

# **Development goals and measures (UMV) 2019-22**

**National Food Institute**

5 July 2018

## 1. Academic profile and expected performance goals of the Institute

The National Food Institute, Technical University of Denmark (DTU), (the Institute), conducts research into and disseminates - through advice, innovation, and teaching - sustainable and value-creating solutions in the area of food and health for the benefit of society and business. The Institute delivers its outcomes through an interdisciplinary cooperation between the disciplines of nutrition, chemistry, toxicology, microbiology, epidemiology, and technology.

The Institute's vision is to generate future prosperity through research into food and health. The Institute makes a difference by producing knowledge and technological solutions to develop sustainable food production, to feed a growing population, and to prevent disease and promote health. See Figure 1.

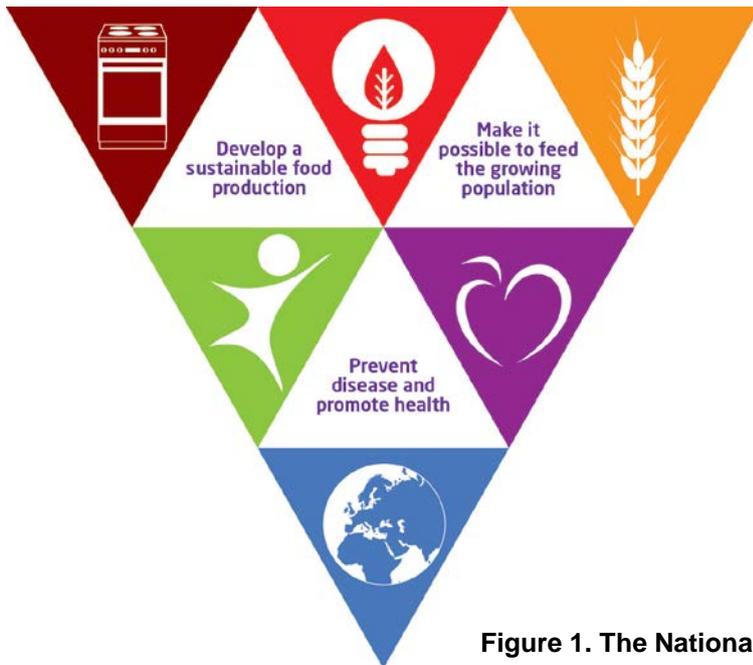


Figure 1. The National Food Institute's vision

The vision is fully aligned with the UN's Sustainable Development Goals, and the Institute contributes to the following goals in particular: Zero Hunger (2), Good Health and Well-Being (3), Quality Education (4), Industry, Innovation, and Infrastructure (9), and Responsible Production and Consumption (12). See Figure 2.

The National Food Institute's vision therefore seeks to solve some of the biggest social challenges the world is facing. The vision also indicates the Institute's direction of travel through strategic initiatives that increase the level of ambition and create a visionary, proactive and more competitive Institute.



Figure 2. UN goals with particular relevance for the National Food Institute

### **Ambitious research**

The National Food Institute is an organization with big ambitions, selecting research areas as beacons in a bid to solve some of the biggest societal challenges facing the world. The strategic objectives for the coming years are to:

- be among the three leading food and health research institutions in Europe
- support an ambitious interdisciplinary environment by focusing its research efforts and attracting more research funds and business partners
- secure strategic investments and better utilize the existing infrastructure in the form of databases, equipment and knowledge across DTU.

### **Socially relevant teaching**

The Institute teaches and educates students for the food sector, public authorities, and the research communities related to the Institute's focus areas. The strategic objectives for the coming years are to create:

- a broader study offering in life science and bioengineering
- clearly profiled study programmes which meet the need in society for graduates with strong and relevant engineering competences in food production and life science
- focus on innovation and entrepreneurship in teaching
- a teaching environment that is conducive to student learning, with a focus on lecturers' didactic development and on inspiring physical surroundings.

### **Competitive advice**

The National Food Institute supplies independent and reliable scientific advice to national and international authorities and companies. The Institute has a duty to take the initiative, which it discharges by ensuring that the advice it gives is research-based and founded on international partnerships, and that the Institute is a forward-looking and constructive sounding board for clients. The international evaluation of the advisory service in 2017 showed high standards in all evaluated areas and only gave rise to a few optimizing initiatives at the Institute.

The advisory service is anchored in a single department, thus ensuring that clients benefit from the Institute's interdisciplinary knowledge in a well-coordinated way. The strategic objectives for the coming years are to:

- retain the Institute's position as the preferred supplier of scientific advisory services in food safety and food technology in Denmark, and to win the public-sector contracts that are put out to tender during the period
- strengthen the Institute's position as the preferred Danish partner for international businesses and public authorities in this field
- develop a competitive advisory service, for example by cooperating more closely with industry and businesses in food technology, food safety and nutrition advice
- refine the quality of advisory services and develop impact metrics for scientific advice.

### **Value-creating innovation**

With a view to utilizing the Institute's research results to benefit businesses and to support knowledge-based social development, innovation forms an integral part of the Institute's research and education activities. The strategic objectives for the coming years are to:

- position and further develop the Institute as a leading innovation incubator
- contribute significantly to job creation and growth in the food sector
- embed innovation in the Institute's research culture in order to deliver value-creating solutions for businesses and public authorities
- boost the commercialization of patents registered by the Institute.

### **Dedicated employees**

Dedicated employees are at the heart of a knowledge-based organization and are motivated by the difference they make to society. The strategic objectives for the coming years are to:

- maintain high levels of job satisfaction centred on the experience of being part of a bigger community, drawing inspiration, learning, and motivation

- allow employees to clearly articulate their expectations with regard to priorities, functions, career planning, and competence development
- celebrate the success of the Institute and the individual, thereby acknowledging the employees' goals and results.

