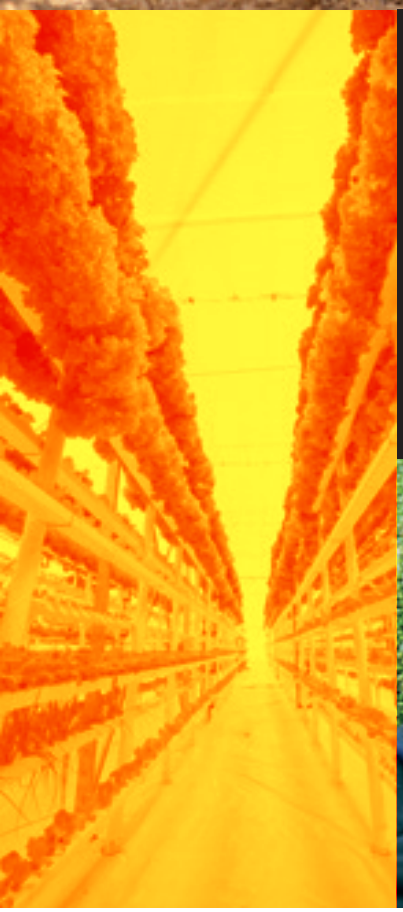


FME VISION ON AGRICULTURE & FOOD

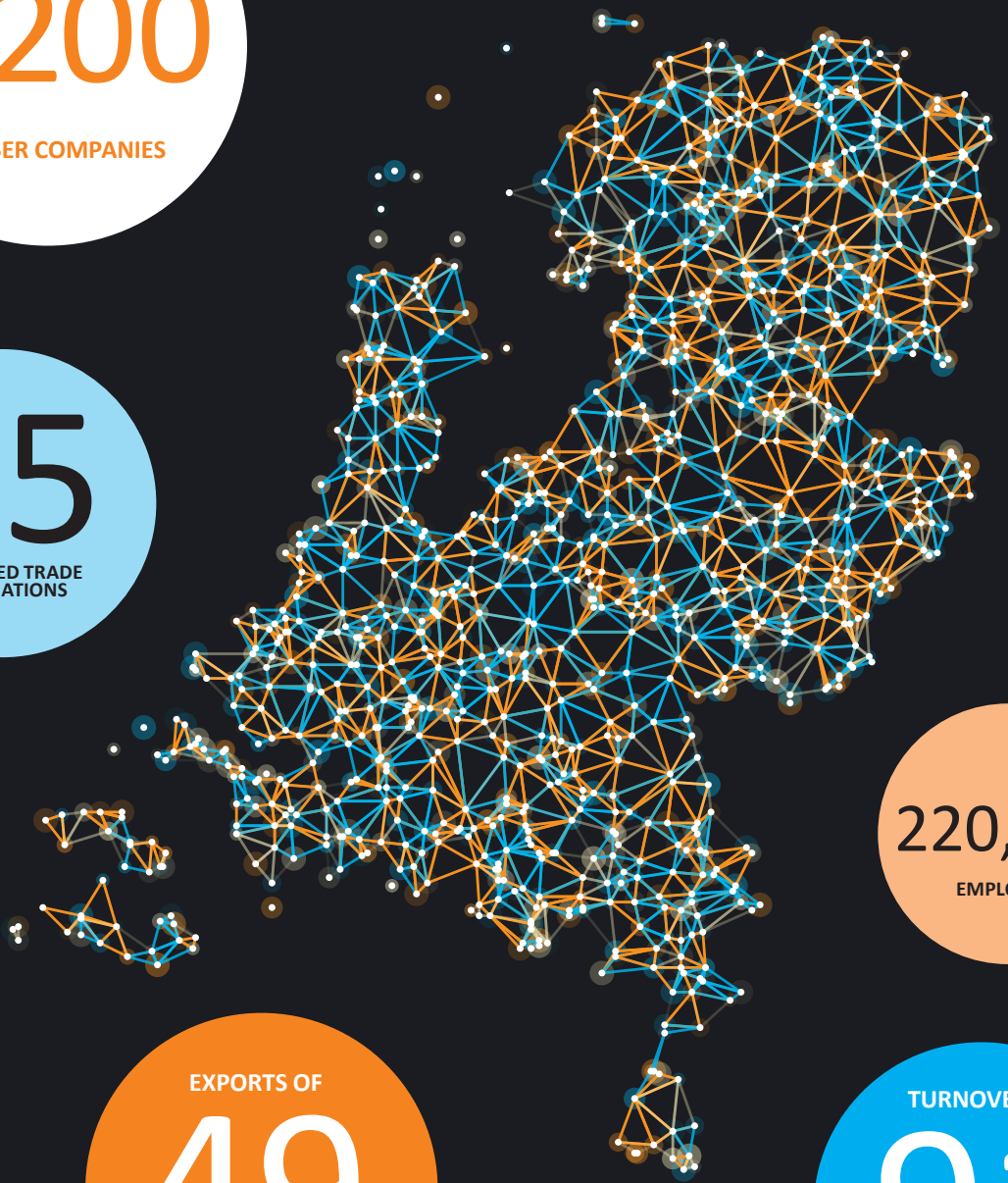
Smart, sustainable and personalized

FME POWERED BY DUTCH TECHNOLOGY

FME in figures

21
BILLION EUROS OF ADDED VALUE

2,200
MEMBER COMPANIES



45
AFFILIATED TRADE ASSOCIATIONS

220,000
EMPLOYEES

EXPORTS OF
49
BILLION EUROS

TURNOVER OF
91
BILLION EUROS

FME is the Dutch employer's organization for the technology industry. The 2,200 member companies are active in production, trade, automation and maintenance in the metal, electronics, electrical engineering and plastics sectors. FME members employ a total of 220,000 employees, generating a combined turnover of € 91 billion, an added value of more than € 21 billion and exports of € 49 billion. The FME members thus account for one sixth of the Netherlands' total revenue from exports. FME has 45 affiliated trade associations.

Towards a Smart Food Industry

The Netherlands is a food country with a global impact. The second-largest food exporter in the world *and* one of the top-three technology manufacturers and exporters in all links of the food supply chain.

These are rankings we can be proud of – and should be doing our utmost to defend. Today more than ever. All over the world, the food supply chain is undergoing dramatic change driven by a plethora of social trends and rapidly advancing digitization. New production methods, distribution chains and business models are coming to the fore. To stay ahead in this dynamic environment, agriculture and food tech businesses need a Smart Food Industry strategy.

This FME Vision Paper is a first step. Looking further into the future, we outline some fundamental shifts in the food supply chain and the attendant opportunities for the technology industry. We also pinpoint what supply chain partners (government, research, education and business) must do to capitalize on these opportunities.

