

Smart Food Manufacturing

A special about Dutch initiatives & innovations

- ✓ Sustainable
- ✓ Healthy
- ✓ Circular



‘Radical new technologies from the Netherlands enable the transition to healthier and more sustainable food’



A new perspective

The perception of food is changing. From production methods, packaging and nutritional value, all the way up to the question how sustainable our food system is. To meet global goals - such as CO₂ reduction, food security and safety, and the rising demand for healthier and personalized food - the food sector is changing rapidly. A lot of the innovations that drive this transition come from The Netherlands, where the government, companies, knowledge institutions and the public sector are working together to make the food sector smart and more sustainable. Within numerous collaborations, the Netherlands is developing and launching new technologies and processes for the entire food manufacturing chain, is researching how nutritious ingredients can replace traditional proteins, and is launching innovative sustainable packaging methods and materials. Thereby taking a leading role in Smart Food Manufacturing.

Photo courtesy of
The Protein Brewery.

In this issue



Change is unavoidable

What is needed to make the transition to a Smart Food Industry? And how is The Netherlands contributing?



The Dutch Diamond

Within various (inter)national partnerships The Netherlands is gearing up to take the lead.



Education

Dutch 'Green' education plays a crucial role by keeping employees skilled and actively participating in innovations.

Smart technology in food processing	10
Dutch initiatives in food	16
Dutch innovations in food processing machines	20
Dutch innovations in (climate) smart packaging	22
What does the future bring?	24
Company profiles	27

How smart technology is shaping tomorrow's food sector

Many of the foods we consume are in some way handled, sorted, dried, processed and packaged to give them longer shelf life or make novel products. In general in the last years we see the shifting trend of a greater need to produce safe, healthy, affordable and sustainable food. Smart food processing is a reaction to this need and a key enabler. By digitizing and innovating the food process, with data management, new biotechnological processes, blockchain, artificial intelligence, augmented reality, robots and cobots, digital twins etc..

Smart manufacturing has an important role to play combating food waste and food loss and making total use of all parts of the raw material. Through sustainable packaging solutions and by optimizing processes and – thus using raw materials more efficiently – and by valorising side streams to valuable food ingredients and applications. Smart technologies can facilitate in-line sensing and quality control which means more flexibility so that faster corrections can take place in the process to avoid batches being rejected at the end of the process and having the ability to use raw materials of variable quality and still produce a desired product.

Parallel we see a movement towards innovation in milder processing technology to ensure less refining and preservation of the natural goodness of the raw materials, aiming at clean label, authentic and nutritious foods.

Furthermore, there is a need to obtain and process ingredients from new sources ('novel' or 'future' foods) and offer new possibilities in the context of the protein transition (e.g. cellular agriculture).

This "SMART" special is the 2nd special – following the earlier published **SMART farming special**. COVID and the current geopolitical situation shows that the Netherlands is in many ways linked and part of a global food system – accelerating discussion on sustainable sourcing closer to home and a circular system approach that includes manufacturing and retail and consumer as integrated parts of the food system.

This special aims to give more insights in the developments and trends in this part of the Dutch sector where technology providers and innovative companies are working on sustainability, smart solutions and new foods. It highlights the Dutch Diamond approach and showcases examples of innovation. It also stresses the essential role that education needs to play in the transformation of the sector and the urgent need to support development of skills for personnel and management.

We are happy to have joined forces for a second time with FME, the association of the technology industry in the Netherlands. We hope this special will inspire to innovate in the field of foodtech worldwide with partners who are working on this same challenges and technologies. We like to thank all the many people that contributed to this edition and provided us with their company profile for the annex.

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Change is unavoidable



The world population is expanding and the demand for safe, healthy, sustainable food with less packaging and waste and loss is growing quickly. The worldwide food production system is under huge pressure to change towards smart industry practices. What does that require and how can the Netherlands contribute to Smart Food Manufacturing?



Employee conducts quality control.

Food is everywhere. It is a fundamental necessity that affects the daily lives, productivity and future prospects of billions of people all over the world. The food that is produced, processed, packaged, transported, and regrettably also often wasted in all four corners of the earth have an impact on numerous facets of life, from our health to the climate. This impact is set to increase further in the decades ahead due to growing populations, as well as an increase in both prosperity and numbers of people with insufficient access to nutritious food. This means the call for climate smart food production will also get louder and louder.

Smart Manufacturing Solutions

In general, there are three solutions which contribute to greater sustainability in the food industry: more sustainable eating habits, reducing food waste and food loss and more efficient, sustainable, and careful food production.

Health

Food and health are, of course, inextricably linked. Almost half the global population have poor eating habits, according to research in the Global Nutrition Report. 48 percent of people eat either too much or too little, with a growing segment of the world population being undernourished. Attitudes to food are changing, especially in the west, and consumer awareness about the food we eat is on the rise. There is an increase in demand for healthier, more sustainable, and more

“Smart tech makes food processing smarter and safer.”

personalized food. Demand for food which is lower in sugar, fat, salt, or calories is growing, and there is a shift from consumption of meat towards meat substitutes.

Reduce food waste and food loss

One of the greatest challenges in limiting the ecological footprint of the industry is reducing food waste and loss. A third of all food which is produced, 1.3 million tonnes of food, is lost in the process. That represents 940 billion dollars each year. About 10 percent of all greenhouse gas emissions come from food that is produced, but not eaten. Reducing food and loss contributes, among other things, to lower greenhouse gas emissions, reduced land use and a circular economy in which resources in the food system can be re-used. In the Netherlands, the initiative ‘Together against food waste’ was established in 2018. The Taskforce aims to reduce food waste in the Netherlands by half by 2030

(compared to the 2015). To this end, activities and pilots have been formulated on four levels: measuring and monitoring food waste; stimulating innovative actions; focus on raising awareness and specific interventions for consumers; focus on changing regulations, legislation and business agreements to remove barriers to the prevention and reduction of food waste.

Packaging solutions

Food packaging has a dual function. It is essential for transportation and for extending the shelf life of food, but the sheer quantities of cardboard, glass and especially plastic which are used put enormous pressure on the environment. According to statistics issued by ING in 2019, of the 500 million kilos of plastic available in the Netherlands each year, 40 percent is destined for the food and drink industry. This is, in part, due to a global growing population which is responsible for an annual increase of around a hundred million items of packaging in the large export-driven Dutch food sector’.

Where does Smart Food Manufacturing fit in?

To be able to respond to these crucial global issues the food sector will have to change through innovation in processes (increased efficiency and chain integration), products (ingredients and novel foods) and packaging (more sustainable materials). With the higher aim of bringing food onto the market in a healthier, safer, and more cost-effective way.



Smart technologies such as the Internet of Things (IoT), artificial intelligence (AI), datafication, and the newest generation of robots are becoming ever more commonplace in the food industry and are making processes smarter, safer and more sustainable. ICT and smart sensors can take over routine tasks in quality controls. Robots take care of repetitive production tasks. Datafication, digital twin technology and AI can play an important role in understanding processes throughout the food manufacturing chain and help to prevent food waste and loss by, for example, generating smart predictions. Digital twin technology, which enables virtual copies of a product or a process, has, in combination with smart sensor technology, the potential to give real-time insight into food processing and the supply chain, making it far easier to make needed adjustments.

Plant based ingredients have become indispensable and play a vital role in the reduction of CO₂ emissions in the food industry as well as in promoting a more nutritious diet. According to research by McKinsey there has been a definite turnaround in consumer thinking and behaviour. “For years, consumers said that they wanted to eat healthier foods and live healthier lifestyles, but their behaviour did not change—until now. Consumers are eating differently, redefining what healthy means, and demanding more products that are natural, green, organic and/or free from sugar, gluten, pesticides, and other additives.”

More sustainable packaging is preferably fully recyclable, but can also include packaging which is lighter, bio-based or made of biodegradable materials or other (re-usable) materials.

What is being done in the Netherlands?

The Dutch food and agriculture sector is a world leader in its field and is widely recognised for its strong, innovative, highly productive and efficient processing. In combination with world class knowledge centres and strong links between businesses, government and education, this creates the ideal conditions for multinationals to base important roles in the Netherlands. But this Dutch role also brings responsibility as well as challenges. To further promote innovation and sustainability within the sector the Netherlands takes up the gauntlet by means of public-private collaboration, with a strong focus on consumer involvement.

Take, for example Plastic Pact NL, in which companies have committed to the exclusive use of sustainable plastic products or packaging by 2025: preferably fully re-usable or at the very least 100% recyclable and using 20% less plastic, for example by reusing materials. Additionally, at least 70 percent of single-use products and packaging must be recycled, and these products must be made of at least 35 percent recycled plastic. The Netherlands has also committed to the UN Sustainability Development Goal 12.3 to halve 2015 levels of global food waste by 2030. This equates to 1 billion kilos of food waste annually in the Netherlands.

