

# FUGE II – Functional Genomics in Norway

## Action Plan 2007-2011

*Vision: "Ideas and societal demands as forces driving the development of the technological landscape"*

### Summary:

The *FUGE II Action plan for 2007-2011* builds on the original FUGE plan from 2002 (the strategy plan), a comprehensive external evaluation of the national technology platforms from 2006, dialogues with the Scientific Advisory Committee and all relevant research institutions as well as a survey among the users of the 11 FUGE technology platforms. In addition, FUGE has invited the research communities to contribute with suggestions. The main focus for the action plan was formed at a meeting with SAC which took place 17 and 18 January 2007, and was approved by the Divisional Board for the Division for Strategic Priorities on 7 February 2007. A report and presentations from the meeting with SAC can be found on the FUGE website.

The main focus in the first phase of the FUGE initiative (2002-2006) was the process of establishing national technology platforms in strategic areas within functional genomics research. This process has now been completed. During the next period, from 2007 to 2011, known as FUGE II, FUGE will continue to develop functional genomics research and the necessary technology as defined by recommendations and administrative decisions made by the Board.

The information provided in the action plan gives concrete and specific information regarding the application deadline on 18 April 2007.

The main challenges for FUGE:

- Continuation, not preservation.
- High ambitions, but limited budget.
- Build on strengths while also developing careers.
- Technology development with focus on research projects.
- Gradual transferral of the platforms to the host institutions while maintaining a national perspective.
- The situation for functional genomics research in Norway after 2011.

The host institutions and FUGE have agreed on having annual meetings for dialogues about challenges, the development towards 2012 and the direction of functional genomics after 2011.

### Budgets and financial means

Thematic distribution of budgeted means will be maintained on the same level as in FUGE I with an equal distribution between basic, marine and medical research. Assuming a growth rate of zero percent, the total of FUGE's budget will be about 910 million NOK for the period 2007-2011. About 420 million NOK will be announced in 2007 according to this action plan (see Table 1). The FUGE Board will work for a budget increase to meet the original goal of 300 million NOK per year as outlined in the original FUGE plan. In accordance with advice given to the FUGE Board by the Research Council and others, the Board has decided to continue existing activities

and start new ones only within a budget filling the zero percent growth budgets until 2012. This means that additional activities can only be initiated if the FUGE budget is increased. Projects aimed at industry development and ethical and social aspects are exempt from these limitations.

In order to prioritise research projects for funding as well as preparing for an institutional take-over of the responsibilities for the continuation of the national infrastructure and competence after 2011, contracts will ensure the gradual decrease in FUGE funding for the platforms during the period alongside the gradual increase of institutional contribution.

FUGE will maintain the budgeted distribution between the thematic areas basic research, marine and medical research with proportionately equal shares to each of the areas. Plant biotechnology is considered part of the basic research theme.

FUGE is now exploiting the means established by the Research Council, but will also consider other means which may be better adapted to FUGE's goals and subject focus.

Updated information about support, means and application deadlines are available at: <http://www.forskningsradet.no/fuge>. FUGE makes announcements according to the application deadlines set by the Research Council.

Table 1: The total FUGE budget in million NOK (shaded area shows calculated budget at zero growth)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
The Research Fund	104	104,5	133	120	70	118	115	120	120	125
Ministry of Education and Research	0	50	49	49	56	52	52	52	52	52
Total	104	154,5	182	169	126	170	167	172	172	177

## Objectives

### Main goal

The FUGE initiative aims at a pronounced strengthening and improvement of the quality of functional genomics research within the fields of basic biology, medicine and aquaculture. Another goal for the initiative is to incite innovation and industry development and incite an increase in both the quality of health care and international collaboration.

### Major goals

The 'Action Plan 2002' listed various goals for the use of the annual sum of 300 million NOK allocated to FUGE by the government. These goals are linked to the thematic fields of effort listed in the White Paper of 1999. The level of ambition has been continually adjusted according to the real budgets. The Board has, based the White Paper of 2005 as well as the evaluation and strategy processes carried out in 2006, stated the following goals:

### Goal for changes in the research system

FUGE will contribute to a change-over in the research system which will lead to larger revenues from the research grants than what is generated at present. FUGE will also contribute to a substantially improved linkage between the research communities and the industry. This also includes strategically important alliances with strong international research communities.

Particular attention will be paid to:

- The continued development of national and regional models for collaboration which will contribute to industry making use of functional genomics research results from the universities and other research institutions.
- The development of models for establishing contact with investor communities which will further incite the development of industry based in functional genomics.
- The integration of Norwegian communities into international networks and collaborations within functional genomics.
- The revision and strengthening of the national FUGE platform network to ensure the platforms' role as driving forces in both research and industry development.
- The establishment of means for integrating systems biology into functional genomics research in Norway.
- Ensuring that the FUGE II research strategy builds areas of commitment according to the statements of the EU 7<sup>th</sup> Framework Programme.
- Ensure that Norwegian biobanks are exploited for the purpose of strengthening Norwegian medical research and raise the quality of Norwegian health care.

## **Thematic priorities**

### **Basic biological research**

FUGE will contribute to maintaining an international standard on the basic research disciplines underlying functional genomics. In addition, Norway will make its mark internationally in chosen areas which are of particular strategic importance and in which Norway has particular advantages. Basic biological research is an important and integral part of both medical and marine research, which are the two chosen thematic research areas for FUGE (see below).

- Young researchers with talent and ambitions for building their own research groups will receive support.
- Preparations will be made to ensure optimal conditions for international collaboration and participation on chosen international arenas in Europe and North America.
- All Ph.D. students and post-doctoral recipients working on projects that receive FUGE funding must complete a qualifying 6-month stay at a foreign institution during their time on the project. As an alternative, they can make several shorter stays abroad that together cover the 6-month period. This will be specifically stated in the contract.

The organization and specialization of the platforms will be based on the evaluation reports and the suggestions made by SAC and the R&D institutions, and will be adapted to changes occurring in their respective fields, nationally and internationally.

