REMO POHL ILLUSTRATION

PORTFOLIO Nº I

INFO-IDEE-KONZEPT

From bean to burger

People are eating less meat for environmental, ethical, and health reasons. They want nutritious alternatives that taste great. Today's plant-based meat substitutes offer both. When it comes to the technology and know-how behind this growing market, Bühler has the edge.

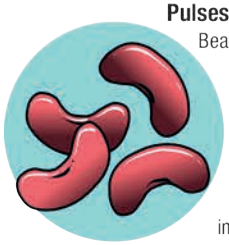
TEXT: CHRISTOPH VOGEL / INFOGRAPHIC: REMO POHL

Raw materials

Soybeans

Some 6% of the world's agricultural land is cultivated with soy. This legume is considered to be the most important oilseed and is widely used for the production of feed. Because of its high protein content, it has also been used in Asia for hundreds of years as a vegetable protein source, for example as tofu.

Pulses

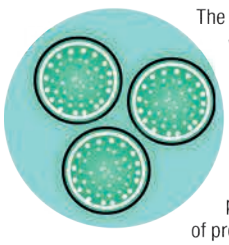


Beans, peas, chickpeas, lentils, vetches, and lupins belong to the legume family and can be dried and used as healthy and nutritious foods. Hundreds of varieties are grown in 173 countries around the world. Pulses are a low-fat source of proteins that also contain fiber, and important micronutrients.

Oilseeds

Oilseeds are energy-dense foods, due to their high oil content. They are rich in protein, fiber, vitamins, and minerals. They make a naturally significant contribution to human dietary protein intake. Sunflower seed and rapeseed expeller cakes are nutritious and healthy ingredients for meat substitutes.

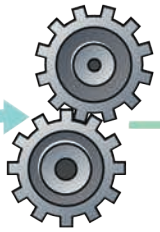
Tomorrow's protein sources



The cultivation of single-cell organisms with a high protein content is a field widely researched at the moment. Many universities and research institutes have developed initial projects for growing microalgae, yeast, fungi, or bacteria in tanks. When extracted as powder they can be a valuable resource of protein for meat substitutes.

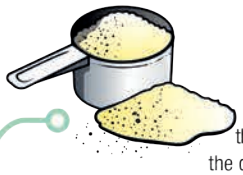
Process

The raw materials are processed into protein isolates (wet process) or protein concentrates (dry process). Both can then be used as the main protein source for the production of alternative meat products.



Starch-rich fraction

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

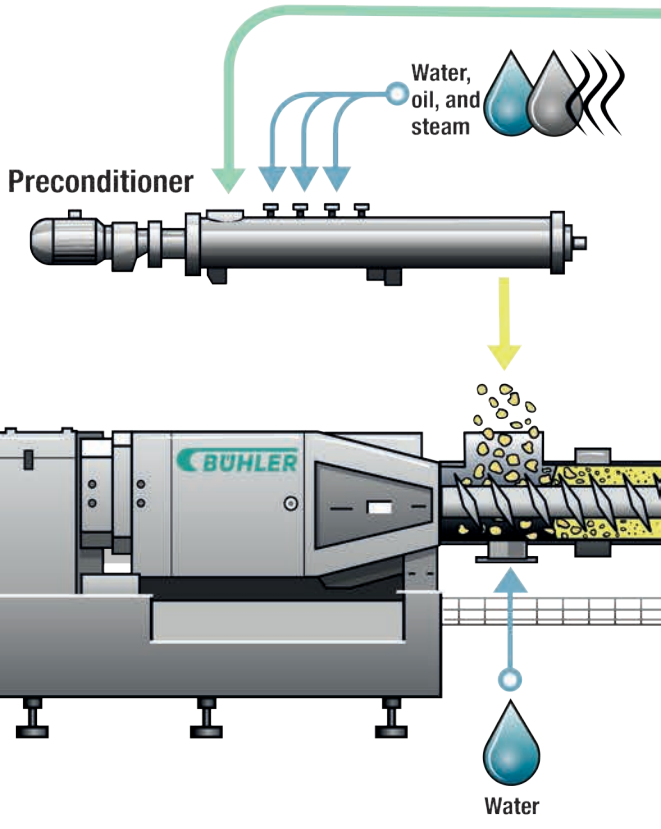


Protein concentrate or isolate and oilseeds

Protein concentrates are derived from the mechanical separation of flour, using the density difference from the 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 content, with less taste from the origin raw material. Oilseeds expeller cake can be upcycled after the oil pressing and used as a high-protein ingredient.

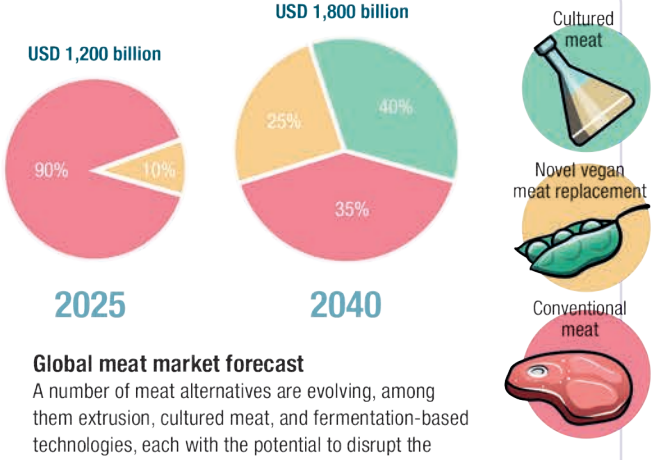
Fiber-rich fraction and flours

Fibers are a healthy ingredient that is naturally available in the raw material. With added fiber, the product texture becomes stronger, and the protein network is more stably interlinked. There is a multitude of fibers available, like pea, citrus, or apple fibers. Flours can also be used as a minor or major ingredient to adjust the product behavior.

