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RISE OF **NON-GMO** IN NORTH AMERICA

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AGENDA

Introduction
Program Overview
Consumer Awareness
Growth of Non-GMO
US Government Stance

INTRODUCTION

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The Non-GMO Project is a mission driven non-profit organization dedicated to building and protecting a non-GMO food supply

The Non-GMO Project offers a third party verification for non-GMO food and non-food products through approved Technical Administrators

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The mission of the National Organic Program is to protect the integrity of organic products in the U.S. and around the world.

Farming practices maintain or improve:

- Water quality
- Biodiversity
- Soil health and carbon sequestration
- Animal Welfare
- Food Quality

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The National Bioengineered Food Disclosure Law (NBFDL) directs USDA to establish national mandatory standard for disclosing foods that are or may be bioengineered

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1996	2000	2006	2007	2008	2016	2017	2018	2019
First lab to use PCR to test for GMOs	First Non-GMO Certification standard	Engaged to support development of NGP PVP Standard	First technical administrator for the Non-GMO Project	Launched SupplyTrak Non-GMO Project compliance management platform	FoodChain ID Verified the 50,000th NGP product	Expansion of team with acquisition of BioAgriCert	Launched USDA Organic services in the US	Launching SupplyTrak Organic certification compliance management platform

FOODCHAIN TESTING

NON–GMO STANDARD

1ST

FOODCHAIN SUPPLYTRAK

50k

bioagricert

USDA ORGANIC

FOODCHAIN SUPPLYTRAK ORGANIC

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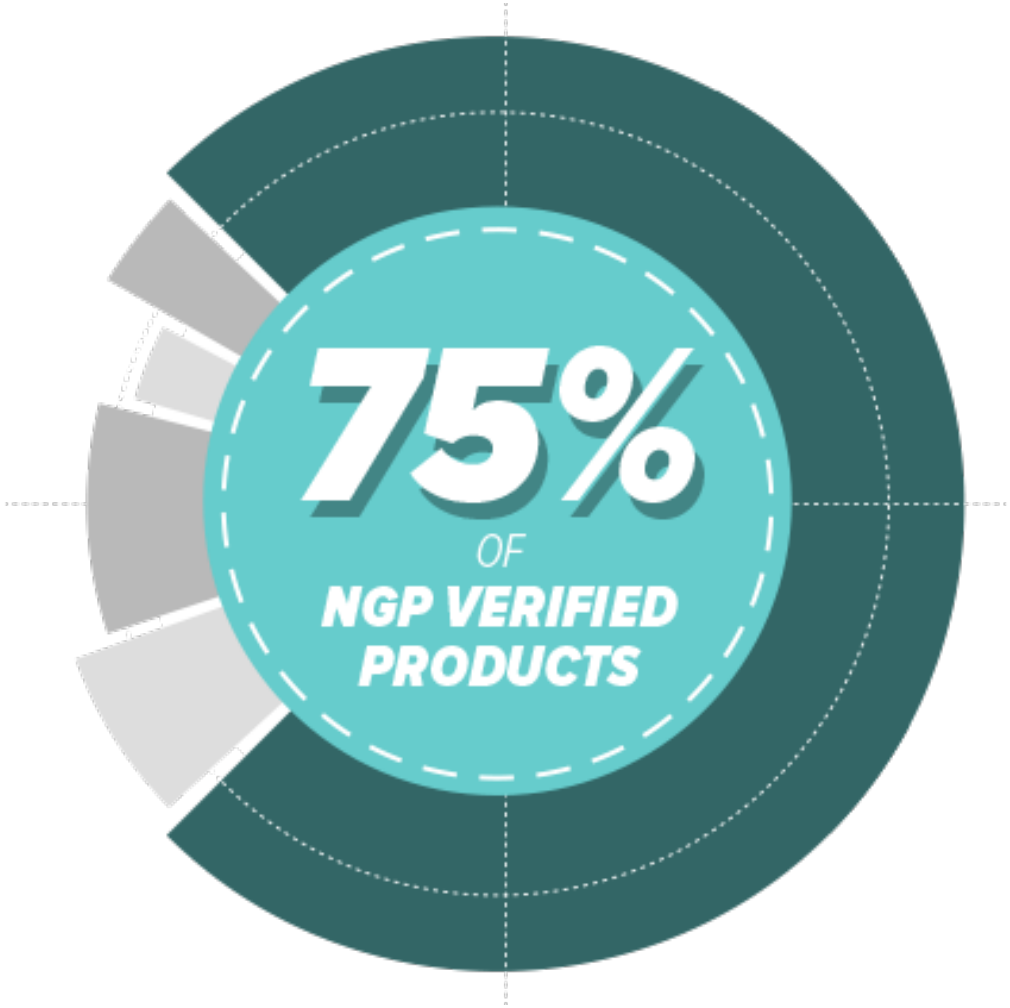

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PROGRAM OVERVIEW

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USDA Organic Objectives

- Organic products are produced without synthetic fertilizers, conventional pesticides, sewage sludge, irradiation, genetic engineering (GMO's), and artificial additives
- People want to know how their food is grown and may be willing pay a higher premium for it
- Organic is the most heavily regulated and closely monitored food system in the US
- The organic standard requires an annual physical inspection
- Identifies physical barriers to prevent contact of organic crops with prohibited substances or the products of "excluded methods" such as GMOs

Multi attribute certification and claim

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Non-GMO Project Objectives

NON GMO Project

- Concerns about the safety of GMOs
- Lack of regulatory structures
- Protect organic products from GMO contamination
- Raise awareness about the GMO issue

- Respect the right to know/enable informed choice
- Manage and minimize risk/ balance meaningfulness and achievability
- May require annual physical inspections

Single attribute verification and claim

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Non-GMO Project vs USDA Organic

USDA Organic

- Addresses a whole/holistic system
- Process centric – a set of practices that imply some kind of outcome
- Certification is of the Operator and their Operation

Non-GMO Project

- Single attribute claim and focus
- Product/Testing centric
- Verification is on the Product, the Ingredient and flow

The two seals are complimentary

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Overview of Roles

Non-GMO Project

- Scheme owner
- Sets the Standard
- Oversees the Product Verification Program
- Conducts market surveillance

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- Technical Administrator
- Verifies compliance with the Standard
- Feeds into the Standard's content, surveillance programs

NON GMO Project

credibility

NON GMO Project VERIFIED nongmoproject.org

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Non-GMO Project Standard

- The Non-GMO Project Standard is owned and managed by the Non-GMO Project which defines the requirements for verifying food and products as Non-GMO.
- The goal of the Standard is to assist farmers, processors and manufacturers in avoiding GMO contamination by providing consistency of definitions and methodology for investigating source materials, testing high-risk ingredients, and building identity preservation practices into the supply chain.
- Food and products are verified based on the review of ingredients contained in them.
- Ingredients are reviewed based on the dry weight percentage of each of them in the product.