### **Medical research**

FUGE will contribute to making the Norwegian health care services better equipped for applying the new knowledge and making use of the new offers in medicine which functional genomics research bring forth. This entails that:

- FUGE works to establish the competence and bring forth the legislation necessary to ensure that functional genomics research has access to material from the human biobanks.
- FUGE contributes to the establishment of functional genomics research at all university hospitals in the country so that their research can contribute to a better understanding of disease and disease mechanisms.

- FUGE collaborates with the Division for Science in the Research Council. FUGE will, in addition, stimulate increased contact with the health trusts to collaborate on a mutual plan for functional genomics research as well as establish a fruitful interplay regarding the exploitation of the research funds which are at the disposal of the health trusts and FUGE. The health trusts must become central partners in the exploitation and production of patient and clinical information as well as the establishment of national networks. A fruitful interplay between FUGE and the health trusts is necessary in order to ensure optimal exploitation of information from the nation's population and patient cohorts.
- FUGE strengthens translational research and contributes to increasing the importance of basic research for clinically related research in the health trusts.
- FUGE contributes to building competence, which in turn will make the development and application of the newest methods for diagnostics and treatment of diseases possible for the university hospitals.
- FUGE contributes to maintaining a strong competence base for basic medical research, which strengthens the level of preparation for potential new global health challenges, including infectious diseases.

### **Marine research**

FUGE will help strengthen the basis for marine research in order to continue the development of the aquaculture industry, ensure optimal exploitation of marine resources and on a long-term basis build a Norwegian biomarine cluster. Marine functional genomics research will be aimed towards the mapping of genetic conditions that are relevant for the development, growth rate, feed utilization, taste, reproduction, stock adaptation and resistance to diseases for fish species which are strategically important for Norway.

FUGE has chosen to organise the majority of the activity in this thematic area as a resource, competence and service platform (GenoFisk). The platform will serve as centre for a network of marine research communities, coordinating national activities aimed towards cod and salmon genome sequencing.

### **Ethics and society**

Resources in the current budget have been earmarked for further work on this theme (3-5 % of the total budget). The establishment of interdisciplinary research collaborations is desired. During this period, high priority will be given to the initiation of viable research projects with international standards that can shed light on problems related to the strengthening of the dialogue with society and the development of robust biotechnological research and industry.

Through FUGE's participation in ERA-SAGE, the value of the support from this ERA-net for the interests of FUGE will be assessed on a continual basis. This approach will also provide this field with the much-needed internationalization. ERA-SAGE<sup>1</sup> addresses problems connected to the dialogue with society and the development of durable research strategies in Europe.

The Board aims to use means to stimulate the establishment of networks and dialogue with society as well as channelling some funds towards international collaboration within the ERA-net.

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<sup>1</sup> [http://www.genomics.nl/homepage/research/special\\_activities/erasage](http://www.genomics.nl/homepage/research/special_activities/erasage)

*Up to 25 million NOK have been earmarked for this purpose for the period 2007-2011.*

### **Industry development**

A goal for the FUGE initiative is to both directly and indirectly contribute to creating value and industry development through its activities. Companies that develop or apply relevant methodology or that have research and development activities relevant to functional genomics research may apply for funding. Consequently, well-established companies with products already on the market generating an income, will not receive the same amount of funding as will small newly established companies still in the stages of developing their products.

FUGE will use the means established by from the Research Council in this area, means such as **“User-led Innovation Projects” (BIPs)** and **“Knowledge-building Projects with User Involvement” (KMBs)**. The FUGE Board will also consider developing and implementing other means of funding. By finding functional models for collaboration with FORNY, FUGE seeks to strengthen its coordinating role in biotechnological industry development. Evaluation criteria, methods and means will be considered in collaboration with the Division for Innovation and FORNY.

The regional FUGE committees collaborate with the regional representatives of the Research Council, the regional representation for FORNY, the TTO representatives for the universities and other regional commercialization units to identify possible industry projects and heighten the awareness of commercialization potentials within the research communities.

The Norwegian Bioindustry Association and Innovation Norway are important collaborators when trying to reach the goals of industry development. MedCoast Scandinavia is also a potential contributor in this respect.

Having completed a doctoral thesis (an “industry PhD”) or a post-doctoral fellowship period in a Norwegian or an international company will be beneficial for a grant application (a practice in line with White Paper no. 20 from 2005).

In order to increase the interchanging of competence and knowledge between academia and industry, FUGE wishes to stimulate exchanges of personnel between the collaborating institutions for shorter or longer periods of time. International exchanges between industry and academia are also desirable.

A minimum 10 % of the total FUGE budget will at all times be allocated for the direct support of projects aimed at industry development based on functional genomics research. More information on industry development can be found in the *FUGE Strategy for Industrial Development 2007-2009* at [www.forskningsradet.no/fuge](http://www.forskningsradet.no/fuge).

***Up to 45 million NOK have been earmarked for industry development in the period 2007-2011.***

FUGE will investigate whether and how service functions within technologies, which may have a client base outside of academia, can be separated from the academic platform structure. For such functions to be run by a professional organization attending to aspects presented by a demanding market would serve the technologies better. Technologies which are relevant for high throughput screening are of particular interest in this respect.

### **FUGE activities within the main thematic areas of biotechnology**

#### ***Red biotechnology (Human medicine)***

Through a biobank platform, FUGE seeks to contribute to the organization of cohorts and Norwegian biobanks and registries, and for their continued running and lending material to research projects. Collaboration with Swedish biobank initiatives will be a central theme. So will the Norwegian biobank initiative, as it is expected to play a central role in the thematic area Health (1.1 and 2.1) in the EU 7<sup>th</sup> Framework Programme.

FUGE aims to follow up on the recommendations for the continued development of the biobank initiative given by the evaluation panel.

FUGE's project funding will be given to human medical research projects within the cardiovascular, diabetes, cancer, immunology and neurology fields alongside internal medicine and microbiology. Both academic research projects and projects directed towards industry (BIPs) will be supported.

FUGE will initiate a dialogue with the health trusts in an effort to find possible collaboration arenas within biobanking, translational research as well as a more basic understanding of diseases and diagnostics.

