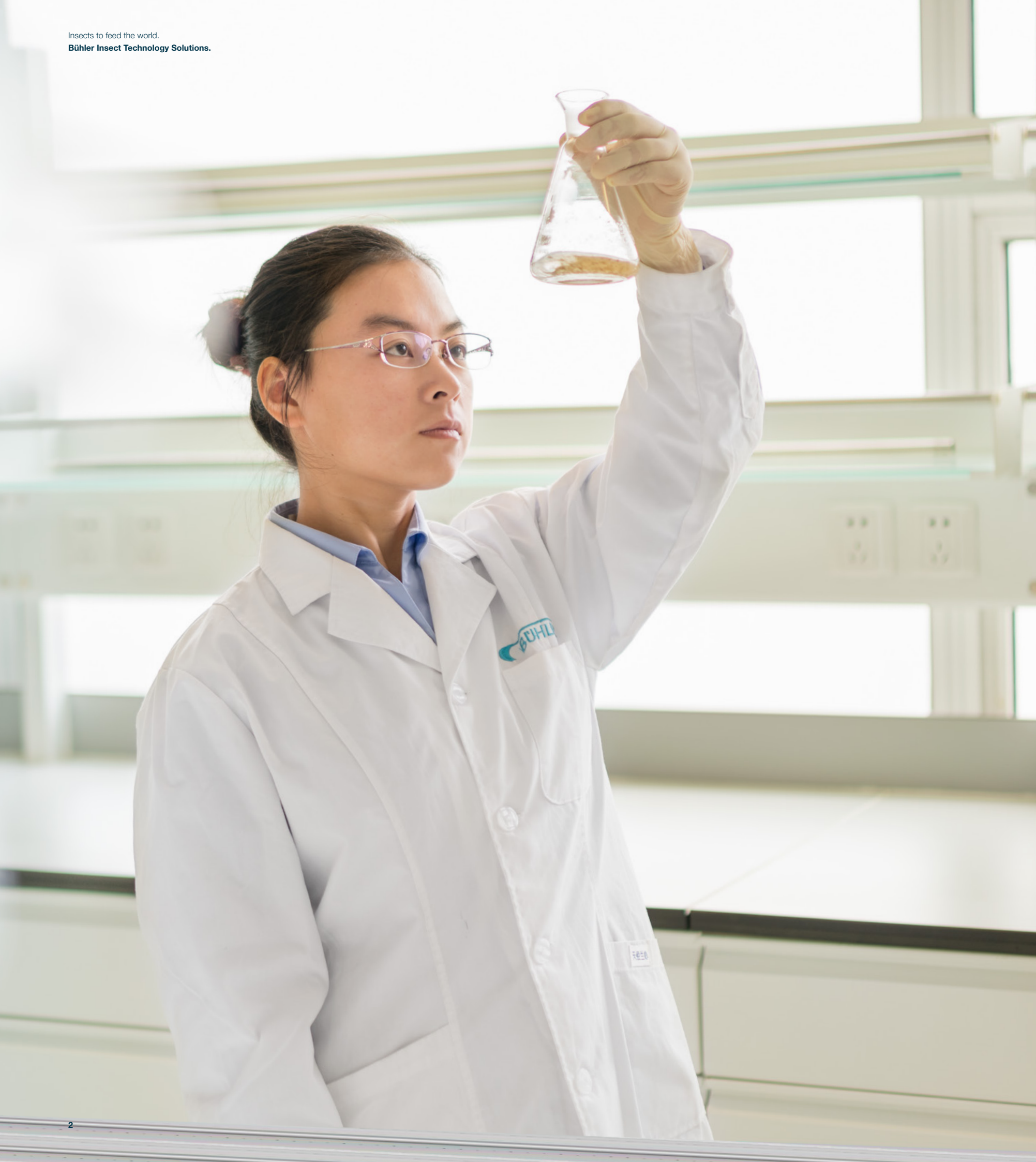


A dramatic photograph of a fish, possibly a trout, leaping out of dark water. The fish is captured mid-air, its mouth wide open in a perfect arc towards a small fly hovering just above it. The fish's body is covered in dark spots and is glistening with water droplets. The background is a deep, dark blue, and the water surface below shows ripples and a splash from the fish's exit. On the left side of the image, there are large, overlapping semi-circular shapes in shades of yellow, green, and blue.

Insects
to feed the world.

Bühler Insect Technology Solutions



An industry of the future is born.

