

Ingeo Feedstocks & Certifications

From Greenhouse Gas to Performance Materials

“While we view carbon as a problem, nature views it as a resource and an essential building block.”

- Bryony Schwan,
The BioMimicry Institute





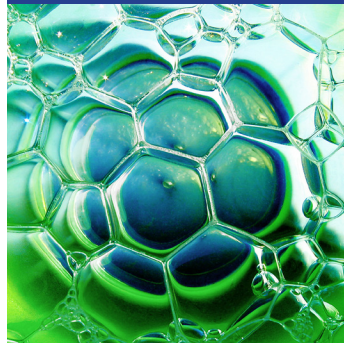
Nature looks at greenhouse gases - atmospheric carbon as a feedstock, a raw material. It's what trees, plants, and huge structures like coral reefs, are built from. At NatureWorks, we're doing the same thing – using our best technologies to turn carbon that's in the atmosphere contributing to global warming, into a portfolio of performance Ingeo™ materials.

How we convert our atmospheric carbon feedstock into Ingeo matters, and we take a hard look at this in everything that we do. Currently, the first step in transforming atmospheric carbon into Ingeo involves using agricultural crops to sequester the carbon, “fixing” it as simple plant sugars through the process of photosynthesis. This rightfully brings up questions around feedstock sourcing: agricultural growing practices, food and biopolymers, and land use.

Performance materials made by transforming the right, abundant, local resources.

At NatureWorks, we're committed to feedstock diversification –to using the most abundant, locally available, and sustainable source of biobased carbon, wherever we produce. Equally, we're committed to critically assessing and assuring the sustainability of each and every feedstock we use.

Diversified Feedstock Portfolio

TODAY	INDUSTRY DEVELOPING	NOW ASSESSING	<p><i>“All feedstocks will have advantages and disadvantages, so the focus should be on committing to the continuous improvement of the best available feedstock option for that technology and sourcing region.”</i></p> <p>- Erin Simon, Bioplastic Feedstock Alliance</p>
			
<p>Dextrose & sucrose from cassava, corn starch, sugar cane, or beets.</p>	<p>Lignocellulosics: Sugars from bagasse, wood chips, switch grass or straw.</p>	<p>CO₂ to lactic acid technology CH₄ to lactic acid technology</p>	

We are cautious about automatically viewing each next generation of feedstock as inherently more sustainable than the previous one. Whether it's the first generation “bridging feedstock” we use today, industrially sourced corn, or whether it's cutting-edge concepts for turning CO₂ or CH₄ directly into green building blocks – bypassing the agricultural step altogether, at NatureWorks, we believe it's vital to assure the integrity of the sustainability of every feedstock we use.

We've partnered closely with select NGO's, brands, and certifiers to create a comprehensive palette of tools for certifying the sustainability attributes of the current Ingeo feedstocks.

CERTIFICATION TOOLBOX FOR INGEO BIOPOLYMERS

Base Certifications



Genescan Certification

Today Ingeo is made from plant-based sugars and does not require a genetically modified (GM) feedstock. Current US corn growing practices produce a mixed stream of GM and conventional (non-GM) corn that we use for production. However, our final product, Ingeo biopolymer, does not contain any GM material due to the high heat used in the manufacturing process. Ingeo is certified to be free of any genetic material by Eurofins GeneScan, recognized by both government and NGOs as the leading authority for testing food, feed and raw materials. eurofinsus.com/gmotesting

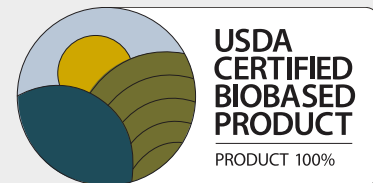


Biobased Carbon Content Certification

Verification that 100% of the carbon in the Ingeo biopolymer originates from renewable agricultural resources instead of oil. 3rd party certification based on ASTM6866 is provided in Europe by Vincotte and in the US by the USDA's BioPreferred program.

USDA BioPreferred: www.biopreferred.gov

Vincotte: www.vincotte.com



Optional Certifications



GM-Free Feedstock Sourcing Certification

Since the majority of US corn is genetically modified and it is not economically possible to set up a totally separate production chain dedicated to conventional (non-GM) corn. NatureWorks offers its feedstock sourcing program for those customers interested in supporting conventional (non-GM) agricultural practice. In this program a conventional corn volume, equivalent to the customer's needs, is purchased and mixed in the stream entering the corn wet mill. The customer receives copies of the farmers conventional seed purchase contract and verification that the corn produced is tested and delivered to the corn wet mill.



