



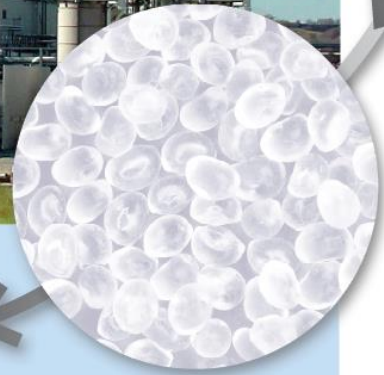
***Latest applications and the future of
bioplastic in Southeast Asia***

***Watid Watanyupaisan
TS&D Engineer
Natureworks Asia Pacific Ltd,***

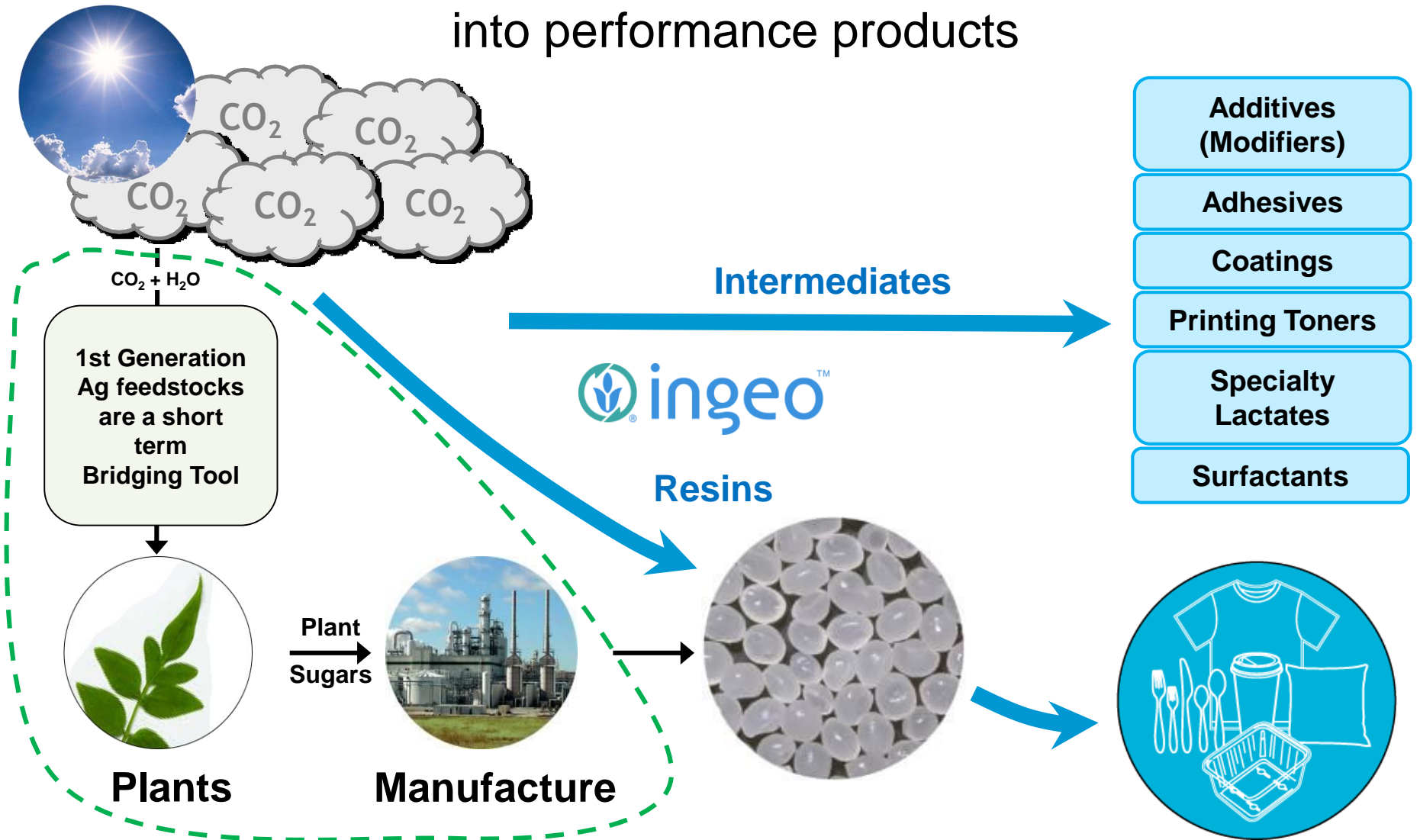
***InterPlas Thailand 2016
July 8, 2016***

