NatureWorks LLC

InCrops Project

Key Benefits and Addressing the challenges associated with Bio Plastics

July ’09

Eamonn Tighe.
NatureWorks LLC
Business Development Manager

ingeo™

NatureWorks LLC

- **Established in 1997 with a JV between Cargill & Dow Chemical Company**
- **Commercial plant opened Jan ‘03**
- **In February 2005, NatureWorks became a wholly owned subsidiary of Cargill**
- **World’s first and largest biopolymer manufacturing facility**
- **Ingeo™ products can be found on more up to 100,000 store shelves around the world**

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NatureWorks® biopolymer is the exclusive raw material used for all Ingeo™ natural plastic products

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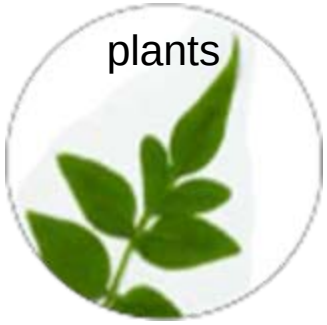

dextrose
(sugar)

fermentation

lactic acid

monomer production

lactide

NatureWorks

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OUR PARTNERS

NatureWorks® biopolymer is the unique raw material used for all Ingeo™ natural plastic products

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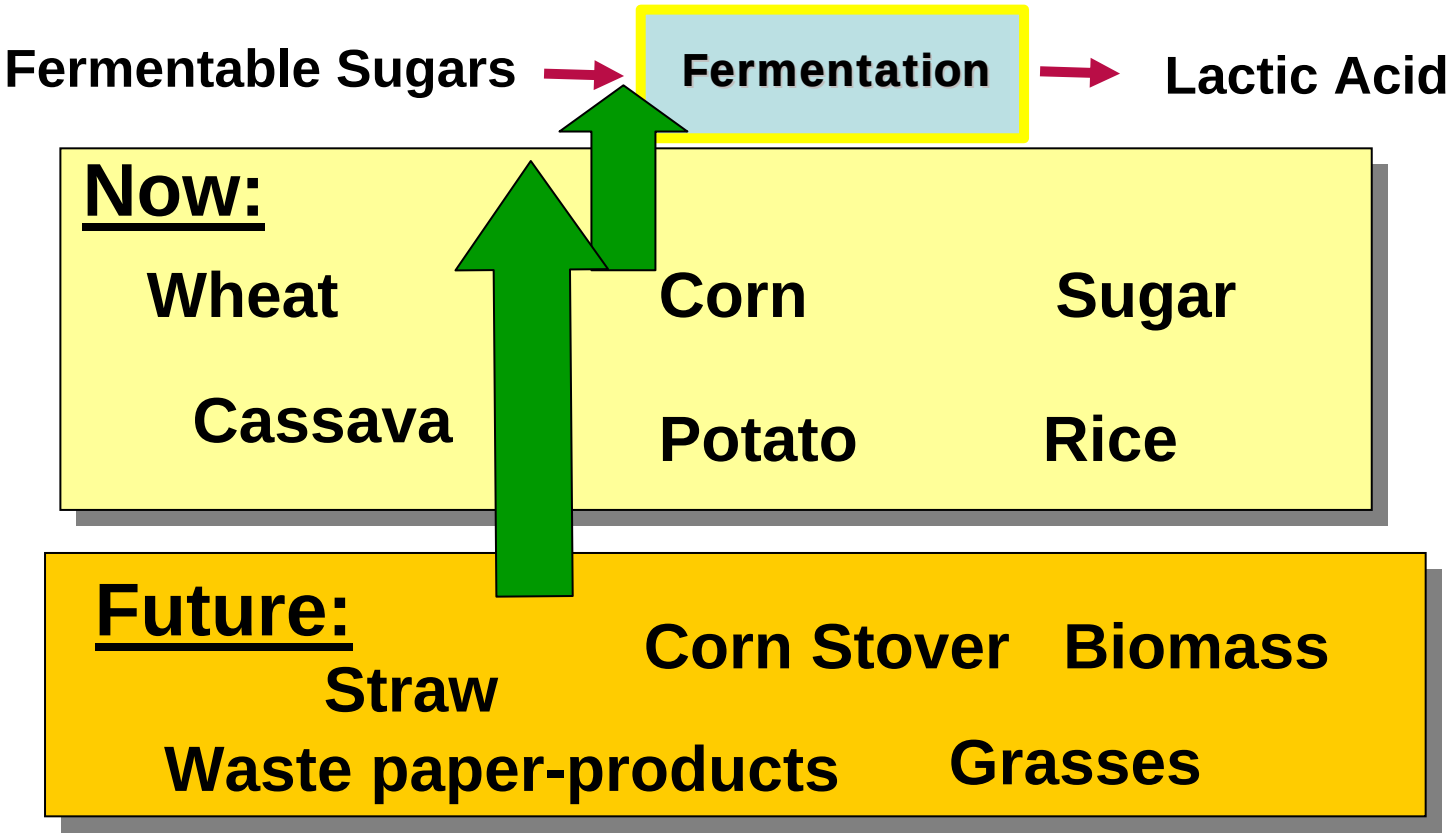
Current and Future Renewable Raw Materials



