



Alternative protein solutions.

Meat and dairy substitutes.

Sustainable nutrition

Food for the future – alternative proteins. Bridging the protein gap sustainably.

Today's challenges.

By 2050, the world's population is projected to reach 10 billion people. In order to feed this larger, more urban and richer population, food production must increase by approximately 70%. We will need more than 250 million metric tons of additional protein a year, and an estimated 50% increase in protein production. The increasing demand for meat and animal-based protein puts pressure on existing protein sources such as soy and fish meal, and is expected to add pressure on land to produce more feed and protein for animals. This in turn will increase the conversion of forests, wetlands and natural grasslands into agricultural lands, which in itself has negative consequences for GHG emissions, biodiversity and other important ecosystem services. Added to the population challenge is the fact that we don't use the food we currently produce very efficiently. A huge amount of food doesn't even reach our tables. Approximately one-quarter of the food produced for human consumption goes uneaten. Loss and waste occurs all along the food chain, from farm to fork. The challenge of feeding a growing population without destroying our planet increases awareness of the impact of food production and consumption on the environment and health.

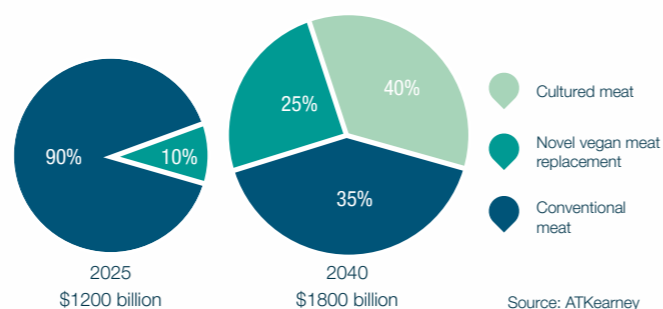
10 billion people
to feed by 2050

250 million metric tons of
additional protein a year

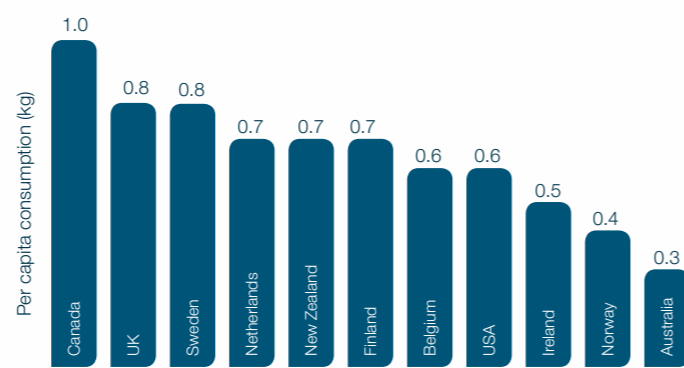
1/4 of food produced for
humans goes to waste

Shift to healthier, more sustainable diets.

Consumer behavior is changing. There has been an extraordinary trend toward plant-based diets in the last couple of years. Many people show a preference towards "mindful eating", healthy and sustainable living by re-thinking their diets. Sustainable sources and conscious engagement with the food industry, how food is produced and consumed is becoming more and more important. Consumers are opting for vegetarian or vegan diets; becoming flexitarians; reducing their meat consumption and looking for attractive meat substitutes. The product portfolio for this segment is constantly expanding and is not only limited to plant-based burgers, chicken-like products, or minced meat, but also towards pork and fish substitutes.



Projected growth of alternative protein solutions.



Total consumption of meat substitutes 2019 in Western Europe, North America, Australasia
Source: Euromonitor International

Bühler solutions – creating a sustainable food future.