Every employee has the opportunity to enter into dialogue with management, and they are involved - either directly or through representatives - in strategic decisions affecting the way they go about their duties.

## 2. Education and teaching

### 2.1 Education and teaching (BEng, BSc, and MSc programmes)

The Institute teaches and educates students for the food and life science sector, public authorities and the research communities related to the Institute's focus areas. By offering teaching at a high academic level, it is the Institute's ambition to equip graduates with the latest relevant engineering skills for the benefit of society and industry both in Denmark and globally. During the UVM period, the strategic goals are to create:

#### **A broader study offering in life science and bioengineering**

The National Food Institute aims to take on greater responsibility and become more active on the teaching side so that the scope of teaching activities will match the DTU departments the National Food Institute aims to compare itself to.

The Institute's staff have considerable competences in biology in a broad sense, so they can help to give biology and life science greater prominence as elements in DTU study programmes. During the UVM period, the Institute will assess the demand for and feasibility of a new general bachelor's degree programme - Bachelor of Biological Science - which could be an introduction to the entire subject of life science. In addition, the Institute will use its experience of student innovation and entrepreneurship in teaching to contribute to the development and delivery of DTU's new initiative MSc Tech Entrepreneurship.

#### **Clear, high-profile study programmes that meet the need in society for graduates with strong and relevant engineering skills within food production and life science**

It is an ongoing task to clearly profile DTU's food study programmes, update graduate competences, and foster links between the study programmes and the Institute's strong research areas.

The National Food Institute aims to raise the profile of DTU's food-related study programmes in the wider landscape of education policy. That is why in 2018, the Institute is conducting an overview of long higher education programmes targeted at the Danish food cluster. This is part of the University of Copenhagen's and DTU's response to the Danish Agriculture and Food Council's innovation strategy. The overview will provide a strategic basis for clearer profiling of the study programmes, and assess where the main educational needs are - and consequently how DTU and the National Food Institute can move forward without overlapping with other programmes. The overview covers universities as well as university colleges, so it can help identify possible correlations between study programmes from different institutions.

The Institute is continuing its efforts to increase admissions to the master's programme in food technology - promoting the programme's fields of study by running and contributing to courses in relevant bachelor's programmes in DTU. The Institute is also still partnering with the University of Copenhagen on the bachelor's programme in food and nutrition, something which new initiatives in DTU study programmes must take into account. In addition, the Institute will monitor admissions to the BEng programme in food safety and assess the feasibility of increasing intake to 60 students per year without a winter intake and course duplication. The BEng programme will undergo a programme evaluation in 2018, after which follow-up will be an important task during the UVM period.

The master's programmes focus on both food production and food safety, a combination that gives it a unique profile. This should be emphasized in the development of existing and new technological specialization courses. The concept of food technology is currently being redefined and expanded, with a greater emphasis on supporting sustainability and the circular economy in courses and in industry partnerships. The offering of new courses that focus on ingredients or microorganisms, for example

fermentation in food production, plays an important part and gives the National Food Institute's teaching particular relevance for the UN's sustainability goals.

### **Focus on innovation and entrepreneurship in teaching**

Thanks to DTU Brewery, Blue Dot projects, and the Ecotrophelia product development competition, the Institute has a solid foundation for embedding innovation, entrepreneurship, and creativity in its programmes. The involvement of the University of Copenhagen, Aarhus University, and Aalborg University means that Ecotrophelia has now become a real national competition. In the next few years, the intention is to extend the partnership to include universities in the Nordic region, for example, and/or national university colleges.

New projects targeted at innovation in food companies in Region Zealand (CPH-Food) and in the Capital Region of Denmark (Growing Food CPH), and the 'innovation pilot' in the BEng programme, will greatly increase the number of students who work with industry as part of research and company projects. The National Food Institute will continue to work on strengthening the interaction between businesses, students and researchers by establishing special courses, MSc theses and final projects with a high degree of business involvement.

### **A teaching environment that is conducive to learning, with a focus on lecturers' didactic development and on inspiring physical surroundings**

The National Food Institute will continue to develop high-quality, academically challenging courses based on a strong pedagogical culture among lecturers, where peer supervision and the development of pedagogical and didactic methods are common practice. This is why the Institute developed and now runs TeachFood, an informal forum for lecturers. Management continues to focus on supporting the students' learning and enthusiasm by, among other things, incorporating new pedagogical methods as well as new ways of learning and organizing exams.

The Institute aims to reduce dropout rates and encourage students to complete their studies within the designated time. A particular effort will be made to overcome the difficulties encountered by BEng students in the first year, in which the study plan contains major theoretical subjects in chemistry. A joint project with DTU Chemistry and LearningLab will encourage lecturers to focus on didactic methods and the relationship between courses, learning objectives and progression. The lecturers involved in the study visit to the Netherlands will report the experience they gained back to lecturers in the National Food Institute in TeachFood, and to other departments in the half-yearly teaching seminars at DTU.

By increasing the use of e-learning, the Institute will improve learning outcomes for students and make the Institute more cost-effective. The Institute will make greater use of the new DTU platforms for feedback and ongoing academic communication and assessment. E-learning is fully integrated into the AQFood course in the master's programme, and the international One Health Summer School. The Institute will increasingly allow these courses to form part of the students' plans for ordinary study programmes, thereby increasing flexibility and giving students more opportunity to study abroad.