### **Blue biotechnology (marine)**

In 2006 FUGE established *GenoFisk*, a national platform for competence and resources for developing functional genomics research in the marine area both nationally and internationally. A central activity will be the preparation for, and in the longer run to partake in international programmes for the sequencing of the cod and salmon genomes. An amount of 10 million NOK has been reserved for strengthening competence in the marine research communities in this area through the GenoFisk platform.

It will be viewed positively if new marine R&D projects make use of resources, competence and services from the GenoFisk platform. Industry directed projects (BIPs) will be funded equally with other projects. The communities working with both salmon and cod have already initiated international collaborative efforts with among others North America and FUGE will contribute to the strengthening of these.

The AQUACULTURE programme and FUGE will on a continual basis assess possibilities for joint areas of effort and joint projects.

### **Green biotechnology (land-based)**

Through FUGE's participation in ERA-PG (Plant Genomics) two Norwegian research groups receive funding as partners. FUGE will consider whether to take part in new announcements.

Green biotechnology is not one of the officially prioritised thematic fields, but FUGE does support basic research projects within this area. Projects related to environmentally relevant themes, with potential for helping to solve problems related to the climate, will in the future be of particular interest for FUGE funding. Systems biology is one approach expected to be of interest in this connection, and projects making use of this approach will be assessed positively (see below).

### **White biotechnology (industrial)**

Within this theme, the goal is to develop industrial processes that make use of biotechnological methods, resulting in a more environmental and efficient production process particularly relevant to microbial biotechnology. FUGE will make positive assessments of applications aiming to investigate such problems, particularly if the projects have a systems biology approach that uses the competence or services of one or more of the platforms.

FUGE participation in the ERA-net ERA-SysBio (systems biology) has ensured funding for five Norwegian research groups as both coordinators and partners within systems biology in micro-organisms.

A definition of systems biology which reflects the general international understanding of the field:

*Systems biology is a multi-disciplinary approach which seeks to explain, predict and control complex cellular and physiological phenomena in living organisms based on underlying molecular regulatory mechanisms which are based on integrated research programmes where the shaping, simulation and analysis of experimental data by using mathematical, statistical and numerical methods hold a key role.*

## **National and regional collaboration**

### **Collaboration with regional committees**

With assistance from the regional FUGE committees in Tromsø, Trondheim, Bergen and Oslo, FUGE has organised regional collaboration schemes to integrate the universities, research institutions and industry in subject fields relevant to functional genomics research. These collaboration schemes will be elaborated further according to local needs and will therefore have different structures specific to each part of the country. Funds have been allocated specifically for the building and maintenance of infrastructures. The regions are invited to seek these funds in direct dialogue with the FUGE Board.

In addition, the University of Oslo has established a steering committee for molecular biology, biotechnology and bioinformatics named EMBIO. This group coordinates FUGE research at the largest university in the country. The other institutions in the region are represented in the steering committee to ensure proper coordination within the region. The research communities at Norwegian University of Life Sciences and Norwegian School of Veterinary Sciences are included in the work of the regional committee.

The University of Bergen has established a Committee for Functional Genomics Research consisting of members from the Faculty of Mathematics and Natural Sciences, the Faculty of Medicine, the Faculty of Law, the Sars International Centre for Marine Molecular Biology, Haukeland University Hospital, the Institute of Marine Research and aquaculture industry. The committee is in charge of coordinating university participation in FUGE and discussing measures for strengthening efforts from the University of Bergen and the Bergen region in the subject field. The University of Stavanger is also included in the Western region.

In Tromsø, a regional FUGE committee has been established, FUGE in Northern Norway (FUGE-N), comprised of representatives from the University of Tromsø and Fiskeriforskning. The committee is currently working on a strategy plan for the FUGE initiative in the Northern region.

A FUGE committee has been established in Trondheim consisting of representatives from various scientific communities at the Norwegian University of Science and Technology, SINTEF, the St. Olav Hospital (Trondheim University Hospital) and industry. With a starting point in existing strategic initiatives, such as medical technology and the Nord-Trøndelag Health Study (HUNT), the committee will work to coordinate and develop further functional genomics activities in the region.

Although the regional collaboration initiatives are important supplements and aids to the FUGE Board, they are primarily regional responsibilities.

## Internationalization

### International collaboration

The FUGE Board underlines that functional genomics internationally is a rapidly expanding research field where Norway must ensure the establishment of solid international collaborative measures both on a scientific and organizational level in order to succeed. Two chief measures are of particular importance when it comes to establishing Norway on the international research forefront: One is to recruit good international researchers with a broad international network to Norwegian laboratories and research communities. The other is to allow Norwegian researchers to travel abroad in order to learn from the best research communities in other countries. By actively participating in international forums on which collaborations are based (such as ERA-nets, Nordic networks, transnational networks, etc.), Norway can form contacts both on an administrative and a scientific level. Contact between Norwegian researchers and elite environments in the Nordic countries, the rest of Europe, USA and other great research nations will allow for access to the necessary competence and help improve the quality of Norwegian research. Such connections may also prove to be of importance to the development of industry based on research results. Norway has a number of potential advantages to benefit this development, such as biobanks connected to health studies and health registries for humans, farmed fish and livestock as well as access to marine resources and unexplored organisms. Another objective for Norway is to collaborate internationally to help solve global problems. FUGE therefore participates actively in making the Norwegian government's strategy for internationalization a reality as described in the White Paper of 2005.

FUGE is an active participant in three ERA-nets: ERA-PG (plants), ERA-SysBio (systems biology) and ERA-SAGE (ethics/society).

However, several evaluations of Norwegian research communities have observed that Norwegian researchers are not mobile enough, and that they are not sufficiently interested in travelling abroad for an increased learning experience. Actions to stimulate researchers to travel more are therefore necessary. As the FUGE Board wishes to make use of foreign competence on different levels, the following measures have been brought about:

- 1) Many of the strongest research communities in Norwegian functional genomics research already collaborate actively with leading research groups in USA and Europe. The FUGE Board will open up for further expansion of this kind of internationalization, qualitatively as well as quantitatively. The means to reach such goals may be:
  - a. Available funding in the regional budgets for institutions to employ internationally leading experts in part-time positions (Professor II positions).
  - b. Setting aside funds for research intended for applications from Norwegian research communities working to initiate international research projects. This measure presents researchers with the opportunity to participate in the ERA-nets. The Board will follow up on this effort if FUGE receives additional funding.
  - c. Mandatory stays abroad for all doctoral and post-doctoral fellows.
- 2) The FUGE Board has experienced that several of the technology platforms have already formed collaborative ties with corresponding groups in Sweden, Finland and Denmark. Through focused strategic work, FUGE aims to take part in the development of such *institutional collaborations between the Nordic countries* as 'Medicon Valley', 'MedCoast Scandinavia' and 'ScanBalt'. 'Nordforsk' is another central collaborator with which FUGE wishes to develop good relations.