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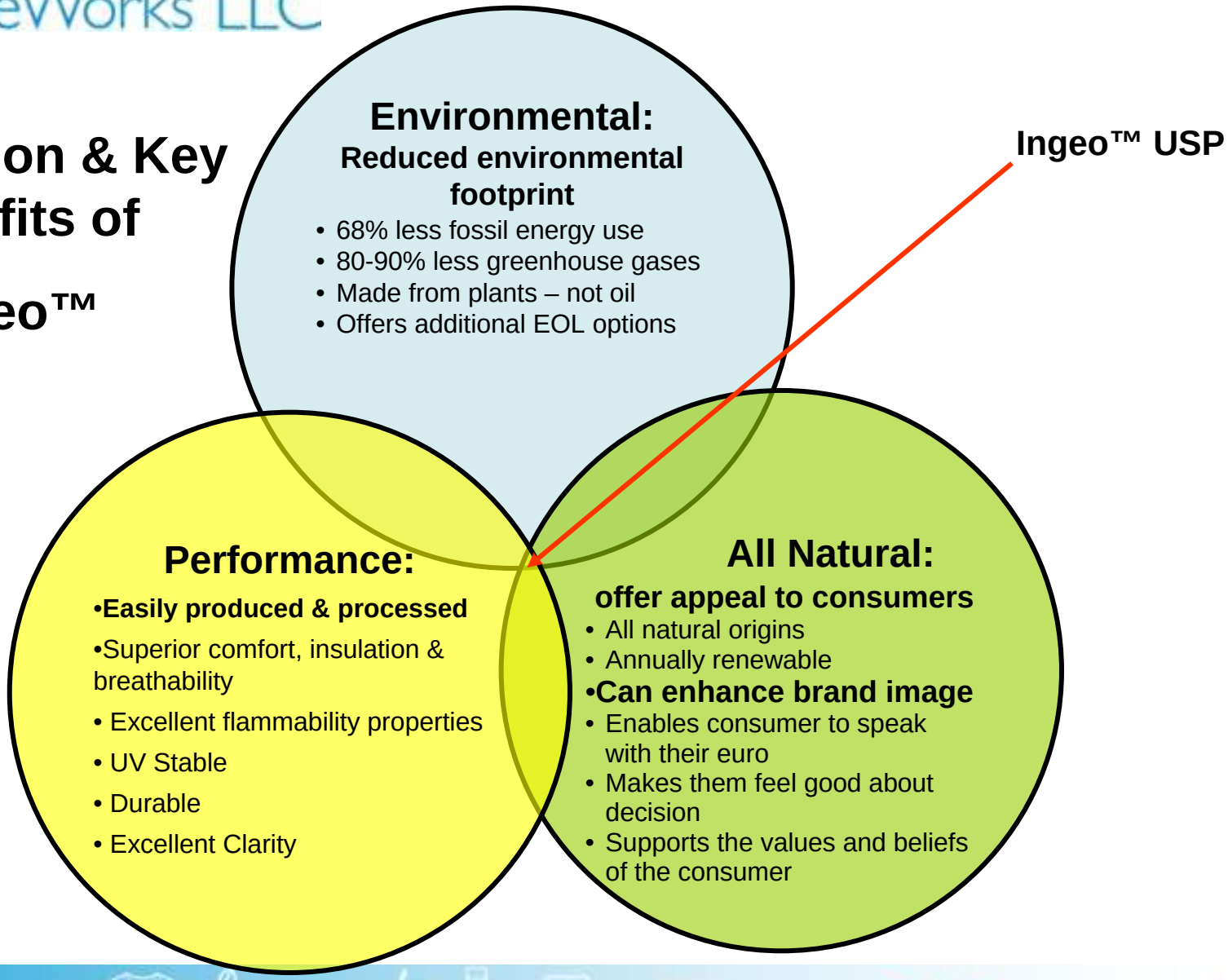
Foundation & Key Benefits of Ingeo™