Based on its role as EU Reference Laboratory for Antimicrobial Resistance (EURL-AR), the Institute offers MOOC/Coursera courses on antimicrobial resistance and whole genome sequencing, which have attracted more than 18,570 and 4,670 participants, respectively. The whole genome sequencing course was designated as one of the 20 best online Coursera courses in 2017. MOOCs will be integrated in the relevant ordinary courses, and quality assurance of MOOCs is the responsibility of the department board of studies.

Now that the Institute has been brought together on the Lyngby campus, there is much more interaction between students, lecturers and researchers in Building 202 and connected buildings. The classified microbiology teaching laboratories, the adjoining classrooms, the open lounge areas, and the canteen all combine to provide an inspiring learning environment. The lecturers have found that there are more students on courses and there is greater interest in project work in research groups, but there is still scope for improvement by providing student offices. In chemistry and food technology, it remains a challenge to find the necessary laboratory facilities for teaching and student projects. So the Institute is looking forward to new facilities - for example in Building 207 and the FoodLab - and greater interdepartmental cooperation.

## 2.2 PhD programme

Strong industrial partnerships place the emphasis on innovation for many of the Institute's PhD projects. PhD students at the Institute must examine the potential for innovation in each new project as a fixed element of the internal, mandatory PhD course.

The Institute is working to increase the number of major collaborative projects with industry and also aims to increase the number of industrial PhDs.

The National Food Institute will raise awareness of relevant and complementary academic fields at DTU by organizing joint seminars, excursions, etc. The purpose is to increase interdisciplinary knowledge and cooperation, and to create a common understanding of the trends in modern technical life science. In addition, the Institute will offer more of the coveted PhD courses for life science PhD students at DTU.

## 2.3 Further and continuing education

Like the rest of DTU, the Institute will develop the continuing education it offers up to 2020. The Institute intends to conclude specific agreements with employers, to which we will contribute our valuable experience from previous training activities in food safety and risk assessment. The Institute is a European reference laboratory in several areas, and the training activities offered in this context will wherever possible also be used in other further and continuing education activities. An agreement was signed with DANIDA in 2018 concerning a special food safety course in which free places on ordinary courses are combined with targeted programmes. The Institute will seek to develop other similar programmes.

In partnership with the University of Copenhagen and international universities in Vienna, Bologna, Valencia, and Wageningen, the National Food Institute launched an Erasmus+ project called BoostEdu at the end of 2017. The aim of the project is to ensure lifelong learning for food sector employees and strengthen the partnership between industry and the food sector throughout Europe. A central part of the project involves setting up a co-creation and implementation platform for flexible continuing education, including innovation and entrepreneurship.

## 3. Research

The National Food Institute is an organization with big ambitions, where all the research groups are already, or are on their way to becoming, world-leaders in particular field. The research groups constantly strive to improve the quality of their research, to benefit society with relevant knowledge, and to find ways to disseminate this knowledge. They do this by maintaining close contact with businesses, public authorities, and funding bodies.

The Institute is working to improve public health, prevent disease and establish sustainability in global food production in the broad sense. The Institute increasingly uses bioinformatics to analyse large volumes of data from global and national databases, its own analysis data, its own statistical computer models, cell and animal experiments, or human interventions (health informatics).

In terms of the UN Sustainable Development Goals, the Institute's research is particularly relevant for the good health and well-being goal (3), and the responsible production and consumption goal (12).

The Institute has a research promotion unit which helps to ensure that the Institute's funding applications are as strategic and professional as possible. During the UMF period, the Institute will submit applications to a broader range of potential funders, including more private foundations than before.

The Institute's research is centred around 12 research groups:

### **Research Group for Bioactives - Analysis and Application**

The group's ambition is to obtain knowledge which can contribute to:

- improving the eating quality, sensory experience and oxidation stability of food products
- increasing the population's intake of healthy foods rich in vitamins, healthy fats and proteins
- developing ingredients from hitherto unexploited resources.

The group will achieve this by producing new and groundbreaking knowledge about the biological activity of vitamins and the underlying mechanisms of lipid and protein oxidation in foods. The group will also develop new strategies for optimizing vitamin content in foods and improving the stability and eating quality of fatty foods. The group is also engaged in optimizing the content of bioactive substances in algal biomass and developing innovative technologies to exploit and ensure the quality of new resources, especially from sidestreams from the seafood industry and from seaweed and microalgae. Finally, the research group will examine consumer attitudes towards foods containing ingredients produced from sidestreams.

#### **Research Group for Nutrition and Health Promotion**

The group conducts population studies aiming to:

- identify the societal challenges associated with Danish dietary habits and health behaviours (diet, smoking, alcohol, and physical activity)
- increase knowledge about the importance of dietary patterns for health and disease prevention
- contribute data to the Institute's risk assessments.

The group conducts interventions in order to document initiatives and structural factors that promote healthy dietary habits and health behaviour in different populations. In addition, the group prepares the scientific background for dietary guidelines and nutrition recommendations with a focus on lifestyle disease prevention.

#### **Research Group for Food Allergy**

The group aims to develop new and improved strategies to prevent, manage, and treat food allergies. Research is focused on determining which properties of food proteins contribute to allergy development, and which contribute to tolerance development, as well as the underlying mechanisms. The research therefore analyses the relationship between different protein-chemical characteristics and the allergy- or tolerance-inducing capacity of the protein, and the relationship between the allergy-inducing capacity of food proteins and the way we are exposed to them.

#### **Research Group for Food Microbiology and Hygiene**

The group's research helps to address productivity challenges faced by the food industry. The group develops and uses new and innovative methods for rapid detection, typing and quantification, and for predicting the growth and survival of microorganisms and infective viruses in food and water.

