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ForeIntegra

Desk Research and Draft Drivers report

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ForeIntegra Desk Research and Draft Drivers Report

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I. EC Europe-wide initiatives and basic concepts

1. European Roadmap for Research Infrastructures (ERRI); Report 2006

Research facilities are increasingly becoming **more complex** and **more expensive.**

ERRI should identify **vital new RIs of pan-European relevance** of different size and scope.

The vision of new RIs arises from the **fundamental challenges** and **developments** faced by Europe:
- ✓global warming,
- ✓energy production,
- ✓water supplies,
- ✓sustainable environment,
- ✓quality of life for ageing population, etc.

It is becoming increasingly important to plan future large scale Research Infrastructures on timescales approaching one or two decades. Research Infrastructures are one of the crucial pillars of the European Research Area, in particular for capacity building. As the frontiers of research are pushed back, research facilities are increasingly becoming **more complex** and **more expensive**, to the point where a single government or indeed a single continent cannot find within itself the financial resources for their realisation. The construction and management of new Research Infrastructures thus becomes a global endeavour. **Since many of the anticipated infrastructures will be funded and managed as truly European facilities, ESFRI took the initiative to propose a synthesis to be put at the disposal of the various decision-makers**

The ESFRI's definition on RI, including the associated human resources, covers major equipment or sets of instruments, as well as knowledge-containing resources such as collections, archives and databases. Research Infrastructures may be "single-sited", "distributed", or "virtual" (the service being provided electronically). They often require structured information systems related to data management, enabling information and communication. These include technology-based infrastructures such as grid, computing, software and iddleware.

The Council stresses that this roadmap should identify vital new European Research Infrastructures of different size and scope, including medium-sized infrastructures and those in the fields of humanities and bio-informatics, such as electronic archiving systems for scientific publications and databases. Research Infrastructures of pan-European relevance provide unique opportunities for world-class research and training as well as to stimulate knowledge and technology transfer, in brief for European capacity building. They **are one key instrument in bringing together a wide diversity of stakeholders to look for solutions to many of the above-mentioned problems.** They can be seen as a focal point for such interactions, in addition to inspiring new research ideas and attracting young enquiring minds.

The vision of new Research Infrastructures arises from an assessment of the fundamental challenges facing Europe and of the unprecedented developments and opportunities in science. These include global warming, energy production, water supplies, a sustainable environment, the threat of terrorism, quality of life for an ageing population, in addition to social issues such as the continuing divide between rich and poor which can lead to instabilities in society. New Research Infrastructures are required to monitor and predict such changes, and to help develop new sustainable production and consumption schemes. In addition some research questions can only be answered by a European and global response.

In the roadmap, ESFRI deals with facilities, resources or services of a unique nature that have been identified by pan-European research communities to conduct top-level activities in all fields. If EU industry is to compete in an increasingly globalised world, it must lead in high tech production. It must assimilate **new "hybrid" technologies such as nano-sciences, bio- or information technologies.** This requires pan-European collaborations to succeed and to get access to high quality international Research Infrastructures. In many cases researchers from a wide range of backgrounds meet around such facilities and this meeting of minds is a rich ground for spawning new areas of interest and looking at problems in a new way leading to new insights.

In addition, most of the large Research Infrastructures now operating with open access in Europe have been built and are mainly funded by single countries. They are "national" in financial terms, but pan-European in scientific terms. They act, in fact, as "Agencies" increasingly transferring resources between Member States, in the form of services given to European researchers. However, today the EU risks losing its international leadership in several fields because many of the critical facilities are nearing the end of their useful life, as shown by a recent survey. Moreover the costs of many envisaged new facilities, or their major upgrade, cannot be met by individual countries as in the past.

The development of a common policy for access to and the provision of new and improved Research Infrastructures gives equal opportunities to all Member States, including those without large research capacities.

Support for agri-food research institutions in the new Member States and Candidate Countries to become truly multidisciplinary and to gain pan-European significance.

2. Concept of European Knowledge-based Bioeconomy

Knowledge-based Bioeconomy (KBBE) is based on the use of renewable bio-resources and bioprocesses for creating new, sustainable, eco-efficient and competitive products.

If EU industry is to compete in a globalised world, it must lead in high tech production and assimilate **new "hybrid" technologies** (nano-sciences, bio- or information technologies). This requires pan-European collaborations on RIs and expertise.

Most of the recent large RIs are "national" in financial terms and "pan-European" in scientific terms. They near the end of their useful life and the costs for upgrades or new facilities are too expensive for a single country.

Knowledge-based Bioeconomy (KBBE) is defined as a portion of the economy based on the use of renewable bio-resources and bioprocesses by transforming life sciences knowledge into new, sustainable, eco-efficient and competitive products. The main research fields for

building the knowledge-based bioeconomy are the so called 'white', 'green' and 'blue' biotechnologies. **White Biotechnology** is an emerging field within modern biotechnology that serves industry through sustainable processing and production of chemicals, materials and fuels. It uses living cells like moulds, yeasts or bacteria, as well as enzymes to produce goods and services. **Green Biotechnology** is rapidly expanding field within modern biotechnology related to plant biotechnology. It mainly involves the introduction of foreign genes into economically important plant species, resulting in crop improvement and the production of novel products in plants. **Blue Biotechnology** is used to describe the marine and aquatic applications of biotechnology.

Development of the Knowledge-based Bioeconomy is grounded on three main pillars

Pillar 1:
Sustainable production and management of biological resources from land, forest, and aquatic environments

- Enabling research ('omics', converging technologies, biodiversity) for micro-organism, plants and animals
- Improved crops and production systems incl. organic farming
- Sustainable, competitive and multifunctional agriculture, forestry and rural development
- Animal welfare, breeding and production
- Infectious diseases in animals, including zoonoses
- Policy tools for agriculture and rural development

Pillar 2:
"Fork to farm"- Food, health and well being

- Consumer, societal, industrial and health aspects of food and feed
- Nutrition, diet related diseases and disorders
- Innovative food and feed processing
- Improved quality and safety of food, beverage and feed
- Total food chain concept
- Traceability

Pillar 3:
Life sciences and biotechnology for sustainable non-food products and processes

- Improved crops, feed-stocks, marine products and biomass for energy, environment, and high added value industrial products; novel farming systems
- Bio-catalysis; new bio-refinery concepts
- Forestry and forest based products and processes
- Environmental remediation and cleaner processing

Recommendation: Coherence of policies impacting on KBBE

3. European Technology Platform "Food for Life"

The ETP's main **objective** is to meet the challenges of demographic changes of European population by **'adding life to years'.**

The ETP's **vision** has to consider the **specifications of the food sector** that require unique solutions.

The **Vision paper** identified strong need to **invest in health and nutrition RI** and enabling technologies

The **tasks** in the vision implementation cover, among others, the fostering of cross-disciplinary RIs and the support to Agri-Food RIs of the New Member States.

The vision of ETP "Food for Life" is directed towards an effective integration of strategically-focused, trans-national, concerted research in the nutritional-, food- and consumer sciences and food chain management will deliver innovative, novel and improved food products for, and to, national, regional and global markets in line with consumer needs and expectations.

The ETP's main objective is to meet the challenges of demographic changes of European population and 'healthy ageing'. The innovative food products, together with recommended changes in dietary regimes and lifestyles, will have a positive impact on public health and overall quality of life by **'adding life to years'. The key challenge for the long-term will be to influence an individual's state of ageing and to deliver a personal regime of nutrients, lifestyle and advice for healthy longevity** as stated in the Vision Document. Foods and drinks, in the right amounts and proportions, make a *major contribution to the well-being and healthy ageing of citizens*. through changes in dietary regimes and lifestyles with positive impact on public health and overall quality of life.

All actions and measures fostering the realization of the vision have to be designed by taking in consideration the **specifications of the food sector** that differ it from other manufacturing industries in a number of ways:

- although large, the sector is overwhelmingly populated by SMEs with a relatively small number of big players,
- its products are highly diverse and often production methods (especially in SMEs) are based upon craft rather than technology,
- the technological/production issues faced by the industry are equally diverse and impact directly upon public health and safety,
- food SMEs are, in general, not research-aware (often lacking specific R&D functions) and do not appreciate the contribution innovation could make to their business. This lack of awareness impacts upon both their competitiveness and on their ability to generate wealth within their community,
- the resource available to implement innovation is highly restricted,
- the timescale by which innovation must produce a return on investment is short,
- the food sector should produce safe foods that fit into a healthy diet and will add to the quality of life of European consumers.
- food products are difficult, if not impossible, to patent,
- products can only be marketed for a short time before similar products appear, and so have only small added-value compared with other manufacturing sectors,
- the market in Europe faces limited growth for demographic reasons (low population growth and an ageing population).

All these factors make the food sector unique and unique solutions are required to ensure a competitive industry.

No longer is it possible to determine the research agenda through the activities of the scientific community alone. Scientists in industry and academia must engage with the public and involve society as a whole in determining the research priorities. Only in this way will the legitimate concerns of the consumer be embraced, and an agenda developed that is in the

interests of all. *The main role of the Technology Platform is to develop and drive such an* **Strategic Research Agenda** *which has to meet the following* **7 challenges:**

Challenge 1: Ensuring that the healthy choice is the easy choice for consumers.
Challenge 2: Delivering a healthy diet.
Challenge 3: Developing value-added food products with superior quality, convenience, availability and affordability.
Challenge 4: Assuring safe foods that consumers can trust.
Challenge 5: Achieving sustainable food production.
Challenge 6: Managing the food chain.
Challenge 7: Communication, training and technology transfer

The ETP "Food for Life" Vision Paper identified the strong need to invest more in health and nutrition research infrastructure and enabling technologies if the EU wants to ensure that Europe remains a world-centre of excellence for nutrition research. By sharing ideas, best practices and databanks, and by establishing structured processes to build trust and consensus, breakthroughs will be created, which will allow the development of more effective nutritional interventions and dietary recommendations.

Tasks envisaged towards Vision's implementation:

- **Foster cross-disciplinary research centres: need for integration and collaboration (public-private partnerships), multidisciplinary approach, dietary surveys across Europe.**
- **Develop libraries, databases, biobanks, standardised protocols, networks of facilities.**
- **Training initiatives** focussed around the skill areas that are judged to be weak in Europe. A particular priority in this regard is the need to train scientists to be effective communicators with other stakeholders, including industry and consumers. In addition there is a dearth of properly trained and equipped young people to take advantage of the opportunities for project management within FP7. Finally, Europe needs to train, identify and support young entrepreneurs who will be key to Europe's vision of innovation.
- **Support for food research institutions in the new Member States and Candidate Countries to become truly multidisciplinary**, of a critical size to be effective, and to ensure a major input into their management structures from stakeholders. This latter might be addressed by co-operation and twinning initiatives through the FOOD*force* network mentioned above.
- The requirement that **effective dissemination to, and interaction with consumers forms part of any research programme** designed to improve the quality of the food chain.

The **Capacities and People pillars that form part of the EU 7th Framework Programme** provide the enabling opportunity to achieve these infrastructure reform objectives, but further analysis of the problems that have been raised should be undertaken as part of the proposed study in best practice (Design Studies).