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Gattinoni wedding dress

Girbaud casuals

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Ahlstrom - latest channel leader to work with Ingeo™

- **Global producer of nonwoven products, including Food nonwovens such as tea & coffee bag materials, meat casing reinforcements**.
- **The Ingeo™ based webs are currently being launched into the premium end tea market as ultrasonically bonded bags for teas and other long leaf infusions.**
- **Also designed for the horticultural, construction and specialist hygienic applications**

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Huggies –

Pure and Natural

- Full Featured “Super Premium” Diaper
- Liner includes natural Aloe & Vitamin E and materials from renewable sources (Ingeo content)
- Nationwide launch and promotion underway
- www.huggiespureandnatural.com

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Broody Chick

- Fully compostable diaper
- 100% Ingeo spunbond liner
- Currently retailed at Thrifty Foods (owned by Sobeys) in British Columbia
- Also sell 100% Ingeo wet wipes
- www.broodychick.com

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DaniMer, International Paper and Green Mountain Coffee

DaniMer Scientific LLC

Improving Lives and Protecting the Environment Through Biodegradable Plastics

INTERNATIONAL PAPER

GREEN MOUNTAIN COFFEE ROASTERS

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Frit-o-Lay

NatureWorks LLC

Bodin, France

- **April 08 :**

Launch of 100% Ingeo packaging: Foam tray + film

Découpe poulet

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After these sandwiches have disappeared, so will the packaging

look behind the label

Ingeo™ film

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DS Fibres
Hoogveld 90
B-9200
Dendermonde
Belgium
00.32 52.25 83.50
00.32.52.38.16.71

Info@dsfibres.com

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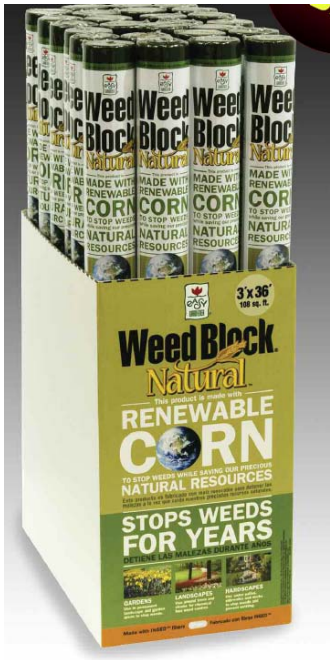

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NatureWorks® biopolymer is the unique raw material used for all Ingeo™ natural plastic products

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Ingeo™ Packaging Applications