Nine billion people are expected to live on our planet by 2050. To feed them all, we will need more than 250 million metric tons of additional protein a year – that is an increase of 50% compared to today. Providing this growing global population with protein requires new and innovative approaches as existing sources are overused and expanding them is problematic for the environment.

Added to the population challenge is the fact that we don't use the food we produce very efficiently. Roughly one-third of the food intended for human consumption is lost or wasted every year. This accounts for approximately 1.3 billion metric tons of food that never reaches our tables. This is not only a loss of valuable nutritional resources, but also a challenge in terms of disposal. In many regions, landfill or incineration are the prevalent solutions for dealing with food waste, and they come with their own problems. There is an ongoing quest for new and efficient technologies to better deal with organic waste.

Insects offer a unique opportunity to address both challenges: protein supply and organic waste disposal. Insects close the loop on organic waste as they recycle nutrients that are otherwise lost and they bring them back into the food value chain. Today, this sustainable solution is not only feasible – it can be realized on a large scale and in an economical way.

Bühler Insect Technology Solutions provides modular systems for the industrial-scale transformation of organic residues into quality products such as protein and lipids for animal feed applications as well as fertilizer suitable for agricultural and horticultural use. This automated process solution meets the safety and quality standards required by the feed industry and will help to sustainably feed the planet.



Watch our video
to learn more.

Today's challenges:

The protein gap

Primary protein production in million metric tons

Year	Primary protein production (million metric tons)
1960	150
1965	180
1970	220
1975	250
1980	280
1985	300
1990	320
1995	350
2000	380
2005	420
2010	450
2015	480
2020	520
2025	580
2030	620
2035	680
2040	720
2045	760
2050	800

additional protein

Today, **85% of arable land** is already in use.

Meat production and consumption

Meat consumption
will increase by 50%
until 2050, most of
which in Asia, Africa,
and Latin America.

Four plant-based proteins are needed on average to make one animal-based protein.

Current feed proteins pose challenges.

The example of soy:

- 80% of production occurs in only three countries
- high price volatility in some regions of the world
- expansion of soy production is contributing to deforestation

Food waste and losses

The infographic illustrates the flow of food from production to consumption, highlighting the significant waste and losses at each stage. The process is divided into several key components:

- Crop production:** Produces 525 million metric tons of primary protein. It includes illustrations of wheat, corn, and a tractor.
- Animal farm:** Receives 35% of the primary protein. It shows chickens and fish in a tank.
- Food processing:** Receives 65% of the primary protein. It shows a factory and a shopping cart.
- Retail:** Shows a shopping cart.
- Consumer:** Shows a person eating. 280 million tons of waste and losses are generated here.
- Waste and losses:** A large orange arrow shows the flow of waste and losses from the consumer back to the crop production stage. The total waste and losses are 710 million tons/year.
- Protein and lipids:** Shows a stack of bags and a processing unit.
- Fertilizer:** Shows a pile of fertilizer.
- Residue processing:** Shows a processing unit.
- Larvae processing:** Shows a processing unit.
- Rearing:** Shows a large building and silos.
- Energy production:** Shows a factory.
- Landfill:** Shows a truck dumping waste.

Key statistics and waste management details:

- Waste and losses:** 710 million tons/year.
- Waste and losses:** 140 million tons.
- Waste and losses:** 170 million tons.
- Waste and losses:** 280 million tons.
- Waste and losses:** ≈1.3 billion metric tons of organic waste.
- Waste and losses:** ≈1.3 billion metric tons of organic waste.

Today's solutions:

Insects are able to recover nutrients from organic residues and bring them back into the food value chain, thereby contributing to a circular economy. Since no fertile land is needed for their production, they are a promising and sustainable new source compared to today's main alternatives. Some species, such as the black soldier fly, are well-suited for growth on large scale.



