

Nordic Energy Research

Annual Report 2002

www.nefp.info



Introduction by the General Manager

2002 was a year of great commitment and a high level of activity in Nordic Energy Research. Research programmes for the period 1999-2002 were concluded with good documented results. A full final report from these programmes can be downloaded from our website at: www.nefp.info. The work under these programmes has focused on significant central Nordic problems, issues and solutions and on building networks and joint competence across national borders. Under these programmes, great importance has also been attached to strengthening the basic competence with high quality. Since 1986, Nordic Energy Research has contributed to approximately 150 doctorate candidates taking their doctor's degree. In 2002, 12 research fellows defended their doctorate theses and 2 scholarship holders defended their licentiate theses. In addition to the establishment of Nordic co-operation, co-operation activities have also been established with the adjacent areas of the Nordic countries in a number of projects.

Nordic Energy Research would like to thank cordially the members of the specialist departments that have been responsible for the energy research programmes involved. The success of these programmes is entirely due to their work, commitment and competence.

Based on a new adopted strategic action plan for Nordic Energy Research, a new project portfolio has been established for the period 2003-2006. New thematic areas and new means give a new direction and new types of co-operation for Nordic Energy Research. In addition to building on continuity, the funding authorities' future expectations are attached to increased flexibility and openness, greater co-operation with industry and public authorities, realisation of goal-oriented research and development with result-oriented focus and focus on the use of these results, support to authority processes that require insight into the field of energy, further building on knowledge and networks that have been developed in previous periods, increased co-operation with national R&D players and increased co-operation with research programmes and players in the EU and IEA.

The first Call for proposal under the auspices of Nordic Energy Research, which was open to all research

institutions as well as trade and industry, was implemented in the winter of 2002. The response was great with 70 applicants and applications for funds of more than NOK 600 million. An in-depth evaluation process was then implemented decentrally in all the five countries in accordance with a set of criteria, where relevance, Nordic profile, finances, objectives and plans were of central importance.

In addition to having good Nordic consortia in the projects that cover central problems and issues in the five theme target areas (integration of the energy market, renewable energy sources, energy efficiency, hydrogen and consequences of climate changes for the energy sector), project activities were also established in the Adjacent Areas (Estonia, Latvia, Lithuania and North-West Russia).

It is also important for Nordic Energy Research to seek solutions to central challenges that have been given priority under the Nordic energy policy co-operation. In this connection, the Nordic Council of Ministers has chosen to concentrate on three areas: the open electricity market, climate policy issues, regional co-operation in the adjacent areas of the Nordic countries.

Nordic Energy Research will also be a driving force in the promotion of Nordic co-operation with the EU framework programme and other international programmes. The Nordic platform has a sound basis for contributing to, engaging in a dialogue with, influencing and participating in large international projects.

Nordic Energy Research is experiencing clear genuine and increasing interest from various players and environments regarding Nordic co-operation in energy research and development. The Nordic countries have many comparative advantages, including: resources, technology bases, industrial clusters, competence and common central national challenges. On this basis, good Nordic co-operation will improve the possibilities of strengthening the Northern Dimension in Europe.

Per Ø. Hjerpaasen
General Manager, Nordic Energy Research

Who Are We?

Nordic Energy Research is a Nordic institution under the Nordic Council of Ministers and is funded by the Nordic Governments.

- The Nordic Energy Research Programme was established in 1986
- Nordic Energy Research was set up as a Nordic institution in 1999



What Do We Do?

The object of Nordic Energy Research is to seek to acquire new knowledge for the development and application of new energy solutions

Why Nordic Energy Research?

The activities of Nordic Energy Research are to contribute to a Nordic profile and Nordic utility so that the activities generate Nordic added value in addition to the energy research results achieved under this co-operation.

