VEOLIA

BUILDING A SUSTAINABLE FUTURE WITH INSECT

THE STORY OF ECOLOGICAL TRANSFORMATION WITH VEOLIA AND ENTOFOOD

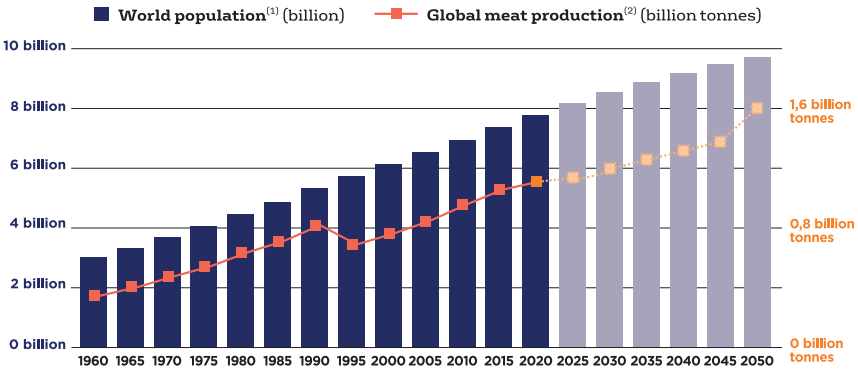
CONTENTS

INCREASING PRESSURE ON **SCARCE RESOURCES**

The human population has never increased so quickly. By 2050, the planet will have 9 billion inhabitants. We will need to produce more food in the next 50 years than in the past 10,000 ones, in particular 70% more of animal protein will be necessary to satisfy the global demand.

Our health relies on the food we eat, animal's health depends on the feed they eat, the food and feed are tightly linked between each other. We therefore urgently need to find new sources of proteins that are more sustainable and environmentally friendly, for both human consumption and livestock feed. It is possible, if we start acting now.

Population (billion) **and Meat production** (billion tonnes)



(1), (2) see bibliography page 30.

Pressing challenge to produce more sustainable proteins

A second planet would be needed in order to feed the world in 2050

70% of farmland are used for livestock farming(4), and is one of the main reasons of deforestation. Moreover, aquaculture requires large amounts of fish meal, which, in turn, is responsible for overfishing and the degradation of marine ecosystems.

7 gigatonnes of CO2 equivalent each year(3) is the emission of the current livestock system, which amounts to 15% of human-induced greenhouse gas emissions according to the FAO.

29% of the water used in agriculture is related to animal production(5). Moreover, we observe that 70% of the water used in the agricultural sector(6) is from water withdrawal.

(3), (4), (5), (6) see bibliography page 30.

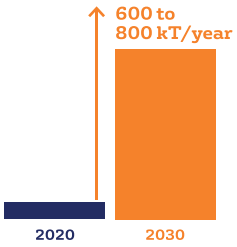
FINDING A SUSTAINABLE ALTERNATIVE SOLUTION: **BIOCONVERSION** BY INSECT

The global protein requirement is expected to grow along with population and diet change, more quality protein needs to be produced to satisfy the demand. What the world needs is an efficient and sustainable way to produce protein: insect provides a great solution and is known for its high protein conversion efficiency.

Black soldier fly is identified as the ideal insect protein, whose natural function is to recycle and decompose organic matters. Black soldier fly is not an invasive specie and is also not a disease vectors. It has a very good nutritional profile for animals including pets, livestock and aquaculture.

The vision of building a healthier world aligns with Veolia's mission to become the champion of ecological transformation. With this vision, Veolia embarks in the journey to develop the insect-based bioconversion solutions.

The market of insect protein is expected to boom in the next 10 years



Veolia's strategy to support the ecological transformation

In 2016 Veolia developed its insect-based bioconversion solution based on insects with two start-ups: Entofood and Mutatec.

As a major industrial player, Veolia has successfully industrialized its first bioconversion site in 2019 in Malaysia, and is currently building a second facility in France.

