Position Paper of the Helmholtz Association of German Research Centres on Earth and Environment Aspects in Horizon 2020

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HELMHOLTZ ASSOCIATION

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Helmholtz-Position paper on HORIZON 2020

On the activities
„Climate Action, Resource Efficiency and raw materials” and

“Food security, sustainable agriculture, marine and maritime research and the Bio-economy”

INHALT

Introduction

The increasing vulnerability of highly organised urban centres to natural hazards; climate change; the growing scarcity of useable land, raw materials and energy sources due to ever increasing population growth and industrialisation; changes in ecosystems and air quality jeopardizing the basis of human life and health: These are some of the enormous societal challenges facing us in the 21st century. The major goals of research should be investigating and mitigating the impact of these developments.

To tackle these challenges successfully, effective strategies should be developed to mitigate and deal with natural hazards and the effects of climate change, to ensure the sustainable and efficient use and protection of geo- and ecosystems over the long term and, finally, to adapt to climate change.

At the same time, the related socioeconomic consequences should be analysed in order to elaborate options for political actions.

From the perspective of Helmholtz Association the following strategic research topics should therefore be addressed at the European level:

Strategic research topics

In the view of the Helmholtz Association, the following two major research areas and subthemes should be addressed at the European level:

1. Climate change, effective and efficient use of resources and raw materials

a. Climate change mitigation and adaptation

Research in this priority area should focus on the development of sustainable and innovative mitigation and adaptation strategies at the regional level as well as on providing complex knowledge in a comprehensible form.

➢ Regional climate change

The effects of global warming vary widely according to geographic region. Therefore, regional climate change research is essential and provides the foundation for the development of mitigation and adaptation strategies.

In 2009, eight research centres of the Helmholtz Association joined together to form the Helmholtz Climate Initiative REKLIM (Regional Climate Change) with the aim of investigating the various aspects of regional climate change. REKLIM focuses on the following seven topics related to climate change, which are also of relevance at the European level:

- **Coupled modelling of regional earth systems**

How does the development of the climate depend on the interaction between the atmosphere- ocean- ice and land surfaces? What are the effects of natural and anthropogenic processes?

This research topic aims to develop a coupled earth-system model for applications at the regional scale. Special areas of investigation here are the polar regions and Europe. The earth-system models consist of high-resolution regional atmospheric models and models for ocean, sea ice, land surface, soil, aerosol chemistry vegetation and other components.

- ## Sea-level changes and coastal protection

  How large are the losses of the continental ice mass (in particular, in Greenland and West Antarctic) and how are sea levels affected by melting ice and ocean warming?

  Melting glacier and ice banks contribute about 40% of the rise in sea levels. Currently, the rate at which ice masses are melting is increasing worldwide. In particular, the evolution of the ice sheets in Greenland and the West Antarctic will be crucial. One important unknown factor involves the dynamics of glaciers and ice flow (and their capacity to transport ice to oceans. Other unresolved questions relate to the reaction of the oceans to warming temperatures and the concomitant increase in the supply of fresh water from melting ice, the changes in the Earth‘s gravitational field as a result of decreasing ice cover and the effects of rising sea levels on coastal areas..

- ## Climate changes in the Arctic

  What are the reasons for major climate changes in the Arctic and what are their long-range effects?

  By measuring processes which occur on land and in the ocean, it is possible to analyse melting permafrost regions and the associated release of greenhouse gases (particularly of methane from gas hydrates) caused by Arctic warming. At the same time, the impact of ice retreat and the influx of fresh water from melting ice on the circulation in the Arctic Ocean should be investigated.

  In addition to the thematic focus of the REKLIM initiative, changes in the Antarctic are of great significance because of the uncertainties relating to the divergencies in developments in the two hemispheres. Because different parts of the Antarctic evolve quite differently from one another, this paradoxically leads to the deceptive conclusion that, taken as a whole, the Antarctic seems stable, even as certain areas of the region are changing dramatically. The divergence in the development of each of the polar area is the key to understanding the underlying processes.

- ## The role of land surfaces in the climate system

  What are the regional impacts of climate change on the ecosystem, water resources, agriculture and forestry and how do these in turn affect climate?

