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# Nordic Energy Research –

## an evaluation of its activities

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# Executive summary

*Nordic* and *networking* are the two keywords when describing the added value Nordic Energy Research provides stakeholders. It is clear that Nordic Energy Research (NER) is a valuable and appreciated player on the Nordic energy research arena, not least given its limited budget. Nordic Energy Research contributes to the Nordic energy research infrastructure by building networks and supporting existing ones, and providing leverage to national research programmes.

More than twenty years of running international research programmes means Nordic Energy Research is an organisation with credibility. This has made it possible for Nordic Energy Research to take an active part in several ERA-nets, where the national participants from member countries find it efficient to leave greater part of the practical work to this joint Nordic organisation.

Nordic Energy Research as a “knowledgeable realist” is a brand worth safeguarding. Nordic Energy Research should continue in the same vein, running a research programme that is well adapted to the (limited) resources available. Here, Nordic Energy Research truly provides an added Nordic value. This Nordic value consists in:

- providing a useful platform for specific Nordic (research) collaborations and an enabler of such collaborations
- a basis for networking across the national borders that otherwise would not take place
- leverage to enter into or strengthen other collaborative research projects

## “Nordic” and ”networking”

When analysing the data collected for this evaluation, two words stand out as central when describing what Nordic Energy Research means for stakeholders such as national administrators, project beneficiaries and participants: Nordic and networking.

*Nordic* because those we have interviewed and the many who have answered our survey to such a large degree point to the worth and merit of Nordic Energy Research as a platform for specific Nordic (research) collaborations and an enabler of such collaborations.

*Networking* because it is quite clear that that is what project participants value the most in these collaborations. The Nordic Energy Research funding makes Nordic network projects possible; some of these would not have seen the light without the Nordic Energy Research funding, others have been strengthened through it.

These are the outcomes or results of participating in a Nordic Energy Research project that project participants would most like to achieve, and they are also what the participants have most often actually gained from their participation. Thus, goal attainment is high from the project participants’ points of view.

## Project portfolio and collaboration

When looking at the project portfolio, there is a clear dominance for Capacity building and competence building projects over other types of projects. This also means that the project portfolio is rather heavily inclined in favour of more basic research projects. Many of these are focused on PhD students, and there are some examples of Nordic Centres of Excellence among the projects.

Project-level collaboration mainly consists of exchange of common research results and exchange of materials and data. Exchange among the Nordic countries also includes mobility of people and to some extent teaching of PhD students. Estonia is the most active country outside the five Nordic ones.

The present project portfolio consists of 16 research projects distributed over five “topic areas”. Given the budget at hand, the number of topic areas seems excessive, and “Nordic addition” rather than “Nordic compromise” should be one central criterion when defining which areas to focus on. One such area that has been mentioned on several occasions is the Nordic interconnection of national electricity grids and the systems challenges and needs for common or compatible regulatory measures that result.

Also, 16 research projects appear to be many. If the research budget is not increased, the number of projects may need to be reduced in order to create a more homogenous project portfolio. This, at least, is true if Nordic Energy Research wants to become a more active researcher funder, with a more decidedly top-down approach. The alternative is to continue to provide additional funding to projects that are priority to the researchers themselves rather than to Nordic Energy Research.

Another criterion would be to focus on those areas where the Nordic Energy Research funding may actually make a difference. From what we have gathered, Nordic Energy Research would seem to get more leverage concentrating on areas where other players are not already investing large sums of money. Spending scarce resources on, for example, hydrogen research would seem to be of little strategic value for Nordic Energy Research since the amount of money Nordic Energy Research invests in this research area is very small indeed compared to what Japan, the US and the EU do. On the other hand, this is the one topic area where project collaboration seems to be most varied and fluent. Not only all the Nordic countries participate but Russia and the Baltic states as well, and all countries are involved in almost all types of exchange.

## The usefulness to the policy making process

The usefulness of the inputs and support provided by Nordic Energy Research to the policymaking process highlights several different elements. One boundary condition for Nordic Energy Research’s project portfolio is that projects funded need to be aligned to one or a small number of “common denominators”. Finding these may imply a time consuming negotiation and search process. Four operational criteria, which to a varying degree are satisfied by the present project portfolio, emerge:

1. Focus needs to be placed on common issues in energy policy, including energy research policy. These include the Nordic interconnection of national electricity grids and the systems challenges and needs for common or compatible regulatory measures that result, and also issues related to the common Nordic electricity market and climate changes as well as energy efficiency. Our analysis of the project portfolio shows that this is also where the emphasis of Nordic Energy Research lies.
2. The priorities of Nordic Energy Research need to correlate well with, rather than complement, national energy research priorities. The consequence is that NERO priorities might need to adapt to changes in national priorities. The questionnaire results show that co-funding from national funding agencies occurs in a substantial part of the projects, which is well in accordance with this principle.
3. Nordic networking should be given higher priority than the creation of something technically new. The formation of Nordic R&D partnerships and access to national programmes in other Nordic countries and improved collaborations are important objectives for project participants and also among their achievements.

4. The opportunities for small or neighbouring countries offered by Nordic Energy Research ought to be observed and exploited. The replies to our questionnaire indicate that this is the case for projects with Iceland, the Baltic States as well as Russia.

The NORIA policy projects that the former Board of Nordic Energy Research initiated are, in this context, an interesting addition to the organisation's arsenal of activities. These projects primary objective is to provide knowledge about input, output and framework conditions for energy research in the Nordic countries on a general level. A secondary objective is to inform Nordic Energy Research's own policy process and strategic development. The policy projects will also, presumably, provide input to the new action plan on energy for the period 2010-2014 that the Nordic Council of Ministers is preparing. Most policy projects have just recently been finished and presented in a joint workshop, but these projects point in several very interesting directions as to where Nordic Energy Research projects and activities could go from here. It would therefore seem important not only that the Nordic Energy Research Board take good heed of the findings, but also that the results and experiences from the seven projects are disseminated to national and international stakeholders in order to make it possible for these projects and this initiative to have a wider audience and impact.

The budget for Nordic Energy Research's research projects is small, as compared to national R&D budgets for this area. An obvious consequence is that it limits the role that Nordic Energy Research can play in practice, though that constraint can partly be compensated for through, for example, the use of co-funding as a criterion. Another response to this constraint is to focus more on long-term objectives and on different policy issues.

### The usefulness to industry and researchers

Concerning usefulness and value to industry, it is quite clear that industry is less involved than could have been hoped for and expected. The greater part of the project portfolio consists of so-called Capacity building and competence building projects, which is the one out of three project types that most focuses on basic research. In general, the results from the questionnaire show that industry is not very active nor a great contributor to many of the projects. In this respect, the expectations raised by the mid-term evaluation of the previous programme period have not been met.

There are, however, good examples and positive signs as well. The results from the questionnaire clearly show that those industry companies that have participated in the research projects are happy with what they have achieved, and have also achieved most in those areas where their expectations were higher. Several projects enjoy good industry collaboration, and some concrete results are being produced. The Social Network Analysis (SNA) analysis showed industry involvement in two projects, even when industry was not formally part of the project. These probably refer to active steering group members.

As for usefulness and value to researchers of the research conducted, this and goal attainment score high.

### Goal attainment on the programme level

Nordic Energy Research have set up a number of "success criteria" or output indicators against which the overall performance of the programme could be measured. Departing from those, we conclude that goal attainment on the programme level seems to be rather good. Nordic Energy Research has developed into a platform to coordinate and promote a Nordic profile in energy research, and the results from the ad hoc policy studies, currently in their final stages of work, will hopefully be a help to the organisation in order to improve further in that direction. Obviously, the research projects in the Nordic Energy Research portfolio are often part of something bigger or different, and it is difficult to assess exactly what this particular funding actually means. We have seen, however, that the Nordic Energy Research money often functions as leverage and does make something come about that otherwise would not have happened, or maybe would have happened on a reduced national or bilateral scale. But the Nordic Energy Research budget is small and this is a small player, which calls for continued realistic expectations of what can actually be done.

## Nordic Energy Research in the international context

Acting at the Nordic level should probably be seen as a complement rather than an alternative to action at national and EU levels. The role of Nordic Energy Research in an international context should therefore, judging from evidence in this evaluation, depend on subject matter and context. In some issues, the complementary role might be the best one, in others the Nordic approach should be more in the forefront.

Nordic Energy Research as an organisation has a unique 20 year record of experience in running international collaborative R&D programmes. The organisation has been able to use this asset to take an active part in the administration of three ERA-nets, two of them still running. Nordic Energy Research acts as a substantial contributor and promotes the interests of single Nordic countries, filling a role that the national Nordic participants are not able to carry out themselves – and also seem happy to hand over to Nordic Energy Research.

Nordic Energy Research's role in the ERA-nets is much appreciated by those we have spoken to. Nordic national administrations or research funders that participate in these ERA-nets mention that Nordic Energy Research carry a big burden by organising calls and being work package leaders. It is seen as a good use of resources to have Nordic Energy Research (rather than the national Nordic participants) run work ERA-net packages. Nordic Energy Research have expanded their role and importance here

There is no consensus on Nordic Energy Research's role in relation to the national programmes, and it also appears that the different Nordic countries hold different views on this depending on the context. From the answers to the questionnaire, we can see that project participants often use the Nordic Energy Research funding as a complement to funding from national sources.

## Nordic Energy Research in the "Nordic innovation system"

Nordic Energy Research's role in the "Nordic innovation system" is rather difficult to define, given the uncertainty caused by the process surrounding the so-called "Top Research Initiative" (TRI). This initiative clearly affects the role of Nordic Energy Research, but to what extent is too early to say. The process has been described as rather less than transparent, and the first proposal as unrealistic in its ambitions, but over the period of this evaluation a change of moods seems to have taken place. What was considered a great threat to Nordic Energy Research is now seen as something benign that the organisation can live with and even grow to like. The Top Research Initiative arguably provides an opportunity for (more) Nordic collaboration, and is as such a welcome contribution to existing instruments. Although it might be argued that the amounts invested are still small compared to some national initiatives, this still remains to be seen. It depends on the net contribution of new money that is invested in this programme, but we do not have access to that information at the time of writing this report.

The Top Research Initiative forced Nordic Energy Research to cancel the second proposal for calls planned for the end of 2008. Instead, Nordic Energy Research will put the money destined for that call into the Top Research Initiative. NOK 30 million of Nordic Energy Research's budget will be earmarked for two TRI programmes, but since these will be administered by Nordic Energy Research the organisation will be able to exert an influence on how these resources are used. Another direct effect of the Top Research Initiative is that the strategy process Nordic Energy Research had planned for the early parts of 2009 will now be postponed somewhat.

Being a small organisation with a small budget, Nordic Energy Research needs to be very clear on what to do and what the priorities are. Nordic Energy Research needs to focus on:

- Issues that are mainly relevant for the further development of Nordic Energy Research's role as a coordinating agent
- Issues with an identified Nordic value (as opposed to "Nordic compromises")
- Long-term goals.

Nordic Energy Research has the advantage of being an organisation with a long track record that is seen as efficient with administrative routines that work well. Project participants give Nordic Energy Research high marks for project administration and support, and several interviewees point out that expanding Nordic Energy Research's budget would be clearly cost-efficient. Nordic Energy Research is seen as a much more active player today than it was until a few years ago, which is an aspect most of those who have commented upon this find to be a good thing.

### Dissemination of knowledge and research results

Finally, concerning dissemination of knowledge and research results, the channels Nordic Energy Research use are adequate in relation to the small resources the organisation have for this purpose. What Nordic Energy Research do in this respect, they do well – but they would benefit from developing their understanding of which impact the intended Nordic Energy Research information spread has – which channels Nordic Energy Research information is actually directed through, who (target) is at the receiving end and what is being achieved as a consequence of this information and knowledge dissemination. Today, Nordic Energy Research information and dissemination activities appear very much to be a supply-push initiative, planned and carried out from the perspective of Nordic Energy Research needs and ambitions. For example, we believe that policymakers as a category needs to be included more clearly among the target groups.

# Sammanfattning på svenska

Nordisk och nätverkande är de två begrepp som bäst beskriver det mervärde som Nordisk Energiforskning (NEF) bibringar intressenter. Det är uppenbart att Nordisk Energiforskning är en värdefull och uppskattad aktör på den nordiska energiforskningsarenan, inte minst i ljuset av organisationens begränsade budget. Nordisk Energiforskning bidrar till den nordiska energiforskningsinfrastrukturen genom att bygga nya och underhålla existerande nätverk, och genom att skapa möjligheter till hävstångseffekter i förhållande till nationella forskningsprogram.

Över 20 års erfarenhet av att driva internationella FoU-program gör Nordisk Energiforskning till en trovärdig organisation. Detta har gjort det möjligt för Nordisk Energiforskning att vara aktivt i flera ERA-nets, där till yttermera visso flera av de nationella nordiska deltagarna finner det rationellt att överlåta en större del av det praktiska arbetet på denna samnordiska organisation.

Nordisk Energiforskning bör vara rädda om sitt varumärke som en “kunnig realist”. Organisationen bör fortsätta på den inslagna vägen att driva forskningsprogram som är väl anpassade till tillgängliga (och begränsade) resurser. Det är här som Nordisk Energiforskning bidrar med sann nordisk nytta. Denna nordiska nytta består i:

- Att tillhandahålla en användbar och nyttig plattform för specifika nordiska (forsknings-)samarbeten, och skapa möjligheter till sådana samarbeten
- En bas för nätverkande över de nationella gränserna som annars inte skulle komma till stånd
- En hävstång in i eller stärkande av andra redan existerande forskningssamarbeten.

## ”Nordisk” och ”nätverkande”

Två ord framstår som centrala för beslutsfattare och andra intressenter då vi analyserar resultaten av denna utvärdering: nordisk och nätverkande.

*Nordisk* därför att så många av de vi intervjuat och som besvarat vår enkät i så stor utsträckning pekar på värdet och betydelsen av Nordisk Energiforskning som en plattform för specifika nordiska (forsknings-)samarbeten, och som en möjliggörare av sådana samarbeten.

*Nätverkande* därför att det framstår som tydligt att just detta är vad projektdeltagarna i forskningsprojekten uppskattar allra mest med dessa samarbeten. Finansieringen från Nordisk Energiforskning möjliggör nordiska nätverksprojekt, och vissa av dessa hade inte kommit till stånd utan detta stöd från Nordisk Energiforskning. Andra samarbeten hade kanske startat ändå, men de har med detta stöd stärkts.

Dessa utfall eller resultat av deltagande i projektsamverkan i ett Nordisk Energiforskning-finansierat projekt är de som projektdeltagarna själva bedömer som de helst ville uppnå med deltagandet – och de är också de resultat som man oftast upplever sig ha uppnått. Måluppfyllelsen är därför, sedd ur projektdeltagarnas synvinkel, hög.

## Projektportföljen och projektsamverkan

Då vi ser till projekten ser vi att kapacitets- och kompetensuppbyggnadsprojekt dominerar projektportföljen tydligt i förhållande till andra typer av projekt. Det innebär samtidigt att projektportföljen har en tydlig övervikt av mer grundforskningsinriktade projekt. Många av dessa har ett doktorandfokus, och vi ser här flera exempel på nordiska Centres of Excellence (NcoE).

Samverkan på projektnivå består mestadels av utbyte av gemensamma forskningsresultat, samt utbyte av material och data. Utbytet mellan de nordiska länderna innefattar även forskar- och doktorandmobilitet, och i viss utsträckning även doktorandundervisning. Av de icke-nordiska länderna är Estland det mest aktiva i detta sammanhang.

Nuvarande projektportfölj består av 16 forskningsprojekt uppdelade på fem ämnesområden (”topic areas”). Med hänsyn till Nordisk Energiforsknings budget kan antalet ämnesområden förefalla väl stort, och ”nordisk summering” snarare än ”nordisk kompromiss” bör vara ett centralt kriterium efter vilket områdena att fokusera på bör väljas ut. Ett sådant ämnesområde som har nämnts ett flertal gånger av intervjupersoner och i enkätsvar är den nordiska sammankopplingen av de nationella elnäten och de systemutmaningar och de behov av gemensamma och kompatibla regler och bestämmelser dessa ger upphov till.

Vidare förefaller 16 forskningsprojekt vara många. Om budgeten för forskningsprojekten inte ökas kan antalet projekt behöva minskas för att skapa en mer homogen projektportfölj. Detta är fallet åtminstone om Nordisk Energiforskning har ambitionen att bli en mer aktiv forskningsfinansiär med en mer uttalad top-down-inriktning på sin verksamhet. Alternativet är att fortsätta bistå med stödfinansiering till projekt som forskarna själva, snarare än NER, prioriterar.

Ett annat urvalskriterium vore att fokusera på de områden där en finansiering från Nordisk Energiforskning faktiskt kan göra skillnad. Vad vi förstår skulle en sådan hävstångseffekt tydligare uppstå om Nordisk Energiforskning koncentrerade sina insatser till områden där andra aktörer inte redan investerar stora summor pengar. Att investera delar av organisationens begränsade resurser på exempelvis forskning kring vätgas förefaller vara av litet strategiskt värde för Nordisk Energiforskning, eftersom de resurser man kan lägga på detta område är mycket små i jämförelse med vad Japan, USA och EU gör. Detta är dock samtidigt det ämnesområde av de fem där projektsamarbetena förefaller vara de mest varierade och fortlöpande. Inte endast samtliga nordiska länder deltar i dessa projekt, utan även Ryssland och de baltiska staterna, och alla nationer omfattas av i stort sett alla typer av samarbete.

## Nyttan för beslutsprocessen

Användbarheten av den input och det stöd Nordisk Energiforskning ger till beslutsprocessen i de deltagande länderna lyfter fram flera intressanta sakförhållanden. Ett grundkrav för Nordisk Energiforsknings projektportfölj är att de projekt som finansieras måste omfatta en eller ett litet antal ”gemensamma nämnare”. Att komma fram till dessa gemensamma nämnare kan vara en tidskrävande förhandlingsprocess. Fyra operationella kriteria framstår som centrala, och dessa uppfylls i olika utsträckning av den nuvarande projektportföljen:

1. Fokus behöver läggas på gemensamma energipolitiska frågor, inklusive energiforskningspolitik. Dessa frågor omfattar den nordiska sammankopplingen av de nationella elnäten och de systemutmaningar och de behov av gemensamma och kompatibla regler och bestämmelser som det ger upphov till, samt även frågor som rör den gemensamma nordiska elmarknaden, klimatförändringar och energieffektivitet. Vår analys av projektportföljen visar att det också är där tyngdpunkten i Nordisk Energiforsknings verksamhet ligger.

2. Prioriteringarna i Nordisk Energiforskning behöver korrelera väl med nationella prioriteringar på energiforskningsområdet, snarare än komplettera dessa. Konsekvensen av detta är att Nordisk Energiforsknings prioriteringar kan behöva anpassas efter förändringar i de nationella prioriteringarna. Enkätsvaren visar att många av projekten samfinansieras från nationella forskningsfinansiärer, något som stämmer väl överens med den principen.

3. Nordiskt nätverkande bör ges högre prioritet än ambitionen att skapa något tekniskt nytt. Skapandet av nordiska FoU-partnerskap och tillgång till nationella program i andra nordiska länder samt förbättrade samarbeten är viktiga målsättningar för att delta i forskningsprojekten, och samtidigt också viktiga prestationer.
4. De möjligheter som Nordisk Energiforskning skapar för små eller angränsande länder bör uppmärksammas och tas till vara. Enkätsvaren tyder på att detta gäller projektdeltagandet från Island såväl som från Ryssland och de baltiska staterna.

De särskilt tillskapade policyprojekten som den förra styrelsen för Nordisk Energiforskning initierade är i detta avseende ett intressant tillskott till organisationens uppsättning aktiviteter. Policyprojektens primära syfte är att ge kunskap om input, output och ramvillkor för energiforskningen i de nordiska länderna på ett generellt plan. Det sekundära syftet är att understödja organisationens egen policyprocess och strategiska utveckling. Tanken är att de även kommer att vara en input till den nya handlingsplan på energiområdet för perioden 2010-2014 som Nordiska Ministerrådet nu förbereder. Policyprojekten har nyligen avslutats och presenterats vid en gemensam workshop, och det förefaller tydligt att de pekar på flera intressanta vägar på vart Nordisk Energiforsknings projekt och övriga verksamhet kan gå. Det förefaller därför viktigt inte bara att Nordisk Energiforsknings styrelse tar till vara på de erfarenheter och kunskaper policyprojekten skapat, utan också att resultaten från de sju policyprojekten sprids till nationella och internationella intressenter i syfte att möjliggöra att dessa projekt och detta initiativ i sig får en större publik och ett större genomslag.

Nordisk Energiforsknings budget för forskningsprojekt är liten, jämfört med de nationella FoU-budgetarna på området. Det innebär helt naturligt en begränsning för vad Nordisk Energiforskning faktiskt kan uträtta i praktiken, även om det är en begränsning som man delvis kan kompensera sig mot genom att exempelvis använda samfinansiering som ett kriterium för finansiering från Nordisk Energiforsknings projektbudget. Ett annat sätt att hantera denna begränsning är att fokusera mer på långsiktiga mål och på olika policyfrågor.

### Nyttan för industrin och för forskarna

Vad gäller Nordisk Energiforsknings betydelse och värde för industrin, är det tydligt att industrin är mindre involverad i verksamheten än man kunde ha hoppats på och förväntat sig. Den större delen av projektportföljen består av så kallade Kapacitets- och kompetensbyggnadsprojekt, vilken är den projekttyp av de tre som finns som mest fokuserar på grundläggande forskningsfrågor. Rent generellt är industriföretagen varken särskilt aktiva projektdeltagare eller större bidragsgivare till många av projekten. De förväntningar som halvtidsutvärderingen av den förra programperioden ställde på verksamheten i detta avseende har inte infriats.

Samtidigt bör det noteras att det finns goda exempel och positiva tecken. Enkätsvaren visar tydligt att de industriföretag som har deltagit i forskningsprojekten är nöjda med vad de fått ut av deltagandet, och de uppger själva också att de områden där de fått ut mest av deltagandet också är just de områden där man hade störst förväntningar på deltagandet. I flera av forskningsprojekten samarbetar industriföretag på ett bra sätt i verksamheten, och vissa konkreta resultat har rapporterats. Den Sociala Nätverksanalysen (SNA) av fyra av forskningsprojekten som utgjort ett av delmomenten i denna utvärdering visar på industrideltagande i två projekt där industriföretag formellt inte ens finns med i projektgruppen. Det handlar här sannolikt om industriföreträdare som är aktiva i styrgrupper till projekten.

Forskarna som bedriver projekt inom ramen för Nordisk Energiforskning bedömer, inte överraskande, att användbarheten och värdet av denna forskning är hög. Även måluppfyllelsen av deltagandet i projekten är hög för forskarnas del.

### Måluppfyllelse på programnivå

Nordisk Energiforskning har satt upp ett antal ”framgångskriterier” eller indikatorer mot vilka den övergripande programverksamheten skulle kunna bedömas. Om vi utgår från dessa kriterier, gör vi bedömningen att måluppfyllelsen på programnivå förefaller god. Nordisk Energiforskning har utvecklats till att bli en plattform för samordning och främjande av en nordisk profil inom energiforskningen, och resultaten från de policyprojekt som just har avslutats kommer förhoppningsvis att utgöra ett stöd för organisationen vad gäller att förbättra sitt funktionssätt ytterligare. Forskningsprojekten i Nordisk Energiforskningsportföljen är naturligen ofta en del av något större eller annorlunda, vilket gör att det är svårt att värdera exakt vad just den finansiering som Nordisk Energiforskning står för faktiskt innebär. Trots detta har vi dock sett att finansieringen från Nordisk Energiforskning ofta fungerar som en hävstång och faktiskt innebär att något kommer till stånd som annars inte hade gjort det, eller som annars kanske hade inträffat i mindre skala på nationell eller bilateral nivå. Men återigen: Nordisk Energiforskning är en liten aktör med en liten budget, och det är därför viktigt att även fortsättningsvis ha realistiska förväntningar på vad som faktiskt kan åstadkommas.

### Nordisk Energiforskning i den internationella kontexten

Att agera på nordisk nivå bör ses som ett komplement än ett alternativ till att agera nationellt eller genom EU. Resultaten av utvärderingen pekar också på att Nordisk Energiforsknings roll i en internationell kontext därför bör bero på sakfrågan och kontexten. I vissa frågor förefaller en komplementär roll vara den bästa, i andra bör den nordiska kontexten kunna lyftas fram mer.

Nordisk Energiforskning har under drygt 20 år bedrivit internationella samarbetsprogram inom FoU, vilket ger Nordisk Energiforskning som organisation en unik erfarenhet att falla tillbaka på. Detta har Nordisk Energiforskning kunnat utnyttja för att aktivt delta i administrationen och genomförandet av tre ERA-nets. Två av dessa pågår fortfarande. Nordisk Energiforskning är en mycket aktiv deltagare i dessa samarbeten, och verkar även för att tillvarata de enskilda nordiska ländernas intressen. Nordisk Energiforskning spelar i dessa samarbeten en roll som de nationella nordiska deltagarna inte har möjlighet till – och även verkar nöjda med att överlåta på denna gemensamma nordiska organisation.

De vi talat med beskriver Nordisk Energiforsknings roll i ERA-netsamarbetena som betydelsefull. Representanter för nationella myndigheter eller forskningsfinansiärer från de nordiska länder som deltar i dessa ERA-nets påpekar att Nordisk Energiforskning bär en tung börda i dessa samarbeten genom att organisera utlysningar och leda olika work packages. Flera menar att det är resurseffektivt att Nordisk Energiforskning – snarare än de nationella nordiska aktörerna - driver work packages i ERA-net. Nordisk Energiforskning har i detta avseende utökat sin roll och sin betydelse.

Det finns ingen samsyn vad gäller Nordisk Energiforsknings roll i förhållande till de nationella programmen. Det förefaller också vara så att de olika nordiska länderna har olika syn på detta beroende på vilken kontexten och sammanhanget är. Av enkätsvaren framgår att projektdeltagarna ofta använder finansieringen från Nordisk Energiforskning som ett komplement till nationella finansieringskällor.

### Nordisk Energiforsknings roll i ”det nordiska innovationssystemet”

Nordisk Energiforsknings roll i ”det nordiska innovationssystemet” är tämligen svår att definiera, inte minst beroende på den osäkerhet som finns rörande det nordiska s.k. Toppforskningsinitiativet (TFI). Initiativet kommer naturligtvis att påverka

Nordisk Energiforsknings roll, men på vilket sätt och mer exakt i vilken utsträckning är ännu för tidigt att uttala sig om. Processen som lett fram till det nu antagna förslaget har beskrivits som otydlig, men i takt med att denna utvärdering framskridit har vi noterat en viss förändring i attityden gentemot initiativet. Det som till en början uppfattades som ett hot mot Nordisk Energiforskning ses nu som något godartat som organisationen kan lära sig att leva med och även uppskatta. TFI innebär otvivelaktigt en möjlighet till bättre koordination och (mer) nordiskt samarbete, och är som sådant ett välkommet tillskott till existerande verktygslåda. Det kan fortfarande hävdas att omfattningen på satsningen är relativt liten jämfört med vissa nationella nordiska initiativ, men om så verkligen blir fallet återstår ännu att se. Det beror på nettotillskottet av "nya" pengar till programmet, men det är information vi saknar då denna rapport färdigställs.

Toppforskningsinititativet föranledde Nordisk Energiforskning att ställa in den andra utlysningsrunda man hade planerat för 2008, och de medel som fanns avsatta för den utlysningen läggs i stället för en utlysning inom ramen för TFI. 30 MNOK av Nordisk Energiforsknings budget öronmärks för användning inom två TFI-program, men eftersom dessa två program kommer att administreras av Nordisk Energiforskning kommer organisationen att kunna påverka hur dessa medel används. En annan direkt effekt av Toppforskningsinititativet är att den strategiprocess som Nordisk Energiforskning hade planerat inleda tidigt under 2009 senareläggs ett drygt halvår.

Eftersom Nordisk Energiforskning är en liten organisation med en liten budget behöver man vara mycket tydliga med vad det är man prioriterar. Nordisk Energiforskning bör fokusera på:

- Frågor som främst är relevanta för Nordisk Energiforsknings fortsatta utveckling som en samordnande aktör
- Frågor som har en identifierad gemensam nordisk nytta (och inte endast är ett utfall av "nordisk kompromiss")
- Långsiktiga målsättningar.

Nordisk Energiforskning har en fördel i att man är organisation med en lång historia som ses som effektiv och med väl fungerande administrativa rutiner. De projektdeltagare som besvarat enkäten ger Nordisk Energiforskning höga betyg för projektadministration och stöd, och flera intervjupersoner påpekar att det vore kostnadseffektivt att utöka organisationens budget. Nordisk Energiforskning ses i dag som en betydligt mer aktiv aktör jämfört med till för några år sedan, vilket de allra flesta ser positivt på.

### Kunskaps- och resultatförmedling

Vad gäller spridningen av kunskap och forskningsresultat, slutligen, använder sig Nordisk Energiforskning av lämpliga kanaler i förhållande till de begränsade resurser man har till sitt förfogande för ändamålet. Det Nordisk Energiforskning gör i detta avseende, det gör man bra. Organisationen skulle dock vara betjänt av att utveckla sin förståelse för vilka effekter man förväntar sig av informationsspridningen. Det handlar om att göra klart för sig genom vilka kanaler Nordisk Energiforsknings information sprids, vilka som är de avsedda mottagarna samt vad som förväntas ske som resultat av informations- och kunskapsspridningen. Nordisk Energiforsknings informationsverksamhet är i dag i stor utsträckning utbudsdriven, och planeras och genomförs utifrån Nordisk Energiforsknings behov och ambitioner. Ett större mått av efterfrågestyrning vore önskvärt, och det skulle öka relevansen och träffsäkerheten i informationsspridningen.

# 1. Introduction

## 1.1 Mission

The terms of reference (ToR) defined the focus of the evaluation in this way:

The evaluation should focus on the current programme period (2007-2010), while also reviewing previous periods in order to include an overview of the development of Nordic Energy Research.

Focus should be placed on lessons learned, on identifying areas for improvement and development, and on how Nordic Energy Research can further strengthen the position of Nordic Energy research and development in an international perspective.

The project should through interviews with key stakeholder groups including the research community, the energy sector and decision-makers provide an evaluation of the work and activities of Nordic Energy Research and give recommendations on thematic focus areas, new types of programmes and instruments and the role of Nordic Energy Research in building a Nordic Energy and Innovation Area in energy.

The report should include evaluations of:

The usefulness and value of conducted research projects with the aim of identifying best practices for Nordic energy research activities in regard to programme and project organisation and implementation.

The role of Nordic Energy Research in EU projects and programmes. Further opportunities for using experiences gained at a Nordic level to contribute to the development of the European Research Area should be identified.

The usefulness of the input and support (including the commissioning and administration of projects, and the administration of working groups) provided to the political decision-making process. Recommendations on how to further develop this role should be made.

The dissemination of research results, policy recommendations and information about Nordic energy cooperation in regard to tools used, target groups, and effectiveness.

The project should provide suggestions for Nordic Energy Research based on an investigation of the strategies, programmes and administration of other international research and development institutions.

## 1.2 Method, approach and work carried out

We have interpreted the four sets of evaluation issues identified by the Terms of Reference in the following way:

*The usefulness and value of the research conducted*. ‘Relevance’ is key, and the usefulness and usability of research results for policymakers, industry and researchers focused. The outcomes and impacts of the work studied must include human capital, not just information.

*The role of NER in relation to EU projects and programmes*. The added value of the Nordic level is a key issue that has been strongly debated in recent years. While NER is widely regarded as one of the most valuable of the Nordic co-operations, the evaluation nonetheless should test the logic of acting at the Nordic level, probably as a complement rather than an alternative to action at national and EU levels.

*The usefulness of the inputs and support provided by NER to the policymaking process* – especially but not only in the Nordic area. How can NER better support policymaking at different levels, as the commitment of national agencies like STEM to NER’s activities suggests is already the case?

*The dissemination of research results* to a range of beneficiary groups. Conventionally, dissemination is seen as a 'supply push' activity, but in reality the ability of potential information users to seek, absorb, quality-control and exploit information ('absorptive capacity') is also crucial, especially when they face many alternative sources of knowledge.

Using multiple tools and triangulating the results they provide is a key principle of robust evaluation. We have used the following tools:

- Document study: relevant documentation provided to us by NER, interviewees and through other means
- Exploratory interviews: twelve interviews (NER, NMR, national ministries and policy makers)
- Semi-structured interviews: about 30 (NER, project participants, other stakeholders)
- Portfolio analysis, based on document studies, questionnaire results and interviews
- Questionnaire sent to all project participants. Response rate about 60% (see appendix)
- Social Network Analysis concerning senior researchers` networks, carried out on four research projects
- Case studies: three case studies, including about 15 interviews

Two expert advisors have contributed valuable inputs at various stages of to the work process.

The NER board has acted as reference group to our evaluation, and provided useful input to the process on several occasions.

## 1.3 Previous evaluations

Whereas the ToR for the present evaluation asked for a more holistic approach, tackling NER as an institution, its working methods and instruments, project implementation and impacts, earlier evaluations have focused on the project level.

A mid-term evaluation of the previous programme period (2003-2006) was carried out in 2005[1]. It focused on the project portfolio, and on how well these projects corresponded to the action and strategy plan. The evaluation served as input to the new strategy plan Nordic Energy Research was then preparing and, subsequently, to define research areas and projects eligible for funding for the present programme period.

"Nordic value" was a central issue of the evaluation, and the evaluation showed that Nordic networks and collaboration patterns developed in all the projects. Research institutions from the Baltic states or Russia participated in some 70% of the projects. All projects proved to have a certain margin of improvement as regards to dissemination of results. The earlier evaluation ended with four recommendations for the next programme period:

- Consciousness-raising of the project leader role
- Industry involvement
- The projects as listening posts
- Nordic Centre of Excellence

[1] Midtveiseevaluering – prosjekter finansiert av Nordisk Energiforskning i 2003-2006 (HNI Partners)

## 1.4 Structure of the report

The rest of this report is structured as follows:

Chapter 2 presents the organisation Nordic Energy Research, its history, mission and goals.