To meet these challenges, we have developed cultivation, extraction and processing technologies for proteins that are more sustainable compared to regular meat and dairy products. From soy, oilseed, pulses to upcycling side streams or newer ingredients like microalgae or insects, we are leading the way in developing sustainable alternatives. Our industrial-scale extrusion solution enables the restructuring of plant proteins into high-quality, tasty meat and fish substitutes. You can adjust the texture, shape, color and flavor of products to benefit from the clear market shift to a more plant-based diet that is motivated by health, sustainability and ethical concerns. With our comprehensive customer service that covers the entire life-cycle of our protein lines, and our worldwide application centers, we are more than just service providers: We are partners for a lifetime. As a leading solution provider across the whole protein value chain, we believe we have a responsibility – and an opportunity – to make a difference.

#meatless

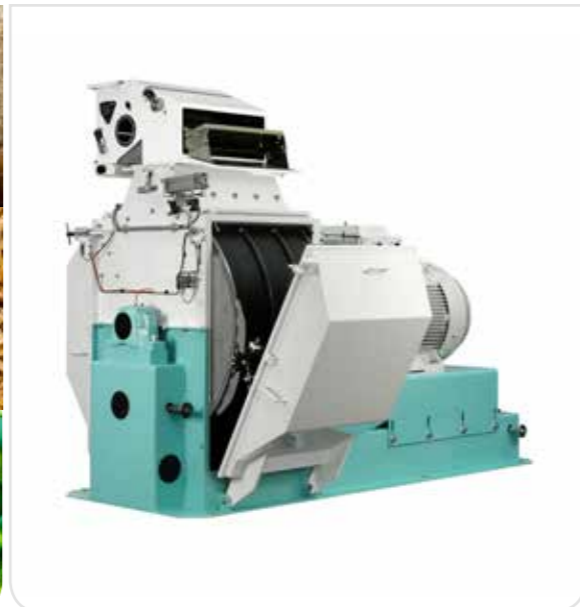
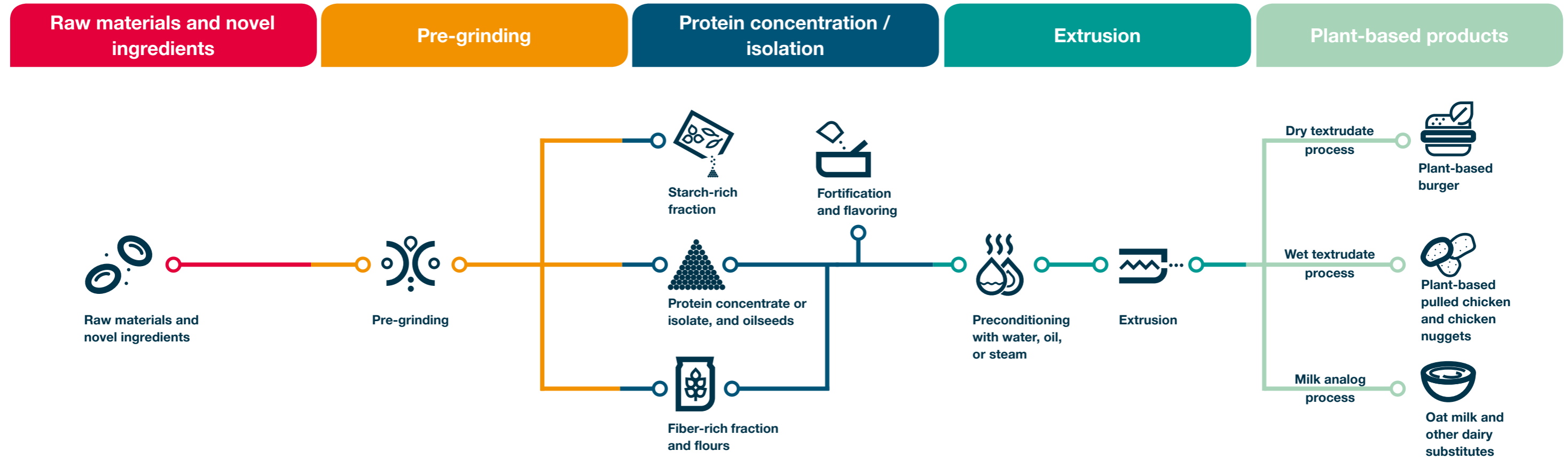
#sustainablenutrition

#alternativeproteins

#plantbaseddiet

Solution provider along the protein value chain. Market leader from farm to fork.