Research related to food for health crosses the responsibilities of many funding authorities in most EU Member States, and there is not always a close co-operation between them.

A feature of the majority of the food research institutions in Europe is their focus on the characterisation of food materials and constituents, and their quantification. **The vast majority of the facilities in Europe are unable to provide all of the skills necessary in a single institution. This is an excellent argument in support of trans-national co-operation and of the European Research Area itself.** There is a notable lack of skilled input from clinical scientists, molecular biologists, nutritionists, toxicologists, and consumer scientists in many of them. In the case of diet and health-related work their input is essential.

In line with this need it is essential to dedicate resources to public interaction and dissemination. **Any institution or organisation that is able to easily access complementary skills, and has the flexibility to adapt to changes in consumer and market needs, will make a greater impact on the innovation process. Few have formed a strategic alliance between academia, government and industry and consumer representatives, in which all stakeholders have a role in determining the research agenda.** Worldwide there are such alliances *and a study of best practice, in the organisation of effective innovation delivery in the food sector, should be undertaken to guide future developments*.

Other Technology Platforms in Agricultural Research Areas are dedicated to: Plant Genomics & Biotechnology, Forest Resources, Animal Breeding, Global Animal Health, Food Technologies, Water Sanitation, Sustainable Chemistry incl. White Biotechnology and Bioenergy.

4. SCAR Committee activities on presenting Infrastructures in the field of agricultural research and Foresight on "EU Outlook Agriculture 2020"

In the context of the new global challenges the agricultural research agenda is **exceeding the national needs and priorities.**

Vital infrastructure for the agricultural research delivery builds sustainable, multifunctional and competitive "agricultural" systems in the long run.

SCAR Committee presented a Note to ESFRI, 31 August 2005 concerning the **"RIs required in the field of Agricultural research"** and identifying the specifics, challenges and trends in agrifood as well as the vital infrastructures for the effective research delivery.

Agricultural research and infrastructure have developed over the past, driven mostly by **national needs and priorities**. Research capacities and infrastructures developed more or less in parallel.

Today, agriculture is confronted with tremendous **new challenges**, be it from ***trade liberalisation*** and ***globalisation***, the ***changing consumer demands***, the increasing ***concerns with ecosystems or technological advances***. While tremendous progress was made in harmonizing and streamlining cross-border research activities at project and also at programme level, primarily due to the EU framework programmes and other integrative programmes, **advances in opening up and coordinating supportive infrastructures for agricultural research have been limited.**

Supportive infrastructures for agricultural research mainly continue to be driven by national needs and priorities, despite the fact that many challenges ahead of the agricultural sector do not stop at national boundaries. This is worrying in many respects as Europe is

highly dependent on functioning ecosystem services of which agriculture and forestry are important parts.

All Member States are confronted in one way or another with the following challenges:

- agriculture and rural areas in Europe will undergo radical changes over the next 15-20
- years (intensification as well as abandonment of activities with consequences for ecosystem services)
- growing threats from new and emerging infectious diseases as well as growing antimicrobial resistance
- already very narrow genetic basis for food and agriculture in Europe and still increasing genetic erosion
- climate change and increased likelihood of abrupt changes in ecosystems (disease emergence, invasive alien species, pollution and eutrophication, fisheries collapse, etc)
- the consumer's demand for healthy food preventing them from diseases like obesity, diabetes, cancers, etc.

The costs for maintaining the necessary infrastructure or to build new ones in order to support researchers in finding solutions to these interlinked and complex problems are getting simply too expensive.

Some individual member states have already responded to the earlier ESFRI calls and provided fiches that propose specific types of new infrastructure. SCAR wish to bring to the attention of ESFRI, a few examples provided by member states, of new infrastructures that may have a specific relevance to future agriculture research capacity. SCAR asks ESFRI to consider these alongside all other types of infrastructures.

Infrastructure that is 'vital' for 'agricultural' research delivery

Under this category falls infrastructure that is of utmost importance for building sustainable, multifunctional and competitive "agricultural" systems in the long run.

As indicated before, **Member States have already set up important agriculture research infrastructures according to their national needs and priorities**. These provide a range of unique support services for research that are critical to delivery at **national scale**. Such 'ongoing' infrastructures will benefit from further organisation, networking and development and should be considered within the thematic priorities of FP7, as well as within the 'Capacities' chapter of the programme.

Over and above these ongoing facilities, it is necessary to consider as well **large-scale infrastructures** and **pilot centres that enable research on new, complex long-term agroenvironmental issues**, which are too expensive to be funded by a Member State alone (unique research infrastructure).

Four categories of such "vital infrastructures" include;

- Genetic and biological resource centres including collections for plant and animal diseases
- Agriculture, Forestry and environment observatories
- Human nutrition research centres
- Advanced, integrated experimental facilities for infectious diseases
- Examples of possible facilities are described in the annex.

SCAR Committee foresight exercise "EU Outlook Agriculture 2020"

SCAR Committee has launched a foresight exercise to analyse possible scenarios for European agriculture in a 20-year perspective, allowing the identification of specific research

needs for the medium and long term. It applies a holistic approach including cross-challenges analyses by considering the following main topics and sub-topics included in the Terms of Reference: animal welfare, competitiveness, education, capacity building, etc. The **Methodology** followed is the elaboration of a set of foresight papers by an appointed expert group on major driving forces like: science and technology, rural economy, health, societal changes, economy and trade, environment, climate change. The **main steps** include a review report from the expert group, a conference in 2007 on Foresight for European Agricultural Research and a report of the Commission to the Council and Parliament

5. The Capacities pillar of the EU 7th Framework Programme

The overall objective of the "Research infrastructures" part of the FP7 Capacities programme is to optimise the use and development of the best research infrastructures existing in Europe. Furthermore, it aims to help to create new research infrastructures of pan-European interest in all fields of science and technology. The European scientific community needs these to remain at the forefront of the advancement of research, and they will help industry to strengthen its base of knowledge and technological know how.

II. Main issues for comparison in policy measures, approaches and challenges in RI by country

1. Typology of the existing Advisory bodies on RI policy

Ad hoc basis of strategic decision-making is mainly applied by countries with no official advisory body on RI policy

Specialized advisory bodies on RI policy operate as independent structures responsible for:
- ✓ long-term strategic planning
- ✓ involvement in national and international LSRI
- ✓ evaluation of proposals for new RI
- ✓ priorities setting for funding expensive equipment

Ad hoc basis is applied in creating temporary expert groups at the specialized advisory bodies.
Researched countries: Spain, Sweden

RTDI advisory bodies cover policy issues specific for RI as part of the overall research policy such as:
- ✓management of competitive calls for new RI
- ✓setting national long-term R&D priorities
- ✓formulation of research policy and administration of research centers

Principally the advice on RIs is given on an ***ad-hoc*** basis and **in different levels** by covering **all disciplines**.
Researched countries: Austria, Bulgaria, Cyprus, Czech republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, The Netherlands, Turkey.

Some specific structures serve as advisory bodies for RI policy-making:
- advisory bodies at state and federal levels
- independent funds
- advisory bodies at research agencies
- intragovernmental advisory bodies on coordination of RTI policies
- high level policy committees for future RI

Researched countries: Belgium, Germany, France, Malta, Romania, UK.

Countries with no official advisory body on RI policy

The vast majority of European countries do not have an officially established and specialized advisory body on RI policy. The strategic decisions are made on ***ad hoc* basis by the various science policy bodies and administrations concerned** – Austria, Belgium, Bulgaria, Czech republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, The Netherlands (*concerning Very large infrastructures*) and Turkey**.**

Countries with specialized advisory body on RI

Two European countries with official advisory bodies on RI have been identified by the recent desk-research. These are Spain and Sweden which in particular cases also apply an *ad-hoc* decision-making.

Spain

Decisions about Large Scale Research Facilities (LSRF) in Spain are taken by the **Ministry of Science and Technology (MCYT)**, with the advice of the **Spanish Advisory Committee of Large Scale Research Facilities** (Comité Asesor de Grandes Instalaciones Científicas, **CAGIC**). In some cases the decisions can involve the collaboration between the MCYT and local governments. CAGIC is an **independent advisory body** created by the Inter-ministerial Commission of Science and Technology (CICYT) to help the Spanish Government in the definition and implementation of policies related to LSRF. It directly reports to the Secretary of State of Scientific and Technological Policy that participates in some of its meetings providing guidelines on future actions and reports. **The main functions of CAGIC are:**

1. To advise on the opportunity of building new LSRF in Spain. To cover this function, the CAGIC can **create temporary *ad hoc* expert groups**. The Committee does not generate detailed technical reports but it focuses its activity on the analysis of viability and opportunity of a specific action.
2. To advise on the **participation of Spain in LSRF facilities located in other countries** and regulated by bilateral or multilateral agreements, or to propose changes in the current level of participation.
3. To evaluate requests for consideration as LSRF presented at CAGIC by scientific or technological entities or communities located in Spain.
4. To evaluate the scientific activity of the LRSF and the degree of users satisfaction with the operating conditions. This is done on the basis of an annual report sent mandatory by every LSRF, including the main activities carried out. The CAGIC can propose eventually the modification of the status of the LSRF included in the official list.
5. To identify general actions to improve long-term support of the operation of LSRF in the framework of the Spanish National RTD Plan.

Sweden

The **Swedish research council (SRC*)*** is the main national body for providing policy-relevant advice on infrastructure. SRC was recently founded in a merger of several specialised

councils and other research bodies. First and perhaps most important for long-term planning is a **high-level strategic committee** to discuss future involvement in national and international infrastructure projects that the SRC is setting up right now. A second kind of committee is more general and also acts as a committee for evaluation of proposals and setting priorities for funding of expensive equipment (**the Dyrk committee**) and national research resources (**the KNR committee**). These two committees are primarily dealing with infrastructure on a national basis.

Countries which advisory bodies on RTDI cover RI policy issues as part of the overall research policy

The **Advisory Council on Research and Technological Development** of **AUSTRIA** established in 2000 provides systematic, independent and sound advice for the design and implementation of a **future-oriented RTD policy** to the federal government and if requested to the federal provinces. The Council operates as the central hub of the widely spread network of the research and technology system,

In **BULGARIA** the National Council for Scientific Research at MES oversees the functioning of the main public research-funding instrument – the National Science Fund (NSF) which manages the competitive programmes for financing RIs. The second major policy formulation body is the **National Innovation Council.**

The research policy in **CYPRUS** is drafted as ***Strategic Development Plan*** by the **Planning Bureau**, and is implemented through the **Research Promotion Foundation (RPF)**, which falls under the control of the **Minister of Finance**. **Several of the RPF's activities relate to the strengthening of research infrastructure in Cyprus**, since it is generally accepted that the adequate infrastructure constitutes the cornerstone for the development of research activities. **RPF** contributed to the establishment of the **Cyprus Research and Academic Network (CYNET)**, an organization which aims at the provision of advanced internet services to the research and academic community of Cyprus and ensures participation in the European Research and Academic Network (GEANT).

The **R&D Council** established in 1992 according to the R&D Act is an advisory body of the Czech Government. The R&D Council clarifies long-term principal trends and proportions of the progress of research and development of the **CZECH REPUBLIC**.