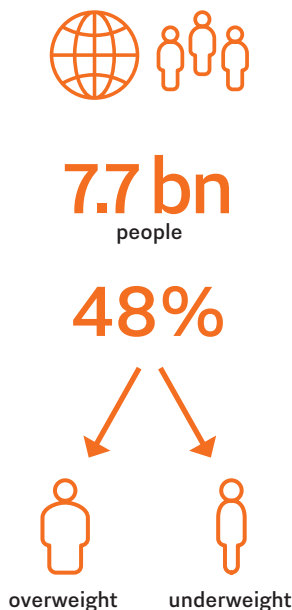


Goals and agreements are only a start. Dutch businesses and centres of knowledge and education develop numerous innovations in the field of bio-based packaging, more efficient processes, and healthier foodstuffs. They are working on ways to use residual streams in new products and reduce water use in food processing. Consumers are advised on healthier food patterns by means of smart tools. And several collaborations are looking at how shorter food manufacturing

chains can limit the sector's impact on the environment and the climate.

In all these activities economic motives and societal challenges go hand in hand. What do the necessary innovations mean for existing business models? How can we create new models, so that the food manufacturing chains can become more ecologically sustainable whilst at the same time maintaining a rock-solid economical basis?

Food production 2022



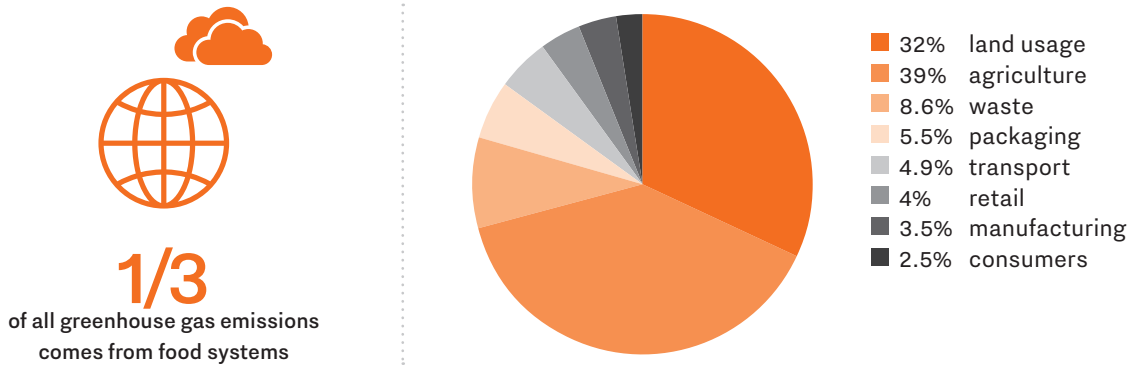
Food waste & loss



IF WE DON'T WASTE FOOD, WE SAVE:



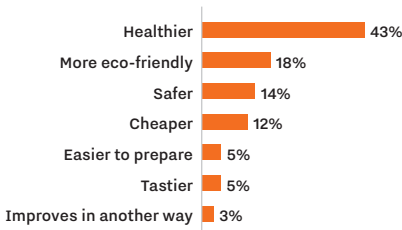
Sustainability



Source: FAO, UN, Global Nutrition Report

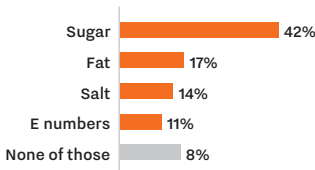
Consumers find it particularly important that food will be healthier in future...

% of respondents to the questions: I think it's particularly important that my food in the future is...



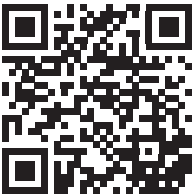
40% of consumers try to avoid sugar

% of respondents to the questions: Which of the following nutrients are you particularly trying to avoid?



Source: ING

Also interested in Dutch Smart Farming solutions? Read our Smart Farming special.





The Dutch food sector is known, among other things, for the close cooperation between governments, educational institutions and companies. Often embodied in field labs/living labs. Together, they look for new and better ways to process and package food.

One such partnership is between the company Spireaux (Rotterdam) and the IJsselcollege. Spireaux produces a neutral tasting, fresh spirulina paste, a type of algae, that can be used as an ingredient to fortify a wide variety of existing food products. Spireaux spirulina contains over 65% protein that contains all essential amino acids. Additionally, it is made up of loads of vitamins, minerals and poly unsaturated fatty acids. Though the high nutritional content is interesting, the sustainability aspect of this new production process is the real game-changer. Spireaux saves over 99% of land, water and carbon dioxide per kg of protein compared to traditional protein sources.

The IJsselcollege has been selected as pilot school for testing a small scale photobioreactor from Spireaux. The cooperation offers students and teachers the opportunity to conduct multidisciplinary research.

You can read more about the Dutch approach to cooperation (page 12) and the role of Dutch education in Smart Food Manufacturing (page 18) further on in this magazine.

Smart Food Manufacturing Technologies

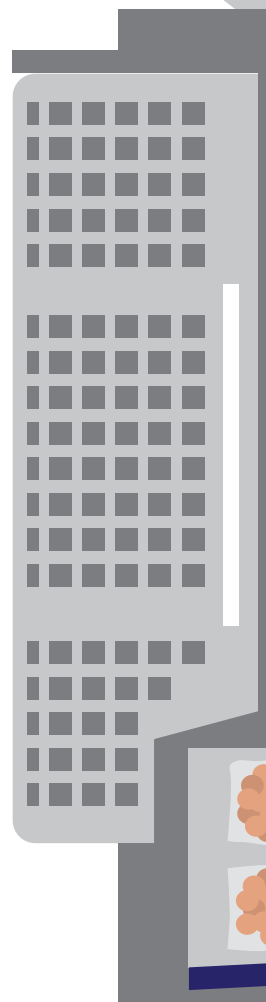
Sensors, artificial intelligence, digital twins, and robotics. Smart digital technologies are opening up a multitude of opportunities for optimizing production processes, making them more sustainable and more flexible.

Real-time
decision making.



Artificial Intelligence

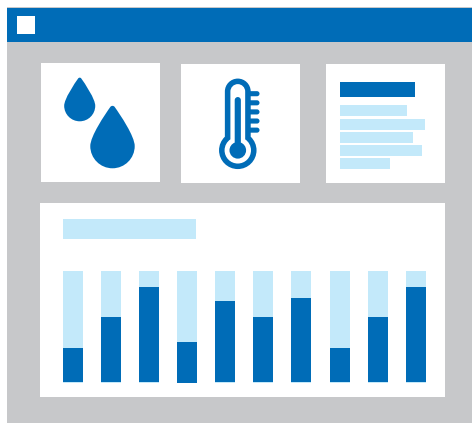
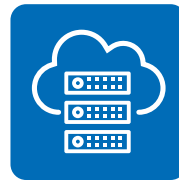
- Smart camera's:
 - Cutting food in right proportions
 - Picking and placing
- Algorithms for prediction tools
 - Maintenance
 - Stock and production organization
 - Matching optimal input with end product
 - Production planning
- Digital Twins:
 - Simulating processes with which outcomes can be predicted precisely, and processes and factories can operate more efficient.
- Sensors:
 - Generating real-time data on manufacturing processes and material streams
 - Monitoring (for example which surfaces are dirty and in combination with hardware, clean them automatically less water, without operator).
 - Shelf-life investigation
 - Freshness evaluation
 - Authenticity assessment and other quality control studies



ufacturing

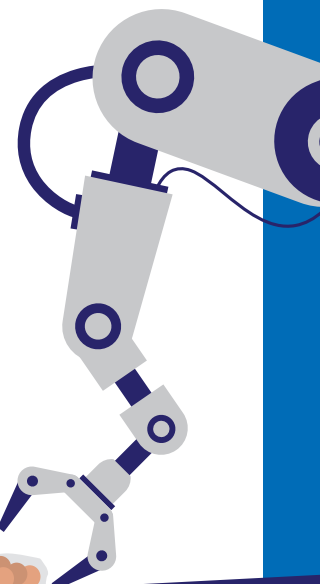
Big Data

- ERP-system
 - Connecting data of employees, IT-systems, sensors, machines, vendors and customers.
- Web- and cloudbased apps
 - Monitoring and controlling entire process and delivering dashboards full of facts and figures about KPIs.



Robotics

- Food Processing
 - Cleaning, sorting, transporting, blending raw food products
 - Combining ingredients to form new food products by cooking, baking, chilling.
- Packaging
 - Packaging individual foods
 - Grouping together individual packages
 - Grouping packages for shipping.





How the Netherlands are working together on Smart Food Manufacturing

The Dutch Diamond works

The food sector faces substantial societal challenges. In the Netherlands, companies, institutes, government and consumers have joined forces to find new approaches to sustainable and healthy food. An approach also known as the Dutch Diamond. Ivo Ploegsma, Innovation broker for Topsector Agri & Food: “This Dutch ecosystem accelerates the sustainability transition.”