We can develop both sustainable and cost-effective solutions across the entire value chain for the food industry. With our holistic knowledge of the processes, reliable machines and large scale capacity, we are the market leader from bean to burger.





Raw materials and novel ingredients. The protein source of the future.



Soy – “new” protein source.

We are already familiar with soy as a meat replacer for vegetarian dishes, like tofu and tempeh. Also for the novel meat-like substitutes, soy is the major ingredient. Soy protein isolates and concentrates can be processed into very strong textured meat substitutes with minimum off-flavors.



Pulses – versatile and excellent protein sources.

Pulses are extremely versatile and can be used in breads, pasta products and meat substitutes. We have developed a wide range of products and solutions to help increase pulse production. Our technology helps to maximize their potential.



Oilseeds – energy-dense.

Oilseeds are energy-dense foods due to their high oil content. They are rich in protein, fiber, vitamins, and minerals. When included in the human diet, they can boost protein intake significantly thanks to their naturally high protein content. Oilseed press cakes are ideal protein sources for plant-based meat alternatives.



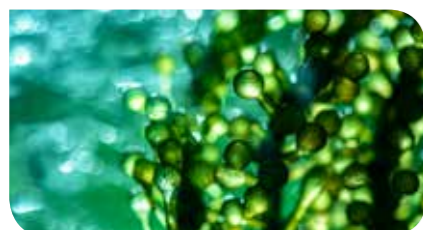
Upcycled side streams.

Side-streams such as spent grain from breweries and oil cakes are being used for the production of dry and wet extruded products. This not only leads to a new range of high-protein products on the market but also prevents food waste, thereby promoting the sustainable use of resources.



Insects – A new horizon for protein source.

A growing population, coupled with diminishing natural resources, means the race is on to find alternative sources of nutrition. One such source is insects, mainly used in feed applications and as a novel ingredient for experimental food applications.



Microalgae – down to the basics.

Single-cell organisms such as dunaliella, spirulina or chlorella contain up to 70% protein. Our solutions can help you to valorize your microalgae and derived ingredients at various stages. Algae proteins reduce the pressure on land use and are an ideal ingredient for fish substitutes.



Protein extraction made possible with Bühler Milling Solutions.



Starch-rich fraction.

The side streams of the protein extraction process contain a high amount of starch, which can still be used as a healthy ingredient for other food and feed. In particular, they are ideally suited for the production of noodles, snacks or chicken feed.



Protein concentrate or isolate, and oilseeds.

Protein concentrates are created by the mechanical separation of flour using the density difference between starch and protein fraction. Protein isolates are further separated with a wet process, where the proteins are dissolved. These products are typically higher in protein with less of the taste from the original raw product. Oilseeds press cake can be upcycled after the oil pressing process and then used as a high protein ingredient.



Fiber-rich fraction and flours.

Fiber is a healthy ingredient which is naturally available in the raw material. With the addition of fiber, the texture of the product and the protein network can be influenced and tailored to the end product specifications. There is a multitude of types of fiber available, like pea, citrus or apple fiber. Flours can also be used as a minor or major ingredient to adjust the behavior of the product.



Fortification and flavoring.

Ideally, meat substitutes contain all the beneficial ingredients of meat, without too much fat and cholesterol. Important vitamins, such as B12, and minerals, such as iron, fortify the textured product. In some cases, natural flavorings or recognizable cooking techniques (such as smoking and roasting) are also added to imitate the taste of real meat in the end product. Alongside our partners, we are developing flavoring solutions to mask off-flavors, improve the succulence of the product, and bridge the gap between the taste of meat and plant proteins.