NON GMO Project VERIFIED nongmoproject.org

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Ingredient Compliance

NON GMO Project VERIFIED

Maximum of 10 ingredients

< .5%

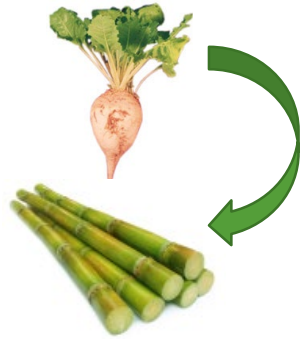
.5 – 5%

System designed to avoid GMO's

Source from verified supplier

>5%

Reduce weight %



Source from a GMO-Free Region or remove/switch ingredient

PCR testing

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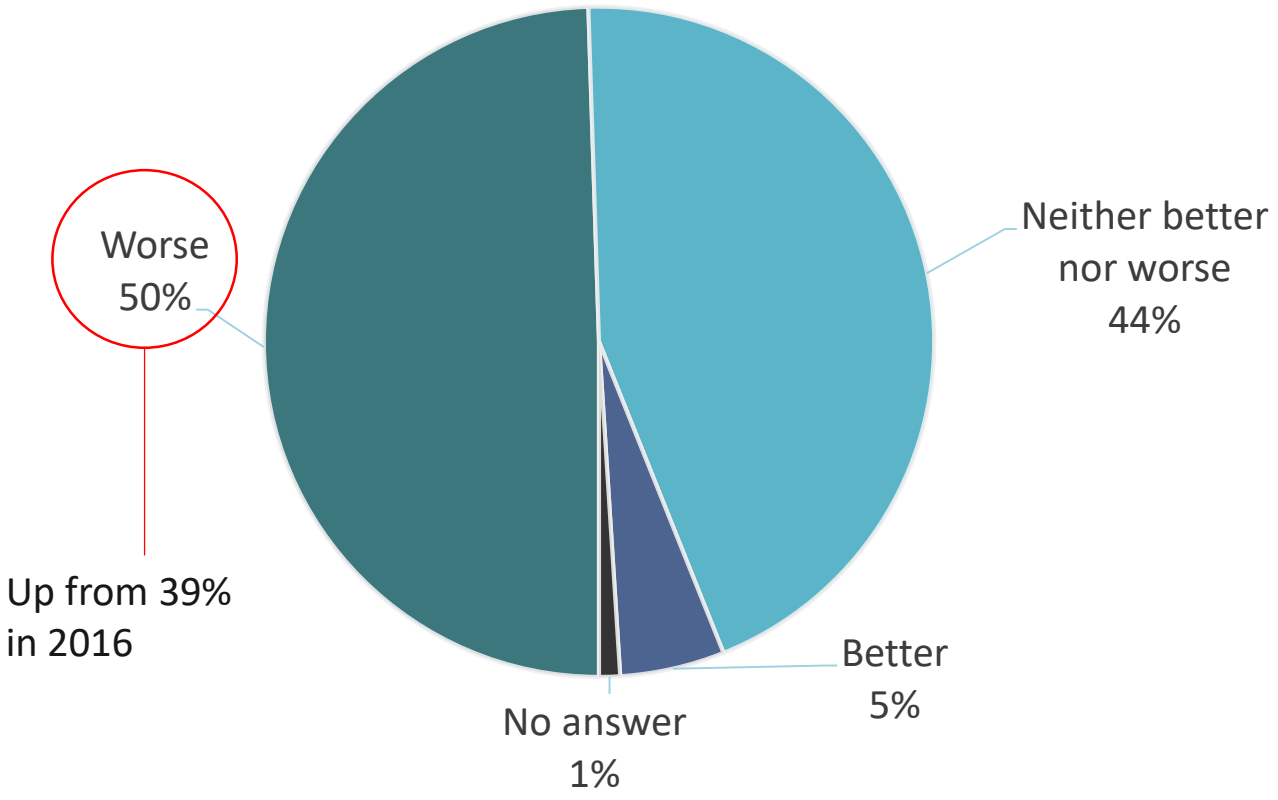
CONSUMER AWARENESS

Consumer Familiarity

About half of U.S. public says GM foods are worse for one's health

% of U.S. adults who say genetically modified foods are _____ for one's health than foods with no GM ingredients



Note: Beliefs about the health effects of genetically modified (GM) foods include those who lean toward each response.
Source: Survey conducted April 23-May 6, 2018
"Public Perspectives on Food Risks"
PEW RESEARCH CENTER

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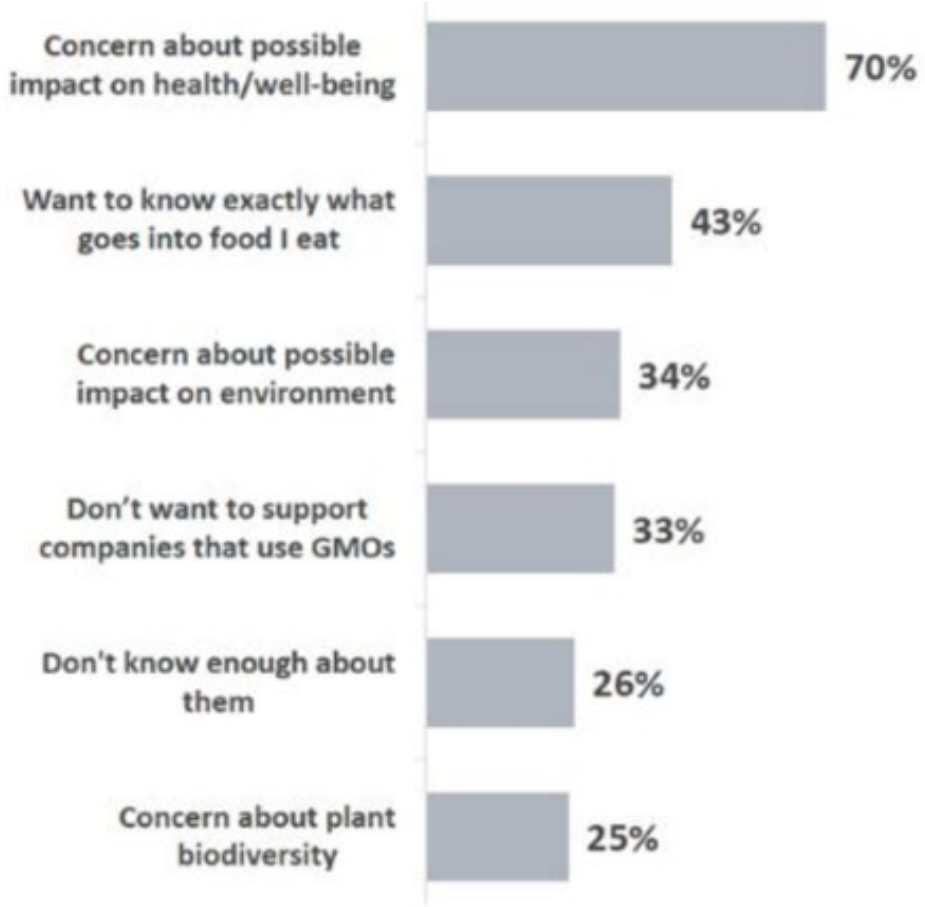
Reason Avoiding/Reducing GMO's



Credit Non-GMO Project

Even though health is one of the primary drivers, many shoppers avoid GMOs for a myriad of reasons

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Highly meaningful	Meaningful	Somewhat meaningful	Not meaningful
The Non-GMO Project	USDA Organic	General non-GMO claims	Natural

Consumer Reports Food Safety and Sustainability Center October 2014

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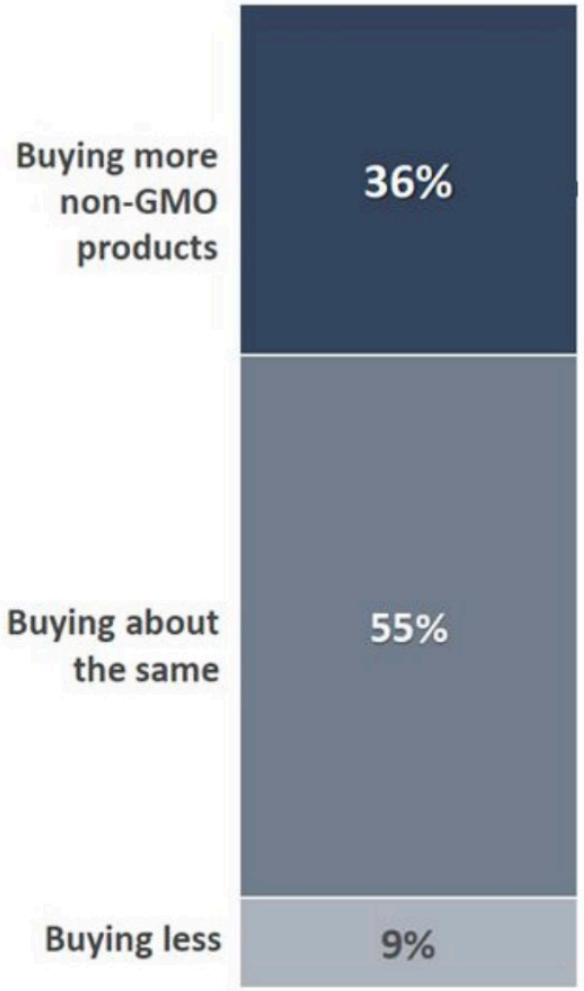
Purchasing