Who we are

- **World's leading bio-polymer player**
 - 150,000 ton plant in Blair, NE
 - Significant manufacturing know-how and an extensive IP position
- **Jointly owned by Cargill and PTTGC**
- **Proprietary portfolio of Ingeo bio-polymers & intermediates**
- **Ingeo - competitive on a cost and performance basis with traditional plastics (PS, PET)**
- **Superior environmental characteristics**
 - Lower carbon footprint , low fossil energy
 - Additional end-of-life options
- **Established global market channels**
 - Over 100,000 ton in annual sales volume
 - Commercial partnerships with global brands



NatureWorks is in the business of turning greenhouse gases into performance products



The various generation biomass feedstocks should not be viewed as inherently better or worse than each other

Performance materials made by transforming whatever are the right, abundant, local resources

GENERATION I



Today

Dextrose & Sucrose from cassava or corn starch, sugar cane or beet

“Bridging Crops”

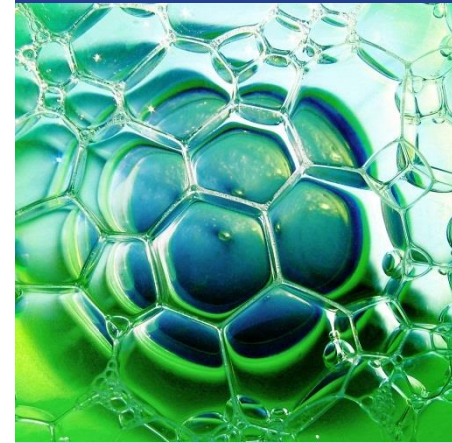
GENERATION II



Next 3-5 years

Lignocellulosics: Sugars from bagasse, wood chips, switch grass or straw.

GENERATION NEXT



And next?

CO₂ to lactic acid technology?

CH₄ to lactic acid technology?