Realistic meat substitutes. Texturization and flavoring.

Once the dry premix has been obtained, two processes are used to mimic the taste and texture of meat. These textured proteins vary in moisture content which is defined by the finished product. Our solutions and processes are used to manipulate fiber structure, color, texture, and taste – making the finished product similar to actual meat.

High-moisture extrusion for wet textured proteins.

High-moisture extrusion with high-protein flours is an efficient process to create textures similar to chicken, beef, fish or seafood. Typically, they have water content of 50 to 70%. The extruded product is cut into chicken nuggets, shredded chicken, pulled pork, fish fingers or other meat-like formats.



Low-moisture extrusion for dry textured proteins.

Dry textured proteins have been on the market for a long time, but with its new fibrous and meat-like texture they have become a core ingredient not only for plant-based burgers but also for use as chunks in vegetarian chili; mince in spaghetti bolognese; and nuggets for a skewer.



“Together with our experts in the global application centers we will accelerate your innovations according to local tastes and ingredients.”

- Christoph Näf
Head of Business Unit
Nutrition, Bühler AG



Revolutionary extrusion applications. Solutions for a wide range of novel products.

Thanks to our market-leading expertise in extruded food and feed production, we have developed cutting-edge solutions to produce meat alternatives at high throughputs – up to 1000 kg/h.

Extrusion processes.

Extrusion is the core technology for a wide range of products, including breakfast cereals, food ingredients, pet food, and aqua feed. Inside the extruder barrel, heat and mechanical shear loading is applied to modify the structure of the raw materials to generate innovative textures and structures for novel products. In just one machine, ingredients can be mixed, hydrated, kneaded, and cooked under highly controlled conditions to ensure the right physical modifications and chemical reactions take place to just the right degree. Thanks to its modular design, a wide range of finished products can be produced depending on the conditions (e.g. moisture content, energy input, die configurations) to obtain just the right structure for your application. By mastering the process with the support of our experts, you will be able to achieve the correct texture and appearance to delight your consumers. Above all, our process is characterized by versatility, comparatively low investment requirement, and low maintenance, and you will benefit from our best-in-class customer service before, during, and well after commissioning, with 100 service stations around the world.

Automation solutions.

Our all-in-one and user-friendly automation solutions allow you to keep everything under control, to ensure a smooth manufacturing experience and easy monitoring. The most important parameters are displayed in real time and safety aspects are engineered directly into the program. By mastering this process, you will be able to maximize capital intensity by reducing downtime and will allow your operators to focus on maximizing production.

Low-moisture extrusion Cutting and drying solutions.

In addition to producing high-moisture meat substitutes, low-moisture textured vegetable proteins can be produced with our extruders. These dry texturates exhibit excellent stability and can be stored and transported in ambient conditions.

PolyTwin™ – twin-screw extruder.

The modular twin-screw extrusion system covers an extensive range in throughput, from laboratory scale to high-throughput production machines. The process configuration of the machine is carefully matched to the specific application at hand. Novel ingredient sources such as plant-based proteins, pulses, vegetables, fresh fish, meat cuts, microalgae, and even insects can be transformed into value-added products with the utmost flexibility.



High-moisture extrusion. High throughput, high quality.

PolyCool 50

Meat substitute development at a laboratory scale.

The PolyCool 50 is an outstanding solution for research and product development purposes with a throughput of up to 50 kg/h. It is particularly well suited to wet texturates aiming to mimic meat and fish textures. This level of throughput enables the development of numerous recipes and process parameters without requiring significant amounts of raw materials, and it is easy to scale production up or down.



PolyCool 500

Medium-scale meat substitute production.

Our high-performance PolyCool 500 matches the standards of medium industry scale production with the ability to deliver throughputs of about 500 kg/h, for different ingredients and novel textures. Thanks to its sleek and hygienic design, it boasts excellent accessibility for easy cleaning and inspection, and is simple to maintain and operate.