Serviceware

Bottles

Rigid Containers

Flexible & Films

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Future opportunities

Durables

Semi-durables

Disposables

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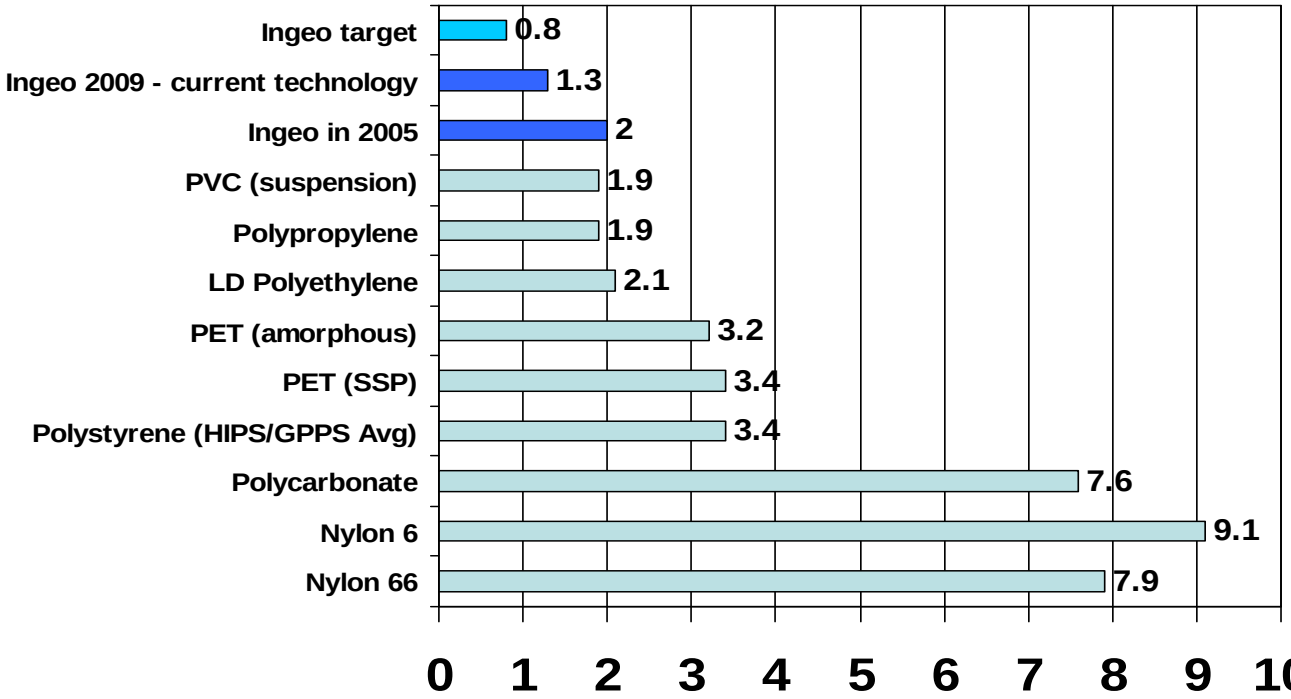
A Broader Comparison

Comparing Environmental Footprints: Greenhouse Gas Emissions



- Ingeo: Vink E.T.H. et all. 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: Plastics*Europe*; www.lca.plasticseurope.org
- GWP_{100} factors according to IPCC (CO_2=1, CH_4=23 N_2O=296)

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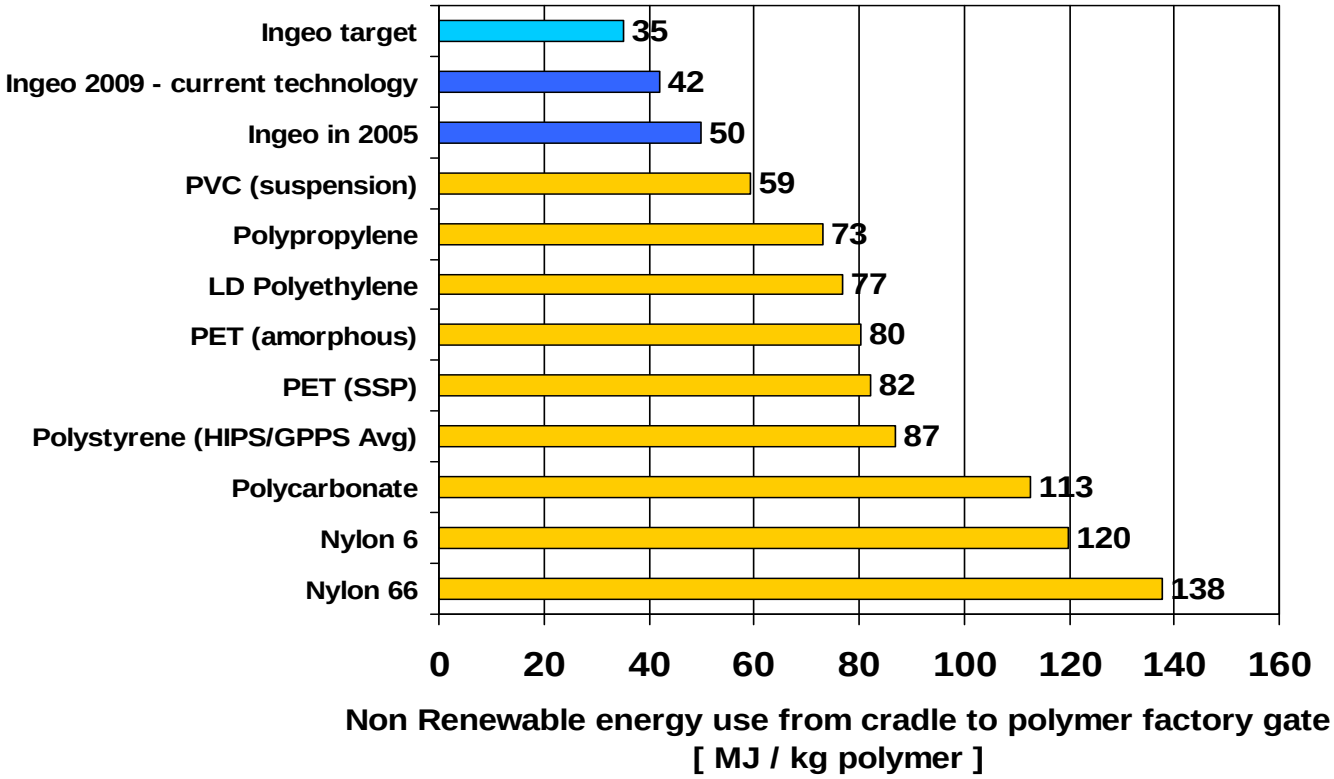
A Broader Comparison