Ivo Ploegsma has been working in the food sector for more than thirty years. He has access to innovative projects on a daily basis, for example through his work in initiating and developing Food Tech Brainport, a FieldLab in Helmond, in the south of the Netherlands. Here agri-food businesses, machine manufacturers, technology developers and the process industry work together on the food industry of the future. According to Ploegsma, Food Tech Brainport is a prime example of how numerous collaborations in the Netherlands are working on increased sustainability in the sector and Smart

Food Manufacturing. “We have a strong belief in cooperation between governments, knowledge centres, and even between businesses who are actually competitors. Cross-industry cooperation and a willingness to look at issues from a variety of perspectives are commonplace. This integral chain approach is what makes the Netherlands a leader in this field.”

Smart

The innovation broker views Smart Food Manufacturing as more than the application of smart technologies. “Smart also says something about your approach to doing

things. Globally, we are facing the same challenges. An integral approach allows you not only to tackle the societal challenges, but also to work towards a sector which is economically as well as ecologically sustainable, with business models which link sustainability to business viability. This is, to me, an essential approach for a future-proof industry.”

The Netherlands is working on new initiatives and have a leading role in innovations. In addition, consumers put an increasing value on more sustainably produced and healthier food. Ploegsma is convinced that “this joint awareness is a catalyst for making the sector more sustainable.”

Field Labs and Living Labs

In Field Labs and Living Labs new models, innovations and approaches are tested. Examples are, amongst others, Brightlands Campus Greenport Venlo, Fieldlab Total Use, No Waste and Future Food Fieldlab. And there is a long list of networks and programmes and the scope is often extensive, including initiatives such as

“Smart also says something about your approach.”

the Alliantie Verduurzaming Voedsel (Food Sustainability Alliance), Holland Robotica, Foodvalley and CARVE (against food waste) and Samen Tegen Voedselverspilling (Together Against Food Waste). This Dutch ecosystem accelerates the sustainability transition.

Magnet

The Netherlands is home to numerous strong global food businesses, such as Unilever, Heineken, Vion and FrieslandCampina. And the Netherlands also has a strong tradition of being well represented among machine manufacturers for the food and agriculture sector: the country is one of the top three exporters of food and agriculture technology. This particular ecosystem and its infrastructure makes the Netherlands a magnet for foreign organisations in the same field, who are keen to set up shop here. Examples include juice producer Innocent and vegan meat producer Beyond Meat. “They make a conscious decision to establish themselves here and become a part of our ecosystem. Thanks to our collaborative mindset and our international outlook, they can speed up innovations in their products and services and reduce time-to-market,” according to Ploegsma’s analysis. Regarding the country’s global outlook. Dutch parties combine forces with foreign organisations in the area of technological innovations. This includes cross border public-private collaborations in which the Dutch both disseminate knowledge and acquire new insights to be applied in research and innovations.

Ploegsma: “At the heart of Smart Food Manufacturing is an approach which not only focuses on health and sustainability, but also on reducing food waste and loss. Per stakeholder we find that one aspect may be more important than others, but the

three areas are always linked. You can work on healthier food, but not without taking sustainability and waste/loss into account. New revenue models can be developed using this triangle, with the aim of tackling joint challenges.”

GEA incorporates sustainability into entire operation

One of the Netherlands-based companies that has incorporated sustainability into its entire operation is GEA, one of the largest suppliers of technology for food processing, among others.

GEA has set itself the goal of being CO2 neutral by 2040. This is only one of the pillars of GEA’s strategy, Mission 26. Other are, Digitalization and New Food. In the New Food segment, GEA has a unique position with supply chain solutions for alternative proteins. Sustainability, digitalization, and New Food are naturally interrelated, and increased investments in Innovation are the basis.

For example, business unit GEA Food Solutions recently introduced the Cookstar1000 Gen 3, a new generation spiral oven, which is greatly improved in capacity and flexibility with also better energy efficiency through dynamic extraction that adapts to conditions. The key here is the implementation of sensor technology to gather data from which the machines can adjust their settings or be used for analysis for continuous improvement.

Read more at www.gea.com/en/index.jsp

A well-established model

The Dutch Diamond is a well-established term for the close collaboration between the Dutch government, business sector, knowledge centres and societal organisations. All stakeholders focus on the same societal goals and a mission driven approach. Motivated by a shared interest, funding is provided by numerous stakeholders for large high-impact programmes that make the sector more sustainable. In total the Dutch Government set out 25 missions that are leading the way to a more sustainable future.

Representatives from all stakeholders are involved in those programmes. This inclusive dialogue and cooperation are pivotal in achieving a sustainable and economically viable food manufacturing system. The Dutch Diamond underpins a strong, knowledge-intensive and efficient ecosystem of Dutch parties. Within the Dutch Diamond, companies big and small cooperate to tackle major societal challenges.

This model is not new. For 150 years, government, companies and knowledge institutions have been building this food and agriculture ecosystem. It is thanks to this experience that collaboration is commonplace in the Netherlands.



Read the factsheet
Dutch solutions to
grand challenges

There are multiple collaborations and initiatives in the Dutch food sector in which both large and small businesses, knowledge centres and government work jointly on innovations in food. Some examples.

SHOWCASE



Smart packaging and sensors in the fight against food waste/loss

The project Innovative Smart Materials and Sensors for Packaging of Raw and Processed Food Products contributes to reducing food waste and loss by researching applications of biodegradable packaging equipped with sensors. This would allow food to be kept for longer, while quality is monitored. There are three central themes. The first is research into environmentally friendly packaging which is partially made using polylactic acid and extracts from lobster shells. The second deals with sensors on or inside packaging, to monitor product shelf-life. This data would enable producers, suppliers, and retailers to improve their supply chains. Finally, research is being done to investigate the effect of sealing packaging using foil or bottle caps. This project is being carried out by Avery Dennison, Delft University of Technology, Eindhoven University of Technology, Trivium, JDE, Peijnenburg, Heineken, Oerlemans Plastics, The Materials Innovation Institute, University of Twente, Wageningen University & Research and Yparex.

Learn more about this project:



SHOWCASE

Dutch processing technology for farmer's earning potential and new and sustainable value chains

Two recently launched projects focus on the coffee farmers in Ecuador and Kenya. The first is Seed Money Project (SMP) 'Valorising cacao pulp to improve farmers' income. To improve the income of Smallholder cacao farmers in Ecuador, the cacao pulp can be valorised by making use of locally deployed Dutch food processing technology. In this SMP the feasibility of the mobile processing units will be studied by a strong consortium of Dutch and Ecuadorian partners.

The second SMP-project 'Understanding and improvement of coffee fermentation' is aimed at forming a consortium that will perform a feasibility study to elucidate the process of coffee fermentation and its influence on coffee quality. To this end, two site visits to a local coffee production area in Kenya, Africa are foreseen where fermentation samples will be taken for microbial analysis. The microbial data will be combined with a general analysis of flavour compounds and linked to coffee quality. This provisional insight will serve as the starting point for future work where the focus will be on directing coffee fermentation to ensure constant quality output. Constant coffee quality will enable a stable income for coffee farmers not only in Kenya, but the knowledge can be applied worldwide. In addition, less coffee will be lost due to failed quality parameters.





SHOWCASE

Plant-based cheese

The Netherlands and cheese are inextricably linked. But can you make good old Dutch cheese using plant-based protein? NIZO Food Research worked on this challenge for two years, together with consortium partners HAS Den Bosch, Bel Leerdammer, FujiOil and Daiya Foods and supported by Topsector Agri & Food. Their aim was to develop enough understanding of the basics so that businesses would be able to develop new products themselves.

Products with a lower ecological footprint but comparable usability and nutritional value as traditional dairy cheese. And they were successful.

The first results delivered a range of raw materials and processes for developing plant-protein based cheese alternatives which had similar smell, taste and texture to traditional cheese made using cow's milk. Producing plant cheese contributes to the protein transition from familiar sources of protein (meat, fish, eggs, dairy) to, for example, plant-based alternatives. The project 'Replacing dairy with plant protein in cheese' is being carried out by NIZO, HAS Den Bosch, Bel Leerdammer, FujiOil and Daiya Foods.

Learn more about
this project:



Novel food

Meating new demands

The supply of nutritious plant-based proteins is growing, with innovations by Dutch companies as important drivers. Companies such as Meatless and The Protein Brewery, which both quickly attracted the interest of a global audience.



50%

Nielsen research: Europe's plant-based food industry grew an astonishing 49 % overall from 2018 to 2020, amounting to a total sales value of EUR 3.6 billion. The Netherlands saw over 50% growth in this period.