The **DANISH Research Council** organisation is a core player in Denmark to give advice in matters regarding research infrastructure. The Danish Research Council advisory system regarding research infrastructure consists of Board for setting up strategic and interdisciplinary issues including RIs and of 7 committees one of them operating on *ad-hoc basis* for evaluation of proposals and setting priorities for funding of expensive equipment by primarily dealing with infrastructure on a national basis.

The two central organisations in **ESTONIAN R&D policy** are the Ministry of Economic Affairs and Communications **(MEAC)**, and the Ministry of Education and Research **(MER)**. They are responsible for nearly all research funding streams and horizontal policies. Both Ministries have their advisory committees for policy development - **Science Policy Committee** (MER) and **Innovation Policy Committee** (MEAC). These Committees include experts from academic sector, industry and public sector. The Committees meet on an *ad hoc* basis upon the invitation of the respective Ministers.

National science, technology and innovation policies in **FINLAND** are formulated by the **Science and Technology Policy Council**, which is chaired by the Prime Minister. Principally

the advice on RIs is given on an ***ad-hoc*** basis and **in different levels** and of the Finnish science and technology system. The **Ministry of Education** and the **Academy of Finland** are the core players in Finland to give advice in matters regarding research infrastructures **of all disciplines**.

The **National Council of Science** of **FRANCE** is made of 25 high level scientists **from different countries**. It meets twice a year and delivers general strategic advices to government and parliament level, which may be relevant to **large scale infrastructures.** The **Research and Technology Council** is made of **French scientists**, either designated or elected. Within that council, a sub-group deals with **large scale infrastructures** and gives independent advices to the ministry of research.

One of the most important advisers to the State government is the **GERMAN Science Council** (Wissenschaftsrat) which is directly attached to the office of the President of the Federal Republic of Germany. Its function is to draw up recommendations on the development of higher education institutions, science and the research sector as regards content and structure, as well as on the construction of new universities.

The **General Secretariat for Research and Technology-GSRT** under the Ministry of Development of **GREECE** is the main governmental authority for the formulation and implementation of RTD policy in the country. A National Council for Research and Technology assists the Ministry and the GSRT in matters of research policy and administration of the research centres.

In the new governmental institutional R&D structure in **HUNGARY**, national science, technology and innovation policies are formulated by the **Science and Technology Policy Council (TTPK)**, chaired by the Prime Minister. Members are the responsible ministers, the President of the Hungarian Academy of Sciences and the President of the Higher Educational and Scientific Council. TTPK's advisory body - composed of eleven highly distinguished representatives of the national scientific community and industry - the **Scientific Advisory Board (TTTT)** supports the TTPK with decision preparation, coordination and evaluation.

In the context of the **IRISH** Government's decision to invest significant resources in research as a basis for the next phase of Irish economic and social development, **two important surveys** have been carried out of the adequacy of research infrastructure on behalf of the Higher Education Authority and Office of Science and Technology of the Department of Enterprise, Trade and Employment as policy-relevant advice mechanism.

A new procedure for the selection and evaluation of Research Infrastructures in **ITALY** is now in evolution, based on the preparation of the National Research Plan and with a specific chapter dedicated to Research Infrastructures.

The central organisation in **LATVIAN** R&D policy is the Ministry of Education and Science, which at the moment is not only the main policy-maker but the Ministry is also directly involved in funding and the implementation of R&D policy as it co-ordinates and manages important research programmes. Another advisory body is the **Strategic Analysis Commission** under the auspices of the President of the Republic of Latvia. It was created in 2003 and its tasks include the analysis of socio-economic issues and the development of recommendations for policy-makers.

As science and technology policy making is a prerogative of **LITHUANIAN** Science council and the Ministry of Education of Science (function delegated to the department of Science and Studies), the latter has established an institutional structure of R&D funding (consisting of institutional funding and competitive funding, administrated by Lithuanian science foundation) and R&D support. The latter being helped by the International Science and

Technology programmes development agency. Both institutions are supporting activities of higher education and public R&D institutions, but they are not limited to do so. Companies are also supported in terms of R&D funding and advise, especially concerning the participation in international R&D programmes.

The "Fonds National de la Recherche" of **LUXEMBOURG** is the body which provides funds to research activities including infrastructures and is consulted by the Department of Research to give advice on research policy

MALTA Council for Science & Technology (MCST) acts as the Government's **lead agency** for primarily business-driven R&I in science and technology as it seeks to catalyse cohesion, coherence and congruency in Government's R&I goals, objectives, policies, programmes and activities. Enhanced co-operation has been established between the knowledge centres (specifically the University of Malta) and the MCST in the area of STI policy research, e-learning, foresight and science education as evidenced by joint participation in Framework Programme Projects (both in FP5 and FP6). Also the National **RTDI Programme 2004-2005** for Malta was designed and coordinated with the support of University experts.

At the policy-making level, the **Council of Ministers** of **POLAND** establishes economic programmes, whereas the Parliament has legislative and control powers over the government. The division of responsibilities at Ministerial level is the following. The **Ministry of Economic Affairs (MG)** is responsible for the demand side (market perspective). The **Ministry of Science and Higher Education (MniSW)** is responsible for R&D and higher education, whereas the **Ministry of National Education (MEN)** for the primary and secondary level education.

The **PORTUGIESE** Ministry of Science and Technology does not have a formal advisory structure addressing research infrastructures. In general, advice is given on an **ad-hoc** basis by working groups mainly composed of foreign scientists. Main bodies of Portuguese Science and Technology Ministry consist of *Science and Technology Foundation (FCT)*, *Institute for International Scientific and Technological Co-operation (ICCTI)* and *Observatory for Science and Technologies (OCT)*.

The Ministry of Education and Research of **ROMANIA** was appointed as the State authority for research and development. In developing its policies, MER is advised by a number of bodies, one of which is the **Advisory Board for R&D and Innovation**, comprised of representatives from the science, technology and industrial communities. Another body, the **National Council for Science and Technology Policy**, to be chaired by the Prime Minister, will have the task of analysing ***long-term strategic R&D priorities***.

The Government of the **SLOVAC REPUBLIC** has its advisory body - the **Council for Science and Technology.** The Council has a right and the duty to discuss any document of substantial relevance to S&T (R&D) and to express its opinion before the document is submitted to the Government.

Science and Technology Council of the Republic of **SLOVENIA** is the main advisory body, providing the Government with science, technology and innovation policy guidelines. The policy is implemented through *National Research and Development Programme* which is adopted by the Parliament for a period of five years. All aspects which are important for a coherent development of national S&T&I system are elaborated in this document, **thus including research infrastructure (RI) as well**.

The main funding organisation for basic research in **THE NETHERLANDS** is the **Netherlands Organisation for Research (NWO)**. It has a role comparable to Research Councils in many other countries. NWO has a specific budget dedicated to fund medium (up

to 1 Million Euro) and large (1 – 5 Million Euro) research infrastructures. Decisions on funding are made after careful evaluation of proposals by a special committee, which advises the Executive Board of NWO. Apart from the advisory committee which has a role to judge proposals for the NWO budget for medium and large research facilities (mentioned above) there does not exist a national advisory body specially devoted to research infrastructures.

The **Supreme Council of Science and Technology (BTYK)** of **TURKEY** is a legally formalised body which determines, directs and co-ordinates science, technology and innovation policies. The **Scientific and Technological Research Council of Turkey (TUBITAK)** which was created in 1963, is affiliated to the Prime Ministry and is the secretary to the BTYK. The BTYK is headed by the Prime Minister and composed of relevant ministers, heads of public and private bodies, universities and non-governmental organisations.

Specific structures with advisory functions for RI policy

- **Countries with federal constitution of governance have advisory bodies affiliated to the State government and Federal governments in GERMANY or to the Federal authority (the Communities)** and the **"federated entities" (the Regions) in BELGIUM.**

  - In **Belgium** the Communities provide the general support for basic and university research, and the Regions- the general support for industrial and technological research and innovation. In each Community and Region and at federal level, an advisory body, the **Science Policy Council** gives the corresponding Government advice and formulates recommendations (at request or on own initiative). The Councils consist of prominent personalities from scientific, university, economic and social circles. ***New initiatives regarding RI's which have nurtured within the scientific community may find their way towards the policy makers through this channel.*** In **Flanders** a permanent **Concertation forum for large-scale infrastructures was established**. Preliminary consultations with the universities, enterprises and the Fund for Scientific Research Flanders started in April-May 2003. ***A mechanism for long-term strategic planning was set up to provide policy-makers with balanced information to decide about future participation in new, internationally planned, large-scale research infrastructures.*** The work of several international discussion fora, such as **ESFRI, the OECD GSF and the ESF**, has been taken in due account.
  - In **GERMANY** the responsibility for science infrastructure facilities first of all rests with the German **State Governments**. The **Federal Government** has only responsibility for large scale instruments and similar infrastructure issues. One of the most important advisers in this respect is the **German Science Council** (Wissenschaftsrat) which is directly attached to the office of the President of the Federal Republic of Germany. Its function is to draw up recommendations on the development of higher education institutions, science and the research sector as regards content and structure, as well as on the construction of new universities

- **Independent funds or financing institutions.** In **BELGIUM** some **independent funds** (eg the Funds for Scientific Research of each Community, FWO-Vlaanderen and FNRS) or **financing institutions** can decide independently how public research appropriations are to be used, in particular for **RI's**

- **Own advisory strategies and bodies established at the research agencies. Coordination of advisory bodies.** In **FRANCE** each of the French research agencies (CNRS (all disciplines); INSERM (Biology and human health) **has its own strategy and advisory about infrastructures**. The Ministry of research has recently created a **dedicated structure of coordination** between the research agencies concerned with **large scale infrastructures** (9 members from the ministry of research). The strategic committee prepares the decisions to be taken by the minister or by the government. **This committee relies itself on different expert groups for in-depth study of the various topics.** The **National Council of Science** is made of 25 high level **scientists from different countries**. It meets twice a year and delivers general strategic advices to government and parliament level, which may be relevant to **large scale infrastructures.** The **Research and Technology Council** is made of French scientists, either designated or elected. Within that council, a sub-group deals with **large scale infrastructures** and gives independent advices to the ministry of research**.**

- **Intragovernmental advisory bodies on RTI policies for coordination of government entities.**
  - An **Intragovernmental Committee on R&I** was set up in **MALTA** in 2006 to bring together appropriate government entities with the brief to formulate joined-up policies on R&I; **attain congruency of R&I policy aims among the various stakeholders; achieve coherency in R&I action; act as a communication and information forum on R&I activity and as an "issue resolution mechanism" on R&I matters.**
  - In developing its policies, **ROMANIAN** MER is advised by a number of bodies, one of which is the **Advisory Board for R&D and Innovation**, comprised of representatives from the science, technology and industrial communities. At a ***higher policy level***, the **Inter-Ministerial Council for Science, Technology and Innovation**, which provides a framework for an inter-ministerial policy dialogue on R&D, is responsible for *ensuring the compatibility of R&D and innovation policies with other social and economic policies and evolving the legislative framework for implementing R&D and innovation activities.* Another body, the **National Council for Science and Technology Policy**, to be chaired by the Prime Minister, will have the task of analysing ***long-term strategic R&D priorities***. The newly established **National Authority for Scientific Research (NASR)** at MER assumed the mission to act as the ***executive manager*** of the Romanian government's decision to rapidly increase the public support for RTD towards the Lisbon "Three Percents for RTD" ambitious goal.