Benefits of insects

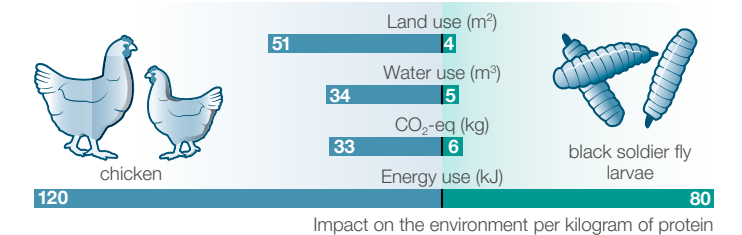


Insect proteins can be **produced locally.**

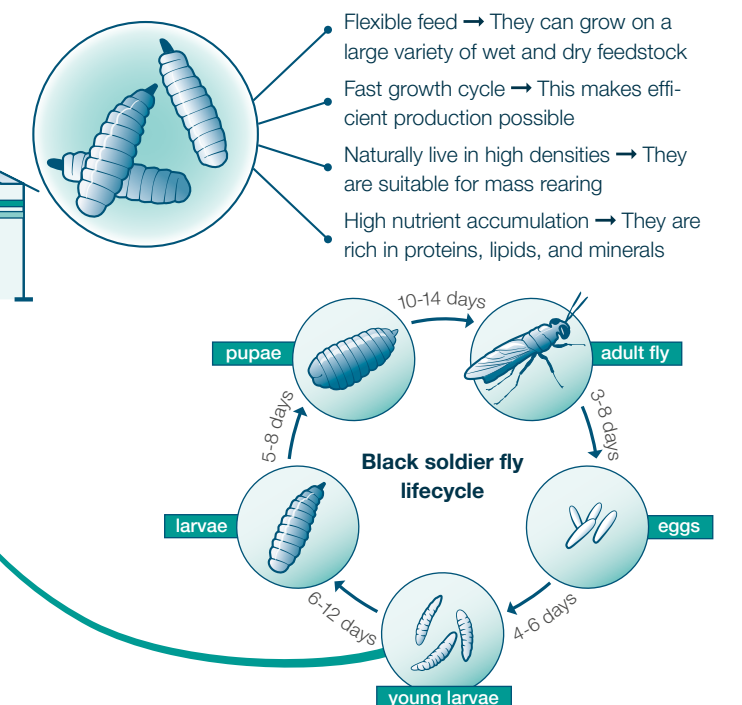


They are the natural diet
of many animals.

Insects can be produced with **little environmental impact**.



The unique features of black soldier fly larvae



Nutrient recovery

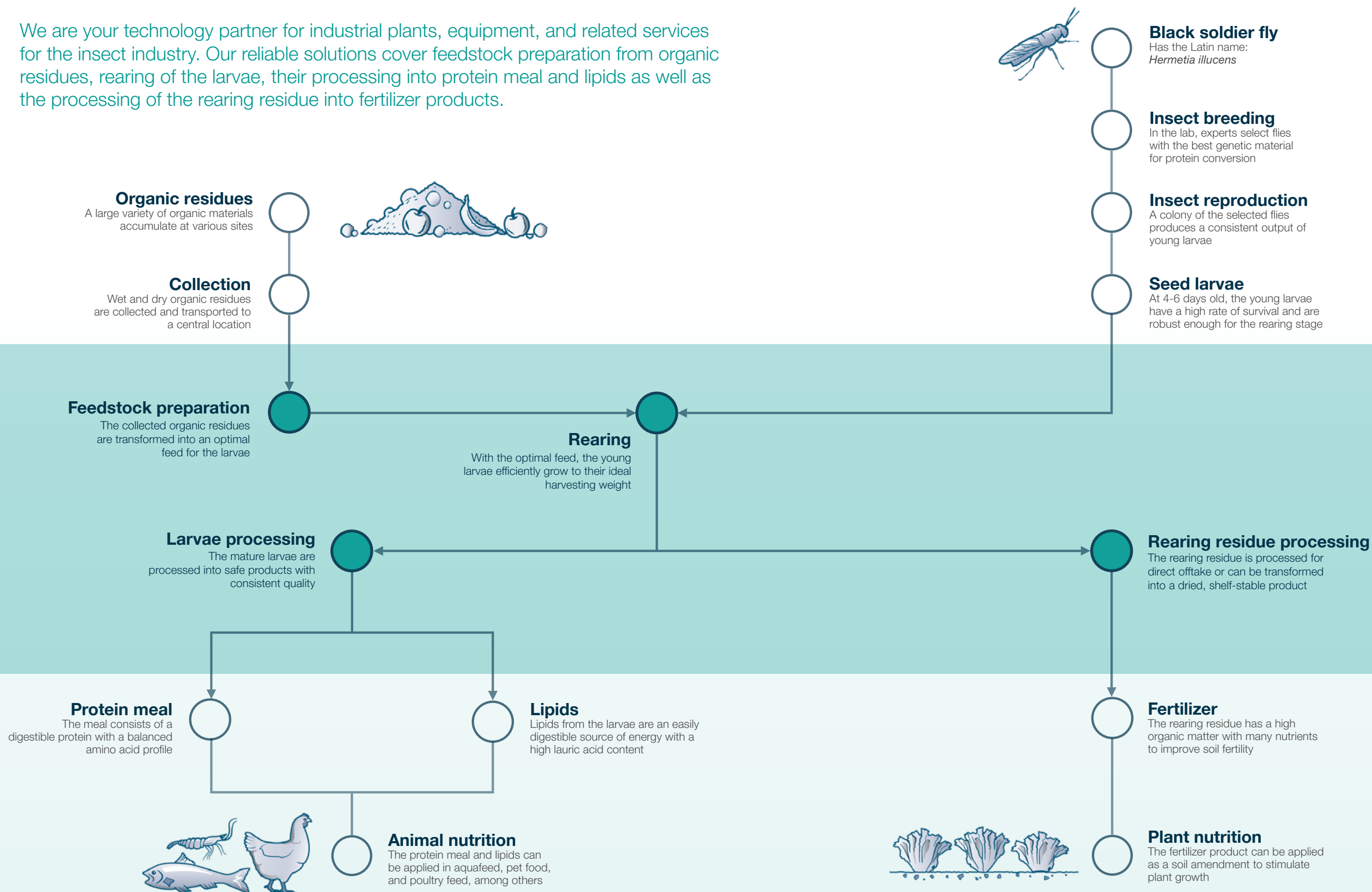
Insects can recover up to 70% of proteins from organic waste.