Meatless

Meatless supplies processed vegetable fibres to producers of meat substitutes. In 2005, the Zeeland based company took its first steps towards a new and affordable product that could meet the rising demand for tasty meat substitutes. The majority of vegetarian food is made of soya, wheat or peas. But the range that Meatless produces is wider and consists of natural, whole foods that have been minimally processed, such as rice, fava beans, wheat, peas, quinoa, lentils, tapioca, sunflower, pumpkin and chickpeas.

Meatless' vegetable fibers are now used by various food companies as ingredients for their vegetarian or vegan end products. Meatless show their commitment to a sustainable production process by not using high pressure or extremely high temperatures. The raw materials Meatless uses are predominantly sourced in Europe

which supports European farmers in producing pulses and grains for the processing of clean label local food. Meatless describes its goal as follows: "We are constantly looking for new opportunities to create better textures and meet the demands of the modern consumer. Health, environment, local origin, taste, minimal processing and nutritional value, are just some of the challenges faced by food manufacturers when developing plant-based food." In 2018, Meatless came up with a new breakthrough, a dried variety of their product. Which until then had only been available as a frozen product. Meatless' search for the next step is far from over. In 2022, the company will open a new R&D centre, creating new opportunities to innovate in texture, shelf life and standard production and packaging procedures.

The Protein Brewery

Located not far from Meatless is The Protein Brewery (TPB). TPB is an innovative developer of protein-rich, alternative fermented ingredients, replacing animals in the food chain. The company uses fermentation technologies for the production of food ingredients with an excellent nutritional and sustainable profile. In 2021 TPB launched Fermotein®, a whole cell food ingredient which can be produced from a large variety of water efficient, non-allergenic and globally available crops including corn, potatoes and sugar beet, resulting in local, scalable, and efficient processes worldwide. It can be used as a food ingredient in, for example, meat substitutes, processed meats, pasta, bread (products), protein bars, and more. Fermotein production uses only 1% of the land and 5% of the amount water required for beef production, it also produces only 3% CO₂. It has one of the lowest ecological footprints of all proteins - whether animal-based and animal-free. According to Wim de Laat, founder of The Protein Brewery: "The amount of Fermotein® we can produce in an hour corresponds to the amount meat produced by 10 cows. On an annual basis, you're talking about approximately 80,000 cows that don't need to be part of the food chain."

Recently, the Protein Brewery started the construction of a new innovative facility of 1,500 m² with a production capacity of thousands of tonnes per year. The plant will be designed to scale up the Fermotein® brewing process. The first commercial-scale plant-based proteins are expected to roll off the production line in late 2022. The Protein Brewery's expectation is that from 2023 onwards it can start building full scale plants, not only in Europe, but also in the US and Asia. "Once these are producing at full capacity, the protein yield can easily save arounda millions of cows a year. There is no shortage of sugar crops."



Fuite Bakery

Since its founding in 1928, the Fuite bakery in Apeldoorn has always placed a high value on innovation and sustainability. "At Fuite we aspire to being the most sustainable bakery in the world," says Klaas Fuite who, together with his brother, is the third generation Fuite to run the bakery. "One essential way of doing so is by reducing food waste and loss".

One way the bakery hopes to achieve this is through its collaboration with online supermarket Picnic. By applying big data, daily demand for bread products can be predicted more and more accurately. Fuite: "Every order provides data. By analysing it we can target our production more precisely, producing the right quantities with less loss." Rather than working on instinct and asking questions such as 'Is this traditionally a busy time of year, or not?', Fuite bases its production on statistics.

But the data takes both parties even further than that, according to Fuite. "The same data also helps us to predict orders in changed circumstances. By linking the data on existing patterns to the demographic composition of a particular area and then extrapolating the data to another area we can predict, with a good level of accuracy, which products will be popular there."

Food loss in this specific collaboration with Picnic is less than 1 percent, says Fuite.

"Although the situation isn't entirely comparable, in an average Dutch supermarket at least 7 percent gets thrown away."

As far as Fuite is concerned, reducing food waste and loss is one of the most important and urgent trends in the food sector. "In the Netherlands we waste 25 percent of our food, worldwide it is a third. Those are figures which are really no longer acceptable."

The essential role Dutch education plays in Smart Food Manufacturing



The Dutch ability to innovate in food manufacturing stems in part from Dutch vocational education. It makes an essential contribution by training new employees with the right skills, by providing additional training to current employees and by actively participating in innovation.

In 2013 the main innovation goals and challenges were identified for all Dutch top sectors, including Agriculture & Food. One of the main challenges the Dutch food sector faced at the time was a rapidly ageing workforce, while not enough people were being trained to meet the anticipated shortage, either at academic or (especially) vocational level.

Regional cooperation

To reverse this trend the Dutch food industry, together with the education sector, outlined what measures would be necessary, especially regarding specific vocational courses. One of their priorities was setting up regional collaborations between business, education, and local government. Some examples are Food Academy Nijkerk, Food Innovation Academy Vlaardingen and Bakery Sweets Centre in Friesland (see map). The specific training developed in such collaborations helps ensure people remain employable, allows them to contribute to innovation and enhances the food sector's profile as an employer and career choice.

“What makes the Dutch system unique is not only the willingness to cooperate, but that it's formalised throughout the chain, even in government policy. In the field of Green Education, this initiative is called the Green education pact. In this, education and companies work together in a unique way - stimulating new knowledge, valorisation of knowledge and innovation in education. What makes this special is that the Ministry of Agriculture supports and facilitates this Green education pact as a policy tool”, says Arry Verhage, director of Stichting Onderwijsfonds Levensmiddelen-industrie (SOL). SOL is the training and development fund for the entire Dutch food industry and coordinates cooperation between the business and education sectors. Verhage emphasizes the vital importance and urgency of such cooperation. “The Dutch workforce is expected to keep getting smaller, with 840,000 people expected to retire in the next ten years. They will have to be replaced. But there is huge competition in the labour market, partly because of other societal challenges such as a chronic shortage of housing and the climate

transition. To ensure the food sector can hold on to employees in the face of such pressure as well as continuous innovation, we need to make sure people's skills remain future-proof. There isn't the luxury of replacing employees who don't have the right skill set with new employees as and when new techniques and technologies are introduced.”

Collaboration throughout the chain

As the use of robots and automation steadily increases, new technologies already play a role in education and training. Verhage explains: “The sooner employees are trained, the sooner a business gets a return on its investment. That starts in schools and through additional training.” Dutch education can provide both short- and long-term training and development programs in food and process technology.

Direct contributions to innovation

The Dutch education sector is also directly involved in food innovation processes. Verhage refers to the Food Application Centre in Leeuwarden, part of the Van Hall

Larenstein University of applied sciences, as a prime example of this. “They have equipment available which enables them to test innovations in product development on a slightly larger scale, before making the actual transition to application on an industrial scale. So this educational establishment directly contributes to food innovations, in this case with a focus on dairy, drinks, sauces, and bakery products.”

Another example is the Food Innovation Centre in Vlaardingen, where businesses and educational institutions are researching new ways of powering bakery ovens. Meanwhile, cheesemaking company Kaaslust asked two Life Sciences students at a vocational college in Leeuwarden to investigate how a cheese production side stream could be used to make a new product. They specifically looked at which process steps were necessary to achieve a good end product in a relatively short period of time.

The close collaboration business and education have fostered is expected to generate many more examples of such hands-on innovation projects.

International outlook

Sustainable production of sufficient, safe, and healthy food is a global challenge. The Dutch GroenPact partnership, which includes 20 educational institutions, 60 sector parties and a multitude of businesses and organisations, is an unique cooperation in this respect. It contributes to increased sustainability in global food production by its application of scientific knowledge, green education and the expertise of Dutch food and agriculture businesses. Supported by government en business funding, the educational institution have build a shared infrastructure for knowledge sharing and cooperation, which facilitates exchange and cooperation of students and educators in close collaboration with companies. It provides both real time learning environments for students and practical solutions for business challenges.



Regional collaborations between education, business, and government



- A Mobiliteitsnetwerk Noord-Nederland, 30 companies, UWV, local governments
- B Bakery Sweets Center: MBO, HBO, 30 companies, Province of Friesland, Leeuwarden municipality.
- C PCPT: Proces Your Future (Twente) MBO, HBO, 20 companies
- D HCA Regio Zwolle, Kennispoort, MBO, 20 companies (agri & food)
- E Food Academy Nijkerk, MBO, over 20 companies, Nijkerk municipality, Province of Gelderland,, labour market region Ede.
- F Food Innovation Academy (Rijnmond) MBO, HBO, over 20 companies, laardingen municipality.
- G NOBW! / AgriFood Capital (Noordoost Brabant) MBO, ROC en varying companies, Province of North-Brabant, 's-Hertogenbosch municipality,
- H Food Tech Brainport (Zuidoost Brabant) MBO, HBO, 20 companies, local governments
- I Rewin/ Delta AgriFood Business (West Brabant) Companies, MBO, HBO, local governments
- J NH Food (Alkmaar) MBO, HBO, Greenport North Holland North
- K Food Delta Zeeland, 20 companies, MBO, HBO, Provence of Zeeland
- L Procestechiek- en Maintenance Limburg, 50 companies (proces technology and maintenance), VMBO, HAVO, MBO.