- **High level Committees for policy development considering future RI requirements**. The **UK** is currently embarking on a process of policy development whereby future research infrastructure requirements are discussed and advice formulated in a high level committee, RCUK which is chaired by the Director General Research Councils in the Office of Science and Technology and whose members are the Chief Executives of the individual Research Councils: BBSRC, CCLRC, EPSRC, ESRC, MRC, NERC, and PPARC. RCUK will consider the scientific capabilities required and the different mechanisms for fulfilling them including international/European collaboration. It will have ownership of the 'Large Scale Experimental facilities Roadmap' a 10 year rolling plan for future large scale facilities, taking account of developments in Europe and elsewhere. The types of facility that fall into this class are typically those that are: large and very expensive; have long useful lifetimes ie10-20 years; have multiple users both nationally and internationally; are interdisciplinary; offer unique capabilities within the UK, or more widely; and are potentially jointly funded or suitable

subjects for international collaboration. These features of such large facilities, often found in combination, require the UK to take a strategic position as to the best way to maintain access for researchers and also to prioritise, manage and fund these investments. It will take on board new information as it develops and will be subject to regular review.

2. Countries' Measures / Actions for upgrading research structures

Some countries' approaches towards RI upgrade:

- securing risk investments and reformation of science funding
- effective cooperation (government, research, business), networking and technology transfer
- more innovative services for SMEs
- attraction of multinational companies
- more Centers of Excellence and incubators
- use of national programmes, FP7 and Structural Funds.

- grants to cover the **risk investments** in new R&D labs **Austria**
- **co-operation** of specialist R&D centers with universities and business to become international **Austria**
- offering **innovative services** for SMEs (measuring-testing-verification-quality assurance-prototype manufacture-engineering) **Austria**
- establishment of more **Centers of Excellence** **Austria** . The most important new structures in **Estonia** are Centres of Scientific Excellence and Competence Centres. Both these structures have been established only in the past couple of years and are really in the process of building up their structures and activities.
- greater integration of universities in the European research structure **Austria**
- improvement of country's position as an attractive location for multi-national companies **Austria**
- development of efficient technology transfer system and linking the R&D system with the country's industrial structure applying R&D results in traditional mid and low tech industries **Austria, Lithuania**
- improved synchronization of support for regional infrastructures and transfer facilities between national government and federal provinces **Austria**
- improved **networking** - establishment of the **Cyprus Research and Academic Network (CYNET)**, an organization which aims at the provision of advanced internet services to the research and academic community of Cyprus and ensures participation in the European Research and Academic Network (GEANT) **Cyprus**
- establishment of **incubators for high technology companies** and **centers for carrying applied research** and development in high technology fields **Cyprus**

- **National programmes and/or Structural Funds**
  - RPF has developed a **competitive programme for strengthening of research infrastructure** in **CYPRUS**. The programme ('ERY') is included in the RPF's Framework Programme for Research and Technological Development (2003-2005). **'ERY' provides for the creation of new research infrastructure, the**

upgrading of existing infrastructure and the creation of research infrastructure networks.

- In 2000 the **GERMAN Federal Ministry of Education and Research (BMBF**) asked the research organisations whether they plan to propose new large scale infrastructure. A **working group "Large Scale Instruments of Basic Research"** of national and foreign scientists and a few persons from the research administration was set up for evaluation of the project proposals (*evaluation made from a view of science policy*). The evaluation of the Wissenschaftsrat is based on the scientific programme and on the technical design report (for some projects not finished).
- The main instrument for the implementation of the RTD policies in **GREECE** is currently the ***Operational Programme for Competitiveness (2000-2006)***, combining community structural and national funds and managed by GSRT.
- In **BULGARIA** the National Science Fund has managed the "Building Research Infrastructures" Call for proposals within the "Scientific Capacity Development" Programme launched in 2005 and designed in compliance with the National Innovation Strategy. Eligible participants are those Bulgarian research teams having applied for the EC specialized call for upgrade of research infrastructures in Bulgaria, Romania and Turkey and overcoming the threshold of 14 points.
- The **Advisory Council on Research and Technological Development** of **AUSTRIA** was asked by the government to give advice on how the extra-financial funds for RTD provided by the government for the years 2004 - 2006 (600 million Euro) should be allocated. The recommendations for distribution of the funds should be based mainly on the "***National Research and Innovation Plan***" which serves as outline for the Council´s ongoing work with its chapter on measures for expansion of RIs.

- **reformation of science financing -** As of future plans, it is likely that the **POLISH National Research and Development Centre (NCBR)** will be established with a view to reform the system of financing science. One could also expect the establishment of **private R&D centres** with the help of one of the incentives introduced by the *Act on Some forms of supporting innovation activities* (29 July 2005)
- **development of specialized new research infrastructures** - In 2004 in **ROMANIA** was introduced the **INFRATEH** programme. This is aimed at the **development of specialised infrastructures for technology transfer and innovation** and focuses on ***development at a regional level***, including ***support for technical assistance and information centres, technology transfer centres, incubators and science and technology parks***.
- **establishment of specialized capacity programmes - ROMANIAN** MER has also launched a **programme for 'Research of Excellence'** geared towards the ***improvement of research capacity*** and its orientation to the priorities of the European Research Area (ERA) and the Seventh Framework Programme for RTD (FP7)

3. Approaches in RTD and RI policy development and financing

Policy

Approaches in policy-making and financing:

- systematic approach
- *ad hoc* basis
- self-renewing structures
- LSRI both for international use and country's needs
- foresight and long-term strategic planning
- strategic planning only at national level
- *ex-post* evaluation by international scientific councils
- inter-organizational decision-making process
- national technology platforms

- **systematic approach** both across various disciplines and between the institutions is stated as commitment. **Austria**

- incentive system to create the conditions for **self-renewing structures**. **Austria**

- development of **socially relevant large-scale international research facility** suitable for **country's needs. Austria**

- a mechanism for **long-term strategic planning** set up to provide policy-makers with balanced information to decide about future participation in new, internationally planned, large-scale research infrastructures. **Belgium**

- **Foresight in support of policy (few examples):**
  - The **CYPRUS Foresight Committee** was appointed by the Planning Bureau, http://www.planning.gov.cy a few years ago but practically it has not been yet very active. As the appointed committee becomes more active it is expected to assume its role and influence policy making.
  - In **POLAND** the National Framework Programme (KPR) can be considered as an attempt in setting up a comprehensive strategy spelling out the main objectives and priorities of R&D policy. In summary, it established a framework for 38 fields of research in 9 strategic research areas i.e. health; environment; agriculture and food; state and society; security; new materials and technologies; ICT technologies; energy; and transport infrastructure. The national foresight project is supposed to confirm the choice of strategic orientations, which will be changed should such need arise in the future. Recently, the Minister responsible for science and higher education has issued a letter inviting concerned parties to submit comments on the design of KPR

by 23 June 2006, however, the results of this consultation have not been made public, yet.;

- The first foresight study of **TURKEY** as mechanism for policy setting was carried out between 2002 and 2004 under the Vision 2023 Project**.**

- Research policy is **formulated only at national level.**
- In **CZECH Republic** There is no specific regional research policy at present.**;**
- In **ESTONIA** among the National R&D programme is the Research and Development Infrastructure Programme focused mostly on equipment acquisition; development of an internationally competitive research infrastructure system);
- The **General Secretariat for Research and Technology-GSRT** under the Ministry of Development of **GREECE** supports, through the launching of a broad spectrum of national programmes, the RTD activities of both the scientific research institutions (public research centres and universities) and those of the productive sector, focussing on key-areas for the national economy and the improvement of the quality of life. **Contributes** to the reinforcement of the country's human resources in RTD
- In the Science Budget 2000 published by the Government of **THE NETHERLANDS** (Ministry of Education, Culture and Sciences) special attention is given to the need for adequate research infrastructures. To get insight into the policy options a survey of future needs of research infrastructure is being carried out. **In 2002 a start was made by developing a national strategy for (inter) national research infrastructures, whit a focus on exploring specific options for international cooperation (within ERA and on a global scale).** NWO and the other national research organizations will formulate this strategy in close consultation, also with the Ministry of Education, Culture and Sciences.

- **International Scientific Councils (Ex-post evaluation)**: In **GERMANY** the large facilities are constructed by the large research institutions. They have **international scientific councils**, which regularly evaluate the scientific programme and the performance of large facilities. They can set up technical committees for questions of the installations
- **Inter-organizational decision-making process.** Within **HUNGARIAN** Academy of Sciences different councils (at various levels) are in place to discuss, make recommendations and decide on RI matters. In the case of higher education the autonomy of the universities makes the decision-making procedure concerning RI more complex, though the second largest users of RIs **are the universities.** The decision-making procedures depend on the number of funding agencies involved, and also evidently on the size of the RI. In certain cases (e.g. for the reconstruction of the research reactor) government level decision is necessary.
- In most of the countries advice is given on an **ad-hoc** basis by national or foreign working groups.
- **National technology platforms** are evisaged in **ITALY** as new organisational research models for getting critical mass of competences and resources in strategic sectors in the context of the internationalisation.

Financing

Financing of RIs is provided through two major sources:

- **national funds** (annual state budget, grants to project proposals, sectoral policy of minitries), and
- **EU funds** (Structural and Cohesion Funds, Framework Programmes for RTD).

- The two main **financial sources** in **HUNGARY** are the **Research and Innovation Fund** and the **Economic Competitiveness Operative Programme**, one of the five Operative Programmes of the National Development Plan (NFT). NFT was prepared by Hungary to qualify for the resources of the Structural and Cohesion Funds of the European Union.
- The state financial support of large R&D infrastructure has been provided particularly by the **Academy of Sciences** of the **CZECH Republic** and/or by the **Ministry of Education, Youth and Sports** as a specific projects/grant or as a part of long-term research plan. The **small infrastructures** are financed by different institutions on the ministerial level (e.g. **Ministry of Education, Youth and Sports, Ministry of Agriculture, Ministry of Health, Ministry of Trade and Industry,** etc.), by the **Academy of Sciences** of the Czech Republic and by the **Grant Agency of the Czech Republic**
- **Project-based funding in GREECE** is organized under two measures**: 1. Measure: "Excellence among research centers under the auspices of GSRT"** General Objective: Upgrading the capabilities and improve competitiveness of the Greek public research centers (operating under the auspices of GSRT) in order to maintain or create excellence and participate successfully to the ERA Networks of Excellence. In the context of the above measure, GSRT has funded the following research centers mainly to improve the **RTD infrastructures in Agrifood and Biotech**. **2. Measure: "RTD Consortia in sectors of national priority"** General Objective: Promote co-operation between research and production through long-term RTD projects in order to produce innovative products, processes or services and to respond to social or cultural needs affecting the competitiveness of the economy. In the framework of the aforementioned measure, a specific call is launched to support **RTD infrastructures** in public research centers under the auspices of GSRT in fields of national priorities **Natural environment and sustainable development** and **Food and rural development, aquaculture.**
- In **SLOVENIA** the financing of research infrastructure is based on public calls for proposals, meaning a **bottom-up approach**. Proposals are evaluated by expert bodies of the **Ministry of Education, Science and Sport (MESS)**, e.g. various Science Committees, Committee on Research Infrastructure, etc. and ranked according to the rules of priority setting. The final decision is taken by the minister. At present MESS allocates around € 12M/year for co-financing of the purchase of research equipment, which represents roughly one third of the total investment. The difference is provided by research institutions themselves or through other sources (e.g. other ministries, industry etc.). During next years Structural funds will be available for this purpose as well.The second budget line provides funds for the operation and maintenance of research infrastructure in the frame of financing infrastructure programme groups. The budget amounts around € 5M/year. Participation of Slovenian scientists in large international collaborations, like CERN and Pierre Auger Observatory is included as well.