Chapter 3 contains an account of the NER project portfolio, as regards types of projects, collaborations and content of project participation.

Chapter 4 examines the usefulness and value of the research and other activities conducted to various target groups: policy makers, researchers and industry.

Chapter 5 examines the role of Nordic Energy Research in an international context.

Chapter 6 summarizes what we have seen concerning the value of NER to the policy making process, and the merits of the NER administration according to project participants and other stakeholders.

Chapter 7 analyses NER´s efforts regarding the dissemination of knowledge and research results.

Chapter 8, finally, gives a summary account of the main findings, in the light of the evaluation questions.

In an appendix section, we have collected the following:

A. ToR for the evaluation
B. Portfolio analysis, per topic area
C. Questionnaire results
Three case studies:
D. Climate and Energy Systems, Risks, Potential and Adaption
E. Nordic Centre of Excellence in Photovoltaics
F. eNERGIA (policy study)
G. Social Network Analysis (SNA): Four examples
H. List of people interviewed

# 2. Nordic Energy Research (NER)

## 2.1 History and background

Nordic Energy Research is an institution which operates under the auspices of the Nordic Council of Ministers. Nordic Energy Research was established in 1985 as a research programme in order to strengthen and expand Nordic co-operation in energy research. Particular emphasis was given to building competence and providing research leaders and scholars with opportunities to work at other universities. For 14 years, Nordic Energy Research continued as a research programme. It was converted into an institution in 1999, as a continuation of the Nordic Energy Research Programme.

The first research programme for the institution NER covered the years 1999-2002 and included co-operation within oil technology, fuel cells, heating systems, energy and society, combustion of biomass and process integration. The primary objective was to strengthen energy research competence in the Nordic countries and their neighbouring countries in the Baltic area and the north western part of Russia by co-ordinating the activities.

The most important element in the 2003-2006 programme was improved flexibility to solve current problems in the energy sector and to make Nordic companies more competitive internationally. Climate change issues, Nordic electricity co-operation and a stronger co-operation in the Baltic area were identified as priority areas. 16 projects within five focus areas were initiated.

## 2.2 Organisation of NER, its mission and goal

The vision for NER is that “the Nordic Region shall be able to consolidate and develop its position as a leading knowledge region for new, environment-friendly energy solutions and efficient and well-functioning energy markets”. Its goal is to be conducive in maximising the results of energy-related research and development in the Nordic Region and their adjacent areas.

NER sees it as its mission to participate in consolidating and developing the Nordic Region as a leading knowledge region for new, environment-friendly energy solutions and efficient and well-functioning energy markets:

– Research and development with a bias towards applied research, innovation and user involvement in projects underpin wealth creation

– Nordic presence in a larger European Research Area, the technology initiatives in the framework programmes and the ERA-nets

– Nordic Region as a testing ground for new technology and policy initiatives for new energy solutions.

NER have formulated a number of success criteria or output indicators against which the overall performance of the programme could be measured. The most important success criterion is defined as “the achievement of maximum Nordic Benefit in the institution’s field of activities”. This Nordic Benefit will include:

– Reinforced interplay between national R&D participants, thereby building Nordic Centres of Excellence and making research results available

– Helping to ensure that Nordic energy clusters are formed (bringing together R&D circles, industry and the authorities, initiating joint projects and coordinating scenario analyses/foresight processes)

– Creating measurable developments and improvements when exploiting new technology, as well as new knowledge about the energy markets

– Relating R&D results to current energy policy issues

– Coordinating Nordic views in order to increase the opportunities for exerting influence, especially in the EU.

In order to facilitate our further analysis, and make it transparent, we chose to display the vision, mission, success criteria, output and activities of NER in the following format (exhibit 1), which can also be seen as our attempt to reconstruct and comment on NER´s programme logic.

The table should be read as follows

First column: General programme logic model
Second column: (Our reconstruction of) NER´s programme logic
Third column: Important, partly implicit assumptions behind NER´s programme logic, conditioning the next higher level of the logic
Fourth column: Some comments on potentially critical factors
Row, from bottom and up: Certain resource inputs (bottom row), are used for activities (next row), that produce immediate outputs or achievements (next row), that cause some outcomes or first order effects (next row), that in their turn give rise to some impacts (second order effects) in accordance with NER´s mission, that finally contribute to the overall objectives of energy policy in the Nordic countries

Exhibit 1: Programme logic of NER

| General programme logic | NER´s programme logic | Underlying assumptions | Some critical factors |
|---|---|---|---|
| Overall objectives of NER | Contribute to the development of a leading knowledge region with appropriate energy solutions and energy markets by maximizing results of energy related results in the Region, including adjacent areas | | |
| Second order intended effects (impact) | Wealth-creating R&D, with emphasis on applied research, innovation and user involvement<br>Presence in ERA, with emphasis on technology initiatives and ERA-nets<br>Establishment of the region as testing area for technology and policy initiatives | Effective interaction with energy policy formation processes in Nordic countries as well as the EU<br><br>Common view between member countries regarding NER´s role | Suitable forms for consultation with science, policy and industrial actors as well as other players on the Nordic scene in NER´s strategy formation |
| First order intended effects (outcomes) | Nordic benefit through<br>Reinforced interplay between national R&D participants<br>Contribution to cluster formation<br>Measurable improvement in exploitation of new technology and new knowledge of markets in the energy field<br>Absorption of R&D results with relevance to current energy policy<br>Influence mainly in the EU through coordination of Nordic views | Market forces and presence of adequate industrial actors in the areas chosen for R&D support<br><br>Effective interaction with energy policy formation processes in Nordic countries as well as the EU | Suitable forms for consultation with science, policy and industrial actors as well as other players on the Nordic scene in NER´s strategy formation |
| Output | R&D projects in five thematic areas for<br>Capacity and competence building<br>Business development and innovation<br>Integration of Capacity building and innovation<br>Input to policy processes<br>Implementation of networking projects<br>Information on activities and projects | Thematic areas reflect common Nordic concerns or policy needs<br>R&D project organization conducive to networking and results dissemination to target groups<br>R&D project budgets are adequate to produce significant results and contribute to critical mass<br>Policy studies are organized to include transfer of results to intended target groups<br>Networking projects are used as platforms for influence<br>Appropriate information channels are used | Converging processes with national principals to define thematic areas of genuinely common interest for Nordic energy policy<br>Budget allocation process that assures adequate synergy with national R&D funding and realistic objectives in each thematic area<br>Adequate staff resources for active monitoring of projects<br>Suitable forms for industrial participation in projects |
| Activities | R&D project application and implementation<br>Policy studies<br>Administration of designated networking projects<br>Communications activities | R&D projects:<br>Selection criteria and two-staged process that are consistent with NER´s programme goals and assure desired Nordic benefit<br>Appropriate requirements for co-funding<br>Efficient implementation routines to assure compliance with project objectives<br>Clear and shared objectives for policy, networking and communication projects | Opportunities to exploit resource and competence complementarity<br>Budgets to allow projects of critical size |
| Input resources | Structured organization<br>Information resources<br>NER staff<br>Financial resources to fund projects | Adequate competence<br>Sufficient and stable funding<br>Efficient communication channels<br>Appropriate contact network | NER´s role is clear and recognized<br>Efficient leadership |

## 2.3 Budget

NER's programme of actions is based on current national allocations as well as a grant from the Nordic Council of Ministers. There are also some incomes from other sources. For 2009, the basic budgetary framework is approximately NOK 42 million, of which national allocations provide some NOK 30 million. The Nordic Council of Ministers' grant is NOK 5.8 million, whereas EU projects add some NOK 2 million to the budget and other projects some NOK 6.5 million. A great part of these resources, approximately NOK 30 million, is spent on research projects. Some NOK 6 million goes to administration, and the remainder to other projects.

The allocation from each member state is in direct proportion to each country's GDP. The organisation funds what the Nordic member states jointly have prioritised - NER as an organisation is not supposed to have any priorities of its own. There is also a paragraph inviting private financers to take part: "The institution will also work to obtain external funding amounting to approx. NOK 10 million per year."

The research projects are partly financed by NER, according to stipulated rules for the category of research project (see chapter 3). The remainder of the project budget comes from "participants and contributors", that is, the organisations carrying out the research and participants in the projects' steering groups. NER are part of all projects' steering groups.

# 3. The project portfolio

## 3.1 Types of projects, project selection and financing

In the current programme period 115 applications for research projects were submitted, out of which 36 were selected after a first review. At the end 16 research projects were finally accepted.

The research projects were selected in a two-tier process. Phase one consisted of an Expression of Interest (EoI), where project applicants formulated short outlines of their proposals. This was done on a pre-established, internet-based format, with a rudimentary budget appraisal. The 115 EoIs presented to NER totalled applications worth 800 MNOK. Since the available research budget for the programme period was only 75 MNOK, a tough evaluation (and elimination) process was needed. This process followed previously published criteria.

In phase 2, a limited number of phase 1 applicants were invited to submit a full project application. An evaluation was carried out by external (non-Nordic) experts, following a pre-set mode of operation. The experts submitted their recommendations to NER, and the Board took the final decision on which projects to support. In general, the Board followed the experts` recommendations, but some projects ranked with a lower priority order by the experts were accepted for funding. Because the Board found so many projects that were good, it was decided to increase the total project budget by an additional 10 MNOK, to a total of 85 MNOK. At the same time, most budgets of the accepted projects were reduced in size.

In total, this selection process up to the final decision took about six months.

The project portfolio consists of five topic areas, each with a different focus:

- Climate and Energy Systems focuses on the Nordic electricity system for the next 20-30 years and covers research on production of renewable energy in the Nordic area.
- Energy efficiency consists of two projects; one is focused on production of energy in the heating market, and the other on efficient energy use within Mechanical pulping.
- Renewable energy consists of five research projects with different approaches. These projects focus on improving technology for renewable energy resources such as biofuel, ethanol, wind energy, photovoltaics and improvements of usage of sustainable energy.
- Hydrogen technology. The four projects within this area deal with several issues related to production, usage and distribution of hydrogen power including production, transport, storage, conversion and safety.
- Energy Markets is focused on harmonisation of regulations and standards as well as issues regarding “hardware” development for improvement of the Nordic energy market.

Exhibit 2: Research projects: topic areas and allocation of budget

| | 1. Climate and Energy Systems | 2. Energy efficiency | 3. Renewable energy | 4. Hydrogen technology | 5. Energy markets |
|---|---|---|---|---|---|
| Budget MNOK | 10 | 12 | 33 | 19,4 | 11,8 |
| NER financing % of projects' total budget | 66 % | 64% | 64% | 67% | 66% |
| Number of projects | 1 | 2 | 5 | 4 | 4 |

The number of projects and the money allocated between the five topic areas are unevenly spread. This is explained by the application process which did not stipulate a specific distribution between the topic areas.

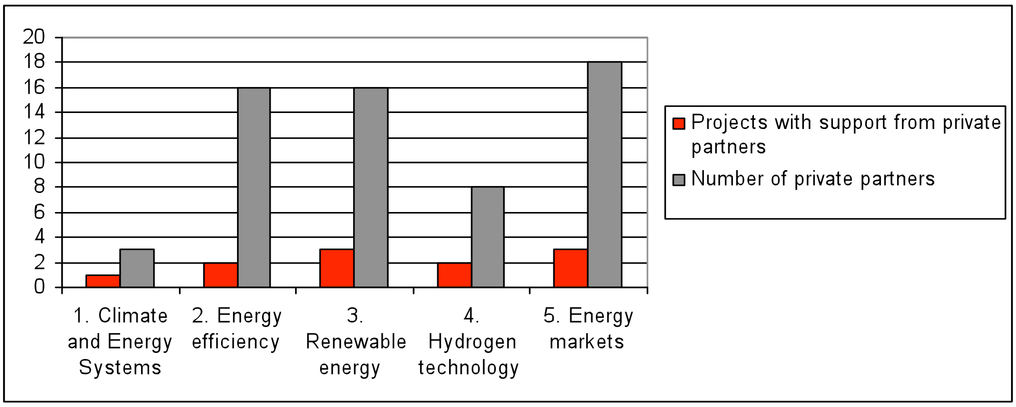
The Strategy Plan for 2007-2010 describes some of the thoughts behind the acceptance of R&D projects. The topic areas are divided into two broad themes: development of renewable energy technologies and development of energy systems and markets. As described in the Strategy Plan, these two themes are not mutually exclusive and the categorization mainly serves as a practical tool when assessing the relevance of the project proposals. The division of the projects into three types, indicating whether they contain more basic or more applied research, serves a similar purpose. These three types of R&D projects are:

- Capacity building and competence building projects
- Business development and innovation projects
- Integrated capacity and innovation projects

As with the division into the broad themes, the division into R&D project types seems to fit the purpose of a practical aide in the review and application process. However, there is a mutual understanding among those interviewed that most of the 16 accepted projects can be labelled as Capacity building and competence building projects. According to NER policy documents, out of the three project types this is the one that is most focused on basic research. The other two project types to a larger extent comprise activities such as applied research and favour industry collaborations.

The imbalance between budget allocations to research topic areas and the balance between basic and applied research is said to be a consequence of the assessment of project proposals. The projects were primarily selected on criteria such as quality of the research, the research group, project goals and content of the project presentation. However, NER follows the development between the topic areas, and continually evaluates the project portfolio in these aspects.

Exhibit 3: Industry engagement in R&D projects and research topic areas[2]




The private financers are mainly players on the energy market such as power producers like Statkraft, Vattenfall and Dong Energy. Other organisations from the private sector are industry associations from all five Nordic countries. Other industries are also represented such as the Finnish forest industry research institute, KCL, who are the coordinating organisation of one of the projects in the topic area Energy efficiency. Most industries that support NER projects are from Denmark and Norway.

Exhibit 4: Private organisations' share of budget and average amount of contribution[3]

| | Average number of private funding organisations | Private funding share of the project budget | Private organisations average share of project budget | Private organisations average amount of contribution (NOK) |
|---|---|---|---|---|
| 1. Climate and Energy Systems | 3 | 18.6% | 6,2 % | 1 133 333 |
| 2. Energy efficiency | 5 | 43.6% | 8,7 % | 844 275 |
| 3. Renewable energy | 5 | 10% | 2 % | 247 735 |
| 4. Hydrogen technology | 2 | 17% | 14.2% | 512 500 |
| 5. Energy markets | 5 | 10.9% | 2.3 % | 112 377 |

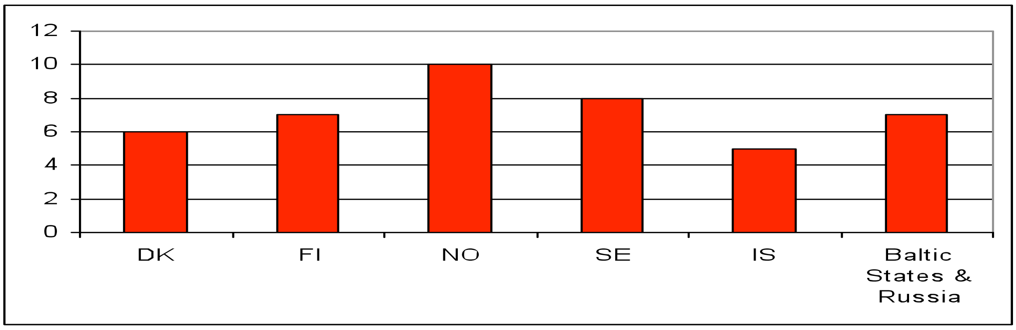
The private organisations´ share of the total budget varies between topic areas and also between projects. The project Climate and energy systems has several strong private financers: Statkraft, Elforsk, Finnish Energy Industries and Dong Energy.

[2] See comments for exhibit 4

[3] Figures are based on information from end of the year reports from the projects 1, 3, 4, 5, 7, 9, 10, 13, 15, 16. Figures on project 11 and 12 are based on the project descriptions and financial information from the Nordic Energy Research's administration. Available information from remaining projects has not been able to use

Most financers of projects in the topic area Renewable energy contribute with smaller amounts. For example, the Nordic excellence centre in photovoltaics has six industry financers that contribute with an average of 389 833 NOK. The seemingly low level of private funding in the topic area Energy markets may not correspond to reality, as we lack data for two of the four projects in this topic area. One of the projects, DIGINN – Distributed generation integrated in the Nordic energy market, has many private funding organisations that contribute with very small amounts under 100 000 NOK.

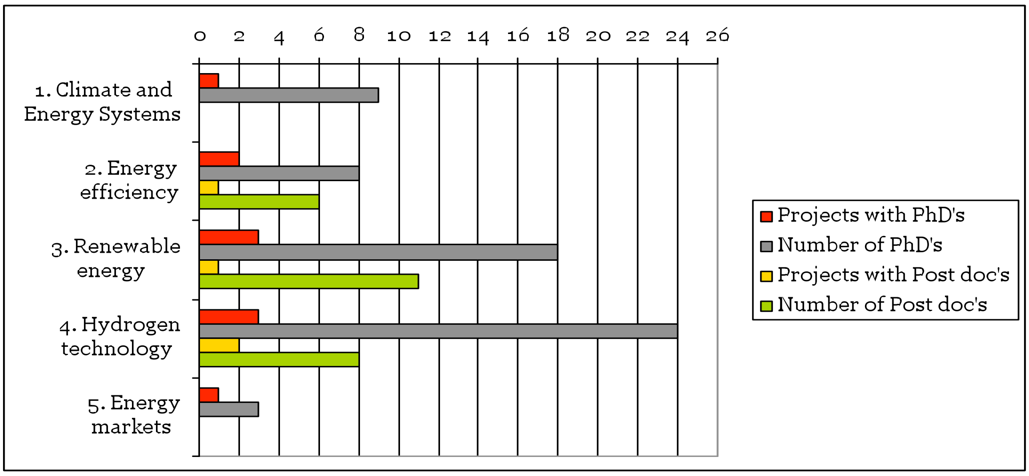
Exhibit 5: Number of participating research organisations divided by country




Norwegian and Danish research institutions are most frequent participants in NER funded projects. Seven Finnish and ten Norwegian research institutions participate in projects on 14 and 17 occasions respectively. The Danish research institutions are comparatively diligent; and six Danish institutions participate in 14 different projects. In proportion, Swedish research institutions are the least involved among the Nordic countries. Eight Swedish research institutions are involved in 14 projects.

Baltic and Russian institutions participate in all topic areas and in a total of 10 projects. The Baltic and Russian organisations principally participate in Capacity building and competence building projects.

Exhibit 6: PhD and Post doc participation within research topic areas

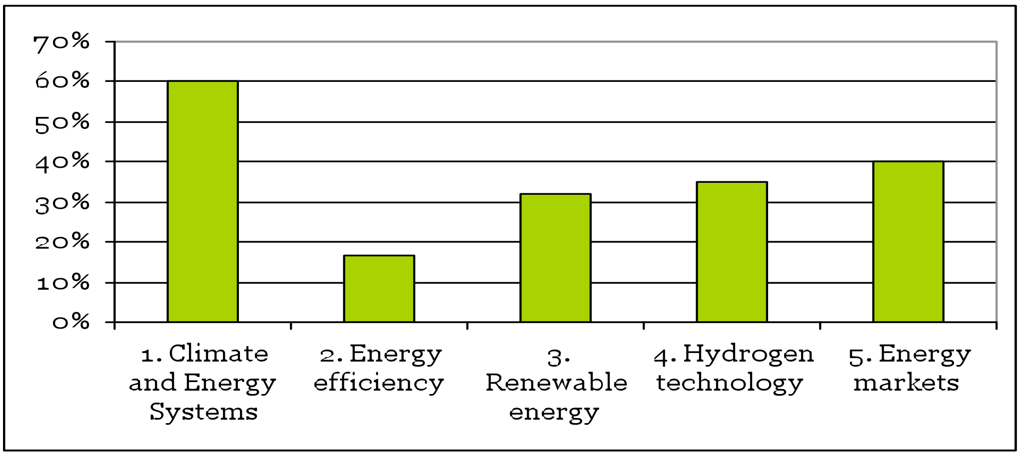



Over 60 PhD students are involved in ten NER funded projects. Most of these projects are graduate schools that are found in the first four topic areas. In the other two cases, it cannot be excluded that the projects with just a few candidates are organised close to

a graduate school at the research institution. The project manager of the project Basic phenomena in mechanical pulping, for example, explains that his project is part of another project called Energy Efficiency in Mechanical Pulping/Wood, with other funding. Just one project in the topic area Energy Markets involves PhD candidates. The number of PhD candidates varies and most PhD students are found in the topic areas of Hydrogen technology (24) and Renewable energy (18). Seven of the PhD students are from the Baltic countries and one is from Russia. These non Nordic candidates are involved in five of the ten projects that involve PhD candidates. None of the PhD candidates are employed by industry. 25 post doc researchers are involved in four projects, ten of them are Finnish and six are Norwegians.

The topic areas 1 and 5 differ from the other in that these projects have a high proportion of industry participation. The four projects in topic area Energy markets involve only three PhD students.

Exhibit 7: Share of recipients that answered that their NER- project is a part of another project or programme in their own organisation. 1.n=5, 2.n=6, 3.n=25, 4.n=23, 5.n=5




The only project that is part of another project is the one in the topic area Climate and energy systems. Those who claim that their NER project is part of another project or programme describe the NER project as adding to the other activity. One project participant claims that this NER project serves as an umbrella for several national projects related to climate change and water resources. Another project participant points at the fact that the NER funding made it possible to raise funds at national level that now complement the NER funding of the project. Other funding organisations that are mentioned are both national and international such as the Swedish Research Council, national industry and the EU.

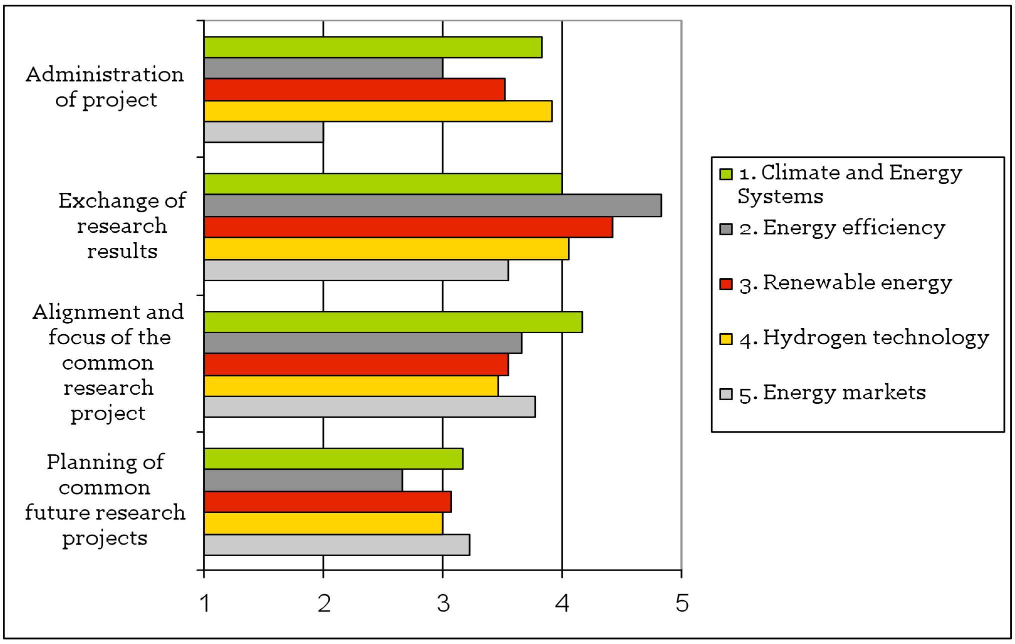
## 3.2 Project participants and content of participation

One project, Distributed Generation Integration in the Nordic energy market, is managed by the organisation ECON which is active in Norway, Sweden and Denmark. All other projects are managed by a research institution. Ten of the 16 projects are managed by Norwegian institutions, with SINTEF being the most frequent project manager with three projects. Three projects have Swedish project leaders, Finland runs two projects and Denmark and Iceland one each.

Each project has a steering group that on average consists of nine persons, including the NER representative. Five steering groups have less than six members, eight of them have more than ten members. Most of the steering group members represent research institutions and only five steering groups include members from industry. These projects are within the topic areas Climate and Energy Change (1), Renewable Energy (1) and Hydrogen Technology (2). A few projects have also set up reference groups with industry participation. The project DIGINN – Distributed Generation integrated in the Nordic energy market has 13 members, most of them representing the financing industry. Another project, Nordic Network for Sustainable Energy Systems in Isolated Locations, has nine persons linked to the project.

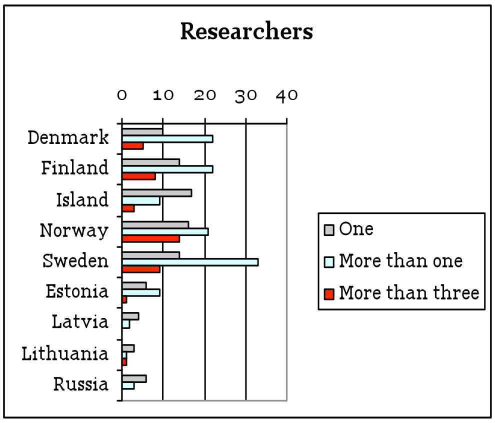
In most projects steering group meetings are held twice a year with all project participants are present. Phone conferences where all project members participate are less frequent, but more likely held between one or two persons within the project. In larger project steering groups it is more likely that all participants meet only once a year, complemented with meetings in between with parts of the steering group gathered. The meetings often take place in connection with a conference or seminar that is arranged within the project or outside the project. Group leaders and project leaders are also to large extent members of steering groups and often work as a link between the research environments and the NER projects´ steering groups.

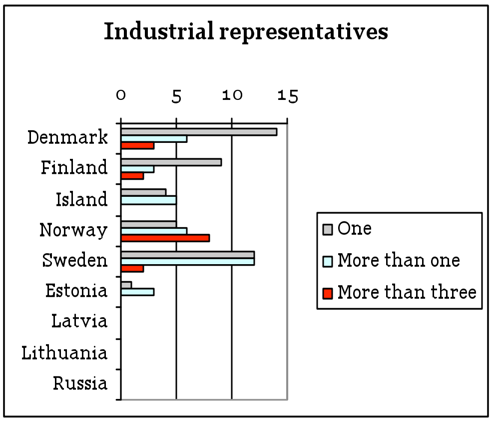
Exhibit 8: Issues dealt with during project group meetings (1 not at all – 5 to large extent)




The exhibit above shows small differences between the projects clusters, and some of them can also be explained by the fact that the response rates between the topic areas vary strongly. There are only six answers from topic areas 2 and 5, while there are 27 from topic area 3. Two divergences can be noticed. In the topic area Energy markets three projects issues related to administration have been given less emphasis than alignment and focus of common research project at group meetings. Exchange of research results are the most discussed issues at the meetings for all topic areas. This is most significant in Energy efficiency and Renewable energy and especially in the projects Basic phenomena in mechanical pulping; New, innovative pre-treatment of Nordic wood for cost effective fuel-ethanol production; and Model development for power system analysis with wind energy capacity installed in the Nordic grid.

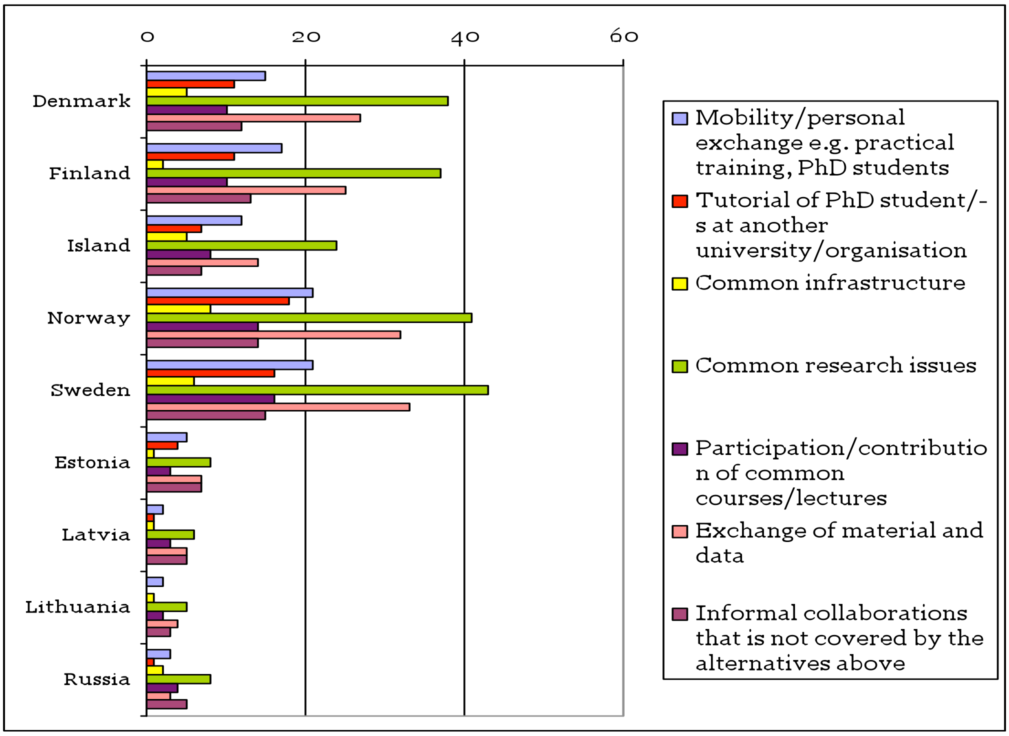
Exhibit 9: Number of project participants that collaborate with one, more than one, more than three from respective nationality. All topic areas. n=56, n=26




The overall picture of the participants' collaboration shows that Denmark, Finland, Norway and Sweden can be considered as core countries. Norway seems to be the centre in many relations. The project participants' relations with the Baltic states and Russia usually consist of a few research contacts. Just two project participants answered that they collaborate with more than three researchers from the Baltic states. Another observation is that the participants don't have many relations with Baltic and Russian industry. Only Estonian industry that is involved in NER funded projects, and in only one project: Model Development for Power System Analysis with a Substantial Wind Energy Capacity installed in the Nordic Grid.

Exhibit 10: Type of exchange. All topic areas. n=64




Collaboration between the participants mainly consists of exchange of common research results and exchange of materials and data. Exchange among the Nordic countries also includes mobility of people and to some extent teaching of PhD students. Participation and contribution of common courses and lectures are less frequent and least frequent is exchange concerning common infrastructure and informal collaborations. Estonia is the most active country outside the five Nordic ones. Informal exchange with Estonian participants is as common as the relations with Icelandic participants.

A Social Network Analysis (SNA) concerning senior researchers` networks was carried out on four research projects[4]. The SNA build on questionnaire answers, and projects with good response rates were chosen. The projects selected were:

- New, innovative pre-treatment of Nordic wood for cost-effective fuel-ethanol production (9 answers out of 12 questionnaires submitted)
- Model Development for Power System Analysis with a substantial wind energy Capacity installed in the Nordic grid (8 answers out of 10)
- BioH2 – Renewable production of H2 using biological systems (9 answers out of 11)
- Nordic Centre of Excellence on Hydrogen Storage Materials (10 answers out of 14).

The results of these SNA analyses in broad terms confirm the findings presented in exhibits 9 and 10. There are some indications in the SNA graphs that project participants from the Baltic countries are perhaps better integrated into the projects than exhibit 9 may hint at.

This is the overall picture of the projects. At a topic area level the following observations can be made:

### *3.2.1 Climate and Energy Systems*

The only project within this topic area is considered to be an industry related research project. The steering group has 12 members. Project collaboration is tied to the research institutes, and Baltic and Russian researchers are also involved. The industrial collaborations seem to be limited to the Nordic countries. (See appendix 2 figure 1)

The answers to the questionnaire show that the exchange within this project consists mainly of common research issues and to a lesser extent of common infrastructure. Six responses concern personal exchange/mobility but they do not collaborate in common courses/lectures. Finland, Iceland, Norway and Sweden are most involved in international exchange where also most informal collaboration is found. Despite several collaborations, types of exchange and the topic area's 9 PhD students, just one case of foreign student teaching can be noticed. (See appendix 2 figure 2).

### *3.2.2 Energy efficiency*

Both of the projects in the topic area Energy efficiency have connections to industry. The project Basic Phenomena in Mechanical Pulping is managed by KCL, the Finnish forest industry owned institute, and the project Primary Energy Efficiency has several private financers. The projects are to a large extent academic project with a total of eight PhD students and six post docs. The collaborations seem to be most intense in Finland, Norway and Sweden, which is partly explained by the fact that these projects are managed from Norway and Finland respectively. The Primary Energy Efficiency project has collaborations with Estonia and there is also Estonian representation in this project's steering group. Estonia is also the only country outside the five Nordic states that is involved in collaborations within this topic area. (See appendix 2 figure 3).