The Netherlands has an outstanding reputation for its knowledge and technology in the field of large-scale food production and supply chains. Let's now work together to secure a leading position in digitizing food chains and exploit our revenue-earning potential to the full in this diverse landscape with multiple small players. To find out more about our vision or activities, please contact me at marcel.van.haren@fme.nl or +31 6 278 903 54.

Marcel van Haren
FME AgriFood Manager

Digitizing food chains: what, how and why?

What will the food supply chains of the future look like and what is necessary to make them smart? Step one involves understanding why change is inevitable and identifying the trends that innovations must zoom in on.

Changes in the food supply chain stem partly from social trends.

- Population growth, climate change and urbanization are increasing the pressure to produce food sustainably and efficiently, close to consumers and without harming the ecosystem.
- Geopolitical developments strengthen this need: the quest for national food self-sufficiency will make our food production more fragmented, smaller in scale, and more concentrated in an ever smaller space.
- At the same time, supply chain partners must increasingly cater to the wishes and demands of consumers and governments, notably regarding transparency on the origin of products and the organization of production.
- In addition, food is increasingly perceived as a vital weapon against disease. Prevention is better than cure.

Digitizing chains

The key to answering such challenges lies largely in technological innovation. Digitization and the development of the Internet of Food open the way to new production chains, business models and even *personalized food*.

These developments are giving rise to a new playing field, on which other countries will seek to challenge the Netherlands' strong position in the agriculture and food tech sector. The increasingly complex arena of food production presents new challenges and risks. Digitization, for instance, makes our food supply chains more vulnerable to malicious attack. Cybersecurity is therefore imperative.