PolyCool 1000

High-scale industrial production.

The PolyCool 1000 allows, for the first time, a throughput of more than 1000 kg per hour. The individual cooling circuits can be controlled independently. This high-throughput cooling die can withstand pressure of up to 50 bar. It cools the extrudate down from some 150 °C to below boiling point. The cooling die has an electropolished surface and meets all hygienic design standards.





Sustainable, nutritious and tasty. plant-based meat alternatives.

Dry textured products.

Die nozzle plates allow customization to meet specific requirements. Below are some examples of dry textured products.



Plant-based burger and minced meat substitutes



We are able to produce different shapes of dry textured products such as pellets, mince, flakes, chips, chunks, steaklets and many more tailored to our customers needs.

Wet textured products.



Plant-based shredded chicken and nuggets

Milk analogs / fortified flour.



Oat milk and other dairy substitutes (e.g. plant-based yogurt)



Extensive range of services. From engineering to training.



Lab services

The laboratories offer a broad range of analyses and tests for food and technical materials in order to innovate processes and improve equipment for our customers.

Spare and wear parts

Highest standards of reliability apply to original Bühler spare and wear parts. They are perfectly adjusted and ensure performance and production reliability.

Consulting

Strategy, plant performance, or energy consulting are just some of the consulting services we provide to improve product quality, production processes and energy efficiency.

Repairs

Dedicated to minimizing downtime in the event of an incident: Fast and reliable technical repair service via the Bühler eTicket or the Bühler Helpline – worldwide, 24/7.

Training

At Bühler training centers – or at any site worldwide – specially trained experts pass on their practical expertise and knowledge to customers' employees.

Reconditioning

Bühler evaluates, reconditions, adjusts or renews customer installations, including Bühler and third-party machines.

Maintenance

Packages are adjusted to fit production cycles to prevent downtime, loss in production efficiency or product quality, ranging from individual services to complete outsourcing of maintenance.