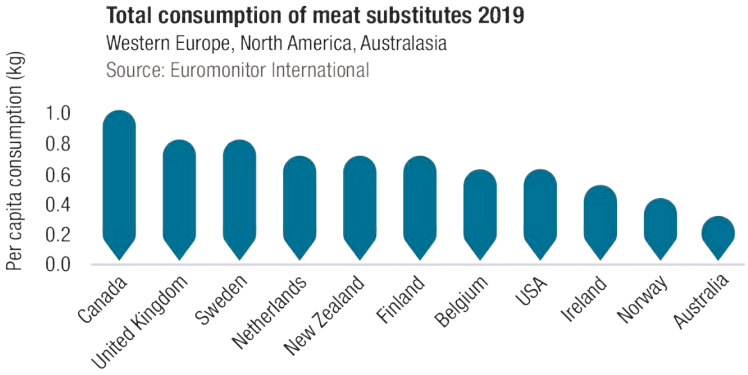


Sources: ATKearney; Euromonitor International; fao.org; pulses.org; sciencedirect.com; The Good Food Institute; Bühler Group.

Text und Konzept: Bühler Group

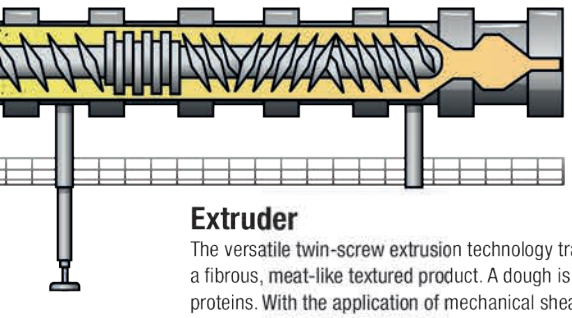


Global meat market forecast
A number of meat alternatives are evolving, among them extrusion, cultured meat, and fermentation-based technologies, each with the potential to disrupt the global meat industry. Source: ATKearney

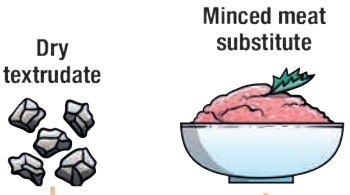


Fortification and flavoring
Ideally, meat substitutes contain all of the positive ingredients of meat, without too much fat and cholesterol. Important vitamins, such as B12, and minerals, such as iron, fortify the textured product. In some cases, natural flavors are added as well to imitate the taste of real meat in the product.

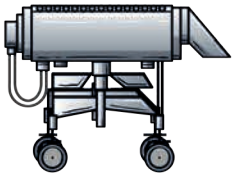
Total investment in the US
Between 2009 and 2018, USD 17 billion were invested in US companies that produce plant-based meat, egg, and dairy products, of which, USD 13 billion were spent in 2017 and 2018 alone. Source: The Good Food Institute



Extruder
The versatile twin-screw extrusion technology transfers the plant protein mixture into a fibrous, meat-like textured product. A dough is created with the mixture of water and proteins. With the application of mechanical shear force and temperature, proteins are denaturated and fibrous structures are generated.



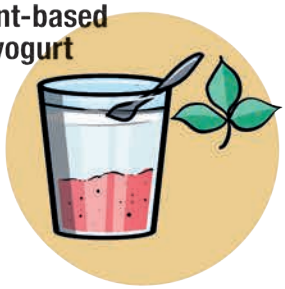
Dry textrudate process
Cutting → Drying → Rehydration & flavor → Gluing & forming



Cooling die
High-capacity cooling die for wet textured products.

Wet textrudate process
Cooling die → Cutting → Forming → Freezing

Milk analogues process
Cutting → Drying → Grinding → Dissolving in water → Yogurt bacteria → Fermentation



HIGHLIGHTS OF 2019

Placeholder

Watch the video of our 2019 highlights

MOVING INTO THE CUBIC

The new CUBIC innovation campus in Uzwil, Switzerland fills with life as **the first employees take up their work** in this hub for collaborative innovation.

BÜHLER JOINS WBCSD

Bühler is welcomed into the **World Business Council for Sustainable Development** (WBCSD) by its nearly 200 members.

A PLATFORM FOR CHANGE

Generation B hosts the first **One Young World Caucus,** in Uzwil, Switzerland as 200 changemakers from all over the world gather in the CUBIC innovation campus.

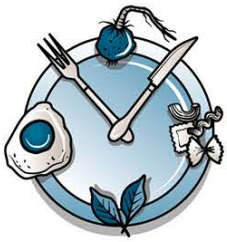
THE INNOVATIONS CONTINUE

Bühler showcases its **new single screw extruder** for the pet food and aqua feed industry at VICTAM in Cologne, Germany.

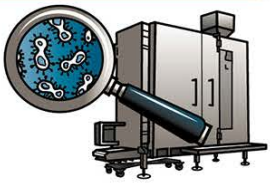
January | February | March | April | May | June

TAKING INITIATIVE

Bühler co-founds the **Future Food Initiative** launched by ETH Zurich and EPFL, together with industrial partners **Givaudan and Nestlé.**



LAUNCHING LAATU



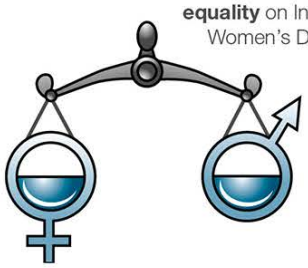
Bühler launches Laatu, a **sustainable microbial reduction solution** for industrial dry food processing at the Microsoft booth at Hannover Messe.

A TRUE MILESTONE

Bühler completes its **10,000th Dolomit roller** mill and delivers it to the world's largest flour producer, **Wudeli in China.**

FOSTERING GENDER EQUALITY

CEO Stefan Scheiber renews Bühler's **commitment to gender equality** on International Women's Day.



A HUB FOR COLLABORATION

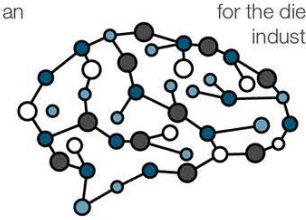
The Bühler family, together with management, officially **open the CUBIC innovation campus,** including eight modernized application centers.

INSECTS TO FEED THE WORLD

The **world's first industrial-sized commercial processing plant for insects,** built by Bühler, opens in the Netherlands. Insects are an ideal protein source for animal feed.