The main opportunities and risks for the Dutch agriculture and food tech sector are encapsulated in this vision paper in four core challenges:

1. Food production: from large-scale and centralized to sustainable and local.
2. Personalized food: new concepts for personalized food and the facilitation of healthy choices.
3. Make sustainable small-scale production profitable through e.g. robotization and precision technology.
4. The smart food factory as a strongly automated integrated hub in an Internet of Food.

Fewer food miles and room for nature

Food production: sustainable and local

For centuries our most important challenge was to produce enough food; today, our main concerns are where that food is produced and how it reaches the consumer.

NOW

Global food production runs to 400 billion tonnes per year, enough to feed 11-12 billion people. But no less than a third is lost: either on the farm, in the supply chain or at the consumer.

One key factor in this wastage concerns the way the logistical chain is organized. 85% of the food is currently grown on a large scale at a considerable distance from the urban consumer. The number of food miles is correspondingly high. Until now, the economies of scale of centralized production outweighed this disadvantage. Advanced Dutch cooling, storage and packaging technology offers an array of solutions to prevent food wastage resulting from large-scale production. However, due to the absence of accessible and small-scale technology for producers in emerging economies and developing countries, many valuable crops are still lost in these regions.

Moreover, the model of large-scale centralized food production is coming under increasing scrutiny. More than half of the world's population now lives in urban areas, rising to an estimated 70% in 2050. A growing amount of food is being produced by a steadily diminishing share of the population. This makes the system more vulnerable. The carbon emissions from transport are huge and large-scale food production is also taking its toll on the ecosystem.

SOON

A sustainable food supply hinges on producing food as close to the consumer as possible. Whilst some large-scale production will remain (preferably closer to the city), a growing share of our food must be produced on a small scale, just outside or even in the city. New small-scale solutions must therefore be found to enable cooling, storage and packaging close to the farmer and to minimize waste.

Production close to the consumer offers multiple benefits. First of all, it saves food miles and carbon emissions, with digitization enabling simpler logistical transactions. It can also lead to a more equitable distribution of wealth by giving urban dwellers and farmers in developing countries a chance to earn an income from producing food. Furthermore, it helps urban dwellers to reconnect with their food and where it comes from, while also creating more room for nature and biodiversity beyond city boundaries.

New food sources such as seaweed and insects open up further opportunities for sustainable food production close to cities (which tend to be located in river deltas near the coast). This is largely dependent on the availability of efficient processing technology. Here lies an opportunity for the technology industry.

Opportunities for the technology industry

To realize this vision for the future, Dutch businesses and knowledge centres can develop new concepts for small-scale, high-grade and efficient food production. Both for existing and new food sources, with less environmental impact and with closed cycles wherever possible.

What needs to be done?

- Continue the public dialogue on the role of new technology and food sources via the AgriFoodTech Platform [1].
- Continue developing the HT2FtW (High Tech to Feed the World [2]) crossover roadmap.
- Knowledge sharing, inspirational contacts and new thematic connections via a network of specialists from various disciplines, thematic meetings and effective dialogue.
- Consortiums of businesses and knowledge centres who jointly start initiatives (e.g. the Sustainable Food Initiative[3]) and commercialize solutions for international markets.
- Alternative financing models and an entrepreneurial culture which celebrates innovation (and accepts failure!)

Local food production trends and scenarios

- The number of supermarkets decreases, food is produced close to consumers (to order), and delivered to their homes using sustainable logistical solutions.
- Self-sufficient cities can increasingly meet their own food requirements in a sustainable circular system thanks to 'vertical farming' and 'urban farming'.
- New offshore agricultural areas (urban agglomerations are concentrated around deltas!) where new consumer crops such as seaweed are cultivated.

Opportunities for new and plant-based food sources?

More prosperity usually translates into greater demand for meat products leading, in turn, to more greenhouse gas emissions. Technology can help counter this. Think of, for instance, the development of high-quality meat substitutes and other protein-rich alternatives with the aid of new high-grade process technologies.

1 - Initiative by FME, LTO Nederland (Dutch Federation of Agriculture & Horticulture), FNLI and the four Dutch universities of technology, supported by the Ministry of Agriculture, Nature and Food Quality (LNV).
2 - Initiative by the four universities of technology (Wageningen UR, Eindhoven University of Technology (TU/e), the University of Twente, Delft University of Technology (TU Delft), FME, three Key Sectors (Agriculture & Food, Horticulture & Starting Materials and High Tech Systems & Materials).
3 - Initiative by Unilever, Wageningen UR and the Institute for Sustainable Process Technology.