Comparing Environmental footprints: Non-renewable Energy Requirements



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Environmental Benefits Estimates

replacing synthetics with Ingeo™

(An Example : Impact of using 1000 tons of Ingeo™ vs 1000 tons of other polymers)

The cradle-to-pellet fossil energy use reduction is equivalent to:

	PET	PP	LDPE
Barrels of Oil saved per year	**6376**	**5149**	**5809**
Passenger Cars not driven per year	**514**	**415**	**469**

References:
1. PlasticsEuropa Eco-profile data; 2. U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990-2001, EPA 430-R-03-004; 3. International Energy Outlook 2005, DOE/EIA-0484(2005); 4. DOE - Properties of Fuels; 5. Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) Version 1.5a, 12/2000, Argonne National Laboratory; 6. "Comparison of passenger vehicle fuel economy and greenhouse gas emissions around the world", 12/04, www.pewclimate.org

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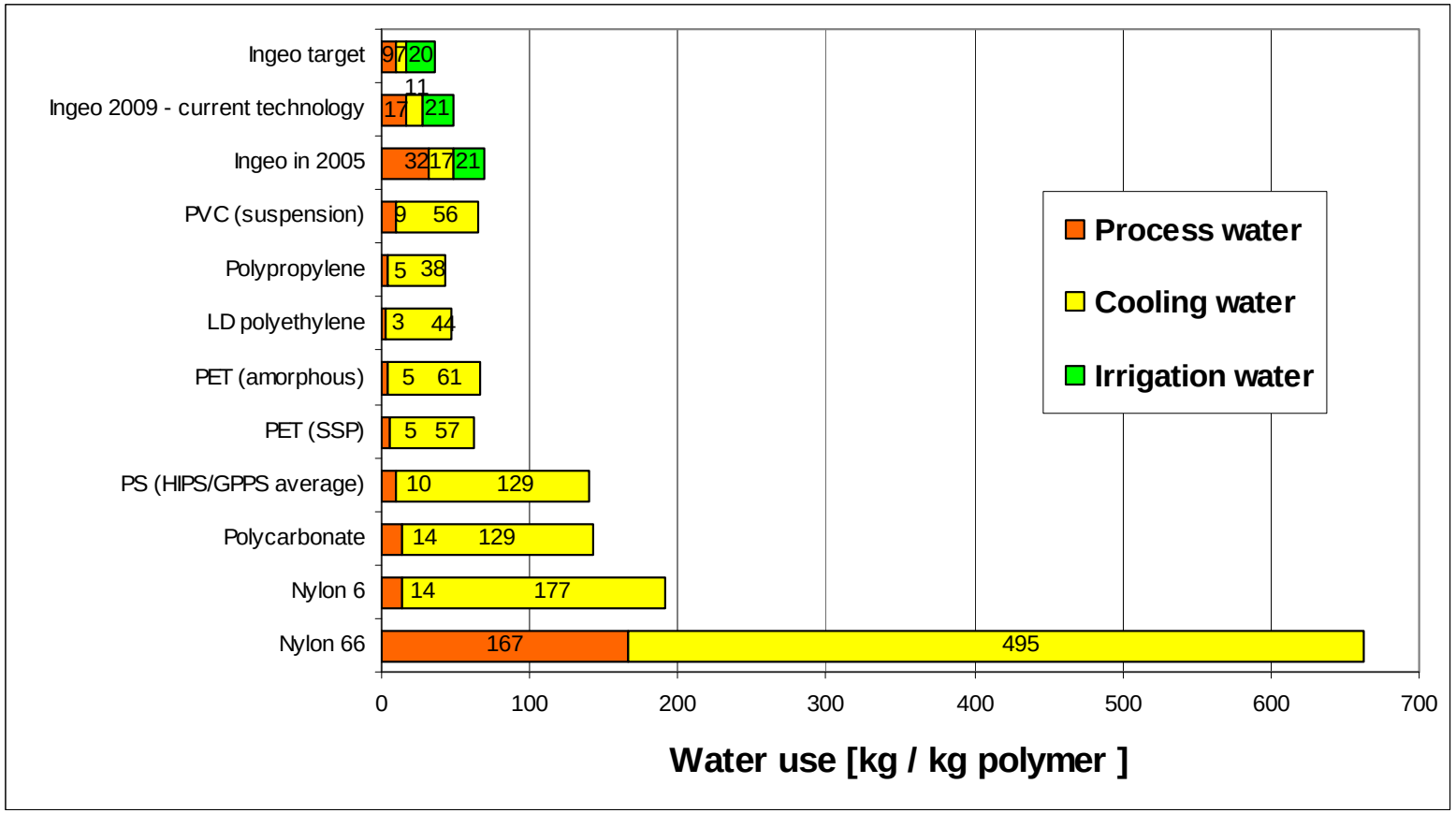
A Broader Comparison