  The complex links between the physical, chemical and biological processes at the interface between atmosphere and land surfaces are as yet imperfectly understood. A better understanding of the complex interconnection is essential to improving the prediction of regional climate change and its impact on human life and health.

- ## Chemistry-climate Interactions

How is regional climate affected by changes in the atmospheric composition?

The careful interpretation of data relating to atmospheric composition and the use of models can improve our understanding of the influence of ozone, aerosols, water vapour and clouds on our climate system in selected regions.

- ## Extreme weather events

How will the severity and frequency of extreme weather events change in a future climate?

The consequences of extreme weather events are determined by local weather conditions and the vulnerability of living spaces and infrastructure. The topic is thus highly relevant, and the results serve as the basis for adaptation measures.

The primary focus of research in this area is the study of extreme weather events such as storms, heavy precipitation, heat waves, droughts and and their effects, e.g. floods, at the local and regional level, both past and future. To tackle this challenge successfully, it is necessary to use all available data sets and detailed modelling to better understand rare extreme events than has previously been the case in more global climate simulation models.

- ## Strategies for regional adaptation to and mitigation of climate change

Integrated climate policies comprise the mitigation of greenhouse gas emissions and adaptation to climate change. Is there an optimal approach to adaptation and mitigation?

Given the current level of economic knowledge, policies relating to adaptation and mitigation can be optimised only by integrating them better into environmental, economic and social policies. Conflicts between different policy goals must be identified and minimized as much as possible.

What priority should be given to climate protection and climate adaptation in different policy areas? What reporting obligations exist? What resources are needed to investigate the effects of mitigation and adaptation? At the same time, innovative approaches to socio-economic research on adaptation in regions are necessary.

In addition, the Helmholtz Association has defined three other priority research topics of great relevance at the European level.

- ### Elucidating rapid climate changes through the use of proxy data

  Research in this area should focus on elucidating the regional evolution of abrupt climate changes. A comparison must be drawn between the present warm period and the previous one which happened about 125,000 years ago. In addition, the rapid climate change which took place at the end of the last two ice ages about 10,000 – 135,000 years ago should be also be a focus. In order to understand the regional implications of these drastic changes, new, extremely precise climate archives should be used. Examples include ice cores from Greenland and the Antarctic, marine sedimentation from the Northern Pacific and the tropical Atlantic as well as the deposits from the Mediterranean and East China. In a next step, these regional climate data should be compared with the models in order to detect previously unknown long-term impacts, feedback loops and quantitative thresholds in the climate system.

- ### Climate change and air quality

  Climate change and air quality should not be considered in isolation because in fact these factors exert a strong mutual influence on each other. To understand how climate change affects human health, these two factors must be considered together. Investigations in this area should help to identify unfavourable living conditions in urban environments and densely populated areas. Based on the findings, measures to alleviate the effects of climate change on persons suffering from chronic diseases should be defined. Adaptation and mitigation strategies could then be evaluated from a health point of view.

- ### Risk assessment and management for climate change adaption and mitigation strategies

  Climate change is already reality in Europe. The average temperature is rising, growth periods are changing and extreme weather events are on the increase. Even if it proves possible to reduce greenhouse gas emissions, many changes will be unavoidable because of the inertia in the climate system. Society must therefore learn to manage the risks associated with climate change. Future European climate policy should be science based in order to estimate risks and to evaluate possible coping strategies. Failure to adapt in a timely manner will lead to considerable detriments to the economy and society.

Research should therefore focus both on climate change and on socio-economic transformations, since both processes are linked to one another in areas such as land use, transport or population settlements. One focus of risk evaluation should comprise extreme meteorological events such as storms, extreme precipitation, floods as well as prolonged periods of drought and storm floods.

➢ Earth System Knowledge Platform

How quickly does the sea level rise? When do invasive species damage native biodiversity? Where are droughts occurring? How high is the risk of earthquakes? Answers to these questions are important for urban planners, farmers, politicians, industry and business. It is essential to analyse and communicate complex knowledge about our earth system in a compact and comprehensible form for different user groups. The Helmholtz Association is currently developing a new information and dialog platform called "Earth System Knowledge Platform" (ESKP) which aims to provide information on the risks and impacts of global change. The platform will also formulate possible global change adaptation strategies appropriate for cities and regions. It thus assumes an advisory function for policy makers, business and industry and society in general.