The research group develops new mathematical models, decision-making tools and software programs for risk assessments, HACCP-based self-assessment programmes, efficient product development, and improved processing and distribution of food products. Results from research projects will lead to resource optimization, new strategies e.g. for safe water reuse, improved hygiene, management, and control of food-related microorganisms, and knowledge about the epidemiology of pathogenic microorganisms in food and water.

#### **Research Group for Food Production Engineering**

The group focuses on food processing and aims to contribute to sustainable and efficient food production, to optimize resource consumption, to exploit by-products, and to design and develop processing technologies and food products for particular needs. The key elements of the group's research are a mechanistic understanding of the interactions between food processing and raw materials, as well as mathematical modelling and monitoring of food production processes at all levels from unit operations to complex systems.

#### **Research Group for Genomic Epidemiology**

The research group conducts targeted research to monitor, predict, and prevent the spread of infectious diseases among people and animals, and to support global detection and control, initially focused on antimicrobial resistance. In the coming years, the research group will continue its efforts to support global monitoring and control of infectious diseases and antibiotic resistance, and will increasingly try to identify global drivers and therefore new opportunities for control. Increasing use will also be made of non-traditional data as a source of information. The focus of research will be:

- sampling and collection of data from relevant hot spots
- development and standardization of analytical methods
- data modelling and interpretation
- microbial ecology and interaction.

Attempts will be made to add epidemiological data and tools, food authenticity studies, and chemical analyses to the concepts which have web-based access to analysis and information infrastructures.

### **Research Group for Risk Benefit**

The group's ambition is to maintain its position as the leading research group in the quantitative risk-benefit assessment of foods. The research group aims to prevent disease and promote health by developing and implementing models and methods in the quantitative health assessment of foods, which can be used in risk-benefit assessments, risk and benefit ranking, and burden of disease studies. In the longer term, the group will add aspects such as economics and sustainability to the overall assessment alongside the health impact assessment.

### **Research Group for Analytical Food Chemistry**

The research group's ambition is to increase trust and transparency around foods by:

- developing the food inspection solutions of the future
- documenting quality and detecting fraud
- identifying risks in food production and from new ingredients.

Through reliable and relevant insight into food chemistry, the group will also contribute to the health-related understanding of the chemicals in food products as a basis for making healthy choices. The goal is reached by exploiting modern mass spectrometry to develop efficient chemical trace analyses of food and biological samples. The methods - developed both as accredited quantitative methods and as general screening methods - are the foundation for national and European reference laboratories.

### **Research Group for Microbial Biotechnology and Biorefining**

The research group works on innovative processes for improving the efficiency and quality of industrial food production in, amongst others, breweries and dairies, with the aim of contributing to sustainable global food production. The research focuses on the production of food and feed ingredients, bio-chemicals and biofuels based on biorefining, and microbial fermentation using industrial by-products from food production and agriculture. Examples include sustainable protein sources of the future based on biorefining from green biomass and microbial production of high-quality protein. The group is also widening its focus to include microbial production of proteins and peptides with biomedical applications.

### **Research Group for Molecular and Reproduction Toxicology**

The group's overall ambition is to prevent diseases that may arise from fetal exposure to chemicals found in foods and the environment.

The research focuses on generating knowledge about undesired effects of exposure to chemical substances - in isolation or in mixtures - as well as the underlying mechanisms. More specifically, the group conducts research into the toxic effects of chemicals (such as endocrine disruptors) which arise during fetal development, and how to best predict these effects in order to optimize risk assessment of chemicals. The research focuses primarily on effects on the reproductive system and associated diseases, as well as effects of thyroid hormones leading to brain dysfunction.

The group aims to contribute to the development of a new paradigm for human-relevant risk assessment of chemicals, with a view to making risk assessment better, faster, and yet reducing and optimizing the use of laboratory animals.

### **Research Group for Nano-Bioscience**

The objective of the research group is to promote health and prevent disease by focusing on nano and microstructured materials and ingredients as well as trace elements in foods. The group works throughout the entire value chain from food production to the synthesis of functional ingredients and delivery systems, via food processing and consumption by humans and in animal models. The research includes the development and application of advanced chemical analysis methods for trace element speciation and nanoparticle characterization.

### **Research Group for Gut, Microbes and Health**

The group's ambition is to discover how diet, food ingredients and food contaminants affect the composition and activity of intestinal bacteria in children and adults. The group's core activities therefore include studies of the effects of diet and dietary components on the microbial population of the gut and derived effects on the immune system and on health. In addition, the group is engaged in projects focused on strategies to alter or exploit the potential of the gut microbiota to prevent and/or cure diseases.

## 4. Scientific advice

In 2017, the Institute conducted an international evaluation of the scientific advice it provides. The results were unequivocally positive. All the evaluated areas were found to be of a high international standard, with international 'fingerprints' in many cases. This puts the Institute in a good position regarding the public-sector advice contracts that are expected to be put out to competitive tender during the UMV period. One of the Institute's particular strengths is its ability to generate added value in its scientific advice based on close collaboration between the focus areas. For example data from studies of Danish diets are central to chemical and toxicological risk assessments, and there is potential for close cooperation between food technology and modelling to improve microbiological food safety.

It is the Institute's ambition to maintain its position as the preferred supplier of scientific advice on food safety and food technology in Denmark, and to strengthen its position as the preferred Danish partner for international businesses and public authorities in the field. This will be done by converting the research results into relevant advice that can improve human health or food supplies, thereby supporting the UN's sustainability goals.

The Institute undertakes international advisory activities, especially for the EU, WHO, and the OECD, but also for the Nordic Council of Ministers. Many tasks are performed under the auspices of the European Food Safety Authority (EFSA), and the close partnership means that the Institute's research influences the European food safety agenda. The close contact with the Institute's sister organizations in Germany and France provides access to knowledge and the latest thinking about food safety in Europe, and this in turn benefits those receiving scientific advice from the Institute.

