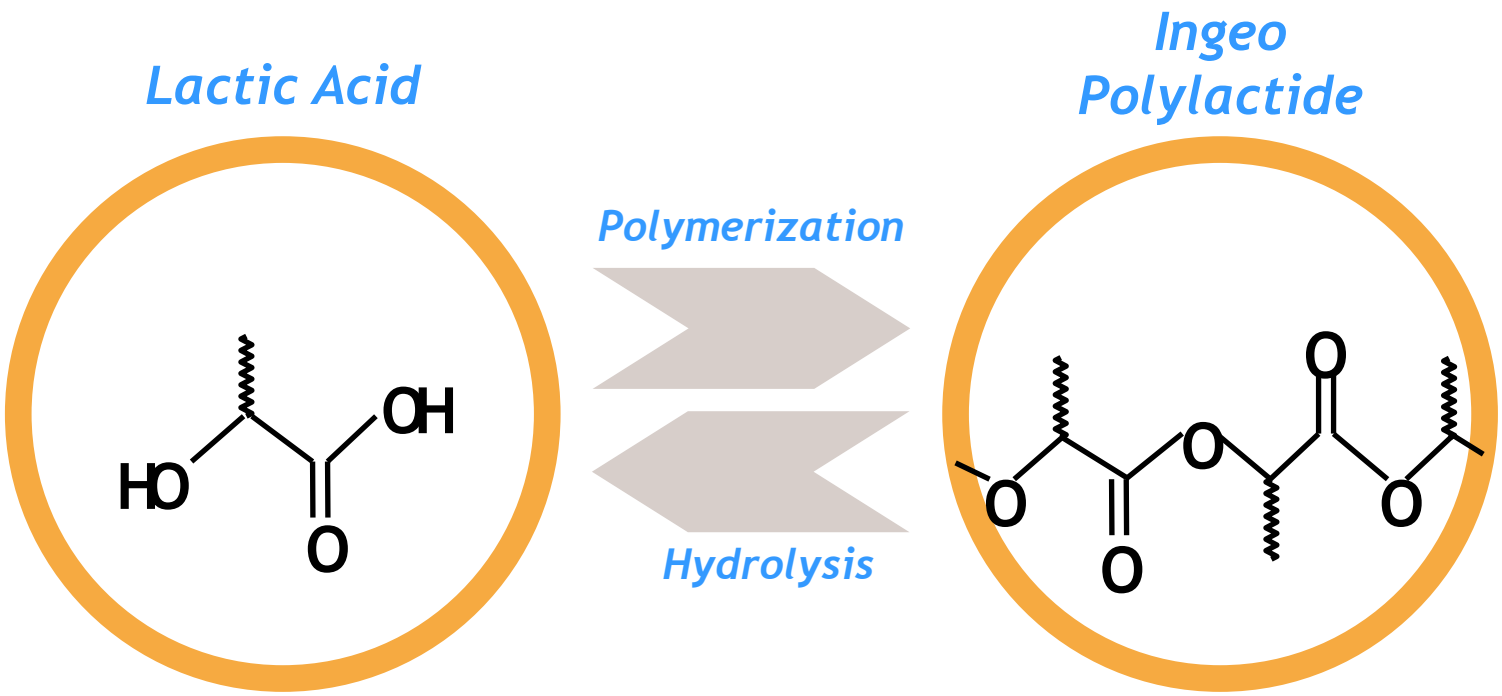
Feedstock Recovery (Chemical Recycle) Recap

NatureWorks Review for Taiwan EPA, ERI

July 23, 2013

What we mean by “Feedstock Recovery”

Ingeo™ is a bio-polymer made from lactic acid



Feedstock Recovery Programs:

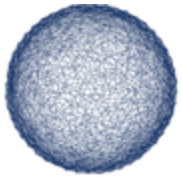
Post Industrial

- Routine Operation
  - Blair Off-grade Ingeo . . . . . .
  - ~ 25 MM Lbs lactic acid feedstock recovered and polymerized back to virgin Ingeo since Blair startup in 2002
  - Technology well demonstrated
  - Economics well demonstrated - with post industrial supply

  - **The hydrolysis process is product & format 'agnostic'**
  - **How do various post consumer materials perform in this process?**

Feedstock Recovery Programs :

Post Consumer

- Case Studies & Working Models
  - UN COP-15 . . . . . 

  - Coleur Café . . . . . 

  - LOC 7000 . . . . . 

"Post Consumer Feedstock Recovery" at the UNFCC

COP15
COPENHAGEN

Ingeo Carpet in use at the COP—15, the UN's Climate Change Conference

1. Developing end markets

"Post Consumer Feedstock Recovery": Ingeo Cups from closed venues.

June, 2011 Brussels Couleur Café music festival

Ingeo Cups in use at EU music festival managed by LOC7000

Ingeo LCA Studies

- *Eco-Profile Fundamentals*
- *Starbucks Cold Cup Comparison PET/PP/Ingeo*
- *Clamshell/Tray Comparison (Ingeo/r-PET*
- *Yogurt Cup comparison (PS / Ingeo)*

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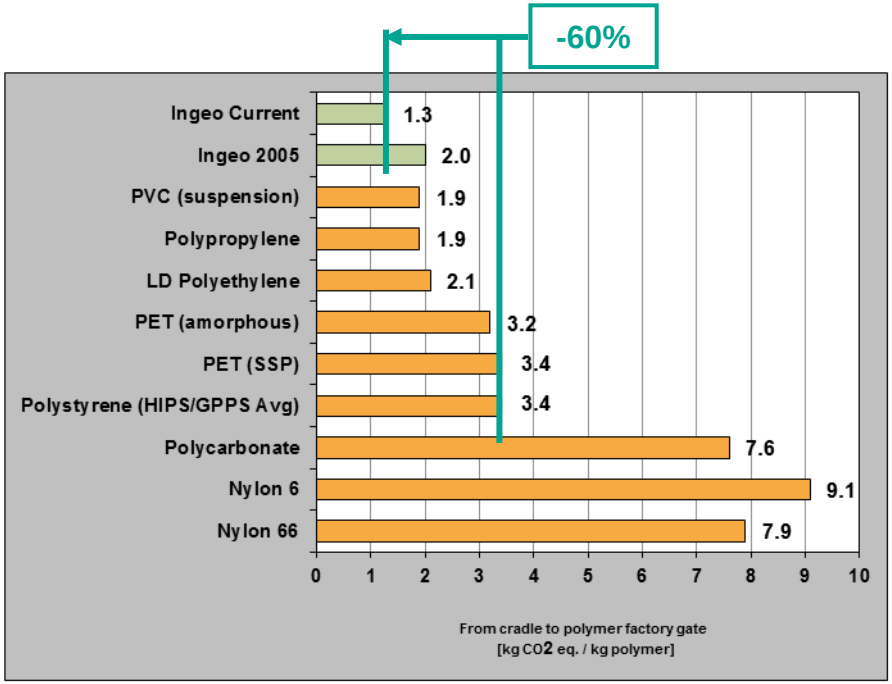
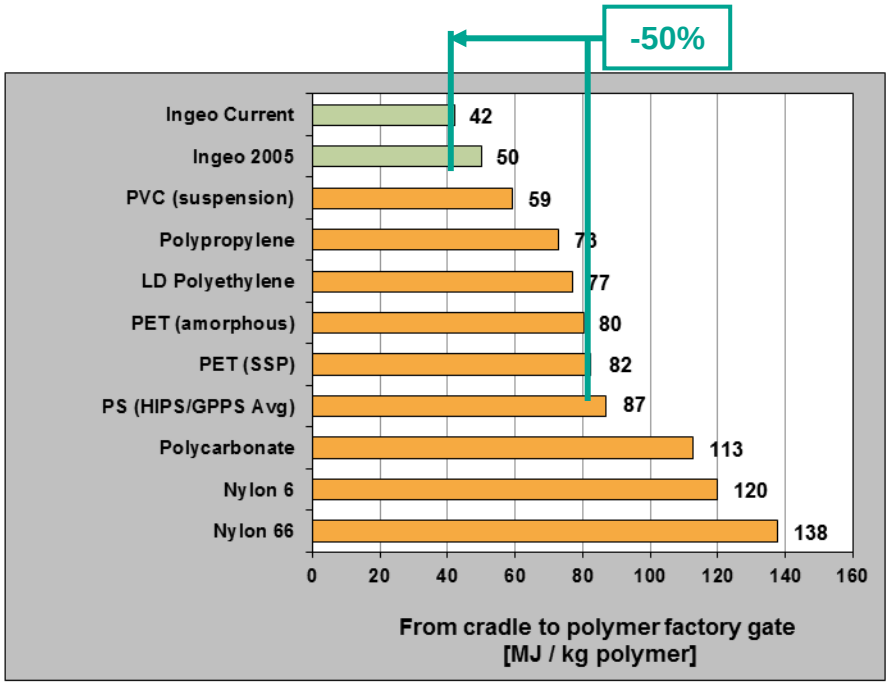
Ingeo Bio-Based Credentials

Greenhouse Gases



Non-renewable energy use



Continuous improvement process

Ingeo 2005 ⇨ Ingeo Current ⇨ Ingeo Future

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Starbucks Ingeo Cold Cup LCA Summary

- A US-focused cradle-to-grave LCA
- Compared 16 ounce clear cold drinking cups and flat lids.
- Materials included are virgin polyethylene terephthalate (PET), virgin Ingeo, and virgin polypropylene (PP).
- It is an original ISO 14040/44-series compliant study.
- It is peer reviewed.

Objective of the study

Support the material selection decisions for 16 ounce clear cold drinking cups within a coffee retail chain by assessing the environmental performance of Ingeo, PET and PP drinking cups throughout their life cycle.

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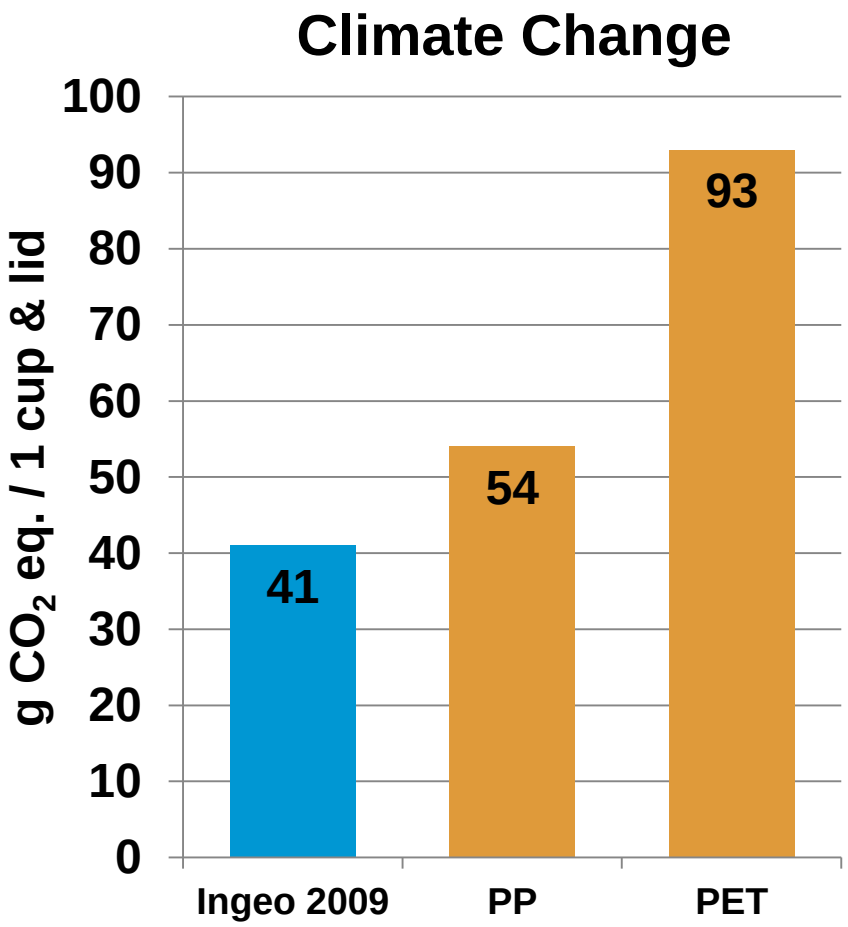
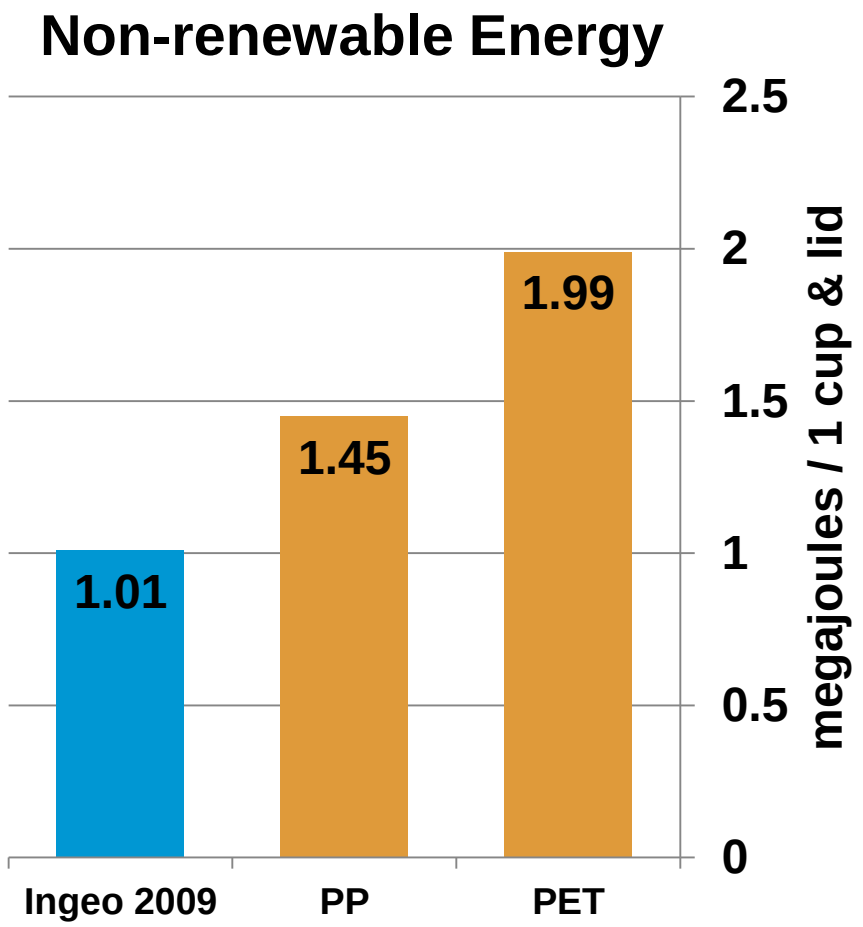
Global Indicator Results

- **PET:** 15.5 g cup / 2.5 g lid
- **PP:** 13.0 g cup / 2.1 g lid (average of PP scenarios)
- **Ingeo 2009:** 14.0 g cup / 2.3 g lid (average of Ingeo scenarios)





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A comparison of Clamshell food packaging made from Ingeo™ and r-PET

Recycled PET

Ingeo

Life Cycle Analysis performed by the IFEU Institute in Heidelberg, Germany

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A North American example: Sam's Club reduced resin use with Ingeo™ compared to rPET