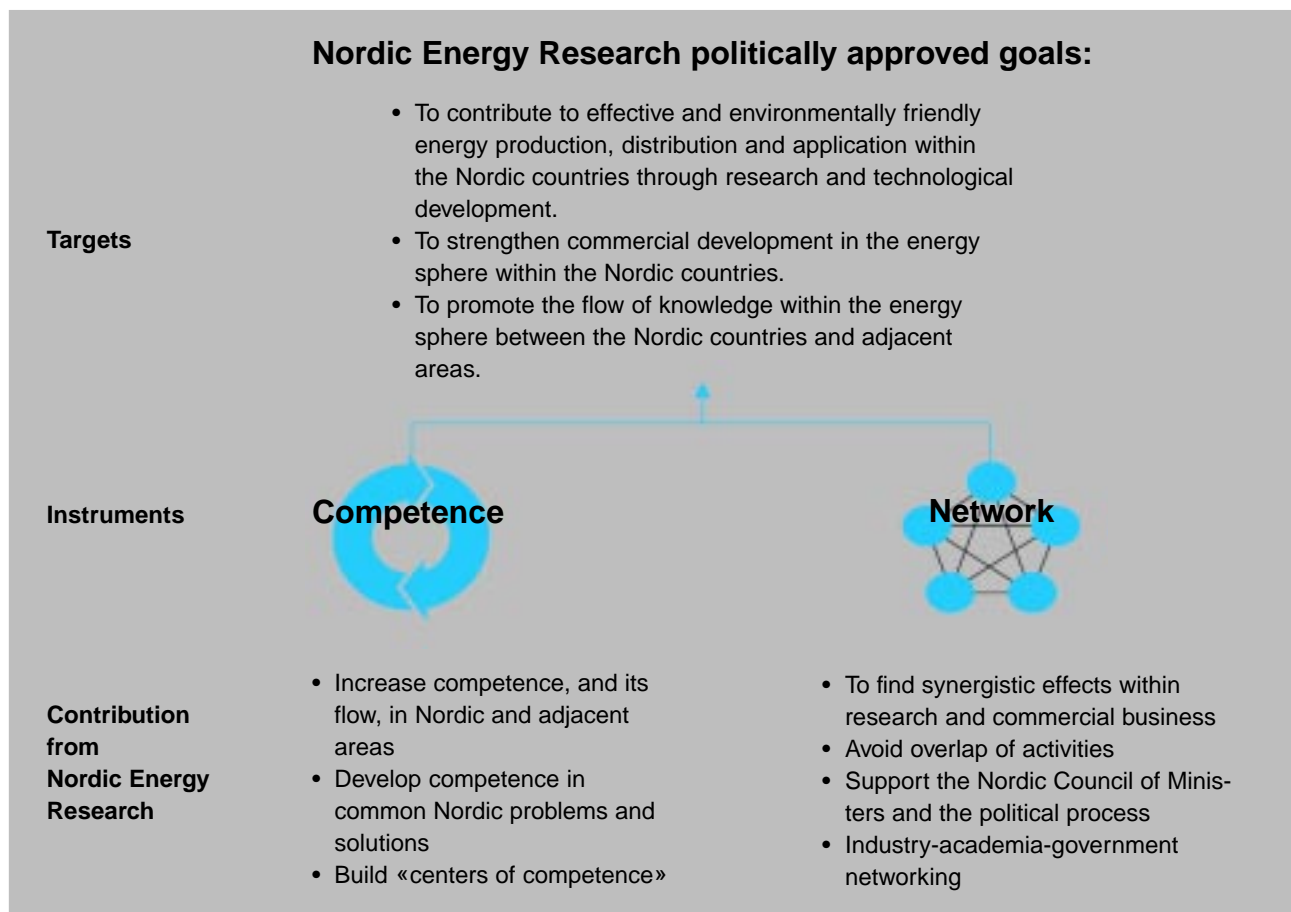
Nordic utility:

- Nordic co-ordination must produce clear positive effects
- Nordic competence and competitiveness must be increased
- Nordic affiliation must be developed

Mission:

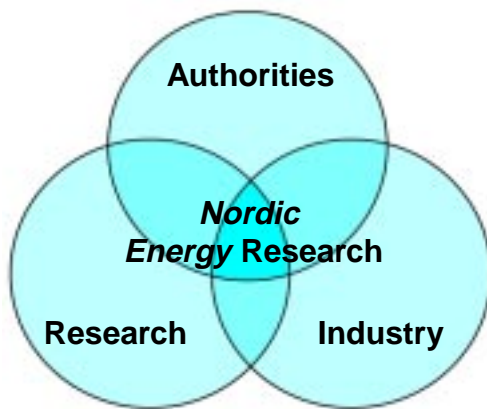
«Nordic Energy Research is to provide long-term contributions to the development and application of knowledge aimed at cost-effective reduction of energy consumption and development of new renewable energy sources and environmentally friendly energy technology by strengthening the competence at universities and colleges as well as other research institutions and creating well-functioning researcher networks between the Nordic countries, between research and trade and industry and with regional players».