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[4] See appendix 8

Most of the exchange in the topic area Energy efficiency consists of exchange of common research and of material and data. Some of the participants also collaborate by participation/contribution of common courses/lectures. All countries are to a varying extent involved in teaching of students at another university, and participants in all countries also have informal collaborations. (See appendix 2 figure 4)

### *3.2.3 Renewable energy*

Renewable energy is the largest topic area as to the number of projects. Three of the five projects in this area are in graduate schools, and involve at least 18 PhD students (information about the project Model Development for Power System Analysis is missing) and 11 post docs. Most of these researchers come from Finland, Denmark, Norway and Sweden. There is also one PhD student from Estonia and one from Russia in the project Nordic centre of excellence in photovoltaics. (See appendix 2 figure 5)

Measured by frequency and quantity of exchange activities, Sweden, Norway, Finland and Denmark are clearly the core countries. Except exchange regarding common research issues, teaching of students and mobility/personal exchange are the most common activities that involve the participants in collaborations. Informal collaborations are most common among the core countries. (See appendix 2 figure 6)

### *3.2.4 Hydrogen technology*

This topic area has a strong research profile compared to the other topic areas; 19 project participants answered the question regarding collaborations with research institutions while just three have networks that involve industrial representatives. Only one of them has collaborations with more than one industrial representative. This can partly be explained by the fact that only one person in this group is defined as an industry representative. As with most Baltic and Russian participants in NER projects, the participants in this topic area from these countries are exclusively from research institutions. (See appendix 2 figure 7)

Hydrogen technology is the topic area where all countries are involved in almost all types of exchange. Exchange of research results is the most frequent activity among the Nordic countries while informal collaborations are important in their linkages with the Baltic States and Russia. Almost all exchange activities to a large extent include the Baltic States and Russia. (See appendix 2 figure 8)

### *3.2.5 Energy markets*

Only six answers to the questionnaire are from this topic area. It is therefore difficult to draw any conclusions. We received only two answers from two projects and only one answer from the other two projects. (See appendix 2 figure 9)

Except one answer, all exchange activities consist of common research issues. Sweden, Denmark, Finland, and to some extent Norway, seem to be the core countries in the topic area Energy markets. (See appendix 2 figure 10)

## 3.3 Added value of the project portfolio

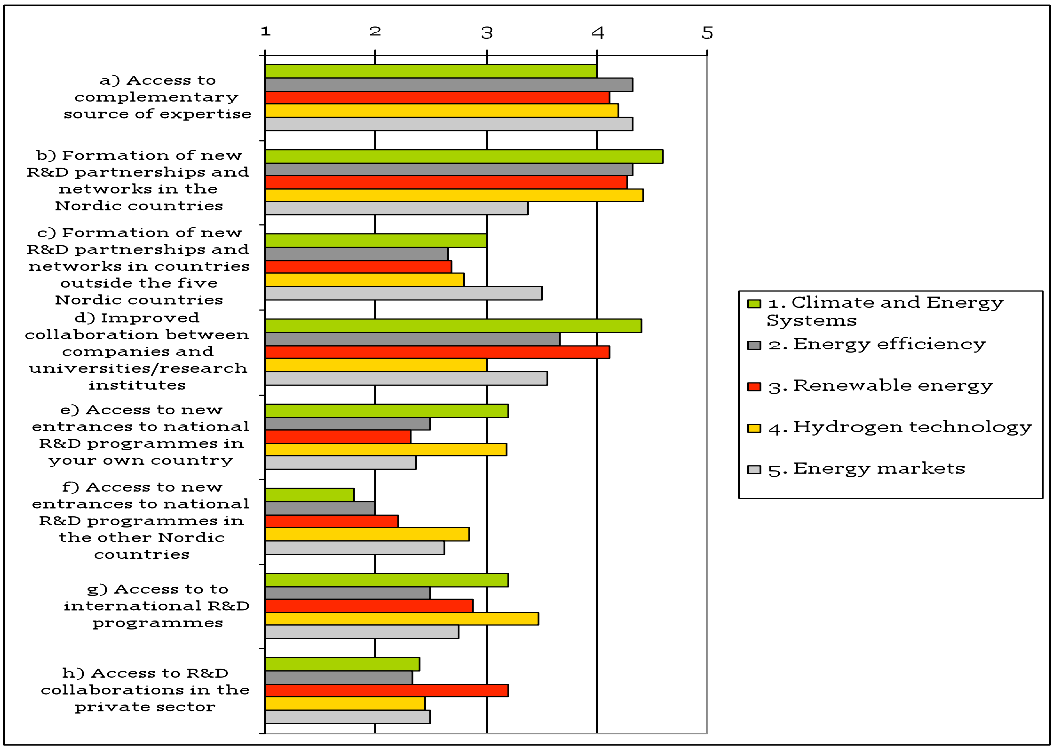
Compared to national and other international funding, the NER funding is often considered as small. In spite of this, several participants underline the added value of the NER funding and several interviewees and survey answers alike point out that it has had a great impact on their Nordic network. Several claim that the funding is the main reason for their entrance and participation in the Nordic network. Others claim that their involvement in a NER project has increased their knowledge of research activities in their own field at the Nordic level.

There is broad agreement that the networking is a key value provided by the Nordic funding. One researcher considers that the NER participation gives an excellent network "for free", that is, in addition to the scientific work that the project focuses on.

Several researchers point out that they would probably not have got in touch with the people that they now collaborate with if it had not been for the funding from NER. One example is the project Nordic centre of excellence in photovoltiacs (NCOE IN PV) where many of the participants collaborate with colleagues in the neighbouring countries that were unknown to them before the project started. The researchers within NCOE IN PV do have different research approaches but the collaboration has been fruitful in many ways and also contributed to new ideas and solutions. A similar development is described in the newly formed network/project Basic Phenomena in Mechanical Pulping as well as in Climate and Energy Systems. The latter has its history in a NER project that was active in the end of 1990s on hydrogen power. Since then the network has been extended both in research areas and number countries, both within and outside the Nordic region. Several participants claim that the project has gathered much of the Nordic competence in the field and that the network now has become a permanent.

Participants also claim that the NER funding has had a significant impact on networks and research activities in their country. Because of earlier funding on district heating a network was formed and the research got established in Island. One of the former Icelandic NER funded PhD students within district heating is now managing the Icelandic participation in the current project Primary Energy Efficiency (PEE). Compared with earlier NER funded projects on district heating PEE has extended network and a research group from Estonia is now part of the network.

Exhibit 11: Participants understanding of their organisations network oriented goals with the participation in the NER funded project. Rating from 1 (not at all important) to 5 (very important)

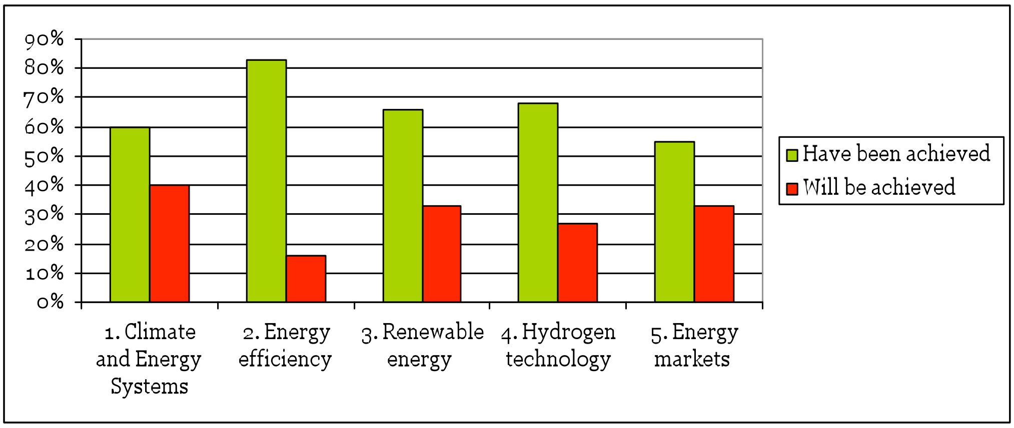


The answers to the questionnaire also show that the participating organisations find the formation of partnerships and networks in the Nordic countries, and access to complementary sources of expertise as important. Less important are for example collaborations in the private sector and formation of networks outside the five Nordic countries. Only the topic areas Climate and Energy Systems and Hydrogen Technology rated access to international R&D programmes as fairly important. One interpretation is that most participants in this project don't see their participation in NER as a tool for participation in EU-programmes. Those in the two mentioned topic areas that answered the survey also rated access to new entrances to national R&D programmes in their home country higher.

The project participants in the topic area Energy Markets rated formation of new R&D partnerships and networks in the Nordic countries lower than everybody else. At the same time these project participants rated formation of new R&D partnerships and networks in countries outside the five Nordic countries higher than everybody else. This could imply that many of the participating organisations in topic area Energy Markets are more focused on building relations outside the Nordic region than other participating organisations.

Access to R&D collaborations in the private sector was rated low by most of the recipients' except in topic area Renewable Energy. This could imply that projects conducted in this topic area are more focused on commercialisation or require more capital for building experimental facilities.

Exhibit 12: Whether the project has led to improved collaborations on the Nordic level according to project participants




A significantly high proportion of the project participants think that the project have resulted in improved collaborations on the Nordic level. At a personal level a big majority thinks that their participation meant that they have an increased awareness of ongoing research in the Nordic countries and a majority also thinks that they have gained increased awareness of ongoing research at an international level.

## 3.4 The NORIA Policy projects

In its advisory role towards the Nordic Council of Ministers and the Nordic energy and research authorities, NER has the ambition to give concrete advice on improvement potentials in the framework conditions for research, development and innovation in new energy technologies and environmentally friendly energy systems in the Nordic region. In line with this, NER in 2007 initiated seven policy studies, each with the aim to contribute suggestions on how to improve the Nordic research and development area in energy. The decision to run these projects was taken by the former NER Board, and implemented by the Board that succeeded it.

The policy studies consist of studies of R&D and innovation systems of importance to the Nordic countries. What is needed to improve input for, structure and output of research, development and demonstration of new energy technologies? These are some of the issues addressed by the call, in order to “assist Nordic decision makers in making good science and technology policies and investment decisions”. NER invited applicants through various channels such as the NER website, the newsletter Orka and direct send-outs to research environments.

The call was open for researchers and experts from institutions, consultancies and organisations. The response was unexpectedly small, and only three policy projects were set up as a result of this initial call. One of these three first policy projects was eNERGIA, described in the case study in appendix 5. At later stages, another four policy projects were accepted and implemented.

The seven policy studies are:

• Competitive policies in the Nordic Energy Research and Innovation Area (eN-ERGIA) (Project leader: NIFU Step, Norway)
• Russian energy research and innovation – prospects for co-operation on renewables and energy efficiency (NUPI, Norway)
• Patterns of need integration and co-operation in Nordic energy innovation systems (Risø, Denmark)
• Nordic Opportunities for Collaboration with China in Energy Research and Innovation (NIAS-Nordic Institute of Asian Studies, Denmark)
• Industrial development and export opportunities for Nordic energy Industry and other companies in the energy field – a research project within Nordic Energy Perspectives (NEP) (Elforsk, Sweden)
• How to bring renewable energies down their learning curves (Lunds Universitet, Sweden)
• Governance and Research of Nordic Energy System Transition (VTT, Finland).

The policy projects have been described as a first attempt to consider how best to plan the organisation’s own energy technology-related research activities. They are short term (they will all be finished in 2008) and focused on different policy aspects within the following areas:

– Energy markets (topics surrounding the design and functioning of the electricity market and related markets)

– Sustainable energy systems (renewable energy, energy efficiency, climate change and sustainable energy in scarcely populated areas)

– Nordic impact on the global agenda (maintain and develop Nordic influence in setting the global agenda and on European cooperation relevant authorities)

These policy projects differ from the regular NER project portfolio. They are specific studies into areas where more knowledge is needed about inputs, outputs and framework conditions for energy research on a more general level in the Nordic countries. Secondly, these projects will provide the Board of Nordic Energy Research with input for the organisation’s new strategy process and action plan. The policy projects are not about networking. It is therefore no surprise to find that only a few of the policy projects have project groups with participants from more than one single country. Also, few people outside the NER Board seem to know about these projects and what they are about. This lack of knowledge has sometimes nurtured the misunderstanding that these projects are in reality just like the research projects. The policy projects have in some interviews received criticism on the assumption that they are research projects.

These policy projects are an interesting addition to Nordic Energy Research's arsenal of activities, and as such in no way exclusively for internal use. The comparative perspective is new to NER, making them interesting also for national players. They will also, presumably, be of value to the new action plan on energy for the period 2010-2014 that the Nordic Council of Ministers is preparing.

# 4. The usefulness and value of the research and other activities conducted

## 4.1 Relevance to national and Nordic decision makers

When assessing the value of Nordic Energy Research (NER), one central criterion is its relevance to Nordic and national decision makers in the general field of energy research and energy policy. In this section we report our findings as regards research areas of common Nordic importance, NER´s contribution to the creation of ERA and to policy relevant networking, the policy relevance of research projects within NER, the special policy studies initiated during 2007, some implications of NER´s relatively small budget and NER´s relationship to the Nordic and national decision structures.

### *4.1.1 Common denominators*

Interviewees have pointed to one obvious boundary condition for NER´s project portfolio, namely that projects funded need to be aligned to one or a small number of "common denominators" and that finding these may imply a time consuming negotiation and search process. Four operational criteria, which to a varying degree are satisfied by the present project portfolio, emerge from our discussions.

The first is that focus needs to be placed on common issues in energy policy, including energy research policy. These include the Nordic interconnection of national electricity grids and the systems challenges and needs for common or compatible regulatory measures that result, and also issues related to the common Nordic electricity market and climate changes as well as energy efficiency. Our analysis of the project portfolio shows that this is also where the emphasis of NER lies. Future projects may well focus on issues at the interface between energy and society, for example introduction of regulatory measures and the political resistance it can induce.

The second is that the priorities of NER in practice need to correlate well with, rather than complement, national energy research priorities. The consequence is that NER priorities might need to adapt to changes in national priorities. The replies to our questionnaire indicate that co-funding from national funding agencies occur in a substantial part of the projects, which accords well with this principle. Whether this part could or should be increased is not something we can judge from the information we have.

The third is that Nordic networking should be given higher priority than the creation of something technically new. The replies to our questionnaire again suggest that formation of Nordic R&D partnerships, and access to national programmes in other Nordic countries, and improved collaborations are indeed important objectives for project participants and also among their achievements.

The fourth is that the opportunities for small or neighbouring countries offered by NER ought to be observed and exploited. The replies to our questionnaire indicate that this is the case for projects with Iceland, the Baltic states as well as Russia.

### *4.1.2 Contribution to ERA*

Several of our interviewees have with appreciation pointed to the fact that NER as an organization has a unique 20 year record of experience of the administration of international collaborative R&D programmes. This is an asset that NER has utilized to take an active part in the administration of three ERA-nets. NER´s role is described as active – more so than some national representatives! NER acts as a substantial contributor and promotes the interests of single Nordic countries. This role on the part of the NER secretariat accords well with the goals and reported achievements of participants in NER projects as is obvious from responses to our questionnaire, where for example improved possibilities of finding collaboration in the EU is considered an important outcome by more than half of the respondents, and more than half also report this will be achieved together with enhanced opportunities of influencing EU projects.

### *4.1.3 Contribution to networking*

Several of our interviewees have likewise mentioned the important networking function the NER projects provide as regards the policy level and have also claimed that this is one of the most important objectives of the whole Nordic energy collaboration. Many of the participants in NER projects will find their way into positions within Nordic or national energy administrations at different levels, and will bring useful contact networks. Our survey shows this to be especially important also for our neighbouring countries and also indicates that collaborations would in many cases not have occurred without NER funding. Access to complementing competencies and increased awareness of ongoing research in the Nordic countries are the more immediate benefits.

### *4.1.4 Varying policy relevance of projects*

The Nordic policy relevance of present NER projects varies according to subject area. As mentioned, issues regarding electricity markets, including renewable energy sources and the consequences of climate change, contain substantial parts of common Nordic interest, while for example bio energy and hydrogen may look more like the product of a “Nordic compromise” to an external observer. A correlation between national energy R&D programmes and NER priorities may be seen as a necessary condition for policy relevance also at the Nordic level, according to our interviewees, and NER funding should not be regarded by researchers as compensation for lack of national funding. The fact that almost half of our respondents in the survey have reported co-funding from national sources indicates that there is a fair correlation already in the existing NER programme. Many respondents also claim that the development of new knowledge aimed to influence policymaking in the Nordic countries is an important goal of the project.

Some interviewees hold the view that NER projects in order to promote progress in energy should become still more bottom-up and move closer to application and solutions to technical problems, and they also have the opinion that NER supports too much basic research and question whether decision makers can really absorb the results. Conditions for moving in that direction vary according to subject areas and the role NER wishes to take in the future is partly bounded by its budget and how NER positions itself in relation to other players on the Nordic scene.

### *4.1.5 NORIA policy studies a novelty*

A number of special policy studies – differing from research projects in several respects – were initiated and funded by the NER in 2007 with the stated intention to support NER itself in its strategic planning. These projects are a novelty for NER and it seems a little too early to assess their benefits, as was evident from several of our interviews. The people we talked to had less knowledge about these studies than we had expected, while they maintained that studies of this kind and direction should be given priority and represent an important possibility for NER to contribute. It was also pointed out that there is a need to define their ambitions as regards the use of new analytical perspectives, as opposed to the administration of forums for policy discussions.

#### *4.1.6 Small budgets as a constraint*

The budget for NER´s research projects is small, as compared to for example national R&D programmes. Some interviewees claim that this fact may lead to doubts as to how committed to Nordic collaboration member nations actually are in practice. An obvious consequence is that it constrains the role that NER can play in practice, though that constraint can partly be compensated for through the use of co-funding as a criterion for instance. This is also to some extent put into practice by NER, as has been pointed out, and is also evident from our survey. Another response to this constraint is to focus more on long-term objectives (which may mean less costly projects) and on different policy issues. A further comment received is that NER now has adequate secretariat resources with a capacity to handle bigger budgets and, if that doesn't occur, the secretariat may appear over-resourced. This issue is dealt with further in chapter 6.

#### *4.1.7 NER and the decision structures*

It has further been pointed out that NER has to meet the challenge of being relevant to the decision structures at the policy level, in spite of its small budget. So far NER has met this by undertaking not only research funding but also networking at Nordic and EU levels and servicing to working parties under NMR, for example. The policy studies mentioned may be seen as another example. It is also important that NER has good contacts and is positioned close to policymakers at both ministry and agency level. This is in reality the case for some member countries, though resources at for example ministry level can act as bottle-necks.

### 4.2 Relevance to researchers

Nordic Energy Research has from the beginning been an organisation that mainly finances basic or pre-competitive research. That focus is still in place, although to a lesser extent. The clear ambition to involve industry more and to achieve a more varied project portfolio has had some positive results, but a recurring theme in the interviews is that "the research projects are good for the researchers". That said, the research carried out seems to be of good quality, supporting network building and PhD training.

The research projects create added value not only for the research projects as such, as for example when it comes to competence building, networking and focusing research capacity:

#### *4.2.1 Competence building*

Competence building refers to people as well as to research areas. By participating in NER research projects together with peers from other Nordic countries, researchers strengthen their competence in core areas and obtain a better understanding of research methods. Researchers find that an important driving force for joining research projects financed by NER is to obtain complementary competences to one's own core competence. The international aspect obviously exercises a certain appeal to many researchers.

Survey answers also provide examples of this. Project collaboration typically covers common research issues, and about half of the respondents say collaboration includes exchange of material and data between researchers in different countries. Researcher mobility or PhD exchange is also relatively frequent. Project group meetings with all project participants are typically held once or twice a year, sometimes accompanied by additional sub-project meetings. Only occasionally are these meetings carried out as telephone conferences; meetings in person are favoured, and several interviewees point out that actually meeting and working together in person is fundamental in cross-country collaborations. In consequence, it is considered vital that the funding received from NER actually makes travelling and exchanges possible.

### *4.2.2 Networking*

The answers from the questionnaire show that there is extended collaboration on a project level between researchers from different countries. Quite clearly, networking with researchers from other countries is one of the great advantages of the NER programme. The participation of researchers from the Baltic states and north-western Russia in the projects is something that these researchers seem to value more than their Nordic project partners do; the academic value achieved by adding Baltic or Russian partners to the project is not in all cases clear to the other project participants. The researchers themselves point out that this academic discussion improves one's own work, and some note that they are now reaping the harvest in this programme period of the creation of networks in the previous period. The financing of graduate schools is of specific significance in this respect.

The responses to the questionnaire furthermore support the idea that the conditions for receiving financing from NER (research projects should include actors from three different Nordic countries, and additional participation from adjacent areas is encouraged) have an effect on the networks. This not only strengthens existing networks and collaborations but also leads to a certain renewal of the networks as this mechanism encourages the invitation of new partners into existing networks. Thus, the funding conditions function as a "focusing device".

The importance of the NER programme as a network builder and facilitator shines through in several interviews with former NER PhD students or researchers. Participating in the programme, the argument is, provides a network for life with people who later turn up in relevant positions in universities or in public administration in the other Nordic countries. One interviewee goes as far as to say that research projects within the NER frame without supporting networking activities are pointless. This said, it should be remembered that it often is a long-term process to create and nurture networks.

### *4.2.3 Focusing*

The Nordic countries are small, and the players involved in energy research are also comparatively small. The NER financing forces different people together, enabling the formation of critical mass on a regional level.

A different but related issue is whether Nordic collaboration works as a springboard to initiatives on an international level. Close to 40% of the questionnaire respondents claim that "increased opportunities to find new co-operations in EU" is an important or very important motive for participation in the NER research projects; in at least three projects that seems largely to have been achieved already, and in a further three projects several participants expect to increase their opportunities to find new co-operations in EU. “Enhanced possibilities of influence in an EU project” has not clearly become true yet, but in at least eight projects the majority of the participants expect that still to happen. 12% of those who answered the survey have financial support from the EU for the NER project in question.

The financing from NER has influenced the research activity in a positive way for a large number of project participants. Interviewees give ample examples of the importance of Nordic collaboration for different research groups, and an often repeated view is that this arena provides a possibility to create a critical mass that would not exist in the home country alone. The Nordic countries (and the Baltic states) are small players, and joining together their research efforts is sometimes and in some areas crucial.

The answers from the questionnaire provide further evidence. Here, some 60% of the respondents consider that the financing from NER has influenced their research activity in a positive way, and 22% of those who responded to the questionnaire point to networking effects whereas about 25% of all the respondents say the financing has had positive effects for their research area. This last issue is interesting, as it not only includes answers such as “without the contribution from NER there would have been no project collaboration”, but several researchers also claim that this funding has opened up a new research area for them.

But there are drawbacks. NER is a small organisation with a small budget, and size-wise this funding does not make much of a difference for most research groups; if you get an EU project, you can take on maybe four PhD students – if you get a NER project, you can hire one PhD at the most, as one researcher puts it. According to one university professor, the NER money does not provide any possibility for structural change. According to others, though, and also judging from the answers to the questionnaire, the relatively small sums from NER in many cases do function as leverage and actually make a difference. The “programme theory”, thus, seems to work in many cases!

## 4.3 The usefulness and value to industry

### *4.3.1 Industry is less involved than hoped for*

The mid-term evaluation of the previous programme period recommended a larger degree of industry involvement in the research projects financed by NER. That evaluation charted the project portfolio according to certain criteria, and the criterion “networks with industry” was not a prominent feature in the projects in the previous programme period. The research projects focused more on basic research and researcher networking, and this also goes for the present programme period. One of the few projects from the previous programme period that was singled out as good examples of collaboration with industry proves to be less of such an example when looking at the continuation under the present period; the industrial partners provide some funding in cash, but are otherwise not very involved in the project as such. Industry is, in general, rather distantly involved in the research projects in this programme period as well, which is also shown by the fact that only 17% of those who answered the questionnaire represent industry.

As our analysis of the project portfolio shows, relevance to industry is not a major theme for the research projects on an aggregated level. Although this has been an objective for NER ever since its foundation, there is still not a great focus on industry and usability. Interviews confirm the relatively limited role played by industry in the project portfolio as such, and some interviewees claim that NER as an organisation is not used to handling business projects, being focused as it is on supporting individual PhD (basic research) projects. The production of academic papers (on its own) is not that interesting for industry, claims another.

There are inherent problems getting industry involved in rather generic research issues (and not only in the Nordic area!) – and especially in small projects such as these. Some voices raise the idea of making the rules for project funding more flexible, in order to open up different forms of participation and networking.

There are, however, good examples and positive signs as well. When discussing the usefulness and usability for industry of the work carried out by NER and the research conducted in the specific projects, we should, however, not only include outcomes and impacts of the work. We should also take into account human capital. And this is where NER makes a difference. Several projects enjoy good and close industry collaboration, and some concrete results are being produced. It should also be noted that the SNA analysis we carried out on four research projects showed industry involvement in two projects, even when these formally were not part of the project. These probably refer to steering group members, who obviously have played an active part in at least two projects. It is also worth mentioning that one successful company is the direct result of NER funding; the Icelandic company Marorka, that produces Energy Management System for ships and provides Energy Management services, was set up on the basis of a PhD thesis, and had it not been for the funding from NER the company would probably not have seen the light of day. The founder of the company and former NER PhD student was awarded the Nordic Council Nature and Environment Prize 2008.

### *4.3.2 But those industries who participate achieve their goals*

The participants from industry have fulfilled or will fulfil most of what they expected to achieve in the projects. Survey results show that those outputs or outcomes that the participants from industry value as the most important ones are also the ones where goal attainment is highest. "Improved collaboration on the Nordic level" scores the highest both in importance and in goal attainment, and all respondents consider that the second most important outcome "Improved internal knowledge and capabilities" either has been achieved already or will be so within the programme period. The three remaining outcomes that industry representatives consider important ("new processes", "Improved possibilities of finding new collaborations in EU" and "Enhanced opportunities of influence in a EU project") will also, according to answers from industry, be achieved to a large degree.

"Improved collaboration between companies and universities/research institutes" ranks high as a goal for project participation. These expectations have been met in several projects, where project participants themselves say existing contacts with industry have been strengthened and/or new contacts have been created. From questionnaire answers, we conclude that the collaboration has led to both strengthened relations and new contacts with industry in at least four projects. Questionnaire results furthermore indicate that new contacts with industry have been created in a further three projects, and in some four projects existing contacts with industry have been strengthened through the NER project. Here, though, the results are less conclusive.

These results are further corroborated by what the project participants from industry say about what participation in the NER programme has meant to them personally. Here, "strengthened existing networks in other Nordic countries", "new contacts with researchers in other Nordic countries" and "increased awareness about ongoing research in the Nordic countries" receive very high scores. Also and interestingly, quite a few consider project participation has led to new contacts with industry. Also, the questionnaire indicates that close to 20% of the project participants co-finance their participation with industry funding.

## 4.4 Goal attainment on project and programme levels

### *4.4.1 Goal attainment on the project level*

On the project level, and from the viewpoint of the project participants, this programme period of NER shows a high degree of goal attainment. Largely, the participants have fulfilled or will fulfil most of what they expected to achieve through participating, and what has not been achieved are as a rule outputs or outcomes that are less important to the project participants. This observation is valid for researchers as well as for participants from industry.

Looking at goal attainment on the project level does not reveal any clear underlying patterns. Out of those 13 projects we can analyse5, only one seems to differ slightly from the overall picture. According to the project participants, "Nordic AMR Forum" is doing poorly in three of the four most important outcomes, but is expected to achieve all traditional academic goals (by project participants considered to be less important). All other twelve projects show good or very good goal attainment in relation to the project participants' own expectations.

Exhibit 13: Table combining questionnaire questions "How important are the following outputs and outcomes for your organisation to value the results of the project as successful?" and perceived achievement.

| Output / Outcome | Importance (1 = Not at all important, 4 = Necessary) | Achieved / Will be achieved within the project (% of answers)6 |
|---|---|---|
| Improved collaborations on the Nordic level | 3,35 | 68 / 34 |
| Improved internal knowledge and capabilities | 3,29 | 55 / 49 |
| Publications in scientific journals | 3,27 | 45 / 58 |
| Other publications | 2,94 | 58 / 46 |
| New methods or tests | 2,84 | 24 / 56 |
| PhD thesis | 2,83 | 30 / 44 |
| Improved possibilities of finding collaborations in EU | 2,79 | 25 / 56 |
| New processes | 2,62 | 13 / 58 |
| Enhanced opportunities of influence in a EU-project | 2,42 | 8 / 56 |
| New products | 2,31 | 9 / 25 |
| New services | 2,23 | 8 / 27 |
| Software or codes | 2,02 | 14 / 36 |
| Patent applications | 2 | 5 / 14 |
| Prototypes | 1,95 | 6 / 22 |
| Filed patents | 1,95 | 5 / 9 |
| Contributions to new standards | 1,90 | 5 / 20 |
| Adjustments to new standards | 1,87 | 5 / 17 |

[5] The response rate from three projects (Energy Systems for isolated locations, Energy Foresight Forum and Distributed Generation Integration in the Nordic energy market) was considered too low, and these projects are therefore not included in this analysis

[6] Some have answered both "have been achieved" and "will be achieved" for some outcomes

As the table shows, project participants rank “Improved collaborations on the Nordic level” highest, followed closely by “Improved internal knowledge and capabilities”. Traditional academic goals, such as publications in scientific journals and PhD degrees, are seen as important or very important goals for a large majority of the project participants.

All these outputs or outcomes that the project participants valued as the most important ones are also the ones where goal attainment is highest. As the table shows, the correlation is almost perfect with the project participants’ own priority order.

Our interviews show that the training of PhD students is one of the important issues for NER, and has been so ever since the beginning of the programme. Co-financing Nordic PhD students and Nordic Centres of Excellence are seen as good examples of creating Nordic value. These PhD students and Centres of Excellence are only partially financed through NER, normally with the larger part of the budget covered by different national R&D programmes. According to many, this construction brings an added value since the small basic funding from NER is upgraded – or leveraged - in a larger context. Other interviewees, however, raise the objection that the little funding NER provides runs the risk of reducing the organisation to act as co-financer of specific projects.

### *4.4.2 Goal attainment on the programme level*

Goal attainment on project level is good, then, but what about goal attainment on the programme level? In order to judge that, we need to go back to the officially stated goals set up for this programme period. According to this, NER strives for maximum “Nordic Benefit” in its field of activities, and we can from this chapter conclude that several of the above mentioned criteria of success have been fulfilled.

Goal attainment on the programme level seems to be rather good. It could well be argued that the organisation NER has developed into a platform to coordinate and promote a Nordic profile in energy research, and the results from the NORIA policy studies will presumably be a help to the organisation in order to improve further in that direction.

That said, it should be remembered that the research projects in the NER portfolio often are part of something bigger or different, and it is for this reason difficult to say exactly what this particular funding actually means. We have seen that the funding from Nordic Energy Research often functions as leverage and does make something come about that otherwise would not have happened. And it is not necessarily the amount of money from NER that matters, but the fact that this international organisation does support the project that is important. But the NER budget is small, and NER is a small player compared to most national research programmes. We discuss this further in chapter 6.

The table below captures the examples of success criteria the organisation itself has set up, with our assessment of goal attainment:

Exhibit 14: Perceived goal attainment of NER "success criteria"

| Success criterion | Comments |
|---|---|
| Reinforced interplay between national R&D participants, hereunder building Nordic Centres of Excellence and making research results available | The programme has facilitated increased networking between national R&D participants. Several Nordic Centres of Excellence have been financed, even though the worth of that could be argued. We have seen from one of our case studies that it was Nordic Energy Research that suggested labelling the collaboration as a Nordic Centre of Excellence, the meaning of which was less than clear for the participants. Research results are being made available through regular academic channels as well as through the Nordic Energy Research website and other dissemination means. This is further discussed in chapter 7. |
| Helping to ensure that Nordic energy clusters are formed (bringing together R&D circles, industry and the authorities, initiating joint projects and coordinating scenario analyses/foresight processes) | It can be argued that this has been achieved in the majority of the research projects. Industry participation, however, is unequal in intensity |
| Creating measurable developments and improvements when exploiting new technology, as well as new knowledge about the energy markets | The NORIA policy projects aim not only at informing the internal NER policy process, and from there on national and private policy makers. Another ambition with these projects is to be a building block that encourages national as well as private policy makers to integrate technology development in the energy policy, and discuss how best to focus R&D in new energy technologies and systems. This would be in line with the EU goals and the IEA call for a technology revolution. |
| Relating R&D results to current energy policy issues | Nordic Energy Research as an organisation is today in a better position than before to do this, with the director's status as observer in the Nordic Committee of Senior Officials for Energy and Industrial Policy ÄK-E, and providing secretary functions to two working groups under the Nordic Council of Ministers.<br><br>Almost half the respondents in the survey have reported co-funding from national sources. Many respondents also claim that the development of new knowledge aimed to influence policymaking in the Nordic countries is an important goal of the project. |
| Coordinating Nordic views in order to increase the opportunities for exerting influence, especially in the EU | This has clearly been achieved, with Nordic Energy Research taking the lead for Nordic participation in three ERA-NET's. Responses to the questionnaire show that a large portion of the project participants believe participation will lead to enhanced opportunities to influence EU projects |

### *4.4.3 Nordic Energy Research in a comparative perspective*

From other evaluations the Technopolis group have carried out, we can compare some of the results from the NER questionnaire with some other research programmes. It is of course a difficult task to compare research programmes in widely different areas and settings, and these comparisons should be taken only as partial indicators for measuring the NER programme to some other research programmes.

We have used the question formulated as ”From your organisation’s perspective, how do costs and benefits of participating in the projects compare?” in several recent studies, and it is clear that NER comes out well in a comparison. The view from the project participants’ horizon is comparable to that in two other recently studied Swedish research programmes covering the automotive industry (ffp, GB 1&2), and more favourable than the view expressed by project participants in the Swedish Wind Power Research Programme (Vindforsk II).

We also have the means to compare the networking effects of this programme with two other evaluations of Swedish research programmes, one being an evaluation of the research programme Manufacturing Engineering Research Area (MERA), and the other a meta evaluation of ten research programmes in the biotech field. The NER programme shows a considerably higher degree of new or strengthened contacts with industry when compared to the ten biotech programmes, and the same (to a slightly lesser extent) goes for networking with other researchers. Compared to Manufacturing Engineering Research Area (MERA), NER has created and strengthened contacts with industry to a lesser degree but been more successful than MERA in networking with academia. Here, it is worth noting that the MERA programme was to an unusually large degree set up and run according to the needs of industry.