In the past year about 1/3 of shoppers have increased their non-GMO purchasing



Credit Non-GMO Project

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GROWTH OF NON-GMO

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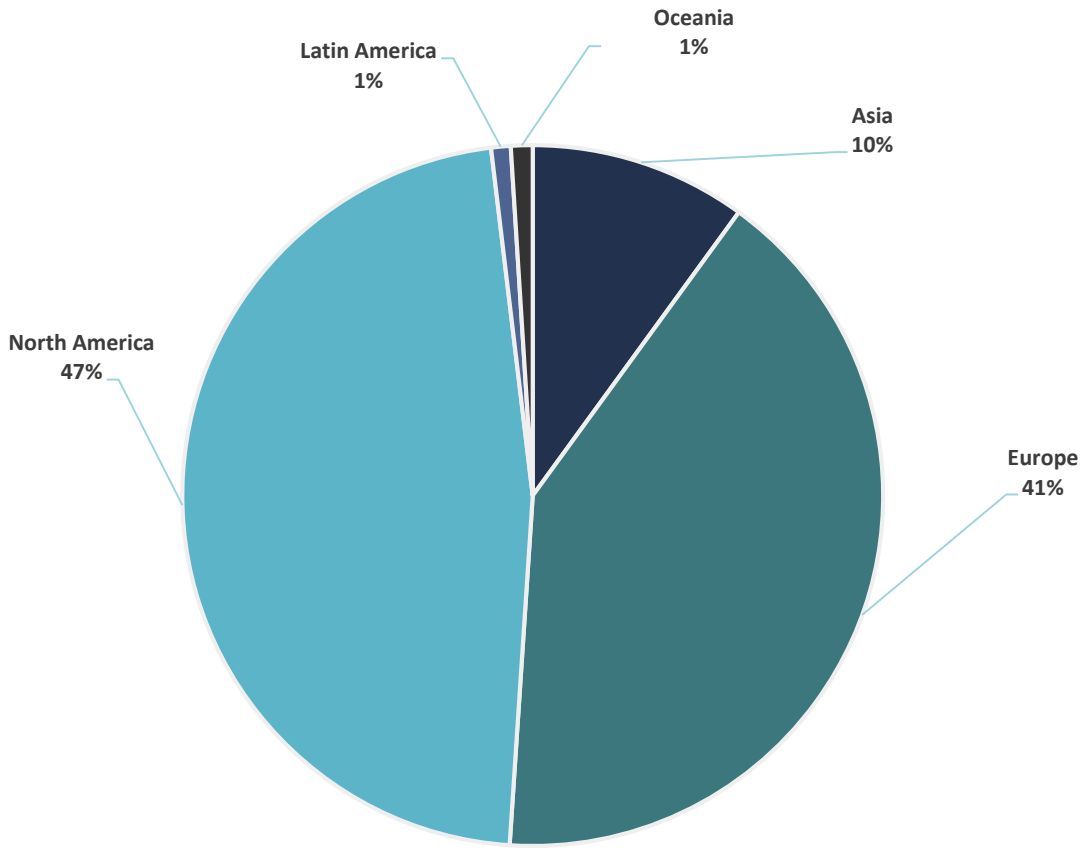
Global Organic Market



Source: FiBL-AMI survey 2019, based on retail sales with organic food

Retail sales value by region 2017

- US Organic Sales exceeded $49B USD in 2017
- The overall growth rate of 6.4% exceeded the growth of the overall food market which grew by 1.1%
- Organic Foods now accounts for 5.5% of total food sales in the US

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FoodChain ID Clients Using Both Seals

NON GMO Project VERIFIED + USDA ORGANIC = 46%

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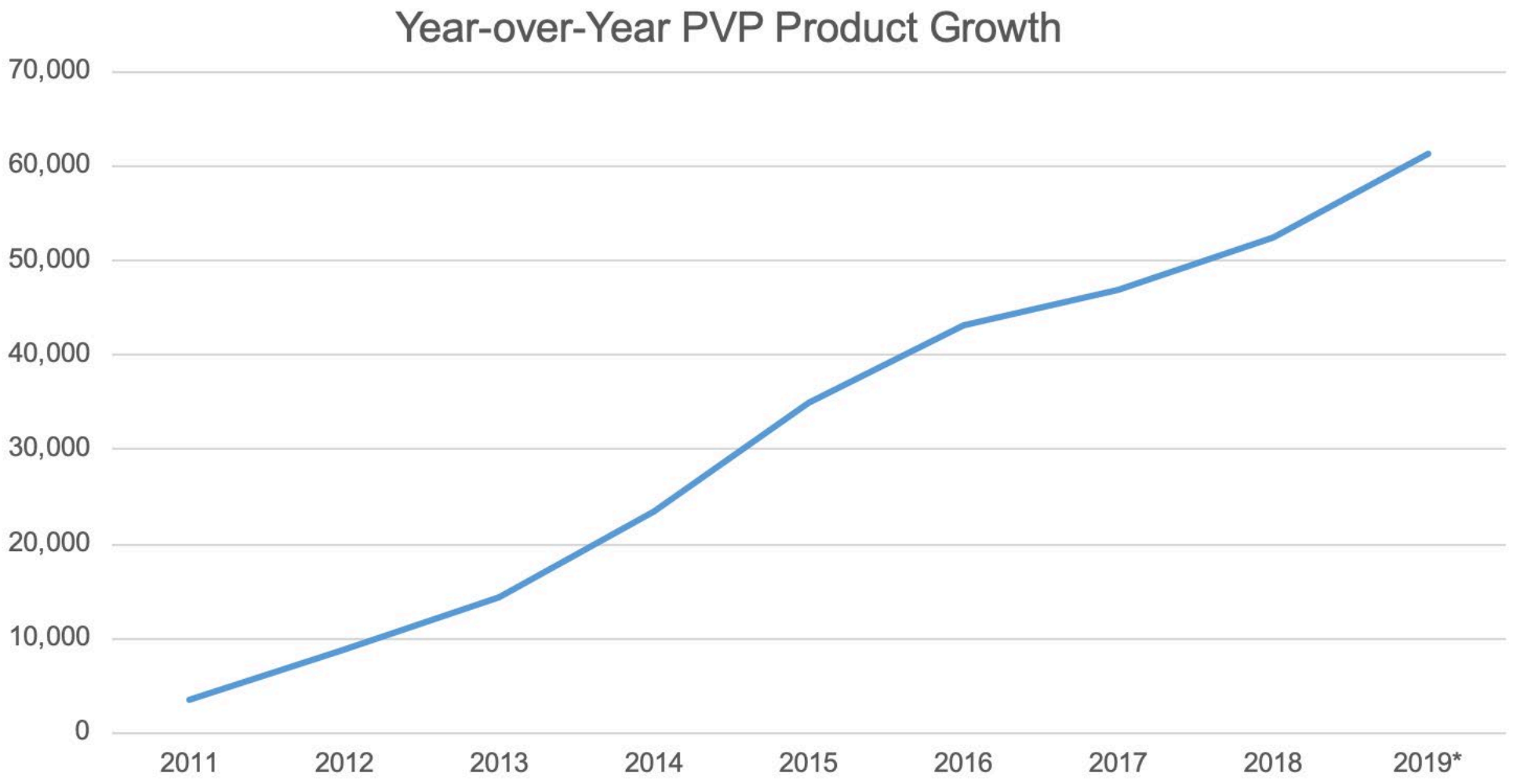
At 9% Non-GMO is the fastest growing consumer attribute/claim in 2018



