

UNIVERSITY OF COPENHAGEN



FP8

Position Paper

2011



Moving towards the 2020 Research Agenda

As one of Europe's leading knowledge institutions, the University of Copenhagen is pleased to present our FP8 Position Paper. The University's academic community has identified some of the major challenges faced by the international society. Our Paper outlines these challenges as well as key research areas necessary in order to create sustainable solutions and continued growth in Europe and beyond.

The University of Copenhagen strongly supports the focus on quality and bottom-up driven instruments such as the ERC and the Marie Curie Programmes. We would welcome and encourage dialogue and exchange of ideas between academic and industrial partners about the content, the shape and the goals of the next generation of the European Framework Programme.

Yours sincerely

Thomas Bjørnholm

Prorector

University of Copenhagen

Short summaries

Sustainable Development and Climate Change

Climate change, globalisation and migration have had massive effects on terrestrial and aquatic ecosystems. Through multi-disciplinary research, the Sustainable Development and Climate Change platform documents the environmental, economic and societal consequences of these developments and proposes new ways of securing sustainable growth.

Energy Security

In view of the current geopolitical challenges, a sustainable energy production is the only viable long-term solution if we are to achieve energy security and improve living conditions for a growing population. The Energy Security challenge must unravel the underexploited technological potential of wind, solar and bio-based energy forms, and demonstrate how we can use these resources in ways that are more energy efficient and less harmful to the environment.

Health and Quality of Life

Chronic diseases such as diabetes, cancer, cardiovascular and neurological diseases represent a major threat to human health in Europe. Various infectious diseases are also becoming more widespread due to increased travel and migration. The Health and Quality of Life platform explores the factors that predispose, cause and protect us against communicable and non-communicable

diseases, with a view to finding new ways of preventing, containing and treating diseases.

Ageing Societies

Demographics show that the number of elderly in Europe is on the increase. This calls for effective therapeutic treatments that will ensure physical, psychological and social well-being for this segment of the population. Through a range of interdisciplinary approaches to ageing, the Ageing Society platform seeks to present effective guidelines on how to ensure a healthily ageing population in Europe.

Diversity and Cohesion in Europe

Europe's role in an increasingly multi-polar world order, and how Europe can develop cohesively when its population is becoming increasingly more diverse, must be examined. Diversity and Cohesion are the internal as well as external challenges facing Europe in a time of change.

Food Security

Securing a sustainable supply of healthy and safe food products is a global challenge that calls for innovative scientific approaches. Focusing on the entire spectrum of food production – from plant and soil ecology to food production and processing technologies – the Food Security challenge shall bring us the latest knowledge on how to develop healthy and sustainable foods with extended shelf life.

Sustainable Development and Climate Change

The challenge

Securing sustainable growth and development in Europe is a significant challenge. The massive effects of climate change on terrestrial and aquatic ecosystems – and on production and welfare – have added new complexities and urgency to this challenge. So has increasing globalisation and migration.

At a regional level, resource scarcity such as limited access to fertile agricultural land and water resources is having huge implications for food and energy security. Climate change also calls for special efforts to protect biodiversity in forests and protected areas, marine ecosystems and the sensitive Arctic region.

Addressing sustainable development and climate change

Future research efforts should focus on entire ecosystems and the human use of these. We need to increase our knowledge of biogeochemical cycles and organisms at all levels in both terrestrial and aquatic ecosystems. An integrative approach is key, drawing on small and macro-level models and addressing the crucial role of ecosystems in the production systems of society.

The size and complexity of this theme calls for a multidisciplinary approach that integrates the latest research from the environmental sciences, mathematical and statistical modelling, as well as the social sciences and humanities. Integrative research will tell us more about the economic, ecological and social challenges caused by resource scarcity and climate change. As a result, we will be able to predict climate and environmental developments, economic and social impacts, and the consequences of different policies with far greater precision.

Key research areas 2014-2020

- Climate change dynamics and its impact on ecosystems
- Social impact of climate change and resource scarcity including migration and urbanisation dynamics in developed and developing countries
- New water resource management technologies spanning from urban to arid ecosystems and focusing on both quantity and quality aspects
- Climate change, marine resources and biology as well as policy instruments for supporting a sustainable marine resource policy in the EU
- Drivers of land use changes and planning and policy instruments
- Integrated and innovative aquatic and terrestrial production systems which can enhance food, fibre and energy production along with key ecosystem services
- Maintenance of genetic resources and germplasm availability for future crops adapted to more extreme climatic events
- The impact of climate change in the Arctic region
- Ocean biogeochemistry and interactions of element cycling
- Societal implications of climate change in Europe (e.g. coastal vulnerabilities and water-related challenges)

Energy Security

The challenge

The global population is growing and so are the demands for better living conditions. To meet these challenges without inflicting more damage on our environment and climate, we need to develop sustainable energy sources and ensure more efficient use of these. Europe faces three very clear energy challenges: reducing the reliance on fossil fuels; ensuring a higher degree of supply security; and developing advanced and competitive energy sources and industries.