A natural endeavour would be to form broad connections between several research communities in Norway and the biotechnological hub currently being built in the Öresund region. Biotechnological and pharmaceutical activities in the Öresund region have experienced such rapid growth that access to qualified personnel could become a challenge. Interest in making Medicion Valley a gathering ground, partly through collaboration with Norway and partly through 'ScanBalt'<sup>2</sup>, is therefore of significant interest. Participation in a larger interregional collaboration in this field in the Baltic Sea area represents possibilities for further expansion of Norwegian biotechnology.

## Promotion

*Promoting* research results, information and debates about functional genomics research to target groups outside the research communities is an important activity which FUGE aims to address through appropriate measures. FUGE has strengthened this work by hiring a communications adviser part-time, 80 %. The main elements of the external communication will be:

- The building of networks through managing different arenas for different interest groups. In the autumn of 2007 FUGE plans to arrange an industry conference where the main focus will be interaction between academia and biotechnological industry development.
- Support for meetings with a subject-specific international profile. Applications will be reviewed continually. Due to the budget situation the Board will make consecutive considerations as to whether this means can be continued.
- Using the FUGE web site actively to distribute news and specific information to the stakeholders.
- The publication of at least four newsletters per year presenting different scientific themes.
- Surveys presenting public opinion on issues of general interest.
- Courses in communication and information dissemination will be offered to all FUGE funding recipients.
- An active dialogue through meetings and easy access for all stakeholders.

The FUGE communication strategy specifies this work further (in-house document).

## Available resources

FUGE's expected zero percent growth budgets will be distributed to several areas of activity, as shown in Table 1. At zero percent growth, available funds for announcements amount to a total of 420 million NOK for the period. The application deadline for FUGE funding is 18 April 2007. In the eventuality of growth in the budget, FUGE will prioritise internationalization of Norwegian research communities, career development and project support.

## Priorities 2007-2011

The FUGE Board bases its priorities on the necessity of building up basic competence in functional genomics research in all university regions, and FUGE will therefore support projects within these fields: basic biological research, bioinformatics, marine research and medicine/health. There is a wish for the specific thematic areas of plants and microbial sciences

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<sup>2</sup> The 'Scandinavian-Baltic research and education arena'

should be continued, particularly if their continuation can help strengthen the competence within systems biology. FUGE plays a central scientific, strategic and structural role as the administration for a generic technology which will be relevant for all kinds of biological problems. Therefore, FUGE does not make narrow limitations as to what types of research communities may apply for funding or which problems they propose to investigate. Relevance and scientific quality as they are evaluated by international expert panels will always be normative and funding priorities will be made accordingly. See White Paper no. 20 of 2005 for details.

The Board maintains the budget distributions which the FUGE I Action plan was based on. This means that the resources will be distributed with at least 20 % for each of the thematic areas basic biological research, marine and medical research. In addition, 10 % will be allocated to industry development (including User-led Innovation Projects, BIPs) and 3-5 % will be allocated to the theme ethics/society. Separate announcements will be made for applications concerning industry development and ethics/society.

### **Political priorities**

Due to general political decisions to which FUGE must adhere, FUGE will prioritise projects in collaboration with and/or with relevance to the areas listed below. FUGE relevance, quality and other criteria already listed must also be fulfilled in order to receive funding:

- The White Paper no. 20 of 2005 underlines the importance of international collaboration with North America, Japan and China in addition to Europe.
- Active participation in the EU 7<sup>th</sup> Framework Programme or research leading up to participation.
- Vaccine research ([www.rcn.no/globvac](http://www.rcn.no/globvac)).
- Research relevant to the Northern areas ([www.forskningsradet.no/nord](http://www.forskningsradet.no/nord) - this website is in Norwegian only).

### **FUGE priorities and regulations**

FUGE II will mainly be characterised by (see Figure 1):

#### **A more diversified platform structure**

- Platforms in the form of networks with two or more nodes will be established (Channel 2) alongside the classical “platform with one host institution” concept (Channel 1).
- The individual node will serve the network and the Norwegian research community, by providing a specialized service and competence (complementary to the service and competence provided by the other nodes within the same platform) or by increasing the capacity of a service that needs high capacity because of high demand.

#### **A more active role for the host institutions**

- The platforms should be gradually assimilated in the host institutions while retaining their national responsibilities.
- For the platforms, FUGE will cover preferentially those costs that are coupled directly to the maintenance of national responsibilities, such as costs incurred by service, networking, and courses.
- The engagement in FUGE activities should be anchored in the institution’s strategic plans and equipment investment plans.

#### **An optimal balance between platform technologies and research projects.**

- FUGE will support high quality research projects that utilize, and benefit from, the infrastructure established through FUGE I, as well as projects that drive the development and/or introduction of new technologies (Channel 3).

**FUGE II will also strive to**

- Optimize the visibility of the FUGE platforms towards academic and commercial users, nationally as well as internationally.
- Secure good integration with EU's 7<sup>th</sup> Framework Programme.

**Channel 1:** FUGE platforms with one host institution. They offer resources, competence and services. They can offer resources, competence and service. Total 5-year budget: 170 – 200 million NOK, to be shared with channel 2.

**Channel 2:** The FUGE platforms organised as a network with nodes, where each node has a host institution. Total 5-year budget: 170 – 200 million NOK, to be shared with channel 1.

**Channel 3:** Research projects building competence and high quality research through the exploitation of established infrastructures or through the introduction and development of new technologies. Total 3-year budget: 220 – 250 million NOK.