Comparing Environmental Footprints: Total Water Use



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Recovery & 'End of Life' options for Ingeo™ products

1. **Composting:** Household bags w/ food waste; Mulch films; Mixed food/packaging waste generated at : fast food restaurants; big events, canteens etc.…….
2. **Anaerobic digestion:** advanced way of composting; Energy recovery.
3. **Incineration w/ heat recovery:** Most packaging ends up in a mixed plastics fraction and used as a fuel; production of Green energy.
4. **Mechanical recycling:** bottles: reuse of materials.
5. **Feedstock recovery:** bottles; packaging; carpets,…cradle-to-cradle concept: recovery of lactic acid from the used polymer.
6. **Landfill:** NO – throwing away of raw materials and energy. Compostable plastics packaging enables to divert organic waste from landfills.

Differentiate the EOL of Bioplastics & look for most sustainable solutions.
sometimes one first needs a critical mass in the market place !

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Food (prices) vs Bioplastics Discussion

World food prices have increased as a result of*:

1. **Poor harvest of wheat and barley in Australia, Ukraine and Europe**
2. **High energy prices resulting in: high fertilizer and fuel prices + expensive long distance transport**
3. **Argentina, Kazakhstan, India, Vietnam and Egypt levied export taxes protecting own food supply**
4. **The production limitations for food products in the EU**
5. **Low prices for food production in the past were not an incentive to invest in technology to increase production**
6. **Rapidly growing demand in SEA: population, income development and changes in diet.**

Biofuels and speculation only have a *marginal* effect on world food prices.

5% of oilseed go into biodiesel and 4.5% of grain into ethanol.

Bioplastics don't make this list

- **Bioplastics are 300-500 times smaller than biofuels.**
- **e.g. Polylactide requires less than 0.04% of global corn supplies.**

Medium/long term: Non food dextrose sources (cellulosic based) under development.

**** Wageningen University & Research Centre June 2008 = World's leading agronomic and agricultural economics research institution***