The most important focus areas for scientific advice include:

### Positioning

The Institute will position itself to win contracts for scientific advice to be put out to competitive tender in future, keeping its place as the preferred supplier of food-related advice to Danish public authorities. The positioning involves investigating potential collaborations with Danish and foreign partners.

### Competitiveness

The Institute will deepen its partnerships with national industries and companies based on the Institute's stakeholder groups in nutrition, food chemistry and microbiological food safety, thereby communicating the scientific basis for the Institute's advice to public authorities while also establishing a basis on which contracts can be won from industries and companies. A particular focus area will be the use of the Institute's expertise in food authenticity.

The Institute has cooperation agreements with sister organizations in countries that are important export markets for Danish food businesses. Through these agreements, the Institute will help to increase risk assessment capacity in the countries concerned, which the Institute expects will indirectly benefit Danish companies.

At European level, the Institute will seek to enhance cooperation with EFSA and the Institute's partner organizations in Germany and France through joint projects, and thereby help to create pan-European solutions to food safety issues. Particular efforts will be made to improve acceptance of gene sequencing methodologies in monitoring, and to make risk/benefit assessment methodologies more widely known.

### Quality of scientific advice

The Institute will develop new paradigms and research-based methods with a view to improving the quality of its advice and decision-making support, especially within the following areas:

- assessing the significance of combining chemical substances to better advise on the potential risk to human health
- risk/benefit analysis in order to consider the potential harmful effects versus the beneficial effects of the food in which they occur
- the significance of gut bacteria for human health, including in relation to lifestyle diseases and the effect of exposure to chemicals
- a common basis for describing dietary composition in different organizations and outlets, and innovative solutions for disseminating more differentiated and targeted dietary recommendations

- value creation through recycling and upcycling of low-value flows from primary production and food production into high-value products
- working to implement biomonitoring in national studies of diet and physical activity and to develop and validate innovative data acquisition methodologies
- working with national and international partners to enhance the Institute's role in a One Health-based approach to solving food safety issues in order to maximize the social impact of initiatives.

The evaluation of the Institute's advisory activities in 2017 revealed that there are no good impact metrics for public-sector advice. During the UMV period, the Institute will work with its partner organizations BfR and ANSES and with AIS to develop these impact metrics.

## 5. Innovation

The National Food Institute aims to be the leading innovation incubator for the food sector through research-based innovation activities.

The Institute wants to maintain and strengthen its extensive network of contacts with the business community. Each year, the Institute enters into more than 60 new research-related cooperation agreements with companies, as well as a wide range of contracts of a more commercial nature. The Institute will handle all these business relationships systematically and professionally.

The Institute will also integrate innovation and entrepreneurship more closely in its educational activities, as student knowledge and student start-ups can make a big contribution to the entire food sector. In addition, employees will be supported as they explore possibility of starting their own companies.

Based on the above ambitions, the National Food Institute's strategic objectives and initiatives for the coming year are to:

### **Position and further develop the Institute as a leading innovation incubator, with the knowledge gained making an active contribution to society**

The National Food Institute will strive to be an outward-looking and high-profile organization that actively seeks to make its knowledge available to businesses, public authorities, and civil society. The aim is for the Institute to be perceived as a preferred and trustworthy partner by all stakeholders looking for scientific advice.

With regard to ingredients, the Institute will continue to position DTU as a whole in the relevant sector through activities and targeted workshops, and in the High Tech Summit.

Opportunities for European cooperation will also be explored through EIT Food by continuing efforts to partner with relevant businesses and universities in Europe.

### **Contribute significantly to job creation and growth in the food sector by enhancing the innovation potential of businesses, public authorities, and civil society**

The National Food Institute will help to enhance the innovation potential of businesses, public authorities and civil society in order to maintain and develop job creation and growth in the food industry.

This will happen by continuing and refining initiatives targeted at small and medium-sized enterprises, providing scientific advice which is important for their business development. The Institute will also focus intensely on new start-ups which can inspire and revitalize the sector, for example by working closely with Skylab.

Particular focus will be on refining the Institute's collaboration with the regions, particularly the three regions behind Greater Copenhagen which all give food and gastronomy prominence in their respective growth strategies. This will involve participating in projects as a knowledge provider and boosting the Institute's presence in the many small initiatives currently flourishing in an uncoordinated way in the regions. Participation will emphasize the values that research-based knowledge can bring to such initiatives.

### **Make innovation an integral part of the research culture at the Institute, with new talents creating innovation and established researchers identifying innovations in their research**

The Institute will work to ensure that PhD students and employees spawn innovation, with the backing of supervisors and other senior employees who see innovation as a way to make research relevant to society as a whole. This will mainly be done by:

- increasing the extent to which researchers across the Institute are involved in projects in direct partnership with a broad range of customers (demand-driven research-based innovation)
- recognizing the fact that innovation springs from research, and that DTU centrally and the Institute have support systems in place for further developing the utility of such innovations for the benefit of society at large (technology-driven and data-driven innovation).

### **Increase the commercialization of patents in order to fully exploit the research portfolio**

The National Food Institute will seek to ensure that the potential for innovation throughout the entire research portfolio is fully utilized with commercialization in mind. The number of patent applications has stabilized at about seven a year, and the focus now is on optimizing the utility value for businesses of the patents already granted.

## **6. Partnerships**

In order to count among the leading research institutions, and to maintain its position as one of the leading national food institutions in Europe supplying independent scientific advice to public authorities, the Institute is part of a number of strategic partnerships which are expected to spawn further activities in future.