High-priority topics in this area include climate change adaptation, extreme weather events, biodiversity and water.

Similar platforms that foster pan-European networking should also be developed in other European countries.

➢ Climate Engineering

Climate Engineering (CE) can be defined as deliberate, large-scale interference in the functioning of earth systems with the aim of counteracting the effects of anthropogenic climate change. In addition to the avoidance of concentrations of greenhouse gases (mitigation) and climate change adaption, CE thus represents a third way of confronting the effects of global climate change. To achieve this, measures like Solar Radiation Management (SRM), which seeks to modify natural earth systems or Carbon Dioxide Removal (CDR) to reduce greenhouse gas concentrations in the atmosphere, are being currently discussed. Examples of SRM include measures to encourage cloud formation by adding condensation or ice crystals or spreading aerosols in the stratosphere. Examples of CDR include fertilising the ocean with micronutrients or artificially accelerating the weathering of silicate rocks.

The aim of the proposed investigations is a scientific analysis of CE technologies that have already been put forth. This includes

- targeted process analyses (laboratory experiments, field measurements, theory) and
- various modelling approaches (local, regional, global models and earth system modelling) that make use of the results obtained during the process analyses as well as
- measurements recorded through different platforms (soil, ship, airborne recording instruments and earth observation satellites) to validate the models and process parameterisations.

In contrast, no new CE methods or technologies for climate interventions that have already been proposed should be developed.

b. Sustainable Management of natural resources and ecosystems

Providing knowledge for the sustainable management of natural resources and efficient exploitation of limited resources should be a central focus to European research objectives.

➢ Sustainable use of resources

The atmosphere, hydrosphere, cryosphere, biosphere and geosphere all hold substantial resources that are the basis for public goods in form of food, drinking water, raw materials or the production of economical goods, as well as temporary or permanent reservoirs of emissions. Various factors like demographic change, intensified land use, mining, the impact of chemicals and climate change jeopardise these natural resources.

In the view of the Helmholtz Association, the following research topics in particular should be addressed:

- Analysis of availability and productivity of these resources in the context of global change on the various relevant scales – global, regional, local
- Development of better forecasting tools (model systems)
- Drawing up adapted technology and management concepts for sustainable and integrated resource stewardship across all scales

- Development of options for action by decision-makers in the social and political arena aimed at sustainable use of natural resources and sustainable interaction with the environment
- Bio-economy and protection of human health are necessary cross-cutting topics in this context

Ideal conditions for tackling these research topics prevail in the Helmholtz Association, both in terms of the scientific competencies and with regard to the existing infrastructure (monitoring systems for all scales).

Major research needs are highlighted below on the basis of examples:

➢ Efficient use and sustainable management of resources – water, soil, plants

WATER:

Water is an essential, but often scarce resource. Water shortage prevails in many regions around the world and pollutants threaten water quality. In future the great challenges for water research will primarily result from the necessity of viewing the topic increasingly in connection with questions of global change, climate change, the growing geopolitical significance as well as energy and health aspects.

In the view of the Helmholtz Association, the following research topics in particular should be addressed:

▪ Influence of global change on water resources (development of scenarios)

In future a third of the world's population will suffer from significant water shortage. There are several reasons for this. As the world population continues to grow, it is depleting water and soil as natural resources. In addition, mega-cities are getting bigger and bigger and extreme events like drought and floods are on the rise. All of this creates additional problems relating to the use of water as a resource. As a consequence, food also becomes tremendously scarce. Realistic future scenarios have to be developed and used as a basis for specifying possible options for taking action.

▪ Sustainable water resource management

Modern water management is based on the idea of "integrated water resource management". Water resources should be viewed and managed holistically. For this reason different factors have to be examined. They include natural regions and ecological questions, an understanding of ecosystem services as a process, protection of drinking water quality and different political systems and institutional structures. These social conditions also have to be incorporated into the new concepts of water management.

- ### Determination of water and materials cycles on a regional scale

  The focus here is on developing methods to determine the pathways of nutrients and harmful substances, such as pesticides or drug residues, in the catchment area of water bodies. The interaction of these substances with water ecosystems should also be investigated.