With its international presence, the Group is able to replicate and adapt its expertise in the field in different geographical areas.

BUILDING **THE FIRST** INDUSTRIAL SIZE **BIOCONVERSION** PLANT IN MALAYSIA IN 2017

In 2017

Entofood and Veolia joined forces to contribute to provide a sustainable solution enhancing the circularity in the Food Chain.

From 2018 to 2020

They successfully scaled up the Bioconversion technology and delivered Veolia Bioconversion Malaysia plant, **Veolia's first industrial scale insect facility into production.**

Today

The Veolia Bioconversion Malaysia plant has the capacity to produce 3000 tonnes of insect meal per year, and is already providing insect ingredient to different animal nutrition markets.

VEOLIA

1853

Founding of Company Général Des Eaux.

1990

Veolia has been working **with the Food & Beverage industries for more than 30 years,** and is constantly challenged by its clients to create more value out of their organic by-products.

2009

Veolia Environment's goal: To become **the industry standard for environmental solutions.**

2016

Restructuring of the group's approach in the Food & Beverage market.

2017

The beginning of **partnership between Veolia and Entofood.**

2018

Start of construction of **the first industrial scale bioconversion plant: "Veolia Bioconversion Malaysia (V.B.M.)".**

entofood

2010

Creation of Entofood by Frédéric and Franck.

2011

Selection of the insect specie: ***Hermetia illucens.***

2013

Entofood awarded with BioNexus status by Malaysian Biotechnology Corporation.

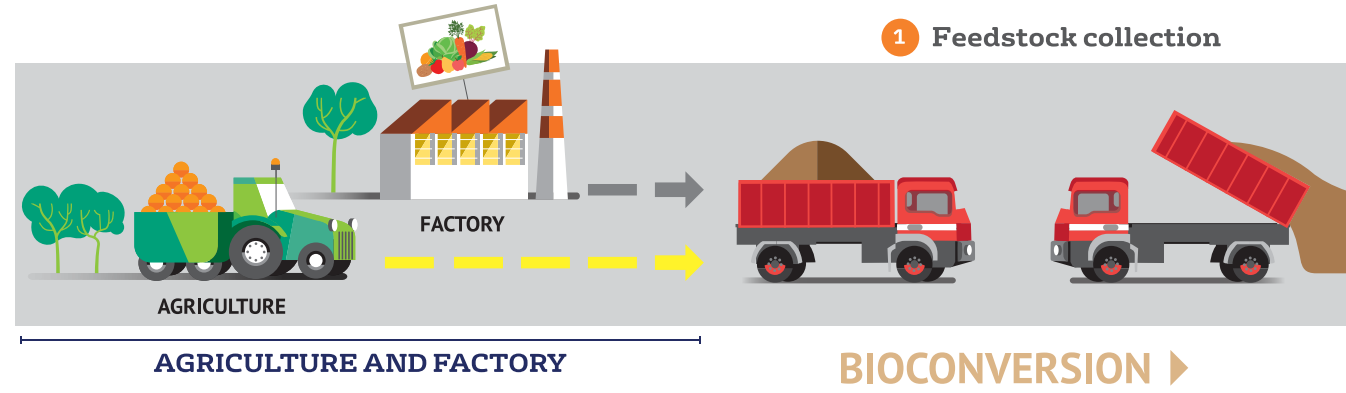
2015

Entofood's pilot farm being successfully running.

ADDING VALUE TO **THE FOOD CHAIN** WITH ZERO WASTE GENERATED

Placed in contact with organic by-products, larvae of black soldier flies feed and grow. When they have reached a sufficient size, they are washed, ground and processed into oil and protein meal.