Bühler Insect Technology Solutions.

Our role in the insect industry.

We are your technology partner for industrial plants, equipment, and related services for the insect industry. Our reliable solutions cover feedstock preparation from organic residues, rearing of the larvae, their processing into protein meal and lipids as well as the processing of the rearing residue into fertilizer products.



Feedstock preparation. Our solutions are fully customized.



The organic residues are stored in silos before they are mixed into a proper feedstock.

Proper feedstock preparation is the first order of business for any successful insect plant. The objective is to transform the different organic residues in a timely manner into safe, palatable, and nourishing feed for insects.

Bühler Insect Technology Solutions (BITS) offers process technologies that can be easily customized in order to deal with the wide range of potential feedstock suitable for rearing insects. The technical solution includes the reception and safe storage of wet and dry raw materials as well as their mixing into a homogeneous feed with a suitable composition and moisture content. If required, additional treatments such as grinding and/or fermentation can be applied in order to facilitate the ideal access to nutrients within the organic materials.

BITS also offers consulting regarding feedstock selection and recipe design to optimize larvae growth performance. Taking into account the nutritional composition of different organic residues, the feed can be tailored to the requirements of the black soldier fly larvae. Additionally, the structure of the feed is adapted to best suit the needs of the larvae.

Feed for the best results. Consistent nutrition is key to quality.

Even though black soldier fly larvae are very flexible in terms of what they can eat, the feed mix they are given must fulfill the necessary energy and protein requirements of the larvae. Energy is mainly provided by starch, sugars and lipids, while for proteins, it is not only the amount that is of importance, but also its digestibility. In addition to these key nutritional factors, black soldier fly larvae consume their feed in slurry form. This offers the possibility to not only use dry sources that have been moistened, but also feedstock with a moisture content of up to 85-95%. This means that many wet industrial byproducts do not need to be dried before they can be used in our facilities. Whether wet or dry, for the industrial production of larvae it is essential that the feed provided is consistent over the whole year. With this in mind, a reliable supply of the feedstock sources is highly recommended. It is beneficial if the transport of the feedstock is minimized and the insect processing factory is built close to the location where organic residues accumulate. Local regulations should also be taken into account as they can limit feedstock options.

Examples of potential feedstock:

Industrial byproducts

- Distiller's grains
- Brewer's spent grains and yeast
- Fruit, vegetable, and potato cutoffs
- Fruit juice pulp
- Sugar beet pulp
- Vinasse and molasses
- Dairy residues
- Corn slurry
- Wine remains
- Rice and wheat bran
- Reject grains
- Tofu industry residues
- Oil cakes / pomace



Agricultural residues

- Fruit and vegetable leftovers



Retail discards

- Old bread
- Supermarket discards
- Hotel and restaurant leftovers



Insect rearing. Our solutions enable modular design.