- In **THE NETHERLANDS** investments in research infrastructure in areas like Energy, Health, Environment etc. are funded mainly on the basis of **sectoral policy for which various government departments have their own responsibilities.** These policies are only coordinated in areas of high priority and of common concern. **An example of this is the recent large initiative in the area of Genomics research, where several government departments and NWO have joined their efforts to fund and execute a national research programme.**

4. Challenges for RTD and RI policy

Challenges for RIs:

- development of decentralized R&D structure
- setting and implementing priorities shared by different stakeholders
- infrastructural and equipment related shortcomings to be met by sustainable investment decisions
- shifting the balance between public and private efforts in S&T research
- concentration of the public research effort in key strategic sectors
- extensive network of research organizations and fragmentation
- overlaps in the research efforts
- scientific career is not attractive for young people
- small countries cannot afford investments in very expensive research equipment.

- The decentralized SME-economy structure requires an adequate **decentralized research and development structure**. This means coordinated setting of priorities in the federal provinces reaching from education to Centers of Excellence in certain fields **Austria**

- In addition, the policies outlined in the existing strategy and the new draft strategy is mostly general and horizontal tackling mostly infrastructural issues. **Cyprus research and development policy is thus still facing the major challenge of how to actually set and implement priorities. Since the political as well as academic circles represent strong views from different sides, it has been literally impossible to establish clear thematic priority areas. Cyprus**

- **Infrastructural and equipment related shortcomings** have long been seen as a major problem in Estonian research system (the problem was alleviated by development of national programme without the determination of thematic priorities in advance). **Among the sub-objectives of the programme are to stimulate the strategic planning of RD activities, incl. establishing priorities and making financially sustainable investment decisions in RD institutions as well as to increase the efficiency of the RD system as a whole through improved inter-relatedness between higher education, RD and innovation, through concentration of resources and enhancing cooperation within and between RD institutions, between different disciplines, between RD institutions and enterprises and at an international level. Estonia**

- **A major objective of research policies is to shift the balance between public and private effort in scientific and technological research**. This is stressed in all sorts of policy documents, such as the PNR National Research Programme 2005-2007. **Italy**

- Other challenge for the research policy is the **concentration of the public research effort in key strategic sectors**, also by enhancing the public-private collaboration and pursuing the excellence of the national research base. **Italy**

- **extensive network of research organizations and fragmentation.**

- **Poland** On the one hand, the Polish research area can be characterised as rich in R&D infrastructure, but on the other, it is evident that it **has numerous problems, mainly due to its extensive network of research organisations that remain to large extent disconnected from industry.** There have been many attempts in recent years to restructure the R&D sector, however, recent strategic policy documents such as the Implementing document of the National Reform Programme (KPR 2005-2008) confirms that the process has still long way to go.
- **Slovakia** One main problems of the Slovak research system is the **fragmentation and lack of coordination of research and development facilities.** Slovakia has a quite a large number of small research facilities that are relatively active in the same field, but do not cooperate. **One major reason for this is the lack of technical equipment and other technical infrastructure and the maintenance of it.** Some of these issues have also been raised by companies and given as reason why the private investment in R&D in Slovakia is low.
- **Bulgaria** - Private R&D expenditures are one of the lowest in Europe; while public expenditure is insufficient and inefficiently spent by the **oversized public research sector** (e.g. Bulgaria has 43 universities on a population of less than 8 million).

- **overlaps in the research efforts**.
  - In **Poland** there is no distinct division of labour between universities (445 in the academic year 2005-2006) and institutes of PAN (78 in 2004). **They cover the same research areas as well as apply for the same financial support from the MniSW.**
  - While it is possible to see the NPRDI as the core support mechanism of MER (it accounts for over half of MER's budget) and the other programmes as complements, **it is nevertheless difficult to differentiate between the separate initiatives given the breadth of activities spanned by each one and the extent to which they overlap each other**. ***It is particularly difficult to assess the degree of overlap and complementarity with initiatives such as the sectoral plans financed by other ministries.*** **Romania**

- Another problem is that the **scientific career is not attractive for young people**. Therefore, one of the long term challenge is to develop more advanced capabilities within Slovakia and turn the continuing decline in business R&D. **Slovakia**

- In general, Slovenia as a **small country cannot afford investments in very expensive research equipment** (around € 1M per item being a maximum), but should use large research facilities available abroad. **Slovenia**

- **Slovenia** is strongly committed to follow Barcelona goal, i.e. 3 % of the GDP for R&D. In financial terms this means roughly a 40 % increase of public funds. Thus the increase of funds for investments in RI will be most probably of the same order. **At the moment it is difficult to predict which new RI this will be.** A tentative speculation would be RI, for research in life sciences and materials sciences (incl. nanosciences).

III. Foresight exercises in RI and Agri-Food

Typology of foresight projects surveyed:

Foresight projects on RIs performed in two research countries:

- **Switzerland:** the project aims at developing a methodology that supports mid- to long-term analysis and strategic decision making for sustainable infrastructure planning at the local or regional level, and
- **The Netherlands**: the project studied the desired knowledge and corresponding infrastructures for the benefit of the rural areas.

Foresight exercises on identification of national/global priorities that include AgriFood (biotech, genetics, sustainable agriculture, nutrition, etc.). **Covered aspects:**

- links between socio-economic and technological trends in AgriFood ('Quality of Life through Healthy Nutrition')
- role of science, research and technology in shaping the future for a knowledge society
- new strategic methods for the decision making in an Enlarged Europe
- improvement of quality of life and long-term international competitiveness – reconstruction of agricultural sector, transformation of R&D structure
- identification of national priorities for future investments in RI, education,

Researched countries: Austria, Germany, Greece, Hungary, Slovakia, Slovenia, Sweden

Foresight on (policy) processes and pathways. Covered aspects:

- study of possible future pathways in selected areas of sustainable production.
- scenarios and visions for innovation policy, analyse different evolution processes, and develop new approaches from systematic long-term research to public discussion (biotech)
- speeding up the process of predicting development paths for improvement in the health and quality of life.

Sector/cluster oriented foresight. Covered aspects:

- various subfields of S&T relevant to the food sector
- rural development and farming policy
- biotechnology and related industrial sectors - agriculture, food production and processing, health
- agriculture and society, agribusiness, consumer behaviour, environment.

Foresights for introduction of methodologies/approaches (pilots)

- agriculture and biotechnology
- knowledge management of Agriculture, Environment and Biotechnology

Foresight on Research Infrastructures

SWITZERLAND

Regional Infrastructure Foresight (RIF) - Transition Management for the Sanitation Sector

Executor: EAWAG-CIRUS. Duration: 2005 to 2008, Web site: http://www.empa.ch/plugin/template/empa/*/42791/---/l=2 Contact: Hans Kastenholz

The projects is a three step project to support the transition towards a sustainable infrastructure at the local or regional level. A methodology is developed to integrate various stakeholder into a decision/consulting process. The developed methodology will be tested in up to three regional clusters of communities which will be under problem pressures in the near future.

The project aims at developing a methodology that supports mid- to long-term analysis and strategic decision making for sustainable infrastructure planning at the local or regional level. The methodology shall be developed and tested for the Swiss sanitation sector. Typical problem profiles of Swiss communities and associated sanitation firms, as well as upcoming socio-technical and organizational innovations will be analyzed in detail**. Based on these analyses, regional foresight exercises will be carried out in three specific case study regions. These will allow identifying strategic alternatives for sustainable infrastructure development. Based on the lessons learned in the sanitation sector, generalization will be endeavoured first for the urban water sector as a whole and then for other infrastructure contexts.**

The project team will analyse the transition towards **sustainable infrastructure systems** as a problem of "regime transformation", where new technologies, new organisational principles and new regulatory institutions develop in a co-evolutionary way. Against this analytical background, we develop a **methodology (Regional Infrastructure Foresight – RIF),** which shall support strategic decision making at the regional and local scale. RIF may therefore be seen as a proposal of a new method for "regional governance", „strategic planning", or "Technology Assessment". As a consequence it is conceived as a strongly interdisciplinary oriented research project, interacting tightly with experts of the respective sector.

From a scientific point of view, the project shall contribute to the emerging scholarly field of Transition Theory in its application to infrastructure systems. Transition Theory has emphasised the highly interconnected dynamics of technical, social and institutional aspects and the role of mutual fit of these elements, in order to reap economies of scale, economies of learning etc. Transition management is concerned with the analysis of conditions to break up existing regimes and to induce transitions from one regime to another.

Beyond its academic goals, the RIF project wants to contribute to practical problem solution related to the sustainable transformation of infrastructures in Switzerland. It will result also in the development of Methodological guidelines for regional infrastructure foresight and participatory technology assessment. Publication of a handbook for Regional Infrastructure Foresight.

THE NETHERLANDS

Rural Areas put on the map, knowledge and innovation priorities, apsirations for the 21st century

Executor: NLRO: Nationale Raad voor Landbouwkundig Onderzoek. Year of completion: 1998. Web site: http://www.agro.nl/nrlo/english/pdf/9819e.pdf ;

Rural Areas put on the Map Knowledge and Innnovation Priorities.pdf

Over the next few years a great deal of money will be spent on investments that are designed to improve and expand infrastructure. They must be seen as an impulse to achieve adequate spatial-economic structures as well as sustainable economic development. One of the challenges will be that investments in spatial planning are used to improve the quality of rural areas. Implementation of policy priorities will strongly appeal to the innovative powers of all those who have an interest in rural areas. **Policy challenges will be highly integrative. It will be necessary to find ways for developing and balancing combinations of functions, for reinforcing green qualities, for reconciling town and countryside, economy and ecology, and for building new coalitions that may be able to combine private and public interests.**

Main view points:

- Research carried out for the benefit of rural areas would be gaining considerably in depth and relevance if a network were created to interconnect the various parts in the knowledge and innovation infrastructure. The aim of the network would be to bridge the gaps between knowledge and technology development and innovation processes, between urban and rural knowledge, between research and design or between knowledge derived from the humanities, the social sciences and the natural sciences.
- **It is suggested to establish model regional centres which will support rural innovations while testing interactive knowledge generation** for diminishing existing tensions between required versus available characteristics of current knowledge infrastructure**.** The centres will participate in innovation projects and they will constitute links between institutes and universities that are focused on more generic types of knowledge, on the one hand, and the actors with their specific fields of experience and domain-specific knowledge who are involved in specific innovation projects in the countryside, on the other.