# 5. The role of Nordic Energy Research in an international context

The added value of the Nordic level is an issue that has been strongly debated in recent years. The logic of acting at the Nordic level is not obvious nor is it undisputed. Some observers claim that Nordic cooperation through NER – or in general, through other Nordic collaboration schemes – functions (or should function) as a testing ground and a “qualification round” for future and bigger international collaborations. One observer notes that NER is indeed a useful tool to create strong Nordic platforms from which to continue to other international collaborations – but this has not been an explicit strategy.

Others have a different opinion, saying that the logic of collaborating in a Nordic setting is different from, for example, the logic of EU programmes. The Nordic collaboration, the argument goes, is a goal in itself and also a useful tool for bringing the national research agendas of the individual Nordic countries in closer harmony.

Interviews indicate that the truth lies somewhere between the two views: it is not “either – or”, but “as well”. Acting at the Nordic level should probably be seen as a complement rather than an alternative to action at national and EU levels. In some issues, the complementary role might be the best one, in others the Nordic approach should be more in the forefront. As one researcher puts it: ”NER has its priorities, and the EU has its priorities. Sometimes these coincide, but most often they do not. But that’s no problem – that’s pluralism! Having the same guidelines on the national, the Nordic level and the EU level would lead to conformity.” Another researcher says that project collaboration through NER ”is the easiest way to Nordic benefit. Sometimes this leads to collaborations in other fora, sometimes not”.

The way we understand the NER programme logic (see section 2.2), the overall objectives of NER are to contribute to the development of a leading knowledge region with appropriate energy solutions and energy markets by maximizing results of energy related results in the Region, including adjacent areas. In order to reach those goals, NER consider effective interaction with energy policy formation processes in Nordic countries as well as the EU to be necessary. The influence in the EU will mainly be exerted through coordination of Nordic views.

Over the last few years, NER has developed into a player with an agenda of its own. One person notes how NER consciously has moved from acting like a ”passive research council” to becoming a more active sectoral public authority. Most of those we talked to seem to consider this a good thing, but it may not be an easy role to play. In any case, the NER administration is seen as an asset, and a potential collaboration partner.

This evaluation provides plenty of evidence to claims that NER is regarded as one of the most valuable of the Nordic co-operations: interviews as well as survey results show that NER could be heralded as a good example to follow for many other Nordic collaboration efforts. NER as a collaboration forum has a distinct advantage to that of the EU, as NER is less bureaucratic and content-wise allows for a tighter focus.

## 5.1 NER´s role in the “Nordic innovation system”

NER’s role in the “Nordic innovation system” is rather difficult to define, given the uncertainty caused by the process surrounding the so-called “Top Research Initiative” (TRI).

The Nordic countries have recently agreed to invest NOK 420 million in the period 2009-2013 into joint climate, energy and environmental research. The aim is to achieve a global leading position in environmental technology and climate research. This Top Research Initiative will be administered jointly by NordForsk, Nordic Innovation Centre (NICe) and NER.

The total initiative in excellence in research consists of six programmes:

• Effect studies and adjustment to climate changes
• Climate change interaction with ice, snow and glaciers
• Nanotechnology and energy efficiency
• Elimination and storage of carbon dioxide
• Integration of wind power on a large scale
• Sustainable bioenergy

The Top Research Initiative caused NER to cancel the second proposal for calls planned to be launched at the end of 2008. Instead, NER will put the money destined for that call to the Top Research Initiative. According to information we have, NOK 30 million of NER's budget will be earmarked for two TRI programmes. However, since these are intended to be administered by NER the organisation will probably be able to exert an influence on how these resources are used. Another direct effect of the Top Research Initiative is that the strategy process NER had planned for the early parts of 2009 will now be postponed until the latter part of 2009 and the beginning of 2010.

Although it is clear that the TRI proposal will affect the role of NER, it is too early yet to say to what extent. What was initially considered a great threat to NER as an organisation is now seen as more of a possibility. The Top Research Initiative arguably provides an opportunity for closer and better coordination and collaboration between three Nordic institutions (NER, Nordforsk and Nordic Innovation Centre, NICe), and is as such a welcome contribution to existing instruments.

The answers to the questionnaire strongly suggest that the NER funding is treated as a way to complement and expand existing (national) research projects. Funding from NER is not usually enough to start and run specific initiatives, but this funding is laid on top of funding from other sources. Many of those who use the funding this way consider this beneficial as this gives their "ordinary" project or programme a Nordic touch that it otherwise would not have. This use of the NER funding also seems to be perfectly in line with NER´s own expectations: this gives certain leverage for a small amount of money.

It is also worth noting the NER funding and the Nordic collaboration it facilitates is attached with a certain amount of goodwill. Asked about six different "strategic management goals" in the survey, the goal defined as "enhanced reputation and image" received the highest marks of all.

### *5.1.1 Participation from Russia and the Baltic states*

Collaboration with north-west Russia and the Baltic countries within the Nordic context is generally seen as a strictly political issue. For most project participants, the participation from Russia and the Baltic states has not brought any direct advantages, but it is also true that few have identified problems or new obstacles of any importance as a result of expanding the Nordic research community. These countries` contributions to the projects are, in most cases, small, and it is quite obvious that most project participants from the Nordic countries see them as net beneficiaries in these collaborations. The Baltic and Russian participants are often weakly integrated in the research projects as a whole.

That said, researchers from these countries do participate in all five topic areas, and do seem to be networking. Results from the survey and the SNA study indicates that participants from these non-Nordic countries in some projects collaborate in many different forms, including both intensive and less intensive activities. It should also be remembered that the participation from these countries in the NER research projects is recent, and you need more time to assess their networking effects. It could well be that several projects have laid the foundations for an increased and more intense collaboration in a “second generation” of the project, as has been the case for some other project collaborations stemming from earlier programme periods.

The issue of (the level and intensity of) the participation from these four countries may soon become a more urgent one to discuss. Up until now, Russia, Estonia, Latvia and Lithuania have not paid anything into the NER budget for participating. This could become a matter for discussion since, as one NER representative says, “the other part should also provide something, to show his commitment”.

## 5.2 NER´s role in relation to ERA

NER participates actively in two ERA-nets: INNER (innovative energy research) and the recently started Smart Grid. NER also participated in the HY-CO ERA-net (hydrogen and fuel cells) from 2004 until it ended in September 2008.

In INNER and HY-CO NER has taken on the responsibility of managing trans-national calls. Through INNER a new trans-national programme was created: The Northern Innovative Energy Research Programme (N-INNER) involving funding agencies in Germany, Denmark, Finland, Iceland, Norway and Sweden.

NER´s role in the ERA-nets is much appreciated by those we have spoken to. Nordic national administrations or research funders that participate in these ERA-nets mention that NER carry a big burden by organising calls and being work package leaders. It is seen as a good use of resources to have NER (rather than the national Nordic participants) run work ERA-net packages. NER have expanded their role and importance here.

NER also does a good job in coordinating the Nordic participation in these ERA-nets, and the organisation could even take on a bigger role in relation to the other Nordic participants. NER provides an important Nordic dimension thinking in EU level.

# 6. The value of Nordic Energy Research to the policy making process

Nordic Energy Research is a small organisation, with a very small budget. This is true on a Nordic level, and has to be remembered when discussing the worth and strength of NER in relation to the policy making processes in the Nordic countries. NER's budget for 2007 was approximately 31 million NOK, whereas, for example, the Swedish Energy Administration the same year had a budget of approximately 175 million NOK (slightly more than 200 million SEK). The Swedish Energy Administration provided NER with a grant of close to 9 million NOK; that is, some 5% of the total budget for the Swedish Energy Administration.

That said, many interviewees consider NER to have quite an important and efficient leverage function. One interviewee points to the important fact that the policy decisions are taken on the national level, and that decisions are not taken on the Nordic level. Importantly, though, the NER funding makes Nordic cooperation legitimate. In the Nordic cooperation context, NER is unique in being a sector-oriented body. Also, twenty years of practical experience in administrating multi-national research programmes lends NER credibility and a possibility to actually "punch above its weight". The fact that NER is very active in three ERA-Nets, and more so than the different national Nordic participants, illustrates this point.

NER activities and results have no obvious direct impact on national policymaking, but indirectly through published results of research projects and by information exchange on seminars and meetings. Important in this respect is to remember that the director of NER has an observer position in ÄK/NE-E, and that NER also provides secretaries to two NMR working groups. This seems to be a good and efficient use of scarce resources for NER. There seems to be a common understanding that this is convenient for the nations' ministries; none of the interviewees at this level claim that NER should contribute further to national policymaking, or be more supportive.

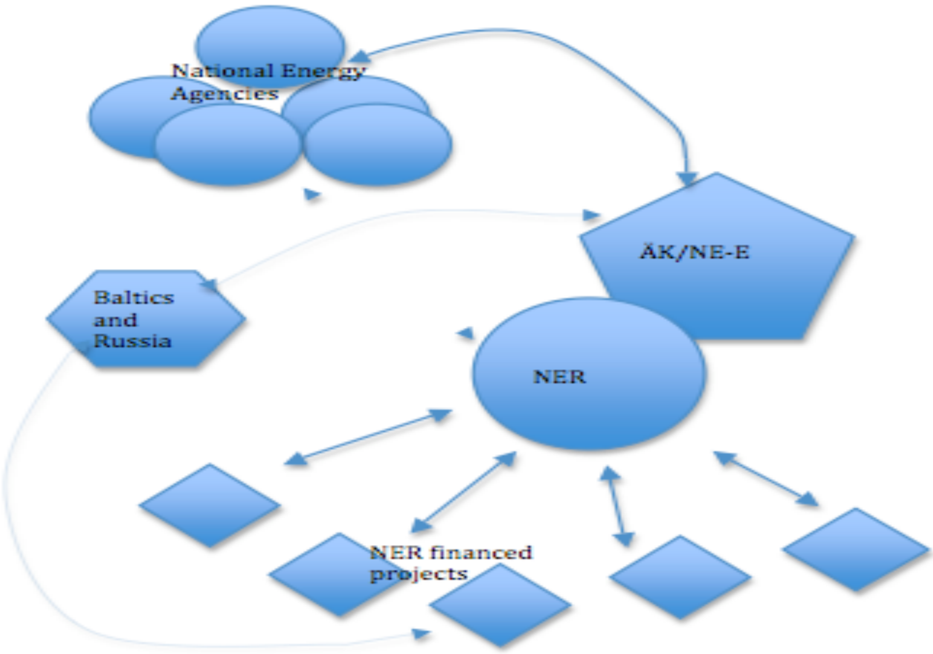
The ministry representatives in ÄK/NE-E contribute with their ministry's mandate, needs and agendas on energy issues of Nordic relevance. NER strategy and research funding are in phase with national needs expressed, compromised and channelled through ÄK/NE-E. Priorities made by NER regarding research projects are an outcome of these collaborations, and indirectly verify political needs on the project level. This link-system, illustrated below, with indirect impacts on NER strategy and priorities seems to be adequate.

The project research plans, in being in line with political priorities conveyed by NER, become an indirect enforcement of political agendas on national levels – what should be political priorities also become research priorities.

Project results are returned to NER, through seminars, articles and reports. NER in turn takes responsibility for transferring the information to relevant actors; among them the members of ÄK/NE-E. The ÄK/NE-E representatives are then responsible for bringing this information back to their respective national ministries.

Strong Nordic collaboration is perceived to be a necessity for collaborations on larger arenas, such as the EU. However, it is considered very important that the issues are relevant for this arena and that the work is concentrated on issues of specific Nordic relevance. One representative states that "Nordic countries are quite homogenous compared to other countries and we have long tradition in cooperation. The Nordic electricity market is a good example of this. It is a good forum to test policy ideas for national and other international purposes."

Exhibit 15: The value of NER to the policymaking process



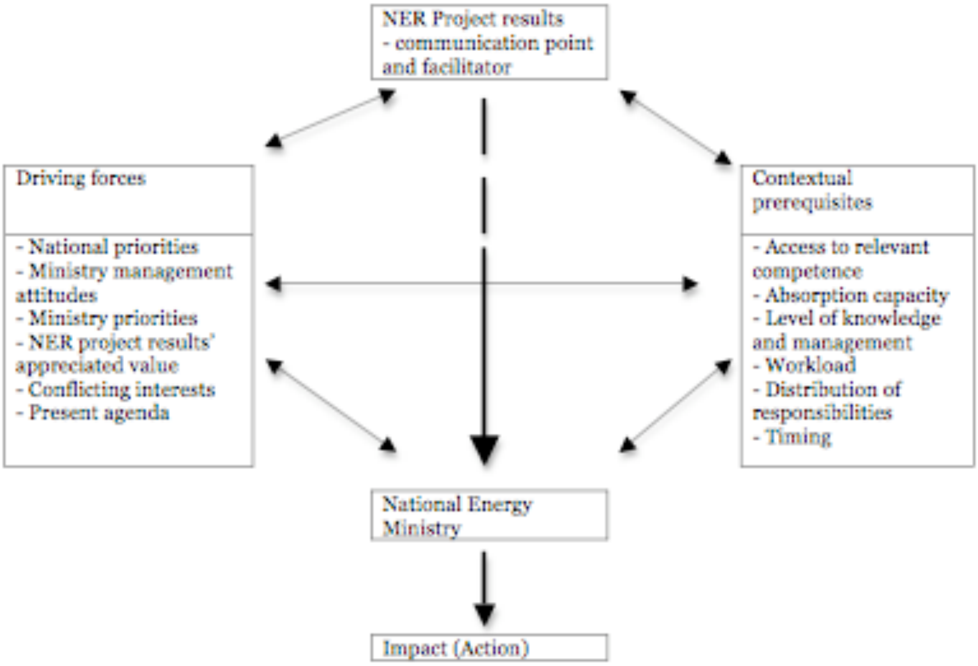

It is also quite clear from our interviews that NER is considered a much more active player today than it was until a few years ago. When NER was converted into a proper organisation at the turn of the millennium, it also became an organisation with an agenda and a will of its own. One interviewee describes this as a conscious aspiration to move from a passive research council function to a more active sectoral public authority with its own competence and resources.

## 6.1 What affects policy makers´ choices and decisions?

The national Energy Ministries continuously receive a large amount of information and input. The information provided by NER (dissemination of research results, etc) is only one of many others, and the level of impact these results can contribute to depends on a variety of factors. This situation is described in the offer-model[7] below.

[7] A model developed by Erik Arnold and Sven Faugert, see *Vad erbjuder FoU-programmet?*, NUTEK Info nr 062-1999. NUTEK, Stockholm.

Exhibit 16: What NER offers policy makers




NER activities and results land in an atmosphere that is the result of a combination of driving forces and contextual prerequisites. If NER activities and project results are perceived to match these, the likelihood of the results coming to use will increase.

One of the interviewees claims that the results of this collaboration and, in the end, the possible impact of research results on policymaking on national levels, depend on individual and organisational competences and capacities. Another comment was that the responsibility for creating this impact is really the national ministries', not NER's.

### *6.1.1 No common view on NER´s role in relation to the national programmes*

There is no clear view on this, and it also appears to be the case that the different Nordic countries hold different views on this depending on the context. The big question, whether NER should be a policy forum or a research programme, has yet to find a consensual answer.

Several interviewees argue for NER concentrating on being a research programme that brings added value to national programmes and initiatives. Here, the networking role of NER is highlighted, and its role in supporting individual PhDs and PhD programmes.

### *6.1.2 The usefulness of the NORIA policy studies*

The NORIA policy studies that NER initiated in 2007 are an interesting addition to the NER portfolio of activities. These are shorter ad hoc-studies, expected to inform the NER Board in its own strategy process. The stated aim of these studies is to "contribute with suggestions for how to improve the Nordic research and development area in energy", and identifying issues on which NER could or should focus is one priority.

The policy studies can also be seen as a way to move the equilibrium from more of a largely researcher-led process to create a more strategic top-down process where NER and its priorities are more in command.

It is still too early to tell what this change of direction will actually mean in practice, since most policy projects have only just finished. From the final joint presentation held in Oslo in November, though, these projects point in several very interesting directions as to where NER projects and activities could go from here. It would therefore seem important not only that the NER Board take good heed of the findings from these projects, but also that the results and experiences from the seven NORIA policy projects are disseminated to national and international stakeholders in order to make it possible for these projects and this initiative to have a wider audience and impact.

#### *6.1.3 Opportunities for development and improvement*

Being a small organisation with a small budget, NER needs to be very clear on what to do and what the priorities are. NER needs to focus on:

- Issues that are of interest to the organisation itself
- Issues with an identified Nordic value (as opposed to “Nordic compromises”)
- Long-term goals.

NER has more than twenty years of experience of administrating international research programmes, and this is something the organisation could exploit in a more efficient way. NER needs to make good use of the acquired knowledge and experience, make it more visible to researchers around the world – and, not least, to policy makers and players in charge of the funding purses in the Nordic countries. The questionnaire and the case studies furthermore suggest that NER could exercise more pressure on project participants to disseminate results and knowledge. Another way to make use of the acquired knowledge would be to produce succinct technology overviews or “think tank”-like documents, aimed jointly at policymakers, industry and academia, in order to be more visible and active in the national and international discussions.

This latter point, to take an active part in the national and international debates, is highlighted by several interviewees. It is pointed out that energy issues have travelled from being interesting mainly for those strictly in the sector itself to become an issue of great importance for the general public. The interface energy – climate is maybe the hottest social issue of today, and several interviewees say NER could provide research data regarded as impartial. Social science research at the interface between energy and society is becoming increasingly important, and this is an area where NER are already present and one that would suit NER well.

When it comes to proposals for new types of programmes and instruments, few concrete suggestions have been made. Several interviewees mention that NER should concentrate on areas where they could make a difference, find its niche. This is also supported by survey answers. Exactly which these areas could be are, however, less obvious. One suggestion is setting up a PhD programme for “District heating as a means to combat $CO_2$ emissions”.

#### *6.1.4 Concrete examples of results exploitation and links from research conclusions to policy development*

We have seen some concrete evidence of the results of NER´s activities feeding into national policy developments.

NER provides valuable input to the long-term strategy work and development platforms of the Swedish National Energy Administration. The national Administration´s Director General participates in an internal working group relying on assessments of the environment for 2011-2014, partly provided by knowledge culled from the NER activities.

For the Swedish Ministry for Industry, Employment and Communication, NER should be close to the senior advisor for energy. NER provides certain help when creating new research environments.

The new strategy for energy research and development in Norway, Energy21, pointed out that intergovernmental cooperation across borders is crucial to reach the environmental goals and in developing new technologies. NIFU STEP, responsible for the NER policy project eNERGIA, participated in the public hearing of the energy research strategy, and also conducted a workshop with the Norwegian Ministry of Education and Research in spring 2008

Apart from evidence of impact of this kind, maybe the most important way for NER to exert influence on national policy developments is a more subtle one. The director of NER has an observer status in the Committee of Senior Officials, and this gives NER valuable insights and first-hand information that may facilitate and reinforce its role as an important support to the policy making processes.

As mentioned before, NER also provides secretaries to two Nordic Council working groups. Even though this could be seen as something that further conditions the possibilities for an already small organisation to act, this is not the way NER sees it. This arrangement also provides the NER Board with continuous and valuable information.

## 6.2 Views on administration of projects and the programme

According to the answers to our survey, project participants are generally satisfied with the project administration and the way the organisation collaborates with the projects. The information from NER to project participants has generally been clear, although as many as 25% claim this has been only partly so. The time between application and decision on funding has been in accordance with expectations, decisions on project grants have been well explained and the feedback from NER on ongoing projects is considered sufficient. However, it seems as though the application process could be improved upon; one third of those who answered the survey agree only partly with the statement that it has been easy to apply for project funding.

In a direct comparison, the administrative routines of NER come out very favourably against the EU Commission (63% consider the NER routines better or much better, only 11% prefer the EU Commission routines), and also against national research funders, (61% against 25%). Compared to EU projects, the NER projects are seen as nimbler. It is worth noting that 25% of those who answered the questionnaire can't assess the routines of the EU Commission.

There are, however, some critical comments. Some project participants say these grants are pretty small for each partner/team but the reporting required is large.

Collaboration on education and PhD research is very important because this produces future industry leaders. "Small projects on specific topics", one Norwegian researcher notes, "do not create any sustainable future network, waste of money".

Another researcher points out that the programme should concentrate on long term research collaboration between Universities to achieve future sustainable network among tomorrow's industry and research leaders as well as to take advantage of using research infrastructure in an improved way and not build up similar structures at different Universities. Although an important observation, we have no indications that this critical comment about sub-optimizing should be shared by other researchers.

# 7. Dissemination of knowledge and research results

## 7.1 Channels and target groups

The NER strategy on dissemination of knowledge and research results is formulated in the Strategy and Action Plan for 2007-2010. The ambition during the period is to strengthen NER´s "function as a communication point and facilitator for actors in the energy sector".

The strategy is a combination of efforts. On the project level, all projects are expected to present a dissemination plan and fulfil it. On the NER level, the administration is appointed responsibility to support the projects and ensure that the projects' information formats are compatible with NER strategy as well as organising NER initiated information and knowledge dissemination activities.

The Strategy and Action Plan identifies the following target groups for NER's general information activities:

- relevant authorities and governments,
- researchers and students, and
- representatives from energy industry and business.

The type of information spread through NER initiatives are, according to the Strategy and Action Plan, divided into three "clusters":

- Information about invitations to the call for expressions of interests and calls for proposals,
- Information about project development as well as preliminary and final results from NER funded and supported projects,
- Information on energy R&D activities and policies in the Nordic and Baltic regions as well as in wider international contexts.

The channels for Nordic Energy Research information are:

- Website www.nordicenergy.net
- ORKA (Newsletter)
- Annual Reports
- Printed information material
- Seminars and workshops.

The website is probably the most important channel and platform for NER information dissemination, supporting the other activities. Most NER publications are available here, from press-releases to research project publications. Even though there is an abundance of information on the site, it is regularly updated, logical and easy to navigate.

The electronic newsletter ORKA is distributed quarterly to about 600 readers within and outside the Nordic region. The newsletter can also be downloaded directly from the website, the total number of downloads is not known.

Exhibit 17: Subscriptions to the ORKA newsletter, divided by country and categories

| Country | Academia | Industry | Public | Total | % of total |
|---|---|---|---|---|---|
| Denmark | 20 (11%) | 87 (50%) | 68 (38%) | 181 (undefined 6) | 30% |
| Norway | 24 (13 %) | 94 (52%) | 58 (32%) | 180 (undefined 4) | 30% |
| Sweden | 31 (32%) | 39 (40%) | 28 (29%) | 98 | 16% |
| Finland | 20 (37%) | 14 (25%) | 21 (38%) | 55 | 9% |
| Iceland | 6 | 5 | 13 (54%) | 24 | 4% |
| Russia | | 3 | | 11 (undefined 8) | |
| Estonia | 3 | | 4 | 7 | |
| Lithuania | | 1 | 2 | 4 (undefined 1) | |
| Latvia | 2 | | 1 | 3 | |
| | | | | 563 | 600[8] |

The distribution of subscribers is spontaneous, and mainly the result of individuals applying for an e-mail subscription on the website. About 30% (some 180 addresses) of the ORKA newsletters are spread in Norway and in Denmark respectively. The Finns, especially the industry sector, and to some extent the Swedes, seem under-represented.

Since most of the NER financing, activities and project results are reported on in brief in the ORKA newsletter, getting it to relevant parties could benefit its long-term impact on policymaking in the Nordic and Baltic countries. However, the number of 600 subscribers appears lower than would be beneficial for its purpose. Presuming ORKA has a beneficial format for this group, strategic invitations to subscribe could be distributed according to the earlier suggested definition of the category policymakers.

NER carries out a number of seminars and workshops every year, partly to disseminate research results, partly to inform and get feedback from stakeholders. This is a beneficial way to expose NER and NER activities as well as research results. Nordic Energy Research also produces a range of printed materials, such as brochures, which are used in connection with information events and workshops. It could be interesting for NER to dig deeper into the direct and indirect knowledge impact of these activities and how they could be devolved in order to further support NER ambitions.

NER is involved in a number of Nordic and international networks related to energy policy and energy research and development activities and policies. At the Nordic level, NER organises information seminars in co-operation with NicE and NordForsk. These information seminars have a broader scope on Nordic Energy Research's general activities than the two other Nordic institutions.

At the European level, Nordic Energy Research organises events and information seminars together with other Nordic and European partners on energy research and innovation activities. NER is also visible through the ERA-nets they participate in. On a global level, Nordic Energy Research strives to position Nordic science and innovation stakeholders and competences in new energy technologies, markets and systems. Examples include the International Energy Agency, the OECD Global Science Forum, World Energy Council, and International Partnership for Hydrogen Economy etc. As one example, in 2007 NER organised the conference "Nordic Green" in California together with the Nordic Innovation Centre (NICe).

The chart below shows how cluster activities and channels are interrelated. It is complemented with a column describing channels used outside NER, e.g. external websites, informal and formal networking and articles published in Nordic Energy publications. In addition to this, the value of the systematic activities in networking with national ministries representatives in ÄK/NE-E is discussed in a separate part of this chapter, se below.

[8] About 65 subscribers are spread over the world, from India to Australia to Canada.

Exhibit 18: Interrelation of cluster activities and channels

| | Website | ORKA | Annual reports | Printed informa-tion materials | Workshops and seminars | Other channels |
|---|---|---|---|---|---|---|
| **Information on calls**<br><br>(mainly academia) | All relevant info Submit applicatio n online | Information about calls, directed to website | Short presentation of present calls | Press releases | Information seminar for potential applicants, also a meeting arena for plausible applicants | Posted on the NMR website and on all board members' websites.<br>Call distributed through formal and informal networks of NER administration and board members |
| **Information on project results**<br><br>(mainly outside academia) | Project reports | Articles on projects. Links to website with reports | Short presentation of projects, results and financing | Reports, articles and other publications, eg books. Press releases | Seminars, workshops and discussion panels for interpreting and spreading results | Project participants function as ambassadors at e.g. conferences.<br>NER admin holds active role in communicating results.<br>Interviews with eg stakeholders published in energy journals in the Nordic region |
| **Information activities in the Nordic and wider contexts.**<br><br>(including all three target groups) | Presented on website | Introduced in ORKA with links to website | Presentation s of most important activities | Materials to support activities | Information seminars in co-operation with Nordic Innovation Centre and Nordforsk.<br>Seminars on Energy R&I activities. | Networks on Nordic, EU and International levels.<br>NER strives to position Nordic science and innovation stakeholders in new arenas |

As we have mentioned, the information and knowledge dissemination is planned in two parts: project activities and NER activities. On the project level, the mechanisms for information vary in scope and ambition. The research projects are required to present a plan for project activities and research results dissemination at the start of the project. Research projects have published articles, publications, arranged courses, workshops or other external activities, and some have their own webpage. Researchers and PhDs offer added value acting as "ambassadors" for their NER-financed projects. In spite of this, it is our impression that NER could put a stronger pressure on the projects to disseminate results to target groups, and follow up to a larger extent than is done today.

In general, we find that NER could benefit from developing their understanding of which impact the intended NER information spread has – which channels NER information is actually directed through, who the target at the receiving end is and what is being achieved as a consequence of this information and knowledge dissemination. As of now, information and dissemination activities on behalf of NER appear to be mainly a supply-push initiative, planned and carried through from the perspective of NER´s needs and ambitions. The ability for potential information users to seek, absorb, quality-control and exploit information – absorptive capacity – is also crucial, especially when they face many alternative sources of knowledge.

However, information dissemination is costly, and NER has limited funding. The limited funding itself does to some extent make NER less visible to stakeholders and in turn less well-known, especially within the industry sector. There may be contextual issues needing to be dealt with in relation to industry, whereas research results with high impact for academia may at times be hard to use for the industry – since e.g. timing and format up-scaling may be crucial for usefulness. In any case, it seems crucial that approved funding from NER carries a stronger obligation on behalf of the beneficiaries to promote what is being done.

## 7.2 Different actors' views on information dissemination

As mentioned above, many claim that NER could do more to support information spread and knowledge dissemination to relevant actors. These are some suggestions made by interviewees:

- NER could invite project participants to represent them at conferences and international research seminars in order to support further dissemination. Focus could be both on NER activities and project results, where the combination would cast more light on NER.
- NER activities could be open to a wider range of actors, not just for internal use, since they are of such high class. Naturally there needs to be a priority made as to whether the increased administrative costs compensate for the increased (less tangible) spread.
- There is an abundance of knowledge within NER and the projects, which could be strengthened and made available in more receiver-friendly formats.
- Spreading information and disseminating knowledge is normally best done through networking, where NER is a facilitator. However, NER could choose beneficial environments more carefully, in order to benefit from the environments which best support dissemination of research results and impacts and in the long run supports NER goals and visions.
- NER could, according to some, also become more strategic through acting and producing papers with more of a think-tank character, which is already taking place to some extent. This could be enforced and may open up for easier communication with policy levels.
- In addition to this, NER could arrange an annual event where energy issues on the Nordic level could be debated, an arrangement which could be rotated between the Nordic countries and be co-planned with other national and regional public, academic and industrial actors.

## 7.3 Connections between researchers and users

The connection between the researchers (emitters) and the users of research (receptors) could be described as follows:

1. research is carried out
2. results are printed and spread in relevant format
3. receptors receive it, read and digest
4. receptors use the information in policymaking (or other ways)
5. new policymaking in line with research results.

In a chain-link format:

Research is carried out → Results are printed and spread in relevant format → Receptors receive it, read and digest → Receptors use information for policymaking → New policymaking in line with research results

The chain-link shows the connections between research and possible policymaking usage and expected impact on policy levels. The links may be weak or strong, either supporting the flow or disturbing it. In every step there are bottlenecks and uncertainties e.g.:

- results are relevant, interesting and sustainable, transferable to printed

format
- timing is right
- results are available in receptor relevant and context-appropriate forms
- receptors are capable of digesting the results and can make use of it (changed or supported attitude or knowledge)
- the information is useful and relevant to policy making in this field and it is surviving the competition from other sources and forms of information

This underlines how complicated it is for research results to actually have an effect on the policymaking levels. As for NER, this points to a need to discuss these matters further. One suggestion would be to draw up communication strategies for each target group. A relevant way of doing this is to analyse the push value in the NER results and information materials, contra the pull value on the receptor's end.

If push is the driving force then an abundance of information is understood to be needed in order to fill all perceived knowledge gaps. If pull can be more of a driving force, information production can be more slimmed and relevant for the receiver. NER is to some extent doing this today with e g the policy project eNERGIA, where a journalist is brought in to write articles on the results for the ORKA newsletter. However, a more stringent analysis of the needs (pull value) of for example policymakers or industry representatives would support this process even better.

# 8. Conclusions

Nordic and networking are the two keywords when describing the added value Nordic Energy Research provides stakeholders. It is clear that NER is a valuable and appreciated player on the Nordic energy research arena, not least taken into account its limited budget. NER contributes to the Nordic energy research infrastructure by building networks and supporting existing ones, and providing leverage to national research programmes.

More than twenty years of running international research programmes means NER is an organisation with high credibility. This has made it possible for NER to take an active part in several ERA-nets, where the national participants from member countries find it efficient to leave greater part of the practical work to this joint Nordic organisation.

NER as a "knowledgeable realist" is a brand worth safeguarding. NER should continue in the same vein, running a research programme that is well adapted to the (limited) resources available. Here, NER truly provides an added Nordic value. This Nordic value consists in:

- providing a useful platform for specific Nordic (research) collaborations and an enabler of such collaborations
- a basis for networking across the national borders that otherwise would not take place
- leverage to enter into or strengthen other collaborative research projects
- coordination of Nordic views in international for a (ERA-nets)

Creating and nurturing networks between researchers across the borders is maybe the one big contribution NER has made. Networking takes time and consistency, and this is something NER with its long history has been able to assist with.

One issue that has been discussed ever since the start of the NER in 1985 is how to get industry involved in the research projects. This was also highlighted in the evaluation of the previous programme period. However, surprisingly little has come out of this, and industry continues to play a relatively small role in the research projects. The NER project portfolio is biased towards rather generic research issues, and there are inherent problems getting industry involved in those types of projects. This difficulty is possibly aggravated by the fact that these projects are rather small in size. Still, NER needs to think about ways to actually get industry to participate in a more active way in future projects, and making the rules for project funding and participation more flexible seems necessary. It is time for NER to test some new ways of attracting industry.

The project portfolio during the present programme period consists of 16 research projects distributed over five "topic areas". Given the budget at hand, the number of topic areas seems excessive; it would probably be a good idea to limit these to a smaller number of areas. "Nordic addition" rather than "Nordic compromise" should be one central criterion when defining these areas. There need to be a clear pan-Nordic interest in the subject areas NER focus on. One such area that has been mentioned on several occasions is the Nordic interconnection of national electricity grids and the systems challenges and needs for common or compatible regulatory measures that result. Other possible research themes of clear common Nordic interest could be "Nordic transmission connections of electricity grids to adjacent areas", "the renewal of hydroelectric power" or "Nordic hydroelectric power as regulating support for wind power in Northern Europe".

Another criterion would be to focus on those areas where the NER funding may actually make a difference. With the limited resources available, NER would seem to get more leverage concentrating on areas where other players are not already investing large sums of money. On the other hand, spending scarce resources on hydrogen research seems to be of little strategic value for NER: the amount of money NER invests in this research area is very small indeed compared to what Japan, the US and the EU do.

Also, 16 research projects appear to be too many. If the research budget is not increased, the number of projects needs to be reduced in order to create a more homogenous project portfolio with more robust projects. This, at least, is true if NER wants to become a more active researcher funder, with a more decidedly top-down approach. The alternative is to continue to provide additional funding to projects that are priority to the researchers themselves rather than to NER.