A VISION FOR DIE CASTING

Bühler introduces its **vision for the Digital Cell,** a solution that aims to deliver 0% scrap, 40% less cycle time, and 24/7 uptime for the die-casting industry.



Text und Konzept: Bühler Group

RAISING THE BAR

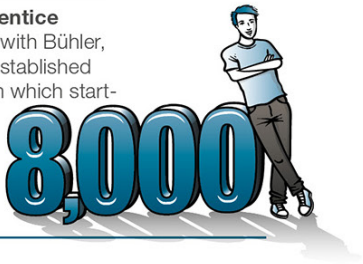
CEO Stefan Scheiber announces **new targets to reduce energy, waste, and water by 50%** in customer value chains by 2025.

WOMEN POWER AT THE CUBIC

Bühler hosts the **"Women Back to Business"** in the CUBIC innovation campus in Uzwil. The program is run by the University of St. Gallen.

APPRENTICE NO. 8,000

The 8,000th apprentice begins his journey with Bühler, continuing a well-established vocational program which started in 1915.



A MILLING REVOLUTION

With Mill E3, **Bühler revolutionizes the milling industry** and sets new standards in speed of build, compactness, and energy consumption.

A ROYAL RECOGNITION

Bühler wins the United Kingdom's most prestigious innovation award – **the Queen's Award for Enterprise** – for its optical sorting

NEW BEGINNINGS

Bühler Raleigh in North Carolina opens its **new facility** after 18 months of renovation work.

THE RICE MILLING HOTSPOT

The International **Rice Milling Academy in Bangalore,** India, starts its first course with 10 participants from the Philippines, Nigeria, Myanmar, China, and Indonesia.

July | August | September | October | November | December

STRENGTHENING OUR ECOSYSTEM

Givaudan and Bühler partner to accelerate market access for food start-ups in Switzerland. The aim is to support start-ups that develop solutions for safe, affordable, nutritious, and delicious food that, if scaled globally, will contribute to feeding 10 billion people by 2050.

AN EXCITING NEW PARTNERSHIP

Bühler and Premier Tech form a strategic cooperation for flexible packaging solutions and agree to **build a design and manufacturing center** in China.

MARKETPLACE OF SOLUTIONS

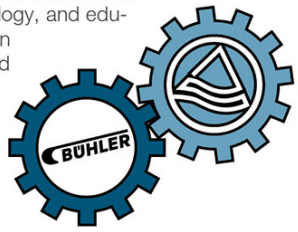
The **launch of the new corporate website** marks an important milestone in Bühler's ongoing digitalization strategy.

CREATING TOMORROW TOGETHER

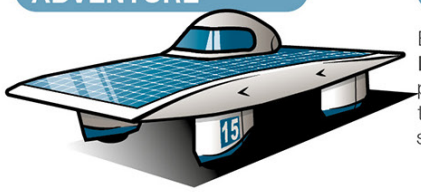
The **Networking Days 2019** brings together over 800 customers, as well as experts, and start-ups to discuss more sustainable food production and mobility.

A PROMISING PARTNERSHIP

Bühler signs a **strategic partnership with Jiangnan University** in China to cooperate in research, technology, and education in the food sector.



SUN-POWERED ADVENTURE



A team of Bühler apprentices participates in the **World Solar Energy Race** across the Australian Outback with their solar race car.

THE PERFECT MATCH

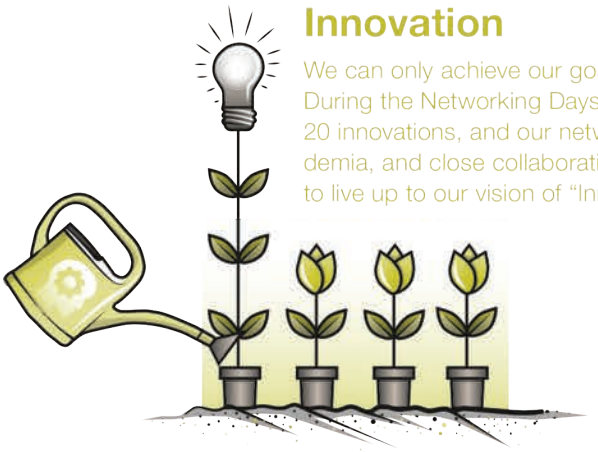
Bühler sells its flour ingredient business to **the Swiss company Bakels** and agrees a **strategic partnership** to unleash the full potential of the business on a global scale.

CONNECTING FOOD CULTURES

Bühler introduces the **AIPesa Milling System** globally. It provides high quality atta flour to consumers outside the Indian subcontinent.