Cultivation of platform activities in the applications going through channels 1 and 2 will serve as a structural foundation for dialogues regarding the institutions' financial and organizational take-over.

**Functional genomics research and platforms offering high quality national service, technology and resources**

One of the premises for high quality functional genomics research is access to relevant technologies of internationally recognised standards – *state of the art*. The evaluation reports conclude that the international platforms work according to the intentions and play a central role in the realization of high quality functional genomics research. However, there are some platforms which have not achieved the intended national role and functions. The evaluations recommend that technologies and themes in FUGE I are continued either as national platforms or as projects in FUGE II, as long as the applications have the necessary level of quality.

In the course of the past few years several of the platform technologies in FUGE I (for instance proteomics, imaging, structural biology, microarray and SNP analysis) have generally become more widespread, which means that they have been established at several Norwegian research institutions. This development is in line with international standards, but it also means that there is no longer a need for one major national centre offering services, resources and competence for technologies which have become commonly widespread. Based on these findings, FUGE II has presented as new platform model (channel 2) based on a network of specialised nodes within the technologies in question (see below). The goal is for relevant expertise and equipment, which have been built up and financed by the various regions, to be incorporated into the platforms in FUGE II and thereby receive funding so that they can offer services on a national level. Such incorporations may take place after applications have been submitted and assessed by the experts.

In the course of the period 2007-2012 FUGE will gradually decrease direct platform funding. The reasons for this are as follows:

1. During FUGE I, the platforms have built a substantial range of equipment.
2. An expressed wish to separate research tied to the platforms from the platform budgets so that the research is financed through specific project funding (channel 3 in the announcement text).
3. Because the question regarding financing of FUGE beyond 2012 is still unanswered, it is important to ensure that the host institutions are prepared to take on full responsibility for the FUGE platforms after that time. The gradual reduction of FUGE funding

between 2007 and 2012 must be seen as preparation for such a transferral of responsibilities.

4. FUGE II must increase support to research projects taking advantage of the technology which is now available. Because of the realistic expectations of a zero percent growth budget, increased funding of research projects presupposes decreased funding for the building of new technologies. A gradual shift of focus – from technology building to technology application through relevant research projects – is a natural turn for the kind of initiatives FUGE represents.

A gradual reduction of FUGE funding for the platforms in the period 2007-2012 will result in a need for gradual escalation of financial involvement by the host institutions (see Figure 2). A potential upgrading of equipment is normally expected to be covered by the host institutions or other financing mechanisms outside of FUGE. FUGE wishes to increasingly direct funding towards platform activities that are directly linked to services and activities on a national level. Budget decisions regarding platform activities towards 2012 will be made after dialogues between FUGE and the host institutions. Individual adjustments will be made where necessary.

While technologies and themes that were funded by FUGE I will be continued as platforms or projects (after application submissions and peer reviews), there is also a need to look towards establishing new technologies based on suggestions from the research communities. Applications for the establishment or development of new technologies (i.e. technologies that were not part of the FUGE I platforms) must be presented as part of a project application (channel 3 in the announcement text). The linkage to a project is necessary in order to ensure that the establishment of any new technologies originates from a fundamental need for research in that area.

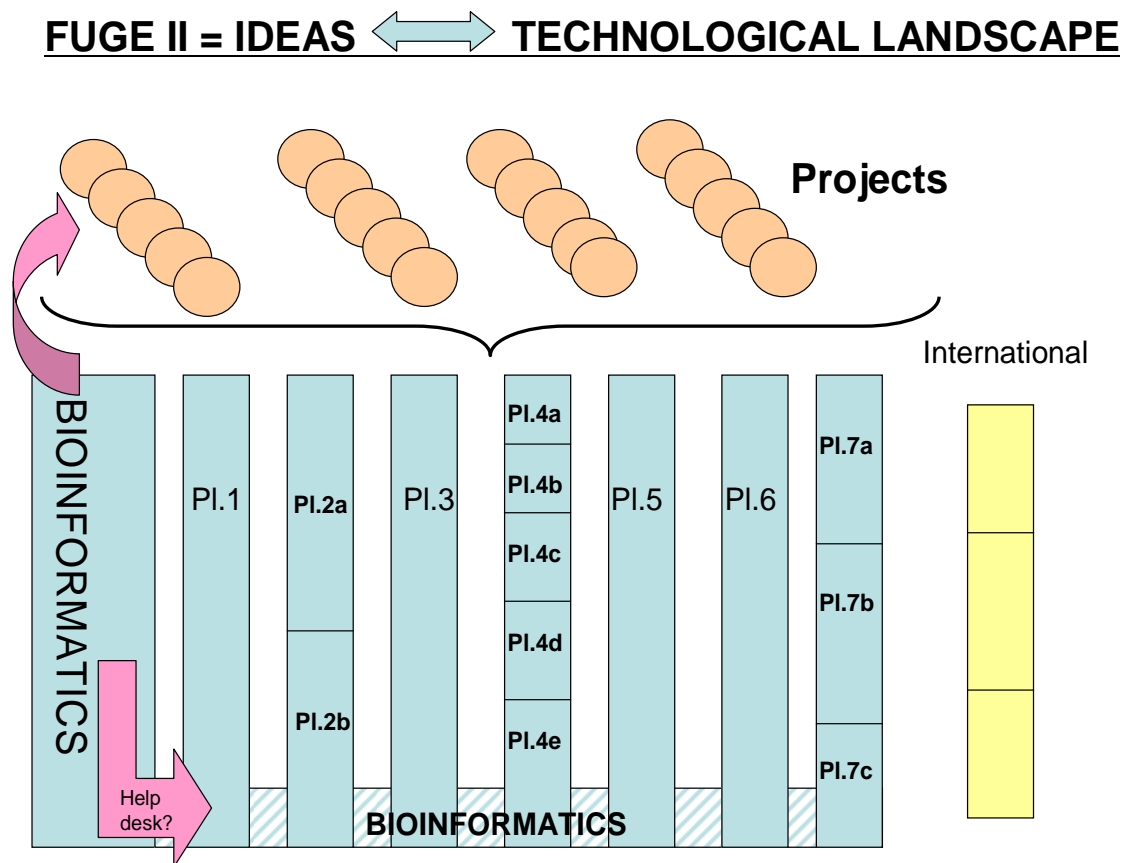
Based on these assessments, funding resources will be announced in three different channels. The following specifies the information needed in order to compile a complete and thorough application. The Call for proposals and the Action plan must be read in connection with each other.