Nordic Energy Research is an effective instrument for meeting the political objectives for research and industrial development in the Nordic energy market





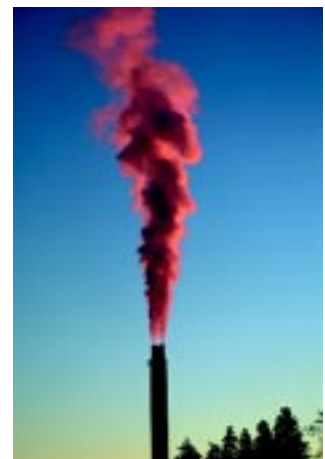
Nordic Energy Research contributes to the Nordic Benefit by accomplishing projects in the interface between research, industry and authorities



- Contribute to increase co-operation between the different participants in the innovation process
- Carry out projects within the whole value chain for innovation in the energy sector with research and analysis
- Promote communication within key areas between participants from the Nordic countries

In spite of differences in the natural structural conditions and hence focus, there is a large potential to achieve Nordic Benefit within many areas of priorities:

- Reduction of CO₂ emission:
 - To meet requirement in the Kyoto agreement
- Increase the share of renewable sources and carriers
- An effective energy market which gives good frame conditions for the competition of business and industry
- Confirmation of security of supply
- Energy efficiency
- Analysis of systems
- A closer co-operation with the adjacent areas



From One Period to a New

We now have behind us what must probably be characterised as the most eventful years in the history of the institution and the programme. And those who are familiar with the programme know that it goes back to 1985 when the Nordic Energy Research Programme was first established. In this context, eventful also means that there have been many changes, which, together with the long history of the programme, has meant that the participation and commitment among those of us who have been involved in these processes have been great. We are many whose hearts beat warmly for Nordic Energy Research. This is another reason why the institution is so strong and generates so many excellent results.

At the end of 2002, we also concluded a 4-year period in Nordic Energy Research. The end of this period and the beginning of the new period also represent a change in the way that Nordic Energy Research operates. Already during the planning of the new 4-year period, it became clear that the most important providers of the premises and conditions for the Nordic Energy Research (those who fund the activities) wanted a change and renewal in the institution. This was primarily motivated by a desire for increased flexibility in the means, a desire to open up the institution further for participation from several players and a desire for even greater focusing on needs-based research activities. It was also important that Nordic Energy Research changed its focus and strategy so that the research activities could support the three core areas for co-operation designated by the Nordic Ministers of Energy: climate, the Nordic electricity market and regional co-operation. An ambition to involve industry and the business sector was also expressed.

In addition to these challenges from the owners of the institution, there was also a clear ambition to preserve the strength of the Nordic energy research co-operation through these 17 years: focus on researcher training and the development of competence in good and strong institutions in networks.

Based on the above, a process was commenced on the preparation of a plan for Nordic Energy Research for the period 2003-2006 in response to the challenges that we were given by our principals. The work commenced with a large working seminar in Sigtuna, at which all the specialist departments involved were represented and participated in the process of identifying theme target areas for the next period. This formed the platform for the new plan, which was adopted by the Ministers of Energy in September 2001, and the first Call for proposal, which was open to all research institutions as well as trade and industry, was implemented in the winter of 2002. The response was great with 70 applicants and with applications for a total

amount of over NOK 600 million. An in-depth evaluation process was then implemented decentrally in all the five countries in accordance with a set of criteria under which relevance, Nordic profile, finances, objectives and plans were of central importance. The scientific quality assurance is still to lie with the steering committees and not least with the quality assurance systems of the universities and research institutes. Based on the national evaluations, the Board began to compose the portfolio for the next programme period in May. At the time of writing, the portfolio is far from being ready, and it is clear that Nordic Energy Research is facing an exciting period – and we know that we will continue to influence both technology development and framework conditions in the Nordic energy systems also in the years to come.