Prevention is better than cure

Personalized food

The emphasis in healthcare is shifting from treatment to prevention. What can healthy personalized food contribute?

NOW

Thanks to medical technology, we can increasingly solve problems that resulted from unhealthy lifestyle choices and dietary patterns. Problems which in many cases could have been avoided.

Many hospitals and care institutions are already investing in personalized meals: food as medicine. This principle can be extended to the whole population. Everyone has individual nutritional requirements. Mass-produced standard food, made from a limited set of basic ingredients, can never cater exactly to these individual needs.

There is another option. Several years ago a method was found for making personalized food profiles based on DNA. This, however, poses two major challenges:

1. More **transparency** is necessary concerning food, origin, production method and the route from farmer to consumer. Labels currently provide too little or incomplete information, for the simple reason that the required data are not available.
2. **Behaviour.** How can we get people to consciously opt for food products tailored to their personal needs and to reject unhealthy choices?

SOON

Technology offers unique opportunities for confronting both challenges:

1. Thanks to digitization and the Internet of Food, information from the entire supply chain can be connected to make the content, preparation and nutritional value of food products more transparent. At the same time, personal food profiles (based on DNA analysis) have become more affordable and more is being discovered about the interaction between nutrition, lifestyle and disease.

   Against this backdrop, it is only a small step for online retailers and logistical parties to offer personalized food – initially aimed at particular target groups and containing specific nutrients – followed by genuinely personalized options at individual level.

2. *Wearables* and other tech devices can give consumers faster and more direct insight into their own health. The same technology will also be used to show the impact of their food choices. And to offer advice on appropriate food choices, tailored to their personal needs and lifestyle. Moreover, technology can also discourage unhealthy options when shopping (online or offline) and help people prepare healthy personalized meals (e.g. using an intelligent food processor equipped with 3D printing technology).

Opportunities for the technology industry

With its strong food industry and leading knowledge centres, the Netherlands is perfectly placed to become a world leader in *personalized food*. The biggest challenge is to convert technological opportunities into international commercial success.

What needs to be done?

- Cross-border cooperation, for instance with high-tech firms in California. In joint projects, knowledge and technology can be translated into business models with global appeal.
- The courage to make *personalized food* a key priority, e.g. by creating a new, internationally leading research centre in which the food industry, health sector and tech firms cooperate. The required government investments will yield valuable returns in the form of economic activity, while also attracting foreign parties and investors. Thus, besides being the global knowledge leader, we will also reap the benefits from growing business activity.
- *Personalized food* must be given a prominent place in the Health & Food Prevention Agreement that is to be concluded between government and the business community. Crucially, the relevant ministries must work together to support this by helping to remove regulatory obstacles.
- Partnerships of businesses and knowledge centres that address technological challenges in such fields as small-scale preparation, storage, packaging and distribution.

Personalized food: examples and scenarios

- Making healthy food easy? Personalized food can transform the convenience market with personalized ready-made meals tailored to individual nutritional requirements.
- The Personalized Nutrition and Health[4] consortium is carrying out research into technology and knowledge that is necessary for personalized food and health advice on a large scale. Participating partners can use insights from the research to develop customized advice and shopping lists or apps that help and motivate people to monitor their health and adapt their behaviour.

4 - Initiative by TNO and Wageningen UR



Accessible technology for going small-scale in a big way

Small-scale production pays

Small-scale food production is an important condition for more sustainable food production. How can we make small scale pay? Technology is becoming more accessible and is thus the key to successful business cases.

NOW

Food is our most basic need. Over the years, advancing technology has dramatically altered the way we meet that need. A major leap forward occurred in the nineteenth century, with the invention of artificial fertilizer. This suddenly unlocked the door to large-scale agriculture and industrial scale food processing. Livestock farming also intensified in the Netherlands, leading to extremely efficient high-quality meat production in our country.

But intensification of agriculture came at a price, in the form of soil depletion and decreased diversity. Today, the media and public opinion are increasingly turning against intensive livestock farming (and its implications for animal welfare), the nuisance caused by factory farming and the manure problem.