- ### Integrated observation and exploration concepts for recording long-term trends and developments

  Six Helmholtz centres have created a Germany-wide network of integrated long-term observatories in the TERENO (Terrestrial Environmental Observatories) research infrastructure. This concept will now be applied to other countries, particularly in the Mediterranean region, with respect to the field of water. The focus is on hydrological questions, such as whether precipitation, runoff and soil moisture should be measured in the catchment area of water bodies. The data collected provide a key basis for hydrological models. This will make it possible to predict the development of water resources more reliably in regions with a low data density.

- ### Applied ecology

  The quality of water resources is primarily determined by self-cleaning processes in surface waters and groundwater. Applied ecological research creating a knowledge-based foundation for environmentally protective management of aquatic ecosystems is necessary to ensure sustainable use of ecosystem services.

- ### Hydrological models

  The objective is to utilise the extensive knowledge on the water cycle and its interactions with the environment in order to develop suitable modelling tools. New software structures and modern tools for data integration shall provide the basis for this.

- ### Scarce water resources in the Mediterranean region

  The problem of water scarcity is particularly pronounced in the Mediterranean region. In view of the future challenges, the Mediterranean region needs proper water management. Research in this connection should focus on data procurement, water management and technological development.

SOIL:

Use of global soil resources has become so intensive that the resulting overexploitation and consumption due to human activities take place faster than the formation of new soil. For this reason it is necessary to conduct soil research in a broad context so it is possible to meet the urgent need for systems solutions aimed at preventing and reversing soil degradation. This research has to take the interplay between soil and water into account, incorporate both natural science and social science research as well as generate technological solutions.

PLANTS:

Plants – basis for food and renewable resourcesals

Production of adequate and safe supplies of food as well as renewable resources represents a worldwide challenge. Plant research should be geared to supplying the scientific bases for sustainable plant production. Based on phenotyping, dynamics of growth processes or plants-environment interactions, the aim is to develop biological system approaches to the environmental interaction of plants that target improved plant production. Biotechnological innovations are supported. Mechanisms and genetic potential that may contribute to improving plant production (e.g. resistance, biodiversity, resource-efficient growth, green biotechnology) should also be investigated and developed further in collaboration with breeders and industry partners..

➢ Future ecological systems

As a result of global change, ecosystems on land and in the sea are changing enormously. **Climate change, intensified land use and the global exchange of organisms impair biological diversity and also have an impact on the distribution of ecosystems.**

In the view of the Helmholtz Association, therefore, there is a need to investigate the consequences of these changes, which range from supply bottlenecks to health problems. The objective is to create a scientific basis for sustainable use and protection of ecosystems – for the benefit of society.

The focus should be on three key research topics of eminent social relevance:

- ## Analysis of ecological processes and functions

  What factors lead to a change in ecosystems? How quickly do changes take place?

  The various ecosystems in the polar regions, in the deep sea, along coasts, on land or in cities differ greatly from one another. In spite of this diversity, it is possible to identify general principles and mechanisms that apply to all ecosystems. On that basis one can develop further options for the management and protection of ecosystems that are subsequently incorporated into international standards..

- ## Influence of global change on the dynamics and capacity of ecosystems

  Oceans, coasts, rivers, mountains, forests, polar, semi-arid and arid zones as well as, in particular, intensively used cultural landscapes are extremely sensitive, and at the same time exceptionally important ecosystems. One of the indispensable missions of future European research is to investigate direct and indirect consequences of global change for these ecosystems, on the one hand, and the results of adaptation and mitigation measures, on the other hand.

- ## Sustainable use of ecosystems

  What impact does use of land and sea have on the biodiversity of ecosystems? How does biodiversity regulate the productivity of ecosystems? Research should examine the consequences of current and future use of ecosystems. The focus should be on key services of ecosystems, such as the production of biomass, soil formation, carbon storage, climate regulation, water purification, water storage and the diversity of genetic resources.