Mastronardi tomato clamshell

When made in rPET

1) 55 grams

2) 16 mil

When made in Ingeo

1) 44 grams

2) 14 mil

20% Actual Weight Reduction due to Ingeo Lightness & Stiffness

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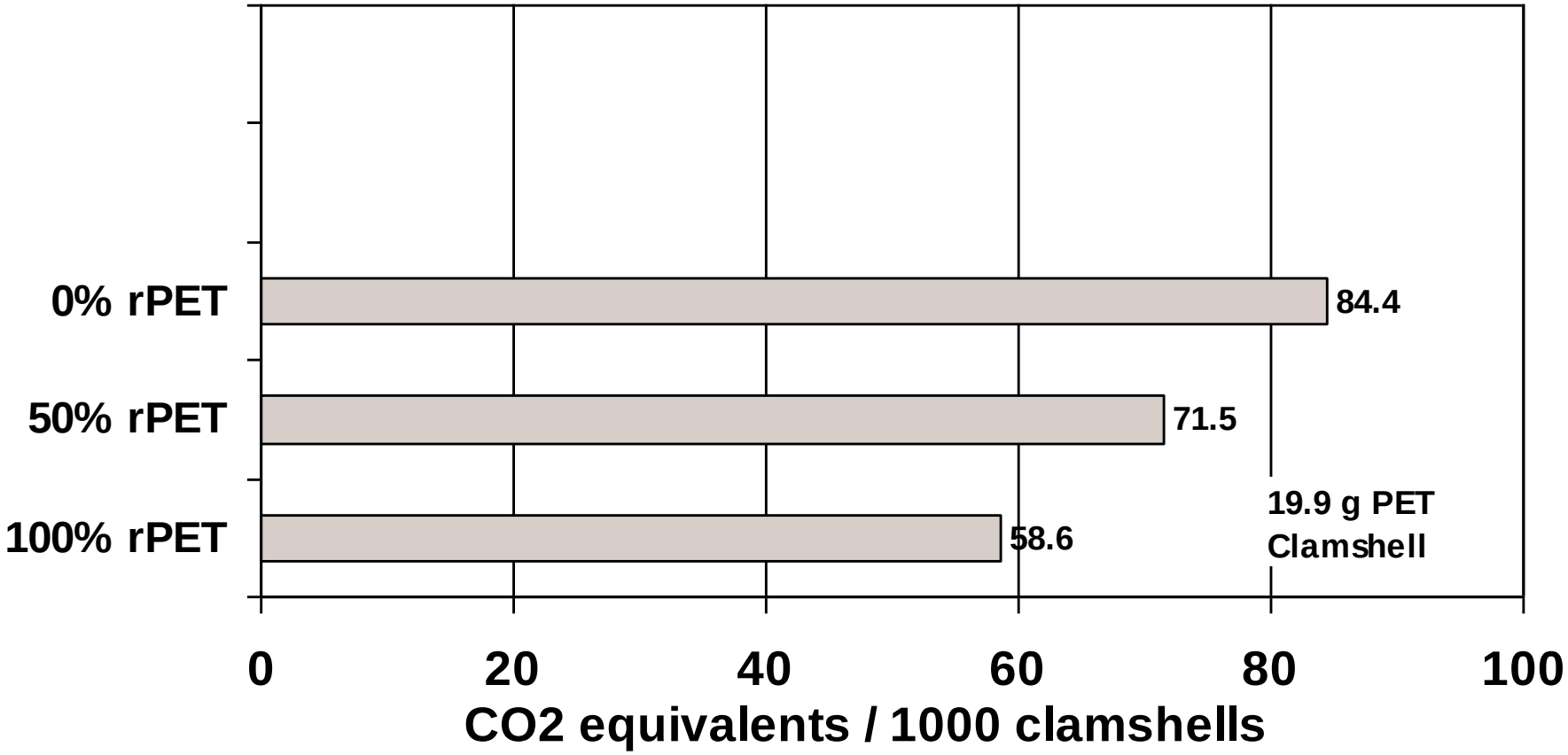
Results for climate change



US EOL: clamshell landfilled after use

As expected, higher r-PET use reduces the environmental burden

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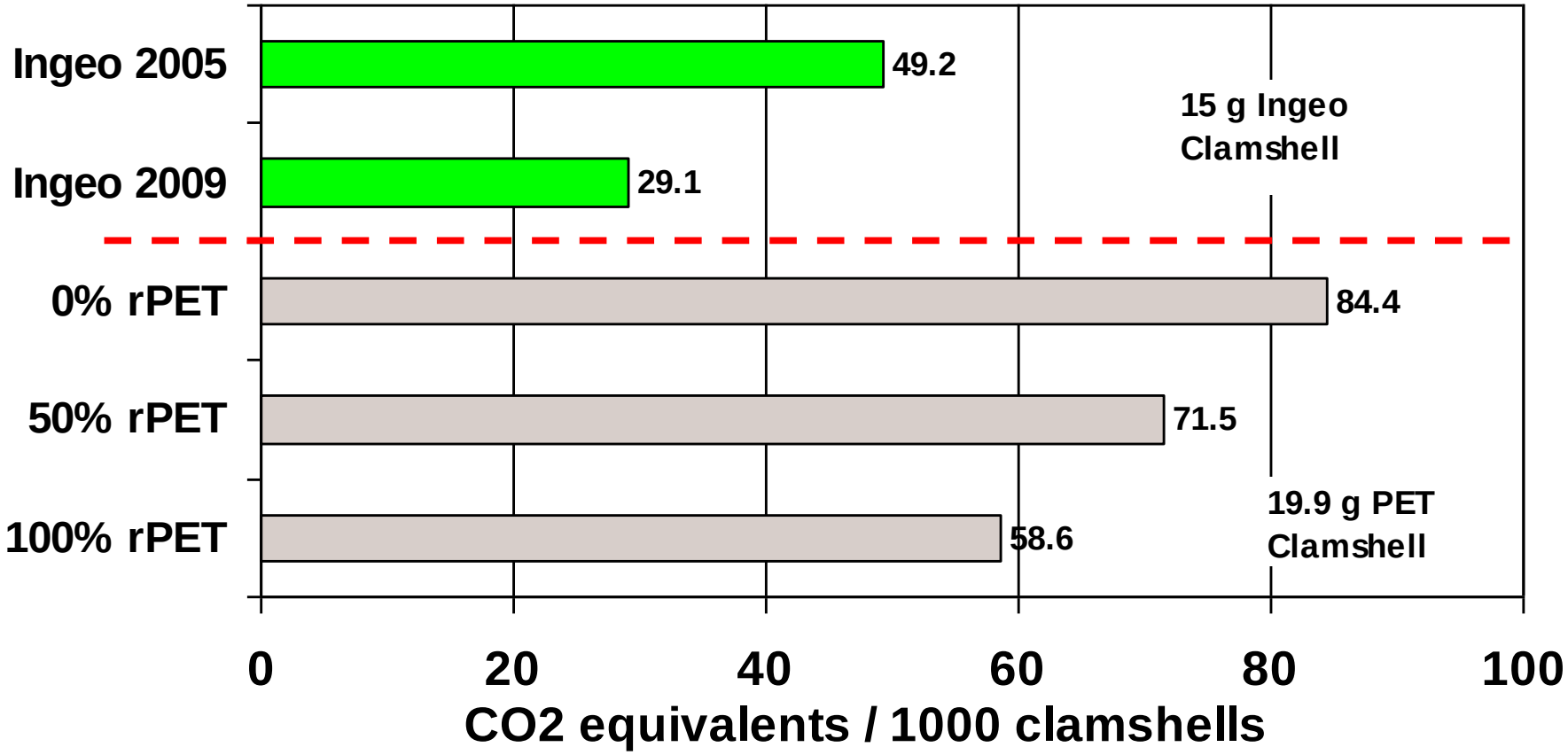
Results for climate change



US EOL: clamshell landfilled after use

Conclusions:

- *In all scenarios, virgin Ingeo has a lower GHG footprint than 100% rPET*
- *Differences in impact increases significantly if rPET content is less than 100%.*

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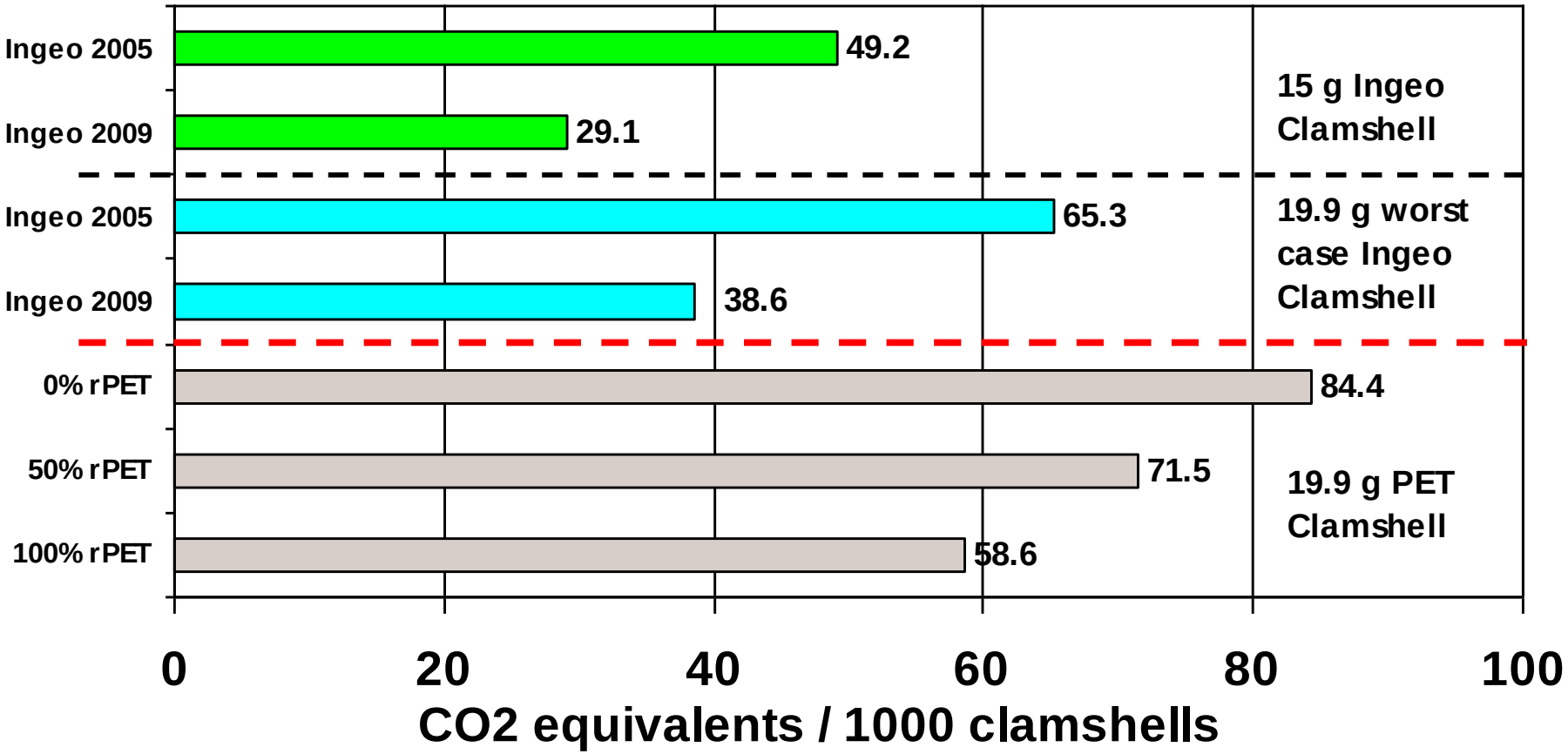
Results for climate change

What happens if Ingeo clamshell is not light-weighted?

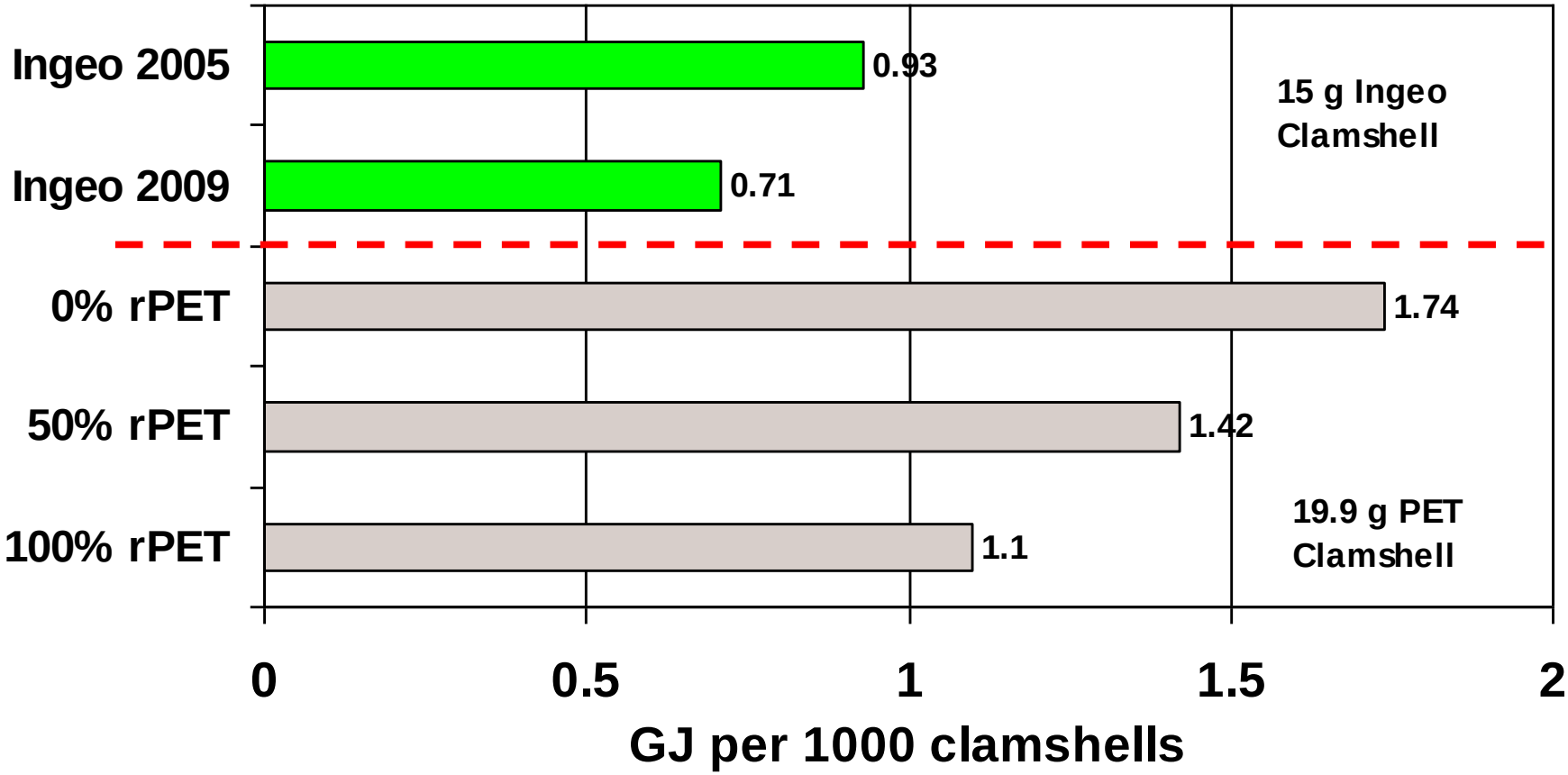


US EOL: clamshell landfilled after use

Conclusions:

- *Even with Overdesigned Ingeo Clamshell, today's virgin Ingeo is still better than 100% rPET*
- *Differences in impact increases significantly if rPET content is less than 100%.*

Results for non renewable primary energy required



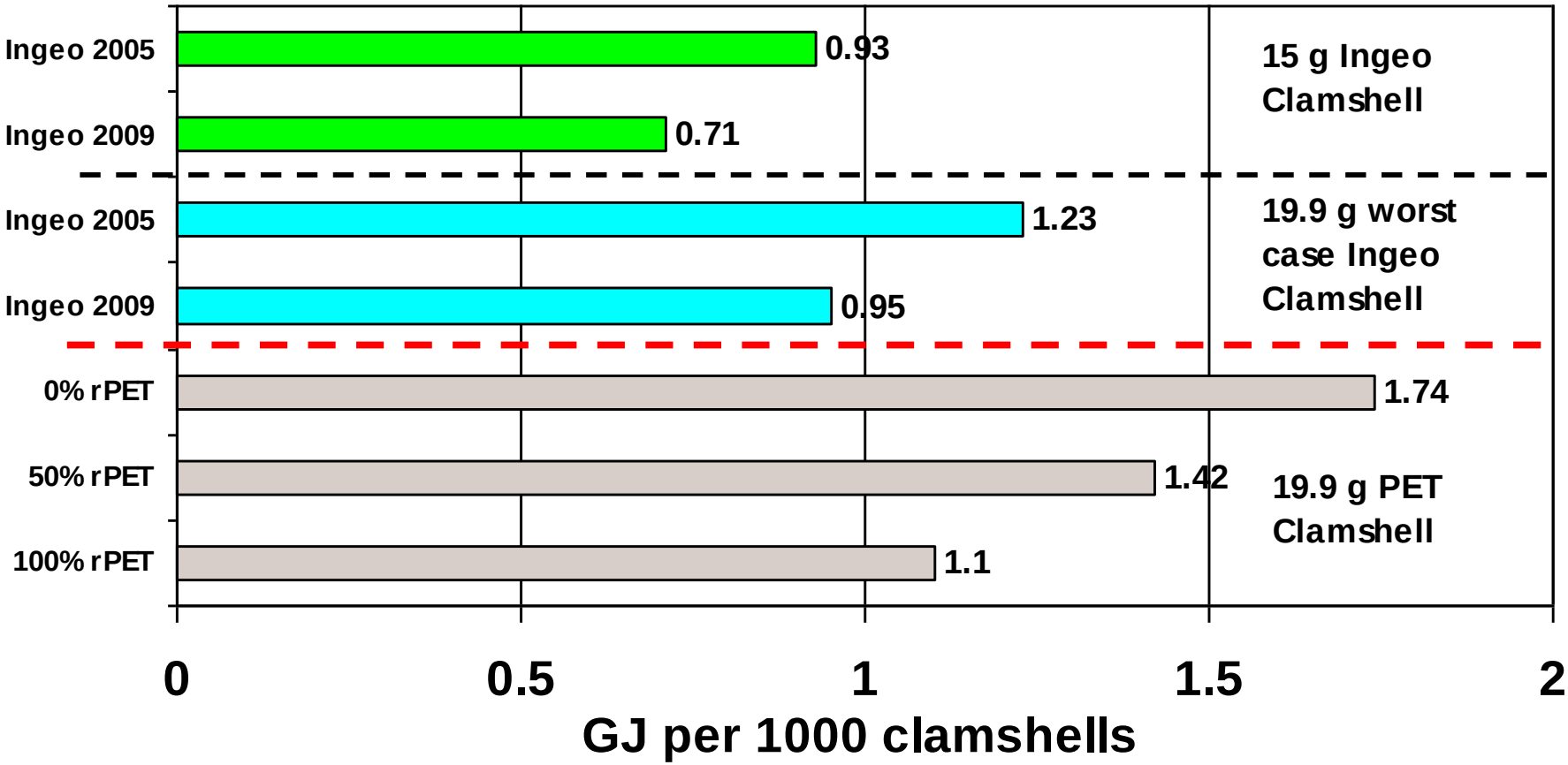
US EOL: clamshell landfilled after use

<u>Conclusions:</u>

- *In <u>all</u> scenarios, virgin Ingeo uses less energy than 100% rPET clam shells*
- *Differences in impact increases significantly if rPET content is less than 100%.*

Results for non renewable primary energy

What happens if Ingeo clamshell is not light-weighted?