***Figure 1: The platform concept under FUGE II***

The figure below illustrates how the needs of individual projects must define the platform structure and must therefore also define the needs. The platforms are made both with and without divided poles in order to underline the possibility of establishing different models. Pl. 4 would for instance typically be established through channel 2 as a platform with nodes, while both P1.1 and Pl. 2 would be established through channel 1 applications: Pl. 1 as an isolated platform with no partners and Pl. 2 with partners, but organised under one host institution.

Bioinformatics has been established as one platform (channel 1) and has a supportive function for the bioinformatics needs of other platforms and projects that must include in their budgets

resources for bioinformatics needs (see the text).



**Channel 1**

***FUGE platforms with resource, competence and service functions.***

*Platforms which can be seen as needing central organization from one host institution.*

The call for proposals establishes which technologies, resources and types of competence are included, and a joint application should be submitted by one host institution (as in FUGE I). The platform may consist of several geographical units in a network, but only one host institution can have the main responsibility. If several units go together to form the platform, the collaboration should be set up in a contract, for instance a consortium agreement. All institutions involved are expected to contribute a considerable share in addition to institutional infrastructure.

The continuation of a bioinformatics platform should state the budgetary and organizational consequences of establishing and running a help desk.

The continuation of a biobank platform must cover both cohorts and disease biobanks, and through FUGE’s funding also refine the resources in the biobank, for instance by creating a marker map of parts of the selected material. Biobanks with information about patients undergoing treatment are considered to be of great strategic value to translational functional genomics research. Recommendations from the platform evaluation state that biobanking within the health care services should be a coordinated activity included in a national biobank platform. Confirmed prioritization and co-financing from the health trusts is essential.

A biobank application should include a description of and budget plans for activities investigating the harmonization of 'best biobanking practices' in the Nordic countries, especially directed towards Sweden.

Applications for the continuation of the transgenic unit for mice must include a description along with a budget overview of how the unit over time may offer assistance regarding phenotyping (possibly in collaboration with identified Norwegian or foreign resource centres). Refer to the web page [http://www.swegene.org/mouse\\_physiology](http://www.swegene.org/mouse_physiology) for a description.

The following cost types are funded in channel 1: Salary for personnel (researchers and technicians) running the platform, commodity goods and service function costs (meetings, courses and travel expenses for external users). Funding for each platform is presumed to total up to 15-35 million NOK over a 5-year period. Funding will not be awarded for equipment except for exceptional needs (upgrading of equipment should be covered by the host institutions or other sources of financing).

## **Channel 2**

***FUGE platforms with resource, competence and service functions organised as a network of several nodes, each node with a host institution.***

*This channel encompasses technologies favoured for continuation in a national node network. See Figure 2 for a graphic presentation of the channel 2 concept.*

The announcement text establishes which technologies are included, and applications are submitted on an individual basis through the host institutions. One of the partners in the network must assume the role of network coordinator and submit a transmittal letter identifying for FUGE which applications are included in the network. An outline of a plan for the organization of the network and a description of how tasks will be divided between the nodes must also be included. The network must, through the network coordinator, present a joint budget plan showing all services offered and identifying types of equipment which may be needed in order to fulfil the demands. It is advisable that the group which served as a platform in FUGE I first take on the role of coordinator before the nodes take turns assuming the coordinator role. Funding for the coordinator role should be posted in the budget as a 20 % position.

Each node is expected to have specific competence complementing the competence found in the other nodes. The result will be a network covering as much of the competence and resource spectrum within the technology as possible. Where expert knowledge must be sought abroad, the relevant centres of competence must be identified in the application. The network must offer service, competence and resources to the entire Norwegian research community. In specific instances, nodes overlapping each other regarding the service, resources and/or competence they offer, may be accepted. This is particularly relevant in technologies where there is a question of capacity due to high demand. A node network in this situation must cite the reasons and supply thorough documentation of the need for duplication.

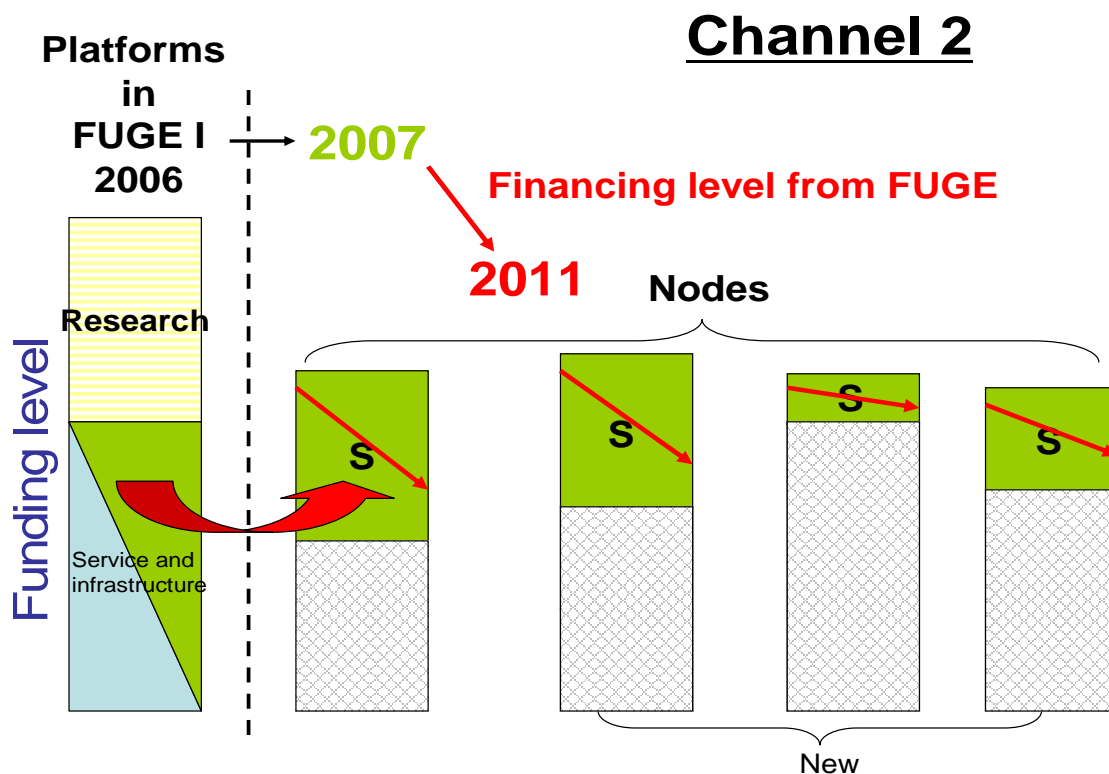
The following cost types are funded in channel 2: Salary for personnel directly involved with providing service and maintenance of the national role, commodity goods and the costs of running service functions (meetings, courses, travel expenses for external personnel). Funding per modified platform is presumed to total 15-40 million NOK over a 5-year period.