Crate handling is fully automated to ensure low operational costs.

Rearing facilities make up the largest part of an insect plant. The objective is to efficiently grow young larvae to their ideal harvesting weight and to separate them from the rearing residue. Typically larvae are grown in crates.

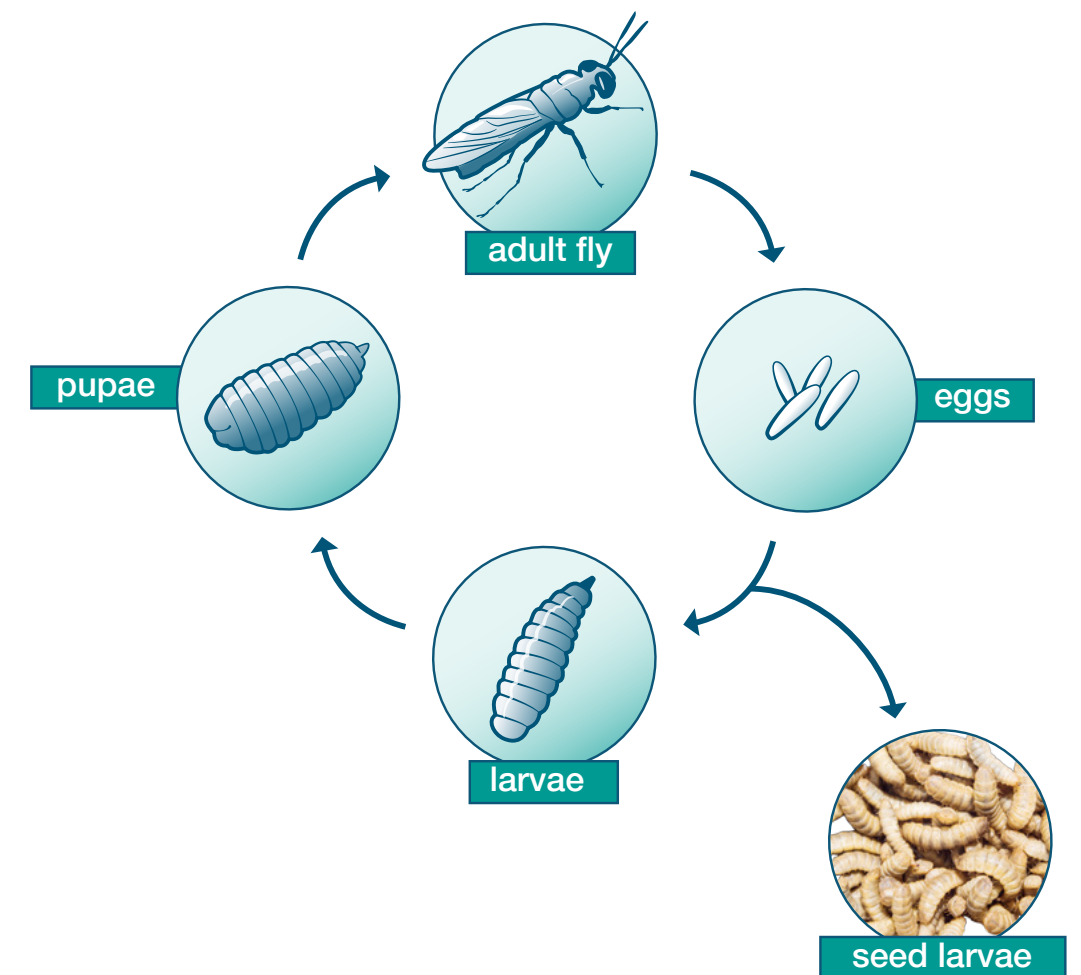
Bühler Insect Technology Solutions works with standardized rearing units with a fixed number of crates that are managed through an automated system. This allows a modular design of the insect growth area, so that the capacity of the plant can be easily adapted to feedstock availability. Larvae are regularly fed with an accurate feeding station in order to optimize the availability and delivery of nutrients. For storage, crates are stacked, which minimizes land use. A ventilation system ensures uniform climate conditions in each crate thus facilitating fast and consistent growth of the larvae. Overall, our solution enables the customer to set and control the rearing conditions in a way that ensures a high productivity with optimized feedstock conversion and minimized development time.

At the end of the rearing cycle, a harvesting process efficiently separates the larvae from the rearing residue. Our technology achieves an exact selectivity resulting in clean larvae with minimal losses in the rearing residue.