I mentioned by way of introduction that this has been a very eventful year, and the above implementation of the first open Call for proposal in Nordic Energy Research is one of these events. I am pleased to note that we employed a new General Manager of Nordic Energy Research in 2002. The General Manager has settled in well and is showing that he wishes to contribute to developing the institution further in line with the ambitions of our owners and in a close dialogue with our participating research environments. I am pleased to have Per Øyvind Hjerpaasen on board the Nordic ship, and I wish him good luck as the new skipper.

With the conclusion of the programme period 1999-2002, our agreement with Bioparken AS in Ås on the leasing of secretariat services was also terminated. Bioparken has provided these services to our great satisfaction for more than 12 years, and I would like to take this opportunity to thank Unni Bruaset and Hanne-Marit Pettersen for their great work during this long period. The effective and smooth implementation of the programme is, to a great extent, due to their work and commitment. Thanks should also be extended to the members of the specialist departments that have been responsible for the energy research programmes involved. The success of the programme has been built entirely on their work, commitment and competence. Many thanks to you all.

We are now looking ahead, and we are rolling up our sleeves in the face of a new period and era for Nordic Energy Research. We are facing many tasks and challenges, and I am happy to say that we are off to a good start, and I feel sure that we are on the right track.

Haneborg, 20 May 2003

Trond Moengen
Chairman of the Board in 2002

Nordic Energy Research 2002

In 2002, Nordic Energy Research concluded its work in seven energy research areas for the period 1999-2002:

- Electrochemical Energy Conversion
- Energy Flexible Thermal Systems
- Energy and Society
- Combustion of Biomass
- Petroleum Technology
- Process Integration
- Technical Systems in an Open Electricity Market

The final report for the activities of Nordic Energy Research in the Nordic countries and the Adjacent Areas in the period 1999-2002 are available in an electronic version and can be downloaded from our website at: www.nefp.info. There have been extensive competence transfer and capacity build-up, network development and result achievement regarding central Nordic problems and issues during the period. All department groups have worked very well on common research themes and challenges.

61 Nordic doctorate research fellows, 20 Baltic/Russian doctorate research fellows and 4 summer scholarship holders were engaged in the above energy research programmes in 2002. In addition, 11 research managers/

senior researchers have been engaged on a full-time or part-time basis in the above energy research programmes in which they have been responsible for guidance and other programme-related activities.

In the course of 2002, a total of 14 doctorate and licentiate theses were defended under Nordic Energy Research's programmes.

The energy research programmes have contributed to supporting and developing basic applied research and development in central energy themes. Through the activities, large networks have been established between various players in the Nordic countries and the Baltic region.

In the programme period 1999-2002, Nordic Energy Research granted 84 PhD fellowships and financed, in full or in part, 16 senior researchers in the Nordic countries. The commitments in the Adjacent Areas (the Baltic states/ North-West Russia) have been an important activity, and a total of 20 PhD fellowships have been granted.

A brief outline of the seven concluded programmes is given below.

Energy and Society

The basis for the Energy and Society programme was to focus on issues concerning optimal energy production, transmission and use as well as on studies on how to organise the Nordic energy markets in order to achieve optimal socio-economic results and performance and meet environmental targets and objectives. Special importance has been attached to market mechanisms and regulatory issues.

Deregulation of the electricity markets boosts trade and improves several aspects of the performance of the market: better utilisation of heterogeneous technologies in an open market environment, an improvement in combined flexibility in supply and demand of randomly changing temperatures and variation in primary energy supply (water supply) and the possibility of achieving advantages through an integrated common environmental policy. All these aspects have been touched on under the Energy and Society programme.

During the regulatory period, the uncertainty about supply

and temperature was handled by increased production capacity. Under a deregulated framework, importance is attached to demand flexibility, which has therefore been studied. The development in the electricity markets in the last 4-5 months in 2002 shows that this is a topical issue.

Even though international protocols aimed at combating environmental problems have been (or will be) signed, it has proved difficult to reach an agreement on the political instruments that may be a help in following up on the targets fixed. Conventional means such as tariffs and quota trade have, so far, not been implemented in an international context.

However, new instruments, the effects of which have not been studied, have been introduced in the political discussions. Green certificates is one example of such an instrument. The Energy and Society programme has presented several articles that deal with this issue.