US EOL: clamshell landfilled after use

Conclusions:

- *Even with an overdesigned Ingeo Clamshell, today's virgin Ingeo uses less energy better than 100% rPET*
- *Differences in impact increases significantly if rPET content is less than 100%.*

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Danone and WWF launch sustainable Ingeo™ Activia Yogurt Cup in Germany

"Biomass resources for bio-based products have to be produced sustainably – the certification systems are now in place"

Martina Fleckenstein,
Director EU-Policy,
Agriculture & Biomass,
WWF Germany, May 2012

Improves packaging carbon footprint by 25% and use 43% less fossil resources

[LCA study conducted by the Heidelberg based LCA institute IFEU]

USA
Biobased Incentives

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July 23, 2013

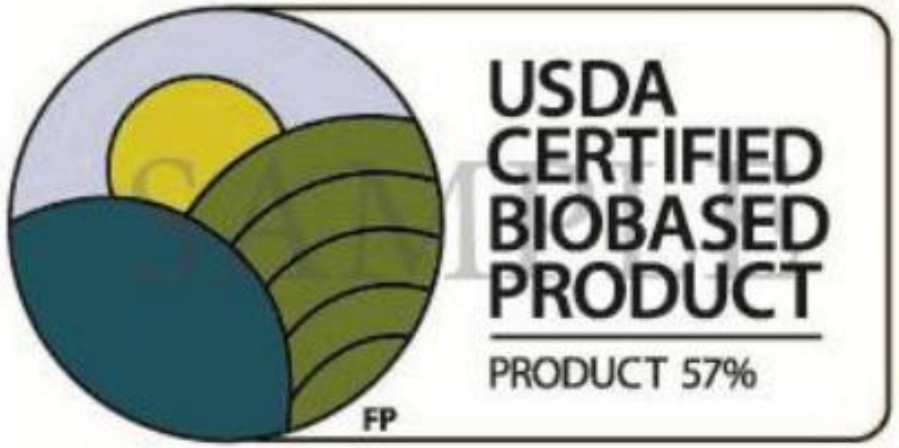
USDA & Bio-Based . . .

USDA BioPreferred℠
www.biopreferred.gov

WASHINGTON, Jan 19, 2011

USDA Launches New Biobased Product Label to Boost Demand for Products Made from Renewable Commodites …

"This new label will clearly identify biobased products made from renewable resources, and will promote the increased sale and use of these products in the commercial market and for consumers…"



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USDA BioPreferred℠ www.biopreferred.gov

Some Points of Reference: Consumer Labels

	Existing	New
USDA	USDA ORGANIC	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 57% FP
DOE	energy	energy ENERGY STAR

Product

Package

Both

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USDA BioPreferred℠ www.biopreferred.gov

Implementation Details

- Minimum Threshold biobased carbon content: 25%
  (Most Ingeo grades are 100% biobased carbon)
- No USDA fee for application & label license & usage
- 3rd party certified labs will do ASTM 6866 biobased carbon testing
- Manufacturer (applicant) is responsible for paying for independent lab testing to 6866 standard
- ASTM will administer the program

The Bioplastics Landscape

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Representative list of Bioplastics

Generic Descriptor	Examples	Biobased Content	Biodegradable
Polylactic Acid (PLA)	Natureworks Ingeo®	100%	Compostable - D6400
Polyhydroxyalkanoates (PHA)	Tellex Mirel®	>90%	Compostable - D6400 Marine - D7081
	Tianan	100%	Compostable - D6400 Marine - D7081
aliphatic-aromatic copolyester (AAC)	BASF Ecoflex®	0%	Compostable - D6400
	IRE Chemical EnPol®		
AAC/Starch blends	Novamont Mater-Bi®	Varies	Compostable - D6400
AAC/PLA blends	BASF Ecovio®	Varies (25-75%)	Compostable - D6400
	Cereplast Compostables®	Varies	Compostable - D6400
Thermoplastic Starch (TPS)	Cereplast Compostables®	Varies	Compostable - D6400
	DuPont Biomax® TPS	Varies	Compostable - D6400 Marine - D7081
Polybutylene Succinate PBS	Showa Bionelle®	?	Compostable - D6400
Polyamide 11 (PA 11)	Arkema Rilsan®	100%	No
bio-Polyolefins (bio-PO)	Braskem (planned)	100%	No
	Dow/Crystalev (planned)	100%	No
Polytrimethyleneterephthalate (PTT)	DuPont Sorona®	37%	No
	DuPont Biomax® PTT	37%	No
Polyamide 6,10 (PA6,10)	BASF Ultramid® Balance	63%	No
	DuPont Zytel®	?	
Conventional plastic/bioplastic blends	Cereplast Hybrid Resins®	Varies	No
Polyether Block Amide	Arkema Pebax® Rnew	100%	No

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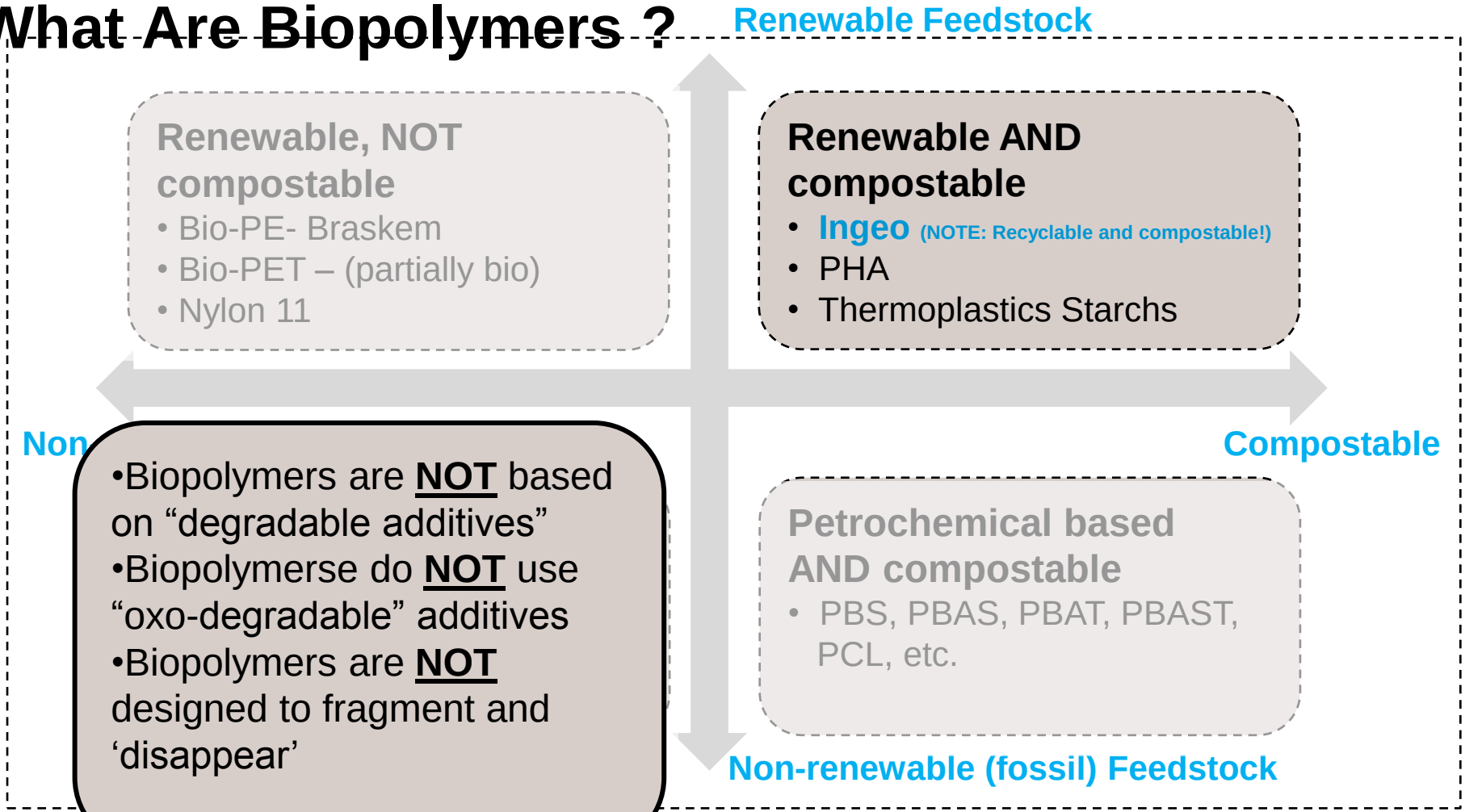
What Are Biopolymers ?



What Happens to Ingeo Should it End Up in Landfill ?

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What Happens to Ingeo Should it End Up in Landfill ?

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Ingeo™ behavior in Anaerobic Conditions . . .

- We've considered two extremes

1		2
What happens to Ingeo Under Landfill conditions ?		***Can Ingeo be forced to generate methane ?***

- Each case has been assessed quantitatively, by independent 3rd party authority OWS (Belgium)

1. What Happens to Ingeo™ in Accelerated Landfill Conditions?

- Long Term Testing Required (ASTM D5526)

ASTM D5526-94 (2002)

"Standard test method for determining anaerobic biodegradation of plastic materials under accelerated landfill conditions"

This static anaerobic biodegradation test determines the biodegradability of a material in a (somewhat optimized) landfill environment.

Test Conditions:

Temp:	**21°C**	**Duration: 6 months (up to 12-24)**
Sample Size:	**pellets**	**Inoculum: Sample ratio: 150 g : 2 g**

Samples:

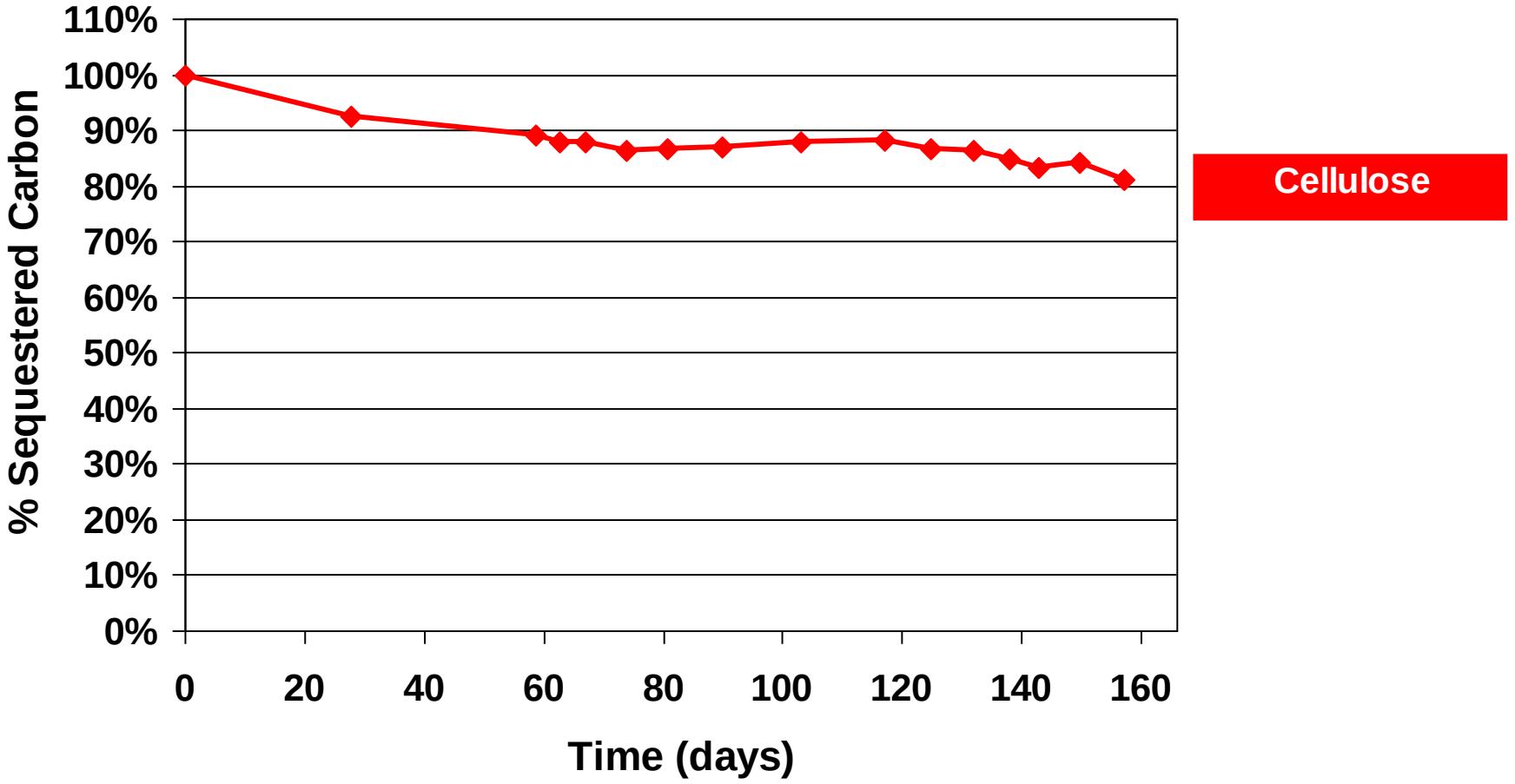
Degradation References:
Cellulose

Test Samples:
Ingeo 2002D; thermoforming grade
Ingeo 4032D: film grade
Ingeo 4060D: film applications