How smart technology and processing are shaping tomorrow's food sector

A worker in a white lab coat, hard hat, and blue gloves is seen from behind, interacting with a digital control panel on a large industrial machine. The machine has a metallic, cylindrical body. The worker is wearing a white hard hat, a blue hairnet, and large black earplugs. The background is a blurred industrial setting with various pipes and machinery.

In recent years Dutch machine manufacturers have invested heavily in innovation. Much has been done to reduce heat stress in food production and use of preservatives, to make energy use more sustainable (for example by going electric) and to enable plant-based products. All of this using radical new technology.

Photo courtesy of
The Protein Brewery

Worldwide, food manufacturers spend around 36 billion euros annually on new machinery and production line equipment. That technology often has its roots in the Netherlands. Dutch machinery manufacturers are world leaders in the food and agriculture sector. “Their radical new technologies are making the transition to healthier and more sustainable food possible,” says Wouter de Heij, board member of GMV, the Dutch trade association for food and agricultural machinery manufacturers.

Dutch machinery manufacturers have been enabling technological innovations in cleaning, preparing, preserving, and packaging food for decades, with a focus on healthy, fresh, and minimally processed food. Dutch machinery manufacturers formed the basis for what De Heij refers to as “refreshing the industry”. From food with a long shelf-life outside of the fridge, to ‘fresh convenience’ food such as sliced vegetables in bags and salads. “Achieving this is quite a big ask for machinery. It can only be done with top-quality technology,” according to De Heij, who has well over 20 years’ experience of innovation within the food and agriculture sector. “Take peppers, for example. If you want to cut them into quarters in large quantities, you need a machine which recognises the vegetables visually, picks and places them before coring and slicing. All of that is possible thanks to smart software and camera recognition systems.”

Great advancements have been made, especially in the Netherlands, in meeting the large-scale demand for fresh convenience using innovative machinery, according to De Heij. Machine manufacturers in this sector often have Dutch roots or are still based here. Due to their accumulated experience and position, Dutch machinery manufacturers are the partners of choice for food producers worldwide. For example, one Dutch firm designed a 20,000 m² factory for fresh convenience food in Saudi Arabia, for the production of fresh juice, sliced fruit and vegetables and ready meals. All of it fresh and cooled. “Half of this factory is filled with machinery, 70 to 80 percent of which comes from the Netherlands,” says De Heij.

Domestic role

The role of Dutch companies at home in the Netherlands is, understandably, huge. De Heij explains: “The 130 machinery manufacturers, mostly small and medium-sized enterprises, drive the whole food and agricultural sector and are involved in technological developments in large supermarket chains and the packaging industry. Their numerous highly trained employees are the ones responsible for the developments that allow the sector to advance Machinery manufacturers are at the heart of the Dutch food and agriculture sector, which has a total annual turnover of 120 billion euros and directly or indirectly accounts for 800,000 jobs.” These businesses look for opportunities to connect and innovate using their own, and each other’s creativity, knowledge, and ideas. It is this ecosystem which has enabled the Netherlands to attain to such an excellent global position. But we shouldn’t take that ecosystem for granted.” GMV, the sector’s trade association accordingly invests in healthy, tasty, and sustainably produced food.

New innovations and the future

Dutch machine manufacturers and technology companies are by no means finished innovating, De Heij observes. For example, he is proud of two recent home-grown developments. One of which focuses on using radio waves for sustainable sausage production, requiring no process steam.

Another innovation, in packaging materials, can extend the shelf-life of food whilst at the same time using less plastic. De Heij explains: “Plastic plays a huge role in product shelf-life. But the pressure plastic puts on the environment is enormous, partially because each type of food product requires a different type of plastic. Thanks to Dutch innovation, laser technology can be used to alter the properties of plastic, so that it is suitable for the specific type of food to be packed. This makes it possible to use only one type of plastic (mono plastic) for packaging which can be altered at the end of the process.”



Scan the QR-code
and read more
about this innovation

Also, De Heij refers to ElkeMelk (literally: every milk), as a perfect example of traceability. ElkeMelk was founded by a Dutch farmer. The milk is packaged ‘per cow’. There was no pre-existing technology available that could process an individual cow’s milk, from milking to packaging, on a small scale (farm level). Two Dutch companies joined forces with ElkeMelk and developed a mini milk robot which complies with the highest standards for safety and hygiene. De Heij: “This is a perfect example of one business using the knowledge and capabilities of other businesses to turn an idea into an innovation which exactly correlates with consumer demand.”



Scan the QR-code
and read more
about ElkeMelk

Photo:
Wouter de Heij



Packaging From plastic to paper



Packaging in the fruit and veg aisle of the supermarket has changed a lot in recent years. Some changes are visible, for example when plastic is replaced by paper, but often the changes and innovations are hidden in the details. And there are more changes to come as countries increasingly seek to reduce (plastic) packaging through legislation. Dutch innovations enable this transition. Take JASA Packaging Solutions, which has already won several international awards.

JASA Packaging supplies packaging machinery, complete production lines and concepts for packaging potato, fruit, vegetable, vegetarian and fish products in bags, containers, and trays. "Innovation is one of three core elements in our business", CEO Eduard de Haan explains. "Our company consists roughly of two parts. We develop machinery for vertical packaging, and we implement projects in which we take care of the whole process, from the moment products arrive in bulk, right up to the moment everything is packed per portion. In both instances we are constantly examining ways to innovate. With a focus on making the sector more sustainable and more efficient."

Paper bags

One sustainable concept is Bag-2-Paper™ which was launched in 2018 and was little short of revolutionary, says product manager Ivo Luijckx. "Conventional wraps are increasingly being replaced by paper solutions. Those paper packaging materials often had a sealable plastic coating. That coating has two disadvantages: it is made of plastic, and a lot of energy is required to seal it. With Bag-2-Paper we no longer need the coating. Instead, a couple of holes are made in the packaging which are covered over with a label". This technology allows us to drastically reduce our use of plastic and the packaging process becomes much more energy efficient. Heat is no longer required to seal the packaging and it is no longer necessary to cool the product afterwards using compressed air. Ivo adds: "This packaging method is four times quicker than traditional sealable bags, processing 60 items per minute instead of 15. Since launching Bag-2-Paper, numerous developments have further improved the quality of sealable paper packaging. These new types of paper can also be processed at high capacity by JASA."

JASA has now applied the Bag-2-Paper principle to their entire range of paper bag packaging and supplies it as an all-in-one solution with all of its existing and new packaging machinery.

Trays

JASA Packaging is also working on more sustainable trays for packing products such as apples, tomatoes, and avocados. In this area, too, plastic is increasingly being replaced by paper. Eduard: "We are about to release a new machine which makes trays from a single piece of cardboard. That will save hundreds of thousands of kilos of paper annually". JASA even has an innovation at the ready for the plastic netting used to pack oranges and lemons, which will mean a transition to 100 percent paper materials. "So no more plastic will be used, even for those products."

A new operating system

Hardware and materials is not the only thing JASA is continually improving. In 2022 it will release a new operating system for new innovations which will regulate predictive maintenance. Eduard: "Using sensors, data and artificial intelligence maintenance planning becomes smarter and more targeted. It enables maintenance work to be done before a malfunction arises, and it means machines have to be turned off less frequently. These smart technologies also give more insight into energy use, enabling packers to improve efficiency and reduce energy use."



What will the future bring?

Three Dutch innovations.

1 Deep Learning – QING and Verbruggen

Deep learning allows large amounts of sample data to be used to train a neural network. An algorithm analyses the sample data and looks for similarities and patterns. The technology then uses these patterns to assess new data in the same way. Deep learning can be used to tackle numerous problems and challenges in the food sector, such as food recognition and classification, calorie estimation, food supply chain logistics, food contamination and quality control of fruit, vegetables, meat and fish.

Dutch engineering company QING and mushroom grower Verbruggen Paddenstoelen jointly researched the possibility and reliability of analysing oyster mushrooms with image processing in order to ensure a consistent sorting

process. This project was also supported by the 'Stuurgroep Landbouw Innovatie Brabant' (LIB).