Electrochemical Energy Conversion

A Nordic fuel cell programme was established in 1991 as one of eight activities under the Nordic Energy Research Programme. In the following 4-year periods, the activity was continued with a wider content under the name "Electrochemical Energy Conversion". In the last four years, the activity included studies of Lightweight Li-batteries and metal hydrides as combined storage and electrode in batteries – as well as studies of SOFC, PEM and direct methanol fuel cells.

The programme has deliberately been implemented as a training programme, and most of the allocated funds have been invested in doctorate fellowships and at senior researcher level. The Board of Nordic Energy Research has also given priority to network development. This has been implemented by arranging two to three workshops a year, usually with two to three invited lecturers from countries outside the Nordic countries. These workshops have thematically alternated between high temperature chemistry, polymers for fuel cells and batteries, advanced electrochemistry and the use of computer simulation to predict ion transport in energy materials. Co-sponsors from other international projects have given more than "critical mass" for the workshops on several occasions.

Many interesting and valuable results have been achieved, and exchange of information and co-operation between Nordic research environments have been improved significantly.

Combustion of Biomass

The objective of the programme was to promote research into combustion of biomass at Nordic universities and research institutions in order to contribute to the development of cleaner and more effective biomass combustion technology.

In the programme period 1999-2002, the Combustion of Biomass programme produced detailed information about, in particular, the following themes: (1) The combustion pattern of biomass under different conditions: the effect of particle size, pressure, temperature and gas atmosphere on pyrolysis/combustion/gasification of various types of biomass. (2) Formation and dissolution of pollutants (emissions) in combustion of biomass. (3) Reactions of the ash and other flue gas components under different conditions.

Furthermore, the focus has been on development and adaptation of (4) mathematical modelling of the combustion chamber, the burner, the fireplace, flow calculation, combustion and emission chemistry as tools for planning and designing better combustion chambers.

The research has been conducted in close co-operation with Nordic industry. The research has been relevant for many biomass techniques, all of which have great industrial interest in the Nordic countries.

The participating universities have all had extensive national project activities in this field, and the role of Nordic Energy Research has been to tie together the national projects. Without the participation of Nordic Energy Research, it would hardly have been possible to maintain the strong Nordic network that has already resulted in successful joint EU projects, etc.

Technical Systems in an Open Electricity Market

The Technical Systems in an Open Electricity Market programme has, in particular, focused on:

- Information technology
- Small-scale production
- Distribution networks
- Risk management



Energy Flexible Thermal Systems

The objective of the Energy Flexible Thermal Systems research programme has been to train PhD, Dr.ing and Tech lic students in the following three areas:

Heat production

- Production plants for concurrent production of several energy products (for example combined heating and power plants)
- Production plants with unconventional production capacity (small-scale plants)
- Production plants with «new» types of fuel or fuel mix

Heat distribution

- Distribution plants for varying temperature requirements (incl. cooling)
- Distribution plants for areas with low «heat density»
- Distribution plants for unconventional distribution media
- Distribution plants for conversion situations

Final use of heat

- Measuring, control, diagnosis and regulatory systems in connection with energy flexible thermal systems
- Energy economic aspects of energy flexibility (incl. end users' load profiles and load development)
- System safety

Another objective of the research programme has been to maintain and develop further the network between the Nordic institutions of education and research environments in this field.

Petroleum Technology

The overall objectives of the Petroleum Technology research programme in this period have been:

- to strengthen Nordic research co-operation in the field of petroleum technology and to maintain and expand the Nordic contact network,
- to work to increase contact to industry for the purpose of increasing external financing of the research programme,
- to work for an expansion of the geographical contact area of this field to include the Baltic states and North-West Russia,
- to expand the research profile of the field to comprise environmental and energy aspects of petroleum technology and to work for a technology transfer from the field of petroleum technology to the environmental and energy sector in general.

During this programme period, the research programme has covered the following areas:

- Oil and gas recovery methods
- Gas distribution techniques
- Chemical reactions
- Separation processes
- Petrophysics

In connection with an adjustment of the profile of the research programme during the period, great importance has been attached to what may be future areas of interest for the industry in the Nordic countries and the Baltic states in areas that relate to petroleum technology.