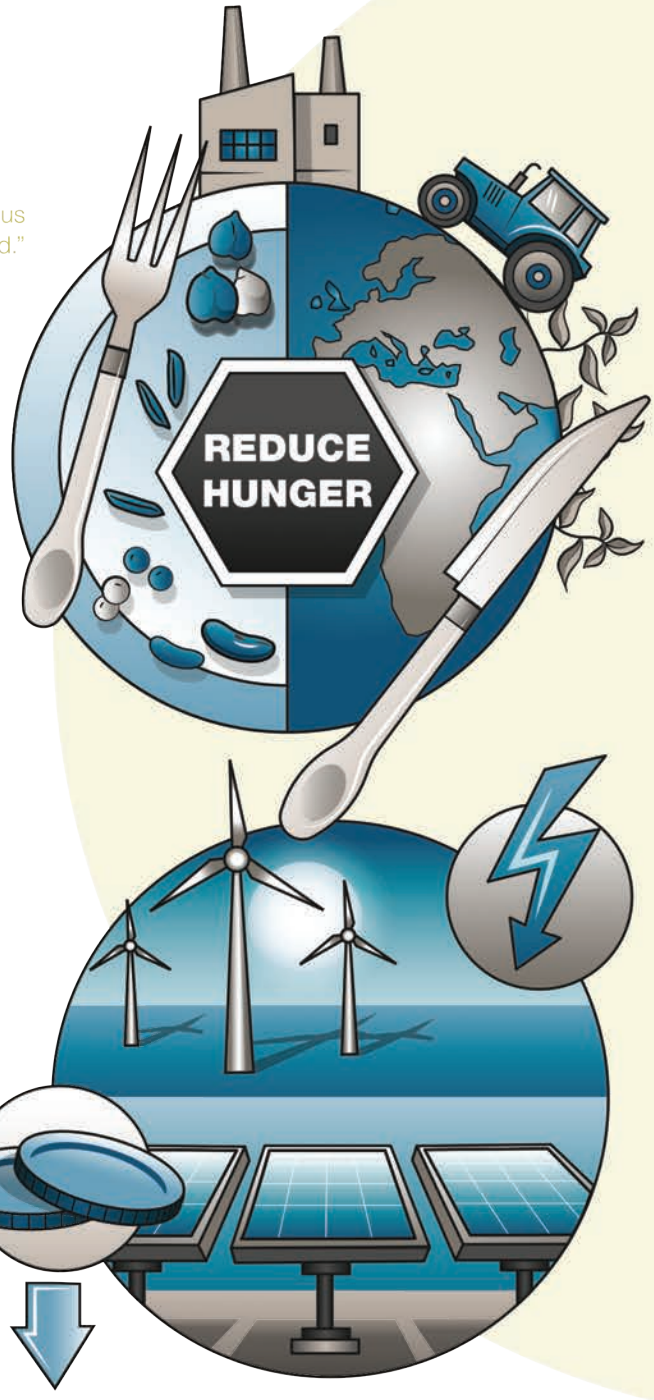
BÜHLER'S CORE TOPICS

During the Networking Days 2019, Bühler raised its sustainability targets with the aim to reduce energy, water, and waste in our customers' value chains by 50% by 2025. To achieve these targets, we identified five core topics and four enablers. We will only be able to reach our ambitious goals by applying a holistic approach across value chains and by harnessing the power of all the enablers.



Innovation

We can only achieve our goals by driving innovation. During the Networking Days 2019, we launched 20 innovations, and our network with start-ups, academia, and close collaboration with customers allows us to live up to our vision of "Innovations for a better world."



FOOD

According to the United Nations, we will have to be able to feed 10 billion people by 2050. To make it even more challenging, we will have significantly less land to do so. That's why in 2019 we invested 4.5% of our R&D budget into food trends such as alternative proteins. We also intensified our collaborative approach by joining the Future Food Initiative launched by ETH Zurich and EPFL.

ENERGY

To reach the goal of the Paris Agreement of reducing greenhouse gas emissions by at least 40% by 2030 compared to 1990, energy consumption in industry plays a key role. In 2019, we invested CHF 149 million to find new ways of making our customers' value chains more energy efficient, among other initiatives. Our new Fusion die-casting platform, for example, can reduce energy requirements by up to 40%.

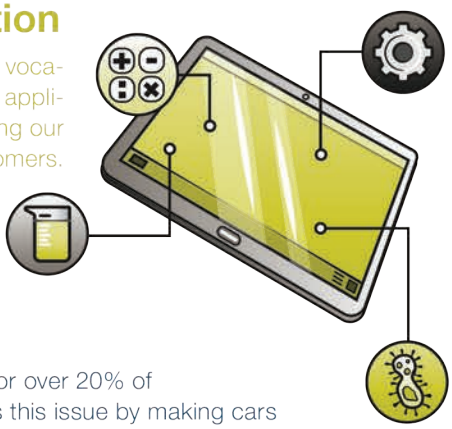
Digitalization

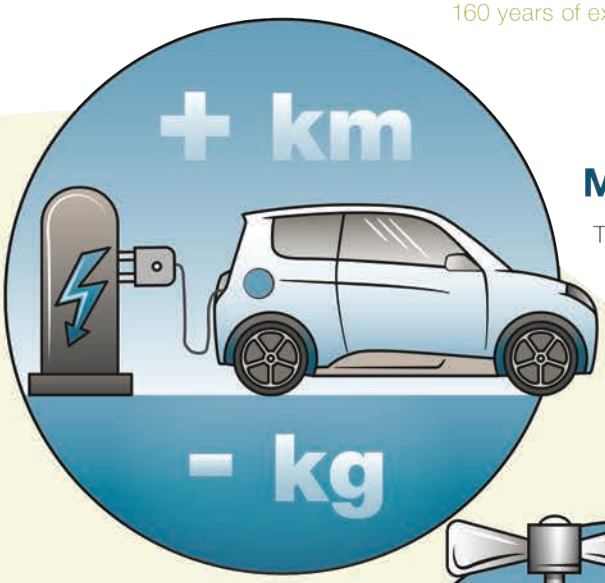
Digitalizing processes is key to achieving our sustainability goals. 85% of our technologies are able to connect to our digital platform Bühler Insights, which allows customers to improve the performance of their machines and reap both sustainability and financial benefits.

Text und Konzept: Bühler Group

Education

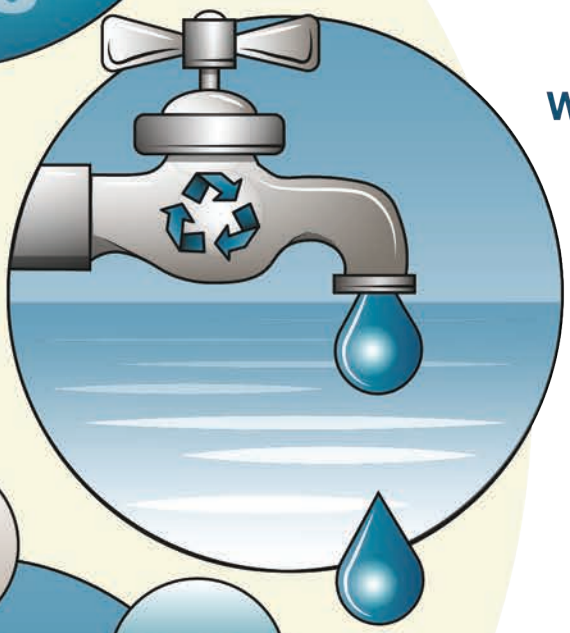
Education and knowledge transfer are in Bühler's DNA. From vocational education and digital training to hands-on learning in our application centers, we continue to harness the power of sharing our 160 years of experience with employees and customers.