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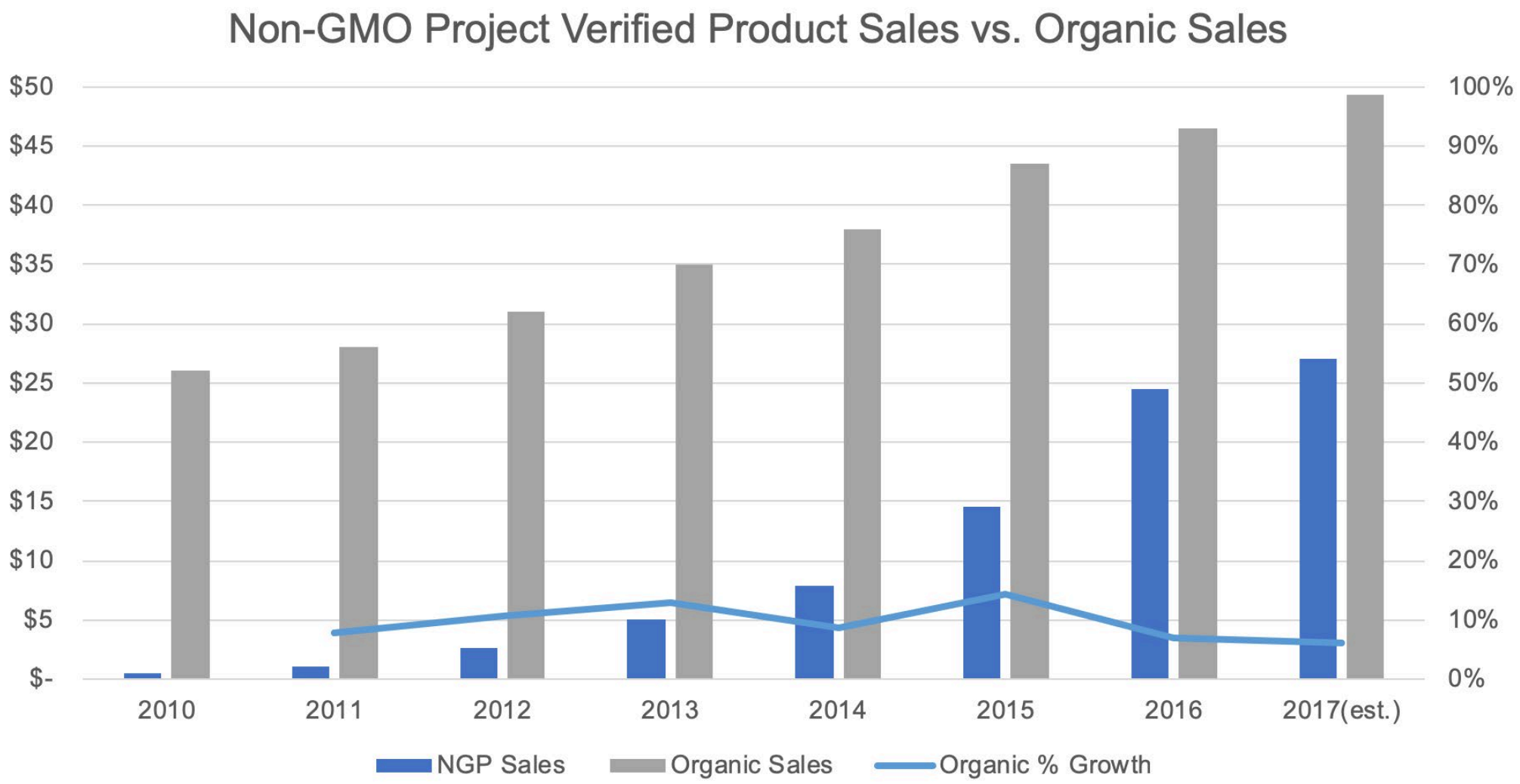

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GOVERNMENT STANCE

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NBFDS – Disclosure requirement

Disclosure requirement

A label for a bioengineered food must bear a disclosure indicating that the food is a bioengineered food or contains a bioengineered food ingredient

Exempted Food and Entities

- Food served in a restaurant or similar retail food establishment
- Very small food manufacturers
- A food in which no ingredient intentionally contains a bioengineered (BE) substance, with an allowance for inadvertent or technically unavoidable BE presence of up to five percent (5%) for each ingredient.

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NBFDS Timeline

- July 14, 2016 – House of Representatives approved the Senate bill to pass the National Bioengineered Food Disclosure Standard
- July 29, 2016 – President Barack Obama signed the Bill into law
- May 4, 2018 – Agricultural Marketing Service published a proposed rule inviting comments by July 3, 2018
- December 21, 2018 – The U.S. Department of Agriculture's (USDA) Agricultural Marketing Service (AMS) published its final rule implementing the National Bioengineered Food Disclosure Standard (NBFDS)

National Bioengineered Food Disclosure Standard

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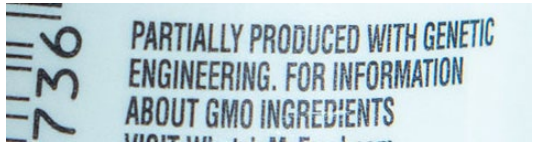
NBFDS – Type of Disclosure § 66.100 (b)

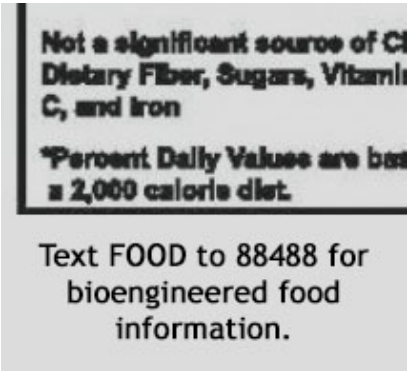
On Label Statement



Symbol

Electronic or Digital Link

Text Message



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Compliance

- Voluntary compliance – Regulated entities may voluntarily comply with the requirements in this part until December 31, 2021.
- Mandatory compliance: Effective January 1, 2022
- NBFDS does not (yet) provide for penalties in cases of non-compliance
  - Enforcement more likely to come in the form of:
    - Consumer Litigation – A Class Action Lawsuit
    - Competitor Suits
- Products certified under the National Organic Program are exempt from disclosure

The Non-GMO Project working to ensure verified products not require BE disclosure

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Criticisms of NBFDS

- Exempts most processed and refined GMO foods, which represents the majority of GMO foods.
- Mandates that the use of the new term bioengineered instead of the familiar “GMO” in disclosures.
- 5% per ingredient threshold for GMO contamination.
- Fails to include any technical requirements to ensure that GMO testing is meaningful.
- Largely exempts GMO ingredients developed through techniques such as CRISPR or RNAi because many will not contain detectable GMO DNA.

Credit Non-GMO Project

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Comparison of GMO Labeling Requirements

USDA Organic

- Regulated by the Government
- GMO"s excluded method

European Union

- Regulated by the Government
- Requires labeling of Genetically Modified Food and Organisms

NBFDL

- Regulated by the Government
- Requires labeling of Bioengineered Food and Products

Non-GMO Project

- Not regulated by the Government
- Allows for labeling of Non-GMO Food and Products

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NOW WHAT?

TRANSPARANCY / CLARITY

APPENDIX

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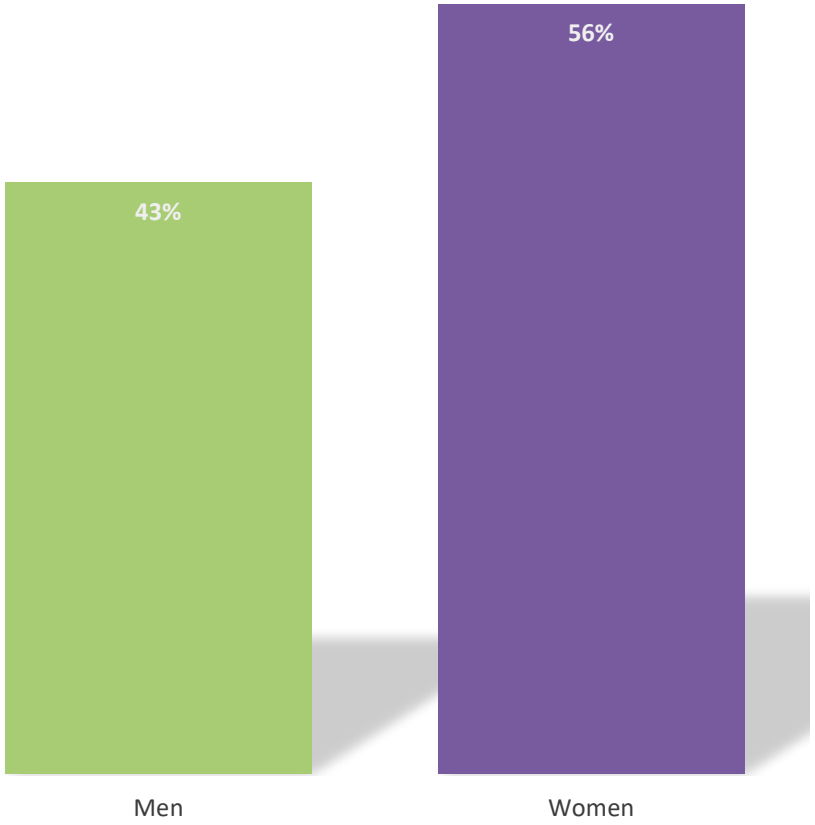
Consumer Familiarity

Women are more inclined than men to see problems stemming from GM foods

% of U.S. adults who say GM foods are worse for health than foods with no GM ingredients



Note: Beliefs about the health effects of genetically modified (GM) foods include those who lean toward each response.
Source: Survey conducted April 23-May 6, 2018
"Public Perspectives on Food Risks"
PEW RESEARCH CENTER

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Consumer Familiarity

Discomfort

Discomfort at the idea of a natural produce being changed by people into something unnatural

Distrust

Distrust in big business and its motivation for profit in producing GMOs, and in science and its ability to have all the answers

Uncertainty

Uncertainty about the consequences of genetic modification for our bodies and the world

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Organic & Natural Report 2018 | ©2018 The Hartman Group Inc.