The cooperation resulted in a deep learning algorithm that is able to assess new data based on patterns in sample data. In this case, the difference between the cap and the stem of oyster mushrooms. Firstly, 1,500 photos were labelled and the segment containing the cap of the oyster mushroom was identified. Next, an algorithm was trained using this data. The result is a system that a system that flawlessly recognizes the oyster mushroom's hat and can determine its size with great precision. And it is less error-sensitive to changes in, for example, ambient light or discoloration caused by

of machines and conveyor belts. Teun Keusters, one of QING's engineers who specializes in this particular technology: "With deep learning, the software really develops an understanding of the object it is looking at, which makes it less sensitive to variations."

According to QING and Verbruggen Paddenstoelen, this technology has the potential to optimize labour requirements and minimize loss during the production process.

[Read more about this project](#)



Robot test setup at Qing

2 Digital Twin – Wageningen University

A digital twin is a digital copy of a real object, such as a machine for processing or packaging food. In the food sector, digital twins offer manufacturers the opportunity to model and simulate their production processes virtually. In this way, (new) processes and working methods can first be digitally tested and possible improvements can be identified without having to set up expensive test systems and set-ups. Processes and working methods are thus optimised before they are actually implemented.

Multiple tech companies are experimenting with digital twin applications, as well as Wageningen University (WUR). WUR is conducting research into the possible use of digital twins in the food and flower sectors, specifically for supply chain planning and control. The main objective of WUR's research is to investigate the implications of virtualization on food and flower supply chain management.

It especially aims to study how digital twins can advance quality management of perishable food and flowers along the supply chain. In cooperation with industry partners, including the food sector, their research also examines the development and implementation of Proof of Concept systems for digital twins can be developed and implemented.

“We are confident that the benefits will appeal widely to consumers.”

3 Cultured Meat – Mosa Meat

In 2013, the world was introduced to the first hamburger made of cultured meat, developed by Dutch professor Mark Post. Cultured meat is ‘built’ from stem cells of living cows. The cells multiply and form muscle fibres in a special culture medium of sugars, amino acids and fats. Post now runs a thriving business in Maastricht: Mosa Meat, which focuses on scaling up the production process, one of the biggest challenges in this young market.

In the coming years, Mosa Meat wants to go to market with a further developed version of the first cultured meat burger. The company is cautious about committing to particular timeframes because of scientific unknowns and external factors such as regulatory processes. While the initial introduction will likely be small-scale the company's ambition is for its product to

become widely available in restaurants and supermarkets in matter of years. Scaling up is not the only challenge.

Our view on eating meat also needs to change. Surveys conducted in European countries provide a varying outcome: from 20 per cent of consumers wanting to try cultured meat to 90 per cent being open to it. “Even 20 percent of the public is an enormous market of first adopters. We are confident that if the product is of high quality and is competitively priced the benefits will appeal widely to consumers”, states Mosa Meat.

Watch a seminar by Mark Post.



Dutch Smart Food Manufacturing solutions

Looking for specific expertise or technological solutions?
In this section Dutch companies in food manufacturing, with international track records, introduce themselves and their portfolios. Read all about their expertise to identify possible partners in your next step towards Smart Food Manufacturing successes.



AMF Bakery Systems Europe BV

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Through innovative, precision engineering informed by our master bakers' expertise, AMF designs integrated production solutions for soft bread and buns, artisan bread and rolls, pizza and flatbreads, cakes and pies, pastries and croissants.

Sustainable bakery systems, digitalization of processes and creating value with data is what makes AMF Bakery the leading supplier and partner for food producers in the future. We make a difference by knowing the bakery process and creating value with our solutions, with leading new technology and innovations. Specialties of AMF Tromp and AMF Den Boer: Sheetting, Laminating, Decorating, Make-up, Depositing, Injecting, Waterfall and Target strewing, Pizza Topping lines, Tunnel ovens,

Hydrogen oven, Proofers and Step proofers, handling systems, robot water scoring and more. We offer Sustainable oven services, to reduce gas use up to 30%.

AMF Bakery Systems launched the world's first emission-free tunnel oven with 99,9999% less CO2 emission in the baking process. Developed by its premium brand in the oven business Den Boer, this oven is a state-of-the-art piece of engineering, using Hydrogen as CO2 neutral fuel for its burners and with this new oven technology expanding its previous offering. Immediate reduction of CO2 emission is a fact, possibly a growth path with a hybrid solution of natural gas and hydrogen use, or even electric tunnel ovens for emission-free baking of pizza, bread, pastry, cakes, pies and many more.

ANDRITZ Gouda BV

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ANDRITZ Gouda is part of the Separation division of the Austrian ANDRITZ Group and specializes in engineering and manufacturing of thermal drying equipment. Gouda dryers are used in the food, chemical, environmental and mineral & mining industry.

The Turbex, our latest innovation is a turbo extraction system." Generating revenue out of natural by-products makes it easier to comply with environmental constraints. This can be

achieved with ANDRITZ Turbex, an innovative extraction system that helps to turn waste from natural products into functional nutrients. Additionally, the extraction process itself can be optimized in terms of yield and quality with ANDRITZ Turbex, a disruptive extraction process powered by cavitation in a counter-current flow. "For example, tea leaves are rich in polyphenols, which find their place in the nutraceutical sector with a high commercial value and are also used as a food additive.

BWT Nederland BV

Norbert de Veen

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BWT has set itself the task of treating existing water on site, to make it available at the desired quality. BWT offers a wealth of innovative products and technologies for a wide range of applications, all meeting the water quality needs of private households, (Food and Beverage) industrial sites, public facilities, swimming

pools, the Hotels & Hospitality sector and hospitals. You'll find BWT wherever you come into contact with water, whether it's clean, soft-to-the-touch water at home, water to enhance the taste of food in restaurants, or presented in the form of hydrogen as a future energy source.

Cyklop Nederland BV

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Cyklop Global Packaging is a worldwide producer and supplier of packing systems and materials. Backed by our products and expertise, we offer our customers optimal solutions for load securement during internal and external transportation, where the emphasis is on the safe and sound transport of goods. We offer solutions tailored to the market: hand-held tools, machines and systems, consumables especially designed for them, professional advice and outstanding service. By replacing plastic flowpack packaging with a recycable Strepper and the ability to attach labels with printing on demand. A customer in the asparagus industry, had the desire to reduce the consumption of plastic film with their end customers and to speed up the packaging process.

Cyklop helped to improve this process, with keeping in mind that labels and print data need to be changed easily, that the asparagus is packaged quickly and that film consumption is drastically reduced.

An Elastobinder with label printer was chosen. This machine bundles asparagus together by means of two thin elastic bands called a Strepper®: is a closed elastic, which does not deform the product and leaves no traces or damage. At the same time a label is attached to one rubber band. The use of a plastic bag is no longer needed to pack the asparagus.

"Now, we can make the labels per day. We can also easily switch between green and white asparagus", says the customer. "Due to the combination of Elastobinder with label printer, the labels no longer have to be printed in advance, but are printed on the spot".

Greencovery BV

Carlos Cabrera

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Find new sources of more sustainable ingredients with the new technology of Greencovery. Greencovery will help food manufacturers recover valuable compounds from food side-streams to produce better and more sustainable ingredients. This allows more productivity per unit of raw food and causes less waste.

Greencovery offers you:

- Identification and analysis of the valuable compounds in your side-stream
- Reduction of CO₂-emissions
- Connection with the ingredient market
- Design and delivery of lab, pilot and industrial scale solutions

Our technology can be used to upcycle ingredients from side-streams of: Fermentation and hydrolysis processes; Dairy manufacturers; Fruit & vegetable juice producers.

The ingredients are targeted to be natural, circular, price-competitive and with a low carbon footprint. The technology can be applied locally and allows tailoring of ingredients to meet the desired characteristics.

The upcycled ingredients can be used in the flavors and fragrance, food supplements and food preservatives industry, and support the innovation trends in the growing markets of sports nutrition, and the production of meat alternatives: Fruity flavors (e.g. banana flavoring); Umami extracts; Preservatives (organic acids); Electrolytes; Amino acids; Fibers.

Helia Biomonitoring

Menno Prins

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We develop sensors to monitor low-concentration biomolecular substances in a continuous manner, for measurement-and-control strategies in food processing. The real-time sensing is much faster than traditional methods used in centralized laboratories, which take hours or days to deliver test results. The real-time sensors give immediate data and allow dynamic adaptations of manufacturing processes. The novel monitoring-and-control strategies deal optimally with process variations, such as composition fluctuations that occur naturally in supplied feedstocks. The real-time sensing helps to improve the efficiency of manufacturing processes, reduce the use of resources, and ensure a high quality of the final product.

Real-time sensors give immediate data and allow dynamic adaptations of manufacturing processes. The novel monitoring-and-control strategies deal optimally with inherent variations, such as composition fluctuations that occur naturally in supplied feedstocks. In a collaboration with large industrial food companies, we develop sensors for real-time sensing of small molecules and proteins in food manufacturing processes. Prototypes are being developed to improve the production of proteins from potato and bioactives from dairy process streams.