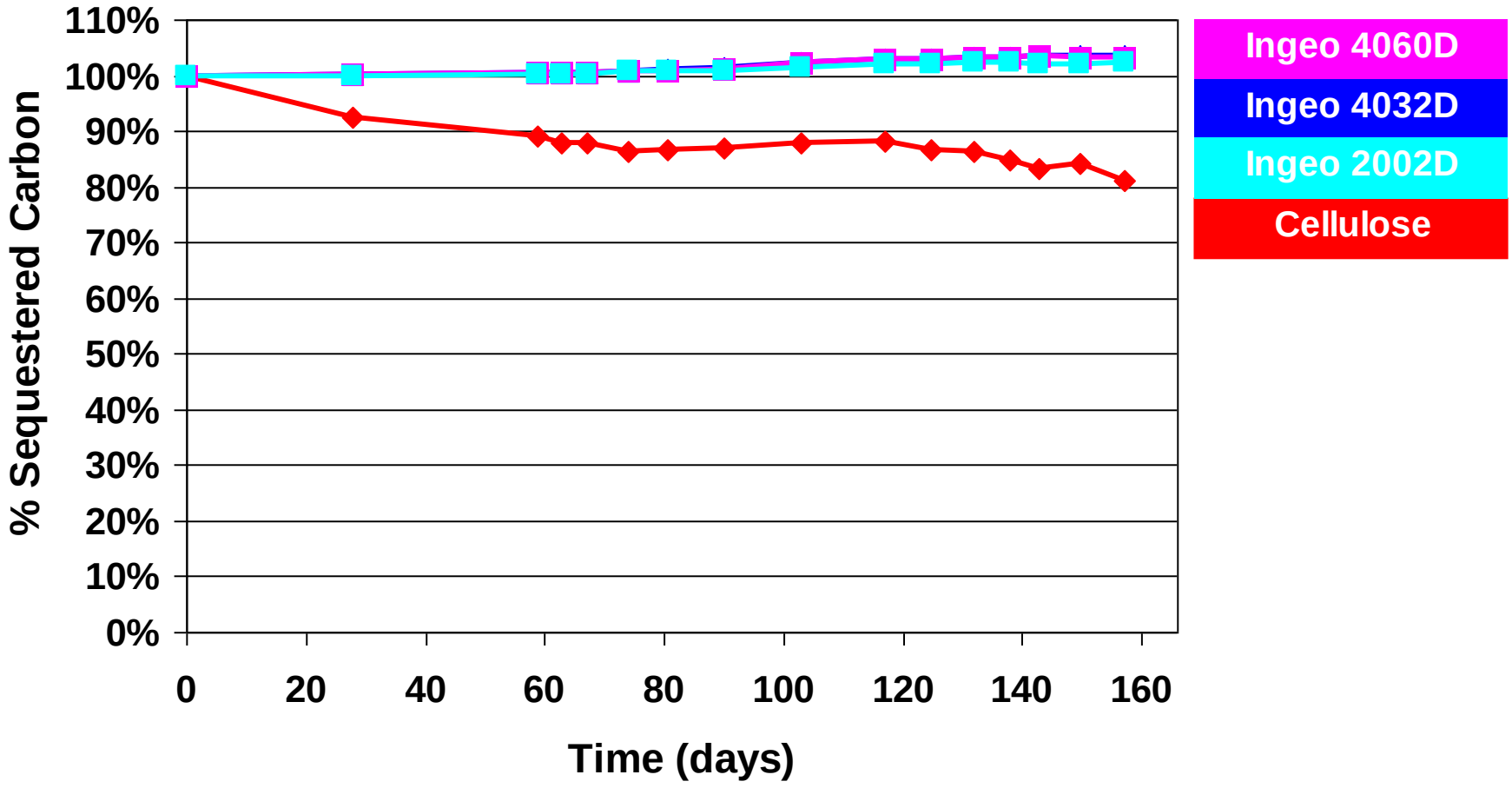
Cellulose = ie white office paper

ASTM Standard D5526 (2002), ASTM International, West Conshohocken, PA, 2003, www.astm.org

ASTM D5526: Accelerated Landfill Simulation



ASTM D5526: Accelerated Landfill Simulation



OWS:

"Biodegradation has not started for any of the Ingeo test samples"

2. Can Ingeo™ be forced to generate methane?

- Accelerated Testing is Appropriate – ASTM D5511-02

ASTM D5511-02

"Standard test method for determining anaerobic biodegradation of plastic materials under high-solids anaerobic digestion conditions"

The biodegradability of plastics is determined through high-rate dry anaerobic batch fermentation with significantly accelerated conditions

Test Conditions:

Temp: **35°C**
Sample Size: **pellets**

Duration: 15 days (up to 30 days)
Inoculum/Sample ratio: 1000 g / 2 g (pH, nutrients, active inoculum,…)

Samples:

Degradation References:
Polyethylene (inert)
Cellulose (fast)

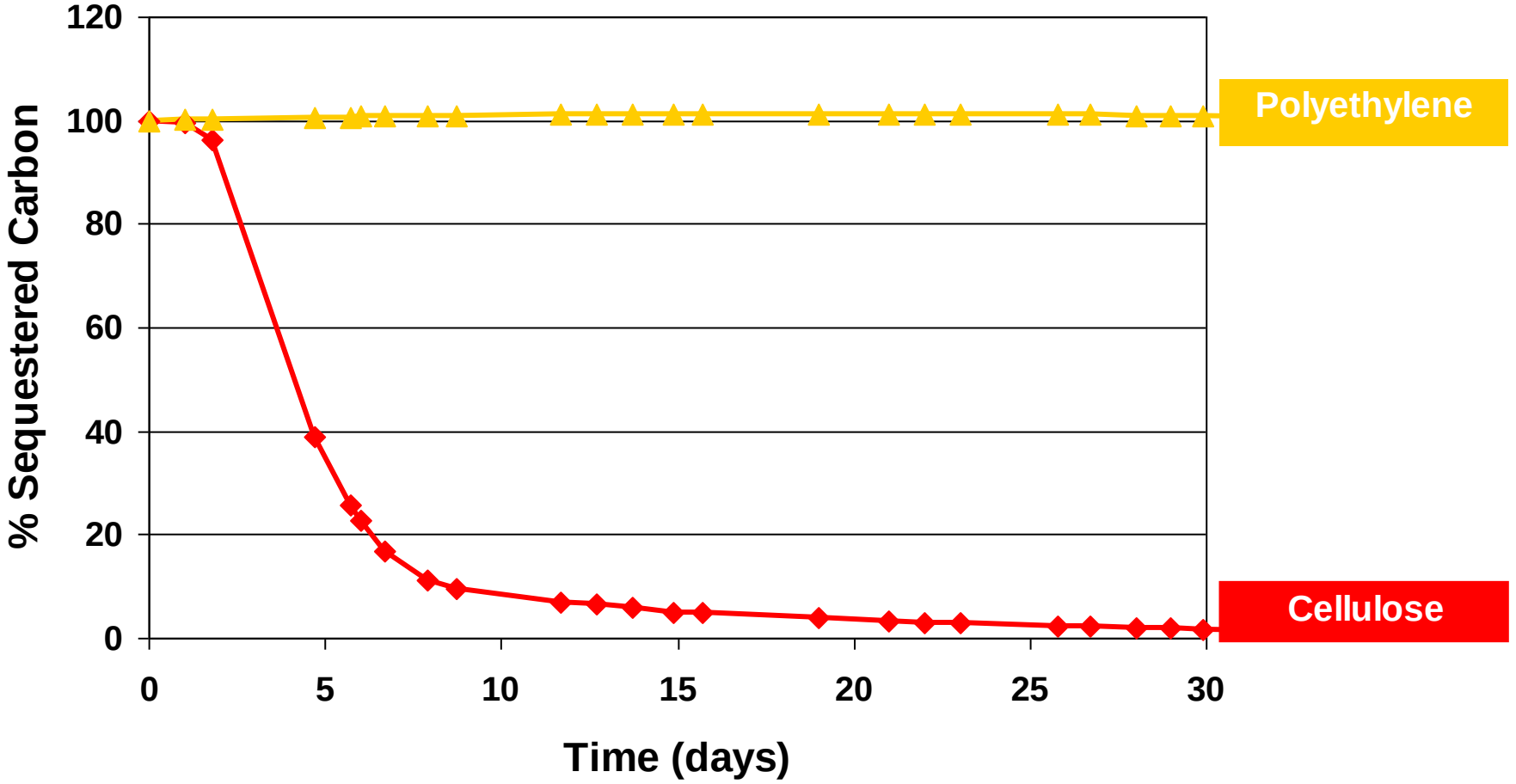
Test Samples:
Ingeo 2002D; thermoforming grade
Ingeo 4032D: film grade
Ingeo 4060D: film applications

ASTM Standard D5511: ASTM International, West Conshohocken, PA, 2003, www.astm.org

4. "Where it Goes"

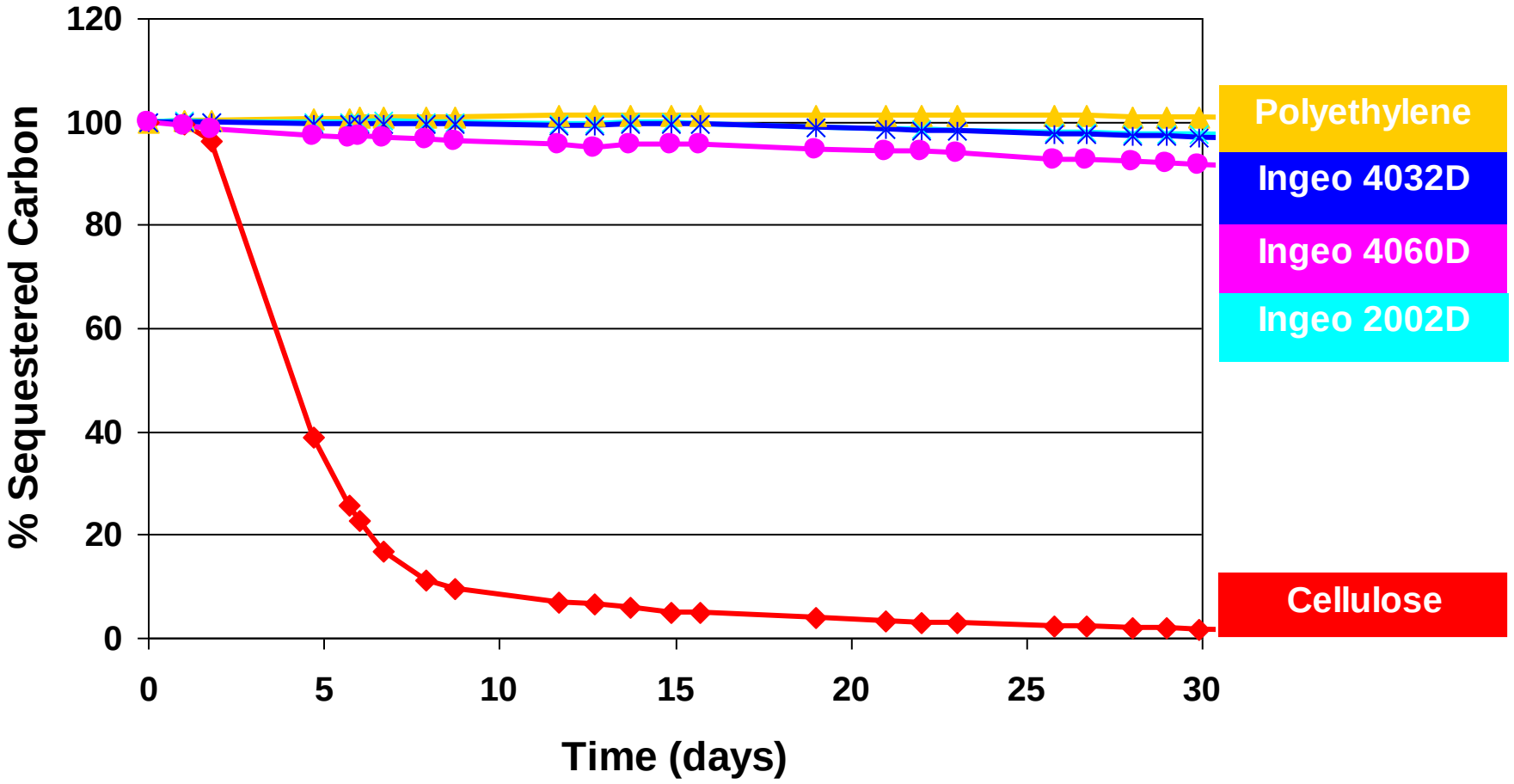
Can Ingeo™ be forced to generate methane?

ASTM D5511: Mesophilic Anaerobic Digester Simulation



Can Ingeo™ be forced to generate methane?

ASTM D5511: Mesophilic Anaerobic Digester Simulation



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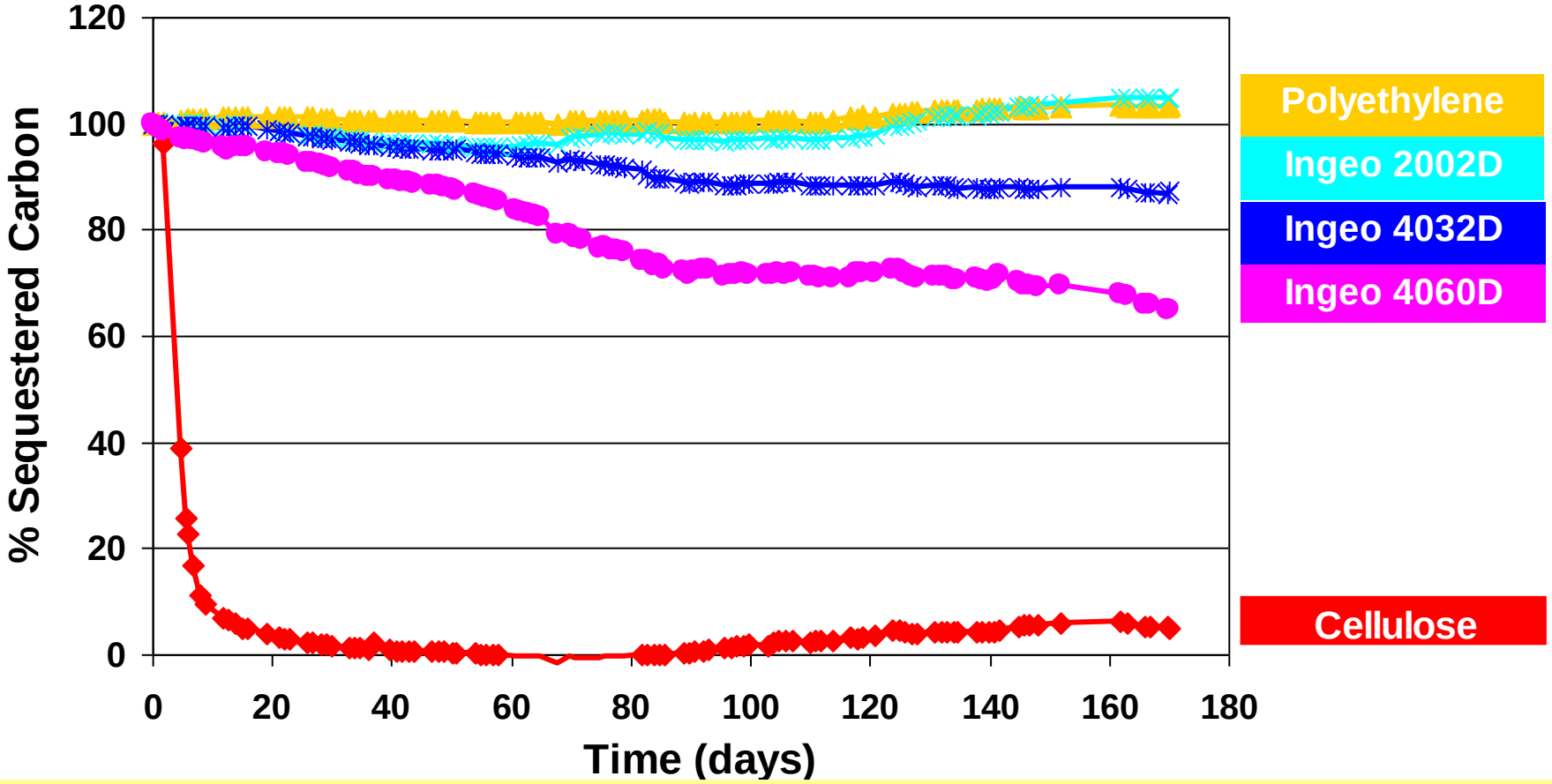
4. "Where it Goes"

Can Ingeo™ be forced to generate methane?