The NORIA policy projects are, in this context, an interesting addition to NER´s arsenal of activities. The primary objective of these policy projects is to provide input, output and framework conditions for energy research in the Nordic countries on a general level, which is also coherent with the organisation's advisory role towards the Nordic Council of Ministers and the national Nordic energy and research authorities. This comparative perspective is new to NER, making the NORIA policy projects interesting also for national players. The policy projects provide an opportunity for NER to regain some of the initiative and create a more strategic top-down decision making process as compared to the relatively bottom-up project initiating process in place until now. This should be seen as positive, but it remains to be seen how NER manages to convert the results and suggestions from the policy projects into a coherent programme strategy. The NORIA policy projects not only serve to inform the internal policy process or that of the participating nations, but they also intend to encourage national as well as private policy makers to integrate technology development in their energy policies. This would be in line with recent EU calls and IEA initiatives.

It is still too early to tell what this change of direction will actually mean in practice, since most policy projects have only just recently finished. From what we have gathered, though, these projects point in several very interesting directions as to where NER projects and activities could go from here. It would therefore seem important not only that the NER Board take good heed of the findings from these projects, but also that the results and experiences from the seven projects are disseminated to national and international stakeholders in order to make it possible for these projects and this initiative to have a wider audience and impact.

The added value of the Nordic level has been strongly debated in recent years. Some observers claim that Nordic cooperation functions (or should function) as a testing ground and a "qualification round" for future international collaborations, others that the logic of collaborating in a Nordic setting is different from, for example, the logic of EU programmes. This evaluation indicates that acting at the Nordic level should probably be seen as a complement rather than an alternative to action at national and EU levels. The role of Nordic Energy Research in an international context would depend on subject matter and context. In some issues, the complementary role might be the best one, in others the Nordic approach should be more in the forefront.

NER has been actively involved in three ERA-nets, and widely acclaimed for how these tasks have been carried out. NER carries a big burden by organising calls and being work package leaders, and it is seen as a good use of resources to have NER (rather than the national Nordic participants) run work ERA-net packages. This is a role NER could develop further.

NER's role in the "Nordic innovation system" is rather difficult to define, given the uncertainty caused by the process surrounding the so-called "Top Research Initiative"

(TRI). This initiative clearly affects the role of NER, but to what extent is too early to say. It arguably provides an opportunity for closer collaboration between NER, Nordforsk and NICe, and is as such a welcome contribution to existing instruments. Although it might be argued that the amounts invested are still small compared to some national initiatives, this still remains to be seen. It depends on the net contribution of new money that is invested in this programme.

Throughout our evaluation we find that the category policymakers needs to be included in the definition of target groups in a more defined way – since their needs may be slightly different from the wider group of relevant authorities and governments. Our experience from other evaluations also shows that there are differences in how information is absorbed and used among politicians and public servants, both on the state and community levels. Policymakers need to be more clearly defined from a NER strategy perspective in order to reach NER goals. Several of our interviewees also claim that NER activities and project results could be used more efficiently, especially within the energy policy area.

# Appendix A

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2 April 2008

## TERMS OF REFERENCE - EVALUATION OF THE ACTIVITIES OF NORDIC ENERGY RESEARCH

To
Erik Arnold, Technopolis, erik.arnold@technopolis-group.com
Mikael Togeby, EA Energianalyse, mt@eaea.dk
Therése Hindman Persson, ECON Sverige, therese.hindman.persson@econ.se
Thomas Bjørnkilde, Rambøll, tbk@ramboll.com

From
Nordic Energy Research

Subject
Evaluation of the activities of Nordic Energy Research

You are hereby invited to tender for the project: Evaluation of the activities of Nordic Energy Research.

**Budget**: 750 000 NOK of which 75 000 NOK is set aside for a final workshop and 50 000 NOK is set aside for publication and dissemination. The budget available for the evaluation is **625 000 NOK**.

**Preliminary time plan**:

22 May - Kick-off meeting, in connection to the Nordic Energy Board meeting in Copenhagen

17 or 18 September - Midterm presentation, in connection to the Board meeting in Sweden

1 November - Draft report

27 November - Presentation of results, in connection to the Board meeting in Finland

### *Brief background and description*

The Board of Nordic Energy Research has decided to conduct an evaluation of the institution, working procedures, instruments, implemented projects and attained results with the objective of providing input into the process of developing a new strategy and action plan for the period 2011 - 2015. The new strategy and action plan is to take into consideration best-practice in promoting energy research and development, the needs of the research community and energy sector and is to be in line with Nordic and international political priorities.

The long-term objective of the Nordic energy cooperation is to promote an efficient, competitive, secure and sustainable energy supply. Since 1985, the Nordic countries have allocated funds for common energy research projects in the Nordic region.

Nordic Energy Research is a key actor in Nordic energy cooperation and has for more than 20 years promoted increased collaboration in the area of energy research and innovation, as well as provided input to the political decision making process.

It is the objective of Nordic Energy Research to participate in the consolidating and developing the Nordic region as a leading knowledge region for new sustainable energy solutions and efficient well-functioning energy markets. In line with this overreaching objective, Nordic Energy Research focuses its efforts on the following key areas:

1. Contribution towards capacity and knowledge building.
2. Promoting innovation and business development in the Nordic region.
3. Assisting Nordic authorities in the policy processes.
4. Contribution towards international network building.

According to the current Strategy and Action Plan (2007-2010) of Nordic Energy Research five focus areas have been defined:

1. Integration of the energy market
2. Renewable forms of energy
3. Energy efficiency
4. The hydrogen society
5. Consequences of climate change on the energy sector

Nordic Energy Research functions as a resource centre for energy research and development through providing:

1. Financial support for RD&D and the development of competence and expertise.
2. Arenas for building relations and exchanging information between research, industry and authorities
3. Specific and active follow-up of research and development projects and initiatives.
4. Communicating and disseminating research results and other topics of relevance to energy research.

The most important success criterion for Nordic Energy Research is the achievement of maximum Nordic Opportunities in the institution's field of activities. In particular this will include:

- Reinforced interplay between national R&D participants
  - Building Nordic *centres of excellence*
  - Making research results available

- Helping to ensure that Nordic energy clusters are formed
  - Bringing together R&D circles, industry and the authorities
  - Initiating joint projects
  - Coordinating scenario analyses/foresight processes

- Creating measurable developments and improvements when exploiting new technology, as well as new knowledge about the energy markets
- Relating R&D results to current energy policy issues
- Coordinating Nordic views in order to increase the opportunities for exerting influence, especially in the EU

***Focus of the project***

The evaluation should focus on the current programme period (2007-2010), while also reviewing previous periods in order to include overview of the development of Nordic Energy Research.

Focus should be placed on lessons learned, on identifying areas for improvement and development, and on how Nordic Energy Research can further strengthen the position of Nordic energy research and development in an international perspective.

The project should through interviews with key stakeholder groups including the research community, the energy sector and decision-makers to provide an evaluation of the work and activities of Nordic Energy Research and give recommendations on thematic focus areas, new types of programmes and instruments and the role of Nordic Energy Research in building a Nordic Energy and Innovation Area in energy.

The report should include evaluations of:

- The usefulness and value of conducted research projects with the aim of identifying best practices for Nordic energy research activities in regard to programme and project organisation and implementation.
- The role of Nordic Energy Research in EU projects and programmes. Further opportunities for using experiences gained at a Nordic level to contribute to the development of the European Research Area should be identified.
- The usefulness of the input and support (including the commissioning and administration of projects, and the administration of working groups) provided to the political decision-making process. Recommendations on how to further develop this role should be made.
- The dissemination of research results, policy recommendations and information about Nordic energy cooperation in regard to tools used, target groups, and effectiveness.

The project should provide suggestions for Nordic Energy Research based on an investigation of the strategies, programmes and administration of other international research and development institutions.

### *Deliverables*

The project is to result in a report and recommendations that can be used as input into the drafting process for the new strategy and action plan for the period 2011 - 2014, as well as provide input to the drafting of a new Action Plan for the Nordic Energy Cooperation 2010-2012.

### *Organisation of the project*

The Board of Nordic Energy Research is the reference group for this project. The administration of Nordic Energy Research will support the project through the provision of suggestions, contact persons and documentation. It is crucial that the consultant is independent from national interest; however, the project should consult stakeholders where it is deemed relevant. This shall be done in an open and transparent way. Cooperation between consultants from different countries is encouraged.

During the project process, the consultant is expected to participate in meetings with the reference group, this includes a kick-off meeting, a mid-term meeting to discuss preliminary results, as well as a meeting to discuss the final report draft.

The project should take into consideration previous evaluations, strategic documents and publications (available at www.norden.org and www.nordicenergy.net).

### *Budget for the project*

The budget frame for the project (exclusive final workshop and dissemination of results) is limited to **625 000 NOK**. This shall cover labour and necessary travel costs for the project team.

### *Formal criteria*

The project proposal should:

1. Be no longer than 5 pages
2. Provide an overview outlining how the task will be solved
3. Include a time and work plan, specifying method, elements of analysis, as well as a tentative division of work between the project members
4. Contain a budget divided into elements of analysis
5. Provide CVs for the responsible project manager(s)
6. Be in English

### *Selection criteria*

The following four selection criteria will be applied to evaluate the project proposals:

1. Competence (the proposal shall document):

- Specific knowledge and understanding the frameworks for renewable energy in the Nordic Countries
- Knowledge and understanding of Nordic energy cooperation and research and innovation projects
- Proven competence and experience from similar projects
- That the responsible project manager possesses the necessary competence (short CV should be included)
- Insight into the coupling between the issue and Nordic Benefit (Nordisk Nytte) in an international context, and on this background work out recommendations for the new strategy and programmes of Nordic Energy Research

2. Relevance: the purpose of the study, in a political context, should be well understood.

3. Form: the proposal should aim at a report to be part of background for the development of a new strategy, and that the suggestions for solution have a suitable form and language for this purpose.

4. Level of ambition: the proposal should be sufficiently ambitious and innovative, and have a reasonable relationship between price and quality.

***Application process***

The proposals will be evaluated by the Board of Nordic Energy Research. The final decision and selection of the consultant will be taken jointly by the Board.

All participants will be notified by the **15th of May, 2008**. The selected consultant will sign a contract with Nordic Energy Research, which is the legal contracting party on this project.

***How to apply***

A project proposal fulfilling the criteria above should be submitted electronically to Nordic Energy Research - vr@nordicenergy.net.

**Proposals are to be submitted no later than the 25th of April, 2008.**

For any questions regarding the project or application process, please contact Nordic Energy Research, Senior Advisor Vida Rozite, vr@nordicenergy.net, +47 90518445.

# Appendix B

## Project portfolio: Topic area analysis

### B.1. Climate and Energy Systems.

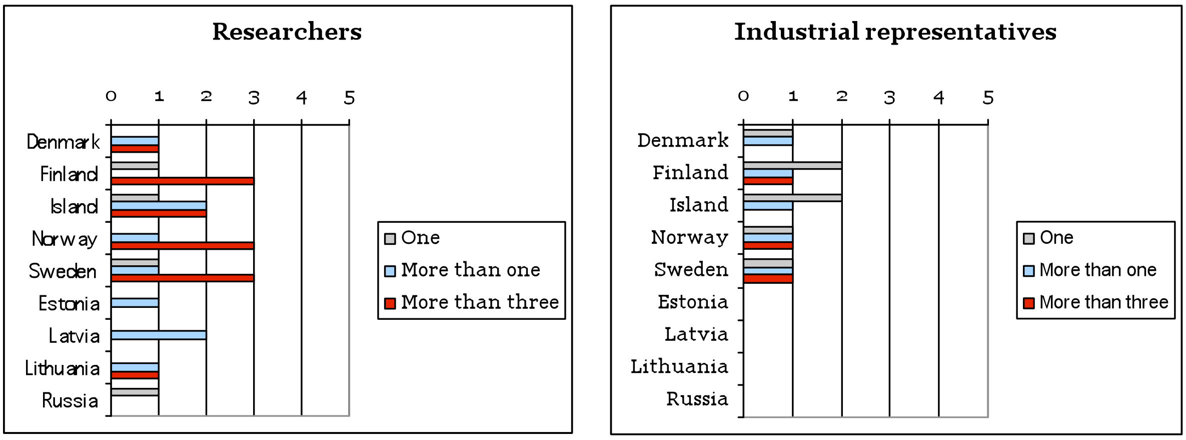



*Figure 1: Number of recipients that collaborate with one, more than one, more than three from respective nationality. Topic area 1. Climate and Energy Systems. n=5, n=4*

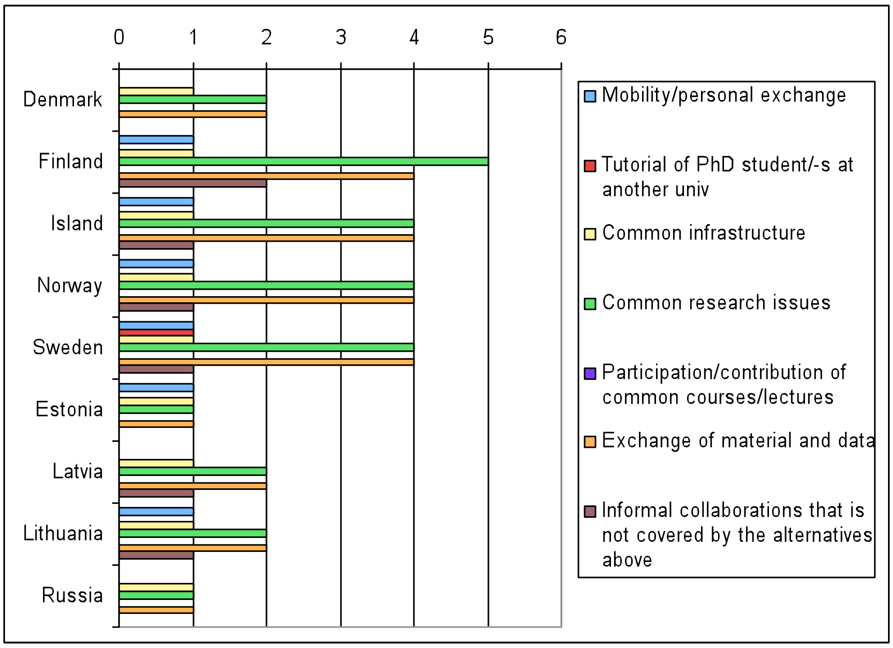
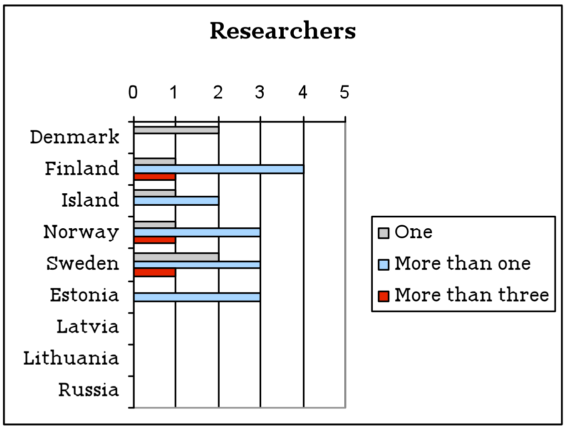



*Figure 2: Type of exchange. Topic area 1. Climate and Energy Systems. n=5*

## B.2. Energy efficiency.



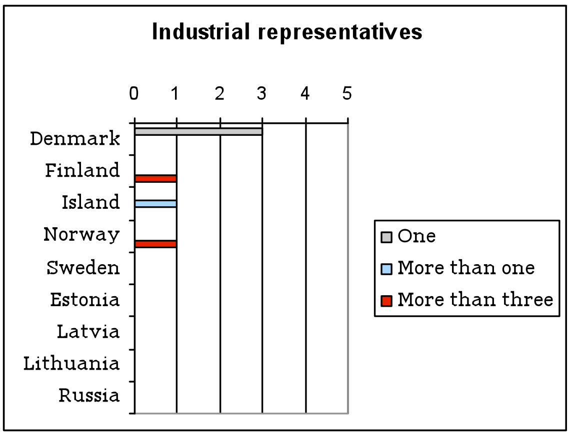




*Figure 3: Number of recipients that collaborate with one, more than one, more than three from respective nationality. Topic area 2. Energy efficiency. n=6, n=3*

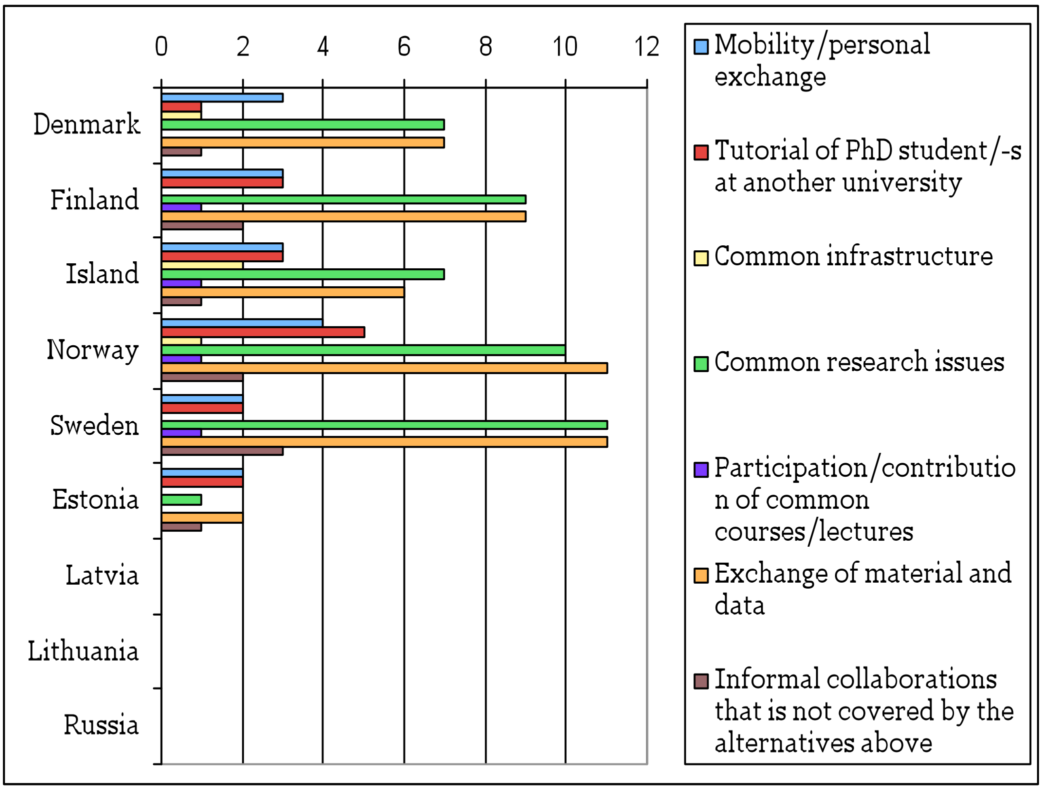
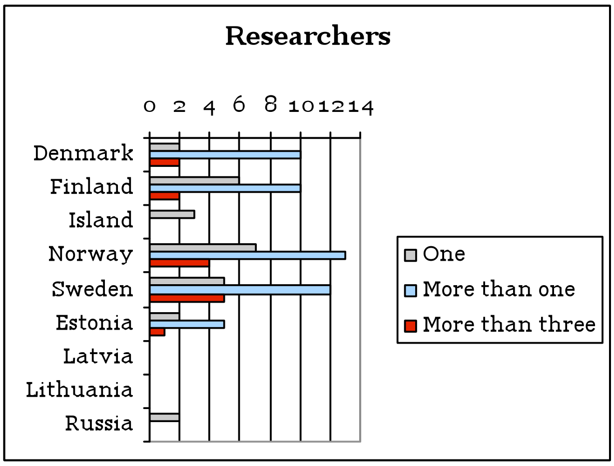



*Figure 4: Type of exchange. Topic area 2. Energy efficiency. n=5*

## B.3. Renewable energy.



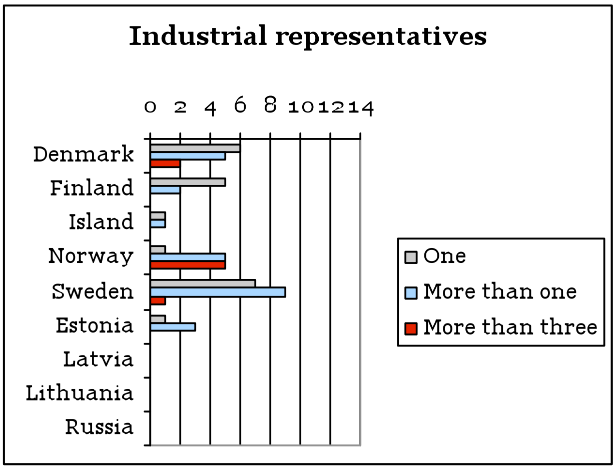




*Figure 5: Number of recipients that collaborate with one, more than one, more than three from respective nationality. Topic area 3. Renewable energy. n=24, n=17*

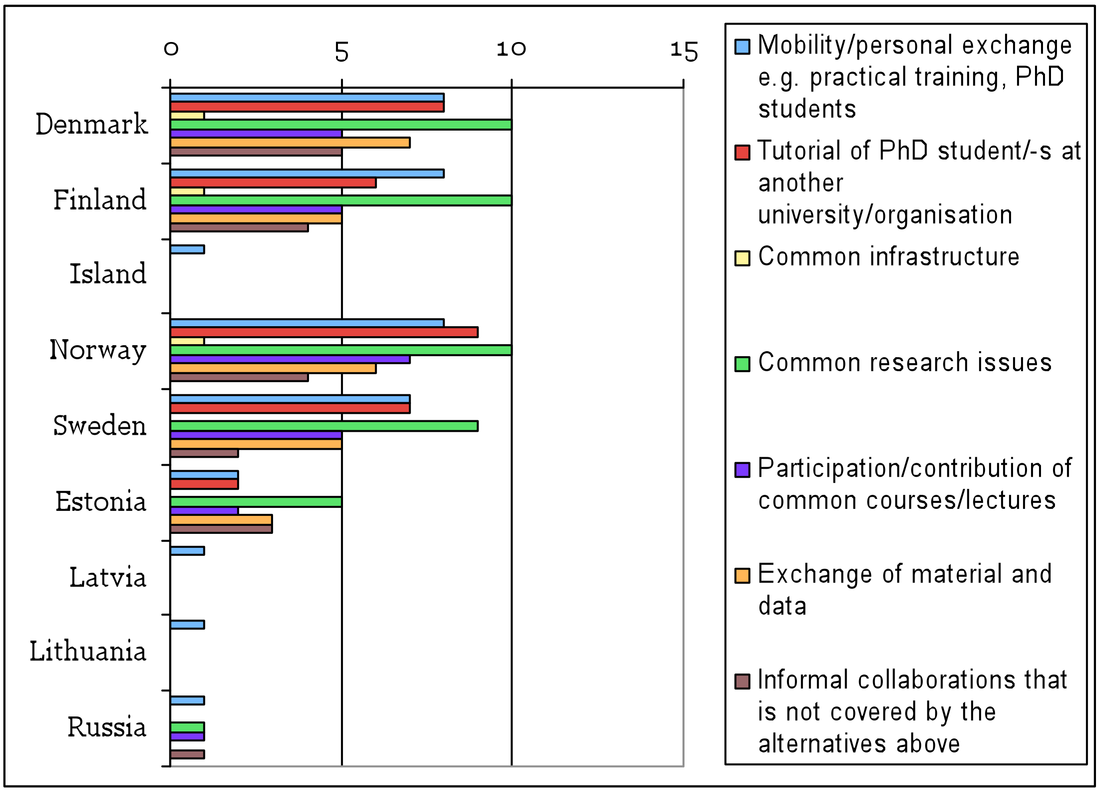
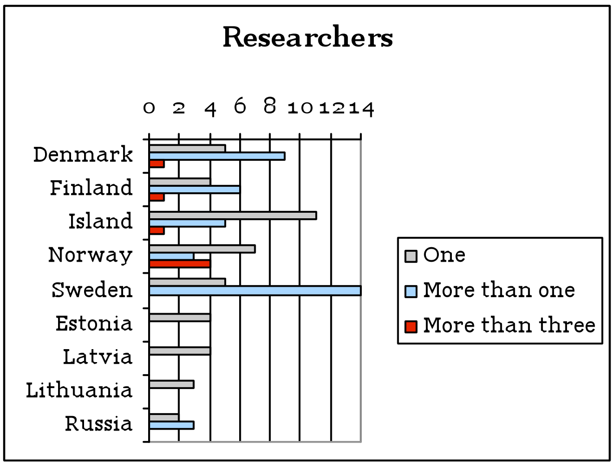



Figure 6: Type of exchange. *Topic area 3. Renewable energy. n=15*

## B.4. 4. Hydrogen technology



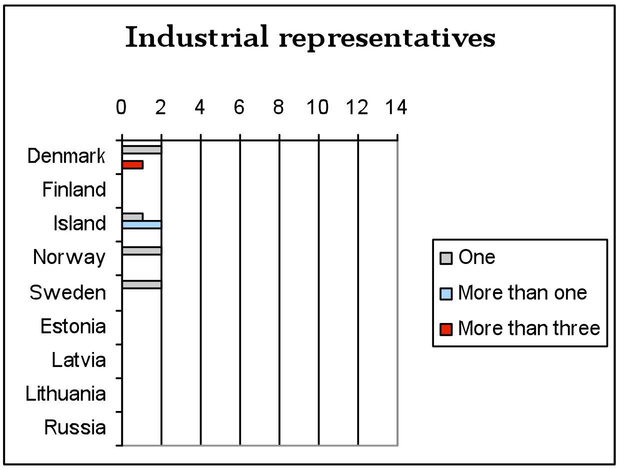




*Figure 7: Number of recipients that collaborate with one, more than one, more than three from respective nationality. Topic area 4. Hydrogen technology. n=19, n=3*

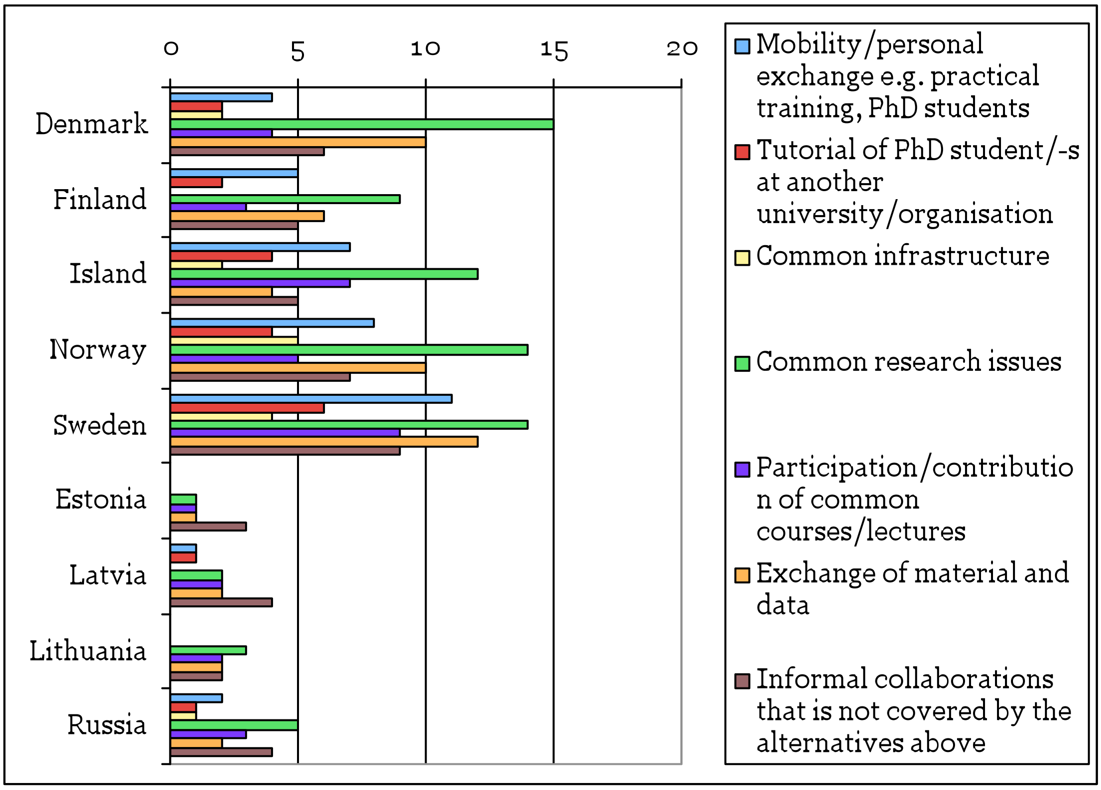



*Figure 8: Type of exchange. Topic area 4. Hydrogen technology. n=20*

## B.5. Energy markets

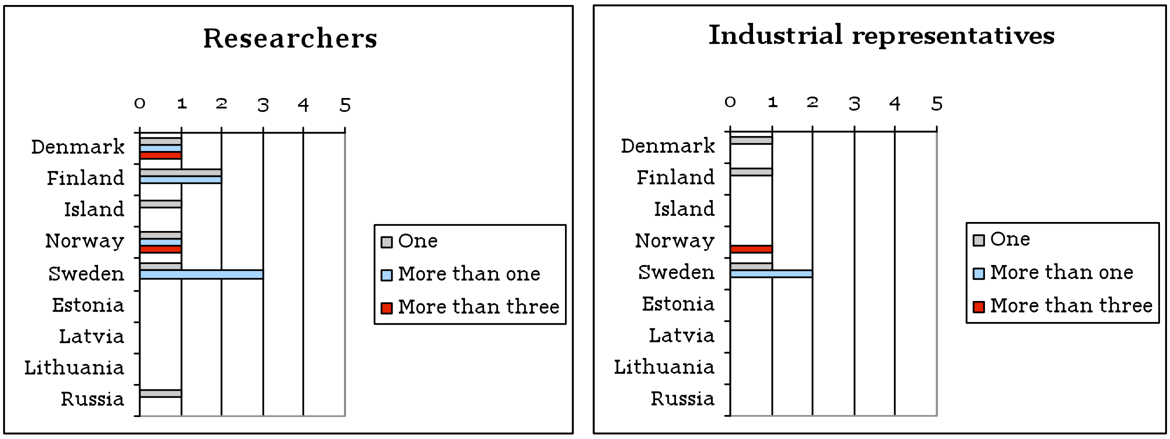



*Figure 9: Number of recipients that collaborate with one, more than one, more than three from respective nationality. Topic area 5. Energy markets. n=4, n=3*

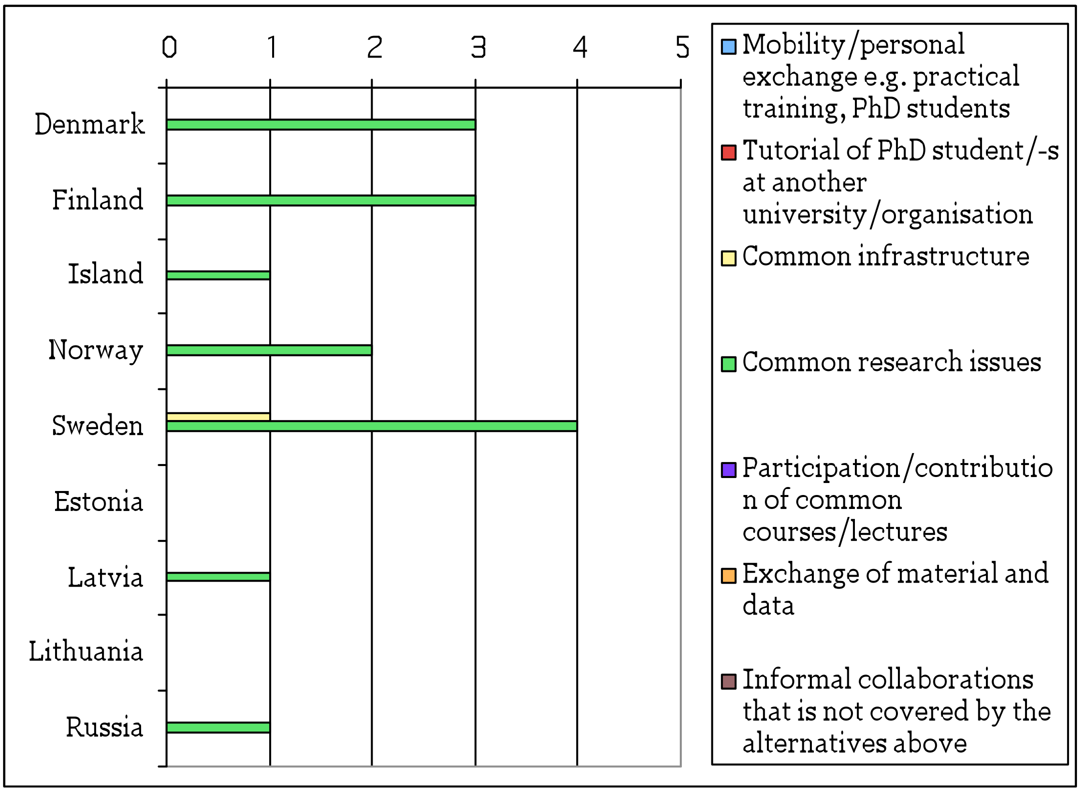



*Figure 10: Type of exchange. Topic area 4. Hydrogen technology. n=4*

# Appendix C

## Nordic Energy Research Questionnaire:

### C.1. Response rate per project

| Project | Number of questionnaires sent | Number of answers |
|---|---|---|
| 1. Risk and potential adaptation | 10 | 6 |
| 2. Primary Energy Efficiency (PEE) | 5 | 4 |
| 3. Basic phenomena in Mechanical Pulping | 5 | 4 |
| 4. Nordic Graduate School in Biofuel Science and Technology – Phase 2 | 13 | 6 |
| 5. New, innovative pre-treatment of Nordic wood for cost-effective fuel-ethanol production | 12 | 9 |
| 6. Model Development for Power System Analysis with a substantial wind energy Capacity installed in the Nordic grid | 10 | 8 |
| 7. Nordic Centre of Excellence in Photovoltaics (PV) | 6 | 5 |
| 8. Energy Systems for isolated locations | 9 | 2 |
| 9. BioH2 – Renewable production of H2 using biological systems | 11 | 9 |
| 10. Nordic Centre of Excellence on Hydrogen Storage Materials | 14 | 10 |
| 11. Development and demonstration of an efficient and cost competitive PEMFC system for cold Nordic climate | 5 | 3 |
| 12. Scandinavian Hydrogen Highway Partnership | 1 | 0 |
| 13. Nordic Energy, Environmental Constraints and Integration (NEECI) | 5 | 4 |
| 14. Energy Foresight Forum | 3 | 1 |
| 15. Distributed Generation Integration in the Nordic energy market (DIGINN) | 10 | 1 |
| 16. Nordic AMR Forum (Automatic Meter Reading) | 5 | 4 |
| **Total** | **124** | **76** |

The overall response rate to the questionnaire was 61.2%. This response rate is sufficient and satisfying, especially considering an unexpectedly high amount of incorrect e-mail addresses and some lists of project participants that were not up-to-date. In order to improve the initially weak response rate, we sent out two reminders and then finally contacted five project leaders by phone.