The whole process takes less than 2 weeks.



entomeal™ INSECT MEAL

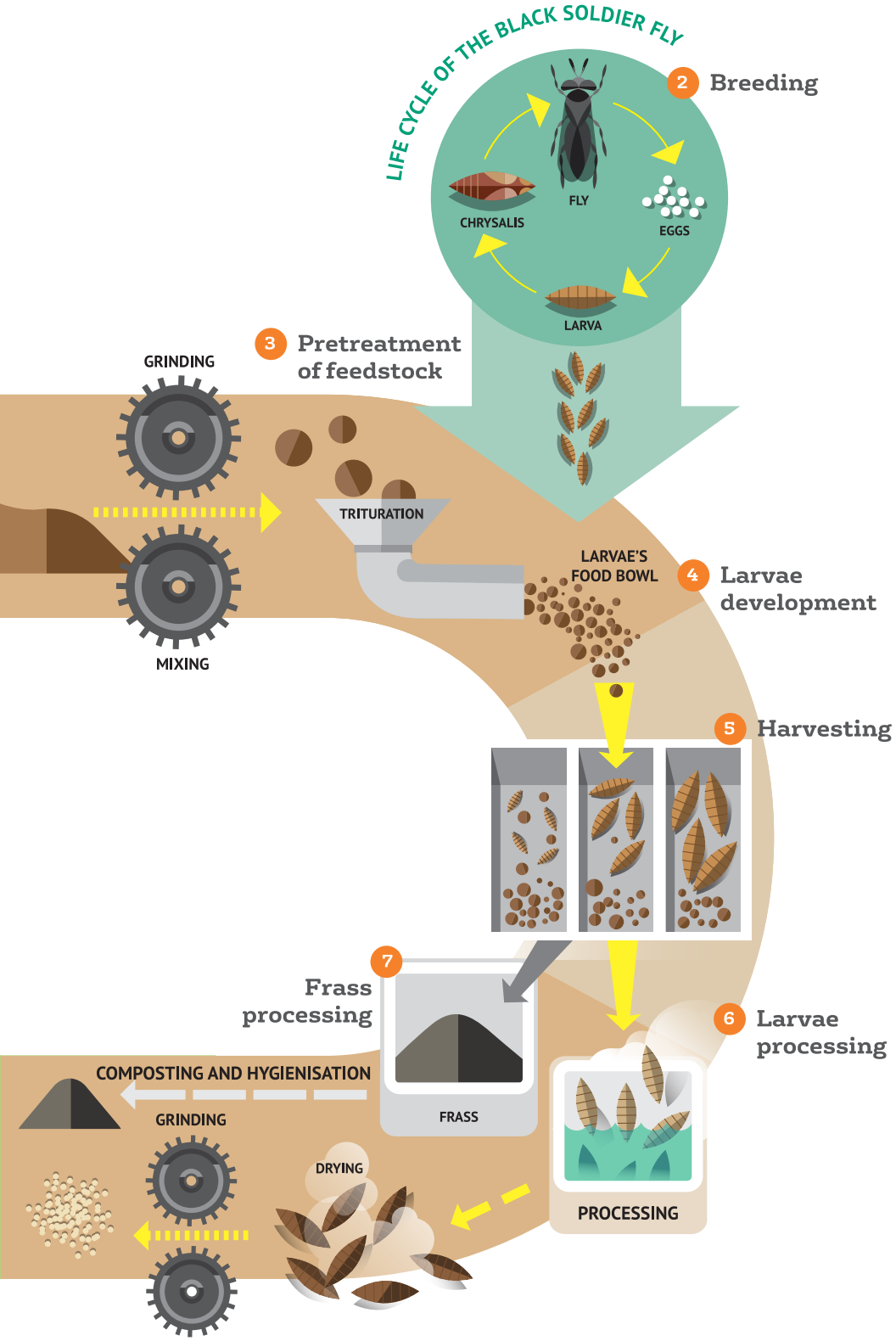
entolipid INSECT OIL

entofrass FRASS

8 Finished products

entofood
A NEW SOURCE OF FEED
by VEOLIA

8



entomeal™

INSECT MEAL

defatted high quality protein meal, has the ideal nutritional and amino acid profiles providing sustainable source of nutrients to pets, aquaculture and livestock.

entolipid

INSECT OIL

is extracted from the larvae, it has a unique fatty acid profile, especially rich in lauric acid, improving animals health and immune system.

entofrass

FRASS

is the residues of the bioconversion process, rich in organic carbon and NPK, is an excellent organic fertilizer as alternative to chemical fertilizer. It is also a soil amendment providing a long lasting positive texture enhancement.