ASTM D5511: Mesophilic Anaerobic Digester Simulation



OWS:

"The Ingeo grades tested would be poor feedstocks for a mesophilic biogasification facility"

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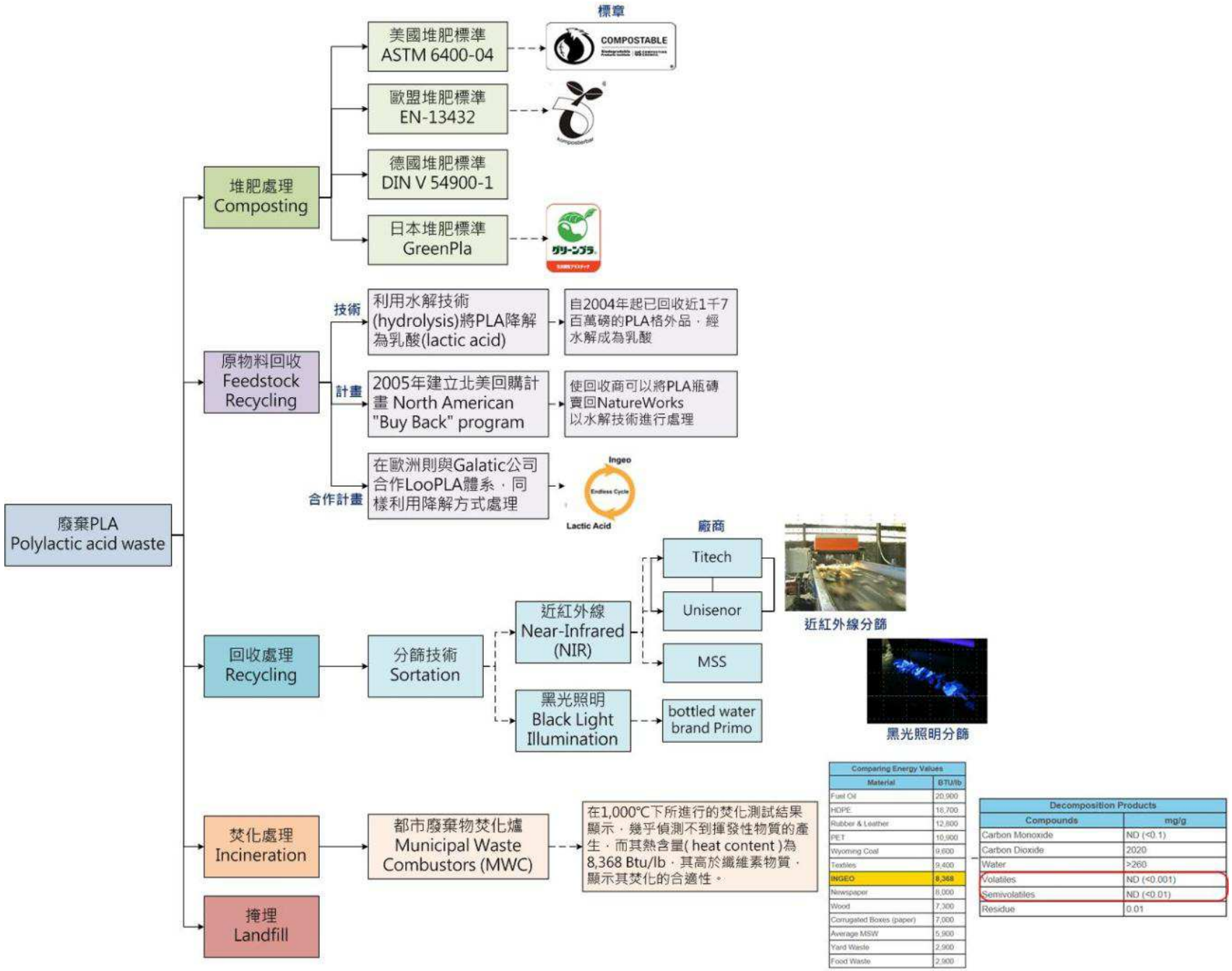
The behavior of Ingeo™ products in landfills

Conclusions

- In Landfill [ASTM D5526] All the carbon in Ingeo remains sequestered

- In an anaerobic digestion facility [ASTM D5511], In anaerobic bio-digester, some grades of Ingeo can be marginally degraded
  - Not viable feedstocks for mesophilic degradation
  - Residuals would be compostable



Comparing Energy Values	
Material	BTU/lb
Fuel Oil	20,900
HDPE	18,700
Rubber & Leather	12,800
PET	10,900
Wyoming Coal	9,600
Textiles	9,400
INGEO	8,368
Newspaper	8,000
Wood	7,300
Corrugated Boxes (paper)	7,000
Average MSW	5,900
Yard Waste	2,900
Food Waste	2,900

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

ANSI/ASABE S596 FEB2006
Recycling Plastic Containers from Pesticides and Pesticide-Related Products

American Society of
Agricultural and Biological Engineers

STANDARD

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

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Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

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ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA ph. 269-429-0300, fax 269-429-3852, hq@asabe.org

ANSI/ASABE S596 FEB2006
Approved April 2006 as an American National Standard

Recycling Plastic Containers from Pesticides and Pesticide-Related Products

Developed by ASABE with the cooperation of CropLife America and the Ag Container Recycling Council. Approved by the ASABE SE Division and adopted by ASABE February 2006; approved as an American National Standard April 2006.
Keywords: Containers, Definitions, Pesticides, Plastic, Recycling, Safety, Storage, Surfactants

1 Purpose and scope

1.1 This Standard specifies management practices for effectiveness and safety in the handling, cleaning and recycling of used non-refillable, high density polyethylene (HDPE) containers embossed with recycling symbol #2 up to 212 L (56 gal) that originally held pesticides and pesticide-related products (defined in paragraph 2.6) labeled for agriculture, forestry, professional specialty pesticide (defined in paragraph 2.8) use, and structural pest control. Containers that originally held antimicrobial products that are subject to a tolerance or that require an exemption from a tolerance are within the scope of this Standard. Containers that originally held other antimicrobial products, veterinary products, consumer products, or consumer home and garden products are outside the scope of this Standard. Examples of HDPE containers covered by this Standard are shown in Fig. 1.

1.2 This Standard is intended to assist applicators of pesticides and pesticide-related products labeled for the uses listed in paragraph 1.1 recycling organizations; sites and facilities where containers are collected; entities that collect and granulate or otherwise reduce the volume of containers; plastic processors; manufacturers of end-use products; users of end-use products manufactured from recycled plastic; regulatory agencies; and chemical manufacturers and distributors.

1.3 This Standard specifies procedures and criteria for rinsing, preparing, inspecting and collecting containers; rejection criteria for unacceptable containers; volume reduction of, storing, and processing the plastic; transporting containers and plastic; manufacturing end-use products; determining acceptable end-use products; and recordkeeping. These procedures and criteria are intended to ensure that the plastic will be handled and utilized to manufacture appropriate end-use products as described in Section 14 in such a way that the plastic will have no unreasonable adverse effect on the environment, people handling the plastic, or users of end-use products manufactured from recycled plastic.

Figure 1 – Typical HDPE Containers

1.4 The specifications in this Standard do not replace, modify, or override regulations of appropriate jurisdictions.

1.5 Recordkeeping requirements are described in Sections 6, 9, 10, 12 and 13. These records shall be maintained to verify that procedures described in this Standard have been followed, to verify that the plastic is only used to manufacture acceptable end-use products, and to facilitate tracing recycled plastic back to its source. The information required shall be recorded on forms similar to the example forms provided in Figures 8-13 in normative Annex A.

2 Definitions

2.1 agricultural crop production: crop production at farms, forests, nurseries and greenhouses.

2.2 dry plastic: reduced-volume plastic that does not leave a moisture residue on an absorbent material (such as paper or corrugated cardboard).

2.3 fully drained container: a container that has been allowed to drain for 30 seconds after the flow is down to a drip.

2.4 HDPE: high-density polyethylene. (See paragraph 9.9.)

2.4.1 blow-mold grade or fractional melt HDPE: HDPE that has a melt index value between 0 and 1.

2.4.2 high molecular weight HDPE: HDPE with a molecular weight numbering in the millions.

2.4.3 injection grade HDPE: HDPE with a melt index value between 6 and 8 and a density of between 0.950 g/cm^3 and 0.955 g/cm^3.

2.5 open head drum: drum with a removable head (top)

2.6 pesticide-related products: For the purposes of this Standard, pesticide-related products are adjuvants that are added to a pesticide spray mix.

2.7 processing plastic: the intermediate steps of handling plastic between volume reduction and end-use product manufacturing other than storage and transportation. Processing plastic includes, but is not limited to, washing, drying, and regrinding the plastic.

2.8 professional specialty pesticides: registered pesticides used by professional end users in turf, ornamental, pest control, aquatic and terrestrial vegetation management and other non-food/fiber applications.

2.9 shipping containers: gaylord boxes, flexible intermediate bulk containers, super-sacs or other vessels used to collect, transport and/or store reduced-volume plastic.

2.10 tight head drum: drum with a non-removable head (top).

3 General safety requirements

3.1 Each of the processes in this Standard shall be performed in a manner that avoids an unhealthy or unsafe work environment, injuries to persons, damage to property and pollution.

3.2 Appropriate personal protective equipment (PPE) shall be used for each process.

3.2.1 For container rinsing, the required PPE is specified on the pesticide label under the directions for use.

3.2.2 When handling containers after they are rinsed, PPE should include, at a minimum, protective eyewear, chemical-resistant gloves and a chemical-resistant apron.

3.2.3 For transportation, storage, processing, and manufacturing end-use products, handlers shall follow relevant workplace safety regulations.

3.3 To minimize any potential risk to human health and the environment, non-refillable pesticide containers that are included in this Standard shall not be reused as containers.

4 Rinsing containers

4.1 Containers shall be emptied of pesticides or pesticide-related products and rinsed as described in this section before they can be recycled.

4.2 Each container shall be triple rinsed or pressure rinsed according to the instructions on its label.

4.3 If the label does not include rinsing instructions or does not define the specific steps of the process (e.g. "Triple rinse or equivalent."), the container shall be rinsed according to paragraphs 4.4, 4.5, 4.6 or 4.7.

4.4 Pressure rinsing containers other than drums.

4.4.1 Empty contents of the container by turning the container so that any product trapped in the handle is allowed to flow out. Once flow is down to a drip, allow the container to drain for an additional 30 seconds.

4.4.2 Immediately begin rinsing procedures or the product may become difficult to remove.

4.4.3 The pressure nozzle shall be connected to a clean water source with a pressure of at least 276 kPa (40 psi). Examples of pressure nozzles are shown in Fig. 2.

4.4.4 Hold the container so the rinsate drains into the spray mix or an appropriately labeled container.

4.4.5 Use the pressure nozzle according to the manufacturer's instructions.

4.4.6 Turn the pressure nozzle inside the container to assure good coverage of all sides including the handle.

4.4.7 Rinse for at least 30 seconds.

4.4.8 Rinse cap into an appropriately labeled container and dispose of the cap as solid waste. Do not re-attach cap to container.

4.4.9 Carefully rinse any formulation from the outside of the container.

4.4.10 Inspect the container to ensure that all visible and dislodgeable residue has been removed.

4.4.11 If any visible and dislodgeable residue is still in or on the container, repeat the process until that residue has been removed.

4.4.12 Containers should be punctured so they cannot be reused as containers or should otherwise be rendered unusable. A punctured container is shown in Fig. 2.

4.4.13 Replace any guards/covers on the rinsing apparatus.

4.4.14 Containers shall be fully drained before they are offered for recycling.

4.5 Triple rinsing containers other than drums.

4.5.1 Empty contents of the container by turning the container so that any product trapped in the handle is allowed to flow out. Once flow is down to a drip, allow the container to drain for an additional 30 seconds.

4.5.2 Immediately begin rinsing procedures or the product may become difficult to remove.

4.5.3 Fill the empty container 1/4 full of clean water.

4.5.4 Securely replace the cap on the container. With the container opening facing left, shake the container left to right over a distance of 10 to 15 cm (4 to 6 in.). Shake the container a minimum of two times per second for 30 seconds.

4.5.5 Drain rinse water into the spray mix or an appropriately labeled container.

4.5.6 Fill the empty container 1/4 full of clean water a second time.

4.5.7 Securely recap the container. With the opening of the container pointed towards the ground, shake the container as described in paragraph 4.5.4. Then drain the rinse water into the spray mix or an appropriately labeled container.

4.5.8 Fill the empty container 1/4 full once more with clean water.

4.5.9 Securely recap the container. With the container in the normal, upright position, shake the container as described in paragraph 4.5.4. Then drain the rinse water into the spray mix or an appropriately labeled container.

4.5.10 Rinse cap into an appropriately labeled container and dispose of the cap as solid waste. Do not re-attach cap to container.

4.5.11 Carefully rinse any formulation from the outside of the container.

4.5.12 Inspect the container to ensure that all visible and dislodgeable residue has been removed.

4.5.13 If any visible and dislodgeable residue is still in or on the container, repeat the process until that residue has been removed.

4.5.14 Containers should be punctured so they cannot be reused as containers or should otherwise be rendered unusable.

4.5.15 Containers shall be fully drained before they are offered for recycling.

4.6 Pressure rinsing drums.

4.6.1 Empty drum to the lowest possible level.

4.6.2 Immediately begin rinsing procedures or the product may become difficult to remove.

4.6.3 The pressure nozzle shall be connected to a clean water source with a pressure of at least 276 kPa (40 psi).

Figure 2 – Examples of Pressure Nozzles and a Punctured Container

Figure 3 – Wedge Cut into a Drum

4.6.4 Insert the pressure rinse nozzle into the drum. This may require drilling a hole into the bottom of the drum for an entry point or cutting a wedge in the drum to drain the rinsate. (See Fig. 3, Wedge cut into a drum.)

4.6.5 Rotate the pressure nozzle inside the drum to rinse all sides.

4.6.6 Rinse drum for at least 30 seconds or until rinsate runs completely clear, whichever is longer.

4.6.7 Rinse bung into an appropriately labeled container and dispose of the bung as solid waste.

4.6.8 Carefully rinse any formulation from the outside of the drum.

4.6.9 Inspect the drum to ensure that all visible and dislodgeable residue has been removed.

4.6.10 If any visible and dislodgeable residue is still in or on the drum, repeat the process until that residue has been removed.

4.6.11 Drums should be punctured so they cannot be reused as containers or should otherwise be rendered unusable.

4.6.12 Replace any guards/covers on the rinsing apparatus.

4.6.13 Drums shall be fully drained before they are offered for recycling.

4.7 Triple rinsing drums.

4.7.1 Empty drum to the lowest possible level.

4.7.2 Immediately begin rinsing procedures or the product may become difficult to remove.

4.7.3 Fill drum with water to 1/4 of capacity. Replace bungs.

4.7.4 Tip drum onto its side and roll it back and forth for 30 seconds, ensuring at least one complete revolution.

4.7.5 Stand the drum on its end, and tip it back and forth several times to rinse the corners.

4.7.6 Turn the drum onto its other end, and tip it back and forth several times to rinse the corners.

Figure 4 – Society of the Plastics Industry Resin Indentification Code for HDPE

4.7.7 Carefully empty the rinsate into the spray mix or an appropriately labeled container.

4.7.8 Repeat steps 4.7.3 through 4.7.7 two more times.

4.7.9 Rinse bung into an appropriately labeled container and dispose of the bung as solid waste.

4.7.10 Carefully rinse any formulation from the outside of the drum.

4.7.11 Inspect the drum to ensure that all visible and dislodgeable residue has been removed.

4.7.12 If any visible and dislodgeable residue is still in or on the drum, repeat the process until that residue has been removed.

4.7.13 Drain all rinse water into the spray mix or an appropriately labeled container. This may require drilling a hole or cutting a wedge into the bottom of the drum to completely drain the rinsate. (See Fig. 3, Wedge cut into a drum.)

4.7.14 Drums should be punctured so they cannot be reused as containers or should otherwise be rendered unusable.

4.7.15 Drums shall be fully drained before they are offered for recycling.

5 Removing non-HDPE components from containers.

5.1 Non-HDPE components attached to containers cannot be recycled and shall be removed from the containers as described in this section before the containers can be recycled.

5.2 All non-HDPE components shall be removed from containers and disposed of as solid waste. Examples of non-HDPE components include, but are not limited to, caps, handles made of metal or different plastic, foil seals and rubber linings.

5.3 Caps shall not be put back on rinsed containers.

5.4 Sleeves, labels and booklets shall be removed from the containers unless local authorities require that labels remain affixed. Glued on labels may remain on the container.

6 Inspecting containers

6.1 An inspection shall be conducted on containers to ensure that they are clean, properly prepared, and included in the scope of the recycling program. (See informative Annex B, Commentary.) Containers shall meet all specifications in this Section.

6.2 Containers shall be non-refillable and made from HDPE. Some HDPE containers have a thin barrier of other co-manufactured material

Figure 6 – Container with Dried Formulation that is Visible and Dislodgeable Residue. This Container is Unacceptable for Recycling. NOTE: To view a more accurate color rendition of Figure 6, a color photo of is available at http://www.asabe.org/standards/images/S696images.html

that is acceptable. HDPE containers will be embossed with recycling symbol #2, which is shown in Fig. 4.

6.3 The capacity of the container shall be 212 L (56 gal) or less.

6.4 The containers shall not have caps or other non-HDPE parts, such as metal handles, seals (typically foil and/or paper) and rubber linings, attached. (See Sections 5.2 and 5.3.)

6.5 Labels and booklets shall be removed from containers. (See Section 5.4.)

6.6 The container shall be empty, properly rinsed, and fully drained as required in Section 4.

6.7 All parts of the container shall be free of visible and dislodgeable residue.

6.7.1 The inside and outside of the container shall be inspected to assure that all surfaces are free of visible and dislodgeable residue. In particular, the pour spout, spout threads and container wall surrounding the spout shall be checked. (See Fig. 5 for an example of a container with visible and dislodgeable residue that is unacceptable for recycling.)

6.7.2 Some pesticides discolor plastic with a penetrating stain. Stained containers are acceptable provided that no material can be smeared or removed when touched by a protective-gloved hand. (See Fig. 6 for an example of a stained container that is acceptable for recycling.)