This improved results noticeably, but was not enough. Due to low response rates, in the analysis of the results we have discarded three projects: numbers 8, 12 and 15. For project 12 we did not receive any answers at all, and also failed in our attempts to get in contact with the project leader. We spoke to the project leaders of projects 8 and 15, but the response rate from those projects are still too low.

The analysis in the main report, thus, builds on the responses from 13 projects. The response rate from these 13 projects is 70.2%.

Please find the survey below, in the order of questions asked.

| 1. Industry: Please indicate your current position: (Multiple answers are possible) | Response Percent | Response Count |
|---|---|---|
| CEO/Director | 38.5% | 5 |
| Product developer | 23.1% | 3 |
| Market researcher | 0.0% | 0 |
| Process developer | 15.4% | 2 |
| **Other, please specify:** | **46.2%** | 6 |
| | *answered question* | 13 |
| | *skipped question* | 64 |

| 2. Academia: Please indicate your current position: (Multiple answers are possible) | Response Percent | Response Count |
|---|---|---|
| PhD student | 4.8% | 3 |
| Post-doc | 3.2% | 2 |
| Researcher | 22.2% | 14 |
| **Research leader** | **50.8%** | 32 |
| Project leader | 38.1% | 24 |
| Other, please specify: | 23.8% | 15 |
| | *answered question* | 63 |
| | *skipped question* | 14 |

| 3. What is your function in the project that is funded by Nordic Energy Research? (Multiple answers is possible) | Response Percent | Response Count |
|---|---|---|
| Researcher | 42.6% | 29 |
| Project manager | 35.3% | 24 |
| Member of the reference group | 7.4% | 5 |
| **Member of the steering group** | **48.5%** | 33 |
| | Other, please specify: | 12 |
| | *answered question* | 68 |
| | *skipped question* | 9 |

| 4. Under what circumstances are project meetings held and how often do you meet? | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **How often** | | | | | | | | |
| | **Don't know** | **Never** | **Once a year** | **Twice a year** | **Three times a year** | **Four times a year** | **More often** | **Response Count** |
| Steering group meetings where all members of the steering group are present | 2.9% (2) | 2.9% (2) | 19.1% (13) | **66.2% (45)** | 7.4% (5) | 1.5% (1) | 0.0% (0) | 68 |
| Project group meetings where all project participants are present | 3.0% (2) | 1.5% (1) | 32.8% (22) | **50.7% (34)** | 6.0% (4) | 6.0% (4) | 0.0% (0) | 67 |
| Project group meetings where parts of the project group are present | **24.2% (15)** | 6.5% (4) | 12.9% (8) | 19.4% (12) | 8.1% (5) | 9.7% (6) | 19.4% (12) | 62 |
| Phone conferences where all members of the steering group participate | 9.7% (6) | **75.8% (47)** | 11.3% (7) | 3.2% (2) | 0.0% (0) | 0.0% (0) | 0.0% (0) | 62 |
| Phone conferences where all project participants participate | 11.1% (7) | **73.0% (46)** | 9.5% (6) | 4.8% (3) | 0.0% (0) | 1.6% (1) | 0.0% (0) | 63 |
| Phone conferences where parts of the project group participate | **33.3% (20)** | 20.0% (12) | 18.3% (11) | 11.7% (7) | 3.3% (2) | 5.0% (3) | 8.3% (5) | 60 |
| | | | | | | | Other type of meetings, please specify: | 13 |
| | | | | | | | ***answered question*** | **69** |
| | | | | | | | ***skipped question*** | **8** |

| 5. b) What issues are dealt with during project group meetings? (Please indicate your level of agreement 1 not at all – 5 to a large extent) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **Don't know** | **Rating Average** | **Response Count** |
| Administration of project | 7.6% (5) | 9.1% (6) | 22.7% (15) | **28.8% (19)** | 25.8% (17) | 6.1% (4) | 3.60 | 66 |
| Exchange of research results | 2.9% (2) | 2.9% (2) | 11.8% (8) | 27.9% (19) | **50.0% (34)** | 4.4% (3) | 4.25 | 68 |
| Alignment and focus of the common research project | 3.0% (2) | 9.1% (6) | 25.8% (17) | **31.8% (21)** | 25.8% (17) | 4.5% (3) | 3.71 | 66 |
| Planning of common future research projects | 10.4% (7) | 17.9% (12) | 25.4% (17) | **31.3% (21)** | 10.4% (7) | 4.5% (3) | 3.14 | 67 |
| | | | | | | | ***answered question*** | **68** |
| | | | | | | | ***skipped question*** | **9** |

| 6. Who do you collaborate with in the research project? | | | | |
|---|---|---|---|---|
| **Researchers** | | | | |
| | **One** | **More than one** | **More than three** | **Response Count** |
| Denmark | 27.0% (10) | **59.5% (22)** | 13.5% (5) | 37 |
| Finland | 31.8% (14) | **50.0% (22)** | 18.2% (8) | 44 |
| Island | **58.6% (17)** | 31.0% (9) | 10.3% (3) | 29 |
| Norway | 31.4% (16) | **41.2% (21)** | 27.5% (14) | 51 |
| Sweden | 25.0% (14) | **58.9% (33)** | 16.1% (9) | 56 |
| Estonia | 37.5% (6) | **56.3% (9)** | 6.3% (1) | 16 |
| Latvia | **66.7% (4)** | 33.3% (2) | 0.0% (0) | 6 |

| | | | | |
|---|---|---|---|---|
| Lithuania | **60.0% (3)** | 20.0% (1) | 20.0% (1) | 5 |
| Russia | **66.7% (6)** | 33.3% (3) | 0.0% (0) | 9 |

**Industrial representatives**

| | One | More than one | More than three | Response Count |
|---|---|---|---|---|
| Denmark | **60.9% (14)** | 26.1% (6) | 13.0% (3) | 23 |
| Finland | **64.3% (9)** | 21.4% (3) | 14.3% (2) | 14 |
| Island | 44.4% (4) | **55.6% (5)** | 0.0% (0) | 9 |
| Norway | 26.3% (5) | 31.6% (6) | **42.1% (8)** | 19 |
| Sweden | **46.2% (12)** | **46.2% (12)** | 7.7% (2) | 26 |
| Estonia | 25.0% (1) | **75.0% (3)** | 0.0% (0) | 4 |
| Latvia | 0.0% (0) | 0.0% (0) | 0.0% (0) | 0 |
| Lithuania | 0.0% (0) | 0.0% (0) | 0.0% (0) | 0 |
| Russia | 0.0% (0) | 0.0% (0) | 0.0% (0) | 0 |

**Other**

| | Consultant | Other | Response Count |
|---|---|---|---|
| Denmark | 33.3% (1) | **66.7% (2)** | 3 |
| Finland | **100.0% (2)** | 0.0% (0) | 2 |
| Island | **50.0% (1)** | **50.0% (1)** | 2 |
| Norway | 33.3% (1) | **66.7% (2)** | 3 |
| Sweden | **50.0% (2)** | **50.0% (2)** | 4 |
| Estonia | 0.0% (0) | 0.0% (0) | 0 |
| Latvia | **100.0% (1)** | 0.0% (0) | 1 |
| Lithuania | 0.0% (0) | 0.0% (0) | 0 |
| Russia | 0.0% (0) | **100.0% (1)** | 1 |
| | | ***answered question*** | **64** |
| | | ***skipped question*** | **13** |

**7. What type of exchanges does the cooperation in your research project consist of? Please mark the alternatives that correspond with the collaborations within your proj**
**your home country and abroad.**

| | Mobility/personal exchange e.g. practical training, PhD students | Tutorial of PhD student/-s at another university/organisation | Common infrastructure | Common research issues | Participation/contribution of common courses/lectures | Exchange of material and data | Informal collaborations that is not covered by the alternatives above |
|---|---|---|---|---|---|---|---|
| Denmark | 31.9% (15) | 23.4% (11) | 10.6% (5) | **80.9% (38)** | 21.3% (10) | 57.4% (27) | 25.5% (12) |
| Finland | 37.0% (17) | 23.9% (11) | 4.3% (2) | **80.4% (37)** | 21.7% (10) | 54.3% (25) | 28.3% (13) |
| Island | 38.7% (12) | 22.6% (7) | 16.1% (5) | **77.4% (24)** | 25.8% (8) | 45.2% (14) | 22.6% (7) |
| Norway | 42.0% (21) | 36.0% (18) | 16.0% (8) | **82.0% (41)** | 28.0% (14) | 64.0% (32) | 28.0% (14) |
| Sweden | 37.5% (21) | 28.6% (16) | 10.7% (6) | **76.8% (43)** | 28.6% (16) | 58.9% (33) | 26.8% (15) |
| Estonia | 31.3% (5) | 25.0% (4) | 6.3% (1) | **50.0% (8)** | 18.8% (3) | 43.8% (7) | 43.8% (7) |

**8. Please indicate if you have other financial support for this Nordic Energy Research project. (Multiple answers are possible)**

| | Response Percent | Response Count |
|---|---|---|
| Don't know | 4.5% | 3 |
| **National research financer** | **45.5%** | 30 |
| EU | 12.1% | 8 |
| Nordforsk | 0.0% | 0 |
| NicE | 0.0% | 0 |
| Other financing from the Nordic Council of Ministers | 0.0% | 0 |
| No, the project is only financed by Nordic Energy Research | 24.2% | 16 |
| Other, please specify: | 34.8% | 23 |
| | ***answered question*** | **66** |
| | ***skipped question*** | **11** |

**9. Has the financing from Nordic Energy Research influenced your research activity? If so, please specify:**

| | Response Count |
|---|---|
| | 47 |
| ***answered question*** | **47** |
| ***skipped question*** | **30** |

**10. Would you have collaborated with the other project participants without the financing from NER?**

| | Yes | Possibly | No | Difficult to estimate | Response Count |
|---|---|---|---|---|---|
| Denmark | 27.8% (15) | **31.5% (17)** | 25.9% (14) | 14.8% (8) | 54 |
| Estonia | 7.4% (2) | 18.5% (5) | **63.0% (17)** | 11.1% (3) | 27 |
| Finland | **33.3% (17)** | 27.5% (14) | 31.4% (16) | 7.8% (4) | 51 |
| Island | 10.8% (4) | 29.7% (11) | **40.5% (15)** | 18.9% (7) | 37 |
| Latvia | 5.6% (1) | 5.6% (1) | **61.1% (11)** | 27.8% (5) | 18 |
| Lithuania | 5.3% (1) | 15.8% (3) | **57.9% (11)** | 21.1% (4) | 19 |
| Norway | 28.0% (14) | **40.0% (20)** | 24.0% (12) | 8.0% (4) | 50 |
| Russia | 15.0% (3) | 10.0% (2) | **45.0% (9)** | 30.0% (6) | 20 |
| Sweden | 28.3% (15) | **47.2% (25)** | 15.1% (8) | 9.4% (5) | 53 |
| | | | | b) Please comment your answer: | 29 |
| | | | | ***answered question*** | **66** |
| | | | | ***skipped question*** | **11** |

| 11. Is the project in question part of another project or programme in your organisation? | | Response Percent | Response Count |
|---|---|---|---|
| **No** | | **64.6%** | 42 |
| Yes. Please specify which programme/project: | | 35.4% | 23 |
| | *answered question* | | 65 |
| | *skipped question* | | 12 |

| 12. Did contacts with the other project partners already exist before the financial support from NER? | | Response Percent | Response Count |
|---|---|---|---|
| Yes | | 21.2% | 14 |
| **To some extent** | | **63.6%** | 42 |
| No | | 15.2% | 10 |
| | *answered question* | | 66 |
| | *skipped question* | | 11 |

| 13. Knowledge oriented goals: | 1 | 2 | 3 | 4 | 5 | Don't know | Rating Average | Response Count |
|---|---|---|---|---|---|---|---|---|
| a) Improved knowledge in technical core area | 6.0% (4) | 6.0% (4) | 10.4% (7) | 28.4% (19) | **46.3% (31)** | 3.0% (2) | 4.06 | 67 |
| b) Improved understanding of new methods and tools | 1.5% (1) | 7.5% (5) | 22.4% (15) | **40.3% (27)** | 25.4% (17) | 3.0% (2) | 3.83 | 67 |
| c) Improved competence in R&D staff | 3.0% (2) | 9.0% (6) | 25.4% (17) | **35.8% (24)** | 22.4% (15) | 4.5% (3) | 3.69 | 67 |
| d) Increased speed in R&D | 3.0% (2) | 13.6% (9) | 24.2% (16) | **34.8% (23)** | 19.7% (13) | 4.5% (3) | 3.57 | 66 |
| e) Re-orientation of R&D portfolio towards more long-term R&D | 13.4% (9) | 11.9% (8) | **32.8% (22)** | 22.4% (15) | 7.5% (5) | 11.9% (8) | 2.98 | 67 |
| g) Re-orientation of R&D portfolio towards more short-term R&D | **43.9% (29)** | 19.7% (13) | 16.7% (11) | 7.6% (5) | 0.0% (0) | 12.1% (8) | 1.86 | 66 |
| | | | | | | | *answered question* | 67 |
| | | | | | | | *skipped question* | 10 |

| 14. Network oriented goals: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Don't know | Rating Average | Response Count |
| a) Access to complementary source of expertise | 0.0% (0) | 4.5% (3) | 14.9% (10) | 37.3% (25) | **41.8% (28)** | 1.5% (1) | 4.18 | 67 |
| b) Formation of new R&D partnerships and networks in the Nordic countries | 4.5% (3) | 1.5% (1) | 7.5% (5) | 35.8% (24) | **47.8% (32)** | 3.0% (2) | 4.25 | 67 |
| c) Formation of new R&D partnerships and networks in countries outside the five Nordic countries | 21.2% (14) | 18.2% (12) | **22.7% (15)** | 19.7% (13) | 15.2% (10) | 3.0% (2) | 2.89 | 66 |
| d) Improved collaboration between companies and universities/research institutes | 10.4% (7) | 7.5% (5) | 13.4% (9) | **38.8% (26)** | 28.4% (19) | 1.5% (1) | 3.68 | 67 |
| e) Access to new entrances to national R&D programmes in your own country | 22.4% (15) | 22.4% (15) | **28.4% (19)** | 10.4% (7) | 13.4% (9) | 3.0% (2) | 2.69 | 67 |
| f) Access to new entrances to national R&D programmes in the other Nordic countries | 26.9% (18) | 20.9% (14) | **28.4% (19)** | 13.4% (9) | 3.0% (2) | 7.5% (5) | 2.40 | 67 |
| g) Access to to international R&D programmes | 13.4% (9) | 17.9% (12) | **29.9% (20)** | 22.4% (15) | 13.4% (9) | 3.0% (2) | 3.05 | 67 |
| h) Access to R&D collaborations in the private sector | 22.4% (15) | 17.9% (12) | **26.9% (18)** | 19.4% (13) | 9.0% (6) | 4.5% (3) | 2.73 | 67 |
| | | | | | | | *answered question* | 67 |
| | | | | | | | *skipped question* | 10 |

| 15. Exploitation-oriented goals: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Don't know | Rating Average | Response Count |
| a) Development or improvement of new processes | 10.6% (7) | 9.1% (6) | 24.2% (16) | 21.2% (14) | **28.8% (19)** | 6.1% (4) | 3.52 | 66 |
| b) Development or improvement of new products or services | **22.7% (15)** | **22.7% (15)** | 19.7% (13) | 18.2% (12) | 10.6% (7) | 6.1% (4) | 2.69 | 66 |
| c) Development, evaluation or improvement of tools or techniques | 6.2% (4) | 4.6% (3) | 29.2% (19) | **32.3% (21)** | 24.6% (16) | 3.1% (2) | 3.67 | 65 |
| d) Production of patents and licenses | **36.4% (24)** | 18.2% (12) | 22.7% (15) | 12.1% (8) | 6.1% (4) | 4.5% (3) | 2.30 | 66 |
| e) Development, new knowledge aimed to influence policymaking in the Nordic countries | 15.2% (10) | 13.6% (9) | **27.3% (18)** | 18.2% (12) | 22.7% (15) | 3.0% (2) | 3.20 | 66 |
| | | | | | | | *answered question* | 66 |
| | | | | | | | *skipped question* | 11 |

| 16. Strategic Management goals: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | Don't know | Rating Average | Response Count |
| a) Access to additional funds | 6.1% (4) | 7.6% (5) | 27.3% (18) | **31.8% (21)** | 22.7% (15) | 4.5% (3) | 3.60 | 66 |
| b) Cost sharing between project partners | 10.8% (7) | 16.9% (11) | **30.8% (20)** | 23.1% (15) | 16.9% (11) | 1.5% (1) | 3.19 | 65 |
| c) Enhanced reputation and image | 6.1% (4) | 7.6% (5) | 19.7% (13) | **33.3% (22)** | 30.3% (20) | 3.0% (2) | 3.77 | 66 |
| d) Risk-reduction in R&D | 21.2% (14) | 24.2% (16) | **30.3% (20)** | 10.6% (7) | 7.6% (5) | 6.1% (4) | 2.56 | 66 |
| e) Enhanced opportunity to influence EU-projects | 6.1% (4) | **28.8% (19)** | 24.2% (16) | 19.7% (13) | 16.7% (11) | 4.5% (3) | 3.13 | 66 |
| f) Increased opportunities to find new cooperations in EU | 10.9% (7) | 15.6% (10) | **25.0% (16)** | 23.4% (15) | 21.9% (14) | 3.1% (2) | 3.31 | 64 |
| | | | | | | | *answered question* | 66 |
| | | | | | | | *skipped question* | 11 |

| 17. How important are the following outputs and outcomes for your organisation to value the results of the project as successful? | | | | | |
|---|---|---|---|---|---|
| | Not at all important | Not very important | Important | Necessary | Response Count |
| New services | 25.0% (16) | 31.3% (20) | **39.1% (25)** | 4.7% (3) | 64 |
| New products | 27.4% (17) | 25.8% (16) | **41.9% (26)** | 6.5% (4) | 62 |
| Prototypes | **39.1% (25)** | 29.7% (19) | 28.1% (18) | 3.1% (2) | 64 |
| New processes | 19.0% (12) | 20.6% (13) | **46.0% (29)** | 15.9% (10) | 63 |
| New methods or tests | 9.5% (6) | 19.0% (12) | **58.7% (37)** | 14.3% (9) | 63 |
| Contributions to new standards | **39.7% (25)** | 33.3% (21) | 23.8% (15) | 3.2% (2) | 63 |
| Adjustments to new standards | **39.7% (25)** | 38.1% (24) | 17.5% (11) | 4.8% (3) | 63 |
| Software or codes | 31.3% (20) | **42.2% (27)** | 20.3% (13) | 6.3% (4) | 64 |
| Publications in scientific journals | 6.0% (4) | 13.4% (9) | 34.3% (23) | **47.8% (32)** | 67 |
| Other publications | 6.1% (4) | 25.8% (17) | **42.4% (28)** | 27.3% (18) | 66 |
| PhD thesis | 12.1% (8) | 22.7% (15) | **34.8% (23)** | 30.3% (20) | 66 |
| Patent applications | 29.2% (19) | **43.1% (28)** | 26.2% (17) | 1.5% (1) | 65 |
| Filed patents | 36.1% (22) | **41.0% (25)** | 21.3% (13) | 3.3% (2) | 61 |
| Improved internal knowledge and capabilities | 1.5% (1) | 3.0% (2) | **66.7% (44)** | 30.3% (20) | 66 |
| Improved collaborations on the Nordic level | 0.0% (0) | 2.9% (2) | **58.8% (40)** | 38.2% (26) | 68 |
| Improved possibilities of finding collaborations in EU | 9.1% (6) | 21.2% (14) | **54.5% (36)** | 15.2% (10) | 66 |
| Enhanced opportunities of influence in a EU-project | 13.8% (9) | 38.5% (25) | **40.0% (26)** | 7.7% (5) | 65 |
| | | | | Other (please specify) | 2 |
| | | | | ***answered question*** | **68** |
| | | | | ***skipped question*** | **9** |

| 18. Please indicate which of the following outputs and outcomes that, in your opinion, have been achieved or will be achieved within the project! | | | | | |
|---|---|---|---|---|---|
| | Have been achieved | Will be achieved | Will not be achieved | Can't assess | Response Count |
| New services | 7.8% (5) | 26.6% (17) | **34.4% (22)** | 31.3% (20) | 64 |
| New products | 9.4% (6) | 25.0% (16) | **39.1% (25)** | 28.1% (18) | 64 |
| Prototypes | 6.3% (4) | 21.9% (14) | **45.3% (29)** | 29.7% (19) | 64 |
| New processes | 12.9% (8) | **54.8% (34)** | 19.4% (12) | 16.1% (10) | 62 |
| New methods or tests | 24.2% (16) | **56.1% (37)** | 6.1% (4) | 15.2% (10) | 66 |
| Contributions to new standards | 4.6% (3) | 20.0% (13) | **50.8% (33)** | 27.7% (18) | 65 |
| Adjustments to new standards | 4.6% (3) | 16.9% (11) | **49.2% (32)** | 32.3% (21) | 65 |
| Software or codes | 14.3% (9) | **36.5% (23)** | 33.3% (21) | 23.8% (15) | 63 |
| Publications in scientific journals | 44.8% (30) | **58.2% (39)** | 6.0% (4) | 0.0% (0) | 67 |
| Other publications | **58.2% (39)** | 46.3% (31) | 3.0% (2) | 1.5% (1) | 67 |
| PhD thesis | 29.7% (19) | **43.8% (28)** | 21.9% (14) | 9.4% (6) | 64 |
| Patent applications | 4.7% (3) | 14.1% (9) | 40.6% (26) | **42.2% (27)** | 64 |
| Filed patents | 4.8% (3) | 9.5% (6) | **44.4% (28)** | 42.9% (27) | 63 |

| | | | | | |
|---|---|---|---|---|---|
| Improved internal knowledge and capabilities | **55.2% (37)** | 49.3% (33) | 3.0% (2) | 1.5% (1) | 67 |
| Improved collaborations on the Nordic level | **68.7% (46)** | 34.3% (23) | 1.5% (1) | 1.5% (1) | 67 |
| Improved possibilities of finding collaborations in EU | 25.0% (16) | **56.3% (36)** | 12.5% (8) | 7.8% (5) | 64 |
| Enhanced opportunities of influence in a EU-project | 8.1% (5) | **56.5% (35)** | 17.7% (11) | 17.7% (11) | 62 |
| | | | | Other (please specify) | 0 |
| | | | | ***answered question*** | **67** |
| | | | | ***skipped question*** | **10** |

| **19. b) Please comment your answer:** | |
|---|---|
| | **Response Count** |
| | 11 |
| ***answered question*** | **11** |
| ***skipped question*** | **66** |

| **20. Did the NER funding enable access to anything that would not have been feasible with national funding?** | **Response Percent** | **Response Count** |
|---|---|---|
| **Yes, we did not have the required competences in our home country.** | **58.5%** | 38 |
| Yes, we did not have the required infrastructure/environment in our home country. | 44.6% | 29 |
| Yes, we did not have the required material/data/natural resources in our home country. | 29.2% | 19 |
| No, the project would have been possible with national funding. | 10.8% | 7 |
| ***answered question*** | | **65** |
| ***skipped question*** | | **12** |

**21. What has the participation in the Nordic Energy Research programme meant for you? (Please indicate 1 not at all important – 5 very important)**

| | **1** | **2** | **3** | **4** | **5** | **Rating Average** | **Response Count** |
|---|---|---|---|---|---|---|---|
| Increased awareness about ongoing research in your home country | **30.3% (20)** | 21.2% (14) | 18.2% (12) | 18.2% (12) | 12.1% (8) | 2.61 | 66 |
| Increased awareness about ongoin research in the Nordic countries | 0.0% (0) | 3.0% (2) | 10.4% (7) | 38.8% (26) | **47.8% (32)** | 4.31 | 67 |
| Increased awareness about ongoing international research | 4.6% (3) | 12.3% (8) | 29.2% (19) | **32.3% (21)** | 21.5% (14) | 3.54 | 65 |
| Increased awareness about ongoing research in other disciplines | 10.9% (7) | 21.9% (14) | **32.8% (21)** | 23.4% (15) | 10.9% (7) | 3.02 | 64 |
| New contacts with industry | 18.5% (12) | 15.4% (10) | 21.5% (14) | **23.1% (15)** | 21.5% (14) | 3.14 | 65 |
| Strengthened existing contacts with industry | 26.2% (17) | 10.8% (7) | 10.8% (7) | **36.9% (24)** | 15.4% (10) | 3.05 | 65 |
| New contacts with researchers in other Nordic countries | 3.0% (2) | 1.5% (1) | 10.4% (7) | 32.8% (22) | **52.2% (35)** | 4.30 | 67 |
| Strengthened existing networks in other Nordic countries | 3.1% (2) | 6.2% (4) | 10.8% (7) | 24.6% (16) | **55.4% (36)** | 4.23 | 65 |
| Secured employment in a relevant area (field) | **35.9% (23)** | 23.4% (15) | 21.9% (14) | 15.6% (10) | 3.1% (2) | 2.27 | 64 |
| Start a spin-off | **50.0% (30)** | 23.3% (14) | 15.0% (9) | 10.0% (6) | 1.7% (1) | 1.90 | 60 |
| | | | | | | ***answered question*** | **67** |
| | | | | | | ***skipped question*** | **10** |

| 22. What is your opinion of the Nordic Energy Research project administration? | | | | | |
|---|---|---|---|---|---|
| | Yes | Only partly | No | Can't assess | Response Count |
| The information from Nordic Energy Research has been clear | **64.2% (43)** | 25.4% (17) | 1.5% (1) | 9.0% (6) | 67 |
| It has been easy to apply for project funding | **52.3% (34)** | 33.8% (22) | 3.1% (2) | 10.8% (7) | 65 |
| The time between application and decision on funding has been in accordance with expectations | **68.8% (44)** | 17.2% (11) | 0.0% (0) | 14.1% (9) | 64 |
| The decisions have been well explained | **60.6% (40)** | 18.2% (12) | 3.0% (2) | 18.2% (12) | 66 |
| The feedback from Nordic Energy Research on ongoing projects are sufficient | **64.2% (43)** | 20.9% (14) | 1.5% (1) | 13.4% (9) | 67 |
| | | | | Please comment your answers: | 9 |
| | | | | ***answered question*** | **67** |
| | | | | ***skipped question*** | **10** |

| 23. If you compare with other organisations for funding research, how would you assess the administrative routines and collaboration with the Nordic Energy Research office? (Please indicate 1 worse – 4 much better) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Don't know | Rating Average | Response Count |
| National research financer | 4.7% (3) | 20.3% (13) | **51.6% (33)** | 9.4% (6) | 14.1% (9) | 2.76 | 64 |
| EU Commission | 4.8% (3) | 6.5% (4) | 24.2% (15) | **38.7% (24)** | 25.8% (16) | 3.30 | 62 |
| Nordforsk | 0.0% (0) | 0.0% (0) | 5.1% (3) | 3.4% (2) | **91.5% (54)** | 3.40 | 59 |
| NicE | 0.0% (0) | 1.7% (1) | 3.4% (2) | 0.0% (0) | **94.9% (56)** | 2.67 | 59 |
| Other financing from the Nordic Council of Ministers | 0.0% (0) | 1.7% (1) | 10.2% (6) | 1.7% (1) | **86.4% (51)** | 3.00 | 59 |
| | | | | | | Please comment your answer: | 8 |
| | | | | | | ***answered question*** | **64** |
| | | | | | | ***skipped question*** | **13** |

| 24. From your organisation's perspective, how do costs and benefits of participating in the project compare? (Mark on the scale, -3 means the cost is greater than the benefit, 0 means costs equal benefits, and 3 means the benefit is greater than the cost). | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -3 | -2 | -1 | 0 | 1 | 2 | 3 | Don't know/Can't assess | Rating Average | Response Count |
| . | 0.0% (0) | 0.0% (0) | 6.2% (4) | 9.2% (6) | 18.5% (12) | **33.8% (22)** | 30.8% (20) | 1.5% (1) | 1.75 | 65 |
| | | | | | | | | | ***answered question*** | **65** |
| | | | | | | | | | ***skipped question*** | **12** |

| 25. Further comments on the implementation and outputs of the programmes: | |
|---|---|
| | Response Count |
| | 11 |
| ***answered question*** | **11** |
| ***skipped question*** | **66** |

# Appendix D

## Competitive policies in the Nordic Energy Research and Innovation Area (eNERGIA) Case study

### D.1. Summing up

eNERGIA, being part of NER policy project strategy, is a research project offering a comparative study, mapping frame factors and specialisation, on the Nordic countries' technology behaviours in order to lay the ground for future policy making within the field. The project ran from August 2007 until June 2008 and was conducted by the Norwegian social science research institute NIFU STEP.

### D.2. Background information

In 2007, NER initiated seven policy studies, each with the aim to contribute with suggestions for how to improve the Nordic research and development area in energy. The policy studies consist of studies of R&D and innovation systems of importance to the Nordic countries.

The policy projects were initiated through different calls, open to researchers and experts from institutions, consultancies and organisations. NER invited applicants through various channels such as the NER website, the newsletter Orka and direct circulars to research environments. NIFU STEP and eNERGIA was one of three in the specific policy call "Towards a Competitive Nordic Innovation and Research Area in Energy" and combine two objectives of the call ("Innovation systems for new energy technologies and systems" and "Assessment of results and impact")[9] as two interconnected and logically integrated parts of the project.

NER organised a joint initiating seminar, a midterm reports seminar and a joint end of project conference, in order to take advantage of potential synergies. Apart from that, the seven policy projects were considered separate and complementing each other.

#### D.2.1. Short presentation of the project

According to the call for policy projects, there is a consensus that "existing technologies will not deliver the necessary solutions to ensure reliable energy supplies, enjoy continued growth and protect the environment". 'This called for a new approach to for example understand how to stimulate innovation and development on a Nordic level within the energy sector to achieve energy-, economic- and climate change goals.

The knowledge acquired in the projects is intended for use by NER and other "Nordic Stakeholders in taking further action to develop a competitive Nordic research and

[9] The other two objectives of the call were "organisation of public and private investment and R&D" and "Business potentials on global markets for new energy technology".

innovation area in new energy technologies". These Nordic stakeholders were defined and identified by the eNERGIA project in relation to the project mission.

The eNERGIA policy project can be described as "sociology meets technology". It is a comparative study of the Nordic countries' "energy technology behaviours", with suggestions for areas of development. According to a NER representative, one aim with eNERGIA was to develop new knowledge, and the use of cross-disciplinary approaches to policymaking. The project was launched mainly because of the lack of evaluations such as the one made in eNERGIA and the perceived need to find out more.

The eNERGIA project, as all policy projects, was expected to give input to the NER strategy process and the Nordic action plan for the energy sector, supporting the needs of all stakeholders. It was to conclude in policy considerations regarding opportunity windows for Nordic policies stimulating the creation of Nordic lead markets in the selected technologies.

### D.2.2. Project history, NER and NIFU STEP in combination

NIFU STEP is an independent Norwegian social science research institute for studies in innovation, research and education, providing theoretical and practical insight into the dynamics of these activities and contributing to relevant policy development. According to their website, their mission is "to be a national resource centre for studies of the relationships between competences and technological development on the one hand and cultural, social and economic change on the other."

The eNERGIA project is in line with NIFU STEP's profile and a logical and strategic addition to the institute's project portfolio. NIFU STEP has participated in and been in charge of several projects dealing with energy technology problems, e.g. the OECD study on innovation in energy technology, EU projects, sectoral Innovation Watch and Erawatch, and an evaluation of DEMO 2000, a large Norwegian technology development programme, which made them a relevant conductor of the project.

### D.2.3. Project "mission"

NER and NIFU STEP expectations met in the project plan, However, several issues were left to the project group to plan for in detail, for example target groups, activities and forms of results presentations. On the NIFU STEP website, the eNERGIA approach is described as follows:

> "Based on a thorough understanding of the framework conditions, strengths as well as weaknesses, of Nordic and Baltic national innovation systems within energy production, what are the degrees of freedom for coordinated Nordic policy interventions targeted to development and commercial promotion of promising renewable energy production technologies?
>
> - Could the Nordic Area be seen as a lead market within these promising technological areas?
> - Would these technologies help Nordic countries to meet key policy objectives and challenges the next 20-30 years?"

The project included an analysis of energy sector activities in the eight Nordic and Baltic countries, a comparative study was conducted on energy politics and policymaking, mapping frame factors and specialisation, case studies of good practice as well as appraisal of environmental consequences were made[10]. The approach concentrated on a few selected energy technologies: Wind energy, CO2 cleaning of gas and coal, photovoltaic energy and second generation bio-energy.

Policymakers and actors in the research fields were defined as target groups for the project. At the post project dissemination level the general public has been included in the definition of target groups, as they are concerned about these issues and could be a potential force in acting and pushing for change.