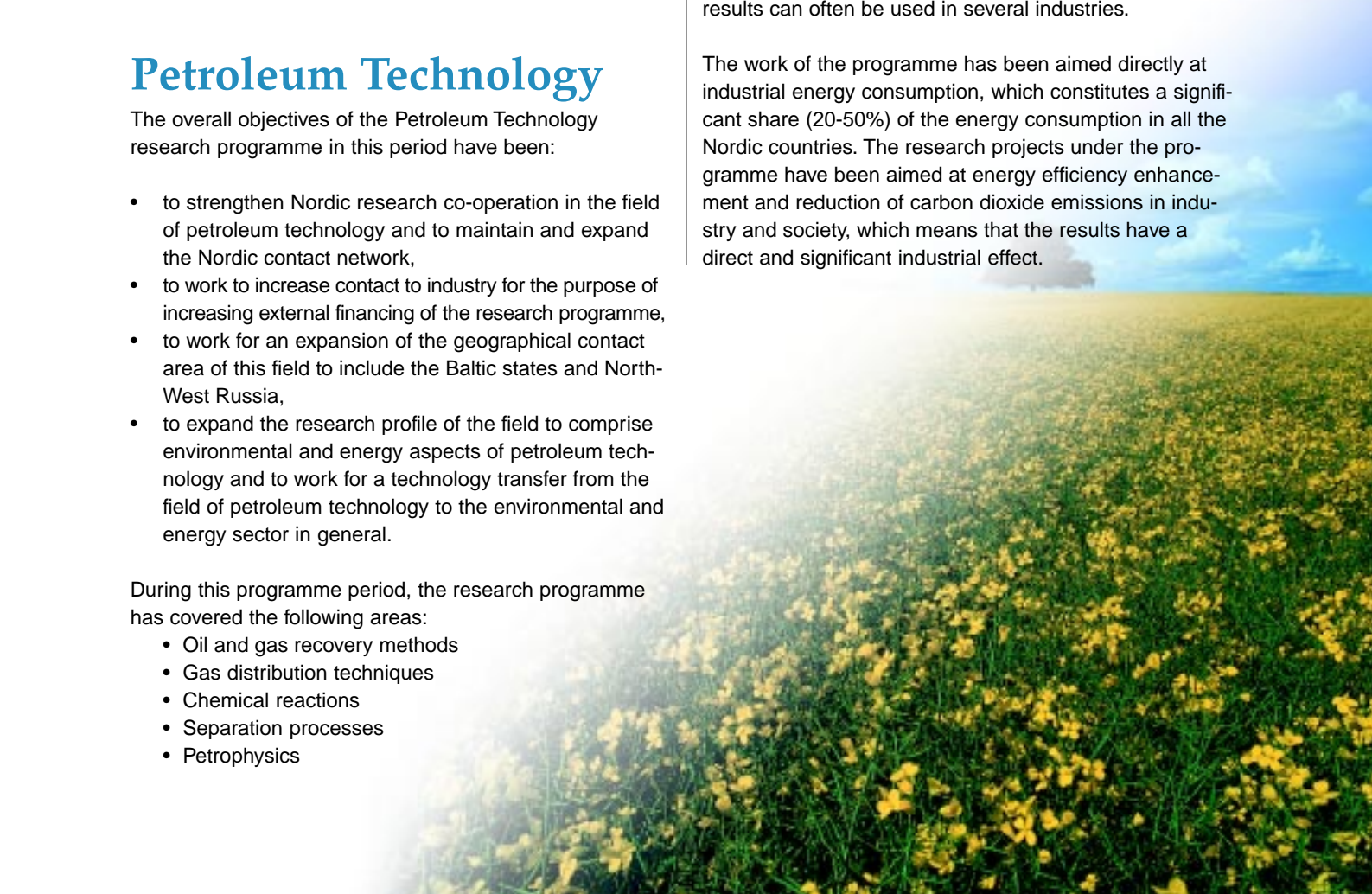
Process Integration

In Nordic Energy Research, process integration is defined as «Systematic and general methods for design of integrated production systems with particular emphasis on effective energy use and reduction of environmental impact». This is in accordance with the definition used in IEA.

During the past 20 years, process integration has developed into methodology for strategic design and planning. Because of this development, process integration can now be used to reduce both operating and investment costs as well as environmental consequences in both the short term and the long term. This has become possible because methods have been developed and are being developed that neutralise the consequences of varying process designs in a system perspective.