Reliable seed larvae supply. Specialists provide sustainable solutions.

As with several other livestock industries, the young animals needed for rearing – in our case seed larvae – are supplied by specialized companies with a great deal of experience and biological know-how. Within this breeding and reproduction process, it is crucial to understand the full lifecycle of the insects and create sufficient redundancy in order to reliably provide seed larvae.

The most suitable seed larvae supply chain needs to be evaluated case by case and is dependent on the size of facility, location, and operational know-how. Seed larvae can be either produced on-site for direct use, or off-site with regular shipment to the insect production plant. If required, our partner Protix can be the supplier of the young larvae. The company has developed proprietary technology and know-how to ensure reliable output.



Larvae and rearing residue processing. Our solutions are flexible.



Experts at Bühler Insect Technology Solutions ensure the highest quality at all stages of production.

Processing is the final stage of the insect plant. The objective is to transform the larvae and the rearing residue into high value end products that are safe and have a consistent quality.

Bühler Insect Technology Solutions offers central processing units that have a wide-range of capacity. We work with three processing lines, which can be operated in two or three shifts. This gives the customer maximum flexibility and also allows for future expansion plans. Our patented process fulfills good manufacturing practices (GMP) and safety standards. Besides washing of the larvae to remove any remaining rearing residue, a heat treatment step ensures inactivation of enzymes and pathogenic microorganisms that might be present. A further valorization is achieved through an efficient three-phase separation. Purification of the lipid fraction, as well as drying of the protein-rich fractions, result in products with good shelf life. The defatted protein meal can be packaged in bags with varying filling volume.

The rearing residue is typically dewatered and pelletized in order to achieve shelf-stable product. As an alternative, it can also be prepared for direct offtake.

High quality end products. Protein, lipids, and fertilizer.



Protein meal.

Benefits

- Balanced amino acid profile.
- Very good digestibility > 85%.
- Highly palatable.
- Adequate techno-functional properties.

Sample applications

- In pet food products, given its nutritional profile and hypoallergenic properties.
- In fish feed for high growth performance, a good feed conversion rate, and a better gut health.
- In shrimp feed as an attractant for better feed intake.
- In broiler and pig feed for better nutrient digestion and satisfactory productive performances.



Lipids.

Benefits

- High in lauric acid that has antibacterial and antiviral properties.
- Easily digestible source of energy.
- Naturally palatable.
- Simple integration into products.

Sample applications

- In piglet feed for improved feed intake and better gut health.
- In broiler feed with satisfactory productive performances and overall meat quality.
- In cosmetics and detergents as an alternative to animal or vegetable fats.



Fertilizer.

Benefits

- High organic matter (>85%) with nitrogen and minerals.
- Contains chitin that improves the defense mechanisms of plants.
- Slow and constant nutrient release over time.
- Safe and ready to be applied on field.

Sample applications

- In soil amendments for farms, gardens, horticulture, and greenhouse.
- In low fertile soil (acid and sandy soil) with satisfactory results.
- In crop production for higher yields.