ISCC PLUS Certification

International Sustainability & Carbon Certification (ISCC) PLUS is a European based 3rd party certification scheme certifying the sustainable production of renewable raw materials including the certification of the chain of custody. ISCC PLUS is an independent, third-party certification program fully owned and controlled by Germany-based ISCC Systems GmbH. It is available to the entire industry and comes with a palette of options which can be tailored to individual customer concerns. ISCC is the world's first state-recognized system for certifying sustainability and greenhouse gas savings. ISCC Systems is active in 100 countries, and as of June 2016, has issued over 10,000 certificates, working with 32 certification bodies and with a basis of 82 members. Since the beginning of the relatively new ISCC PLUS program 92 certificates have been issued. The ISCC certification system is supported by the German Federal Ministry of Food, Agriculture and Consumer Protection via the Agency for Renewable Resources (FNR). www.iscc-system.org



ISCC PLUS continued...

Some of the production criteria include:

- The farmer cannot source from land with high biodiversity, high carbon stock or from peatland. The reference year is 2008.
- The farmer must meet sustainable agricultural practices concerning e.g. fertilizer & pesticide use, storage, disposal, tillage practices, equipment calibration and irrigation.
- The farmer must have measures in place to protect the surrounding environment such as the natural vegetation and water courses; the farmer also has to take measures to avoid soil erosion and to increase soil organic matter.
- The farmer must meet a set of social sustainability related criteria on e.g. child labor, workers protection, labor condition, land rights, training and water rights.

If a customer wants to participate in this program, NatureWorks contracts farmers which are then audited and certified along these criteria by an independent auditor and supervised by ISCC Systems GmbH. In this program a crop weight equivalent to the customer's needs is purchased and mixed in the stream of corn entering the corn wet mill.

The program also includes the certification of the chain of custody. This means that the total volume of Ingeo received by the customer is traced back, via a "mass balance book keeping system," to the equivalent amount of certified, sustainable corn produced and delivered to the corn wet mill.

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ISCC PLUS & GM-Free Feedstock Certification

Since in today's ISCC PLUS program specification of GM/conventional corn is not a part of the requirements, a combination of NatureWorks' feedstock sourcing program and the ISCC PLUS program is used. In this way both aspects are covered: conventional corn sourcing combined with sustainable corn production. We consider this as an intermediate solution and ISCC Systems is working on a project including the conventional corn requirement in the ISCC PLUS scheme.



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Working Landscape Certificates

The US-based NGO, the Institute of Agriculture and Trade Policy (IATP), provides the Working Landscapes Certificate (WLC) program; an independent third-party scheme certifying sustainable agricultural production for emerging biomaterials sectors, including the bioplastics industry. WLC includes the requirement of using conventional corn seed. Both ISCC PLUS and WLC focus on sustainable farming practices, but have slightly different sets of criteria. www.iatp.org



Some of the production criteria for WLC's include:

- Use of non-genetically modified (GM) crop varieties to protect biodiversity
- No continuous annual crop production on same acreage
- Soil testing on contracted acres and fertilization according to test results and state agronomic recommendations to assure that nutrients are used efficiently and are not likely to leach or run-off
- No use of chemicals that are known human or animal carcinogens, including atrazine
- Use of cover crops or assurance that at least 70 percent of crop residues remain on the entire field to minimize soil erosion
- Creation of farm plan that includes information on biodiversity, energy use and greenhouse gas emissions to help identify and encourage improvements in sustainability areas not currently addressed by WLC's

Certification Options for Ingeo Biopolymers Summary

	Base Certifications		Optional Certifications			
	Biobased Carbon Content Cert.	Genescan	GM-Free Feedstock Sourcing	ISCC PLUS	ISCC PLUS & GM-Free Feedstock	Working Landscape Certificates
	✓	✓	1	2	3	4
Biobased carbon content	✓					
No GM material in Ingeo		✓				
GM-free feedstock			✓			
Certified sustainable agriculture				✓	✓	✓
Certified GM-free feedstock					✓	✓
Pricing*	Included	Included	≤ 4%	≤ 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.

Assuring Feedstock Sustainability at Every Step of the Journey

Society is realizing that it needs to put more effort into sustainable development from an economic, social, and environmental point of view. Our major needs include mitigating global climate change and becoming less dependent on fossil resources. National and international authorities, several NGO's and big brands around the globe increasingly recognize that we need to move to a more circular economy, a process which is enabled by the fast technological innovations in industrial biotechnology.

Biopolymers are one of the new building blocks in this new circular economy and as one of the first movers in the space, NatureWorks is committed to working with key partners and critical stakeholders to assure the sustainability of its products as it continues its feedstock innovation journey.

What do you do if you want your Ingeo-based product certified?

Discuss the program with your Business Development Manager (BDM) and specify which options you are interested in purchasing.

Learn More

Go to natureworkslc.com | inquiry@natureworkslc.com | [@natureworks](https://twitter.com/natureworks)