6.8 Records shall be maintained to identify the site where the containers were inspected, the name and affiliation of the container inspector, and the date of inspection and to include a certification that the containers were inspected. The records shall be maintained for a minimum of 3 years from the date of inspection. See the example Inspection Certificate in Fig. 8 in normative Annex A.

7 Rejecting unacceptable containers.

7.1 This Section provides procedures for properly handling and managing containers that are unacceptable for recycling.

7.2 Containers that do not meet the cleanliness standards in paragraphs 6.6 and 6.7 shall be rejected.

7.3 Proper management of rejected containers shall remain the responsibility of the person bringing in the containers and offering them for recycling.

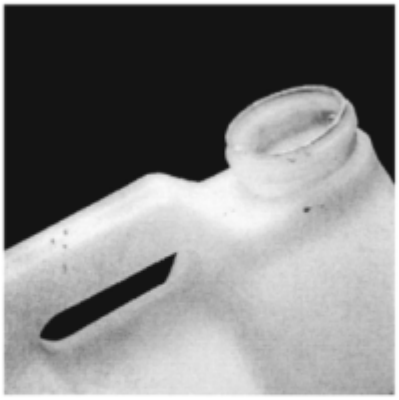


Figure 6 – Container That is Stained But Has No Visible and Dislodgeable Residue. This Container is Acceptable for Recycling. NOTE: To view a more accurate color rendition of Figure 6, a color photo of is available at http://www.asabe.org/standards/images/5696images.html

7.4 Rejected containers may be properly rinsed, cleaned, prepared and presented again for acceptance.

7.5 Rejected containers shall be handled and processed with adequate precautions and in accordance with all applicable federal, state and local laws and regulations to prevent any potential risk to human health and the environment. (See informative Annex B, Commentary.)

8 Collecting containers and managing collection sites.

8.1 Containers shall be inspected according to Section 6 prior to accepting the containers at the collection site.

8.2 Containers shall be stored such that they remain clean and fully drained. (See informative Annex B, Commentary.)

8.3 The collection site shall be in compliance with all federal, state and local laws.

8.4 Container collection sites shall maintain the appropriate level of cleanliness before, during and after containers are collected. All materials that are at the collection site but not processed for volume reduction shall be collected from the site at the completion of work. Final management or disposal of these materials shall be in accordance with local, state and federal requirements. These materials may include closures (including caps, bungs and lids), handles, labels, inserts or cartons; waste generated by the volume reduction activities; trash (coffee cups, food wrappers, etc.); spills (oil, gasoline, plastic flakes, etc.); and other debris.

9 Volume reduction of containers.

9.1 Empty containers occupy a lot of space. The efficient packaging, transportation, and management of containers are facilitated by first reducing the volume of the containers. This section describes procedures for volume reduction and standards for volume reduction sites.

9.2 All containers shall be properly rinsed, prepared and inspected according to Sections 4, 5, and 6 before volume reduction.

9.3 Volume reduction includes but is not limited to granulation, baling, and shredding. Attempting to reduce container volume by driving heavy equipment over containers is ineffective and potentially unsafe.

9.4 Plastic should be dry at the end of the volume reduction process. Climate variations may require additional processing or storage steps to achieve this goal.

9.5 Volume reduction processes that are conducted repetitively at the same site shall be conducted on an impervious surface and protected from contamination, such as sand, gravel, dust, and moisture. This

Figure 7 – Field drain pipe.

specification is intended to keep the plastic dry and clean and to minimize any potential contamination of the volume reduction site.

9.6 The volume reduction site shall assure containment of the plastic.

9.7 Previous and current activities conducted at volume reduction sites shall not contaminate the plastic in such a way as to render it unacceptable for recycling. (See informative Annex B, Commentary.)

9.8 Volume reduction of the plastic shall be conducted so as to not adversely affect current or future activities at the site.

9.9 Containers should be segregated into the following HDPE categories before volume reduction:

9.9.1 Blow-mold grade or fractional melt HDPE, which includes but is not limited to bottles, jugs and tight head drums with capacities up to and including 212 L (56 gal).

9.9.2 High molecular weight HDPE, which includes but is not limited to tight head drums with capacities greater than 19 L (5 gal) and less than 212 L (56 gal).

9.9.3 Injection grade HDPE, which includes but is not limited to open head pails or drums with capacities less than 212 L (56 gal) (i.e., injection-molded pails or drums).

9.10 Reduced-volume plastic may be packaged in shipping containers as defined in paragraph 2.9. Shipping containers shall be free of contamination that would render the plastic unacceptable for recycling.

9.11 Shipping containers or units (such as bales) shall be marked to identify the contents as HDPE from pesticide and pesticide-related product containers. Referring to a code from a log or record is acceptable.

9.12 Reduced-volume plastic shall be labeled in a way that the HDPE category (if applicable) and collection site can be identified.

9.13 The entity that authorizes volume reduction shall ensure that the plastic is delivered to a manufacturer of end-use products that are acceptable according to the criteria in Section 14.

9.14 The entity that authorizes volume reduction shall complete the applicable parts of a form similar to the example Recycling/Shipping Certificate for Volume Reduction in Fig. 9 in normative Annex A and shall ensure that the form is delivered to a storage, processing, or end-use manufacturing facility or a broker. The Recycling/Shipping Certificate for Volume Reduction shall include the shipping container or unit numbers that were shipped, the destination of the plastic, and a certification that the plastic was shipped to that location.

9.15 Records shall be maintained to identify the plastic as plastic from pesticide and pesticide-related product containers, and to identify the HDPE category (if applicable), collection site location/address, date of volume reduction, estimated weight, and the manufacturer of the end-use product. The records shall be kept for a minimum of 3 years from the date of volume reduction. See the example Volume Reduction Form in Fig. 10 in normative Annex A.

10 Transportation of containers or plastic.

10.1 The procedures described in this Section ensure that rinsed containers and reduced-volume plastic are transported in good condition (dry and clean) to proper locations.

10.2 Containers or plastic shall be transported directly to a volume reduction site, storage site, processing site, or an end-use product manufacturer that meets the conditions in this Standard.

10.3 Containers and plastic shall be kept dry and contained in the vehicle during transportation.

10.4 Dry, visually clean shipping containers shall be used to transport plastic.

10.5 Each shipping container shall be clearly identified as containing HDPE from pesticide and pesticide-related product containers.

10.6 Records shall be maintained to identify the plastic with the transportation starting point, shipping company, destination, and net weight. The records shall be retained for a minimum of 3 years from the date of delivery to the destination. See the example Transportation Form in Fig. 11 in normative Annex A.

11 Storage of plastic.

11.1 Plastic shall be stored under conditions that maintain its quality and cleanliness, as described in this section.

11.2 Previous and current activities conducted at plastic storage sites shall not contaminate the plastic in such a way as to render it unacceptable for recycling. (See informative Annex B, Commentary.)

11.3 The plastic shall be stored so as to not adversely affect current or future activities at the site.

11.4 Storage shall be in compliance with federal, state and local regulations.

11.5 A storage facility shall be designed to keep the plastic dry and to protect the plastic from contamination such as sand, gravel, dirt and moisture.

11.6 To allow circulation of air during storage, a separation shall be maintained between the shipping container and the floor.

12 Processing the plastic.

12.1 Plastic shall be processed in accordance with this section to ensure that it remains uncontaminated and to maintain cleanliness at processing sites.

12.2 Previous and current activities conducted at plastic processing sites shall not contaminate the plastic in such a way as to render it unacceptable for recycling. (See informative Annex B, Commentary.)

12.3 The plastic shall be processed so as to not adversely affect current or future activities at the site.

12.4 Processing activities shall be in compliance with federal, state and local regulations.

12.5 Waste generated during processing activities may have an adverse impact on the material being processed, the environmental health of the site, and on the community at large. Best efforts should be made to minimize the amount of waste generated while processing the plastic. Waste minimization plans and activities should include efforts to minimize the volume of water used during processing.

12.6 Records shall be maintained to identify the plastic with the processing site location/address, date of processing, and type of processing. The records shall be retained for a minimum of 3 years from the date of processing. See the example Plastic Processing Form in Fig. 12 in normative Annex A.

13 Manufacturing end-use products.

13.1 End-use products shall be manufactured in accordance with this Section to restrict the use of the plastic for manufacturing acceptable end-use products, to ensure that manufacturing does not contaminate the plastic, and to maintain cleanliness at manufacturing sites.

13.2 Previous and current activities conducted at end-use product manufacturing sites from the plastic shall not contaminate the plastic in such a way as to render it unacceptable for use. (See informative Annex B, Commentary.)

13.3 End-use products shall be manufactured from the plastic so as to not adversely affect current or future activities at the site.

13.4 End-use product manufacturing activities shall be in compliance with federal, state and local regulations.

13.5 The end-use product manufacturer shall only use the plastic for the manufacture of products that are acceptable according to the criteria in Section 14.

13.6 The end-use product manufacturer shall complete the applicable parts of a form similar to the example Recycling/Shipping Certificate for Volume Reduction in Fig. 9 in normative Annex A and shall ensure that

a copy of the completed form is delivered to the volume reducer. The Recycling/Shipping Certificate for Volume Reduction shall include the name and location of the end-use product manufacturer, the end-use product that was manufactured, and a certification that the plastic was only used to manufacture the acceptable end-use product identified on the form.

13.7 Records shall be maintained to identify the plastic with the end-use product manufacturing site location/address, date of manufacture and the end-use product manufactured. The records shall be retained for a minimum of 3 years from the date of manufacture. See the example End-Use Product Manufacturing Form in Fig. 13 in normative Annex A.

14 Determining acceptable end-use products.

14.1 Acceptable end-use products shall be determined such that they will have no unreasonable adverse effect on the environment, people handling the plastic, or users of the end-use products manufactured from the recycled plastic.

14.2 Products with frequent human exposure, such as food or beverage containers, toys, playground equipment and similar products are not acceptable end-use products.

14.3 Acceptable end-use products include marine pilings, bridge pilings, field drain pipe, fence posts, construction site mats, speed bumps, parking stops, hazardous waste drums, scaffold nailing strips, commercial truck sub-floor support members, and commercial truck/ manure spreader decker boards. (See Fig. 7, field drain pipe, which is an acceptable end-use product.)

14.4 Other acceptable end-use products shall be identified by conducting a risk assessment that accounts for the following factors:

14.4.1 Physical, chemical and toxicological properties of pesticides and pesticide-related products.

14.4.2 The probable concentration of pesticides and pesticide-related products in or on the surface of the end-use product.

14.4.3 The general characteristics of the end-use product, including the potential human and environmental exposure.

14.5 To the extent possible, the inputs to the risk assessment for determining acceptable end-use products should be based on statistically valid sampling and analytical data.

Annex A
(normative)
Example Recordkeeping Forms

Annex A includes full-sized and reproducible versions of the example forms cited in the Standard. The following table identifies the form title, the paragraph(s) of the Standard that refers to the form, and the figure number in Annex A.

Form Title	Paragraph in the Standard that Cites Form	Figure Number in Annex A
Container Inspection Certificate	6.8	8
Recycling/Shipping Certificate for Volume Reduction	9.14, 13.6	9
Volume Reduction Form	9.15	10
Transportation Form	10.6	11
Plastic Processing Form	12.6	12
End-use Product Manufacturing Form	13.7	13

Figure 8 – Example Inspection Certificate

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pesticides and Pesticide-Related Products

Container Inspection

Site Information:

Description or Address: _____
County: _____ Town/City: _____ State: _____
Site Contact: _____ Phone: _____

Container Inspector:

Name: _____
Affiliation: _____
Address: _____
Phone: _____
Authorized by: _____

Work Description:

Date: _____
Approximate weight/number of containers inspected: _____
Comments (if any):

Certification

As a participant in a pesticide container recycling program, I, _____ (print), hereby certify that the containers at this site were inspected on the date indicated below. Based on a visual examination, the accepted containers were judged to be: (1) appropriate for this ANSI/ASABE S596 FEB2006 pesticide container recycling program; (2) properly rinsed; and (3) properly prepared in accordance with ANSI/ASABE S596 FEB2006, Recycling Plastic Containers from Pesticides and Pesticide-Related Products.

Signed: _____ Date: _____
Authorized Personnel Signature

Note: This form should be filled out by a person who inspects plastic pesticide and pesticide-related product containers.

Figure 9 – Example Recycling/Shipping Certificate for Volume Reduction

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pesticides and Pesticide-Related Products

This section to be filled in by the Volume Reducer:

Company/Organization Name: _____
Shipping Container or Unit Numbers (Lots) that were shipped: _____
_____
_____
Net Weight of Shipped Plastic (lbs): _____
(shipped to) Name and Location of Storage, Processing or End-Use Product Manufacturing Facility or Broker: _____
Description of Plastic (HDPE Category, if applicable): _____
Other Comments (if any):

I, _____, of _____, hereby certify that the above
(Agent of Volume Reducer) (Company/Organization Name)

plastic from pesticide and pesticide-related product containers was shipped to _____ on _____.
(Name of Storage, Processing or End-Use Product Manufacturing Facility or Broker) (Date)

Signature: _____

- -

This section to be filled in by End-Use Product Manufacturing Company. If shipped to Broker, Broker assumes responsibility for assuring appropriate destination for plastic from pesticide containers reclaimed in accordance with ANSI/ASABE S596 FEB2006.

I, _____ of _____ at the location identified as
(Name of company representative) (Name of end-use product manufacturing company)

_____ in _____, _____,
(Site name) (City) (State)

hereby certify that:

Plastic recovered in accordance with ANSI/ASABE S596 FEB2006, Recycling Plastic Containers from Pesticides and Pesticide-Related Products, shall only be utilized to manufacture acceptable end-use product(s) specified below, and that the manufacture and distribution shall conform to ANSI/ASABE S596 FEB2006.

Product(s): _____
Signature: _____
(Authorized Agent)

Figure 10 – Example Volume Reduction Form

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pesticides and Pesticide-Related Products

The plastic identified on this form is plastic from pesticide and pesticide-related product containers.

Volume Reduction Company/Entity NAME:
Authorized Agent NAME:

Shipping Container or Unit #	Collection Site (Location/Address)	Volume Reduction Date	Estimated Weight in ( )	HDPE Category (if applicable)

Note: This form should be filled out by a company or entity that reduces the volume of the plastic pesticide and pesticide-related product containers.

Figure 11 – Example Transportation Form

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pesticides and Pesticide-Related Products

The plastic identified on this form is plastic from pesticide and pesticide-related product containers.

Shipping Company NAME:
Authorized Agent NAME:
Date:

Shipping Container or Unit #	Transportation Starting Point (Company and Address)	Transportation Destination (Company and Address)	Net Weight in ( )

Note: This form should be filled out by a company or entity that transports plastic from pesticide and pesticide-related product containers.

Note: A manifest may be used in lieu of this form.

Figure 12 – Example Plastic Processing Form

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pestcides-Related Products

The plastic identified on this form is plastic from pesticide and pesticide-related product containers.

Plastic Processing Company NAME:
Processing Site LOCATION/ADDRESS:
Authorized Agent NAME:

Shipping Container or Unit #	Processing Date	Type of Processing (washing, drying, etc.)

Note: This form should be filled out by a company or entity that processes plastic from pesticide and pesticide-related product containers.

Figure 13 – Example End-Use Product Manufacturing Form

ANSI/ASABE S596 FEB2006: Recycling Plastic Containers from Pesticides and Pesticide-Related Products

The plastic identified on this form is plastic from pesticide and pesticide-related product containers.

End-Use Product Manufacturing Company NAME:
End-Use Product Manufacturing Site LOCATION/ADDRESS:
Authorized Agent NAME:

Shipping Container or Unit #	Manufacturing Date	End-Use Product Manufactured

Note: This form should be filled out by a company or entity that manufacturers end-use products from plastic from pesticide and pesticide-related product containers.

Annex B
(informative)
Commentary

Annex B provides additional information and explanation about several paragraphs in the Standard that could be open to interpretation. The paragraphs discussed below set performance standards that inherently include flexibility to account for personal judgment and experience, differences in climate and a variety of activities or situations that may occur at the facilities. The descriptions below are intended to reflect the experience and collective wisdom regarding pesticide container recycling that was represented on the committee that developed this Standard.

6.1 Inspecting containers: Section 6.1 specifies that "An inspection shall be conducted on containers to ensure that they are clean, properly prepared and included in the scope of the recycling program." This requirement is intended to provide flexibility during the inspection process and is not intended to mandate that all containers must be individually inspected. The inspector can rely on past experiences with the person providing the containers, his/her best judgment, inspecting a randomly selected sample of containers, certification of cleanliness and appropriateness from the person providing the containers, or other options to determine the degree necessary to ensure that the containers meet the standard of being clean, properly prepared and included in the scope of the recycling program.