MOBILITY

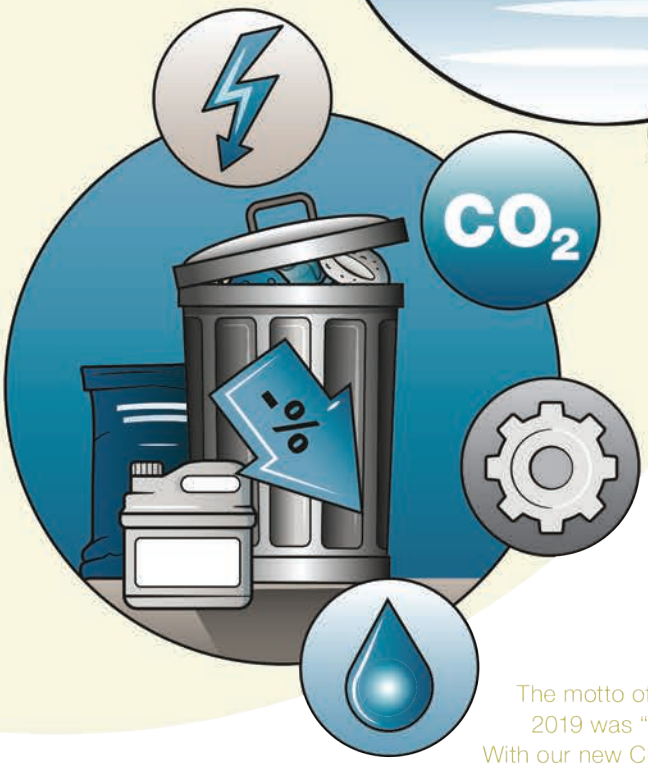
The transportation sector accounts for over 20% of global CO_2 emissions. We address this issue by making cars lighter with our die-casting systems, and electric vehicles more energy efficient with our solution for electrode slurry. In addition, we are driving collaboration between industry and academia by bringing stakeholders together, for example in our new Die Casting Technology Center in Uzwil, Switzerland.



WATER

Agriculture uses 71% of the global fresh water supplies. To feed up to 10 billion people sustainably by 2050 and achieve our goals of reducing water usage by 50% by 2025, we must drastically improve efficiency. We see great potential in applying steam instead of water in food processing, as seen in our Prime Masa process for manufacturing Nixtamal corn flour, which reduces water usage by a staggering 90%.