The Process Integration programme under Nordic Energy Research has developed a considerable level of knowledge in the most important parts (in terms of energy technology) of the industries for which the programme caters. These industries are primarily thermal power plant industry, mass production industry and paper industry, the food industry and chemical/petrochemical industry. The wide and general nature of this field of research means that the results can often be used in several industries.

The work of the programme has been aimed directly at industrial energy consumption, which constitutes a significant share (20-50%) of the energy consumption in all the Nordic countries. The research projects under the programme have been aimed at energy efficiency enhancement and reduction of carbon dioxide emissions in industry and society, which means that the results have a direct and significant industrial effect.



New Period 2003-2006

Based on a new strategic and action plan for Nordic Energy Research, a new project portfolio has now been established for the next 4-year period. New thematic areas and new means give a new direction and new co-operation types for Nordic Energy Research.

The action plan for 2003-2006 gives a new direction – but also continuity:

- Goal-oriented research (projects) with focus on results and their use
- Increasing linking to and co-operation with industry and public authorities
- Support for authority processes that require specialist insight into energy-related issues
- Further development of knowledge and networks developed in previous periods
- Increased co-operation with national R&D players
- Increased co-operation with research programmes in the EU and IEA
- Increased flexibility

On the basis of the overall priorities in the Nordic energy co-operation with special commitment to three core areas as well as the long-term research challenges that the Nordic countries are facing, 5 target areas have been identified in which problem-oriented research has a central position:



3 Core areas

- 1 Climatic themes
- 2 Nordic electricity co-operation
- 3 Regional co-operation

5 Target areas

- 1 Integration of the energy market
- 2 Renewable energy sources
- 3 Energy efficiency
- 4 Hydrogen / Fuel cell
- 5 Consequences of climate changes for the energy sector

Annual Accounts 2002

REVENUES	Total 2002	Total 2001
1. Ordinary budget funds from NMR	1 119 800	1 178 900
2. Project grants from NMR	1 967 081	850 925
3. National grants*	27 500 000	27 500 000
4. Other revenues (interest/transfers, etc.)	3 518 761	1 873 729
TOTAL REVENUES	34 105 642	31 405 554
EXPENSES		
5. Administrative expenses	3 211 286	2 767 725
6. Activity area expenses/adjacent areas	2 264 425	1 895 379
7. Project expenses	29 248 154	26 182 081
TOTAL EXPENSES	34 723 865	30 845 185
NET PROFIT/LOSS FOR THE YEAR**	-618 223	560 369

ASSETS:

Trade debtors	3 750
Grants receivable	457 500
Costs paid in advance	525 000
Cash at bank	5 390 065
Cash at bank	23 405 249
TOTAL ASSETS	29 781 564

LIABILITIES:

Disposable funds allocated for increased activity	6 268 872
Provisions, accrued costs	1 063 950
Course/project provisions	306 965
Funds allocated for head of institution's disposal	500 000
Funds earmarked for Baltic activities	5 078 678
Provisions, EOS 02-05	990 885
Provisions for liabilities for 03-04	10 840 179
Management project provisions	332 681
For free disposal of prior-year result	355 809
Trade creditors	4 046 299
Inter-account	-2 754
TOTAL LIABILITIES	29 781 564

*	Nordic activity	Adjacent area
Denmark	6 075 000	607 500
Finland	4 575 000	457 500
Iceland	275 000	27 500
Norway	5 500 000	550 000
Sweden	8 575 000	857 500
TOTAL	25 000 000	2 500 000

**Increased cost incurrence in 2002, but within the total allocated national funds and the approved budget for the period 1999-2002.

The Board of Nordic Energy Research in 2002

Board members:

Trond Moengen, Norway (Chairman)
 Per Buch Andreassen, Denmark
 Robin Gustafsson, Finland (until August 2002)
 Teija Lahti-Nuutila, Finland (from August 2002)
 Thorkell Helgason, Iceland
 Lars Guldbrand, Sweden

Alternate members:

Aksel Mortensgård, Denmark
 Timo Ritonummi, Finland
 Sveinbjörn Björnsson, Iceland
 Tore Grunne, Norway
 Lars Tegnér, Sweden



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