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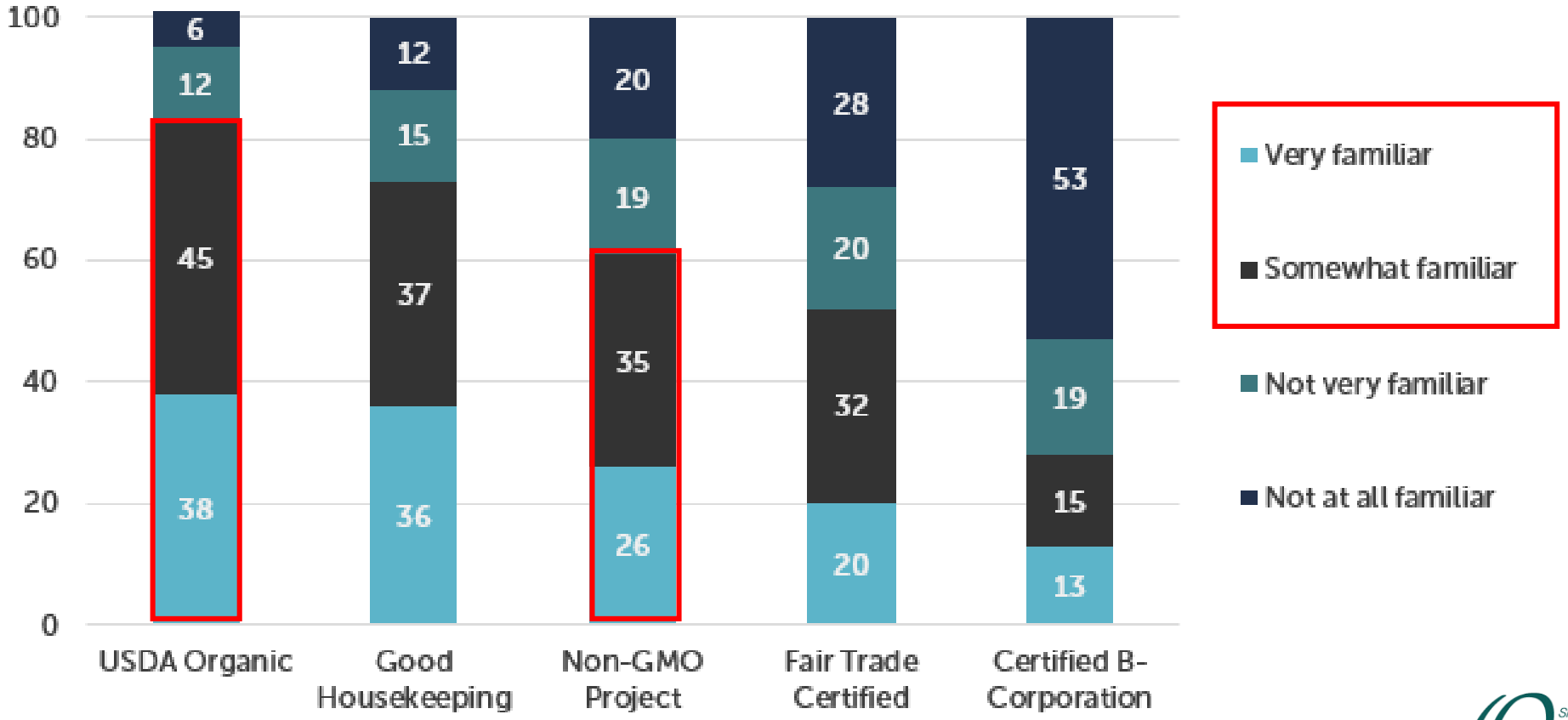
CONSUMER FAMILIARITY



SINCE 1985 Organic trade association

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Comparative Terminology

Genetically Modified Organism (European Union)

An organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination.

Bioengineered Food (USDA)

A food that contains genetic material that has been modified through in vitro recombinant deoxyribonucleic acid (rDNA) techniques and for which the modification could not otherwise be obtained through conventional breeding or found in nature; provided that such a food does not contain modified genetic material if the genetic material is not detectable

Non-GMO or Non-GM (Non-GMO Project, North America)

An organism or derivative of such an organism whose genetic structure has not been altered by biotechnology.

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Organic

- The USDA organic regulations describe how the word "organic" or the USDA organic seal can be used on food, feed, or fiber products
- Packaged labeling:
  - **100% Organic –** only certified organic agricultural ingredients and certified organic processing aids (water and salt can be added) - (7 CFR 205.303)
    - Can use USDA seal and/or our seal (our seal can't be more "prominent" than USDA's)
  - **Organic –** at least 95% certified organic ingredients plus allowed non-organic ingredients (listed in 7 CFR 205.605 and 7 CFR 205.606) - (7 CFR 205.303)
    - Can use USDA seal and/or our seal (our seal can't be more "prominent" than USDA's)
  - **Made with Organic ___ (food ingredient or food group) –** at least 70% organic ingredients plus allowed non-organic ingredients (7 CFR 205.304)
    - Can't have organic and non-organic forms of the same ingredient.
    - Can use our seal but not USDA's.
    - Can state the % of organic ingredients on the front of the panel (restriction on font size).
  - **Less than 70% organic ingredients (7 CFR 205.305)**
    - Can only use the word organic when identifying organic ingredients in the ingredient panel.
    - No seal use allowed
    - No reference to certification

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NGP Technical Overview

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Non-GMO Project Scope – Possible Products

Yes

- ✓ Seed and other propagation materials
- ✓ Products that are either ingested or applied directly to skin: human food, ingredients, supplements, and personal care products, including lotions, soaps, balms, makeup, etc.
- ✓ Over the counter (OTC) drugs, including homeopathic remedies
- ✓ Livestock feed and supplements
- ✓ Products that are not ingested or applied directly to skin, such as packaging, cleaning products, and textiles
- ✓ Pet food

No

- × Products that include controlled substances under U.S. or Canadian law
- × Products that are not sold in the U.S. or Canada
- × Certain medicines and other medical products
- × Live animals
- × Products composed entirely of non-risk inputs and that are part of a non-risk category

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Non-GMO Project Scope – Inputs/Ingredients

Must

- Unprocessed agricultural inputs
- Manufacturing inputs, including flavorings, seasonings, colorings, additives
- Animal-derived inputs
- Processed agricultural inputs or ingredients
- Packaging that is directly immersed or combined with liquid (eg tea bags)
- Livestock feed components
- Inputs used in personal care and cosmetic products, and textiles
- Dietary supplements, vitamins, and herbal preparations
- Microbial starters and enzymes, media, and derivatives

Optional

- Seeds
- Other agricultural inputs, such as fertilizers, pesticides, and herbicides (but not compost)
- Cleaning products
- Packaging materials
- Veterinary inputs, but **not** rBGH or rBST, which are prohibited inputs

Not eligible

- Processing Aids if present in the finished product at less than 0.5% and not declared on the retail ingredient panel or the input disclosure documentation of a wholesale product. Fermentation microorganisms are not considered to be Processing Aids.
- Purified Carbon Dioxide (CO2) from either biological or non-biological sources

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Activities covered by the Standard