- ## Risks due to chemicals in the environment

  What risks result from worldwide use of chemicals for our ecosystems and, in the end, for people? How can we assess and minimise these risks? What is necessary is prospective chemical safety research that identifies innovation potential for the development of materials and products and, at the same time, strives to improve our understanding of ecosystem services for the management of pollutant degradation. This requires analytical tools for identifying and evaluating causal drivers in ecosystems subject to multiple stresses as well as combining location-specific assessments of detected stresses with prospective evaluations with the aim of improving extrapolation models. Creation of intelligent expert systems for integrative risk management is imperative. The same applies to coupling the development of environmental process technologies to environmental assessments. Synergy potential between human- and environment-oriented risk research should be exploited better.

➢ Development of sustainable global environment-related observation and information systems

In the view of the Helmholtz Association, the methods and approaches listed below are urgently necessary for observation of ecosystems on land and in the sea. The Helmholtz Association has the prerequisites for this based on the multidisciplinary aspects, the substantial research infrastructure, both existing and still to be developed, as well as the long-term oriented research:

- **Observation and monitoring of the environment** (research stations, research vessels and aircraft, measuring and observation systems)
- **Large-scale ecosystem experiments**
- **New modelling approaches from molecular to global scale**
- **Development of use and management strategies for ecosystems**

These analyses and research strategies can only be realised if natural-science-oriented ecological research is supported by socio-economic research. The social sciences provide important information on the types and mechanisms of anthropogenic effects on ecosystems.

c. Understanding natural hazards and estimating risks

Earthquakes, volcanic eruptions, floods and storms cause enormous damage worldwide every year. Creeping risks, too, like climate change, threaten humanity to an increasing extent, e.g. through the rise in sea levels or permafrost thaw.

For this reason the objective should be to understand natural hazards better, analyse their risks and develop methods offering protection against unavoidable natural events. It is thus essential to monitor the processes on the Earth using measuring instruments, develop precise models and make these models even more reliable using measurement data. Consequently this research should also receive support at the European level.

- ### A better understanding of extreme events

  The risks of future extreme events for the population are assessed by reconstructing past extreme events on the basis of data series of measurements and geological archives (e.g. deposits on the sea floor, marine sediments or ice cores). Major research topics here include the possible triggering of volcanic eruptions by severe earthquakes, the economic and ecological consequences of massive emissions of harmful substances and of flooding or storm surges.

- ### Early- warning systems

  The focus is on developing early- warning systems on the basis of case examples (e.g. tsunami early- warning system) by optimally combining the capacities for data collection for early- warning systems (satellites, aircraft, measurement observatories on land and in the sea) with analytical and simulation tools.

- ### Catastrophe management

  The key objective is to create better bases for catastrophe management decisions. This involves developing new methods for analysing hazards, vulnerability and risks. Other important aspects include the incorporation of socio-economic developments, simulation (of the extent) of damage to regional infrastructure caused by extreme weather events, and research on flexible strategies for prevention and follow-up.

To ensure sustainable supply of non-energy mineral resources in Europe, the following research topics in particular appear relevant in the view of the Helmholtz Association:

d. Sustainable supply with mineral resources

➢ Geo-resources

The objective is to develop new concepts and technologies for exploration, extraction and precautionary, efficient and sustainable use of the natural energetic, metallic and mineral resources of the Earth. This includes terrestrial as well as marine exploration and raw materials research (e.g. submarine massive sulphide deposits, deep sea mining).

➢ Anthropogenic resources

The objective is to develop new methods relating to technology and business management (e.g. secondary raw materials management) for exploration, extraction and processing of anthropogenic (i.e. human-induced) resources ("urban mining"). One focus shall be on non-ferrous metals (Cu, Zn, Pb), precious metals (Au, Ag, Pt) and deposits of special elements (In, Ga, Ge, Se) for high-tech applications. The recovery of phosphorus from wastewater is of central interest as peak phosphorus will be in about 20-30 years. Phosphorus is an important component in agriculture fertilisation and therefore a main element in the bioenergy concept. The new recovery technologies need to be based on microbial concepts of ecosystems analysis.