Desired knowledge and corresponding infrastructure

Addressing the key issues in innovation and knowledge discussed above will make special demands upon both the nature of research studies and the relation between knowledge and innovation. Some of them are discussed below.

- A sector-specific orientation should not be allowed to dominate: **knowledge should be aimed at integration.** This is meant to imply that, in knowledge development, several sectors (agriculture, recreation, nature management, water management) should be considered comprehensively from a specific perspective, just as innovation of the countryside is often associated with a broadening and combining of functions. This is not a matter of bringing together sector specialists. Rather, it requires **integrative knowledge development**, which may be applied to analyse, assess and schedule spatial developments of specific areas. Sector-specific knowledge may be useful only if it contributes to developing integrative knowledge. Research into the interaction between town and countryside presupposes ‘ruban’ knowledge development, i.e. an interdependent approach of urban and rural developments.
- A significant proportion of **research efforts should be design-oriented**. Design is seen here as a link between the worlds of system and living environment, between material and immaterial world. **Designs are also (foresight) projections of suggestions for a particular use of land.** A designing approach is an outstanding requirement since the quality of rural areas frequently can be made manageable only through spatial representations.What is implied here is research into the methodologies to be used for expressing and representing proposals for regional developments, sometimes even including their implementation, which may then become instruments in communication, analysis and assessment. It is also called designing research. Developments in information and communication technology are major incentives, both to the development of these methodologies and their practical implementation.

- **There is a need for multi- and interdisciplinary working methods in research by combining existing disciplines or by taking new cognitive objects as a starting-point**. In designing research this is frequently the only way to build an adequate knowledge base.
- This leads to the almost inevitable conclusion that **fragmentation should be avoided by interrelating all the various knowledge questions by using more comprehensive problem definitions referring to rural areas as a whole.** Steering processes applied by various ministerial departments might become interconnected through a cross-over of issues.

- **Towards a knowledge and innovation network (to design networks of infrastructures instead of establishment of new ones) -** proposal for knowledge development and a knowledge infrastructure in relation to rural areas

- The thoroughness and relevance of the study of rural areas might benefit considerably if a network was created to establish interconnections between various parts of the knowledge and innovation infrastructure. Bridges should be built to span the gaps between:
    - basic scientific research and applied scientific research, technology development and innovation processes;
    - urban and rural knowledge;
    - investigating and designing;
    - knowledge available in both the humanities and the social and natural sciences.
    - A Rural Area (RA) knowledge and innovation network might well be able to perform that function with the following observations:
- **The network has a great number of participants**: university institutions, public knowledge institutes, ministerial departments, provincial authorities, town councils, polder districts, social organisations, property developers, private agencies and other knowledge producers and consumers active in rural areas.
- As soon as a research programme or an innovation project is initiated, **some of the participants will be activated to build consortia of knowledge institutes** and private parties surrounding particular programmes or projects.
- The network **is managed by a small office** which will be responsible for ensuring both internal and external communications as well as exchange of information, gathering interested parties, monitoring the implementation of research programmes and innovation projects and initiating new ones.
- Main products of the network will be **knowledge products**: theoretical understandings, new technologies and skills that may be used as instruments to achieve country innovations.
- Financially, programmes and projects will be based **on public resources** (ministerial departments, university budgets), to be supplemented with means derived from project assignments.

Foresight on identification of national/global priorities:

- **Technology Delphi Austria - Expert panels** *focused on ICT*, ***biotechnology***, ***medical technology/health technology assessment, environmental technology***. Panels developed content for large Delphi survey among wider group of experts. **– Austria**

- **Futur – The German Research Dialogue** **Organizer:** IFOK (Institut für Organisation und Kommunikation) in co-operation with Fraunhofer ISI, IZT, VDI/VDEIT and Pixelpark. Futur. The German Research Dialogue is designed to **assess the future needs and demands for science and technology and to consider their broader implications for the socio-economic and cultural development of the country. A major motivation for the German Research Dialogue is the search for new topics to be funded by the Federal Ministry of Education and Research.** These topics link socio-economic and technological trends in a complex and inter-dependent way. The technology and

socioeconomic dimension of these visions cannot be strictly separated from each other. ***'Quality of Life through Healthy Nutrition'*** addresses the question how a balanced diet can increase human health. The topic has recently become a lead vision and touches issues such as **sustainable supply chain of nutrition, transfer from nutrition science into every-day practice, and the role of the food sector in the innovation system. *'Biological engineering'*** is a subject for a possible future lead vision aiming to use biological systems, biological engineering and engineering sciences. The expectation is that this combination would open up new possibilities for the systemic technical use of biological systems.

*The German Research Dialogue Futur was designed as a **bottom up process**. That is to say that the priorities were formulated over the course of a range of conferences, workshops, focus group meeting as well as online-voting.* **– Germany**

- **2021 Scenarios for Greece** Executor: General Secretariat for Research and Technology, NTUA, NSPH, EUA, LOGOTECH SA & K-NET SA. Year of completion: 2001. Web site: www.foresight-gsrt.gr

The National Foresight Programme in Greece mainly focused on exploring the future and potential of the Greek economy and society and more specifically the role of science, research and technology in shaping the future in terms of achieving the development of a knowledge society in Greece. 2021 SCENARIOS FOR GREECE.doc

Scenario I: Garden: In Greece, R&D&I focuses on the best possible use of domestic / local natural resources, informatics, health and quality of life and social sciences.

Scenario II: Two-speed scenario or niches of differentiation: New institutions and a new organizational model are established. However, they cannot keep old institutions isolated resulting to a dual reality, two different worlds. Politics depend on these two worlds by reinforcing the new institutions while protecting the old ones.

Scenario III: Competitive – liberal model: In practice, the market is the policy maker as it is the main decision maker, wealth producer and distributor.

Scenario IV: Instability Scenario: power becomes centralized and authoritarian, and there is a trend for the "law and order" domination due to force major reasons **– Greece**

- **Greek National Technological Foresight Exercise** Executor: General Secretariat for Research and Technology, Ministry of Development. Year of completion: 2005. Web Site: http://www.efmn.info/kb/efmn-brief12.pdf

The National Foresight Programme in Greece was implemented in the framework of the Operational Plan for Competitiveness (Community Support Framework 2000-2006) and was co-funded by 75% from the European Union (European Regional Development Fund) and 25% by the Greek Public Sector. **The programme was undertaken in order to explore new strategic methods for the decision making that will promote the development and competitiveness of the country within an Enlarged Europe – time horizon: 2015 & 2021. The main objective was the creation of a potential Foresight centre for exploiting the know-how and promoting further foresight activities in Greece.** The approach was mainly based on the scenario building method.

These scenarios examined the potential future developments for Europe and Greece. **At the micro level the analysis mainly focused on 11 thematic areas** among which were: Biotechnology, Health and Quality of Life, Industrial Production and Manufacture, Materials, Information and Communication Technologies, Agricultural Development and Fisheries.

Visions of the Way Forward

Biotechnology: This is considered a critical and emerging scientific field. Although Greek citizens are well informed about GMOs and their impact there is limited information sharing among scientists and researchers. There is a need to raise awareness and inform society and industry about the applications and impact of biotechnology, to promote synergies with other research fields, stimulate the interest of private

investors and **promote collaboration between research centers, universities and industrial sectors for the development of innovative and competitive products.**

ICT: Greece has a low level of 'digitalization' compared to the EU average. The trend is to promote 'technology pull' rather than 'technology push' mechanisms. **The main goal for 2021 is to change this pattern for example by promoting synergies with domains such as Biotechnology and Nanotechnology with a view to creating new hybrid technologies and help develop an Information Society with extended ICT usage and deeper knowledge and understanding of the sector by industry.**

Materials: Through materials science it is expected that sustainable development will be attained. It is expected that through the use of new technologies in particular through the **interaction of ICT, biotechnology, environment, energy, agriculture, industry, transport, tourism, culture, health & defense, hybrid technologies with industrial applications will arise and lead to the development of new competitive industrial sectors.**

Agricultural Development: By 2021 about 5-10% of the population will be employed in the agricultural sector. **The main objective of 'Agricultural Development' is to achieve sustainable development through the development and interaction of the countryside and agriculture. – Greece**

- **Hungarian Technology Foresight Programme** (TEP) *Executor: National Committee for Technological Development (OMFB). Year of completion: 2000. Web site:* ***http://www.om.hu/****; http://www.tep.hu/*

Given the transition process, Hungary was undergoing fundamental economic and social changes, and major institutions were being shaped when TEP was launched. Thus it was a suitable time to think about medium and long-term issues: ***how to improve quality of life and enhance long-term international competitiveness***. Foresight was perceived as an appropriate tool to bring together business, the science base and government in order to identify and respond to emerging opportunities in markets and technologies and to make strategic decisions. **One of the 7 foresight panels was focused on Agriculture and Food Industry from industry perspective.**

The thematic panels analysed the key aspects of the following, closely interrelated areas: Human resources (education and employment); Health and life sciences; Information technology, telecommunications and the media; Protection and development of the natural and built environment; Agribusiness and food industry

Horizontal approach

R&D activities play a major role in the exploitation of Hungary's favourable conditions for agricultural production**, but the position of R&D must be strengthened further.** The current, considerable research capacity is linked through numerous ties to the education system. The number of R&D units and their personnel have decreased in the past decade. **The internal structure of research has also altered**: the relative proportion of basic research, leading to new discoveries, has fallen, and the proportion of commercial services has grown due to the pressure of financial considerations. **Unless the government takes firmer steps (both as a source of orders for specific research projects and in creating the necessary infrastructure) in order to increase the proportion of basic research, the efficiency of the commercial services will also suffer in the long run.**

The R&D sector also suffers from the same general **shortage of capital** that afflicts the whole country, and from **the cuts in government funds and financial resources that have helped maintain research institutes and infrastructure at a survival level, at least**. **With the increasing role of foreign direct capital in the country, businesses have less interest in supporting domestic research.** While the privatisation process has led to a drastic reduction in the economic role of the state, it has failed to create a new source of demand for R&D.

It is extremely difficult to find the financial sources required for the changeover. The large volume of postponed (never implemented) capital expenditures which are so much overdue in

the agro-industry are also proving that fact. **Today the task is not just to expand production and undertake technological modernisation, but also to execute often very costly transformation and reconstruction work that needs to be carried out in order to meet the environment protection or food hygiene regulations of the EuropeanUnion.**

Vertical Approach

The Hungarian food industry constitutes the most important partner of the Hungarian agricultural sector.

The panel experts recommendations support the realisation of the Scenario 1 model, based on a fast development of knowledge- and labour-intensive activities integrated into a scheme of landscape management:

Scenario.1: "Horticulture-centered" model (development of knowledge- and labour-intensive activities)

The system of producers' marketing organisations must have a very special role. These organisations are formed in accordance with the requirements presented by the given product for preparation, storage, and distribution; production tasks are allocated on the basis of contracts made with processing firms, retailing networks, or purchasing companies; the preparation, stockage, and marketing of the product are all regulated and organised. The implementation of marketing and development programmes, or the operations of credit organisations may all easily be coordinated through them.