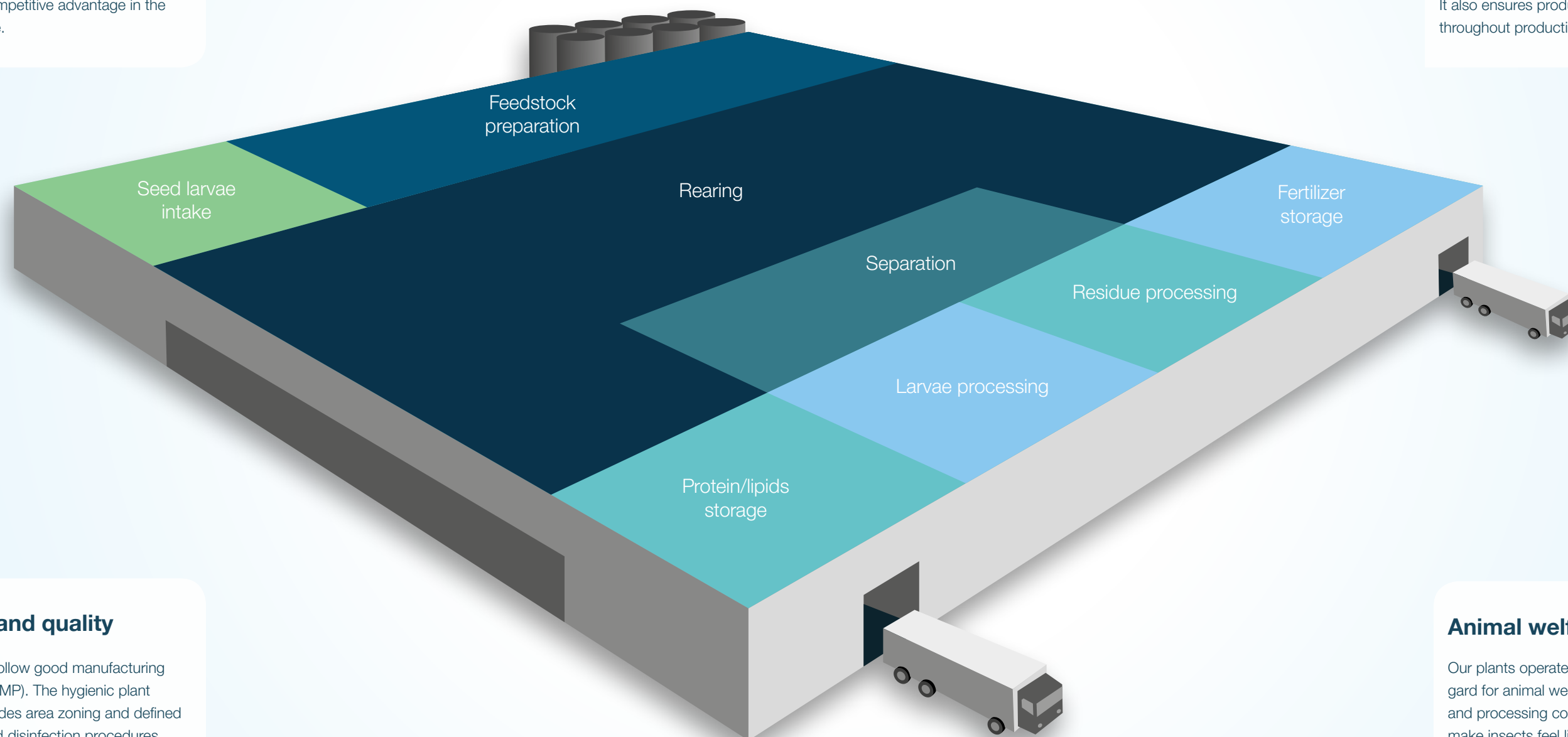
A plant overview. Our integrated solution.

Sustainability

Our plants ensure efficient and economical use of raw materials, land, water, and energy. This facilitates production with low operating costs, giving plant owners a crucial competitive advantage in the marketplace.

Automation

Our automated system with data-driven technology enables the reliable control of operations and continuous improvement of overall equipment effectiveness (OEE). It also ensures product traceability throughout production.



Safety and quality

Our plants follow good manufacturing practices (GMP). The hygienic plant design includes area zoning and defined cleaning and disinfection procedures ensuring safe and consistent output of end products.

Animal welfare

Our plants operate with the highest regard for animal welfare. We set rearing and processing conditions in a way to make insects feel like they do in nature, which in turn ensures stable growth and better disease control.

Phased approach.

Step-by-step to a successful plant.

We offer a phased integral solution that goes from the complete plant feasibility analysis to the successful fulfilment of the project. Moreover, we provide after-sales service that ensures efficient plant operation for many years to come.