Type of Activity	Comment
Agricultural production—seeds and crops	Includes farm production, harvest, and post-harvest handling and storage on farm or farm-related facilities
Handling	Includes any form of post-harvest movement, storage, transformation, or labeling of goods along the entire chain of custody from seed to consumer, except for products enclosed in final retail packaging
Storage	Includes all links in the chain of custody from seed to finished product
Distribution	This may or may not involve physical handling of goods
Processing	Includes all conveyance, storage, processing, handling, assembly, or packaging of goods within any given production facility
Manufacturing	Involves the production, and combination of, inputs to make the final product
Packaging and labeling	Includes any and all events where the package or labeling of goods is altered

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NGP Verification Methodology

Management of Processes

- Quality Assurance (critical control point and root cause analyses, corrective actions)
- Input Evaluation
- Segregation
- Cleanout
- Traceability
- Identity Preservation
- Labeling

Testing

- Sampling procedures
- Testing methods
- Statistical significance

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GMO Risk Categories and Risk Lists (1) – High Risk

Testable

1. Crops

- Alfalfa
- Canola
- Corn (except popcorn)
- Cotton
- Papaya
- Soy
- Sugar beets
- Zucchini and yellow summer squash

2. Animal products

- Eggs
- Hides and skins
- Honey and other apiculture products
- Meat
- Milk
- Seafood from aquaculture

3. Processed inputs (non-exhaustive)

- Amino Acids
- CO_2
- Citric Acid
- Corn Syrup
- Ethanol
- Maltodextrin
- Molasses
- Xanthan Gum
- Vinegars
- Vitamins

Non-Testable

1. Crops

- Canola (ODM)18
- Potato (RNAi)
- Soy (TALEN)19

2. Microbe and Enzyme Inputs

- Enzymes— including chymosin
- Microbial cultures and starters — including yeast
- Algae from aquaculture

3. Ingredients or Substances Potentially Sourced via Synthetic Biology

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GMO Risk Categories and Risk Lists (2) – Monitored Risk

Testable

- *Beta vulgaris* (e.g., chard, table beets) – cross pollination risk from GM sugar beets
- *Brassica napa* (e.g., rutabaga, Siberian kale) – cross pollination risk from GM canola
- *Brassica rapa* (e.g., bok choy, mizuna, Chinese cabbage, turnip, rapini, tatsoi) – cross pollination risk from GM canola
- *Cucurbita pepo* (e.g., acorn squash, delicata squash, patty pan squash, pumpkin, and spaghetti squash) – cross-pollination risk from GM squash
- Flax
- Mustard
- Rice
- Wheat

Non-Testable

1. Crops

- Apple
- Camelina (false flax)
- Corn (CRISPR-Cas9, INzyme®)21
- Mushroom
- Orange
- Pineapple
- Salmon
- Sugarcane
- Tomato

2. Ingredients or Substances Potentially Sourced via Synthetic Biology

- Spider silk

Treat Monitored Ingredients as Low Risk; ongoing surveillance and updates by the Non-GMO Project

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GMO Risk Categories and Risk Lists (3) – Low Risk

- Not on high risk or monitored risk lists.
- Also entails:
  1. Examining the complete input disclosure to confirm the absence of components with GMO risk, including compound ingredients.
  2. Verifying that the input was produced under conditions designed to avoid cross-contamination with genetically modified (GM) materials.
- Biologically-derived, but no evidence of commercialization or environmental release.
  - The Non-GMO Project constantly researches and monitors development, approval, and releases, employing 2 full-time staff dedicated to this task.
- Downgrading to low risk — a key ideal goal for the Non-GMO Project!
- High risk or monitored risk inputs may be downgraded to low risk based on geography, isolation, and similar factors that remove the threat or suspicion of a higher degree of risk.
  - (Conversely, an input may be changed from low to higher risk based on empirical findings of GMO contamination, new releases, changes in geographical distribution, etc.)

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GMO Risk Categories and Risk Lists (4) – Non-Risk

- Inputs that do not come from biological sources, i.e. no genetic material to modify.
- Need to assure that no other components carry any risk level.
- Examples: salt, mineral feed supplements

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Ingredient Classification

- Major: 5% or more of the finished product or is a defining ingredient
- Minor: At least 0.5%, but less than 5% of the finished product, and is not a defining ingredient
- Micro: Less than 0.5% of the finished product and is not a defining ingredient
  - ***Exempt Micro Ingredients–*** Micro Ingredients are generally exempt from evaluation provided that any given product does not contain more than 0.9% total exempt Micro Ingredients
    - Until 20 May 2019, up to 10 exempt micro ingredients per formulation are allowed
    - Review exempted for growth medium or feed.
  - ***Micro Ingredients that require evaluation –***
    - Any added nutrient, vitamin, or other active component contained in a finished supplement product must be non-GMO, regardless of amount.
    - The following ingredients are not allowed if they are the direct product of genetic modification:

      i. For finished retail goods, if they are listed on the ingredient panel; or

      ii. For products sold without retail labeling, if they are listed on the input disclosure documentation:

      - Viable Microbes
      - Functional Enzymes.
      - Products of synthetic biology (synbio)

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Testing (1) – Action Thresholds

Category	Action Threshold
Seed and other propagation materials	0.25% [(a)]
Inputs to human food, ingredients, supplements, personal care products, and other products that are either ingested or applied directly to skin, and pet food	0.9%
Livestock feed and supplements, including those used for animal-derived inputs to human food products	5% [(b)]
Inputs to packaging, cleaning products, textiles and other products that are not ingested or applied directly to skin	1.5%

(a) For seeds of species not listed in Appendix B, and for all species not listed in Appendix B, there is no allowable presence.
(b) This Action Threshold is based on the annual average of all lots tested.

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Testing (2)

- For high-risk inputs
- At least once post-harvest
- Necessitates having intact DNA
- Requires quantitative Real-Time or Digital PCR tests at 0.1% detection level or qualitative PCR at 0.01% - for all known commercialized GMO events for the input in question.
- Laboratories must be ISO 17025 accredited for the protocols and ingredients in question.
- Strip tests may be used for in-field testing, spot testing input samples, and for compositing for PCR tests.
- Compositing lot samples:
  - Must ensure that any single sample in excess of the relevant Action Threshold produces a positive result for the composite sample as a whole.
  - 90% confidence level
- Statistically valid sampling plan must be in place, practiced by trained employees.

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Affidavits to show compliance of inputs

For non-testable inputs

- …stating that any such Non-Testable High-Risk Input is not the product of genetic modification
- Becoming more important with the advent of newer gene editing techniques

Insufficient if a high-risk input's precursor would have detectable intact DNA

- The precursor must also have a PCR test result

For testable Minor and Micro ingredients

- Possible if no PCR test results are available; and
- Produced in a "system designed to avoid GMOs" (e.g. organic)

For low-risk inputs

- attesting to all components of the input in question, and no threat of contamination

Equivalent certification programs' certificates can supplant an affidavit.

- The Standard also allows for reciprocity with other Non-GMO Standards, to be reviewed on a case-by-case basis.

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Animal-derived ingredients and products
(just the tip of the iceberg)

As a Major ingredient, the feed must be verified compliant with the Standard:

- Minor feed ingredients are exempt, if affidavits can attest to being from a system designed to avoid GMOs

Verification based on seed tests

- PCR from the seed supplier
- Farmer strip tests below Action Threshold for their own saved seed
- Traceability of harvest to feeding to assure no contamination

For purchased feed

- PCR on the composite feed or strip tests on all lots of individual high-risk inputs
- Provide annual (averaged) feed ration of animals' diet

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Claims and Labeling

NON GMO Project VERIFIED
nongmoproject.org

Claims must be “accurate and truthful” – e.g. no declaration of “GMO free,” “zero GMOs,” etc.

The Non-GMO Project allows a “made with non-GMO _____” for product formulations that:

- Contain >70% of the named high-risk ingredient, e.g. corn chips “Made with Non-GMO Project verified corn”
- Contain no more than 25% of an animal-derived product, which is not considered a “defining ingredient” in the product (i.e. whose name appears in the name of the product) **and** which have >5% of the named made-with high-risk ingredient in the made with claim.
- Are verified to not have dairy ingredients produced using rBST/rBGH
- Do not use the Non-GMO Project on the product label (i.e. text claim only)

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Site Inspections?

Inspections are **not** required for:

- Products in which there are only low-risk Inputs and exempt micro inputs, or non-testable and meeting relevant declaration requirements.
- Products produced in a facility where there is no parallel processing of the specific Major High-Risk Inputs used in products verified under the Standard.
- Products of a facility that is dedicated to certified organic production, if no parallel processing of the specific Major High-Risk Inputs is occurring in the facility.
- Contract processors that are made by an operation contracted by the Participant may be evaluated and approved, as long as it is a product of a system that has been designed to avoid GMOs.