7.5 Handling rejected containers: Section 7.5 states that "Rejected containers shall be handled and recycled or disposed of with adequate precautions." Similar to Section 6.1, this provides the people at the container collection site with flexibility to use their best judgment in handling rejected containers. If there is a small amount of dried residue in the container that can be easily removed and collected for proper disposal, a collection site worker may choose to hand that container back to the person who provided it but continue inspecting the other containers. If the first group of containers taken from a load is consistently dirty, a collection site worker may choose to reject the whole shipment.

8.2 Storing containers at collection sites: Section 8.2 states that containers shall be stored in a way that they remain clean and fully drained. This is intended to prevent containers from becoming dirty, blowing around and being rained upon. The specific practices needed to accomplish this vary according to the climate – what works in the Southwest (storing the containers outside in a vessel that prevents them from blowing around) may not work in a rainier part of the country.

9.7, 11.2, 12.2 and 13.2 Other activities at facilities: If other activities occur at these sites, the plastic should be properly segregated or separated and other appropriate precautions taken to prevent the other activities from contaminating the plastic.

Annex C
(informative)
Bibliography

The following documents are cited as reference sources used in the development of this Standard:

1 Ag Container Recycling Council, *Inspection Checklist.*

2 Ag Container Recycling Council, *The Recycle Option*.

3 Ag Container Recycling Council, *Technical Committee Review Process (Form 1).*

4 Ag Container Recycling Council, *Technical Committee Site Review and Approval Form.*

5 Ag Container Recycling Council, web site, http://www.acrecycle.org.

6 Hutton, Steven A. and Scott W. Allison, *Using Statistics and a Computer-Based Risk Assessment Model to Evaluate Use Options forRecycled Plastic*, Presentation at the National Pesticide Stewardship Alliance Conference, 2000.

7 Society of the Plastics Industry, *SPI Material Container Coding System*, web site: http://www.plasticsindustry.org/outreach/recycling/residcodes.htm.

8 Society of the Plastics Industry, *SPI Resin Identification Code Guide to Correct Use*, web site: http://www.plasticsindustry.org/outreach/recycling/2124.htm.

9 University of Nebraska-Lincoln, *Rinsing and Recycling Pesticide Containers.*

10 University of Nebraska-Lincoln, web site, http://pested.unl.edu/recyguide.htm.

除害劑之空容器管理指引

Guidelines on Management Options for Empty Pesticide Containers

聯合國農糧署於 2008 年 5 月發布「除害劑淨空容器管理指引」(Guidelines on Management Options for Empty Pesticide Containers)，其中說明了：

清洗容器的好處

1.「以沖洗節省開銷」：一個尚能流出液滴的容器，或許還殘有 2%的內含物質(除害劑)，因此，藉由沖洗的方式將沖洗液倒入收集槽中(除害劑噴灑設備)，便不會造成浪費。

2.適當沖洗過的容器可以有效降低除害劑殘留物的污染性，以視為非有害性(non-hazardous)廢棄物，因此不論是回收或者丟棄處置，均可大幅降低其花費。

三次沖洗

此法適用於無專屬沖洗設備時，也是最實用的方法。適合施用於各種尺寸的除害劑容器，僅對於可直接搖晃與無法直接搖晃的容器，在步驟上有些許差異。

大小適於搖晃者:

1.將容器中的殘留物倒入應用設備中或混合槽中，待殘留物由流柱轉變為液滴流出後，持續瀝乾 30 秒。

2.填裝 1/4 的清水。

3.將原蓋蓋回。

4.搖晃、滾動、反覆倒置該容器，使水可與容器內部各處接觸。後將清洗液倒入應用設備或混合槽中，待後續使用或是丟棄。

5.待清洗液由流柱轉變為液滴流出後，持續瀝乾 30 秒。

6.重複上述步驟至少 2 次以上，直到容器被徹底洗淨(肉眼觀察)為止。




容器過大，不適於搖晃者:

1.將容器中的殘留物倒入應用設備中或混合槽中。

2.填裝 1/4 的清水。

3.將原蓋蓋回。

4.輕敲及來回滾動該容器，確保容器內各處均被清水沖洗，該步驟需持續 30 秒。

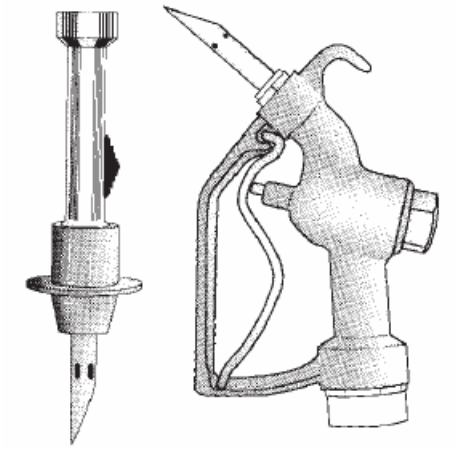
4.倒立容器後，前後輕敲數次。

5.接著正立容器，前後輕敲數次。

6.接著將清洗液倒至應用設備、混合槽或者清洗液貯存桶中(待後續使用或者丟棄)。重複上述步驟至少 2 次以上，直到容器被徹底洗淨(肉眼觀察)為止。

高壓沖洗

此法是利用高壓設備將清水經由噴嘴高壓射出，該噴嘴可以是固定式或轉動式，噴射出的水柱沖擊容器內側，以除去或溶解除害劑殘留物。某些高壓沖洗設備包括尖銳的裝置，以穿刺容器進行沖洗。此類裝置需根據廠商的指示說明進行操作，以避免意外發生。

小型容器的高壓沖洗

1.根據產品包裝之標示說明做好個人防護裝備。

2.將高壓噴嘴連接在供水水管上。

3.讓殘留物從容器由流柱轉變為液滴地流入沖洗槽中後，持續瀝乾 30 秒。

4.將高壓沖洗噴嘴壓進容器中(直接破壞容器)，直到該噴嘴穩固且完全地插入，接著沖洗容器 30 秒(沖洗液流入沖洗槽中)。在沖洗的過程中需來回轉動各種角度，使沖洗水柱能夠觸及容器內各處。

5.待清洗液由流柱轉變為液滴流出後，持續瀝乾 30 秒。

6.上蓋的清洗則是將其置於水中浸泡約 3 分鐘，後將上蓋栓回容器上，該清洗液則倒入沖洗槽中。

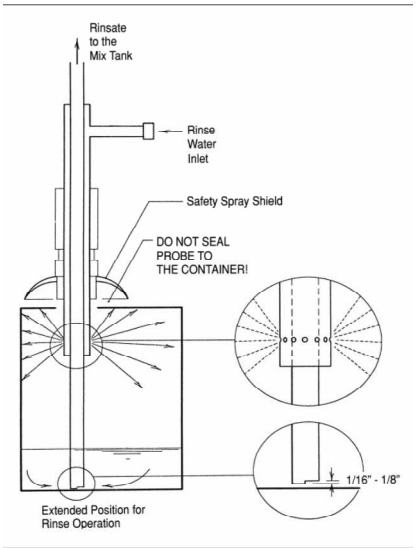
<u>對於大到難以倒置於沖洗槽上者(如 200 公升的圓桶)</u>

可利用沖洗/抽吸兩用式噴嘴進行處理。

1.利用抽吸管將清洗液輸送至沖洗槽中，使容器呈稍微傾斜狀態，使清洗液集中，以利抽吸作業進行。

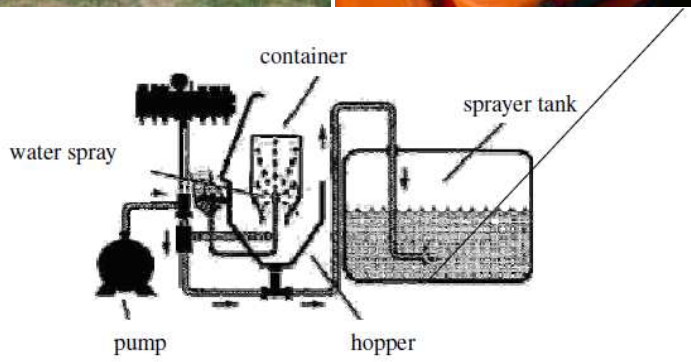
2.確定抽吸作業正確執行後，則開始進行沖洗作業，兩者同時並行。此步驟持續 3 至 5 分鐘。

3.將沖洗噴嘴關閉，並持續進行抽吸作業。將容器傾斜，確保清洗液被完全抽吸至沖洗槽中。



綜合沖洗

此法將沖洗步驟與大型拖拉機的沖洗設備整合，不僅耗時較少(通常約需 15 公升的清水，耗時 30 秒)，且同時進行三次沖洗與高壓沖洗，是最具效率且提供較高安全性方法。清洗液直接自動與噴撒液體(除害劑)混合以供使用。



容器的上蓋可以將其擺置於抽吸進料斗中，利用三次沖洗、搖晃的方式洗淨。操作者需完全遵照廠商所附之指引執行。

一旦確定容器被徹底洗淨後，需立即對其鑽孔或剪壞，使該容器確保不再被重複利用。

不論是採用何種沖洗方式，都應立即將清洗液與噴撒液體(除害劑)

混合使用，如果是以貯存方式供近期內使用者，應確保其不致過期，且儲存容器需清楚標示。如需棄置清洗液，則應合法遵照 FAO 的指引。

溶劑沖洗

如果除害劑是以溶劑、非水溶性或非水懸性等成分組成者，則沖洗步驟應使用溶劑做為清洗媒介。利用容器沖洗的清洗液或許不適合再被利用，因此需視為廢棄除害劑處理。

自動溶劑沖洗與壓桶

自動化設備可以沖洗填裝含有油或溶劑等除害劑的容器，此類設備可以有效地清洗及擠壓淨空容器。

1.將淨空容器(圓筒)置於該機器中，後將門關上。

2.噴灑溶劑的噴嘴將會刺穿該圓筒。

3.在容器內部進行溶劑噴灑。

4.清洗液(溶劑與除害劑殘留物)則被抽出容器。

5.被徹底洗淨的容器會直接被擠壓。

6.該溶劑可被回收重複使用，直到除害劑濃度過高。

7.被除害劑污染(以致無法再回收重複使用)的溶劑將被視為廢棄除害劑處理。

經過三次沖洗後的殘留物殘留情形

約殘留 28 克有效成分的容器(容量為 22.5 公升)		
沖洗階段	**除害劑殘留物**	**殘留百分比**
瀝乾後	14.2 克	100 %
第一次沖洗	0.2 克	1.4 %
第二次沖洗	0.003 克	0.0021 %
第三次沖洗	0.00005 克	0.00035 %

經沖洗之廢容器的分類

在多數歐洲國家及北美國家，經沖洗後之廢容器被視為「非有害性」廢棄物；少數歐洲國家如西班牙、法國及愛爾蘭等，則將該類容器視為「有害性容器」。

根據歐洲廢棄物目錄(European waste catalogue)中，將包裝容器中有殘留物質或是含有危險性物質者，若其高度**危害性成分濃度低於 0.1 %，則應分類為「非有害性」**。加拿大已分別分析過 40 種高度有

害物質殘留之容器，進行三次沖洗後有害物質殘留程度的研究，結果顯示其殘留濃度均低於 0.1 %。

FAO/WHO 建議應將適當沖洗過之容器視為「非有害性」廢棄物。

沖洗法之比較

特性	高壓沖洗	三次沖洗
步驟數	8	17
耗時	1-2 分鐘	4-9 分鐘
沖洗容器種類	全部	全部
特殊沖洗設備需求	高壓噴嘴	無

沖洗後之容器丟棄處理

燃燒

以未經控制的火源燃燒塑膠及除害劑，並無法完全分解有害成分，且有可能會產生具環境持久性的毒害。**唯一能夠降解塑膠及除害劑的熱處理方式是高溫焚化，且利用水泥窯有效控制焚化物質逸散。**除害劑產品不應於任何使用場址進行燃燒，如農地等。各國應執行預先警告或是相關法規，以避免所有一級包裝(primary packaging；直接接觸除害劑者)被隨意燃燒，不論該包裝(容器)是否已被沖洗過。

掩埋

不應在使用處掩埋已沖洗過之除害劑容器。塑膠容器具有高度穩定性，且不具生物降解性，各國應規範不論任何容器均需避免採用掩埋法，並發展容器管理架構(container management scheme)，讓使用者可以能夠簡易地返回淨空容器。

二級包裝(secondary packaging)的丟棄

乾淨的二級包裝，如紙板等，無直接接觸除害劑者，可視為一般性垃圾，或是回收再利用。

美國除害劑註冊公告 83-3：

標示改善計畫-貯存與丟棄標示說明

根據 P**esticide Registration (PR) Notice 83-3**，**家用除害劑**應附有下列其中一項之丟棄指示：

容器類型	**處理方式**
家用除害劑 (包括**居家庭園使用**之除草劑、殺蟲劑等等)	
非噴霧型產品 (瓶裝、罐裝)	該容器(瓶、罐)不得重複利用(reuse)。於丟棄前應充分沖洗(rinse)，後視為一般垃圾進行丟棄。
非噴霧型產品 (袋裝)	該容器(瓶、罐)不得重複利用。於丟棄前應充分沖洗，後視為一般垃圾進行丟棄。
噴霧型產品	蓋上原上蓋，後視為一般垃圾進行丟棄。不得自行焚化或穿刺破壞該容器。
其它除害劑產品(非家用)	
金屬容器 (非噴霧型)	需沖洗 3 次後，利用回收再製、鑽洞後衛生掩埋或其它經主管機關核可之程序處理。
塑膠容器	需沖洗 3 次後，利用回收再製、鑽洞後衛生掩埋、焚化或經主管機關核可之燃燒等方式處

容器類型	處理方式
	理。若以燃燒方式進行處理，請務必遠離燃燒所生成之煙霧。
玻璃容器	需沖洗 3 次後，以衛生掩埋或其它經主關機關核可之程序處理。
具內襯的紙桶	利用搖晃方式或輕敲的方式使內襯的黏性物質鬆脫，以完全去除。內襯進入應用設備處理後，接著利用衛生掩埋法或焚化法(若主觀機關許可)丟棄。若該紙桶經污染而無法再回收利用者，則同樣以上述方式處理之。
紙袋或塑膠袋	完全淨空該袋，進入應用設備處理後，接著以衛生掩埋、焚化或經主管機關同意之燃燒等方式處理該袋。若以燃燒方式進行處理，請務必遠離燃燒煙霧。
壓力鋼瓶	將空之鋼瓶送環原廠，重複使用。

美國除害劑註冊公告 94-2:

空噴霧罐容器之回收

美國環保署認為金屬噴霧罐可以安全且適當的被回收利用，此舉不僅能夠維持且善用具有價值的金屬資源，更能夠降低衛生掩埋法所需的空間。該回收程序包括**擠壓**及以**燃燒**方式融熔金屬。金屬噴霧罐能夠不具危害性及不具爆炸性的被擠壓，而之後在不鏽鋼火爐或煉鋁爐以高溫加熱的方式，可以焚化任何具有毒害性的殘留物(即除害劑)。

在包裝標示上，需說明僅能回收**空噴霧罐**及回收計畫的有限利用性，且詳細說明該空噴霧罐需以標示上之使用說明方式使用盡(不得以鑽孔方式取出內容物)後進行回收。若無法回收，則將該容器視為一般垃圾處理。

「**不得鑽孔及自行焚燒**」為標示上之物理及化學性危害欄必備的標語，避免使用者以鑽孔的方式達到淨空金屬噴霧罐的目的。

美國除害劑註冊公告 2001-6：

家用非抗菌性除害劑產品標示之丟棄說明

「家用非抗菌性除害劑產品」之定義:

1.一般民眾於居家住所室內或周圍環境使用之除害劑。

2.該除害劑產品為一般民眾適用的容量或類型[註]，不論其是否為農業用途。

註：液體 1 加侖以下；固體 5 磅以下；居家環境使用之肥料除草劑混合產品 25 磅以下。

避免以報紙或紙類包裹

曾經，消費者被指導**將廢棄容器以報紙或紙類包裹**，以減少衛生工作者的潛在暴露量，然而此舉並**無法在實質上對衛生工作者有任何的保護**，甚至會造成一些意外性或未知性的暴露，因此建議在產品標示的丟棄說明上刪除此項。