Addressing energy security

Within both the private and public sector, we need to increase research efforts to develop competitive wind, solar and bio-mass-based energy forms. Bioactive compounds and enzymes, for example, have great potential for exploitation. By combining basic and applied research we can utilise these resources to develop technologies that are more energy efficient and less harmful to the environment.

A full lifecycle approach to biorefinery processes is also on the research agenda in the energy security field. This includes the design of environmentally friendly processes

that integrate the production of food and feed with the production of energy sources from residual products.

While carbon-neutral energy sources promise great benefits, we cannot ignore their negative impact on their immediate surroundings (e.g. noise, smell, security risks, and aesthetic concerns). If we boost research into methods that can assess the benefits as well as costs of new energy sources, their regional impacts, including techniques to reduce negative effects, we will stimulate the use of sustainable energy sources – to the benefit of the environment and our common future.

Key research areas 2014-2020

- Improve technologies to enhance energy efficiency, flexible energy systems and energy use, including knowledge about energy consumer behaviour
- Second-generation biofuel technologies and extensions to more available biomass resources and development of biorefineries
- More efficient and sustainable use of all energy resources
- Marine biomass algae and bacterial biotechnology for direct energy carrier production
- Plant biomass research with optimized composition for energy purposes without compromising food security
- Combined systems of food and energy production that enhance ecosystem services
- Improve technologies in solar photovoltaic systems and fuel cells, as both energy production and energy carrier, in energy storage methods, grid or stand alone
- Enhanced efforts in CO₂ sequestration and CO₂ storage in geologic formations
- Development of a European knowledge base for the design of biorefineries

Health and Quality of Life

The challenge

Chronic non-communicable diseases – such as diabetes, cancer, cardiovascular and neurological diseases – represent a major threat to human health in Europe. These diseases not only increase morbidity and mortality rates; they also significantly reduce quality of life for the people affected. The same can be said for conditions such as obesity and impaired reproductive health. Moreover, the global increase in travel activity, migration and climate change has led to an increase in the transmission of infectious diseases worldwide, affecting the European countries as well.

Addressing health and quality of life

Serious investment in research is crucial if we are to combat the dual burden of communicable and non-communicable diseases – not only in Europe but worldwide. To explore the factors that predispose, cause and protect against these diseases, we need to invest in integrated research on genomics (mammalian species, pathogens) in combination with proteomics, cellomics, organomics, metabolomics nanomedicine and bio-imaging. Moreover, an interdisciplinary approach to the interaction between environmental, genetic and lifestyle

factors will pave the way for more effective disease prevention and treatment of chronic conditions such as obesity.

To meet the need for new pharmaceuticals and food products, we suggest much closer collaboration between scientists and the private sector – particularly small and medium-size enterprises since they are typically more agile and quicker to adjust market conditions than large enterprises. We also wish to draw on strong research platforms used within law, social sciences and the humanities to address the ethical and regulatory aspects of lifestyle and disease, as well as the individual and political choices involved in building a society that makes healthy choices available and attractive.

Key research areas 2014-2020

- Interdisciplinary approach to non-communicable diseases (cancer, cardiovascular and neurodegenerative disorders, obesity, metabolic syndrome)
- Interdisciplinary approach to infectious diseases (HIV, tuberculosis, malaria, dengue fever) and emerging/re-emerging zoonoses (SARS, avian influenza)
- Molecular mechanisms and modelling diseases
- Bioactive health promoting compounds
- Incentives and regulation – preventive action
- Securing quality of life
- Understanding mental health through interdisciplinary human-computer usability research
- Human microbiome and metagenome in relation to nutrition, health and disease
- Personalised diagnosis and treatment through individualised medicine

Ageing Societies

The challenge

Longer life expectancy and lower fertility rates indicate that Europe's elderly population is on the increase. With this tendency comes the task of keeping the elderly population healthy and, if possible, in employment for as long as possible – to the benefit of the individual and society. Ensuring healthy ageing is obviously costly. Increasing the quality and cost efficiency of therapeutic treatments has a major impact on the economies and competitiveness of European countries.

Addressing ageing societies

We need to know more about the way in which our genetic and cellular makeup contributes to healthy ageing and long life, and how social class, lifestyle and education influence this process. Only by adopting a multidisciplinary approach that includes contributions from a range of scientific fields, governmental agencies and the general public, can we solve current critical problems and produce effective guidelines for healthy ageing.