The priority accorded to the development of horticultural activities also means that up-to-date cultivation skills and knowledge must be propagated among a broader range of recipients, and that greater readiness to cooperate should be encouraged**. It is impossible to keep the knowledge and skills of hundreds of thousands of people up-to-date and to sustain their readiness to cooperate with each other without a professional advisory system and consultation forms that attract public attention.**

This model may only hope to be successful if and when there is a willingness and readiness among the business participants to cooperate with each other, or if they are at least prepared to respect each other.s fundamental interests, and if the state sets up a system for organising land management and accepts responsibility for creating its share of appropriate services.

The **European Union's scenario in the agricultural sector must also be dealt with**.
The European Union has also announced its own foresight programme, which is based to a significant degree on the national programmes of the member states. **One of the studies in the programme also calls for specialisation in the agricultural sector of the European economy, and foresees three clearly distinct regions for the future. In the northern areas of western Europe, it calls for the preservation of the landscape and stresses leisure and recreational uses. In the southern zones of the European integration, they recommend the production of special agricultural goods. Eastern Europe should concentrate on the production of mass commodities.** The role assigned for the countries wishing to join the Union could easily develop by itself without any particular external intervention under the scenario described in the "drifting" model of development. **– Hungary**

- **Technology Foresight Slovakia 2015** *Executor: Institute for Forecasting. Year of completion: 2004. Web site: http://www.foresight.sav.sk/* In the Slovak Republic, a long-term forecast of development and utilisation of science and technology, using of the forecast method - Technology foresight, has not been elaborated, up to now. Among the supply-driven science and technology themes is **Genetics and biotechnology** and among demand-driven

science and technology themes are **Sustainable development of agriculture** and Implementing science and technology into practice.**– Slovakia**

- **Technological Development in Slovenia** *Year of Completion 2003. Technology Forsight in Slovenia - paper.pdf* The first phase of the second Slovenian research in Technology Foresight was conducted in 2004. Its task was to make a preliminary identification of priority technological topics for eight thematic fields: ICTs, Materials, **Biotechnology**, Environment, Construction, Traffic, Life-long-learning and medicine.

  Thematic field: Biotechnology, pharmaceuticals and nutrition

  Over the last ten years, biotechnology has become a key generator of progress biosciences and related industries in economically advanced countries. Unfortunately there are currently very few commercial operators in the field of biotechnology in Slovenia, which means that Slovenia has limited chances for development in this important high-tech area**. - Slovenia**

- **Swedish Technology Foresight** *Executor: Teknisk Framsyn. Year of completion: 2004. Web site: http://www.tekniskframsyn.nu Choosing Strategies.pdf*

  Today Sweden faces a number of strategic choices that will be crucial to its long-term development and prosperity. These strategic choices can be summarized as follows:
  - the resources on **investments and projects for the future** must be concentrated.
  - the **national infrastructure, which was largely built during the 1950s, 60s and 70s, is beginning to wear out and needs extensive maintenance** (We must ponder the implications of having roads, rail systems and cities that were built for the requirements and needs of the industrial society.)
  - **development of knowledge in the form of education and research is obviously among the most important investments for the future. - Sweden**

Foresight on (policy) processes and pathways

- **Transition to Sustainable Production Systems - Austria 2020** *Executor: ARC systems research. Year of completion 2003. Sponsors: Austrian Ministry for Transport, Innovation and Technology (BMVIT).* The project served to explore possible future pathways in selected areas of **sustainable production**. Based on the development of future scenarios for the areas of 'bio-refineries' and 'wood-plastic-composites/biopolymers', strategic options for research, industry and 'policy were explored.*A particular emphasis was put on the role of RTD-policy* **– Austria**
- **Technology Foresight within the Finnish Innovation System** *Executor: Tekes (the National Technology Agency).* The Ministry of Trade and Industry coordinates technology foresight in Finland. The main task of the project was to produce scenarios and visions for innovation policy, analyse different evolution processes, and develop new approaches from **systematic long-term research** to public discussion. Information and communications technology, **biotechnology** and material technology are the global technologies that seem to promote change in the future. **Finland has a good competitive edge in some sub-sectors within these technological fields, both in industry and in research institutes. - Finland**

- **The Polish Foresight Pilot - Health and Living Sceince 2013** Executor: Ministry of Science and Information Society Technologies. Year of completion: 2005. http://www.dynamo.tno.nl/efmn/download.asp?id=543

  This pilot Foresight project in the area of **Health and Living** was aimed at speeding up the process of predicting development paths that would lead to improvement in the health

and quality of life of Polish citizens. *The 'Health and Living' area was selected for analysis due to the widespread perception that the biological and medical sciences develop very fast nowadays and this pace of change poses new challenges for policy makers across a range of domains.* Among the 11 thematic areas were: **Bioinformatics and biomedical engineering; new bio- and nanotechnologies in medicine and healthcare; conditions of the quality of life; food safety and health; food production and the environment as well as environmental protection. – Poland**

Sector/cluster oriented foresight

- **Food Industry in Flanders - Towards 2010**. A regional national foresight process covering various subfields of S&T relevant to the food sector, taking account of socio-economic and cultural trends. ***One of the aims of this foresight exercise:*** to identify and analyse those **factors that would facilitate timely anticipation on these developments** such as research capacity, **infrastructure** and other economic issues such as labour cost List of drivers in food sector identified **– Belgium**

- **Flanders' FOOD' - the innovation platform for the Flemish Food Industry** addresses the need to support small and medium sized industry in their search for innovation in the sector **– Belgium**

- **Regional Technology Foresight Flanders 2015**. Expert validated priority setting on technology and innovation within 6 strategic clusters in Flanders. Strategic cluster 3 covered Healthcare – Food and Agriculture – Prevention and treatment. The following aspects are taken in consideration:
    - Relation between food and health
    - Agricultural biotechnology
    - Industrial biotechnology

A knowledge intensive society cannot survive and grow without periodic reflections on upcoming techno-economic trends and evolutions. In Flanders, there is a clear need for foresight exercises at the *macro* level. Such insights are now at the roots of a framework for policy makers which supports their strategic choices related to technology and innovation policies. Also, industrialists and scientists will be induced to act by these insights. **– Belgium**

- **'Countryside with a Future'** is the first phase of a project on rural development and farming policy. The aim is to identify the driving factors (e.g. socio-economic factors) and find evaluation criteria (or assessment factors). Together with the main stakeholders, viWTA seeks parameters for rural development and rural policy, accompanied by an evaluation of their possible effects. At a later stage, this information can be made available to policymakers, actors in the civil society, and/or the general public. Together with the King Baudouin Foundation (Brussels, Belgium), viWTA reworked and improved the **Participatory Methods Toolkit** they wrote in 2003. **This Toolkit is a practical and pragmatic guide for everyone who wants to organize participation on every level**. Among the methods represented are Delphi, expert panels, focus groups and scenario building, which are widely used in foresight exercises. **– Belgium**

- The Ministry of Science, Technology and Innovation was given funds to carry out a **Denmark Technological Foresight** (TF) project during a three-year period, from 2001 to 2004.One of the foresight themes was :

- **ICT from farm to table** - a technological foresight which analyses future possibilities for the application of ICT within the whole value chain in the next 5-10 years in Danish agricultural and food sectors. The foresight was implemented to create insight and readiness in the business sector and innovation system about the future possibilities and challenges which will be identified in the cross field of ICT, agriculture and food production**.**
- **Green technologies –** a technological foresight on more environmentally-friendly agriculture
- **Bio and healthcare –** a technological foresight on developments in biotechnology and health technology.
- **Technological Foresight on Nanotechnology – Denmark**

- **e-Foresee in Estonia: Biotechnology Foresight in Estonia** Executor: Institute of Baltic Studies and PRAXIS Center for Policy Studies The project concentrates on developing innovation and industrial policy measures and elements in order to create long-term (10-20 years) possibilities of sustainable growth and development in **biotechnology and related industrial sectors in Estonia**. It focuses on the development of institutional, economic and legal measures which enable to create and sustain biotechnology as a new paradigm leading industry as well as to manage various economic, developmental and social 'side-effects' due to the development of biotechnology within and without Estonia.**. – Estonia**

- **The Future of the Food Industry (ETU 2030)** *Executor:* Finland Futures Research Centre. Year of completion: 2001. Web site: **The intention of this project is to collect relevant research reports and clarifications of different circles on the future of the food industry. These reports will serve as basis to form an overall picture of the food industry's development up to 2030. – Finland**

- **Food Technology Foresight in Finland.** Food industry is traditionally investing very little on R&D and is as a sector in front of many future challenges**. The foresight exercise aims to identify technological opportunities for Finnish food industry and tries to stimulate the industry.** The foresight also provides important input to Tekes, National Technology Agency for directing its future technology programmes targeted to food industry.The basic idea is analysis of the future challenges of the industry and its research and technology system. **– Finland**

- **Agriculture and Territories. Four scenarios for 2015** *Executor: La DIACT. Year of completion 1997.* Examination of the future of agriculture, its products and markets, the way it functions and the strategies of those involved in it in the context of globalization of markets, the increasing size of farms, the growth of industrial food production, the consumer demands on quality, safety and environmentally friendly products and multifunctionality of rural areas' economy **– France**

- **INRA 2020** *Executor: National Institute for Food Processing Research (INRA).*_INRA 2020 is a prospective exercise intended to shed light on future possibilities for the National Institute for Food Processing Research (INRA). This project, launched in September 2001, is a contribution to the current debate, as well as the one to come, on the role and organisation of research, particularly public research in life science - in France and Europe. **– France**
- **Future Impacts of Biotechnology on Agriculture, Food Production and Food Processing** Executor: ISI Fraunhofer Institute for Systems and Innovation Research; EC Research DG.

Web site: http://www.vonl.com/chips/futureim.htm **Main goals** of the exercise were to test the methodology, especially on a **supranational base**; to identify if different experts groups have different opinions concerning the future and if differences between the EU countries can be identified. **This foresight is done in coordination with 4 other European countries so that the results are comparable**. **– Germany**

- **Foresight for Rural Ireland 2025** Executor: NUI Maynooth, University College of Dublin and Teagasc Liam Downey - NUI Maynooth. Year of completion: 2005. Web site: http://www.teagasc.ie/

  A foresight on the future of rural Ireland in 2025 - takes account of the **whole of the rural economy, the chanegs that will hapen to farming as a result of demographics, abandonment, CAP reform and climate change.** It considers a **diversified knowledge based rural economy in which multi-funtionality based farming** plays an important role from a social and environmental perspective even if it has a lower direct impact on the economic.

  What Future Could Be Achieved?

  Rural Ireland in 2025 could be closer to the situation envisaged in the goals for national policies. However, this requires **taking action now on the following**:

  - **Rapid communications and supporting infrastructure would provide greater accessibility throughout all parts of the country.**
  - The rural economy could sustain more competitive enterprises through the development of additional entrepreneurial and management skills, as well as further innovation in products, business organisation and marketing.
  - **The agri-food industry could have more developed business, technological and innovative capacities, with a widely differentiated product portfolio selling in international markets.**
  - **A knowledge-based bio-economy could emerge built on the comparative advantage of Ireland's natural resources.**
  - 'Old economy' enterprises could be upgraded, and manufacturing small and medium sized enterprises (SMEs) could increase their contribution to the rural economy.
  - Clusters of internationally oriented companies could exploit the full potential of natural resources in food, the marine, forestry and tourism.
  - ***Realising Attainable National Policy Goals***
  - Overall changes required to achieve the above perspective and the ultimate goals of rural policies are summarised below.
  - Greater commitment to rural and regional development throughout government.
  - **Construct an effective institutional framework to ensure that policies respond to the defined needs of the rural economy and rural communities.**
  - **Recognition that rural development requires a strong focus on multi-sectoral development, tailored to the circumstances of different regions and sub-regions and goes beyond agriculture and agricultural policy.**
  - **Emphasis on applying knowledge and research based information in decision-making and innovation at all levels**.