SOON

Smart technology – combined with digitization – can reduce the impact of intensive agriculture and livestock farming as well as increase the transparency in the food supply chain. In addition, technology is clearing the way for more sustainable food production. Small-scale farming, for instance, is becoming more profitable, which is particularly important in developing countries in order to boost the earning power of the local population. Small-scale solutions for cooling, storage and packaging are pivotal in this development.

New technology can reduce the ecological impacts of large-scale food production. Polyculture, which requires fewer pesticides and fertilization than the current monoculture, can now be practised at acceptable costs and with minimal labour thanks to robotization. Precision technology makes it easier to monitor and optimize crop growth, while also reducing the impact on the environment through better use of fertilizer and crop protection agents. New animal housing systems can improve animal welfare and reduce carbon emissions.

Moreover, technology combined with IT (e.g. blockchain) is already becoming so accessible that local farmers and horticulturalists can compete with large-scale food producers. Sensors, IT tools, apps and process control systems are becoming more affordable and easier to use. Armed with these high-tech tools, small-scale producers can vie with large food producers and supermarket chains. Until recently, distribution was still a stumbling block for small-scale initiatives, but online logistics giants like Amazon are now stepping in to fill this gap.

Opportunities for the technology industry

New solutions can be tailored to the opportunities and needs of small-scale high-tech food production. Most machine builders have traditionally focused on large-scale customers and solutions. A vacuum is now developing, which is attracting new players and high-tech start-ups.

Bron: Farmbot (farmbot.org)

What needs to be done?

- Create awareness that small-scale food production is viable alongside industrial scale operations (e.g. via the AgriFoodTech Platform).
- Increase existing top technology players' focus on smaller-scale and simpler processes: large-scale and small-scale can go hand in hand!
- Create stronger connection between research programmes at knowledge centres and small-scale and/or local food producers.
- Increase support from government and lenders for scale-ups. There is a large pool of promising start-ups, but too many good initiatives go under in the 'valley of death' phase.

Small-scale high-tech food production: examples and scenarios

- Technological innovation that boosts the income from micro- or small-scale agriculture. For inspiration: the Farmbot[5] is even suitable for a highly-productive kitchen garden.
- Local livestock slaughter, with on-site facilities or a mobile service that visits livestock farmers once every few weeks. Besides saving lots of food miles, this also prevents stress (and associated diseases) for the animals.
- Shorten existing supply chains and minimize the intermediate links as much as possible. Parties must genuinely add value to survive.

5 - An open source project with hardware, software and documentation enabling micro-precision agriculture.

Innovation and digitization in the factory and supply chain

The smart food factory

The Dutch food processing industry stands out for its long history of continuous improvement and automation. The next step in this development is the advent of smart food factories, which are not only intelligently organized within the factory walls but also lead the drive towards a fully digitized food supply chain.

NOW

Despite far-reaching automation, food production today continues to rely heavily on human labour. A lack of skilled and motivated workers is a growing problem for companies throughout the supply chain. Due to its physically demanding and repetitive nature, there are simply not enough people who are willing and able to do this work. Smart solutions are vital.

At the same time consumers and governments, particularly in western countries, are calling for more transparency to ensure a sustainable and reliable food supply. Meeting this demand for transparency is a major headache for players in all links of the supply chain. Lots of data are being gathered, but connecting and making sense of all these data is labour-intensive and the added value for the business is unclear.

SOON

The food factory is digitizing and becoming smart. Robots will take over repetitive production tasks. Analyses, data and information gathering and quality checks will become routine tasks, performed by smart sensors and IT. Humans will play a different role in smart factories, with more emphasis on tasks where the human brain can really make a difference.

Moreover, the factory and machinery will become an integral part of the overall food supply chain, from farmer to consumer. Everything will be connected to guarantee transparency, safety, health and sustainability. But this also raises new questions. Who owns all these data? How can data sharing be organized in a safe and transparent manner? And how do we protect our food supply against disruptive attacks from criminals and terrorists?

Opportunities for the technology industry

The future calls for solutions (based on e.g. blockchain) that give supply chain partners the reassurance that they can share data – traditionally perceived as the source of earning power – in a safe, fraud-proof and transparent manner. While also ensuring that data are only shared if necessary and with parties who are entitled to this information.

Furthermore, the technology industry has a key role to play in the development of rapidly and automatically adjustable production systems. This has a high priority: changeover times are costly and small-scale production means that a growing range of products or varieties must be processed on the same production line.