More about our key topics and enablers

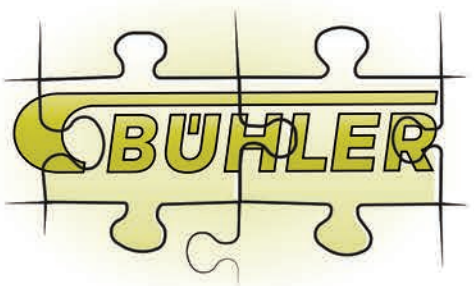


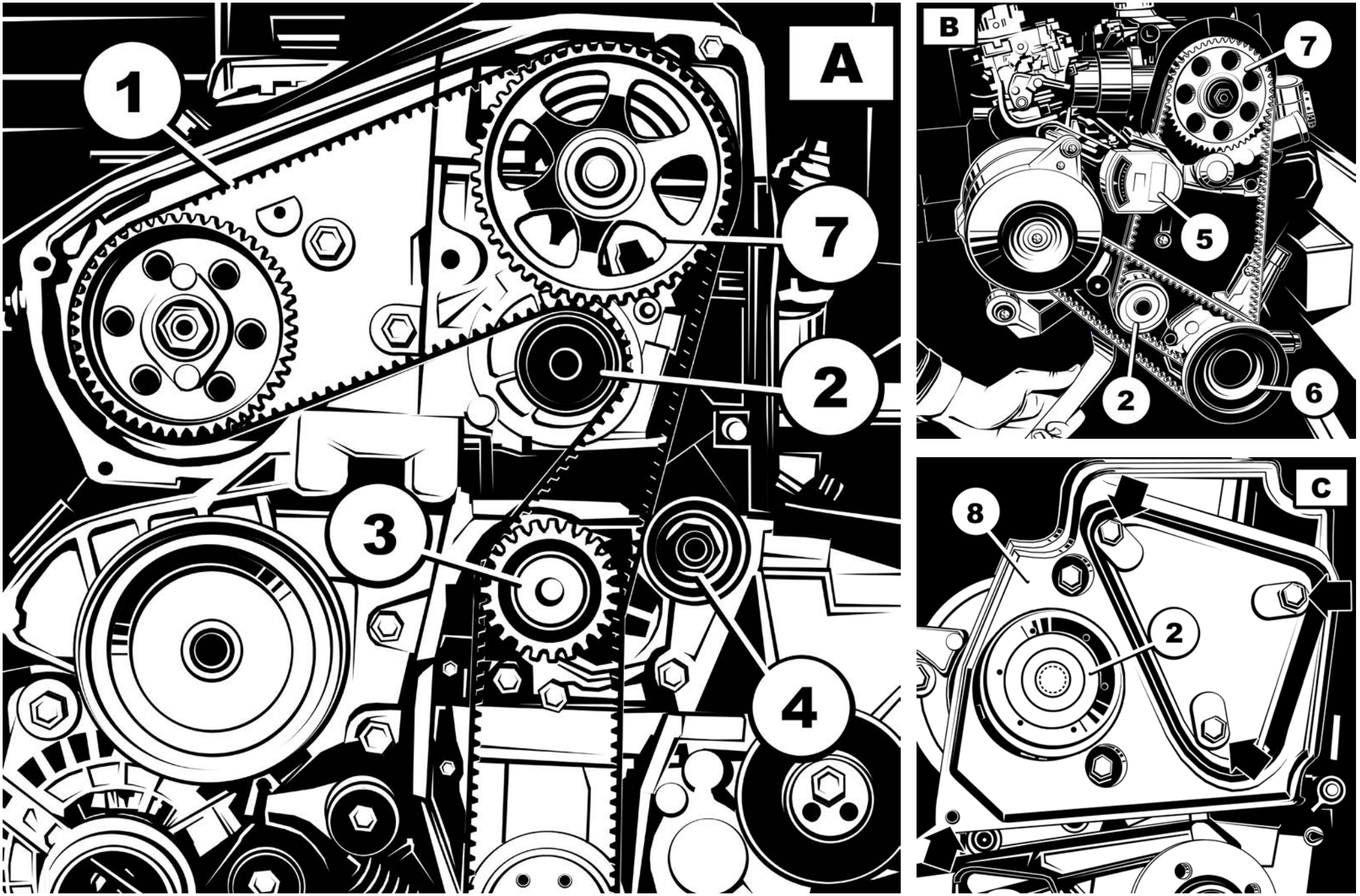
WASTE

30% of food is lost or wasted from field to fork. Meanwhile, an estimated 840 million people are suffering from hunger. We continue to improve our solutions to prevent losses in food processing: from intake to cleaning, sorting, storing, processing, and bagging. Our LumoVision, for example, identifies and removes cancer-causing, aflatoxin-infected grains and reduces yield loss to below 5%.

Collaboration

The motto of the Bühler Networking Days 2019 was "Creating tomorrow together". With our new CUBIC innovation campus, the global network of application centers, and our Networking Days concept, we want to establish an innovation ecosystem which enables the rapid transformation needed to reach our goals.

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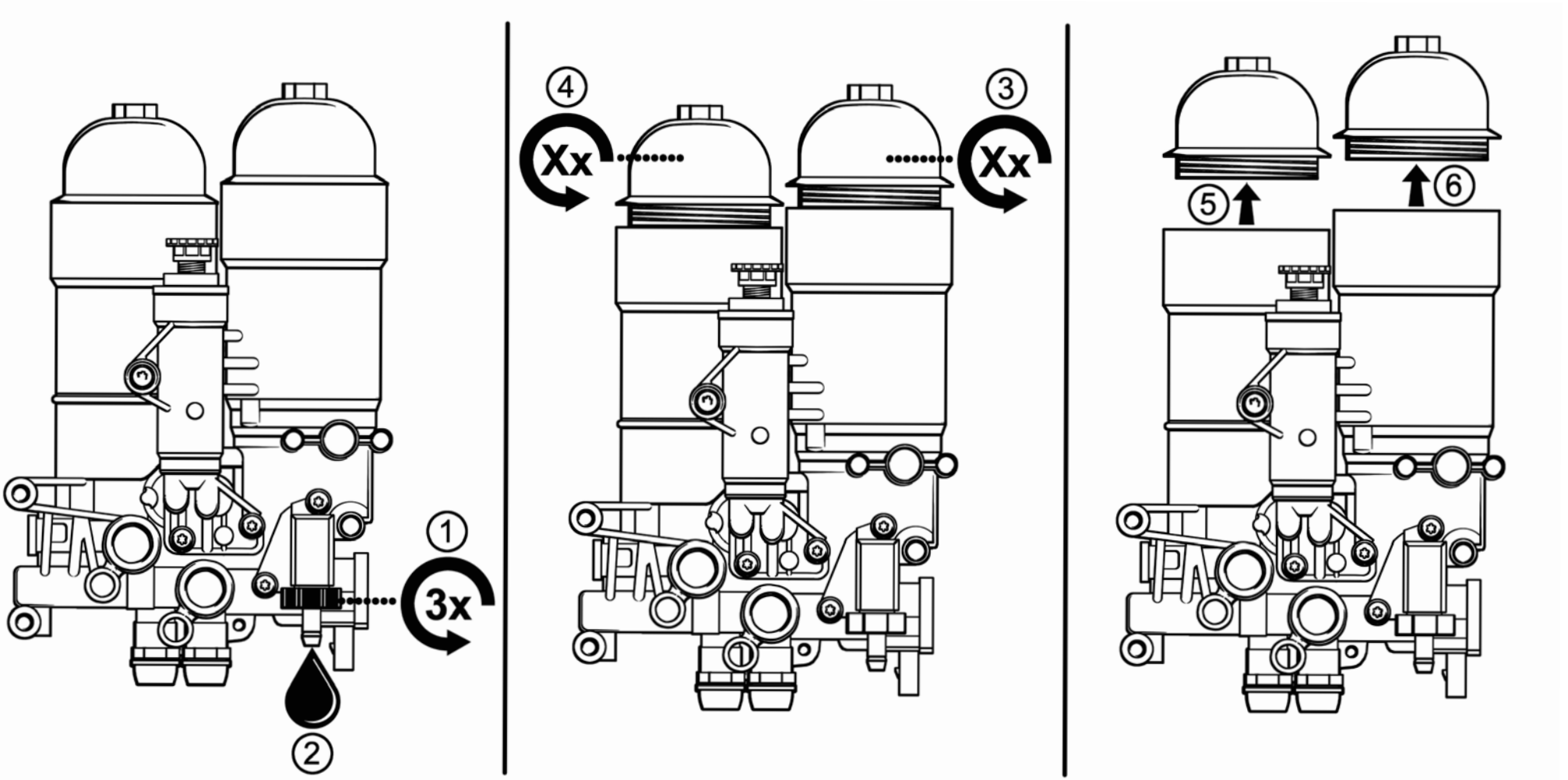
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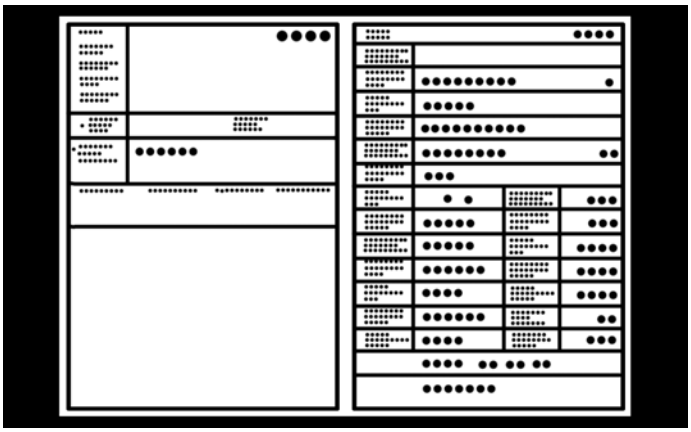