Applications for structural biology are expected to include arguments for the need and budgeting for access to international facilities delivering technologies which are not available in Norway (ESRF/SNBL, Maxlab and/or others). See an evaluation report on SNBL at [www.fuge.no](http://www.fuge.no).

**Figure 2: Platforms organised as a node network**

The figure illustrates how the average platform in 2006 had an activity level consisting of about 60 % service and 40 % research. Were this to be continued in FUGE II, the established infrastructure would serve as the foundation for continued FUGE funding of the service function (S). New nodes with complementary infrastructures will be established in the network. FUGE II will through channel 2 support the service function of the new nodes. Applications for research funding will go through channel 3. The arrow pointing downwards illustrates that FUGE funding of the service function will decrease towards 2011 while funding of the total budget for the service function is expected to be maintained at the same level by increased funding by the host institution.

Incorporated in the chart is a research section to illustrate that all nodes should have an element of research, which should be financed through applications through FUGE’s channel 3 or through other financial sources. The size of the boxes is random.



**Common for channels 1 and 2**

Funding for research projects is not to be included in the budgets for applications in channels 1 and 2. Applications for research projects go through channel 3 (this also applies to projects directly related to the development of technology in the platforms).

The FUGE Board reserves the right to suggest alternative structures to those for which applications are submitted. This may also entail the moving of nodes between channels and the exclusion of nodes from networks for which applications have been submitted. Only occasionally (and only after receiving authorization from the FUGE secretariat) will FUGE review applications from research communities wishing to take on a nodal function without presenting the application as a proper part of a node network. In such cases, the FUGE Board may decide (after peer reviewing and consultation with SAC) that the community be included as a node in the network which is being established within the technology in question.

***In FUGE II, it is presumed that established and upgraded technologies should be offered as 'high throughput' analyses wherever relevant.***

Platforms which cannot offer such analyses are required to pass on information about other Nordic or international units offering the service in question.

The dividing into thematic areas in the channels should serve as a guideline, and well-argued suggestions for changes can be included in the application. Alternative well-reasoned changes must take into consideration FUGE's guidelines concerning national organization of services, competence and technology which serve to ensure that certain technologies are now established more places than when FUGE started.

Descriptions of a technology's commercial potential are of interest and should be included with descriptions of potential patenting and/or other ways of protecting the commercial interests.

### **Channel 3**

***Research projects building competence and first class science through utilization of the established infrastructure or through introduction or development of new technologies (i.e. technologies not represented in the platforms of FUGE I).***

*Research projects based on the exploitation of infrastructures established in FUGE I or research projects introducing new technologies.*

Projects within the themes mentioned in the call for proposals will be prioritised, but projects originating from other themes may also apply. No clear guidelines are set regarding the organization of projects in relation to the platforms except that the projects are required to use one or more of the technologies or resources built up in FUGE I. An alternative could be that the project plans and budgets include posts for new technologies (i.e. technologies not included in the platforms of FUGE I).

Any new technology must show potential user value for other research communities than that of the applicant's and should primarily be described as a national resource. Applicants introducing new technologies must present this as part of a high quality research project. The project and the technology will be reviewed as one unit and funding will be awarded to this unit. Applicants receiving funding in this category will after a positive review receive full funding for a total period of 5 years. Projects that introduce new technologies should therefore be organised as 3+2 year activities. It is strongly recommended that new technologies and methods be made available for the national research community. However, within the available budget it is highly unlikely that such project applications can receive full funding. Such projects should therefore budget with considerable funds from other sources (> 60 %).

Applications which include budgets for career development will be prioritised for funding if the quality allows. Such applications may be submitted by the candidate in question or by more established researchers. If a more established researcher has the role of project leader, the application must explain how the young researcher intends to establish his/her own activity and how he/she proposes to finance it.

Candidates applying for funding to establish their own research groups (with a separate application or as part of a larger application submitted by a more established researcher) must have completed one or two post-doctoral periods and must demonstrate significant potential for establishing a research group. Female researchers are encouraged to apply. There is no maximum age limit, but at the time of the application deadline, no more than 8 years must have passed since



the presentation of the doctorate, not including legally established leaves of absence. The candidate should not be employed in a permanent scientific position.

Applications in channel 3 must be promoted by a research institution in the university or college sector or any other research institution, and the institution will be responsible for the project.

According to the FUGE Board, building resourceful research groups with activities that allow for collaborations, exchanges and internationalization requires an *annual budget of at least 2 million NOK*. Young researchers who wish to establish their own groups, but who for various reasons apply with more established researchers, should also have annual budgets of at least 2 million NOK.

Projects organised as real national, Nordic or international collaborations within their fields will be prioritised.

***Knowledge-building Projects with User Involvement (KMBs)*** are important means to improve interaction between academia and industry. They will build competence for basic problems relevant to the industry and will be prioritised for funding. Academic communities apply in collaboration with company that provides at least 20 % of the budget.