  What Are The Most Essential Enabling Measures?

  For the proper implementation of the range of strategic initiatives advocated in this Foresight report, three overarching measures are necessary:

  1. **Establishment of a Rural Policy Implementation Group to facilitate efficient resource use in developing a competitive and sustainable rural economy.**
  2. **Development of Regional Innovation and Research Systems to support the development of a knowledge based rural economy.**

3. **Provision of Education and Training Programmes to raise the human resource capabilities of rural businesses, and of rural populations generally.**

Without these measures the rural economy will not attain the prospects outlined above, and further more the declared goals of rural policy will not be achieved **– Ireland**

- **eForesee in Malta - Biotech Pilot** *Executor:* Malta Council for Science & Technology. Year of completion: 2002. Main documents: Biotech Pilot Mission Statement ; Biotech Launch Programme

  The Core Objective of the Pilot was to promote capacity-building in the fledgling Maltese Biotechnology sector through a collaborative venture between academia, the public and private sectors and society. The full name of the exercise was "Realizing a Thriving Maltese Biotechnology Industry by 2015".

  Two **aspects of biotechnology** were distinguished in the pilot, namely its **applications within the health sector** and the **non-health sector** and for this purpose two separate expert panels were set up. Through expert consultations with academia and the the private sector, as well with society at large, the pilot sought to draw out recommendations which have at their core improved science and technology education at all levels and the introduction of RTDI-related incentives to attract FDI. Such recommendations and action lines would serve as a basis for the drafting of a ***National Biotechnology Strategy for 2015***. The process itself helped forge closer working partnerships between the various sectors (academic, business and public sectors) in Malta to tap merging market niches in biotechnology as well as provide an appropriate direction and support for publiclyfunded research. **– Malta**

- **The Impact of Biotechnology on Agriculture, Farming and Forestry**
  Executor: OPTI Foundation. Year of completion: 2004. Web site: http://www.opti.org/

  This study analyses the state of the current research in agro-biotechnology in Spain and identifies strengths in this area. It also investigates the future of agro-biotechnology research in Spain and its potential application to industry.

  The final conclusions chapter deals with the social acceptance problems that this technologies have. **It also highlights the multidisciplinarity of this field and the huge of the task that it addresses.** Although there's such a long way to go, this science promises immediate applications. **In order to reach success in this industry, the final chapter includes a set of recommendations for the Spanish policy makers and industries. – Spain**

- **Agro-Food**
  Executor: OPTI - AINIA - CDTI - CITMA – MCYT. Year of completion: 2003. Web site: http://www.opti.org This study gathers the conclusions of the three previous works carried out by the OPTI Foundation on the agro-food industry: "Food preservation technologies", "Biotechnology applied in agro-food industry" and "Agro-food packing technologies". A workshop of experts from OPTI Foundation, The Ministry of Science and Technology and CDTI, worked upon the results of these three studies in order to write this report. **The aim of the report is to review the emerging technologies in the agro-food industry that will become more important in the next years. – Spain**

- **NRLO's foresight programme**
  Executor: National Council for Agricultural Research.
  http://www.agro.nl/nrlo/english/nrint2pg.shtml

During the years 1995-1998 the NRLO focused its attention on conducting an interconnected series of foresight studies in Dutch agrosector. The Dutch agrosector has traditionally provided its customers and society with an important service through the production of food and agricultural commodities. The importance of this contribution will remain undiminished in the future. And more than that, on the way to the 21st century it will gain added breadth and depth. The principal findings of these studies have been integrated in five reports on the **main themes**: "Agriculture in society: a new prespective", "Globalization and agribusiness", "Market strategies and consumer behaviour", "Agriculture and environment", "Towards healthy animal production". **– The Netherlands**

- **Functional Foods. Position and future perspectives**
  Executor: Wageningen University. Year of completion: 2001. Web site: http://www.agro.nl/nrlo/programmeringsstudies/nr010401.shtml
  This report endeavours to clarify the drifferent aspects of **functional foods** in an integrated approach tot their development. The various viewpoints on aspects such as food technology, nutrition and health, legal aspects of health claims and the consumer perspective have been discussed by experts in these areas in a series of workshops. The desired developments and gaps in knowlegde and in our current approach to functional foods have been identified. **– The Netherlands**

- **Food supply in the 21th century**
  Executor: Innovatienetwerk Groene Ruimte en Agrocluster. Year of completion: 2003. Web site: http://www.agro.nl/innovatienetwerk/vgs/publicaties.html. Work document on the future of social issues, technological development and policy in the food industry. Report and essay on a symposion, workshop and additional interviews on the future of the food industry. **– The Netherlands**

- **UK National Foresight: Agriculture in the UK - its Role and Challenge** ForesightAgricultureReport.pdf
  This paper is intended to provoke and facilitate discussion about the future of agriculture as a commercial activity in the UK. It is written at a time of acute distress as a result of a series of farming misfortunes, BSE, food scares, and most recently, the outbreak of Foot and Mouth Disease. However, the debate to which it is intended to contribute, and of which the creation of the Department for the Environment and Rural Affairs forms part, is of much longer standing. **– UK**

- **The Future of the UK Food Chain** Executor: The Henley Centre, Year 2004, The Future of the UK Food Chain.doc Henley Centre foresees **four areas of importance with regard to the national interest:** - *The health of the nation: how food may be used to combat the health costs of issues such as obesity and ageing - The competitiveness of the nation: how food is the tool for continued world-beating performances by the UK's major supermarkets - The quality of rural areas and sustainable communities: how the different drivers, in particular the power of major retailers, may affect rural Britain for better or worse - The nation's role in the international community: how Britain has sufficient influence to be a major player in the developments in the food chain that will become necessary for environmental, political and financial reasons.* This project process utilised a number of established futures techniques initially to identify drivers of the future of the food chain, to filter them for importance, and then to analyse their impact.

Foresights for introduction of methodologies/approaches

- **FORETECH**

  Introduction of the use of foresight as a tool for policy development at national, regional and sectoral level. The aim was to customize a foresight methodology to the Bulgarian environment. This was tested by implementing two foresight pilots in the fields of:
  • e-Government, as well as
  • Agriculture & Biotechnology**.** - **Bulgaria**

- **eForesee Cyprus**

  Foresight exercise in Cyprus, exploring Foresight from a **Knowledge Management** perspective, and in particular for the areas of **Agriculture, Environment and Biotechnology**.. **The scope of the Conference within the project was to explore the opportunities and challenges for agriculture after joining the EU, utilizing foresight methodology through the selection of possible strategic visions. More specifically it was stressed that foresight: can be applied to adoption of the aquis communautaire by accession countries and to reform the agricultural sector. – Cyprus**

- **National Program of Oriented Research** *Principal promoter and sponsor:* The Ministry of Education, Youth and Sports (MEYS). Year of completion 2001.

  The Government decided to prepare the **National Research and Development Policy of the Czech Republic (NRDP)** as a key strategic document defining the relationship of the state to the research and development. **The NRDP declared the need of early identification of priorities of oriented research using some of the proven methodologies (or a combination of methodologies) of the technology foresight.** The accomplishment of this task was the principal objective of the national technology foresight exercise conducted in the Czech Republic in 2001. **– Czech Republic**

- **Foresight Embedding in Malta** On the event of accession to the European Union, Malta like all new members states, experienced considerable pressure for change. This included a drive to adapt RTDI policies for participation in the European Research Area. For a small transition economy with limited resources there was a need to adopt a creative approach to policy development. In the period 2002-2003 foresight was introduced to Malta via three pilot projects conducted by the **MCST** (eForesee). Foresight is now an integral part of the day-to-day work of the MCST which continues to promote and encourage its application to other policy domains.

  The major challenges identified included:
  • Ensuring a more holistic and integrated approach to strategic policy-making in ICT and Knowledge Management,
  • Embedding foresight in key policy areas for the knowl-edge-based economy, and
  • Allocating appropriate levels of resources to each of the pilot exercises. **-Malta**

IV. Identified trends and drivers

Agriculture Issues, Trends and Drivers

- Trade liberalisation and WTO => greater competition
- CAP Reform (*Growing concerns regarding agriculture's environmental footprint (towards sustainable farm production?); Animal welfare; Growth in non-food production; Intensification and Extensification; Abandonment, e.g. due to lack of competitiveness; Genetic erosion / biodiversity; Focus on wider rural economies and regional development)*
- Co-existence of agricultural practices (Design and diffusion of GMOs; Organic farming)
- Incidences of new and emerging diseases, and the risks from zoonosis
- Water management
- Soils management
- Decline in employment
- Greater use of technologies to move up an extended value chain

Food Issues, Trends and Drivers

- Food for Life (Health and Longevity) – the growing synergies between Nutrition and Health
- Food Safety Concerns, reflected in regulation and consumer behaviour
- Food Security
- Packaging, preparation, preservation, distribution and consumption of food
- Growing domination of food retailers
- Consolidation of the industry into transnational conglomerates
- Lengthening of food supply chains

Wider Socio-Economic Issues, Trends and Drivers

- Demographic and lifestyle changes
- Globalisation
- Regionalism
- Rise of BRICs (Brazil, Russia, India and China) economies
- Climate change
- Increased emphasis upon knowledge / learning societies
- Growing resource scarcity, for example, around energy supplies
- Global economic growth and industrialisation

Biotechnology Issues, Trends and Drivers

- 'omics (Genomics, Nutrigenomics, Proteomics, Metabolomics)
- Systems biology
- Epigenetics
- Apomictic technologies
- Marker-assisted breeding
- Reproductive and cloning technologies
- Biopharming

- Bio-catalysis and bio-reactors
- Bioinformatics
- Converging Technologies
- Increased availability of diagnostics, e.g. DNA chips and biosensing devices
- Continuing convergence and divergence of scientific disciplines
- Public acceptance / rejection
- Capital investment markets
- Management
- ICT
- nanosciences

Research Infrastructures Issues, Trends and Drivers

- European Research Area
- Increasing diversity of disciplines using a broader range of RIs, e.g. increasing number of biological scientists making use of radiation sources; multi-and interdisciplinarity
- Greater sharing of RI facilities
- Network of decentralised infrastructures – might be more about improved development and better networking of existing national infrastructures as opposed to building large scale Europe-wide facilities (even the latter might consist of distributed centres)
- Increased sophistication of RIs being used in the area => higher costs
- Changing organisation and conduct of science
- Prestige and the concomitant competition among states for hosting RIs
- Increasing industry use of facilities
- Broadening missions of RIs to reflect multiple roles and purposes
- Ageing and sometimes out-dated infrastructures in much of Europe

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