Technical Administrators may require site inspections (announced or unannounced) at their discretion and with reason.

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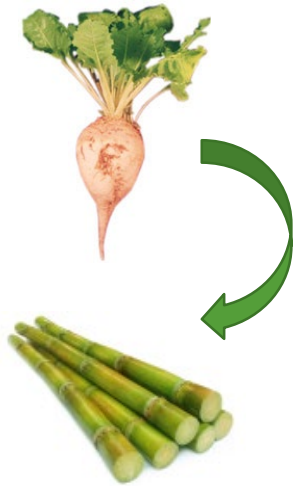
Formulation

Source from an already Approved/Verified Supplier

Reformulate: reduce weight %

Compliance Options

Reformulate: switch to a similar ingredient or source ingredient from a GMO-Free Region



PCR Testing

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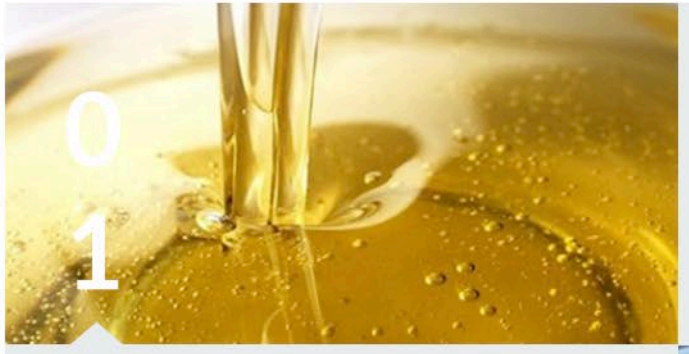
Ingredient Examples | Confirm & Clarify



Vegetable oil from 100% bioengineered canola

NOT SUBJECT TO DISCLOSURE as long as a validated refining process confirms the absence of detectable modified material

Corn meal with 5% bioengineered content

NOT SUBJECT TO DISCLOSURE as long as the 5% bioengineered substance was inadvertent or technically unavoidable

Bread made with 0.4% yeast, or rolled in 0.5% corn meal

SUBJECT TO DISCLOSURE?

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SYSTEM

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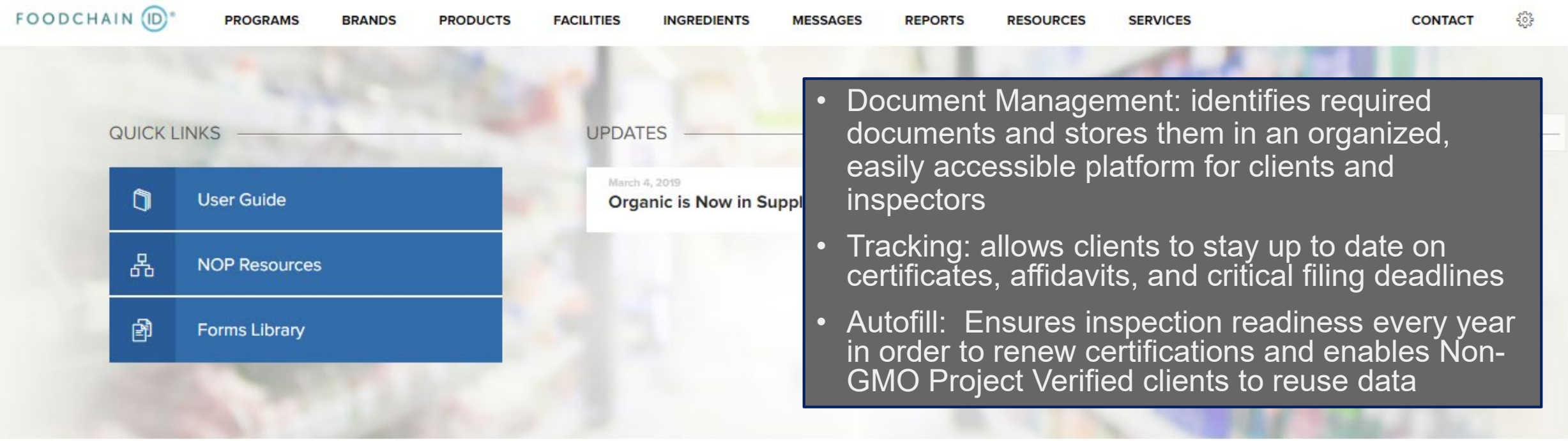
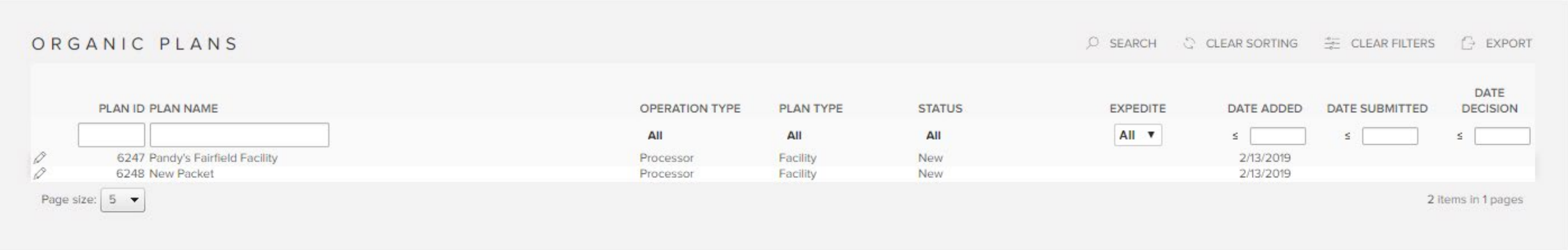
SupplyTrak: Digitization of the Supply Chain



- Document Management: identifies required documents and stores them in an organized, easily accessible platform for clients and inspectors
- Tracking: allows clients to stay up to date on certificates, affidavits, and critical filing deadlines
- Autofill: Ensures inspection readiness every year in order to renew certifications and enables Non-GMO Project Verified clients to reuse data



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FOODCHAIN ID | PROGRAMS | BRANDS | PRODUCTS | FACILITIES | INGREDIENTS | MESSAGES | REPORTS | RESOURCES | SERVICES | CONTACT | Help

PRODUCT 3340: Organic Sliced Smoked Mozzarella

DETAILS | INGREDIENTS | MICRO EXCL CALC | MESSAGES | ADD MESSAGE | BACK TO PRODUCTS

NAME: Organic Sliced Smoked Mozzarella

BRAND: Pandy's Natural Cheese

BRAND TYPE: Temp

RETAIL CATEGORY: Please Select...

INTERNAL REF. #: 123

KEYWORD:

DESCRIPTION:

☑ PRODUCT IS PRODUCED IN ONE OR MORE COMPANY OWNED FACILITIES

☐ PRODUCT IS PRODUCED IN ONE OR MORE CO-PACKER (CONTRACT MANUFACTURER) FACILITIES

Save | Delete | Validate Page

NGP | NOP

IS CERTIFIED? ◉ Yes ○ No

CERTIFICATION SCHEME: USDA Organic

CERTIFICATION BODY: Oregon Tillth

CERT ISSUE DATE: 10/20/2018

CERT ANNIVERSARY DATE: 10/20/2019

LABELING CATEGORY: Organic

Validate for Organic

ORGANIC DOCUMENTS

PRODUCT DATA SHEET: Test.txt

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ORGANIC PLAN 345: Pandy's Pella Facility - In Progress

DATE ADDED: 2/27/2019 PROCESSOR | FACILITY

DETAILS MESSAGES ADD MESSAGE BACK TO ORGANIC PLANS

NAME Pandy's Pella Facility

FACILITY Pella

Refresh Submit for Review

Organic Plan Summary

Facility	Pella
Products	3
Ingredients	7
Suppliers	11
Forms	Ready to Submit: 3 of 21 In Progress: 18 of 21

ORGANIC PRODUCTS TREEVIEW [X] Product List is complete (?)