### **For all channels**

#### Bioinformatics/data analysis:

Bioinformatics should be continued as a central discipline organised under one host institution. The decision is based on the need to maintain a strong research and development environment close to the international research front which can bring forth new knowledge and new tools for building knowledge and competence in other platforms and projects. All applications, regardless of channel, should plan for and budget for support for bioinformatics. In addition to covering the costs for bioinformatics positions this also includes expenses for advice and guidance from other institutions, as well as any establishment of project collaborations.

The applications must describe how bioinformatics can be integrated both in the planning phase and throughout the rest of the project. Through dialogues with the bioinformatics platform and the applicants, FUGE will seek to find appropriate solutions to obtain the best possible coordination and exploitation of all existing bioinformatics resources. This relates to the role of the bioinformatics platform as support for the collective bioinformatics demand in FUGE.

Some activities will need to include data analysis and the building/maintaining of large amounts of data in databases. This also calls for 'bioinformatics' resources which FUGE considers necessary to build and maintain in a national arena.

### **Application processing**

The FUGE Board has agreed that the call for proposals will be open with quality evaluations by international expert panels that work out prioritised funding recommendations within their specific areas. These will form the basis for the final aggregated recommendations for the Board, or the Substitute Board in cases where conflicts of interest leave the Board unable to make the decisions.

### **Channels 1 and 2:**

The evaluation panels consist of 4 to 6 members. The applications will be divided into groups according to their technological focus. Each application will be assigned one panel member as primary responsible expert. He or she will after the meeting compile a written statement which

will form the basis for the panel's recommendations for the application. The statement must be approved by each member of the panel.

Applications which cannot be assessed satisfactorily by a panel will be reviewed individually by separate experts. These recommendations will be part of the panel discussions.

The FUGE Board reserves the right to suggest alterations in the applied-for structures and make acceptance of these changes by the applicant a prerequisite for funding. The Board will use information given in annex 1 about the research projects, along with the letters of support from the platforms in channel 3, as the basis for the assessment of whether the platforms have the required user base.

### **Channel 3:**

The evaluation panels will consist of 4 to 10 members. The applications will be divided into groups according to information given in attachment 4. Each application will be assigned one panel member as responsible expert. He or she will after the meeting compile a written statement which will form the basis for the panel's recommendations for the application. The statement must be approved by each member of the panel.

Applications which cannot be assessed satisfactorily by a panel will be reviewed individually by separate experts. These recommendations will be part of the panel discussions.

### **For all channels:**

- Only the 10 most relevant publications should be listed.
- The FUGE administration is free to decide whether to use the recommended expert or not.

The FUGE Scientific Advisory Committee (SAC) will be consulted about the final decisions regarding the funding structure.

### ***National collaboration and changes in the research system***

The platform evaluations clearly reveal an increased will and ability for national collaboration. This became particularly clear during the establishment of the platforms. Strong research groups from several different regions either came together to form larger applicant groups or they have since then established technology and research-based collaborations. In addition, a wider understanding has been achieved for the importance of interregional sharing of technology, thereby avoiding technology development duplication. Summed up, this means that the national research resources are being exploited in a more rational manner.

***The regional FUGE committees*** are important collaborators for the FUGE Board. The regional initiatives will lead to competence building, changes in the research system, linkages between academia and industry and also international positioning. The FUGE Board will in the upcoming period continue the close dialogue with the regional committees, and will also assess the need for financial support through regular joint meetings. Self-evaluations and an activity plan with budgets will form the basis for continued funding.

*A total of 20 million NOK have been allocated to regional support during the next period. FUGE will make direct contact with the regional leaders for an invitation to submit applications for funding.*

## Goals, milestones and result indicators

The main objective for the FUGE initiative is to build the infrastructure and competence necessary for Norwegian research communities to make their mark in the international competition and for being interesting collaboration partners. International evaluations will assess how well FUGE succeeds in the effort.

FUGE's *research projects* and *KMB projects* are means with which to both build competence through PhDs and lay the foundation for industry development. Each research project is therefore expected to result in an average of two doctoral candidates. In the FUGE portfolio, a significant number of young researchers and post-docs receive support. FUGE uses these as necessary result indicators in its report. The foundation for the industry development projects must be documented through focused communication aimed at researchers and entrepreneurs.

FUGE industry development may result from activities in the national platforms as well as from funded research activities. The concept has many phases and nuances, and the collaboration on the verification phase and the evaluations of ideas and projects with the FORNY programme will serve as good indicators of whether FUGE reaches its goals. Other good indicators will be FUGE's support level in this area alongside the results and patents obtained through funding.

FUGE's internationalization activities will become visible through a recording of the participation of Norwegian research groups in those international activities where Norway participates.

FUGE's success as one of the Large-Scale Programmes will become clear through evaluations by international experts.

## Coordination with other Research Council activities

FUGE covers an area which touches on all three Research Council divisions, which creates a demand for good internal coordination.

Administrative collaborations with other divisions within the Research Council will be the responsibility of the '*Coordinating Committee for Biotechnology (KUB)*', which includes representatives from all divisions.

*Close contact, both through KUB and on a case by case basis, will be maintained between the programmes 'Programme for molecular medicine and gene technology', 'Grunnleggende næringsrettet bioteknologi (GNBIO)', 'Ethical, legal and social aspects of biotechnology (ELSA)', 'Commercialising R&D (FORNY)' and 'User-driven Research-based Innovation (BLA)'.*

## Organising FUGE

According to Proposition no. 1 to the Storting (2001-2002) from the Ministry of Church Affairs, Education and Research FUGE has its own board which was appointed by the board of the Division for Strategic Priorities in the Research Council of Norway and a secretariat. An international advisory expert committee (Scientific Advisory Committee – SAC) comprising 8 members. Ad hoc committee are used when necessary. The secretariat consists of a coordinator, two senior advisers, three executive officers and an external communication adviser. Resources are available from the Division for Innovations for FUGE's activities directed towards industry.

To ensure that the initiative is optimally coordinated with the other programmes and resources of the Research Council it is administratively sorted under the Department for Future Technologies,

which is responsible for the Large-Scale Programmes of the RCN. All biotechnology in the RCN is coordinated through the '*Coordinating Committee for Biotechnology (KUB)*'.