The Institute has a strategic partnership with the two most important independent food institutes in Europe: the Federal Institute for Risk Assessment (BfR) in Germany and the French Agency for Food, Environmental and Occupational Health & Safety (ANSES). The American Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA), the European Food Safety Authority (EFSA), the European Centre for Disease Prevention and Control (ECDC), and the Dutch National Institute for Public Health and the Environment (RIVM) are also strategically important research and scientific advice partners.

DTU has other cooperation agreements with the China National Center for Food Safety Risk Assessment (CFSA), the Food Safety Commission of Japan, and Nanyang Technological University in Singapore. In addition, the Institute participates in Med-Vet-Net - a network comprising 13 countries, which focuses in particular on research and advice about zoonoses, and also in the Danish Food Cluster, which represents most Danish food companies and the Danish universities active in the field. The Institute will work to link up with the EIT Food community in TUM, which will involve a strategic selection of international universities to work more closely with.

The Institute will continue its involvement in the international Center for Food Safety and Technology in partnership with Hong Kong Polytechnic University in China, Lund University in Sweden, and the University of Bologna in Italy. This initiative will potentially lead to greater cooperation with and access to the Chinese market in particular, as well as student exchanges.

## **7. HR**

The National Food Institute's strategy supports its ambition to be a leading, excellence-driven institution with strong research groups and research beacons. An ambitious and value-creating strategy helps to maintain staff commitment. Commitment and motivation are driven by academically exciting projects which are aimed at solving the challenges facing society. The work is meaningful, and takes place in an environment in which individual employees are able to enter into dialogue with management and are involved in the strategic work which is relevant to their day-to-day activities.

The next UMV period will focus on developing the Institute strategically, and on preparations for competitive tendering of public-sector scientific advice. The Institute will meanwhile prepare for an international research evaluation to take place in 2019.

## 7.1 Organization

The organization is structured around four academic departments and 13 groups. The aim is to have a small number of focused research teams which support the vision and the strategic goals. See Figure 3. In addition, the Institute has two units that are important in order to support research: An animal facility and a service unit handling the needs of multiple departments.

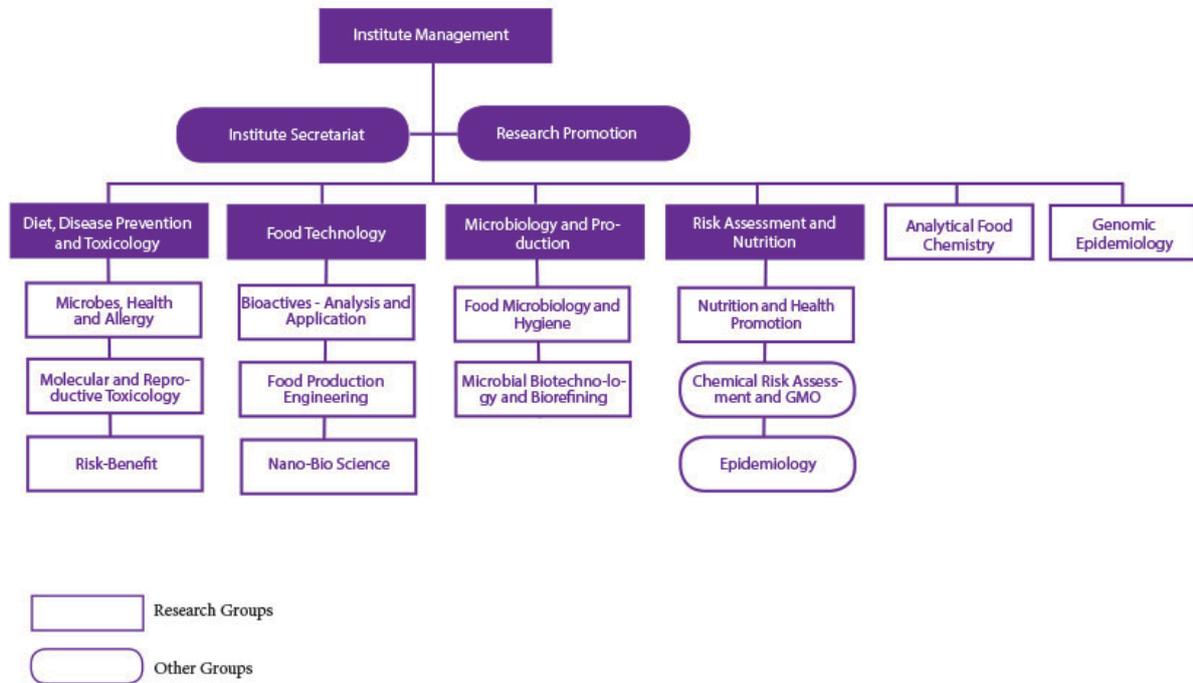


Figure 3. Organization chart

Interdisciplinary coordination of teaching, research, advice, innovation and finance is embedded in the management team. The departmental managers each have a coordinating leadership function that extends across the Institute and clearly defines responsibility both internally and externally. The leadership function is therefore located in the line organization (staff) and across (academic) in a matrix which is illustrated in Figure 4.

In all its activities, the Institute consistently promotes collaboration across DTU.