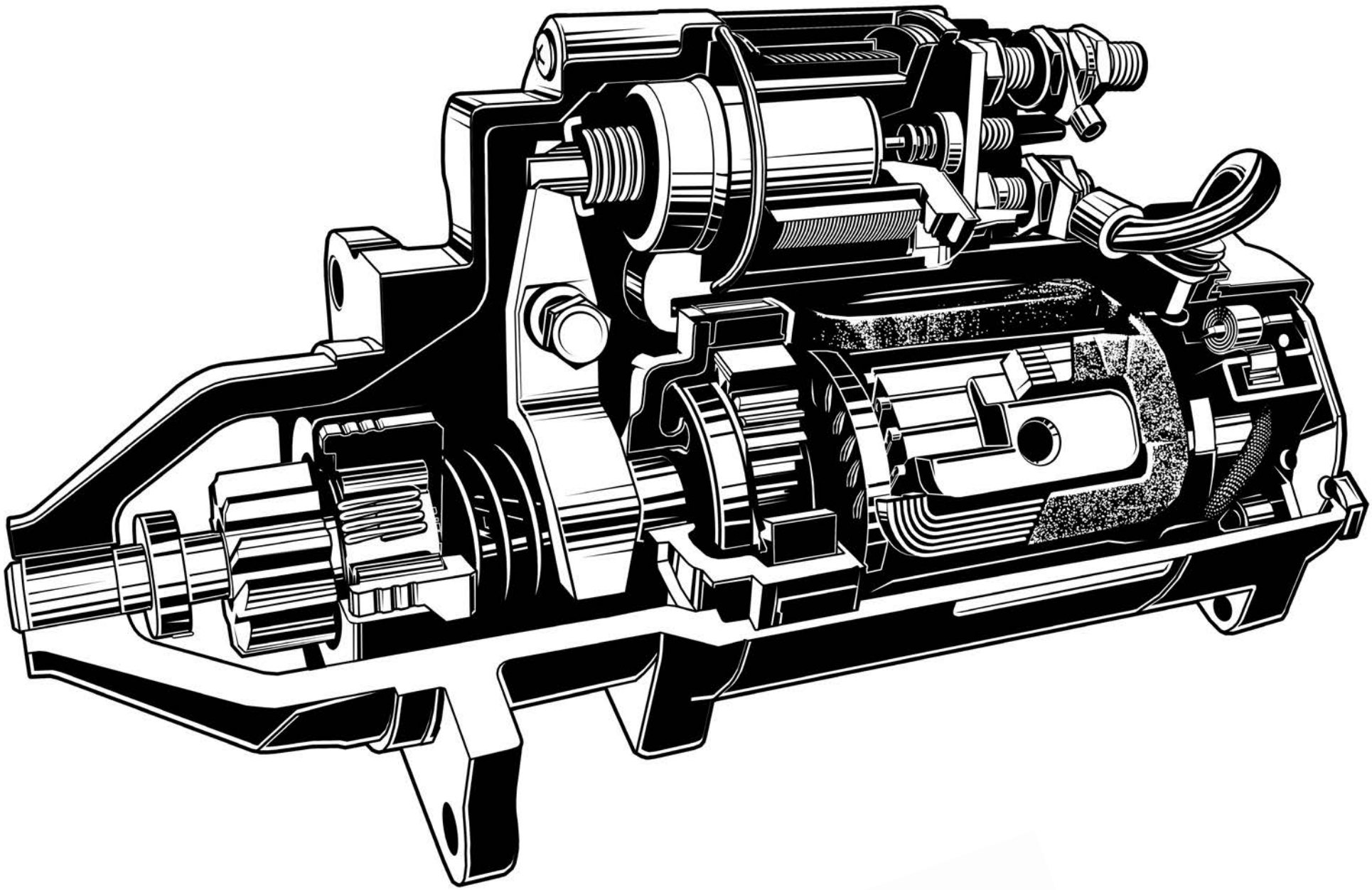


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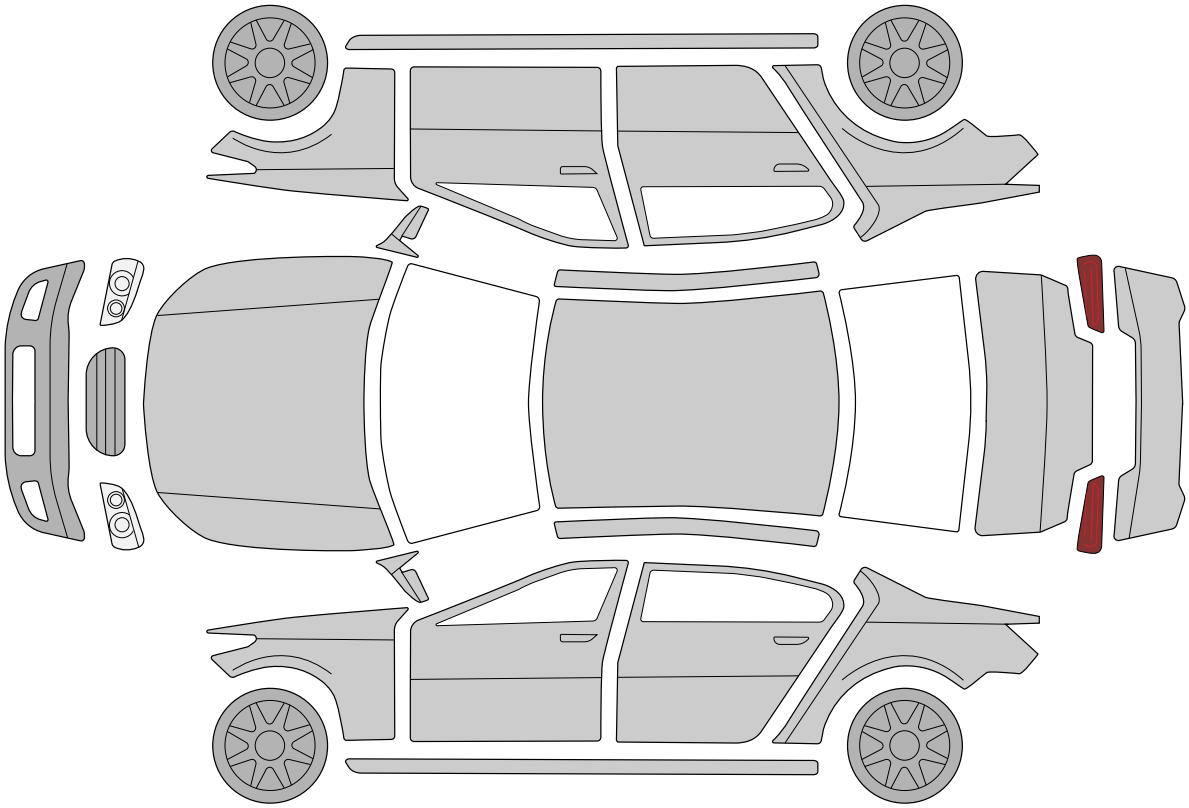