Retrofitting

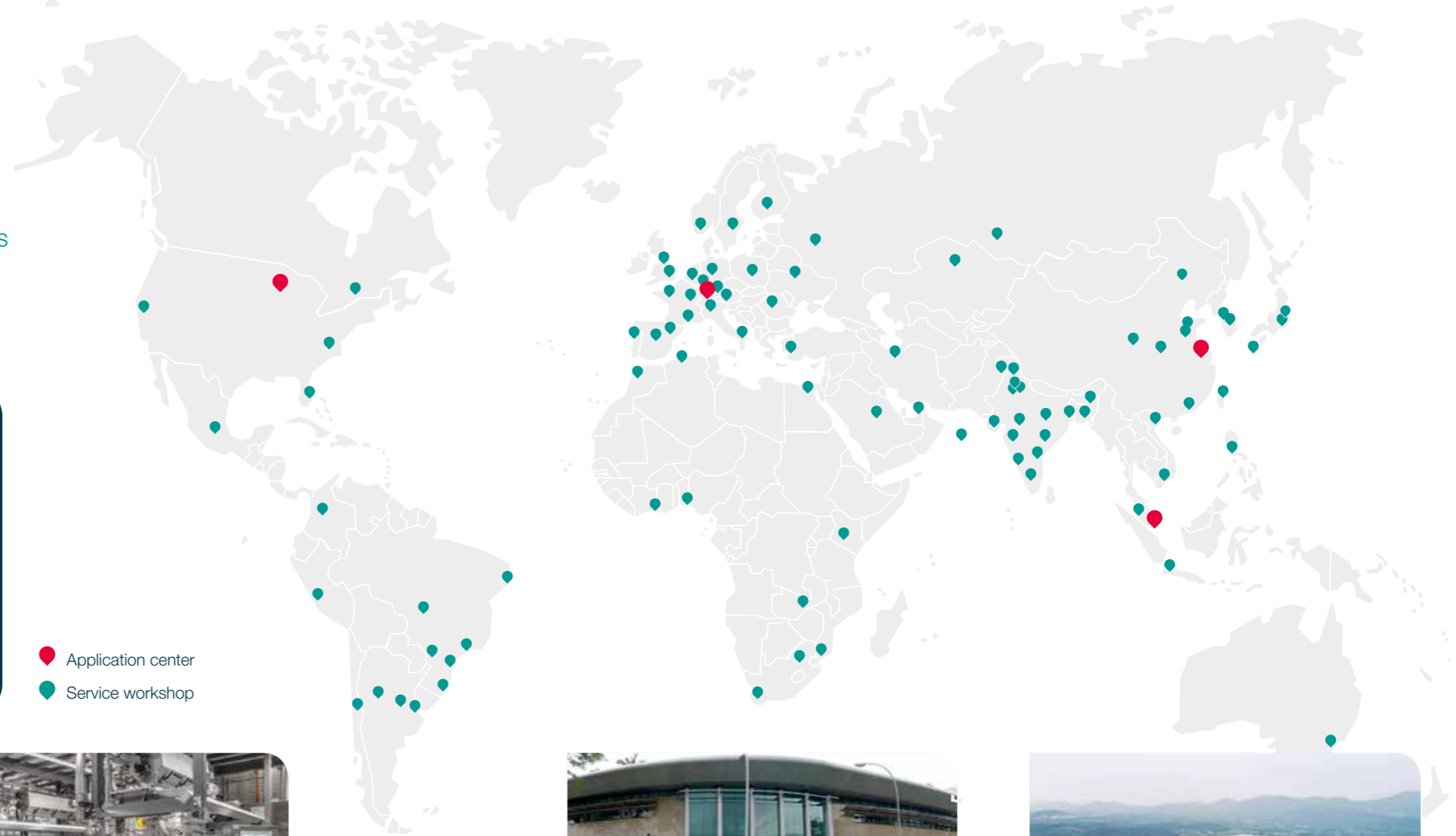
With individual upgrades and conversion sets, time-worn Bühler machines will perform to current standards of technology and efficiency.



Global expertise Local presence. A lifetime of customer service.

Bühler customer service provides assistance not only to keep your machines, plants and facilities running at a high operational level, but also to prolong their lifetime, thus maximizing return on investment. You can test new products, shapes, recipes, textures, flavors, technologies and optimize your production process on fully equipped production lines and laboratories at our application centers worldwide.

- With specialist manufacturing and service locations all around the world, our support engineers and technicians are never far away, ready to help you solve issues or take a proactive role in improving the overall performance of your facility.
- Join a seminar or let us train you in person. We run several workshops a year for theoretical and practical training. These can also be conducted at the application centers or at your production site.
- Work across multiple application centers to optimize all processes across the production line (e.g. grain technology and milling solutions) and develop end-to-end solutions.



Food Application Center Minneapolis, USA

The Food Application Center (FAC) in Minneapolis is the playground that exemplifies our vision for the Future of Food. Developing new ways to transform peas, chickpeas, beans, corn, oats, special grains and many other sources of alternative proteins, into flours, flakes, snacks, pasta, breakfast cereals, meat substitutes, and a myriad of extruded products together with you.



Extrusion Application Center Uzwil, Switzerland

Our Extrusion Application Center is a multi-purpose lab, where you can conduct tests on food and animal feed. In our Extrusion Application Center we have fully-equipped production lines where we run trials at a laboratory-scale, but also use industrial-size equipment under real operation conditions.



Innovation Center Singapore

Bühler's equipment and processing expertise combined with Givaudan's flavor, taste, ingredient, and product development expertise creates a unique offering and synergy that will be greatly advantageous to those developing new products, particularly when using wet or dry extrusion.



Extrusion Application Center Changzhou & Wuxi, China

Test our new technologies and production processes and see how our latest technologies can help make your products. We use state-of-the-art technology – with the option to integrate your own machines.



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