We need to give high priority to the study of pathological conditions and drug discovery research for diseases that are prevalent in

the elderly population (e.g. Alzheimer's, Parkinson's, diabetes, cardio, neuro and vascular diseases, pain, cancer, vision and eye diseases, osteoporosis, arthritis, incontinence, hearing and sleep disorders). We also wish to acquire more precise knowledge of how ageing influences the effect of existing and new drugs, and how events early in life can affect the healthy ageing process. Our intervention programmes, long-term medication regimens and multiple therapeutic principles should be integrated and refined to limit side effects and drug-drug interactions, and increase compliance. Given the complexity of medication systems and management, it is clear that we need to educate cross-disciplinary professionals to support advances in this field.

Key research areas 2014-2020

- Molecular and cellular ageing (neurobiology, cellular processes)
- Muscle metabolism including age-related loss of muscle function
- Life course perspective on ageing
- Health care policy and preventive medicine
- Health promotion, communication and user-driven innovation
- Pathophysiological mechanisms in advanced animal model and model organisms
- Proteomics, cellomics, nanomedicine, bio-imaging, organomics
- Personalised medication
- Poly-pharmacology and drug discovery
- Diet and ageing/healthy foods for the elderly

Diversity and Cohesion in Europe

The challenge

Europe is changing. The EU currently has 27 member states and further enlargements are expected. While economic and political integration clearly has its benefits, cooperation involves significant challenges. The economic and geo-political world order is becoming increasingly multi-polar, posing significant political, economic and societal challenges for Europe. Moreover, an ageing population and widespread immigration is changing Europe's demographic composition, increasing the need to attract labour from abroad and deal with the risk of tension and social exclusion. This scenario of challenges raises one central question: How can Europe ensure social cohesion when its community is becoming increasingly diverse?

Addressing diversity and cohesion in Europe

Globalisation has changed the character and dynamics of conflicts. We need to understand these new types of conflict, their socio-cultural origins and develop new solution strategies if we are to reduce the number of detrimental conflicts in Europe, as well as between Europe and new centres of power worldwide. Research into communication complements such strategies, as communication and mass

media play an important role in the development, containment and conclusion of social, political and cultural conflicts.

The movement of people and migratory flows has changed as a result of the new multi-polar world order. By studying the emerging migrant trajectories and new global connections, we will be able to predict their impact on immigration to Europe.

In the wake of continued EU expansion, European society has grown to encompass a more diverse range of cultural and linguistic resources. This calls for new insights into the processes that lead to language development, language change and language transfer.

Research in education and learning will help to achieve the ambitious goal of education for all, and ensure that young Europeans gain the knowledge necessary to build the Europe of tomorrow.

Key research areas 2014-2020

- New conflict dynamics during globalisation
- Migration and livelihoods
- Communication in global conflicts
- Poly-lingualism and communicative super-diversity
- Knowledge of Asia – a necessary perspective for solving Europe's great challenges
- Education in Europe

Food Security

The challenge

We need to ensure that the food we eat is of good quality – and that there is enough of it to feed our own and future generations. Securing a sustainable supply of healthy food products is one of the greatest challenges of the 21st century.

Addressing food security

Plants, the basis of all food, need fertile soil to grow in. Agricultural research should focus on regimes that render high yields without risking eutrophication or exhaustion of the soil and the sustainable use of feed resources for livestock production to secure global food production for a growing human population. To achieve this, we must increase our knowledge of plant and soil ecology, soil microorganisms, plant-microbe interactions, plant stress and pest resistance, and use this knowledge to cultivate new approaches to crop development, soil management and food production and processing technologies to develop sustainable yield regimes.

We need to build a European knowledge base on quality and safety in animal derived production and products, improve efficiency of conversion of feed to animal product and

improve livestock management systems to reduce pressure on arable land and water. Ideally, our efforts in sustainable crop and animal food derived production should be supported by global trade systems that ensure the distribution of healthy and sustainable foods.

Certain foods have an adverse effect on our health. Current research has revealed that major human health problems may be linked to the microbial interactions in our digestive system. The implications of these discoveries for human health and society at large are significant and need to be explored further.

Key research areas 2014-2020

- Production tools and crops for sustainable food production
- Management systems for sustainable intensification of livestock production
- New crop and livestock genotypes
- Safer global food transportation
- Decreased food and feed spoilage
- The nature and biology of emerging food safety and food production threats
- The human gut microbiome's contribution to human health and disease
- Disseminating antibiotic resistance through food
- Global epidemiology and alert systems
- New food processing technologies for side stream utilisation and shelf life extension
- Food intake for nutritional, social, and environmental sustainability
- Sustainable animal derived food production
- Global trade system
- Crop plants and livestock systems with increased pathogen resistance
- Innovation systems
- Crop plants with increased tolerance towards environmental stress
- Crop plants with increased nutritional value (vitamin A, zinc and iron)

UNIVERSITY OF COPENHAGEN
RESEARCH & INNOVATION
OLE MAALØES VEJ 3, 1ST FLOOR
DK-2200 COPENHAGEN N
PHONE +45 35 32 66 03
WWW.FI.KU.DK