ENSURING COMPLIANCE WITH GOOD MANUFACTURING PRACTICES & **QUALITY ASSURANCE**

Backed by the robust industrial capability of the Group, Veolia Bioconversion Malaysia produce high quality sustainable ingredients for the animals and plants nutrition.

Leveraging cutting-edge agricultural technologies, entomeal™'s production follows the highest industrial standards and the most stringent regulation requirements ensuring a premium product.

+200 ongoing contracts
for the provision of on-site waste, water & energy services to F&B Customers

+50 countries served
Worldwide

+30 years of experience
of delivering environmental services to F&B Customers

+120 organic waste facilities managed

How?

Why Veolia's expertise in organic by-products management is a value creation enabler?

Capability to source large amounts of feedstock from Food & Beverage industries. Expertise of organic valorisation ensuring **consistency of quality**

of the feedstock and selection of the best feedstock for insect bioconversion purpose. Creating value by relying on its worldwide presence,

Veolia can **target the feedstocks that are today undervalued and that is the most accessible,** and replicate its successes.

Logistics and responsiveness ensuring continuous operation of the Bioconversion plant **with the capability to manage variability in large volumes.**




How?

Why Veolia's scale up capability bring guarantees to product performance?

CONSISTENCY

Sucessfully operating at its industrial scale production, Veolia Bioconversion Malaysia provides stable and consistent products.

The larvae and flies health and environmental conditions for growth and rearing are closely monitored by the experts for tracking and optimization.

FULL TREACEABILITY

Throughout the **entire production cycle,** each batch of product is **meticulously tracked from raw materials to the end product** via daily samplings, all year-round.

Certified lab provides the certificates of analysis for 3rd-party guaranteed product safety and performance.

PREMIUM QUALITY

The feedstock used in Veolia Bioconversion Malaysia facility is defined by the **most stringent regulation - European Commission regulatory framework,** ensuring a premium product quality.

HIGHEST STANDARDS

By implementing best practices such as GMP+, ISO 22000:2018, the transformation process **ensures highest product quality** and a reduction of resources consumption.

SUPPORTING ANIMAL PEFORMANCE WITH A **FUNCTIONAL NUTRITIONAL SOLUTION**

Insect meal is an easy-to-use, healthy and functional supplement for any animal feed application.

The larvae are fed on traceable organic by-product of the food & beverage industries, enabling a nutritious, safe and sustainable animal feed product.

PET

Insect meal are used for their **hypoallergenic properties** in dog foods, as they carry novel, previously uneaten protein which minimizes the risk to an allergenic response. It is been studied that insect meal can **reduce skin diseases and allergies in pets.**

AQUACULTURE

Insect meal can boost the performance of shrimp and fish (e.g. salmon, trout, european seabass), including:

- **Reduce mortality and disease.**
- **Increase palatability.**
- **Improve digestibility.**

POULTRY, SWINE & OTHERS

In pigs and broilers, **antimicrobial peptides** improve growth performance, promote nutrient digestibility and gut health, **positively alter intestinal microbiota,** and enhances immune function.

Insects have the highest Antimicrobial Peptide (AMP) reservoir of all animals. Insect AMPs are cationic and comprise less than 100 amino acids. They are produced on the surface or within their digestive tract giving it the ability to protect itself against microbial infections. As they lack an adaptive immune system, they are unable to synthesize antibodies.

These insects peptides exhibit an antimicrobial effect by disrupting the microbial membrane (via different mechanisms such as formation of ion channels or transmembrane pores) and do not easily allow microbes to develop drug resistance. AMPs are being studied as an alternative to antibiotics in animal feeds.