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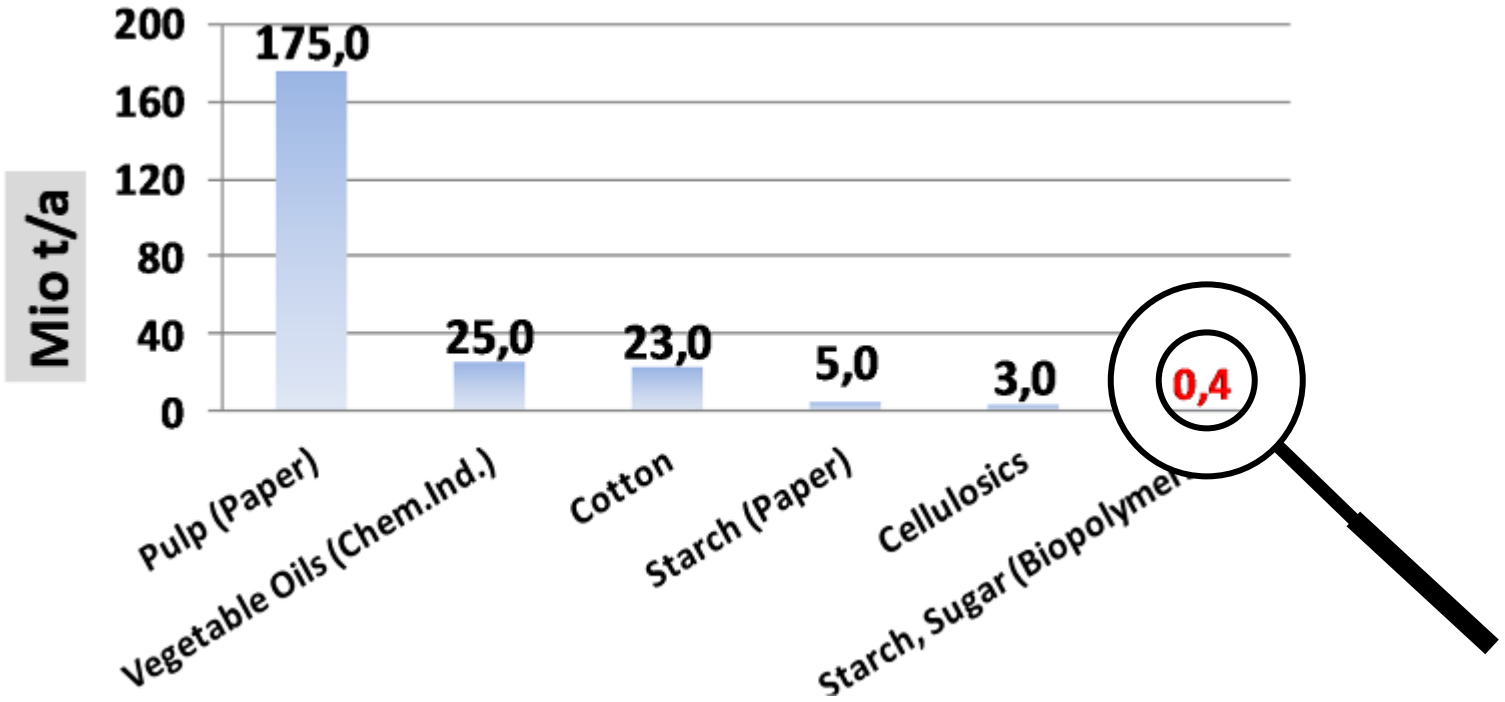
Global annual consumption of renewable raw materials for technical applications



Still missing: f.i. sugar for polyols and ethanol (fuel), non-food lactic acid application, starch for ethanol and vegetables oils for biodiesel etc. etc..

Source: Prof. Dr.-Ing. Hans-Josef Endres, Fachhochschule Hannover

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Corn sourcing-related Options

- **Certification Option**

  Certification of “non GMO” NatureWorks® Polymer by lot, order, run (whatever our customers’criteria) according to GeneScan, Inc.

- **Source selection Option**

  Similar to green energy, partners are offered the option to participate in a purchase program of GM-free corn in relation to their resin needs. NatureWorks LLC will purchase, verify and deliver an equivalent amount of non-GM corn to the corn mill based on the volume of PLA delivered to the participating partner.

- **Identity Preserved Option**

  Large-volume customers with multiple-year supply contracts will be given the opportunity to purchase 100% NatureWorks® Polymer sourced and produced from identity preserved dextrose feedstock.

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Regulatory support

- **Packaging Directive Germany:** certified bio packaging excluded from DSD fee (up to Euro 1.39/kg)
- **Lower packaging disposal fee in Holland**: background is CO2, now linked to EN norm (up to Euro 0.30/kg)
- Current incentives based on composting norm, while post consumer bio packaging waste isn't recovered nor allowed in Organic waste systems
- **Lead Market Initiative**: **EU Commission** and EU parliament added **Biobased** materials to short list of key growth and innovation areas that will be supported by an integrated approach of legislation and incentives
- Need for Bio-based norm and certification to allow for Carbon-friendly legislation