Houdijk Holland

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HOUDIJK HOLLAND

Houdijk Holland excels in biscuit handling: taking over the product flow from the oven and feeding the biscuits in piles, slugs, with or without plastic or carton tray, into the packaging machine.

We define 'biscuits' as baked or frozen dough ware, such as hard biscuits, cookies, crackers, sandwich biscuits, chocolate (enrobed) products and cake-like products, which are produced in sufficient numbers, from 500 up to 50.000 units per minute.

Currently, we recognize two drivers of change within the biscuit industry:

1. Flexibilization – customers want to be able to produce – on the same line - multiple biscuit and package variations and volumes in closer interaction with actual consumer demand.
2. Health and environmental considerations
- biscuit composition and packaging materials will adapt to match a growing

health consciousness and waste/recycle requirements

These challenges are met by the introduction several years back of vision-guided robotics, or – in Houdijk speak – COOKIEBOTS. These robots (and peripheral equipment) are particularly suited for fast and gentle handling of fragile products and have the flexibility to handle a large variety of product shapes, package styles and packaging materials.

Houdijk Holland was founded in 1922 and is now a world-leading manufacturer of high speed and high precision robotics, with a workforce of 250 dedicated engineers and a worldwide presence, servicing medium-sized and large biscuit manufacturers.

With our equipment product waste is limited, and various packaging solutions can be realised with one piece of equipment.

JASA Packaging Solutions BV

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JASA represents innovation. Thinking out of the box is our second nature, a trait that enables us to offer our customers innovative and smart packaging solutions. We also bring in our 35 years of experience as a system integrator; in that position, we assume full ownership for your complete packaging process. We will

handle it all. From product infeed to weighing to (robotized) filling and closing the packaging. While designing our packaging solutions, JASA always keeps the environment in mind. We believe it is crucial to reduce plastic packing materials and reduce energy consumption while creating maintenance-friendly systems."

IFM Electronic

Edwin Slot

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ifm is a reliable partner when it comes to innovative automation and digitization technology. With more than 7,300 employees in 95 countries and over 50 years of experience in sensor technology and industrial automation, the ifm group is one of the innovative leaders worldwide. Our customers are always in the centre of our work; in close cooperation with the customer, we look for a suitable solution for each application.

Extensive product portfolio

Ifm stands for high quality. In addition to component solutions for every industry, the exceptionally large product portfolio also includes complete control systems for industrial automation with links to ERP systems. From position and process sensors to connection

technology, power supplies and safety components: it is all part of the range. Above that, ifm offers products for industrial image processing, AS-Interface, but also identification systems (RFID) and systems for mobile machines. Last but not least, ifm develops more and more innovative Industry 4.0 solutions, including software and cloud solutions.

Industry 4.0

From sensor to a complete system solution. ifm – driven by applications, with a focus on digitization and insight into your production process or machines to improve your OEE, based on real-time maintenance, energy monitoring and tracking & trace. Together with you, ifm works on continuity and flexibility.

Kiremko BV

Ton Hendrickx

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Kiremko is a Dutch company founded in 1965 the Netherlands. As a world leader in the manufacture of process lines for the potato processing industry, we focus on product development, continuous improvement, innovation, sustainable technologies and co-operation.

With a team of over 180 qualified personnel we innovate, design, manufacture and install advanced processing lines worldwide. We specialize in lines to process potatoes into French fries, potato chips, potato flakes, pellet snacks, fresh cut and pre-cooked potato products such as hash browns and other potato specialties. Kiremko's strength is to deliver total solutions in potato processing from the infeed of product

to the packaging line resulting in a high quality end product. Our success is achieved by working in total co-operation with our customers to achieve their specific requirements. We aim to get the best out of the product and the customers processing line. We do this by allowing machines to work together based on data. With this we strive to work towards factory of the future in which sustainable output is what we sell. Kiremko's innovations are not only based on knowledge, vision, market trends and data analyses of production sites from around the world but also on the experiences of our customers. By constantly improving our products, we not only meet today's requirements but our solutions are able to fulfill the needs and expectations in our market for the future.

Marel Poultry BV

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Marel is the leading global provider of advanced poultry processing systems and services. In partnership with our customers, we are transforming the way food is processed, by developing pioneering innovations and supplying proven solutions.

With the largest installed base worldwide, we drive excellence in performance, food safety and sustainability. Our solutions can be tailor-made for each process step, from live bird supply, evisceration, chilling, cut-up, deboning, portioning to packing and labeling. These full-line processing equipment and software systems are known for their high yields, unequalled reliability, lowest cost of ownership and well thought-out maintenance concepts.

Marel invests substantially in Research & Development, with projects often conducted in close cooperation with renowned research and scientific institutes, resulting in groundbreaking innovations. Today, we enable end-to-end poultry processing in smart factories at a capacity of 15,000 broilers per hour.

For decades, we have supported poultry processors all over the world to add the most value to their processes and optimize their operations. We offer dedicated processing systems for broilers, turkeys and ducks. We provide our customers with data-driven insights to optimize their use of raw materials, enhance poultry meat quality and food safety, and guarantee traceability and support for continuous improvement.

Meatless BV

Jos Hugense

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As a member of a third-generation family of butchers and meat processors, the choice of switching to plant-based production was a surprising one in 2005. Nevertheless, Jos Hugense was convinced that the perspective for plant-based products was better compared to expectations for meat production. Meatless developed into a successful B2B supplier for the fast-growing vegetarian market and is now producing a broad portfolio of textured products used by large food processors in more than a dozen countries.

The company was awarded numerous times and succeeded in introducing new directions

in the production of plant-based products, like texturizing fava beans and quinoa, and developing bright white fish textures. Recognized as one of the best performing raw materials on footprint and effects on the environment, Meatless now has a firm position in the world of texturized plant-based products and presents very healthy growth of its production and sales. Our story started at the beginning of this century in a beautiful part of Europe, surrounded by spectacular scenery, and has now grown to an internationally recognized partner for the development of plant-based food products. Let's make progress in better food together!

**Naaykens, Luchttechnische
Apparatenbouw BV**

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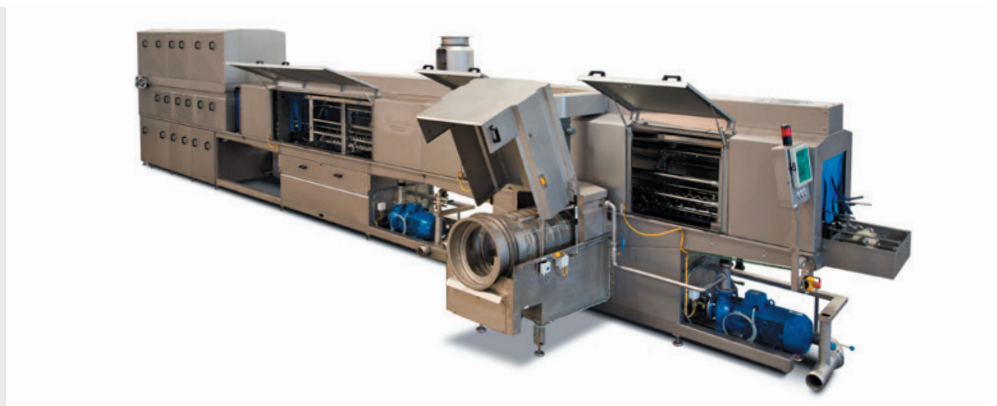
Naaykens' has been building industrial fans for over 75 years. As a result, we have a large know-how in the field of application, implementation and material choices for fans in various branches of the industry. With a Naaykens' fan that is equipped with a frequency controller, you benefit from the advantages of high precision, user-friendly interfaces, distributed intelligence and low operating costs. Optimizing processes and significantly reducing energy and maintenance costs. Variable speed drives convert the values of the speed- and pressure sensors into current values, allowing you to set the fan control based on a fixed flow rate or a fixed differential flow rate. This optimizes both airflow precision and energy consumption. To further improve fan control, frequency bands that cause resonance and damage in the (duct) system can be excluded. The AC drive processes logic rules and inputs

from sensors. This allows the AC drive to better control many functions, such as: flow balancing between supply and extract / process air; cascaded P-Pi for Temperature Control; Process monitoring. Based on the relationship between current and speed, the frequency converter can reliably recognize a change in the process. Lack of or excess airflow is immediately detected so that action can be taken to reduce costs and downtime. Naaykens fans equipped with SPM sensors and reading equipment ensure reliability of the production process. The sensors are used to measure/monitor both bearing condition and imbalance. The fans can be fitted with only the necessary sensors, which can be connected to existing PLCs, etc., but also with reading equipment, for simple reading with 3 alarm levels, or forwarding via Mod-bus RTU network.