➢ Earth Engineering

Of relevance here are investigations of rock deep underground, in particular specific rock-fluid interactions. Furthermore, it appears important to develop and implement technologies and strategies for utilising underground areas for geothermic energy production as well as to acquire an understanding of the processes involved in technical manipulation of the fluid system.

e. Eco-innovation, sustainable production and consumption

➢ Sustainable production

The aim of this research field is to research and develop new methods and processes for economic, ecological and social assessment of resource technologies. On this basis, strategies for ensuring sustainability must then be researched and developed. There is a necessity for assessing sustainability in all stages of the raw material value chain:

- deposit assessment, e.g. through specific consideration and quantification of environmental and social risks,
- extraction, e.g. especially for small deposits or for in-situ extraction (by means of leaching or gasification),
- processing, e.g. in line with holistic assessment of non-conventional extraction and processing methods in marine mining and deep-sea mining,
- refinement, e.g. through comprehensive assessment and optimisation of refinement processes with simultaneous reduction in harmful emissions and wastes, and
- recycling, e.g. by means of new approaches in secondary raw materials logistics.

In addition, regarding technological development in all stages of the value chain, it is necessary to keep in mind the high priority of raw materials and energy efficiency and to take this into account accordingly right from the development stage. Moreover, those involved in the product design stage must ensure that products are designed with an eye to subsequent recycling of the recoverable components ("smart design").

➢ Consumption

With regard to recycling of recoverable materials, industry, government and society have to ask themselves how marketable end products using recycled material really are. Not only does the question of the general price and demand sensitivity play a role, but also, for example, whether and to what extent consumers are willing to pay for this or even tolerate it (e.g. in the case of use of recycled components in automobile production).

2. Food safety and sustainable bio-resources

a. Sustainable bio-economy

The sustainable bio-economy is aimed at utilising biological resources efficiently and sustainably. It strives to reduce the current overexploitation of ecosystems and looks for long-term innovative solutions for this purpose. Sound knowledge about plants, microorganisms, animals and their biotic communities form the basis of a sustainable bio-economy. Many branches of industry already utilise biological resources in an innovative manner. Plants, animals and microorganisms form the basis of agriculture and forestry, fisheries and the food industry. Parts of the chemical, pharmaceutical, cosmetics and textile industries are also dependent on them. In addition, biomass in the form of wood, biogas and bio-fuels is gaining importance as a source of energy.

However, the limits of sustainable use will soon be reached. More and more land is cultivated by people. The demand for food and animal feed as well as energy and raw materials is rising because of the rapid growth in the world population in the last century and its current increase at the present time. As a consequence of overexploitation, supply bottlenecks may emerge and ecosystems may be damaged.

The enormous advances made in genetics and molecular biology offer great opportunities for solving these problems.

In the view of the Helmholtz Association, four innovative research topics with considerable future potential should be addressed:

➢ Plants – basis for food, renewable resources and bioenergy

Plants are used in a variety of ways. They serve as food and animal feed and as renewable resources, and are used to produce bioenergy and recyclable materials. To meet the growing demand, biomass production has to be increased – at constant or even better quality. There are limits to growth, however, because soil and water resources are finite and there is a shortage of plant varieties with high resource use efficiency. Furthermore, climate change is altering the conditions for cultivation.

The following research approaches should be advanced. Stress resistance of plants, for instance, should be improved by employing state-of-the-art genetic and biochemical tools. Moreover, we should examine how plants interact with the environment, e.g. with pathogens or microorganisms in the area immediately surrounding the roots. In addition, new methods should be developed to represent functions like photosynthesis and growth with the help of computer models. These methods help to develop new varieties of crops and resource-protecting production processes.

➢ Integrated production systems

To cover biomass needs, it is not only necessary to optimise the plant system. Agricultural production also has to be intensified. This can be achieved by means of better production systems for using existing areas as effectively as possible and also in a sustainable manner. However, climate change makes it increasingly difficult to increase production: extreme weather events that will occur more frequently in future may cause harvest losses.

Sustainable production systems should protect soil and groundwater. This means special production systems have to be developed for locations that are not suitable for food production, e.g. so-called multi-species grassland systems. These systems are aimed at producing biomass for energy production and at the same time protecting biodiversity. Another research topic involves rapidly growing trees that are grown in plantations and supply good yields even in dry regions. They can contribute to soil improvement and water protection.