Clearly Defined Value Drivers

3 “P’s” for Ingeo

Properties

- **Broad and adjustable physical property set**

Price

Sugars vs oil

Favorable yields,

Economies of scale






Feedstock hedging capabilities

Cradle to cradle economics

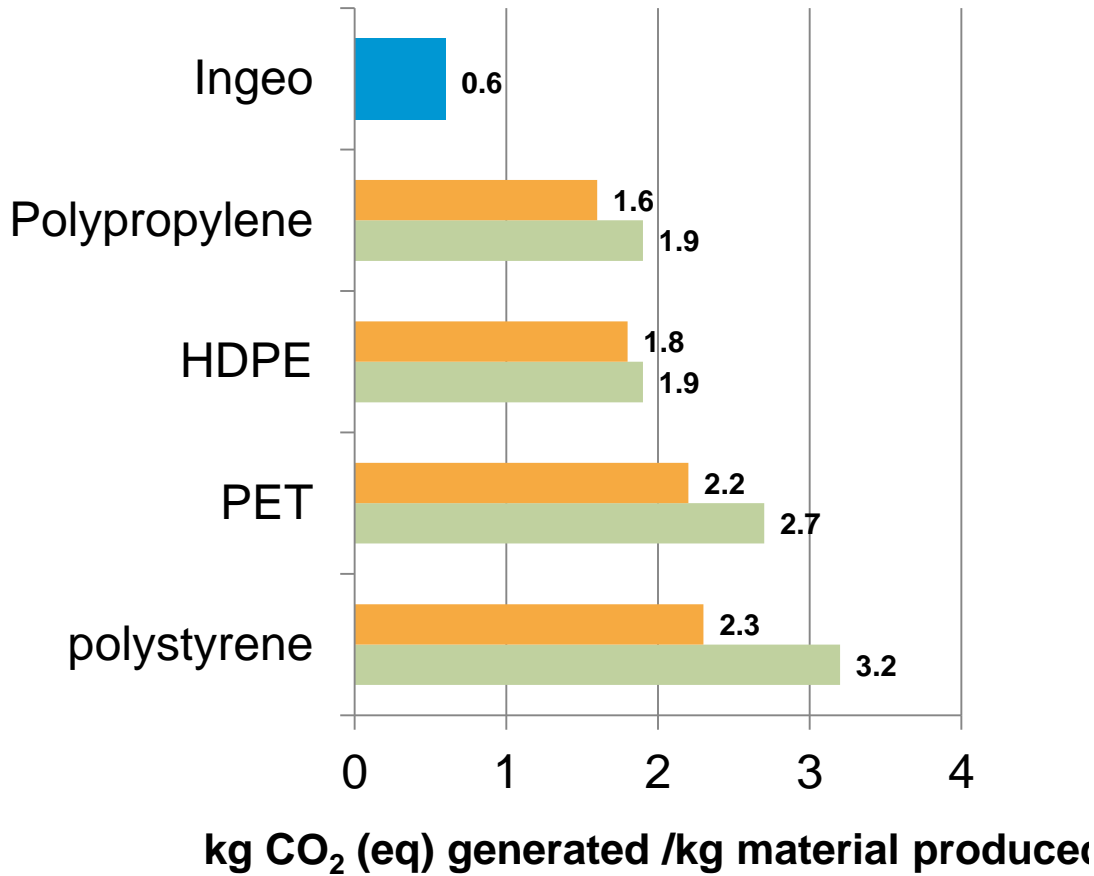
Preferences

- **Lower carbon footprint and energy usage**
- **Health Concerns**
 - **BPA free**
 - **Phthalates free**
 - **Acrylonitrile free**
 - **Styrene free**

Properties: Over the last 10 years, NatureWorks has optimized Ingeo grades towards specific applications

Nonwovens / Fibers	Rigids	Durables	Food Serviceware	Films
 <p>Ingeo nonwovens naturally advanced materials ingeo</p>	 <p>Ingeo food packaging naturally advanced materials ingeo</p>	 <p>Ingeo durable goods naturally advanced materials ingeo</p>	 <p>Ingeo serviceware naturally advanced materials ingeo</p>	 <p>Ingeo films naturally advanced materials ingeo</p>
<p>Key Properties</p> <ul style="list-style-type: none"> ■ Range of melting points/crystallinity levels ■ Tunable hydrolysis ■ Hydrophilic / moisture wicking ■ Inherent odor resistance ■ UV resistance ■ Low bonding temp 	<p>Key Properties</p> <ul style="list-style-type: none"> ■ Stiffness ■ Gloss, transparency ■ Printability ■ Weight reduction (vs. PET) 	<p>Key Properties</p> <ul style="list-style-type: none"> ■ Stiffness ■ Miscibility ■ Improved flow ■ Chemical resistance 	<p>Key Properties</p> <ul style="list-style-type: none"> ■ Stiffness ■ Compostability ■ High versatility for injection, extrusion and coating processes 	<p>Key Properties</p> <ul style="list-style-type: none"> ■ Seal strength ■ Stiffness ■ High gloss & transparency ■ Dead fold / twist retention ■ Grease, oil & aroma barriers ■ Chemical resistance ■ High throughput

“Preference” ... (cradle-to-polymer-production)



US Producers
 APC - American Plastics Council
<http://plastics.americanchemistry.com>

EU Producers
 PlasticsEurope
www.lca.plasticseurope.org



Peer Reviewed Benchmarking



Summary: Certification Tools for Ingeo Biopolymers

	1 Biobased Content Certification	2 Genescan Certification	3 ISCC PLUS	4 Feedstock Sourcing Certification	5 ISCC PLUS & Feedstock Sourcing	6 Working Landscape Certificates
Biobased content	✓					
No GM material in Ingeo		✓				
Sustainable farming			✓		✓	✓
GMO-free feedstock				✓	✓	
3rd party certified GMO-free feedstock						✓
Pricing*	Included	Included	≤ 2%	≤ 4%	≤ 6%	≤ 10%



*Final costs will depend on the number of programs selected, committed (annual) purchase volumes, the degree of administrative support required, as well as other related factors. Please contact your NatureWorks Business Development Manager directly for more detailed pricing information

Ingeo in the market

Rigids



Food Serviceware



Films



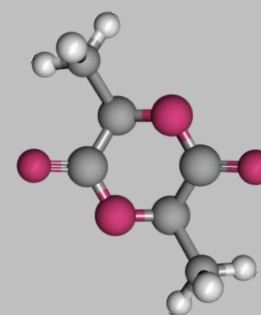
Nonwovens / Fibers



Durables



Lactides



Bus. Dev.



Ingeo in the market

Rigids



Food Serviceware



Films



Nonwovens / Fibers



Durables



Lactides

Additives
Coatings
Printing
Toner
Lactates
Surfactants

Bus. Dev.