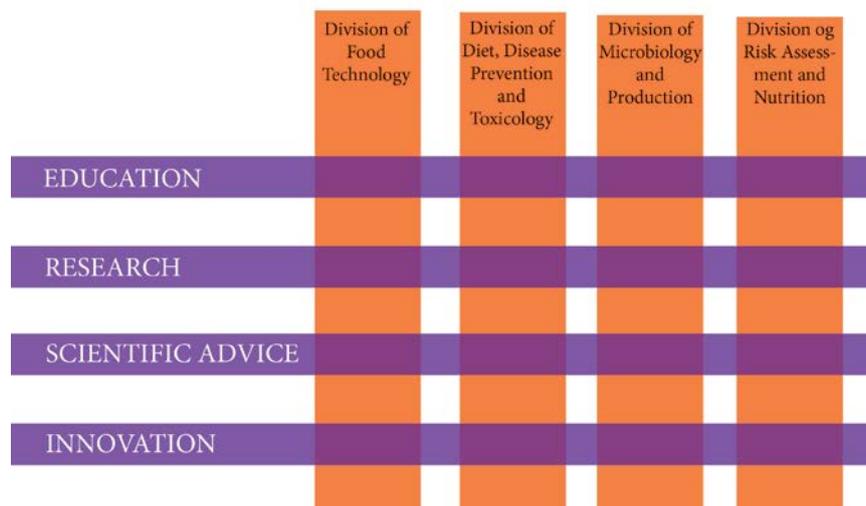


Figure 4. Matrix-organized leadership responsibility

## **7.2 Leader and leadership development**

The Institute deploys dynamic and strategic management in order to support continuous progress. The management recognizes the importance of ensuring there is room for academic passion and dedication, while also making the Institute's competitive profile an academic priority.

Managers - both heads of department and group leaders - play a key role in implementing the strategy and accompanying changes. The managers translate and communicate the purpose of the strategic goals, and thus act as culture bearers.

## **7.3 Employee development**

The National Food Institute maintains a constant focus on the academic and personal development of all staff groups. During the UMV period, the Institute will continue to spur on its employees to meet future requirements. This includes, among other things, initiating activities that improve the Institute's chances of winning research funding, continuing to provide competitive advice for the longer term, encouraging employees to think in terms of business-oriented innovation, supporting the lecturers' pedagogical development, and creating a common teaching culture based on continuous dialogue among lecturers.

For the employees, this means being actively and jointly responsible for supporting an academic, proactive environment where their expertise is deployed throughout the department, the Institute, and beyond, and which further develops the individual and the Institute to be among the best.

To support DTU's elite development, the Institute offers a network programme for ambitious young project managers at the Institute. The focus is on young postdocs, researchers and assistant professors with maximum elite development potential for the Institute and DTU. The programme comprises eight structured meetings, and includes inspiration and discussions on how to build up a research field, apply for external funding, expand networks, and prepare a personal plan of action. The employees are also encouraged to take steps that support elite and talent development. One example is the Early Career Researcher (ECR) Committee, which was set up by the young researchers at the Institute.

## **7.4 Attracting and recruiting**

The Institute expects that its clear, prioritized, and ambitious strategy and profile - supplemented by academic visibility in the research - will help to attract new employees.

The recruitment of new employees must help to make the Institute stronger culturally, academically, and internationally as part of its ambition to be an 'elite institution' with a healthy degree of diversity that supports the Institute's international orientation.

The Institute goes out of its way to spot the brightest talents among its MSc students, and encourages them to do a PhD as part of efforts to establish an excellence-driven research environment.

The Institute often welcomes visiting researchers, and still regards this as one way of enriching the research environment and establishing contacts with leading universities with which the Institute can exchange students and researchers.

# **8. Material resources**

## **8.1 IT**

The National Food Institute's strategy for IT infrastructure concerns the general IT workplaces, databases, and laboratory and research systems which are continually being developed in parallel. Due consideration is given to IT security, including implementation of ISO 27001 (formerly DS 484) and a quality assurance system focused particularly on mobile units and laboratory IT.

**Databases:** The Institute's databases contain considerable research capital. It is therefore important to safeguard data management and accessibility at all times. The Institute works with partners such as DTU Compute and DTU Bioinformatics on databases and competence development, and with WHO and EFSA on dietary and food data. An urgent need to upgrade the Institute's food database to a new platform has triggered a collaboration with AIT, and the Institute aims to improve opportunities to combine information about dietary intake with information on exposure to chemical and microbiological food contamination as a basis for improved scientific advice - for example using an analysis platform

that collects food data. This platform must take monitoring data for nutrition, pollution, and microbiology, and convert it into knowledge that can be used for research purposes as well as for public benefit. Furthermore, the Institute is planning to build up a database of monitoring data for pesticides and other chemical pollutants for the last 10 years which will be searchable and accessible to the public.

It is a significant challenge that the Institute's bioinformatics pipeline (a joint initiative with DTU Bioinformatics) - originally developed for research purposes - must now be used in day-to-day operations and contingency planning. This places completely new demands on uptime and support.

**Laboratory and research systems:** Much of the Institute's IT infrastructure is in the laboratory environment, which imposes a number of specific hardware and IT requirements. The objective is for data and instruments to be accessible from all workplaces, and for raw data and metadata to be acquired centrally in the Institute's database environment. Strategic partnerships have been established with other departments on joint LIMS development, and the Institute is likewise working on specialist software - SAS, Origin Pro and ACD for example - with other DTU departments.

## 8.2 Laboratory equipment/scientific infrastructure

The National Food Institute's research infrastructure has been developed to supply and maintain data about foods, health and production processes, and it is a key hub for all the Institute's activities, including participation in international partnerships, and for attracting skilled researchers from Denmark and abroad. In particular, the Institute will highlight:

**Chemical profiling and metabolomics:** The platform is part of the national food-chemical preparedness system and is included in the national and EU reference laboratory activities. The backbone comprises a range of modern mass spectrometers selected to provide sensitive, detailed and accurate chemical data about the contents of foods and other biological matrices. One aim is to develop a comprehensive analytical DTU network in partnership with DTU Bioengineering and DTU Chemistry.