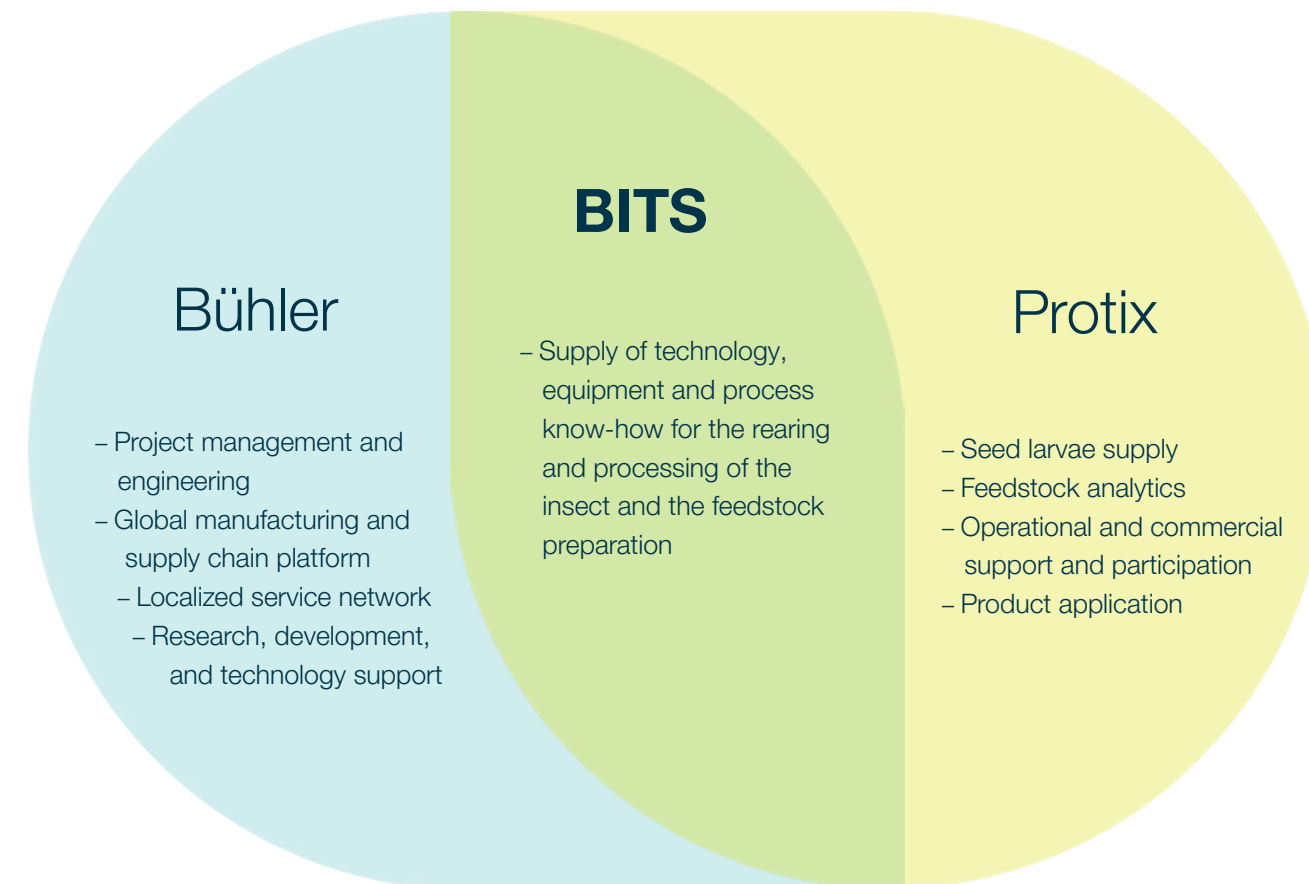
Bühler Insect Technology Solutions. Your partner for reliable production.



Kees Aarts, Founder and CEO PROTIX and Andreas Aepli, CEO Bühler Insect Technology Solutions.

Bühler Insect Technology Solutions (BITS) is a Joint Venture between Bühler, the leading technology and solution provider for the food and feed industry, and Protix, the leading insect company.

BITS was founded in 2017 and is based in Switzerland and China. It is a fully dedicated technology partner for plants, equipment, and related services for the insect industry. BITS considers every aspect that will bring a new protein source to the market and answers the world's growing need for protein.



- Founded in Switzerland (1860).
- The family-owned company now has about 11,000 employees in some 140 countries with turnover of CHF 2.67 billion in 2017.
- More than 150 years of experience in developing and installing scalable, cost effective, and hygienic plants and processes for food and feed products all around the world.
- Leading solution provider for processing grain into flour and feed, as well as for the production of pasta and chocolate, and in die casting, wet grinding, and surface coating.
- Invests up to 5% of its turnover every year in R&D.



- Founded in the Netherlands (2009).
- Fast-growing company with highly talented and motivated people.
- Commercial pilot plant operational in the Netherlands. Raised EUR 45 million more in 2017 to build a large industrial plant in the Netherlands.
- Successful product introductions such as Friendly Salmon.
- Acquired Fair Insects with cricket, locust, and mealworm in 2017.
- Joined forces with Hendrix Genetics to develop a world leading insect breeding program.
- World Economic Forum Technology Pioneer award, globally recognized for its innovation status.

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