YOU CAN CONTACT US
for the full technical data sheet, certificate of analysis and material safety data sheet.

bioconversion@veolia.com

How?

Why insect can add value to the food chain?

Using black soldier fly larvae to produce feed ingredients has a number of advantages:

- **No arable land needed** for production.
- **High feed-conversion efficiency:** 2-7 times higher than conventional livestock species.
- Being detritivore in nature, BSF larvae **is a natural nutrient recycler.**
- Upcycling organic side streams, **with zero waste generated.**
- **Low water requirement**
- **Non invasive & non vector of diseases**

SUSTAINABLE DEVELOPMENT GOALS

Bioconversion direct impacts are evaluated to directly contribute to at least 6 of the UN's sustainable development goals

> DO YOU KNOW:

Bioconversion by B.S.F. larvae can help to effectively combat climate change!

Each ton of insect protein produced helps the food chain to avoid GHG emission comparing to reference scenarios.

In fact, all of the three products from Bioconversion contribute significantly to improve our ecosystem: improve soil fertility by frass, preserving terrestrial and marine biodiversity.

Bioconversion vs Soybean meal production	
Land use	↙
Water scarcity	↙↙↙↙
Eutrophication freshwater	↙
Eutrophication marine	↙

LEGISLATIVE MOVEMENT ENCOURAGING THE DEVELOPMENT OF **INSECT INDUSTRY**

Sourcing with the highest quality standard

Veolia is complying the most stringent standard which is EU regulation, using only the organic by-products and traceable feestock, providing the highest quality inputs for the bioconversion process.

Veolia Bioconversion plant in Malaysia adheres to the highest industrial standards and the most stringent regulation requirements ensuring a consistent, premium product,entomeal™ (insect meal) and entolipid (insect oil) with full traceability from black soldier fly eggs to finished products.

	VEOLIA Bioconversion material sourcing
Type	**Traceable feedstock**
Sources	Industrial, Agricultural sources
Applicable to?	**Traceable, Safety** ▶ **Compliant with EU regulation**

The facility has undergone and passed ISO 22000 and GMP+ certifications. Farmed with zero-waste methods, the larvae are freshly processed after harvest ensuring premium quality, nutritious, safe and sustainable alternative protein and functional ingredients in pet food and animal feed industries.

YOU CAN CONTACT US for TDS, COA, MSDS and more detailed information on our products.

bioconversion@veolia.com

Animal nutrition application with BSF larvae ingredients

The fast track legislative development is encouraging signals for the future of the insect industry.

In the EU, major milestones have been achieved to confirm the "Farm to Fork" strategy in supporting the creation of sustainable and novel feed materials and food with insects as one of the most promising innovations.

Since August 2021, the EU regulation authorised the use of processed animal protein derived from insects in poultry and pig feed, in addition to the aquafeed and pet food authorisation in 2017, building a bright future for insect ingredients.

The same legitative movement is also observed in North America and in Asia. BSF larvae ingredients have been approved for most animal diets for less than five years, the remaining regulatory hurdles may be overcome very soon.

The regulatory trends below should be confirmed according to the authorities in each country.

	Petfood	Aqua feed	Poultry feed	Swine feed
E.U.	✓	✓	✓	✓
U.S.	✓ Insect based products are authorized under certain conditions, you can contact the respective authorities in your country to find out more about the regulation on insect product application.			
Canada				
China				
Japan				
Thailand				
Others				

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A NEW SOURCE OF FEED

by VEOLIA

Scan to **contact us!**

bioconversion@veolia.com

Resourcing the world

Veolia Bioconversion Malaysia Sdn Bhd (1245166-T)
Unit 20-1 and 20-2, Level 20, Mercu 3, No.3 Jalan Bangsar
KL Eco City 59200 Kuala Lumpur , Malaysia
Email: bioconversion@veolia.com
www.veolia.com.sg/bioconversion