## D.3. Project organisation and activities

The project group consisted of the following people; all associated one way or the other with NIFU STEP:

- Dr. phil. Antje Klitkou – project team leader
- Dr. phil. Trond Einar Pedersen, senior researcher
- Senior researcher Åge Mariussen
- Programme Director Aris Kaloudis
- Researcher Lisa Scordato

The team was put together for the benefit of the purpose of the project, e.g. Åge Mariussen with a lengthy experience of making comparative studies on a Nordic level. Within the project group, relationships were previously established, though new relations were established with information givers in most countries as well as with the other two policy projects members.

Plenty of time and work was spent initially on getting national experts interested in contributing. Technological experts were not too keen on contributing fully to this research project with a sociological touch, until they realized the width and the value of the results and contributed more willingly with input and then wanted to share the results. Due to the initial difficulties in getting national experts to join, the initial ambition to have a Nordic reference group was put on hold – instead national experts were given opportunities to give feedback on results later in the process.

The project used information from a broad range of organisations in the eight countries and the national contact points and experts were various national actors, research environments, industry actors, authorities and agencies[11].

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[10] Combinations of qualitative and quantitative approaches were used, e.g. quantitative analysis of EU indicators, patent, desktop and bibliometric analysis, case studies and interviews with key experts.

[11] **Norway:** Research Council of Norway, Ministry for Education and Research, Ministry of Petroleum and Energy, Ministry of Trade and Industry, Norwegian Water Resources and Energy Directorate, Gassnova, Teknologirådet, Bellona, Zero, Norsk bioenergiforening Nobio, University of Bergen, University of Oslo, Norwegian University of Science and Technology (NTNU), University for Environment and Bioscience (UMB), Institute for Energy Technology (IFE), CMR Christian Michelsen Centre for Industrial Measurement Science and Technology, International Research Institute of Stavanger (IRIS), Aker Clean Carbon, Renewable Energy Corporation (REC), Statkraft;

**Sweden:** Swedish Energy Agency, SEKAB, Örnskölsvik, Biofuelregion AB, Umeå;

**Denmark:** Danish Energy Authority, Technical University of Denmark (DTU), Danish Council for Strategic Research, Danish National Advanced Technology Foundation, Teknologi-Rådet;,

**Finland:** Ministry of Trade and Industry, Confederation of Finnish Industries, TEKES, Finnish Science Park Association. Helsinki University of Technology;

**Iceland:** Icelandic Center for Research, RANNIS, National Energy Agency, Ministry of Industry;

The project team also had contact with the energy R&D experts in the European Commission. The project used input from the media, especially from the press in Norway and Denmark. Members of the team attended conferences and workshops on energy issues, such as 'New trends in Nordic innovation', Oulu, Finland, November 2007, or the two Nordic workshops on Bio energy, the first in Oslo (October 2007) and the second in Stockholm (March 2008).

The project was planned in three phases, "sector innovation system of energy production technologies in the Nordic and Baltic countries", "study of good innovation practice and appraisal of environmental gains in selected energy technologies in the Nordic countries" and "synthesis and policy implications". Since the project was short, and the planned activities were time-consuming, no project phase was planned for dissemination of results. However, dissemination is actively taking place post-project, both by NIFU STEP and NER (more can be read on dissemination of results below).

During the project period two workshops were held for stakeholders and project members to interpret results:

- A workshop on environmental consequences of deployment at scale of these technologies to replace existing energy systems, with a focus on wind energy and photovoltaic energy, carbon dioxide and storage, and second-generation bio energy was held at NIFU STEP $24^{th}$ and $25^{th}$ April with experts on the technology fields.
- A policy workshop was held on $18^{th}$ June in Oslo at the Research Council of Norway, organized in cooperation with the Research Council of Norway and Nordic Energy Research. The objective of this workshop was to study and learn from selected Nordic good practices in innovation and policy. Keynote speakers came from the Swedish Energy Agency, the Danish Energy Authority, Nordic Energy Research, the Research Council of Norway and the eNERGIA project team.

### D.3.1. Project budget

The major part of the project funding came from NER (0.999 million NOK or 76.3% of the final budget, and co-funded by NIFU STEP (0.310 million NOK or 23.7% of the final budget).

## D.4. Usefulness and value of research conducted

### D.4.1. Short presentation of eNERGIA major results

The final report has a focus on research and innovation policy in the Nordic and Baltic countries, based on the analysis of framework conditions for the sector innovation systems for energy production. Key actors and institutions have been identified. SWOT analysis were conducted, based on a performance assessment made on quantitative indicators of publishing and patenting, international collaboration and funding data, which identified common or diverging characteristics, challenges, framework conditions, energy-technology specialisation and cases of good practice.

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**Latvia:** Ministry of Economics, Ministry of Education and Science, Latvian Academy of Sciences, Riga, Centre for Science and Technology Studies, Riga Technical University, Latvian Bioenergy Association, Latvenergo;

**Lithuania:** Ministry of Economy, Ministry of Education and Science, Lithuanian Energy Institute, Vilnius Gediminas Technical University, Kaunas University of Technology;

**Estonia:** Ministry of Economic Affairs and Communications, Tallinn University of Technology, Estonian Agricultural University, Estonian Science Foundation, Estonian Biomass Association, Estonian Wind Power Association, Tallin, AS Eesti Energia.

The synthesis report presents conclusions and policy recommendations in four groups – policy framework conditions and energy policy, energy policy instruments, the Nordic dimension and Policy recommendations. The results, including the 25 policy recommendations, are perceived both by NIFU STEP and NER to be balanced, interesting and very useful to policymakers, researchers and industry. The challenge now is to make it accessible to these actors.

### D.4.2. Short discussion on research usefulness, impact and added value

The usefulness and possible impact of research results are perceived to be at a high level, although it remains to be seen since results are so recently summarized. There is, as already mentioned, a high level of relevance for researchers and policymakers, on national and Nordic level in general, and for NER and NMR in particular. The relevance for industry is also quite high -- as a complement to what they are doing today in order to understand and adapt to development on national and Nordic levels within these technologies. Report information could also be used for further discussing the framework and pathways for all actors within these areas.

Another benefit of conducting this type of research on Nordic and Baltic levels is that it strengthens the region contra e.g. EU in giving weight to the region, funding region specific ambitions.

The project group collected data on national levels through technology experts, and analysed it on a comparative Nordic level. There is an abundance of information, and this is still accessible and useful for coming projects. Collecting all this data was more time-consuming than initially expected and resulted in a time shortage at the end. Some of the interviewed group members claim that this resulted in extensive reports that were not as efficiently formulated as could be wished for.

It may be a little premature to claim success on behalf of eNERGIA and the impact of the results, since the project is recently finished. However, both NER and NIFU STEP are at present contributing to dissemination to relevant categories. Concrete examples of results exploitation and links from research conclusions to policy development may be hard to find yet, though activities may have considerable impact. Impact is to be expected mostly on policy-making levels, though to some extent within industry, research and public activities.

### D.4.3. Dissemination of knowledge and results

eNERGIA final results were shared at a workshop in Oslo in June 2008, a combination of country-specific presentations and a joint Nordic approach,.

As already shown, dissemination of results was not initially a planned phase in the project, but rather left to NER and NIFU STEP to take care of after project finish. As of now, several post-project dissemination activities are planned for both by NER and by NIFU STEP.

NER have a journalist writing articles for Orka, NER newsletter, based on eNERGIA results, and also planning for publishing a book in a more accessible format.

NIFU STEP participated in the public hearing of the energy research strategy "Energi 21". They conducted a workshop with the Norwegian Kunnskapsdepartementet (Ministry of Education and Research) in spring 2008 and project results were presented at an international workshop on the post carbon society at the NTNU in Trondheim in September 2008. One article for NIFU STEP's research magazine

Forskningspolitikk has been published.[12] In addition, NIFU STEP is together with Washington University planning for publishing a book.

The reports have been distributed among the experts, who will most likely further disseminate the information. eNERGIA group members are anticipating being invited by national the experts to present the results in the respective countries, though there is no funding set aside for this by NER. However, NIFU STEP has presented eNERGIA results at international conferences, such as the Nordic Climate Solutions in November 2008 in Copenhagen or the Scandinavian Renewable Energy Forum in October 2008 in Lillestrøm.

The connection between NIFU STEP and NER has also lead to NIFU STEP contributing to another workshop organized by NER ("Who shall do the job?"), presenting research results showing the lack of competence and knowledge within the energy sector. Other workshops may happen in the future, though none are planned as for now.

In interviewing NER, they claim responsibility for ensuring relevant usage of eNERGIA results. For NER, this has apparently been a very interesting policy project where the width of and the potential in the results may not yet have been fully experienced, since results have not yet reached or come to use in policymaking levels.

### D.4.4. Other project results

Initially this project was not aimed to give input to other coming projects, since focus was to give input to policymaking on Nordic level and NER activities. However the abundance of information collected is still useful for NIFU STEP and funding for further analysis and use of this material have been applied for, though confidential at this stage.

Inter-policy project exchange was minor and not really planned for by NER, though it would have been appreciated by the eNERGIA project group. The view is that inter-policy project interaction could be a way to better support and prepare for coming possible synergies and mutual learning opportunities, beneficial to project development and NER learning opportunities.

The project research and results are also very useful in other NIFU STEP projects were cross-project-use and learning is taking place. Energy issues will be addressed also in other international projects, especially at the European level.

## D.5. Usefulness and value of project

### D.5.1. Part of NER strategy

The policy projects are a strategic choice of NER, breaking new grounds both research-wise and for NER, where technological perspectives have been prevailing since 1985. Mainly, the policy projects are part of the NER strategy to "contribute towards

[12] Antje Klitkou, Trond Einar Pedersen, and Lisa Scordato (2008). Fornyelse gjennom fornybar energi: nordisk innovasjon og forskning innenfor energi. In: Forskningspolitikk 31(2008) nr. 3, p. 15-17.

maintaining and developing a framework to further strengthen the Nordic region as a global winner”[13].

However, since NER was breaking new grounds it was complicated to predict project outcome and the potential value and usefulness of it. NER followed the project with “supporting curiosity”, has shown large interest in the project, its work and its results. The eNERGIA project group perceived NER to be good collaborators, some claiming:

NER employees are “dynamic and clever people, and NER is so much more than a Norwegian organisation, collaborating closely with other Nordic organisations and funders in a very constructive way, opening doors for us, which is really supporting us in conducting project work”.

In December 2008, NER hosted a seminar to discuss and analyse the results of the policy projects, with international experts, where all the seven policy projects were discussed. A stakeholder roundtable discussion on possible next steps on energy issues for the Nordic community was held, and representatives from industry, authorities and governments, NGOs, R&D institutions and the NER styre will be present.

## D.6. Short discussion on project added value

There are advantages and disadvantages related to being an all-Norwegian research group[14] in a Nordic comparative study. However, advantages found are closeness, both geographically and culturally, between the members of the project group, which resulted in higher efficiency. An all Nordic representation in the project group would most likely have been more time-consuming due to travels and other communication barriers. Another advantage was the closeness to NER that facilitated for the NER representative to attend eNERGIA project meetings regularly in a convenient way. Having representatives in all nations would most likely have included a shorter path to national policymaking, when disseminating results.

There are also added values for NIFU STEP. Most of the project participants claim that this has been one of the most interesting projects in their research careers and a project to learn from, in spite of time shortage and issues with getting national experts to join.

Both on behalf of NER and NIFU STEP, goals and expectations were high on the project, according to interviewees. “An ambitious proposal fulfilled at large, even though time was scarce”, according to a project member.

[13] Strategy and Action Plan NER 2007-2010, s 17

[14] The project team has an international background: it includes researchers from Norway, Sweden, Germany and Greece.

# Appendix E

## Climate and Energy Systems, Risks, Potential and Adaption (Clim-I2 or CES)

This is a case study of Climate and Energy Systems, Risks, Potential and Adaption, a research project funded by NER. Information for the case study has been collected from interviews with CES participants and funders, NER contact persons, CES website, project proposal, other documents and a survey.

CES is a research project with 55 Nordic and Baltic participants, public and private, divided in nine workgroups creating climate and energy systems scenarios in order to support coming policy making within the region.

### E.1. Background information

CES state on their website that the "Nordic energy sector is sensitive to natural variability since a large part of the electricity and energy production is derived from renewable energy resources. Therefore, it is also sensitive to impacts of climate variability and change. The sector will thus benefit greatly from a coordinated research effort on the impacts of global change on renewable energy sources".

Strategic information about this system development is of high relevance for governmental agencies, policy makers and private investors. *Policy makers and other governmental agencies* need systematic studies of the real system as support for making strategic decisions on e.g. different policy instruments. *Private investors* need the information for strategy planning regarding e.g. investments in new projects or to assess profitability and risks for long-term contract management.

#### E.1.1. Short presentation of research field

CES is motivating their research as follows[15]:

> "Impacts on renewable energy sources in a changing climate is an important issue in the Nordic region with its large amount of hydropower production, development of wind power and potential for bio-energy including peat. Knowledge about past, present and future variability in climate and hydrology is therefore of vital importance to the energy sector. A change in hydro-climatological variability may lead to changes in the operation of reservoirs and wind turbines and the energy production potential itself. In particular the variability in hydropower is a great concern in the light of some very wet years and some sudden dry years, which have resulted in highly variable prices on electricity.
>
> The power industry and society needs to make long term decisions, for example, investments in new production capacity. The dam safety issue is also high on the agenda in all countries and the industry requests guidance on how to cope with

[15] Source: www.os.is/ces, oktober 2008.

> the climate change in this respect. Therefore the uncertainty in the climate issue is highly relevant and the goal of this project is to improve the ability of the energy sector to handle the increased uncertainty and risk caused by climate change.”

The Climate and Energy Systems (CES) (2007-2010); Risks, Potential and Adaptation is in many ways a follow up on the Climate and Energy (CE) Nordic-Baltic research project (2003-2006)16, both funded by Nordic Energy Research and the Nordic energy sector.

The CE-project, Climate and Energy project conducted scenario research with quite a vast timeframe, up to 2100, resulting in images and weather maps valid around the turn of the next century. It was found that the results were interesting and important, though called for a more narrow approach, the coming 20-30 years, more useful and relevant to present decision-makers on renewable resources both in policymaking and industry, which is now the focus for the CES project.

### E.1.2. Project "mission"

CES focus on *risks, potentials and needs for adaption* related to predictable future changes in climate and weather, focusing on hydropower, wind and bio-energy. A vast amount of information is needed for this type of research and therefore a Nordic coordinated research effort on climate variability and change is relevant since neither of the Nordic countries would be large enough geographically or financially to conduct this type of research alone. Nor is weather and climate national bound.

Climate and energy systems is defined as an integrated project, based on cooperation between different scientific fields to improve the quality of research and to gain further understanding of the impacts of climate change on the energy systems.

CES claim in the project proposal, on their website and confirmed through interviews, that it will address how the conditions for production of renewable energy in the Nordic area might change due to global warming. It will also focus on the potential production and the future safety of the production systems as well as uncertainties. The key objectives are summarized as:

- Understanding of the natural variability and predictability of climate and renewable energy systems at different scales in space and time.
- Assessment of the risks due to changes in probabilities and nature of extreme events.
- Assessment of the risks and opportunities due to changes in production of renewable energy.
- Development of guiding principles for decisions under climate variability and change.
- Development of adaptation strategies.
- A structured dialog with stakeholders.

One of the challenges in the project, shortly described on the CES website, is to bridge the gap between scientists and corporate planners. The question posed is “how can the scientific results be put to end use?” The CES vision is that prediction of future climate scenarios should be utilized to develop business strategies for decisions on

[16] The main objective of the CE project was to make a comprehensive assessment of the impact of climate change on renewable energy resources in the Nordic area including hydropower, wind power, bio-fuels and solar energy. The results of the CE project serve as an important basis for an in-depth understanding of the impact of climate change on Nordic renewable energy resources, but are also important for rational decisions regarding strategies for energy policies including strategies for the reduction of greenhouse gas emissions. Reference here to the final report would be helpful.

future development and for estimation of the impacts on the existing installations. In order to increase the potential for end use, CES have an Information Management work-group and planned for e.g. case studies for analysing of procedures and results developed for decision making within the energy sector.

### E.1.3. Project members

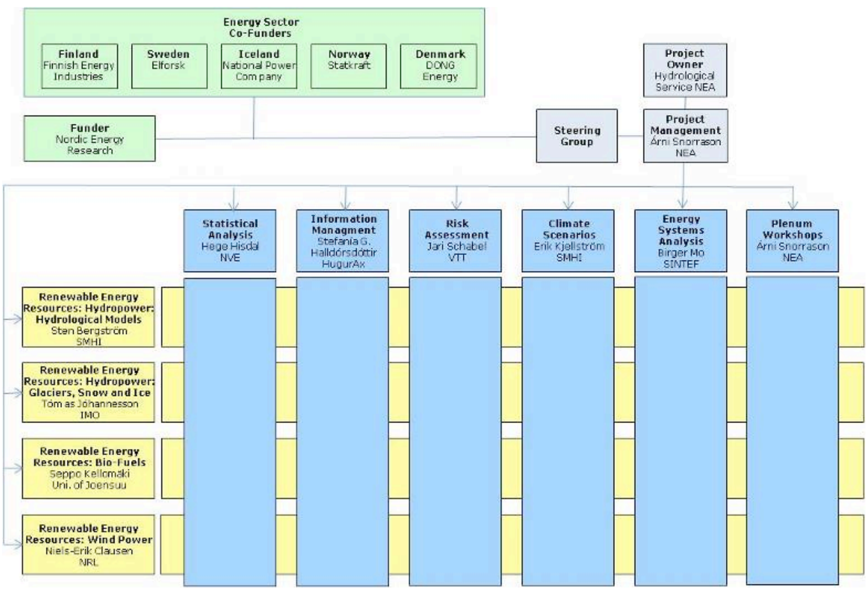
The CES project manager is Arni Snorrason, PhD in hydrolsystems engineering and director of the department of Hydrological Service, Orkustofnun (Iceland National Energy authority). There are about 55 partners in the project, representing industry, academia and the public sector to a varying degree in the Nordic and Baltic regions.

| **Members** (Nation) (Private/Public) | **Role in project** | **Workgroups** (9) (WG representatives in the Steering group are in bold) | **Financing** | **PhD candidates** (9) |
|---|---|---|---|---|
| NER | Representative in steering group | | 10.000.000 | |
| SINTEF research institute (NO) | | **Energy systems (Birger Mo)** | | |
| NVE, The Norwegian Water Resources and Energy Directorate (NO) | | **Statistical analysis (Hege Hisdal)** | | |
| Statkraft (N)(Pu) | Member of steering group, financier | | 1.200.000 | |
| University of Bergen (NO) | | | | Ms Reiar Kravik (2008) |
| University of Oslo (NO) | | | | Ms Anne Fleig (20xx) |
| SMHI, Swedish meteorological institute (Swe) | | **Climate modelling and scenarios (Markku Rummukainen)** | | |
| | | **Hydropower, hydrology (Sten Bergström)** | | |
| Elforsk (Swe) (Pr) | Member of steering group, financier | | 1.200.000 | |
| VTT, Technical Research Centre of Finland (SF) | | **Risk Assessment (Helena Kortelainen)** | | |
| Finnish Energy Industries (SF) (Pr) | Member of steering group, financier | | 1.200.000 | |
| University of Helsinki (SF) | | | | Ms Leena Ruokolainen (2009) |
| | | | | Ms Noora Vaijalainen (2010) |
| FMI, Finnish Meteorological Institute (SF) | | **Bio-Energy (Seppo Kellomaki)** | | Ms Andrea Vajda (2007) |
| | | | | MS Tiina Kilpeläinen (2010) |
| NEA, National Energy Authority (IS)(Pu) | Member of steering group, financier | **Information management (Stefania G Halldorsdottir)** | 1.200.000 | |
| IMO, Icelandic Meteorological Office, (IS) | | **Hydropower, Glacier Snow and Ice (Tomas Johannesson)** | | |
| University of Bergen and Iceland (IS) | | | | Olafur Rognvaldsson (2007) |
| University of Lund (IS) | | | | Jona Finndis Jonsdotter (2007) |
| DONG Energy (DK) (Pr) | Member of steering group, financier | | 1.200.000 | |
| Risö, DTU, Technological University of Denmark (DK) | | **Wind Energy (Niels-Erik Clausen)** | | |
| Latvian Environment, Geology and Meteorology Agency | | | | |
| Russia, Voeikov Main Geophysical Obs. (VMGO) | | | | |
| Laboratory of Hydrology, Lithuanian Energy Insitute | | | | Ms Diana Meilutyte-Barauskiene (2009) |

In general, most relationships – both intra work group and intra CES – were established already during the CE-project period, though, some relationships mainly on the individual basis are new to CES. The presence of the Baltic and Russia were initiated in CES and suggested by NER. Several of the interviewees claim that the project strengthens and develops the cooperation and the relationships between participating individuals and organisations.

### E.1.4. Project organisation

The CES project is organized as a matrix organisation with working groups, WG, on the renewable energy resources. Crosscutting issues are also delegated to WG. These WG are supported and served by a Steering group with one representative from each of the Working Groups, a representative from each of the five co-funders from the energy sector, and representative from NER as well as the Project Manager of CES. An Information management group is responsible for information dissemination, active stakeholder involvement and public outreach.




The Steering group meets Bi-annually. Working groups have their workshops in conjunction with annual and additional meetings .. At the national level, CES-national groups are established to secure national collaboration during and in-between activities.

The CES ambition is to create a knowledge flow between the working groups, where the Climate Scenario and Statistics groups provide information for the other ones to analyse and draw conclusions from, all ending up in the information management group. This intra-dependence is strengthened through the cross cutting issues and other working group interaction, e.g. the Climate Scenarios group producing customized regional climate scenarios for risks analyses in cooperation with the Risk Assessment working group.

All participants in the CES project have access to a project web page for information dissemination within the project, with a workspace for each group and each workshop.

There is also a metadata platform on the web containing information on data produced to support preparing data for public access on the official web page of the project, www.os.is/ces.

We include a chart showing the matrix organisation and the potential interaction between workgroups below:

### E.1.5. Project budget and financing

The total project budget is 18.235.00 NOK, spread over four years. NER financing amounts to 53%, for the period 2007-2010, according to the end-of year report 2007. Co-financers are from the energy sector, i.e. DONG, Elforsk, National Power Company of Iceland, Finnish Energy Industries, and Statkraft, and the individual research parties.

660.000 NOK have been earmarked for Baltic/Northwest Russian participation, which is covering some of the expenses in relation to their participation.

Initially 12.000.000 NOK were applied for in order to conduct CES over a four-year period. However, NER had many proposals with interesting and well-aimed research ambitions and in order to get value for money, they discounted all applicants in order to fit the projects into the NER portfolio, and cut the funding with 2 MNOK on behalf of CES. CES then approached their partners in the energy sector and were able to convince them of contributing additional 1.8 MNOK, so the budget is in line with the proposal.

## E.2. Usefulness and value of research conducted

### E.2.1. Research added values for industry

Regarding its relevance to strategy and overall goals of Nordic Energy Research, the size and variability of hydropower generation, bio-energy and wind-power generation are critical issues for the energy balance and energy system stability in the Nordic power system at present and in the future. CES is the single project in the NER strategy area of Climate and Energy Systems. The project will give increased understanding of the likely development of these technologies under climate change and for the different scenarios regarding economic, technological and regulatory evolution.

For the Hydropower industry research results from CES is important in order to plan for renovation of dams, up keeping of water basins and river benches. Most of the Nordic dams are quite old and need up scaling in one form or the other, even though the lasting time of a dam is somewhere around 50-100 years. If the climate changes with an impact on precipitation or melting of glaciers, and consequently the amounts of water in rivers, relevant alterations on the dams need to be planned for.

For example, renovating a dam takes about a decade from planning to finished renovation. In the Nordic region, there are a few hundred dams that may need renovation in one form or the other within the shorter timeframe since most of them were constructed during the earlier periods of the 1900s. The influence of future enhanced glacier melting and potential down-pour, causing increased run-off and higher water pressure in the dams, including increased power production are vital aspects to take into account. Resources are scarce, time, manpower and funds, and therefore it becomes vital to know which type of renovation best meets future conditions.

The issues are similar for the wind-energy industry, which find large interests in these scenarios and wind-maps in order to plan for where to most beneficially position wind plants, what winds coming generations of wind mills need to sustain and how much energy can be derived due to these changes in winds, directions and strengths.

Regarding the bio-fuels industry, the coming climate prerequisites are analysed in order to understand future Nordic access to biomass.

### E.2.2. Post graduate students and CES relations with academia

The usefulness for academia lies in the multidisciplinary nature of the project that gives new insights for the project participants. Thus, the project provides a useful framework also for Nordic research education and postdoctoral researchers, contributing to enabling academia to pursue high-level expertise and a competence pool that the Nordic energy sector may draw on in the future.

A total of nine PhD students are associated with CES activities in one way or the other. However, these are only partially financed through NER-funding.

There is interaction taking place with academia on a sub-project level, though to a varying degree. In Sweden, for example, the research conducted within SMHI is not ordinarily the type of research conducted within academia, which gives other benefits such as industry closeness and other forms of credibility.

Several of the project participants have dual positions, which strengthens and facilitates knowledge diffusion between fields.

Some suggest that CES function as an umbrella organisation for most research conducted within the area in the Nordic countries. On work-group level some CES projects are combined with other studies and workgroups. E.g. SMHI have combined funding from NER and co-funders with project funding from EU-levels (e.g. ENSEMBLES, GLACIODYN and WATCH) in order to find more advantageous financial situations as well as adding to research value. These combined efforts amount to an immense quality return to NER, especially in relation to funds invested by NER.

Please find below a chart on the distribution of countries, organisations, some PhDs and the different workgroups. (please Arni – add to it as you'd like)

### E.2.3. Work-groups themes and expected results

The CES project mission is, as already mentioned, broken down into work group missions. The work groups are shortly described below, including mission and participating organisations/countries.

The *Climate Scenarios group* is mainly working on the extension of long observational time series of temperature, precipitation and runoff to 2050. (participating organisations: Finnish Meteorological Institute, University of Helsinki, Swedish Meteorological and Hydrological Institute SMHI, Denmark Meteorological Institute, Iceland Institute of Meteorological Research, Russia Voeikov Main Geophysical Obs. VMGO).

*Hydropower, hydrology group* and the *Hydropower, snow and ice group* will use the climate scenarios and work together on method for modelling changes in glacier covered areas. The hydrology group will perform an analysis of dam safety in a changed climate. Another common interest for all countries is future changes in the hydropower potential. (participating organisations HH: Finnish Environmental Institute SYKE, Swedish Meteorological and Hydrological Institute SMHI, University of Copenhagen, Iceland National Energy Authority, Norwegian Water Resources and Energy Directorate NVE, Tallinn University of Technology, Lithuanian Energy Institute, Latvian Environment, Geology and Meteorology Agency. Participating organisations in H, SIG: Stockholm University, Geological Survey of Denmark and Greenland, Icelandic Meteorological Office, Iceland National Energy Authority, University of Iceland, Norwegian Water Resources and Energy Directorate NVE)

The *Wind Energy group* will provide an extreme wind atlas of the Nordic countries, with 50-year wind in 100 m height for structural design. They will also develop a model of sea-state to estimate fair-weather windows for offshore wind farms and conduct forecasts of the most probable developments of the Nordic electricity system for the next 20-30 years, taking into account the most recent information regarding climate change. (participating organisations: Finnish VTT, Risö National Laboratory DK)

The Bio Energy group… (participating organisations: University of Joenssu SF, Risö National Laboratory DK)

The results of the hydrological models, the wind energy groups and the bio energy group will be delivered to the *Energy Systems, Risk Analysis* and *Statistical Analysis groups*.

The *Statistical Analysis group* will use the climate scenarios and the results of the hydrological models to assess the variability in climate and hydrology in the past and the future. The group will focus on extremes, uncertainty and effect on the energy sector and study changes in flood frequency, variability in extreme events and dam safety. (participating organisations: FMI, SMHI, University of Edinburgh, Iceland National Energy Authority, NVE)

The *Energy System group* will focus on providing a forecast on how the energy system will look like in 2020, and how the demand for electricity will change until 2020. The group will deploy a model on fuel prices, economic and technological development, and CO2 prices. (Participating organisations: SYKE, SMHI, Optensys Energianalys Swe, Risö, Ea Energianalyse A/S DK, Iceland National Energy Authority, Iceland National Power Company, NVE, SINTEF No)

the *Risk Analysis group* will explore project methods for sophisticated risk analysis accounting for climate change. The Risk group will use climate scenarios to assess risk in the nearest future taking climate changes into account. (Participating organisations: VTT, SMHI, Risö, Ea Energianalyse A/S DK, CICERO Center for Klimaforskning No)

The *Information Management Group* is responsible for information dissemination, active stakeholder involvement and the public outreach. (participating organisations: SYKE, FMI, IVL svenska miljöinstitutet, SMHI, Risö, Iceland National Energy Authority, HugurAx Software Solutions, NVE, CICERO)

### E.2.4. Short presentation of dissemination of knowledge and results

As already mentioned, CES results are perceived to be useful for relevant authorities since policy makers and other governmental agencies need systematic studies of the energy system when they consider specific concessions and different policy instruments for the energy sector. CES are also approaching the challenge in getting the results to relevant levels within industry and policymaking through the Information Management working group. As for now, they are supplying the website with information which they in turn receive from the other working groups, they plan for workshops, stakeholders meetings etc.

The working groups themselves, the financiers and the researchers are also making efforts in getting their results to relevant levels for usage. For example, the Hydropower Hydrology group representative explained that he presents research results in one way or the other at least once a week the whole year around, e.g. at Elforsk-dagen[17] the 14$^{th}$ of October 2008.

[17] Elforsk is a Swedish industry financer of CES, Elforskdagen is a yearly conference where most Elforsk financed research is presented.

Worth mentioning is that the CE project resulted in a few hundred publications, and the CES publicationlist is initiated on www.os.is/ces

### E.2.5. Short discussion on research usefulness, impact and added values

The Nordic Nations are quite small, and thus collaborating across borders enlarge the regional research arena, which makes it more interesting and challenging to conduct research. Some of the researchers even claim that they may not even conduct this type of research if it had not been for the added values of working cross-nations in the Nordic region.

For the research community both the methodology used when transferring the climate scenarios to impacts and the uncertainty due to choice of climate scenario and modelling strategies are of great interest. This has a strong impact on the level of relevance the results are given in the scientific debate.

Maps of water resources for the Nordic region under present (1961-1990) and future (2071-2100) conditions have been produced using the hydrological models HBV and WaSiM-ETH. The maps have been assembled from simulations performed in Finland, Iceland, Latvia, Norway and Sweden using models from the hydrological institutes of each country. Although model structure, process parameterisation, input data and spatial resolution vary, the maps present a relatively consistent view of hydrological conditions in the Nordic region.

Present and future conditions for hydrological state variables and fluxes are shown. In particular, there are maps presenting annual and seasonal runoff, annual evaporation, annual maximum snow water equivalent, number of days per year with snow covered ground, and annual maximum soil moisture deficit.

## E.3. Usefulness and added values of the CES and NER combination

One aspect mentioned by some participants is that the Nordic energy sector is quite an important player in the European energy market due to its capacity in regulatory powers (seasonal as well as day/night) – a value estimated by CES only to increase since scenarios on climate change predict beneficial changes for the renewables. The Nordic aspect offered through NER activities possibly facilitates a development of this role through combining the renewables in a Nordic sector approach, an angle not offered through the EU.

However, in posing questions of national added values on Nordic collaboration with CES, it appears, not surprisingly, that the nations are more or less interested in the variation of renewables and at times claim e.g. that wind power is more interesting to Denmark and hydropower more interesting to Sweden, Norway, Iceland, and to some extent Finland. On behalf of CES the surplus value of including the three renewables gives opportunities to posing such issues as how the these could complement each other.

The internet based survey and the interviews we conducted show that the CES project would not have come about without NER funding. The added values on Nordic level are, as already mentioned, several. More than half of the respondents in the survey claim that they did not have either ” the required competences in our home country” or ”the required infrastructure/environment in our home country” to conduct research on such a specialized level. We have also found that the credibility in getting funding from NER facilitated raising funds at the national level to complement the NER project.

# Appendix F

## Nordic Centre of Excellence in Photovoltaics (NCOE IN PV)

### F.1. The research field

Solar cells are classified into three generations which indicates the order of development. *The first generation* solar cells are based on pure silicon, and use a single junction for extracting energy from photons. These solar cells are high-cost but also high-efficiency. In contrast, *second generation* solar cells are low-efficient and low-cost. These cells are based on less expensive materials; copper indium gallium selenide, cadmium telluride, amorphous silicon and micromorphous silicon. Cells and research conducted also embrace thin film solar cell technologies. CIGS solar cells are one of the technologies studied within NCOE IN PV. *Third Generation s*olar cells are aimed at enhancing the lower electrical performance of second generation and at the same time maintaining low production costs. Within NCOE IN PV there is research conducted in all three generations.

Research on solar cells can roughly be summarised as improving production cost and efficiency in solar cell technologies. Within NCOE IN PV the research also captures ageing and lift time studies of solar cells. In the previous programme period the network also included design of new solar modules dedicated to building integration and solar cells in mobile applications.