➢ Polygeneration: plants as chemical factories and power stations

Biomass serves as the basis for diverse products. Plant residues and animal biomass can be converted into heat, electricity, fuel or raw materials for the chemical industry. The aim of the bio-economy is to utilise biomass as completely as possible. The concept of polygeneration is applied to achieve this aim. This involves combining different production processes in a single facility to produce several products. One of the prerequisites is to develop methods enabling production of energy and raw materials from biomass at the same time. Furthermore strategies for process control and optimization as well as concepts for the use of gaseous starting materials have to be developed. Furthermore, research should be conducted on the use of residual substances for the production of bio-fuels. This requires development of methods for producing and utilising methane, methanol, hydrogen and carbon monoxide microbiologically. Concepts of microbial ecosystems analysis need to be involved.

Infrastructure

Research infrastructure plays a key role in connection with the capacity and innovativeness of European research and technological development. The application of research infrastructure (such as satellites, research vessels, research aircraft, radar stations, observatories) is indispensable for obtaining new findings in many scientific and technological fields. They not only serve to carry out experiments and measurements, but also offer platforms for scientific and technological collaborations. Aside from that, they represent an excellent training centre and thus generate highly qualified junior researchers. Research infrastructure should be extensively promoted according to its great significance for the capacity and innovativeness of the European Research Area. The European Union and the Member States are called on to develop new concepts coordinated at the regional, national and European level for more effective financing of investment and operating costs for the research infrastructure.

European Climate Research Alliance (ECRA)

Strategic partnerships between European research organisations and institutes accelerate our tackling of the great social challenges and should therefore be promoted.

In the field of climate research nine leading European research organisations (SMHI, ENEA, NMI, DTU, FMI, CIEMAT, KNMI, NCAS and the Helmholtz Association of German Research Centres) officially joined under the lead management of the Helmholtz Association to form a European Climate Research Alliance – ECRA in October 2011.

The research organisations and institutes play a major role in the formulation and implementation of strategic research agendas with respect to key scientific and technological questions. They work on the development of international standards, network with research partners in different countries and sectors and operate important research infrastructure for the international research community. They represent a major link between the EU, the Member States and other players and sectors in the pan-European science system. Through greater incorporation into the shaping of research programmes (bottom up) and networking of research organisations and institutes among one another it is possible to achieve greater synergies by bundling research capacities.

The EU should therefore provide funds for coordination measures for strategic alliances of research organisations and institutes in major sectors of industry and fields of research. This is the only way to optimally tackle the great present-day and future challenges.

BRIEF PORTRAIT OF THE HELMHOLTZ ASSOCIATION

In the Helmholtz Association, 18 German research centres have joined forces to share their resources in strategically oriented programmes to investigate complex questions of societal, scientific and technological relevance.

They concentrate on six major research areas: energy; earth and environment; health; aeronautics, space and transport; key technologies and structure of matter. The scientists work closely together across the centres on these issues.

The Helmholtz Association provides the necessary resources, a framework for long-term planning, a high concentration of scientific competence and an outstanding scientific infrastructure with major projects, some of which are unique worldwide.

The research objectives of the Helmholtz Association are set by the funding bodies after discussions with the Helmholtz centres and the Helmholtz Senate and Assembly of Members. Within this framework, the scientists of the Helmholtz centres determine the themes of their research through strategic programmes in the six research areas across centres.

(Source: “Strategy of the Helmholtz Association,” Berlin 2009 - updated 2012)

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Helmholtz Centres

- Alfred Wegener Institute for Polar und Marine Research
- Deutsches Elektronen-Synchrotron DESY
- German Cancer Research Center
- Deutsches Zentrum für Luft- und Raumfahrt
- Deutsches Zentrum für Neurodegenerative Erkrankungen
- Forschungszentrum Jülich
- GEOMAR - Helmholtz Centre for Ocean Research Kiel
- GSI Helmholtz Centre for Heavy Ion Research
- Helmholtz Centre Potsdam GFZ, German Research Centre for Geosciences
- Helmholtz Centre for Environmental Research – UFZ
- Helmholtz Centre for Infection Research
- Helmholtz-Zentrum Berlin für Materialien und Energie
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research
- Helmholtz Zentrum München, German Research Center for Environmental Health
- Karlsruhe Institute of Technology
- Max Delbrueck Center for Molecular Medicine (MDC) Berlin-Buch
- Max Planck Institute for Plasma Physics (associated member)

This paper presents a consensus of the views
of the Helmholtz Association and its centres.

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