Numafa Cleaning and Automation BV
Samantha Been

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Numafa Cleaning & Automation is the global leader for industrial cleaning and handling systems. We develop, manufacture and deliver cleaning machines for both food and non-food industry and also provide full service. We also produce systems for (de) palletizing,

(de)stacking, crate folding and unfolding, storage and transport. Our headquarter is located in Heinenoord, the Netherlands. We also have branches in Italy and a worldwide network of agents.

Oceanz 3D Printing

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For the food sector, it is more important than ever before to be able to switch quickly, to adapt processes and to seize opportunities. Within the sector, the demand for smart industry is also increasing, with a growing role for 3D printing. Because only 3D printing materials that are intended for food contact and certified for food safety may be used for 3D printing of food applications, professional 3D printing company Oceanz offers the option of 3D printing through EC 1935/2004 legislation.

In order to deliver a food-safe 3D printed product, the material must be suitable according to the requirements of EC 1935/2004 and produced in accordance with the EC directive 2023/2006 (Good Manufacturing Process). Because we comply with these criteria, we can issue declarations.

The material is therefore safe for production with consumption purposes or may come into contact

with food. Oceanz 3D printing processes are designed to comply with these regulations. The processes are included in the quality system and validated by external accredited parties. These testing facilities will adhere to various government-mandated risk tolerances and approved substances.

The choice to opt for 3D printing within the food tech industry offers advantages such as design freedom. Think of the production of custom parts and complex or organic shapes. This, in particular, can be very attractive for food-related applications. It also enables small stocks and ensures rapid development from prototypes to functional parts.

Some application examples are: grippers, nozzles, machine parts, prototypes, robots, and drones. Oceanz Food Grade is also well applicable within the AgriTech sector.

OMVE Netherlands BV

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OMVE Lab & Pilot Equipment designs, engineers and supplies small-scale processing equipment [10 L/h, up to 1000 L/h] for labs & pilot applications in the liquid food and food-related industries.

OMVE delivers complete aseptic processing plants that are user friendly, guarantee maximum safety and flexibility and ensure an easy scale-up.

We enable our clients the possibility to develop their products on a small scale. It mimics the definitive production, which will result in a product that will be reliable for testing new recipes, etc. We have delivered many pilot plants for companies who develop plant-based beverages, dairy products, juices, CSD, nutraceuticals and other liquid food.

OneThird BV
Marco Snickers

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OneThird has developed a method to predict shelf-life of fresh produce. We're using an AI-based infra-red scanner together with smart phone imaging and a smart data information platform. This gives real-time decision power to growers, distributors and retailers to get the right product to the right place at the right time.

Resulting in increasing efficiencies, saving millions of euros and preventing >1/3 of their food waste.

If the intrinsic quality of the produce is known BEFOREHAND, smart decisions can be made at various points in the supply chain to prevent the food from going to waste: dynamic routing to send fresher products farther away, dynamic day

codes to make them reflect the actual shelf-life instead of an assumed one, and dynamically marking down soon-to-expire products to get them sold (and eaten) instead of tossed.

OneThird provides the supply chain with knowledge of the remaining shelf-life of produce shortly after harvest. In the supply chain of a large Dutch retailer, strawberry growers are generating and sharing this information with the other parties in the supply chain. In this way, growers, distributors and retailers are working together to make sure the right product gets at the right place, whether it's diversion to export, shipment to a store close by or any form of repurposing.

Royal Pas Reform
Henry Arts

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Royal Pas Reform is an international company, which has specialized in the development of integrated hatchery solutions (incubators, hatchery automation and climate control systems) for the poultry sector since 1919. The company has earned its position as one of the world's leading hatchery equipment manufacturers, through decades of research into the biological and physiological aspects of embryo development, combined with a thorough understanding of all aspects of the poultry production chain - and a dedicated focus on the future. Early feeding methods - in ovo and post-hatch - can have a huge impact on the chick's overall growth and wellbeing. Royal Pas Reform has developed an advanced technological solution to deliver safe and effective in-ovo vaccination and nutrition: SmartVac™.

SmartVac™ is a new, patented technology that allows 100% safe, consistent and accurate in-ovo vaccination and nutrition. It delivers the injectables only into the amniotic fluid, thus preventing possible injury to the growing embryo.

SmartVac™ enables the poultry industry to apply a wide range of vaccines in-ovo, including Gumboro, Marek, ND and Coccidiosis vaccines. This is optionally performed in combination with nutritional components, for chickens with a healthy gut, favourable microbiota, enhanced immunity and thus improved field performance.

Sanders Machinebouw BV

Rob Habraken

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A world-wide leading company in the food industry, handling chocolates, fruit, meat etc. A company that distinguishes itself in client specific machinery.

As a global player Sanders Machinebouw is the specialist in innovative, complex and well thought-out machinery in pre-processing, product forming, -filling and end of line solutions. Eventually combined with robotics, vision and artificial intelligence. Think about the possibilities to combine your client specific requirement with machines which are not available in the market or standard machines that need process improvements such as faster, more efficient, more controlled future proof production processes. From simple single line machines up and until complete turn key line solutions.

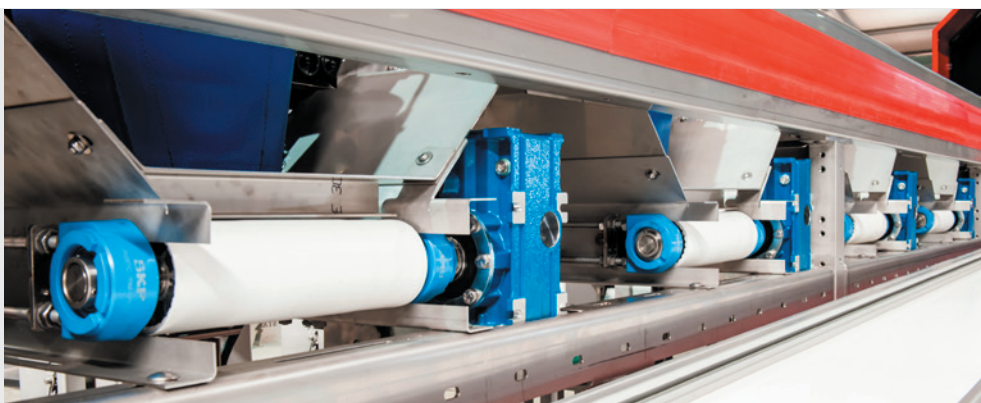
The Head Quarter's of Sanders Machinebouw is based in the industrial area nearby Eindhoven, the Netherlands. Our factory is equipped with a state of the art machine park to process almost every type of material in house. A team of skilled engineers and project managers is eager to get involved in the development of R&D, greenfield and complex projects in which we engineer cost consciously, where we take sustainability and socially responsible entrepreneurship into account.

In search for a trusted partner? Sanders Machinebouw B.V.!

SKF

Hanco Hazenboom

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SKF's mission is to be the undisputed leader in the bearing business. We do this by offering solutions that reduce friction and CO2 emissions, whilst at the same time increasing machine uptime and performance. Our products and services around the rotating shaft include bearings, seals, lubrication management, artificial intelligence and wireless condition monitoring. SKF is represented in more than 130 countries and has around 17,000 distributor locations worldwide. Annual sales in 2020 were SEK 74 852 million and the number of employees was 40,963.

With the continuous pressure to optimize production, reduce costs and comply with strict health, safety and environmental regulations, food and beverage processors and OEMs are turning to SKF to find out about new technologies and services that can address these business challenges.

For instance, our new sealed bearing with food-grade grease. A smart combination of proven technologies for non-corrosive environments, reducing food safety risks and at the same time increasing reliability. Or SKF Food Line ball bearing units, the relubrication-free solution supporting food safety.

SMC Nederland

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SMC is the leading expert with a passion for industrial automation, striving to be recognized as the knowledge partner for safe and sustainable technology. Since the company entered the pneumatics market it has evolved, together with its customers' requirements, to build a comprehensive automated control equipment portfolio. Japanese values are the basis of SMC's actions towards employees and clients.

Our portfolio includes industrial automation solutions that cover all industries. Five technical centres, two of them located in Europe (UK and Germany) vouch for our technical drive and customer support.

SMC and the food industry

The food industry is highly influenced by legal regulations and standards which can be complex for food processing machine builders and end-users. Our knowledge of these requirements is crucial for applying SMC technology in food processing machinery. Dedicated SMC experts know which design choices should be made to comply with food regulations and standards.

SMC's sustainable components keep up with 24/7 production processes and also meet the demands of efficient maintenance. A team of experts boasts specific expertise to support daily food challenges with either standard or customized solutions.

Van Zutphen Service

Theo van Zutphen

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Installation of equipment, machines for processing, transporting and refrigeration for food preparation.

Also maintenance and service with leading solutions for the entire range of food at: Group catering; Care catering; Restaurants; Chain stores; Commercial kitchens etc.

The entire Professional kitchen industry.

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