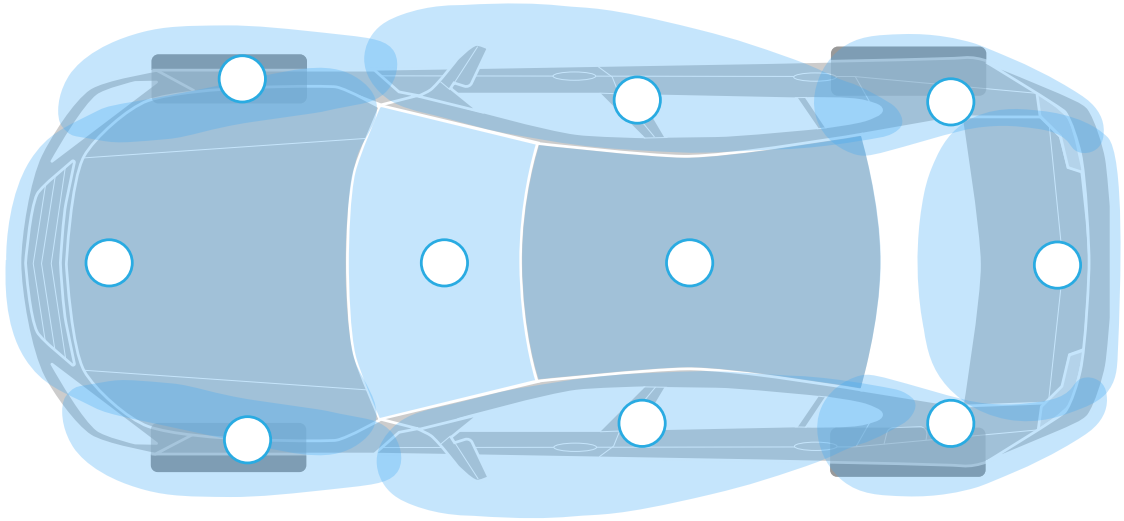

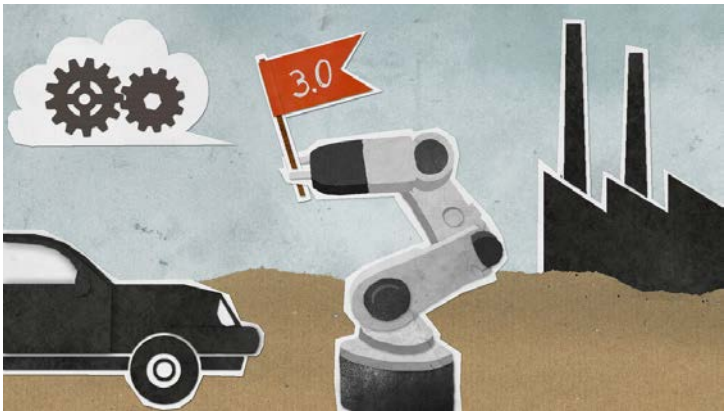
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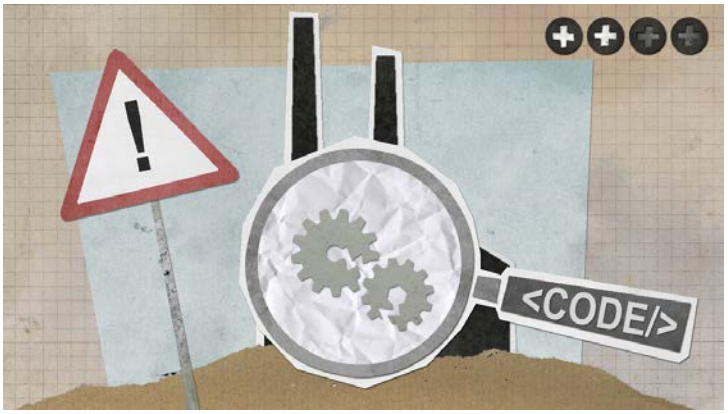
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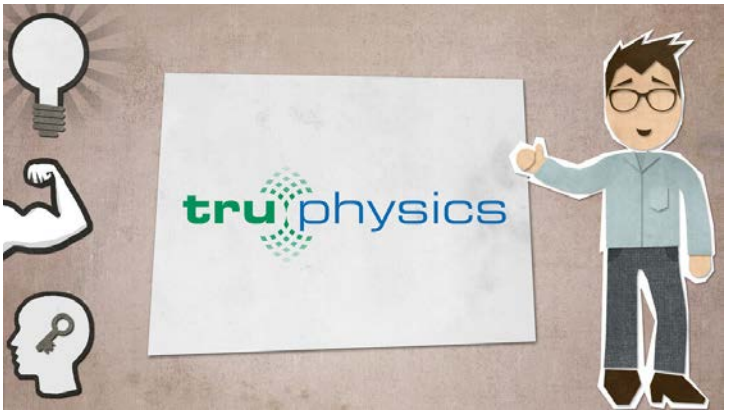
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