40 CFR Subpart H 156.146

美國聯邦條例法典 40 第 156.146 條

非重複充填式除害劑容器之殘留物移除指示	
三次沖洗指示說明 (可以水稀釋者)	
容器大小適於搖晃之液體除害劑產品	1.將容器中的殘留物倒入應用設備中或混合槽中，待殘留物由流柱轉變為液滴流出後，持續瀝乾 10 秒。 2.填裝 1/4 的清水，並將原蓋蓋回，搖晃 10 秒。 3.接著將清洗液(rinsate)倒至應用設備(application equipment)、混合槽(mix tank)或者清洗液貯存桶中(待後續使用或者丟棄)，待殘留物由流柱轉變為液滴流出後，持續瀝乾 10 秒。 4.將步驟 2 與 3 重複執行 2 次。
容器大小適於搖晃之固體除害劑產品	1.將容器中的殘留物倒入應用設備中或混合槽中。 2.填裝 1/4 的清水，並將原蓋蓋回，搖晃 10 秒。 3.接著將清洗液倒至應用設備、混合槽或者清洗液貯存桶中(待後續使用或者丟棄)，待清洗液由流柱轉變為液滴流出後，持續瀝乾 10 秒。

非重複充填式除害劑容器之殘留物移除指示	
	4.將步驟 2 與 3 重複執行 2 次。
容器大小不適於搖晃之除害劑產品	1.將容器中的殘留物倒入應用設備中或混合槽中。 2.填裝 1/4 的清水，並將原蓋蓋回。 3.輕敲及來回滾動該容器，確保容器內各處均被清水沖洗，該步驟需持續 30 秒。 4.倒立容器後，來回滾動數次。 5.接著正立容器，再次來回滾動數次。 6.接著將清洗液倒至應用設備、混合槽或者清洗液貯存桶中(待後續使用或者丟棄)。 7.將步驟 2 至 6 重複執行 2 次。
高壓沖洗指示說明 (可以水稀釋者)	
液體稀釋型除害劑產品	1.將容器中的殘留物倒入應用設備中或混合槽中，待殘留物由流柱轉變為液滴流出後，持續瀝乾 10 秒。 2.將容器倒置於應用設備或混合槽以收集清洗液，供後續使用或丟棄。 3.插入高壓沖洗噴頭於容器側面，以 40 psi 的高壓水柱沖洗約 30 秒。

非重複充填式除害劑容器之殘留物移除指示	
	4.待清洗液由流柱轉變為液滴流出後，持續瀝乾 10 秒。
固體稀釋型除害劑產品	1.將容器中的殘留物倒入應用設備中或混合槽中。 2.將容器倒置於應用設備或混合槽以收集清洗液，供後續使用或丟棄。 3.插入高壓沖洗噴頭，以 40 psi 的高壓水柱沖洗約 30 秒。 4.待清洗液由流柱轉變為液滴流出後，持續瀝乾 10 秒。
非水稀釋劑	
1.若一除害劑需以非清水之稀釋劑(如溶劑)稀釋者，則註冊申請人需呈交「變更殘留物移除指示」，待美國環保署文件許可後，方能進行販售。 2.申請者必須說明以非清水之稀釋劑稀釋之必要性，也需呈交合適該除害劑產品及稀釋劑殘留物移除指示與廢棄指示等，同時標明稀釋劑種類。如果該指示說明允許殘留物及非水稀釋劑之混合物被使用時，則應表示該混合物可直接倒入應用設備或混合槽中，反之，則應註明需另外收集貯存該混合液至清洗液收集系統(rinsate	

非重複充填式除害劑容器之殘留物移除指示
collection system)中。 3.當美國環保署認為其所呈交之指示說明是必要且合適的，將會核可通過該申請。

美國明尼蘇達州(Minnesota)

除害劑之空容器回收計畫

針對高密度聚乙烯(High Density Polyethylene；HDPE)材質所製成的塑膠容器為回收對象。

回收對象與條件：

1.所有的回收容器都必須經過三次沖洗或高壓沖洗使除害劑無殘留於回收容器上，同時需移除上蓋與標籤紙等。

2.容器內部需完全乾燥。

3.玉米油容器若清除所有玉米由殘留物，也同樣可以被回收。

4.高密度聚乙烯所製之除害劑圓桶也同樣可被回收。

非本計畫回收之對象：

1.噴霧罐容器、玻璃容器、金屬容器、塑膠容器、紙袋或紙板。

2.非除害劑之塑膠容器，如牛奶罐、清潔劑容器、汽水或飲用水瓶。

3.廢棄除害劑。

4.水槽。

回收利用後之產品

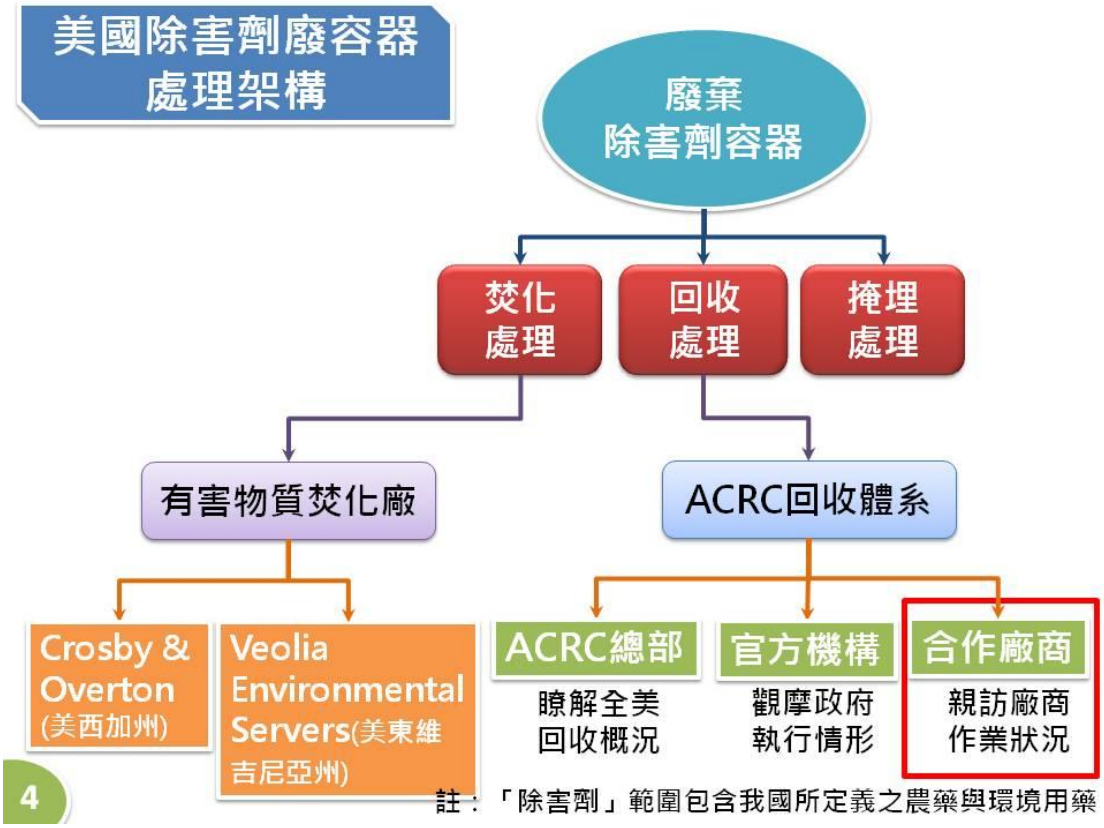
非消費性產品，如排水管、海上用管樁等。

簡報大綱

- 農藥廢容器參考資料
  - 美國除害劑處理架構
  - 美國農藥廢容器回收處理管道簡介
  - 歐盟定義之植物保護產品
  - 歐盟各國收集率
  - 歐洲農藥廢容器回收體系簡介

– 美國除害劑處理架構
– 美國IAP參訪點簡介

農藥廢容器參考資料



註：「除害劑」範圍包含我國所定義之農藥與環境用藥

Agriculture Container Recycling Council (ACRC)

ACRC

源起

由農業相關產業(製造、調配及包裝商)界自發設立的回收體系，為一全國性的非營利組織

1992年 → 2013年

共計回收350,000,000磅(158,756,500公斤)的塑膠

回收對象

容器類型:

1.塑膠分類回收標誌為2號之高密度聚乙烯(HDPE)容器

2.為非重複填充性之容器

3.回收容量56加侖(約212公升)以下者

上述所填裝之產品類型:

1. EPA註冊於農業用、林業用、園藝用植物保護產品、佐劑、作物油及界面活性劑等

2.不包括獸醫用、居家用或庭院用之植物保護產品

Agriculture Container Recycling Council (ACRC)

回收步驟

三次沖洗-瓶罐類

三次沖洗-桶類

高壓沖洗

收集

造粒

製成非民生用品

美西 ACRC

Interstate Ag Plastics(加州 回收廠商)

436 East Front Street
Buttonwillow, CA 93206

網站

IAP官方網站首頁
http://www.interstateagplastics.com/index.php

簡介

定點式

加州地區共28個回收定點

客製式

或，填寫IAP會員申請表得知該公司之回收需求，後主動聯繫相關事項

地區

IAP主要負責加州、內華達州與亞利桑那州的農藥廢HDPE容器

掩埋場

除了IAP總部設有回收據點外
掩埋場也設有回收服務

American Ave Landfill
18950 West American AVe Kerman, CA

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美西 ACRC

Interstate Ag Plastics(加州 回收廠商)

造粒設備

mobile chipping truck

製成非民生用品

參訪重點

1. 美國農藥廢容器收集、處理方式分別有哪些？
2. Mobile chipping truck之尺寸？建置成本？
3. Mobile chipping truck之處理效率？(噸/天、噸/月)
4. Mobile chipping truck是否汙染防治與環境檢測設備？
5. 台灣針對農藥廢容器物質回收廠，另設有汙染防制設備、環境檢測之標準，不知美國是否有相關規範？
6. 農藥廢容器經物質回收後的流向？儲存的地點與方式？
7. 經物質處理後，後續再利用管道為何？
8. 農藥廢容器回收除了物質回收外，是否有採焚化之回收管道？

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- 美國農藥廢容器回收體系簡介
- 歐盟定義之植物保護產品
- 歐盟各國收集率
- 歐洲農藥廢容器回收體系簡介

農藥廢容器參考資料

美東 ACRC

USAg Recycling (維吉尼亞州回收廠商)

網站

USAg Recycling官方網站首頁

http://www.usagrecycling.com/index.asp

地區

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簡介

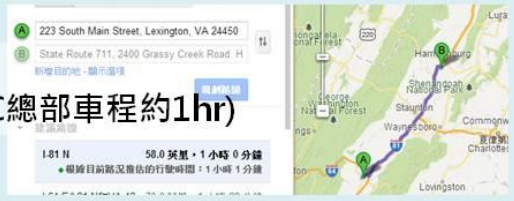
造粒機

合格容器 不合格容器

車程

Rockingham County Landfill
2400 Grassy Creek Road Harrisonburg, VA

回收地點
(距離ACRC總部車程約1hr)



美西政府 蒙大拿州 農業部 (官方主導回收)

605 2nd Ave S, Room 204A
Glasgow, MT 59230

網站

蒙大拿州 農業部 官方網站
http://agr.mt.gov/agr/Business/Pesticides/Environmental/ContainerRecycling/index.html

地區

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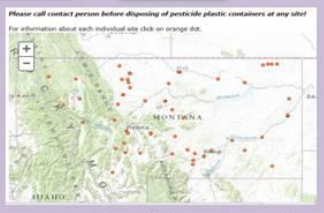
簡介

定點式



蒙大拿州境內各回收點(共50處)

機動式

2012年9月份為期11天回收地點的時程安排(2013年尚未公告)

回收點

Valley County Landfill Shop
501 Court Square Glasgow, MT 59230

距離農業部最近的回收點
步行約5分鐘

美東政府 緬因州 除害劑部門 (BPC) (官方主導回收)

網站

緬因州BPC官方網站
http://www.maine.gov/agriculture/pesticides/contact/index.htm

地區

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簡介

實行回收前

實行回收後

Rt. 9 AMHI Campus, Deering Bldg., Rm 333, Augusta, ME

車程

與BPC合作之回收者

由BPC出發

Mid Maine Solid Waste Association
69 Airport Rd, Corinna, ME, 04928
207-924-3650
(距離Mid Maine Solid Waste Association Recycling center，車程15分鐘)

車程約1.5 hr

Northern Aroostook Regional Incinerator Facility (焚化廠)
74 Airport Ave, Frenchville, ME, 04745
207-543-6372

車程約5 hr
或是利用regional機場

美西焚化

Crosby & Overton(加州 焚化廠)

1610 W. 17th St Long Beach, CA 90813

網站

Crosby & Overton官方網站首頁
http://crosbyoverton.com/

簡介

專門處理RCRA規範之有害廢棄物
(Resource Conservation and Recovery Act)

地區

車程

距IAP(加州ACRC合作廠商)約2.5 hr

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美東焚化

Veolia Environmental Servers (維吉尼亞州 焚化廠)

網站

VES官方網站
http://www.veoliaes.com/en/services/enterprise/waste/incineration.html

簡介

2910 Deepwater Terminal Road
Richmond, VA 23234

- 專門處理各種有害廢棄物
- 有旋轉窯式(rotary kilns)及固定床式焚化爐(fixed-hearth)等設備
- 可以處理大量或是桶裝有害廢棄物

地區

車程

距離ACRC總部車程約2.5hr

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植物保護產品定義

我國定義	國際間專有名詞	適用地區
農藥	植物保護產品 plant protection products	歐盟地區
環境用藥	生物除害劑 biocides	
農藥 + 環境用藥	除害劑 pesticide	美澳地區

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歐盟各國收集率

名次	國家	收集率	名次	國家	收集率
1	比利時	90%	6	西班牙	48%
2	德國	76%	7	奧地利	35%
3	法國	66%	8	葡萄牙	30%
4	波蘭	58%	9	羅馬尼亞	21%
5	匈牙利	55%			

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http://www.adivalor.fr/en/will/company-history.html?

荷蘭農藥廢容器回收體系 - STORL

荷蘭STORL官方網站首頁
http://www.storl.nl/

簡介

回收體系: STORL

設立時間: 1988年

總部位置: 荷蘭，海牙

回收對象: 針對有 STORL VERPAKKING 圖示之包裝容器

回收物分類:
事業廢棄物
小型有害廢棄物

STORL logo

事業性廢棄物

小型有害廢棄物

回收容器需經沖洗

可呈至KCA回收點

比利時農藥廢容器回收體系 - Phytofar-Recover

Phytofar-Recover官方網站首頁
http://www.phytofarrecover.eu/lang.php

Auguste Reyerslaan 80
1030 Brussel, Belgium

簡介

回收體系: Phytofar-Recover (由農業相關產業所組織的協會)承包負責全國之農藥容器、包裝物的回收

設立時間: 1997年

總部位置: 比利時，布魯塞爾

回收對象: 針對專業用戶所使用的農藥廢容器(包括瓶罐、錫箔、紙箱等)

回收物分類(針對一級包裝):
可沖洗者 → 非有害物質
無法沖洗者 → 有害物質

回收時間: 9-11月(農藥噴灑季節過後)

處理方式: 監督下游授權公司進行回收處理或焚化處理

處罰

分類: 分類得當者，可以免費回收處理；分類不得當者，處以20歐元的罰緩及15歐元/袋的處理費用

沖洗: 經沖洗卻未完全乾燥者，視同未沖洗，並處以罰緩

德國農藥廢容器回收體系 - PAMIRA

PAMIRA官方網站首頁
http://www.pamira.de/

Friedrichstr. 6,
65185 Wiesbaden, Germany

簡介

回收體系: PAMIRA(由農藥相關產業自發設立)

設立時間: 1991年

總部位置: 德國，黑森州，威斯巴登

回收條件:

1.容器上須攜有 PAMIRA 標誌

2.須經過三次或高壓沖洗

3.須完全瀝乾

4.須依照容器材質(塑膠、金屬或袋類等)分別儲存 (即不侷限於塑膠容器)

5.容器的拴蓋必須與容器分開回收

6.超過50公升以上之容器，須先行切割

7.回收項目也包括具有彈性容量之容器，如麻袋、袋、塑料或紙箱

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法國農藥廢容器回收體系- ADIVALOR

ADIVALOR官方網站首頁
http://www.adivalor.fr/en/index.html

68 Cours Albert Thomas
69008 Lyon, France

簡介

回收體系: ADIVALOR (由各種農業相關聯盟所組成之非營利組織)

設立時間: 2001年

總部位置: 法國，里昂

監督機關: 法國生態、永續發展及能源部 (French Ministry of Eology and Sustainable Development)

回收容器: 採漸進方式擴大回收項目

2001 2003 2007 2009

農藥廢容器
(塑膠瓶罐)

過期農藥
(塑膠或金屬)

裝填肥料及土壤改良劑之塑膠袋

農用塑膠膜

種子用袋

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