#### F.1.1. Project mission

NCOE IN PV is one of the projects within the area of Renewable energy. The project has its origins in the former NER framework programme and the research programme Solar Electricity, From Materials to System Integration (Nordic PV). The goal of the programme is described in a similar way in both periods:

> The overall challenge for the solar cell industry is to bring down the cost/kWh in order to become competitive with other energy resources in the future. Currently the annual increase of the shipment of solar cells is higher than 30 % and has been 25% and 40 % during the last decade. This large increase has mainly been stimulated by national programmes with favourable feed-in tariffs and/or subsides of investment costs. However, in the near future there will probably be a shift from program-stimulated expansion to market driven expansion...[18]

From a Nordic perspective the programme is motivated by the fast expansion of the Nordic solar electricity industry and the need to secure the continued expansion of the industry. The project's main activity is to provide seven PhD-students with broad knowledge in the photovoltaic area. It is also argued that a coordinated marketing effort of scientific personnel and their research areas, characterisation equipment and

[18] NCOE IN PV (2008), *Nordic Centre of Excellence in Photovoltaics (NCOE IN PV)*, conference paper

process equipment within the Centre will give industry a better overview of the R&D possibilities available in the Nordic region.

Five cross-disciplinary research topics of common interest for all the groups involved in the centre are defined: Search for new materials, Encapsulation and lifetime of solar panels, 3D modelling of solar cell structures, Contacting of solar cells, and light collection/light trapping.

### F.1.2. Project members

The programme consists of seven research environments from four Nordic countries, Estonia and Russia. NCOE IN PV embraces different technologies covering all three generations of solar cells; technology already on the market or expected to be on the market in the future:[19]

| | |
|---|---|
| **Institute for Energy Technology (IET)** (Norway) | • Project managing organisation<br>• Research focused on silicon based solar cells<br>• Laboratory for producing silicon-based solar cells<br>• Characterization laboratory for doing electrical, optical and structural characterizations<br>• 25 employed researchers and engineers |
| **Danish Technological Institute (DTI)** | • Covers a wide ranch of research and development of dye-sensitized solar cells (DSCs)<br>• Research and development towards semi-automated and standardized lager-scale DSC production<br>• Dye-sensitised cells in architectural applications (e.g. façade integration, light-filtering systems and as decorative elements)<br>• 10 employees are involved in the solar cell activity at the institute |
| **Helsinki University of Technology (HUT)** | • Research focused on novel solar device concepts, in particular the nano-structured dye-sensitized solar cells<br>• The strategy is to develop an approach based on easily available and cheap base materials (e.g. spraying, printing, pressing)<br>• Key areas of research are devise optimization (e.g. charge transfer, advanced characterization, integration of nanotechnology components) industrial substrates (e.g. metals, plastics), and scaling up of structures. |
| **Ioffe Psysico- Technical Institute in St. Petersburg** | • Main solar activity is connected with development of multi-junction solar cells operating under concentrated solar radiation.<br>• High efficient monolithic GaInP/GsAs solar cells and concentrator tandem stacks based on GaInP/GaAs-GaSb |

[19] NCOE IN PV (2008), *Nordic Centre of Excellence in Photovoltaics (NCOE IN PV)*, conference paper

| | |
|---|---|
| | cell<br>• High-efficiency space and terrestrial concentrator modules and autonomous photovoltaic installations with tandems have been developed. |
| **Norwegian University of Science and Technology (NTNU)** | • Mainly focused on material research for first and third generation solar cells<br>• Key areas of first generation: Silicon ingot characterization and wafer characterization.<br>• Key areas of third generation: focus on the so called quantum dot intermediate band solar cells.<br>• In solar cell activities NTNU collaborates with SINTEF, through the Gemini centre – PV Solar cell materials. |
| **Tallin University of Technology** | • The research is concentrated at use of low cost through cheap materials (replacing rare and highly cost In by Zn and Sn in CIS to yield CZTS), the use of cheap technologies for both material production and device assembling (such as recrystallization in molten salts to produce powders, electrodeposition and chemical deposition, spray pyrolysis and sol-gel deposition for thin films production and R2R preparation of PV cells).<br>• The research is located at the university's department of Material Science which has been nominated both as EU Centre of Excellence in PV Materials ad Devices, and as Estonian Centre of Materials Science.<br>• The centre has around 40 employees where 10 are PhD students. |
| **Uppsala University (UU)**<br>(Sweden) | • Two main activities are related to PV at the division of Solid State Electronics: thin solar cell (CIGS) research and the Dye sensitized solar cell (DSG) research.<br>• The research on CIGS is mainly focused on absorbing CIGS layer and on the interface between the CIGS layer and the buffer layer.<br>• Research of DSC is mainly concentrated at development of organic dyes for solid state DSC and process development of DSC modules based on monolithic geometry.<br>• 16 of the divisions 23 employees are PhD students. |

### F.1.3. Project organisation

The project manager runs the programme supported by a steering group consisting of the seven senior researchers from the participating research environments. Meetings covering issues of common interest such as planning of courses, seminars, conferences and student exchange are held twice a year, and complemented by phone meetings. When meetings are coordinated with programme network activities, students also present the progress of their research.

### F.1.4. Project budget and financing

Except for the financing from NER, NCOE IN PV receives funding from several companies within the Nordic energy sector. Other financers are the participating research institutions that are located at five universities and two research institutes. The programme is managed by Institute for Energy Technology (IFE), located near Oslo.

| | | Amount in NKR | Share of total budget |
|---|---|---|---|
| **NER** | | 8 000 000 | 63 % |
| **Industry** | **Country** | | |
| Elkem Solar AS | NO | 400 000 | 3, 1 % |
| RE CASA | NO | 400 000 | 3, 1 % |
| Solibro Research AB | SE | 400 000 | 3, 1 % |
| Topsil A/S | DK | 80 000 | 0,6 % |
| Energinet | DK | 440 000 | 3, 4 % |
| Luvata, Finland | SF | 160 000 | 1, 2 % |
| Other industry | | 232 000 | 1, 8 % |
| **Research organisations** | | | |
| NTNU | NO | 462 000 | 3, 6 % |
| IFE | NO | 462 000 | 3, 6 % |
| UU | SE | 588 000 | 4, 6 % |
| HUT | SF | 478 000 | 3, 7 % |
| DTI | DK | 437 000 | 3, 4 % |
| TTU | EST | 130 000 | 1 % |
| IOFFE | RUS | 97 000 | 0, 7 % |
| **TOTAL** | | **12 766 000** | |

### F.1.5. Project history and development

Nordic PV was initiated by the Norwegian manager of the programme who is department head of Solar Energy at the Institute for Energy Technology. The network that forms NCOE IN PV was to a large extent the result of networking within the framework of Nordic Energy Research. The programme manager has his background in fuel cell research, and describes his connections with solar cell research community as limited at the outset of the project. By asking around among his contacts in the former programme of NER, where he himself was a PhD-student, he got in contact with the now participating environments.

In the first period the NCOE IN PV was solely an academic project without industry participation. Except for four PhD-students and common courses, the previous project also supported four post docs. In the current period NER put as condition that the programme needed co-funding from industry which also meant that NERs support decreased from 14 300 000 NOK to 8 000 0000 NOK. Despite several co-funding solar cell companies, the total budget has decreased compared with previous period. The project manager claims this has had a significant impact. In order to preserve the level of joint activities, it was decided that the programme should accept more PhD students at the expense of post docs. Despite the cost-cutting, there are difficulties of keeping up the joint activities at the same high level as in the previous period.

Another great difference in the current period is that the network has been extended with partners from Tallinn University of Technology and Ioffe Psysico- Technical Institute in St. Petersburg. Interviewed participants think that the collaboration between the researchers were close in the first period, and one of the researchers points at the common Nordic mentality and similar languages as big advantages in the start-up of the network. Another participant claims that the most important achievement of the first period was the consolidation of the Nordic network. In the planning process of the current period, there was mutual understanding within the steering group that the network was mature enough to be extended. This was important for the invitation of other parties. Another important factor was that NER, in the current programme period, gave priority for proposals that embraced collaboration with the Baltic region and Russia. The collaboration is still new for a majority of the interviewed and it is therefore too early for them to comment on the impact of these collaborations.

Apart from the inclusion of Estonian and Russian research environments, the industrial participation is also new. Seven companies are now co-financers of the programme. As mentioned, this was mainly a result of the NERs new funding conditions.

## F.2. Usefulness and value of the conducted research

The demand for alternative energy resources has increased as a result of the growing climate debate and the improvement of renewable energy resources. The solar cell technology is no exception to this. The production volume in Europe has grown rapidly over the last years and several Nordic companies have emerged. Norway is the leading Nordic country and several Norwegian companies are active on the international solar cell market.

### F.2.1. Industry

Most of the funding companies are in different ways attached to the Nordic solar industry. The Norwegian company ***Elkem Solar*** develops metallurgical processes for producing silicon metal for the ***solar*** cell industry. REC, also from Norway, specializes in grid-tied solar electric design and installation. The Finnish company Luvata produces high performance copper interconnectors that are used in solar cells.

The collaboration with the programme is in most cases linked through the individual research environment. Representatives from both industry and academia confirm that the collaboration between industry and NCOE IN PV embraces mostly financing of projects connected to the network. This is for example the case in the relation between DTI and the Danish company Energinet. DTI and Energinet have a history of collaboration and the research projects that are connected to NCOE IN PV are part of a bigger project concerning development of solar cell techniques. The project in the previous programme period is described as a side project to the development project that the institute usually does on assignment for the industries and Energinet. The NCOE IN PV projects, on the other hand, are described as experimental research projects that leave room for in depth experimental studies. In a long term perspective, the group leader values these kinds of research projects as important as the industry assignments.

A similar relationship exists between Uppsala University and the company Solibro. Solibro is a Swedish manufacturer of solar cells and was established in 2001 as a spin-off from the solar cell centre at Uppsala University. There are many links between the two organisations, for example, the group leader at the university, also one of the founders of Solibro, split her time between the university and the company. There are also collaboration projects between the two organisations. One of them is managed by an industrial PhD student. The PhD student that is involved in the NCOE IN PV is not engaged in a project that could be characterised as a day to day collaboration with the Solibro. The group leader at Uppsala University describes their NCOE IN PV project more as a project that adds knowledge that are of common interest for the two organisations in the long run. The industry relations in both Norway and Estonia are also characterised in the same manner. For the representative at Elkem Solar Solar in Norway the support to NCOE IN PV means that they can keep up with the development within photovoltaics in a broad sense. In contrast to other research projects they support, the support to NCOE IN PV is not a collaboration focused on development problems in their core activity. The participation in NCOE IN PV gives Elkem Solar a good opportunity to follow the development and learn more about technologies the company has to compete with. In practice, Elkem's engagement is limited to participation in seminars and workshops arranged by NCOE IN PV.

According to the interviewed researchers and representatives of the industry, the participating companies' main interests are people that have high competence in photovoltaic. The labour market for PhD-students and engineers is very good. There is a strong demand for people skilled in conducting tests and measuring efficiency in solar cells, methods that are the same irrespectively of what solar cell that are handled. There is also a high demand for engineers educated in the field, which also was visible when the recruitment of PhD-students to the programme started. Some of the environments find it hard to recruit PhD-candidates. The high demand of engineers in combination with the less attractive location of some research institution made it hard to recruit candidates which in the end caused a delayed programme kick-off.

### F.2.2. Academia

NCOE IN PV is a network programme with a broad research activity. The research spans over all generations of solar cell technology. According to the project manager, group leaders and the interviewed PhD-student, this is also something that affects the network collaboration. On the one hand, there are few researchers within NCOE IN PV who conduct research in collaboration with other participants in their core area of research. On the other hand, the interviewed researchers are convinced that this is not a limitation, rather the opposite. There is broad agreement that the network have a positive impact on their research. Everyone mention that the NCOE IN PV has broadened their personal networks which have meant that they now have more colleagues to discuss research and solutions to difficulties in their research. A couple of them claim that the network has had a significant impact on their activity.

NCOE IN PV has also meant that the Nordic researchers can appear as a unit in international conferences. The group leader from DTI points at this as an advantage. The last two years NCOE IN PV have joined up for a presentation at the European Photovoltaic Solar Energy Conference. According to the group leader, these joint actions have probably resulted in relatively more attention than would have been achieved by the researchers on their own. As a result of the participation in NCOE IN PV, the Danish group has met researchers from other countries on this conference. One of these new contacts is valued to be of great importance by the group leader.

#### 8.1.1.1 NCOE IN PV – mainly a PhD-programme

All of the interviewed group leaders underline the fact that NCOE IN PV is a network where the PhD-students´ learning is in focus. It is therefore argued that NCOE IN PV must be seen as a package of joint activities relevant for improving the PhD-students skills in photovoltaics. The aim is to provide the PhD students with a broad knowledge enabling them to work in industry with any of the applied technologies. Several activities serve to meet this goal.

The main joint activities are of three types:

- One of the core activities is the workshops where the students participate in two week courses that are arranged twice and take place at one of the participating research institutions. In the previous programme period a PhD-course about the CIGS solar technology were held at Uppsala. The course started with theoretical studies and it was followed by the task to build a CIGS solar cell.
- In-depth workshops are another activity within the programme. These are held three times a year with invited speakers from abroad. One example is an in-depth workshop in Uppsala that took place October 2008. This meeting was coordinated with a dissertation of one of the previous programme period PhD-student's thesis. The topic of the in-depth workshop was 3D modelling in photovoltaic which was the same as the American opponent's research. Except speaker from America, a Polish researcher, also an expert on 3D modelling, participated as an invited speaker as well.
- A third type of activities is the general meetings. One of these meetings where held in Narvik, March 2008, as a kick-off for the project. Several speakers participated during the two-day meeting in discussions on subjects like light trapping, advanced characterisation for solar cells and alternative solar cell structures. The workshop was wound up with a site visit to the manufacturer REC ScanCell.

One of the most important activities is the compulsory exchange of PhD-students. All PhD-students have to go abroad to study at least six months at another university. The exchange doesn't have to be done within the participating institutions. Despite the different approaches to solar technology, most of the exchanges seem to be conducted within NCOE IN PV. Interviewed group leaders are well aware of the limitations of the PhD-students activity during the exchange and therefore most exchanges have been focused on activities connected to research of common interest. The group leader at UU points at two examples that in her perspective have been fruitful, despite the research environments different technology. One Swedish PhD student spent time at HUT in Finland for research connected to advanced damp measurement in solar cells which are important for understanding efficiency of solar cell regardless of photovoltaic technology used. A Norwegian PhD-student spent his exchange at UU to learn about printing techniques in CIGS solar cells. This student's research was focused on silicon solar cells and the project was about transferring the CIGS production technology to Silicon solar cell development.

These exchange programmes also mean that the research environment can use each other's equipments which are often very expensive.

## F.3. Dissemination of knowledge and results

In the previous programme period a number of workshops were open also to industry and other researchers. The contact we have had with supporting industry and researchers shows that at least one conference had over hundred participants and some of these participants came from the industry. Hands-on workshops are also an activity within NCOE IN PV. The aim is to spread knowledge about the different solar cell technologies. Researchers and industry outside the network are invited to these workshops. One of the Hands-on workshops dealt with possibilities of transferring technology from CIGS based solar cell processing to crystalline solar cell processing within some process steps related to contacting and reflection.

According to some of the participants, the research conducted is at such a basic research level that mainly researchers within the field are interested in taking part of the results. Production of scientific articles for publishing in peer review journals is given top priority for disseminating research results. However, the programme has also as its goal to publish articles in popular science magazines. Due to the small budget for producing popular science articles, the project manager sees that this ambition is difficult to match.

## F.4. Research usefulness, impact and added value

The final report of the previous period describes the forming of a strong collaboration between the Nordic research institutions as one of the most significant accomplishments. According to the researchers, the collaboration has enhanced both research and the involved research institutions. One success factor behind the collaboration is the exchange and the mutual use equipment which imply that more characterisation equipment is available for the participating researchers. The interviewed researchers all agree that the NER funding is important. According to the group leaders it is doubtful if there would have been any collaboration between the Nordic countries without the NER funding.

Apart from extending the participants' network, NCOE IN PV also gives the participants an opportunity to learn more about other participant's techniques. These are techniques that are, or will be, competing with one another on the market. Despite the diversity of technologies, the collaboration is described as open and the researchers generously share their experiences. One of the interviewed group leaders says this way of collaborating is of benefit for the participants regardless of their research approach and helps them to enhance their own technology. According to him, this will speed up the photovoltaic development in the Nordic countries. The collaboration has also resulted in projects outside NCOE IN PV as for example the exchange of a senior researcher from Uppsala University who will spend six months at ITE in Norway. According to the Swedish group leader, the exchange will not only benefit the research competence on silicon in Sweden, but will also have an impact on the basic education at the Solar Centre at Uppsala University.

The denomination *Excellence Centre* was decided by NER. Even though the programme manager doesn't think that the name suits the level of funding, the network has had a great importance on some of the participation research institutions. ITE's department for photovoltaics has expanded its activity from three persons to twenty five since the start of the previous programme period. The project manager, who is also department manager at ITE, sees that NER's funding strongly contributed to this expansion. From this perspective it can be argued that the NER funding has a comparably small impact on ITE's activity today but, on the other hand, the project manager still thinks that the funding is indispensable for keeping up the activity within the Nordic network.

The other participating research institute is NTNU. Norway is the leading Nordic country with several companies in the photovoltaics industry. The Swedish group leader points out that the other countries are interested to learn from the Norwegian success and the funding from NER is, in many cases, essential to this knowledge exchange.

As mentioned earlier, the collaboration with the industry must be considered as less active and there are mainly two explanations for this. Research conducted within NCOE IN PV is foremost basic research and most of it is still far from market application. In some cases the contacts with the companies are located in the higher levels of the company hierarchies, and this does not help the day to day collaboration in the research projects. Industry, however, do benefit from supporting the environments. Almost every one of the last project period's post docs went to work in the industry and the PhD-students are expected to find employment in the industry as soon as they enter the labour market.

## F.5. Summing up

NCOE IN PV is a network programme that consists of seven research institutions located in four Nordic countries, Estonia and Russia. The broad approach to solar cells is argued to benefit both Nordic research on photovoltaics and Nordic solar cell industry. Through coordination of different research in photovoltaics the industry is argued to get a good overview of the opportunities in the Nordic countries. The network will enhance the competence within the solar cell industry in the Nordic countries. In practice the collaboration between academia and industry consists almost only of financial contributions to participating research institutions. However, in many cases close collaborations exist between funding companies in other projects and the NCOE IN PV projects adds to the common academia-industry interest of building competence.

Despite small funding from NER and the small budget, the participants widely agree that the network created have had a positive impact on their activity and their networks. At a senior level new collaborations have developed that have contributed to better understanding of other solar cell technologies. However, the programme is foremost a PhD-programme and most of the activities are focused at this level. Through workshops, seminars and exchanges the students get a broad understanding of different solar cell technologies. There is a high demand of skilled people in the industry and every one of the post-docs in the previous period is now working in the industry.

# Appendix G

## SNA Analysis of four Research Projects

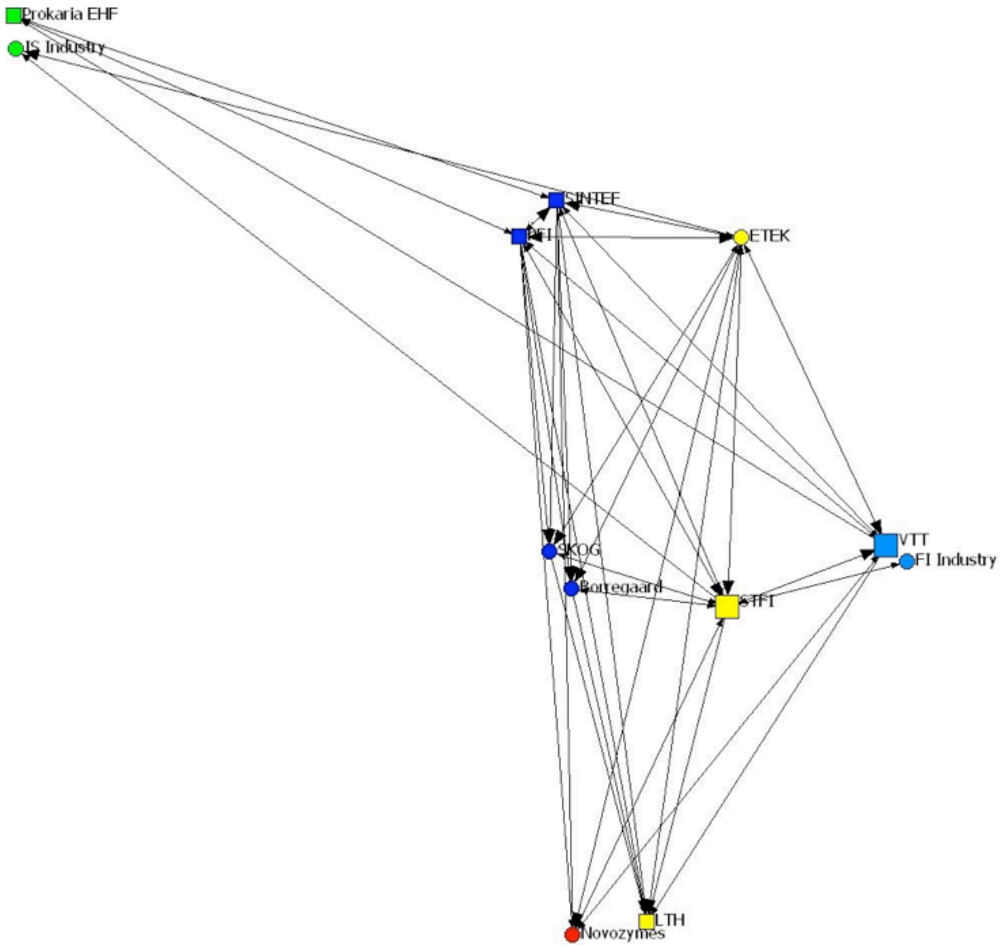
### G.1. Short presentation

A Social Network Analysis (SNA) was carried out on four of the NER research projects. Questionnaire answers were used for the analysis, and four projects with good response rates were used.

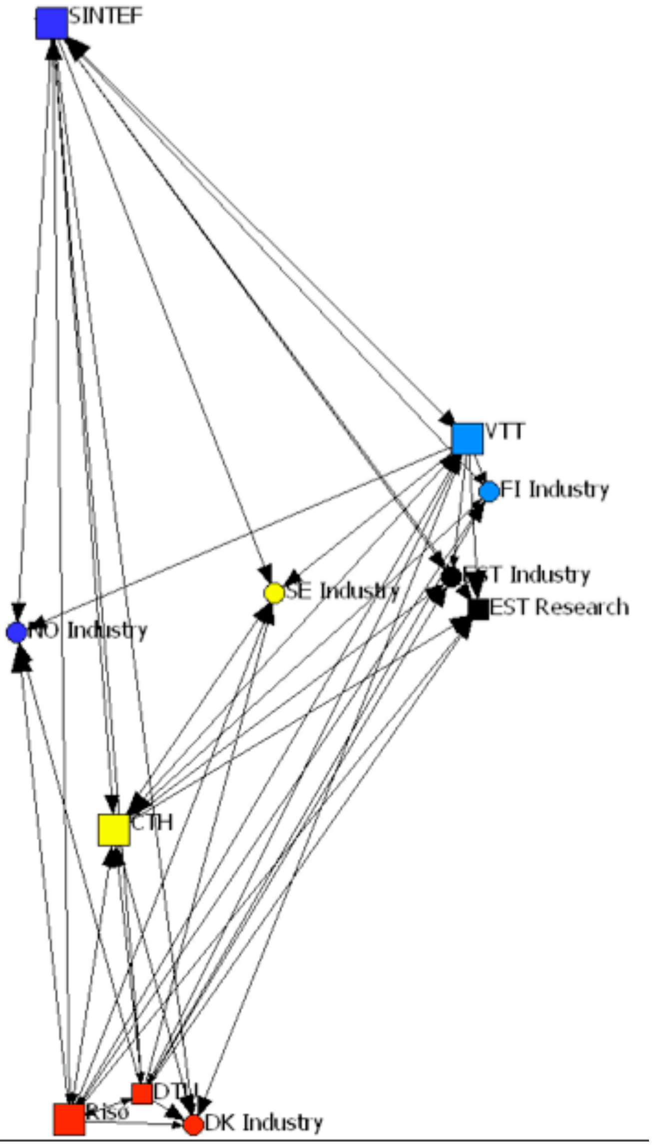
The SNA analysis consists of nodes and links. The nodes represent the participating entities, and the colour which country they come from (yellow: Sweden; red: Denmark; light blue: Finland; navy blue: Norway; light green: Iceland; dark green: Lithuania; lilac: Latvia; black: Estonia; white: Russia). The size of the node indicates how many participants each entity has in the project. The shape of the node, finally, indicates type of entity (square: R&D; circle: industry).

The links between the nodes illustrate their relations in the research project. The size of the arrow indicates the number of persons in one organisation (a) that have answered that they collaborate in the project with two or more persons from another organisation (b). One person in the organisation (b) may at the same time have indicated that he or she collaborates with only one person in organisation (a), which is the reason why the arrows to same link may be of different sizes.

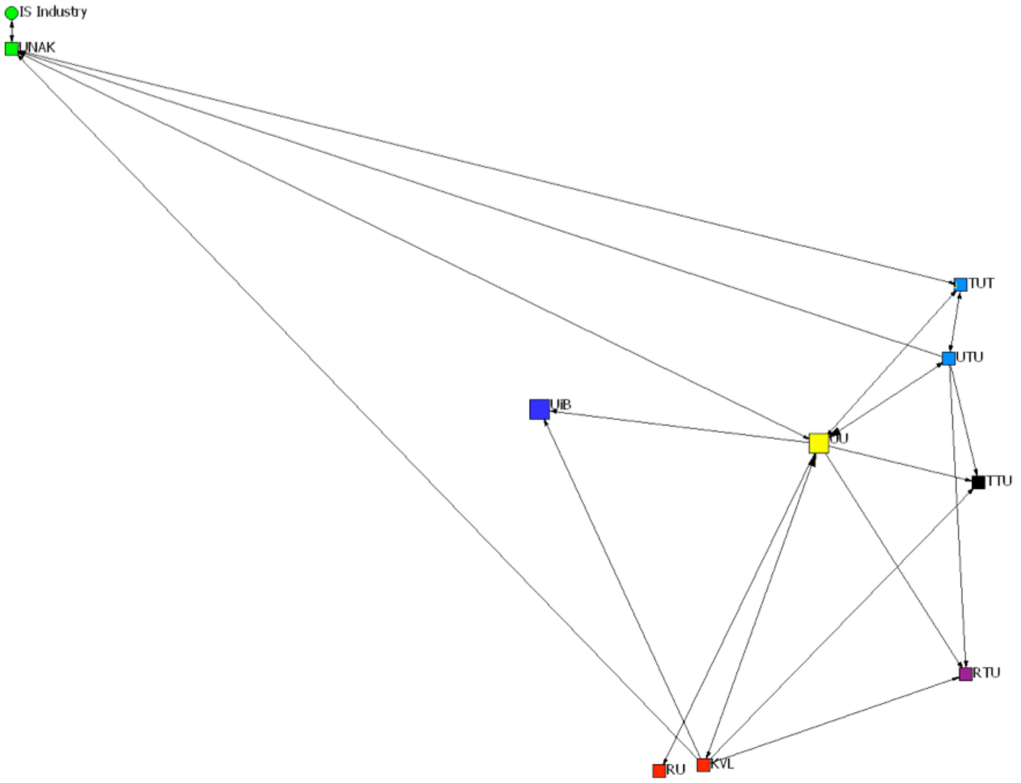
## G.2. Project 5


Prokaria EHF
IS Industry
SINTEF
PFI
ETEK
SKOG
Borregaard
STFI
VTT
FI Industry
LTH
Novozymes

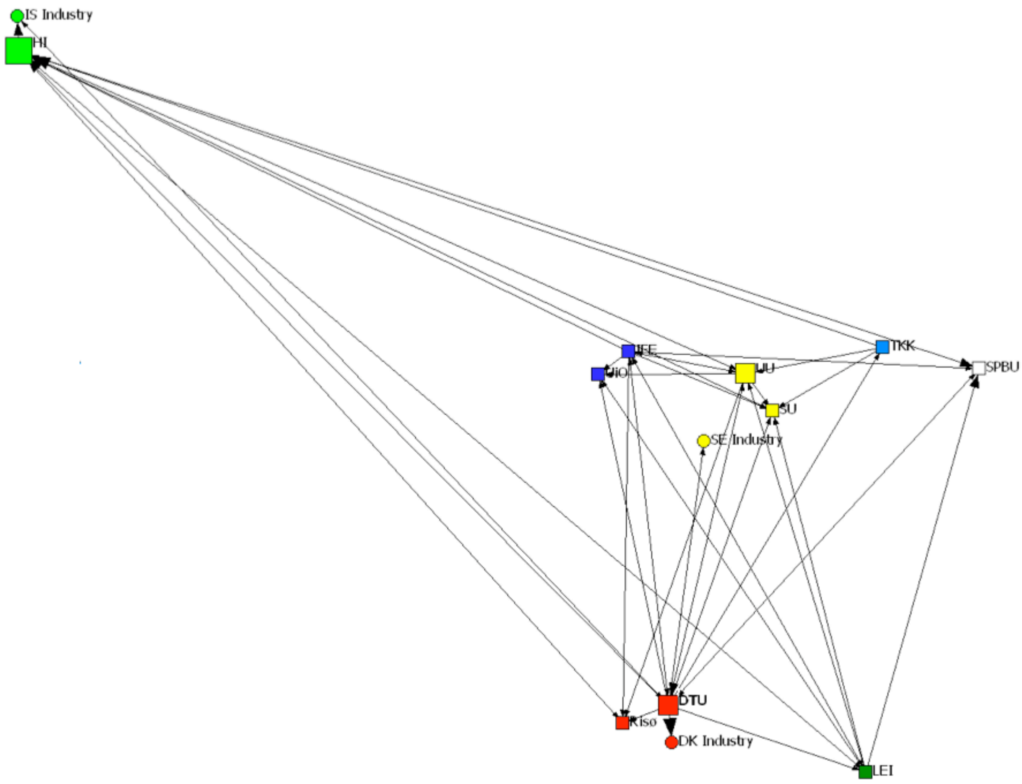
## G.3. Project 6


SINTEF
VTT
FI Industry
EST Industry
EST Research
SE Industry
NO Industry
CTH
DTU
Risö
DK Industry

## G.4. Project 9




## G.5. Project 10a



# Appendix H

## List of people interviewed

| Name | Country | Organisation |
|---|---|---|
| | | |
| **Exploratory interviews** | | |
| Halldor Asgrimsson | | NMR |
| Kristian Birk | | NMR |
| Kim Dam-Johansen | Denmark | Risö DTU National Laboratory for Sustainable Energy |
| Lars Guldbrand | Sweden | Swedish National Energy Administration / NER |
| Lise Jörstad | | NER |
| Jann Langseth | Norway | SINTEF |
| Trond Moengen | Norway | The Research Council of Norway |
| Flemming Nielsen | Denmark | Danish Energy Agency |
| Vida Rozite | | NER |
| Björn Telenius | Sweden | Ministry of Industry and Energy / NER |
| Ragnheifur Thorarinsdottir | Iceland | Orkustofnun /NER |
| Jouko Varjonen | Finland | Ministry of Employment and the Economy |
| | | |
| **Semi-structured interviews** | | |
| Mads Borup | Denmark | Risö DTU National Laboratory for Sustainable Energy |
| Thorstein Bye | Norway | Statistics Norway |
| Jorgen Calundann | Denmark | Danish Energy Agency |
| Ola Carlsson | Sweden | Chalmers Technical University |
| Olafur G. Flovenz | Iceland | Isor (Iceland Geosurvey) |
| Carl Johan Fogelholm | Finland | Helsinki University of Technology |
| Gillian Glaze | Germany | Forschungszentrum Jülich |
| Maria Gårding Wärnberg | Sweden | Ministry of Industry and Energy |

| | | |
|---|---|---|
| Hans Otto Haaland | Norway | The Research Council of Norway |
| Liisa Hakamies-Blomqvist | | Nordforsk |
| Birte Holst Jorgensen | | NER |
| Mikko Hupa | Finland | Åbo Akademi University |
| Madis Karnabik | Estonia | The Nordic Council of Ministers Office |
| Ivar Kristensen | | Nordic Innovation Center (NICe) |
| Seppo Kärkkäinen | Finland | VTT |
| Peter Lindblad | Sweden | Uppsala University |
| Hannu Lipponen | Finland | TEM |
| Mikael Lucander | Finland | KCL |
| Olafur P Palsson | Iceland | University of Iceland |
| Solveig Roschier | Finland | TEKES / NER |
| Bo Rydén | Sweden | Profu |
| Jón Agúst Thorsteinsson | Iceland | Marorka |
| Henrik Thunman | Sweden | Chalmers Technical University |
| Rolf Ulseth | Norway | NTNU |
| Pall Valdimarsson | Iceland | Enex |
| Nicolai Zarganis | Denmark | Danish Energy Agency |
| Vivi Yieng-Kow | Denmark | Danish Energy Agency |
| Maria Wärnberg | Sweden | Swedish Enterprise Ministry |
| | | |
| | | |
| **Case study interviews** | | |
| Case study: Risk, potential, adaption | | |
| Sten Bergström | Sweden | SMHI |
| Mikael Forss | | NER |
| Lars Hammar | Sweden | Elforsk |
| Aksel Hauge Pedersen | Denmark | Dong Energy |
| Helena Kortelainen | Finland | VTT |
| Arni Snorrassson | Iceland | Orkustofnun |
| | | |
| Case study: Nordic Centre of Excellence in PV | | |
| Marika Edoff | Sweden | Uppsala University / Solibro |
| Erik Enebakk | Norway | Elkem Solar |
| Arve Holt | Norway | Institute for Energy Technology |

| | | |
|---|---|---|
| Hanne Lauritzen | Denmark | DTI |
| Enn Mellikov | Estonia | Tallinnn University of Technology |
| Jonas Pettersson | Sweden | Uppsala University |
| | | |
| Case study: Energia (policy study) | | |
| Jeppe Bjerg | | IEA |
| Antje Klitkou | Norway | NIFU Step |
| Åge Maurisson | Norway | NIFU Step |
| Amund Wik | | NER |
| | | |