What needs to be done?

- Technology suppliers must take the initiative. Individual farmers or food manufacturers can never set the standard. Technology must lead the way, other sectors will automatically follow.
- Cooperation in the entire technology chain, including an agreement on data sharing protocols with respect for the interests of those who are making their data available.
- More knowledge development around the (full or partial) robotization of production processes, with robots taking over physically demanding and repetitive work from humans.

Smart Food Factory: examples and scenarios

- Within the Internet of Food & Farm 2020 EU programme, Wageningen UR, the business community and the Ministry of Agriculture, Nature and Food Quality are playing a crucial role in the research into Internet of Things applications in food and agriculture.
- Knowledge and experience of robotics from diverse sectors is being brought together in Holland Robotics[6], creating a tremendous source of inspiration for application in the agricultural and food tech sector.

6 - Initiative by 4TU, VU Amsterdam, RUG and industrial parties Demcon, VDL ETG, Philips Lely and Vanderlande Industries, with HighTechNL and FME as drivers.

Conclusions and recommendations

Food supply chains will change beyond recognition in the coming decades. More food must be produced on less land. Consumer preferences and needs are evolving, both in terms of products and shopping patterns.

Food transition

The food transition is in full swing, driven by social trends, technological innovation and digitization. To facilitate this process, new food sources and more sustainable production methods and logistics are vital, as are new supply chains and business models.

The main challenge for technology **entrepreneurs** is to show more leadership. Do not wait for the food industry, farmers and horticulturalists to make the first move. Remember that technology is the key to innovation and sustainability in the supply chain. Now is the time to seize opportunities like the Sustainable Food Initiative and make change happen.

Research at universities and knowledge centres must inspire the business community by offering new avenues of development. Vice versa, scientists must tailor their applied research to requests from the business community. The focus in fundamental research must be on social challenges such as sustainability, circularity and health. Connections with European research programmes such as EIT Food and Internet of Food & Farm 2020 and an agenda-setting role for KP9 (successor of the Horizon2020 programme) are essential.

Educational institutions can play a crucial part in the transfer of new knowledge, in close cooperation with the business community. Speed is key. So more scope must be created and funding provided to promote lifelong learning, thereby creating a climate in which new knowledge can be smoothly translated into new applications.

Crossing borders in food and technology

The Netherlands is strong in food, health and technology. Drawing on our knowledge and expertise in these three sectors, our goal is to take the lead in developing international, cross-disciplinary solutions. Drawing not just on the expertise of existing players, but especially also that of entrepeneurs in adjacent areas.

We, in the Netherlands, cannot excel in everything. And even if we could, our country does not have the resources that all our small and highly innovative businesses urgently need to develop and commercialize their ideas.

International connections

Enabling the food transition also requires structural international cooperation. No single country can excel in everything or muster the resources that small and highly innovative businesses need to develop and commercialize their ideas.

International cooperation with other urban regions is necessary to jointly build the critical mass we need to address the issues arising from digitization and urbanization. Partners such as California, Copenhagen, Tokyo, Toronto and Sydney all face similar urban challenges and have business and knowledge communities that complement Dutch competences and strengths.

Such joint innovation creates momentum and speeds up the food transition, creating both a global market for innovative players and resulting in knowledge and solutions that help (developing) countries to shape their own future.

FME facilitates growth

FME mobilizes and connects the Dutch technology industry to meet every need and challenge confronting the world of today and tomorrow. That's how we boost the earning power of all our members, both individually and collectively.

We aim to further augment our country's leading position. As a key player, the Dutch agriculture and food tech sector can play a crucial role in addressing one of the biggest social challenges of the century: in the coming forty years the world will need as much food as has been produced in the past 8,000 years. To achieve this, we must join forces. Not just within the food production and technology sectors, but also with other stakeholders such as governments, knowledge centres and consumers.

FME AgriFood wants to contribute to the transition towards a future-proof food system. For more information on our agriculture and food tech activities, go to www.fme.nl/agrifood. Or contact Marcel van Haren, FME AgriFood Manager on +31 6 278 903 54 or marcel.van.haren@fme.nl

FME
Zilverstraat 69
P.O. Box 190
2718 RP Zoetermeer
The Netherlands

+31 (0)79 353 11 00
info@fme.nl
www.fme.nl