Add

ID	Name	Status	Labeling Category	Formulation	Organic Ingr	Non-organic Ingr	Nat. Flavor	Certification
123	Organic Gouda Loaf	✓	Organic	Complete				
234	European Style Organic Butter	✓	Organic	Complete				
456	Organic Sliced Smoked Mozzarella	⚠	Organic	Needed				
6245	Cultured	✓				Y		
6246	Enzymes	✓				Y		
5776	Hickory Wood Smoking Chips	✓				Y	Y	
6243	Milk	⚠			Y			
20078	Hosbond's Dairy	✓						Active
20097	Thicke's Dairy	✓						Active
20098	Yoder's Dairy	⚠						Expired
6244	Salt	✓			Y			

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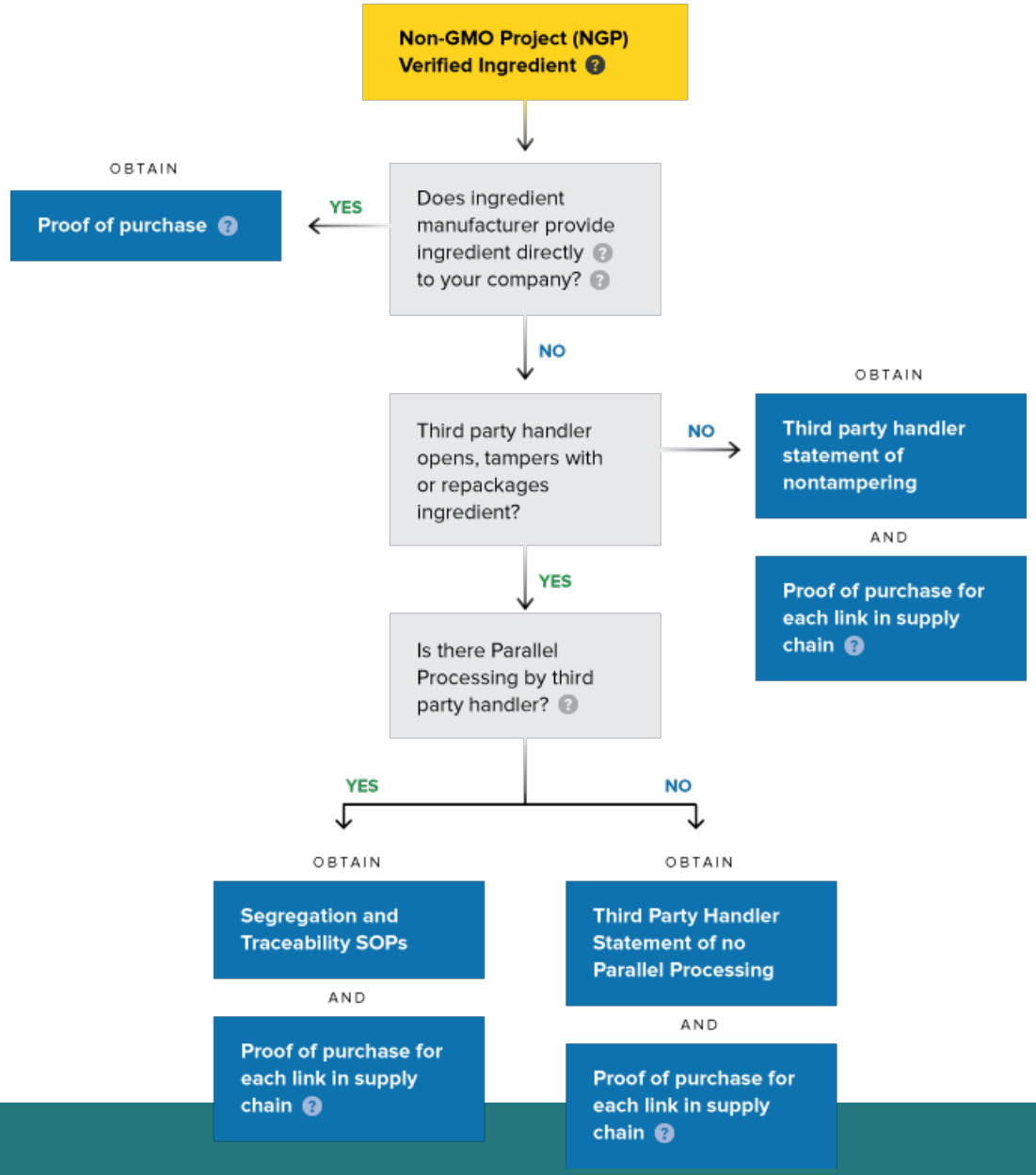
Non-GMO Project Verified Ingredients



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TESTING

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GMO Detection Methods

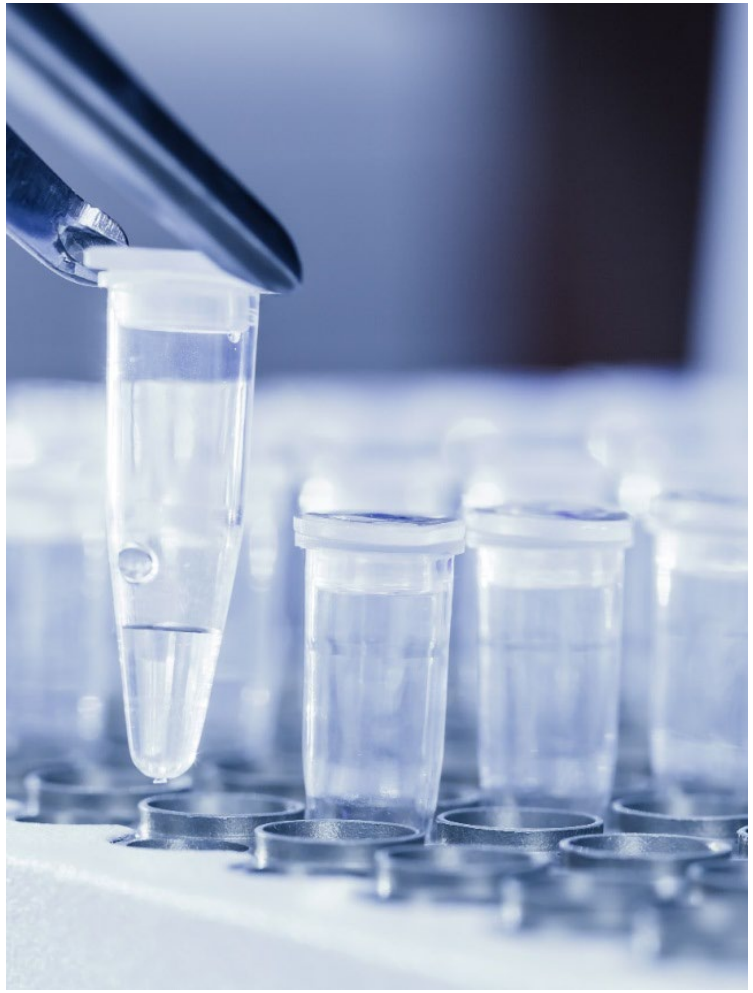
- GMO detection methods often target the modified DNA or protein product

DNA

- Polymerase Chain Reaction (PCR) test
- Highly sensitive and specific
- Allows definitive quantification
- Effective with a broad range of food products

Protein

- Immuno (antibody)-based strip tests detect the GMO protein
- Rapid, on-site method for screening purposes
- Applicable for initial seed/grain
- Not appropriate for processed products



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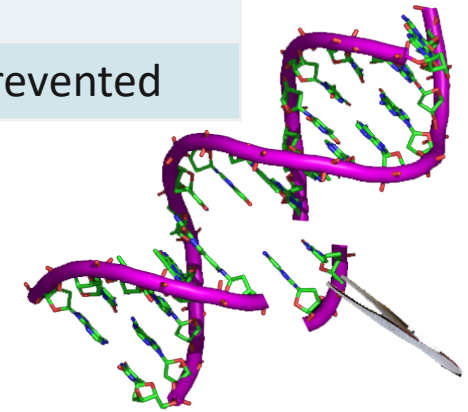
Genetic Engineering Technologies

Method	Technology	Description
Genetic modification (GMO)	Transgenesis Chemical mutagenesis	Transfer of genes from one species to another Induce random mutations in the genome
Gene editing	CRISPR/Cas Zinc finger nuclease TALEN Oligonucleotide-directed mutagenesis	Genes are inserted, deleted, or modified
Gene silencing	RNA interference	Gene expression is prevented



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