**Microbiology laboratories:** Microbiological analytical technology based on modern molecular biological methods supports the Institute's research and forms part of the national food safety preparedness system, which supports the authorities and reinforces enterprises' self-monitoring and control at national and international levels.

**Animal facilities:** The Institute's laboratory animal facilities is mainly for rats and mice, and is essential to study the effects of chemical substances, diet and probiotics. Its work with germ-free animals is unique. The facilities and the Institute's expertise in the area are made available to all DTU researchers and are offered to external customers. The facilities are part of the national authority preparedness system for the Ministry of Environment and Food of Denmark.

**National food databases:** The Institute's databases constitute its most significant research capital, and comprise a range of internationally unique data that contain long time series and feature high methodological consistency. Going forward, the databases provide the opportunity to acquire much better epidemiological descriptions of foods and health of great interest to businesses, public authorities, and consumers alike. The central databases focus on:

- the dietary and nutritional intake of the Danish population
- the nutrient content of foods ([frida.fooddata.dk](http://frida.fooddata.dk))
- chemical pollutants in foods (under construction in partnership with EFSA and WHO GEMS Food)
- QSAR predictions for the health effects of chemical substances on the basis of their structures
- evaluation of plants, fungi, and their component parts in dietary supplements and herbal teas
- zoonoses, bacteria and antimicrobial resistance.

**Food technology pilot plant:** The pilot plant has been designed to operate on a relatively small scale, where systematic studies of product/process interaction and the design of production processes can be carried out as controllable trials with minimal ingredient requirements, including what are known as proof of concept studies in collaboration with industry.

**DTU Brewery** demonstrates a polytechnic approach to biotechnological processes with a view to minimizing the resources used in the brewing process and developing new processes and products. The running of the brewery is to a very large extent based on the students' efforts and activities.

The Institute collaborates with other departments at DTU on better utilization of the pilot plant and DTU Brewery for teaching and innovation.

**DTU Centre for Hygienic Design** is located at the National Food Institute in cooperation with IPU, Staalcentrum and EHEDG Denmark. The centre combines research, education, and advice for the biotech and food industry within hygienic design, and also has the same status as the official EHEDG test centre in Denmark with DANAK accreditation for the hygiene certification of production equipment.

**Laboratory services:** The National Food Institute now has HR responsibility for the shared service unit, which performs service tasks primarily in Buildings 201-205B. This encompasses the infrastructure for laboratory services that are essential to the Institute's lab-based research and teaching activities, including physical facilities and machinery for glassware and equipment cleaning, autoclaving and sterilization of materials, responsible chemical waste management, and autoclaving of biological waste.

The Institute is working towards a common DTU infrastructure cooperation in open science, for example, and shared utilization of the Institute's data, animal facilities, a chemical centre of excellence, a fermentation platform, and innovation hubs.

### **8.3 Premises**

The Institute was brought together on the Lyngby campus in 2017, centred around Buildings 201-205, and this facilitates the interdepartmental sharing of laboratories, equipment and competences among the departments in the building complex.

The Institute is also exploring the possibility of vacating the areas it occupies in Building 227 and further consolidating in Building 202. This will require the allocation of additional laboratory areas for research, teaching and student projects in food technology, something that may be possible when The National Veterinary Institute's contingency planning moves to the University of Copenhagen.

To further enhance interaction with students, the Institute is very keen to create student offices, for example in open-plan areas in direct contact with the biosphere. However, this is only possible if the Institute is given office space elsewhere.

## **9. Communication**

The National Food Institute's communication goals in the coming years are focused on:

- showing how the Institute's research results and advice, teaching and innovation activities within food and health make a difference - in particular when it culminates in knowledge and technological solutions that prevent illness and promote health, make it possible to feed a growing world population, develop sustainable food production, and thereby contribute to several of the UN's sustainability goals
- raising the profile of life science and bioengineering at DTU
- marketing DTU's food study programmes to potential students and employers of BEng and MSc graduates in order to increase admissions and strengthen partnerships with employers around internships and project collaborations
- supporting internal communication, primarily through DTU Inside.

The Institute will continue to prioritize news and media management in Danish and English at a level that supports the goals set out above, through the Institute's website, food.dtu.dk, the Institute's international Twitter and LinkedIn profiles, PR activities, and articles in the DTUavisen news sheet and Dynamo.

In this connection, the Institute will continue to work with the authorities to coordinate the way important food safety and nutritional health messages are communicated in Denmark. The Institute will also disseminate the results of risk assessments and other news from the European Food Safety Authority (EFSA) in Denmark, which is one of the duties of an EFSA focal point in Denmark.

## **10. Process and employee involvement**

The National Food Institute's development goals and measures (UMV) have been prepared as part of an lengthy process, in which the Institute's employees have been involved in many ways.

The Institute's heads of studies and lecturers have contributed to Chapter 2 on education and teaching. As part of the development goals and measures (UMV) process, all the research groups have, in Chapter 3, updated the description of their strategic focus for the next UMV period. The group leaders involved have contributed to Chapter 4 on scientific advice, and the relevant staff have contributed to Chapter 5 on innovation. The liaison committee's B side has had the opportunity to provide input to Chapter 7 on employee development. A coordinator for the management team has been appointed to prepare individual parts of the development goals and measures (UMV), and the management team has discussed the Institute's development goals and measures at several management meetings. The final draft of the development goals and measures was prepared by the Institute's secretariat and approved by the Director of Institute.

Following the presentation of the development goals and measures (UMV) to the Executive Board of DTU, the Director of Institute will present an outline at open staff meetings.